

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	seed-snipes; 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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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. Moult-strategies 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 rynchokinetic, decurved to straight or slightly upturned; in most Tringini, shorter and straighter, and only moderately rynchokinetic 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; Fjeldså 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 nebularia Gunnerus, 1767 in K. Leem, *Beskr. Finn. Lapp.*: 251 — Norway.

The specific epithet is compounded from Latin *nebula*, mist or cloud, and *arius*, possessing, and refers to the grey and spangled upperparts. An alternative etymology suggests the name mirrors the Norwegian *skoddefole*, mist foal, referring to the misty breeding habitat.

OTHER ENGLISH NAMES Greater Greenshank, Large Tringine Sandpiper, Cinereous Godwit.

MONOTYPIC

FIELD IDENTIFICATION Length 30–35 cm; wingspan 55–65 cm; weight c. 170 g. Large heavily built though elegant wader, with long, robust, slightly upturned bill, and long yellowish-green legs; at rest, tips of folded primaries fall level with or just beyond tip of tail. Larger, bulkier, and taller than Marsh Sandpiper *Tringa stagnatilis*, with bigger head, shorter and thicker neck, heavier bill and proportionately shorter legs. In flight, all plumages show uniformly dark upperwing and contrasting white rump extending in white wedge up back, whitish tail and tips of toes projecting slightly beyond tip of tail. Sexes alike. Some seasonal variation. Juvenile and immatures separable.

Description Adult breeding Head and neck, white, heavily streaked black, with indistinct whitish fore-supercilium, diffuse dark loreal stripe continuing indistinctly behind eye, and narrow white eye-ring. Feathers of mantle, scapulars and tertials vary: some brownish grey with white fringes, thin blackish shaft-streaks and submarginal lines and dark spots on edges (particularly on tertials), and some black, fringed or notched white, which tend to form untidy or solid longitudinal black lines on sides of mantle and on scapulars. Innerwing-coverts mostly brownish-grey with white fringes, grading to black on leading-edge of wing; inner greater coverts have blackish submarginal spots. Underbody, white, with fine black streaks on chin and throat, heavier streaks on foreneck and sides of neck, and bold black chevrons on breast and flanks. In flight, show dark upperwing (with contrasting white shaft to outer primary); bold white pointed wedge extending from uppertail-coverts to upper back; and rather pale, whitish tail with pale-grey central rectrices and irregular narrow dark barring on tail and longest uppertail-coverts. Underwing, white

with faint brownish barring on coverts. Bill, bluish grey or greenish grey on basal half, grading to black at tip. Iris, dark brown. Legs and feet, pale greyish-green, sometimes greenish yellow or dull yellow. **Adult non-breeding** Differ from breeding by: head and neck, paler, white with fine dark grey streaks only from centre of forehead, over crown, to hindneck and onto sides of neck, and with incomplete dark loreal stripe (paler in front of eye). Mantle, scapulars, tertials and innerwing-coverts, plainer, pale brownish-grey, with narrow white fringes and indistinct thin dark shaft-streaks, submarginal lines and some dark spotting on edges of feathers (latter strongest on tertials and inner greater coverts); lesser innerwing-coverts, darker and contrasting more (but often concealed by scapulars and feathers of flanks). Underbody, white, with fine dark streaks on sides of neck continuing onto sides of upper breast. **Juvenile** Like adult non-breeding but head and neck slightly darker with heavier, darker, streaking, indistinct white supercilium and more solid dark loreal stripe; some show pale stripe from side of breast to side of neck (visible at long distance); upperparts and innerwing-coverts, browner and darker, reducing prominence of dark submarginal lines and spotting; feathers of mantle, scapulars and wing-coverts more pointed, usually with neat buffish-white fringes giving slightly streaky appearance; unlike adult, pale fringe of wing-coverts broken at tip of feather by dark central wedge. Underparts like non-breeding, but foreneck and upper breast more heavily streaked, and sides of lower breast and fore-flanks have some dark-brown barring. Bare parts as adult, but legs and feet occasionally bright pale-yellow, dull yellow or dull slate-grey. **First immature non-breeding** Like adult non-breeding, but distinguished by some retained worn juvenile innerwing-

coverts and tertials, contrasting with fresh brownish-grey and white-fringed feathers of rest of upperparts. Primaries worn by midsummer (in adult, all fresh, or outer primaries still in moult). Some replace outer 1–6 primaries, Jan.–Mar., and can then be distinguished by strong contrast between fresh outer and heavily worn brownish juvenile inner primaries (primaries uniformly fresh or slightly worn in adult). **First immature breeding** Extent of breeding plumage varies. Some, especially those wintering in our area, retain worn first-immature non-breeding plumage while others acquire partial or complete breeding plumage; distinguished from adult breeding by differences in primary wear and moult-patterns given for immature non-breeding.

Similar species In flight, large size, long white wedge up back, unmarked dark upperwings and loud trisyllabic call, distinctive. On ground, can be confused with several congeners, especially **Marsh Sandpiper**, which is smaller and slimmer, with proportionately smaller head, slimmer neck, much finer, darker, usually straight bill, and proportionately longer legs (which project farther beyond tip of tail in flight); appears more delicate on ground, with more attenuated form in flight; usual flight call of Marsh Sandpiper not unlike Greenshank in tone but higher-pitched and thinner. In adult breeding and first immature breeding, supercilium usually more distinct behind eye and lores are paler; and upperparts paler and greyer, with dark markings more widely scattered on scapulars, and bolder on wing-coverts and tertials; these markings also shaped differently; breast generally marked. In non-breeding plumages, best distinguished by differences in patterning of head. Marsh has more contrasting and capped appearance: darker, less streaked cap, more distinct dark eye-stripe, paler lores, cleaner white forehead, and longer bolder, square-ended white supercilium, which extends well behind eye to above rear ear-coverts; upperparts more uniformly grey (fewer or no dark lines and spots), and blackish shoulder-patch is darker and more prominent; breast is usually less streaked. Juvenile differs from juvenile Greenshank by same differences in pattern of head as in non-breeding plumages except: crown heavily streaked pale, and eye-stripe generally darker, contrasting more with white lower face; upperparts (especially tertials), and innerwing-coverts, more buff, because dark and buff internal markings heavier and more intricate; streaking on breast is rather fine and usually restricted to sides, leaving centre of breast unmarked. Greenshanks with yellow or orange tone to legs could be confused with **Lesser Yellowlegs** *Tringa flavipes*; that species has much brighter chrome-yellow or yellow-orange legs; is much smaller and slimmer, with shorter, finer, straight dark bill; and readily distinguished in flight by dark back and square white patch on rump. **Redshank** *Tringa totanus* and **Spotted Redshank** *Tringa erythropus* easily separated by bright reddish legs. Very similar Spotted Greenshank *Tringa guttifer*, not acceptably recorded in HANZAB region (for discussion of differences, see Kennerley & Bakewell 1991).

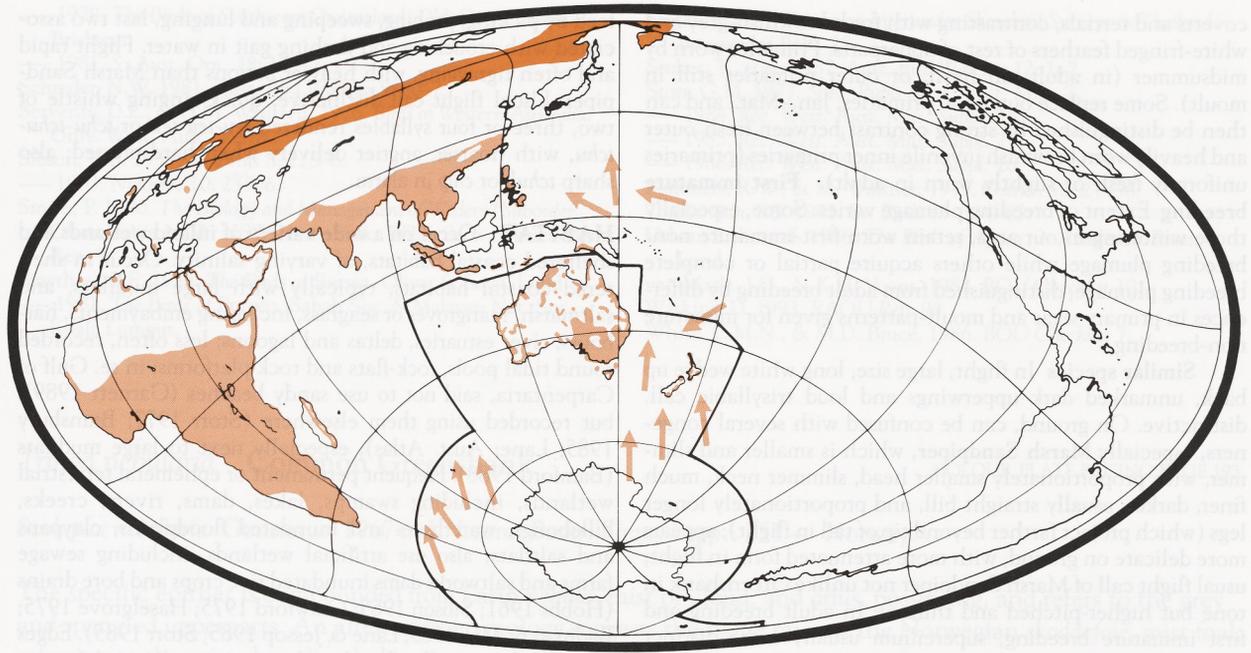
Seen singly or in small to large flocks (sometimes hundreds) in variety of coastal and inland wetlands, such as mudflats, estuaries, saltmarshes and mangroves, round margins of coastal and inland lakes and swamps. Wary, noisy and excitable; bob head in alarm, and flush with ringing calls, often long before other species. Freely associate with other waders, and often seen with Marsh Sandpipers, especially in saltfields. Stance usually rather erect. Feeding actions typical of genus, but have more stalking character; typically seen walking briskly along shoreline or chasing small fish through shallows with lolling gait and erratic changes of direction;

feed by picking, probing, sweeping and lunging, last two associated with crouching and dashing gait in water. Flight rapid and often zigzagging, with heavier actions than Marsh Sandpiper. Usual flight call distinctive, quick ringing whistle of two, three or four syllables rendered *teu-teu-teu* or *tchu-tchu-tchu*, with hoarser, angrier delivery when hard-pressed; also sharp *tchuk* or *chip* in alarm.

HABITAT Occur on a wide variety of inland wetlands and sheltered coastal habitats, of varying salinity. Occur in sheltered coastal habitats, typically with large mudflats, and saltmarsh, mangroves or seagrass, including embayments, harbours, river estuaries, deltas and lagoons; less often, recorded round tidal pools, rock-flats and rock platforms; in se. Gulf of Carpentaria, said not to use sandy beaches (Garnett 1989), but recorded using them elsewhere (Storr 1977; Bransbury 1985; Lane; Aust. Atlas), especially next to large mudflats (Bamford 1988). Frequent permanent or ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats; also use artificial wetlands, including sewage farms and saltworks dams inundated rice crops and bore drains (Hobbs 1961; Sibson 1965; Crawford 1975; Haselgrove 1975; Badman & May 1983; Lane & Jessop 1985; Storr 1985). Edges of wetlands generally of mud or clay, occasionally sand; bare or with emergent or fringing vegetation, including short sedges and saltmarsh, mangroves, thickets of rushes, canegrass, lignum or chenopods, and dead or live trees (Thomas 1968; Loyn 1975, 1978; Badman & May 1983; Pegler 1983; Wakefield 1984; Storr 1985; Gibson 1986; Bamford 1988; Jaensch *et al.* 1988; Henle 1989). Once recorded with Black-winged Stilt *Himantopus himantopus* in pasture (Sibson 1965); generally absent from dry grassland (Garnett 1989; Bamford 1990; R.P. Jaensch).

Forage at edges of wetlands, in soft mud on mudflats, in channels, or in shallows round edge of water (Sibson 1965; Ewart 1973; Park 1983; Wakefield 1984; Gibson 1986); often among pneumatophores of mangroves or other sparse, emergent or fringing vegetation, such as sedges or saltmarsh (Thomas 1968; Loyn 1975, 1978; Pegler 1983; Tideman & Copley 1988). Occasionally feed on exposed seagrass beds (Thomas 1968). Roost and loaf round wetlands, in shallow pools and puddles, or slightly elevated on rocks, sandbanks or small muddy islets (Sibson 1965; Loyn 1975; Park 1983; Garnett 1989; Lane). Occasionally perch and roost on stakes (Forest 1982; Wakefield 1984).

DISTRIBUTION AND POPULATION Breed Eurasia: n. British Isles; Scandinavia, e. Estonia and ne. Belarus, through Russia, E to middle reaches of Anadyr R., Kamchatka Pen., n. Sakhalin and lower Amur R.; also isolated breeding in n. Ukraine; s. limit: c. 55°N in Europe and w. Siberia, c. 52°N in e. Siberia, and c. 50°N in Far East; n. limit about Arctic Circle, extending to c. 70°N at Kola Pen. On migration, recorded widely from w. Europe to Kurile and Commander Is. During non-breeding period, occur Europe, Africa, Asia, Melanesia and A'asia. Scattered records in British Isles, Atlantic coast of France and Iberian Pen., and coast of Mediterranean Sea. Widespread throughout Africa, S of Tropic of Cancer; also along coasts of Horn of Africa and Red Sea; Nile Valley; Madagascar; coastal Asia, from Red Sea, Arabian Pen., Persian Gulf and Arabian Sea; throughout Indian subcontinent, Indomalaya, se. Asia, Indochina and s. China (transient n. China and Japan); regular visitor to Philippines and w.



Melanesia (Palau, Yap, Marianas, Truk), s. New Guinea (mainly transient) and Aust.; regular visitor to NZ in small numbers. Accidental to Iceland, Faeroes and Azores (Dement'ev & Gladkov 1951; Parslow 1967; Ali & Ripley 1980; de Schauensee 1984; Coates 1985; Pratt *et al.* 1987; BWP; P.S. Tomkovich).

Aust. The most widespread scopacid in Aust., with Atlas records in 39% of all 1°-blocks (Aust. Atlas). **Qld** Widespread in Gulf Country and e. Gulf of Carpentaria; recorded most coastal regions, though Aust. Atlas records a gap between n. C. York Pen. and Cooktown; inland, few records S of line from near Dalby to Mt Guide, and sparsely scattered elsewhere. **NSW** Recorded in most coastal regions; widespread W of Great Divide, especially between Lachlan and Murray Rs, the Darling R. drainage basin, including Macquarie Marshes, and nw. regions. **Vic.** Widespread: in coastal regions, mainly between Gippsland Ls and Port Phillip Bay; inland, mostly in W, and in Murray R. Valley (Vic. Atlas). **Tas.** Mainly coastal, from round Temma in NW, to Hobart region; unconfirmed record in SW, at Port Davey (Thomas 1979; White 1985). **SA** Throughout area E of 145°E, but few records from Flinders Ras; in all coastal regions W to at least Streaky Bay, with scattered records elsewhere along coast; in inland SA, W of 145°E, four Atlas records, but also recorded at Mintabie (Cox 1991). **WA** Generally absent from Western Deserts, though a few records from Great Sandy Desert and Nullarbor Plain. Occur round most of coast from C. Arid and Carnarvon. In Kimberley Div., recorded in SW and NE, with isolated record from Bonaparte Arch. **NT** Sparsely scattered throughout, including occasional records in Tanami Desert. Recorded in small numbers at L. Sylvester, Birrindudu and L. Woods, Barkly Tableland (R.P. Jaensch cf. Aust. Atlas). Not recorded n. Simpson Desert and SW (Aust. Atlas).

NZ First recorded 1874, when specimen, shot somewhere in Otago, was purchased in a Dunedin market (Oliver); next recorded, Awapuni Lagoon, near Gisborne, 17 Nov. 1952 (Stidolph 1953); regular visitor in small numbers since. **NI** Regularly recorded Te Werahi Stream, Manukau Harbour, Matahui Pt in Tauranga Harbour, and L. Wairarapa. Also

recorded: Parengarenga and Houhara Harbours, and Mimiwhangata Bay in Northland; Aotea Harbour; Awapuni Lagoon, Muriwai and Mahia, all round Gisborne; New Plymouth; Rangitikei R.; and Manawatu R. estuary. **SI** Regularly recorded Awarua Bay, Southland. Also recorded Puponga and elsewhere round Farewell Spit; Waimea Inlet; in Canterbury, round Ashley R. estuary, L. Ellesmere, Ophi R. estuary, Washdyke Lagoon and L. Wainono; in Southland (apart from Arawa Bay), at Waituna Lagoon, Oreti R. mouth and Invercargill. Only West Coast record appears to be from Westport, Nov. 1969 (Stidolph 1953; Bell 1964; Sibson 1965; Keeley & Sagar 1967; Edgar 1974; Sagar 1976; Owen & Sell 1985; CSN).

Lord Howe I. At least three records: single, Nov. 1962 (McKean & Hindwood 1965); single, 18 Nov. 1969 (Disney & Smithers 1972); two, 16 Nov. 1986 (NSW Bird Rep. 1986).

Norfolk I. Recorded before 1911, but without details (Iredale 1911; Schodde *et al.* 1983).

Macquarie I. Single, specimen, 1962 (Simpson 1965).

Heard I. Single, 25 Nov.–19 Dec. 1987 (Tideman & Copley 1988).

Chatham Is Single, 1 Jan. 1978 (CSN 25; NZCL).

Snares Is Single, 20 Nov.–13 Dec. 1968 (Warham & Keeley 1969).

Prince Edward Is Single, 1 Oct.–29 Nov. 1974; single, 1 Dec. 1977 (Burger *et al.* 1980); two, 6–12 Nov. 1986; single, 23 Nov. 1986 (Gartshore 1987).

Iles Kerguelen Records include: single, May 1952 (Jouanin & Paulian 1954); single, 22 Jan. 1979 (Thomas 1983); four, 15–20 Jan. 1988; eight, 17 Mar. 1988; four, 3 Apr. 1988 (Ausilio & Zotier 1989).

Iles Crozet One to three, Ile de la Possession, 25–30 Oct. 1980 (Stahl *et al.* 1984); previously recorded on Ile de la Possession and Ile de l'Est (Despin *et al.* 1972; Barrat 1974).

Populations Aust. Estimated at 20,000 (Watkins 1993). Sites of significance and maximum or average counts from summer and winter surveys round Aust., 1981–85, were: Eighty Mile Beach, WA, 2240; se. Gulf of Carpentaria, Qld, 1240;



Gulf St Vincent, SA, 1130; The Coorong, SA, 720; w. coast of Eyre Pen., SA, 580; Hunter R. estuary, NSW, 560; Roebuck Bay, WA, 560; Port Phillip Bay, Vic., 460 (Lane). Other areas of international importance (Watkins 1993) include: Great Sandy Str., Qld, 1069 (Driscoll 1990); Wilson Inlet, WA, 568 (Watkins 1993); Westernport Bay, Vic., 492 (AWSG Summer 1981 Count); Clinton Conservation Park, SA, 460 (Watkins 1993); St Kilda Saltworks, SA, 450 (Close & McCrie 1986). Totals for summer and winter counts, 1986–91, summarized in Table 1 (Hewish 1986, 1987a,b, 1988, 1989a,b, 1990a,b; Anon. 1992; Naismith 1992). Recorded on 53 of 197 wetlands surveyed in sw. WA, 1981–85 (Jaensch *et al.* 1988).

Table 1

Year	Summer Total	No. Sites	Winter Total	No. Sites
1986	2126	23	493	23
1987	2381	22	338	23
1988	1974	23	244	23
1989	2129	22	420	21
1990	1980	21	13	21
1991	1246	21	–	–

MOVEMENTS Migratory; breed Palaearctic; move S in broad front, overland and along coasts, to non-breeding areas (BWP). During non-breeding season, most birds within Aust. apparently resident, though possibly some dispersive movements. At least some movements made at night (Berney 1904; Wheeler 1955; Badman & May 1983).

Departure Adults leave before juveniles. On passage in Russia, July–Sept., occasionally till end Oct. or Nov. On migration, recorded widely from w. Europe to Kurile and

Commander Is (Dement'ev & Gladkov 1951). Pass ne. China, Aug.–Nov. (la Touche 1931–34); most common Jiangsu Province, China, Aug.–Sept. (Hui 1992; AWB 1993). Move through Korea (Gore & Won 1971), and Japan, where usually most abundant on s. migration (Orn. Soc. Japan 1974; AWB 1993). Hong Kong, mostly from mid-Aug. (Chalmers 1986); Taiwan, from Sept. (Severinghaus & Blackshaw 1976). At Samut Sakhon Province, Thailand, 1984, migration evident Aug., and again Nov. (Starks 1987). On Olango I., Philippines, common from Aug., 1989 (Magsalay *et al.* 1990). Common Singapore (Hails & Jarvis 1987). First arrive Brunei, early Sept. (Harvey & Elkin 1991). Common Bali (Ash 1984), and Wallacea, from Aug. (White & Bruce 1986). Mainly passage migrant in New Guinea, Aug.–Dec. (Beehler *et al.* 1986). **Aust.** Arrive Aug., possibly mainly in W (Lane), though also passage migrant Torres Str. (Draffan *et al.* 1983). Birds appear to move elsewhere in Aust. from w. Aust. by Nov., but no apparent difference in timing of arrival between coastal and inland or n. and s. sites (Lane); numbers increase slowly at most sites during Aug. and Sept., with larger increases at some (widely scattered) sites in Oct. and Nov. (Alcorn 1988). Several records in Nov. from Lord Howe I. and regular in NZ in summer.

Non-breeding In Aust., overland movement recorded (e.g. Schrader 1981); small numbers common at many inland localities (e.g. Badman & May 1983; Hobbs 1961), and occasionally so at other inland sites (e.g. Henle 1989). Birds disappear from Mt Isa district, Qld, after mid-Dec., with advent of thunderstorms (Liddy 1955, 1960) suggesting at least some movement is dispersive in response to rainfall. Also recorded moving to temporary wetlands that have recently been filled (Curry 1979). Most birds resident during non-breeding period, as numbers generally stable, though numbers fluctuate at some sites in SA and Vic. between Dec. and Feb. indicating some

movement (Hobbs 1958; Alcorn 1988; Lane). Some NZ birds recorded at one locality for months (e.g. CSN 34). Numbers fluctuate mid-Feb. to mid-Apr., with greater fluctuations in n. Aust. than in s. Aust. (Starks & Lane 1987; Alcorn 1988). Tend to roost and fly in large flocks before migration (Wheeler 1955; Close & McCrie 1986).

Return In Aust., n. migration occurs Mar. and particularly in Apr., when numbers decline at sites throughout Aust. and influxes recorded in Vic., SA, and along e. coast (Starks & Lane 1987; Alcorn 1988; Lane). Some sites N of 28°S show influxes in Mar., earlier than in se. Aust., which suggests that birds from se. Aust. do not stop on e. coast on n. migration (Alcorn 1988). Other counts suggest two waves of migration: first late Feb. and early Mar. when birds leave s. and n. Aust., with some s. birds touching down in n. Aust.; and second in late Mar. and early Apr. when birds from s. Aust. fly straight out of Aust., only a few stopping in nw. Aust. (Starks & Lane 1987).

Extralimitally, transient e. New Guinea, Apr. and May (Coates 1985); usually leave Port Moresby district, Apr. (Hicks 1990). Not uncommon S of Papar, Borneo, Mar.–Apr. (Smythies 1981); passed through Kuala Selangor, Pen. Malaysia, Mar.–May 1986 (AWB 1993). In Wallacea, only one dated record after Mar. (White & Bruce 1986). On Olango I., Philippines, common Mar. and Apr., 1989 (Magsalay *et al.* 1990). Most leave Hong Kong by end May (Chalmers 1986). Pass through Japan, end Apr. to end May (Dement'ev & Gladkov 1951); through Korea (Gore & Won 1971); and through ne. China, Apr.–May (la Touche 1931–34). Move through Russia, mainly along river valleys, Mar.–May (Dement'ev & Gladkov 1951).

Breeding Extralimitally, remain in s. China and often in Indonesia and New Guinea (Yuren 1991; Lane). In Aust., birds winter at only a few sites; these reached expected wintering numbers late Apr. to early May (Alcorn 1988); in winter, found as far S as se. Tas. (Sedgwick 1940; Glover 1954; Wheeler 1955; Thomas 1970; Storr 1977, 1984; Badman & May 1983). Proportion of summer population that winters varies between years at some sites, e.g. in se. Tas., none of preceding summer population remained in 1965, 11% remained in 1966, 17% in 1967, and 5% in 1968 (Thomas 1970). At two sites in SA with significant wintering populations, numbers stable through winter, indicating little movement (Alcorn 1988). However, in Hobart region, wintering birds moved much (Thomas 1968). Several winter records from NZ (Sibson 1965), where one bird resident for 9 years, and another for 10 years (Davies & Riegen 1989).

FOOD Carnivorous; molluscs, crustaceans, insects, occasionally fish and frogs. Extralimitally, also annelids, lizards, and rodents. **Behaviour** Detailed extralimital summary by Nethersole-Thompson & Nethersole-Thompson (1979). Diurnal and nocturnal. Active and agile, finding prey by sight or, occasionally, by touch. Wade in shallow water along edge of water in tidal estuaries, muddy claypans, saltworks and saltpans. Glean from surface of mud, vegetation or water. Pursue insects on surface of water, with bill half opened and partially immersed and head and neck outstretched; also pursue insects in air (Smith 1966). Fish taken by dash-and-lunge technique; prey occasionally manipulated, crushed and washed before being swallowed whole, especially large items, e.g. eels. Swim, up-end, submerge entire body, foot-tremble on mud, and use bill to raise small stones (Nethersole-Thompson & Nethersole-Thompson 1979; BWP). Take fish *Galaxias* by following move-

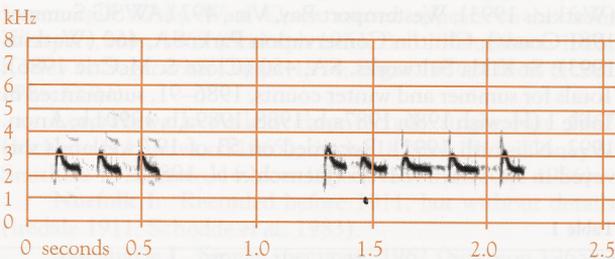
ments of fish with bill partly immersed, then striking rapidly (Wheeler 1955). Hoary-headed Grebes *Poliiocephalus poliocephalus* may associate with foraging Greenshanks, taking prey disturbed in mud (Smith 1985); recorded feeding in unison with other species of *Tringa* (BWP).

Adult At L. Cowal, NSW (three stomachs; Vestjens 1977): Plants: sds (Malvaceae: *Sida*; Fabaceae) 2 stomachs; Animals: Molluscs: gastropods 3; Crustaceans: cladocerans 1; ostracods 1; malacostracans: shrimps 1; Insects: Hemiptera: Corixidae 1; Notonectidae 1; Coleoptera: Carabidae 2; Dytiscidae 2; Diptera: ads 1; larv. 2; Hymenoptera: Formicidae 1; Amphibians: frogs 1.

Other records Animals: Molluscs: bivalves: Hyriidae (FAB); Crustaceans: anostracans: *Artemia* brine shrimps (Wheeler 1955); copepods (Tideman & Copley 1988); malacostracans: shrimps (McLennan 1917); Insects (Smith 1966): Odonata: Zygoptera: larv. (FAB); Anisoptera: larv. (Cleland; FAB); Orthoptera: Gryllidae (FAB); Acrididae; Hemiptera (van Tets *et al.* 1969); Coleoptera: Dytiscidae: ads, larv. (FAB); Diptera: Coelopidae kelp fly larv. (Wheeler 1955); Lepidoptera: Noctuidae: larv. (FAB); Hymenoptera: Formicidae (van Tets *et al.* 1969); Fish: Galaxiidae: *Galaxias* (Wheeler 1955).

VOICE Repertoire best known of any shorebird (Miller 1992); detailed study, with many sonagrams, by Nethersole-Thompson & Nethersole-Thompson (1979; also 1986); additional details and sonagrams in BWP.

Adult CONTACT-ALARM CALL: most familiar call in HANZAB area; loud, ringing, rapid but evenly spaced *tchu-tchu-tchu* (sonagram A), typically with slight drop in pitch on last note (BWP); often given in triplets, but sometimes 1–6 or more evenly spaced syllables (Nethersole-Thompson & Nethersole-Thompson 1979; BWP).



A F. van Gessel; Darwin, NT, Oct. 1984; P36

PLUMAGES Prepared by A.M. Dunn. Partial post-juvenile moult to immature non-breeding plumage begins at staging areas on migration, and completed after arrival at non-breeding areas. Sometimes followed by partial pre-breeding moult to immature breeding. Thereafter, begin complete post-breeding moult during s. migration and partial pre-breeding moult before return to breeding grounds, producing alternate non-breeding and breeding plumages. Probably first breed in second year.

Adult breeding (Second and subsequent alternate). **Head and neck** Crown, nape, hindneck, cheeks, sides of neck and lower throat, white with black-brown (119) shaft-streaks to feathers; streaks of crown and nape, broader, forming slightly darker cap; other streaked areas appear evenly streaked black-brown (119) and white. Forehead, mostly white with small black-brown (119) speckles or streaks; streaking heavier to-

ward crown. Chin, white with fine black streaks. Eye-ring, white. Indistinct supercilium from bill to front of eye, white, with scattered small black-brown (119) flecks. Short loreal stripe, black-brown (119), speckled white, extends from base of bill to just in front of eye. **Upperparts** Feathers of mantle and inner scapulars vary: black (89) with narrow off-white fringes; light grey-brown (27) with black-brown (119) shaft-streak and dark brown (121) submarginal fringe; or light grey (85) with small black (89) blobs and broad black (89) shaft-streak along one side of feather, and white fringe. Individuals generally have mix of these feathers, giving mottled or scaly appearance. Outer scapulars, dark brown (119A) with light grey-brown (119C) and dark-brown (121) barring along margins. Back and rump, white; in flight, conspicuous white wedge extends up back almost to level of shoulders. Uppertail-coverts, white, with wavy dark-brown (219) barring. **Underparts** White, with coarse dark streaks on upper breast and sides of lower breast, formed by dark-brown (121) base and thick shaft-streak to feathers; flanks, white heavily marked with dark-brown (121) chevron-shaped bars; axillaries, finely barred brown (28). **Tail** Similar to non-breeding, but inner feathers often replaced. Inner feathers, white, with narrow wavy dark-brown (219A) barring and dark-brown (219) shaft-streak; central two rectrices have light brownish-grey (c80) tinge to distal half. **Upperwing** Mostly retained from non-breeding plumage, replacing some secondary coverts and tertials. Median and lesser secondary coverts, grey (84) to light grey-brown (119C) with broad black-brown (119) shaft-streaks, dark brown (121) submarginal fringe or lateral spots, and white to off-white fringes; some feathers mostly black-brown (119) with off-white fringe. Tertials like scapulars but most have black-brown (119) lateral spots or half-bars along margins of feathers. **Underwing** Retained from non-breeding plumage.

Adult non-breeding (Second and subsequent basic). Differences from adult breeding: **Head and neck** Forehead, white, finely streaked dark grey from centre of forehead to crown; throat and cheeks, white. Crown, nape and ear-coverts, white, with brown (28) shaft-streaks to feathers giving evenly streaked appearance. Loes, white, lightly speckled brown (28). **Upperparts** Mantle and upper back, grey-brown (c119B) with dark brown (219) shaft-streaks, narrow white fringes and narrow, slightly darker brown (28) subterminal fringes to feathers. Scapulars, as mantle except dark-brown (219) broken subterminal barring instead of subterminal fringe. Uppertail-coverts, white, with widely spaced, narrow wavy dark-brown (219a) barring. **Underparts** White with varying amount of fine brown (28) streaks at sides of upper breast. **Tail** Inner rectrices, white, with narrow wavy dark-brown (219) barring; central pair (t1) have light brownish-grey (c80) tinge to distal half. Markings gradually reduced toward t6, which is sometimes all white. **Upperwing** Marginal coverts, lesser primary coverts, and alula, black-brown (119) with white tips to marginal primary coverts. Outer lesser secondary coverts, black-brown (119); inner lesser and median secondary coverts, dark brown (121), narrowly fringed white, and with slightly darker shaft-streaks. Greater primary coverts, black-brown (119) with narrow white tips, most obvious on innermost feathers. Greater secondary coverts, dark brown (121), narrowly fringed white; innermost greater secondary coverts also have narrow black-brown (119) subterminal fringe. Primaries, black-brown (119); innermost primaries, narrowly fringed white. Secondaries, mostly dark brown (121), narrowly fringed white. Trailing-edge of secondaries, white, speck-

led dark brown (121). Tertials, as innermost greater coverts, but subterminal band on innermost tertial is broken, giving barred pattern. **Underwing** Primaries and secondaries, mostly grey (84); inner primaries and all secondaries, narrowly fringed white; inner web of secondaries, faintly speckled. Greater primary and secondary coverts, light grey (c85) fringed white; bars gradually increase toward innerwing. Median and lesser primary and secondary coverts, white, with brown (28) subterminal fringes and central wedges.

Juvenile Head and neck Like adult non-breeding; differs by: streaking on crown and nape slightly heavier, with brown (28) streaking extending over forehead to base of culmen. White supercilium extends from base of culmen to just above front of eye. Loes, mostly brown (28) to black-brown (119), some feathers finely fringed white and appearing speckled; loreal stripe often shorter than that of adult breeding. **Upperparts** Mantle and scapulars, dark brown (219); feathers often paler toward base, with broad buff (114) fringes fading to white with wear. Larger scapulars have rows of alternating black-brown (119) and buff (124) spots along margins of feathers. General appearance browner and fringes of feathers broader than in adult breeding. Uppertail-coverts said to have very narrow black (89) terminal fringe (BWP) but this not seen in available Aust. specimens. **Underparts** White, with dark spots or streaks on breast and foreneck, formed by dark-brown (121) centres to feathers; feathers at sides of breast occasionally barred dark brown (121). Slightly more streaking than adult non-breeding. Breast said to be slightly tinged buff when fresh on some (BWP), but not observed in Aust. specimens. **Tail** Central two or three pairs of feathers, blotched or barred with widely spaced wavy bars; not as closely spaced or regular as in adult; sometimes tinged buff (c124) near tips. Outer feathers, mostly white with one or two very thin wavy dark-brown (219) bars and short half-bars along outer webs. **Upperwing** Mostly as adult non-breeding. Lesser and median coverts, black-brown (119) with fine buff (124) to off-white fringes, broken at tip of feather. Greater coverts similar to adult breeding, but fringe often broader and tinged buff (124). Tertials and tertial coverts, dark brown (c121), fringed buff (124) to off-white, with rows of alternating black-brown (119) and buff (124) spots along edge of fringe. **Underwing** As adult.

First immature non-breeding (First basic). Similar to adult non-breeding but usually with some retained juvenile feathers on back, rump, uppertail-coverts, tail, tertials and greater upperwing-coverts. Retained juvenile plumage very worn and contrasts with fresh non-breeding plumage. Often, moult of outer primaries occurs before or overlaps pre-breeding moult (see Moults).

First immature breeding (First alternate). Varies; often similar to adult breeding and difficult to distinguish. Some undergo partial moult to breeding plumage, retaining much non-breeding plumage. Some moult directly into adult non-breeding plumage. Inner primaries usually show considerable wear; outer primaries often fresher after moulting 1–6 primaries between Mar. and June (see Ageing). Some heavily worn juvenile upperwing-coverts often retained, especially lesser and greater coverts. Outermost rectrices often heavily worn, contrasting with fresher central rectrices.

BARE PARTS Based on photos (Pringle 1987; Chandler 1989; unpubl.: M.A. Barter, H.M. Gibbs, labels (HLW, MV) and descriptions (BWP). **Adult** Iris, dark brown (219). Bill, dark blue-grey (78) basal half grades to black (89) tip; base tinged olive in some. Legs, olive-grey (42); occasionally

yellowish or greener. **Juvenile** Like adult, but iris occasionally dark grey (83); legs occasionally yellow-olive (c52) or dull grey (c84).

MOULTS Based mainly on data collected from n. hemisphere (Dement'ev & Gladkov 1951; Pienkowski *et al.* 1976; Pearson 1975; Boere 1976; Tree 1979; BWP), a small sample ($n=44$) of Aust. skins (ANWC, HLW, MV, SAM, WAM), and data on primary-moult from 260 live birds caught Vic. and nw. Aust. between Nov. and Mar. (AWSG, VWSG). Aust. data show similar trends to data gathered overseas. **Adult post-breeding** (Third and subsequent pre-basic). Complete. Primaries outwards, beginning July–Sept.; start not synchronised and varies greatly; most of those wintering in w. Palaearctic and Africa begin in breeding grounds or staging areas (Pearson 1975; Boere 1976; BWP), but those reaching Aust. appear to begin upon arrival. Moult of primaries finished, Sept. to early Feb.; most in Aust. complete moult in Jan. Those starting primary-moult before migration often suspend moult, then complete it in non-breeding areas (Pearson 1975; Boere 1976). Moult of body usually begins June; completed late Aug.–Sept., before migration (Boere 1976; BWP); sometimes suspend moult of body with 20% old feathers remaining, then complete moult Sept.–Dec. in non-breeding areas (BWP). Little data available on condition of birds arriving in Aust., but seems that most arrive without any breeding plumage. **Adult pre-breeding** (Second and subsequent pre-alternate). Partial moult of body, involving head, neck, mantle, many scapulars, some of back, underparts, tertials, many median and some lesser upperwing-coverts, and usually some inner rectrices. Begins Jan. in non-breeding areas and completed by May in breeding areas (Dement'ev & Gladkov 1951). Condition on leaving Aust. varies; some have 25% breeding plumage, others leave in full breeding plumage. **Post-juvenile** (First pre-basic). Partial; involves most feathers of body except some lesser and median coverts and some scapulars; begins Aug. in staging areas, and completed in Mar.; protracted (Dement'ev & Gladkov 1951). First replace some feathers of mantle and scapulars, then head, neck and underparts (BWP). Resemble first-basic plumage in early Oct. to Nov., but replace upperwing-coverts, back to uppertail-coverts, and inner rectrices after this (BWP). **Post-juvenile moult of primaries** (First pre-supplemental). Many moult outer 2–5 primaries between Feb. and Mar. of first year (Pearson 1975; Tree 1979); most Aust. first-year birds begin moulting outer primaries in Mar. (VWSG). Number of primaries moulted varies greatly between individuals. **First pre-breeding** (First pre-alternate). Extent varies greatly; may moult to similar extent as adult pre-breeding or not moult at all. Mainly Apr. to early May. in w. Palaearctic (BWP); timing not known in Aust. Individuals staying in non-breeding areas over breeding season often stay in non-breeding plumage (first basic or first supplemental); subsequently moult directly into adult non-breeding plumage. **First post-breeding** (Second pre-basic). Complete; timing varies greatly. Often moult earlier than adults; in Africa, moult of primaries begins late May, completed from mid-Sept. (Tree 1979). In w. Palaearctic, some moult very early: starting Mar.–Apr., and completed in June, some moult at a similar time to those in Africa; those reaching breeding grounds moult as adults (BWP). Little data for Aust., but most have PMS of c. 30 in Nov., which is similar to adults at that time.

MEASUREMENTS Aust., skins (ANWC, HLW, MV, SAM, WAM): (1) Adults; (2) First basic.

	MALES	FEMALES	
WING	(1) 184.7 (6.33; 170–192; 11) (2) 179, 182	186.8 (5.90; 176–202; 25) 186	ns
TAIL	(1) 71.2 (3.16; 66–76; 13) (2) 67, 73	73.2 (4.52; 66–85; 28) 75	ns
BILL	(1) 54.7 (4.67; 47.7–65.8; 11) (2) 50.0, 51.3	54.7 (2.81; 49.9–61.7; 23) 55.2	ns
TARSUS	(1) 59.0 (2.82; 53.8–63.6; 14) (2) 55.1, 60.0	59.6 (2.61; 54.2–65.0; 29) 60.1	ns
TOE C	(1) 36.5 (1.32; 33.6–38.8; 13) (2) 35.3, 37.6	36.3 (1.70; 33.4–39.5; 24) 34.6	ns

No significant differences between sexes in Aust. specimens. In w. and central Europe and w. Africa, significant differences between sexes in length of bill and toe (BWP); also significant differences between sexes in length of wing (Tree 1979).

Aust., unsexed, live (VWSG, AWSG): (4) Adults; (5) First alternate or second basic, with retained juvenile p10; (6) Juveniles and first basic.

	VIC.	NW. AUST.	
WING	(4) 195.2 (5.82; 176–210; 128) (5) 193.1 (6.39; 184–202; 12) (6) 190.3 (6.83; 181–209; 18)	193.0 (5.38; 181–201; 20) – 187.5 (5.64; 179–198; 14)	ns – ns
BILL	(4) 55.5 (2.65; 49.0–65.6; 137) (5) 54.3 (2.46; 50.5–57.6; 12) (6) 55.2 (2.19; 51.6–59.4; 19)	54.9 (2.39; 51.2–62.0; 19) – 54.8 (1.68; 51.7–58.2; 14)	ns – ns
THL	(4) 92.1 (2.80; 84.4–98.9; 137) (5) 91.0 (2.56; 85.4–93.9; 12) (6) 92.1 (1.78; 88.0–95.0; 19)	91.6 (2.18; 89.0–97.0; 18) – 91.7 (1.99; 88.7–95.5; 14)	ns – ns

Length of wing differed significantly between first basic, first alternate and adults from Vic., but bill and total head-length did not differ significantly with age. Differences in length of wing would reflect differences between juvenile and adult in the length of p10. In w. and central Europe and w. Africa, juvenile wing and tail were significantly shorter than those of adult (BWP). Tree (1979) found no differences between adults and juveniles in measurements of wing and bill.

WEIGHTS (1) Aust., adults, skins (ANWC, MV, SAM, WAM). (2) Throughout range, all year (BWP).

	MALES	FEMALES	
(1)	219 168.7 (9.36; 160–188; 7)	–	
(2)	172 (28.5; 129–245; 26)	175 (21.2; 135–225; 25)	ns

Aust., unsexed, live (VWSG, AWSG): (3) Adults; (4) First immature breeding, aged on wear of feathers and pattern of moult; (5) Juveniles and first immatures.

	VIC.	NW. AUST.	
Sept.	(3) –	115.5 (2)	
Nov.	(3) 174.0 (9.75; 154–202; 53) (4) 177.1 (13.24; 157–202; 10) (5) 166.0 (8.72; 156–172; 3)	163.0 – –	
Dec.	(3) 171.1 (14.64; 151–192; 13)	147.7 (3)	
Mar.	(3) 187.4 (16.97; 125–230; 74) (5) 167.4 (22.00; 108–209; 16)	191.5 (21.59; 160–221; 6) –	
Apr.	(3) –	183.2 (14.08; 164–204; 10)	

(6–7) Morocco (Dick & Pienkowski 1979): (6) Juveniles; (7) Adults. (8–9) S. Africa (Summers & Waltner 1979): (8) Adults; (9) Juveniles.

UNSEXED

Aug.	(6)	153.4 (4.8; 5)
Sept.	(6)	154.7 (2.3; 24)
	(7)	149.8 (9.0; 5)
Oct.–Nov.	(8)	173.6 (3.4; 168–177; 5)
Dec.–Feb.	(8)	208.6 (23.7; 175–243; 11)
Mar.–Apr.	(8)	258.9 (24.3; 213–290; 9)
All year	(9)	167.4 (15.8; 145–185; 8)

Extralimitally, weights average about 170 g while in non-breeding areas: arrival weights usually c. 150 g, Aug.–Sept.; may approach 300 g before return to breeding grounds, Mar.–Apr. (Dick & Pienkowski 1979; Summers & Waltner 1979; Tree 1979); estimated flight-range of 7800–9800 km (Tree 1979). First-year birds that do not migrate do not gain weight in Mar.–Apr. Adults gain c. 100 g before migration (Tree 1979).

STRUCTURE Wing, long, narrow and pointed. Eleven primaries; p10 longest; p9 2–5 mm shorter, p8 10–15, p7 22–28, p6 31–39, p5 46–51, p4 57–65, p3 67–77, p2 78–88, p1 86–96; p11 minute. Fourteen secondaries, including four tertials; tips of longest tertials fall between p6 and p8 on folded wing. Tail, short and square; t1 projects slightly beyond rest of rectrices; 12 rectrices. Bill, c. 1.5 times length of head; slender, laterally compressed, and distal half kinked slightly upward; tip of culmen very slightly decurved. Tarsus, long and laterally compressed; scutellate. On tibia, 20–32 mm of bare skin exposed. Outer toe 83–87% of middle, inner 79–81%, hind 20–27%. Small web between outer and middle toe to level of basal joint; web between inner and middle toe minute.

AGEING After arrival in Aust., from about Aug.–Dec., three age-classes can be recognized: (1) juveniles and birds in first basic; (2) adults; and (3) birds undergoing second pre-basic moult (first immature 'breeding' or second basic). Juveniles and first immature non-breeding arrive with juvenile plumage and fresh primaries, which are retained until about Mar.; first-basic plumage attained by about Oct. Adults arrive with all primaries worn or in early stages of primary-moult; adults undergo active moult of primaries till Jan. First immature breeding and second basic can be identified before about late Nov. by very worn inner primaries contrasting with newer 2–5 outer primaries; between late Nov.–Dec. and Jan., new inner primaries only contrast slightly with slightly worn outer primaries. All birds with fresh wings aged as adults from Jan., but first immatures (first basic) separable at this time by heavily abraded primaries.

GEOGRAPHICAL VARIATION Very slight variation in size; populations in e. Siberia have slightly shorter bill and tarsus than those in Europe (see BWP).

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J.D. Davies 1993

Volume 3, Plate 10

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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