

Order CHARADRIIFORMES

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

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

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

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

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

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

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

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

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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. Molt-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; 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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Tringa stagnatilis **Marsh Sandpiper**

COLOUR PLATE FACING PAGE 192

Totanus stagnatilis Bechstein, 1803, *Orn. Taschenb. Dtl.*: 292, Pl. 29 — Germany.

The specific epithet is derived from the Latin (*stagnatilis*, from *stagnum*, belonging to pools or marshes) and refers to its habitat.

MONOTYPIC

FIELD IDENTIFICATION Length 22–26 cm; wingspan 40–45 cm; weight c. 70 g. Medium-sized, delicate and long-legged wader. General shape and plumage similar to Greenshank *Tringa nebularia*, but smaller and slimmer, with smaller head

and longer slimmer neck; much finer and usually straight, needle-like bill; and longer legs. Slightly larger than Wood Sandpiper *T. glareola*. In flight, all plumages show contrasting blackish outerwing, very pale whitish tail, and bold white

wedge up back; toes and part of tarsi project beyond tip of tail. Sexes alike. Marked seasonal variation. Juveniles and immatures separable.

Description Adult breeding Crown, nape, hindneck and sides of neck, pale grey or white, heavily streaked black and with finer dark streaking on ear-coverts; face appears pale, with whitish forehead, lores and lower cheeks, finely streaked and speckled dark grey and with diffuse dusky spot in front of eye, and whitish supercilium extending well behind eye and broadening to squarish end above rear ear-coverts; narrow white eye-ring. Mantle, scapulars, tertials and rest of upperparts, buffish grey, sparsely streaked, blotched and barred black, and finely streaked white when fresh. Inner greater, median and longer lesser wing-coverts, like scapulars and tertials, grading to uniform darker greyish-black on rest of innerwing-coverts, which forms blackish shoulder-patch at rest (often concealed by scapulars or feathers of flanks). Coarseness of black markings on upperparts varies: in those with narrow markings, plumage appears mostly buffish grey when fresh, pale grey-brown when worn; in others with broader black markings, upperparts appear rather black when worn. Underbody, white, with bold black streaks and spots on foreneck and centre of breast, broader spots or short bars on sides of breast and narrow wavy dark bars or chevrons on fore-flanks; rear flanks have a few dark chevrons, and lateral undertail-coverts often have some narrow dark streaks or arrowheads. In flight from above, buffish-grey, spotted and blotched black, grading to darker black on outerwing and carpal, with contrasting white shaft of outermost primary, bold white pointed wedge extending from uppertail-coverts to upper back, and white tail with pale buffish-grey wash and irregular, narrow dark barring on central rectrices. Underwing mostly white, with narrow dusky leading-edge to lining, and dusky bar through median primary coverts. Bill mostly brownish-black, paler greenish-grey on basal third or less (palest on base of lower mandible). Iris, dark brown. Legs and feet, yellowish-green or brighter yellow. **Adult non-breeding** Patterning of head distinctive; differs from adult breeding by: crown, nape, hindneck, sides of neck, ear-coverts and varying diffuse dusky patch in front of eye, paler grey, faintly speckled darker and finely streaked white; forehead, lores, cheeks, eye-ring and supercilium, white, contrasting with cap and ear-coverts; in some, nape and hindneck paler, enhancing capped appearance. Rest of upperparts and innerwing-coverts, paler, grey, and more uniform than breeding, with faint scaly appearance when fresh (feathers of mantle, scapulars, tertials and greater coverts, grey, narrowly fringed white and with dark shaft-streak and thin dark submarginal line); innerwing-coverts gradually darken from pale grey on greater coverts to black on lesser coverts and carpal; have similar blackish shoulder-patch to breeding. Underbody, white, with sides of breast, grey, finely streaked and spotted darker. In flight, as breeding, except buffish-grey of saddle and innerwing-coverts more uniform pale-grey. Bare parts as breeding except legs and feet, dull greyish-green or yellowish green. **Juvenile** Like adult non-breeding but darker and browner above, with more conspicuous and coarse buff or white streaks and bolder dark and buff markings. Differences from adult non-breeding: crown and patch on ear-coverts, darker, with heavy black streaking and fine white mottling; contrast with somewhat paler grey-and-white streaking on nape and hindneck, to give more capped appearance and contrasting head-pattern. Mantle, scapulars, tertials and innerwing-coverts, dull black, with varying greyish-buff wash and bold buff spots and fringes, which are broken at tip (cf. narrower, complete white fringe in

non-breeding adult), and with bold rows of blackish spots or short bars on tertials and coverts; have similar blackish shoulder-patch at rest. Streaking on sides of neck and breast, coarser and darker. Bare parts as non-breeding. Upperparts and innerwing-coverts become darker with wear, as buff spots and fringes abrade, leaving shallow notches on sides of some feathers (particularly tertials). **First immature non-breeding** Like adult non-breeding, but distinguished by worn, retained juvenile tertials and innerwing-coverts, which contrast with fresh pale-grey and white feathers of rest of upperparts. Usually at least some coverts and tertials retained through first non-breeding season. **First immature breeding** Varies. Some, especially those wintering in HANZAB area, retain non-breeding plumage and heavily worn juvenile primaries (adults in breeding plumage have fresher remiges); many others attain varying amount of breeding plumage and can appear similar to adult breeding; distinguished by heavily worn retained juvenile primaries, or by strong contrast between fresh outer 2–5 primaries and very worn inner primaries.

Similar species Often confused with **Greenshank**; see that text for differences. **Wood Sandpiper** is slightly smaller, with much shorter bill and legs; in all plumages, upperparts darker, browner, with pale spots (though some heavily worn birds can have little spotting and look very dark above, they always have some spots on wing-coverts); centre of forehead, dark; well-defined dark loreal stripe; more green, grey or brown at base of bill; in flight, appears more compact, with shorter wings and bill, and feet do not project beyond tail; distinguished by squarish white patch on rump and dark back. **Wilson's Phalarope** *Phalaropus tricolor* in non-breeding plumage is slightly smaller, bulkier and with shorter, yellow legs; pale-grey of crown extends to base of bill, and usually have at least a trace of a grey loreal stripe; demarcation of grey upperparts and white underparts along sides of neck, sharper; readily distinguished in flight by squarish white patch on rump, grey back, and feet do not project so far beyond tip of tail; when feeding, often walk on mud and wade in shallows but, unlike Marsh, often swim well in deep water and spin in manner typical of phalaropes. For distinctions from Lesser Yellowlegs *Tringa flavipes*, see that account.

Occur singly or in small to large flocks on wide variety of fresh and brackish wetlands; avoid open beaches. Wary, active and excitable. Associate with other waders and often seen with Greenshanks, especially in saltfields. Feeding actions typical of genus, but delicate and graceful; feed by wading in shallow water with brisk steady walk, pecking from surface of water and, sometimes, sweeping bill from side to side; may feed in tight co-ordinated groups, and sometimes feed with other wading birds; probe in deeper water and crouch to pick along edge of water; also dash after prey in deep water; occasionally swim. Stance often more erect than that of other *Tringa*, particularly when alarmed, when bob head and stretch both neck and wings. Flight, rapid and agile, with lighter, more delicate actions than Greenshank. Usual alarm call a loud *teoo* or *chip* recalling Black-winged Stilt *Himantopus himantopus*, often repeated rapidly; also clear fast whistle *plew* or *tew*.

HABITAT Permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, salt pans, saltmarshes, estuaries, pools on inundated floodplains, and intertidal mudflats; also regularly at sewage farms and saltworks (Lane & Jessop 1985). Less often at reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes (Favaloro

1943; Bravery 1964; Serventy & Whittell 1976; Badman 1979; Badman & May 1983; Storr 1985).

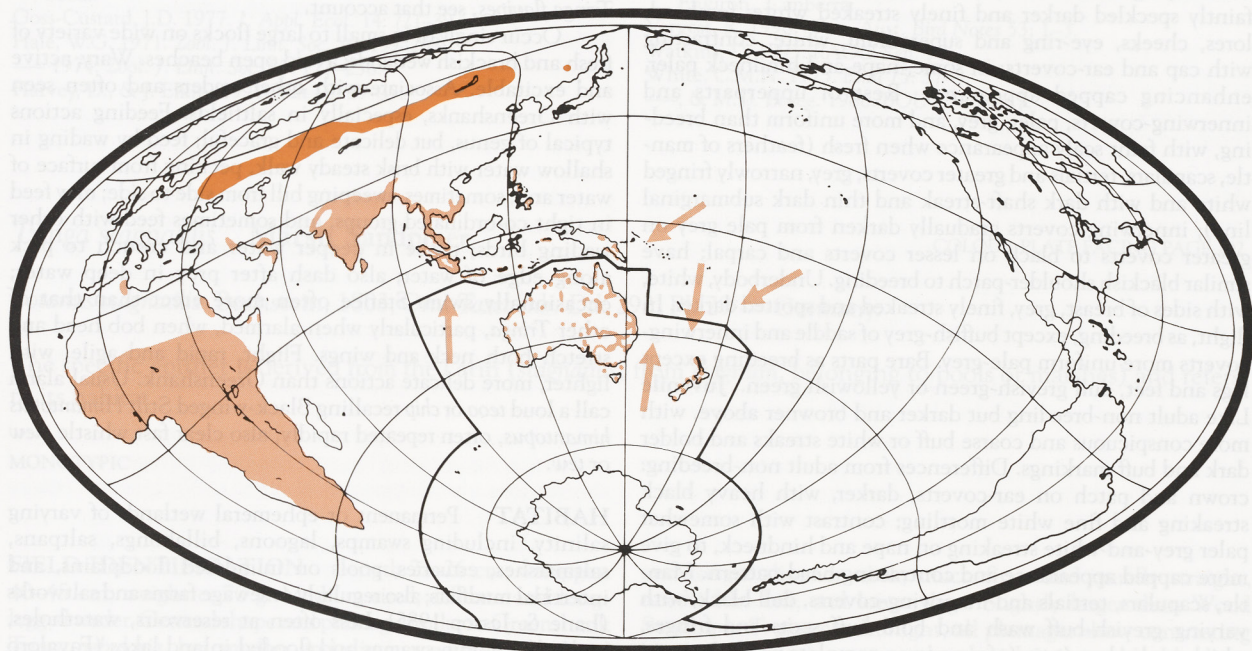
In n. Aust., said to prefer intertidal mudflats (Sibson 1963; Morris 1975; Storr 1977, 1984; Watkins 1993; Lane), though surveys in Kakadu NP recorded more birds round shallow freshwater lakes than in areas influenced by tide (Bamford 1988), and, in Top End, often use ephemeral pools on inundated freshwater and tidal floodplains (R.P. Jaensch). Three of the five sites with highest recorded numbers are saltwater habitats (Hunter Estuary, NSW; Port Hedland Saltworks, WA; Tullakool Evaporation Ponds, NSW) (Watkins 1993). In se. Gulf of Carpentaria, recorded round both saline and fresh waters (Garnett 1989). Elsewhere, said to avoid, or rarely occur in, tidal habitats (Crawford 1972; Roberts 1979; Vic. Atlas), and rarely occur on beaches (Congreve & Congreve 1985). In WA, said to prefer freshwater to marine environments (Serventy & Whittell 1976). In se. Aust., prefer inland saline lakes and coastal saltworks (Lane & Jessop 1984; Lane). Infrequently round mangroves (Favaloro 1943; Sibson 1963; Colston & Harrison 1968; Drake 1981; Jaensch *et al.* 1988; Bamford 1988, 1990; Jaensch *et al.* 1988; Morris *et al.* 1990).

Usually forage in shallow water at edge of wetlands. May wade far from shore (Vic. Atlas), though Drake (1981) only saw birds feeding within 1–2 m of edge of water. Probe wet mud of mudflats or among marshy vegetation (Favaloro 1943; Drake 1981; Lane). Recorded roosting or loafing on tidal mudflats, near low saltmarsh, and round inland swamps (Sibson 1963; Garnett 1989).

DISTRIBUTION AND POPULATION Breed from e. Europe to e. Siberia; for expansion of breeding range, see Tomkovich (1992). Occasional isolated breeding Rumania, near w. coast of Black Sea; no longer breed Hungary; sporadic breeding formerly recorded in e. Europe in nineteenth and early twentieth centuries; in 1970s, breeding confirmed Finland and Latvia. Main breeding range extends from lower reaches of Pripyat R. in W, E to Transbaikalia, round the

headwaters of the Amur R., E of L. Baikal; recent records on middle reaches of Amur R. N. and s. boundaries of breeding range poorly known: n. limit generally S of c. 57°N; in W, to just S of Rybinskoye Vodokhranilishche (reservoir); in central part of range, N of 60°N, to near confluence of Irtysh and Ob Rs; in E, N to Yukutsk on Lena R. S. limit of breeding probably mostly N of c. 48°N. Breeding recorded n.-central and ne. Mongolia. Isolated breeding in s. Ussuriland, round L. Khanka and Sungacha R., and in w. Heilungkiang province in China. During non-breeding period, occur throughout s. Africa, as well as valley of Nile R. and coast of Red Sea; passage migrant through North Africa; also occur Persian Gulf and lower reaches of Tigris, Euphrates and Karun Rs and round coasts of Arabian Sea to Indian subcontinent. Widespread Indomalaya, extending well inland along course of Irrawaddy R., Malay Pen., and s. Indochina; regular visitor to Sumatra and Borneo, and from Wallacea to New Guinea and Bougainville; also recorded Philippines and w. Micronesia. Passage migrant e. China, Korean Pen. and Japan. Accidental to Scandinavia and w. Europe, though regular to Norway and Holland in recent years; also accidental to Aleutian Is (Dement'ev & Gladkov 1951; Ali & Ripley 1980; Smythies 1981; AOU 1983; de Schauensee 1984; Flint *et al.* 1984; Coates 1985; Urban *et al.* 1986; White & Bruce 1986; Pratt *et al.* 1987; van Marle & Voous 1988; Tomkovich 1992; BWP).

Aust. Qld Widespread in coastal regions, from s. Gulf of Carpentaria to Edward R., and from Cooktown to se. Qld; the only records from N of line from Edward R. to Cooktown, are of birds on passage on Badu, Boigu and Stephens Is in Torres Str. W of Great Divide, widespread but sparsely scattered N of c. 24°S. Isolated records from Dynevor Downs in SW (Corben 1972; Roberts 1975; Schrader 1981; Draffan *et al.* 1983; Qld Bird Reps; Aust. Atlas). **NSW** Recorded in all regions. Sparsely distributed on n. coast; more widespread round central and s. coasts. Inland, widespread on w. slopes of Great Divide and w. plains, though infrequently in SW and area roughly bounded by the Lachlan, Murray, Darling and Bogan





Rs (NSW Bird Reps; Aust. Atlas). **Vic.** A few Gippsland records between Rotamah I. and Jack Smith's L.; also Westernport Bay. Most in Port Phillip Bay. Scattered records from Western Districts, between L. Corangamite and Portland. Many inland records: isolated record at Buninyong; scattered in belt from round Shepparton, W to Rupanyup and Hindmarsh and Albacutya Ls; many records from Murray Valley, round Barmah, Kerang–Swan Hill district, and round Mildura (Vic. Atlas; Vic. Bird Reps). **Tas.** Vagrant (singles unless stated): Scott's Lagoon, Flinders I., 6 Mar. 1969 (Milledge 1970); Adelaide Bay, Flinders I., 20 Mar. 1972 (Tas. Bird Rep. 2); Tomahawk, 16 Mar. 1979 (Tas. Bird Rep. 9); five, Sea Elephant R., King I., 16 Feb. 1985 (Tas. Bird Rep. 15); Orielton Lagoon, 27–28 Dec. 1990 (Tas. Bird Rep. 20). **SA** Most records E of c. 137°E. Occasionally recorded in SE, mostly from The Coorong to Yorke Pen., including inland along Murray Valley (SA Bird Reps; Aust. Atlas). On Eyre Pen., recorded from Whyalla to Little Swamp and Coffin Bay (Eckert 1972; Cox 1974; SA Bird Reps 1970–71, 1977–81; Aust. Atlas). Widespread L. Eyre drainage basin (Badman 1979, 1989; Badman & May 1983). In W, recorded at Mintabie, 3 Dec. 1990 (Cox 1991). **WA** Scattered, mainly round coast. Few records from s. coast, scattered from Eyre, W to round Denmark; in SW, recorded from Busselton, N to Namming NR and Guraga L.; occasionally round Shark Bay, N to Lyndon R. In Pilbara region, recorded round coast between Onslow and Port Hedland, and inland at Shay Gap and round Wittenoom. In Kimberley Div., occur from round Broome to lower Ord R. Isolated inland record from Sturt Ck HS (Ford 1966; Serventy & Whittell 1976; Storr 1984, 1985; Congreve & Congreve 1985; Howard 1986; Jaensch *et al.* 1988; Aust. Atlas). Record from Leonora (Reid 1976; Storr 1986), was a Greenshank. **NT** Scattered records in coastal Top End, from Keep R. to Oenpelli and Alligator R.; few Atlas records from e. Arnhem

Land and w. Gulf of Carpentaria include Nhulunbuy–Gove Pen., Emerald R. and Ngukurr–Roper R.; also, 65, Bing Bong (near Borroloola), 29 Mar. 1993 (R.P. Jaensch). Inland records from Top End include: Marrakai and Mamukala and Mungena Waterhole in Kakadu NP, Humpty Doo and Victoria R. Downs; farther S, recorded inland at Renner Springs, Warrego, Alice Springs, upper Sturt Ck on Birrindudu Floodplain, L. Woods, and L. Sylvester (Deignan 1964; Parker 1969; Crawford 1972; Braithwaite & Stewart 1975; Boekel 1980; Roberts 1981; Aust. Atlas; R.P. Jaensch; H.A.F. Thompson & D.K. Goodfellow).

NZ Regular visitor in very small numbers. First recorded 24 Mar. 1959 at Manukau Harbour (Sibson 1959). **NI** Multiple records from Kaipara (Jordan's Farm; four records) and Manukau (Mangere, Karaka; seven) Harbours, Firth of Thames (Miranda, Access Bay, Waitakaruru Ck; ten), Maketu (Kaituna Cut; five) and round Napier (Westshore, Ahuriri; four). Scattered records elsewhere, including Ninety Mile Beach, 15 Nov.–4 Jan. 1988 (CSN 36), Rangaunu Harbour, 1 Apr. 1991 (CSN 39), Waimango, 29 Dec. 1986 (CSN 36), Port Whangarei, 10 May 1989 (CSN 37); Muriwai Lagoon, 13 Dec. 1964 (Blackburn 1965), Whakaki Lagoon, 20 Jan. 1970 (CSN 19 Suppl.), L. Wairarapa, 2 Jan. 1989 (CSN 37) and Hawera, 1 Nov. 1963 (MacDonald 1964). **SI** First recorded, 5 May 1968 at Orawaiti, Westport (Harrow 1968). Recorded Farewell Spit, May 1989 (CSN 37), L. Grassmere, Mar. 1988, 21 Jan. 1989 (CSN 36, 37), L. Ellesmere, 13 Nov. 1981–17 Apr. 1982, Nov. 1988–Feb. 1989, 7 Nov. 1989 (CSN 30, 37, 38), Cooper Lagoon, 12 Feb 1982 (CSN 30), Hawksbury Lagoon, 6 Feb.–Mar. 1985 (CSN 33), Waituna Lagoon, 3 Jan. 1985 (CSN 33), Awarua Bay, 2 Dec. 1984 (CSN 33) and Orawaiti, Westport (see above).

Lord Howe I. Vagrant. Single, 18 Apr. 1977 (NSW Bird Rep. 1977).

Norfolk I. Vagrant. Single, Dec. 1969 (Hermes *et al.* 1986); 1–5, 31 Oct.–16 Nov. 1981 (Moore 1985); single, 4–11 Dec. 1984 (Moore 1985).

Chatham Is Undated records (Freeman 1994).

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

Population Aust. Estimated at 9000 (Watkins 1993). Totals for summer counts throughout Aust., 1986–91, <400; summarized in Hewish (1986, 1987, 1989, 1990), Anon. (1992), and Naismith (1992). Sites of significance and maximum or average counts of Marsh Sandpipers for summer and winter surveys, 1981–85, were: se. Gulf of Carpentaria, Qld, 1150; Port Hedland Saltworks, WA, 500; L. Namulla, Cunnamulla, Qld, 500; Hunter R. estuary, NSW, 280; Eighty Mile Beach, WA, 140; Parkes region, NSW, 130; Port Phillip Bay, Vic., 80 (Lane). Other areas of national importance (Watkins 1993), include: Buffalo L. area, Normanton, Qld, 600 (Claridge *et al.* 1988); Tullakool Saltworks, NSW, 500 (Smith 1990); Kakadu NP, NT, 394 (Bamford 1988); Parry R. floodplain, WA, 300 (Jaensch & Vervest 1990); Peel Inlet, WA, 276 (SW Waterbird Project Database, RAOU; CALM); Camballin, WA, 276 (Jaensch & Vervest 1990); Third Marsh, Kerang, Vic., 200 (Vic. Bird Rep. 1981); Reedy L., Moolap, Vic., 130 (Vic. Bird Rep. 1983); Macquarie Marshes, NSW, 120 (Smith 1990); Hospital Swamp, Moolap, Vic., 100 (Vic. Bird Rep. 1985); Swan Hill Sewage Farm, Vic., 100 (Vic. Bird Rep. 1982); Alva Beach (Ayr), Qld, 95 (Johnson 1987); Moolap Saltworks, Vic., 91 (AWSG Summer Count 1988); ICI Saltworks, SA, 90 (Close & McCrie 1986). Other sites with high totals, not already mentioned, are: Kooragang I., NSW, up to 500, 22 Nov. 1975 (NSW Bird Rep. 1975); Sandringham Stn, sw. Qld, c. 400 passed through in 3 h (Schrader 1981); Charters Towers, Qld, 215, 2 Oct. 1987 (Qld Bird Rep. 1987).

MOVEMENTS Migratory; breed e. Europe, s. Siberia and n. China and migrate S for boreal winter to non-breeding areas from Africa, across s. Asia to Aust.; most spend non-breeding period in Africa and Indian subcontinent. On migration, move in broad fronts overland; staging areas far apart (BWP).

Departure From first half July to early Sept. with little difference between timing of adults and juveniles (BWP). Move through central Mongolia (Kozlova 1932), and central, ne. and coastal China (see Lane). Only occur Korea during s. migration (Aug.–Sept.); only found in significant numbers in Japan during s. migration (Gore & Won 1971; Orn. Soc. Japan 1974; AWB 1993). In China, pass Beidaihe, mainly late Aug. and early Sept. (AWB 1993); pass Jiangsu Province, Aug. and Sept. (Hui 1992) and apparently abundant on passage at Yellow R. Delta (Lane 1992). Not recorded in large numbers in Taiwan (AWB 1993; Lane). Pass through Hong Kong, late Aug. to late Oct. (Chalmers 1986). Uncommon but regular in Burma (Smythies 1953); recorded Cambodia (AWB 1993); common visitor to Thailand, apparently arriving about Sept. (Starks 1987; Lekagul & Round 1991). Pass through Malaysia (Medway & Wells 1976) and Sumatra (van Marle & Voous 1988). Regular visitor to Borneo (see Smythies 1981), passing through Brunei about late Sept. (Harvey & Elkin 1991). Apparently uncommon in Wallacea (White & Bruce 1986) but common on w. coast of Sulawesi from Sept. (Escott & Holmes 1980). Rare Philippines (Delacour & Mayr 1946). Occur Bali, generally in small numbers, late Aug. to late Oct. (Ash 1984). Also seen se. Irian Jaya, Sept.–Dec. (Lane). Mostly transient in PNG, Oct. to early Nov. (Coates 1985), though usually arrive in some districts in Sept. (Finch 1982; Hicks

1990); small numbers regularly visit Bougainville I. (Hadden 1981). Uncommon passage migrant in Torres Str. (Druffan *et al.* 1983).

Arrive Aust., Sept. (Lane). Apparently move S across Aust., Sept.–Dec. (Lane); vagrant to Tas. (Aust. Atlas). Regular to NZ in very small numbers (Falla *et al.* 1981; Battley 1991).

Non-breeding Numbers vary on Hunter estuary, NSW, Dec.–Feb. (Lane) suggesting some movement during this period. Birds may remain at sites for up to at least 3 weeks (Bravery 1970). Some movements possibly dispersive, e.g. at Leanyer, Darwin, not recorded July or Aug. when area dry (Crawford 1972).

Return In Aust., migrate N, Mar. and Apr., when temporary influxes occur at some sites on e. coast. Birds move to n. end Gulf St Vincent before leaving; leave Port Hedland Saltworks, nw. Aust., mid-Apr. (Lane) and apparently leave se. Gulf of Carpentaria after this (Garnett 1986). Extraliminally, usually leave Port Moresby district, Apr. (Hicks 1990), though few records of return passage from PNG (Coates 1985). Small passage in Brunei, Mar. and Apr. (Harvey & Elkin 1991). Apparently not common after Apr. on w. coast of Sulawesi (Escott & Holmes 1980). Apparently only pass through Red R. Delta, Vietnam, on n. migration (AWB 1993). Pass through Hong Kong, late Mar. to late Apr. (Chalmers 1986); fewer pass Jiangsu Province, China, on n. migration; small passage Apr. and Mar. through Taiwan (AWB 1993). Breeding areas reoccupied mid-Apr. to mid-May (BWP).

Breeding Extraliminally, many non-breeders said to remain in non-breeding areas, or at sites between breeding and non-breeding areas (Hayman *et al.* 1986). Few remain in Aust. during winter (Aust. Atlas); mainly in N, e.g. 50, July, Kimberley Div., WA (Campbell 1990); 300, Parry Floodplain, 15 July 1984 (Jaensch 1989). Sometimes recorded during winter in Vic. (Vic. Atlas), NSW (e.g. Lane & Starks 1985) and SA (e.g. Hewish 1987). Recorded wintering in NZ on at least five occasions, including single at Firth of Thames from Feb. 1987 to at least end June 1989 (Battley 1991).

Banding No relevant recoveries.

FOOD Carnivorous; insects, molluscs and, outside HANZAB area, crustaceans; plant material has been found in stomachs of birds in Aust. but may have been ingested incidentally.

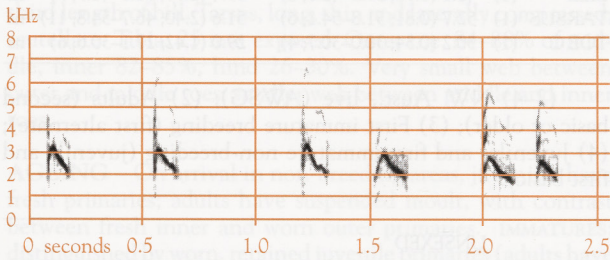
Behaviour Usually feed in shallow water, often wading deeper than level of tarsus; walk briskly and steadily, or dash about, turning in half-circles; sometimes swim. Generally pick at surface of water or mud; may glean from vegetation; rarely, lunge and grab prey, and recorded scything and probing. Feed singly or in groups and recorded following ducks, egrets and other waders, feeding on prey disturbed by activity of other birds (BWP).

Adult No detailed studies. Plant material; Animals: Molluscs (Boehm 1963); Insects (McKeown 1934); Odonata: Anisoptera (Boehm 1963): larv. (Cleland); Coleoptera (McKeown 1934; Boehm 1963); Carabidae; Hymenoptera: Formicidae: *Chalcoptera metallica* (McKeown 1934).

VOICE Most common call in our area is single or irregularly repeated loud and clear *teoo*; when given in alarm, call a much more clipped, sharp *chip*, recalling that of Black-winged Stilt *Himantopus himantopus* (BWP). See BWP for details and sonagrams; also Bergmann & Helb (1982) and Maclean (1985) for sonagrams.

Adult Usual call when flushed a loud *tew* or *tschoo*

(sonagram A), very like Contact-Alarm Call of Greenshank (BWP), but higher pitched and thinner (Hayman *et al.* 1986). Also like call of Lesser Yellowlegs. Two examples are shown in sonagram A, each with three syllables.



A First three syllables: F. van Gessel; Darwin, NT, Oct. 1984; P36; second three syllables: R. Swaby; Price, SA, Nov. 1972; P36

PLUMAGES Prepared by A.M. Dunn. Undergo partial post-juvenile (first pre-basic) moult to immature non-breeding plumage. Most immatures in A'asia moult outer primaries in first pre-supplemental moult, Feb.–Mar. Undergo partial first pre-breeding (first pre-alternate) moult, Feb.–late Apr., acquiring breeding plumage similar to adults and migrate N. Thereafter, moult twice annually: a complete post-breeding (pre-basic) moult to non-breeding plumage, starting on breeding grounds, suspended on migration, and completed in non-breeding areas; and a partial pre-alternate moult to adult breeding before n. migration. Age at first breeding, 1 year or older.

Adult breeding (Second and subsequent alternate). **Head and neck** Forehead, crown and hindneck, black-brown (119) with white to pale-grey (86) fringes to feathers. Indistinct white supercilium extends from base of bill to well behind eye. Lores, cheeks, sides of neck, and ear-coverts, white, heavily speckled or streaked dark brown (121), more coarsely on lower neck. Chin, throat and narrow eye-ring, white. **Upperparts** Mantle, upper back and smaller scapulars, light grey-brown (119C–27) with broad black (89) central wedge to feathers; longer scapulars, light grey-brown (119C–27) with thin black (89) shaft-streak and irregular broken black (89) bars or blotches. Amount of black on feathers varies greatly between individuals; in some, black marks narrow and even; in others, marks broad and feathers look black when feathers wear. Lower back and rump, white. Uppertail-coverts, white, narrowly barred black-brown (119). **Underparts** Breast, white, with rounded or elongate black-brown (119) spots; on sides of breast, spots usually broader, forming short bars. Upper flanks, white, with narrow wavy dark-brown (219) bars. Belly, vent, and undertail-coverts, white, with some very thin, black (89) shaft-streaks on coverts, particularly on outer feathers. **Tail** T1, light grey-brown (119D), barred dark brown (219) and tipped white, with thin dark-brown (219) shaft-streak. Outer feathers, white, with irregular dark-brown (221) partial bars, blotches or speckling; brown markings concentrated near outer margins of feathers. **Upperwing** Marginal coverts, dark brown (121). Lesser and median secondary coverts, boldly patterned like scapulars; some smaller feathers, dark brown (121). Greater secondary coverts, dark brown (119A), narrowly fringed white. Greater primary coverts, alula and outer primaries, black-brown (20); p10 has white shaft. Inner primaries, mostly black-brown (20) with narrow white tip and narrow white edge to

inner web; concealed base of inner web, white, speckled dark brown (121). Secondaries, brown (28), narrowly fringed white. Inner tertials, mostly black-brown (119), notched light grey-brown (119C). Outermost tertial, mostly light grey-brown (119c) with narrow black-brown (119) shaft-streak and thin wavy black-brown (119) bars. Marginal primary coverts, dark brown (121) with white tips. **Underwing** Marginal and lesser primary coverts, brown (28), tipped white. Lesser secondary coverts and median primary and secondary coverts, white. Greater primary and secondary coverts, white with faint brownish-grey (80) speckling, mainly at base of feathers. Primaries, brownish grey (79) with pale-grey (86) base to inner web, speckled brownish grey (79). Secondaries, light grey (85), fringed white, with some light brownish-grey (79) speckling along inner margins.

Adult non-breeding (Second and subsequent basic). Differences from adult breeding: **Head and neck** Forehead, lores, cheeks, chin and throat, white. White supercilium extends from forehead to above ear-coverts. Crown, nape and hindneck, light grey-brown (27) to brown (28) with dark-brown (219) shaft-streak to feathers. **Upperparts** Mantle, upper back and scapulars, brownish grey (79 to 80), feathers fringed white and with very thin dark-brown (219) shaft-streaks. Lower back and rump, white. Uppertail-coverts, white, with dark-brown (219) bars and shaft-streaks. **Underparts** White, with dark-brown (219) shaft-streaks on some feathers of flanks and sides of breast. **Tail** Inner feathers, white, barred dark brown (219); outer feathers, white, with dark-brown (219) subterminal edges. **Upperwing** Median and greater secondary coverts, light grey-brown (119C), narrowly fringed white, with thin dark-brown (121) shaft-streaks and dark-brown (119A) subterminal fringe. Tertials, light grey-brown (c119C), thinly fringed white, with very thin dark-brown (219) shaft-streaks; sometimes with faint dark-brown (c121) wavy lines near margins of feathers, or subterminal fringe. **Underwing** As adult breeding.

Juvenile Differences from adult non-breeding. **Head and neck** Centre of forehead and lores faintly streaked brownish-grey (80). Crown, black-brown (119), mottled white. Streaks on sides of neck and hindneck slightly broader and darker. **Upperparts** Mantle and scapulars, black-brown (119) with buff (c123D) fringe and shallow buff (c123D) lateral spots; fringe broken at tip of feathers; centre of feather often washed buff to light grey-brown (c119C) with black-brown (119) shaft-streaks. Uppertail-coverts often washed buff (c123D) with narrow black (89) terminal fringe when fresh. **Underparts** Sides of breast, off-white, with grey (c84) spots or streaks. **Tail** Fringes of t1, narrower and buff (c123D); black (89) divides fringe at tip of feather. Dark bars narrower and more closely spaced than in adult. **Upperwing** Lesser secondary and primary coverts near angle of wing, black-brown (119) narrowly fringed buff. Median secondary coverts, black-brown (119) with small buff spots at sides of feathers. Greater secondary coverts, black-brown (119) with buff (c123D) fringe, which is broken at tip of feather, and submarginal buff (c123D) spots. Fringes of secondaries and inner primaries wider than on adult. P7–p9 often narrowly fringed white when fresh. Tertials, light grey-brown (c119C), fringed buff (c123D) at sides; fringe and centre of feather separated by rows of black-brown (119) spots or half-bars; tips of feathers, black-brown (119). **Underwing** As adult.

First immature non-breeding (First basic). Similar to adult non-breeding; retain some worn juvenile plumage in outer tail, tertials and upperwing-coverts, which contrasts

with fresh non-breeding plumage. Some remiges may be replaced, which contrast with heavily worn and abraded juvenile primaries.

First immature breeding (First alternate). Do not breed in this plumage. Varies between individuals; some attain breeding plumage similar to adult breeding, others remain in non-breeding plumage, particularly if wintering in non-breeding areas during breeding season.

BARE PARTS Based on photos (Pringle 1987; Chandler 1989) and descriptions (BWP). **Adult, Juvenile** Bill, mostly dark brown (119A); tip and ridge of culmen, black (89); base, tinged olive-grey (43). Iris, dark brown (219). Legs, olive-grey (42) to olive (51) when not breeding; olive (50) to yellow (c56) when breeding.

MOULTS Based on data from 61 live birds from nw. Aust. (AWSG), 22 Aust. skins (AM, ANWC, MV, QM, SAM, WAM), and data from n. hemisphere (Dement'ev & Gladkov 1951; Pearson 1974; Pettet 1980; BWP). **Adult post-breeding** (Second and subsequent pre-basic). Complete. Primaries outwards. Starts early, in mid-July, on or near breeding grounds, with head, neck and upperparts, followed by some feathers of underparts, primaries, tertials and median upwing-coverts. Suspend moult during s. migration; extent of moult completed when moult suspended varies with time of departure and migration route. In Indonesia, on arrival in early Aug., moult suspended and PMS, 0–20; in early Sept., PMS 20–30; in late Sept. to early Oct., 35–45. In Kenya, Sept.–Oct., adults have either finished moult of primaries, or moult of inner 6–9 primaries suspended (Pearson 1974). Moult re-starts soon after arrival in non-breeding areas and is finished, early Nov.–Jan., though some delay continuation of moult and do not finish till early Mar. **Adult pre-breeding** (Second and pre-alternate). Partial; involves head, neck, and underparts, all or most of mantle and scapulars, varying numbers of tertials, median and lesser wing-coverts; begins mid-Dec. to Feb.; complete early Feb. to early Apr., before n. migration. **Post-juvenile** (First pre-basic). Partial. Most start mid-Aug. to early Sept.; moult of head, neck, mantle, scapulars and underparts mostly complete by late Sept.–Oct., though not till Jan. in some; moult back to tail, tertials and upwing-coverts (except most greater and some lesser coverts), Nov.–Jan. **Post-juvenile moult of primaries** (First pre-supplemental). Varies. In New Guinea, Indonesia, se. Asia and s. Africa, all immatures have new outer primaries (usually 2–3, but up to five), Feb.–Mar. In Kenya (Pearson 1974) and other parts of e. and w. Africa, 10–15% of immatures replace outer four primaries. No information in Aust.; probably as in New Guinea. **First immature pre-breeding** (First pre-alternate). Most birds that moult outer primaries in pre-supplemental moult attain breeding plumage similar to that of adults in first pre-alternate moult between Feb. and late Apr. and migrate N with adults. Birds that do not moult outer primaries have little or no pre-breeding moult and most stay in non-breeding areas. **First immature post-breeding** (Second pre-basic). Birds staying in non-breeding areas begin moult of primaries, May to late June. Those that migrate begin second pre-basic moult at the same time as adults.

MEASUREMENTS (1) Aust., adults, skins (AM, ANWC, MV, QM, SAM, WAM).

	MALES	FEMALES	
WING	(1) 136.3 (2.94; 132–141; 6)	137.0 (6.22; 124–147; 9)	ns
TAIL	(1) 53.7 (2.94; 49–57; 6)	55.4 (2.91; 51–60; 11)	ns
BILL	(1) 40.1 (0.98; 39.3–42.0; 6)	39.4 (2.35; 36.0–41.9; 9)	ns
TARSUS	(1) 52.7 (0.81; 51.8–54.1; 6)	51.6 (2.40; 46.7–54.8; 11)	ns
TOEC	(1) 30.2 (0.34; 30.0–30.7; 4)	29.0 (1.42; 27.1–30.6; 6)	ns

(2–4) NW. Aust., live (AWSG): (2) Adults (second basic or older); (3) First immature breeding (first alternate); (4) Juveniles and first immature non-breeding (juvenile and first basic).

	UNSEXED
WING	(2) 141.2 (3.89; 129–151; 38) (3) 134, 140, 140 (4) 139.2 (4.64; 130–145; 11)
BILL	(2) 40.3 (1.39; 37.6–43.5; 43) (3) 37.7, 39.6, 43.3 (4) 39.4 (1.49; 36.7–41.3; 12)
THL	(2) 68.5 (1.67; 64.5–72.3; 43) (3) 66.0, 68.9, 69.7 (4) 67.9 (1.82; 64.2–70.1; 12)

There were no significant differences in measurements between age-classes in nw. Aust.

WEIGHTS (1) Adults, museum labels, throughout year (AM, ANWC, QM, WAM).

	MALES	FEMALES	
(1)	65, 67, 78	70.6 (12.89; 52–95; 8)	ns

(2) NW. Aust., adults (second year or older), live (AWSG). (3) Aust., adults (ABBBS).

	UNSEXED
Sept.–Oct.	(2) 57, 65.9, 73
Nov.	(2) 72.5 (4.95; 64–79; 10)
Dec.	(2) 62.1 (4.03; 57–68; 6)
Mar.	(2) 73.1 (7.17; 61–93; 20)
Apr.	(2) 88.7 (13.30; 74–100; 4)
ALL YEAR	(3) 65.3 (6.51; 55–77; 20)

In Aust., average weight c. 65 g through most of non-breeding season; about Mar., begin gaining weight before migration. In Africa, birds increased weight between Mar. and early Apr.; birds with incomplete breeding plumage and very worn primaries had significantly lower weights than those in complete breeding plumage and with fresh primaries, and were probably first-year birds that did not migrate to breeding grounds; fat content of African birds before migration, c. 30%; on arrival in s. Africa, Aug.–Sept., weights lower than average, but vary little between Oct. and Jan., remaining at c. 74 g (Pearson *et al.* 1970; Summers & Waltner 1979).

STRUCTURE Wing, long, narrow and pointed. Eleven primaries; p10 longest; p9 0–1 mm shorter, p8 6–8, p7 13–17, p6 21–28, p5 31–37, p4 39–47, p3 48–56, p2 56–64, p1 64–70; p11 minute. Fourteen secondaries, including four tertials; tips

of longest tertials fall between p7 and p8 on folded wing. Tail, short and square; 12 rectrices; t1 about 5 mm longer than rest. Bill, long, thin and pointed, about 1.5 times length of head; straight, with slightly decurved tip overhanging lower mandible; nostril, small and slit-like, set in nasal groove about one third length of bill. Tarsus, long, thin and laterally compressed; scutellate. Tibia, 25 mm exposed. Outer toe, 84–88% of middle, inner 82–85%, hind 26–30%. Very small web between outer and middle toes; smaller web between middle and inner toes.

AGEING On arrival in non-breeding areas, juveniles have fresh primaries; adults have suspended moult, with contrast between fresh inner and worn outer primaries. **IMMATURES**: distinguished by worn, retained juvenile primaries (adults have finished moult and primaries uniformly fresh). In Feb.–Mar., immatures moult outer primaries and differ from adults by contrast between worn inner and fresh outer primaries; separable from adults till second pre-basic moult well advanced, c. Sept., and worn inner primaries replaced.

GEOGRAPHICAL VARIATION None known. Wing of adults and tail of male in small Aust. samples (above) slightly but significantly shorter than samples from throughout range (in BWP); Aust. samples may include higher proportions of birds with worn primaries and rectrices, causing differences.

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Volume 3, Plate 9 [caption error corrected from original]

Lesser Yellowlegs *Tringa flavipes* (page 153)
1 Adult breeding; 2 Adult non-breeding; 3 Juvenile; 4, 5 Adult

Marsh Sandpiper *Tringa stagnatilis* (page 136)
6 Adult breeding; 7 Adult non-breeding; 8 Juvenile; 9, 10 Adult