

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]):

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| 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. |
| Jacaniidae | 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, Jacaniidae) 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 Jacaniidae. 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. Moults of subadults complex and vary considerably with species, route of migration and age of first breeding. Adult plumage attained when 3–21 months old; most scolopacids of our region (except snipes) first attain adult plumage through partial first pre-alternate moult when c. 8–11 months old, or through complete second pre-basic moult when c. 12–16 months old (see discussion of Moults in General Introduction). Swift runners; wade expertly and some species swim habitually (Phalaropodinae). Stance often upright. Flight, fast and direct, often in tight flocks.

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

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

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

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

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

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

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

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

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

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

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

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

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28 Gallinagoninae

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Subfamily LIMNODROMINAE dowitchers

Medium-sized (33–36 cm) migratory shorebirds, with long snipe-like bills. Three species in single genus *Limnodromus*, all breeding in Temperate to Arctic zones of North America and e. Palaearctic. One species, Asian Dowitcher *L. semipalmatus*, occurs HANZAB region; two species extralimital in New World: Long-billed *L. scolopaceus* and Short-billed *L. griseus* Dowitchers. Inclusion in Scolopacidae is not in doubt, and the monophyly of the dowitchers has been defended by Rand (1950). However, relationship to other scolopacids not clear. Often included in Gallinagoninae on the basis of cranial characters, internal feeding apparatus and pattern of downy young (e.g. Lowe 1931; Jehl 1968; Burton 1974), but these features, and mallophagan parasites, have also been used to support inclusion with Tringinae (especially godwits *Limosa*) or Calidridinae (e.g. Timmerman 1957; Fjeldså 1977; Strauch 1978). In mitochondrial-DNA study of phylogeny of phalaropes, Long-billed Dowitcher *L. scolopaceus* clustered with Red Knot *Calidris canutus* in several analyses (Dittman & Zink 1991), but no comparisons were made with Gallinagoninae. Apparently no detailed biochemical studies of affinities of dowitchers available. In view of this, and the contradictory nature of existing classifications, we have followed Wolters (1978) in placing dowitchers in their own subfamily; arrangement within the Scolopacidae follows Christidis & Boles (1994).

Bill, long and straight, with sensitive tip where Herbst's corpuscles abundant; highly rynchokinetic. Morphology of bill and skull, and musculature of jaw very similar to that of Gallinagoninae (for details, see Lowe 1931; Rand 1950; Burton 1974) but also show distinct similarities to godwits *Limosa*, e.g. some features of fibres in *M. adductor* only occur in *Limosa* and *Limnodromus* and the hyoid resembles that of *Limosa* in general form, with proportionately longer basihyal than in snipes (Burton 1974). Wings, rather long and narrow; flight, strong and direct with long fast glides but without erratic style of flushed *Gallinago* snipes. Tail, almost square in adults, slightly more wedge-shaped in juveniles; 12 rectrices. Tarsi, moderately long and scutellate on both sides. Partial webbing occurs between bases of anterior toes, especially in Asian Dowitcher *L. semipalmatus*; hallux short, raised.

In breeding plumage, underparts and head mainly dull to bright rufous; upperparts, dark brown to black, finely barred, flecked or streaked with rufous and buff. Non-breeding plumage, grey-brown above and white below, with varying gorget. Juveniles separable; upperparts rather like those of adult breeding but generally pale below, with buff tinge to foreneck and breast when fresh. Plumages of Asian Dowitcher show strong superficial similarity to those of Bar-tailed Godwit *Limosa lapponica*. Plumages of Short-billed and Long-billed Dowitchers very similar to one another and they were not widely recognized as full species till review by Pitelka (1950); field identification of these species usually dependent on calls, as plumage so similar (see Wilds & Newlon 1983; Paulson 1993). Moulting strategies broadly similar to those of Calidridinae and Tringinae; adult plumage attained in first pre-alternate or second pre-basic moult when about 1 year old. Long-billed and Short-billed Dowitchers usually mature in first year (Paulson 1993) but age of first breeding probably delayed longer in Asian Dowitcher. Downy young similar to those of snipes (Jehl 1968): variegated dark brown, chestnut and black above, grading to cinnamon on underparts; small white powder-puffs form broad white stripe on each side of mid-dorsal line, wide circle on each thigh, and, *contra* Fjeldså (1977), distinct stripes on nape and wing-pads. Fjeldså (1977) pointed out similarities of pattern to some Calidridinae; also regarded pattern as similar to simplest pattern of godwits, though this not consistent with Bent (1962), Pitelka (1948), Rand (1950), Jehl (1968) or available photographs (unpubl.: M.A. Weston).

In non-breeding season, inhabit coastal and estuarine mudflats and lagoons; Long-billed Dowitchers prefer freshwater habitats. Feed on invertebrates, by probing deeply and continually, characteristically with bill moved vertically and rapidly in style often likened to sewing-machine action.

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Limnodromus semipalmatus Asian Dowitcher

COLOUR PLATE FACING PAGE 97

Macrorhamphus semipalmatus Blyth, 1848, *J. Asiat. Soc. Bengal* 17: 252 — Calcutta, India.

Limnodromus is from the Greek for marsh (λίμνη) and running (δρόμος), and refers to the wintering habitat of the Short-billed Dowitcher *L. griseus* in Brazil. *Semipalmatus* combines the Latin *semi*, for half, small, and *palmatus* for palmate, marked with the hand, and refers to the webbing of the feet.

OTHER ENGLISH NAMES Asiatic Dowitcher, Snipe-billed Godwit and Asiatic Snipelike Godwit.

MONOTYPIC

FIELD IDENTIFICATION Length 33–36 cm; wingspan 59 cm; weight: male 180 g, female 190 g. Large distinctive wader, combining elements of snipe and godwits, with long neck, long dark legs, and diagnostic long dark straight snipe-like bill. Slightly larger and bulkier than Greenshank *Tringa nebularia*. Smaller and slimmer than male Bar-tailed Godwit *L. lapponica*, with slightly longer, thicker, straighter bill with bulbous tip; proportionately smaller head with shallower, more sloping forehead; slightly shorter legs; and shorter wings, tips of folded primaries falling roughly level with tip of tail at rest, giving more truncated rear-end. In all plumages, barred tail and finely spotted and barred rump extend in wedge to upper back; pale area across secondaries and inner primaries contrasts with rest of upperwing; underwing, white. Female slightly larger and longer-billed; breeding plumage slightly duller with more white flecking in chestnut of underparts. Marked seasonal variation. Juvenile distinct. Immatures separable.

Description Adult breeding Head and neck, chestnut-red, with thick black streaks on crown, and finer streaks on centre of hindneck; narrow dark stripe down centre of forehead to bill; narrow dark loreal stripe, indistinct behind eye; chin, whitish; thin whitish eye-ring. Mantle, scapulars and tertials, black, broadly fringed chestnut-red and narrowly tipped white, appearing to be heavily streaked black and chestnut. Back, rump and uppertail-coverts, white, with heavy black spotting on back and blackish barring on rump and coverts; in flight, forms pale wedge up back, contrasting with darker rest of upperparts and slightly darker, more broadly dark-barred tail. Upperwing: innerwing-coverts mostly dark grey-brown, with varying number of brightly coloured feathers patterned as upperparts; rest of upperwing, dark brown, with narrow white tips of greater secondary coverts and narrow white fringes and internal markings of secondaries and inner primaries forming diffuse pale panel contrasting with dark leading-edge and outerwing. Throat, foreneck, breast and fore-flanks, chestnut-red, blotched white on upper belly; rest of belly and flanks, white, with narrow dark-brown bars on flanks; vent and undertail-coverts, white, finely spotted and barred dark-brown on coverts. In some birds, chestnut feathers of underbody narrowly fringed whitish when fresh. Axillaries and underwing, white with narrow greyish trailing-edge. Bill, black. Iris, dark brown. Legs and feet, dark grey or black. **Adult non-breeding** Crown, white, heavily streaked blackish; forms dark cap that continues as narrow stripe through centre of forehead to bill. Rest of head and neck, white, with: dense grey streaks that become finer and sparser across lower cheeks; prominent dark loreal stripe, broad at base of bill then fading behind eye; and white supercilium, broad and bulging before eye, continuing

narrowly over eye and broadening to squarish end above rear ear-coverts; in some, supercilium fades behind eye. Mantle, scapulars, tertials and innerwing-coverts, dark grey-brown with diffuse darker centres to feathers and contrasting narrow white fringes, producing variegated pattern. Rest of upperparts as breeding; dark-spotted and barred back to uppertail-coverts contrast little with darker rest of upperparts. Underbody, white with band of short dark grey-brown streaks and spots across foreneck and breast, narrow dark bars on flanks, some dark spotting on sides of vent and fine dark spotting and barring on lateral undertail-coverts. Underwing as breeding. Bare parts as breeding except bill usually has small pinkish patch at base of lower mandible. **Juvenile** Differs from adult non-breeding by: crown more heavily streaked and appears to have darker cap contrasting with white supercilium. Mantle, scapulars and tertials, darker, with narrow buff fringes to feathers giving striped appearance to upperparts when fresh; innerwing-coverts, similar but with pale-brown centres. Underbody, white, with buff wash to sides of neck, foreneck, breast and flanks when fresh, fine dark streaks on foreneck and breast, narrow crescentic barring on flanks, and dark spotting and barring on sides of vent and undertail-coverts. Buff fringes reduced with wear and buff wash on underbody soon fades to paler whitish; worn birds appear rather uniform black above. **First immature non-breeding** Differ from adult non-breeding by many retained worn juvenile innerwing-coverts, contrasting with fresh plumage of upperparts, which is paler, grey-brown, with white fringes to feathers; retained juvenile primaries fresh till end of first calendar year (cf. moulting in adults). **First immature breeding** A few birds gain plumage similar to adult breeding, but most birds wintering in HANZAB area attain only a little breeding plumage, and generally not before adults leave in about Apr.; during Jan.–July, separable from adults by retained worn juvenile primaries (cf. fresh in adults from about Mar.).

Similar species Bar-tailed Godwit (q.v.).

Gregarious, usually in pairs or small groups, but sometimes in large flocks of >100 at favoured feeding and roosting sites. Coastal; prefer estuarine and tidal mudflats and muddy lagoons in coastal saltworks; roost on sandy beaches and points. When roosting, associate with other waders, especially godwits and knots, though tend to feed with Dowitchers. Normal gait, leisurely, with long jerky strides, though capable of faster walk when pressed. At rest, stand with neck drawn into body and with bill pointing slightly downwards. Stand upright when alert, with neck appearing long and slim when fully upstretched and bill held either horizontally or down at 45°; resulting stiff toy-like stance distinctive and rather more erect than godwits. Feed by almost continuous vertical probing, with neck held

rigid and bill thrust to full length into mud in distinctive sewing-machine action; usually feed up to knee or belly in water, sometimes fully submerging head. Normal flight swift, powerful and direct, similar to that of godwits, occasionally erratic. More vocal than godwits during non-breeding season; usual contact calls are yelping *chep-chep* or *chowp*, and soft moaning *kiaow*, latter with strange quality like distant human voice.

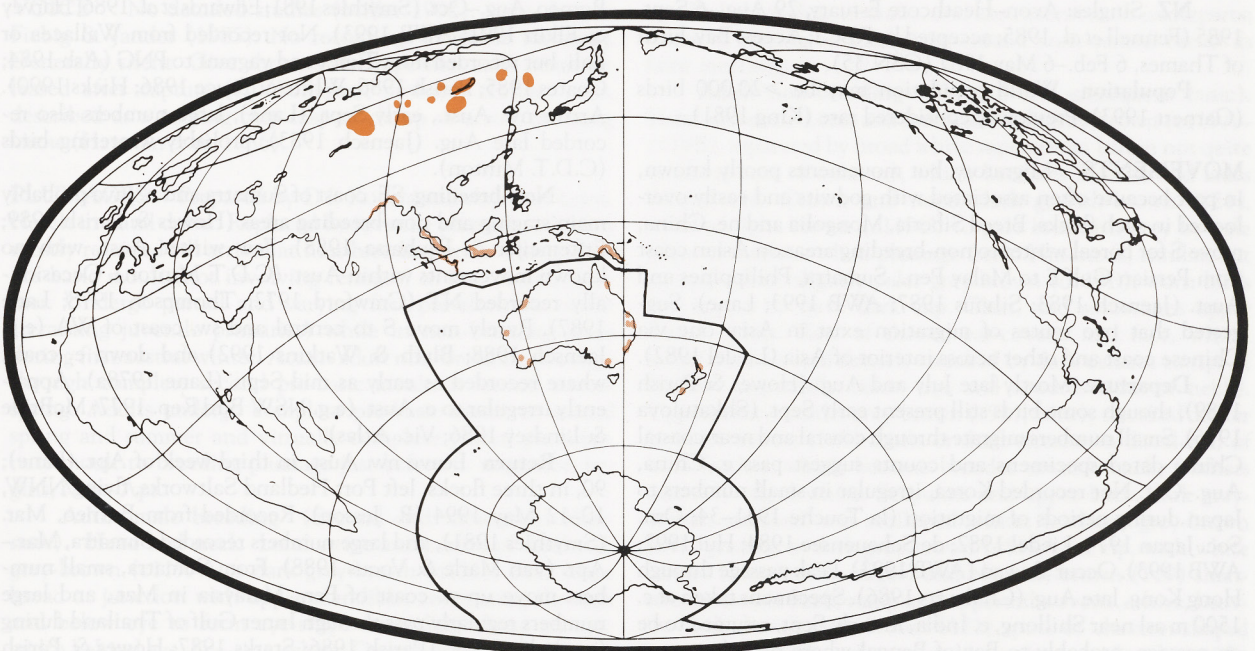
HABITAT Occur in sheltered coastal environments, such as embayments, coastal lagoons, estuaries and tidal creeks, where they frequent shallow water and exposed mudflats or sandflats; occasionally on islands in similar habitats; in Aust., saltworks most important regular habitat, e.g. Port Hedland Saltworks, WA (Crawford 1972; Smith 1974a; Klapste 1975; Lane 1978b; Storr 1984; McBride & Lindsey 1986; Jaensch 1989; C.D.T. Minton). Round ponds and channels of saltworks and sewage farms; also margins of near-coastal swamps and lakes (Thompson 1978; Blyth & Watkins 1992). In NZ, recorded round tidal mudflats in river estuary (Fennell *et al.* 1985).

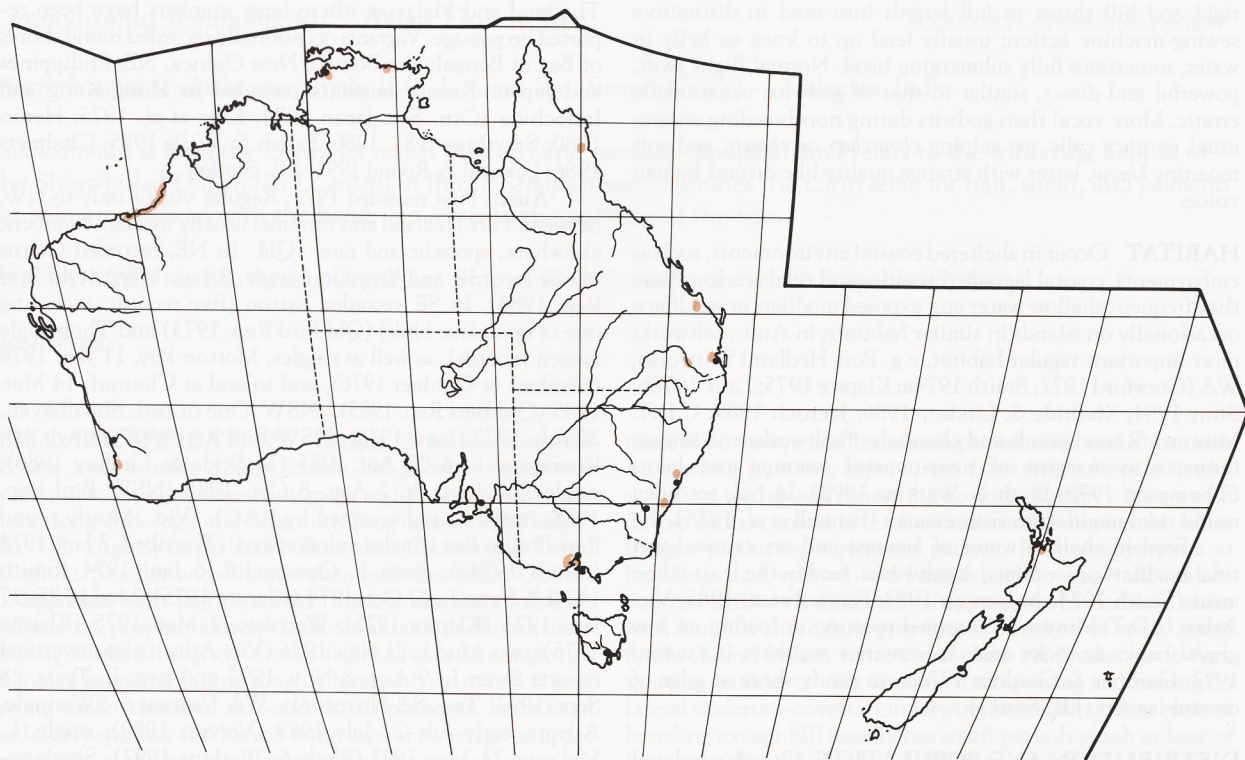
Feed in shallow water of lagoons and on exposed wet tidal mudflats or sandflats; at saltworks, feed in the least saline areas (Smith 1974a,b; Jaensch 1983; Fennell *et al.* 1985; Vic. Atlas; C.D.T. Minton). Observed roosting or loafing on low gravel banks or rocky areas in estuaries and bays (Crawford 1972; Gardner & Gardner 1976); on sandy shore at edge of coastal lagoon (J.R. Starks).

DISTRIBUTION AND POPULATION Breed in isolated colonies in central and e. Siberia, Mongolia and ne. China; in Russia, between Omsk and Tara (Irtys R.); round Barnaul district (Ob R.); s. and se. shores of L. Baikal; round Chita district; in nw. Mongolia, round L. Orok-nor; in ne. China, near Qigihar in Heilongjiang (la Touche 1931–34; Dement'ev & Gladkov 1951; Flint *et al.* 1984; de Schauensee 1984). Main non-breeding area probably e. and se. coastal Sumatra (Silvius 1987; van Marle & Voous 1988); a few winter in peninsular

Thailand and Malaysia, where large numbers have been reported on passage. Vagrants occasionally recorded round shores of Bay of Bengal; also Borneo, New Guinea, NZ, Philippines and Japan. Passage migrants recorded in Hong Kong and Indochina (Orn. Soc. Japan 1974; King *et al.* 1975; Heron 1980; Smythies 1981, 1986; Parish & Wells 1985; Chalmers 1986; Lekagul & Round 1991; J.R. Starks).

Aust. First recorded 1971. Regular visitor only to NW, between Port Hedland and Broome, usually in small numbers; elsewhere, sporadic and rare. **Qld** In NE, recorded Cairns (three records) and Yeppoon (single, 3 Jan. 1988) (Qld Bird Rep. 1988). In SE, recorded Lytton (five records, including one of up to five birds) (Qld Bird Rep. 1973) and Thorneside (seven records), as well as singles, Morton Bay, 11 Jan. 1976 (Gardner & Gardner 1976), and inland at Clontarf, 14 Mar. 1985 (Qld Bird Rep. 1985). **NSW** One or two, Shoalhaven, 20 Feb. 1977 (Lane 1978b; NSW Bird Rep. 1977); single (?), Kooragang I., 6–27 Apr. 1985 (McBride & Lindsey 1986); single, Stockton Pt, 2 Aug.–8 Oct. 1988 (NSW Bird Rep. 1988; initial record accepted by RAC). **Vic.** Mostly round Port Phillip Bay (singles unless stated): Werribee, 7 Jan. 1973 (Smith 1974a); Swan I., Queenscliff, 6 Jan. 1974 (Smith 1974b); Swan I., 27 Oct. 1974 (Klapste 1975); Mud I., 25–27 Jan. 1975 (Klapste 1975); Werribee, 2 Mar. 1975 (Klapste 1975); two, Mud I., 21 Nov. 1976 (Vic. Atlas); also unverified reports Swan I., 9 Aug.–8 Nov. 1992 and two, L. Tyers, 28 Sept. 1992. **Tas., SA** No records. **WA** Vagrant to SW: single, Albany, early July–22 July 1989 (Vervest 1989); single, L. McLarty, 21 Mar. 1992 (Blyth & Watkins 1992). Single recorded, L. McLeod, near Carnarvon, 29 Sept. 1987 (Jaensch & Vervest 1990). Regular visitor in small numbers to ne. Pilbara and sw. Kimberley Div. (Jaensch 1983, 1989; Vervest 1989). Occur regularly at Port Hedland Saltworks (30–120 birds, Sept. to mid-Apr.; with maximum of 145, 10 Apr. 1994) and Roebuck Bay, Broome (20–25 at high-tide roosts with >20, May–July 1993) (Jaensch 1982; Anon. 1984; R. Jessop; C.D.T. Minton; V. and M. Pattinson). Occasional records





from Eighty Mile Beach (C.D.T. Minton). Single, Ashmore Reef, 16 Apr. 1994 (G.D. Pike). NT Several records in Top End: single, specimen, Frances Bay, Darwin, 16 Oct. 1971 (Crawford 1972); single, Sanderson Sewage Farm, Darwin, 10–11 Sept. 1977; two, Leanyer Swamp, Darwin, 15 Oct. 1977; single, Lee Pt, Darwin, 29 Jan. 1978 (Thompson 1978); 15, Boucat Bay, Arnhem Land, Oct. 1986; single, Millingimbi, Arnhem Land, 21 Oct. 1986 (Lane 1987, 1988). Unverified report of single, Darwin, 5 Sept. 1992.

NZ Singles: Avon–Heathcote Estuary, 29 Aug.–6 Sept. 1985 (Fennell *et al.* 1985; accepted by RBC); Access Bay, Firth of Thames, 6 Feb.–6 May 1987 (CSN 35).

Population World population may be >20,000 birds (Garnett 1993). Previously considered rare (King 1981).

MOVEMENTS Migratory, but movements poorly known, in part because often associated with godwits and easily overlooked in such flocks. Breed Siberia, Mongolia and ne. China; move S for boreal winter to non-breeding areas on Asian coast from Persian Gulf E to Malay Pen., Sumatra, Philippines and Aust. (Jaensch 1983; Silvius 1987; AWB 1993; Lane). Suggested that two routes of migration exist in Asia: one via Chinese coast and other across interior of Asia (Liedel 1982).

Departure Mostly late July and Aug. (Howes & Parish 1989), though some birds still present early Sept. (Shkatulova 1976). Small numbers migrate through coastal and near-coastal China; dated specimens and counts suggest pass e. China, Aug.–Oct. Not recorded Korea, irregular in small numbers to Japan during periods of migration (la Touche 1931–34; Orn. Soc. Japan 1974; Liedel 1982; de Schauensee 1984; Hui 1992; AWB 1993). Occur Taiwan (AWB 1993). Peak passage through Hong Kong, late Aug. (Chalmers 1986). Specimens taken at c. 1500 m asl near Shillong, e. India, in early Sept. assumed to be on passage, probably to Bay of Bengal where records suggest

birds occur regularly (Ali & Ripley 1980; Ripley 1982). Apparently vagrant as far W as Arabia (see Paige 1965), even Kenya (Hayman *et al.* 1986). Recorded from Burma (Smythies 1986). Passage through Thailand, Aug. to late Oct.; large numbers recorded Sumatra, from Oct. (Parish 1986; Starks 1987; van Marle & Voous 1988; AWB 1993); smaller numbers, Malaysia and Philippines, Aug.–Oct. (Delacour & Mayr 1946; Melville & Round 1982; Howes & Parish 1989; Magsalay *et al.* 1990). Recorded irregularly but sometimes in large numbers in Borneo, Aug.–Oct. (Smythies 1981; Edwards *et al.* 1986; Harvey & Elkin 1991; AWB 1993). Not recorded from Wallacea or Bali, but recorded from Timor and vagrant to PNG (Ash 1984; Coates 1985; Parish 1986; White & Bruce 1986; Hicks 1990). Arrive nw. Aust., early Sept. (Lane); large numbers also recorded late Aug. (Jaensch 1983), probably wintering birds (C.D.T. Minton).

Non-breeding SE. coast of Sumatra and n. Java probably main staging and non-breeding areas (Howes & Parish 1989; Erfemeijer & Djuharsa 1988). Few winter Aust. with no known movements within Aust. (C.D.T. Minton). Occasionally recorded NT (Crawford 1972; Thompson 1978; Lane 1987). Rarely move S to central and sw. coast of WA (e.g. Jaensch 1988; Blyth & Watkins 1992) and down e. coast, where recorded as early as mid-Sept. (Lane 1978a). Apparently irregular to e. Aust. (e.g. NSW Bird Rep. 1977; McBride & Lindsey 1986; Vic. Atlas).

Return Leave nw. Aust. in third week of Apr. (Lane); 90, in three flocks, left Port Hedland Saltworks, flying NNW, 10–12 May 1994 (R. Jessop). Recorded from Borneo, Mar. (Smythies 1981), and large numbers recorded Sumatra, Mar.–Apr. (van Marle & Voous 1988). From Sumatra, small numbers move up w. coast of Pen. Malaysia in Mar., and large numbers regularly pass through Inner Gulf of Thailand during first half of Apr. (Parish 1986; Starks 1987; Howes & Parish

1989). Small numbers pass Red R. Delta, Vietnam, Mar. and Apr. (AWB 1993). Leave Olango I., Philippines, between end Mar. and mid-Apr. (Magsalay *et al.* 1990; Magsalay 1991). Peak passage through Hong Kong during second half of Apr. when large flocks occasionally recorded (see Chalmers 1986). Collections made Shanghai, e. China, in Mar. and Apr. (la Touche 1931–34); farther N, at Beidaihe, peak passage mid- to late Apr. (AWB 1993). Specimens taken at c. 1500 m asl near Shillong, e. India, in late Apr. and near Turkestan, Russian Central Asia, during Apr. (Dement'ev & Gladkov 1951; Ali & Ripley 1980) suggest an inland route through Central Asia. Apparently move into breeding range during May (see Dement'ev & Gladkov 1951; Shkatulova 1976).

Breeding Nest from late May (Leonovitch 1973; Hayman *et al.* 1986). Small groups recorded wintering at Roebuck Bay, Broome, each year (C.D.T. Minton). Several records of up to 60 birds from nw. Aust. during winter; three recorded June and July 1987 near Brisbane, Qld; and single recorded during winter at Albany, s. WA (Mitchell 1987; Anon. 1989; Hooper & Wells 1989; Vervest 1989; Pattinson & Pattinson 1992).

Banding Fifteen banded in nw. Aust. 1981–90 with no recoveries (Minton 1992).

FOOD Poorly known. Carnivorous; mainly polychaete worms and larvae; insect larvae and molluscs (Dement'ev & Gladkov 1951; Ali & Ripley 1980; Johnsgard 1981). **Behaviour** Feed in tight single-species flocks or loosely associated with flocks of other species, particularly Bar-tailed Godwits (C.D.T. Minton). Probe continuously with bill held vertically, or nearly so, in sewing-machine action; usually probe to full length of bill. Prey pulled out slowly and with tremendous effort, using legs for leverage, with neck curved and swollen. May wade in shallow water (50–100 mm deep), often up to belly, occasionally submerging bill and head (Paige 1965; Smith 1974a,b; Jaensch 1983; Blyth & Watkins 1992). May return to small preferred feeding site after disturbance.

Adult In Aust., only polychaete worms recorded (Smith 1974a,b).

VOICE No detailed studies (Miller 1992); some data in Fiebig & Jander (1985). No recordings available for study. Generally silent. Give short, soft, snipe-like calls when released after capture (P.J. Fullagar); probably contact calls, described as a yelping *chep-chep* or *chowp* or a soft moaning *kiaow* (Hayman *et al.* 1986).

PLUMAGES Prepared by D.I. Rogers and A.J. van Loon. Hatch in natal down. Replaced by juvenile plumage, which is mostly retained till arrival at non-breeding areas. Partial first pre-basic moult (not involving remiges) in first austral summer. Undergo partial and varying first pre-alternate moult (retaining juvenile primaries) while in non-breeding areas during first austral winter. Attain adult non-breeding plumage through complete second pre-basic moult in second austral spring. Adults undergo complete pre-basic moult in austral spring and summer and virtually complete partial pre-alternate moult to breeding plumage just before n. migration begins, Mar.–Apr.

Adult male breeding (Second and subsequent alternate). **Head and neck** Loral stripe and centre of forehead, grey-brown (c119A) to dark grey-brown (c121); loral stripe broad at junction with upper mandible, continuing through and below eye to form eye-stripe extending about an eye-width behind eye. Eye-ring, white. Crown and hindneck, dark

brown (119), mottled grey-brown (121–c119B) by partially exposed bases of feathers; sides of crown and hindneck, streaked paler by edges of feathers, which grade from pale rufous (240) to white at tip. Supercilium, face and throat, mainly rufous-brown (240–340); chin and front of supercilium often tinged whitish; narrow white tips to feathers of throat and foreneck give faintly scalloped appearance in fresh plumage. **Upperparts** Mantle, upper back and scapulars, black-brown (119), boldly streaked by broad rufous-brown (38–340) edges to feathers; narrow white tips to feathers only conspicuous on longest scapulars. Lower back to uppertail-coverts, similar to non-breeding, except for occasional rufous suffusion on uppertail-coverts. **Underparts** Breast, flanks and belly, mostly rufous (240–340) with varying amount of white blotching (often considerable) on lower belly and rear flanks; undertail-coverts and axillaries, mostly white. Feathers often have narrow faint dark-brown subterminal bars, reduced to scattered specks on upper breast. Flanks, vertically barred black-brown (119–121); bars narrower and more chevron-shaped on undertail-coverts; axillaries, sparsely barred or spotted dark brown (c121) towards bases. In fresh plumage, breast faintly scalloped white by narrow fringes to feathers. **Tail** Dark brown (121) with broad, white, roughly V-shaped bars, which are more broadly spaced at tip of feathers; pale bars have rich reddish-brown (c340) tinge, sometimes as strong as on breast (at least when fresh). Outer feathers sometimes or often retained from adult non-breeding. **Upperwing** As adult non-breeding (q.v.), but tertials black-brown (c121–119) with paler light rufous-brown (c38) fringes, grading to narrow white fringes at tips. May replace some median secondary coverts with breeding feathers: rufous-brown (38–240) with broad black shaft-streaks and narrow white tips; outermost median secondary coverts (and a few lesser coverts) similar to non-breeding but with light rufous-brown (38) to cinnamon (c39) bases to edges of feathers. **Underwing** As adult non-breeding.

Adult female breeding Differences between sexes not well known and not clear if sex of birds can be determined in field; following information from Pitelka (1948), and small samples of skins (RMNH, ZMM). Rufous coloration of females usually lighter than in males, and less extensive on underparts; traces of barring on flanks can extend onto central breast as faint mottling.

Adult non-breeding (Second and subsequent basic). **Head and neck** Loes and forehead, dark grey-brown (c119A–c119B), separated by broad white supercilium (often not quite reaching base of culmen), which becomes broader and fades behind eye. Crown and nape, dark greyish-brown (121), streaked light brown (c119C) to pale brownish-grey by pale edges to feathers when plumage fresh. Hindneck, similar, but ground-colour slightly paler grey-brown (c119B); worn birds can appear to have dark cap. Chin, and sometimes upper throat, white. Rest of throat, ear-coverts and face, white, rather coarsely and densely streaked by dark centres to tips of feathers (especially below eye and towards sides of neck). **Upperparts** Mantle, grey-brown (c91), faintly streaked darker by black-brown (119) shafts or shaft-streaks on distal half of each feather, which become broader towards back; feathers narrowly edged white. Scapulars and upper back, dark grey-brown, streaked and scalloped white; feathers, grey-brown (c91) grading to dark grey-brown (c119A) at tip, with white fringes (broadest on edges) and blackish-brown (119) shaft-streaks. Lower back, rump and uppertail-coverts, white, heavily flecked with dark brown (121) spots or chevron-shaped bars on each feather of rump and lower back, and with straight

to convex blackish-brown (c119–c121) bars on uppertail-coverts. **Underparts** Mainly white. Breast, obscurely mottled darker; basal half of feathers, grey-brown (c91) (sometimes bisected by white shaft-streaks), and 1–2 irregular but convex grey-brown (c91–121) bars on each feather. Flanks more distinctly barred black-brown (c119A); bars straight, and about one-quarter width of alternating white bars. Undertail-coverts flecked with dark brown (119A–121) spots and chevrons; axillaries inconspicuously spotted or dark brown (c121) at bases. **Tail** Mostly barred dark brown (121) and white; bars, straight to slightly convex, c. 2–5 mm wide, dark bars broader; each feather narrowly fringed white. On t1, patterning indistinct (especially at tips); white barring is narrower, less sharp, and varying washed grey-brown (c19) and white fringe narrower than on other feathers; tail often appears to have dark centre. **Upperwing** Tertiaries and most coverts, similar to scapulars and upper back, though ground-colour of marginal coverts slightly darker. Greater secondary coverts, broadly tipped white; outermost feathers, grey-brown to dark brown (119A–121) with varying (sometimes much) white mottling or barring near centres of feathers, and short dark-brown (119A–121) shaft-streaks (not reaching tips of feathers). Pale markings narrower on inner greater secondary coverts; innermost coverts, mostly dark-brown, fringed or notched white along edges. Alula, primary coverts and outer primaries, dark brown (c121) with white shafts and narrow white fringes at tips, which can be lost with wear. Other primaries similar but with sharply defined white shaft-streaks; innermost also have some white blotching on inner webs. Secondaries, dark brown (c121), more broadly fringed white than in Bar-tailed Godwit, and with broad white shaft-streaks and broad white barring across inner webs. **Underwing** Mostly white; leading-edge finely speckled darker by dark-brown (c119A) tips to marginal coverts and incomplete dark-brown (c119A) shaft-streaks on smallest lesser coverts; greater primary coverts irregularly barred or spotted light brownish-grey. Light brownish-grey (c80) subterminal markings on secondaries and tips of primaries form indistinct dark trailing-edge; remiges also have dark outer webs and dark margins to shafts on inner webs, but these only exposed on p10.

Juvenile Not well known; following based mostly on two fresh skins (ZMM) and four skins of worn individuals, some undergoing post-juvenile moult (ANWC, RMNH, WAM). **Head and neck** When fresh, lower throat, foreneck and sides of throat strongly washed buff (124), sharply contrasting with mainly white chin, face and upper throat. Pale edges to fresh feathers of crown and hindneck, slightly warmer than adult non-breeding, light brown (119C–c223D). When worn, similar to adult non-breeding. **Upperparts** In Aust. skins, retained juvenile plumage similar to worn adult non-breeding but feathers generally smaller and narrower. Mantle, upper back and scapulars, dark brown, neatly streaked or scaled buff to pale rufous; feathers, dark brown (c119A–121) grading to blackish-brown (c19) at tip, and broadly fringed light-rufous; when worn, fringes bleach to cream (c92) and can be lost at tip. Lower back to uppertail-coverts, as adult non-breeding. **Underparts** In fresh plumage, have intense buff (124) wash on breast and foreflanks that grades to white on belly and undertail-coverts; buff areas bleach to white with wear, then appearing superficially similar to adult non-breeding. Otherwise differ from adult non-breeding by: feathers of breast, smaller and narrower; convex barring on feathers is narrower and less noticeable, and generally encloses neat whitish spot (which may give appearance of pale flecking to underparts,

especially on sides of breast and at border of breast and belly); dark bases of feathers are larger, and more broadly interrupted by white shaft-streaks (Fig. 1). **Tail** Similar to adult breeding, though feathers narrower, and pale areas tinged buff rather than reddish-brown. **Upperwing** Tertiaries, dark brown (121) with broad (2–3 mm) buff-brown (39) fringes on outer edges; fringes narrower, off-white when worn. Otherwise similar to adult non-breeding except for uniform wear of plumage and slightly narrower median and greater secondary coverts, which have narrower, more convex barring. **Underwing** As adult.

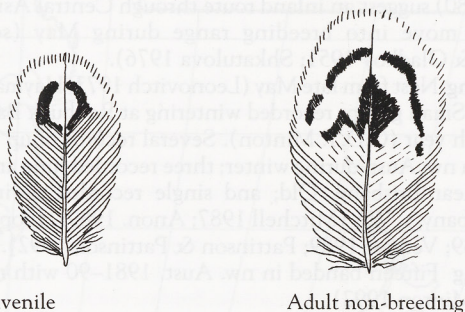


Figure 1 Breast-feathers

First immature non-breeding (First basic). Very similar to adult non-breeding; distinguished only by retained juvenile plumage. Primaries, primary coverts, secondaries and many secondary coverts retained through first austral summer.

First immature breeding (First alternate). Do not breed in this plumage. In first austral winter, many attain varying amount of breeding plumage (similar to adult breeding); some appear like adult breeding, differing by worn retained juvenile primaries, primary coverts and secondaries. More often, attain only traces of breeding plumage (up to 25% of body-plumage); it is not known if non-breeding-type plumage seen on such individuals is dull first alternate or retained first basic.

BARE PARTS From photos (Coates 1985; Pringle 1987; Rogers 1992; Strange & Jeyarasigam 1993; Tipper 1993; unpubl.: H.M. Gibbs; P. Straw; AWSG) except where stated. **Adult** Bill, grey-black (82) to black (89); some, perhaps in non-breeding plumage, have small, often faint, dusky-pink (4–c3) smudge at base of lower mandible. Iris, black-brown (119). Legs and feet, usually grey-black (82); olive tinge suggested in some photos and also reported in some literature (e.g. Lane 1978a; Thompson 1978). **Juvenile, Immatures** Similar to adult but dusky-pink smudge at base of lower mandible may be larger and more conspicuous.

MOULTS Following based mainly on data from 45 birds captured in nw. Aust. (AWSG), and 58 skins, mostly from Java (ANWC, BMNH, RMNH, WAM), and photographs.

Adult post-breeding (Third and subsequent pre-basic). Complete. Primaries (and corresponding primary coverts) moult outwards, up to four inner primaries growing concurrently; usually only one outer primary grows at one time. Begin moult of secondaries at about the same time as p6; tertiaries slightly earlier. Moult of body begins well before primaries (may start on breeding grounds) and, on arrival in Aust., some have little or no breeding plumage; starts with head, chin and throat, finishing (in Java) with breast and belly in the last half of Sept. Moult of primaries begins soon after arrival at non-breeding areas; PMS of seven birds (nw. Aust., 27 Sept.), 1–18. In Java,

moult of primaries seems to start earlier than in Aust.; earliest active records are 22 and 24 Aug. (two males with moult-formulae 1⁰6), and five, collected 12–15 Aug., that had not begun moult of primaries; moult of primaries completed mid-Oct. to mid-Dec. Dates of finishing moult in Aust. not well known: two caught early Nov. had PMS of 26 and 32, but no subsequent Aust. data till mid-Mar. when all have completed moult of primaries. **Adult pre-breeding** (Second and subsequent pre-alternate). Partial; not including primaries or secondaries. Includes most or all feathers of body and tertials; some also replace most median secondary coverts and a few lesser coverts (coverts are among last feathers to be replaced). All moult t1 and some moult whole tail. In Aust., moult active Mar.–Apr.; complete in some before leaving Aust. in Apr.; probably begins during Feb. but no details. Apparently occurs slightly later in Java, where two were beginning moult in mid-Mar. and two were in late moult in early to mid-May. **Post-juvenile** (First pre-basic). Partial, not including primaries or primary coverts, secondaries or tail; one caught early Apr. also retained some juvenile feathers on mantle, breast and outer greater secondary coverts. At least some arrive in Aust. and Java in nearly complete (though worn) juvenile plumage. Moult of body active and intense by Oct.; not known when moult finished but probably early in first austral summer, given that first-basic plumage moderately worn by Apr. **First immature pre-breeding** (First pre-alternate). Partial, probably varying in extent but only involving feathers of body and, possibly, some wing-coverts; at least some develop dull feathering (like non-breeding plumage). Of 14 caught in first austral winter, nine had no breeding-type plumage, four had some (up to 25% of feathering), and one was in full breeding plumage. Birds in first alternate plumage recorded May and June, but little information on period of active growth of feathers, except one bird in early Apr. in early stages of moult of tertials, crown and mantle. **First immature post-breeding** (Second pre-basic). Complete. Sequence similar to adult post-breeding moults. Moult of primaries begins much earlier than in adults; in Aust., earliest records from July, and moult nearly complete by late Sept.; PMS of five birds caught late Sept., 39–50. Moult may be even earlier in Java, where a female had PMS of 20 by 13 June, a male had a PMS of 28 on 18 Jan. and PMS of 27–44 in mid-Aug.

MEASUREMENTS (1–3) Java and n. and nw. Aust., skins (ANWC, RMNH, WAM): (1) Adults; (2) Immatures with juvenile p10; (3) Ages combined. (4–5) Probably throughout range, skins; method of measuring not known (Pitelka 1948): (4) Adults; (5) Adults and immatures (at least 8 months old).

| | MALES | FEMALES | |
|--------|--------------------------------|----------------------------|----|
| WING | (1) 176.6 (4.00; 172–184; 8) | 179.6 (3.21; 177–185; 5) | ns |
| | (2) 172, 172, 175 | 176, 176, 183 | ns |
| | (3) 175.1 (4.80; 166–184; 14) | 176.3 (2.71; 173–180; 10) | ns |
| | (4) 169 (164–172; 8) | 174 (168–181; 6) | |
| | (5) 65.5 (3.25; 61–70; 8) | 64.0 (1.87; 62–67; 5) | ns |
| TAIL | (2) 59, 59 | 59 | ns |
| | (3) 65.0 (2.84; 60–71; 22) | 64.8 (2.75; 60–71; 14) | ns |
| | (5) 80.1 (74.7–81.9; 14) | 82.9 (78.3–87.1; 9) | ** |
| BILL | (3) 81.2 (2.85; 74.9–85.2; 24) | 84.6 (3.13; 78.9–90.7; 23) | ** |
| | (5) 80.1 (74.7–81.9; 14) | 82.9 (78.3–87.1; 9) | |
| TARSUS | (3) 50.5 (2.57; 46.6–55.4; 24) | 51.1 (2.15; 47.4–54.9; 23) | ns |
| | (5) 50.7 (45.8–52.7; 14) | 50.8 (47.6–54.0; 9) | |
| TOE | (3) 35.0 (1.60; 30.7–38.0; 23) | 36.3 (1.23; 34.5–39.0; 23) | ** |

(6–10) NW. Aust., live, unsexed (AWSG): (6) Adults with fresh p10; (7) Adults with worn p10; (8) Immatures with fresh juvenile p10; (9) Immatures with worn juvenile p10; (10) Ages combined.

| UNSEXED | |
|---------|---------------------------------|
| WING | (6) 183.1 (6.37; 172–197; 14) |
| | (7) 178.3 (5.38; 171–184; 4) |
| | (8) 184 |
| | (9) 169.9 (4.07; 163–176; 17) |
| BILL | (10) 82.8 (4.44; 75.0–95.2; 44) |
| THL | (10) 115.3 (4.51; 107–129; 34) |

Above data appear to show that wing is shorter when worn, and that length of wing of immatures substantially shorter than that of adults; variation in length of bill and total head with age appears slight.

WEIGHTS N. and nw. Aust., live (AWSG) and three museum labels (ANWC, WAM): (1) Adults, Sept.–Nov.; (2) Adults, Mar.–Apr.; (3) Immatures, including first immature breeding in first austral winter.

| UNSEXED | |
|---------|----------------------------|
| (1) | 156.3 (6.95; 146–166; 9) |
| (2) | 211.9 (12.69; 190–235; 14) |
| (3) | 158.4 (11.01; 144–180; 25) |

Adults significantly heavier Mar.–Apr. when gaining weight before migration; little other seasonal variation in weight in our region in adults and immatures. Few weights available from birds of known sex; above samples include first-basic male of 180 g and female of 148 g, Oct. Other data: males 181 (168–194; 3), females 190 (168–245; 5), possibly birds on passage (Shaw 1936); male, Manchuria, July, 160 g (Pitelka 1948).

STRUCTURE Wing, long and pointed; rather broad for a wader. Eleven primaries; p10 longest, p9 0–6 mm shorter, p8 7–12, p7 17–22, p6 28–33, p5 40–46, p4 51–58, p3 61–68.5, p2 70–80, p1 80–92; p11 very narrow and short, concealed by primary coverts; no emarginations. Fourteen secondaries, including four tertials; tips of tertials lie about level with tips of p7–p8 on folded wing. Tail, rather long and square at tip, except t1 projects 3–5 mm beyond other rectrices; 12 feathers. Bill, very long (about 2.5 times length of skull), straight, shaped like that of *Gallinago* snipe; depth at base greater than width, with small slit-like nostrils. Tips of both mandibles (especially upper), swollen at sides with neat narrow median grooves; in dried skins, tips heavily pitted by small hollows; two series of barbs on palate, parallel to midline of bill and pointing backwards. Legs, slender and rather long; unfeathered section of tibia about 40% length of tarsus; tarsus, scutellate with some reticulate scales on sides. Toes, moderately long; webs between front three toes extend almost to tip of toes but are partial, with main body of webs only extending to about first joint; outer toes 82–93% of middle, inner 77–90.5%, hindtoe 36.5–45%.

AGEING In our region, most easily determined in the hand by moult and wear of primaries. (1) From c. Jan. to Apr., only

two age-classes distinguishable: adults have fresh primaries and attain much alternate plumage in Mar.–Apr.; first basic immatures have rather worn retained juvenile primaries, and attain virtually no alternate plumage when adults return to breeding areas. (2) From May to about Aug., only first immatures seem to stay in Aust. (but see below), retaining juvenile primaries (which become very worn) until complete second post-breeding moult begins July–Aug. (3) From late Aug. or early Sept. to about Nov., three age-classes separable: distinctive, newly arrived juveniles, retaining rather fresh juvenile primaries throughout this period; adults have worn primaries and begin complete moult of primaries on arrival in Aust.; birds in their second year (which were in our region for first austral winter), have more advanced moult of primaries than adults, and are separable until p10 moulted (much more worn than in adults).

One captured nw. Aust., late Sept. (AWSG), differed from above, having primary-moult N^24O^2 (as advanced as would be expected in first-immature post-breeding moult) but with outer primaries too fresh to have been retained from juvenile plumage. This suggests that not all birds spending austral winter in our region are in first year.

GEOGRAPHICAL VARIATION None. Relationships discussed in Pitelka (1948) and Rand (1950).

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Volume 3, Plate 4

Bar-tailed Godwit *Limosa lapponica* (page 82)

1 Adult male breeding; 2 Adult female breeding; 3 Adult female non-breeding; 4 Juvenile; 5, 6 Adult

Asian Dowitcher *Limnodromus semipalmatus* (page 206)

7 Adult breeding; 8 Adult breeding; 9 Adult non-breeding; 10 Juvenile; 11, 12 Adult

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