

## 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]):

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

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



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

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

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

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

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

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

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



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

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

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

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

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## 28 Gallinagoninae

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## Subfamily TRINGINAE godwits, curlews, 'shanks' and allies

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

Table 1

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

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

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

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

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

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



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

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## *Limosa limosa* Black-tailed Godwit

COLOUR PLATE FACING PAGE 96

*Scolopax limosa* Linnaeus, 1758, *Syst. Nat.*, ed. 10(1): 147 — Europe.

*Limosa* is from the Latin *limosus*, muddy (from *limus*, mud) and refers to the tidal and marshy habitat of the species.

The origin of the name Godwit is obscure.

OTHER ENGLISH NAMES Large Godwit.

POLYTYPIC Nominate *limosa* breeds w. Siberia and Europe; subspecies *islandica* Brehm, 1831, breeds Iceland; subspecies *melanuroides* Gould, 1846, breeds e. Siberia and Mongolia, between 45°N and 65°N. Only subspecies *melanuroides* recorded in HANZAB region.

**FIELD IDENTIFICATION** Length 40–44 cm; wingspan 63–75 cm; weight 200–300 g. Large graceful wader, with rather small head, long neck, very long straight or slightly upturned bill, and very long legs. Slightly smaller than Bar-tailed Godwit *Limosa lapponica*, with straighter and slightly blunter bill, longer neck, shallower forehead, slimmer body and longer legs, giving more attenuated appearance. In all plumages, pattern in flight diagnostic. Long bill, and feet and part of tarsi extending beyond tip of tail, give more elongated profile in flight than that of congeners. Female slightly larger with slightly longer bill and duller breeding plumage. Marked seasonal variation. Juvenile distinct. Immatures separable.

**Description Adult male breeding** Head, neck, upper mantle and upper breast, chestnut with: narrow black streaking on forehead and crown; white chin; narrow dark loreal stripe; short white supercilium grading to chestnut behind eye; some dark-brown flecks along centre of hindneck; bold black crescents on sides of lower neck and breast; and dark centres to feathers of mantle. Rest of underbody, white, with chestnut blotches and bold crescentic black barring on lower breast and upper belly, and blackish barring along flanks to undertail-coverts. Lower mantle, scapulars and tertials, black, blotched pale cinnamon and chestnut; usually with varying number of plain dark grey-brown non-breeding feathers. Back and upper rump, uniform dark grey-brown. Innerwing-coverts, plain, worn grey-brown with paler fringes, though sometimes acquire a few

bright feathers (patterned as upperparts). Flight-pattern diagnostic: from above, show bold narrow white wing-bar contrasting with grey-brown innerwing-coverts and blackish remiges and primary coverts; a bold white band across lower rump and uppertail-coverts, and mostly black tail; below, white axillaries and underwing, narrowly bordered by black leading-edge and tips to remiges; upperwing-bar shows as translucent white central stripe. Distal third or more of bill, black; base, flesh; more orange when breeding. Iris, dark brown. Legs and feet, grey or black. **Adult female breeding** Similar to, but usually duller than, adult male breeding. Often retain much grey-brown non-breeding feathers in upperparts; rest of mantle, scapulars and tertials like those of male breeding, or between those of male and adult non-breeding; cap and face, paler and streaked brown; chestnut on sides of neck, foreneck and breast, paler and duller, very finely barred brown and often flecked white; dark crescentic barring on underparts usually duller brown and less well marked. **Adult non-breeding** Upperparts plain, dark grey-brown grading to slightly paler grey-brown on face, foreneck, breast and flanks; centre of breast often darker; rest of underparts, white. Innerwing-coverts, dark grey-brown as upperparts, narrowly fringed white when fresh. Short white supercilium prominent in front of eye, contrasting with dark loreal stripe, but faint behind eye. Bare parts and pattern in flight as breeding. **Juvenile** Superficially like adult breeding but with no ventral barring. Forehead and



crown, cinnamon, streaked black; whitish supercilium prominent above dusky loreal stripe but fades behind eye; rest of head, grey with varying buff tinge grading to white on chin and throat. Neck, breast and fore-flanks, cinnamon-buff, grading to white on rest of underbody and with faint brown mottling on centre of hindneck and on sides of breast. Mantle and scapulars, black with narrow cinnamon fringes and subterminal dots or bars, producing tortoiseshell pattern; tertials, dull grey grading to dark grey at tips, with prominent cinnamon-buff notches or bars and fringe. Innerwing-coverts, grey with dark shafts and narrow cinnamon-buff fringes, giving neat scaly pattern to folded wing when fresh; inner coverts also have cinnamon-buff spots and dusky subterminal blotch. Flight-pattern and bare parts as adult. With wear, cinnamon fringes, notches and bars of upperparts and wing-coverts fade and become reduced, and cinnamon-buff of neck, breast and flanks fades to duller greyish-buff; worn juvenile best distinguished by lack of ventral barring. **First immature non-breeding** Distinguished from adult non-breeding by retained worn juvenile innerwing-coverts and, often, some tertials, contrasting with dark grey-brown of rest of upperparts; with wear, indistinguishable from adult; in spring–summer, primaries fresh whereas in adult, worn or moulting. **First immature breeding** Gain only a little breeding plumage, often intermediate between breeding and non-breeding in birds wintering in HANZAB area; many remain in complete non-breeding plumage; primaries are worn whereas fresh in adults.

**Similar species** For differences from **Bar-tailed Godwit**, see that account. In all plumages **Hudsonian Godwit** *Limosa haemastica* distinguished by: (1) diagnostic pattern of underwing, which is grey, with mostly black coverts and axillaries, and diffuse whitish central stripe across bases of remiges; (2) narrow white band at base of tail, slightly narrower than black tail-band (equal to or slightly broader than black band on Black-tailed); (3) slightly narrower and much shorter white upperwing-bar; and (4) structural differences including: at rest, slightly bulkier, with shorter neck and legs (especially tibia) and slightly upturned, finer-tipped bill; in flight, appear deeper-chested, with feet not projecting as far beyond tail as in Black-tailed. Other differences include: in adult breeding plumage, male has darker chestnut underbody with dark bars; female always shows at least some chestnut and dark barring on belly; non-breeding almost identical to non-breeding Black-tailed, differing mainly in slightly broader, more bulging white fore-supercilium; juvenile similar to juvenile Black-tailed, but generally duller with more grey-brown, less buff neck, breast and flanks.

Gregarious; occur singly or in small to large groups, numbering hundreds at favoured roosting sites. In HANZAB area, prefer coasts, especially estuarine mudflats and sandy beaches but also often round inland wetlands, unlike Bar-tailed Godwit. Associate with other waders; often at edges of flocks of other species of godwit and, in NZ, sometimes with Black-winged Stilts *Himantopus himantopus*. Gait measured and graceful, with upright stance; will enter deep water. Feed in more leisurely manner than Bar-tailed Godwit, with preference for deeper water; pick from surface or walk slowly in shallows, using bill in series of vigorous rapid vertical or forward-angled probes followed by sudden deep thrust of entire bill (often immersing head completely) when prey encountered. When roosting, characteristically raise wings briefly, showing underwing. Flight, swift and direct, often low over water, occasionally erratic; bill and line of body horizontal in flight. Usually do not call much outside breeding season; contact

calls are short, firm, but not loud, *tuk* or *kek*, often repeated; audible at some distance and useful for detecting individuals in mixed flocks (R.P. Jaensch).

**HABITAT** In HANZAB region, mainly coastal, usually in sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats; spits, banks and berms of mud, sand or shell-grit; occasionally rocky coasts (Storr 1984) or coral islets (Amiet 1957). In tidal regions, use of habitat depends on stage of tide; at low tide, birds are more selective (J. Thompson). Also near-coastal wetlands that are shallow and sparsely vegetated, such as saltmarsh, saltflats, river pools, swamps, lagoons and floodplains (Storr 1977, 1980; Bamford 1988; Vic. Bird Reps). Few inland records; occur round shallow, freshwater and saline lakes, swamps, dams and bore-overflows (Badman & May 1983; Storr 1985, 1986; Vic. Bird Reps). Lagoons in sewage farms and saltworks (Boekel 1976; Lane & Jessop 1985).

Mainly forage on wide intertidal mudflats or sandflats, in soft mud or shallow water; occasionally in shallow estuaries. Use similar habitats on shores of inland lakes and other wetlands. Muddy areas often open and unvegetated, but commonly use drying marshy wetlands preferred by Pectoral Sandpipers *Calidris melanotos* and Long-toed Stints *C. subminuta* (R.P. Jaensch); sometimes forage among mangroves. Roost and loaf on low banks of mud, sand or shell, bars, islets and beaches in sheltered areas; also on saltflats behind mangroves. May occur in unvegetated areas, or among low vegetation, such as samphire (Smith 1964; Ewart 1973; Pegler 1983; Bransbury 1985; Garnett 1989; Lane; Vic. Atlas).

**DISTRIBUTION AND POPULATION** Breed Iceland and The Faeroes in n. Atlantic, Europe, Russia and China; in widely scattered localities in n., w. and s. Norway, s. and se. Sweden and w. Finland; throughout Netherlands, sparsely scattered sites through British Isles, France, Belgium, Germany, Denmark, Austria and n. Italy. Breed at scattered sites in Czechoslovakia, Hungary, Yugoslavia and Rumania; widespread from Estonia, Latvia, Lithuania and w. Poland, E into Russia, where breeding range extends from shores of L. Chudskoye, S to Carpathian Mts, and SE to Crimean Pen., thence E (N of Caspian and Aral Seas and L. Balkash) to round headwaters of Ob R.; n. boundary is generally c. 55°N, E of Urals, and up to 60°N farther W. Also round lakes E of L. Balkash, between Altai and Tien Shan Mts; in area bounded by upper Lena and Vilyny Rs; lower reaches of Anadyr and Amur Rs. Breed in China from w. Heilungkiang, S to w. Liaoning, and also in nw. Sinkiang. During non-breeding period, a few occur in British Isles, France, the Iberian Pen. and along n. coasts of Mediterranean. In Africa, occur in n. Algeria and nw. Morocco, occasionally elsewhere along s. Mediterranean, but mainly from w. Africa (s. Mauritania to Cameroon), E to sw. Red Sea and coast of Kenya; smaller numbers occasionally visit Horn of Africa and areas S of main range, including scattered records in s. Africa. Also occur in n. Persian Gulf and s. Caspian Sea. On Indian subcontinent, occur in Pakistan and n. India, E to Bihar and nw. Bay of Bengal. Also occur from Burma, E through Thailand to Indochina, and S throughout se. Asia to New Guinea and A'asia. Passage migrant in e. China, Korean Pen., Japan, Taiwan and Philippines, with some on passage through Indochina, se. Asia and Indomalaya. Vagrants to islands in n. Atlantic, Bering Sea, and in North America and Micronesia (Dement'ev & Gladkov 1951; Ali & Ripley 1980; de Schauensee 1984;

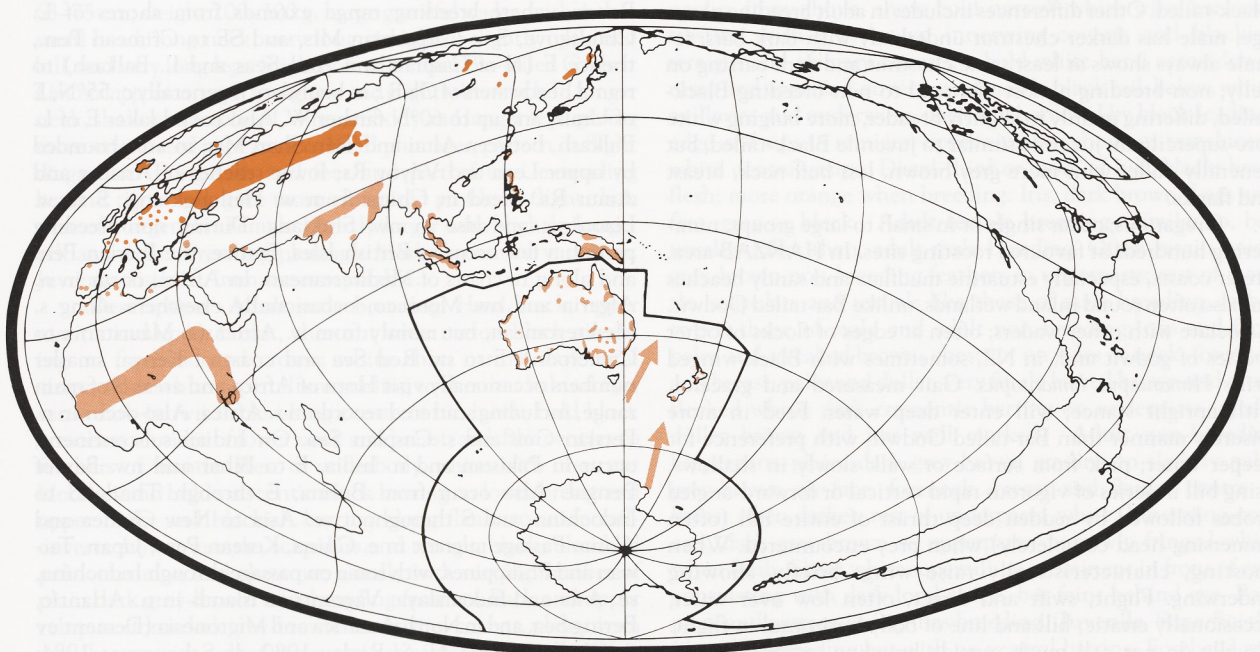


Maclean 1985; Chalmers 1986; Urban *et al.* 1987; AWB 1993; BWP).

**Aust.** Most common on n. coast between Darwin and Weipa; generally small numbers elsewhere (Watkins 1993). **Qld** S., se. and e. Gulf of Carpentaria, from mainland W of Mornington I., E through Karumba, where largest concentrations occur, and along w. Cape York Pen. to Weipa. Single record Torres Str. (Aust. Atlas); not recorded there by Draffan *et al.* (1983). Recorded along most of coast S of Cairns. Scattered inland records, mostly in N: from Camooweal and Mt Isa, where they occur regularly, N to Georgetown, E to Charters Towers, and S to L. Buchanan. Also recorded in SW at Dynevor Downs (Carruthers 1966; Corben 1972; Horton 1975; Storr 1977; Garnett & Bredl 1985; Garnett 1989; Qld Bird Reps; Aust. Atlas). **NSW** Scattered records along coast S to Narooma and Bermagui (Morris *et al.* 1981; Whiter 1989). Widespread but scattered inland records, probably of birds on passage, in Murray–Darling Basin, from Narran L. in N, S to Riverina (including Fivebough and Nerrcon Swamps, Tullakool Saltworks), and W to Fletcher's L. and Gol Gol Swamp. Sometimes also in N. Tablelands, on w. slopes of the Great Divide, and in far NW round L. Bullea, Westwood Downs Stn and Fort Grey (Heron 1970; Thomas 1970; Gosper 1973; Morris *et al.* 1981; NSW Bird Reps; Aust. Atlas). **Vic.** Mostly round Port Phillip Bay; rarely recorded Gippsland. Inland, records include Lough Calvert, N of Colac; Hindmarsh and Albacutya Ls; wetlands round Mildura; lakes between Swan Hill and Kerang; and Tatura (Thomas 1970; Vic. Bird Reps; Vic. Atlas). **Tas.** All singles: Ralph's Bay, 28 Jan. 1965 (Thomas 1966); Sorell, 19 Nov. 1966 (Anon. 1968); Orielton Lagoon, 30 Jan.–28 Feb. 1976 (Newman 1977; Tas. Bird Rep. 6); Ralph's Bay, 12 Feb. 1977 (Tas. Bird Rep. 7). **SA** Most records are from saltfields at St Kilda and Price (SA Bird Reps); recorded from wetlands in SE, e.g. Mullins Swamp, Bool Lagoon and lakes of Lower Murray, NW to ne. and n. Eyre Pen., round Whyalla and L. Gardiner (Gawler Ras), and NW to Big Swamp. In NE, vagrants, assumed to be on passage, recorded L. Eyre drainage basin (Badman & May 1983; Badman

1989; Matthew & Carpenter 1993; SA Bird Reps; Aust. Atlas). **WA** Sparse records on s. coast between Eyre and Albany; scattered and widespread along coast between C. Leeuwin and Hamelin Stn; more widely spread along coasts of Pilbara, and Kimberley, at least to Fitzroy R.; few scattered records elsewhere in Kimberley Div.: round Bonaparte Arch., Lesueur I. and Ord R.–L. Argyle. Inland records include Kalgoorlie and Rowles Lagoon in se. interior; Coyrecup and Ibis L. in SW; and L. Annean in e. Gascoyne Region (Ford 1966; Storr 1980, 1985, 1986; Jaensch *et al.* 1988; Jaensch & Vervest 1990; West. Aust. Bird Notes *passim*; Aust. Atlas). **NT** Mainly in coastal regions of Top End: S as far as Keep R. estuary in W, and to Maranboy and Roper R. (inland), and w. Gulf of Carpentaria, in E. Inland, round Tennant Ck, Alice Springs, and, single, Sturt Ck, Birrindudu Floodplain. Group of 112, L. Sylvester, Dec. 1993 (Boekel 1976; Storr 1977; Lane; Aust. Atlas; H.A.F. Thompson & D.K. Goodfellow; N. McCrie; R.P. Jaensch).

**NZ** Regular visitor in small numbers; maximum in a year, 21 (1985); largest flock, 11 (L. Ellesmere, 1985) and most records are singles (S. Davies; A. Riegen). First record 30 Aug. 1952 at Miranda (Sibson 1956) with c. 123 individuals to 1992 (G.A. Taylor). Recorded at 22 sites throughout NZ. **NI** Widespread. **FAR NORTH, NORTHLAND:** Parengarenga Harbour (3, 1969); L. Ohia (1, 1991); Whangarei Harbour (1, 1978–79). **AUCKLAND, s. AUCKLAND:** Jordan's, Kaipara Harbour (3, 1971); Manukau Harbour (Mangere, Seagrove, Karaka) (16, 1959–89); Firth of Thames (Kaiarau, Miranda, Piako R. estuary) (50, 1952–92); Whitianga Harbour (1, 1992). Other NI localities: Tauranga Harbour (3, 1983–86); Kaituna Cut, Maketu estuary (2, 1985); Kopuawhara R. mouth, Gisborne (1, 1964); Whakaki Lagoon (1, 1992); Ahuriri estuary (2, 1963); Manawatu R. estuary (5, 1977–83); L. Wairarapa (2, 1976–77) (Sibson 1956, 1967; Edgar *et al.* 1969; Edgar 1971, 1978; Arnold 1976; Veitch 1978, 1979; Ann. Locality Reps; CSN). **SI NELSON:** Farewell Spit (1, 1982); Nelson Haven (2, 1978–86). **CANTERBURY:** Ashley estuary (2, 1989); Avon–Heathcote estuary (7, 1985–86); L. Ellesmere (15, 1972–88);







Wainono Lagoon (2, 1976–77). **SOUTHLAND:** Woodend, Invercargill estuary (2, 1963–66); L. George, Colac Bay (1, 1985) (Pierce 1980; Miskelly & Cooper 1985; Fennell *et al.* 1985; CSN; G.A. Taylor).

**Lord Howe I.** Singles: 18 Nov. 1964 (Disney & Smithers 1972); 19 Nov. 1964 (McKean & Hindwood 1965); 17–21 Oct. 1974 (NSW Bird Rep. 1974).

**Auckland Is** Singles: Enderby I., Jan. 1963 (Sibson 1965; B.D. Bell); Derry Castle Reef, 8 Dec. 1976 (Penniket *et al.* 1986).

**Population Aust.** Estimated at 81,000 (Watkins 1993). Sites of significance and maximum or average counts for summer and winter surveys round Aust., 1981–85, were: se. Gulf of Carpentaria, Qld, 49,400; ne. Arnhem Land, NT, 11,400; s. Gulf of Carpentaria, NT, 1,360; Van Diemen Gulf, NT, 870; Roebuck Bay, WA, 500; Hunter R. estuary, NSW, 470; sw. Gulf of Carpentaria, NT, 450; Darwin area, NT, 360 (Lane). Totals for summer counts, 1986–91, 285–2950 birds; summarized in Hewish (1986, 1987, 1989a, 1990), Anon. (1992) and Naismith (1992).

**MOVEMENTS** Migratory; breed n. hemisphere and move S, in broad fronts and often overland, for boreal winter.

**Departure** Leave Anadyr Territory, Russia, by late Aug. Pass through Russian Ussuriland; common passage migrant, Japan, Sept. and Oct.; Korea, probably Aug.–Nov. (Dement'ev & Gladkov 1951; Gore & Won 1971; Orn. Soc. Japan 1974; AWB 1993). Transient Manchuria, Mongolia, along Chinese coast and on Hainan, July–Sept.; also pass through w. China (Kozłowa 1932; la Touche 1931–34; de Schauensee 1984). Uncommon Taiwan, from Oct., but recorded as early as Sept. (Severinghaus & Blackshaw 1976; AWB 1993). Small numbers pass through Hong Kong, Aug.–Nov. (Chalmers 1986). Few occur Burma; pass through Thailand; numerous on w.

coast of Pen. Malaysia; uncommon Singapore. In 1985, passed w. Borneo, mid-Oct. (Parish & Wells 1984; Smythies 1986; AWB 1993). In Sumatra (van Marle & Voous 1988) large numbers recorded from July, possibly before moving on (Silvius 1987; Danielsen & Skov 1989; Watkins 1993). Rare E of w. Borneo (Delacour & Mayr 1946; Smythies 1981; Pratt *et al.* 1987; AWB 1993), though small numbers pass through Wallacea, with dated records Sept.–Nov. (White & Bruce 1986). In 1982, uncommon Bali (Ash 1984). Locally abundant, New Guinea, arriving as early as early July; greatest numbers Oct. and Nov. (Coates 1985; Hicks 1990); not recorded as passage migrant in Torres Str. (Draffan *et al.* 1983).

**Aust.** First arrive NW, late Aug. (Lane); numbers fall from Sept. to mid-Nov. (Aust. Atlas). Pass through Darwin, Nov. (Lane); arrive Gulf of Carpentaria, Sept.–Dec. (Garnett 1989) with a flock observed flying S into the Gulf in Dec. (Carter 1983). Most stay in n. Aust., especially coastal Arnhem Land and se. Gulf of Carpentaria; some move to e. and s. Aust., where occasionally recorded in hundreds (e.g. Close & McCrie 1986; Hewish 1989a, 1990; Anon. 1992). Arrive Gulf St Vincent, SA, Nov.–Dec., later than other groups of Palaearctic migrants, though a few may arrive July or early Aug. (Close & McCrie 1986). Birds moving to s. Aust. may cross continent (Thomas 1970; Garnett 1989; Lane; Aust. Atlas). Small numbers move through Mt Isa region, Qld, mainly Sept.–Nov. and down e. coast as far S as estuary of Hunter R. (Thomas 1970; Lane). Occur regularly in Vic. mainly from Aug. onwards (Vic. Atlas); rarely move farther S to Tas. (see Newman 1977). Some apparently move to sw. Aust. (Bailey & Creed 1993). Rare Lord Howe I. (Hutton 1991); currently almost regular to NZ.

**Non-breeding Aust.** Regular to some inland localities and irregular to others (see Vic. Atlas). Numbers rather stable in Gulf of Carpentaria and estuary of Hunter R., Dec.–Feb.



(Lane). Some dispersive movements in Aust. (Bravery 1964; Vic. Atlas). NZ Mainly on NI, particularly Firth of Thames and Manukau; also several estuaries S to Bluff, s. NI, rarely on SI; vagrant to Auckland Is. Small flocks may remain in suitable localities for months, e.g. Miranda and Avon-Heathcote (Falla *et al.* 1981; CSN 36).

**Return** Few Vic. records after May (Vic. Atlas). Probably move regularly through area of Murray R., Mar. and Apr. (Thomas 1970). In Gulf St Vincent, SA, numbers increase Feb.-Apr., occasionally later (e.g. 80 birds [c. 60 in breeding plumage], 28 Apr. 1979), followed soon after by rapid decline, possibly as birds migrate N (Close & McCrie 1986). In sw. WA, some evidence for small flocks on passage along coast during Apr. (Baker 1988); and inland records during Mar. and Apr. (Jaensch *et al.* 1988). Move up e. coast of Qld, Mar. and Apr.; no influxes in Darwin or nw. Aust. at this time (but see Hooper & Wells 1989) suggesting birds move N from Arnhem Land, and Gulf of Carpentaria where departure rapid after mid-Apr. (Garnett 1986; Lane). In 1986, left Broome, nw. Aust., 18-19 Apr. (Lane 1988).

Extralimitally, large flocks in se. Irian Jaya, Apr.-May; small, irregular passage through Port Moresby district, PNG, Mar. and early Apr. (see Coates 1985; Hicks 1990; Lane). No records after Mar. in Sumatra (van Marle & Voous 1988). Considered rare in s. Vietnam (Wildash 1968) but common n. Vietnam, Mar. and Apr. 1991 (Lane 1991). Flocks on passage, Burma and Sulawesi, Mar. and Apr. (Escott & Holmes 1980; Smythies 1986; White & Bruce 1986). Pass through Hong Kong (more numerous than on s. migration) and se. China, Mar.-May (la Touche 1931-34; Chalmers 1986); pass Jiangsu coast, e. China, Apr. and May, and Beidaihe mainly during Mar. (AWB 1993); fewer in Japan on n. than on s. migration; apparently pass Korea, Apr. and May; pass through s. Ussuriland, Russia. Recorded arriving in Anadyr, Russia, May (see Dement'ev & Gladkov 1951; Gore & Won 1971; AWB 1993).

**Breeding** Large numbers spend breeding season S of breeding range (BWP). In Aust., overall reporting rates 0.8% in summer and 0.2% in winter (Aust. Atlas). Substantial numbers remain in N during winter, e.g. Gulf of Carpentaria (Garnett 1989). Generally, those wintering farther S in small flocks, but sometimes in hundreds (e.g. Hewish 1988); winter records from as far S as Corner Inlet, Vic. (Hewish 1989b; Vic. Atlas); single recorded inland NT (Birringudu Floodplain), June 1993 (R.P. Jaensch). Recorded wintering in NZ (e.g. Sibson 1959); one bird (with aberrant plumage cycle) recorded Firth of Thames, summer and winter, for about 4 years (Sibson 1956). One record from Kiribati, July (Child 1982).

**Banding** No international recoveries. Bird with Aust. band, originally placed on a Curlew Sandpiper *Calidris ferruginea*, recovered in s. Thailand (Starks 1985). Extralimitally, bird banded Hong Kong recovered n. Vietnam (Lane 1991).

**FOOD** Omnivorous. Invertebrates and occasionally seeds; extralimitally, annelids, crustaceans, arachnids, fish eggs and spawn and tadpoles of frogs (BWP). Seeds and berries especially important after breeding and on migration (BWP). **Behaviour** Diurnal and nocturnal, perhaps more active at dawn and dusk. Locate food by touch and sight. Often waded up to belly in water (Liddy 1960). Probe for long periods, often immersing head; up to 36 probes/min. Make shallow exploratory probes with bill held vertically, then suddenly probe deeply, pull out prey and swallow it immediately. Also glean

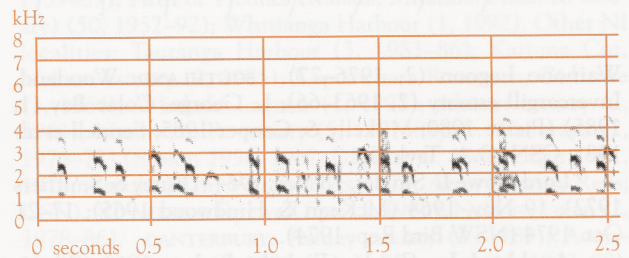
from ground and vegetation. Recorded foot-trembling to disturb prey. Sometimes wash food.

**Adult** Plants: seeds (Mathews 1909). Animals: Molluscs: Bivalves: Hyriidae shell-grit; Insects: Coleoptera: Dytiscidae: 6 larv.; *Antiporus* 2 ads; Hydrophilidae: *Borosus* 1 ad. (Vestjens 1972, 1977).

**Intake** Extralimitally, use c. 30 kcal/day with daily food intake of 86 kcal/day of *Nereis* (BWP).

**VOICE** Usually silent in HANZAB area; when feeding, calls soft and chattering. Roosting flocks often silent or very quiet, calls only audible if flushed. For extralimital information and sonagrams see: Bergmann & Helb (1982), Richard (1991), Glutz von Blotzheim *et al.* (1977), Maclean (1985), Wollemann & Olaszky (1977), and BWP. Calls of males said to be higher pitched and sharper than females but much variation in repertoire (at least on breeding grounds) with intergradation between calls (see BWP).

**Adult** Softly repeated whistle: staccato, slightly harsh or strident, *witta-wit*, or *reeta reeta reeta* (Pizzey 1980). Contact call, short quiet *tuk* or *kek* (Hayman *et al.* 1986). Sonagram A shows typical calls given by birds in flock. These calls, often given as a quickly repeated couplet, have a clear triple harmonic structure with most energy at 2.5-3.0 kHz. Each call is short, c. 40-50 ms, quickly rising in frequency, followed by a much longer fall, spanning a range of c. 0.8-1.0 kHz, for the strongest components.



A R. Swaby; St Kilda, SA, Apr. 1979; P36

**PLUMAGES** Prepared by R.P. Scofield and D.I. Rogers. Fledge in distinctive juvenile plumage. Undergo partial first pre-basic moult, beginning on s. migration, to first immature non-breeding. Most stay in non-breeding areas in first austral winter, some undergoing partial first pre-alternate moult, which produces varying amount of breeding plumage. Adult non-breeding first attained through complete second pre-basic moult at start of second austral summer. Thereafter, partial pre-alternate moult produces sexually dimorphic breeding plumage just before n. migration, and complete pre-basic moult to non-breeding plumage occurs late in, or after, s. migration. Extralimital subspecies first breed at 2 years or older. Subspecies *melanuroides* described below.

**Adult male breeding** (Second and subsequent alternate). First attained at end of second austral summer. **Head and neck** Crown, black-brown (119), broadly streaked by rufous-brown (c340) edges to feathers. Supercilium, white, extending just behind eye; speckled rufous-brown (c340) in front of eye. Black-brown (119) loreal stripe borders lower edge of supercilium, then runs below and behind eye. Inconspicuous narrow eye-ring, white. Chin and upper throat, white, varyingly washed rufous (140). Hindneck, rufous-brown (c340) with obvious flecking caused by prominent black-brown (119)



shaft-streaks. Rest of head and neck, light rufous-brown (240), faintly speckled by dark brown (119A) shaft-streaks to some feathers, specially on cheeks. **Upperparts** Mantle and scapulars, cinnamon to rufous-brown, varying blotched black and with varying amount of retained greyish-brown non-breeding plumage. Feathers of mantle, rufous-brown (340) with broad black-brown (119) subterminal rosethorn and pink-buff (121D) tips to feathers, and with brown (119B) bases (which rarely meet black-brown rosethorns). Scapulars vary somewhat in pattern: generally brown (119B) with pale grey-brown (119C) or rufous-brown (c340) tips divided by incomplete black-brown (119) shaft-streaks; most are striped by three rufous or rufous-brown (140, 240, c340) bars which do not quite meet in centre of feather or, in some, these bars reduced to spots on either side of feather. Feathers of back and most of rump, brown (119A–119B), grading to black-brown (119) toward edges, and with narrow off-white fringes; some feathers have dark-brown (119A) shaft-streaks. Bold white patch formed by posterior 1–2 rows of feathers on rump and shorter uppertail-coverts. Longer uppertail-coverts, black (89). **Tail** Black (89), narrowly tipped white when fresh; t1 and t2 have brown (119B) subterminal bands and black (89) shafts. Bases of feathers, white; area of white increasing from one-fifth of t1 to one-third of t5; on t6, basal half of outer web and basal third of inner web, white. **Underparts** Feathers of breast, flanks and thigh-patch, rufous-brown (c340) with 2–3 black-brown (119) subterminal bars that are broadest on lower breast and flanks. Belly and undertail-coverts, white, with dark bars formed by dark-brown (119A) subterminal bars to feathers of belly (indistinct on central belly) and black subterminal bars on undertail-coverts; bars usually edged rufous-brown (340), especially anteriorly. Axillaries, white. **Upperwing** Brown (119B), becoming black-brown (119) on some lesser and marginal coverts and most primary coverts. Most coverts are old and worn, retained from non-breeding; some inner greater and median secondary coverts, and most tertials and tertial coverts, new. New coverts and tertials, black-brown (119) with pale grey-brown (119C) or rufous-brown (c340) tips, divided by incomplete black-brown (119) shaft-streaks; most have three rufous-brown (340) broken bars or pairs of lateral spots. May retain some old, worn light grey-brown (119C) tertials. Old coverts, worn and tipped light grey-brown (119C). Greater secondary and inner greater primary coverts, broadly tipped white; these combine with white bases of some remiges to form bold white wing-bar. Remiges, dark brown (119A) with white bases to outer webs of p1–p6, white outer webs of s9–s11, and dark-brown (119A) subterminal streaks on s10 and s11; shafts, white except at tips. Wear gradual; still retain narrow white tips to remiges by start of breeding season. **Underwing** Coverts mostly white; marginal secondary coverts and bases of marginal primary coverts, dark brown (119A), and bases of top row of lesser coverts, brown (119B). Remiges, patterned as upperwing, though mostly brown (119B) with bases of primaries, light grey (85).

**Adult female breeding** Usually retain more light grey-brown (119C) non-breeding plumage than does adult breeding male (may look more like subspecies *limosa*). In Aust., mainly differ from adult breeding male in having more new scapulars; these have pale grey-brown (119C) tips, often washed rufous-brown (c340) (never uniform rufous-brown [140 or 240] of new scapulars in males). However, replace fewer tertials and wing-coverts than male; also, moult of breast and belly incomplete, so look overall more mottled and less rufous-brown (340) than males.

**Adult non-breeding** (Second and subsequent basic). First attained at start of second austral summer. **Head and neck** Forehead, crown, lores, cheeks, hindneck and sides of neck, uniform brown (119B); feathers have light grey-brown (119C) tips when fresh. Supercilium, prominent but short, not extending behind eye; white or buff (124), often washed or speckled light grey-brown (119D), specially near bill. Often have small white spots below eye. Chin, white; throat and foreneck, pale grey-brown (119C). **Upperparts** Mantle, scapulars, back and upper rump, rather uniform brown (119B); inconspicuous shaft-streaks of feathers, dark brown (119A). Lower rump and uppertail-coverts, as adult non-breeding. **Underparts** Breast and flanks, pale grey-brown (119C), becoming darker grey-brown (119B) on sides of breast, and fading to off-white (54) on lower flanks, lower breast and upper belly. Rest of underparts, white (usually contrasting with pale grey-brown gorget) with some brown (119B) streaks on lateral undertail-coverts. **Upperwing** Like adult breeding but: coverts, fresh and equally worn, light grey-brown (119C) with brown (119B) shaft-streaks and centres to some feathers; remiges, fresh, black-brown (119) with white tips to secondaries and inner primaries; tertials, brown (119B) with dark-brown (119A) shaft-streaks. **Underwing** As adult breeding.

**Juvenile** Few seen in full juvenile plumage in A'asia, except on arrival in nw. Aust. Differences from adult breeding: **Head and neck** Feathers of crown, black-brown (119), narrowly edged rufous-brown (240). Supercilium, pale buff (124); may be washed rufous-brown (240) near bill; broad in front of eye, extending behind eye 1.5–2 times width of eye. Loral stripe, black-brown (119), faintly fringed light rufous-brown (139); extends below eye, broadening behind eye to cover upper ear-coverts. Feathers of chin, lower ear-coverts, cheeks and nape, light grey-brown (119D) edged buff (124), becoming rufous-brown (139) on chin. Sides of neck, nape and throat, rufous (240). **Upperparts** Upper mantle, brown (119B) grading to black-brown (119) on lower mantle and scapulars; all feathers have rufous-brown (240) fringes, which rapidly fade to buff (124), thus appear neatly scalloped above (cf. more blotched pattern of adults). **Underparts** When fresh, rather like adult breeding but without bold ventral barring; breast, rufous-brown (240) with pale grey-brown (119) shaft-streaks and subterminal bars to some feathers, especially on sides of breast; flanks, pale rufous-brown (139), grading to buff (124) or cream (54) on lower flanks. These areas fade to duller greyish buff when worn. Rest of underparts, off-white. **Upperwing** As adult male breeding but: inner greater coverts and longer lesser and median coverts, tipped buff (124); tertials, black-brown (119) with cream (54) tips divided by dark shaft-streaks and three rufous-brown (240) bars which do not quite meet in centre of feather or, in some, these bars reduced to spots on either side of feather.

**First immature non-breeding** (First basic). Identified by combination of wear of plumage, timing of moult of primaries (see Ageing), and pattern of tertials. Differs from adult non-breeding by retaining some juvenile remiges, wing-coverts and feathers of upperparts: (1) Back, rump, uppertail-coverts and tail, old, worn and faded; ground-colour, light grey-brown (119C) except on white patch on rump; fringes of feathers mostly worn away, leaving rough abraded edges; any remaining fringes, faded, off-white. (2) All feathers of wing retained; best identified from adult by wear of tertials, which fade to pale grey-brown (119C) with dark-brown (119A) tips and off-white fringes; also have partial bars or lateral spots; fringes



wear rapidly, so feathers appear notched or sharply pointed by late austral summer.

**First immature breeding** (First alternate). Do not breed in this plumage. Varies and poorly known in A'asia. Only material one skin (AM O 56601) and published description of probable first alternate (Dowding & Arnold 1986). Most plumage of body retained from first basic or is similar in appearance (not known if some first alternate feathering resembles non-breeding plumage). Some feathers of head, mantle, scapulars and lower breast and sides of breast replaced in first pre-alternate and inseparable from adult breeding. Retain juvenile inner median coverts and some tertials, which are very worn, ragged and sharply notched, pale grey-brown (119D) with no off-white fringes remaining.

**BARE PARTS** Subspecies *melanuroides*. Based on photos (Japan Bird Club 1983; Pringle 1987; Strange & Jeyarajasingam 1993; NZRD; H.M. Gibbs) and museum labels (MV). **Adult**, **Immature** Iris, dark brown (119A). Bill: upper mandible varies: black (89) with pinkish (3) wash at base, or pink (3, 7) to orange-pink (c106) on basal half (exceptionally, two-thirds) with black (89) tip; lower mandible, pink (3, 7) to orange-pink (c106) or pink-red (10) on basal three-fifths, with black (89) tip. In non-breeding plumages, pale areas on bill become smaller and salmon (6) or dirty buff (124). Legs and feet, grey-black (82) or dark grey (83) or black (89) with olive (30) wash. **Juvenile** As adult, but pale areas on bill deeper pink-red (10) or red (13).

**MOULT** From BWP, Prater *et al.* (1977), c. 20 Aust. skins (AM, ANWC, HLW, MV, SAM, WAM) and c. 90 birds banded in nw. Aust. (AWSG).

**Adult post-breeding** (Third and subsequent pre-basic). Complete. Begins with some moult of body before arrival in Aust., but most moult occurs in our region. Primaries moult outwards; rapidly at first, with inner three dropped almost simultaneously; in some, p1–p5 may be growing concurrently. Outer primaries moult more slowly. In n. WA, birds in active moult (excluding those growing p1 or p10) had 2.37 (0.76; 19) primaries growing concurrently when PMS < 25 and 1.76 (0.43; 17) growing concurrently when PMS > 25. In n. WA, earliest records of active moult of primaries from 2 Sept., though 9% had not started moult by 1 Oct. Variation in starting date also suggested by wide scatter of PMS in sample from 1 Oct.: 17.6 (9.77; 0–33; 45) (AWSG). Moult completed about Dec. (samples of birds in late moult are small). In Firth of Thames, NZ, a bird with reversed moult cycles was resident for 4 years, moulting into breeding plumage in Aug. and in non-breeding plumage from at least Mar. (Sibson 1956). In nominate *limosa* in w. Europe, body-moult starts May on breeding grounds, continues at staging points before s. migration, and completed at non-breeding areas; moult strategies of *islandica* and e. populations of *limosa* (BWP) apparently more similar to A'asian birds. **Adult pre-breeding** (Second and subsequent pre-alternate). Partial, usually starting late in austral summer. Varies in extent; males replace more feathers than female. Both sexes replace all feathers of head and neck; males also replace most of mantle, scapulars, underparts, inner tertials and central rectrices. Females replace fewer of these feathers before leaving A'asia, and probably do not replace them all before breeding. **Post-juvenile** (First pre-basic). Partial; begins during migration; few (if any) arrive Aust. in full juvenile plumage. Replace feathers of head, neck, mantle, scapulars, inner tertials, underparts, central rectrices and inner median

wing-coverts. Superficially like first immature non-breeding by Sept., though moult still active till at least mid-Dec. **First pre-breeding** (First pre-alternate). Partial; active moult recorded in our region Apr.–May but duration for individuals not known. Replace same feathers as in adult pre-breeding, though birds that remain in non-breeding areas during first breeding season usually replace fewer feathers and so have scruffy, incomplete appearance. In nominate *limosa*, those that return to breeding areas may moult all tracts that adults do; not known if any *melanuroides* migrate N in first year. **Post-juvenile moult of primaries** (First pre-supplemental?). Only recorded from Aust. Not properly understood; details of moult of primaries available from 31 birds (most from n. WA) in first austral winter and second austral spring, but these show confusing scatter of moult-scores at most times; separation of first pre-supplemental moult from early second pre-basic moult of primaries sometimes problematic, and relation of timing to first pre-alternate unknown. Partial, only known to include primaries and associated greater primary coverts; undertaken by at least 50–60% of birds in first austral autumn and early winter. Primaries moult outwards; usually complete but some records of birds retaining 3–8 outer primaries; one aberrant bird only replaced p10. Timing varies; earliest record at start of Apr. (when PMS of 3 and 24 recorded) but some start much later (e.g. PMS of 12 recorded 5 June); probably completed July–Aug. Slower than adult post-breeding moult of primaries, especially when in early stages; even when birds with interrupted moults excluded from analysis, number of primaries growing concurrently only 1.2 (0.42; 1–2; 10) (AWSG). **First immature post-breeding** (Second pre-basic). Do not breed before this moult. Complete; like adult post-breeding but the little data available suggest it begins earlier: PMS, 28 on 21 Aug. (NSW), 40 and 3 on 2 Sept. (n. WA; latter bird a vagrant *limosa*) and 27.1 (16.4; 3–50; 8) (AWSG) on 1 Oct. Date finished not known, probably similar to adults. No obvious difference in timing between birds that have and have not undertaken a first pre-supplemental moult of primaries.

**MEASUREMENTS** Subspecies *melanuroides*. (1–3) Aust., skins (AM, ANWC, MV, SAM): (1) Adults; (2) Immatures; (3) Ages combined. (4) Aust., live, ages combined; sexed using PCF method (HUMPS UV; Rogers 1995) (AWSG).

	MALE	FEMALE	
WING	(1) 190.0 (6.33; 184–198; 4)	198.9 (7.42; 189–211; 7)	ns
	(2) 193.8 (5.76; 190–204; 5)	194, 206	–
TAIL	(1) 71.3 (4.64; 67–77; 4)	70.1 (6.47; 62–83; 7)	ns
	(2) 71.6 (3.29; 68–76; 5)	71, 73	–
BILL	(3) 74.4 (2.31; 71.6–77.2; 9)	85.8 (4.38; 75.9–89.3; 8)	**
	(4) 72.9 (2.93; 35)	80.2 (3.22; 32)	–
TARSUS	(3) 62.4 (2.08; 60.1–67.0; 8)	66.4 (2.51; 63.2–63.9; 7)	**
TOE	(3) 40.3 (2.77; 35.7–45.0; 8)	41.6 (1.52; 39.4–43.2; 7)	ns
UNSEXED			
WING	(3) 196.8 (9.18; 172–217; 72)		
BILL	(3) 76.4 (4.77; 66.1–90.0; 67)		
THL	(3) 112.3 (8.74; 96.3–122.7; 26)		

Insufficient data to examine variation related to age. In nominate *limosa*, juvenile wing and tail 6 and 4 mm shorter than those of adults; attain adult bill-length, Sept.–Oct.; tarsus and toe similar to those of adult from fledging (BWP). For



measurements of nominate *limosa* and subspecies *islandica*, see BWP and Roselaar & Gerritsen (1991).

**WEIGHTS** (1–4) Aust. *melanuroides*, mostly from n. WA; combined data from banding (AWSG; ABBBS) and museums (AM, ANWC, MV, SAM): (1) Immatures in first basic; (2) Immatures in first basic to first alternate; (3) Immatures in first alternate to second pre-basic (possibly include small number of adults that spent more than one winter in Aust.); adults all from NSW in late Aug. (ageing methods unknown); (4) n. WA; immatures in second pre-basic.

	ADULTS	IMMATURES	
Nov.–Feb.	(1) 230.5 (38.71; 165–310; 13)	190.2 (38.08; 160–255; 5)	ns
Mar.–Apr.	(2) 296.6 (31.28; 250–375; 12)	231.0 (29.45; 195–260; 5)	**
May–Aug.	(3) 239.0 (28.98; 194–288; 16)	207.2 (28.36; 164–250; 16)	**
Sept.–Oct.	(4) 213.0 (32.88; 148–325; 32)	208.0 (36.89; 154–254; 7)	ns

Above samples do not include first pre-alternate immature male from NT of 127 g on 7 May, or probable nominate *limosa* from n. WA of 279 g on 20 July. Sexes probably differ in size, as reported for nominate *limosa* (BWP); too few Aust. data to determine but it is the most likely explanation for significant positive correlation between weight and length of bill (e.g. in n. WA adults on 1 Oct.,  $r_s = 0.519$ ,  $n=21$ ;  $P < 0.05$ ). Adult weight increases significantly Mar.–Apr., though complete extent of gain in weight before migration probably not reflected in above samples; adults significantly lighter Sept.–Oct., just after arrival from s. migration. Seasonal differences in weights of immatures in above samples not statistically significant but larger samples needed to test possibility of slight increase in weight, Mar.–Apr.

**STRUCTURE** Wing, rather long, narrow and pointed. Eleven primaries: p10 longest, p9 2–5mm shorter, p8 9–14, p7 18–23, p6 29–37, p5 43–51, p4 57–63, p3 70–85, p2 84–88, p1 94–101; p11 minute, narrow, pointed, hidden by lesser primary coverts; p10 level with, or extending slightly beyond, tail when wing closed. Seventeen secondaries, including six tertials; longest tertials extend to p7–p10 on closed wing. Tail, short, with square tip; 12 rectrices (difference between shortest and longest rectrices, 3–5 mm). Bill, very long and straight, sometimes with very slight, gradual upturn along entire length (much less marked than in *L. lapponica*). Tip, slightly swollen, dorso-ventrally compressed and slightly spatulate, with small hook on extreme tip of upper mandible. Lower tibia, exposed, with c. 40 mm bare. Tarsi, long, scutellate and slightly laterally compressed, giving distinct oval profile. Toes, long; minute webs on three front toes; outer toe c. 81% of middle, inner c. 80%, hind c. 34%. Claw of middle toe, very long and straight with pectinate inner edge.

**AGEING** JUVENILE, distinct (see Plumages). **FIRST IMMATURE NON-BREEDING** readily aged till at least Feb. by unmoulted juvenile remiges (adults begin complete moult of primaries soon after arrival and primaries are much fresher than juvenile primaries when moult completed about Dec.). **FIRST SUPPLEMENTAL, FIRST IMMATURE BREEDING, IMMATURE POST-BREEDING (SECOND PRE-BASIC)**: From Apr. to Aug., distinguished from those adults that migrate N by moult of primaries; either retain juvenile primaries, which become very worn, or enter pre-supplemental moult of inner or all primaries c. Apr.–July

(when breeding adults have relatively fresh, unmoulted primaries). Also have less breeding plumage than breeding adults at this time, and may retain diagnostic tertials and inner median coverts from juvenile plumage. Second pre-basic moult begins Aug. (slightly earlier than adult post-breeding) and wear of outer primaries Aug.–Oct. differs from breeding adults: either very worn (if retained from juvenile plumage) or fresher than in returning adults (if outer primaries were moulted in pre-supplemental). Age at first n. migration and breeding, unknown; possibly some adults also spend austral winter on non-breeding grounds. Not known if above ageing characters will separate such individuals.

**GEOGRAPHICAL VARIATION** Three subspecies, varying considerably in size and less so in plumage. Common subspecies in our region is *melanuroides* (breeds e. Asia; described above); much smaller, and with darker grey-brown upperparts than other subspecies (Prater *et al.* 1977; Hayman *et al.* 1986; BWP); may also differ in developing less strong orange tinge to bill when breeding. Subspecies *limosa* may reach Aust. as vagrant; measurements of an immature banded at Broome, WA, 20 July 1970 (wing 212, bill 106.3 and THL 148.3) (AWSG), consistent with central Siberian males of this subspecies.

Nominate *limosa* breeds w. Europe to Yenisey R.; in breeding plumage less rufous on underparts than *melanuroides* but with stronger cinnamon tinge to these areas; pre-alternate moult of *limosa* is less complete (BWP) and there is less dark barring on belly, flanks and undertail-coverts. Largest subspecies, length of bill and tarsus varying clinally; average measurements follow: in Europe and w. USSR, male: wing 207, bill 91, tarsus 73; female: 219, 107, 81; in central Siberia, male 212, 103, 80.1; female 214, 116, 85.3 (BWP). Subspecies *islandica* most similar to *melanuroides* in plumage and to *limosa* in size; average measurements: male: wing 208, bill 79, tarsus 67; female 216, 91, 74. Said to form superspecies with *L. haemastica* (BWP, which see for additional information).

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Hudsonian Godwit *Limosa haemastica* (page 77)

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

Black-tailed Godwit *Limosa limosa* (subspecies *melanuroides*) (page 68)

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

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