

## Order CHARADRIIFORMES

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

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

Thinocoridae	seed-snipes; four species, S. America.
Pedionomidae	Plains-wanderer; monotypic, Aust.
Scolopacidae	sandpipers, snipes and allies; c. 85 species, cosmopolitan.
Rostratulidae	painted snipes; two species, s. America and Old World.
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; diastatic 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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## 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 lapponica* **Bar-tailed Godwit**

COLOUR PLATE FACING PAGE 97

*Scolopax lapponica* Linnaeus, 1758, *Syst. Nat.*, ed. 10, 1: 147 — Lapland.

The specific epithet refers to the type-locality (Modern Latin *Lapponia*, Lapland).

**OTHER ENGLISH NAMES** Barred-rumped, Pacific Ocean, Southern or Small Godwit.

**POLYTYPIC** Three subspecies: nominate *lapponica* breeds n. Eurasia from Taymyr to Lapland; subspecies *baueri* Naumann, 1836, breeds ne. Siberia from round Kolyma R., E to Chukotski Pen., and in w. Alaska, from Wales to Barrow; subspecies *menzbieri* Portenko 1936, n. Siberia, between Khatanga R. and delta of Kolyma R.

**FIELD IDENTIFICATION** Length 37–39 cm; wingspan 62–75 cm; weight 250–450 g. Large long-necked wader with very long upturned bill, with dark tip and pinkish base, and medium-length legs. Slightly larger and stockier than Black-tailed Godwit *Limosa limosa*, with shorter neck and legs, steeper forehead, and more upturned and slightly more pointed bill. All plumages have rather uniform upperwing-pattern and dark back and upper rump, but dark barring on white lower rump, uppertail and lining of underwing distinguishes from other godwits. Sexes differ: female, larger, with longer bill, and duller breeding plumage. Marked seasonal variation in plumage. Juvenile distinctive. Immatures separable.

**Description Adult male breeding** Head and neck, deep rufous with: thick black streaks on forehead, crown and nape, and finer streaking on hindneck, sides of lower neck and lower ear-coverts; dark eye-stripe from bill to ear-coverts; and plain rufous supercilium. Supercilium, chin and cheeks, sometimes paler rufous, or off-white. Mantle, scapulars and tertials vary: black, with broad rufous fringes or spots, and some white fringes or spots admixed; often retain some brownish-grey non-breeding tertials and longer scapulars on upperparts. Back and rump, white, heavily spotted black, and uppertail-coverts barred black and white, with varying chestnut suffusion; in flight, combine to form distinct pale V extending to upper back (which becomes less obvious with wear). Tail barred black and white. Upperwing: innerwing-coverts, dark grey-brown, grading to black on leading-edge; remiges and primary coverts, darker black, with narrow white fringes to secondaries. Underparts vary; typically uniform deep rufous with black streaks on sides of breast and irregular black barring on vent and undertail-coverts; may have scattered white blotching on underbody. Underside of remiges, dark grey; axillaries and underwing-coverts, white, heavily streaked and barred dark grey-brown. Distal half of bill, black; base, pink or yellow-pink. Iris, dark brown. Legs and feet, dark grey, sometimes tinged green or blue. **Adult female breeding** Duller than male; most lack rufous below and appear similar to adult non-breeding. Upperparts like male, but dull cinnamon or buff, not deep rufous; head like non-breeding, with whitish supercilium. Underparts vary: brightest have foreneck, sides of throat, breast and fore-flanks blotched pale chestnut or cinnamon with dark streaks on foreneck and sides of breast, and fine black spots and bars on breast. Dullest have throat, breast and fore-flanks tinged pink-buff to cream, with fine dark streaks on throat, foreneck and sides of neck, and fine dark-grey barring on breast, flanks and undertail-coverts. **Adult non-breeding** Crown, upperparts and innerwing-coverts, pale brownish-grey narrowly streaked black and white, appearing variegated above; neck and sides of head, slightly paler than rest of upperparts and finely streaked darker, with dark eye-stripe and bold white supercilium becoming broader behind eye and extending to rear of ear-coverts. Underbody, white with pale brownish-grey wash and fine dark streaks on breast, and some narrow dark streaks or bolder arrowheads on sides of vent. Rest of plumage and flight-pattern as breeding, but without rufous. Bare parts as breeding. **Juvenile** Similar to non-breeding, but: crown more heavily streaked darker, giving capped appearance; eye-stripe darker and white supercilium bolder; mantle, scapulars and tertials, darker, black, with sharply defined buff or pale-buff notches giving curlew-like pattern to upperparts; innerwing-coverts, dull grey-brown with blackish streaks, and broad white fringes and notches. Pale-buff wash (when fresh), and fine dark streaks on foreneck, breast and fore-flanks form indistinct gorget, contrasting with whitish rest of underbody.

Pale spots and streaks soon fade to off-white and reduced by wear, leaving deeply notched edges to feathers, e.g. on tertials. **First immature non-breeding** Differ from adult non-breeding by retained juvenile innerwing-coverts and tertials, which contrast with paler and plainer fresh grey-brown non-breeding feathers of upperparts. **First immature breeding** Male similar to adult breeding, but sides of head and neck, chin and throat paler, and with varying number of retained non-breeding feathers (often many) in upperparts. Females duller than dullest breeding females, underparts faintly tinged pink-buff and barring reduced or absent. Thus in Mar.–June of second calendar year immatures have little or dull breeding plumage, with heavily worn retained juvenile remiges, or primaries in moult (cf. uniformly fresh primaries in adults). Many birds wintering in our area appear little different from non-breeding.

**Similar species Black-tailed Godwit:** In all plumages, flight-pattern distinctive: from above shows white wing-bar, black tail, and white band across lower rump and uppertail-coverts; from below, underwing white with narrow black border. Flight-profile also differs: feet and part of tarsi project beyond tip of tail and, with longer neck and more slender build, has more attenuated shape (in Bar-tailed, head and neck retracted to give heavy-chested appearance and toes hardly project beyond tip of tail, giving noticeably truncated rear end). More easily confused at rest: Black-tailed has more elegant jizz, though differences in structure are somewhat obscured by sexual dimorphism in size in both species. In breeding plumage, Black-tailed always shows white lower belly and vent, with rufous of foreneck and upper breast giving way to heavy irregular barring on white lower breast, upper belly and flanks. In non-breeding plumage, Black-tailed has darker and plainer upperparts, head, neck and breast, and dark foreneck, breast and flanks, contrasting more with white rest of underbody; white supercilium is usually restricted to in front of eye. Juvenile Black-tailed differs from Bar-tailed of same age by: uniform bright-orange face, neck and breast merging into white rest of underbody; difference in supercilium as for non-breeding, though some have white supercilium behind eye; upperparts have distinctive tortoiseshell pattern of black and dull rufous or orange; innerwing-coverts mostly grey with black marks and narrow pale-buff fringes, contrasting with richly coloured rest of upperparts. **Asian Dowitcher** *Limnodromus semipalmatus*: In all plumages superficially similar to Bar-tailed but: smaller (body-size close to Great Knot *Calidris tenuirostris* or Greenshank *Tringa nebularia*) with smaller, more snipe-like head and shorter wings giving more truncated rear end (tips of folded primaries roughly level with tip of tail at rest); bill straight, black, thick along whole length, and swollen laterally at tip; legs proportionately longer, with more of foot (whole length of toes) projecting beyond tip of tail in flight. Further differs from all ages of Bar-tailed by: (1) darker crown and loreal stripe; (2) broader, more bulging snipe-like fore-supercilia with narrow dark central stripe on forehead; (3) white axillaries and underwing; (4) pale panel across upper secondaries and inner primaries. In adult breeding plumage, distinguished from adult male Bar-tailed by: boldly striped black and chestnut upperparts; and barred flanks and white belly, rear flanks, vent and undertail-coverts. In non-breeding plumages, best distinguished from same of Bar-tailed by: darker and more contrastingly patterned upperparts (recalling Great Knot), paler chest, and barring on flanks and undertail-coverts. Juvenile distinguished from juvenile Bar-tailed by: neat narrow buff fringes to feathers of upperparts and innerwing-coverts giving striped pattern above; stronger buff colour on

foreneck, breast and flanks, with crescentic barring on flanks and some spotting and barring on undertail-coverts. Voice and feeding behaviour also differ markedly.

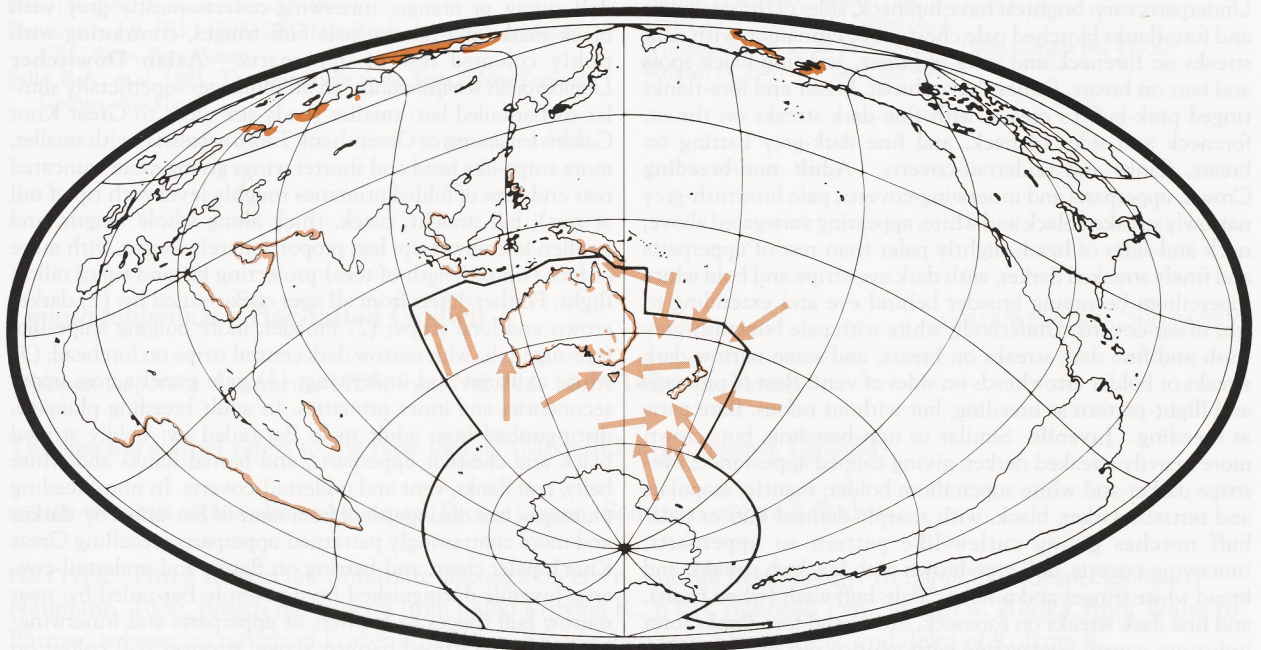
Gregarious; usually in pairs or small groups but may gather in large flocks (1000s) at favoured roosting sites. Coastal, favouring estuarine and tidal mudflats, also sandy or shelly beaches and banks, mangrove-fringed lagoons, sewage farms or saltfields; occasionally inland. Associate with other waders. At high tide, never forage, but roost in large groups on open sandy islands and beaches. Typically feed along edge of water, with longer-billed females in deeper water than males; forage in loose groups, walking steadily over mud or in shallow water, using bill in rapid stitching action or series of vertical probes followed by sudden deep thrust of entire bill when prey encountered. Gait easy but rather awkward compared to Black-tailed Godwit; occasionally run after prey. Flight swift and direct, with fast wing-beats similar to those of smaller waders; often fly in large flocks, in long lines or chevrons; flocks sometimes perform aerial manoeuvres like those of smaller waders, e.g. sudden tilts and twists, steep plunges. Not very vocal outside breeding season, but contact and alarm calls given throughout year are barking *kerk-kerk*, deep *kirruc*, and variants of these.

**HABITAT** In A'asia, mainly coastal; on large intertidal sandflats, spits and banks, and, less often, mudflats, estuaries, inlets, harbours, coastal lagoons and bays; often round beds of seagrass (Watt 1947; Thomas 1968; Evans 1975; Dann 1979; Pegler 1980; Garnett 1989; Peter 1990; Thompson 1990) and, sometimes, in nearby saltmarsh (Stidolph 1954; Vic. Atlas). Also coastal sewage farms and saltworks; sandy ocean beaches (Pegler 1983; Thompson 1993), rock platforms (Storr 1977) and coral reef-flats (Domm & Recher 1973). In NZ, seldom found in estuaries with hard substrate (J. Hawkins). Recorded on saltlakes and brackish wetlands near coasts (Storr 1977, 1985; Vic. Bird Rep. 1986); also on shingle river bed (Parrish 1988). Rarely on inland wetlands (e.g. Child 1973; Vic. Atlas; Vic. Bird Rep. 1983) or in areas of short grass, such as farm-

land, paddocks and airstrips. However, use grassy areas commonly in some areas of NZ and on islands: in NZ, occur in paddocks next to estuaries after heavy rain (Fien 1971; J. Hawkins); on Norfolk I., recorded on grassy town common, and in creek during prolonged drought (Wakelin 1968); on Kermadec Is, more commonly recorded in farm paddocks and grassy flats than on coastal mudflats (Sorensen 1964; Merton 1970). On Snares Is, recorded in shallow water and on supralittoral rock platform in cove, as well as in *Olearia* forest and swampy or grassy clearings within it (Horning & Horning 1974).

Usually forage near edge of water or in shallow water, mainly in tidal estuaries and harbours. Appear not to forage at high tide. Prefer exposed sandy substrates on intertidal flats, banks and beaches; also soft mud; often with beds of eelgrass *Zostera* or other seagrasses; in Westernport Bay, Vic., mudflats had 10–15% coverage of eelgrass (Thomas 1968; Dann 1979; Garnett 1989; Morris *et al.* 1990; Peter 1990; Thompson 1993; Vic. Atlas). Occasionally, forage among mangroves (Ewart 1973), and on coral reefs among rubble, crevices and holes in reef-flat (Domm & Recher 1973). Seen feeding on rocky shore platform and in *Olearia* forest (Horning & Horning 1974). Rarely forage in grassy areas. In NZ, in Firth of Thames and Kaipara, a few feed in wet grasslands and farmlands where they also roost (A. Riegen; S. Davies). Recorded roosting on sandy beaches, bars and spits; near-coastal saltmarsh; and at edge of water in sheltered bay (Ewart 1973; Garnett 1989; Morris *et al.* 1990; Vic. Bird Rep. 1986; Lane).

**DISTRIBUTION AND POPULATION** Breed n. Scandinavia, Russia and nw. Alaska. In n. Sweden, between Konkama and Lanio Rs; in ne. Norway and n. Finland between 69° and 70°N, from s. Fennmarksvidda, E through L. Inarijarvi to Pasvikelv R. In Russia, breed in several isolated areas: central and s. Kola Pen., s. Kanin Pen., s. Yamal Pen., s. and central Taymyr Pen. (with occasional records in N) E to Khatanga R. area, Yana R. E to delta of Kolyma R., round Chaun Gulf and in lower Anadyr R. area, Chukotka. Also breed Alaska, from



w. Seward Pen., round Wales, N and E to Pt Barrow, and S to delta of Yukon R. In w. Europe, most spend non-breeding period in Germany, Netherlands, British Isles, with few elsewhere along Atlantic coasts of France and Iberian Pen.; rarely in inland Europe (S of breeding range) and round Mediterranean. In Africa, most round Atlantic coasts between sw. Morocco and Guinea-Bissau, especially Mauritania; smaller numbers round coasts of Gulf of Guinea and Namibia and w. Cape Province. Rare inland records, between Nigeria and Sudan, and in SE, from Kenya to s. Africa. Mainly passage migrant round coasts of Indian Ocean, but small numbers in n. Somalia and round Red Sea. Occasionally Arabian Pen. and Persian Gulf, E to Pakistan and w. India; rarely inland. Passage migrant through ne. Asia, in e. China, Korean Pen. and Japan; some spend non-breeding season from se. China, S to Indonesia, and W to Thailand, and E into sw. Pacific Islands, E through Micronesia, to Fiji, and uncommonly to Samoa and Niue; some are passage migrants through these regions. A'asia, including widespread but sparse records in New Guinea. Vagrant to Pacific and Atlantic coasts of North America, Iceland, Faeroes, Spitsbergen, e. Europe, Mediterranean coasts, Madeira, Sri Lanka and Maldives (Dement'ev & Gladkov 1951; Ali & Ripley 1980; AOU 1983; de Schauensee 1984; Coates 1985; Pratt *et al.* 1987; AWB 1993; BWP).

**Aust. Qld, NSW, Vic.** Scattered records in Gulf of Carpentaria; widespread Torres Str.; recorded Iron Ra. Widespread along e. and se. coasts, including offshore islands, S from Cooktown to Port Phillip Bay; less so W of Bellarine Pen. Few inland records in NSW and Vic.: E of Great Divide, records include 30 km N of Walcha, and L. Bathurst; W of Great Divide in NSW, a few records from Darling R. and its tributaries, but also Riverina, including Fivebough and Nericon Swamps, and Tocumwal; Canberra; in Vic., inland records from L. Albacutya, L. Woorinen, wetlands between Swan Hill

and Kerang, and Whingee Swamp, N of Bendigo (Roberts 1975; Morris *et al.* 1981; Favaloro 1982; Draffan *et al.* 1983; NSW Bird Reps; Vic. Bird Reps; Vic. Atlas; Aust. Atlas). **Tas.** Occasionally on King I. and Furneaux Grp. Scattered records on n. and e. coasts; mostly in SE, between Orford and Southport Lagoon; few records from w. coast include Bond Bay, Davey Head, Macquarie Heads and Strahan. Recorded inland at Oatlands (Green 1969; Green & McGarvie 1971; Thomas 1970a, 1979; Newman *et al.* 1984; White 1985; Tas. Bird Reps). **SA** Rarely recorded in SE, e.g. round Port MacDonnell, Beachport (SA Bird Rep. 1970-71; Aust. Atlas); not recorded during regular surveys in SE between mouth of Murray R. and Vic., 1982-83 (Bransbury 1985). Mostly recorded round coasts from L. Alexandrina to Denial Bay (Eckert 1974; Aust. Atlas). **WA** Widespread round coasts, from Eyre Bird Observatory to Derby. Elsewhere in Kimberley Div., few scattered records in N and NW (Aust. Atlas). Single, L. Gregory, late Aug. 1986 (Jaensch & Vervest 1990). **NT** In Top End, from Darwin and Melville I., E to Alligator R. and Croker I.; also in Gulf of Carpentaria, round Gove Pen., Groote Eylandt, Numbulwar and Sir Edward Pellew Grp; six recorded Alice Springs (Boekel 1976; Schodde 1976; Storr 1977; Aust. Atlas; H.A.F. Thompson & D.K. Goodfellow).

**NZ NI** Widespread along coast from Parengarenga Harbour, S through Firth of Thames and Bay of Plenty to Waipatu R.; on nw. coast, recorded on Ninety Mile Beach, and harbours S to Manukau Harbour. Scattered records on E. Coast and Hawke's Bay, mainly between Mahia Pen. and Whakaki Lagoon, and round Napier; also at Blackhead and Porangahau R. estuary. Occasional records Wairarapa, including L. Wairarapa. Widespread from Waikanae, N to round mouth of Waitotara R.; also along n. coast of Taranaki, N from New Plymouth. Also recorded at Kawhia and Aotea Harbours. Recorded inland at L. Rotorua. **SI** In Nelson, occur widely



Farewell Spit, Golden Bay and Tasman Bay. Occasionally Marlborough, round Havelock and L. Grassmere. Scattered records along coast of Canterbury, mainly from n. Pegasus Bay to L. Ellesmere, and occasionally round Wainono and Washdyke Lagoons. Round Otago Pen. In se. Otago and Southland, between Inch Clutha and Riverton; also on Ruapuke and Stewart Is. On w. coast, once recorded S of Haast, but mostly between Okarito and Karamea. Inland records include junction of Rakaia and Wilberforce Rs, L. Wanaka, Te Anau and Dipton (Stidolph 1954; Wright 1969; Child 1973; Sibson 1975; CSN; Oliver; NZ Atlas).

**Christmas I.** Listed by van Tets (1983) as a regular migrant; Stokes (1988) mentions 'a record in October 1963'.

**Norfolk I.** Regular migrant (Schodde *et al.* 1983).

**Lord Howe I.** Regular migrant (Hindwood 1940; Hutton 1990).

**Kermadec Is** Common passage migrant to Raoul I. (Sorensen 1964).

**Chatham Is** Regular summer visitor (Archev & Lindsay 1924; Freeman 1994).

**Macquarie I.** Single, specimen, 20 Oct. 1912 (Falla 1937); single, specimen, 20 Dec. 1951 (Lindholm 1952).

**Snares Is** Six, Nov. 1985; one, Nov.–Dec. 1987 (P.M. Sagar).

**Auckland I.** Unknown number, 1972–73 (Yaldwyn 1975); one or two, 8 Dec. 1976 (Penniket *et al.* 1986).

**Campbell I.** Two, 1906; single, 14–23 Dec. 1941; single, specimen, 27 Nov. 1943; single, 1–22 Dec. 1945; single, specimen, 12 Oct. 1946; two (including one specimen), 12 Oct. 1946; one or two, 12–14 Nov. 1947; single (unconfirmed), 28 Jan. 1960 (Bailey & Sorensen 1962).

**Populations Aust.** Estimated at 165,000 (Watkins 1993). Totals for summer and winter counts, 1986–91, summarized in Table 1 (Hewish 1986, 1987a,b, 1988, 1989a,b, 1990a,b; Anon. 1992a; Naismith 1992). Sites of significance and maximum or average counts for summer and winter surveys round Aust., 1981–85, were: Roebuck Bay, WA, 65,000; Eighty Mile Beach, WA, 34,300; Hervey Bay–Great Sandy Strait, Qld, 7700; Corner Inlet, Vic., 7300; Moreton Bay, Qld, 6300 (cf. 10,500 counted 18–28 Mar. 1989; Thompson 1993); se. Gulf of Carpentaria, Qld, 2210; n. coast of NSW, 1830; estuary of Hunter R., NSW, 1300; Gulf St Vincent, SA, 1240; Broad Sound and Shoalwater Bay, Qld, 1070 (Lane). Other sites of national importance: Mackay area, Qld, 2963 (AWSG); Elcho I., NT, 2302 (Lane 1988); Darwin area, NT, 2200 (Hewish 1988). **NZ** Totals for summer and winter counts, 1983–92, summarized in Table 2; mean total summer count: NI, 57,490 (sd=5944); SI, 28, 271 (sd=3647) (OSNZ Nat. Wader Count; P.M. Sagar). Sites of importance, with mean summer counts (n=10 summers) were: **NI** Parengarenga, 3717 (1441; 384–5200); Rangaunu, 3975 (2153; 500–7850); Whangarei Harbour, 3224 (1563; 1258–7245); Kaipara Harbour, 10,381 (3204; 2456–14,507); Manukau Harbour, 15,534 (4133; 10,693–22,571); Firth of Thames, 6479 (2672; 4314–12,264); Kawhia Harbour, 3693 (879; 2400–5350); Tauranga Harbour, 5105 (835; 3850–6900). **SI** Ohope–Ohiwa, 3952 (549; 3200–5000); Farewell Spit, 13,557 (2639; 8130–17,181). Other important sites (counts of  $\geq 4500$  birds; CSN 19–39) include: Bay of Plenty (including Tauranga Harbour), c. 12,500, mid-Jan. 1978 (CSN 25); Karaka, 4 Dec. 1983, 9000 (CSN 32); Access Bay, 23 Sept. 1981, 20 Nov. 1983, 8000 (CSN 30, 32); Mangere Sewage Farm, 2 Dec. 1990, 7500 (CSN 39); Tasman Bay, Dec. 1989, 6882 (CSN 38); Sulphur Pt, Bay of Plenty, 3 Dec. 1978, 6000+ (CSN 26); Pukorokoro Ck, 9 Feb. 1986,

Table 1

Year	Summer Total	No. Sites	Winter Total	No. Sites
1986	20,670	23	3416	23
1987	23,368	22	3831	23
1988	23,489	23	4092	23
1989	24,514	22	6812	21
1990	21,375	21	3793	21
1991	15,268	21	–	–

Table 2

Year		Winter Total	No. Sites	Summer Total	No. Sites
1983	NI	–	–	57,155	31
	SI	–	–	15,484	43
1984	NI	6187	42	54,767	44
	SI	2885	68	28,194	73
1985	NI	4648	60	58,700	79
	SI	2544	83	24,129	65
1986	NI	6973	91	53,758	75
	SI	2637	77	23,551	73
1987	NI	4458	66	58,623	54
	SI	1997	53	28,809	63
1988	NI	10770	58	71,401	65
	SI	5731	66	30,370	54
1989	NI	10889	56	52,516	30
	SI	6281	65	32,603	56
1990	NI	9967	34	47,919	31
	SI	5927	49	34,631	40
1991	NI	7267	33	61,822	37
	SI	4962	47	24,244	35
1992	NI	8156	45	58,235	34
	SI	3515	52	27,904	44
1993	NI	8879	43	–	–
	SI	5195	42	–	–

6000 (CSN 34); Port Whangarei, 2–3 Jan. 1991, c. 5500 (CSN 39); Paua, 24 Oct. 1986, 5 Nov. 1984, 5000 (CSN 33, 36); Tapora, 2 Mar. 1991, c. 5000 (CSN 39); Southland lagoons, 30 Dec. 1978, 4925 (CSN 26).

In NZ, once legally shot and much hunted, but protected since 1941; some illegal shooting persists (Stidolph 1954; Sibson 1975; CSN 31). Formerly important food for Maori (Oliver).

33S115E	10	U	U	43	11724	13	ABBBS
32S115E	12	U	U	41	11446	11	ABBBS
33S151E	03	J	M		11085	360	ABBBS
61N16W	07	P	U	11	10593	217	BBL
18S122E	03	1	U	63	10201	15	ABBBS
20S118E	11	2+	F	18	9929	13	ABBBS
17S122E	09	2+	U	21	9794	6	ABBBS
19S121E	04	2+	M		8356	13	ABBBS
33S151E	03	2+	F	13	8065	339	ABBBS
33S151E	03	1+	F	13	8065	339	ABBBS
33S151E	03	1+	F	13	8065	339	ABBBS
33S151E	03	2+	F	13	8065	339	ABBBS
18S122E	04	2+	F		6141	357	ABBBS
19S121E	04	2+	F		5642	1	ABBBS
19S121E	04	2+	U		5642	1	ABBBS
19S121E	04	2+	M	24	5638		ABBBS
19S121E	04	1	M	24	5612		ABBBS
19S121E	04	2+	M		5564		ABBBS

19S121E	04	2+	U	24	5564	ABBBS
19S121E	10	3+	U	53	5544	ABBBS
19S121E	10	3+	U	5	5544	ABBBS
18S122E	03	2+	U		5503	359 ABBBS
18S122E	09	2	M	43	5500	359 ABBBS
18S122E	04	1	U	48	5500	359 ABBBS
18S122E	10	3+	U	6	5500	359 ABBBS
18S122E	10	3+	U		5479	359 ABBBS
18S122E	03	1	U	48	5474	359 ABBBS
18S122E	04	1	U	48	5474	359 ABBBS
18S122E	03	1	U	36	5429	359 ABBBS
18S122E	09	U	U	79	5410	359 ABBBS
22N114E	09	1	U	6	4591	168 BTO
38S146E	03	2	F	30	2532	95 ABBBS
27S153E	05	1+	U	10	2302	123 ABBBS
32S151E	12	1+	U	22	2191	109 ABBBS
27S153E	09	1+	M	12	764	194 ABBBS
32S151E	12	1+	U	7	632	15 ABBBS
20S118E	04	1	U	23	276	67 ABBBS
18S122E	04	1	U	54	177	218 ABBBS

**MOVEMENTS** Migratory; breed n. hemisphere, moving S for boreal winter. Populations of nominate *lapponica* move to non-breeding areas on North Sea and coasts of Europe and Africa, and in smaller numbers to coast of Arabian Sea as far E as Bombay, India; populations of subspecies *baueri* and *menzbieri* move to non-breeding areas from se. Asia to Aust., NZ and Pacific islands (Ali & Ripley 1980; AOU 1983; Hayman *et al.* 1986; Pratt *et al.* 1987; BWP). Rest of account refers to subspecies *baueri* and *menzbieri*. Morphometrics and band-recoveries suggest that birds in nw. Aust. breed central n. Siberia (subspecies *menzbieri*); and that birds in NZ and se. Aust. are from populations that breed farther E, in Siberia and Alaska (subspecies *baueri*), though there appears to be overlap in their breeding ranges in Siberia (Barter 1989a; Lane; see Banding, Geographical Variation).

Probably undertake long non-stop flights (Barter & Hou 1990; Lane). Flight-speed at least 70–80 km/h (CSN 38). Fly by day and night (e.g. CSN 26). Many records from NZ of birds moving in flocks, often in hundreds and sometimes thousands (e.g. CSN 4, 5). On 31 Oct. 1979, single Godwit flew past ship 11.5 miles S of Raoul I., Kermadec Is, heading S (Jenkins 1980). Often migrate just offshore, though several records of overland flights, many along rivers and over lakes; also over cities (McKenzie 1967; Child 1973; Hayman *et al.* 1986; CSN 39).

**Departure** Leave Alaska, Aug. (Oliver); e. Siberia and islands of Bering Sea, July–Aug. and Sept. (see Dement'ev & Gladkov 1951). After breeding, move rapidly S to moulting sites on coast (Hayman *et al.* 1986). Migrate on broad front. Common migrant w. Kamchatka and Sakhalin, late July to early Sept. (P.S. Tomkovich). At least some from central n. Siberia (nw. Aust. non-breeding population) probably move S along e. Asian coast (Barter 1989a; see Banding and Colour-marking). Uncommon transient e. China; juveniles arrived Hebei Province, ne. China, Sept. 1986; first arrived Jiangsu Province, Aug. 1991 (la Touche 1931–34; de Schauensee 1984; Parish *et al.* 1987; Hui 1992). Peak passage in Hong Kong, about mid-Sept. (Chalmers 1986). Considered uncommon to scarce in Taiwan, Vietnam, Thailand and Malaysia (la Touche 1931–34; Wildash 1968; Glenister 1971; Lekagul & Round 1991), though large numbers recently recorded in latter two countries (Starks 1987; Lane & Mundkur 1992). Pass

through Philippines, e.g. arrived Olango I., Aug.–Oct. 1989 (Magsalay *et al.* 1990; AWB 1993). Small numbers recorded passing Borneo from Sept. (see Smythies 1981). Common Sumatra, where recorded from July (van Marle & Voous 1988). Pass through Wallacea; dated records, from Oct. (White & Bruce 1986).

First arrive nw. Aust., Aug. (Lane) with numbers increasing till mid-Nov. (Aust. Atlas). Juveniles appear to reach nw. Aust. in Oct. (Barter 1989b). Small numbers move S from nw. Aust., apparently down w. coast, arriving sw. Aust. as early as late Aug.; at tidal sites, however, usually arrive mid-Oct. to mid-Dec.; numbers at sites in sw. Aust. vary from year to year (Carter 1904; Ford 1957, 1965; Bailey & Creed 1993; Alcorn 1992; Lane). Some apparently move as far as se. WA, with passage noted at Eyre, mainly late Sept.–Dec. (Dymond 1988; Hooper & Wells 1989b; Congreve & Congreve 1982).

Breeders from far e. Siberia and Alaska may generally migrate S via trans-Pacific route (Barter 1989a). Migrate along Bering Sea coast of Alaskan Pen. and through Aleutian and Pribilof Is (AOU 1983). Many apparently pass through Ussuriland late July to early Oct. (P.S. Tomkovich), and Japan, Sept.–Oct. (Dement'ev & Gladkov 1951), before crossing Pacific. Common passage migrant Korea, mainly Sept.–Oct. (Gore & Won 1971). In Pacific, uncommon on Niue and apparently rare but regular transient through Hawaiian Is, and Kure and Midway Atolls (AOU 1983; Pyle 1984; Pratt *et al.* 1987). Arrive Gilbert and Ellice Is about mid-Oct. (Child 1956). Common throughout Micronesia and Fiji, where numbers increased above wintering levels before end Aug. (Smart 1971), during second half of Sept. at Suva Pt (Skinner 1983). Less common farther E in Samoa, where small rise in numbers on Ontong Java, June–Oct. 1970 (Bayliss-Smith 1972; Pratt *et al.* 1987). Regular Kermadec Is, particularly during s. migration (Falla *et al.* 1981; Oliver). Generally uncommon New Guinea, apparently moving N to S, particularly in SE; in Port Moresby district, usually arrive late Aug. (Beehler *et al.* 1986; Hicks 1990). Common passage migrant through Torres Str. (Draffan *et al.* 1983) but apparently do not pass through Gulf of Carpentaria (Garnett 1989). Many remain in ne. Aust. (e.g. Draffan *et al.* 1983), though hundreds to thousands recorded Vic. (Vic. Atlas). Arrive e. Qld by early Aug., with temporary influxes on e. coast till Nov., suggesting birds move S down coast; numbers at most sites in se. Aust. increase late Sept.; arrive at one site in SA, late Aug.–Nov. (Amiet 1957; Alcorn 1988; Lane). Inland records, Oct.–Dec. suggest some passage overland (Thomas 1970b; Favaloro 1982; Aust. Atlas). Juveniles appear to reach se. Aust. in Oct. (Barter 1989b). Regular to Tas.; usually arrive Ralphs Bay, end Aug. to mid-Oct. (Wall 1953; Alcorn 1988), late Sept. to mid-Nov. (Thomas 1968), though timing and numbers arriving may vary between years (Wall 1953).

Arrive Norfolk I. and Lord Howe I. from Sept. (Schodde *et al.* 1983; Hutton 1990), and late Aug. to Oct. in NZ (Stidolph 1954; CSN 39) with flocks arriving at s. SI till Dec. (Moncrieff 1929; Stidolph 1954; CSN). Birds flagged Firth of Thames or Kaipara, NZ, sighted Farewell Spit on n. migration (P. Battley), indicating that some birds staging in N continue through to SI (S. Davies). Regular E of NZ on Chatham Is and straggle S of NZ to Snares, Auckland, Campbell and Macquarie Is (Falla 1937; Lindholm 1952; Horning & Horning 1974; Falla *et al.* 1981).

**Non-breeding** Range extends S from se. China, including s. half of New Guinea and sw. Pacific islands (la Touche 1931–34; Lane). In Aust., mainly along e. and s. coasts as far

W as Gulf St Vincent, SA, and from nw. Aust., E to at least Darwin. No movement recorded between se. and nw. Aust., with high fidelity to non-breeding site apparent in both areas, though birds known to move from e. Aust. to NZ between seasons (Barter 1989a,b; Lane; see Banding). Numbers stable at most coastal sites in e. Aust., Dec.–Feb. (Lane), Oct.–Feb. (Alcorn 1988), but at some sites substantial local movement apparent, including significant numbers leaving then returning mid-Nov. to mid-Feb. (Alcorn 1988, 1992).

In NZ, mainly on NI in Far North, Northland, Auckland, South Auckland and Bay of Plenty regions; also on SI, particularly in N (e.g. Nelson), but as far S as Stewart I. where thousands may occur (Moncrieff 1929; Stidolph 1954; Sagar 1992). Some evidence for high site-fidelity within non-breeding period (e.g. CSN 33). Numbers at some localities stable for most of period (e.g. CSN 3), but decrease at some localities during summer as birds move to other estuaries (e.g. Heathcote Avon Estuary, CSN 37). Movements between e. and w. coasts of NI recorded (McKenzie 1967). Fly up to c. 20 km from feeding to roosting site, sometimes even overland (Anon. 1910; Stidolph 1954; Amiet 1957; McKenzie 1967; Crawford 1972; Oliver). Pre- and post-migratory restlessness includes circling, massed erratic flights and calling (Watt 1947; Stidolph 1954; McKenzie 1967; CSN 20, 24).

**Return** Leave some sites in SI, NZ, Feb. (Stidolph 1954), though recorded leaving s. SI, Mar. and Apr. (Moncrieff 1929; CSN 20, 38). In nw. SI, flocks appear late Feb. and Mar. (at Nelson Haven influxes of 5–600 birds occur overnight), stay for short period, then fly out to sea. Suggested that birds from SI leave directly from Farewell Spit, without staging in NI (Moncrieff 1929; Hawkins 1980; S. Davies; CSN 25, 35), but influxes in s. NI in Feb. and Mar., and observations of birds flying N along e. coast, suggest at least some SI birds move through NI (Cunningham 1957; CSN 26, 30). Pass through, then leave, Auckland district, Mar. and Apr. (Stidolph 1954; McKenzie 1967). Leave North C. and other locations in far n. NZ between Feb. and Apr.; at some sites in N, high numbers occur before migration (Anon. 1910; Watt 1947), e.g. late Mar. to mid-Apr. at Paua (CSN 25). In Mar., flocks seen flying N over sea from NI (CSN 3; Oliver). Largest flocks occur on Lord Howe I. in Mar. when birds begin leaving (Hutton 1990).

In e. Aust., leave Ralphs Bay, Tas., between end Feb. and mid-Apr., with evidence that some move to Sorell 4–5 weeks before start of n. migration (Thomas 1968; Alcorn 1988). Numbers decline slowly at most sites on e. coast, generally early Feb. to mid-Apr. Temporary influxes occur at some sites on e. coast in Mar. and early Apr. (Alcorn 1988; Lane); in 1989, at Moreton Bay, Qld, spatial segregation of ages and sexes was apparent during period of n. migration, with evidence of more birds staging on nearby islands than mainland (Thompson 1990). Count results suggest s. birds probably do not touch down in n. Aust. (Alcorn 1988 *contra* Starks & Lane 1987) and, as departure weights are greater in se. than nw. Aust., possible that birds may fly non-stop from se. Aust. to mainland Asia (see Barter & Hou 1990). Lack of band-recoveries and sightings of colour-marked birds S of Korea and Japan suggest at least some birds from se. Aust. and NZ cross Pacific to Korea and Japan, some then continuing N along e. coast of Asia. Single recovery indicates some NZ birds move via Bering Is (see Banding and Colour-marking).

Influx to tidal sites occurs sw. Aust., late Feb. to mid-Mar., birds then leaving mid-Mar. to late Apr. (Alcorn 1992). Many birds from farther S do not seem to pass through Darwin or nw. Aust. (Lane) and birds from nw. Aust. probably use

different routes to reach Asian mainland than those used by se. Aust. and NZ birds (Barter 1989b). Leave nw. Aust. in first weeks of Apr. (Lane) and probably fly non-stop to China (see Barter & Hou 1990).

Extraliminally, usually leave Port Moresby district, PNG, in Mar. (Hicks 1990). In Pacific Ocean, high numbers recorded during period of n. migration in Fiji (Smart 1971; CSN 1); leave Pacific islands, Mar. and Apr. (Child 1956; Bayliss-Smith 1972; Watling 1982; Skinner 1983). Influx to Olango I., Philippines, in Mar. 1989 (Magsalay *et al.* 1990). Dated records indicate passage through Wallacea, Mar. and May (White & Bruce 1986). In Asia, not recorded Borneo or Sumatra after Apr. (see Smythies 1981; van Marle & Voous 1988); influx in Apr. at Klang Is, Pen. Malaysia; small passage at Red R. Delta, Vietnam, in Mar. (AWB 1993). Peak passage in Hong Kong, about mid-Apr. (Chalmers 1986). Birds from nw. Aust. pass through China; peak passage through Beidaihe, late Apr. to early May (AWB 1993; see Banding and Colour-marking). Numbers passing Korea in Apr. include birds from e. Aust. (Gore & Won 1971; see Banding and Colour-marking). Birds from NZ and e. Aust. known to mix in Japan, where much more numerous on n. migration, and generally occur from mid-Apr. (see Dement'ev & Gladkov 1951; AWB 1993; see Banding and Colour-marking). Small numbers move along coastal Ussuriland in late Apr.–May (P.S. Tomkovich). Occur on: s. Sakhalin, May; w. Kamchatka, May to early June; Commander and Pribilof Is, May and June. In Siberia, arrive n. and ne. Chukotka, ne. Yakutia and Anadyr Territory in late May (Kondratiev 1982; Dement'ev & Gladkov 1951); arrive Alaska, May and early June (Oliver).

**Breeding** Many remain in non-breeding range all year (Hayman *et al.* 1986). Many young, non-breeding birds winter in Aust.; reporting rates 3.7% in summer and 1.5% in winter (Aust. Atlas); c. 17% of Nov.–Feb. population present in winter at many sites (Alcorn 1992), though at some sites proportion varies from year to year (Amiet 1957). In e. Aust., wintering numbers stable by Mar. and late Apr. (Alcorn 1988). High numbers recorded nw. Aust.; some occur Darwin during winter (e.g. Hewish 1989a; Hooper & Wells 1989a). Most move N from s. coast and Tas. during winter (Lane; Aust. Atlas), though recorded as far S as sw. WA (e.g. Hewish 1990b), Vic. (Vic. Atlas) and Tas. (Thomas 1968); influxes occur June and July in e. Qld and Darwin (Lane). Wintering numbers stable at most sites on e. coast, indicating lack of widespread movement (Alcorn 1988); during winter, however, Tas. birds tend to move from locality to locality (Thomas 1968). Small numbers winter on Lord Howe I. (Hutton 1990). Commonly winter on NI and SI of NZ, often in large numbers (Cunningham 1957; CSN 5). Wintering numbers at some localities vary from year to year (e.g. Firth of Thames and Manukau, McKenzie 1967). In Tauranga Harbour numbers stable during winter but almost completely gone by Aug. (CSN 5); at other localities, numbers in winter vary considerably, e.g. Parengarenga Harbour, Nelson Haven (Stidolph 1954; Hawkins 1980).

**Banding and Colour-marking** Birds banded in nw. Aust. recovered e. China (n=15), Sakhalin (n=1) and central n. Siberia (n=2); two birds recovered in China 11 and 12 days after being banded in nw. Aust. One banded Hong Kong recovered in nw. Aust. Birds banded in sw. WA recovered in central n. Siberia (n=2). Birds banded in e. Aust. recovered NZ (n=1), South Korea (n=1) and e. Siberia (n=1). One bird banded NZ recovered on Bering I., Russia; one banded at Jordan's Farm, Kaipara Harbour, NZ, recovered L. Bolshoe

(52°30'N, 156°23'E), sw. Kamchatka Pen.; and one banded on Pribilof Is, Alaska, recovered in NZ (Barter 1989a,c; ABBBS 1992, 1993; Riegen & Davies 1993; A. Riegen). Single colour-marked bird at S. Kaipara, NZ, in Dec. 1991 was seen in Japan in Apr. 1992 associating with birds colour-marked in Qld and Vic. (Riegen 1992). Birds colour-marked Vic. also sighted NI, NZ (n=2; possibly same bird) (Minton 1993). Bird colour-marked Qld, sighted NZ (Anon. 1992b); bird banded 3 Mar. 1993 in Qld killed on a powerline in Tamaki Estuary, Auckland, NZ, 7 Mar. 1994 (A. Riegen). All Aust. retraps close to banding location (Barter 1989b) with one recovery of a young bird in Vic., representing movement of 60 km ESE, within non-breeding season (Anon. 1983).

**FOOD** Mainly carnivorous: worms, molluscs, crustaceans, insects and some plant material; also extraliminally, fruits, fish and tadpoles; mainly insects on breeding grounds (BWP). **Behaviour** Time of feeding varies with tide and time of year. Outside region, feed mainly during day on either side of high tide, but during full moon and mid-winter feed at night (BWP). In Apr. in Westernport Bay, Vic., feed for 5.5 h of tidal cycle, i.e. almost entire time feeding grounds were exposed (Dann 1979). Feeding style more active than Black-tailed Godwit, and possibly use sight more to locate prey. Probe in mud, often in water up to 15 cm deep; probe vertically, rotating head slightly as bill pushed into substrate (Evans 1975). Also use shallow sewing-machine action, and mowing action similar to that of Common Redshank *Tringa totanus* (moving head from side to side with tip of bill just touching mud and lower mandible vibrating to disturb prey). Sometimes glean from surface of substrate (BWP). Observed raking muddy sand with feet (Howell & Harrison 1981); also fluttering above breaking waves taking unidentified prey from surface of water (Dale 1988). On Heron I., seen feeding on insect larvae among roots of *Casuarina* in area disturbed by the digging of turtles. On Heron I., on wet sand, search-rate 110–130 paces/min; on this substrate males, which have shorter bills, probe more and are more successful than females: c. 14 probes/min with 7 items/min captured compared with c. 6–7 probes/min with 3 items/min captured (Evans 1975). In Westernport Bay, stealing of food by Silver Gull *Larus novaehollandiae* reduces feeding rate of Bar-tailed Godwits from 71.8 probes/100 s with 8.0 items ingested/100 s to 37.0 probes/100 s with 5.1 items ingested/100 s (Dann 1979).

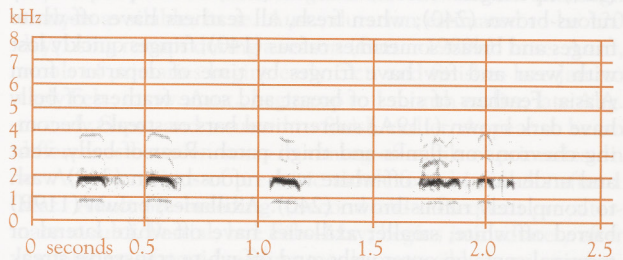
**Adult** Plants: sds; Poaceae lvs (Cleland 1911). Animals: Annelids (FAB); Polychaetes (Lane); Spionidae: *Nerinides* (Evans 1975); Oligochaetes (Cleland 1911); Crustaceans: crabs (photo in Pringle 1987); *Macrothalmus laterfrons* (Dann 1979); Insect larv.: Lepidoptera (Evans 1975); Noctuidae. Shell fragments (Cleland 1911).

**Intake** On Heron I., 3–7 polychaetes ingested/min (Evans 1975) and in Westernport Bay 2.1–2.8 items ingested/100 s (Dann 1979). In Holland seen taking on average 3 items/min, i.e. 189–216 g wt per low-tide feeding period. In English estuaries estimated to take 97 kcal of polychaetes plus 148 kcal bivalves and are calculated to have BMR of c. 34.3 kcal/day (BWP).

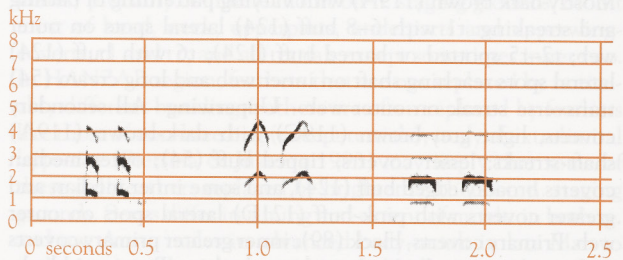
**VOICE** No detailed studies (BWP). Generally quiet in HANZAB region. In flocks, give contact and alarm calls when feeding and, especially, when flushed. For more details see BWP, Glutz von Blotzheim *et al.* (1977); additional sonagrams in Bergmann & Helb (1982), and Byrkjedal *et al.* (1989).

**Adult** Contact call, a sharp *kerk* or *kerk-kerk*; sometimes

with faster more rippling variant (sonagram A); lasts c. 130–150 ms, often in couplets, with four obvious harmonics to each call, second most strongly stressed, at c. 2 kHz. Each call rises quickly in pitch to a crescendo, then stable or falls slightly, before abrupt fall, which produces a symmetrical pattern. The last example in the sonagram is the more rippling form of the call. Sonagram B is a composite, to compare the calls of the three godwits in the HANZAB region.



A R. Swaby; Cairns, Qld, Mar. 1974; P36



B Calls of Black-tailed Godwit, Hudsonian Godwit and Bar-tailed Godwit; see accounts of each species for details

**PLUMAGES** Prepared by R.P. Scofield and D.I. Rogers. First migrate S in distinctive juvenile plumage. Delay partial first pre-basic moult to first immature non-breeding till near or at non-breeding areas. Usually remain in non-breeding areas through first austral winter, with partial first pre-alternate moult sometimes bringing on subdued breeding appearance. Adult (non-breeding) appearance attained with complete second pre-basic moult, about Aug.–Sept. of second year. Thereafter, two moults annually: partial pre-alternate to (sexually dimorphic) breeding plumage just before n. migration, and complete pre-basic to non-breeding, just after s. migration. First breed when at least 2 years old. Subspecies *baueri* (NZ and e. coast Aust.) described below.

**Adult male breeding** (Second and subsequent alternate). First attained at end of second austral summer. **Head and neck** Crown and centre of forehead, black-brown (119), broadly and evenly streaked by rufous-brown (240) edges to feathers. Often have prominent white spot above and in front of eye. Rest of supercilium, rufous-brown (240), bordered below by thin black (89) loreal stripe, which becomes a broad dark smear on central and lower ear-coverts. Rest of ear-coverts, rufous-brown (240). Cheeks, cream (54) with varying rufous-brown (240) wash; sometimes uniform rich rufous-brown (240). Chin, white next to bill; rest, rufous-brown (240). Throat, nape and neck, rufous (c140). **Upperparts** Mantle, upper back and scapulars, black-brown (119), mottled or streaked by uneven rufous-brown (240) fringes to feathers (which are often broken into 2–3 terminal spots); feathers can be narrowly tipped white. Lower back, dark brown (119A) with narrow white fringes at tips of feathers. Rump and shorter



uppertail-coverts, white, heavily barred and speckled dark brown; feathers, black-brown (119) basally, with pair of broad buff (124) or white lateral spots (often meeting at shafts to form subterminal band), broad brown (119B) terminal bands, and narrow white fringes at tips. Longer uppertail-coverts, buff (124) to white with series of inverted black-brown (119) rosethorns that become dark brown (119A) near tip; final, subterminal rosethorn edged rufous-brown (240); broad buff (124) tip fringed with rufous-brown (240). **Underparts** Mostly rufous-brown (240); when fresh, all feathers have off-white fringes and breast sometimes rufous (140); fringes quickly lost with wear and few have fringes by time of departure from A'asia. Feathers of sides of breast and some feathers of belly have dark brown (119A) subterminal bars or streaks, becoming chevrons on flanks and thigh-patch. Rear of belly, vent and undertail, vary: off-white with rufous-brown (340) wash to completely rufous-brown (240). Axillaries, brown (119B) barred off-white; smaller axillaries have off-white lateral or terminal spots on outer webs, and off-white transverse streak on inner web, and barring is sometimes broken or angled. **Tail** Mostly dark brown (119A) with varying patterning of barring and streaking: t1 with 6–8 buff (124) lateral spots on outer web; t2–t5 spotted or barred buff (124); t6 with buff (124) lateral spots reaching shaft on inner web and long cream (54) transverse streak on outer web. **Upperwing** All secondary coverts, light grey-brown (119C) with dark-brown (119A) shaft-streaks; lesser coverts, tipped buff (54); outer median coverts broadly edged buff (124), and some inner median and greater coverts with pink-buff (121D) lateral spots on outer web. Primary coverts, black (89); inner greater primary coverts and greater secondary coverts tipped white. Remiges, black-brown with almost black (89) outer webs; basal fifth of inner webs mottled white. Secondaries and inner primaries retain broad white tips from basic plumage. Fresh (breeding) tertials, dark brown (119A) with black-brown (119) shaft-streaks and orange-buff (118) terminal spots on inner webs. Humerals, brown (119B) with complete white fringes broken by small terminal or subterminal spots with pink-buff (121D) or dull-pink (5) wash. **Underwing** Appears white heavily barred brown (cf. subspecies *lapponica*). Marginal and lesser coverts, white with broad brown (119B) bases. Primary and median secondary coverts, white with broad dark-brown (119A) submarginal bands and brown (119B) shaft-streaks. Greater coverts, light grey (85) with narrow white fringes on greater primary coverts; outer greater secondary coverts have broad white fringes (formed by white submarginal marks) and increasing white submarginal streaks and spots on inner greater secondary coverts.

**Adult female breeding** (Second and subsequent alternate). Varies, but always duller than adult male breeding and sexing usually possible in field (especially combined with longer bill of females). Usually lack all rufous tinges of adult male breeding and appear similar to adult non-breeding, differing from both by combination of: (1) feathers of crown, mantle, scapulars, tertials and upperwing-coverts have large dark centres (like adult male breeding) but with pale-cinnamon (c39) to buff (124) edges or marks; (2) tips of scapulars partly grey; (3) usually retain more grey non-breeding plumage on upperparts and upperwing-coverts than adult male, especially among scapulars; (4) uppertail-coverts barred dark and white, usually without any cinnamon or buff tinge; (5) usually have buff (54–124) to rufous-cinnamon (c39) tinge to foreneck, breast, fore-flanks and sides of neck and throat, though in some this restricted to sides of breast and fore-flanks, and in a

few, ventral ground-colour like adult non-breeding; (6) underparts and neck more extensively barred or streaked darker than adult non-breeding, with broad dark-grey streaking on foreneck and sides of neck merging to fine barring on breast, and coarser, dense dark brownish-grey barring on flanks and undertail-coverts. Some more brightly coloured, like adult male: underparts, head and neck have many rufous-brown feathers, usually lighter and more cinnamon (c240) than males but not differing in brightest birds; in general plumage has scattered off-white feathering on underparts, especially on belly, rear-flanks and lower breast; supercilium, usually off-white and upperparts similar to duller adult females. Dark barring and streaking of underparts and neck less striking than in duller females, but usually visible on breast and flanks (cf. breeding males). Such birds rarely seen in our region (e.g. Thompson 1990), but appear to be more common on breeding grounds (ZMM).

**Adult non-breeding** (Second and subsequent basic). First attained at beginning of second austral summer. **Head and neck** Forehead and crown, streaked brown (119B) and off-white. Broad white supercilium, speckled light grey-brown (119C) and bordered below by indistinct brown (119B) eyestripe extending from bill to nape. Chin, white. Throat and foreneck, off-white, with indistinct brown (119B) shaft-streaks. Ear-coverts, sides of neck, nape and hindneck, streaked brown (119B) and pale grey-brown (119C). **Upperparts** Feathers of mantle and scapulars, brown (119B), becoming light grey-brown toward edges, with black-brown (119) shaft-streaks and narrow white tips when fresh. Back and rump, as adult breeding. Uppertail-coverts, barred white and black-brown (119). **Underparts** Upper breast and upper flanks, light grey-brown (119C) with narrow white tips to feathers when fresh, and dark-brown (119A) shaft-streaks; when worn, shaft-streaks visible on sides of breast. Lower flanks, sides of vent and lateral undertail-coverts, white with some subterminal brown (119B) bars to feathers. Rest of underparts, white. **Upperwing** Like adult breeding but all secondary coverts, fresh, brown (119B) with black-brown (119) shaft-streaks and even white fringes. **Underwing** Like adult breeding but lesser and median coverts may be lighter brown (c119B).

**Juvenile** Similar to adult non-breeding in general appearance. **Head and neck** Crown, dark brown (119A) with narrow cream (54) edges to feathers. Broad buff (124) to white supercilium, indistinctly streaked brown (119B); supercilia separated on forehead by narrow dark-brown (119A) streak and bordered below by dark-brown (119A) loreal stripe, which is narrow next to bill, becoming narrower at eye and broadening and becoming brown (119B) on ear-coverts. Chin, throat, nape and neck, cream (54) with some brown (119B) shaft-streaks. **Upperparts** As for adult breeding but mantle and scapulars more neatly and boldly variegated or speckled by buff (124) edges and spots on edges of dark-brown (119A) feathers. Feathers of back, rump and uppertail-coverts, darker brown (119B) with heavy off-white barring; brown (119B) shaft-streaks; and off-white bars near tip, with rufous-brown (340) wash when fresh. **Underparts** Mostly off-white, with breast and flanks, cream (54) to buff (c124). Bases of feathers of breast have dark-brown (119A) shaft-streaks, giving mottled brown (119B) appearance with wear, especially on sides of breast. Hind-flanks and lateral undertail-coverts with 1–3 narrow brown (119B) subterminal chevrons. **Tail** As adult breeding but rectrices barred buff (124) across width of rectrix, with faint rufous-brown (340) wash. **Upperwing** Median and greater secondary coverts, dark brown (119A) with 2–3 large

buff (124) terminal spots. Lesser coverts, black-brown (119) with narrow buff (124) edges. Pattern very different from broad buff (124) fringes of nominate *lapponica* and easily distinguished in field (see Geographical Variation). Primaries and secondaries, black (89) with broader white fringes than in adult (Cronau *et al.* 1986). Tertiaries, black (89) with 4–6 large orange-buff (118) terminal spots on both webs (cf. just on inner webs in adult breeding). **Underwing** Like adult breeding but lesser and median coverts flecked with brownish grey (79) and greater coverts, light grey (86) with fewer submarginal flecks and streaks.

**First immature non-breeding** (First basic). Like adult non-breeding but retaining old, very worn juvenile feathers on back, rump, most of tail, inner upperwing-coverts and remiges till at least Mar. Back and rump almost completely brown (119B). Inner rectrices with irregular markings, like adult (not regularly barred like juvenile). Outer tertiaries old and very worn, showing traces of juvenile plumage. With wear, inner upperwing-coverts become notched at edges, with only traces of buff (54) terminal spots remaining. Contrasting worn juvenile and fresh non-breeding feathers very different from uniformly fresh adult non-breeding plumage.

**First immature male breeding** (First alternate). Do not breed in this plumage. Some (c. 10%; Barter 1990) develop varying amount of feathering like adult male breeding but can be distinguished by retained juvenile innerwing-coverts and tertiaries, which become very worn and faded (cf. adult breeding plumages). New feathers of crown, nape, hindneck and upperparts, edged paler rufous-brown (240) than in adult male breeding; breast and flanks variably mottled white and rufous-brown (240) with some subterminal brown (119B) barring to feathers on many. In general, birds in our region also have much other plumage like non-breeding (not known if this developed in first pre-alternate moult or retained from first basic). Not known if some become as colourful as extralimital *lapponica*, in which some resemble adult male breeding but have paler sides of head and neck, chin and throat, and paler edges to feathers of upperparts (BWP).

**First immature female breeding** (First alternate). Do not breed in this plumage. Ageing and extent of first pre-alternate moult similar to male. Imperfectly known in our region; probably like extralimital *lapponica*, in which duller than dullest adult female breeding, with underparts only tinged buff, and less streaking or barring.

**Second immature non-breeding** (Second basic). Like adult non-breeding (not consistently separable) but second pre-basic moult usually completed before adults return, and thus remiges and coverts generally more worn than in adults later in season.

**BARE PARTS** From photos (e.g. Farrand 1983; Pringle 1987; NZRD) and museum labels (AIM, AM, WAM, SAM, ANWC, MV, HLW). **Adult** Bill: basal two-fifths to two-thirds, pink (7); tip, black (89). In breeding plumage, upper mandible darker or, exceptionally, black (89); lower mandible, red (13) or pink (108C), especially in males. Iris, black-brown (20 or 119). Tarsi and feet vary: black (89) to grey-black (82) to black-brown (119), or, exceptionally, dark olive-brown (129). Claws, black (89). **Juvenile, Immature** Like adult; base of bill of some juveniles appears dull salmon (6), though may be because bill dirty (Farrand 1983).

**MOULTS** From published sources (Prater *et al.* 1977; Barter 1989b; Thompson 1990; BWP), 85 skins (AIM, AM, HLW,

MV, QM, SAM) and banding data (AWSG).

**Adult post-breeding** (Third and subsequent pre-basic). Complete; primaries outwards; July–late Feb. Moult of body thought to begin either at breeding grounds or while staging during s. migration. Timing may vary with sex; on arrival in se. Aust. in early Nov., males had traces of body-moult, females had none. In A'asia, moult primaries later than in Europe or nw. Africa; probably take longer to moult than the 90–116 days reported from these regions (BWP) but no thorough analysis available; in se. Aust., duration estimated to be 120 days using retraps during a season (Barter 1989b). In se. Aust., moult of primaries begins early Oct. and finishes late Jan. to early Feb.; in nw. Aust., begins up to 1 month earlier, late Aug. to early Sept., and assumed to finish earlier. Appear to be no differences between sexes in timing of moult of primaries. In se. Aust., no signs of pre-basic moult found in adults after 1 Mar. **Adult pre-breeding** (Second and subsequent pre-alternate moult). Partial, late Feb.–May; begins immediately after completion of post-breeding moult or possibly even overlapping. Begins in HANZAB region but many (especially females) probably complete moult on n. staging grounds. Moult most of head, neck, upperparts, underparts and upperwing-coverts, t1 and t2, and all tertiaries except sometimes inner two. In HANZAB region, feathers that are not replaced by noticeably different breeding feathers are often replaced by feathers like those of non-breeding (except tertiaries); study of extralimital *lapponica* (Piersma & Jukema 1993) may imply that some of these dull feathers replaced by brighter feathers on n. staging grounds. Sexes differ in timing and extent of moult: in both se. and nw. Aust., males in advanced body-moult in late Mar. to early Apr.; pre-breeding moult probably begins earlier in nw. WA (Barter 1989b). Also appears to begin early in NZ; at Farewell Spit, 10% of (unsexed) birds observed 18 Jan. 1994 were attaining reddish breeding plumage (P. Battley). For detailed study of pre-alternate moult in nominate *lapponica*, see Piersma & Jukema (1993). **Post-juvenile** (First pre-basic). Partial; mid-Sept. to Feb. Most arriving se. Aust. in Oct. still have much juvenile plumage and one in se. Qld in Dec. still in full juvenile plumage (photo in Pringle 1987). Moult head, neck, mantle, scapulars, outer upperwing-coverts, some uppertail-coverts, t1 and t2 and shorter tertiaries. **First pre-supplemental** Further study needed; as yet, only recorded in Aust., where many birds replace some or all primaries in outwards moult of primaries (Barter 1989b). In nw. Aust., c. 25% of birds in first non-breeding (first-basic) plumage were undergoing moult of primaries in late Mar.–early Apr. and c. 10% had completed moult at that time. In se. Aust. in mid-June, 63% (n=19) of first non-breeding (first-basic) females had undergone complete moult of primaries, while 36% (n=28) of males had done so. Another 11% of females and 21% of males had arrested moult after replacing inner primaries; in both sexes, 25% do not moult at all (Barter 1989b). Suggestion that more undergo this moult in nw. Aust. (Barter 1990) needs confirmation. **First immature pre-breeding** (First pre-alternate). Partial; varies; Apr.–May; in some, probably overlaps with first pre-supplemental moult. Some may complete full pre-breeding moult and appear like adults. In se. Aust. in Mar., no immatures had any breeding plumage; by mid-June, four of 28 males and one of 19 females had some breeding feathers (<10% of adults). In nw. Aust., 2% of birds in first non-breeding were showing some breeding plumage by late Mar. to early Apr. and all were males, with the most for any bird being 25% of full adult breeding plumage. About 10% attain traces of breeding plumage (Barter 1990). Not known if

there is any cryptic moult involving feathers that cannot be distinguished from non-breeding. **First immature post-breeding** (Second basic). Complete, primaries outwards, July–Oct.; may start immediately after completion of first immature pre-breeding (first pre-alternate) and first pre-supplemental moults. Those that spend breeding season in non-breeding areas start long before adults return. In nw. Aust., those that have completed partial or complete first pre-supplemental moult or have extremely worn primaries (i.e. first alternate) are in moult again as adults arrive in late Aug. to early Sept.; in se. Aust., these have almost completed moult when adults return 1 month later.

**MEASUREMENTS** Subspecies *baueri* (see Geographical Variation), from se. Aust. and NZ: (1–2) E. coastal Aust., skins (AM, HLW, MV, QM, SAM): (1) Adults; (2) Immatures with juvenile p10. (3–4) SE. Aust., mostly Vic., live (Barter 1989a; AWSG): (3) Adults; (4) Immatures with juvenile p10. (5–6) NZ: (5) Adult, skins (AIM, CM, NMNZ); (6) Ages combined, live (A. Riegen, S. Davies; NZWSG).

	MALES	FEMALES	
WING	(1) 221.5 (8.72; 201–236; 26)	230.4 (8.56; 213–242; 20)	**
	(2) 218.1 (8.23; 200–231; 20)	229.2 (9.97; 215–249; 9)	**
	(3) 224.6 (sd = 6.6)	238.7 (sd = 6.8)	**
	(4) 217.5 (sd = 6.7)	232.9 (sd = 6.2)	**
	(5) 224.5 (4.94; 217–235; 13)	236.9 (6.04; 225–248; 14)	**
TAIL	(1) 75.0 (3.31; 69–84; 26)	76.5 (5.14; 62–82; 13)	**
	(2) 74.4 (3.61; 68–79; 16)	76.4 (3.84; 70–83; 9)	**
BILL	(1) 80.4 (4.40; 73.5–94.2; 26)	105.5 (7.41; 89.7–122.4; 18)	**
	(2) 80.1 (3.42; 75.4–85.8; 20)	104.7 (4.24; 98.9–112.7; 10)	**
	(3) 82.0 (5.2; c. 340)	106.4 (6.7; c. 327)	**
	(4) 81.5 (5.6; c. 77)	106.8 (7.3; c. 52)	**
	(5) 84.7 (6.47; 74.1–94.4; 12)	106.7 (6.55; 98.0–118.8; 14)	**
THL	(6) 83.3 (6.11; 116)	108.0 (7.91; 185)	**
	(3) 118.5 (5.64; 112)	143.4 (6.83; 106)	**
TARSUS	(4) 119.3 (5.48; 48)	145.9 (6.7; 38)	**
	(1) 53.1 (2.06; 49.1–58.5; 25)	57.8 (2.15; 54.5–61.3; 13)	**
TOE	(2) 52.9 (1.69; 50.0–55.4; 16)	56.2 (1.99; 53.8–60.3; 9)	**
	(1) 34.7 (1.14; 32.6–37.6; 14)	36.9 (2.01; 33.5–39.4; 8)	**
	(2) 35.2 (1.52; 33.6–37.7; 10)	35.2 (1.26; 33.4–36.6; 6)	ns

Subspecies *menzbieri* (see Geographical Variation): (6–8) NW. Aust.: (6) Adults, skins; includes bill measurements of immatures collected after Feb. (HLW, MV, WAM). (7–8) Live, sexed using PCF (HUMPS–UV): (7) Adults (wing, n=128) (Barter 1989a; AWSG); (8) Immatures with juvenile p10 (wing, n=213) (Barter 1989a).

	MALES	FEMALES	
WING	(6) 216.7 (1.86; 215–220; 6)	215, 217, 223	ns
	(7) 219.2 (sd = 5.9)	233.2 (sd = 6.8)	**
	(8) 208.0 (sd = 6.6)	217.6 (sd = 6.2)	**
TAIL	(6) 75 (6.69; 65–79; 4)	70	
BILL	(6) 84.9 (3.67; 80.1–89.6; 8)	105.5 (6.10; 90.2–106.7; 5)	**
	(7) 86.1 (4.9; c. 306)	108.2 (5.6; c. 144)	**
	(8) 87.5 (4.1; c. 464)	109.3 (5.2; c. 219)	**
THL	(7) 125.6 (5.20; 97)	148.7 (5.20; 52)	**
TARSUS	(6) 53.0 (1.49; 51.6–55.0; 4)	51.2	
TOE	(6) 34.4	33.3	

Adult skins from breeding areas. (9–10) **Subspecies menzbieri**: (9) Yakutia (ZMM); (10) between Lena R. and

Anadyr region (Portenko 1936). (11–13) **Subspecies baueri**: (11) Coasts of Bering Sea; method of measuring wing not recorded, probably flattened chord (Portenko 1936); (12) Bering Sea coast, Alaska, N of 64°N (Rynn 1982); (13) Bering Sea coast, Alaska, S of 64°N (Rynn 1982).

	MALES	FEMALES	
WING	(9) 217.1 (5.44; 206–225; 9)	226.5 (3.67; 221–231; 11)	**
	(10) 213.9 (209–223; 8)	225.4 (218–239; 11)	
	(11) 211.9 (199–228; 17)	227.1 (216–240; 14)	
	(12) 220.7 (5.20; 210–231; 32)	234.4 (5.39; 222–244; 31)	**
	(13) 224.0 (5.57; 211–232; 24)	238.3 (8.78; 216–251; 26)	**
BILL	(9) 84.6 (3.74; 80.5–91.0; 7)	105.3 (3.46; 101.2–111; 11)	**
	(10) 83.7 (80–86; 8)	105.8 (95–110; 9)	
	(11) 79.4 (72–88; 17)	109.9 (96–116; 14)	
TARSUS	(12) 78.9 (5.07; 70.5–93.0; 31)	103.4 (5.98; 93.0–115.5; 31)	**
	(13) 85.7 (5.04; 76.5–96.5; 24)	107.2 (8.35; 86.0–119.0; 26)	**
	(9) 52.6 (1.51; 48.9–54.1; 9)	54.4 (1.32; 52.5–56.4; 11)	**
	(12) 53.5 (1.91; 50.0–58.0; 32)	59.8 (2.33; 57.0–67.0; 33)	**
	(13) 55.5 (1.83; 52.5–59.0; 25)	59.3 (2.80; 53.5–64.5; 28)	**

Females significantly larger than males, with measurements of bill and THL allowing c. 90% of individuals to be sexed with at least 95% confidence (Rogers 1984; Barter 1989a [which see for sexing criteria]); differences between males and females usually easy to see in field (Thompson 1990). In nominate *lapponica*, wing and tail of juveniles shorter than that of adults by c. 5 and c. 2 mm respectively (BWP); similar tendencies exist in Aust. birds, though probably exaggerated in wing measures from n. WA as most birds were caught Mar., when adults have fresh primaries and juvenile primaries retained in immatures are worn. Tarsus and toe similar to adult from fledging (BWP) and bill about fully grown by time young birds first reach HANZAB region; in live samples from n. WA, immatures had significantly longer bills than adults, possibly because wear of feathers on culmen greater in immatures in these (largely Mar.) samples (Barter 1989a).

**WEIGHTS** Subspecies *baueri*: (1–2) SE. Aust. (banding data, Barter 1989b; also see Rogers 1984): (1) Adults; (2) Immatures in first austral summer (most in post-juvenile body-moult).

	MALES	FEMALES	
Sept.	(1) 304.4 (45.6; 9)	362.8 (24.9; 17)	**
	(1) 266.9 (16.5; 7)	332.8 (31.5; 14)	**
Oct.	(1) 276.3 (24.6; 40)	327.0 (38.2; 28)	**
	(2) 333.3 (19.2; 12)	421.7 (52.6; 6)	**
Dec.	(1) 288.2 (21.4; 114)	344.7 (29.2; 110)	**
	(2) 295.5 (42.7; 9)	341.9 (48.9; 6)	**
Jan.	(1) 284.1 (24.3; 40)	348.9 (19.8; 23)	**
	2nd half Mar.	(1) 406.6 (63.3; 85)	503.8 (60.7; 99)
		(2) 298.8 (51.4; 16)	352.7 (17.4; 12)

Females much heavier than males, so samples of unsexed birds serve only to reveal magnitude of variation in weight, e.g. in se. Aust., unsexed adults throughout year 387.9 (100.80; 190–630; 1056) (VWSG). Only unsexed data available from NZ (A. Riegen & S. Davies, NZWSG): adults 311.9 (35.41; 205–405; 190); immatures in first year 298.9 (45.24; 230–384; 28); immatures in second pre-basic or basic in second austral spring and early summer 313.3 (45.48; 240–515; 60).

Subspecies *menzbieri*: (3–5) NW. Aust., live (Barter 1989b): (1) Adults; (4) Immatures less than 1 year old (juvenile to first pre-supplemental); (5) Immatures in second year (second pre-basic).

	MALES	FEMALES	
Sept.	(3) 246.8 (18.7; 29)	299.5 (23.2; 11)	**
	(5) 249.0 (22.3; 40)	308.8 (23.2; 15)	**
Oct.–Nov.	(3) 263.9 (22.7; 119)	292.4 (17.6; 53)	**
	(4) 208.0 (30.6; 4)	260	
3rd week Mar.	(5) 247.1 (25.6; 15)	282.1 (22.0; 7)	**
	(3) 350.9 (24.8; 6)	413.6 (44.1; 7)	*
4th week Mar.	(4) 237.0 (20.9; 96)	284.6 (30.2; 52)	**
	(3) 358.5 (24.0; 14)	400.0 (77.8; 2)	
1st week Apr.	(4) 240.9 (21.3; 98)	283.1 (28.6; 32)	**
	(3) 348.8 (31.4; 84)	421.4 (47.1; 39)	**
	(4) 240.5 (17.4; 189)	292.8 (27.4; 102)	**

At all ages, significantly heavier in se. Aust. than in nw. Aust.; in nw. Aust., immatures appear to be lighter than adults early in non-breeding season, while in se. Aust. at this time immatures are significantly heavier than adults. Weights fairly stable through most of austral summer, though re-trapped adults in se. Aust. may tend to lose some weight early in non-breeding season (Barter 1989b). Weights of adults increase significantly late in austral summer; no data on rate of gain in weight before migration but, on departure, males may weigh as much as 405 g in n. WA and 475 g in se. Aust.; females as much as 505 g in nw. Aust. and 630 g in se. Aust. Barter (1989b) used these weights as basis of flight-range estimates, which probably need revision in the light of discovery that 33–35% of such gains in weight in nominate *lapponica* consist of non-fat components (largely protein) (Lindstrom & Piersma 1993; Piersma & Jukema 1990).

**STRUCTURE** Wing, long narrow and pointed. Eleven primaries: p10 longest; p9 3–8 mm shorter; p8 12–20; p7 27–34; p6 43–49; p5 61–65; p4 77–80; p3 90–96; p2 105–112; p1 116–122; p11 minute, covered by lesser primary coverts. Seventeen secondaries, including six tertials; longest tertials vary, reaching to between tips of p7 and p10 on closed wing. Tail, short, square at tip; 12 rectrices (difference between shortest and longest rectrices, 3–8 mm). Bill very long; tapering sharply from broad base to slender middle and tip; slightly to strongly upturned from middle onwards but varying; less steeply upturned in males with short bills; tip very slightly flattened and strongly pointed (cf. *L. limosa*). Tarsus slender, scutellate; ovate in cross-section; c. 25 mm of lower tibia bare. Outer toe c. 87% of middle toe; inner c. 82%, hind c. 37%. Minute, narrow webs along sides of toes and between front toes (much smaller than webs of *Limnodromus semipalmatus*). All claws, uniform, short, unspecialized (cf. *L. limosa*).

**SEXING** In breeding plumage, usually readily sexed on plumage characters. At other times, length of bill most useful sexing character (see Rogers 1984; Barter 1989a): females have longer bill compared to total head-length, allowing reliable sexing in field by experienced observers (e.g. Thompson 1990).

**GEOGRAPHICAL VARIATION** Marked, involving size and plumage. Broadly speaking, size and darkness of rump and underwing increase from W to E of breeding range. Traditionally, two subspecies recognised, *lapponica* and *baueri* (Vaurie

1965), but there is a need for a more complete review of geographical variation. Here, subspecies *menzbieri* also recognised, following Rynn (1982) and examination of skins in ZMM.

Nominate *lapponica* extralimital, breeding in Scandinavia and w. Siberia, E to Khatanga R. Bill and wing significantly shorter than in other subspecies; e.g. on Taymyr Pen., wing of males 210.2 (2.64; 207–214; 6) and females 225.5 (6.45; 218–233; 4); bill of males 79.5 (4.36; 73.3–83.7; 6) and females 95.8 (4.40; 89.3–98.7; 4) (ZMM). Rynn (1982) suggests that *lapponica* is slightly larger in W of range; for other measurements, see BWP. In all plumages, differ considerably from other subspecies in: (1) clean white rump, lower back and shorter uppertail-coverts, sometimes with a few lanceolate dark-brown shaft-streaks in midline; (2) axillaries mostly white, with dark-brown bars (about half width of white bars) along shaft, usually not extending to edges of feather; (3) underwing-coverts almost wholly white, sometimes with dark shaft-streaks or small spots (especially on longer feathers); (4) heavier dark barring of tail; (5) inner upperwing-coverts, paler brown (119B) (cf. dark brown [119A] in subspecies *baueri*). Juveniles also separable by broad buff (124) fringes to secondary coverts (cf. mostly dark brown [119A] with only narrow edges to lesser coverts and buff (124) terminal spotting on median and greater coverts in subspecies *baueri*). Apparently lack first pre-supplemental moult of primaries (BWP).

Subspecies *baueri* has darkest rump and uppertail-coverts, underwing and axillaries; described above. Breeds Alaska and Bering Sea coast of Chukotka; w. limits of breeding range not well known. Geographic variation within breeding range needs to be studied; breeding birds in Alaska have significantly longer bills and longer wings S of 64°N (see Measurements).

Subspecies *menzbieri* (Portenko 1936) breeds between subspecies *lapponica* and *baueri*, from at least as far W as Lena R. to at least e. Kolyma R. and w. Anadyr; intermediate in plumage between *lapponica* and *baueri*, though closer in general appearance to latter, with which it was lumped by Vaurie (1965). Treated as valid subspecies here as plumage characters reasonably consistent across large breeding range; intergrades with both *baueri* and *lapponica* exist (Portenko 1936); zones of intergradation poorly known but presumably small, as most skins in ZMM collected on breeding grounds readily assigned to subspecies. Subspecies *menzbieri* differs from *baueri* in following characters: (1) lower back and rump look more strongly barred white; feathers, black-brown (119) basally, with wider buff (124) to white subterminal bands and off-white fringes at tips, separated by broad brown (119B) angular spot or chevron at tip; in some, chevrons meet dark bases of feathers, isolating buff to whitish spot in centre of feather. (2) Axillaries have narrower brown barring, with less strong longitudinal orientation; c. 50% white. (3) Underwing-coverts, slightly whiter than *baueri*; inner greater secondary coverts c. 50% white. (4) Remiges, light grey (85) on underside, with bases of inner webs of primaries heavily mottled off-white. (5) In adult male breeding, mantle may look more heavily mottled than *baueri* (and less mottled than *lapponica*); feathers of upper back, black-brown (119) with two large buff (124) spots on tips, separated by narrow dark shaft-streak that reaches tip. (6) Size; in samples of females above, wing and tarsus of *menzbieri* significantly shorter than *baueri*; in samples of males, bill significantly longer than male *baueri* in N of breeding range, and wing and tarsus significantly shorter than male *baueri* in S of breeding range; possibility that sexual size dimorphism is more marked in *baueri* than in *menzbieri* needs study.

On the basis of measurements, Barter (1989a) suggested

that subspecies occurring in n. WA is *menzbieri*; this now confirmed through combination of band- and flag-recoveries (see Movements), better samples of measurements from breeding grounds (see Measurements) and plumage. Typical e. limits of non-breeding *menzbieri* in Aust. unknown (no information from NT and n. Qld); band-recovery suggests *menzbieri* occurs in s. WA. Plumage and small number of recoveries (see Movements) show subspecies *baueri* to be much the most common subspecies occurring se. Aust. and NZ; measurements from se. Aust. most similar to those of *baueri* in N of breeding range. Available data suggest NZ birds have slightly longer wings and bills than those in se. Aust. (see Measurements); may imply NZ has more birds from S of breeding range of *baueri*. It is not clear that *baueri* is the only subspecies occurring in e. Aust.; rump of some se. Aust. birds seems paler than typical *baueri* (though no detailed descriptions available) and a bird banded Botany Bay, recovered Yakutia (see Movements) must have been *menzbieri*.

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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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