Text and images extracted from
Higgins, P.J. & Davies, S.J.J.F. (editors) 1996. Handbook of Australian, New Zealand & Antarctic Birds. Volume 3, Snipe to pigeons. Melbourne, Oxford University Press. [Vol. 2, pages 648-649]
Vol. 3, pages 25-28, 67-68, 103-112; plate 6.

Order **CHARADRIIFORMES**

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

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

Thinocoridae	seedsnipes; four species, S. America.
Pedionomidae	Plains-wanderer; monotypic, Aust.
Scolopacidae	sandpipers, snipes and allies; *c.* 85 species, cosmopolitan.
Rostratulidae	painted snipes; two species, s. America and Old World.
Jacanidae	jacanas; seven species, pantropical.
Chionididae	sheathbills; two species, Antarctica and subantarctic islands.
Burhinidae	thick-knees, stone-curlews; nine species, widespread in Old World and two in Neotropics.
Haematopodidae	oystercatchers; *c.* 11 species, worldwide in tropics and temperate regions.
Recurvirostridae	avocets and stilts; about seven species, worldwide in tropical and temperate regions.
Ibidiorhynchidae	Ibisbill; monotypic, central Asia.
Charadriidae	plovers and lapwings; *c.* 60 species, cosmopolitan.
Pluvianellidae	Magellanic Plover; monotypic, S. America.
Dromadidae	Crab Plover; monotypic, Arabian region.
Glareolidae	pratincoles, 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, Procellariformes, penguins, grebes, divers (Gaviidae) and also Falconiformes. All these were combined in huge order Ciconiiformes by Sibley & Ahlquist (1990).

Taxonomy and relationships reviewed in Sibley & Ahlquist (1990), Christian *et al.* (1992) and BWP (and references therein). Recent reviews have included: patterning of downy young (Jehl 1968; Fjeldså 1976, 1977), osteology (Strauch 1978; Mickevitch & Parenti 1980; Olson & Steadman 1981), DNA–DNA hybridization (Sibley *et al.* 1988, Sibley & Ahlquist 1990) and electrophoresis of tissue proteins (Christian *et al.* 1992). The studies of allozymes, DNA–DNA hybridization and the most recent osteological study of the entire order (Strauch 1978) have agreed in finding two or three well-knit, monophyletic assemblages within the Charadriiformes: scolopacids and allies (Thinocoridae, Pedionomidae, Scolopacidae, Rostratulidae, Jacanidae) and charadrids and allies (Chionididae, Burhinidae, Haematopodidae, Recurvirostridae, Ibidorhyncidae, Charadriidae, Pluvianellidae, Dromadidae, Glareolidae, Stercorcariidae, 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 charadrids (e.g. Sibley & Ahlquist 1990). Further relationships within the Order discussed in introductions to families.

Because the Order comprises so many species and adaptations are so diverse, few characters shared by all species; those that are shared are mostly anatomical features of the skull, e.g. most or all have schizorhinal nostrils, schizognathous palates, well-developed vomer, lachrymals fused with ectethemoid and pre-frontal bones, well-developed supra-orbital grooves; see Olson & Steadman (1981) for more information on osteological characters. Wings usually have 11 primaries, with p10 longest and p11 minute; 15–24 secondaries; diastataxic except in *Scolopax minor*, as far as is known. Usually 12 tail-feathers. Necks usually rather long with 15–16 cervical vertebrae. Oil-gland bilobed and tufted. Syrinx, tracheo-bronchial; two carotids (type A-1 of Glenny 1955); caeca present. Legs usually rather long; hind toe small or lacking in most but all toes greatly elongated in Jacanidae. Feathers with small thin afterfeathers. Normally two moults annually: complete post-breeding and partial pre-breeding; some jacanas and alcids have flightless periods when moulting remiges. Young, downy, usually with intricate cryptic patterns on upperparts of three chief types: pebbly, spotted and striped, matching characters of habitat (Fjeldså 1976, 1977): precocial, nidifugous usually, self-feeding or not depending greatly on parents.

Thirteen families recorded in HANZAB region, with 54 species breeding, 41 occurring as regular non-breeding migrants and *c*. 38 as accidentals or probable accidentals. Scolopacidae, Stercorcariidae, 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, rhynchokinesis 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 Westernport 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[1])
Numenini	*Limosa* (godwits)	4 (2NB, 1A)
	Numenius (curlews and whimbrels)	8 (3NB, 1A, 1D)
	Bartramia	1 (1A)
Tringini	*Tringa* ('shanks')	10 (4NB, 4A, 1D)
	Xenus	1 (1NB)
	Actitis	2 (1NB)
	Heteroscelus (tattlers)	2 (2NB)
	Catoptrophorus	1 (0)
Prosobiniini	*Prosobonia*	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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Numenius phaeopus Whimbrel

COLOUR PLATE FACING PAGE 129

Scolopax phaeopus Linnaeus, 1758, *Syst. Nat.*, *ed.* 10(1): 146 — Europe.

The specific epithet is Greek for grey (φαιός) foot (ηούς) and refers to the greenish-grey colour of the legs.

The English name is derived from its call.

OTHER ENGLISH NAMES Eurasian, Asiatic, Siberian, Eastern, American and Australian Whimbrel; Jack Titterel; Hudsonian or Little Curlew, Mayfowl, Shipmate, Medium Curlew.

POLYTYPIC Nominate *phaeopus*, breeds n. Europe to w. Siberia; subspecies *alboaxillaris* Lowe, 1921, breeds N of Caspian Sea and Aral Sea; subspecies *variegatus* Scopoli, 1786, breeds ne. Siberia; subspecies *hudsonicus* Latham, 1790, breeds Alaska and n. Canada. Subspecies *variegatus* and *hudsonicus* recorded in HANZAB area.

FIELD IDENTIFICATION Length 40–45 cm; wingspan 76–89 cm; weight c. 350 g. Medium-sized curlew with long neck, long decurved bill, and medium-length legs. Much larger and bulkier than Little Curlew *Numenius minutus* with longer, thicker, more decurved bill; much smaller than Eastern Curlew *Numenius madagascariensis*, with much shorter bill and slightly shorter legs. Dark brown above, varyingly spotted and fringed paler, and white below coarsely streaked darker. No seasonal variation. Juvenile and first immature non-breeding separable at close range. Two subspecies in HANZAB area: *variegatus* and *hudsonicus*, differing mainly in colour of rump, back and underwing.

Description Subspecies *variegatus*. Adult Head strongly patterned: crown and eye-stripe, dark brown, with narrow whitish median crown-stripe and supercilium (finely streaked dark brown); rest of head and neck, white, heavily streaked dark brown except on chin and throat. Mantle, scapulars, tertials and upperwing, dark brown speckled paler grey-brown; remiges boldly spotted and barred white, becoming uniformly blackish brown on outer primaries and black on outer greater primary coverts; central innerwing-coverts, slightly paler than rest of upperparts, with paler off-white spots, fringes and tips. Uppertail-coverts and tail, grey-brown, narrowly barred dark brown and tipped white. In most, rump, white, with narrow brown barring, grading to white on back (faintly blotched and barred brown) and forming obvious white V in flight; in some, back darker, grey-brown, not contrasting much with rump, though still retain faint impression of paler V. Underbody, white, suffused with brown, and with coarse dark-brown streaks on foreneck and upper breast, and fine wavy barring on lower breast and broad wavy barring on flanks; often some narrow dark-brown streaks or fine wavy bars on sides of vent and undertail-coverts. Underwing, white, heavily barred grey on remiges and greater coverts and dark brown on axillaries and rest of lining. With wear, paler markings of upperparts and innerwing-coverts fade and abrade to off-white, often leaving notches on edges of feathers, especially on tertials; sides of head and whole of neck, breast and flanks darken. Bill, blackish brown, with paler brown or pink on base of lower mandible. Iris, dark brown. Legs and feet, dull bluish-grey, sometimes tinged green. **Juvenile** Differs from adult by: pale median crown-stripe often less distinct; mantle, scapulars, tertials and innerwing-coverts darker black, with clearer, larger and more prominent off-white (initially buff) spots; upperparts appear darker black and more pale-spotted; dense whitish spotting on wing-coverts often gives appearance of broad pale panel contrasting with rest of upperparts; breast has buff wash and fine dark streaking at first. Juvenile plumage often distinct to Nov.; with wear, all buff tones fade to white, and pale spots abrade, forming notches on edges of feathers, especially scapulars and tertials. **First immature non-breeding** Distinguished from adult non-breeding only if some retained juvenile innerwing-coverts or tertials can be seen, contrasting with fresh rest of upperparts, which are paler grey-brown with finer and more diffuse pale spots. In second calendar year, most show heavily worn primaries (cf. fresh in adults). **Subspecies *hudsonicus*.** In all plumages, similar to *variegatus* but: upperparts slightly warmer brown and, in fresh plumage, ground-colour of foreneck, breast and flanks, pale buff; best distinguished by brown back and rump uniform with rest of upperparts (no white or pale V in flight), and buff (not white) ground-colour of underwing-coverts.

Similar species Most often confused with larger **Eastern Curlew** (q.v.). **Little Curlew** shares striped head-pattern but is much smaller, with slimmer build and much shorter, thinner and less decurved bill. Plumage generally more buff, underparts less heavily patterned (flanks almost unmarked), and incomplete dark loral stripe gives more open-faced expression. In flight show: dark-brown back, rump and uppertail-coverts uniform with rest of upperparts (matched only by subspecies *hudsonicus* and some *variegatus*); uniformly dark remiges; buff ground-colour to underwing-coverts (similar in subspecies *hudsonicus*); and upperwing with contrasting pale central panel. Habitat differs: generally occur inland, and only occurring with Whimbrel in coastal habitats during migration. Vagrant **Bristle-thighed Curlew** *Numenius tahitiensis*, is similar in size and shape but with slightly thicker, blunter bill; plumage very different: tone distinctly buff in fresh plumage, with upperparts and innerwing-coverts boldly spotted with cinnamon-buff; underparts buff (paler creamy-cinnamon on undertail-coverts) with heavy brown streaks on breast and flanks; bright colours fade to off-white with wear, resulting in overall plumage tone and appearance closer to Whimbrel at rest; in flight, always separable by dark back, diagnostic unbarred bright-cinnamon patch on rump and uppertail-coverts, and cinnamon ground-colour of tail and underwing-coverts; calls also very different.

Mainly coastal, on tidal and estuarine mudflats, particularly those with mangroves. Generally singly or in small groups when feeding but gather in large flocks to roost, often with other waders such as Eastern Curlew and godwits *Limosa*, especially Bar-tailed Godwit *L. lapponica*. Sometimes feed with godwits. Usually wary, taking flight when other species unperturbed; sometimes walk warily away; noted as shyest wader in NZ, flying away if person approaches closer than 200 m (G.R. Parrish). Gait more active and nimble than that of Eastern Curlew, feeding with faster, more vigorous actions and often making short runs; probe often, but feed more by picking than does Eastern Curlew. Fly strongly, with faster wing-beats than Eastern Curlew; take off easily without run; land with quick flutter of wings. Commonest call distinctive, far-carrying rippling titter transcribed as *bibibibibibibi...* or *pupupupupupupu...*

HABITAT Intertidal mudflats of sheltered coasts, harbours, lagoons, estuaries and river deltas (Morris 1975; Schodde 1976; Pegler 1983; Garnett 1989; Oliver); prefer mudflats with mangroves, but also occur on open, unvegetated mudflats (Ewart 1973; Pegler 1983; Garnett & Bredl 1985; Garnett 1989). Occasionally on sandy beaches, or sand with scattered exposed rocks (Gibson 1977; Smith *et al.* 1978; Morris 1989), and sometimes recorded on coral or rocky islets, reefs and platforms exposed by low tides (Hindwood *et al.* 1963; Storr 1964; Domm & Recher 1973; Loyn 1975). Infrequently, saline or brackish lakes near coast, saltflats with saltmarsh, or saline grasslands with standing water left after high spring-tides, and in similar habitats in sewage farms and saltfields (Storr 1964, 1977, 1984; Schodde 1976; Lane & Jessop 1985c; Garnett 1986; Storr & Johnstone 1988; Vic. Bird Rep. 1984). Rare inland records from saline lakes and canegrass swamps (Jarman 1978). Also recorded in coastal dunes and well-treed areas (Fien 1972; Smith & Chafer 1987).

Forage on intertidal mudflats, and along muddy banks of estuaries and in coastal lagoons, either in open unvegetated areas or among mangroves; sometimes also on sandy beaches or among rocks (Ewart 1973; Pegler 1983; Lane; Vic. Atlas; Aust. Atlas). Occasionally feed on exposed coral or rocky reefs and rock platforms, probing holes and crevices among rubble and on reef flats, but not on reef crest (Storr 1964; Domm & Recher 1973; Lane; Vic. Atlas). Once recorded feeding on grassy football field (Smith & Chafer 1987).

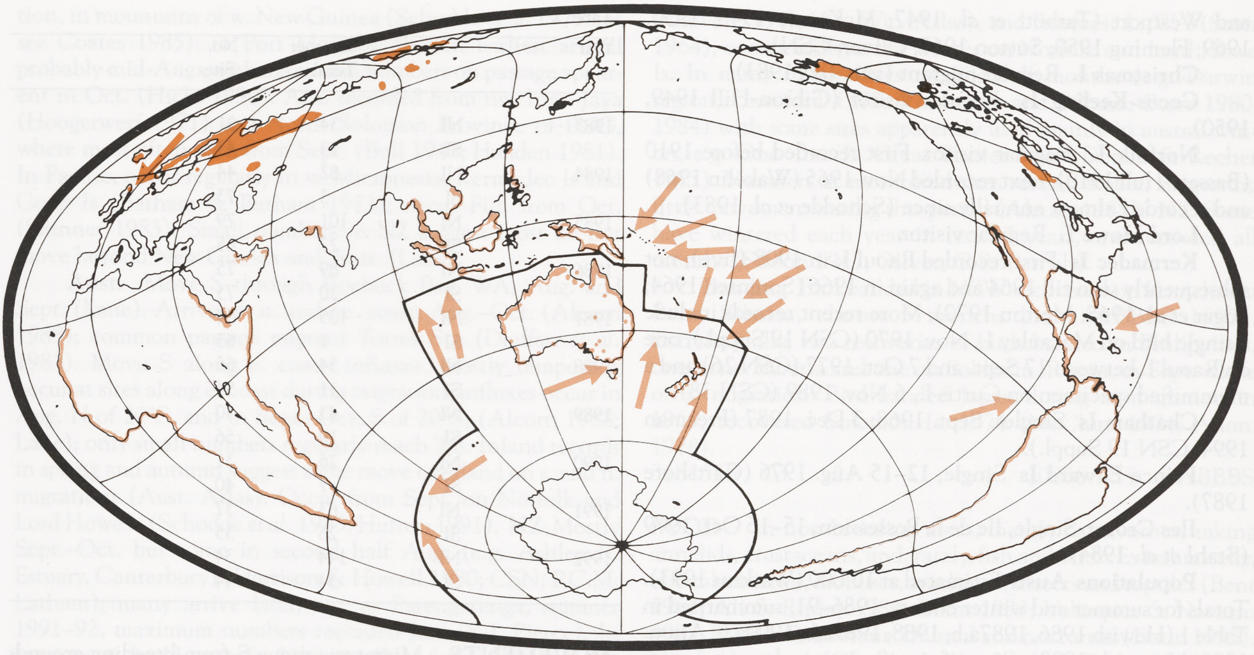
Often roost in branches of mangroves round mudflats and in estuaries; occasionally in tall coastal trees, including *Casuarina* (Fien 1972; Ewart 1973; Garnett & Bredl 1985; Prendergast *et al.* 1985; Garnett 1989). Also on ground (sometimes under mangroves or in shallow water), on muddy, sandy or rocky beaches; rocky islets and coral cays (Loyn 1975; Lane; Aust. Atlas). Once recorded perched on upright stakes attached to oyster racks (Forest 1982); on Rottnest I., seen perched on cliff-tops at high tide (Storr 1964).

During a survey in Corner Inlet, Vic., birds were flushed by people walking 50–200 m away (Peter 1990).

DISTRIBUTION AND POPULATION Breed n. and w. Alaska: from Norton Sound to n. Yukon and nw. Mackenzie, in area from sw. Yukon to central Alaska and Alaska Ra., and round w. Hudson Bay between se. Keewatin and nw. James Bay; Iceland; in Eurasia: a few in n. Scotland and nearby islands; from Scandinavia to w. Kola Pen.; s. boundary from near Dvina R. to n. Urals and SE to confluence of Ob and Irtysh Rs and N to about Arctic Circle and E to just W of Ob R. Scattered breeding occurs in Estonia; between Ural R., Ural Mts and Kuybyshev on Volga R.; round middle stretches of Yenisey R., round headwaters of Maymecha R.; Yana R. at the Arctic Circle; the lower reaches of Kolyma R.; and in Anadyrland. During non-breeding period, on the Pacific coasts of central California, USA, S through Central America, to sw. Tierra del Fuego; and on Galapagos Is; and on Atlantic coasts from South Carolina, through the Gulf of Mexico and the Caribbean islands, to s. Brazil and Uruguay, and rarely, n. Argentina. In Africa, round coast from Morocco to South Africa and N to sw. Red Sea; Madagascar; passage migrant in coastal n. Africa; rarely inland: in central Mali, from s. and central Ethiopia to n. Tanzania, and in Zambia and n. Zimbabwe. In Asia, scattered along e. coast of Red Sea and elsewhere along coasts of Arabian Pen.; also coasts of Persian Gulf, Arabian Sea and w. coasts of Indian subcontinent. Widespread coastal Indomalaya S to Irrawaddy R.; throughout se. Asia, Indochina, Philippines, s. China (Kwangtung, Hainan), and Taiwan. Widespread New Guinea region, including Bismarck Arch., Bougainville and Solomon Is; throughout Micronesia, Melanesia and Polynesia; regular visitor to Aust. and NZ (Dement'ev & Gladkov 1951; Johnson 1965; Blake 1977; Ali & Ripley 1980; AOU 1983; Urban *et al.* 1986; Pratt *et al.* 1987; BWP).

Aust. Regular visitor; more common in N. **Qld, NSW** Coasts from se. Gulf of Carpentaria to s. NSW. Inland records include: L. Powlathanga, 24 Sept. 1987 (Qld Bird Rep. 1987); L. Broadwater, SW of Dalby, 23 Nov. 1990 (Qld Bird Rep. 1990); L. Cawndilla and Euligal L., Kinchega NP, Sept. 1977 (Jarman 1978; NSW Bird Rep. 1977); Willow Pt Stn, Darling R. Anabranch, 2 Nov. 1979 (Aust. Atlas). **Vic.** Small numbers round Gippsland Ls; most from round Corner Inlet, and Westernport and Port Phillip Bays (Vic. Atlas; Vic. Bird Reps); Port Fairy, 6 Feb. 1982 (Vic. Bird Rep. 1982). Recorded inland at L. Woorinen, early Dec. 1976 (Jarman 1978). **Tas.** Regular visitor in small numbers; regularly observed round estuary of Tamar R. at George Town, at Sorell, Marion Bay and C. Portland; since 1986, one or two recorded annually in estuary of Derwent R. during summer surveys. Irregular and sporadic records elsewhere. Occasionally recorded Flinders I., but not King I. (Green 1969; Bulman & Patterson 1987; Bulman 1988, 1989, 1990, 1991; Lord 1992). **SA** In SE, recorded from Carpenter Rocks, South End and The Coorong; most records between mouth of Murray R., Kangaroo I. and Gulf St Vincent; regularly recorded at Price and St Kilda (ICI) Saltfields (SA Bird Reps). Scattered records round coastal Eyre Pen., between Whyalla and C. Bauer (Cox 1974; SA Bird Reps; Aust. Atlas). Recorded inland at L. Appanburra, 21 May 1980 (Badman & May 1983; Aust. Atlas). **WA** Few records from s. coast; sporadically recorded in SW, N to round Shark Bay; numerous and widespread along coast from Carnarvon to ne. Kimberley Div. **NT** Widespread round coasts of Top End, from Joseph Bonaparte Gulf, E to w. Gulf of Carpentaria, including Groote Eylandt (Deignan 1964; Crawford 1972; Schodde 1976; Aust. Atlas; H.A.F. Thompson & D.K Goodfellow). May occur in subcoastal areas, having followed rivers, such as South Alligator and Adelaide Rs, upstream (H.A.F. Thompson & D.K. Goodfellow; Aust. Atlas); recorded inland at Mataranka (Aust. Atlas).

NZ Information supplied by P.C.M. Latham. Regular visitor in small numbers (100–200 per year); most common n. NI. First record, a specimen shot at mouth of Wairau R., some time before 25 July 1874; few other records before 1950 (Turbott *et al.* 1947; McKenzie 1950; Oliver). Numbers may be increasing, e.g. at Whangarei Harbour between 1970s and 1990s, 10–16 per year, then 27 in 1992–93, and 35 in 1993–94 (G.R. Parrish). **NI** Most records from n. coasts. NORTHLAND: Parengarenga, Rangaunu and Whangarei Harbours; smaller



numbers at Bay of Islands, Mangonui, Kerikeri Inlet and Mangawhai–Pakiri; AUCKLAND: Manukau and Kaipara Harbours, and Firth of Thames; also Waiheke I., Piha and Clevedon; BAY OF PLENTY: Tauranga and Ohiwa Harbours; also Maketu–Little Waihi, Matarangi and Maketu; WAIKATO: Kawhia Harbour. Also recorded Mokohinau, Great Barrier, Cuvier and Great Mercury Is. Elsewhere, scattered records in all regions from East Coast to Taranaki, including Gisborne, Mahia Pen., Wairoa, Napier, Porangahau, mouth Ohau R., L. Wairarapa, Wellington Harbour, estuaries of Manawatu, Rangitikei and Wanganui Rs, and Bell Block. SI Regular at Farewell Spit, Waimea Estuary, mouth of Ashley R., Avon–Heathcote Estuary, and Invercargill district (Invercargill Estuary, Fortrose, Waituna Lagoon). Elsewhere, scattered records, including mouth Wairua R., Kaikoura Pen., L. Wainono, Karitane, Aramoana and, on W. Coast, Okarito, mouth of Orowaiti R., and Westport (Turbott *et al.* 1947; McKenzie 1948, 1950, 1969; Fleming 1950; Sutton 1967; Oliver; CSN).

Christmas I. Regular migrant (van Tets 1983).

Cocos-Keeling Is Regular visitor (Gibson-Hill 1949, 1950).

Norfolk I. Regular visitor. First recorded before 1910 (Bassett-Hull 1910); next recorded Nov. 1965 (Wakelin 1968) and recorded almost annually since (Schodde *et al.* 1983).

Lord Howe I. Regular visitor.

Kermadec Is First recorded Raoul I. in 1908 (five); not subsequently seen till 1964 and again in 1966 (Sorensen 1964; Edgar *et al.* 1965; Merton 1970). More recent records include a single bird on Macauley I., Nov. 1970 (CSN 19 Suppl.), one on Raoul I. between 17 Sept. and 7 Oct. 1977 (CSN 26) and a mummified specimen on Curtis I., 6 Nov. 1989 (CSN 38).

Chatham Is Singles: Sept. 1968; 3 Dec. 1987 (Freeman 1994; CSN 19 Suppl.).

Prince Edward Is Single, 12–15 Aug. 1976 (Gartshore 1987).

Iles Crozet Single, Ile de la Possession, 15–16 Oct. 1979 (Stahl *et al.* 1984).

Populations Aust. Estimated at 10,000 (Watkins 1993). Totals for summer and winter counts, 1986–91, summarized in Table 1 (Hewish 1986, 1987a,b, 1988, 1989a,b, 1990a,b; Anon. 1992; Naismith 1992). Sites of significance and maximum or average counts for summer and winter surveys, 1981–85, were: se. Gulf of Carpentaria, Qld, 1100; Roebuck Bay, WA, 1020; Broad Sound and Shoalwater Bay, Qld, 570; n. coast of NSW, 340; Moreton Bay, Qld, 280; Eighty Mile Beach, WA, 180; Mackay area, Qld, 140; Pilbara coast, WA, 120 (Lane). Other areas of international (marked with *) and national importance (Bamford 1988; Driscoll 1993; Watkins 1993; AWSG) include: Great Sandy Str.*, Qld, 3128; mouth of Ross R., Toolakea, Qld, 306; Darwin area, NT, 266 (summer 1987); Bakers Ck–Far Beach, Qld, 208; Kakadu NP, NT, 200. **NZ** Totals for summer counts, 1983–92, summarized in Table 2; mean total summer count (n=10 summers): NI, 74 (35; 26–144); SI, 16 (10; 3–34) (OSNZ Nat. Wader Count; P.M. Sagar). Sites of importance, with mean summer counts given below; maximum counts that exceeded maxima from OSNZ Nat. Wader Counts are also given: **NI** Parengarenga Harbour, 26 (17; 0–53); Kaipara Harbour, 16 (12; 0–39); Manukau Harbour, 6 (5; 0–15), also *c.* 30, 1 Jan. 1986 (CSN 34); Firth of Thames, 19 (14; 0–47); Kaituna Cut–Maketu Estuary, 3 (2; 0–7); Ohope–Ohiwa Harbour, 3 (2; 0–5), also 12, 1993–94 (G.R. Parrish). **SI** Farewell Spit, 15 (8; 1–29). Other important sites and maximum counts (CSN 19–41 unless stated) were: Whangarei Harbour, 35, 1993–94 (G.R. Parrish); Rangaunu Harbour, 32, 1–3 Nov. 1971; Maungawhio Lagoon, Gisborne, 14, 1993–94 (G.R. Parrish); Waimea Estuary, 7; Mahia Pen., 6; Ahuriri Estuary, 6. Reports of up to 5000 at Paua, Parengarenga Harbour (CSN 36) incorrect (CSN 37).

Table 1

Year	Summer Total	No. Sites	Winter Total	No. Sites
1986	801	23	311	23
1987	1145	22	512	23
1988	636	23	72	23
1989	832	22	244	21
1990	785	21	65	21
1991	352	21	–	–

Table 2

Year		Summer Total	No. Sites
1983	NI	34	31
	SI	13	43
1984	NI	82	44
	SI	3	73
1985	NI	101	79
	SI	27	65
1986	NI	89	75
	SI	20	73
1987	NI	105	54
	SI	1	63
1988	NI	54	65
	SI	11	54
1989	NI	43	30
	SI	19	56
1990	NI	26	31
	SI	7	40
1991	NI	63	37
	SI	26	35
1992	NI	144	34
	SI	34	44

MOVEMENTS Migratory; move S from breeding grounds for boreal winter. Nominate *phaeopus* breeds central Siberia to Iceland and migrates to Afrotropical region and islands and coasts of w. Indian Ocean, where it overlaps with non-breeding range of *alboaxillaris*, which breeds in s. Russia. Subspecies *variegatus* breeds e. Siberia and migrates to Bay of Bengal through to Melanesia, Micronesia, Aust. and NZ. Subspecies *hudsonicus* breeds Alaska and migrates to s. USA through to Chile and Brazil, and South America (BWP); also recorded widely in tropical Pacific (Pratt *et al.* 1987), vagrant to New Guinea (Hayman *et al.* 1986); one record Aust. (Darwin), and small numbers in NZ (McKean *et al.* 1976; Harrison & Howell 1980). Said to occur widely through inland on migration (Hayman *et al.* 1986). Ship-assisted passage noted (Turbott *et al.* 1947).

Departure Begins July (Hayman *et al.* 1986). Subspecies *variegatus* moves down coast of e. Asia; populations of subspecies *hudsonicus* breeding in Alaska move down Pacific coast of North America; those breeding in Canada migrate overland to Canadian maritime provinces and New England and then move S down coast. Pass over Kamchatka Pen., early Aug. to late Sept.; on Sakhalin, from early Aug. Passage migrant in Korea and Japan, end Aug.–Oct., where more common on n. migration (Dement'ev & Gladkov 1951; Gore & Won 1971; Orn. Soc. Japan 1974; AWB 1993). Migrate along coast of China, where common late July–Sept., and till Oct. in Canton (la Touche 1931–34; de Schauensee 1984); on passage, Hong Kong, 1 Aug.–20 Nov., with peak passage last week of Aug. to late Oct. (Chalmers 1986). Move through Taiwan (Severinghaus & Blackshaw 1976). Common Philippines and s. Vietnam (Hachisuka 1931; Delacour & Mayr 1946; Wildash 1968; du Pont 1971). At Bangpoo, Thailand, on passage Aug. to mid-Dec., with maximum numbers in last week of Aug. in 1984 (Starks 1987). In Singapore, arrive as early as July (Hails & Jarvis 1987). High numbers recorded in Sumatra and surrounding islands, July–Sept. (van Marle & Voous 1988). Common Borneo (Smythies 1981); on passage Brunei, Sept. to early Dec. (Harvey & Elkin 1991). Records from Wallacea suggest mainly transient Aug. and Sept. (White 1975; White & Bruce 1986). Sightings of birds, presumed to be on migration, in mountains of w. New Guinea (Schodde *et al.* 1975 but see Coates 1985); in Port Moresby district, earliest arrival probably mid-Aug., with maximum numbers on passage apparent in Oct. (Hicks 1990). Also recorded from nw. Irian Jaya (Hoogerwerf 1971) and North Solomon Province of PNG, where most often seen from Sept. (Bull 1948; Hadden 1981). In Pacific, occur regularly in w. Micronesia, Kermadec Is and Cook Is (Batham & Batham 1973); occur Fiji, from Oct. (Skinner 1983). Small numbers in NZ suggest most do not move beyond New Guinea and Aust. (Lane).

Aust. Move S through Roebuck Bay, WA, Aug. and Sept. (Lane). Arrive on n. and ne. coast, Aug.–Oct. (Alcorn 1988); common passage migrant Torres Str. (Draffan *et al.* 1983). Move S along e. coast: influxes, mostly temporary, occur at sites along e. coast during migration; influxes occur in Aug. N of 20°S, and in Sept.–Oct. S of 20°S, (Alcorn 1988; Lane); only small numbers regularly reach Tas. Inland records in spring and autumn suggest some move overland on s. and n. migrations (Aust. Atlas). Occur from Sept. on Norfolk and Lord Howe Is (Schodde *et al.* 1983; Hutton 1991). **NZ** Mostly Sept.–Oct. but some in second half Aug. (e.g. Ashley R. Estuary, Canterbury) (Harrison & Howell 1980; CSN; P.C.M. Latham); many arrive later, e.g. at Parengarenga, summer 1991–92, maximum numbers recorded Jan. (R.J. Pierce). In some years, build-up in far N, Sept.–Oct., followed by drop in numbers in Nov., birds possibly moving S (P.C.M. Latham). Recorded Prince Edward Is and Iles Crozet during period of s. migration.

Non-breeding In Aust., mainly in N; smaller numbers regularly in S (Lane) with large flocks occasionally recorded, e.g. 94 at Westernport Bay, Vic., 20 Dec. 1975 (Schulz 1976). Numbers at most sites lower in summer than during s. migration, suggesting birds disperse widely along coast in non-breeding period (Alcorn 1988; Lane). Numbers at monitored sites vary between counts, even between days, suggesting local movements (Amiet 1957; Alcorn 1988); several records in NSW of singles or groups staying in one place for at least 1 month (Hindwood & Hoskin 1954; Smith & Chafer 1987).

Return NZ Leave late Mar. to mid-Apr. **Aust.** Flock on passage noted mid-Feb. in County of Northumberland, NSW (Morris 1975). MacGillivray (1917) observed possible pre-migratory flocking on w. Cape York Pen., Qld, late May. N. migration begins late Feb. on coasts of n. Qld (Amiet 1957). Influxes occur at most sites in Qld, early Mar. to early Apr.; leave n. and ne. coasts by late Apr. (Alcorn 1988). Most leave Roebuck Bay, n. WA, probably mid- to late Apr., though less numerous than on s. migration (Lane & Jessop 1985a). Several sightings of migrating flocks flying NW and WNW from Broome region, nw. WA (Lane & Jessop 1985b).

Extralimitally, last leave Port Moresby district, PNG, early May, with greatest numbers apparent in Apr. (Hicks 1990). Evidence of passage in Sarawak, Borneo, during Apr. (Howes 1986); in 1986 passed Kuala Selangor, Peninsular Malaysia, Mar.–May (AWB 1993). Pass through Hong Kong in lower numbers than on s. migration, mainly mid-Apr. to early May (Chalmers 1986). Transient coastal China, Apr. and May (la Touche 1931–34; AWB 1993). Move through Korea, Apr.–May (Gore & Won 1971); through Japan, end Apr. to early June; in Kamchatka, May–June (Dement'ev & Gladkov 1951).

Breeding Many non-breeders said to remain in non-breeding areas all year (Hayman *et al.* 1986). In e. Aust., greater proportions winter at favoured sites N of 27°S (Alcorn 1988; Aust. Atlas), though recorded wintering as far S as SA (Glover 1954), Vic. (Vic. Atlas), and Rottnest I., WA (Storr 1964); occasionally, a few winter on Norfolk and Lord Howe Is. In many n. localities recorded all months (e.g. Darwin region, Crawford 1972; Kimberley and Pilbara, Storr 1980, 1984) with some sites apparently used mainly in austral winter, e.g. One Tree I., Great Barrier Reef (Domm & Recher 1973). Numbers at monitored sites remain stable, suggesting little movement during this period (Alcorn 1988). **NZ** Some have wintered each year in last 10 years, and recorded all months (Sibson 1947; Oliver; G.R. Parrish).

Banding Bird banded in NSW recovered on Kamchatka Pen., Siberia, almost 5 months later (ABBBS 1992). Extralimitally, two recoveries of birds banded in Philippines, one in ne. Siberia and one on Sakhalin, Russia, in Sept. while on s. migration. Bird banded Japan during n. migration in 1969, recovered Solomon Is, 1974 (McClure 1974; Anon. 1978).

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FOOD In non-breeding areas, mainly carnivorous, taking annelids, crustaceans, and, rarely, fish and birds. Extralimitally, also take berries, molluscs, arachnids, insects and reptiles (Bent 1962; Ali & Ripley 1980; Dann 1993; Velàsquez & Navarro 1993; BWP). **Behaviour** Diurnal and nocturnal (Dann 1993). Use both visual (Glutz von Blotzheim & Bauer 1975) and non-visual cues to locate prey. When feeding on reef-flats, probe among percolation holes in hard substrate (Domm & Recher 1973). On beaches, feed at low tide, running in quick bursts and capturing prey away from water (Lane). Take crabs *Helice crassa* by probing burrows with bill, using curve of bill to follow direction of burrow; catch prey with downward lunge, followed by screwing motion of head and bill, often turning head up to 360° either way before extracting prey; withdraw prey, drop it, then take fresh grip; prey then battered on ground with a few hard sideward and downward strokes (Latham 1978; Parrish 1984); or mandibulate till legs of crabs drop off (Sedgwick 1987; Harrison & Howell 1980; Harrison & Petch 1991; Dann 1993). Swallow with quick backward toss of head (Latham 1978). Six crabs taken in 6 min (Harrison & Howell 1980). Scavenge beachcast invertebrates; glean insects from vegetation on breeding grounds (Bent 1962). May wash food before swallowing (Dann 1993). At **Rhyll Inlet, Vic.**, birds prefered mudflats with 10–50% cover of *Zostera* (56% use in 10,863 mins obs.); followed by areas of sand and mud (29%); bare mudflats (13%) and rock platforms (2%). Fed mainly by pecks (39%) and jabs (38%); probes, up to full length of bill (76 mm in male; 84 mm in female), made up rest of observations (23%). Most captures preceded by runs of 0.5–10 m. Feeding rate of 0.15 feeding actions/s (0.07; 0.08–0.33; 62 min) with success rate of 0.02 prey items/s (0.02; 0.004–0.06; 62 min). Diurnal feeding period 240 min/cycle (56.0; 170–300; 6) though feeding not continuous over cycle, as disturbances, interspecific interactions, preening, inactivity and movement between sites reduce time spent feeding to *c.* 70% of total time (Dann 1993). On non-breeding grounds, mainly coastal, following tidal cycles and feeding at edge of water. Extralimital study of success and substrate preferences by Velàsquez & Navarro (1993).

Adult **Rhyll Inlet, Vic.** (10 pellets, 61 items; Dann 1993): Crustaceans: shrimps: Alpheidae: *Synalpheus maccullochi* 5% no., 20% freq.; *Alpheus euphrosyne* 2, 10; crabs: Goneplacidae: *Litocheira bispinosus* 8, 20; Hymenosomatidae: *Paragrapsus gaimardi* 13, 40; Portunidae: *Nectocarcinus tuberculosus* 10, 40; Ocypodidae: *Macrothalamus laterifrons* tr.;

Pilumnuidae: *Pilumnus fissifrons* 61, 70; Leucosidae: *Philyra laevis* 2, 10.

Other records Animals: Annelids: polychaetes (Harrison & Howell 1980); Crustaceans: crabs (McLennan 1917; Harrison & Howell 1980; Sedgwick 1987; Harrison & Petch 1991); Grapsidae: *Helice crassa* (Latham 1978); Ocypodidae: *Macrophthalmus latifrons* (Lane); *Ocypode* (two in 1 stomach; Merton 1970); Fish (photo, Pringle 1987). Birds: Little Tern *Sterna albifrons* chicks (Rose 1994).

VOICE Information supplied by P.C.M. Latham. Best known and easily recognized call is highly distinctive, rapid trill or tittering. Some variations of call can sound like calls of other curlews (*N. madagascariensis* and *N. arquata*) but differences usually obvious. Probably no differences in calls of subspecies but not well known. Comprehensive review of calls in BWP and Skeel (1978); other useful descriptions, with sonagrams, in Bergman & Helb (1982).

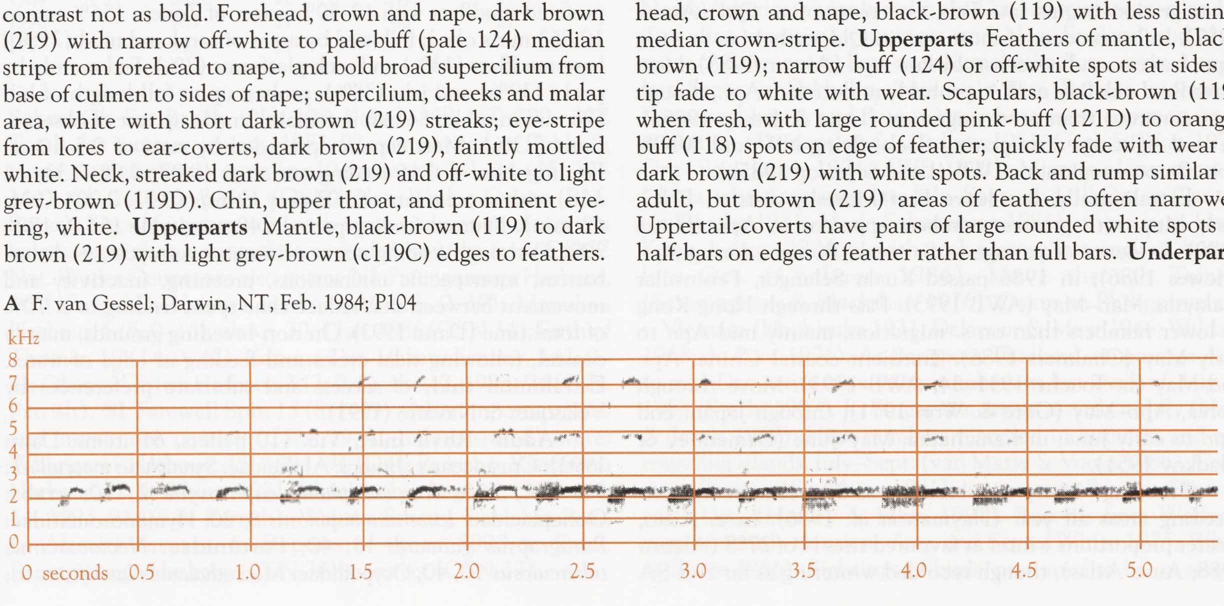
Adult TITTERING: A high, rapid, flat-toned but musical *ti-ti-ti-ti-ti-ti-ti*, usually of 6–8 notes, in even time and with even emphasis throughout (BWP; P.C.M. Latham); see sonagram A. Usually given in flight or when flushed but given repeatedly from ground by bird disturbed while feeding. In NZ, call mimicked well by Song Thrush *Turdus philomelos* (P.C.M. Latham). **Other calls** In NZ, while defending feeding territory from godwits, heard to call persistently with series of harsh calls and to give loud screaming call (Harrison & Howell 1980).

PLUMAGES Prepared by A.M. Dunn. Begin partial post-juvenile (first pre-basic) moult soon after arrival in non-breeding areas. First pre-supplemental moult of outer primaries seen once. First and subsequent pre-alternate moult not observed in Aust. and appearance does not change seasonally (see Moults). Adult non-breeding plumage first attained in second pre-basic moult. Thereafter, undergo pre-basic moult each year. Probably breed in second year, but many non-breeders winter in Aust., so some may not breed till third year. Four subspecies recognized; *variegatus* occurs regularly A'asia and *hudsonicus* occurs as vagrant. Subspecies *variegatus* described below.

Adult (Second and subsequent basic). **Head and neck** Striped appearance of head similar to that of Little Curlew but contrast not as bold. Forehead, crown and nape, dark brown (219) with narrow off-white to pale-buff (pale 124) median stripe from forehead to nape, and bold broad supercilium from base of culmen to sides of nape; supercilium, cheeks and malar area, white with short dark-brown (219) streaks; eye-stripe from lores to ear-coverts, dark brown (219), faintly mottled white. Neck, streaked dark brown (219) and off-white to light grey-brown (119D). Chin, upper throat, and prominent eye-ring, white. **Upperparts** Mantle, black-brown (119) to dark brown (219) with light grey-brown (c119C) edges to feathers. Back generally appears pale; feathers, dark-brown (219) to brown (28), broadly edged white. Rump and uppertail-coverts, dark brown (c219) with off-white barring. Much individual variation in appearance of back and rump with variation in thickness of bars and wear of tips of feathers; always contrasts with darker mantle. Scapulars, black-brown (119) to dark-brown (219) with indistinct or smudged light grey-brown (c119C) to off-white rounded or triangular spots at sides and tips of feathers. **Underparts** Upper breast, white streaked darker by brown (28) shaft-streaks that broaden towards base of feather. Lower breast and sides of breast, white with brown barring, formed by wavy brown (28) bars on feathers; often have brown shaft-streak near tip of feather. Flanks, white, barred brown (28). Belly and vent, white. Undertail-coverts, white with widely spaced, narrow dark-brown (c219) barring. **Tail** Brownish-grey (c79) with dark-brown (219) barring, often with white to off-white tip. **Upperwing** Marginal and lesser primary and secondary coverts, dark brown (121) with narrow off-white fringes. Alula, black-brown (119) with small white spots at sides of tip of feather. Greater primary coverts, black-brown (119) with white tips and 1–2 small white spots along margins of feathers. Median and greater secondary coverts, brown (28) with long shallow indistinct white to off-white spots along margins of feathers. Outer 4–5 primaries, black-brown (119) with concealed white mottling or half-bars along basal half of inner web. Rest of primaries and secondaries grade from black-brown (119) to dark brown (219) with narrow white tips and small, widely spaced spots along edges of feathers, which become deeper toward inner wing. Tertials, dark brown (121) with large indistinct spots grading from off-white near edge of feather to light grey-brown (119C). **Underwing** Lesser primary and secondary coverts and subhumerals, evenly barred dark brown (219). Median and greater primary and secondary coverts, white, evenly barred brownish grey (brownish 84). Outer 4–5 primaries, dark brownish-grey (brownish 83) with white mottling to basal half of inner web. Rest of primaries and secondaries grade from dark brownish-grey (brownish 83) to brownish grey (brownish 84) with evenly spaced white spots or half-bars along inner webs, and narrow white tips. Tertials, brownish grey (c84) with small rounded off-white spots along edges.

Juvenile Differs from adult by: **Head and neck** Forehead, crown and nape, black-brown (119) with less distinct median crown-stripe. **Upperparts** Feathers of mantle, black-brown (119); narrow buff (124) or off-white spots at sides of tip fade to white with wear. Scapulars, black-brown (119) when fresh, with large rounded pink-buff (121D) to orange-buff (118) spots on edge of feather; quickly fade with wear to dark brown (219) with white spots. Back and rump similar to adult, but brown (219) areas of feathers often narrower. Uppertail-coverts have pairs of large rounded white spots or half-bars on edges of feather rather than full bars. **Underparts**

A F. van Gessel; Darwin, NT, Feb. 1984; P104



Less streaking on breast. Upper breast, white with narrow light-brown (223C) shaft-streaks, which divide near base of feather to form Y-shaped mark. Flanks, similar to adult but some feathers have large white spots on edge of feather rather than bars. **Tail** Broader white tips than adult. **Upperwing** Median and greater secondary coverts, dark brown (121) with large pink-buff (121D) to off-white spots along margins and at tip of feather. Tertials, dark brown (219) with small closely spaced pink-buff (121D) to off-white spots along margins, which are much more sharply defined than in adult.

First immature non-breeding (First basic). Similar to adult, but retain some juvenile plumage on back, rump, outer rectrices and most upperwing-coverts. Retain juvenile primaries, which are more worn than those of adults. Some may be indistinguishable from adults after undergoing moult of primaries, Jan.–Apr. (BWP).

BARE PARTS Based on photos (Farrand 1983; Pringle 1987; Chandler 1989). **Adult, Juvenile** Iris, dark brown (219). Bill: upper mandible, dark brown (219) to black-brown (119); lower mandible, dark brown (c219) to black-brown (119) near tip, with dull-pink (5) basal half; base sometimes dark brown (c119) (e.g. Pringle 1987; Chandler 1989); possibly only when breeding, though Paulson (1993) said that variation in colour of bill not associated with age, sex or seasonal variation. Legs, light blue-grey (88) to grey (87); sometimes with green or yellow tinge.

MOULTS Based on *c.* 46 skins of subspecies *variegatus* (AM, HLW, MV, QM) and published data for nominate *phaeopus* (Boere 1976; Pienkowski *et al.* 1976; BWP). **Adult post-breeding** (Third and subsequent pre-basic). Complete; primaries outward. Moult of primaries starts early Sept., after arrival at non-breeding areas; complete, Mar.–Apr. Moult of body can begin before migration, with some feathers of head and neck; most feathers replaced at non-breeding areas, beginning about Oct. and complete by Jan.–Mar. Occasionally, feathers of body replaced before start of moult of primaries. **Adult pre-breeding** (First and subsequent pre-alternate). Few, if any, moult. Occasionally replace some feathers of head, neck, mantle, scapulars (BWP). In Aust., no birds found in this moult. **Post-juvenile** (First pre-basic). Partial. Begins after arrival in non-breeding areas, late Oct.–Nov.; mostly complete, Jan.–Apr. Involves most feathers of body, except for some upperwing-coverts, tertials, rectrices and remiges. First replaced are feathers of lores, forehead, mantle and scapulars, then sides of head, neck, breast, underparts and central rectrices. **Post juvenile moult of primaries** (First pre-supplemental). One Aust. bird replaced outer five primaries before Aug., but retained very worn juvenile primaries on inner wing. Not known what proportion of birds normally undergo this moult. **First post-breeding** (Second pre-basic). Complete. Usually begins earlier than in adults, starting with inner primaries, mid-May to mid-July, followed by feathers of body, tail and wing-coverts. Complete, late Sept.–late Dec. Some n. hemisphere birds replaced inner primaries, Jan.–Mar., but suspended moult, Apr.–June and completed moult of primaries, late Sept. (BWP).

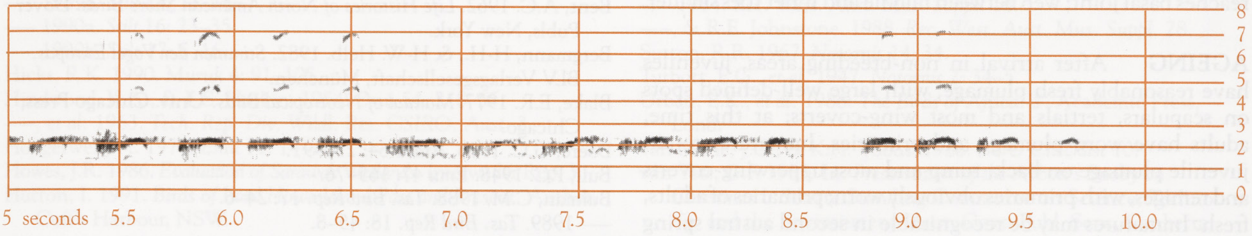
MEASUREMENTS (1) E. Aust. and PNG, adults, skins (AM, ANWC, MV, QM, SAM, WAM). (2) NW. Aust., adults, skins (HLW). (3) Indonesia, adults, skins (BWP). (4) E. Aust. and PNG, juveniles and immatures, skins (AM, ANWC, QM, SAM). (5) NW. Aust., juveniles and immatures, skins (AM, ANWC, HLW).

		MALES	FEMALES	
WING	(1)	230.1 (8.67; 218–240; 7)	240.0 (9.38; 227–254; 7)	ns
	(2)	234	240, 246, 252	
	(3)	237 (5.82; 224–247; 17)	245 (5.83; 237–256; 21)	**
	(4)	224.7 (5.06; 219–229; 4)	222, 231, 245	
	(5)	223, 252	227, 227, 245	
TAIL	(1)	92.3 (4.15; 87–99; 7)	95.6 (4.72; 89–100; 7)	ns
	(2)	90	90, 98, 100	
	(4)	90.5 (5.20; 83–94; 4)	94, 95, 99	
	(5)	97, 98	90.7 (3.40; 88–95; 4)	
BILL	(1)	76.7 (4.26; 68.7–81.2; 7)	84.2 (3.02; 80.9–89.0; 7)	**
	(2)	79.4	81.2, 83.7	
	(3)	79.8 (3.86; 70–85; 39)	86.6 (3.68; 79–93; 38)	**
	(4)	75.8 (0.67; 75.3–76.8; 4)	73.3, 81.7, 88.0	
	(5)	90.0	81.5 (8.38; 72.0–92.2; 4)	
TARSUS	(1)	57.1 (1.55; 54.3–59.3; 7)	60.6 (2.76; 56.4–64.5; 7)	*
	(2)	59.4	57.6, 57.8, 60.1	
	(3)	57.5 (2.36; 53–62; 46)	61.0 (2.52; 57–66; 40)	**
	(4)	59.5 (1.64; 57.9–61.6; 4)	56.9, 62.0, 62.3	
	(5)	62.0, 65.4	58.6 (2.80; 55.6–61.3; 4)	
TOE C	(1)	37.6 (0.85; 36.7–38.8; 6)	40.3 (2.28; 38.0–43.2; 4)	*
	(2)	38.3	38.3, 38.7, 38.8	
	(4)	39.4	40.0, 40.8	
	(5)	42.9	36.1, 39.3	

(7–8) Vic. and nw. Aust., live (VWSG; AWSG): (7) Adults; (8) Juveniles and immatures (first year).

Unsexed adults in Vic. had significantly longer wings and significantly shorter bills and total head-length than those in nw. Aust. Reason for differences not known, but not simply explained by differences between sexes, as measurements of sexed birds show that females tend to be larger than males and this is evident in measurements of wing and bill. May differ because: (1) populations in Vic. and nw. Aust. may come from different parts of breeding range; (2) methods of measuring differed; or (3) wear of feathers differed at time of measuring.

continued



	UNSEXED		
	VIC.	NW. AUST	
WING	(7) 252.9 (4.79; 245–259; 8)	245.9 (7.83; 234–262; 16)	*
	(8) 237.1 (5.87; 230–245; 7)		
BILL	(7) 77.6 (4.46; 69–84; 12)	85.8 (5.57; 76.0–95.5; 17)	**
	(8) 77.0 (2.48; 72–79; 7)	–	
THL	(7) 116.9 (4.60; 110–125; 12)	124.5 (6.00; 113.9–136.0;16)	**
	(8) 117.1 (2.88; 114–122; 6)	–	

Subspecies *hudsonicus*: (6) North America, adults, skins; combined data from BWP and Aust. museums (AM, MV, SAM, WAM).

	MALES	FEMALES	
WING	(6) 237.5 (7.12; 221–248; 14)	254 (3.70; 246–260; 18)	**
TAIL	(6) 82, 95	92.2 (2.99; 89–96; 4)	ns
BILL	(6) 82.3 (4.3; 74–89; 14)	90.9 (4.28; 80–99; 16)	**
TARSUS	(6) 56.7 (1.89; 54–60; 14)	59.9 (2.14; 57–62; 18)	**
TOE C	(6) 36.3, 37.9	40.1 (1.67; 38.2–41.7; 4)	ns

WEIGHTS Subspecies *variegatus*: (1) E. and nw. Aust., adults, live (ABBBS; AWSG; VWSG).

	UNSEXED	
	E. AUST.	NW. AUST.
Sept.	(1) –	305.5 (7.55; 300–316; 4)
Oct.	(1) –	340, 470
Dec.	(1) 378	–
Jan.	(1) 370, 440	–
Mar.	(1) 460.9 (29.45; 403–495; 13)	402.5 (59.69; 300–490; 11)
Apr.	(1) –	419.5 (50.57; 370–490; 4)

Aust., skins (ANWC, QM): adult males 297, 310; adult females 385, 470, 515. Though there are few data, in e. Aust., birds seem to begin to gain weight before migration in Feb.–Mar.; in nw. Aust., birds appear not to gain weight till Apr.

STRUCTURE Wing, long, narrow and pointed. Eleven primaries; p10 longest; p9 1–6 mm shorter, p8 10–17, p7 25–32, p6 40–50, p5 57–68, p4 73–86, p3 86–102, p2 99–107, p1 109–129; p11 minute. Fifteen secondaries including four tertials; tips of longest tertials fall between p6 and p8 on folded wing. Tail, short and slightly rounded; 12 rectrices; t1 longest, t6 7–10 mm shorter. Bill, long, slender, downcurved, tapering; about 1.5 to 2.5 times length of head; depth of curve about 10 mm near centre of bill. Nostril, long and slit-like; set in shallow nasal groove about half length of bill. Tarsus, slender, moderately long; scutellate on front, reticulate on rear. Tibia, 25–30 mm exposed. Outer toe 82–86% of middle, inner 75–82%, hind 35–39%. Web between middle and outer toes reaches basal joint; web between middle and inner toes smaller.

AGEING After arrival in non-breeding areas, juveniles have reasonably fresh plumage, with large well-defined spots on scapulars, tertials and most wing-coverts; at this time, adults have worn plumage and primaries. Immatures retain juvenile plumage on back, rump and most upperwing-coverts and remiges, with primaries obviously worn; primaries of adults, fresh. Immatures may be recognizable in second austral spring by contrast between slightly worn outer and very worn inner primaries.

SEXING Females slightly larger but much overlap in all characters (see Measurements; also Dann 1993). Skeel (1982) used discriminant function analysis based on length of wing, culmen and tail to correctly sex over 70% of sample.

GEOGRAPHICAL VARIATION Slight. Four subspecies, two of which, *variegatus* and *hudsonicus*, recorded HANZAB region. Clinal variation in size and colour across breeding range in n. Europe and Asia. In subspecies *phaeopus* of w. Europe, back and rump, white, becoming gradually darker to E; in subspecies *variegatus* in Siberia, back is blotched and barred dark brown (c219); subspecies *hudsonicus* of North America is darker than *variegatus*; subspecies *alboaxillaris*, from SSE of Urals, similar to *phaeopus* but tend to have paler fringes to feathers of upperparts and upperwing-coverts, with some dark streaks on lower rump and tail-coverts. Tail and wing longest in Iceland, becoming progressively shorter E across Europe, and shortest in e. Siberia; male *hudsonicus* similar in size to *variegatus* but female slightly larger (BWP); *alboaxillaris* has longer wing and tarsus than nominate *phaeopus* from Europe.

Some variation in colour of rump within *variegatus*: in e. Siberia, barring on rump darker and coarser than in w. Siberia. In a small number of specimens in Aust., birds from e. Aust. appear to have slightly darker rumps (with narrower white barring) than those of w. Aust., which may reflect origin of birds. However, there is also variation within these regions and further study needed.

Subspecies *hudsonicus* differs from *variegatus* by: (1) most areas of white in *variegatus* usually pink-buff (121D) in *hudsonicus*; (2) feathers of back and rump, dark brown (121) with pink-buff (121D) fringes, giving appearance of very dark rump, uniform with rest of upperparts; (3) uppertail-coverts, dark brown (119A) with pink-buff (121D) to light grey-brown (119C) barring; (4) most of underparts washed pink-buff (121D).

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Bristle-thighed Curlew *Numenius tahitiensis* (page 112)
1 Adult; **2** Juvenile; **3, 4** Adult

Whimbrel *Numenius phaeopus* (page 103)
5 Adult; **6** Juvenile; **7, 8** Adult