

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

Most species undergo marked seasonal change in appearance of plumage; *Numenius*, *Bartramia* and *Prosobonia* do not. Sexes usually alike in breeding plumage, except in *Limosa*, in which males brighter. In general, plumages typical of Scolopacidae and sequences of moult resemble those of Calidridinae. Down of precocial young, soft and ramose; at least three patterns (Jehl 1968; 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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*Scolopax madagascariensis* Linnaeus, 1766, *Syst. Nat.*, ed. 12 (1): 242 ex Brisson, 1760, *Ornithologie* 5: 322 — Madagascar in error for Macassar, Sulawesi (Celebes) *apud* Newman 1932 and for Philippines *apud* Stresemann 1941.

The specific epithet refers to the erroneous type-locality. Linnaeus no doubt meant to write *macassarensis*.

OTHER ENGLISH NAMES Australian or Sea Curlew, Far Eastern Curlew; Curlew.

MONOTYPIC

**FIELD IDENTIFICATION** Length 60–66 cm; wingspan c. 110 cm; weight c. 900 g. Largest wader in HANZAB area. Bulky wader with long neck, long heavy strongly decurved bill and long legs. Much larger and bulkier than Whimbrel *Numenius phaeopus*, with much longer bill and slightly longer legs. Plumage rather uniformly patterned; in flight, show dark back and rump uniform with rest of upperparts, heavily barred underwing. Usual call diagnostic. Sexes alike, but female slightly larger and with a longer bill. Slight seasonal variation. Juvenile and immatures separable at close range.

**Description Adult breeding** Head and neck, buffish brown, streaked dark brown except for whitish chin and throat, rather prominent thick, whitish eye-ring, diffuse pale forehead and indistinct dusky loreal stripe. Feathers of mantle, back, scapulars and tertials show blackish centres, with narrow blackish cross-bars on tertials and larger scapulars; all feathers have broad pale rufous or brownish-olive edges or notches (or both). Rump and uppertail-coverts, pale rufous with narrow dark barring. Tail, grey-brown, suffused pale rufous on central feathers and with narrow dark barring throughout. Upperwing: innerwing-coverts similar to upperparts; secondaries and inner primaries, dark brown with prominent white notching and narrow diffuse white trailing-edge; primary coverts and outer primaries, uniform blackish brown, darker than rest of upperwing. Underbody, dark brownish-buff, somewhat paler creamy-buff on rear belly and vent, with dense fine dark-brown streaking on foreneck and breast, becoming thicker arrow-shaped streaks and barring on foreflanks; upper belly, rear flanks and lateral undertail-coverts have finer and sparser dark streaking. Underwing, whitish, finely barred darker, appearing dark. Bill, dark brown, with varying fleshy-pink base. Iris, dark brown. Legs and feet, dull blue-grey. **Adult non-breeding** Like adult breeding but: upperparts duller grey-brown, without rufous tones, and ground-

colour of head and underbody, paler creamy-buff, palest on rear belly and vent. **Juvenile** Similar to adult breeding but: generally paler, neater and with fresher appearance; feathers of mantle, back, scapulars and tertials have more sharply defined pale rufous or buffish-white edges and notches; innerwing-coverts similar but with contrastingly paler buffish-white edges and notches; better-defined narrow white trailing-edge to upperwing, extending to primaries 7 and 8 (to primary 6 in adult); finer streaking on underparts; at first, bill shorter, though little different on arrival in non-breeding range. Distinct in field to about Nov., after which obscured by moult and wear. **Immatures** Non-breeding separable from adult non-breeding only by retained juvenile innerwing-coverts or tertials. In second calendar year, separable only by very worn primaries (fresh in adults).

**Similar species** Combination of large size, long decurved bill, uniformly patterned plumage with dark back, rump and uppertail-coverts in flight, and distinctive contact call distinguish from other waders. Superficially similar **Whimbrel** differs by much smaller size and shorter bill; strongly marked, striped head; more active, nimble gait and faster feeding actions; and flight-pattern: white V up back (subspecies *variegatus*), faster wing-beats, and feet not projecting beyond tip of tail (cf. most of feet project conspicuously beyond tip of tail in Eastern Curlew); calls also very different, a far-carrying rippling titter. Subspecies *orientalis* of **Eurasian Curlew** *Numenius arquata* differs most obviously by large area of white on rump and lower back, obvious in flight; and virtually unmarked white axillaries and underwing-coverts; also by paler plumage and whiter lower belly, vent and undertail; for further distinctions, see Hayman *et al.* (1986).

Seen singly, in small groups or, occasionally, in large flocks of hundreds. Essentially coastal, on beaches, estuaries, mangrove swamps and saltmarsh. Usually feed singly or in

loose flocks; typically roost in large flocks, separate from other waders; sometimes roost in trees. Extremely wary; fly at first sign of danger, long before other waders nearby become nervous. Feeding actions slow and deliberate; stalk slowly and sedately about sandy or muddy flats, picking from surface but mainly probing deeply with long bill. Take flight with short run; flight strong, direct and heavy, with rather slow, deliberate wing-beats recalling those of large gull rather than the quicker wing-beats of Whimbrel and other large waders; in flight, note very long bill and head-up, crop-out posture, with most of feet clearly projecting beyond tip of tail. Usual contact call, from ground or in flight, diagnostic loud repeated melancholy *coor-ee*, *croo-lee* or *ker-lee*, with second syllable rising in pitch; also give strident *ker ker-ee-ker-ee* when disturbed or agitated; wide range of other similar calls and long bubbling trill rarely heard in non-breeding areas.

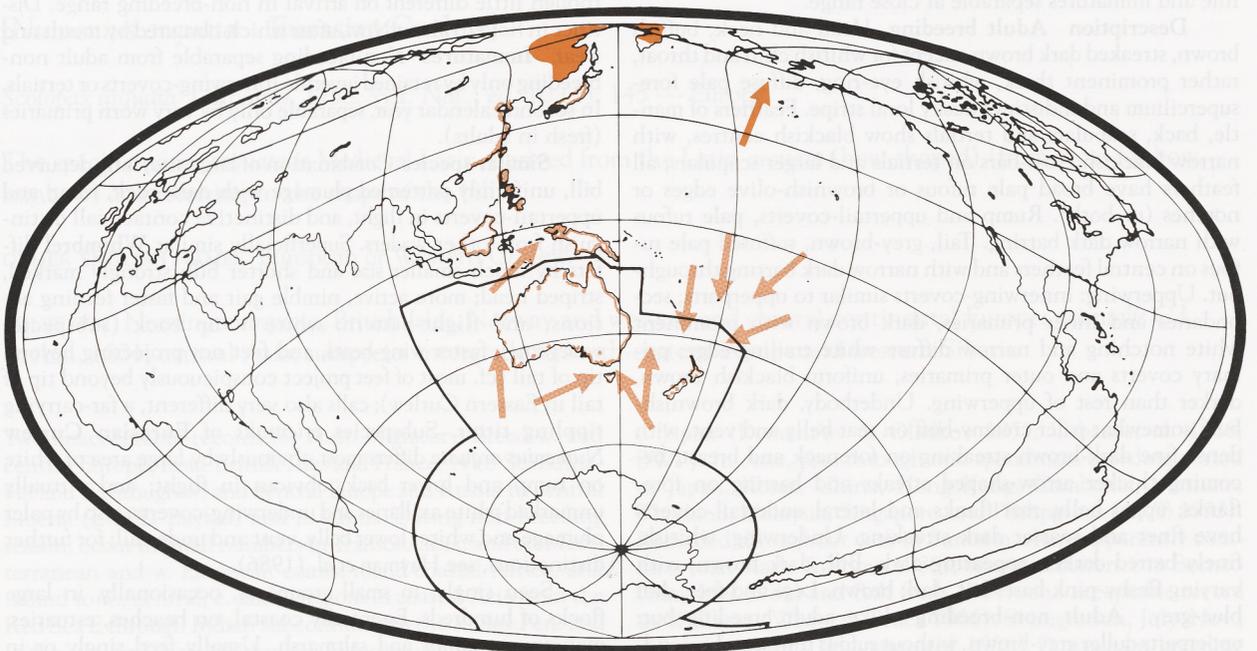
**HABITAT** In Asia, sheltered coasts, especially estuaries, embayments, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally on ocean beaches (though often near estuaries), and may occur on coral reefs and rock platforms; sometimes on rocky islets (Schulz 1990). Often recorded among saltmarsh, including areas infested with *Spartina* in NZ (J.L. Moore) and on mudflats fringed by mangroves; use mangroves in many regions, but said not usually to occur in mangroves round Darwin (Crawford 1972). Also in saltworks and sewage farms (Lane & Jessop 1985; Vic. Bird Reps); and, in Southland, NZ, in peat swamps (J.L. Moore). Occasionally roost round near-coastal lakes (Lane), but rarely recorded farther inland; in NT, may occur inland on tidal reaches of large rivers, e.g. S. Alligator R. (H.A.F. Thompson & D.K. Goodfellow); infrequently recorded round muddy margins of inland lakes (Storr & Johnstone 1988; Vic. Atlas). Once found sitting on road in Katherine R. Gorge (H.A.F. Thompson & D.K. Goodfellow).

Mainly forage on soft sheltered intertidal sandflats or mudflats, open and without vegetation or covered with seagrass;

often near mangroves (Pegler 1980, 1983; Garnett 1989; Morris *et al.* 1990; Peter 1990; Vic. Atlas). Also on saltflats and in saltmarsh (Robertson & Dennison 1979; Garnett 1989; Oliver); rockpools and among rubble on coral reefs (Hindwood & Hoskin 1954; Domm & Recher 1973; Vic. Atlas); ocean beach near tideline (Robertson & Dennison 1979). Rarely on near-coastal lakes (Lane); once recorded on grassy edge of Monger's L., WA (Jenkins 1969); on Norfolk I., may feed in rough pasture at high tide (J.L. Moore). Roost on sandy spits and islets (Park 1983; Vic. Atlas); dry sand of beach near high-water mark (Robertson & Dennison 1979). Also among coastal vegetation, including low saltmarsh, mangroves (Thomas 1968; Loyn 1978; Pegler 1980; Lane); once recorded perched high in dead tree (Hopkins 1971). Occasionally on reef-flats, in shallow water of lagoons and other near-coastal wetlands, in gutter in estuarine river bank (Crawford 1972; Robertson & Dennison 1979; Pegler 1983; Close & Newman 1984). Recorded perching on upright stakes of oyster-racks (Forest 1982).

In Is Alexandrina and Albert, SA, reclamation of land, construction of barrages and stabilization of water levels has destroyed feeding habitat (Close & Newman 1984).

**DISTRIBUTION AND POPULATION** Breed Russia and ne. China but distribution poorly known. Known to breed in s. Ussuriland; Iman R.; scattered through s., w. and n. Kamchatka; lower and middle Amur R. basin; Lena R. basin, between 110°E and 130°E up to 65°N; and on Upper Yana R., at 66°N. Not known to breed n. Mongolia (Dement'ev & Gladkov 1951; Etchecopar & Hue 1978; AOU 1983; P.S. Tomkovich). Common passage migrant Japan, Korea and Borneo; less common in transit in e. China, Hong Kong, Philippines and New Guinea (and adjacent islands); rarely recorded moving through Thailand and Malay Pen. A few birds winter in s. Korea and Taiwan (Etchecopar & Hue 1978), but most spend non-breeding season in n., e. and se. Aust., with small numbers regularly visiting NZ. Vagrants recorded from Chukotka area, Aleutian and Pribilof Is, w. Alaska, e. Iran,



Fiji, w. Samoa and w. Micronesia (Dement'ev & Gladkov 1951; Etchecopar & Hue 1978; AOU 1983; Pratt *et al.* 1987; Lane).

**Aust.** Widespread in coastal regions in N, E, and S, including Tas. Rarely recorded inland (Thomas 1979; Morris *et al.* 1981; Anon. 1983, 1989a; Storr & Johnstone 1988; Aust. Atlas; Vic. Atlas; H.A.F. Thompson & D.K. Goodfellow).

**Qld, NSW** Continuously along coast, including islands of Torres Str. **Vic.** Patchily distributed round Gippsland Ls, from Corner Inlet to Port Phillip Bay, and on far w. coast; and islands of Bass Str. **Tas.** N. and e. coasts. **SA** Scarce between Vic. border and C. Jaffa, and patchily distributed from The Coorong, NW to round Streaky Bay. **WA** In S, recorded from Eyre; scattered records from Stokes Inlet to about Leschenault Inlet; scarce visitor to Houtman Abrolhos and adjacent mainland, recorded round Shark Bay; continuously distributed from Barrow I. and Dampier Arch., through Kimberley Div. to NT border. **NT** Continuously along coast (Eckert 1974; Davies & Chapman 1975; Thomas 1979; Draffan *et al.* 1983; Close & Newman 1984; Storr *et al.* 1986; Storr 1987; Storr & Johnstone 1988; Anon. 1989a; Aust. Atlas; Vic. Atlas; H.A.F. Thompson & D.K. Goodfellow).

**NZ** Information from J.L. Moore and OSNZ National Wader Counts. Regular non-breeding visitor in small numbers (20–50). More than 85% of population annually recorded at four localities. **NI** Recorded from Far North–Northland, S through Taranaki to Manawatu and Wanganui regions; also in Bay of Plenty (CSN). Most occur Manukau Harbour (up to ten annually) and Firth of Thames (ten). Smaller numbers recorded: Parengarenga Harbour, Kaituna–Maketu, estuary of Manawatu R., Kawhia Harbour, and Kaipara Harbour. Scattered records of 1–2 birds in all regions. **SI** Most occur Farewell Spit ( $\leq 16$ ) and Southland ( $\leq 13$ ). Smaller numbers recorded at Nelson–Mapua and Avon–Heathcote and Ashley

Estuaries, Christchurch. Records of 1–2 birds scattered in Nelson, Marlborough, Otago, Southland and n. West Coast.

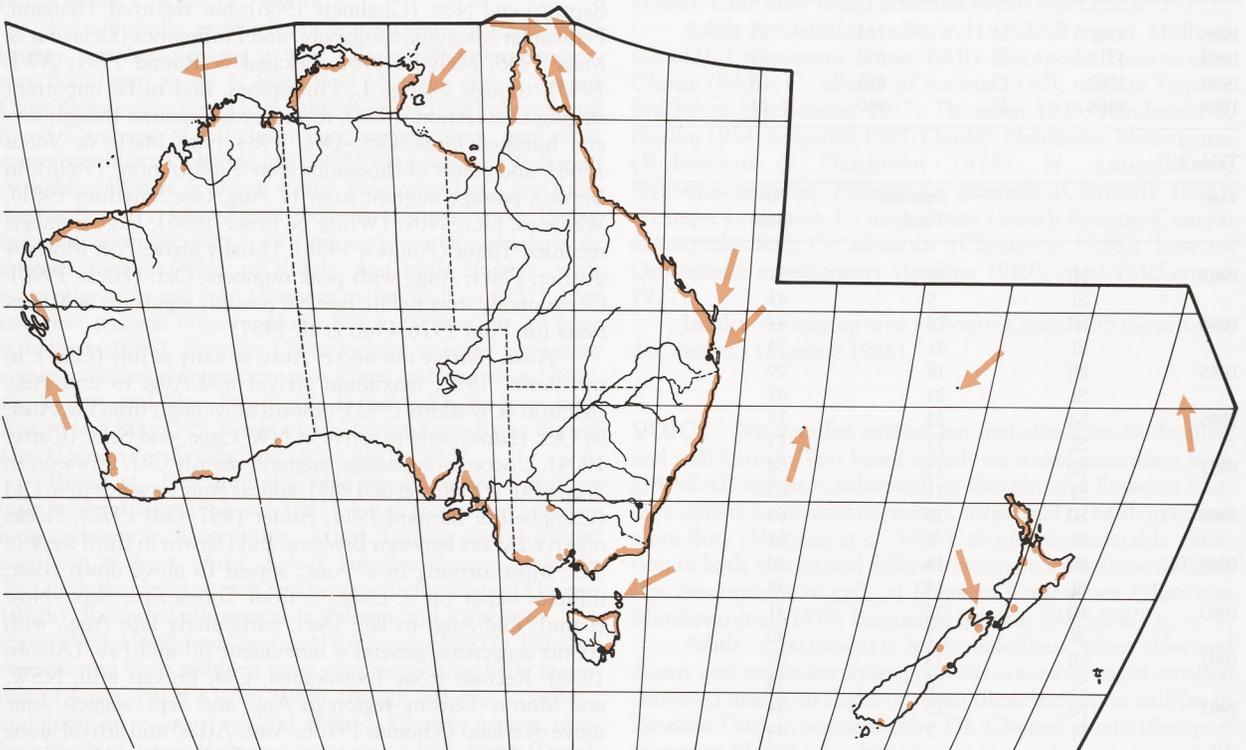
**Norfolk I.** Considered 'regular' (Disney & Smithers 1972); first published record in 1968: two, 18–29 Nov. 1968 (Smithers & Disney 1969); single, Feb. 1969 (Schodde *et al.* 1983); single, 6–12 Nov. 1980 (Moore 1981); two, Dec. 1984 (J.L. Moore).

**Lord Howe I.** Irregular visitor; no recent records (Hutton 1991). Singles, specimens: 8 Sept. 1853; 1889; 8 Jan. 1914 (Hindwood 1940); three records between 1950 and 1965 without details (McKean & Hindwood 1965).

**Kermadec Is** Single, N. Meyer I., Herald Grp, 4 Oct. 1974 (CSN 22).

**Chatham Is** Single, Mar. 1972 (NZ Atlas).

**Status** Rare (Parish & Howes 1989; Brouwer & Garnett 1990), mainly through loss of habitat and disturbance, and possibly persecution and decrease in available food through pollution. **Populations** World population probably  $< 20,000$  birds. **Aust.** Estimated at 19,000 (Watkins 1993). Earlier, estimated 13,500 in Aust.: 10,000 on e. and se. coasts, c. 1500 in nw. Aust., and 2000 in Gulf of Carpentaria (Brouwer & Garnett 1990; Lane; S.T. Garnett). Sites of significance and maximum or average counts from summer and winter surveys round Aust., 1981–85, were: Hervey Bay–Great Sandy Str., Qld, 1970; Corner Inlet, Vic., 1740; Moreton Bay, Qld, 1080; Westernport Bay, Vic. 1020; Roebuck Bay, WA, 960 (Lane). Other sites of international importance (having supported  $\geq 500$  birds) (Watkins 1993), include: Port Stephens, NSW, 960; Swan Bay–Mud I., Vic., 808; Mackay area, Qld, 710; se. Gulf of Carpentaria, Qld, 690; Hunter R. Estuary, NSW, 653. Totals for summer and winter counts, 1986–89, summarized in Table 1 (Hewish 1986, 1987a,b, 1988, 1989a,b, 1990a,b). Summer and winter counts on Derwent R., Tas., 1980–90 were: 22, 4; 149, 2; 140, 8; 141, 13; 146, 3; 160, 12; 128, 4; 133,



2; 116, 9; 120, 4; 136, 16 (Patterson 1982, 1983, 1984, 1985, 1986; Bulman & Patterson 1987; Bulman 1988, 1989, 1990). **NZ** Totals for summer counts, 1983–92, summarized in Table 2; mean total summer count: NI, 18 (4; 13–26); SI, 12 (6; 6–24) (OSNZ Nat. Wader Count; P.M. Sagar). Sites of importance, with mean summer counts (n=10 summers) were: **NI** Parengarenga Harbour, 2 (1; 0–4); Manukau Harbour, 9 (4; 2–19); Firth of Thames, 4 (2; 1–8); Manawatu Estuary, 1 (1; 0–3). **SI** Farewell Spit, 8 (2; 5–13); Ashley Estuary, 1 (1; 0–2). **Change in populations** Numbers have fallen significantly in some areas of Vic., Tas., SA, and NZ, but it is not clear if populations have declined, or there has been a change in non-breeding range (Close & Newman 1984; Thomas 1987; Brouwer & Garnett 1990; J.L. Moore). **Aust.** In Vic., numbers have declined in Westernport Bay (Brouwer & Garnett 1990). In Tas., declines recorded round Blackman's Bay (c. 100 and 75 recorded in 1948 and 1955; <20 in 1982); Ralph's Bay (283 in 1948; 13 in 1982); and round Hobart (c. 450, 1948–50 [Wall 1953]; average of 265, 1965–69 [Thomas 1968, 1970a]; 140 1981–82 [Close & Newman 1984]). May have declined, nw. Tas. and Flinders I. (Close & Newman 1984). Marked declines in SA (Close & Newman 1984): Franklin Harbour, e. Eyre Pen. (plentiful, 1923 [Weidenbach 1924]; single bird, 1982); on Yorke Pen. (widespread, 1930s [Bonnin 1933; Jarman 1940]; total 13 birds, early 1980s); at Outer Harbour (900–1000 birds, 1930–1938 [Pearce 1931; Clements 1938]; c. 200–300+ by early 1950s [Glover 1954]; generally ≤16 by 1968 [SA Bird Rep. 1967–68]; maximum population 55 between Sept. 1980 and Mar. 1981); round Ls Alexandrina and Albert (formerly widespread in small numbers between 1920s and 1940s; rare since 1960s; single bird counted in 1982); and n. Coorong

(common from 1930s to 1967–68; 15 in 1981; 22 in 1982 [Anon. 1981; Randell 1930, 1935; Sutton 1930]). **NZ** Five-yearly maxima at Farewell Spit indicate a decline there over the last 30 years: 1960–64, 37; 1965–69, 35; 1970–74, 22; 1975–79, 18; 1980–84, 7; 1985–89, 16 (CSN; OSNZ Nat. Wader Counts).

Easily disturbed by people at feeding and roosting sites (Close & Newman 1984). In Corner Inlet, fly when person on foot is within 140 m (50–250), with birds flying >100 m to escape; less disturbed by boats (Peter 1990). Birds found shot in Vic., Tas. and SA (Wall 1953; Newman & Fletcher 1981; Park 1983; Close & Newman 1984); formerly shot for food in Tas.: 'taste much nicer than wild duck' (Park 1983). Pollution round settled areas may have reduced availability of food (Close & Newman 1984). Extraliminally, hunted much on breeding grounds and at stopover points while on migration (Nokikov 1976; Parish & Howes 1989).

**MOVEMENTS** Migratory. After breeding, move S for boreal winter. Migrate by day and night (Hindwood & Hoskin 1954); migration usually coastal c. 100 m from shore (Driscoll 1993); migrating flocks recorded at varying altitudes, from c. 15 m asl (Le Souëf 1913) to a 'few hundred feet' asl (Hindwood & Hoskin 1954).

**Departure** Leave Kamchatka Pen. from mid-July; weak migration through Ussuriland, Russia, mid-July to late Sept. (P.S. Tomkovich). Pass through Kurile Is and Sakhalin, mid-July to late Aug. (P.S. Tomkovich). Fewer appear in continental Asia on s. migration than on n. migration (Dement'ev & Gladkov 1951). Common on migration in Korea, Aug. and Oct. (Gore & Won 1971; AWB 1993); high numbers counted on s. migration in Japan, Aug.–Oct. (Dement'ev & Gladkov 1951); transient central China and along coast to Hainan (de Schauensee 1984); over 2000 counted on s. migration in ne. China (Lane 1992); scarce passage migrant Hong Kong, mid-Sept. to end Nov. (Chalmers 1986); few reported Thailand, Peninsular Malaysia, Singapore, and Philippines (Delacour & Mayr 1946; Melville 1982; Lekagul & Round 1991; AWB 1993), though Olango I., Philippines, said to be important staging area (Anon. 1988); few records Sumatra, though several hundred birds, Oct.–Dec. 1984 (van Marle & Voous 1988), and count of thousands after 1988 (Anon. 1989b); in Borneo, passage migrant from 17 Aug. (see Smythies 1981). Wallacea, Oct.–Nov. (White & Bruce 1986); large numbers recorded Timor (Andrew 1986). Usually arrive Port Moresby district, PNG, Aug., with peak numbers, Oct. (Hicks 1990). Occasionally stray to Fiji; rare but possibly regular in w. Micronesia (du Pont 1976; Pratt *et al.* 1987).

**Aust.** Arrive nw. and e. Aust. as early as July (Lane). In nw. Aust., 1992, maximum arrival mid-Aug. to end Aug. (Minton & Watkins 1993); onward movement from nw. Aust. by Oct. (Lane); said to arrive at NW. Cape, end Sept. (Carter 1904). Uncommon passage migrant, mainly Oct. onwards, in Torres Str. (Druffan *et al.* 1983); appear Aug. onwards in n. Qld (Campbell & Barnard 1917; Amiet 1957; Gill 1970). Flocks observed at sea between Brisbane and Darwin in third week of Oct. Most arriving in e. Aust. appear to move down coast; influxes occur on e. coast, S from Torres Str., Sept.–Nov. (Lane); mid-Aug. to late Dec., particularly late Aug., with counts suggesting general s. movement till mid-Feb. (Alcorn 1988). Records from Toowoomba, Qld, Broken Hill, NSW, and Murray–Darling region in Aug. and Sept. suggest some move overland (Thomas 1970b; Aust. Atlas) and arrival along e. and se. Aust. coasts suggests some fly directly to these areas

Table 1

Year	Summer Total	No. Sites	Winter Total	No. Sites
1986	4381	23	784	23
1987	4712	22	852	23
1988	3767	23	655	23
1989	4468	22	960	21

Table 2

Year		Summer Total	No. Sites
1983	NI	19	31
	SI	9	43
1984	NI	26	44
	SI	21	73
1985	NI	16	79
	SI	24	65
1986	NI	22	75
	SI	17	73
1987	NI	15	54
	SI	11	63
1988	NI	16	65
	SI	8	54
1989	NI	14	30
	SI	14	56
1990	NI	22	31
	SI	7	40
1991	NI	13	37
	SI	6	35
1992	NI	15	34
	SI	7	44

(Alcorn 1988). In Vic., most arrive Nov., with small numbers moving W along coast as early as Aug. (Lane). In s. Tas., arrive third week of Aug. to early Oct.; also stragglers till Dec. (Wall 1953; Thomas 1970b). When first arrive in Tas. found at many localities before congregating at Ralphs Bay or Sorell (Thomas 1968). NZ Median date of arrival, mid-Oct., ranging from second week of Aug. to mid-Nov., with records in S as early as Sept.; numbers increase at some localities till mid-Dec., probably through dispersal within NZ (OSNZ National Wader Counts; J.L. Moore).

**Non-breeding** Extralimitally, small numbers in s. Korea, Japan, China, Taiwan, Indonesia, occasionally PNG, Borneo and also possibly Peninsular Malaysia and the Philippines (Gore 1968; de Schauensee 1984; Coates 1985; Barter 1990; Hicks 1990; AWB 1993). In Aust., mostly at small number of sites on e. and s. coasts and in nw. Aust. (Lane). Numbers stable at most sites Nov. or Dec.–Feb., indicating little movement (Alcorn 1988; Lane); said not to wander far once established on Qld coast (Amiet 1957). Move locally between high-tide roost-site and intertidal feeding zone (Hall 1924; Thomas 1968), probably up to at least 3 km (Pegler 1983).

**Return** In Aust., mostly leave late Feb. to late Mar., though in 1985 numbers decreased steadily till last week of Apr. (Starks & Lane 1987; Alcorn 1988). Leave Tas., Mar. and Apr. (Thomas 1970b). In Vic., one flock, apparently migrating, heard moving inland in Mar. (Shepherd 2009). Unknown if influxes of adults occur on e. coast during n. migration; apparently overfly n. coast (Alcorn 1988; Lane). Numbers decrease at Raby Bay, n. Qld, during Feb. (Amiet 1957). Said to be common in Kimberley, nw. WA, during passage in Mar. (Storr 1980); no influx at Broome region, nw. Aust., where flocks seen leaving mid-Mar. (Wells & Wells 1989; Lane). In NZ, median date of departure, end of Mar., ranging from mid-Mar. to mid-May at all localities; in some years, increase noted in Auckland–North Auckland before departure (OSNZ National Wader Counts; J.L. Moore).

Extralimitally, usually leave Port Moresby district, PNG, in Apr., numbers peaking in Mar. (Hicks 1990); large migratory flock seen to fly N from Port Moresby region toward Owen Stanley Ra. on 12 Mar. 1967 (Coates 1985) plus carcass found Carstensz Massif, Irian Jaya, suggest some may cross central cordillera (Schodde *et al.* 1975). On passage in Wallacea, Apr.–May (White & Bruce 1986). One record of a few hundred in Sumatra, Mar.–Apr. 1986 (van Marle & Voous 1988). In Japan, fewer occur than on s. migration; on Kyushu I., birds migrate from mid-Mar.; at Kobdo, first birds 26 Mar., with main migration end Apr. (Dement'ev & Gladkov 1951). Uncommon passage migrant Hong Kong, 10 Mar. to 12 May (Chalmers 1986). Fly over China, where at some sites most common during n. migration; pass Korea and Ussuriland, Russia, in Apr. and May. Pass Kurile Is and Sakhalin from mid-Apr. to late May (P.S. Tomkovich). Arrive Kamchatka during May (Dement'ev & Gladkov 1951; AWB 1993).

**Breeding** Extralimitally, also spend austral winter at least in New Guinea (Coates 1985). Large proportion of population winters in Aust. (Aust. Atlas). During austral winter, mostly in n. Aust. (Aust. Atlas), but also along e. coast. In Tas., birds that have not left by May remain for winter (Thomas 1970b). Recorded all months in Pilbara and Kimberley, WA (Storr 1980, 1984), and Darwin, NT (Crawford 1972). Number of wintering birds stable at most sites, suggesting little movement (Anon. 1913; Alcorn 1988), though influxes occur May and June on e. coast of Qld (Lane). Counts suggest non-breeding birds move N along e. coast after adults depart (Lane);

winter counts at some roosts in Great Sandy Str., se. Qld, are higher than summer counts (Driscoll 1990). In NZ, regularly winter at Manakua Harbour, Firth of Thames and Farewell Spit (>50% of winter population); other scattered records, as far S as Dunedin in mild winters (Oliver; J.L. Moore; see Distribution).

**Banding** Birds banded in e. Aust. recovered in Central Province, PNG, China, and South Korea (Coates 1985; ABBBS 1992).

38S145E	11	2+	U	53	10086	344	ABBBS
34S151E	02	2+	U		8400	340	ABBBS
34S151E	02	1+	U		8400	340	ABBBS
34S151E	02	2+	U	21	8353	339	ABBBS
34S151E	02	1+	U	21	8353	339	ABBBS
32S151E	01	1+	U	2	2559	351	ABBBS
32S151E	01	1+	U	2	2559	351	ABBBS
32S151E	01	1+	U	2	2559	351	ABBBS
32S151E	01	1+	U	2	2559	351	ABBBS

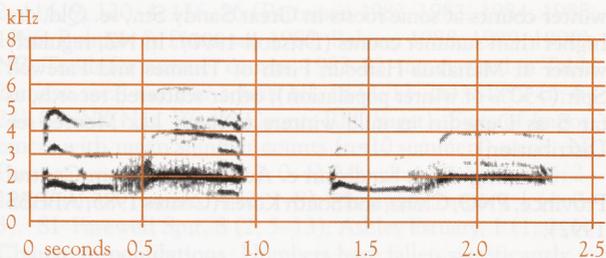
**FOOD** Carnivorous; mainly crabs and small molluscs; also insects. **Behaviour** Poorly known. Diurnal and nocturnal. On sandbanks, find burrows of Ghost Shrimp *Callinassa australiensis* by sight during day or in bright moonlight; in poor light, locate crabs by touch by probing in eelgrass briefly exposed by tide. One in 20 probes successful. Sexual differences in length of bill lead to corresponding differences in diet: females feed solitarily on sandbanks, on *Callinassa*, and defend non-breeding territories; males feed in loose flocks in eelgrass, on crabs (Lane). Rarely feed on rocky shores. Manipulate crabs and *Callinassa* at tip of bill, breaking off legs and claws then working item up to mouth before swallowing. Sometimes wash food before swallowing. Swallow whole crabs <2 cm long (Hindwood & Hoskin 1954; Sedgwick 1987; Lane). For observations at staging site in S. Korea, see Piersma (1986). Crab claw found attached to bill (McLennan 1917).

**Adult** No detailed studies in HANZAB region. Molluscs (Gould); Crustaceans (Lane; FAB): Decapoda: Parastacidae: *Cherax* (FAB); *C. albidus* (d'Andria 1970); nippers *Trypaea*; Brachyura (McLennan 1917; Thomson 1935; Hindwood & Hoskin 1954; Sedgwick 1987; Gould): Heliciidae: *Helice crassa* (Robertson & Dennison 1979); *H. haswellianus*; Hymenomatidae: *Paragrapsus gaimardii* (Clements 1938); Shrimps: *Callinassa*; *C. australiensis* (Lane); Prawns: *Crangon novaezealandiae*; *C. edwardsi* (Clements 1938); Insects: Orthoptera: grasshoppers (Jenkins 1969). Mud (McLennan 1917).

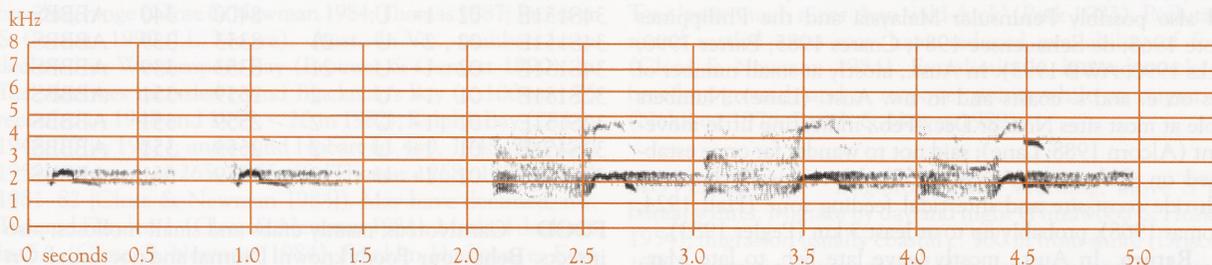
**Intake** At staging area in South Korea, 1.95 mg ash-free dry weight/s (Piersma 1986).

**VOICE** No detailed studies, but melodious *cur-loo* familiar and well known. Text based mainly on sound recordings from HANZAB region. Curlew-call of Eastern and Eurasian Curlews similar but that of Eurasian Curlew said to be sharper and more fluty (Hayman *et al.* 1986), though considerable variation in both species and differentiation on calls alone difficult (for descriptions of calls of Eurasian Curlew, see Glutz von Blotzheim *et al.* 1977; Bergmann & Helb 1982; BWP).

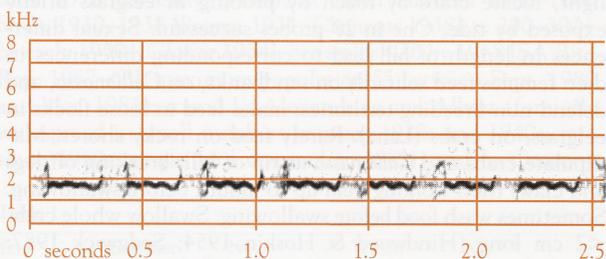
**Adult** CURLEW-CALL: loud, melodious, often slow and drawn out *cuuur-lee* (sonagram A), or more rapid *cur-looo* delivered mostly in flight or when disturbed; main call (as in Eurasian Curlew, see sonagram D). Clipped *clee-ip* (first part sonagram B) and a harsher version (second part sonagram B)



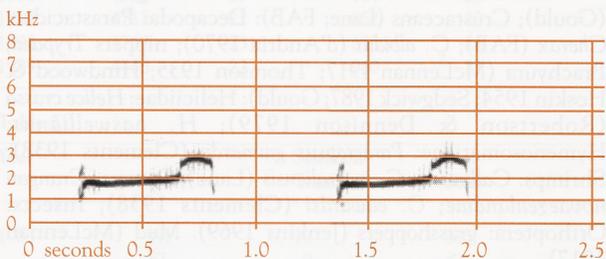
A F. van Gessel; Darwin, NT, Dec. 1984; P36



B F. van Gessel; Darwin, NT, Jan. 1986; P36



C F. van Gessel; Darwin, NT, Jan. 1986, P36

D Typical *cour-loo* of Eurasian Curlew: D. Bower; Nairnshire, May 1972; Kettle 1987: *Br. Bird Songs & Calls. Cass. A: 24b. Br. Lib. Natn. Sound Archive*

are typical variations of Curlew-call. Variety of rippling calls, presumably versions of the BUBBLING SONG (as in Eurasian Curlew; see BWP), usually given during display at breeding areas, but often heard in our region (sonagram C).

**PLUMAGES** Prepared by A.M. Dunn. Finish partial post-juvenile (first pre-basic) moult to first immature non-breeding plumage before arriving in Aust. Stay in non-breeding areas through first, and possibly second, year. Partial first (and possibly second) pre-alternate moult to immature breeding poorly known. First attain adult non-breeding plumage in complete second pre-basic moult, starting in first austral winter. Thereafter, moult twice annually; begin complete pre-basic moult to

non-breeding plumage on breeding grounds, and continue moult after s. migration; begin pre-alternate moult to breeding plumage before n. migration. Complete pre-alternate moult may not occur till third year or older. Age at first breeding, unknown; possibly third or fourth year (see Barter 1990).

**Adult breeding** (Second and subsequent alternate). Possibly only some males; usually restricted and sometimes only a few scattered feathers (see Moults). **Head and neck** Mostly basic plumage. Feathers of crown fringed rufous-brown (c38) to orange-rufous (132D). **Upperparts** Mantle, smaller scapulars and back, black-brown (119), feathers broadly edged rufous-

brown (c38) to orange-rufous (132D). Larger scapulars, similar, but with faint black-brown (119) barring on margins. Rump and uppertail-coverts, rufous-brown (c38) to orange-rufous (132D), with black-brown (119) barring and shaft-streaks to feathers. **Underparts** Mostly as non-breeding plumage, with more streaking; scattered streaks on belly. **Underwing** All retained from non-breeding plumage.

**Adult non-breeding** (Second and subsequent basic). **Head and neck** Forehead, crown, nape, cheeks and neck, off-white, heavily streaked dark-brown (121) to black-brown (119); streaks broader and darker on forehead and crown. Indistinct supercilium, off-white, lightly streaked dark brown (121); extends from base of bill to above eye. Chin, off-white. Lores and malar area, off-white, finely streaked dark brown (121). Large, prominent eye-ring, white. Often, various areas of off-white washed buff (123d) to pink-buff (c121). **Upperparts** Mantle, back and upper scapulars, light grey-brown (119C), with broad black-brown (119) central wedges to feathers and appearing more heavily streaked than head and neck; narrowly fringed off-white when fresh. Larger scapulars, as others but faintly barred black-brown (119) along margins. Rump and uppertail-coverts, light grey-brown (119C) to off-white, with black-brown (119) barring and shaft-streaks to feathers. Lighter areas of feathers sometimes washed buff (c123D) to pink-buff (c121D). **Underparts** Mostly off-white, lightly washed buff (c123D) to light pink-buff (c121D). Shaft-streaks of breast-feathers, dark brown (121) to black-brown (119). Feathers of flanks have black-brown (119) shaft-streaks and dark-brown (121) barring. Undertail-coverts have black-brown (119) shaft-streaks and narrow, widely spaced, dark-brown (121) bars. **Tail** Rectrices, light grey-brown (27), with widely spaced dark-brown (219) barring and pale tips. **Upperwing** Marginal and lesser secondary coverts, dark brown (121) with white to off-white fringes. Median and lesser primary coverts and alula, black-brown (119), some with very fine traces of white on margins. Greater primary coverts, black-brown (119), tipped white; outer feathers have finer tips; outermost feather has no white; inner feathers have 1–2 very fine white notches on margins of feathers. Median and greater secondary coverts, dark brown (121) with white fringes and rounded lateral spots. White areas on all feathers washed buff (c123D) to pink-buff

(c121D). Secondaries and tertials, dark brown (219) with white notches or half-bars along margins of feathers. White areas of all feathers, particularly median and greater secondary coverts, wear quickly, leaving feathers pointed or notched on margins or both. P1–p6, black-brown (119) with large rounded lateral spots or half-bars along margins and white tips; p7–p10, mostly black-brown (119) with concealed white spots along margins of inner web. All primaries have white shafts. **Underwing** Lesser and median primary and secondary coverts, white with thin dark-brown (219) shaft-streaks and broad dark-brown (219) bars or blotches. Greater primary and secondary coverts, primaries and secondaries, white with broad dark brownish-grey (c83) barring.

**Juvenile** Poorly known; differences from non-breeding adult: **Head and neck** Less streaked on forehead and cheeks. **Upperparts** Feathers of mantle, back and rump, fringed orange-buff (c118). Scapulars, more strongly marked with black-brown (119); centre of feather, black-brown (119), with sharply defined, rounded, orange-buff (118) notches along edges giving feather scalloped appearance. **Underparts** Less and fainter streaking, making contrast between upperparts and underparts more obvious than in adults. **Upperwing** Coverts have larger black-brown (119) central wedge and buff (123D) fringes; feathers have similar scalloped pattern as scapulars. Tertials like scapulars. P1–p8, tipped white.

**First immature non-breeding** (First basic). Similar to adult, but retain juvenile wing, which is more worn than adult wing at similar time.

**BARE PARTS** Based on photos (Kragh *et al.* 1986; Pringle 1987; Paulson 1993; Knystautas 1987) and museum labels (HLW, MV). **Adult** Iris, dark brown (219). Bill, black-brown (c119), with basal third to half of lower mandible, dull pink (5). Legs, dark olive-grey (c42) to light blue-grey (88). **Juvenile** Iris, dark brown (c22). Bill, upper mandible and tip of lower mandible, dark blue-grey (c78); base of lower mandible, pink (7). Legs, blue-grey (c78–c88).

**MOULTS** Based on data from 396 live birds from Vic. (Barter 1990, VWSG), 30 live birds from nw. Aust (AWSG), and 45 Aust. and NZ skins (AM, ANWC, HLW, MV, NMNZ, QM, SAM, WAM). **Adult post-breeding** (Third and subsequent pre-basic). Complete, primaries outward. In Vic., moult of primaries starts late Aug., and is completed late Dec. to early Jan. Moult of body probably begins before arrival in non-breeding areas and completed by about Dec. **Adult pre-breeding** (Third and subsequent pre-alternate). Poorly known because breeding plumage is superficially like non-breeding. Begins shortly before n. migration (early Feb.–Mar.) and probably continues while staging or even on breeding grounds. Little or no moult seen in HANZAB region, though moult of crown, mantle, scapulars, back, rump and uppertail-coverts has been recorded. Photo of bird in June on breeding grounds (Knystautas 1987) shows light-rufous wash to head, neck and upperparts and much streaking on underparts, suggesting extensive or even complete body-moult. Virtually nothing known about second pre-alternate moult. Further study needed. **Post-juvenile** (First pre-basic). Probably occurs before arrival in Aust. No data available. **First pre-breeding** (First pre-alternate). Little data available. Seems to begin after adult; probably very restricted. **First post-breeding** (Second pre-basic). Complete; primaries outward. Starts earlier than adults, with advanced moult recorded, early Aug. (Barter 1990).

**MEASUREMENTS** (1–2) Aust., skins (AM, ANWC, HLW, MV, NMNZ, QM, SAM, WAM): (1) Adults; (2) First immatures.

	MALES	FEMALES	
WING	(1) 308.5 (9.14; 297–319; 6) (2) 286, 296	310.1 (12.37; 292–336; 19) 310, 312	ns
TAIL	(1) 110.4 (6.35; 100–118; 7) (2) 109, 110	114.8 (5.75; 101–124; 21) 112, 113, 116	ns
BILL	(1) 158.0 (10.95; 146.9–178.6; 6)	179.5 (16.19; 135–207; 19)	**
TARSUS	(1) 88.2 (2.19; 86.0–92.4; 7)	91.6 (5.11; 82.7–100.9; 21)	*
TOE C	(1) 51.9 (1.89; 50.0–54.8; 5)	51.9 (3.77; 43.2–57.0; 13)	ns

(3–4) Vic., live; sexes separated by bivariate analysis of length of wing and bill; measurements given as mean (standard deviation; % of birds in sample) and total sample size in column labelled 'N'; correlation coefficients between length of wing and bill estimated as 0.1082 for adults and 0.0536 for immatures and are assumed to be the same for each sex (Rogers *in press*): (3) Adults; (4) Immatures with juvenile p10.

	MALES	FEMALES	N	
WING	(3) 312.5 (7.38; 32.4%) (4) 298.4 (9.07; 41.4%)	325.5 (7.69; 67.6%) 308.1 (9.36; 58.6%)	327 29	** **
BILL	(3) 153.0 (8.11; 32.4%) (4) 153.8 (7.55; 41.4%)	183.1 (9.71; 67.6%) 189.1 (9.28; 58.6%)	327 29	** **

Differences between sexes significant, and sex-ratio in Vic. strongly skewed towards females. Too few data from nw. Aust. to test whether size differs from that of adults in Vic. Juvenile wing significantly shorter than wing of adult.

**WEIGHTS** (1) Vic., adults; method of separating sexes and presentation of data, as in samples (3) and (4) of Measurements (AWSG; Rogers *in press*).

	MALES	FEMALES	N	
Aug.	(1) 699.8 (63.39; 31.7%)	828.4 (50.63; 68.3%)	26	**
Sept.	(1) 721.0 (38.07; 33.5%)	816.3 (58.25; 66.5%)	71	**
Oct.	(1) 696.6 (52.86; 36.2%)	796.7 (43.44; 63.8%)	80	**
Nov.	(1) 732.2 (39.99; 33.8%)	813.7 (54.26; 66.2%)	91	**
Dec.	(1) 697.2 (9.32; 21.6%)	807.9 (45.03; 78.4%)	18	**
Jan.	(1) 760.1 (30.14; 39.9%)	976.1 (137.53; 60.1%)	5	ns
Feb.	(1) 1089.3 (73.18; 13.5%)	1224.5 (69.27; 86.5%)	19	*
Mar.	(1) –	1250	1	
May	(1) 737.0 (12.36; 29.1%)	806.2 (42.10; 70.9%)	10	*

(2–4) Aust., live (from banding studies; AWSG, VWSG; M.A. Barter): (2) N. WA, adults; (3) N. WA, immatures; (4) Vic., immatures.

	UNSEXED	
Aug.	(4) 734.4 (147.87; 390–860; 8)	
Sept.	(2) 780 (4) 793.0 (55.86; 735–880; 5)	
Oct.	(2) 765.8 (88.57; 640–890; 12)	
Dec.	(2) 890	
Feb.	(4) 820, 1200	
Mar.	(2) 902.5 (87.32; 780–970; 4)	

Apr.	(3) 690.0 (76.16; 590–770; 4)
May	(3) 680 (n=2)
	(4) 778.1 (48.84; 735–860; 8)
July	(3) 758.3 (75.7; 660–840; 6)

Above samples do not include Vic. adult that weighed 1400 g in Feb. but was sexed as male on measurements (see Rogers *in press* for details on exclusion of outliers). In Vic. adults, gain in weight before migration begins Jan. (Barter 1990); attain departure weight in late Feb., probably about 1250–1350 g. Immatures do not undergo rapid increase in weight in late summer and remain in HANZAB region through first austral winter; small sample from May (see above) shows that some adults do not gain weight and remain here, perhaps implying that some delay first breeding attempt till at least 3 years old.

**STRUCTURE** Wing, long narrow and pointed. Eleven primaries; p10 longest; p9 2–6 mm shorter, p8 14–20, p7 31–40, p6 52–64, p5 72–83, p4 91–102, p3 110–125, p2 127–139, p1 142–153; p11 minute. Eighteen secondaries, including four tertials; tips of longest tertials fall on folded wing between p7 and p9. Tail, short and square; 12 rectrices. Bill, very long, narrow, curved downward, and about four times length of head; heavy at base, gradually tapering to rounded tip. Upper mandible longer than lower. Nostril, long, slit-like, set in shallow nasal groove that extends along 90% of bill. Tarsus, long and rather stout; scales, scutellate on front, reticulate on rear. Tibia, 30–35 mm exposed. Outer toe, 85–90% of middle, inner 84–86%, hind 32–37%. Small webs between base of each toe.

**AGEING** Juveniles have: much shorter bills for the first few months of life; dark centres to scapulars and tertials; orange-buff fringes to tertials and feathers of upperparts; coverts, fringed buff; p1–p8 tipped white; and underparts less streaked than adult. Immatures distinguished only by presence of extremely worn juvenile primaries and earlier moult of primaries; recognizable until second pre-basic moult completed.

**GEOGRAPHICAL VARIATION** None.

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**Sponsors: Mr P Boag, Northern NSW Group of the RAOU**

