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 **CALIDRIDINAE** arctic sandpipers and allies

Small to medium-sized (15–29 cm) migratory shorebirds. Twenty-four species in seven genera (see Table 1); six genera monotypic; *Calidris* comprises remaining 18 species (though these were once placed in several different genera). In HANZAB region, 19 species recorded: ten regular non-breeding migrants, eight accidental, one doubtfully recorded (and one problematic hybrid). *Calidris* may contain 2–3 species-groups (BWP): (1) knots (two species), which have much in common with Surfbird *Aphriza virgata*, especially Great Knot C. *tenuirostris* (Jehl 1968a); (2) sandpipers with partially webbed feet ('*Ereunetes*' group: C. *pusilla* and C. *semipalmatus*); and (3) other sandpipers ('*Erolia*' group). Groups (2) and (3) do not differ greatly, and may be more closely related to *Micropalama*, *Limicola*, *Eurynorhynchus*, *Tryngites* and *Philomachus* than they are to knots and Surfbirds (Jehl 1968a; BWP). Patterns of downy young suggest possible affinities of Calidridinae to Gallinagoninae, Limnodrominae and, possibly, Arenariinae (Jehl 1968a,b; Fjeldså 1977) but precise relationships not clear; allozyme and DNA research so far (e.g. Dittman *et al.* 1989; Dittman & Zink 1991; Christian *et al.* 1992) have not included comparison with all other subfamilies of Scolopacidae.

Table 1

GENUS	NUMBER OF SPECIES	NUMBER OF SPECIES IN HANZAB REGION[1]
Aphriza	1 (Surfbird)	0
Calidris	18	8 NB, 6A, 1D
Eurynorhynchus	1 (Spoon-billed Sandpiper)	0
Micropalama	1 (Stilt Sandpiper)	1 NA
Tryngites	1 (Buff-breasted Sandpiper)	1 NA
Limicola	1 (Broad-billed Sandpiper)	1 NB
Philomachus	1 (Ruff)	1 NB

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

Females generally slightly larger than males, but male is larger in polygynous species: Pectoral C. *melanotus*, Sharp-tailed C. *acuminata*, and Buff-breasted *T. subruficollis* Sandpipers, and Ruff *P. pugnax* (Jehl & Murray 1986). Bill, short and finely pointed in most species, but superficially plover-like in *Tryngites* and broad and flattened in *Eurynorhynchus*. Nostrils in a depression extending anteriorly as a groove that nearly reaches tip of upper mandible. Highly rhynchokinetic except in *Aphriza*; upper jaw typically lightly built and tip of bill sensitive, with many Herbst's corpuscles (associated with tactile foraging). Muscles of jaw and tongue hypertrophied in *Limicola* and *Tryngites*; latter also has hypertrophied salivary glands, in these respects resembling plovers. Internal feeding apparatus of *Calidris* and *Micropalama* very similar (Burton 1974) and further research needed on whether *Micropalama* merits generic recognition. Legs, moderately long and tarsus scutellate. Hindtoe small and raised in most; uniquely among Scolopacidae, it is absent in Sanderling C. *alba*. Anterior toes usually unwebbed but *Calidris* of '*Ereunetes*' group have small basal web between front toes.

Adult breeding plumage finely patterned in rufous, black, grey and buff; white or rufous below, usually with dark spotting, streaking or suffusion on breast. Sexes alike or nearly so, except for strong sexual dimorphism in Ruff, which is also unusual in attaining breeding plumage in pre-supplemental (rather than pre-alternate) moult. Adult non-breeding usually much plainer, grey to brown above and mostly white below; in *Tryngites*, little seasonal change in appearance. Juvenile plumage distinctive, usually with upperparts superficially like that of adult breeding and underparts more like adult non-breeding. All species replace most of juvenile body-plumage early in first pre-basic moult (attaining plumage like non-breeding), typically when in late stages of s. migration or after arrival in non-breeding areas. Thereafter, moult-strategies of subadults complex, but can be separated into three broad categories: (1) Undergo complete moult of all juvenile feathers in first pre-basic when *c.* 6–8 months old, developing adult breeding plumage in first pre-alternate moult just before first n. migration when *c.* 9–10 months old (e.g. most Little Stints C. *minuta*, Least C. *minutilla* and Sharp-tailed C. *acuminata* Sandpipers). (2) Retain juvenile remiges, and often much of tail and wing-coverts, through first pre-basic; may replace some outer primaries in partial first pre-supplemental moult; attain plumage very similar to that of adult breeding in first pre-alternate moult before undertaking first n. migration when *c.* 9–10 months old (e.g. Dunlin C. *alpina* and Purple Sandpiper C. *maritima*). (3) Like second strategy, but first pre-alternate moult produces dull plumage, mostly like non-breeding but often

with varying number of feathers like breeding plumage (colours of these feathers often duller than adult breeding); such birds typically delay first n. migration until at least 2 years old, first attaining adult non-breeding plumage in complete second pre-basic moult when *c.* 12–15 months old (e.g. Red-necked Stint C. *ruficollis*, Curlew Sandpiper C. *ferruginea* and Great Knot C. *tenuirostris*). Down of precocial young, long and loose, especially on nape. Mainly ochraceous to rich brown above, with complex patterns of black blotches and bands, including characteristic marking shaped like hour-glass on centre of back; white below, often with brown wash on foreneck and breast. As in Gallinagoninae and Limnodrominae, spotted dorsal pattern formed by white powder-puffs attached to tips of black down. In most species, white barbules at each feather-tip densely packed and interlock with those of other feathers as large closely knit puffs (resembling scattering of large snow-flakes). In knots and *Aphriza*, powder-puffs have looser microstructure and do not entangle much, so some areas (especially in older chicks) may appear to have diffuse white mottling rather than distinct spots. Some other variation in colour and pattern of downy young attributed to breeding habitat rather than taxonomy (see Jehl 1968b; Fjeldså 1977; BWP).

Most species breed in tundra, a few in other open habitats S to Temperate regions of n. hemisphere. Highly migratory; those breeding high Arctic breed faster and migrate farther than most other species of waders. In non-breeding season, inhabit wide range of shallow wetlands. Some species almost exclusively coastal (e.g. Red C. *canutus* and Great C. *tenuirostris* Knots and Sanderling C. *alba*); some typically occur on inland wetlands (e.g. Long-toed Stint C. *subminuta*); others rather catholic in choice of habitat. Feeding behaviour varies; include probing and stitching (a rapid series of shallow probes made close to one another). Usually forage by touch and several species known to detect prey by chemoreception or detection of vibrations (e.g. van Heezik *et al.* 1983; Gerritsen 1988).

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Micropalama himantopus Stilt Sandpiper

COLOUR PLATE FACING PAGE 352 & 353

Micropalama himantopus Bonaparte, 1826, *Ann. Lyc. Nat. Hist. N.Y.* 2: 157 — Long Branch, New Jersey.

Micropalama is compounded from the Greek μῐκρος small, and παλάμη the palm of the hand, and refers to the small palm-shaped lobes between the toes. The specific name comes from the generic name of the stilts *Himantopus*, and refers to the long legs.

MONOTYPIC

FIELD IDENTIFICATION Length 18–23 cm; wingspan 38–41 cm; weight 58 g. Small, slim, rather long-necked and elegant sandpiper, with long slightly decurved bill with swollen tip, and long legs; general appearance more like that of a *Tringa* than a small calidrid. Very similar in size and shape to Curlew Sandpiper *Calidris ferruginea*, but with flatter more sloping forehead, longer neck, and slightly deeper belly, slightly longer thicker straighter and blunter bill, and much longer legs, which make bird stand taller and appear larger. Folded primaries extend beyond tip of tail at rest. In flight, all plumages have squarish white patch on rump and uppertail-coverts, like that of Curlew Sandpiper, and inconspicuous wing-bar; toes and part of tarsus project well beyond tip of tail, combining with long wings and bill to give distinctive cruciform shape. Typically seen feeding belly-deep in water, with dowitcher-like vertical probing action. Sexes alike. Marked seasonal variation. Juvenile distinctive. Immatures separable in good view.

Description **Adult breeding** Head and neck, black, with fine white streaking on forehead, crown and nape, more coarse white streaking elsewhere, and with diffuse dark loral stripe; prominent white supercilium from bill to sides of nape (usually finely streaked darker behind eye); varying rufous streaking on sides of crown and nape, and varying rufous suffusion to lores, which, with bright rufous ear-coverts, forms distinctive mask. Mantle and scapulars, black, with crisp white or rufous spots and tips. Tertials vary: black or grey-brown, narrowly fringed white or pale rufous; often show mixture of feathers. Innerwing-coverts, dark grey-brown, with narrow pale fringes, contrasting with black-and-white upperparts (often, a few inner median and greater coverts are black, with dull-rufous or white tips and notches as lower scapulars). Underbody, white, with coarse black streaking on foreneck and upper breast and dense black barring over rest (barring tends to be greyer in females). In flight: show mostly dark grey-brown innerwing-coverts and slightly darker greater coverts, primary coverts and remiges, with indistinct fine off-white wing-bar formed by narrow white tips to greater secondary coverts; back, black; rump and uppertail-coverts, white, with messy dark barring and spotting, forming prominent squarish white patch that contrasts with light-grey tail (some rectrices, especially central ones, paler, with dark barring in some birds); underwing-coverts mostly white, with narrow dusky leading-edge at carpal, contrasting with dark-grey remiges, primary and greater secondary coverts and barred underbody. With wear, dull rufous spots and tips (if present) on upperparts fade to buff or white and, with white edges much reduced, mantle and upper scapulars, especially, appear more uniform, black; grey-brown innerwing-coverts very worn and faded by end of breeding season. In austral spring, adults likely to have mixture of worn breeding and new non-breeding plumage. Bill, black, sometimes tinged grey or brown at base. Iris, dark brown. Legs and feet, dull green or yellowish green; toes partially webbed. **Adult non-breeding** Like breeding, but differing by: forehead and crown, dark brownish-grey, with fine dark streaking, appearing slightly darker than rest of head and neck and giving subtle capped effect; hindneck, sides of neck and ear-coverts, brownish-grey, finely streaked darker; cheeks, white, finely streaked grey and grading to white on chin and throat; narrow dark loral stripe; prominent white supercilium from bill ending squarely above hind ear-coverts (and often finely dark-streaked behind eye). Mantle, back, scapulars, tertials and innerwing-coverts, dark brownish-grey, with fine dark shafts and fine white fringes; tertials and some larger lower scapulars have slightly darker centres. Underbody, white, with varying light brownish-grey wash and fine dark streaks and spots on foreneck and breast; flanks, vent and undertail-coverts streaked grey, streaks sometimes coalescing to form long wavy lines down flanks. Flight-pattern as breeding, except: rump and uppertail-coverts vary from mostly white to heavily marked with messy dark streaks and spots. With wear, feathers of upperparts become browner, and fine white

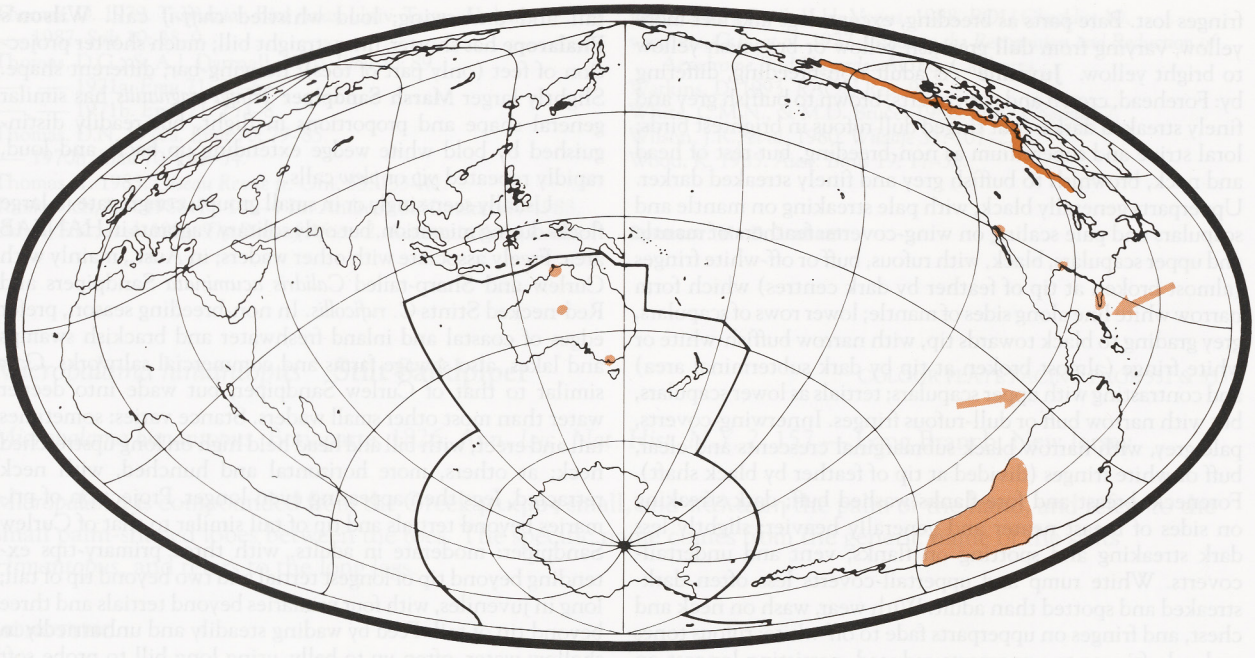
fringes lost. Bare parts as breeding, except: legs and feet more yellow, varying from dull greenish yellow or brownish yellow to bright yellow. **Juvenile** As adult non-breeding, differing by: Forehead, crown and ear-coverts, brown to buffish grey and finely streaked darker, but tinged dull rufous in brightest birds; loral stripe and supercilium as non-breeding, but rest of head and neck, brownish to buffish grey and finely streaked darker. Upperparts generally black, with pale streaking on mantle and scapulars and pale scaling on wing-coverts: feathers of mantle and upper scapulars, black, with rufous, buff or off-white fringes (almost broken at tip of feather by dark centres) which form narrow white line along sides of mantle; lower rows of scapulars, grey grading to black towards tip, with narrow buffish-white or white fringe (almost broken at tip by dark subterminal area) and contrasting with upper scapulars; tertials as lower scapulars, but with narrow buff or dull-rufous fringes. Innerwing-coverts, pale grey, with narrow black submarginal crescents and clear, buff or white fringes (divided at tip of feather by black shaft). Foreneck, breast and fore-flanks washed buff; dark streaking on sides of breast neater and generally heavier; slightly less dark streaking and spotting on flanks, vent and undertail-coverts. White rump and uppertail-coverts less often dark-streaked and spotted than adult. With wear, wash on neck and chest, and fringes on upperparts fade to off-white; rufous tones and pale fringes to upperparts reduced, persisting longest on innerwing-coverts. Full juvenile plumage unlikely to be seen in our area; neat streaked and scaly pattern may be distinct into Oct. **First immature non-breeding** Like adult non-breeding but distinguished by retained, worn juvenile tertials and innerwing-coverts, contrasting with fresh non-breeding upperparts; also, retained juvenile remiges fresh in austral spring–summer (worn or moulting in adults). In austral summer–autumn, worn juvenile tertials and innerwing-coverts less distinct or replaced with fresh first non-breeding; most birds replace varying number (1–7, but usually 3–4) of juvenile outer primaries in pre-supplemental moult and show a contrast between old worn brownish inner and new fresh blackish outer primaries (primaries uniform and fresh in adults), but note that contrast may be difficult to see in those replacing many primaries; in some, no primaries replaced, all appearing uniformly worn. **First immature breeding** Extent of breeding plumage varies: most like adult, but separable by contrast in primaries up to Sept.; a few less advanced birds often retain all juvenile primaries and replace first non-breeding plumage with adult-like non-breeding plumage or in part with a plumage intermediate in character between adult breeding and non-breeding.

Similar species Adult in breeding plumage, distinctive; only breeding **Grey-tailed** *Heteroscelus brevipes* and **Wandering** *H. incana* **Tattlers** have similarly barred underbody, but easily separable by: slightly larger size; uniform dark-grey upperparts; no white patch on rump and uppertail-coverts; noticeably shorter, straight bill; much shorter legs; different calls, habits and habitats. Can be confused with non-breeding and juvenile **Curlew Sandpiper**; see that text for details. Flight-pattern of **Lesser Yellowlegs** *Tringa flavipes*, **Wood Sandpiper** *T. glareola* or **Wilson's Phalarope** *Steganopus tricolor*, similar, all having squarish white patch on rump and some projection of feet beyond tip of tail. **Lesser Yellowlegs** is larger, with shorter straight bill; slightly longer projection of feet beyond tip of tail; barred tail; no wing-bar; finely barred underwing-coverts; distinctive whistled *tew-tew* call. **Wood Sandpiper** differs by shorter straight bill; slightly shorter projection of feet; more compact appearance; no wing-bar; barred tail and underwing; loud whistled *chiff-if* call. **Wilson's Phalarope** has shorter, finer straight bill; much shorter projection of feet (only part of toes); no wing-bar; different shape. Slightly larger **Marsh Sandpiper** *Tringa stagnatilis* has similar general shape and proportions in flight, but readily distinguished by bold white wedge extending up back, and loud, rapidly repeated *yip* or *plew* calls.

Usually seen singly or in small groups; congregate in large flocks during migration, but only solitary vagrants in HANZAB area. Freely associate with other waders; in Aust., mainly with Curlew and Sharp-tailed *Calidris acuminata* Sandpipers and Red-necked Stints *C. ruficollis*. In non-breeding season, prefer edges of coastal and inland freshwater and brackish swamps and lakes, also sewage farms and commercial saltworks. Gait similar to that of Curlew Sandpiper, but wade into deeper water than most other small waders. Stance varies: sometimes tall and erect, with bill and head held high on long upstretched neck; at others, more horizontal and hunched, with neck retracted, legs then appearing even longer. Projection of primaries beyond tertials and tip of tail similar to that of Curlew Sandpiper: moderate in adults, with three primary-tips extending beyond tip of longest tertial and two beyond tip of tail; long in juveniles, with four primaries beyond tertials and three beyond tip of tail. Feed by wading steadily and unhurriedly in shallow water, often up to belly, using long bill to probe soft mud in rapid, vertical sewing-machine action recalling that of dowitchers *Limnodromus*; often immerse head and neck completely; also pick insects from surface of water or emergent vegetation, stalking and snatching from a half-crouching posture; peck and probe on wet mud like *Calidris* sandpipers. Flight strong and powerful on large wings, with flight recalling that of *Tringa* and *Calidris*; long bill and legs and feet projecting well beyond tip of tail always prominent in flight, giving cruciform shape. Usual flight call a soft rattling trill *kirrr* or *grrrt*, recalling that of Curlew Sandpiper; also utter single low *whu* or *tew*, reminiscent of single note of Lesser Yellowlegs, only much quieter.

HABITAT In non-breeding period, shallow wetlands, including flooded pasture and marshes, ponds, margins of shallow lagoons and drying lakes, estuaries and tidal mudflats (Bent 1962; Blake 1977; Myers & Myers 1979). Forage in open water of coastal estuaries and flooded marshes and pasture (Myers & Myers 1979); rarely in soft, wet mud or sand; usually away from emergent vegetation, but recorded among dead emergent stubble in puddles (Bent 1962; Myers & Myers 1979). In Aust., recorded on shallow ponds at sewage farms and saltworks (McKean *et al.* 1982; Benson 1991; Smith 1992); forage in shallow water, to depth of belly, often well away from shore, occasionally close to muddy edge, and rarely on exposed mudflat; often among short emergent remnants of *Sclerostegia* (Smith 1992 cf. Myers & Myers 1979). Recorded loafing or roosting on rocky fringe or exposed mudflat in pond or in shallow water (Benson 1991; Smith 1992).

DISTRIBUTION Breed n. Alaska, round Prudhoe Bay, E through n. Yukon, n. Mackenzie and s. Victoria I. to w. and s. Hudson Bay in se. Keewatin, ne. Manitoba and n. Ontario, to C. Henrietta Maria. Passage migrant through USA, between Rocky Mts and Mississippi and Ohio Valleys, and through Central America; less often along Atlantic coast from New Brunswick and Nova Scotia, S through Caribbean; rarely W of Rocky Mts from se. Alaska. Spend non-breeding period in South America, mainly from Bolivia and s.-central Brazil, S to



Uruguay, and n. regions of Argentina and Chile. Occasionally recorded w. and s.-coastal Alaska, Pribilof Is, Bermuda, Galapagos Is and se. California. Accidental to w. Europe, Japan and Aust. (Jehl 1973; AOU 1983; Hayman *et al.* 1986; BWP).

Aust. Three acceptable records (RAC), all singles: Sanderson Sewage Farm, Darwin, NT, 30 Aug.–4 Sept. 1980 (McKean *et al.* 1982); Alice Springs Sewage Farm, NT, 7–16 Oct. 1991 (Benson 1991); Werribee Sewage Farm, 17 Jan. 1993 (RAC). Report of single, Avalon Saltworks, Vic., 8 Dec. 1990–3 Mar. 1991 (Smith 1992) not submitted to RAC and unverified.

MOVEMENTS Migratory; breed North America and migrate S to main non-breeding areas in central South America. S. migration, mid-July (adults) or mid-Aug. (juveniles), till at least Sept. (BWP). Few move along Pacific coast of Americas (AOU 1983; BWP); not recorded tropical Pacific Ocean (Pratt *et al.* 1987). In Asia, rare passage migrant in Japan; recorded Taiwan (AWB 1993). Aust. records within period of s. migration and normal non-breeding period. In Aust., one bird remained in same area for almost 3 months (Smith 1992). N. migration between Mar. and June. Some stay in non-breeding areas during breeding season (BWP), though no such records from HANZAB region.

PLUMAGES Prepared by A.M. Dunn and A. Rogers. Insufficient material in museums in Aust. or NZ to provide full texts on plumages and related matters; see BWP for full details. Post-juvenile (first pre-basic) moult to first immature non-breeding (first-basic) plumage generally begins at staging areas on s. migration. Most immatures then undergo partial moult of primaries (first pre-supplemental), starting Nov.–Feb. Undergo partial first immature pre-breeding (first pre-alternate) moult to first-immature breeding plumage before n. migration; some that have little pre-alternate moult remain in non-breeding areas. Thereafter, moult twice annually: complete post-breeding (pre-basic) moult to non-breeding plumage beginning on breeding grounds, continuing at staging areas, and completed in non-breeding areas; and partial pre-breeding (pre-alternate) moult to breeding plumage, before n. migration. Age of first breeding not known.

MOULTS Based on extralimital studies (Bent 1962; Jehl 1973; BWP) and four specimens from North America (MV). **Adult post-breeding** (Second and subsequent pre-basic). Complete; primaries outward. Start moult of head and neck on breeding grounds in July. Moult suspended during migration but continues at staging areas in USA and the Carribean; birds reach non-breeding areas with fresh plumage on much of head, neck, chest, mantle, scapulars and about half of underparts. Moult of wings occasionally starts at staging areas but usually begins with continuation of moult of body and tail in non-breeding areas, late Aug.–early Oct.; finished late Dec.–Feb. Immatures that moult few feathers in first pre-alternate and remain in non-breeding areas start second pre-basic moult of primaries early, about July. **Adult pre-breeding** (Second and subsequent pre-alternate). Partial; mainly early Mar. to late Apr.; involves head, neck, mantle, scapulars, varying number of inner upperwing-coverts (sometimes many, specially median coverts), and, occasionally, a few central or outer rectrices (rarely, all of tail). **Post-juvenile** (First pre-basic). Partial. Starts on head, neck, mantle, scapulars and chest, about mid-Aug.; sometimes on breeding grounds but mostly at staging areas on migration; continues in non-breeding areas and is almost complete, late Sept. to early Oct. The few remaining juvenile feathers of body, wing-coverts and tail replaced Nov.–Feb. **Post-juvenile moult of primaries** (First pre-supplemental). Partial. Some replace outer 1–7 primaries, beginning Nov.–Feb. **First immature pre-breeding** (First pre-alternate). Like adult pre-breeding, but varying more in extent; some replace more upperwing-coverts than adults, some attain very little, if any, first immature breeding plumage. **First immature post-breeding** (Second pre-basic). Immatures that do not undergo first pre-supplemental moult remain in non-breeding areas and begin second pre-basic moult late June or July. In others, moult like adult post-breeding.

MEASUREMENTS Throughout range, skins: (1) Adults (BWP and four adult skins in MV); (2) Immatures (BWP).

		MALES	FEMALES	
WING	(1)	131.7 (2.94; 127–136; 31)	133.8 (2.73; 129–138; 27)	**
	(2)	131 (4.20; 124–139; 15)	133 (3.11; 128–137; 9)	ns
TAIL	(1)	49.4 (1.48; 47–52; 16)	50.1 (1.28; 48–51; 15)	ns
	(2)	47.7 (1.98; 45–51; 9)	48.6 (0.75; 48–50; 4)	ns
BILL	(1)	39.6 (1.35; 38–42; 42)	41.2 (1.89; 38–44; 36)	**
TARSUS	(1)	40.2 (1.99; 35–44; 47)	41.5 (3.92; 38–46; 37)	*
TOE C	(1)	25.7 (1.03; 24–28; 25)	25.7 (0.85; 24–28; 19)	ns

Wing and tail of juveniles not significantly shorter than those of adult.

WEIGHTS (1) Alaska and n. Canada (BWP).

	MALES	FEMALES	
late May to early June	(1) 55.8 (48–66; 25)	60.4 (5.91; 54–68; 8)	
late June	(1) 55.9 (2.58; 52–85; 4)	63.0 (3.25; 59–66; 4)	**
early July	(1) 52.7 (4.01; 47–58; 9)	57.9 (3.32; 54–62; 6)	*
late July	(1) 52.3 (1.82; 51–55; 4)	52.0	

Average weight in non-breeding areas apparently slightly lower than on breeding grounds, e.g. in n. South America, adults, Sept.–Oct., 49.7 (7.35; 40–58; 9). Gain in weight before migration poorly known; see BWP for additional information.

AGEING See Field Identification.

GEOGRAPHICAL VARIATION None.

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Volume 3, Plate 19

Stilt Sandpiper *Micropalama himantopus* (page 326)
1 Adult non-breeding; **2** Juvenile; **3** First immature non-breeding

Cox's Sandpiper (page 307)
4 Adult non-breeding; **5** Juvenile, fresh plumage; **6** Juvenile, worn plumage

Curlew Sandpiper *Calidris ferruginea* (page 315)
7 Adult non-breeding; **8** Juvenile; **9** First immature non-breeding

Dunlin *Calidris alpina* (page 308)
10 Adult non-breeding; **11** Juvenile; **12** First immature non-breeding

Volume 3, Plate 20

Curlew Sandpiper *Calidris ferruginea* (page 315)
1 Adult breeding, fresh plumage, bright bird; **2** Adult breeding, fresh plumage, dull bird; **3** Adult breeding, worn plumage; **4, 5** Adult

Cox's Sandpiper (page 307)
6 Adult breeding; **7, 8** Adult

Dunlin *Calidris alpina* (page 308)
9 Adult breeding; **10, 11** Adult

Stilt Sandpiper *Micropalama himantopus* (page 326)
12 Adult breeding; **13, 14** Adult