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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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Calidris melanotos Pectoral Sandpiper

COLOUR PLATE FACING PAGE 321

Tringa melanotos Vieillot, 1819, *Nouv. Dict. Hist. Nat.* 34: 462 — Paraguay. Based on *chorlito lomo negro* No. 40 of Azara, 1802–5 *Apuntiamentos para la historia natural de los Paxaros del Paraguay y Rio de la Plata*.

The specific epithet is Greek for black (μέλᾰς, μέλᾰνος) and back (νῶτον).

The English name refers to the heavily streaked breast.

OTHER ENGLISH NAMES American Pectoral Sandpiper, Pouter-shorebird.

MONOTYPIC

FIELD IDENTIFICATION Length 19–24 cm; wingspan 37–45 cm; weight: male *c.* 85 g, female *c.* 60 g. Small to medium-small sandpiper, with flat back, plumpish body tapering to somewhat drawn-out rear end, small rounded head on long neck, and short legs; bill varies: short and straight to medium-length and gently decurved. At rest, folded primaries level with, just short of, or just beyond, tip of tail; primary projection short in breeding adults, long in juveniles. Very similar in size, shape, general appearance and plumage to Sharp-tailed Sandpiper *Calidris acuminata* but slightly slimmer, with longer neck, more rounded crown and lower more sloping forehead, slightly shorter legs and, on average, slightly longer and more strongly decurved bill. Pattern of underparts similar in all plumages, with diagnostic heavily dark-streaked gorget sharply demarcated from clean white belly. In flight, show prominent white sides to dark-centred rump and tail and indistinct narrow white wing-bar. Sexes differ: male larger, and pattern of gorget in breeding plumage differs slightly. Slight seasonal variation. Juvenile distinct. Immatures separable.

Description Adult breeding Crown and centre of forehead, brown, tinged dull chestnut when fresh and coarsely streaked black; supercilium varies: typically white and prominent in front of eye, becoming narrower, streaked darker and usually much less distinct behind eye where tapers to sides of nape; dull and indistinct on some; usually obvious narrow off-white lateral crown-stripes (faint or lacking in some) join supercilium above lores to create distinct split supercilium; overall effect is of somewhat snipe-like pattern when seen from head on. Chin and throat, white. Rest of head and neck, pale brown to buff, coarsely streaked black, with warmer orange-buff tinge to ear-coverts, narrow dark loral stripe and indistinct narrow white eye-ring. Mantle, back and scapulars, black, with broad dull-chestnut or brownish-buff fringes grading to off-white at tips (pale tips bisected by thin dark shafts); tips of feathers of outer mantle and lower row of upper scapulars often align to form prominent whitish mantle V and scapular lines. Tertials sometimes retained from non-breeding; usually acquire a few new breeding feathers patterned as scapulars. Innerwing-coverts mostly retained from non-breeding, appearing dark greyish-brown to blackish-brown with narrow cream fringes; some acquire new median and a few inner greater coverts, patterned much as scapulars. In fresh plumage, foreneck, breast and fore-flanks, brownish-buff, coarsely and densely streaked by black shaft-streaks, forming diagnostic neat uniformly streaked gorget, with very sharp demarcation between lower breast and upper white belly; slight downwards point in centre of bottom edge of gorget, which also tends to have somewhat spiky appearance. Male sometimes separable on pattern of breast (see Plumages). Rest of underbody, white, with some smudgy grey-brown streaks on flanks and a few fine dark streaks on sides of vent and undertail-coverts. In flight, show: broad blackish line through centre of rump and uppertail-coverts, contrasting with narrow white sides; lateral uppertail-coverts have dark streaks and chevrons (often also visible at rest). Central tail-feathers, blackish brown; rest, paler, grey-brown. Upperwing mostly blackish brown, slightly paler on bases of remiges, and with indistinct narrow white wing-bar along tips of greater coverts; shaft of outermost primary, white. Underwing, mostly white with contrasting grey remiges, greater primary coverts and band of dark mottling along leading-edge. Bill, black, with varying dull brown tinge to basal third to half of both mandibles, usually grading to small paler olive-yellow patch at base. Iris, dark brown. Legs and feet, from dull brownish or olive, to yellow or straw-yellow. **Adult non-breeding** Pattern of plumage like adult breeding, but head, neck and upperparts darker, browner and more uniform, and bare parts generally brighter. Differ by: Head-pattern more subdued, lacking rusty tones on cap, and ear-coverts only faintly tinged warmer brown. Feathers of mantle, scapulars, tertials and innerwing-coverts have diffuse blackish centres and paler buff-brown or grey-brown edges giving strongly patterned appearance to upperparts without chestnut edges, white tips and pale mantle and scapular lines (though, often, a few longer scapulars and tertials have warmer dull-chestnut edges and white tips). Bill usually obviously bicoloured, with basal third to half of both mandibles from greyish olive or brownish, to brownish yellow, yellow or bright orange-yellow. Legs and feet, from dull green or brown to, more typically, yellow or bright orange-yellow. **Juvenile** Superficially like adult breeding; differs by: Slightly capped appearance, as chestnut forehead and crown slightly brighter, contrasting more with nape and hindneck (rusty tones of cap always paler than fringes of tertials); and supercilium, cleaner white and more prominent. Feathers of mantle, scapulars and tertials have more rounded blackish centres and slightly darker chestnut fringes grading to clean white at tips of outer webs; upperparts appearing neater, more scaly, generally brighter, and rusty, with pale feather-tips aligning to form narrow, though much more distinct, white mantle V and scapular lines. Inner few greater secondary coverts, as tertials; other innerwing-coverts have darker-black centres and pale-chestnut fringes grading to clean white tips, latter clearly bisected by dark shafts. Pattern of underbody like that of fresh adult breeding (but never attaining dark-chested appearance of some males); dark streaking on rear flanks and sides of vent and undertail-coverts, fainter than in adults, often barely visible. In worn plumage, chestnut fringes and white tips of upperparts much reduced: rusty tones of cap appear duller; mantle, scapulars and tertials appear more uniform, black-brown and only faintly scalloped or fringed chestnut; pale mantle V and scapular lines faint or absent; pale fringes and tips of innerwing-coverts fade to white or buff (usually remaining obvious after pale fringing of rest of upperparts reduced by wear). Juvenile plumage usually distinct till late Nov. Bare parts as adult non-breeding. **First immature non-breeding** Very similar to adult non-breeding; separable during first austral spring and early summer by retained worn juvenile innerwing-coverts and, occasionally, tertials, contrasting with fresh non-breeding upperparts. Most distinguished by differences in wear of primaries: in austral summer, by retained worn juvenile primaries (primaries moulting or fresh in adults) or, during second austral spring, by marked contrast between fresh outer and very worn retained juvenile inner primaries. Those few that replace all juvenile plumage inseparable. **First immature breeding** Poorly known (see Plumages); similar to, or inseparable from, adult breeding, though plumage may be slightly duller in those that attain breeding plumage intermediate in character between breeding and non-breeding plumages. May be distinguished by differences in wear of remiges as in first immature non-breeding.

Similar species Combination of size; short to medium-length bill with brownish or yellowish base; yellowish legs; well-streaked gorget sharply demarcated from white underparts; and harsh reedy *kreep* flight call separate Pectoral from other small sandpipers; only likely to be confused with **Sharp-tailed Sandpiper** (q.v.).

In HANZAB area, usually solitary, in pairs, and, occasionally, in small loose groups (<10); on wide variety of freshwater and brackish wetlands, both coastal and inland. Show marked preference for vegetated edges of shallow freshwater wetlands but also often found at similar sites within sewage farms and commercial saltworks. Freely associate with other small waders, especially Sharp-tailed Sandpipers, and also commonly feed and roost with mixed flocks of Sharp-tailed and Curlew *Calidris ferruginea* Sandpipers and Red-necked Stints *C. ruficollis*. Typically shy and wary, rarely allowing close approach. When relaxed, with head hunched into body, tend to maintain more upright stance than Sharp-tailed Sandpiper; when alarmed, adopt characteristic upright posture with tail down and head raised on long slim neck, well above level of congeners; may also crouch in alarm but usually flush if pressed. Gait and feeding actions leisurely, very similar to those of Sharp-tailed Sandpiper; when feeding, move slowly and steadily along grassy fringe or in shallows with head down and legs flexed, combining picking with rapid shallow probing. Flight similar to that of Sharp-tailed Sandpipers, lacking flutter of smaller congeners; when moving between feeding areas, flight leisurely, with loose measured wing-beats recalling flight of female Ruff *Philomachus pugnax*; when flushed, spring into air, calling hoarsely and repeatedly and fly fast and low in twisting, snipe-like manner before shooting skyward and changing to steadier, more direct path; usually fly some distance before dropping into cover. Typical flight call distinctive, characteristic loud harsh reedy *trrip*, *kirrp* or *preep*, often repeated and resembling harsher, lower-pitched version of call of Curlew Sandpipers.

HABITAT In A'asia, mainly shallow fresh to saline wetlands; usually coastal or near-coastal, but occasionally farther inland; includes: coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains, and artificial wetlands. Wetlands often have open fringing mudflats, and low, emergent or fringing vegetation, such as grass or samphire; also recorded in swamp overgrown with lignum (Hobbs 1958a,b, 1959, 1961; Serventy 1960; Smith 1963, 1964; Sibson 1966; Speechly 1966; Eckert 1967; Thomas 1968; Humphries 1984; Storr 1984a, 1985, 1986; Storr & Johnstone 1988; Jaensch 1985; Vic. Bird Reps). In NZ, often on open wet sandflats, away from thick vegetation, or in pools among sparse vegetation (B.D. Heather). Occasionally recorded inland at lakes, swamps, lagoons, floodplains, grassy or

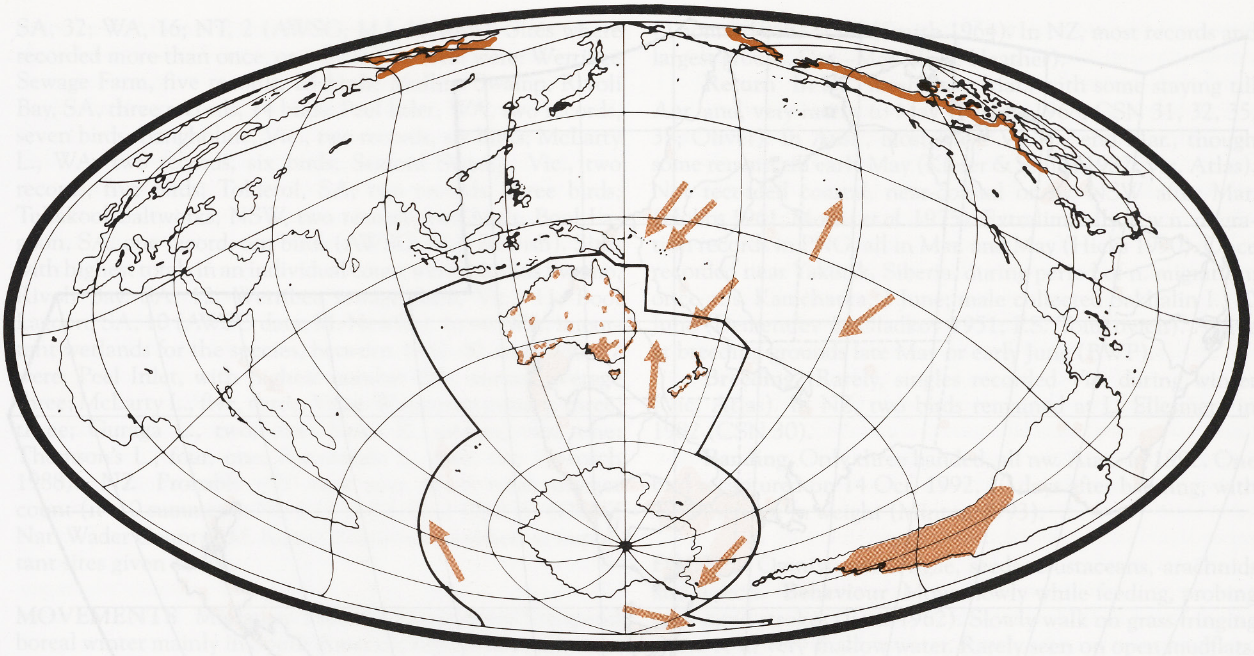
Plate 15

Baird's Sandpiper *Calidris bairdii* (page 283)
1 Adult breeding; 2 Adult non-breeding; 3 Juvenile

White-rumped Sandpiper *Calidris fuscicollis* (page 279)
4 Adult breeding; 5 Adult non-breeding; 6 Juvenile

Broad-billed Sandpiper *Limicola falcinellus* (page 333)
7 Adult breeding; 8 Adult non-breeding; 9 Juvenile;
10 First immature non-breeding

Sanderling *Calidris alba* (page 237)
11 Adult breeding; 12 Adult non-breeding;
13 Juvenile; 14 First immature non-breeding



lignum swamps, inundated grassy paddocks and round bores (Hobbs 1958a,b, 1959, 1961; Sibson 1966; Badman & May 1983; Vic. Bird Reps).

Forage in shallow water or soft mud at edges of, or on low islets in, wetlands, often close to low fringing or emergent vegetation (Smith 1963, 1964; Sibson 1966; Eckert 1967; Vic. Atlas).

Use artificial wetlands, including sewage farms and saltworks, irrigation channels, inundated rice paddocks, farm dams and artesian bores (Storr 1980; Badman & May 1983; Jaensch 1988; Vic. Bird Reps; NSW Bird Rep. 1981).

DISTRIBUTION AND POPULATION Breed n. Russia and North America: from Yamal Pen., E along Arctic coast, through deltas of Lena and Kolmyra Rs, to Chukotskiy Pen.; in North America, from Goodnews Bay, N through Wales to Pt Barrow, and E to n. Canada, from n. regions of Yukon and Mackenzie, N to Banks, Bathurst, Devon and n. Baffin Is, and S to w. Hudson Bay; locally S to C. Henrietta Maria. Transient through Central America and Caribbean, *en route* to non-breeding areas in South America, from Peru and Bolivia, S to s.-central Chile, and from s. Brazil, S to Argentina. In tropical Pacific, scattered records from Hawaii, Polynesia and Micronesia; regular visitor in small numbers to A'asia. Regular in small numbers through e. Asia, including Ussuriland, Japan and Korean Pen. Vagrant to Yenisei R. and Transbaikalia, continental Europe and British Isles, Azores, n. Africa, and s. and e. Africa including Kenya, S from Zambia to South Africa (Dement'ev & Gladkov 1951; Holyoak 1976; Blake 1977; Kinsky & Yaldwyn 1981; AOU 1983; Coates 1985; Urban *et al.* 1986; Pratt *et al.* 1987; Beckon 1990; BWP; P.S. Tomkovich). Numbers of records in Aust. and NZ reflection of ability to identify species in field. In Aust., the first specimen collected at Albany, WA, in 1919, but remained incorrectly identified till 1936 (Brooks 1936); the next record was of a single bird observed near Geelong, 18 Jan. 1952 (Hitchcock 1952) with increasing numbers of published records from 1950s to 1970s, when realized a regular visitor (Hewish 1987). In NZ, first specimens collected L. Ellesmere in 1903, 1909 and 1920, and at Nelson in 1930 (Stead 1923; Falla 1936); now considered regular visitor in small numbers.

Aust. Regular visitor in small numbers. **Qld** Most records round Cairns (Qld Bird Reps; Aust. Atlas). Scattered records elsewhere, mainly E of Great Divide, between Townsville and Yeppoon, and in SE (Qld Bird Reps; Aust. Atlas). Few inland records, including Mt Isa, Longreach and Oakley (Storr 1984b). Various unverified records published (*QOS Newsl. passim*) **NSW** Widespread but scattered records E of Great Divide, from Casino and Ballina, S to Ulladulla (Humphries 1984; NSW Bird Reps; Aust. Atlas); W of Great Divide, widespread in Riverina and Lower Western regions (Hobbs 1958a,b, 1959; Morris *et al.* 1981; NSW Bird Reps). **Vic.** Most records from Port Phillip Bay and valley of Murray R. between Kerang and Piangil; elsewhere, recorded once at Coronet Bay in Westernport Bay, and at scattered sites in W, in Western Districts, Wimmera and Mallee (Vic. Bird Reps; Vic. Atlas). **Tas.** First recorded 19–28 Nov. 1965 at Cambridge (Smith *et al.* 1971). Most records from a few locations in NE and SE. Between 1971 and 1991, 30 reports (Tas. Bird Reps 1–21), from ten locations: 12 records of up to four birds from C. Portland, six records from Orielton Lagoon–Sorell,

Plate 16

Red-necked Stint
Calidris ruficollis (page 258)
1, 2 Adult

Little Stint
Calidris minuta (page 250)
3, 4 Adult

Long-toed Stint
Calidris subminuta (page 270)
5, 6 Adult

Broad-billed Sandpiper
Limicola falcinellus (page 333)
7, 8 Adult

Sanderling
Calidris alba (page 237)
9, 10 Adult

White-rumped Sandpiper
Calidris fuscicollis (page 279)
11, 12 Adult

Baird's Sandpiper
Calidris bairdii (page 283)
13, 14 Adult

and three each from Barilla Bay and Clear Lagoon. Elsewhere, isolated records from Cameron Inlet, Flinders I. (Newman *et al*. 1984) and Henty R. (Tas. Bird Rep. 13). **SA** Mostly in SE, N to Murray R., and W to Yorke Pen. (SA Bird Reps; Aust. Atlas). Outside this region, occasionally recorded in the N and W, including Innamincka, Welcome Bore and Mintabie (Badman & May 1983; May 1986; Cox 1991). **WA** Rarely recorded; Nullarbor Plain: Eyre, 1982, 1983, 1985 (Congreve & Congreve 1985; Dymond 1988). Record at Reid, 1954 (McCrum & Slater 1955), dismissed by Boehm & Condon (1958). In S, sporadic records between Stoke's Inlet and Grassmere L., including Warden L., Dalyup and Yellilup Swamp; numerous records on Swan R. coastal plain between Benger Swamp and Guraga L. (Spence 1973; Jaensch 1988; Jaensch *et al*. 1988; *West. Aust. Bird Notes passim*; AWSG; Aust. Atlas). Isolated records from Wittecarra, and Harding R. near Roebourne in coastal Gascoyne and Pilbara regions respectively (Anon. 1984; Storr 1984a); few Kimberley Div. records, in SW and NE (Storr 1980; Jaensch 1989a,b). Occasionally inland, in regions of Goldfields, Pilbara and Kimberley (Curry 1979; Storr 1984a, 1986; Jaensch 1989a; Aust. Atlas). **NT** First recorded 6 Sept. 1967 (Crawford 1972); 17 records in Darwin area between 1967 and 1989 (H.A.F. Thompson & D.K. Goodfellow). Only other record: single, Alice Springs Sewage Farm, 17 Dec. 1978, 10 Jan. 1979 (Roberts 1980).

NZ Regular visitor in small numbers (probably <20 annually); largest flock, ten. Maximum numbers recorded given for regularly used sites. **NI** Scattered records in most regions. Harbours and bays S to Auckland, including Kokota Spit (six, 20 Jan. 1983; CSN 31), Parengarenga, Karikari Pen. (five, 6 Mar. 1977; CSN 24), and Whangarei, Kaipara and Manukau Harbours; Firth of Thames, including Miranda (three); Bay of Plenty: Kaituna Cut (four, 22 Dec. 1982; CSN 31) and Matata; coastal E. Coast, Gisborne and Hawke's Bay, from Muriwai to Porangahau estuaries, including Ahuriri Lagoon, Napier (four, 16 Dec. 1986; CSN 35). In SW, records clustered at L. Wairarapa (four, 23 Feb. 1974, 23 Dec. 1984; CSN 21, 33) and Manawatu R. estuary (seven, 20 Jan. 1973; CSN 20), and as far N as mouth of Turakina R. In Taranaki: between Rahotu and Waitara R. Also inland, including L. Waahi (Waikato) and L. Hatuma (Hawke's Bay) (Sibson 1966, 1972). **SI** Farewell Spit. Widespread in E, from L. Grassmere, S to Inch Clutha (six, 21 Feb. 1985; CSN 33), including L. Ellesmere (nine, summer 1981–82, 29 Dec. 1990–28 Mar. 1991; CSN 30, 39) and L. Wainono (ten, 10 Jan. 1984; R.J. Pierce; B.D. Heather). In Southland, from Waituna Lagoon (five, 30 Dec. 1974; CSN 22) to L. George, Colac Bay, including Waimatuku R. estuary (four, 11 Mar. 1973, 10 Feb. 1974; CSN 20, 21). Also inland, including Spider Lagoons, Cass R. delta at L. Tekapo, and near Ranfurly, central Otago (CSN; Child 1983). Southernmost record, Ruapuke I., Foveaux Str. (CSN 36).

Norfolk I. Accidental; 1–3, 31 Oct.–16 Nov. 1981 (Moore 1985).

Lord Howe I. Singles: 27 Feb.–7 Mar. 1986 (NSW Bird Rep. 1986); 12 Nov. 1992 (NSW Bird Rep. 1992).

Kermadec Is Specimen, claimed to be this species, collected *c*. 1910 (Falla 1936) but specimen missing and claim unverified (B.D. Heather).

Chatham Is Undated records (Freeman 1994).

S. Georgia Bird I., singles: specimen, 26 Dec. 1971 (Prince & Payne 1979); 27 Oct. 1976 (Prince & Payne 1979); specimen, 1 Jan. 1982 (Prince & Croxall 1983).

Prince Edward I. Single, 18–19 Nov. 1986 (Gartshore 1987).

Antarctic Pen. Single, Rothera Pt (67°34', 68°08'), date unknown (Prince & Croxall 1983).

Populations In summer surveys round Aust., 1981–85, a total of 123 was recorded: Qld, 9; NSW, 15; Vic., 42; Tas., 7;

SA, 32; WA, 16; NT, 2 (AWSG; M.J. Hewish). Sites where recorded more than once, or >5 birds in total were: Werribee Sewage Farm, five records, 23 birds; Mullins Swamp, Rivoli Bay, SA, three records, 14 birds; Peel Inlet, WA, two records, seven birds; Bangholme, Vic., two records, six birds; McLarty L., WA, two records, six birds; Seaford Swamp, Vic., two records, five birds; Tolderol, SA, two records, three birds; Tullakool Saltworks, NSW, two records, two birds; Bool Lagoon, SA, one record, ten birds (AWSG; M.J. Hewish). Sites with highest totals in an individual count were: Mullins Swamp, Rivoli Bay, SA, 12; Werribee sewage farm, Vic., 11; Bool Lagoon, SA, 10 (AWSG data; M. Hewish). In sw. WA, important wetlands for the species, between 1981–82 and 1986–87 were: Peel Inlet, with highest number five, annual average three; McLarty L., five, three; Vasse-Wonnerup estuary, three, three; Guraga L., two, one; Swan R. estuary, two, one; Thomson's L., four, one; Forrestdale L., four, two (Jaensch 1988). **NZ** Probably <20 each year. Mean total summer count (n=10 summers): NI, 2 (2; 0–5); SI, 2 (2; 0–5) (OSNZ Nat. Wader Count; P.M. Sagar). Maximum numbers at important sites given above.

MOVEMENTS Migratory. Breed in Arctic; move S to spend boreal winter mainly in South America; regular in small numbers on some Pacific islands, and in A'asia (AOU 1983; Flint *et al.* 1984). Origins of birds in HANZAB region not known.

Departure Males leave from late June; females to early Aug.; and juveniles, from early Aug. (Hayman *et al.* 1986; P.S. Tomkovich). Most of population breeding in Siberia appears to move E to Alaska and Canada, then migrate with Nearctic population (Dement'ev & Gladkov 1951; Hayman *et al.* 1986; BWP). Nearctic breeding populations move S, mostly overland, and mainly through interior of North America, probably with some e. elements crossing w. Atlantic Ocean to n. South America (AOU 1983; BWP). Occur on coasts of e. Asia, S from Magadan (Sept.), Commander Is (Sept.–Oct.), Kurile Is (Sept.), Sakhalin (Sept.) and Ussuriland (Sept.), and occasionally to Japan (Dement'ev & Gladkov 1951; Orn. Soc. Japan 1974; AOU 1983). Recorded Korea. On se. Asian coasts not recorded farther S than China, Taiwan and Hong Kong (Chalmers 1986; AWB 1993). Very occasionally visit Pribilof and Aleutian Is (AOU 1983). Common s. passage migrant, Hawaiian Is (Sept.–Oct. on Kure and Midway Is) (Pyle 1984). Regular passage migrant, Phoenix and Line Is in central Pacific; scattered records for Johnston Atoll, Niue, Scilly, and Rapa Is, Micronesia and Bougainville (Kinsky & Yaldwyn 1981; Coates 1985; Hayman *et al.* 1986; Pratt *et al.* 1987). Small numbers regularly occur on s. passage in Port Moresby district, PNG, Aug.–Jan., but usually arrive in Oct. with maximum numbers Nov. (Coates 1985; Hicks 1990). Not recorded Torres Str. (Draffan *et al.* 1983) or Gulf of Carpentaria (Garnett 1989); recorded Darwin from Sept. and Oct. (Crawford 1972). Recorded nw. Aust., Sept.–Oct. (Lane 1988; Minton 1993). Vagrant to Lord Howe I. (Hutton 1990). In NZ, recorded from Sept. with most arrivals early Nov., and less often late Oct. (Falla *et al.* 1981; CSN; B.D. Heather; Oliver).

Non-breeding In Aust., said to occur most often in SE (Lane) though lack of n. records may reflect lack of observers (Aust. Atlas). Recorded NSW from Sept. (Hobbs 1961; Morris *et al.* 1975); coastal and inland Vic., from Sept., though mostly from Nov. (Kieser & Smith 1982; Vic Atlas); SA, from Oct. (Eckert 1967); Tas., Oct.–Nov. (Thomas 1970b). Possibly dispersive in Aust.; visit temporary wetlands (Hobbs 1958b; Curry 1979) and known to disappear after wetlands dry (Thomas 1968) or fill (Smith 1964). In NZ, most records and largest groups, Dec.–Mar. (B.D. Heather).

Return In NZ, most leave Mar., with some staying till Apr. and, very rarely, to May (Barlow 1968; CSN 31, 32, 35, 37; Oliver). In Aust., most leave Vic. by end Mar., though some remain till early May (Kieser & Smith 1982; Vic. Atlas). Not recorded coastal, near-coastal or sw. NSW after Mar. (Hobbs 1961; Morris *et al.* 1975). Extralimitally, few n. migration records in PNG, all in Mar. and May (Hicks 1990). Once recorded near Yakutsk, Siberia, during period of n. migration; once at s. Kamchatka, 2 June; male collected Sakhalin I., 10 June (Dement'ev & Gladkov 1951; P.S. Tomkovich). Arrive at breeding grounds late May or early June (BWP).

Breeding Rarely, singles recorded Vic. during winter (Vic. Atlas). In NZ, two birds remained at L. Ellesmere in 1982 (CSN 30).

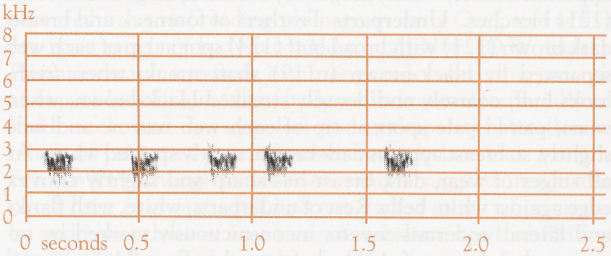
Banding Only three banded, all nw. Aust. in 1992. One bird recaptured on 14 Oct. 1992, 10 days after banding, with 40% increase in weight (Minton 1993).

FOOD Omnivorous. Algae, seeds, crustaceans, arachnids and insects. **Behaviour** Move slowly while feeding, probing with rapid strokes (Bent 1962). Slowly walk on grass fringing water or in very shallow water. Rarely seen on open mudflats. Probe repeatedly in small area. Adopt characteristic semi-crouched position while gleaning (Smith 1963).

Adult No detailed studies: Plants: sds (Hitchcock 1952). Insects (Hobbs 1958b; Smith 1963): Hemiptera; Coleoptera: Dytiscidae larv. (Hitchcock 1952). Sand (Hobbs 1958b). Extralimitally, see Bent (1962), Bowdish (1902), Preble & McAtee (1923), and Kistchinski (1973).

VOICE No detailed studies or published sonagrams (Miller *et al.* 1988). Not very vocal. In HANZAB area, most common call a hoarse dry reedy chirrup. Usually heard as double, treble or irregularly repeated note (BWP).

Adult The *churt* call (sonagram A) a reedy *krrik* or grating *trrip-trrip* or *prrp* when flushed, becoming harsher and louder if alarmed (Colston & Burton 1988). Also rendered as *kriik*, *krrrt*, *chirrp*, *chreep* or *trreep* (see BWP). Call complex; energy centred on *c.* 2 kHz as a strongly wavering tone superimposed over a mushy sound; different from calls of Sharp-tailed Sandpiper (q.v.).



A Cornell LNS; South Dakota; *Western Bird Songs: Peterson Field Guides*, CD #1: track 29

PLUMAGES Prepared by D.I. Rogers. Hatch in natal down; replaced by juvenile plumage, which is retained until arrival in non-breeding areas. Undergo partial first pre-basic moult to first-immature non-breeding plumage soon after arrival; some may also moult primaries and secondaries. Partial first pre-alternate moult to first immature breeding well advanced or complete before leaving on n. migration. Thereafter, alternating complete pre-basic moult to non-breeding plumage and partial pre-alternate moult to breeding plumage, mostly in non-breeding areas.

Adult male breeding (Second and subsequent alternate). First attained in second austral summer. **Head and neck** Crown to hindneck, dark to blackish brown (121–119), coarsely streaked when fresh by broad warm-brown (123A) edges to feathers; edges become narrower and fade to pale brown (c223D–c119D) with wear, crown to hindneck then appearing more uniform, dark brown (edges broader and more rufous in Sharp-tailed, forming more contrasting and ginger cap). Supercilium, off-white, faintly flecked dark brown (121–119) (especially behind eye) by shaft-streaks to lateral feathers; supercilium broadest in front of eye and about width of eye for most of length over ear-coverts (supercilium of Sharp-tailed cleaner white and broadens more behind eye). Supercilia separated by narrow dark-brown (c119A–c119B) median stripe on forehead (mottled by whitish edges to feathers). Often have short white lateral crown-stripes that meet white of upper lores and extend back to about level of eye, giving appearance of split supercilium. Narrow brown (c119A–c119B) loral stripe and narrow white orbital ring. Chin and upper throat, off-white. Sides of throat and face, pale brown (c223D) to white, densely and coarsely streaked by dark-brown (121) shaft-streaks, which are broader towards hindneck and forethroat; rear of ear-coverts to hind edge of eye generally tinged orange-buff (c118) to cinnamon (39). Foreneck, as breast. **Upperparts** Mantle and back, black-brown (119), densely and evenly scalloped when fresh by broad light rufous-brown (38–123A) fringes to feathers; fringes fray and bleach with wear, mantle and back then appearing blackish brown, broadly streaked cream (c92) to light brown (c123A) by remains of pale fringes towards bases of feathers. Patterning of scapulars similar to that of mantle, but fringes broader at tips, where they grade to brown (119B–119C) even when fresh; pale fringes divided by narrow black-brown (119) shaft-streaks; dark-brown (121) bases of feathers less concealed than on mantle. When worn, more pale fringes of scapulars retained than on mantle, though they can fade to white at tips. Pale tips can line up to form narrow mantle V and scapular lines. Lower back, rump and uppertail-coverts, usually retained from non-breeding plumage; even if replaced in pre-alternate moult, feathers like adult non-breeding except that hindmost lateral uppertail-covert, white, irregularly barred by large dark-brown (121) blotches. **Underparts** Feathers of foreneck and breast, dark brown (121) with broad buff (124) spot at tip of each web separated by black-brown (c119) shaft-streak; when fresh, looks buff, coarsely and densely streaked black-brown; when worn, paired pale spots at tip of each web narrow and fade slightly, so breast appears dark brown, neatly spotted white. At all stages of wear, dark breast has sharp and slightly convex edge against white belly. Rest of underparts, white, with flanks and lateral undertail-coverts inconspicuously marked by tapering dark-brown (c121) shaft-streaks. Fore-flanks tinged pale brown (c223D), contrasting with clean white axillaries. **Tail** Similar to, and usually retained from, non-breeding plumage, though some attain a few breeding central rectrices, with light rufous-brown (39) tinge to pale fringes, strongest on edges of feathers. **Upperwing** Sometimes retained from non-breeding plumage, but more often moult a few tertials, and may moult median secondary and some inner greater secondary coverts. Tertials, black-brown (119) grading to brown (119B) at tip, with broad rufous-brown (38–136) edges that grade to narrow white fringes at tip. Median and greater secondary coverts, differ from non-breeding by pale fringes that grade to light rufous-brown on edges. Tertial coverts, dark brown (121) to blackish brown (119) with even white fringes that are tinged buff (c92) at tips of longest feathers. **Underwing** Retained from non-breeding plumage.

Adult female breeding (Second and subsequent alternate). Differs from male by finer dark streaking on breast (Hayman *et al.* 1986) but variation not as striking as that caused by wear (e.g. BWP) and of little use in sexing birds in our region.

Adult non-breeding (Second and subsequent basic). First attained in second austral spring. Similar to non-breeding Sharp-tailed Sandpiper. **Head and neck** As adult breeding, but duller. Differs by: Edges to feathers of crown, duller brown (c26) and, when worn, edges become narrower and fade to pale brown (c119D) (dark cap much less ginger than in Sharp-tailed). Feathers of hindneck and nape have lighter-brown (119C) edges. Supercilium usually broader, though similar in shape (does not broaden behind eye, cf. Sharp-tailed Sandpiper). Dark streaks of sides of face and neck, slightly finer (coarser than in Sharp-tailed Sandpiper). Foreneck, as breast. **Upperparts** Duller than breeding and juvenile plumages, without rufous and white fringes to feathers. Feathers of mantle, back and scapulars have black-brown (119) centres, tapering slightly at point (slightly broader and not as lanceolate as dark feather-centres of Sharp-tailed); fringes, light brown (c223C), becoming narrower and fading to pale greyish-brown (119C–119D) with wear. Lower back, rump and uppertail-coverts, black-brown (119) with narrow brown (239) tips to feathers when fresh. Lateral uppertail-coverts, white, forming narrow white sides to rump in flight; white feathers have broad dark-brown (121, 119) central marking, larger on outer web, which tapers to sharp point; usually these dark markings broken by large white patch at shaft, thus appearing as broad dark-brown chevrons broadest on outer web. **Underparts** Superficially similar to fresh breeding plumage, but appearance varies little with wear. Foreneck and breast, buff (c223D) to white, densely streaked by dark-brown (121) shaft-streaks on terminal half of each feather; basal halves, grey-brown (c119A), very slightly exposed in worn plumage to give grey tinge to foreneck and breast. Demarcation from rest of underparts less sharp than in breeding, with dark shaft-streaks often encroaching slightly onto upper belly and extreme sides of foreflanks (still more distinct than in non-breeding Sharp-tailed, which has less heavy dark-brown markings on breast and white of belly extends far onto centre of lower breast). Rest of underparts, like breeding. **Tail** T2–t6, grey-brown (c45), neatly fringed white; t1, black-brown (c119), lacking pale fringes. (Ground-colour more uniformly dark in Sharp-tailed). **Upperwing** Alula, primaries, secondaries, all primary coverts and greater secondary coverts, black-brown (119), wearing to dark brown (c119A); inner greater secondary coverts paler brown (c119B–119C) in centre. Greater secondary coverts have white fringes, broad at tips, which meet white tips of inner greater primary coverts to form neat narrow white wing-bar. White tips of greater primary coverts very narrow; no more than 1 mm wide on inner five feathers and often missing on outer five (cf. Sharp-tailed Sandpiper). Secondaries and inner primaries have narrow white fringes, broadening at tips of s6 or s7 through to s10. P10 has white shaft; other primaries have dark-brown (23) shafts grading to small paler-brown (c119C) area near tip. Tertials, and tertial, median and lesser secondary coverts, similar to scapulars, though centres of feathers, dark brown (121), grading to slightly lighter brown (119B) at bases, and tapering slightly more at tip; fringes, light brown (c223C–119C), giving coarsely scalloped appearance; marginal coverts, similar but ground-colour slightly darker brown and pale fringes narrower, forming dark leading-edge. Pale fringes and tips of all secondary coverts much reduced by wear, fading whiter. (Very similar to non-breeding Sharp-tailed Sandpiper, except shafts to primaries darker, and wing-bar smaller). **Underwing** Remiges, glossy grey (c79), grading to white area at base of inner webs, especially on inner secondaries; shafts, white. Coverts, mostly white, greater primary coverts have large glossy grey (c79) centres; lesser primary coverts and marginals, dark brown (121) with white fringes, forming narrow dark leading-edge. Similar to Sharp-tailed Sandpiper.

Juvenile Retained until at least Nov., later than in most other *Calidris* in Aust. except for Sharp-tailed Sandpiper. Superficially similar to adult breeding. **Head and neck** Differs from adult breeding by slightly darker rufous-brown (136) streaking on crown and nape, forming slightly stronger contrast with hindneck. White supercilium, slightly broader. Foreneck, as breast. **Upperparts** Mantle, similar to adult breeding but scalloped, not streaked, in fresh plumage; feathers slightly smaller, uniformly worn, with more smoothly rounded dark centres, and darker rufous-brown (136–340) fringes. Fringes of longest feathers of mantle and scapulars, darker rufous-brown (136–340) than in adult breeding, grading to white at tip; tips align to form neat narrow V on mantle and one or more lines along lower scapulars, which are much more distinct than in adult breeding (and more distinct than in juvenile Sharp-tailed Sandpiper, which also has more convex rounded tips to dark centres of feathers). In worn plumage, white fringes and rufous tones to upperparts much reduced, with fringes of feathers fading to cinnamon (c223D) or light brown (119D); unlike worn breeding plumage, upperparts appear uniformly worn and neatly scalloped by faded remnants of pale fringes. Rufous-brown (136) tips to uppertail-coverts and feathers of rump, slightly narrower and darker than in breeding. **Underparts** Foreneck and breast, buff (c124–c119D), densely streaked by dark-brown (121) shaft-streaks of uniform width (very different from clean buff breast of juvenile Sharp-tailed Sandpiper). Superficially similar to fresh adult breeding but appearance little affected by wear and never have very dark breast; streaking of rear flanks and lateral undertail-coverts fainter, often barely noticeable; often no white centres to dark markings of lateral uppertail-coverts. **Tail** Similar to adult but t2–t6 have faint dark-brown (c121) submarginal line and white tips more broadly bisected by dark-brown (c121) shaft-streaks. T1 has narrow light rufous-brown (38) fringes; t2 has cinnamon (c39) edges, grading to off-white on t4–t6. **Upperwing** Similar to adult breeding. Marginal and tertial coverts have light rufous-brown (39) fringes; fringes of marginal coverts bleach to pale brown (c92). Lesser and median secondary coverts have conspicuous pale edges, almost meeting at tips of feathers; grade from light rufous-brown (c39) at bases to white distally; rufous-brown areas larger on inner feathers, and bleach to buff (c92). **Underwing** As adult.

First immature non-breeding (First basic). Very similar to adult non-breeding and perhaps not consistently separable when in complete first pre-basic. When present, retained juvenile plumage on wing-coverts, primaries, secondaries, and from back to tail, are best indicators of age; tertial coverts and innermost median coverts retain light rufous-brown fringes (cf. usually pale buff to whitish in adults) but other feathers may only appear different from those of adult in same period by slightly greater wear.

First immature breeding (First alternate). Not known to breed in this plumage. Like adult breeding and probably not separable if complete post-juvenile moult has occurred. Otherwise, differs by retained, heavily abraded juvenile plumage on upperwing and from back to tail; as retained non-breeding coverts and feathers of body of breeding adults also worn, best separated on heavily abraded juvenile primaries and secondaries; some also retain remnants of rufous to buff fringes on bases of inner median coverts.

BARE PARTS From photos (mainly Kaufmann 1987; Pringle 1987; Delin & Svensson 1988; Moon 1988; Chandler 1989; Paulson 1993; Aust. RD; NZRD; as well as numerous other published sources; unpubl.: D.W. Eades; J.N. Davies).

Adult breeding Bill, grey-black (82) to black (89) with varying brown (239) tinge at base restricted to base of tomium, and barely noticeable in some individuals; in some, up to basal half of bill may be tinged brown (239), grading to small olive-yellow (57) patch at base of bill (pale area at base of bill much larger than that of Sharp-tailed Sandpiper). Iris, black-brown (119). Legs and feet, yellow (55, c153) or straw-yellow (57) to olive (51, c42), often with dusky-grey (83) tinge to joints (generally yellower than in Sharp-tailed). **Adult non-breeding, Immature non-breeding** Similar to adult breeding, but pale area at base of bill generally larger, especially on lower mandible; colour varies from greyish olive (43) or light olive-brown (c239) to olive (51) or olive-yellow (52) and may extend over basal half of bill. **First immature breeding** Not known; probably similar to adult breeding. **Juvenile** At fledging, bill and feet, blackish grey (Parmelee *et al.* 1967); later, similar to adult non-breeding. In some, pale base of bill has pinkish-brown (223C, c221B) tinge; not known if this also occurs in some adult non-breeding.

MOULTS Mostly from BWP, supplemented by data from 14 caught in Aust. (ABBBS, AWSG) and 45 skins, including 15 from Aust. (AM, ANWC, HLW, MV, SAM, WAM).

Adult post-breeding (Second and subsequent pre-basic). Begin in second austral spring; complete. Moult of body begins near breeding grounds, from early July to early Aug.; underparts start first. Seem to moult little before s. migration; most birds on s. passage have only a few fresh non-breeding feathers on head, mantle, scapulars, sides of breast and belly, and often there is no fresh non-breeding plumage (BWP). In Vic., female observed in worn breeding plumage in early Oct., and active pre-basic moult of body recorded in mid-Nov. (D.W. Eades). Primaries moult outwards, beginning on non-breeding grounds after post-breeding moult of body well advanced (especially on head, neck, mantle, scapulars and underparts). Duration of moult of primaries poorly known; roughly late Oct. to early Feb. (BWP), though small Aust. sample suggests moult may occur later (e.g. one adult had not started moult of primaries by end Nov.; three of four birds of unknown age had PMS of 46–49 in Mar., with moult of primaries overlapping early stages of pre-alternate moult of body). In Vic., moulting birds retaining two outer primaries recorded 24 Dec. and 31 Jan.; birds with one old outer primary recorded 9 Jan. (n=3) and 20 Jan. (D.W. Eades). **Adult pre-breeding** (Second and subsequent pre-alternate). Occurs mid- to late Feb. to early May; in Vic., early pre-alternate moult of some scapulars and tertials recorded mid-Jan. (D.W. Eades). Partial, not including primaries or secondaries. Involves head, neck, mantle, underparts, most or all scapulars, often a few inner or longer tertials (rarely all), some tertial coverts and sometimes a few median upperwing-coverts; usually retain non-breeding plumage from back to tail but a few moult some central rectrices or part of back and uppertail-coverts. **Post-juvenile** (First pre-basic). Partial, possibly complete in some. Begins late Nov. or Dec. (later than in most *Calidris* occurring Aust.) and apparently delayed until arrival in non-breeding areas. Moult head, neck, mantle, underparts and most scapulars, some median upperwing-coverts and, sometimes, some tertials or central rectrices (BWP). Some may moult primaries and other juvenile plumage in this moult or in a first pre-supplemental (e.g. immature in se. SA with early moult of primaries 1^3O^7 on 26 Nov.; see also BWP). How often post-juvenile moult of primaries occurs, not known; may be common in Aust., where there are few records of immatures after Dec., and where moult of primaries of apparent adults seems unusually late (see Adult post-breeding). **First immature pre-breeding** (First pre-alternate). Partial; similar in extent to adult pre-breeding moults; not known if moult occurs slightly later (as is the norm in *Calidris*).

MEASUREMENTS (1) Aust., skins, ages combined (AM, ANWC, HLW, MV, SAM, WAM). (2–4) North and South America, skins; combined data from BWP and Aust. museums (AM, MV, SAM, WAM): (2) Adults; (3) Juveniles and immatures with juvenile p10 and central rectrices; (4) Ages combined.

		MALES	FEMALES	
WING	(1)	144.7 (4.08; 140–152; 6)	130.9 (4.75; 123–136; 10)	**
	(2)	142.7 (3.30; 135–148; 23)	132.0 (3.75; 126–143; 20)	**
	(3)	144.0 (3.35; 136–150; 20)	130.7 (3.66; 125–138; 15)	**
TAIL	(1)	60.1 (4.52; 55–67; 7)	54.0 (4.90; 45–62; 12)	*
	(2)	59.0 (3.39; 55–70; 23)	53.3 (2.80; 48–58; 20)	**
	(3)	56.3 (2.35; 53–62; 20)	50.6 (2.34; 46–54; 13)	**
BILL	(1)	28.9 (1.83; 26.9–32.0; 8)	27.3 (1.69; 24.3–29.6; 13)	*
	(4)	29.2 (1.27; 26.1–32; 40)	27.5 (1.35; 23.8–30; 35)	**
TARSUS	(1)	28.7 (1.70; 26.1–31.7; 7)	27.2 (1.07; 25.0–28.6; 13)	*
	(4)	28.7 (1.03; 26.1–31; 43)	27.1 (1.10; 24–28.8; 35)	**
TOE	(1)	29.7, 28.8, 28.5	26.6 (0.40; 26.0–26.9; 6)	**
	(4)	27.7 (1.20; 24.8–31; 40)	26.4 (1.13; 24.8–28.7; 31)	**

No significant differences between Aust. and America, or between length of wing of juveniles and adults. Tails of juveniles slightly but significantly shorter than in adults.

WEIGHTS (1) Aust., adults, live and skins, including some sexed on measurements (AM, ANWC, MV, SAM, WAM, AWSG, ABBBS). (2) N. Alaska, adults (Pitelka 1959): June (courtship and early laying period); (3) July.

	MALES	FEMALES	
(1)	70.0 (5.14; 62–78; 7)	51.7 (5.29; 45–63; 10)	**
(2)	94.6 (6.30; 82–105; 11)	65.9 (5.65; 68–86; 8)	**
(3)	85.0 (10.96; 75–102; 5)	58.9 (5.23; 50–71; 27)	**

At breeding grounds, adults heaviest early in breeding season, when females about to lay and territorial males have large deposits of subcutaneous tissue in breast (see Structure); average weights of adults decline while breeding (Pitelka 1959; Parmelee *et al.* 1967). Variation in weight associated with migration poorly known; gain of weight before s. migration occurs S of breeding grounds (Pitelka 1959); only Aust. data are adult female of 92 g in sw. Aust. on 23 Mar. (WAM), which may have been approaching departure weight, and juvenile male staging in nw. Aust. of 58 g on 4 Oct. and 82 g when recaptured 10 days later. In N of South America at end Sept. and first half Oct., recently arrived juveniles males 49.8 (45–55; 5), females 44.3 (31–54; 7) (McNeill 1970). See also BWP and references therein.

STRUCTURE Wing, long, pointed and narrow. Eleven primaries; p10 longest, p9 1–4 mm shorter, p8 6–13, p7 15–24, p6 24–34, p5 34–45, p4 43–54, p3 51–62, p2 57–70, p1 62–74; p11 minute, narrow, concealed by primary coverts. Mostly similar in structure to Sharp-tailed Sandpiper (q.v.) but differs by: (1) Shape of tail consistently different: short and square (cf. wedge-shaped in Sharp-tailed Sandpiper) with less pointed rectrices; t1 longest and pointed at tip, projecting 3–9 mm beyond t2 (which may also be slightly pointed when worn); other rectrices rounded at tip; t3–t5 shortest, about equal in length and 6–14 mm shorter than t1. (2) Bill usually proportionately longer; 95–120% of length of skull, looking about same length as head; upper mandible slightly more decurved at tip. (3) Tarsus proportionately shorter (though difference often not apparent in the field because Sharp-tailed Sandpiper has heavier build). Toes, long and slender; outer toe c. 84% of middle, inner c. 80%, hind c. 25%. During courtship, throat and chest of breeding males distinctly swollen by flaccid, highly vascularised, subcutaneous tissue that can rapidly change position and volume during displays, though mechanism for this is not known; weight of this tissue up to 30 g (Parmelee *et al.* 1967).

GEOGRAPHICAL VARIATION None. Available measurements for Aust. birds do not differ from those from American flyways.

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Volume 3, Plate 18

Pectoral Sandpiper *Calidris melanotos* (page 287)
1 Adult male breeding; **2** Adult female non-breeding; **3** Juvenile; **4, 5** Adult

Sharp-tailed Sandpiper *Calidris acuminata* (page 295)
6 Adult male breeding; **7** Adult female non-breeding; **8** Juvenile; **9** First immature non-breeding; **10** First immature male breeding; **11, 12** Adult

Buff-breasted Sandpiper *Tryngites subruficollis* (page 329)
13 Adult male; **14** Juvenile; **15, 16** Adult