

Order CHARADRIIFORMES

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

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

Thinocoridae	seed-snipes; four species, S. America.
Pedionomidae	Plains-wanderer; monotypic, Aust.
Scolopacidae	sandpipers, snipes and allies; c. 85 species, cosmopolitan.
Rostratulidae	painted snipes; two species, s. America and Old World.
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	pratinoles, coursers, and Egyptian Plover; c. 15 species, widespread in Old World.
Stercorariidae	skuas and jaegers; about seven species, mostly in Arctic and Antarctic regions.
Rhynchopidae	skimmers; three species, pantropical.
Laridae	gulls; c. 47 species, cosmopolitan.
Sternidae	terns; c. 42 species, cosmopolitan.
Alcidae	auks; c. 20 species, Arctic and temperate regions of n. hemisphere.

Apparently monophyletic. Pteroclididae (sandgrouse) probably sister-group of Charadriiformes (e.g. Fjeldså 1976, 1977; Sibley & Ahlquist 1990; BWP), though whether best placed within Charadriiformes or in separate order is debated. Flamingoes (Phoenicopteridae) and divers (Gaviidae) have also been treated as Charadriiformes (Olson & Feduccia 1981; Fjeldså 1976, 1977) but DNA–DNA hybridization studies (Sibley & Ahlquist 1990) inconsistent with these theories. Affinities to other orders still controversial; DNA–DNA hybridization has suggested closest links are to large waterbirds, such as storks, herons and allies, Pelicaniformes, Procellariiformes, penguins, grebes, divers (Gaviidae) and also Falconiformes. All these were combined in huge order Ciconiiformes by Sibley & Ahlquist (1990).

Taxonomy and relationships reviewed in Sibley & Ahlquist (1990), Christian *et al.* (1992) and BWP (and references therein). Recent reviews have included: patterning of downy young (Jehl 1968; Fjeldså 1976, 1977), osteology (Strauch 1978; Mickevitch & Parenti 1980; Olson & Steadman 1981), DNA–DNA hybridization (Sibley *et al.* 1988, Sibley & Ahlquist 1990) and electrophoresis of tissue proteins (Christian *et al.* 1992). The studies of allozymes, DNA–DNA hybridization and the most recent osteological study of the entire order (Strauch 1978) have agreed in finding two or three well-knit, monophyletic assemblages within the Charadriiformes: scolopacids and allies (Thinocoridae, Pedionomidae, Scolopacidae, Rostratulidae, Jacanidae) and charadriids and allies (Chionididae, Burhinidae, Haematopodidae, Recurvirostridae, Ibidiorhynchidae, Charadriidae, Pluvianellidae, Dromadidae, Glareolidae, Stercorariidae, Rhynchopidae, Laridae, Sternidae, Alcidae); Strauch (1978) treated Alcidae as separate lineage, but skeletons may be so highly modified for foot-propelled diving that they do not reflect relations well (Sibley & Ahlquist 1990); gulls and allies have also been regarded as a separate lineage (Christian *et al.* 1992) or as allied to charadriids (e.g. Sibley & Ahlquist 1990). Further relationships within the Order discussed in introductions to families.

Because the Order comprises so many species and adaptations are so diverse, few characters shared by all species; those that are shared are mostly anatomical features of the skull, e.g. most or all have schizorhinal nostrils, schizognathous palates, well-developed vomer, lachrymals fused with ectethemoid and pre-frontal bones, well-developed supra-orbital grooves; see Olson & Steadman (1981) for more information on osteological characters. Wings usually have 11 primaries, with p10 longest and p11 minute; 15–24 secondaries; 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, Stercorariidae, Laridae and Sternidae will be dealt with in Volume 3 of HANZAB.

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Order CHARADRIIFORMES

Family SCOLOPACIDAE sandpipers and allies

Small to large shorebirds (12–66 cm) with long bills and legs. Largest family of suborder Charadrii, with some 88 species in c. 24 genera; most species only breed in higher latitudes of Holarctic, but migrate long distances and occur almost worldwide in non-breeding period. In HANZAB area, 51 species in 18 genera: two breeding species, 27 regular non-breeding migrants, 19 accidentals and three doubtfully recorded. All are transequatorial migrants except for the two species of *Coenocorypha* that breed NZ, which are sedentary. The family is usually split into six subfamilies (e.g. Jehl 1968; BWP): Scolopacinae, Gallinagoninae, Tringinae, Arenariinae, Calidridinae and Phalaropodinae; we place the dowitchers *Limnodromus* in a separate subfamily, Limnodrominae (q.v. for details). All except Scolopacinae (woodcocks) represented in HANZAB region. Though they are convenient groupings, these subfamilies may not be wholly monophyletic (e.g. Strauch 1978; Dittman *et al.* 1989; Sibley & Ahlquist 1990; BWP); until phylogeny within the Family is understood, sequence of genera and species followed by different authors is likely to remain unsettled. Sequence and taxonomy used here follows Christidis & Boles (1994). Studies of allozymes (Christian *et al.* 1992), DNA hybridization (Sibley *et al.* 1988; Sibley & Ahlquist 1990), osteology (Strauch 1978) and patterns of downy young (Jehl 1968) generally agree in treating Scolopacidae as monophyletic, with distant links to Jacanidae, Rostratulidae, Thinocoridae and Pedionomidae.

Body-form diverse, from slender to stocky. Females slightly to considerably larger than males, though in a few species males are larger (Jehl & Murray 1986). Wings, long and pointed; p10 longest; 15–22 secondaries, including elongate tertials, which, with scapulars, cover back and rump when at rest. Tail, short; 12 feathers except in *Gallinago*, which have 14–28, and *Coenocorypha*, which have 14. Neck, long. Shape of bill varies considerably, though generally long and slender; usually straight to decurved, but recurved in a few Tringinae; tip of bill, fine or only slightly swollen (cf. Charadriidae) with sensory pits. Compared to Charadriidae, eyes small and head narrow. Unlike Charadriidae, have numerous fine pores in premaxillary bone to accommodate Herbst's corpuscles, which are assumed to be associated with more tactile, less visual, methods of foraging; some species have been shown to be capable of sensing buried prey, either through chemoreception (van Heezik *et al.* 1983) or mechanical detection of vibrations or self-induced pressure signals (Gerritsen *et al.* 1983; Gerritsen 1988; Piersma *et al.* 1994). Skeleton and musculature of jaw distinctive (Burton 1974). In most species, rynchokinesis of skull highly developed, enabling flexible upper mandible to be opened or retracted at tip only (to grasp prey while probing). Tarsi and tibiae, short to long, with transverse scales (except in *Numenius*). Four toes in all species except Sanderling *Calidris alba*; toes fairly long with lateral membrane (webbed in some); hindtoe, small and raised (except in Arenariinae). No crop. Caeca present. Apparently no other waders have spiral sperm cells (similar to those of Passeriformes).

Non-breeding plumage mostly dull and cryptic: mottled greys and browns above, and paler or white below, with or without streaks and spots. Breeding plumage generally much brighter (except in curlews, snipes and woodcocks), with more rufous or black. In HANZAB region, adults seen mainly during austral summer in non-breeding plumage, though breeding plumage can be seen on birds just before n. migration or on arrival after s. migration. Sexes usually similar. Bills, legs and feet variously, sometimes brightly, coloured. Adults generally have two moults per cycle: (1) a partial pre-breeding (pre-alternate) moult of most feathers of body, and, often, some tertials and upperwing-coverts; and (2) a complete post-breeding (pre-basic) moult; both usually performed in non-breeding areas or while staging on migration. Primaries moult outwards, usually after s. migration; some subspecies of Dunlin *Calidris alpina* (q.v.), Purple Sandpiper *C. maritima* and Rock Sandpiper *C. ptilocnemis* moult all primaries on or near breeding grounds before s. migration, a strategy rare in *Calidris*; Bristle-thighed Curlew *Numenius tahitiensis* moult remiges rapidly, inducing flightlessness in 50–70% of birds, apparently uniquely among Charadriiformes. Precocial young nidifugous; most feed themselves. Down varies greatly in structure and pattern; pattern mainly of spotted or striped type (Fjeldså 1977). Juvenile plumage usually distinctive; most like that of non-breeding adults, but often a little brighter, especially in Calidridinae. Moults of subadults complex and vary considerably with species, route of migration and age of first breeding. Adult plumage attained when 3–21 months old; most scolopacids of our region (except snipes) first attain adult plumage through partial first pre-alternate moult when c. 8–11 months old, or through complete second pre-basic moult when c. 12–16 months old (see discussion of Moults in General Introduction). Swift runners; wade expertly and some species swim habitually (Phalaropodinae). Stance often upright. Flight, fast and direct, often in tight flocks.

When breeding, most scolopacids (except some snipes and woodcocks) are birds of open habitats, including tundra. At other times, use a variety of habitats, including forests (woodcocks) and open sea (phalaropes), though most prefer shallow, fresh, brackish or intertidal wetlands. Greatest concentrations occur on intertidal mudflats,

especially estuaries. Feed mainly by touch, and the mandibular skeleton has distinctive features associated with tactile methods of foraging. When feeding, most probe into soft, moist substrata to catch invertebrates; some (e.g. Arenariinae) forage on rocky shores; surface-tension mechanism for feeding on plankton, recently described for Red-necked Phalaropes *Phalaropus lobatus* (Rubega & Obst 1993), may prove to be widespread among scolopacids with fine bills. Mixed-species foraging flocks common.

Migration the most striking feature of scolopacids. All but some Gallinagoninae, Scolopacinae and two aberrant Tringinae migrate (though some Tringinae partly resident in Europe), usually from breeding grounds in higher latitudes of n. hemisphere to lower latitudes of n. or s. hemispheres; many undertake extremely long migration steps, with non-stop flights of several thousand kilometres preceded by dramatic increase in weight. Scolopacids of HANZAB region breed mainly in e. Russia, Mongolia, n. China and Alaska; Latham's Snipe *Gallinago hardwickii* breeds Japan and in small numbers in e. Russia.

Migratory routes vary dramatically depending on the relationship between breeding and non-breeding ranges, and the ability to undertake long-distance non-stop flights. Some species migrate overland, some via coastal routes and others cross oceans; many species use a combination of these routes. Some species return to breeding grounds by the same route used in s. migration while others return by different routes, and make a loop migration (e.g. Curlew Sandpiper *Calidris ferruginea*). Timing of departure from breeding grounds often varies between sexes (e.g. Bar-tailed Godwit *Limosa lapponica*) and between ages; juveniles often leave at slightly different time (e.g. Bar-tailed Godwit *Limosa lapponica*) or migrate via a different route (e.g. Sharp-tailed Sandpiper *Calidris acuminata*). Most regular non-breeding migrants to Aust. migrate via East-Asian–Australasian Flyway; others to Aust. and, especially NZ, cross Pacific Ocean. Generally, in Aust. and NZ, s. migration Aug.–Nov. and n. migration, Feb.–May. Individuals of most species display a high degree of site-fidelity at breeding, non-breeding and even staging areas; others have little fidelity to breeding site and populations mix much (e.g. Curlew Sandpipers; P.S. Tomkovich). In HANZAB region, displays sometimes seen before migration, e.g. Red Knots in tight single-species flocks in nw. Aust. before migration (Lane & Jessop 1985). Pre-migratory flighting observed during Mar. in NZ (McKenzie 1967).

In non-breeding areas, most species undertake regular local movements between feeding and roosting sites or between different feeding sites. Most local movements are in response to tides, which affect exposure of feeding grounds (e.g. Hindwood & Hoskin 1954; Carter *et al.* 1976; Saunders & de Rebeira 1985; Smith 1985; Lane). Some roosting and feeding sites are close together, birds gradually dispersing from or returning to roosting sites as tides fall and rise (e.g. Robertson & Dennison 1979). At other sites, roosting and feeding sites farther apart, with birds even flying between islands or between islands and mainland (Saunders & de Rebeira 1985); in Capricorn Grp, Qld, Ruddy Turnstones and Grey-tailed Tattlers *Heteroscelus brevipes* fly at least 4 km from Tyron I., where roost at high tide, to North West Reef, where thought to feed (Prendergast *et al.* 1985); at Cairns, Qld, Whimbrels *Numenius phaeopus* move to mouth of Barron R. every evening (Amiet 1957) and can travel up to c. 20 km between roosting and feeding sites (McKenzie 1967; Garnett 1989). In poor weather, such as days of high winds or in storms, may move to sheltered areas other than normal roosting sites, such as near-coastal wetlands or pools in dunes (e.g. Crawford 1972; Forest 1982; Aust. Atlas). Some species dispersive, either locally or over longer distances (see accounts), sometimes in response to availability of food or availability of suitable wetland habitat. In NZ, Common Greenshanks *Tringa nebularia* tend to move round within harbours rather than returning to roosting site each day (Sibson 1965) and, in Tas., Common Greenshanks appear to move between coastal sites (Wall 1953); Curlew Sandpipers apparently move from Westport Bay, Vic., in Aug. when daily exposure of intertidal feeding grounds reduced (Loyn 1978; see also Hindwood & Hoskin 1954; Alcorn 1988).

Mainly feed and roost in single-species flocks. All species are strong fliers and those that form flocks often perform spectacular and complex aerial movements, which are performed with remarkable precision. Many species territorial during breeding season, but others lack specific territorial boundaries and are semi-colonial. Courtship displays, elaborate, including spectacular song-flights, often associated with formation of pairs. Distraction displays include repetitive display-flights, rodent-runs, and feigning injury.

Mating systems extraordinarily diverse, including monogamy (some species pair for life), polygyny (in some species, males display on leks, mating with females that visit their territories; in others, males maintain simultaneous pair-bonds with more than one female but provide no parental care) and polyandry (including double-clutching monogamy, where female lays two successive clutches, each of which is incubated by single adult; and classical polyandry, where female maintains pair-bonds with more than one male). Reasons for diversity of mating systems not clear but short breeding seasons and ability of single parent to incubate clutch and brood and raise chicks probably involved; possibly also related to phylogenetic history. For reviews of mating systems, see Ligon (1993) and Pitelka *et al.* (1974).

In CALIDRIDINAE, mating systems remarkably varied, including monogamy, polygyny, polyandry; most species monogamous (e.g. Pitelka *et al.* 1974). Role of sexes in parental care as diverse as mating systems. Apparently solely by female in the four polygynous species; roughly equally shared in some (e.g. Dunlin *C. alpina*), though female tends to leave chicks earlier; in others, male undertakes more of work and females leave before chick-rearing (or even

incubation) complete. Behaviour more complex in successive polyandrous species, with males raising first brood while females may lay and raise another clutch. In GALLINAGONINAE, mating systems poorly known but several species monogamous; Great Snipe *Gallinago media* promiscuous, mating at leks, and apparently unique among snipe in performing courtship display on ground; others have crepuscular or nocturnal display-flights accompanied by distinctive calls and non-vocal sounds (see Gallinagoninae). Mass flights of displaying snipes have been said to be aerial leks in several species, but confirmation needed (could be result of unsettled territorial boundaries early in breeding season) (Byrkjedal 1990). In TRINGINAE, most species monogamous but successive polyandry can occur in Spotted Redshank *Tringa erythropus* and Spotted Sandpiper *Actitis macularia*. Parental care shared about equally or females leave breeding grounds early while males undertake or finish rearing chicks. ARENARIINAE are monogamous; Ruddy Turnstone territorial and aggressive. LIMNODROMINAE, poorly known; apparently monogamous; territorial but *L. semipalmatus* nests in small colonies. Both sexes incubate; males undertake most of chick-rearing. In PHALAROPODINAE, many sex roles reversed when breeding; females almost unique among Scolopacidae in undertaking courtship behaviour, contesting access to mates in 'scramble displays' (Reynolds 1987; Colwell & Oring 1988a). Phalaropes usually monogamous, though polyandry recorded in all three species; incidence of polyandry may vary between populations but reasons not yet clear (e.g. Colwell & Oring 1988b). Males undertake virtually all incubation and raise chicks alone (see Colwell 1986; Colwell & Oring 1988a,b).

Most scolopacids breed first at 2 years old, though some species can breed in their first year and maturity may be delayed for more than 2 years in some large long-distance migrants. Usually nest on ground, often concealed in herbage. The scrape, often made during a scraping ceremony by the male in the presence of female, is often lined, usually after laying the first egg and more lining is added during incubation. Unusually, Solitary *Tringa solitaria*, Green *Tringa ochropus* and some Wood *Tringa glareola* Sandpipers recorded nesting in trees, usually in nests of other birds (see BWP). Usually four eggs per clutch, in some cases two or three. Eggs usually pyriform, with dark-brown and black markings, over paler ground-colour; all are cryptically coloured. Incubation normally starts with laying of last egg and chicks hatch almost simultaneously. Both sexes usually share incubation, though one bird often takes greater share. Downy young leave nest within 1 day of hatching and generally accompanied by brooding adult till able to fly. Social organization, social behaviour and breeding not discussed further in subfamily accounts.

In East-Asian–Australasian Flyway, hunting and destruction of wetland habitats major threats to shorebirds; this Flyway said to be probably the most threatened migration system in world (Lane & Parish 1991). Outside Aust. and NZ, hunting widespread, mainly for food, but little information available on impact on populations (Lane & Parish 1991). For example, in Thailand and n. Vietnam, both Great Knot and Red-necked Stint on passage or overwintering are eaten, and captive birds are kept to act as decoys to catch other waders; band-recoveries of Red-necked Stints in n. Vietnam have come from birds taken for food (Starks 1987; J.R. Starks). Many wetlands destroyed by reclamation for agriculture, aquaculture, salt-production, and urban or industrial development, including wetland habitats in Aust. and NZ (Lane & Parish 1991). Aust. is signatory to the Ramsar Convention and to bilateral treaties with Japan (JAMBA) and China (CAMBA) to protect migratory birds.

In many n. hemisphere breeding areas, breeding success cyclical and thought to be linked to population cycles of lemmings, which in turn influence levels of predation of breeding birds (Underhill *et al.* 1993). For example, in breeding areas of Curlew Sandpipers, decreased populations of lemmings *Lemmus sibiricus* and *Dicrostonyx torquatus*, the regular prey of Arctic Foxes *Alopex lagopus*, results in increased predation of eggs and young of Curlew Sandpipers (Roselaar 1979). Reproductive success in n. hemisphere in preceding breeding season reflected in numbers and proportion of juveniles and immatures in populations in non-breeding areas, such as Aust. and NZ.

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28 Gallinagoninae

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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 Surf-bird *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 Surf-birds (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
<i>Aphriza</i>	1 (Surf-bird)	0
<i>Calidris</i>	18	8 NB, 6A, 1D
<i>Eurynorhynchus</i>	1 (Spoon-billed Sandpiper)	0
<i>Micropalama</i>	1 (Stilt Sandpiper)	1 NA
<i>Tryngites</i>	1 (Buff-breasted Sandpiper)	1 NA
<i>Limicola</i>	1 (Broad-billed Sandpiper)	1 NB
<i>Philomachus</i>	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. melanotos*, 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 rhyndokinetic 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; Fjelds  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 bairdii Baird's Sandpiper

COLOUR PLATE FACING PAGE 289

Actodromas bairdii Coues, 1861, *Proc. Acad. Nat. Sci. Philad.* 13: 194 — Fort Resolution, Mackenzie District, Canada.

The specific and English names are in honour of Professor Spencer Fullerton Baird, 1823–87, mammologist and ornithologist, Assistant Secretary of the Smithsonian Institute, Washington, founder of the US National Museum, Washington, mentor of the author Elliott Coues, and early student of geographical variation.

MONOTYPIC

FIELD IDENTIFICATION Length 14–16 cm; wingspan 36–40 cm; weight c. 40 g. Distinctive small slim attenuated wader with short straight slender and finely pointed bill; short legs; and very long wings, projecting well beyond tip of tail at rest. Appears somewhat like large attenuated Red-necked Stint *Calidris ruficollis*, but with longer and finer bill and slightly longer legs. Similar in size and shape to White-rumped Sandpiper *Calidris fuscicollis*. In all plumages, mainly buff-brown above and white below with complete buff gorget and indistinct pale supercilium. Has characteristic horizontal stance,

usually with legs flexed, and often appears to have flat back. In flight, appears long-winged, with narrow white wing-bar, and little contrast between narrow greyish-buff sides of rump and uppertail and distinctive broad dark line through centre. Sexes alike. Marked seasonal variation. Juvenile distinctive. Immatures separable in close view.

Description Adult breeding Head and neck, buffish brown, heavily streaked black on centre of forehead, crown and nape, finely streaked elsewhere, and with indistinct pale-buff supercilium from bill to sides of nape (slightly paler off-

white in front of eye); thin cream eye-ring; narrow, dark-brown laral stripe (broadening in front of eye) and warm buff-brown ear-coverts combining to form indistinct diffuse dusky eye-stripe; and chin and throat, off-white. Mantle and scapulars, black, fringed and broadly tipped buff; tertials, brownish black, narrowly fringed buff. Innerwing-coverts, plain grey-brown with narrow white fringes; slightly darker blackish brown on greater coverts. Underbody, mostly white; foreneck and breast, buff, finely streaked darker, grading to larger black spots on sides of breast in some; gorget fairly sharply demarcated from white belly; a few have buff suffusion or a few indistinct streaks on flanks. In flight: innerwing-coverts, grey-brown with darker blackish-brown greater coverts and remiges, and weak narrow white wing-bar (tips of greater secondary coverts and diffuse paler bases of primaries); blackish-brown back and broad, blackish-brown line through centre of rump, uppertail-coverts and tail, contrasting rather poorly with narrow white sides to rump and buffish-grey sides to uppertail-coverts (which are marked with narrow dark Vs or bars, sometimes visible in flight or when perched); underwing, white, with narrow dusky-brown leading- and trailing-edges and greater coverts. With wear, buff fringes and tips of upperparts fade to cream and then reduced or lost, producing blotched appearance above; also, paired subterminal pale spots or bars on bases of some lower scapulars exposed, buff tones are reduced throughout, and sides of breast patterned with coarse black spots and blotches; at end of breeding season, may appear rather blackish on mantle and scapulars. In austral spring, likely to show mixture of worn breeding and much fresh non-breeding on head, neck, chest and upperparts. Bill, black, occasionally with green tinge at base. Iris, dark brown. Legs and feet, black or blackish grey, often tinged greenish. **Adult non-breeding** Like adult breeding, but: Head and neck, grey-brown or buff-brown (except for white chin and throat) with finer dark streaking on centre of forehead and crown, slightly more distinct dark laral stripe, and pale supercilium (usually paler off-white in front of eye and washed buff and finely streaked darker behind). Rest of upperparts and innerwing-coverts uniform grey-brown or buff-brown, with tertials and greater coverts slightly darker brown and all feathers finely fringed grey-buff or white, and tipped white when fresh; upperparts finely streaked darker, but have little or no dark centres (though upperparts can sometimes appear faintly dappled darker). Underbody, white, with foreneck and breast, grey-buff, finely streaked darker, and neatly demarcated from white belly. On some in fresh plumage, sides of neck and lower breast noticeably brighter and richer buff than rest of plumage. For discussion of rare grey forms, see Hayman *et al.* (1986). **Juvenile** As adult non-breeding, differing mainly by distinct scaly pattern above: plumage has strong buff tone when fresh; streaking on centre of forehead and crown slightly thicker, bolder black, and supercilium over and behind eye washed buff. Feathers of mantle, black, with narrow white fringes; scapulars have fine dark shafts, grey-brown centres that grade to black, and narrow, buffish-white fringes and white tips; lower scapulars, tertials and innerwing-coverts, slightly paler (paler bases more exposed). Foreneck and breast washed buff and finely streaked darker (sparser and finer in centre of breast); rest of underbody, white; occasionally with some fine streaks or arrowheads along sides of vent and undertail. With wear and fading, upperparts appear darker and more uniform, contrasting with innerwing-coverts which remain somewhat scaly. **First immature non-breeding** Like adult non-breeding but distinguished by retained, somewhat worn juvenile innerwing-coverts (with distinct pale fringes)

and tertials, contrasting with fresh non-breeding plumage of upperparts. Also, retained juvenile remiges fresh in spring-summer (worn or moulting in adults). In summer-autumn, many show contrast between old, worn brownish inner and fresh, darker blackish outer primaries (primaries uniform and fresh in adults); some may be inseparable from adult. **First immature breeding** Like adult breeding but retained juvenile remiges very worn, or, if moult takes place, show contrast between fresh outer and worn inner primaries (uniform and rather fresh in adult); some may remain in non-breeding plumage.

Similar species Combination of small size; long-winged, attenuated profile; short, straight, slender, finely pointed black bill; short, blackish legs; mainly buffish-brown plumage, with complete, buff and finely streaked gorget; narrow white wing-bar; and broad dark central line through rump and uppertail, with poorly contrasting narrow pale sides, diagnostic. Only vagrant **White-rumped Sandpiper** is similar in size and shape. In ALL PLUMAGES, White-rumped differs by: (1) generally fuller body, which is not so elongated; (2) bill, slightly heavier, slightly decurved throughout length, and usually slightly swollen at tip; base of lower mandible almost always tinged brownish orange, forming conspicuous pale base (Baird's never has conspicuous pale base to bill); feathering at base of lower mandible does not extend so far out towards tip of bill; (3) in flight, distinguished by narrow band of white across uppertail-coverts contrasting with dark rump and tail, like that of Curlew Sandpiper; (4) flight call a short, sharp, high-pitched, squeaky, insect-like *jeet* or *tzeet*, often repeated and quite different from that of Baird's. In ADULT BREEDING PLUMAGE, differs by: (1) distinct rufous tone to crown, ear-coverts, mantle and, with wear, scapulars; general upperparts coloration of Baird's more buffish; (2) head, rufous and white, with coarse black streaking and cleaner off-white supercilium; (3) ground-colour of foreneck and breast, off-white or washed buff, overlain with coarse blackish streaks that continue on flanks as arrowheads. In NON-BREEDING PLUMAGE differs by: (1) rather dark, brownish-grey upperparts with dark shaft-streaks of varying prominence (generally slightly more uniform and buffish brown on Baird's); (2) more prominent off-white supercilium; (3) gorget, paler, off-white or faintly washed brownish-grey, finely streaked darker; usually with some streaking along flanks (flanks unmarked in Baird's). In JUVENILE PLUMAGE, differs by: (1) more prominent and contrasting white supercilium and, usually, at least slight rufous tinge to crown and ear-coverts; crown, especially, contrasts more, with nape and hindneck more finely streaked and paler grey (on Baird's, whole head and neck buff and less contrastingly patterned); generally, dark laral stripe slightly narrower and more clear-cut; (2) feathers of mantle and upper scapulars black with rufous fringes; contrasting whitish V on sides of mantle and second whitish V formed by whitish tips of outer row of upper scapulars; also, lower two rows of scapulars have extensive pale bases contrasting with blackish subterminal areas and white tips, and contrast markedly with black-centred upper rows of scapulars; (3) colour and pattern of underbody differs from Baird's in much the same way as described for adult breeding; White-rumped usually shows some fine dark flank-streaks (always lacking in Baird's). Confusion is also possible with superficially similar **Long-toed Stint** *Calidris subminuta* and **Sharp-tailed C.** *acuminata* and **Pectoral C.** *melanotos* Sandpipers. **Long-toed Stint** smaller, with shorter rear-end, and lacking long-winged attenuated appearance of Baird's; bill slightly shorter, with conspicuous pale base to lower mandible; legs proportionately longer and

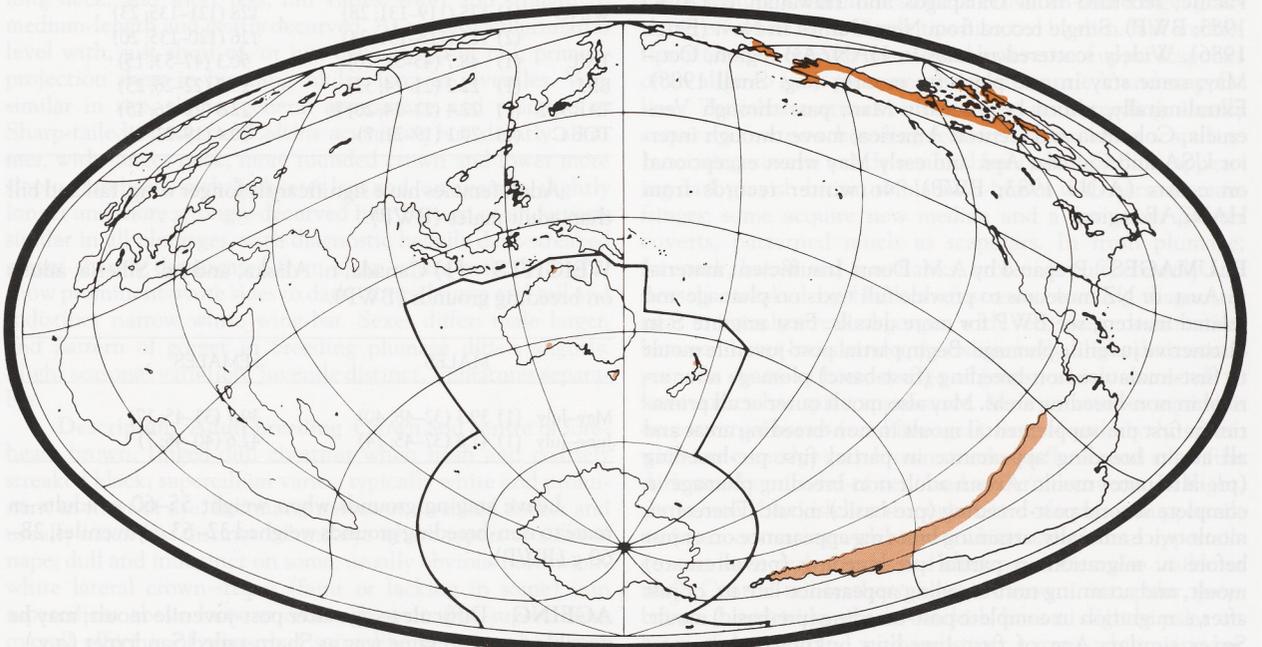
pale, usually yellow, and tips of toes trail conspicuously beyond tip of tail in flight; in flight, wings appear shorter and more rounded at tips, and rump and uppertail show narrower dark central line, with larger and more contrasting white sides; breeding and juvenile plumages very rufous, with prominent white lateral crown-stripes and mantle and scapular Vs, while non-breeding plumages are distinctly darker brown above, with contrasting dark centres to feathers. **Sharp-tailed** and **Pectoral Sandpipers** much larger and bulkier, with shorter wings; heavier, decurved bills with pale bases; and much longer pale, greenish or yellowish legs; flight-pattern and breeding, juvenile and non-breeding plumages differ in much the same way as described for Long-toed Stint; Sharp-tailed also differs in all plumages by usually obvious rufous cap, dark-streaked flanks, vent and undertail-coverts, and distinctive flight calls.

Less gregarious than most calidrids; usually seen singly or in small groups; only solitary vagrants reported HANZAB area. Associate freely with other waders; in our area, with Red-necked Stints, other small to medium-sized calidrids and Red-capped Plovers *Charadrius ruficapillus*. Coastal and subcoastal in our area, preferring edges of freshwater and brackish wetlands. Prefer drier, sparsely vegetated areas, often foraging on upper beach or dry fringes of wetlands though, equally, will forage in grassy areas or among vegetation and also on mudflats; rarely, forage in dense swamp vegetation favoured by Sharp-tailed and Pectoral Sandpipers and Long-toed Stints. Tame, though look more alert than many other small calidrids; may crouch when approached or, when alarmed, stand upright or maintain characteristic horizontal stance but with head raised high above chest. Long fine wing-tips project well beyond tip of tail at rest (though birds moulting outer primaries can have shorter projection); typically, three primary-tips project beyond tip of tail, with tips of outer two very closely spaced and tip of fourth outermost falling roughly level with tip of tail; and, typically, 2-3 primary-tips are exposed beyond tip of longest tertial in adults, four in juveniles; tips of folded wings cross, and describe large ovals as bird walks and dips forward. Gait varies, but typically brisk and deliberate, with speed of runs exaggerated

by fast action of short legs; at other times, slower and stint-like. Feeding actions brisk, but slower than those of stints, typically keeping legs well flexed; on dry substrates, walk rapidly, picking at prey with quick jab of bill; when feeding on muddy shores, probe repeatedly in one spot with full length of bill before breaking off and running to new spot; sometimes turn head sideways to position bill almost parallel with ground and stretch forwards to peck at prey; occasionally wade up to belly in water, picking at prey from surface or surrounding vegetation or immersing bill or entire head in water. Flight typical of genus, but can appear loose owing to very long wings; wing-beats perceptibly slower than those of stints. Usual flight call fairly low-pitched, slightly harsh but still rather soft, rolling trilled note *krrt*, *kyrrt*, *kirrp* or *kyrrp*, recalling Pectoral and Curlew Sandpipers; also, sharp *tsick*.

HABITAT During non-breeding season, prefer dry, terrestrial habitats; also round bare or dry grassy margins of receding wetlands; occasionally in upper littoral zone of estuaries, mudflats and beaches (Blake 1977; Myers 1979 & Myers 1979; AOU 1983; BWP). Often recorded well away from water (BWP cf. AOU 1983). In A'asia, on sparse or low vegetation, or bare mud, on shores of lakes and lagoons (Milledge 1968; Smith 1987; Snell 1988); shallows of saltlake (Smith & Swindley 1975); round sewage ponds (McKean 1984). Also on mudflats (Milledge 1968; McKenzie *et al.* 1971); on short vegetation paddock just behind harbour beach that was occasionally inundated by sea (McKenzie *et al.* 1971). Once among tide-wrack round high-water mark on narrow sandy ocean beach (Curry 1979).

DISTRIBUTION Breed high Arctic; mostly North America, in n. regions of Alaska and Canada, from Seward Pen., N to Pt Barrow, and then E through n. Yukon and North West Territories to s. Melville Pen., Southampton I. and Baffin I. (N of Arctic Circle), and N through islands in Franklin to nw. Greenland, in small numbers in ne. Siberia, Chukotskiy Pen. and adjacent islands. Spend non-breeding season in South



America, mostly from central Peru, S through Bolivia, Paraguay, Uruguay, Argentina and Chile, to Tierra del Fuego; some birds winter in Andes of Ecuador. Vagrants occur widely, and have been recorded on The Faeroes, S. Orkney Is, and from British Isles, Scandinavia, w. and central Europe, Ussuriland, Azores, Senegambia, Namibia, Galapagos Is, Hawaii, Kurile Is, Aust., NZ (Dement'ev & Gladkov 1951; Blake 1977; AOU 1983; Urban *et al.* 1986; BWP).

Aust. Five acceptable records (RAC): Eyre, WA, 7 Mar. 1979 (Curry 1979); Palmerston, NT, 28 Oct. 1983 (McKean 1984); specimen, Lauderdale, Tas., 15–24 Oct. 1966 (Milledge 1968; BMNH); L. Connewarre, Vic., 1–c. 25 Feb. 1986 (Smith 1987); Buckland Park L., SA, 17 Dec. 1986–4 Feb. 1987 (Snell 1988). Report of single, L. William, Vic., 15 Nov. 1974 (Smith & Swindley 1975) not submitted to RAC and unverified. Unacceptable records (RAC): Botany Bay, NSW, 23 Nov. 1976 (Cook & Waugh 1977); N. Stradbroke I., Qld, 22–24 Oct. 1979 (RAC); Waratah Bay, Vic., 15 Sept. 1984 (RAC); Dry Ck Saltfields, 5–8 Dec. 1992.

NZ All singles: Karaka, 28 Mar. 1970 (McKenzie *et al.* 1971); Miranda, 6 Dec. 1970 (Brown *et al.* 1971); Karaka, 21 Apr. 1976 (CSN 23); Manuwatu, 23–31 Oct. 1976 (CSN 24); Firth of Thames, 29 Oct. 1972 (CSN 20).

S. Orkney Is Single, Signy I., 5 Dec. 1985–Jan. 1986 (Rootes 1988).

MOVEMENTS Migratory; breed in high Arctic, and move S to non-breeding areas, mostly in South America (BWP). Route of birds visiting Aust. unknown but may involve passage across Pacific or Southern Oceans, through e. Asia or even via Europe and s. Asia (see Curry 1979). Adults leave breeding grounds in July; juveniles from mid-July (P.S. Tomkovich). Those breeding in Siberia cross to Alaska and Canada and migrate S with Nearctic birds; straggle down e. Asian coast as far S as Japan; no confirmed records elsewhere in Asia (Lane; BWP). Migrate through interior of Canada and USA. Recorded less often on Pacific and Atlantic coasts of North America, mainly during s. migration (mostly juveniles). Adults cross e. Pacific Ocean, at least on s. migration; in Pacific, recorded from Galapagos and Hawaiian Is (AOU 1983; BWP). Single record from New Guinea in Nov. (Finch 1986). Widely scattered records in HANZAB region, Oct.–May; some stay in one place for months (e.g. Snell 1988). Extralimitally, return begins early Mar.; pass through Venezuela, Columbia and Central America; move through interior USA and Canada, Apr. and early May when exceptional on coasts (AOU 1983; BWP). No winter records from HANZAB region.

PLUMAGES Prepared by A.M. Dunn. Insufficient material in Aust. or NZ museums to provide full texts on plumage and related matters; see BWP for more details. First migrate S in distinctive juvenile plumage. Begin partial post-juvenile moult to first-immature non-breeding (first-basic) plumage after arrival in non-breeding areas. May also moult outer or all primaries in first pre-supplemental moult in non-breeding areas and all attain breeding appearance in partial first pre-breeding (pre-alternate) moult. Attain adult non-breeding plumage in complete second post-breeding (pre-basic) moult. Thereafter, moult twice annually, attaining breeding appearance on or just before n. migration in partial pre-breeding (pre-alternate) moult, and attaining non-breeding appearance late in, or just after, s. migration in complete post-breeding (pre-basic) moult. Sexes similar. Age of first breeding unknown, but most

immatures thought to migrate N in first austral autumn (Paulson 1993).

MOULTS Poorly known. Based on extralimital data (Bent 1962; BWP), and five specimens from Americas (AM, MV). **Adult post-breeding** (Second and subsequent pre-basic). Complete; primaries outwards. Some begin moult of body in July, before beginning s. migration; exceptionally early records include: one in Canada, with advanced body-moult on 16 July, and two in US, in non-breeding plumage in Aug. (Paulson 1993). Most migrate through n. America in full, or nearly full, breeding plumage; most adults attain full non-breeding body plumage by mid-Oct. in South America (Paulson 1993). Moult of primaries begins shortly after arrival in non-breeding areas; complete, Dec.–Feb. One skin from Peru had PMS of 37 in Jan. (MV). **Adult pre-breeding** (Second and subsequent pre-alternate). Partial; Mar.–early May, before or on n. migration; involves crown, mantle, scapulars, some tertials and some or all feathers of underparts. **Post-juvenile** (First pre-basic). Partial; includes most feathers of body, and some tertials and upperwing-coverts. Starts after arrival in non-breeding areas, about Oct.; date of completion, unknown, but before late Mar. **Post-juvenile moult of primaries** (First pre-supplemental). Few data. Some undergo complete moult of primaries; not known when moult starts but no earlier than late Oct.; finished Mar. Others retain juvenile primaries throughout first year or moult only outer juvenile primaries in similar way to other *Calidris*. Paulson (1993) considered complete moult of primaries to be the most common strategy. **First pre-breeding** (First pre-alternate). Few data; probably indistinguishable from adult once moult complete (Bent 1962). More information needed to determine if some still distinguishable by retained, worn juvenile primaries.

MEASUREMENTS Throughout range, skins (BWP; AM, MV): (1) Adult; (2) Juvenile.

	MALES	FEMALES
WING	(1) 125 (119–131; 28) (2) 125 (118–131; 24)	128 (121–135; 23) 126 (120–135; 20)
TAIL	(1) 48.7 (45–52; 20)	50.3 (47–53; 15)
BILL	(1) 22.2 (21–24; 32)	23.7 (22–26; 25)
TARSUS	(1) 22.4 (21–24; 20)	22.8 (22–26; 15)
TOEC	(1) 20.1 (19–21; 7)	20.4 (19–21; 6)

Adult females have significantly longer wing, tail and bill than adult males (BWP).

WEIGHTS (1) Canada, n. Alaska, and ne. Siberia, adults on breeding grounds (BWP).

	MALES	FEMALES
May–July	(1) 39.3 (32–48; 40)	39.7 (33–45; 17)
June–July	(1) 41.8 (37–45; 14)	42.6 (40–46; 7)

Leave staging grounds when weight 55–60 g; adults *en route* to non-breeding grounds weighed 32–63 g; juveniles, 28–60 g (BWP).

AGEING Difficult to age after post-juvenile moult; may be possible to age in same way as Sharp-tailed Sandpiper (q.v.).

GEOGRAPHICAL VARIATION None.

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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



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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