Higgins, P.J. & Davies, S.J.J.F. (editors) 1996. Handbook of Australian, New Zealand & Antarctic Birds. Volume 3, Snipe to pigeons. Melbourne, Oxford University Press. [Vol. 2, pages 648-649] Vol. 3, pages 25-28, 213-214, 270-278; plates 16 & 17.

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.

REFERENCES

Christian, P.D., *et al*. 1992. *Aust. J. Zool.* 40: 291–302.

Fjeldså, J. 1976. *Vidensk. Medd. dansk. Natur. Foren.* 139: 179–243.

—— 1977. *Guide to the Young of European Precocial Birds*. Scarv Nature Productions, Tisvildeleje.

Glenny, F.H. 1955. *Proc. US natn. Mus.* 103 (3346): 525–621.

Jehl, J.L., Jr. 1968. *Mem. San Diego Soc. nat. Hist.* 3.

Mayr, E., & D. Amadon. 1951. *Am. Mus. Novit.* 1496.

Mickevich, M.F., & L.R. Parenti. 1980. *Syst. Zool.* 29: 108–113.

Olson, S.L., & A. Feduccia. 1981. *Smithson. Contrib. Zool.* 323: 1–24.

——, & D.W. Steadman. 1981. *Smithson. Contrib. Zool.* 337: 1–25.

Sibley, C.G., & J.E. Ahlquist. 1990. *Phylogeny and Classification of Birds of the World*. Yale Univ. Press, New Haven.

——, & B.L. Monroe. 1990. *Distribution and Taxonomy of the Birds of the World*. Yale Univ. Press; New Haven.

——, *et al*. 1988. *Auk* 105: 409–423.

Strauch, J.G., Jr. 1978. *Trans. zool. Soc. Lond.* 34: 263–345.

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.

REFERENCES

Alcorn, R. 1988. *Stilt* 12: 7–23.
Amiet, L. 1957. *Emu* 57: 236–54.
Burton, P.J.K. 1974. *Feeding and the Feeding Apparatus in Waders.* Br. Mus. Nat. Hist., Lond.
Byrkjedal, I. 1990. *Ornis scand.* 21: 239–47.
Carter, M.J., *et al.* 1976. *Aust. Bird Watcher* 6: 173–7.
Christian, P.D., *et al.* 1992. *Aust. J. Zool.* 40: 291–302.
Christidis, L., & W.E. Boles. 1994. *RAOU Monogr.* 2.
Colwell, M.A. 1986. *Auk* 103: 611–12.
—, & L.W. Oring. 1988a. *Behav. Ecol. Sociobiol.* 22: 165–73.
—, — 1988b. *Wilson Bull.* 100: 567–82.
Crawford, D.N. 1972. *Emu* 72: 131–48.
Dittman, D.L., *et al.* 1989. *Auk* 106: 324–6.
Fjeldså, J. 1977. *Guide to the Young of European Precocial Birds.* Skarv Nature Publs, Strandgården, Tisvildileje.
Forest, B.S. 1982. *Aust. Bird Watcher* 9: 159.
Garnett, S.T. 1989. *RAOU Rep.* 58.
Gerritsen, A.F.C. 1988. Unpubl. PhD thesis, Univ. Lieden.
—, *et al.* 1983. *Neth. J. Zool.* 33: 485–96.
Hindwood, K.A., & E.S. Hoskin. 1954. *Emu* 54: 217–55.
Jehl Jr, J.R. 1968. *Mem. San Diego Soc. Nat. Hist.* 3.
—, & B.G. Murray. 1986. *Current Orn.* 3: 1–86.
Johnsgard, P.A. 1981. *The Plovers, Sandpipers and Snipes of the World.* Univ. Nebraska Press, Lincoln.
Lane, B.A., & A. Jessop. 1985. *Stilt* 6: 2–16.
—, & D. Parish. 1991. *ICBP Tech. Publ.* 12: 291–312.
Ligon, J.D. 1993. *Current Orn.* 10: 1–46.
Loyn, R.H. 1978. *Emu* 78: 11–19.
McKenzie, H.R. 1967. *Notornis* 14: 154–7.
Piersma, T. 1994. *Close to the Edge: Energetic Bottlenecks and the Evolution of Migratory Pathways in Knots.* Uitgevij Het Open Boek, Den Burg, Texel, Netherlands.
—, *et al.* 1994. Paper 3 **In**: Piersma 1994.
Pitelka, F.A., *et al.* 1974. *Am. Zool.* 14: 185–204.
Prendergast, H.D.V., *et al.* 1985. *Sunbird* 15: 80–3.
Reynolds, J.D. 1987. *Ibis* 129: 225–42.
Robertson, H.A., & M.D. Dennison. 1979. *Notornis* 26: 73–88.

Roselaar, C.S. 1979. *Watervogels* 4: 202–10.
Rubega, M.A., & B.S. Obst. 1993. *Auk* 110: 169–78.
Saunders, D., & P. de Rebeira. 1985. *The Birdlife of Rottnest Island.* Authors, Perth.
Sibley, C.G., & J.E. Ahlquist. 1990. *Phylogeny and Classification of Birds*. Yale Univ. Press, New Haven.
—, *et al.* 1988. *Auk* 105: 409–23.
Sibson, R.B. 1965. *Notornis* 12: 44–6.
Smith, F.T.H. 1985. *Bird Obs.* 643: 81–2.
Starks, J. 1987. *Report on Shorebird Surveys in Thailand.* Interwader Publ. 25.
Strauch Jr, J.G. 1978. *Trans. zool. Soc. Lond.* 34: 263–345.
Underhill, L.G., *et al.* 1993. *Ibis* 135: 277–92.
van Heezik, Y.M., *et al.* 1983. *Neth. J. Sea Res.* 17: 47–56.
Wall, L.E. 1953. *Emu* 53: 80–6.

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).

REFERENCES

Burton, P.J.K. 1974. *Feeding and the Feeding Apparatus in Waders*. Br. Mus. Nat. Hist., Lond.
Christian, P.D., *et al*. 1992. *Aust. J. Zool*. 40: 291–302.
Dittman, D.L., & R.M. Zink. 1991. *Auk* 108: 771–9.
—–, *et al*. 1989. *Auk* 106: 324–6.
Fjeldså, J. 1977. *Guide to the Young of European Precocial Birds*. Skarv Nature Publs, Strandgården, Tisvildileje.
Gerritsen, A.F.C. 1988. *Feeding Techniques and the Anatomy of the Bill in Sandpipers (Calidris)*. Unpubl. PhD thesis, Univ. Leiden.
van Heezik, Y.M., *et al*. 1983. *Neth. J. Sea Res*. 17: 47–56.
Jehl Jr, J.R. 1968a. *Condor* 70: 206–10.
—– 1968b. *Mem. San Diego Soc. nat. Hist*. 3.
—–, & B.G. Murray. 1986. *Current Orn*. 3: 1–86.

Calidris subminuta Long-toed Stint

COLOUR PLATE FACING PAGE 289

Tringa subminuta Middendorf, 1851, *Reise N.O. Sibir.* 2: 222, Pl. XIX, Fig. 6 — Stanowoj Mountains, Siberia.

The specific epithet is compounded from the Latin *sub-*, somewhat like, related to, and the specific name of the Little Stint, *minuta*, as Middendorf considered the two very similar in appearance and size.

OTHER ENGLISH NAMES Long-toed Sandpiper, Middendorf's Stint.

MONOTYPIC

FIELD IDENTIFICATION Length 13–16 cm; wingspan 26.5–30.5 cm; weight c. 25 g. Very small sandpiper with distinctive shape: small head, long slim neck, rounded belly and short rear-end; long legs, often held flexed; and short straight bill tapering to finely pointed tip; folded primaries fall level with tail and show little or no primary projection beyond tertials (very short or absent in adults and juveniles); toes (especially middle toe) are longer and thin, giving impression of awkwardly large foot. Distinctive shape also enhanced by stance. Slightly smaller and more finely built than Red-necked Stint *Calidris ruficollis*. In all plumages, combination of yellow legs and feet, pale-brown or yellow base to lower mandible, and well-streaked gorget, distinctive; in flight, show indistinct thin white innerwing-bar and typical pattern of stints of white sides to black-centred rump and uppertail-coverts; underwing has more contrasting pattern than other stints. Flight call distinguishes from other stints in HANZAB region. Sexes alike. Juvenile distinct. Immatures separable.

Description Adult breeding Centre of forehead and crown, orange-rufous, coarsely streaked black, forming distinct cap set off by prominent white supercilium; supercilium broader and cleaner in front of eye, and finely streaked dark and sometimes washed orange-rufous behind eye. In most, dark forehead joins narrow dark loral stripe; and most have narrow dull-white lateral crown-stripes that join supercilium just above and in front of eye to form split supercilium. Nape, hindneck and sides of neck, pale brown, streaked black. Chin and throat, white, merging to finely dark-streaked buff-brown or orange-buff lower cheeks and ear-coverts; darker-brown upper ear-coverts form dark patch that can combine with loral stripe to form subdued dark eye-stripe. Mantle coarsely streaked orange-rufous and black, with narrow buff mantle V. Scapulars, black, broadly fringed orange-rufous, and with broad greyish-white tips that sometimes align on lower row of upper scapulars to form pale scapular line. Tertials and inner few greater coverts (and occasionally innermost few medians), black with thick orange-rufous fringes and small white tips. Rest of innerwing-coverts, black, with broad pale-rufous or buff edges and whitish tips. Underbody, white, with pale orange-rufous wash and black streaks on foreneck, upper breast, sides of breast and foreflanks; streaking becomes finer, and often indistinct, in centre of foreneck and upper breast; in some, a few fine dark streaks extend farther along flanks. In very fresh plumage, upperparts appear mostly pale grey with black markings and hints of rufous, contrasting with orange-rufous tertials; pale tips soon reduced with wear, exposing orange-rufous and making pale mantle and scapular lines less obvious. In flight from above, show: mostly blackish upperwing, with panel of pale-fringed coverts on central innerwing; indistinct thin white innerwing-bar along tips of greater secondary coverts; and contrasting white shaft of outermost primary; white sides to rump and uppertail-coverts; and blackish centre to otherwise pale-grey tail. Underwing, white, with dark-brown remiges, greater primary coverts and broad dark band of mottling along leading-edge. Bill, black, with paler brown or green-yellow tinge at base of lower mandible; rarely, basal half may be tinged so. Iris, dark brown. Legs and feet vary: yellowish brown, greenish yellow or green; sometimes pale orange-yellow. **Adult non-breeding** Compared with black-legged stints, upperparts darker, browner and more heavily patterned; and foreneck and breast, darker, grey-brown and more boldly streaked, somewhat like Sharp-tailed Sandpiper in appearance. Differ from adult breeding by: pattern of head more subdued: crown, grey-brown, coarsely streaked black, giving slight capped effect; dark coloration extends through centre of forehead to base of bill then broadens to join narrow dark loral stripe at sides of forehead; fewer have split supercilium. Rest of head and neck, grey-brown streaked black, often slightly darker on upper ear-coverts and merging to clean white chin and throat. Rest of upperparts and innerwing-coverts dark, grey-brown strongly patterned with black; when fresh, all feathers have fine dull white tips, which are lost with wear, upperparts becoming slightly darker and browner. Underbody, white, with strong grey-brown wash overlaid with prominent black streaks on foreneck, upper breast and fore-flanks; streaking heaviest at sides but finer and sparser towards centre of breast; a few fine dark streaks and broader grey-brown smudges on flanks. **Juvenile** Distinct in field to late Nov. Like adult breeding but richer and darker, rufous above; further differs by: crown, rufous, coarsely streaked black, forming more distinct dark cap, which contrasts more with paler grey-brown nape, hindneck, sides of neck and head. Facial pattern, distinctive: dark loral stripe narrower in centre and curves upwards to join dark centre of forehead, giving white fore-supercilium characteristic bulb shape (sometimes seen in adult breeding and non-breeding); supercilium also cleaner white and more prominent (though still finely dark-streaked) behind eye; and rufous or whitish lateral crown-stripes and split supercilium more pronounced. Mantle, scapulars, tertials and innermost few greater coverts, black, with broad rich-rufous fringes and broad white tips, which form thick white mantle V and narrow white scapular lines. Other innerwing-coverts, black or grey-brown with dark shafts, and usually with prominent buff-white (rarely, pale rufous) edges, these coverts contrasting noticeably with rest of upperparts. Underbody, as breeding except ground-colour of gorget duller, grey-buff, often grading to much paler buff or white and only faintly streaked in centre of breast. With wear and fading, rufous fringes of upperparts much reduced, paler cream or dull white, making crown appear duller and reducing contrast between coverts and rest of upperparts; in very worn plumage, mantle and scapulars can look almost uniformly black, contrasting with still cream-fringed coverts. **First immature non-breeding** Separable from adult non-breeding (till late in first austral spring) by many retained juvenile innerwing-coverts and tertials, which are worn but still have distinct pale fringes, and which contrast with fresh grey-brown upperparts. **First immature breeding** Little known. Some remain in dull non-breeding plumage during boreal summer, but most attain bright plumage similar to adult breeding, and then only separable from adult by very worn retained juvenile remiges (fresh in adults).

Similar species At all times, distinguished from black-legged stints by combination of slightly smaller size, finer build, and distinctive jizz; yellowish legs and feet; pale-brown or yellow base to lower mandible; well-streaked gorget; thinner upperwing-bar, and darker and more contrastingly patterned underwing; and distinctive flight call. May be confused with **Little** and **Red-necked Stints**; see those accounts for differences. Ought not to be confused with superficially similar **Sharp-tailed Sandpiper**, which is much bigger and heavier; with noticeably heavier and blunter bill; and longer and more prominent wing-bar; in all plumages, show distinctive forward-sloping rufous cap (matched only by juvenile Long-toed) and no pale lateral crown-stripes or split supercilium; legs darker, olive or greyish olive; and different flight call; flight heavier, more leisurely and direct, with loose measured wing-beats.

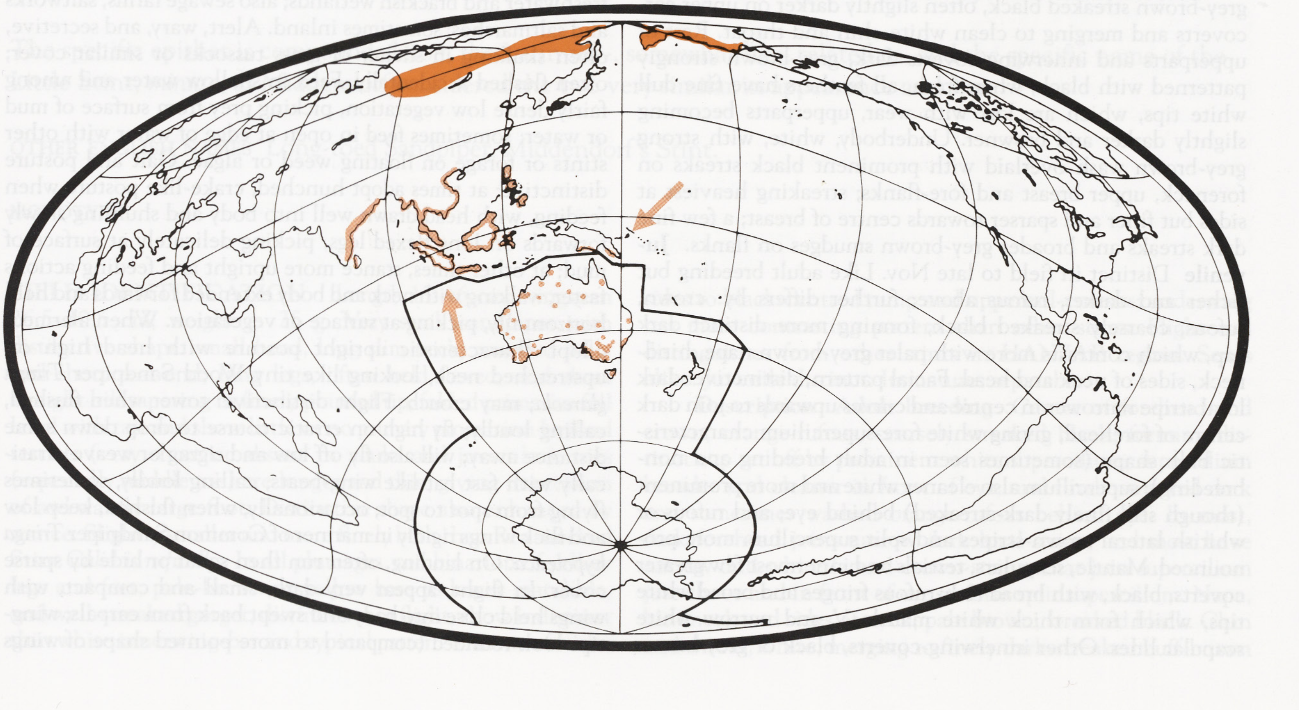
Less gregarious than other stints; usually seen singly or in pairs in HANZAB area, sometimes in larger flocks at favoured sites, especially in WA. Associate with other small waders. Prefer muddy or vegetated edges of coastal and near-coastal freshwater and brackish wetlands; also sewage farms, saltworks and saltmarshes; sometimes inland. Alert, wary, and secretive, often skulking in shelter of grass tussocks or similar cover; often flushed accidentally. Feed in shallow water and among fairly dense low vegetation, picking prey from surface of mud or water; sometimes feed in open at edge of water with other stints or forage on floating weed or algae. Gait and posture distinctive: at times adopt hunched, crake-like posture when feeding, with head drawn well into body and shuffling slowly forwards on long flexed legs, picking delicately at surface of mud; at other times, stance more upright and feeding actions faster, walking with neck and body extended forwards and held horizontally, picking at surface or vegetation. When alarmed, adopt characteristic upright posture with head high on upstretched neck, looking like tiny Wood Sandpiper *Tringa glareola*; may crouch. Flight distinctive: tower when flushed, calling loudly; fly high on erratic course to drop down some distance away; will also fly off low and zigzag or weave erratically with fast bat-like wing-beats, calling loudly, sometimes flying from spot to spot; occasionally, when flushed, keep low and flick wings rigidly in manner of Common Sandpiper *Tringa hypoleuca*. On landing, often run then squat or hide by sparse cover. In flight, appear very dark, small and compact, with wings held close into body and swept back from carpals; wing-tips look rounded (compared to more pointed shape of wings of other stints) and, unlike other stints (except Western Sandpiper), show much of toes trailing beyond tip of tail. Voice distinctive: usual flight call short, soft rippling *prrp*, *chrrp* or *chulip*, sometimes like that of Curlew Sandpiper *Calidris ferruginea*.

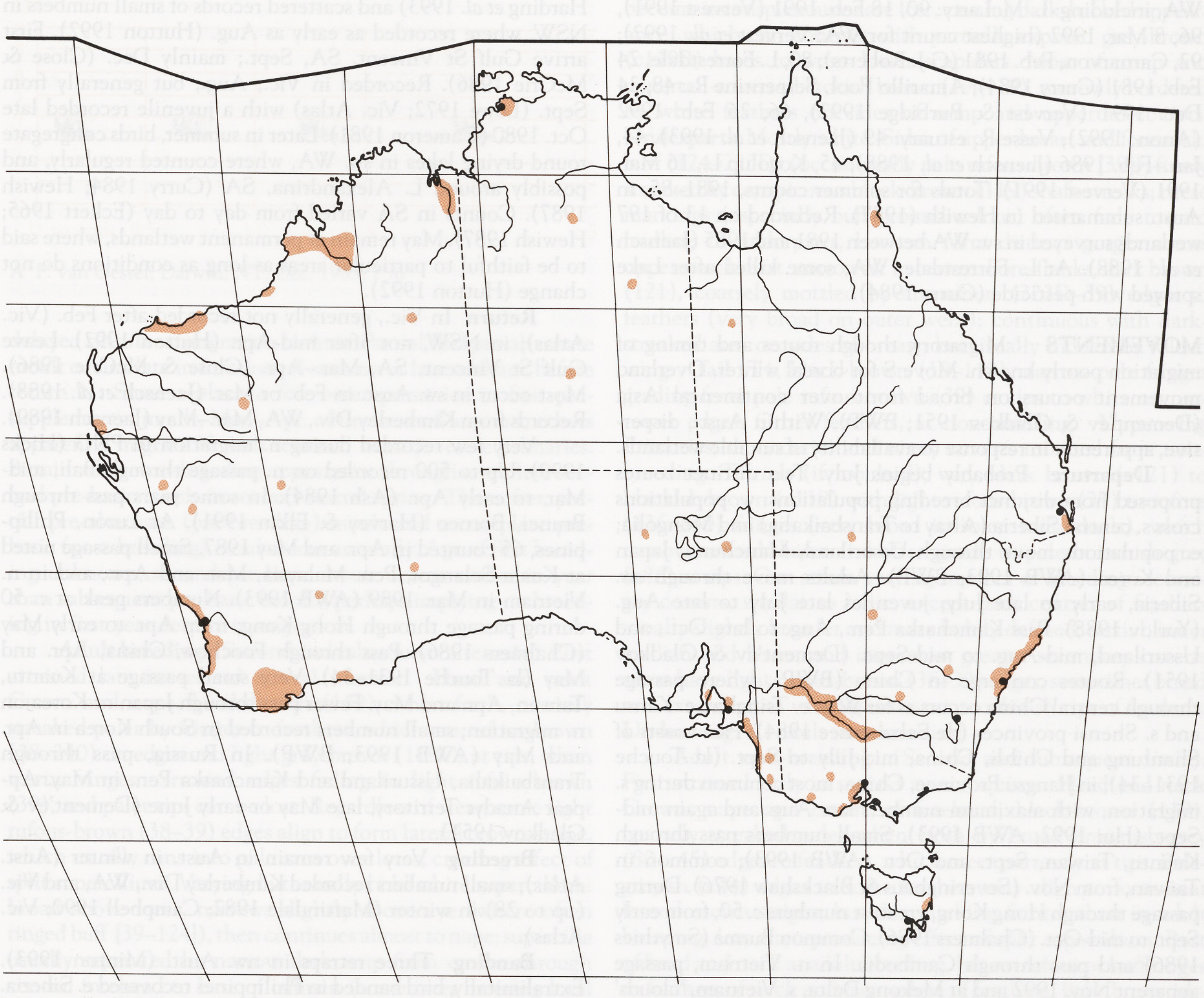
HABITAT In Aust., occur in variety of terrestrial wetlands. Prefer shallow freshwater or brackish wetlands (Smith 1968; Jaensch 1984, 1988), such as lakes, swamps, streams, river floodplains, lagoons and sewage ponds; with areas of muddy shoreline, and growths of short grass, weeds, sedges, low or floating aquatic vegetation, reeds and rushes and, occasionally, stunted samphire (Eckert 1965, 1972; Smith 1968; Curry 1979; Badman & May 1983; Jaensch 1984, 1986, 1988). Occasionally occur on open, less vegetated shores of larger lakes and ponds. Often on muddy fringes of drying ephemeral lakes and swamps (Curry 1979; Hewish 1987; Jaensch 1988; Storr & Johnstone 1988), but also frequent margins of permanent wetlands, such as reservoirs and artificial lakes (Horton 1975; Schmidt 1978; Jaensch & Vervest 1990). Infrequently round tidal estuaries, saline lakes, saltponds and bore swamps (Smith 1968; Curry 1979; Jaensch 1984, 1986, 1988; Hewish 1987).

Forage on wet mud or in shallow water, often among short grass, weeds and other vegetation on islets or round edges of wetlands. Occasionally feed in open water, well away from shore, especially in drying ephemeral wetlands. Recorded foraging in shallows round edge of flooded samphire; once seen feeding among washed-up patches of floating waterweed (Eckert 1965; Smith 1968, 1969; Curry 1979). Usually roost or loaf in sparse vegetation at edges of wetlands, and on damp mud in or near shallow water. May also squat or roost in small depressions in mud, including footprints in dried mud (Eckert 1965; Smith 1968; McKean *et al*. 1976; Jaensch 1988; R.P. Jaensch).

DISTRIBUTION AND POPULATION Breeding distribution poorly known: widely scattered in Siberia, possibly in separate populations: e. Chukotskiy Pen.; Koryak Plateau; Komandorskiye Is; Kurile Is; n. coast of Sea of Okhotsk round Magadan; n. Verkhoyanskiy Mts; and on Ob R., round Nizhnevartovsk, c. 400 km E of junction with Irtysh R. (Dement'ev & Gladkov 1951; Flint *et al*. 1984). Passage migrant through e. Asia. Winter from se. China, through Indochina, Indomalaya and Philippines S to Malay Pen. and Indonesia, and W to Burma and Bangladesh, with small numbers reaching the Indian subcontinent, N to Nepal, W to Bihar and S to Sri Lanka; may visit Maldive Is regularly in small numbers. Regular but uncommon visitor to New Guinea and Aust. Vagrant, Sweden, e. and s. Africa, w. Melanesia, nw. Hawaii, nw. USA, mainland w. Alaska and islands in the Bering Sea (Phillips 1963; Ali & Ripley 1980; AOU 1983; de Schauensee 1984; Coates 1985; Pratt *et al*. 1987; Urban *et al*. 1987; AWB 1993; BWP).

Aust. Regular summer visitor, but uncommon in E. First recorded 21 Sept. 1886 near Lukins Crossing, lower Fitzroy R., when single specimen obtained (Storr 1980); considered rare vagrant till 1960s (Aust. Atlas). Most records from WA. **Qld** Not recorded in Aust. Atlas. At Mt Isa: single, captured, Nov. 1963; three seen, Nov. 1964 (Horton 1975); common, Sept.–Nov. 1966 (Carruthers 1966; Thomas 1970; Horton 1975). Single, Lytton, 20 Dec. 1986–22 Feb. 1987 (Qld Bird Reps 1986, 1987); single, Cairns, 24 Oct. 1988 (Qld Bird Rep. 1988) (though claim of 220 in 1989; Hewish 1990); single, Dynevor Downs, Dec. 1971–Jan. 1972 (Corben 1972). **NSW** Irregular, widely scattered records (singles unless stated): estuary of Richmond R., Feb. 1989 (AWSG); Kooragang I., 31 Aug. 1980 (Aust. Atlas); Pitt Town Lagoon–McGrath's Hill, 29 Oct. 1977–18 Mar. 1978 (NSW Bird Reps 1977, 1978); Bushell's Lagoon, Hawkesbury R., 1–8 Feb. 1987 (NSW Bird Rep. 1987); Shell Pt, Botany Bay, 1–2 Nov. 1986 (NSW Bird Rep. 1986); Parkes, 11–22 Nov. 1979 (NSW Bird Rep. 1979); Fivebough Swamp, 26 Oct. 1985–9 Feb. 1986, 8 Mar.–12 Apr. 1987, 18 Aug.–14 Dec. 1991 (Hutton 1992); Tullakool Saltworks, 3 Nov. 1982, 18 Dec. 1987 (NSW Bird Reps 1982, 1987); Fletcher's L., Dareton, 6–15 Nov. 1969, 26 Dec. 1983–20 Feb. 1984 (NSW Bird Reps 1983, 1984; J.N. Hobbs);





Mortanally Billabong, Wentworth, 28 Dec. 1981 (NSW Bird Rep. 1981); two, Cobar, 23 Nov. 1975–7 Feb. 1976 (Schmidt 1978; NSW Bird Rep. 1976). **Vic.** First recorded 4 Apr. 1962, Altona (Smith 1962). Most records from Port Phillip Bay: in E, round Carrum and Seaford (Smith 1969; Vic. Bird Reps 1985, 1986); in W, from Altona to Werribee Sewage Farm; occasionally recorded at Moolap and lakes of Lower Barwon R. (Smith 1968; Vic Bird Reps 1981, 1983, 1985, 1986). Elsewhere, recorded Apollo Bay (Vic. Atlas), lakes in Western Districts (including L. Murdeduke, Calvert Lough and L. Pertobe) (Smith 1968; Thomas 1970), central highlands (including Merin Merin Swamp and L. Goldsmith) (Vic. Atlas), round Mildura (Merbein, L. Ranfurly) (Thomas 1970; Vic. Bird Rep. 1982), and wetlands between Swan Hill and Kerang (Ls Woorinen and Tutchewop, Mystic Park) (Smith 1969, 1976; Lowe 1972, 1981; Klapste 1977; Vic. Bird Rep. 1981; MV). **Tas.** Single, Moulting Lagoon, 25 Oct. 1980 (Fletcher *et al.* 1981). **SA** Frequent records from Bool Lagoon W to Big and Little Swamps, s. Eyre Pen., with most records from The Coorong, Langhorne Ck and ICI (St Kilda) and Price Saltworks (Eckert 1965, 1972; Beruldsen 1972; Stove 1994; SA Bird Reps; AWSG; Aust. Atlas; SAM). Inland records rare: Cannuwaukininna Bore, Birdsville Track, 6 Dec. 1980 (Badman & May 1983; SAM); Oodnadatta, 12 Oct. 1980 (Aust. Atlas). Unconfirmed record from Leigh Ck, 1 Nov. 1981 (Badman & May 1983). **WA** Widely scattered records. On s. coast, from Esperance to Albany, and inland to L. Cassencarry (near Ongerup) and Dumbleyung (Newbey & Newbey 1985; Jaensch *et al.* 1988; Aust. Atlas); on sw. coast, many records between Vasse R. estuary and Guraga L. and Namming NR (Jaensch *et al.* 1988; ABBS; *West. Aust. Bird Notes passim*; Aust. Atlas; specimens: WAM, SAM, ANWC). Occasionally recorded Gascoyne Region round L. Wooleen, Meeberrie Stn and McNeill Claypan (Serventy & Whittell 1976; Storr 1985; Aust. Atlas). Widespread Pilbara region and Kimberley Div., between Karratha and Wyndham–Kununurra (Curry 1984; Jaensch & Vervest 1990; AWSG; *West. Aust. Bird Notes passim*; Aust. Atlas). Inland records include: L. Brown, Hannan L., L. Violet, Newman Sewage Farm and L. Gregory (Brooker *et al.* 1979; Curry 1979; Storr 1984, 1986; Jaensch & Vervest 1990; Aust. Atlas; AWSG). **NT** First recorded Harrison Dam, 4 Oct. 1969 (Crawford 1972). Only three records in Aust. Atlas, but often recorded Leanyer (H.A.F. Thompson & D.K. Goodfellow) and elsewhere round Darwin (Crawford 1972; McKean *et al.* 1976). Also at Daly Waters and Alice Springs Sewage Farm (Aust. Atlas); L. Sylvester in Barkly region, Dec. 1993 (R.P. Jaensch).

Christmas I. Two, Sept. 1940 (Gibson-Hill 1947); single, 21–22 Sept. 1978; two, 3 Nov. 1978 (Stokes *et al.* 1987).

Population Records of >40 in Aust. all on w. coast of

WA, including: L. McLarty: 90, 18 Feb. 1991 (Vervest 1991), 96, 8 Mar. 1992 (highest count for WA; Vervest *et al.* 1992); 92, Carnarvon, Feb. 1981 (G.J. Roberts); 80, L. Forrestdale, 24 Feb. 1981 (Curry 1984); Amarillo Pool, Serpentine R.: 48, 24 Dec. 1991 (Vervest & Burbidge 1992), 66, 26 Feb. 1992 (Anon. 1992); Vasse R. estuary: 49 (Jaensch *et al.* 1993), 44, Jan.–Feb. 1986 (Jaensch *et al.* 1988); 45, Kogolup L., 16 Mar. 1991 (Vervest 1991). Totals for summer counts, 1981–85, in Aust. summarized in Hewish (1987). Recorded on 13 of 197 wetlands surveyed in sw. WA between 1981 and 1985 (Jaensch *et al.* 1988). At L. Forrestdale, WA, some killed after Lake sprayed with pesticide (Curry 1984).

MOVEMENTS Migratory, though routes and timing of migration poorly known. Move S for boreal winter. Overland movement occurs on broad front over continental Asia (Dement'ev & Gladkov 1951; BWP). Within Aust., dispersive, apparently in response to availability of suitable wetlands.

Departure Probably begins July. Two distinct routes proposed from disjunct breeding populations: w. populations cross s. central Siberia (Altay to Transbaikalia) and Mongolia; e. populations move through Ussuriland, Manchuria, Japan and Korea (AWB 1993; BWP). Adults move through sw. Siberia, early to late July; juveniles late July to late Aug. (Yurlov 1988). Pass Kamchatka Pen., Aug. to late Oct., and Ussuriland, mid-Aug. to mid-Sept. (Dement'ev & Gladkov 1951). Routes converge in China (BWP), where passage through central China occurs as far W as e. Tsinghai, e. Kansu and s. Shensi provinces (de Schauensee 1984). Pass coasts of Shantung and Chihli, China, mid-July to Sept. (la Touche 1931–34); in Jiangsu Province, China, most common during s. migration, with maximum numbers late Aug. and again mid-Sept. (Hui 1992; AWB 1993). Small numbers pass through Kuantu, Taiwan, Sept. and Oct. (AWB 1993); common in Taiwan, from Nov. (Severinghaus & Blackshaw 1976). During passage through Hong Kong, greatest numbers *c.* 50, from early Sept. to mid-Oct. (Chalmers 1986). Common Burma (Smythies 1986) and pass through Cambodia. In n. Vietnam, passage apparent Nov. 1992 and at Mekong Delta, s. Vietnam, 'clouds' reported in Nov. 1980. Apparently arrive Thailand from Aug. or Sept., but numbers increase at some sites till Jan. (Starks 1987; AWB 1993). Common w. coast of Pen. Malaysia, Jan.–Feb. (R.P. Jaensch). Rare Sumatra (but almost certainly overlooked) (van Marle & Voous 1988). Pass through Borneo (Smythies 1981), where large numbers appear from Aug. (Beadle & Whittaker 1985; Harvey & Elkin 1991; AWB 1993). Only records from n. Sulawesi, Sept.–Oct. (White & Bruce 1986). Scarce n. coast of Java, Aug. and Sept. 1984, when only adults recorded (Bowler *et al.* 1985). Up to 200 recorded during s. passage from mid-July to early Oct. in Bali (Ash 1984). Pass through Philippines (apparently an important non-breeding site) (McClure 1974; AWB 1993). Uncommon migrant in w. Micronesia (Pratt *et al.* 1987). Uncommon and irregular passage migrant in Port Moresby district, PNG, where usually arrive late Sept. (Hicks 1990); probably numerous in w. New Guinea (Beehler *et al.* 1987). Begin arriving in Aust. in Aug. (Aust. Atlas).

Non-breeding Aust. Movements regular but dispersive, between temporary wetlands. Apparently arrive n. coast, W of Darwin, NT, and occupy freshwater wetlands in w. Kimberleys and Pilbara, WA. During summer, disperse across continent, when found between Pilbara and coast of SA, with few moving farther E (Curry 1979, 1984; Hewish 1987). Recorded round Darwin, NT, and Mt Isa, Qld, in Oct. (McKean *et al.* 1976; Harding *et al.* 1993) and scattered records of small numbers in NSW, where recorded as early as Aug. (Hutton 1992). First arrive Gulf St Vincent, SA, Sept.; mainly Dec. (Close & McCrie 1986). Recorded in Vic., Aug., but generally from Sept. (Lowe 1972; Vic. Atlas) with a juvenile recorded late Oct. 1980 (Cameron 1981). Later in summer, birds congregate round drying lakes in sw. WA, where counted regularly, and possibly around L. Alexandrina, SA (Curry 1984; Hewish 1987). Counts in SA varied from day to day (Eckert 1965; Hewish 1987). May remain at permanent wetlands, where said to be faithful to particular areas as long as conditions do not change (Hutton 1992).

Return In Vic., generally not recorded after Feb. (Vic. Atlas); in NSW, not after mid-Apr. (Hutton 1992). Leave Gulf St Vincent, SA, Mar.–Apr. (Close & McCrie 1986). Most occur in sw. Aust. in Feb. or Mar. (Jaensch *et al.* 1988). Records from Kimberley Div., WA, Mar.–May (Jaensch 1989).

Very few recorded during n. migration in PNG (Hicks 1990). Up to 500 recorded on n. passage through Bali, mid-Mar. to early Apr. (Ash 1984). In some years pass through Brunei, Borneo (Harvey & Elkin 1991). At Luzon, Philippines, 65 counted in Apr. and May 1987. Small passage noted at Kuala Selangor, Pen. Malaysia, Mar. and Apr., and in n. Vietnam in Mar. 1989 (AWB 1993). Numbers peak at *c.* 50 during passage through Hong Kong, from Apr. to early May (Chalmers 1986). Pass through Foochow, China, Apr. and May (la Touche 1931–34). Very small passage at Kuantu, Taiwan, Apr. and May. Fewer pass through Japan or Korea on n. migration; small numbers recorded in South Korea in Apr. and May (AWB 1993; BWP). In Russia, pass through Transbaikalia, Ussuriland and Kamchatka Pen. in May. Appear Anadyr Territory, late May or early June (Dement'ev & Gladkov 1951).

Breeding Very few remain in Aust. in winter (Aust. Atlas); small numbers recorded Kimberley Div., WA, and Vic. (up to 28) in winter (Martindale 1982; Campbell 1990; Vic. Atlas).

Banding Three retraps in nw. Aust. (Minton 1993). Extralimitally, bird banded in Philippines recovered e. Siberia. Birds banded at Palawan, Philippines, and at Taiwan have been recaptured in subsequent years (McClure 1974; Chuang 1992).

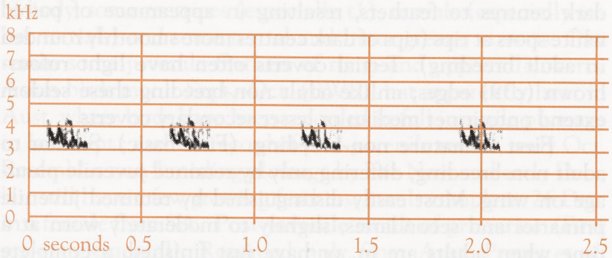
FOOD Poorly known. Omnivorous: seeds, molluscs, crustaceans and insects. **Behaviour** Mainly feed on fresh waters; singly or in small flocks in shallow water, on floating weed or algae (Hayman *et al.* 1986), or in low vegetation with crouched or hunched posture (Smith 1968). Deliberate, bent-kneed walk, slower and less urgent than gait of Red-necked Stint; glean from surface of mud and water; sometimes probe or turn head to flick over debris (Hutton 1992). Possibly defend feeding territory in non-breeding period (Smith 1968).

Adult No data from A'asia. Extralimitally, see Dement'ev & Gladkov (1951).

VOICE No detailed studies; poorly described. Brief comments in BWP, Hayman *et al.* (1986), Colston & Burton (1988). Most common call a dry purring (Colston & Burton 1988).

Adult Purring *prrp* or *chrrp* (sonagram A), very different from usual calls of Red-necked Stint (q.v.).

PLUMAGES Prepared by D.I. Rogers. Undergo partial post-juvenile (first pre-basic) moult of body-feathers that may be



A F. van Gessel; Darwin, NT, Dec. 1983; P36

delayed till after s. migration to Aust. Partial first pre-alternate moult occurs late in first austral autumn or late summer, before return N. Some replace a few outer primaries in first pre-supplemental moult, Mar.–Apr. of first austral autumn; others apparently migrate N with retained worn juvenile primaries. Attain adult non-breeding appearance through complete second pre-basic moult in second austral spring. Thereafter, partial pre-alternate (pre-breeding) moult and a complete pre-basic (post-breeding) moult occur annually. Age of first breeding unknown; second pre-basic moult occurs earlier in year than subsequent pre-basic moults, perhaps implying no breeding in first year despite n. migration.

Adult breeding (Second and subsequent alternate). First attained late in second austral summer. **Head and neck** Crown and nape, black-brown (119); when fresh, coarsely streaked paler by fringes to feathers, which are rufous-brown (38–240) on edges and light grey-brown (119C) at tips; when worn, fringes narrower, edges fading to light rufous-brown (39), and paler tips can be lost. Regardless of wear, some light rufous-brown (38–39) edges align to form lateral crown-stripe, which usually runs into pale area over lores, creating effect of split supercilium. Varying but usually bold white supercilium: broad above lores, narrows slightly above eye (where often tinged buff [39–124]), then continues almost to nape; supercilia usually separated by narrow dark strip from crown through central forehead to base of culmen (sometimes meeting loral stripe). Loral stripe, dark brown (121), sometimes scalloped rufous-brown (38) by edges of feathers when fresh; narrow in centre, broadening gradually towards bill and abruptly in front of eye, where there is often a large dark smudge. White orbital ring, narrow, usually distinct. Upper ear-coverts, brown (119B) to dark brown (119A), indistinctly streaked by grey-brown (c45) to light rufous-brown (39) edges to feathers; coverts form varying dark smudge, often meeting rear of eye, that, combined with loral markings, form distinct eye-stripe. Rest of face and sides of neck, buff to dull white, densely but indistinctly streaked by grey-brown (c119B) to dark-brown (119A) centres of feathers; looks buff to greyish brown at distance, contrasting with white chin and throat. Hindneck, light grey-brown (c45) to light rufous-brown (39), coarsely streaked by dark-brown (121) centres to feathers. Foreneck, as uppermost breast. **Upperparts** Mantle, upper back and inner (upper) scapulars, black-brown (119), coarsely streaked when fresh by pale fringes, especially rufous-brown (38–240) edges, which merge to inconspicuous light grey-brown (119C) tips; outer (lower) scapulars similar in pattern but broader light grey-brown (119C) to whitish tips to feathers encroach more onto edges of feathers and cause paler, more scalloped appearance. Longest feathers of mantle have buff (c124) outer edges, lining up to form varying, often distinct mantle V. With wear, mantle V narrows (can be lost), and fades to white; rufous edges become inconspicuous or are lost, causing dark-backed appearance, which can contrast with partially exposed grey-brown (c119B) bases to worn lower scapulars. Most of rump and uppertail-coverts, blackish brown (19–119), narrowly bordered by white feathers on sides of rump and uppertail-coverts. **Underparts** Mostly white. Sides of upper breast and foreneck, buff (124–223D) (occasionally pale rufous-brown [39]), finely streaked by conspicuous black-brown (119) shaft-streaks; these markings (especially buff ground-colour) often fade toward midline of underparts, but can form distinct gorget across uppermost breast, narrowest in centre. Fore-flanks, dark brown (121), coarsely mottled by cinnamon (223D–39) edges to feathers (very broad on outer webs); continuous with dark-streaked area on sides of breast, but usually hidden by folded wing. **Tail** T1, black-brown (19–119), narrow pale fringes grading from pale rufous-brown (39) at tips to white on narrower edges. Other feathers, as non-breeding. **Upperwing** Primaries, secondaries and many coverts retained from non-breeding. Tertials (if moulted), vary: dark brown (c121) to blackish brown (c119) with light rufous-brown (39) to rufous (136–340) fringes (very broad in some individuals), which narrow towards bases and often grade to pale brownish-grey (c86) at tips. Can attain varying number of breeding secondary coverts, similar to basic, except dark centres of feathers usually slightly broader and more boldly defined; tertial, inner median and lesser, and innermost greater secondary coverts often have light rufous-brown (38–39) edges, sometimes broad and extending to varying extent onto whitish tips of feathers. **Underwing** As adult non-breeding.

Adult non-breeding (Second and subsequent basic). First attained early in second austral spring. **Head and neck** Crown, nape and centre of forehead, black-brown (119), coarsely streaked paler when fresh by broad brownish-grey (80–c45) edges to feathers, which meet narrowly at tips. Pale-greyish (c44) edges to some feathers may align to form neat lateral crown-stripes, but this marking fainter than in adult breeding, less often producing effect of split supercilium. Rest of head and neck as adult breeding, but no rufous or buff tinges to feathers of neck and face; edges of feathers, light brownish-grey (c44–c45) on hindneck, grading to pale brown (c119D) or whitish below eye and on sides of neck; brown (119B) centres to ear-coverts lighter and less distinct than in adult breeding, less often contributing to effect of dark eye-stripe. Orbital ring usually less distinct. **Upperparts** Mantle, upper back and inner (upper) scapulars, brownish grey (c45) to grey (80), coarsely mottled by rounded and sharply defined black-brown (119) centres to feathers. Mottling on outer (lower) scapulars less bold, dark centres of feathers smaller (grading to brown-grey [c80] at bases of feathers, which are often partially exposed) and sometimes noticeably browner (121) than blackish (119) shafts. Rump to uppertail-coverts, mostly blackish brown (19–119), narrowly bordered by white at sides of rump and uppertail-coverts. **Underparts** Mostly white. Uppermost breast (and sometimes sides of foreneck), pale grey-brown (119D–c44) with finer dark-brown (119A) streaking than in adult breeding; streaks form gorget, broadest and most distinct at sides of breast; narrower, and in some, broken, in midline. Fore-flanks slightly darker than gorget, with dark-brown (119A) shafts surrounded by varying brown (119B) areas to feathers. **Tail** T1, black-brown (19–119) with brownish-grey (c79) edges, narrower toward bases: T2–t6 grade from dark grey-brown (c119A) on t2 to grey-brown (c119B) on t6; when fresh, neatly fringed white; ground-colour may be greyer when very fresh. **Upperwing** Primaries, secondaries, primary coverts and alula, black-brown (119), fading to dark brown (121–c119A) when worn; when fresh, secondaries and alula narrowly tipped white. Shafts of most primaries, dark brown (223), often grading to small paler-brown (123) area near tip; shaft of p10, cream (92) to dull white, often grading to brown (c123) at base. Tertials, dark brown (119A–121) with darker blackish (119) shafts; indistinctly and narrowly fringed pale brownish-grey (c44) to white. Greater secondary coverts, dark brownish-grey (c80) to dark brown (c121) with white tips (2–3 mm wide when fresh) forming narrow wing-bar. Other secondary coverts, brownish grey (c80, browner when worn) with dark-brown (c121) centres and bases; dark-brown areas larger on marginal coverts, contributing to dark appearance of leading-edge. Pale greyish (c86) to white fringes (*c.* 1 mm wide) to median and lesser secondary coverts, smaller on marginal coverts (where they extend less onto edges of feathers). **Underwing** Primaries, secondaries and greater primary coverts, grey (c84); secondaries and some primary coverts (especially inner coverts) narrowly tipped white. Grey can extend onto bases of otherwise white greater secondary coverts. Other coverts, white but large dark-brown (121) bases to marginal and smaller lesser coverts give appearance of broad and mottled dark-brown leading-edge.

Juvenile Similar to adult breeding; differs by: **Head and neck** Edges of feathers of top of head (which are slightly smaller), slightly more orange-rufous (40–240), grading to smaller grey-brown (119C) areas at tips; give appearance of more rufous cap in some in fresh plumage. Light rufous-brown (c39) to buff (124) lateral crown-stripes, narrower and often indistinct or absent, so seldom have split supercilium. Dark area of forehead continues to bill, usually meeting anterior end of dark loral stripe, which is broader near bill, but narrower in centre and near eye than adult breeding, and sometimes broken in front of eye; thus anterior end of white supercilium (which is usually broader and better defined than in adult breeding) is distinctly bulb-shaped. Ear-coverts often pale behind and below eye (matching malar area), so often lack appearance of distinct eye-stripe. Orbital ring, usually less distinct. Hindneck, face and foreneck, seldom tinged light rufous-brown to buff, and dark-brown streaking on sides of neck is generally finer. **Upperparts** Feathers smaller than in adult breeding, those of central rump often narrowly tipped brown (c123C). When fresh, feathers of mantle and scapulars fringed slightly more orange-rufous (40–240), not grading to grey-brown at tips; nevertheless, juveniles usually appear to be streaked rufous (rather than scalloped) because dark centres to feathers narrower and more tapered than adult breeding. White V on mantle much bolder. Sharply defined white tips to rufous fringes of outer (lower) scapulars much bolder, forming distinct scalloping or even a scapular V. **Underparts** Gorget of uppermost breast usually narrower and fainter, and more often broken in centre. Ground-colour of gorget, greyish-buff (c119D) to white, seldom tinged cinnamon; dark-brown (119A) streaking of gorget and especially fore-flanks, narrower than in adult breeding. **Tail** Pale fringes to t1, light brown (123) towards tips. **Upperwing** Tertials less varying than those of adult breeding (which usually has dull tertials admixed); when fresh, blackish brown (19–119) with orange-rufous (c40–c39) fringes almost broken at tips by narrow projection from dark centres of feathers (cf. smoothly rounded boundaries to dark centres of adult breeding). Median and lesser secondary coverts (and less distinctly, tertial coverts) have broader and more sharply defined white fringes at tip than adult breeding; these generally broken (or nearly broken) at tips by tapered continuation of dark centres to feathers, resulting in appearance of paired white spots at tips (tips of dark centres more smoothly rounded in adult breeding). Tertial coverts often have light rufous-brown (c39) edges; unlike adult non-breeding these seldom extend onto inner median or lesser secondary coverts.

First immature non-breeding (First basic). Similar to adult non-breeding, differing only by retained juvenile plumage on wing. Most easily distinguished by retained juvenile primaries and secondaries, slightly to moderately worn at a time when adults are in, or have just finished, a complete moult of remiges. Also retain juvenile upperwing-coverts; with wear, lesser and median secondary coverts lose paired white spots at tips but distinguishable by cleaner white fringes and they are smaller than adult coverts; many also retain rufous-edged juvenile tertial coverts.

First immature breeding (First alternate). Not known if breeding occurs in this plumage. Similar to adult breeding, though some similar to adult non-breeding (Veit & Jonsson 1984). Separable by more worn primaries and secondaries (some have fresh outer primaries from first pre-supplemental moult). Can also retain many juvenile lesser and median secondary coverts (and less often, tertial coverts), these sometimes becoming too worn to be reliable for ageing, with fringes of tertial coverts fading to buff (Prater *et al.* 1977).

BARE PARTS From photos (Pringle 1987; Delin & Svensson 1988; Alström & Olsson 1989; Chandler 1989; Gosler 1991; Patten & Daniels 1991; Dunnett 1992; Paulson 1993; Strange & Jeyarajasingam 1993; Tipper 1993; unpubl.: D.W. Eades). **Adult, Juvenile** Bill, grey-black (82) to black (89), usually with a pale spot at base of lower mandible varying in size, and in colour from greenish yellow (56, 57) to yellow (53) or orange-brown. Iris, black-brown (119). Legs and feet usually olive (51, c52, 59) to yellow (92, 53) or orange-buff (c118, 153); dull orange said to be characteristic of breeding birds (Veit & Jonsson 1984), but orange-buff (153–c118) reported in some juveniles, which suggests overlap occurs; olive-grey (42) reported in some non-breeding birds, but legs may have been covered in mud.

MOULTS Based on 26 skins, mostly from Aust., including 12 subadults (AM, ANWC, MV, SAM, WAM) and data on primary-moult from 27 birds caught in nw. Aust. (AWSG).

Adult post-breeding (Third and subsequent pre-basic). Complete, primaries outwards. Timing given as Aug.–Nov. (Prater *et al.* 1977) or Aug.–Dec. (BWP); probably similar in Aust. but few data. At least some arrive in HANZAB region before moult of primaries started; in nw. Aust. in early Oct., one had not begun moult of primaries, and another in SA was in early stages of moult of primaries ($N^1 4^1 3^2 1^1 O^5$). Moult complete by Jan., though male from s. WA had PMS of 48 on 4 Jan. **Adult pre-breeding** (Second and subsequent pre-alternate). Partial, involving all feathers of body and sometimes all of tail and tertials, and some inner greater and median secondary coverts. Often retain all basic upperwing-coverts; may retain some outer tertials; some retain tail or moult only t1 or t5 and t6. Timing apparently varies: said to be Mar.–May (BWP) but two, from Vic. and SA, had almost completed moult in late Jan. (another had not started in early Jan.). At least some complete pre-alternate moult before n. migration from se., sw. and n. Aust.; moult often complete by mid- to late Mar., but may continue later in some Aust. birds. **Post-juvenile** (First pre-basic). Partial, not involving primaries, secondaries or most wing-coverts; can moult all feathers of body, some rectrices (especially t1), tertials (especially inner tertials) and some tertial and inner greater coverts. Can retain some juvenile feathers of rump and uppertail-coverts. Asian birds moult Sept.–Oct. (BWP), but apparently later in Aust. where birds have been recorded in full juvenile plumage in late Sept.; earliest record of post-juvenile moult, early Oct. Resembles non-breeding plumage by late Nov. and early Dec., but still have a few growing feathers; moult complete, 26 Dec. in a female from SA. **Post-juvenile moult of primaries** (First pre-supplemental). Recorded only from Aust. Prater *et al.* (1977) and BWP stated that juvenile primaries retained throughout first year, probably based on study of extralimital specimens. In Aust., some moult a few outer primaries, with records of active moult from end Mar.; of birds examined from end Mar. of first year, to mid-Oct. of second year, three retained all juvenile primaries, three had replaced p9 and p10, and three had replaced at least one or two outermost primaries in first pre-supplemental (in latter birds p1 to p8 or p9 had been replaced in second pre-basic). One bird caught nw. Aust. with moult of primaries $N^{8}4^{1}0^{1}$ on 31 Mar., perhaps just an aberrant adult moulting unusually late, but possibly a young bird moulting all primaries in first pre-supplemental. Unusually, Aust. data suggests that this moult occurs after first pre-alternate; more study needed. **First immature pre-breeding** (First pre-alternate). Not known whether this moult precedes a breeding attempt. Partial; similar in extent to adult pre-alternate. One bird had moulted most secondary and tertial coverts, while retaining juvenile marginal, inner lesser and all primary coverts. Timing poorly known; given as Apr.–May (BWP), but only Aust. records from 27 Feb. and 15 Mar. **First post-breeding** (Second pre-basic). Similar to adult post-breeding but occurs earlier; in nw. Aust., PMS 23–24 (n=2) on 15 Sept., 25–38 (n=5) on 4 Oct., and 42–47 (n=3) on 14 Oct. (AWSG).

MEASUREMENTS Combined data (BWP; AM, ANWC, MV, NMNZ, SAM, WAM): (1) Adults; (2) Juveniles; (3) Ages combined.

		MALES	FEMALES	
WING	(1)	92.6 (2.28; 88–95; 23)	95.1 (2.49; 91–102; 21)	**
	(2)	92.9 (1.91; 89–97; 22)	93.8 (2.27; 88–97; 27)	ns
TAIL	(1)	37.5 (1.61; 35–41; 28)	38.3 (1.71; 36–42; 18)	ns
BILL	(3)	17.7 (0.72; 16.2–19.2; 46)	18.7 (0.71; 17.4–20.4; 46)	**
TARSUS	(3)	21.8 (0.93; 19.4–23.4; 42)	22.0 (0.86; 20.2–23.8; 44)	ns
TOE C	(3)	23.2 (0.87; 21.0–25.0; 41)	23.3 (1.10; 21.2–25.5; 38)	ns

Tails of juveniles slightly shorter than those of adult (BWP); length of bill, tarsus and toe of juveniles similar to that of adult from Sept.

(4) NW. Aust., ages combined (AWSG; ABBBS).

		UNSEXED
BILL	(4)	18.4 (0.88; 16.0–20.0; 26)
THL	(4)	39.4 (0.88; 37.3–41.5; 26)

See also Prater *et al.* (1977).

WEIGHTS Aust., sexes combined, skins (museum labels) and live birds; immatures in first year (juvenile to first alternate) (ANWC, MV, SAM, WAM; AWSG; ABBBS): (1) N. Aust., mostly Roebuck Bay, Sept.–Nov.; birds classed as adults mostly in second pre-basic (14–16 months old). (2) Broome, n. WA, late Mar.; (3) S. Aust., Oct. to mid-Mar.

	ADULTS	IMMATURES
(1)	24.1 (1.16; 22.0–26.0; 12)	23.0 (1.78; 20.5–27.0; 12)
(2)	22, 24	20.5, 20.3
(3)	30.5 (0.87; 30–32; 5)	26.5, 29.0, 27.0

Seasonal changes in weight poorly known. In samples above, birds from s. Aust. significantly heavier than those from tropical Aust. S. Aust. samples include male weighing 30 g and female weighing 32 g collected before birds would have been expected to have gained weight before migration; light birds in n. WA at end Mar. may be staging on migration. At staging site in Hopeh, China, males 29 (23–33; 12), females 32 (28–37; 8) (BWP).

STRUCTURE Wing, long, narrow and pointed (though less so than other stints occurring Aust.). Eleven primaries; p10 longest, p9 0–1 mm shorter, p8 2–4, p7 7–10, p6 15–18, p5 21–25, p4 27–31, p3 32–36, p2 36–41, p1 41–46; p11 minute, concealed by primary coverts. Fifteen secondaries, including five tertials; when folded, wing-tip about level with tip of tail and tips of longest tertials level with p8. Tail, square to slightly wedge-shaped; 12 feathers: t1 rather pointed and projects 2–4 mm beyond t2, 4–6 beyond t6; t3–t5 equal to or slightly shorter than t6. Bill, short (80–90% of length of head), straight and slender, except that base moderately deep (4.5–5 mm) and tip slightly expanded. Tarsus and tibia, scutellate, long for a stint and rather slender; toes, unwebbed, elongate and slender. Middle toe especially long, *c.* 105–115% length of tarsus; outer toe *c.* 86% of middle, inner *c.* 84%, hind *c.* 28%.

RECOGNITION In the hand, readily distinguished from other Aust. stints on many plumage characters, (usually) yellowish base to lower mandible, greenish or yellowish (not blackish) legs, and middle toe being longer than tarsus and bill (see Measurements). In adult breeding and non-breeding, can be very similar to corresponding plumages of extralimital Least Sandpiper *C. minutilla*; for discussions of field identification, see Grant & Jonsson (1984), Veit & Jonsson (1984), Alström & Olsson (1987) and Paulson (1993). In the hand, reliably separated by colour of shafts of primaries (mostly dark in Long-toed Stint except for p10; shafts of all primaries predominantly pale in Least Sandpiper) and measurements; Least generally smaller (though with proportionately longer bill, often faintly decurved) with much shorter tarsus and toe; in female Least Sandpiper (larger sex), tarsus 19.1 (0.46; 18.4–19.8; 22; BWP) and toe with claw 19.6 (0.83; 18.0–20.6; 20; BWP). Length of toe (with claw) about equal to bill in Least Sandpiper (shorter if claw excluded); consistently longer than bill in Long-toed Stint, with ratio of bill-length to length of middle toe and claw of 0.71–0.86.

GEOGRAPHICAL VARIATION None.

REFERENCES

Ali, S., & S.D. Ripley. 1980. *Handbook of the Birds of India and Pakistan*. 2. OUP, Delhi.
Alström, P., & U. Olsson. 1989. *Br. Birds* 82: 360–72.
Anon. 1992. *West. Aust. Bird Notes* 63: 2.
AOU. 1983. *Check-list of North American Birds*. Am. Orn. Union, Lawrence, Kansas.

Ash, J.S. 1984. *Bull. Br. Orn Club* 104: 24–35.

AWB. 1993. *A Status Overview of Shorebirds in the East Asian–Australasian Flyway*. Asian Wetland Bureau Internal Rep. 2.

Badman, F.J., & I.A. May. 1983. *S. Aust. Orn*. 29: 29–39.

Beadle, D., & A. Whittaker. 1985. Pp 79–118 **In:** Parish & Wells 1985.

Beehler, B.M., *et al*. 1987. *Birds of New Guinea*. Princeton Univ. Press, Princeton.

Beruldsen, G.R. 1972. *Aust. Bird Watcher* 4: 147–50.

Bowler, J., *et al*. 1985. Pp 143–9 **In:** Parish & Wells 1984.

Brooker, M.G., *et al*. 1979. *Emu* 79: 176–90.

Cameron, M.A. 1981. *Geelong Nat*. 18: 66–9.

Campbell, J. 1990. *Stilt* 16: 58.

Carruthers, R.K. 1966. *Aust. Bird Watcher* 2: 211–14.

Chalmers, M.L. 1986. *Birds of Hong Kong*. Hong Kong Bird Watching Soc., Hong Kong.

Chandler, R.J. 1989. *The MacMillan Field Guide to North Atlantic Shorebirds*. MacMillan, Lond.

Chuang, Y-H. 1992. *Stilt* 20: 44–7.

Close, D.H., & N. McCrie. 1986. *Emu* 86: 145–54.

Coates, B.J. 1985. *The Birds of Papua New Guinea*. 1. Dove, Alderley, Qld.

Colston, P., & P. Burton. 1988. *A Field Guide to the Waders of Britain and Europe with North Africa and the Middle East*. Hodder & Stoughton, Lond.

Corben, C. 1972. *Sunbird* 3: 80–4.

Crawford, D.N. 1972. *Emu* 72: 131–48.

Curry, P.J. 1979. *West. Aust. Nat*. 14: 109–13.

—— 1984. *RAOU Newsl*. 60: 11.

de Schauensee, R.M. 1984. *The Birds of China*. OUP, Oxford.

Delin, H., & L. Svensson. 1988. *Photographic Guide to the Birds of Britain and Europe*. Hamlyn, Lond.

Dement'ev, G.P., & N.A. Gladkov (Eds) 1951. *Birds of the Soviet Union*. 3. Israel Prog. Scient. Trans., Jerusalem (1969).

Dunnett, J.B. 1992. *Br. Birds* 85: 429–36.

Eckert, J. 1965. *Emu* 65: 125–8.

—— 1972. *S. Aust. Orn*. 26: 42–7.

Fletcher, A.W.J., *et al*. 1981. *Tas. Bird Rep*. 10: 28–35.

Flint, V.E., *et al*. 1984. *A Field Guide to the Birds of the USSR*. Princeton Univ. Press, Princeton.

Gibson-Hill, C.A. 1947. *Bull. Raffles Mus*. 18: 87–165.

Gosler, A. 1991. *The Hamlym Photographic Guide to Birds of the World*. Hamlyn, Lond.

Grant, P.J., & L. Jonsson. 1984. *Br. Birds* 77: 293–315.

Harding, S., *et al*. 1993. *Qld Orn. Soc. Inc. Newsl*. 24: 2–3.

Harvey, D., & J. Elkin. 1991. *Stilt* 18: 29–37.

Hayman, P., *et al*. 1986. *Shorebirds*. Croom Helm, Lond.

Hewish, M.J. 1987. *Stilt* 11: 23–31.

—— 1990. *Stilt* 16: 23–35.

Hicks, R.K. 1990. *Muruk* 4: 91–105.

Horton, W. 1975. *Sunbird* 3: 49–69.

Hui, W. 1992. *Stilt* 20: 48–50.

Hutton, K. 1992. *Aust. Birds* 26: 20–8.

Jaensch, R.P. 1984. *West. Aust. Bird Notes* 29: 6–8.

—— 1986. *West. Aust. Bird Notes* 37: 3–4.

—— 1988. *Stilt* 12: 54–7.

—— 1989. *RAOU Rep*. 61.

——, & R.M. Vervest. 1990. *RAOU Rep*. 32.

——, *et al*. 1988. *RAOU Rep*. 30.

——, *et al*. 1993. *West. Aust. Birds Notes* 68 Suppl.: 5.

Klapste, J. 1977. *Aust. Bird Watcher* 7: 56–9.

la Touche, J.D.D. 1931–34. *Birds of Eastern China*. 2. Taylor & Francis, Lond.

Lowe, V.T. 1972. *Aust. Bird Watcher* 4: 130–1.

Lowe, T. 1981. *Mid Murray Field Nat*. 9: 16–17.

Martindale, J. 1982. *Stilt* 2: 2–9.

McClure, H.E. 1974. *Migration and Survival of the Birds of Asia*. US Army, Bangkok.

McKean, J.L., *et al*. 1976. *Aust. Bird Watcher* 6: 143–8.

Minton, C. 1993. *Stilt* 22: 10–12.

Moscow Soc. App. Nature. 1988. *Waders in the USSR: Distribution, Biology and Protection*. Proc. 3rd Conf. Dist. Biol. Cons. Waders. Nauka, Moscow.

Newbey, B.J., & K.R. Newbey. 1985. *West. Aust. Nat*. 16: 45–8.

Parish, D., & D. Wells. 1985. *Interwader Annual Report 1984*. Interwader Publ. 2.

Patten, M.A., & B.E. Daniels. 1991. *West. Birds* 22: 131–8.

Paulson, D. 1993. *Shorebirds of the Pacific Northwest*. Univ. Washington Press, Lond.

Phillips, W.W.A. 1963. *J. Bombay Nat. Hist. Soc*. 60: 546–84.

Prater, A.J., *et al*. 1977. *Br. Trust Orn. Guide* 17.

Pratt, H.D., *et al*. 1987. *A Field Guide to the Birds of Hawaii and the Tropical Pacific*. Princeton Univ. Press, Princeton.

Pringle, J.D. 1987. *The Shorebirds of Australia*. Angus & Robertson, Sydney.

Schmidt, B.L. 1978. *Aust. Birds* 12: 61–86.

Serventy, D.L., & H.M. Whittell. 1976. *Birds of Western Australia*. Univ. West. Aust., Perth.

Severinghaus, S.R., & K.T. Blackshaw. 1976. *The Birds of Taiwan*. Mei Ya Publ., Taipei.

Smith, F.T.H. 1962. *Aust. Bird Watcher* 1: 214–15.

—— 1968. *Aust. Bird Watcher* 3: 132–40.

—— 1969. *Aust. Bird Watcher* 3: 167–8.

—— 1976. *Aust. Bird Watcher* 6: 292–9.

Smythies, B.E. 1981. *The Birds of Borneo*. Sabah Soc. & Malayan Nat. Soc., Sabah & Kuala Lumpur.

—— 1986. *The Birds of Burma*. Nimrod, England.

Starks, J. 1987. *Report on Interwader Shorebird Surveys in Thailand*. Interwader Publ. 25.

Stokes, T., *et al*. 1987. *Aust. Bird Watcher* 12: 1–7.

Storr, G.M. 1980. *Spec. Publs West. Aust. Mus*. 11.

—— 1984. *Rec. West. Aust. Mus. Suppl*. 16.

—— 1985. *Rec. West. Aust. Mus. Suppl*. 21.

—— 1986. *Rec. West. Aust. Mus. Suppl*. 26.

——, & R.E. Johnstone. 1988. *Rec. West. Aust. Mus. Suppl*. 28.

Stove, K. (Ed.) 1994. *S. Aust. Orn*. 31: 195–265.

Strange, M., & A. Jeyarajasingam. 1993. *Birds. A Photographic Guide to the Birds of Peninsular Malaysia and Singapore*. Sun Tree Publishing, Singapore.

Thomas, D.G. 1970. *Emu* 70: 145–54.

Tipper, R. 1993. *Br. Birds* 86: 231–42.

Urban, E.K., *et al*. 1987. *The Birds of Africa*. 2. Academic Press, Lond.

van Marle, J.G., & K.H. Voous. 1988. *BOU Checklist* 10.

Veit, R., & L. Jonsson. 1984. *Am. Birds* 38: 853–76.

Vervest, R. 1991. *West. Aust. Bird Notes* 58: 1–3.

——, & A.H. Burbidge. 1992. *West. Aust. Bird Notes* 61: 2.

——, *et al*. 1992. *West. Aust. Bird Notes* 62: 2.

White, C.M.N., & M.D. Bruce. 1986. *BOU Checklist* 7.

Yurlov, A.K. 1988. Pp 162–7 **In:** Moscow Soc. App. Nature. 1988.

Volume 3, Plate 16

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

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

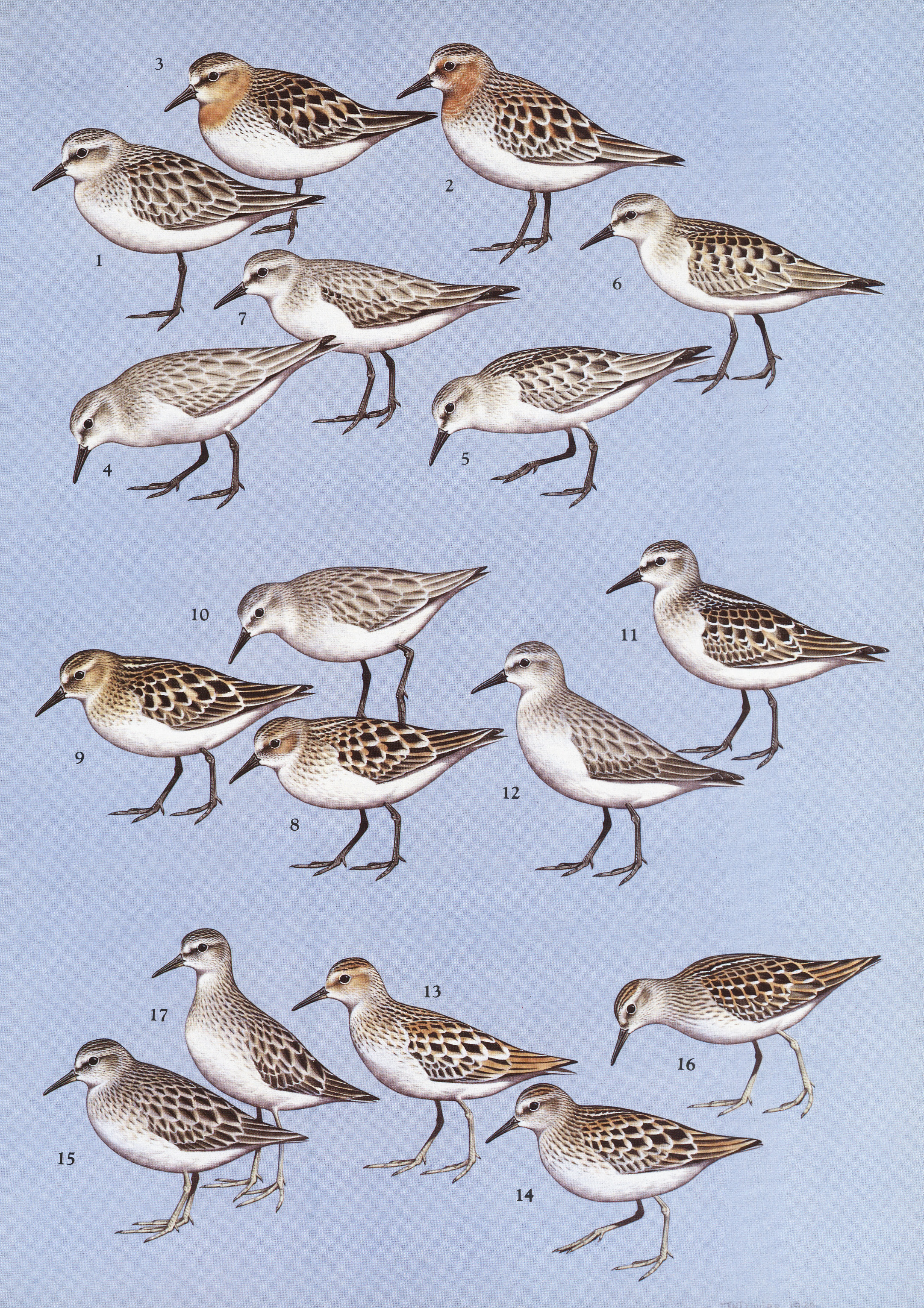
Long-toed Stint *Calidris subminuta* (page 270)
5, 6 Adult

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



Volume 3, Plate 17

Red-necked Stint *Calidris ruficollis* (page 258)
1 Adult breeding, pale bird; **2** Adult breeding, bright bird; **3** Adult breeding, worn plumage; **4** Adult non-breeding; **5** Juvenile, typical; **6** Juvenile, bright plumage; **7** First immature non-breeding

Little Stint *Calidris minuta* (page 250)
8 Adult breeding, fresh plumage; **9** Adult breeding, worn plumage; **10** Adult non-breeding; **11** Juvenile; **12** First immature non-breeding

Long-toed Stint *Calidris subminuta* (page 270)
13 Adult breeding, bright plumage; **14** Adult breeding, typical plumage; **15** Adult non-breeding; **16** Juvenile; **17** First immature non-breeding