

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.
Jacaniidae	jacanas; seven species, pantropical.
Chionididae	sheathbills; two species, Antarctica and subantarctic islands.
Burhinidae	thick-knees, stone-curlews; nine species, widespread in Old World and two in Neotropics.
Haematopodidae	oystercatchers; c. 11 species, worldwide in tropics and temperate regions.
Recurvirostridae	avocets and stilts; about seven species, worldwide in tropical and temperate regions.
Ibidiorhynchidae	Ibisbill; monotypic, central Asia.
Charadriidae	plovers and lapwings; c. 60 species, cosmopolitan.
Pluvianellidae	Magellanic Plover; monotypic, S. America.
Dromadidae	Crab Plover; monotypic, Arabian region.
Glareolidae	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, Jacaniidae) and charadriids and allies (Chionididae, Burhinidae, Haematopodidae, Recurvirostridae, Ibidiorhynchidae, Charadriidae, Pluvianellidae, Dromadidae, Glareolidae, Stercorariidae, Rhynchopidae, Laridae, Sternidae, Alcidae); Strauch (1978) treated Alcidae as separate lineage, but skeletons may be so highly modified for foot-propelled diving that they do not reflect relations well (Sibley & Ahlquist 1990); gulls and allies have also been regarded as a separate lineage (Christian *et al.* 1992) or as allied to charadriids (e.g. Sibley & Ahlquist 1990). Further relationships within the Order discussed in introductions to families.

Because the Order comprises so many species and adaptations are so diverse, few characters shared by all species; those that are shared are mostly anatomical features of the skull, e.g. most or all have schizorhinal nostrils, schizognathous palates, well-developed vomer, lachrymals fused with ectethemoid and pre-frontal bones, well-developed supra-orbital grooves; see Olson & Steadman (1981) for more information on osteological characters. Wings usually have 11 primaries, with p10 longest and p11 minute; 15–24 secondaries; 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 Jacaniidae. Feathers with small thin afterfeathers. Normally two moults annually: complete post-

breeding and partial pre-breeding; some jacanas and alcids have flightless periods when moulting remiges. Young, downy, usually with intricate cryptic patterns on upperparts of three chief types: pebbly, spotted and striped, matching characters of habitat (Fjeldså 1976, 1977): precocial, nidifugous usually, self-feeding or not depending greatly on parents.

Thirteen families recorded in HANZAB region, with 54 species breeding, 41 occurring as regular non-breeding migrants and c. 38 as accidentals or probable accidentals. Scolopacidae, Stercorariidae, Laridae and Sternidae will be dealt with in Volume 3 of HANZAB.

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Order CHARADRIIFORMES

Family SCOLOPACIDAE sandpipers and allies

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

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

Non-breeding plumage mostly dull and cryptic: mottled greys and browns above, and paler or white below, with or without streaks and spots. Breeding plumage generally much brighter (except in curlews, snipes and woodcocks), with more rufous or black. In HANZAB region, adults seen mainly during austral summer in non-breeding plumage, though breeding plumage can be seen on birds just before n. migration or on arrival after s. migration. Sexes usually similar. Bills, legs and feet variously, sometimes brightly, coloured. Adults generally have two moults per cycle: (1) a partial pre-breeding (pre-alternate) moult of most feathers of body, and, often, some tertials and upperwing-coverts; and (2) a complete post-breeding (pre-basic) moult; both usually performed in non-breeding areas or while staging on migration. Primaries moult outwards, usually after s. migration; some subspecies of Dunlin *Calidris alpina* (q.v.), Purple Sandpiper *C. maritima* and Rock Sandpiper *C. ptilocnemis* moult all primaries on or near breeding grounds before s. migration, a strategy rare in *Calidris*; Bristle-thighed Curlew *Numenius tahitiensis* moult remiges rapidly, inducing flightlessness in 50–70% of birds, apparently uniquely among Charadriiformes. Precocial young nidifugous; most feed themselves. Down varies greatly in structure and pattern; pattern mainly of spotted or striped type (Fjeldså 1977). Juvenile plumage usually distinctive; most like that of non-breeding adults, but often a little brighter, especially in Calidridinae. 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 (Surfbird)	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; Fjeldså 1977; BWP).

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

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Calidris ruficollis Red-necked Stint

Tryngra ruficollis Pallas, 1776, *Reise Prov. russ. Reichs* 3: 700 — *Circa lacus salsos Dauriae campestris* = Kulustay, Transbaikalia *apud* Ridgway, 1919.

The specific epithet is Latin for red (*rufus*) neck (*collum*).

OTHER ENGLISH NAMES Rufous-necked Stint; Red-necked, Redneck or Little Sandpiper; Land Snipe; Little Stint, Eastern Little Stint, or Least Sandpiper.

MONOTYPIC

FIELD IDENTIFICATION Length 13–16 cm; wingspan 29–33 cm; weight c. 25 g. Very small sandpiper, with small head and steep rounded forehead; long thickset body, with attenuated rear-end; short legs; short, straight or slightly decurved bill with slightly bulbous or finely pointed tip. Smaller than Broad-billed Sandpiper *Limicola falcinellus* with much shorter bill. Very similar in size, shape and plumages to Little Stint *Calidris minuta*. At rest, folded primaries reach level with or slightly beyond tip of tail (rarely, slightly short of tip); primary projection moderate in adults and juveniles (similar to that of Little Stint). In flight, all plumages show typical pattern of stints, with white wing-bar and white sides to black-centred rump and uppertail-coverts. Calls important in identification. Sexes similar. Juvenile distinct. Immatures separable.

Description Adult breeding Extent of rufous on head, neck and upper breast varies greatly. Typically, head, neck and centre of upper breast, light rufous, with: coarse black streaks on centre of forehead and crown and finer streaks on nape and hindneck; diffuse dusky loreal stripe broadening in front of eye; indistinct fine dark streaks on upper ear-coverts, sometimes forming subdued dusky stripe behind eye; diffuse dull-white supercilium, often tinged rufous and finely streaked darker above and behind eye; and, often, off-white on chin and round base of bill, giving white-faced appearance. In very fresh plumage, all feathers of head and neck have narrow whitish tips reducing rufous tones. Dullest birds have rufous restricted to ear-coverts, lower cheeks and narrow band above necklace of dark streaks across lower breast. Mantle, back and scapulars mostly pale grey, with prominent black centres to feathers, very little rufous, and faint suggestion of broad pale lines along sides of mantle. Tertiaries typically a mixture of worn, dull brownish-grey feathers (retained from non-breeding) and varying brightly coloured breeding feathers which are like scapulars, with black centres, broad rufous fringes and white tips, or somewhat duller. Innerwing-coverts, plain brownish grey, with fine dark shafts and narrow white fringes; rarely, a few inner median and greater coverts like scapulars. Lower breast to undertail-coverts, white, with black streaks restricted to necklace encircling lower breast and fore-flanks (below rufous of throat and upper breast); in some, a few extend to rear-flanks. In flight from above, show plain brownish-grey innerwing-coverts contrasting with slightly darker primary coverts and remiges; clear narrow white wing-bar along tips of greater coverts; white sides to rump and uppertail-coverts, with black line through centre; and black centre to pale-grey tail. Underwing, white. With wear: head, neck and upper breast appear rich rufous-chestnut; retain small pale area round base of bill and pale supercilium (though latter often washed ru-

fous). Mantle appears coarsely streaked black and rufous, with usually distinct broad yellow or cream lines along sides (not forming complete V and lost only with much wear); scapulars and new tertiaries appear black with bold rufous fringes, contrasting with grey innerwing-coverts and rest of tertiaries; scapulars typically brightest rufous area of upperparts. Bill, black. Iris, dark brown. Legs and feet, black; occasionally grey-black. **Adult non-breeding** Differences from adult breeding. Centre of forehead and crown, nape, hindneck and sides of neck, pale brownish-grey with fine black streaks; chin, throat and malar area, white. Prominent white supercilium from bill to above rear ear-coverts, broadest and cleanest in front of eye. Narrow dusky loreal stripe typically broadening in front of eye. Brownish-grey ear-coverts, finely streaked and speckled dark along lower edge where merging into white of lower face; sometimes combines with loreal stripe to form subdued dark eye-stripe. Upper half of thin white eye-ring sometimes seen against supercilium. Rest of upperparts and innerwing-coverts, pale brownish-grey, with black streaks that become broader on tertiaries and some lower scapulars, and all narrowly fringed white when fresh. Underbody, white, with diffuse pale brownish-grey patches at sides of foreneck and upper breast. With wear, upperparts become slightly darker and browner, and white fringes disappear. **Juvenile** Strength of rufous tones and dark feather-centres on upperparts vary considerably, with some birds brighter and others grey and colourless. Differences from adult breeding: Head-pattern rather plain (plainer than other juvenile black-legged stints) with dark loreal stripe and whitish sides to forehead often standing out as most prominent features. Centre of forehead and crown, light rufous-brown with coarse black streaks, forming dark central ridge, with paler, greyer and more finely streaked sides of crown. Nape, hindneck and sides of neck, pale brownish-grey with indistinct dark streaks. Supercilium, dull white, clearest and broadest above lores and often joining over bill to form pale forehead; often broken in front of eye (making thin dull-white eye-ring stand out clearly); on some, short thin dull-white lateral crown-stripes join supercilium above lores to form indistinct split supercilium. Narrow dark loreal stripe broadens in front of eye, sometimes combining with brownish-grey and finely streaked upper ear-coverts to form dark eye-stripe. Chin, throat and lower face, white, with fine faint dark streaks below eye. Above, coverts, tertiaries and lower scapulars, plain pale grey, contrasting with streaked black and rufous-brown upper scapulars and mantle, and with thin pale mantle V (faint or lacking in some); upper scapulars, black, with narrow rufous-brown fringes and white tips on outermost row of feathers; lower two rows of scapulars, light brownish-grey, with black

shafts or black subterminal markings and narrow white fringes at tips; tertials and innerwing-coverts, plain, brownish grey with diffuse dark streaks and narrow dull-white or dull rufous-brown fringes. Underbody, white, with sides of foreneck and breast, pale brownish-grey overlain with faint dark streaking; sides of breast faintly suffused pinkish buff in very fresh plumage, and grey sometimes extends right across breast. Some more brightly coloured and strongly patterned; have stronger rufous-brown tones to crown, mantle and scapulars, distinct rufous fringes to coverts and tertials, and stronger buff wash on sides of foreneck and breast; lower scapulars have larger dark subterminal markings, and centres of tertials and innermost few greater coverts may also be slightly darker. Some birds very dull greyish and colourless above, with only faint rufous-brown tones on crown, mantle and upper scapulars and very grey patch on sides of breast. In all birds, rufous fringes to feathers of mantle and upper scapulars quickly reduced with wear, these areas appearing almost uniform black and contrasting with much paler, grey lower scapulars, coverts and tertials. **First immature non-breeding** Separable from adult non-breeding (till late in austral spring) only by some retained juvenile innerwing-coverts and tertials, which are usually worn and contrasting with fresh non-breeding upperparts. **First immature breeding** Much variation in plumage. A few attain full breeding plumage similar to adult breeding, while others develop scattered breeding plumage on head, neck and upperparts and then resemble dullest adult breeding; separable from adult only by wear or pattern of moult of primaries. Most very similar to non-breeding but with broader and often darker blackish shaft-streaks to feathers of crown, mantle, scapulars and tertials, with some also having large rounded black centres to larger scapulars. All distinguished from adult breeding during first austral autumn to late winter by wear and moult of primaries: either all retained from juvenile plumage and very worn, or show contrast between fresh outer and very worn retained juvenile inner primaries (cf. all rather fresh and uniformly aged in adults).

Similar species Following discussion of differences between **Little Stint** and Red-necked Stint based on Grant & Jonsson (1984), Lewington *et al.* (1991), Veit & Jonsson (1984), Hayman *et al.* (1986) and Alström & Olsson (1989). Much like Little Stint in all plumages; fairly easily separated in adult breeding plumage but juveniles and birds in non-breeding plumages much more similar and combination of structure, plumage and calls essential for distinguishing the species. Little slightly smaller with: (1) proportionately smaller head looking narrower across crown (from head-on), and with more rounded, sloping forehead; (2) primary projection similar but shorter wings, less elongated body and more rounded belly give dumpier build, accentuated by slightly longer legs and generally more upright stance; (3) on average, bill slightly longer with finer tip (though much overlap). Call easy and safe way to distinguish Little from Red-necked: usual flight call is short, clear incisive *tip*, *tit* or *sit*, quite different from lower-pitched, more rolled *kreet*, *kreet*, *chreek* or more disyllabic *chirit* calls of Red-necked. In **ADULT BREEDING PLUMAGE**, Little differs by: (1) more orange-rufous in colour (pinkish rufous in Red-necked) with difference most obvious from mid- to late boreal summer when wear of feathers reveals most rufous on head, neck, upperparts and breast; (2) white (not rich rufous) throat; (3) orange-rufous areas of face and neck always finely streaked and spotted (unmarked rufous on Red-necked); importantly, Little has dark streaks and spots over orange-chestnut on sides of breast (on Red-necked, sides of

breast, white, with dark streaks and arrowheads that do not extend onto rufous of throat, sides of neck, and centre of upper breast); (4) innerwing-coverts and tertials, black, with broad orange-rufous fringes, as rest of upperparts (on Red-necked, plain brownish-grey, contrasting with mantle and scapulars); for birds in advanced moult to non-breeding, different colour and pattern of coverts is the most consistent difference (though some Red-necked can have a few innermost median and greater coverts and one or more tertials brightly patterned like rest of upperparts); (5) in fresh plumage, prominent broad yellow, cream or white mantle V, with white tips of lower row of upper scapulars often aligning to give impression of second pale line; even with wear, mantle V usually still obvious (Red-necked has narrower, pale mantle V and only hint of scapular line, and only in fresh plumage); (6) streaking on crown typically confined to narrow dark central ridge; normally has obvious whitish lateral crown-stripes joining fore-supercilium to form split supercilium (faint or lacking on Red-necked). In **NON-BREEDING PLUMAGES**, Little differs by: (1) slightly darker and more brownish- or olive-grey upperparts (more grey in Red-necked) with larger and more prominent dark shaft-streaks and diffuse dark centres giving more patterned appearance, though much overlap, especially with worn Red-necked; (2) some have complete grey wash across breast overlain with clearer and finer dark streaks (Red-necked typically has more diffusely streaked greyish patches at sides of breast that do not form complete band); (3) at least some first immature non-breeding have paler olive legs and feet. Other less reliable differences include: at least some appear to have slightly dark cap, set off by cleaner and broader white supercilium behind eye; more heavily streaked ear-coverts, nape and hindneck; and slightly paler loreal stripe. Typical **JUVENILE** Little differs by: (1) lower two rows of scapulars have larger and darker blackish centres, without clear dark shafts and diffuse anchor- or drop-shaped subterminal markings of Red-necked; (2) tertials and inner few greater coverts also have larger and darker blackish centres (never blackish on Red-necked) and better defined, more contrasting and richer rufous fringes; (3) rest of innerwing-coverts also with darker centres and distinct rufous fringes, thus matching general colour and pattern of mantle and scapulars; (4) broader and much more prominent white mantle V and line along lower row of upper scapulars; (5) sides of breast, brighter, orange-rufous, with less but crisper and more prominent dark streaking, which, at distance, appears as narrow, dark-streaked lateral breast-patches; (6) rather pale grey nape and hindneck contrasting much more with cap; black streaking on crown restricted to dark central ridge, emphasized by clear white lateral crown-stripes that join fore-supercilium to form prominent split supercilium (ridge and crown-stripes much less prominent on Red-necked). Brightest juvenile Red-necked very similar to juvenile Little; best distinguished by consistently darker-black centres of tertials and innermost few greater coverts (these feathers never black on Red-necked); and patch on ear-coverts separated from eye by usually obvious pale area. In worn plumage, many Red-necked Stints cannot be separated from Little on plumage. May be confused with **Western Sandpiper** *Calidris mauri*, particularly with males with very short bills in non-breeding and juvenile plumages. At all times, Western is slightly bigger and taller; appears to have bigger head and shorter wings, with shorter primary projection, less attenuated rear-end and more front-heavy carriage; unlike Red-necked, tips of toes normally project a little beyond tip of tail in flight; bill normally longer and more decurved (even males with short bills), usually with finer tip

than any Red-necked; if seen, partially webbed toes distinctive. In breeding plumage, easily distinguished by bright rufous on sides of crown, nape, ear-coverts and scapulars, combined with bold blackish streaks and arrowheads on white underbody. In non-breeding plumage, best distinguished by differences in size, structure and call; following subtle differences in plumage may also help: (1) plainer grey above with clear black shafts (Red-necked often more heavily marked, with broader dark shaft-streaks and diffuse dark centres); (2) crisper and darker fine black streaking on sides of breast, which extends as necklace across upper breast. Juvenile Western differs by: (1) even more contrastingly rufous upper scapulars; (2) distinctly more pointed lower scapulars, with better-defined anchor- or diamond-shaped (cf. drop-shaped) blackish subterminal markings; (3) more distinct head-pattern, with cleaner and whiter face, narrower dark loreal stripe, and more distinct supercilium, especially behind eye; (4) paler breast, more distinctly streaked on sides. Red-necked (particularly worn, rather dark-plumaged juveniles) sometimes also confused with **Long-toed Stint**, which differs at all times by: (1) smaller and more finely proportioned with smaller head, slimmer neck, and much shorter rear-end; when relaxed, forward-leaning posture exaggerated by longer legs set well back on body and, when alert, characteristic upright stance with craned neck (never matched by Red-necked); (2) finer bill (particularly at tip) with obvious paler brown, green or yellow area at base of lower mandible; (3) paler, green or yellow legs and feet, with much longer toes; (4) darker chest, with complete gorget of dark streaks; (5) in juvenile and breeding plumages, more orange-rufous tone to upperparts, with more prominent white mantle and scapular lines and lateral crown-stripes, and more prominent split supercilium; (6) in non-breeding plumages, head, neck and upperparts, noticeably darker, browner and more patterned. (7) In flight, differs by: more contrasting and darkly patterned underwings and much finer upperwing-bar; more rounded wing-tips and long toes extending beyond tip of tail. (8) Flight call distinctly different: soft rippling repeated *prrr* or *kyrrit* recalling Curlew *Calidris ferruginea* or Pectoral *C. melanotos* Sandpipers. Often confused with **Sanderling**, which has superficially similar breeding and non-breeding plumages. Sanderling is bigger, with slightly longer, heavier bill and longer legs; distinguished by lack of hindtoe. In breeding plumage, lower face, throat, foreneck and breast, bright rufous (as on Red-necked), but these areas spotted and blotched with black. Coverts and tertials often black, with pale-rufous fringes not contrasting with mantle and scapulars; unlike Red-necked, blackish markings on scapulars are often serrated at tips, and scapulars generally show more prominent rufous centres; coverts and tertials often have pale-rufous subterminal markings (never on Red-necked). In non-breeding plumage, Sanderling much paler, more uniform, grey above, without dark streaks and centres of feathers; also has whiter face, smaller and paler grey patches at sides of breast, and distinctive black shoulder-patch, which is sometimes concealed. In flight, distinguished by striking upperwing-pattern: black leading- and trailing-edges and broad white wing-bar. In normal habitat on beaches, behaviour much more active than Red-necked, particularly when feeding. Usual flight call rather quiet *twick* or *kip*, quite different from call of Red-necked.

Gregarious; often in dense flocks of hundreds or thousands, both when feeding and roosting. Mix freely with other waders; at Manukau and Firth of Thames, associate with flocks of Wrybills *Anarhynchus frontalis* at high-tide roosts. In HANZAB region, mainly coastal, preferring estuarine mudflats,

but also on wide variety of freshwater and brackish wetlands and also on saline wetlands, such as saltworks. Occasionally also on sandy beaches and rocky shorelines. Gait and feeding actions similar to those of Little Stint, but stance more horizontal, with more elongated shape at rest. When feeding, move forwards with head hunched into rather rounded shoulders, picking constantly and rapidly at muddy surface and occasionally probing, with bouts of feeding interspersed with rapid runs; generally keep to dry or wet mud but occasionally wade into shallows and emerse face or even entire head while rapidly probing. Flight is swift, agile and direct, with shallow flickering wing-beats and fluttering action when landing. Do not tower when flushed. Usual flight call variously given as *chit* or *prip*; and *kreet*, *kreep* and *chreek* or similar variants, either on same pitch or with slight inflection of *ee* sound; also utter more disyllabic *chirit* and similar variants and shorter *kreep*, *kiep*, and *klyt* notes, latter recalling flight call of Sanderling.

HABITAT In A'asia, mostly coastal, in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats; often near spits, islets and banks; sometimes on protected sandy or coralline shores (Thomas 1968b; Loyn 1975; Patterson 1982a; Park 1983; Jones 1985). Occasionally on exposed or ocean beaches (Ewart 1973; Bransbury 1985; Congreve & Congreve 1985); sometimes on stony or rocky shores, reefs or shoals (Hindwood & Hoskin 1954; Morris 1975, 1989; Gibson 1977; Storr 1980; Patterson 1982a; Morris *et al.* 1990). Also occur in saltworks and sewage farms; saltmarsh; ephemeral or permanent shallow wetlands near coast or inland, including lagoons, lakes, swamps, riverbanks, waterholes, bore drains, dams, soaks and pools in saltflats; sometimes in flooded paddocks or damp grasslands; rarely, recorded on dry gibber plains with little or no perennial vegetation (Hobbs 1961; Masters & Milhinch 1974; Badman & May 1983; Storr 1984; Garnett 1989).

Mostly forage on bare wet mud on intertidal mudflats or sandflats, or in very shallow water (Dann 1983; Garnett 1989); mostly in areas with film of surface water, close to edge of water; also, though less often, in very shallow water, <2.5 cm deep and ≤30 cm from edge of water (Thomas 1968b; Thomas & Dartnall 1971b). During high tides, may forage in non-tidal wetlands (Vic. Atlas), feeding in wet mud above edge of water or in shallow water, usually 1–2 cm, rarely up to 4 cm, deep, and ≥30 cm from shore (Thomas & Dartnall 1971b). May also forage in samphire; generally avoid beds of seagrass, but may feed along edges (Loyn 1975; Patterson 1982a). On L. Reeve, Vic., rarely fed on algal mats (Dann 1981a); in se. Tas. observed foraging on duckweed in lagoon (Thomas 1968b). In Westernport Bay, Vic., forage on beaches without mangroves (Loyn 1975); on Pelsaert I., WA, recorded on mud beneath mangroves (Warham 1956). On sandy ocean beaches, forage in beachcast seaweed (Bransbury 1985; Congreve & Congreve 1985). Recorded foraging in flooded paddocks (Loyn 1975) and in freshly cropped lucerne paddock near lagoons (Tas. Bird Rep. 9).

Roost on sheltered beaches, spits, banks or islets, of sand, mud, coral or shingle; often in saltmarsh or other vegetation (Thomas 1968b; Patterson 1982a; Jones 1985). During very high tides, may be forced from usual roosts to sand dunes or claypans (Patterson 1982a; Jones 1985). Occasionally roost on exposed reefs or shoals (Schulz 1990; M. Weston); rarely on ocean beaches. Once recorded roosting c. 1.5 km from inland lake, in close-cropped grass; sometimes roost among beachcast seaweed or clods of mud or dried cow-pats (Hobbs 1961).

DISTRIBUTION AND POPULATION Breed ne. Siberia and sporadically in n. and w. Alaska, probably from Taymyr region to Anadyr Territory and Koryakland, though limits not well known: delta of Lena R., Kresta Bay, Chukotskiy Pen., Anadyr Territory and Koryakland; possibly round Ust-Yansk, Kurile Is and in Ussuriland; at Pt Barrow and Seward Pen. (Dement'ev & Gladkov 1951; Myers *et al.* 1982; AOU 1983; BWP; Lane); possibly St Lawrence I. (Kessel & Gibson 1978). Common passage migrant through Japan, Korean Pen., se. China, Taiwan, Hong Kong, Vietnam, Malaysia, Philippines and w. Micronesia. Winter in A'asia, mostly in Aust. with smaller numbers in New Guinea and NZ; small numbers winter e. India, Gulf of Thailand, Malay Pen. and Indonesia. Sporadic to Pacific coast of North America; rare or accidental, British Isles, Germany, ne. USA, and islands of sw. Pacific (Ali & Ripley 1980; AOU 1983; Coates 1985; Pratt *et al.* 1987; Starks 1987; BWP; Lane).

Aust. Most common Palaearctic wader. Widespread; recorded all coastal regions, with sporadic inland records from all States; many inland records in s. NSW, Vic. and e. SA not of transient birds; other inland records probably birds on passage.

NZ Widespread; regular visitor in small numbers; greatest numbers recorded L. Ellesmere, SI; see Populations (below). **NI** Recorded in greatest numbers and most often in Far North and Auckland regions, especially Parengarenga, Kaipara and Manukau Harbours and Firth of Thames; smaller numbers regularly Bay of Plenty (especially Kaituna Cut-Maketu Estuary) and Hawke's Bay (especially Porangahau Estuary). Small numbers irregularly elsewhere. **SI** Recorded all regions; mostly from Canterbury, especially L. Ellesmere; Nelson, especially Farewell Spit; and Southland (NZ Atlas; CSN; OSNZ Nat. Wader Count; S. Davies).

Norfolk I. Irregular visitor: two, Aug. 1967 (Wakelin 1968); single, Nov. 1968 (Smithers & Disney 1969); single, 16-21 Nov. 1979; 3-5, 5-20 Nov. 1980 (Moore 1981).

Lord Howe I. Single specimen, 1887 (Hindwood 1940); two, 21 Nov. 1959 (McKean & Hindwood 1965); single, 13 Nov. 1977 (NSW Bird Rep. 1977).

Chatham Is Te Whanga Lagoon, Chatham I.: singles, 17 Nov. 1985, 24 Nov. 1987; two, 3 Dec. 1987 (Freeman 1994).

Macquarie I. Said to be vagrant (Anon. 1987).

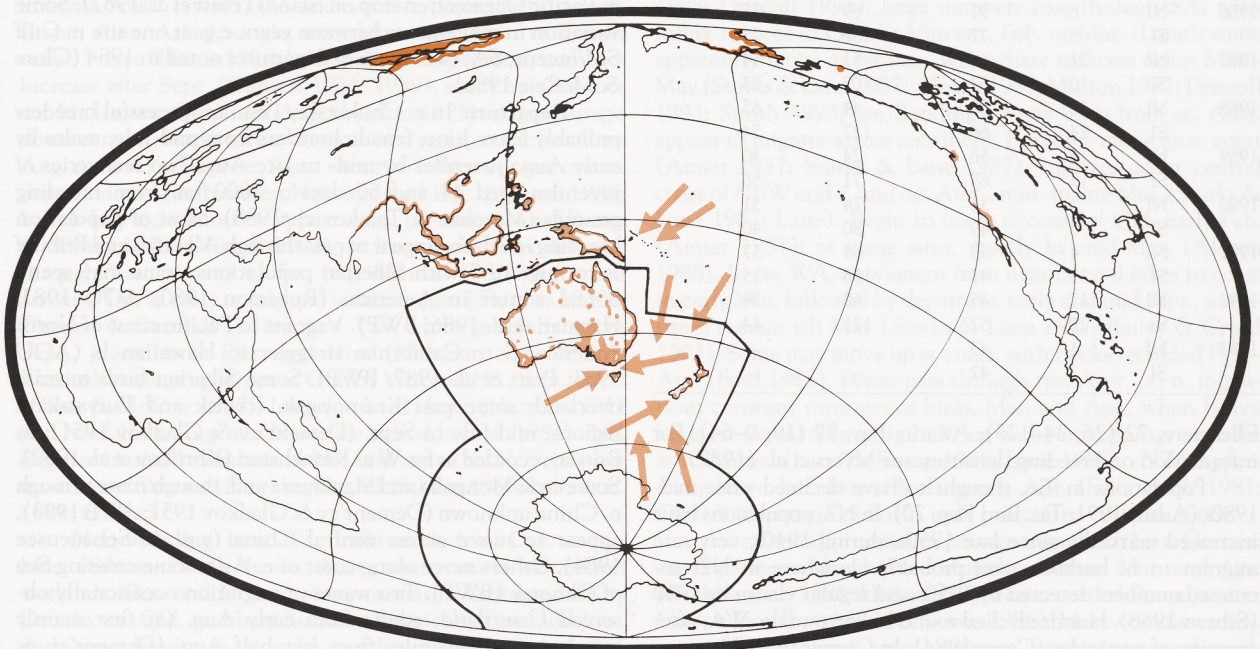
Auckland Is Unknown number, 1963 (NZCL).

Populations Aust. Estimated at 353,000 (Watkins 1993).

Totals for summer and winter counts, 1986-89, summarized in Table 1 (Hewish 1986, 1987a,b, 1988, 1989a,b, 1990a,b). Sites of significance and maximum or average counts from summer and winter surveys, 1981-85, were: The Coorong, SA, 63,800; Eighty Mile Beach, WA, 60,000; SE Corner, Gulf of Carpentaria, Qld, 35,200; Gulf St Vincent, SA, 24,000; Port Hedland Saltworks, WA, 23,000; Port Phillip Bay, Vic., 22,600; Roebuck Bay, WA, 19,800; Corner and Shallow Inlets, Vic., 15,600 (Lane). Other areas of international importance, having supported >7500 birds, (Watkins 1993) include: Wilson Inlet, WA, 15,252; Alfred Cove NR, WA, 10,000; L. Macleod, WA, 8312; Peel Inlet, WA, 8063; Spencer Gulf, SA, 7600. Summer and winter counts round Derwent R. region, Tas., 1980-90, summarized in Patterson (1982b, 1983, 1984, 1985, 1986), Bulman (1988, 1989, 1990) and Bulman & Patterson (1987). **NZ** Totals for summer and winter counts, 1983-92, summarized in Table 2; mean total summer count (n=10 summers): NI, 49 (19; 24-81); SI, 122 (28; 71-166) (OSNZ Nat. Wader Count; P.M. Sagar). Sites of importance, with mean summer counts were: **NI** Parengarenga Harbour, 6 (8; 0-18); Kaipara Harbour, 5 (4; 0-11); Manukau Harbour, 16 (9; 4-35); Firth of Thames, 5 (6; 0-20); Kaituna Cut-Maketu Estuary, 4 (3; 0-10); Porangahau Estuary, 7 (5; 0-14). **SI** Farewell Spit, 15 (7; 0-25); L. Grassmere, 5 (5; 0-14); L.

Table 1

Year	Summer Total	No. Sites	Winter Total	No. Sites
1986	82,882	23	8,864	23
1987	63,864	22	3,923	23
1988	54,528	23	6,949	23
1989	66,679	22	3,669	21



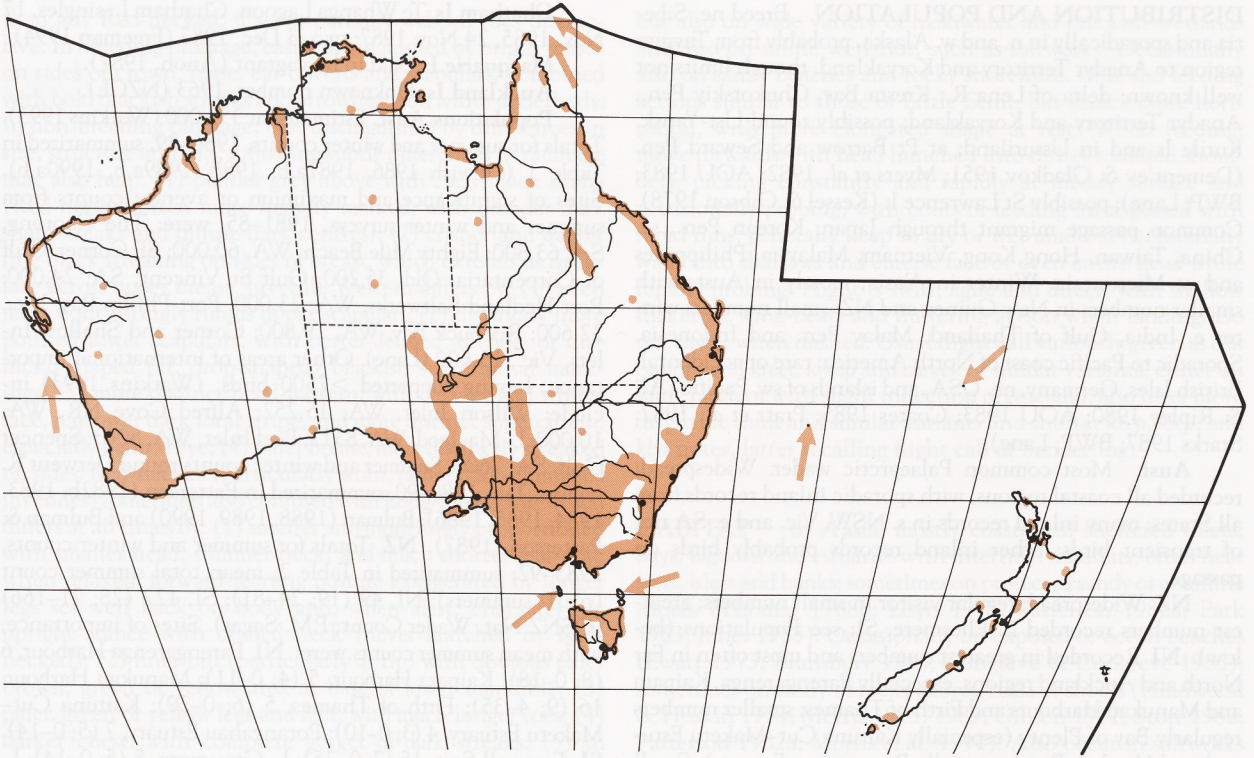


Table 2

Year		Winter Total	No. Sites	Summer Total	No. Sites
1983	NI	–	–	81	31
	SI	–	–	150	43
1984	NI	1	42	43	44
	SI	9	68	143	73
1985	NI	11	60	45	79
	SI	40	83	119	65
1986	NI	6	91	69	75
	SI	5	77	136	73
1987	NI	22	66	51	54
	SI	10	53	107	63
1988	NI	20	58	44	65
	SI	24	66	127	54
1989	NI	19	56	24	30
	SI	13	65	71	56
1990	NI	2	34	24	31
	SI	0	49	80	40
1991	NI	4	33	65	37
	SI	33	47	166	35
1992	NI	17	45	40	34
	SI	28	52	121	44
1993	NI	1	43	–	–
	SI	2	42	–	–

Ellesmere, 72 (26; 24–125); Awarua Bay, 27 (19; 0–64). For information on breeding densities, see Myers *et al.* (1982).

Populations in Tas. thought to have declined since mid-1980s (Ashby 1991; Tas. Bird Rep. 20). In NZ, populations have increased markedly since late 1950s; during 1940s, very rare migrant to n. harbours and probably elsewhere in NZ; increased numbers detected by 1950s and regular visitor by 1960 (Sibson 1968). Hundreds died round L. Forrestdale, WA, after spraying of pesticides (Curry 1984). In Corner Inlet, Vic., not

greatly disturbed by pedestrian and boating traffic (Peter 1990).

Longevity Up to c. 10–15 years (Minton & Barter 1987). **Survival** Annual survival estimated at 80% (Harris 1983b).

MOVEMENTS Migratory. Breed ne. Siberia, and w. Alaska. Move to non-breeding areas in se. Asia and A'asia, S of c. 25°S (BWP; Lane). Probably migrate in large flocks (Boehm 1960); heard passing at night (Serventy 1938). Flocks migrating across w. Pacific Ocean often stop on islands (Pratt *et al.* 1987). Some variation in movements between years, e.g. at one site in Gulf St Vincent, SA, two waves of departures noted in 1984 (Close & McCrie 1986).

Departure In e. Chukotskiy Pen., unsuccessful breeders probably leave June; female breeders from mid-July; males by early Aug.; juveniles by mid- to late Aug. Two recoveries of juveniles aged 44 and 50 days c. 2000 km from breeding grounds (Morosov & Tomkovich 1988). Most of population breeding in Alaska appear to pass through Aleutian and Pribilof Is to migrate S with Siberian populations; some may spend boreal winter in Americas (Roberson 1980; AOU 1983; Hayman *et al.* 1986; BWP). Vagrant to Pacific coast of North America, S to California; straggler to Hawaiian Is (AOU 1983; Pratt *et al.* 1987; BWP). Some Siberian birds migrate overland; some pass Krasnoyarsk, Irkutsk and Buryatskaya regions, mid-July to Sept. (Dement'ev & Gladkov 1951); in Russia, recorded as far W as Kazakhstan (Khrokov *et al.* 1980). Some cross Mongolia and Manchuria and, though route through n. China unknown (Dement'ev & Gladkov 1951; AWB 1993), appear to move across central China (e.g. de Schauensee 1984). Others move along coast of e. Asia, some crossing Sea of Okhotsk (BWP). Two waves of migration occasionally observed Ussuriland: adults from early Aug. (at first mainly females), and juveniles from last half Aug. (Dement'ev &

Gladkov 1951). Many pass through Japan, and Korea, Aug.–Oct. (Gore & Won 1971; Orn. Soc. Japan 1974); more numerous during s. migration (see AWB 1993). In China, pass ne. coast between mid-July and Oct.; in 1991, passed Jiangsu Province from mid-Aug.; common coastal se. China, early Sept. to early Oct. (la Touche 1931–34; Hemmingsen & Guildal 1968; Hui 1992; AWB 1993). Pass through s. Taiwan, where common, early Aug. to mid-Oct. (Severinghaus & Blackshaw 1976; Blackshaw 1978); Hong Kong, Aug.–Nov. (Chalmers 1986). Common Burma (Smythies 1986) and Vietnam (Wildash 1968). In Samut Sakhon Province, Thailand, migration peaked Aug. 1984, with second peak, possibly juveniles, in Nov. (Starks 1987). Common passage migrant Pen. Malaysia and Singapore (Medway & Wells 1976; AWB 1993). Abundant passage migrant Borneo, adults arriving before juveniles; move through Brunei, late Aug.–Oct. (probably adults) and late Nov. (probably juveniles) (Smythies 1981; Beadle & Whittaker 1985; Harvey & Elkin 1991; AWB 1993). Common Wallacea, mostly on passage, with dated records Aug.–Nov. (White & Bruce 1986). Common Sumatra; earliest records mid-Sept. (van Marle & Voous 1988). Recorded passing n. coast of Java, Aug.–Sept. 1984 (Bowler *et al.* 1985). Locally abundant Bali (Ash 1984). Pass through Philippines, Aug.–Dec.; maximum numbers said to occur Sept. (Alcasid 1969; Magsalay *et al.* 1990; AWB 1993). Common migrant w. Micronesia; less common E to Marshall Is and Fiji (Pratt *et al.* 1987). Very few Solomon Is, apparently from Aug. (Bayliss-Smith 1972). Very common passage migrant New Guinea, sometimes recorded far inland; pass through Port Moresby district, early Aug.–Dec. (Coates 1985; Beehler *et al.* 1987; Hicks 1990).

Aust. First arrive, late Aug.; large numbers first appear early Sept. (Lane). Abundant passage migrant Torres Str. (Draffan *et al.* 1983). Arrive and pass through nw. Aust., Sept., with fewer present Oct.; second influx, Nov. From nw. Aust., some move to sw. Aust., possibly along w. coast where large numbers and flocks recorded Sept. and Oct. (Ford 1965; Bamford 1983; Jaensch 1988; Bailey & Creed 1993; see Banding). Passage on s. WA coast between Aug. and early Dec. (Alcorn 1988; Eyre Bird Obs. Reps). Many cross continent from nw. Aust., toward s., se. and e. coasts, particularly in Sept. (Lane; Aust. Atlas); single moved from nw. Aust. to Tas. in only 33 days (Harris 1983a). In Gulf of Carpentaria, numbers increase after Sept. (Garnett 1986, 1989); small numbers occur Mt Isa, nw. Qld, from Aug. (Horton 1975). Some passage down e. coast; flocks arrive on most of s. and e. coast from late Aug. to Nov.; at some se. Aust. sites two influxes occur, one in Sept. and another between Nov. and mid-Dec. (Alcorn 1988; Lane). In Vic., adults first appear Aug., juveniles, Nov. (Paton & Wykes 1978; Driscoll 1993); at least some juveniles pass through Vic. *en route* to Tas. (e.g. Minton 1982). Recorded arriving Tas. as early as July and as late as Jan. (Thomas 1970a; Thomas & Dartnall 1971a); in s. Tas., adults generally arrive Sept., juveniles in Oct. and Nov. (Newman *et al.* 1985). Through passage apparent at Gulf St Vincent, SA, Sept.–Oct. (Close & McCrie 1986). Irregular, Lord Howe (Hutton 1991) and Norfolk Is, Aug. and Nov. (see Schodde *et al.* 1983). NZ Regular in small numbers to NI; first arrive in N, Sept., but most arrive Oct. and Nov.; regular, SI (Sibson 1968; Falla *et al.* 1981; Oliver).

Non-breeding In n. NZ, flocks stable from Dec. to end Mar. (Sibson 1968). In se. Aust., many occur on inland wetlands, Oct. and Nov., moving to marine embayments by Dec. In ne. Qld, numbers fluctuate erratically Dec. and Jan., with most leaving n. sites by end Feb.; numbers at marine

embayments in s. and se. Aust. stable Dec. till early Mar. or Apr. (Alcorn 1988; Lane). Once established at non-breeding sites in se. Aust., movements local; first-year birds seem to move more than adults. In Vic., little movement recorded between sites c. 25 km apart (Dann 1981b), though some longer movements recorded (Minton 1980). Retraps from Vic. and Tas. suggest high site-fidelity between years in adults (Dann 1981b; Newman 1982; Minton 1993). Banding near Hobart showed birds more likely to be recaptured where banded, though movement continuous between localities 10–15 km apart (Newman 1982). In sw. Aust., banding recoveries indicate at least some site-fidelity (Smith 1993). Most banding recoveries that indicate movement between non-breeding areas between years involve juveniles (Driscoll 1993). Some movements dispersive, e.g. move from coastal Westernport Bay, Vic., in Aug. when low diurnal exposure of intertidal feeding grounds (Loyn 1978); leave wetlands affected by drought (e.g. Park 1983); move to recently filled ephemeral wetlands (e.g. Curry 1979). Birds in some non-coastal wetlands in n. Aust. apparently move before or at onset of wet season (e.g. Crawford 1972; Horton 1975). Tend to fly and roost in unusually large flocks before migration (Close & McCrie 1986). In Tas., apparently concentrate at particular sites before n. migration, e.g. Barilla Bay (Patterson 1982a).

Return Aust. Leave early Mar. to mid-Apr. (Lane), late Feb. to end of Apr. (Alcorn 1988). In Tas., adults generally leave Mar. and Apr.; mostly overfly Vic. and islands of Bass Str., though some first-year birds recorded there during n. movement. In Tas., departure protracted in Hobart area. Estimated that adults in Hobart can fly non-stop over 3200 km (i.e. to nw. Aust.) (Barter 1984), possibly farther (Newman 1982; Newman *et al.* 1985; Thomas 1987; Driscoll 1993). At many sites in se. Aust., numbers begin to drop late Feb. and early Mar., and influxes recorded at other sites (Starks & Lane 1987; Alcorn 1988). Estimated that birds from Vic. can fly 2200–2800 km without stopping (Starks & Lane 1987), to n. Aust.; birds from se. Aust. probably stage across wide area of n. Aust. (Garnett & Bredl 1985; Garnett 1989; Lane). Some birds from se. Aust. first move W to SA (Minton 1980; Alcorn 1988; Driscoll 1993); large numbers pass through SA, with influx to sites in Gulf St Vincent, Feb. or Mar. (Lane); some apparently move as far as s. WA, where influxes occur Mar.–May (Starks & Lane 1987; Alcorn 1988; Minton 1992; Driscoll 1993; Smith 1993; see Banding). Most birds from se. Aust. appear to migrate across continent, but some move up e. coast (Amiet 1957; Starks & Lane 1987). Influxes occur central coast of NSW and e. and ne. Aust., mid- to late Mar. (Starks & Lane 1987; Lane). Begin to leave e. coast of Qld, early Feb. (Amiet 1957); at some sites, mostly by mid-Mar. (Alcorn 1988). In sw. WA, movement from near-coastal lakes to coast in early Mar. followed by departure, early and mid-Apr., sometimes remain till May (Starks & Lane 1987; Bailey & Creed 1993). Some may move up w. coast, with flocks recorded Feb.–Apr. (Ford 1965). Fewer pass through nw. Aust. on n. migration; constant turnover of birds, Mar. and Apr., when heavy birds estimated able to fly 2400 km without stopping, i.e. as far as s. Borneo (Lane & Jessop 1985; Lane 1988). NZ Apparently leave late Mar. (A. Riegen); Apr. (Falla *et al.* 1981; Oliver); departure of flocks in N protracted (Sibson 1968).

Extralimitally, common passage migrant in New Guinea; small passage through Port Moresby district, Mar. and Apr. (Beehler *et al.* 1987; Hicks 1990). Not recorded Sumatra after May or June (van Marle & Voous 1988). More common on w. coast of Pen. Malaysia on n. migration. Smaller passage through

Brunei on n. migration, with greatest numbers Jan. to late May (AWB 1993). Common Wallacea, probably mostly on passage, with dated records Apr.–June (White & Bruce 1986). Passage at Olango I., Philippines, Feb.–Apr., with maximum numbers in Mar. (Magsalay *et al.* 1990; Magsalay 1991). Higher numbers pass through Hong Kong on n. migration, where some gain of weight occurs, late Mar. to late May, with large numbers passing between mid-Apr. and mid-May (Melville 1981; Chalmers 1986; AWB 1993). Pass through s. Taiwan from late Apr. to mid-May (Blackshaw 1978). Pass along Chinese coast, Apr. and May (la Touche 1931–34; Barter 1989; AWB 1993). Pass both coasts of Korea in high numbers, Apr.–May (Gore & Won 1971) and common Japan (Orn. Soc. Japan 1974). Cross Ussuriland second half May and early June; by end of period vanguard has reached nesting grounds (Dement'ev & Gladkov 1951).

Breeding Many, mostly first-year birds, winter in Aust.; reporting rates in summer 5.5%, winter 1.5% (Paton & Wykes 1978; Aust. Atlas). Number wintering probably affected by breeding success of previous year (Harris 1983a; Sagar 1989). Many remain in s. and n. Aust.; no apparent latitudinal difference in proportion of summer population wintering at e. coast sites (Alcorn 1988). Many winter Tas., but colour-marking and counts suggest some move to mainland for winter (Fletcher *et al.* 1982; Lane). Small numbers winter sw. WA (e.g. Anon. 1992), though some may move farther N during winter (Serventy 1938). Counts and sightings of colour-marked birds suggest some young move inland in winter (Minton 1993; Lane). At sites in s. Aust., wintering numbers reached by end Apr. Generally no fluctuation in numbers during this period (Alcorn 1988), though some dispersive movements noted (Newman *et al.* 1985; Lane). Colour-marking near Hobart shows some young remain in one place for winter, though will move between bays (Fletcher *et al.* 1982). NZ Recorded wintering on NI and SI (Oliver); 37 recorded during winter 1991 (Sagar 1992).

Banding, Colour-marking Substantial. International recoveries (see Fig. 2): birds banded Aust. recovered on s. migration (Aug.–Nov.) in Java, Taiwan, Japan, se. and central Siberia; during non-breeding season (Nov.–Feb.) in Java, s. Thailand, s. China coast; on n. migration (Mar.–May) in Borneo, Vietnam, along China coast, Taiwan; during breeding season (June and July) in e. and ne. China coast, Japan, central Siberia and in breeding range (see Driscoll 1993).

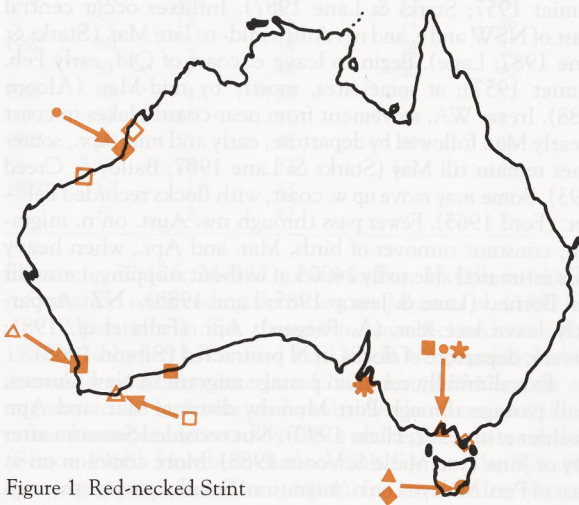


Figure 1 Red-necked Stint

Of birds banded extraliminally, one banded Taiwan recaptured nw. Aust.; birds banded Hong Kong, recovered Vic. and Tas.; one banded Japan, Aug., recovered less than 2 months later in NSW; one banded central Siberia recovered nw. Aust.; one banded n. Sea of Okhotsk, Siberia, recovered sw. WA (ABBBS 1992, 1993; Driscoll 1993).

Most Aust. recoveries near banding site. Recoveries within Aust. indicate movement between nw. and se. Aust., from SA and sw. WA to Vic., between Vic. and Tas. (all banded as first-years), from nw. to sw. WA and around sw. Aust. (see Fig. 1; also Driscoll 1993). Birds colour-marked in Vic., sighted elsewhere in Vic., and in SA, Tas., NSW, se. and ne. Qld, s. and nw. WA, SI of NZ and extraliminally in Brunei, Hong Kong and Japan. Many sightings of colour-marked birds within Aust., Mar.–May, possibly first-year birds (Minton 1993; Smith 1993).

Extralimital banding (Philippines and Taiwan) shows a high recapture rate of banded birds, at least a year after banding. One banded Taiwan, and one banded Japan, recaptured Philippines (McClure 1974; Chuang 1992; AWB 1993).

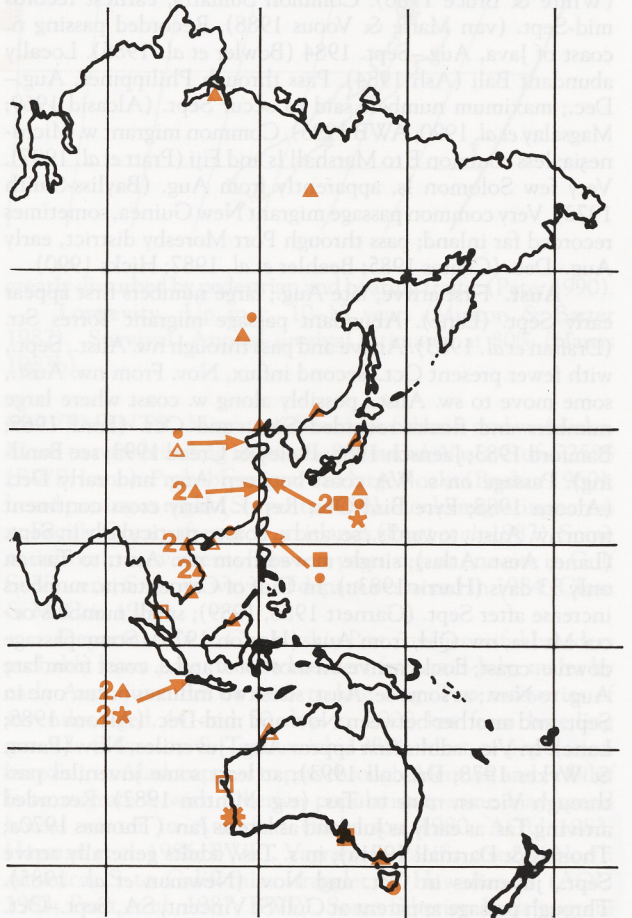


Figure 2 Red-necked Stint

FOOD Omnivorous. Extraliminally, recorded taking seeds, insects and pebbles (Dement'ev & Gladkov 1951). **Behaviour** Forage on intertidal and near-coastal wetlands, jab (6.6%) and probe (49.3%) with bill, to depth of 20 mm, into soft mud for small invertebrates. Also glean (44.1%) from plants in saltmarsh, water and surface of substrate; 1.38 feeding movement/s (n=6). Feeding method varies with time of tide and substrate; usually feed for entire period mudflats are exposed

(Lane). Some variation in diet between months (Thomas & Dartnall 1971b; Poore *et al.* 1979; Dann 1983). Sometimes feed in dense flocks that spread out as tide recedes (Jones 1985); often feed with other species, especially Sharp-tailed Sandpipers and Curlew Sandpipers (Pierce 1983; Wood 1985; Aust. Atlas). Foraging distribution changes when feeding with other waders (Thomas & Dartnall 1971b).

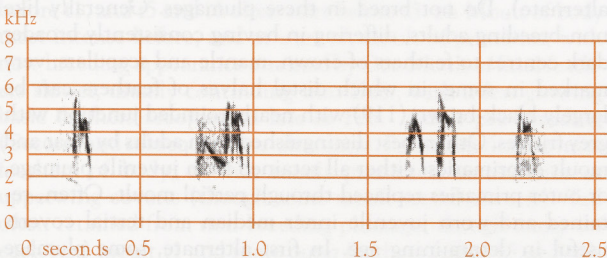
Adult At L. Reeve, Vic. (10 stomachs; Poore *et al.* 1979): Plants: *Ruppia* sds 50% freq.; Animals: Molluscs: gastropods: Pomatiopsidae: *Coxiella striatata* 40; Crustaceans: amphipods: *Parhyalella* 40; ostracods: *Australocypris hypersalina* 30; Insects: larv. (Diptera incl. Tipulidae and Neuroptera) 30; pupae (Diptera: Chironomids) 40; ads (Diptera: Blephariceridae and Hemiptera: Aphididae) 20. In **se. Tas.** (59 stomachs; Thomas & Dartnall 1971b): Plants: fragments and sds 13.5% freq.; Annelids: polychaetes: Orbiniidae: *Haploscoloplos* 3.3; Molluscs: Gastropods: Assimineidae: *Assimineia brazieri* or *A. tasmanica* 32.0; bivalves 4.9; Crustaceans: ostracods: 18.6; Amphipods: *Paracorophium* 38.9; others (incl. Mysidacea: *Parachialina augusta*) 3.3; Insects: Coleoptera: larv. 5.1; Curculionidae: *Aphela alorum* ads. 8.5; Diptera: ads 2.4; larv., pupae 30.3; debris 5.0. At **Aust. airports** (11 stomachs; van Tets *et al.* 1977): Plants: Fabaceae: *Trifolium* sds 36% freq.; *T. dubium* sds 18; *T. fragiferum* sds 18; *T. repens* sds 36; Animals: Molluscs 9; Insects: Coleoptera: Scarabaeidae: ads, larv. 18; Lepidoptera: larv. 18; Noctuidae: larv. 9. Grit 9.

Other records Plants: sds (Mathews 1909; Dann 1983); Ruppiaceae: *Ruppia* sds (Lane); Polygonaceae: *Polygonum* sds; Boraginaceae: *Heliotropium* sds; Fabaceae: *Trifolium dubium* sds (FAB). Animals (Mathews 1909): Annelids: polychaetes: *Ceratonereis eurythraeensis* (Dann 1981a); Molluscs: bivalves; gastropods (FAB): Assimineidae: *Assimineia granum*; Crustaceans (Lea & Gray; FAB): amphipods (Dann 1983); *Paracorophium* (FAB); Arachnids: spiders (FAB); Insects (Mathews 1909): larv., pupae (Dann 1983); Coleoptera: ads, larv. (FAB); larv. (Lane); Dytiscidae; Diptera: ads, larv., pupae (FAB); Chironomidae: larv. (Lane; FAB); Hymenoptera: Formicidae (FAB); Grit (Mathews 1909; Lea & Gray).

Intake In one stomach, 53 polychaete jaws (Poore *et al.* 1979).

VOICE No detailed studies; brief comments in BWP, Hayman *et al.* (1986), and Colston & Burton (1988). Very like calls of Little Stint. Typical calls *chit* or *trip* said to be slightly coarser and perhaps a little lower pitched than in Little Stint (Hayman *et al.* 1986).

Adult CONTACT-ALARM: like *chit* of Little Stint (sonagram A). Call of Little Stint possibly shorter, if examples chosen for comparison are typical (P.J. Fullagar).



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

PLUMAGES Prepared by D.I. Rogers. Undergo partial (body) moult into first-immature non-breeding (first-basic)

plumage soon after arrival in non-breeding areas; later in first austral summer, many replace outer primaries in first pre-supplemental moult. Stay in non-breeding areas throughout first year. Partial first pre-alternate moult occurs in first austral autumn and winter, resulting in patchy breeding coloration. Adult non-breeding plumage attained with complete second pre-basic moult in second austral spring; thereafter, moult twice a year, with partial pre-alternate moult to breeding plumage taking place before, or at staging points during, n. migration.

Adult breeding (Second and subsequent alternate). First attained late in second austral summer. **Head and neck** Feathers of crown and nape, black-brown (119) with broad rufous (240) edges that grade to white at tips (narrowest round shaft); when fresh, rufous crown and nape scalloped white; when worn, tips mostly lost and rufous edges more exposed, crown appearing to be streaked rufous and black. Hindneck, like crown, but feathers have narrower dark-brown (121) centres, and broader white tips. Rest of face and throat, rufous (240), except for: indistinct dark-brown (c121) lores, which form dark smudge in front of eye; brown (c119B) shafts to ear-coverts and feathers below and behind eye form dark patch (less conspicuous than dark lores), which sometimes combines with lores to form broad subdued eye-stripe; white feathering on chin and at base of bill merges with indistinct supercilium, which is clearest and whitest above lores and tinged pale rufous-brown (121) and finely streaked by dark shafts above and behind eye (supercilium less distinct in worn plumage, as white tips to feathers on side of crown are lost); when fresh, throat and foreneck varyingly scalloped by broad white tips to all feathers (which also have concealed white bases); sides of foreneck, neatly streaked by dark-brown (121) shaft-streaks, boldest when white tips of feathers worn away. **Upperparts** When fresh, mantle, back and scapulars appear coarsely streaked black and rufous-brown, and scalloped white; with wear, white scalloping lost, general area appears more streaked, and rufous areas become more cinnamon. Feathers, black-brown (119), grading to dark brown (121) at base, with broad rufous-brown (240–236) edges (broadest and most conspicuous on central scapulars) and white tips c. 2 mm wide; white tips align neatly where mantle and scapulars meet, forming mantle V (not strongly marked and lost when worn); also have fainter V on scapulars. Rump and uppertail-coverts, similar to non-breeding plumage; pale tips of feathers may be slightly broader and tinged light rufous (c38). **Underparts** Mostly white; uppermost breast, rufous, continuous with rufous of foreneck, and sharply demarcated from white of rest of breast; upper breast and sides of breast below rufous, boldly marked by dark-brown chevrons. Feathers of upper breast, brown (119A–119B), grading to white or pale grey-brown at base, with black-brown (119) shaft-streaks and broad white tips; proximal edge of white tips forms acute wedge pointing to tip of feather; wedges more acute on centre of upper breast, which appears sharply streaked; on sides of breast, white tips narrower. In worn birds, centre of upper breast particularly sharply streaked, as shaft-streaks not obscured by white tips, and sides of breast can look wholly brown mottled by darker shaft-streaks. **Tail** As non-breeding. **Upperwing** Mostly retained from non-breeding. Most birds replace many or all tertials; most breeding tertials, dark brown (119A–119) with rufous-brown (240–36) edges c. 1 mm wide, which are inconspicuous when worn, quickly fading to pale rufous-brown (c39). Tertials grown earliest in pre-breeding moult can be almost as dull as non-breeding tertials (Veit & Jonsson 1984). **Underwing** As non-breeding.

Adult non-breeding (Second and subsequent basic). Attained about Sept. of second austral spring. **Head and neck** Crown and nape, light brownish-grey (c80), rather coarsely streaked and spotted by black-brown (119) shaft-streaks, which broaden to dark spot near tip of feathers. Short white supercilium, broad and clear above lores, forming obvious white spots which may meet above culmen; supercilium continues narrowly above eye (often broken), and broadens behind eye, with square rear-end; less striking than white spots above lores because feathers have pale brownish-grey (c45) shaft-streaks. Loral stripe, brownish grey (c79–c121), narrow near bill but broadening to eye; stripe continues through and below eye to ear-coverts, forming indistinct eye-stripe. Ear-coverts and hindneck, brownish grey (brownish 80), indistinctly streaked by dark-brown (c121) shaft-streaks. Chin, throat and malar area, white. Sides of foreneck, brownish grey (c80) to pale brownish-grey, narrowly streaked by dark-brown shafts; feathers tipped white when fresh. **Upperparts** Mantle, back and scapulars, light brownish-grey (brownish 80), streaked darker by narrow (often <1 mm wide) black-brown (119) shaft-streaks; in some, varying obscure dark-brown (121) spot, <2 mm wide, round distal half of shaft-streaks (especially on scapulars); shaft-streaks do not extend to tip of feather; when fresh, feathers narrowly tipped white. Rump and most uppertail-coverts, black-brown (c1191), tipped white; tips most noticeable on feathers of rump. Lateral uppertail-coverts, white, forming narrow white sides to rump in flight. **Underparts** White; sides of uppermost breast, as foreneck. **Tail** Most feathers, light brownish-grey (c79–c80) (slightly paler and browner when worn), narrowly fringed white; t1, blackish brown (c119) with slightly browner basal edge. **Upperwing** Remiges, alula and outer primary coverts, black-brown (119) with white shafts (tinged brown at base of p7–p9); become dark brown (121) with wear. White bases to inner edges, larger on inner feathers but not usually visible from above; inner secondaries narrowly fringed white. P11, black-brown (119) narrowly fringed white and with broad white shaft; fringes usually broader near tip of outer web (making black feather-centres look stepped) but symmetrical in some birds. Greater secondary coverts, carpal covert and inner greater primary coverts, black-brown (119) with broad white tips forming bold narrow wing-bar. Median and lesser coverts, brownish grey (c80) (browner [c121] when worn) with black-brown (119) shaft-streaks and white fringes at tip; marginal coverts similar but with darker brownish-grey (c121) ground-colour. **Underwing** Remiges and greater primary coverts, glossy grey (84, 85, 86) with white tips to coverts, which broaden on inner feathers; inner secondaries have larger white inner edges. Most other coverts, white; partly exposed dark-brown (121) bases to marginal coverts make leading-edge look darker, especially round carpal.

Juvenile Retained till about Oct.; varies individually and with wear; brightest and freshest individuals can be very similar to juvenile Little Stint (q.v.). **Head and neck** Pattern of head plain for a juvenile stint; white sides to forehead and dusky lores may be most obvious features. Crown, pale brown (c223D) lightly streaked by dark-brown (c121) centres to feathers; when worn, pale fringes of feathers become greyer (c119D) and fray somewhat, creating dark-capped appearance. Dull-white supercilium extends from culmen, narrowing and often broken over eye, and continuing more broadly above ear-coverts. In some, short white lateral crown-stripes meet white supercilium above lores, giving effect of split supercilium very like that of Little Stint. Grey-brown (c119B)

to dark grey-brown (11) loral stripe (narrow at base of bill and broadening toward eye) generally continues below eye to meet light grey-brown (c119C) auricular patch. Lower ear-coverts, chin and throat, white. Hindneck and sides of foreneck, light brownish-grey (in fresh plumage, greyer than crown) faintly streaked by dark-brown (121) shafts; streaking extends onto sides of lower foreneck and upper breast. **Upperparts** Mantle, upper back and upper scapulars (inner three rows), dark (121) to blackish brown (119) with concealed grey-brown (119C) bases to feathers; when fresh, neatly scaled by rufous-brown (123A) fringes to feathers (which are much reduced with wear, back often appearing almost black just before post-juvenile moult of body-feathers). Lower scapulars (outer two rows), light brownish-grey (greyish 119B) with white fringes at tips of feathers, which sometimes grade to narrow rufous edges; varying blackish-brown (119) spot at tips usually small and somewhat anchor-shaped, but can be large, so scapulars look as dark-centred as in some Little Stints. Lower back, dark brown (121), grading to black-brown (119) rump and uppertail-coverts; feathers fringed cold grey-brown (119B–119C) when fresh. As in other plumages, lateral uppertail-coverts and rump, white. **Underparts** Mostly white. Light brownish-grey of hindneck and sides of foreneck continues onto sides of breast and forms diffuse breast-band, narrowing towards centre of breast and often incomplete; in fresh plumage, band can be washed buff, or even orange-buff (c118) on sides of breast; sides of breast and foreneck faintly marked by brown (119B) shaft-streaks (sometimes absent). **Tail** As adult. **Upperwing** Primaries, primary coverts, alula and secondaries, as adult, except pattern on p11 usually less symmetrical. Greater, median and lesser secondary coverts, light brownish-grey (brownish 80) with narrow black-brown (119) shaft-streaks; greater coverts broadly tipped white, and narrowly fringed off-white. Median and lesser coverts have diffuse, usually buff (c124) fringes, which, when fresh, sometimes grade to light rufous-brown (c39–c40) at tip (especially on inner coverts); often have small dark-brown (c121) area round blacker shaft-streaks near tip of feather. Tertials and innermost greater secondary coverts, brownish grey (greyish 119B–119A) with black-brown (119) shaft-streaks and rather narrow, diffuse pale fringes, which are often strongly tinged rufous (c39–c40) when fresh. **Underwing** As adult.

First immature non-breeding (First basic). Like adult non-breeding but retain juvenile primaries and secondaries (see Ageing), most upperwing-coverts and, often, some tertials. Buff fringes of upperwing-coverts and tertials can be much reduced by wear, but retained on inner median and tertial coverts until moulted.

First immature breeding (First supplemental and first alternate). Do not breed in these plumages. Generally like non-breeding adults, differing in having consistently broader dark centres to feathers of crown, mantle and scapulars; very marked in some, in which distal halves of feathers can be largely black-brown (119) with neatly rounded junction with grey fringes. Others best distinguished from adults by wear and moult of primaries: either all retained from juvenile plumage, or outer primaries replaced through partial moult. Often, retained and worn juvenile inner median and tertial coverts useful in determining age. In first alternate, some plumage often coloured as in adult breeding; such colouring usually sparse, restricted to a few scapulars, tertials, and feathers of back and throat; a few perhaps develop as much breeding coloration as adults, then only distinguished from adults by wear of primaries.

BARE PARTS From photos (Alström & Olsson 1989; Chandler 1989; Pringle 1987 and various other published sources; unpubl.: J.N. Davies, D.W. Eades, H.M. Gibbs). **Adults, Juveniles** Iris, black-brown (119). Bill, legs and feet, grey-black (82) to black (89); claws, black (89).

MOULTS Based mainly on Paton & Wykes (1978), large (and incompletely analysed) data-set from live birds captured in n. WA and Vic., including c. 50,000 records of primary-moult (AWSG; K.G. Rogers & D.I. Rogers), and 90 Aust. skins (HLW, MV). Most information on sequences of moult within tracts from sample of 141 adults and 30 immatures from Werribee, Vic., 31 Dec. 1990 (D.I. Rogers). Note, Paton & Wykes (1978) correct errors that were published by Thomas & Dartnall (1971a) and Evans (1975), and which were repeated in BWP.

Adult post-breeding (Third and subsequent pre-basic). Complete. Most moult, including all primaries, occurs in non-breeding areas, though can moult some feathers of body while staging on migration, at least in those populations migrating to s. Aust. In Vic. most arrive with much worn breeding plumage and some arrive with complete worn breeding plumage. In Tas., birds in complete breeding plumage seldom recorded on arrival (Thomas 1968a; Thomas & Dartnall 1971a). Primaries (and associated primary coverts) moult outwards; rate of replacement faster in earlier stages; usually about four grow concurrently in early stages, 1–2 in later stages; no confirmed records of suspended moult of primaries (*contra* Evans 1975). Several published estimates of duration of moult of primaries: from Tas., 110–115 days (Thomas & Dartnall 1971a) and 135 days (Woehler 1983); from Vic., 130 days (Paton & Wykes 1978). None of these estimates especially satisfactory in view of methods of analysis and apparent failure to exclude all birds in second pre-basic (which start moult earlier than adults). Better estimates available from retraps in same season from Vic. (VWSG; K.G. Rogers & D.I. Rogers): 118 days (17; 81–169; 96); in this sample, average starting date 27 Oct. (16 days; 28 Sept.–16 Dec.); average completion date 22 Feb. (18 days; 13 Jan.–14 Apr.). Further study needed to verify claims that moult may occur earlier in those with more n. non-breeding range (e.g. Prater *et al.* 1977). Secondaries moulted inwards and rapidly; begin after inner 4–5 primaries dropped, with 3–5 feathers (occasionally as many as 6–8) growing concurrently (D.I. Rogers); tertials moulted in irregular sequence about same time; both completed before moult of primaries completed. Moult of tail begins late in moult of primaries and may be completed after p10 fully grown; roughly centripetal, but t2 sometimes starts before t1, and t5 and t6 often start before t3–t4. Moult of body most intense before, and at start of, moult of primaries, with non-breeding appearance attained by Oct. Moult of final feathers slower, usually continuing into Dec., with a few growing basic feathers recorded as late as Feb. **Adult pre-breeding** (Second and subsequent pre-alternate). Partial, including most feathers of body; do not moult primaries, secondaries or upperwing-coverts (though some moult tertial coverts). Tail often retained from non-breeding plumage, though many (of each sex) moult t1 and some outer feathers (often t5 and t6). Varying number of feathers of rump and uppertail-coverts retained in some. Active moult recorded Feb.–May, timing probably varying with location of non-breeding area. In Tas., active pre-breeding moult recorded late Mar. and early Apr.; moult suspended before migration and no birds recorded in

complete fresh breeding plumage (Thomas & Dartnall 1971a). In Vic., pre-breeding moult also suspended before migration but some attain full breeding plumage before leaving; moult begins earlier than in Tas., usually late Feb., and continues through Mar. and early Apr. Birds in full breeding plumage not common until mid-Apr., when many have already left Vic. Birds leaving in suspended pre-breeding moult, presumably complete moult on staging grounds farther N. **Post-juvenile** (First pre-basic). Partial, involving most or all feathers of body (some retain uppertail-coverts and, perhaps, some scapulars and feathers of rump), some tertials and sometimes central rectrices. Retain primaries and secondaries and most or all upperwing-coverts. Except for tertial coverts and inner median coverts, most retained juvenile coverts replaced soon after in first pre-supplemental or pre-alternate moults. Typically begins mid-Oct.; earliest records Sept. Some moult may occur while staging on s. migration, but some arrive in complete worn juvenile plumage; absence of 'distinctive juvenile features' noted in birds soon after arrival in Vic. (Paton & Wykes 1978), probably caused by wear rather than moult. Most moult occurs shortly after arrival in non-breeding areas, with last feathers replaced gradually, Dec.–Jan., and possibly later; Paton & Wykes (1978) recorded moult of body Dec.–Apr., but later records should perhaps have been attributed to first pre-alternate. **Post-juvenile moult of primaries** (First pre-supplemental). Partial. In Vic., <10% of birds undergo this moult, moulting varying number of outermost primaries in outwards sequence; usually outer 3–6 (Rogers *et al.* 1990), but sometimes only 1–2 (Paton & Wykes 1978); occurs Feb.–May; occurs more commonly in nw. Aust. than in Vic. (Rogers *et al.* 1990). Can also moult many outer lesser and median coverts and rest of juvenile tail and tertials (though moult of these feathers may be better attributed to first pre-alternate). Paton & Wykes (1978) considered this moult to occur in birds with greatest wear of juvenile primaries. **First pre-breeding** (First pre-alternate). Do not breed in resultant plumage. Partial, not involving primaries, secondaries or wing-coverts. Can replace all feathers of body and most tertials; some retain a few basic scapulars, feathers of rump and uppertail-coverts; several tertials (usually outermost) retained from first basic or juvenile plumage. (Suggestion that few feathers are moulted [Paton & Wykes 1978], apparently because they did not recognize that most feathers coloured as in non-breeding plumage, with only a small varying number of scapulars, tertials, and feathers of throat and back coloured like breeding.) Active moult, Apr.–July; generally of low intensity, with a few records of heavy moult in Apr. (Thomas & Dartnall 1971a) and July. **Second immature post-breeding** (Second pre-basic). Complete. Not properly known because adults and immatures late in second pre-basic difficult to separate. Similar to adult post-breeding, but moult of primaries more protracted; duration estimated from retraps in same season, at 156 days (24; 116–223; 24) (VWSG; K.G. Rogers & D.I. Rogers). Moult of primaries begins earlier than in adults (and before adults arrive from s. migration): 20 Sept. (10 days; 29 Aug.–4 Oct.); finishes at about same time as in adults: 23 Feb. (29; 3 Jan.–9 May).

MEASUREMENTS (1–2) Vic., freshly dead (D.I. Rogers, T. Piersma): (1) Adults with worn p10; (2) First immatures with slightly worn juvenile p10. (3–5) Indonesia, skins, all year (BWP): (3) Adults; (4) Juveniles; (5) Ages combined.

	MALES	FEMALES	
WING	(1) 103.1 (2.30; 98–108; 62)	105.5 (2.76; 98–113; 49)	**
	(2) 102.7 (2.13; 98–106; 12)	104.3 (2.14; 101–109; 18)	ns
	(3) 103.5 (2.36; 98–107; 37)	106.2 (2.09; 102–112; 39)	**
	(4) 101.1 (3.07; 94–107; 27)	102.6 (3.00; 100–108; 22)	ns
TAIL	(1) 45.5 (1.93; 39–49; 54)	46.0 (2.11; 41–52; 44)	ns
	(2) 43.4 (1.97; 41–47; 12)	45.5 (2.41; 41–50; 18)	*
	(3) 42.7 (1.87; 38–46; 17)	43.8 (2.25; 40–48; 16)	ns
	(4) 42.7 (2.18; 39–46; 16)	42.5 (1.92; 39–45; 11)	ns
BILL	(1) 17.59 (0.912; 15.9–20.2; 70)	18.59 (1.094; 16.7–21.9; 56)	**
	(2) 17.08 (0.477; 20.1–22.6; 12)	18.15 (0.729; 16.9–19.8; 18)	**
	(5) 17.5 (0.68; 16.1–18.9; 20)	18.7 (0.89; 17.5–20.9; 18)	**
THL	(1) 38.6 (0.93; 36.1–40.6; 70)	39.8 (1.03; 38.0–42.3; 56)	**
	(2) 38.5 (0.81; 37.1–39.7; 12)	39.4 (0.96; 37.6–41.1; 18)	*
TARSUS	(1) 19.9 (0.91; 18.3–22.0; 70)	20.3 (0.92; 18.1–23.0; 56)	**
	(2) 20.0 (0.67; 18.7–21.0; 12)	20.0 (0.49; 19.3–21.0; 18)	ns
	(5) 19.7 (0.64; 17.9–20.8; 20)	19.9 (0.58; 18.9–21.1; 20)	ns
MTC	(1) 19.2 (1.00; 16.9–21.8; 70)	19.2 (0.93; 17.6–21.5; 56)	ns
	(2) 18.9 (0.64; 18.0–20.3; 12)	19.0 (0.77; 17.7–20.6; 18)	ns
	(5) 18.3 (0.55; 17.3–19.3; 19)	18.5 (0.73; 17.3–19.8; 20)	ns

(6–10) Vic., live (K.G. Rogers; VWSG); (6–7) Adults: (6) Mar., p10 fresh; (7) Nov., p10 worn; (8–10) Juveniles and immatures with juvenile p10: (8) Nov., p10 fresh; (9) Apr., p10 moderately worn; (10) Sept. of second year; p10 very worn.

UNSEXED

WING	(6) 108.1 (2.74; 99–117; 887)
	(7) 105.1 (2.86; 97–126; 263)
	(8) 104.3 (2.29; 99–109; 145)
	(9) 103.0 (2.28; 95–110; 576)
	(10) 101.9 (2.38; 96–108; 120)

Females have significantly longer wing, bill and tarsus than males but differences too slight to be of practical use in sexing. Wing of juveniles significantly shorter than that of adults. Adult wing-length attained after first pre-supplemental moult of primaries, e.g. in Vic. in Apr., wing of immatures that have recently replaced p10 in first pre-supplemental, 107.7 (2.58; 102–113; 38) (K.G. Rogers; VWSG). Wing-length decreases significantly with wear of primaries.

WEIGHTS Vic., freshly dead (from heat stress, 30 Dec. 1990) (D.I. Rogers, T. Piersma): (1) Adults; (2) Immatures in first basic.

	MALES	FEMALES	
(1)	26.4 (1.60; 22.3–31.5; 70)	27.2 (1.76; 22.1–31.0; 56)	**
(2)	26.7 (2.49; 24.0–33.5; 12)	28.3 (2.01; 24.6–31.3; 18)	ns

Differences between sexes significant but small enough to suggest they have little effect on seasonal changes shown by banding studies.

Tas. (several sites), live (Barter 1984): (3) Adults; (4) First year (juveniles and first basic, a few in first pre-alternate); (5) Second year (first alternate and second pre-basic, 12–18 months old).

Weight of adults at each site in Tas. differed slightly. First-year birds showed no differences between sites but second-year birds appeared to be developing differences between sites (Barter 1984). Adults and first-year birds have fairly

	(3) ADULTS	(4) FIRST YEAR	(5) SECOND YEAR
Sept.	29.7 (1.80; 241)	–	29.1 (1.75; 102)
Oct.	30.7 (1.79; 722)	30.2 (3.48; 11)	29.1 (1.69; 168)
Nov.	29.0 (1.76; 559)	28.4 (1.92; 67)	28.2 (1.62; 187)
Dec.	29.4 (2.30; 228)	28.5 (2.59; 160)	28.1 (2.07; 65)
Jan.	29.7 (2.0; 220)	29.6 (2.20; 176)	–
Feb.	30.4 (2.44; 134)	31.1 (3.29; 8)	–
Mar.	32.5 (3.35; 288)	29.5 (1.84; 49)	–
Apr.	41.6 (3.6; 70)	31.9 (2.0; 19)	–
May	–	28.3 (2.0; 21)	–

stable weights through most of non-breeding season. Marked increase in weight of adults in 2 months before n. migration; differences between sites may explain apparent tendency in combined samples for adults to gain weight gradually from Nov. to Feb. Weight of first-year birds fairly stable through most of non-breeding season; may vary more in period before migration, when weights appear to increase slightly (though far less so than in adults) before declining again in May. Tas. data broadly consistent with much larger but incompletely analysed data-set from Vic. (AWSG; K.G. Rogers & D.I. Rogers)

Estimated flight-range of adults leaving Tas., c. 3200 km (Barter 1984 using methods of Summers & Waltner 1979), enough to reach staging areas in n. Aust. Estimates from adults leaving nw. Aust. indicate they can reach Indonesia and s. Philippines (Lane & Jessop 1985). Weights in Thomas & Dartnall (1970, 1971a,b) incorrect (see Paton & Wykes 1978).

STRUCTURE Wing, long, narrow and pointed. Eleven primaries; p10 longest, p9 0–2 mm shorter, p8 5–8, p7 13–17, p6 21–26, p5 28–34, p4 35–41, p3 42–47, p2 46–53, p1 50–58; p11 narrow, shorter than and usually concealed by greater primary coverts. Fifteen secondaries, including five tertials. Tail, square and short, 12 feathers; t1 projects 4–7 beyond tip of t2 and t6; others usually 1–2 shorter than these, occasionally equal to t6. Bill, short (80–85% of length of skull), slender and straight; laterally compressed, though broadening slightly at tip, which is finely pitted. Tarsus and tibia, short and slender, only slightly laterally compressed; tarsus scutellate. Toes, unwebbed, short and slender; middle toe c. 93% of tarsus, outer toe c. 85% of middle, inner c. 82%, hind c. 22%.

RECOGNITION Confusion possible with other dark-legged stints, especially Little Stint and extralimital Semipalmated Sandpiper when in juvenile and non-breeding plumage; see Little Stint.

AGEING Mould of primaries simplest character for ageing in the hand in our region. Three ages separable from Aug. to Nov.–Dec.: (1) juveniles arrive with fresh primaries, which are retained throughout this period; (2) adults arrive with worn primaries, which are in conventional outward moult of primaries by Dec.; (3) birds in their second year (in first alternate or second pre-basic moult) have extremely worn outer primaries or show contrast between fairly fresh outer primaries and very worn juvenile inner primaries; like adults they begin a complete moult of primaries in this period (starting slightly earlier); by Nov., some second-year immatures have moulted all retained juvenile primaries and are not reliably separable from adults (some remain separable into Dec.). After about Dec., only two ages separable: (1) adults usually complete moult by

Feb. and then have fresher primaries than first-year immatures; (2) first-year immatures may moult some outer primaries, Feb.–May, and are generally the only age in Aust. through austral winter.

GEOGRAPHICAL VARIATION None. Specific separation from Little Stint shown by Gladkov (1957).

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Volume 3, Plate 16

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

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

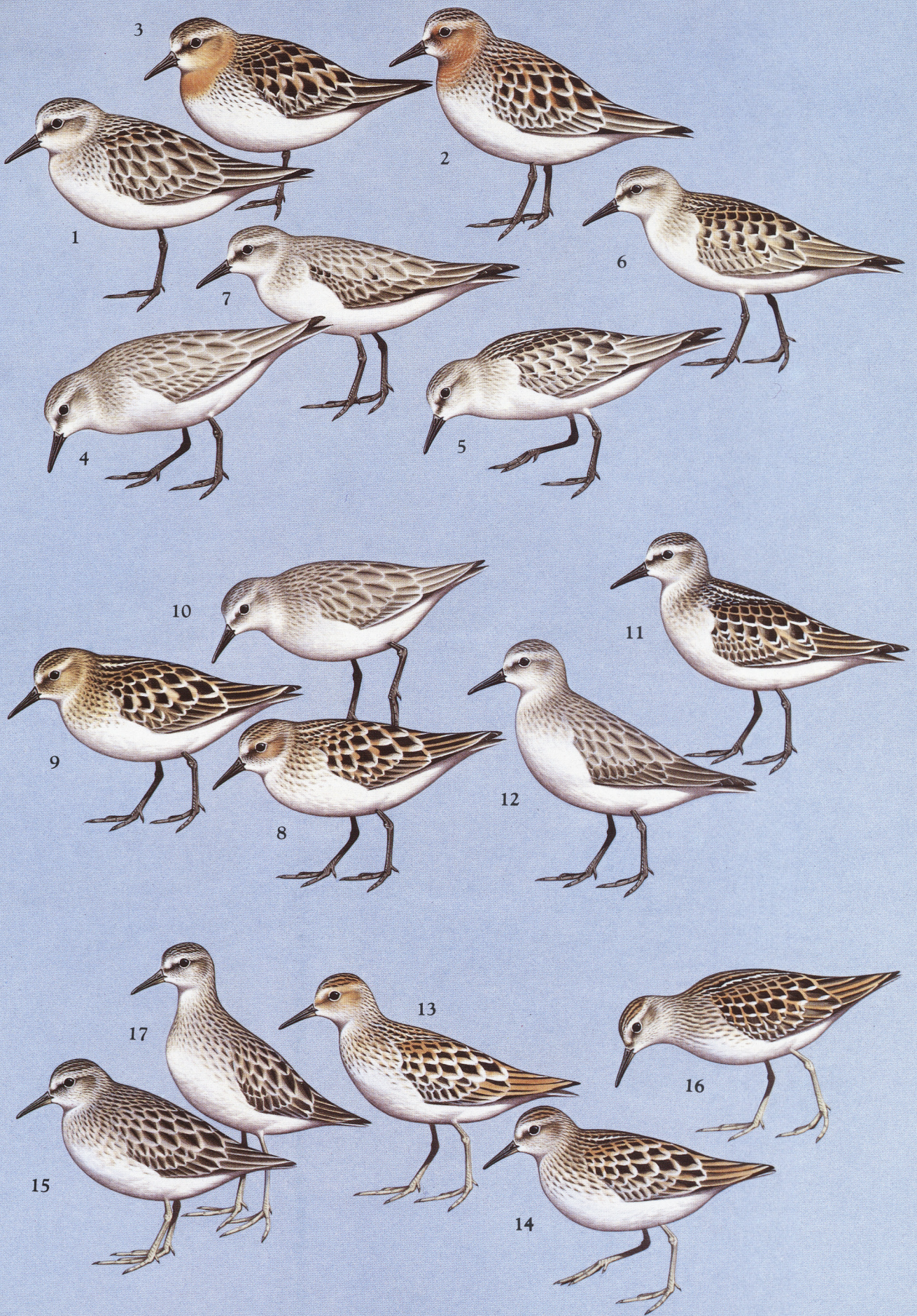
Long-toed Stint *Calidris subminuta* (page 270)
5, 6 Adult

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