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Order **CHARADRIIFORMES**

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

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

Thinocoridae	seedsnipes; four species, S. America.
Pedionomidae	Plains-wanderer; monotypic, Aust.
Scolopacidae	sandpipers, snipes and allies; *c.* 85 species, cosmopolitan.
Rostratulidae	painted snipes; two species, s. America and Old World.
Jacanidae	jacanas; seven species, pantropical.
Chionididae	sheathbills; two species, Antarctica and subantarctic islands.
Burhinidae	thick-knees, stone-curlews; nine species, widespread in Old World and two in Neotropics.
Haematopodidae	oystercatchers; *c.* 11 species, worldwide in tropics and temperate regions.
Recurvirostridae	avocets and stilts; about seven species, worldwide in tropical and temperate regions.
Ibidiorhynchidae	Ibisbill; monotypic, central Asia.
Charadriidae	plovers and lapwings; *c.* 60 species, cosmopolitan.
Pluvianellidae	Magellanic Plover; monotypic, S. America.
Dromadidae	Crab Plover; monotypic, Arabian region.
Glareolidae	pratincoles, coursers, and Egyptian Plover; *c.* 15 species, widespread in Old World.
Stercorariidae	skuas and jaegers; about seven species, mostly in Arctic and Antarctic regions.
Rhynchopidae	skimmers; three species, pantropical.
Laridae	gulls; *c.* 47 species, cosmopolitan.
Sternidae	terns; *c.* 42 species, cosmopolitan.
Alcidae	auks; *c.* 20 species, Arctic and temperate regions of n. hemisphere.

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

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

Because the Order comprises so many species and adaptations are so diverse, few characters shared by all species; those that are shared are mostly anatomical features of the skull, e.g. most or all have schizorhinal nostrils, schizognathous palates, well-developed vomer, lachrymals fused with ectethemoid and pre-frontal bones, well-developed supra-orbital grooves; see Olson & Steadman (1981) for more information on osteological characters. Wings usually have 11 primaries, with p10 longest and p11 minute; 15–24 secondaries; diastataxic except in *Scolopax minor*, as far as is known. Usually 12 tail-feathers. Necks usually rather long with 15–16 cervical vertebrae. Oil-gland bilobed and tufted. Syrinx, tracheo-bronchial; two carotids (type A-1 of Glenny 1955); caeca present. Legs usually rather long; hind toe small or lacking in most but all toes greatly elongated in Jacanidae. Feathers with small thin afterfeathers. Normally two moults annually: complete post-breeding and partial pre-breeding; some jacanas and alcids have flightless periods when moulting remiges. Young, downy, usually with intricate cryptic patterns on upperparts of three chief types: pebbly, spotted and striped, matching characters of habitat (Fjeldså 1976, 1977): precocial, nidifugous usually, self-feeding or not depending greatly on parents.

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

REFERENCES

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

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

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

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

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

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

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

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

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

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

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

—, *et al.* 1988. *Auk* 105: 409–423.

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

Order CHARADRIIFORMES
Family SCOLOPACIDAE sandpipers and allies

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

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

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

When breeding, most scolopacids (except some snipes and woodcocks) are birds of open habitats, including tundra. At other times, use a variety of habitats, including forests (woodcocks) and open sea (phalaropes), though most prefer shallow, fresh, brackish or intertidal wetlands. Greatest concentrations occur on intertidal mudflats, especially estuaries. Feed mainly by touch, and the mandibular skeleton has distinctive features associated with tactile methods of foraging. When feeding, most probe into soft, moist substrata to catch invertebrates; some (e.g. Arenariinae) forage on rocky shores; surface-tension mechanism for feeding on plankton, recently described for Red-necked Phalaropes *Phalaropus lobatus* (Rubega & Obst 1993), may prove to be widespread among scolopacids with fine bills. Mixed-species foraging flocks common.

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

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

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

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

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

In CALIDRIDINAE, mating systems remarkably varied, including monogamy, polygyny, polyandry; most species monogamous (e.g. Pitelka *et al.* 1974). Role of sexes in parental care as diverse as mating systems. Apparently solely by female in the four polygynous species; roughly equally shared in some (e.g. Dunlin *C. alpina*), though female tends to leave chicks earlier; in others, male undertakes more of work and females leave before chick-rearing (or even incubation) complete. Behaviour more complex in successive polyandrous species, with males raising first brood while females may lay and raise another clutch. In GALLINAGONINAE, mating systems poorly known but several species monogamous; Great Snipe *Gallinago media* promiscuous, mating at leks, and apparently unique among snipe in performing courtship display on ground; others have crepuscular or nocturnal display-flights accompanied by distinctive calls and non-vocal sounds (see Gallinagoninae). Mass flights of displaying snipes have been said to be aerial leks in several species, but confirmation needed (could be result of unsettled territorial boundaries early in breeding season) (Byrkjedal 1990). In TRINGINAE, most species monogamous but successive polyandry can occur in Spotted Redshank *Tringa erythropus* and Spotted Sandpiper *Actitis macularia*. Parental care shared about equally or females leave breeding grounds early while males undertake or finish rearing chicks. ARENARIINAE are monogamous; Ruddy Turnstone territorial and aggressive. LIMNODROMINAE, poorly known; apparently monogamous; territorial but *L. semipalmatus* nests in small colonies. Both sexes incubate; males undertake most of chick-rearing. In PHALAROPODINAE, many sex roles reversed when breeding; females almost unique among Scolopacidae in undertaking courtship behaviour, contesting access to mates in 'scramble displays' (Reynolds 1987; Colwell & Oring 1988a). Phalaropes usually monogamous, though polyandry recorded in all three species; incidence of polyandry may vary between populations but reasons not yet clear (e.g. Colwell & Oring 1988b). Males undertake virtually all incubation and raise chicks alone (see Colwell 1986; Colwell & Oring 1988a,b).

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

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

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

REFERENCES

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

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

Subfamily **ARENARIINAE turnstones**

Medium-small (22–25 cm), chunky shorebirds, breeding in Arctic and migrating to rocky coastlines. Two species in single genus *Arenaria*; Surfbird *Aphriza virgata* previously included, but now placed in Calidridinae (Jehl 1968a). Circumpolar Ruddy Turnstone *Arenaria interpres* occurs HANZAB region; extralimital Black Turnstone *A. melanocephala* breeds Alaska and winters on w. coast of North America. Though previously considered as Charadriidae by some authors, studies of anatomy (Lowe 1931; Burton 1974; Strauch 1978), parasitology (Timmerman 1957), egg-white proteins (Sibley & Ahlquist 1972; Ahlquist 1974a, 1974b) and downy young (Jehl 1968b; Fjeldså 1977) all support inclusion in Scolopacidae. Usually accorded subfamily rank because feeding adaptations distinctive, but precise affinities are not clear; variously claimed or suggested to be close to Tringinae (e.g. Jehl 1968a,b; BWP) or Calidridinae (e.g. Fjeldså 1977) but no conclusive biochemical studies have been done.

Bill, short and sturdy, deep at base but tapering sharply, with lower mandible upturned, giving wedge-shaped appearance; highly rhynchokinetic. Musculature of jaw and neck much enlarged; powerful build of neck, jaws and bill associated with specialized feeding behaviour (see below). Wings, rather long, pointed; tail, long and slightly rounded. Tarsi short with scutellations on both sides. Anterior toes strong, without webbing at bases; despite this, swim well and take off easily from water. Hindtoe slightly larger than in most scolopacids and unusually, not raised.

Males slightly brighter than females in breeding plumage, which is white below and boldly pied on head, neck and upperparts (Ruddy Turnstone has much rufous above), with characteristic and obvious diamond-shaped patch on back in flight; legs, dull pink to orange. Non-breeding plumage somewhat duller than adult breeding. Juvenile plumage distinctly duller than adult breeding. Moult-strategies broadly similar to Calidridinae (q.v.); adult plumage attained when 8–15 months old and first breed when 1–2 years old. Downy young, light buffish-grey, obscurely marked by diffuse dark-grey to black bands and mottled areas, without white powder-puffs; pattern variously interpreted as intermediate between pebbly types of Charadriidae and spotted type of Calidridinae (e.g. BWP; Fjeldså 1977) or as extreme modification of three-striped pattern of Tringini (Jehl 1968b).

Breed mostly in Arctic and usually not far from coast. In non-breeding season, almost exclusively coastal, characteristically on rocky shorelines. Ruddy Turnstone more catholic in choice of habitat than Black, but prefers rocky, shingly or weed-covered shorelines. Feed mostly on invertebrates and, opportunistically, on carrion; feeding actions, vigorous, flicking over stones or shells, scraping algae off rocks, or digging small holes in sand in search of invertebrates.

REFERENCES

Ahlquist, J.E. 1974a. *The Relationships of the Shorebirds*. Unpubl. PhD thesis, Yale Univ.

—— 1974b. *Discovery* 10: 14–25.

Burton, P.J.K. 1974. *Feeding and the Feeding Apparatus in Waders*. Br. Mus. Nat. Hist., Lond.

Fjeldså, J. 1977. *Guide to the Young of European Precocial Birds*. Skarv Nature Publs, Strandgården, Tisvildileje.

Jehl Jr, J.R. 1968a. *Condor* 70: 206–10.

—— 1968b. *Mem. San Diego Soc. nat. Hist.* 3.

Lowe, P.R. 1931. *Ibis* (13) 1: 491–534.

Mercer, A.J. 1966. *Br. Birds*. 59: 307.

Sibley, C.G., & J.E. Ahlquist. 1972. *Bull Peabody Mus. Nat. Hist.* 39: 1–276.

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

Arenaria interpres **Ruddy Turnstone**

COLOUR PLATE FACING PAGE 256

Tringa interpres Linnaeus, 1758, *Syst. Nat.*, *ed.* 10 (1): 148 — Europe and North America.

Arenaria is from the Latin (*arenarius*), relating to sand (from *arena*, sand), no doubt referring to the seashore habitat. The specific name is Latin, *interpres*, an interpreter. Linnaeus, on his visit to Gotland in 1741, received the mistaken impression that the local name *tolk* for the Common Redshank (q.v.) was applied to the Ruddy Turnstone. In standard Swedish, *tolk* means interpreter or translator. However, the specific name may refer to going in between the tide lines.

The English name refers to the habit of the species of turning stones with its bill.

OTHER ENGLISH NAMES Turnstone; Eastern Turnstone, Sea-Dotterel, Beachbird, Calico-bird.

POLYTYPIC Nominate *interpres*, western Alaska, Ellesmere and Axel Heiberg Islands in Canadian Arctic, Greenland, and northern Eurasia; *morinella* (Linnaeus, 1766), arctic Canada.

FIELD IDENTIFICATION Length 22–24 cm; wingspan 50–57 cm; weight *c.* 115 g. Stocky, medium-sized wader with short, slightly uptilted, wedge-shaped bill and short orange-red legs; between Curlew Sandpiper *Calidris ferruginea* and Lesser Knot *C. canutus* in size though closer to latter. In all plumages, have distinctive black or dark-brown breast with pale areas, and striking dark-and-white flight-pattern. Bustling gait and habit of turning stones, distinctive, and flight call diagnostic. Sexes similar but, within breeding pairs, sometimes separable (see Plumages). Marked seasonal variation. Juvenile and immatures separable.

Description **Adult breeding** Head, mostly white, with: black streaks on crown (tinged buff when fresh); black spot on sides of nape; black line across forehead between eyes; and black line from gape joining vertical black band running from eye, down cheeks to broad black breast-patch. Neck, black, with narrow white hindneck collar that broadens into white patch on sides of breast. Upperparts and central innerwing-coverts, black with bright chestnut tips giving variegated tortoiseshell pattern, and often forming broad chestnut bands across inner scapulars and innerwing-coverts that contrast with mostly black mantle and outer scapulars. In flight, pattern of upperparts diagnostic: back, uppertail-coverts and tail, white, with black rump and broad black subterminal tail-band; upperwing, black with chestnut central innerwing-coverts, white triangle at base of wings, and long white wing-bar. Underparts white except for black breast, narrow dark trailing-edge to wings and blackish subterminal tail-band. Bill, black, paler at base of lower mandible. Iris, dark brown. Legs and feet, bright orange-red. **Adult non-breeding** As breeding but duller, with no chestnut in upperparts. Upperparts and innerwing-coverts, blackish grading to grey-brown or sandy buff at margins of feathers, appearing mottled. Head mostly dark grey-brown, with hint of black facial pattern of breeding plumage, indistinct dull-white supercilium behind eye, diffuse pale patch on sides of head, and white chin and throat. Breast mostly dull black, with paler smudges, and enclosing irregular brownish-white patches at sides. Bill, black, often with grey, olive or brown basally. Legs and feet, pale orange, often grey at joints. **Juvenile** Similar to adult non-breeding except: larger pale patches on head; upperparts and innerwing-coverts, blackish-brown scaled white to buffish-white (fringes wear and fade rapidly); more pale smudging and fringing on breast (centre of breast especially appearing paler), and paler, more contrasting patches from hindneck to sides of breast. Legs and feet duller, yellow-brown. **First immature non-breeding** As adult non-breeding but with retained worn juvenile innerwing-coverts and some tertials. **First immature breeding** Varying mixture of heavily worn juvenile, worn first non-breeding, and adult-like breeding plumages; strong contrast between new, bright chestnut lesser and median inner upperwing-coverts and heavily worn grey-brown rest of coverts (contrast less marked in adult breeding); retained juvenile primaries more worn than on adult; bare parts generally duller than adult breeding.

Similar species None; slight risk of confusion with juvenile and immature **Shore Plover** *Thinornis novaeseelandiae* (q.v. *HANZAB* II).

Singly or, more usually, in loose groups of 20–100, along coasts; occasionally inland. Walk with rolling gait, run well. Flight, strong and direct, usually low, with rather stiff shallow wing-beats; fly in tight co-ordinated flocks when moving locally, but in loose lines when migrating. Foraging behaviour distinctive: feed busily by probing, pecking and prying into crevices, using sturdy bill to flip over stones, shells, seaweed and other objects; often dig large holes in sandy areas. Generally alert and bustling, and tame. Noisy and quarrelsome: usual flight-call a diagnostic clear, rapid, rolled staccato *trik-tuk-tuk-tuk* or shorter *tuk-e-tuk*; when flushed, may give short, sharp *chick-ik* or monosyllabic *kuu*.

HABITAT In A'asia, mainly coastal on exposed rock or coral reefs, platforms and shelves, often with shallow tidal pools and rocky, shingle or gravel beaches; also on sand, coral or shell beaches, and shoals, cays and dry ridges of sand or coral. Occasionally in estuaries, harbours, bays and coastal lagoons; among low saltmarsh or on exposed beds of seagrass; round sewage ponds; on mudflats. In n. Aust., occur in a wide variety of habitats, and may prefer wide mudflats; in s. Aust., prefer rockier coastlines; less numerous on large embayments with extensive mudflats (Lane & Jessop 1983; Lane; R.H. Loyn). On Flinders I., Tas., occur round rocky reefs during spring and summer, and move to bays and estuaries for autumn and winter (Newman *et al.* 1984). In sw. Aust., may occur on pebble-strewn shores of saltlakes near coast (Storr 1965; Storr & Johnstone 1988). On Rottnest I., prefer shores with scattered fragments of limestone (Storr 1965). In NZ, occur both on rocky shores and sheltered beaches and flats; favour sandy estuaries and harbours with flats of *Zostera* (Parrish 1984 *contra* Falla *et al.* 1981); once recorded on shingle river bed (Parrish 1988). Sometimes on fallow, stony or poorly grassed paddocks near coast (Skegg 1962; CSN 29), on grassy common (Wakelin 1968). Sometimes recorded away from coast, such as on river bed >15 km upstream (Taylor 1981), inland lakes and adjacent farmland (Favaloro 1981).

Mainly forage between lower supralittoral and lower littoral zones of foreshores, from strand-line to wave-zone (Hornsby 1978; Lane); often forage among banks of stranded seaweed or other tide-wrack (Robertson & Dennison 1979; Bransbury 1985; Schulz 1985); in NZ, observed flicking over *Zostera*, seaweed, and small pieces of driftwood; and foraging among *Samolus* on rocky platforms and on open beaches along waveline (G.R. Parrish). Also forage on exposed rocky platforms and coral reefs (Hogan 1925; Domm & Recher 1973; Evans 1975; Park 1983); and mudflats (Loyn 1975). In se. Gulf of Carpentaria, Qld, feed only on mangrove mudflats, especially those near shingle beaches (Garnett 1989). Sometimes round coastal lagoons (Clapp 1968) and sewage treatment ponds (Mills 1984); occasionally among low vegetation in saltmarsh, on exposed beds of seagrass (Robertson & Dennison 1979), or among dunes on coral cays (Warham 1961). Sometimes in grassy areas above tideline (Loyn 1975); short pasture or ploughed paddocks (Skegg 1962). On Norfolk I. and Lord Howe I., observed foraging on grassy common and in floodwaters (Wakelin 1968; R.H. Loyn). Roost or loaf on beaches, above tideline, among rocks, shells, beachcast seaweed or other debris; also on rocky islets among grassy tussocks, and on mudflats and sandflats (Sibson 1946; Clapp 1968; Joseph & Reid 1977; Hornsby 1978; Mills 1984; Vic.

Atlas). Sometimes fly round or land on ships at sea (Jenkins 1967, 1971, 1978; Child 1982).

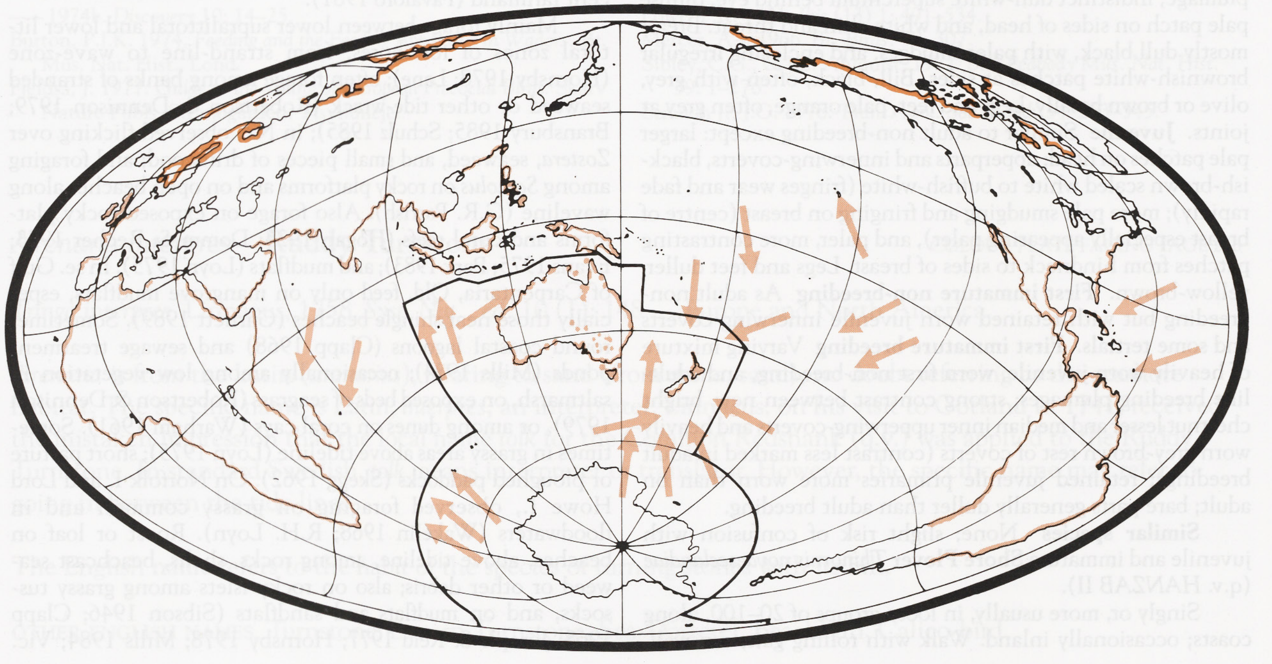
DISTRIBUTION AND POPULATION Breed coasts of Europe, Asia and North America, generally N of 60°N: Norway, Denmark, Baltic coasts of Sweden and Finland, Spitsbergen, Estonia; from Norwegian border, E to sw. Kanin Pen., including coasts of White Sea; Ostrov Kolguyev; s. Novaya Zemlya; and from Ostrov Vaygach and Yugorskiy Pen., E along n. coast to e. Chukotski Pen.; w. and n. Alaska, from St Lawrence I. and delta of Yukon R., E through Canadian Arctic islands, from Banks I., N to Ellesmere I., and E to sw. Baffin I. and Southampton I., and other islands in n. Hudson Bay; probably also n. Mackenzie and Keewatin. N. and e. Greenland, and Iceland. Non-breeding distribution almost cosmopolitan. Occur British Isles; coasts of North Sea and English Channel between mouth of Elbe R. and ne. Bay of Biscay; Iberian Pen.; round Mediterranean Sea; in Africa, most of coast and, occasionally, inland from junction of Nile Rs, S through L. Victoria, to n. and central South Africa; also Madagascar; most Asian coasts, from Arabian Pen. and Persian Gulf, and Indian subcontinent; widespread in small numbers in Burma, Thailand, Malaysia and Indochina, also in se. China, from s. Chekiang to Fukien and Kwangtung; and Taiwan; pass through Indonesia; Pacific and Atlantic coasts of North and South America, from central California, S through Mexico and Central America to s. Chile, and from New York, S through Gulf of Mexico and Caribbean to Argentina; Pacific islands from Hawaii and Micronesia, S to Fiji, Tonga and Samoa; occasionally E to Cook Is; scattered records on Society Is and Tuamotu; common A'asia (Dement'ev & Gladkov 1951; Johnson 1965; Blake 1977; Ali & Ripley 1980; AOU 1983; de Schauensee 1984; Coates 1985; Urban *et al.* 1986; Pratt *et al.* 1987; BWP).

Aust. Widespread round most of coastal mainland, including offshore islands (Aust. Atlas). Few records Gulf of Carpentaria (possibly through lack of observers), though recorded Gove Pen., Groote Eylandt, Sir Edward Pellew Grp, Gore Pt, Bynoe R., Pt Austin, Spring Ck, and Chapman R. (Carruthers 1966; Boekel 1976; Schodde 1976; Garnett & Bredl 1985; Garnett 1989; Aust. Atlas). Also sparsely recorded n. Great Australian Bight, and Kimberley Division, between Dampier Pen. and Joseph Bonaparte Gulf (Aust. Atlas). Occasional records inland (probably on passage): L. Moondarra, Mt Isa, Qld (Qld Bird Rep. 1988); W of Darling R., in Murray Valley, and in Riverina, NSW (Disher 1962; Thomas 1970; Favaloro 1981; Lowe 1981; Morris *et al.* 1981; NSW Bird Reps); Mallee and Wimmera district, Vic. (Hobbs 1961; Vic. Bird Reps; Vic. Atlas); round L. Harry, Billa Kalina Bore and Mintabie, ne. and n. SA (Badman & May 1983; Cox 1991; Aust. Atlas); L. Annean, S of Meekatharra, WA (Jaensch 1986). **Tas.** Widespread on Bass Str. coast: mostly between Temma and St Helens, and on King and Flinders Is; more scarce in S. Rarely on w. coast, and at various sites in E and SE (Thomas 1970; Schulz 1993; Schulz & Kristensen 1994; Tas. Bird Reps; Aust. Atlas).

NZ Most congregate in a few favoured sites (NZCL), especially harbours in Northland (Parrish 1984); scarce away from these localities (CSN 19). **NI** Most records from harbours N of line between Tauranga and Manukau Harbours. Favoured localities where congregations occur include: Parengarenga, Houhora, Rangaunu, Kaipara, Manukau and Tauranga Harbours and Firth of Thames; flocks of 30–50 regular at Karikari Pen., Waipu and Mangawhai Estuaries; 30–50 recorded Maketu Estuary (CSN 41, 42). Sparsely scattered elsewhere round coast. Occasionally L. Wairarapa (CSN 39). **SI** Mainly Farewell Spit, Tasman Bay and lagoons in Southland. Elsewhere, scattered records along e. coast from near C. Campbell, SW to about Nugget Pt. Stewart I. (NZ Atlas; CSN).

Lord Howe I. Regular visitor (Hindwood 1940; Disney & Smithers 1972; Fullagar *et al.* 1974; Brown 1979; Hutton 1991; NSW Bird Rep. 1975).

Norfolk I. Regular visitor. First recorded mid-1800s (Ramsay 1888), and not again till Oct. 1962 (Anon. 1963); regularly recorded since (Wakelin 1968; Moore 1981,1985; Schodde *et al.* 1983; Hermes *et al.* 1986).



Christmas I. Regular migrant (van Tets 1983). **Cocos-Keeling Is** Regular visitor in small numbers (Gibson-Hill 1949, 1950; Stokes *et al.* 1984); more than 50 recorded on South I., 19 Jan. 1982 (Stokes *et al.* 1984). **Macquarie I.** Ten, 28 Dec. 1976 (Green 1989). **Kermadec Is** Probably regular visitor (NZCL); recorded Raoul I., Macauley I., Milne Islets, Meyer Islets (Edgar *et al.* 1965; Merton 1968, 1970). **Chatham Is** Regular visitor (Freeman 1994; NZCL). First record, 50, 20–22 Mar. 1957 (Lindsay *et al.* 1959); ≥500 recorded in Te Whanga Lagoon, 24 Nov. 1978 (CSN 26). On South-East I., two, se. coast, 5 Dec. 1979; three, Thinornis Bay, 8 Dec. 1979 (Nilsson *et al.* 1994). **Antipodes Is** Probably regular visitor (NZCL). **Auckland Is** Regular visitor; up to 100 recorded on Derry Castle Reef, off Enderby I. (Pierce 1980). **Campbell I.** Single, 15 Nov. 1967–2 Jan. 1968 (Kinsky 1969). **Prince Edward Is** Two, 25 Apr. 1976; two, 26 Feb. 1977; two, 18–20 Jan. 1979; single, 21 Jan. 1981; single, 22 Dec. 1981 (Burger *et al.* 1980; Berruti & Schramn 1981; Newton *et al.* 1983; Gartshore 1987). **Iles Crozet** Three, Ile de l'Est, Feb. 1971; two, Ile de la Possesion, 23 Jan.–3 May 1979; singles, 28 Sept. 1980; 19 Nov.–5 Dec. 1981; 7–13 Dec. 1982 (Stahl *et al.* 1984). **Iles Kerguelen** Three, 29 Jan. 1986; three, 29 July 1986; single, 19 Sept. 1986 (Ausilio & Zotier 1989).

Population Aust. Estimated at 14,000 (Watkins 1993). Totals for summer and winter counts throughout Aust., 1986–91, summarized in Table 1 (Hewish 1986, 1987a,b, 1988, 1989a,b, 1990a,b; Anon. 1992; Naismith 1992). Sites of significance and maximum or average counts from summer and winter surveys round Aust., 1981–85, were: Roebuck Bay, WA, 2060; se. coast SA, 900; King I., Tas., 830; w. coast Eyre Pen., SA, 780; Eighty Mile Beach, WA, 740; Spencer Gulf, SA, 470; Kangaroo I., SA, 440 (Lane). Other sites of international importance (Watkins 1993), include: n. Great Barrier Reef, Qld, 827 (Cornelius 1987); Shipwreck Pt, Perkins I., Tas., 550 (Ashby 1991); Hunter R. estuary, NSW, 520 (Smith 1990); Five Islets, Robbins I., Tas., 550 (Ashby 1991); Rottnest I., WA, 480 (Saunders & de Rebeira 1986); Kangaroo I., Tas., 450 (Ashby 1991); C. Northumberland–Green Pt, SA, 443 (AWSG); Carpenters Rocks, SA, 400 (AWSG); Wright Bay, SA, 310 (AWSG); Rivoli Bay, SA, 303 (AWSG); Swan Bay–Mud I., Vic., 293 (AWSG); Warrnambool–Port Fairy, Vic., 289 (AWSG); Price Saltfields, SA, 284 (Close & McCrie 1986). Other large totals, not mentioned by Watkins (1993) are: Christmas I., Tas., 5000–10,000 (Tas. Bird Rep. 17); Robbins I., Tas., 650 (Tas. Bird Rep. 19); Shipwreck Pt, Perkins I., Tas., 460 (Tas. Bird Rep. 20). **NZ** Totals for summer and winter counts, 1983–92, summarized in Table 2; mean total summer count NI, 2213 (736; 602–3121); SI, 2200 (494; 1713–3119) (OSNZ Nat. Wader Count; P.M. Sagar). Sites of importance, with mean summer counts (n=10 summers) given below; maximum counts (between 1976–77 and 1990–91; CSN 24–39) that exceeded maxima from OSNZ Nat. Wader Counts are also given. **NI** Rangaunu Harbour, 256 (165;

Table 1

Year	Summer Total	No. Sites	Winter Total	No. Sites
1986	2137	23	340	23
1987	1104	22	212	23
1988	1608	23	146	23
1989	1329	22	745	21
1990	1380	21	50	21
1991	991	21		

Table 2

Year		Summer Total	No. Sites	Winter Total	No. Sites
1983	NI	–	–	2371	31
	SI	–	–	3143	43
1984	NI	285	42	3119	44
	SI	434	68	2803	73
1985	NI	143	60	2056	79
	SI	149	83	2370	65
1986	NI	522	91	2707	75
	SI	448	77	1713	73
1987	NI	210	66	2615	54
	SI	140	53	2225	63
1988	NI	227	58	2299	65
	SI	261	66	1917	54
1989	NI	350	56	1536	30
	SI	583	65	2336	56
1990	NI	3	34	602	31
	SI	80	49	1792	40
1991	NI	69	33	1704	37
	SI	224	47	1395	35
1992	NI	885	45	3121	34
	SI	603	52	2306	44
1993	NI	202	43	–	–
	SI	22	42	–	–

0–510); 800+, 23 Oct. 1978 (CSN 26); Parengarenga, 915 (465; 409–1500); 3100, 24 Mar. 1992 (CSN 41); Kaipara Harbour, 423 (200; 35–618); 642 (Tapora), 2 Mar. 1991 (CSN 39); Manukau Harbour, 427 (205; 130–803); Firth of Thames, 106 (54; 36–196); Tauranga Harbour 250 (70; 170–402); 800–1000, 3 Apr. 1982 (CSN 30). **SI** Farewell Spit, 846 (351; 451–1792); Moteuka Estuary 252 (130; 0–434); L. Grassmere 58 (66; 0–200); Kaikoura Pen. 71 (35; 8–132); Riverton Estuary 104 (115; 0–338); Invercargill Estuary 574 (250; 276–1150); Awarua Bay 203 (165; 16–591); Fortrose 75 (39; 13–137). Other sites of importance (with maximum counts) include: Southland lagoons, 1247, 9 Nov. 1985 (CSN 34); Houhora, *c*. 550, 22 Oct. 1982 (CSN 31).

MOVEMENTS Migratory. Five holarctic breeding populations, which move S to non-breeding areas, with partial overlap of population on passage: (1) birds breeding e. Siberia and w. Alaska move to se. Asia, S to Aust., w. Pacific islands S to NZ, and Pacific coast of California and Mexico; (2) birds breeding White Sea to central Siberia move to e. Mediterranean, Red Sea, Persian Gulf, and islands and coast of Indian Ocean; vagrant to Iles Crozet; (3) birds breeding Fenno-Scandia and w. Russia move mainly to Morocco and w. Africa; (4) birds breeding Axel Heiberg I. and Ellesmere I. in Canadian Arctic, and in Greenland move to w. Europe; (5) birds breeding ne. Alaska to Baffin I., Canada (subspecies *morinella*), move to Gulf of Mexico and South Carolina, S to central Chile and central Argentina (possibly vagrant to NT) (Deignan 1964; Storr 1967; Hayman *et al*. 1986; Mathews; BWP). Possibly two routes of migration to Aust.: birds occurring e. Aust. and NZ migrate S across Pacific and return N via e. coast of Asia; birds in w. Aust. appear to migrate S and N via e. Asia; few occur PNG or Gulf of Carpentaria (Thompson 1973; Lane). May associate with golden plovers *Pluvialis* on migration (Sullivan 1929; Sibson 1946). Ship-assisted passage recorded (Jenkins 1971).

Departure Leave Siberia and St Lawrence I., about July; after breeding, many occur Pribilof Is, Bering Sea, leaving mid-Aug. to early Sept., some into Oct. (Dement'ev & Gladkov 1951; Thompson 1973). EAST ASIAN ROUTE: migrate through Korea (Gore & Won 1971). Pass through Japan on way to Philippines (though birds marked in Pribilof Is not recorded Japan) (Hachisuka 1932; Thompson 1973; Lane). Some pass Mongolia; common e. China (la Touche 1931–34; AWB 1993); abundant Hong Kong, late Aug. to early Oct. (Chalmers 1986); pass Cambodia; small numbers move through Vietnam (AWB 1993). Greatest passage Olango I., Philippines, Aug. in 1988 (Magsalay *et al*. 1990). Move through Borneo (Smythies 1981); Sumatra, mainly from Sept. (van Marle & Voous 1988); and Wallacea, Sept.–Nov. (White 1975). Arrive Darwin, NT, and n. and s. WA, Aug. (Lane); arrive Rottnest I, sw. WA, from mid-Aug. to mid-Oct. (Storr 1965); regular passage migrant Eyre, s. WA, Sept.–Oct. (Congreve & Congreve 1982). TRANS-PACIFIC ROUTE: birds marked Pribilof Is sighted on islands of sw. Pacific, NI, NZ, and e. Aust. Only small proportion of population migrating across Pacific reaches Aust. (Lane). Birds move from island to island, probably flying directly from Pribilof Is to Hawaiian or Marshall Is, arriving early Sept. to Nov. (Thompson 1973). At Suva Pt, Fiji, numbers increase mid-Sept. to late Oct. (Skinner 1983). Arrive Solomon Is after mid-Sept. (Bayliss-Smith 1972). Small numbers usually arrive Port Moresby region, PNG, Aug. (Hicks 1990); passage migrant in Torres Str. (Draffan *et al*. 1983). Arrive e. Aust., Sept.; begin to arrive SA and Vic., Sept., with maximum numbers, Nov.–Dec. Inland records, Sept.–Nov. suggest some movement overland to s. coast (Lane; Aust. Atlas). Hundreds occur n. Tas. but few move farther S (Wall 1953; Thomas 1968; Ashby 1991). Birds seen at sea between Fiji and NZ in late Nov., apparently moving S (Jenkins 1967). Arrive Lord Howe I. from Sept. when flocks of up to 130 seen, possibly *en route* to NZ (Hutton 1991). First arrive NZ from mid- to late Aug. (McKenzie 1968), in ones, twos or small flocks; appear to move S, though some still in Auckland Harbour in midsummer (Sibson 1946).

Non-breeding In se. Aust., numbers at most sites stable Dec.–Feb., though some movement occurs (Lane). At some sites birds not present every year (e.g. Wheeler 1955). In NZ, largest flocks at Parengarenga Harbour, Farewell Spit and Southland Lagoons, though numbers visiting may fluctuate between years (McKenzie 1968; Robertson & Dennison 1979); flocks sometimes occur at sites where few normally recorded (e.g. Waimea Inlet, Owen & Sell 1985). Formation of flocks before departure recorded NZ and Aust. (Sibson 1946; Templeton 1973).

Return NZ Influxes occur Firth of Thames, Manukau Harbour, Motueka and Farewell Spit; after Christmas, flocks appear suddenly at Manukau Harbour, Feb. or Mar.; flocks smaller by mid-Mar., and few birds in non-breeding plumage remain into May; leave Farewell Spit, late Apr.–early May (J. Hawkins). Last birds leave NZ as late as May (Sibson 1946; McKenzie 1968). **Aust.** Leave most sites in S, mid-Mar., though at some sites numbers remain high into Apr. (Starks & Lane 1987; Lane). Flock left ne. coast of Tas., late Apr. (Legge 1933); usually leave King I. by May (Templeton 1973). Influxes in Mar. and Apr. to coastal SA and s. and central NSW suggest birds move short distances along s. coast before leaving (Lane). Leave Lord Howe I., Apr. (Hutton 1991). Just before n. migration, estimated that Vic. birds can fly non-stop to se. Asia or nearby Pacific islands (Lane), the Philippines (Houston & Barter 1990), Wallacea or New Guinea (Starks & Lane 1987). No influxes occur in ne. or n. Aust., and lack of inland records in Mar. and Apr. also suggest birds fly over n. Aust.

(Lane). Leave Rottnest I., end Apr. to late May or early June (Storr 1965); continuous passage through nw. Aust. from late Mar. to third week of Apr. (Lane & Jessop 1985); some birds from S may touch down in nw. and, less often, n. Aust. (Starks & Lane 1987). Influx recorded in third week of Apr. near Broome, WA, though banding suggests these birds different from those passing S through area in Aug. and Sept. (Lane; but see Banding). Estimates based on departure weights suggest heavier adults in nw. Aust. capable of flying non-stop to s. coast of China (Lane & Jessop 1985; Houston & Barter 1990). Route taken by birds from e. Aust., not known; recovery of bird in Taiwan suggests at least some move N along e. Asian coast S of Japan (see Banding).

Extralimitally, small numbers leave Port Moresby area, Jan. (Hicks 1990). In Pacific, leave Suva Pt, Fiji, end Apr. (Skinner 1983); leave Solomon Is by early May (Bayliss-Smith 1972). N. route of birds spending non-breeding season in Pacific, not known, though may fly non-stop from sw. Pacific to Japan (Thompson 1973). Passed through Kuala Selangor, Malaysia, mainly Mar.–May 1986 (AWB 1993). Pass through Hong Kong, late Mar. to early June, especially last half of Apr. (Chalmers 1986). Greatest numbers on passage through Beidaihe, China, early May. Pass Korea and more abundant in Japan on n. migration (AWB 1993). Arrive n. and ne. Chukotka, Siberia, during May (Kondratiev 1982).

Breeding Most 1-year-olds remain S of breeding grounds during first breeding season (Thompson 1973). Proportion of summer population wintering at counted Aust. sites 1982–86, 9–57% (Hewish 1987a). Recorded as far S as Iles Kerguelen during winter (Ausilio & Zotier 1989).

Banding Birds banded in e. and w. Aust. have been recovered in e. Russia. One banded nw. Aust., recovered Shanghai, China. One banded Queenscliff, Vic., recaptured five months later in Taiwan and then retrapped at Queenscliff 1 year after banding, indicating that at least some birds that spend boreal winter in se. Aust. return via e. Asian coast (ABBBS 1992). Three birds banded nw. Aust., Aug.–Sept. 1981, recaptured Mar.–Apr. 1982 in same area (Jaensch 1982). Extralimitally, adult banded Japan recovered Ninigo Is, N of PNG (Coates 1985). Recoveries suggest Marshall Is most important centre of distribution for birds moving S from Pribilof Is through Pacific (Thompson 1973).

18S122E	03	2+	U	14	9689	5	ABBBS
32S151E	01	1+	U	19	8692	345	ABBBS
32S151E	01	1+	U	19	8692	345	ABBBS
32S151E	01	1+	U	19	8661	344	ABBBS
32S151E	01	1+	U	19	8661	344	ABBBS
38S144E	11	2	U	5	7244	335	ABBBS
19S121E	08	2	U	92	5568		ABBBS
38S146E	03	2+	U		4058		ABBBS
37S175E	10	1+	U	22	2336	291	NZNBS

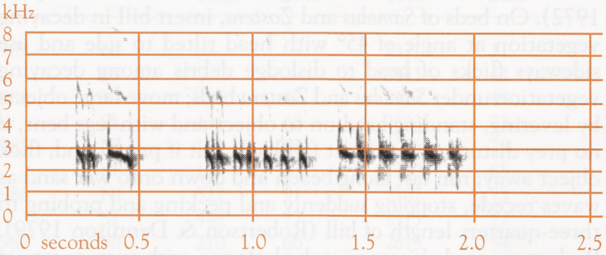
FOOD Carnivorous; insects, worms, crustaceans, molluscs, spiders; occasionally eggs and carrion. **Behaviour** Diurnal and nocturnal. On Heron I., Qld, feed on tide-line for first 2–3 h of falling tide then mainly on exposed coral rubble on reef-flat (Evans 1975). On Farewell Spit, NZ, last waders to come to roost, 2.5 h before high tide; rarely feed at roost; last to resume feeding after high tide (Robertson & Dennison 1979). Use strong neck and bill to toss shells, kelp and small stones to one side, searching for invertebrates (Sutton 1927; Hindwood & Hoskin 1954; Simpson 1972; Domm & Recher 1973; Schultz 1985). Prefer foraging on decomposing, rather than fresh, kelp (Robertson & Dennison 1979). Flip over tufts of mown grass (Hutton 1991). Bulldoze fine seaweed, often forming small mounds (Smith 1964, 1966); dig holes in wet sand (Simpson 1972). On beds of *Samolus* and *Zostera*, insert bill in decaying vegetation at angle of 45° with head tilted to side and use sideways flicks of head to dislodge debris among decaying vegetation under *Samolus* and *Zostera* beds; move large objects by levering, standing head-on to object and with legs bent, if no prey disturbed, let object fall back, but if prey found, flick object away; run fast along beach and down onto wet sand as waves recede, stopping suddenly and pecking and probing to three-quarters length of bill (Robertson & Dennison 1979). Peck at exposed objects on rock platforms, with average rate of 46 pecks/min (Schulz 1985). Chase small crabs to burrow and sometimes probe up to base of bill, often side-stepping right around hole until crab dislodged; crab then flipped on to back and pecked at ventral carapace. One bird seen excavating crab burrows; those over a certain size not opened (Robertson & Dennison 1979). In Broome, WA, turn over echinoid sand dollars and peck out flesh through underside (Bornman 1985). Occasionally scavenge (Storr 1966; Gill 1986; Lane), e.g. on mussels that have been opened by Pied Oystercatchers *Haematopus longirostris* (Smith 1966); in n. Qld, break open tern *Sterna* eggs and also scavenge those broken by Silver Gulls *Larus novaehollandiae* (Hulsman 1977; Cornelius 1985). On Lord Howe I. readily take scraps thrown by humans (Lane). Once recorded feeding on beachcast human corpse (Mercer 1966).

Adult On rocky shore platform, **Phillip I., Vic.** (10 faeces, 58 items; Schulz 1985): Molluscs: gastropods: unident. 100% freq., 100% no.; *Littorina unifasciata* 50, 10.3; *Modiolus pulex* 100, 63.8; Crustaceans: barnacles: *Cthamalamus antennatus* 20, 3.4; *Chamaesipho columna* 30, 5.2.

Other records Plants (Lea & Gray). Animals: marine invertebrates (Gould); Annelids (Robertson & Dennison 1979): worms (Simpson 1972); Molluscs (Lea & Gray): gastropods (Evans 1975); bivalves (Gould): Mytiliodae: mussels (Smith 1966); Crustaceans (Sutton 1927; Robertson & Dennison 1979; Gould); barnacles: *Lepas* (Evans 1975); amphipods: Talitridae: sandhoppers (Simpson 1972; stomach, Sutton 1927): *Talorchestia* (Schulz 1985); isopods: *Ligia novaezelandiae* (Robertson & Dennison 1979); crabs: *Helice crassa* (Robertson & Dennison 1979); Insects (Hindwood & Hoskin 1954): Coleoptera beetles: Curculionidae: *Mandalotus* (Hindwood & Hoskin 1954; McKeown 1944; Lea & Gray); Hymenoptera: Formicidae ants (FAB): *Iridomyrmex* (Hindwood & Hoskin 1954; McKeown 1944); Echinoderms: echinoid sand dollars (Bornman 1985). Fish: Exocoetidae: flying fish: eyes and gills (Jenkins 1971); Birds: Laridae tern eggs (Hulsman 1977). Raw and cooked meat, raw fat, raw and fried fish, bread, biscuits, mashed and chipped potatoes, banana, uncooked rice (Jenkins 1971); bread, chocolate and 'unhealthy morsels' (Lane). Shell-grit (Sutton 1927); sand (McKeown 1944); pebbles & grit (Lea & Gray).

VOICE Well described (Miller 1992). Sonagrams in Bergmann & Helb (1982), BWP, Maclean (1985), Nadler & Königstedt (1986) and Tikhonov & Fokin (1979, 1980, 1981). Noisy and quarrelsome, with sharp and incisive *kittick*, clear *keeu*, and chuckled *tak-a-tuk-tuk* described as usual calls of birds feeding or in flocks (see BWP).

Adult CONTACT-RATTLE: most common call in HANZAB area; a clear, rapid and rolling staccato whistle (several variants shown in sonagram A) with a machine-gun-like quality; a short tremolo or staccato chuckle (see BWP; Hayman *et al.* 1986); often becomes a rippling trill (sonagram B).



A C. Chappuis; *Sounds of Migrant and Wintering Birds —Western Europe*. Cassette 2: #65

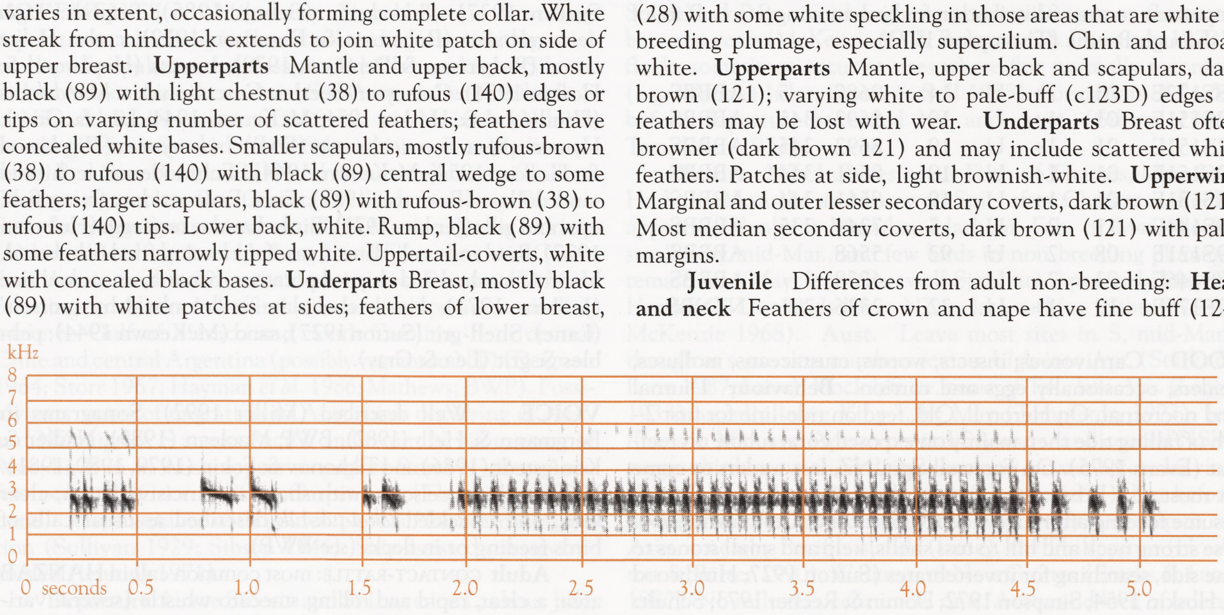
PLUMAGES Prepared by A.M. Dunn. Nominate *interpres* from Aust. described below. Finish partial post-juvenile (first pre-basic) moult to immature non-breeding plumage soon after arrival in non-breeding areas. Undergo partial first pre-breeding (pre-alternate) moult to first immature breeding plumage, Apr.–June; some immatures remain in our region through first austral winter while others return to breeding grounds. Thereafter moult twice annually: complete post-breeding (pre-basic) moult to non-breeding plumage during and just after s. migration, and partial pre-breeding (pre-alternate) moult to adult breeding just before n. migration. Adult non-breeding plumage first attained in complete second pre-basic moult early in second austral spring.

Adult male breeding (Definitive alternate). **Head and neck** Head appears mostly white with highly varying pattern of black markings on crown (Ferns 1978a). Feathers of crown, black (89), broadly edged white, giving streaked appearance; some edges, buff (124) when fresh. White supercilium extends from forecrown to white cheek-patch. Black (89) stripe runs across forehead between eyes. Black (89) stripe extends from gape to black (89) areas of breast. Vertical black (89) band runs downwards from eye to malar stripe. Lores, chin and throat, white, bordered black (89). Nape and hindneck, mostly white; black (89) band extends from breast up sides of neck; varies in extent, occasionally forming complete collar. White streak from hindneck extends to join white patch on side of upper breast. **Upperparts** Mantle and upper back, mostly black (89) with light chestnut (38) to rufous (140) edges or tips on varying number of scattered feathers; feathers have concealed white bases. Smaller scapulars, mostly rufous-brown (38) to rufous (140) with black (89) central wedge to some feathers; larger scapulars, black (89) with rufous-brown (38) to rufous (140) tips. Lower back, white. Rump, black (89) with some feathers narrowly tipped white. Uppertail-coverts, white with concealed black bases. **Underparts** Breast, mostly black (89) with white patches at sides; feathers of lower breast, narrowly fringed white. Centre of lower breast, belly, flanks, vent and undertail-coverts, white. **Tail** White, with broad black (89) subterminal band. **Upperwing** Marginal and outer lesser secondary coverts, dark brown (121) with narrow rufous (140) tips. Innermost lesser secondary coverts, black-brown (119) with broad white tips. Innermost median secondary coverts, white, forming white triangular patch on innerwing. Rest of median secondary coverts, mostly rufous (140) with partly concealed dark-brown (219) bases mixed with some older brown (28) feathers. Greater secondary coverts, dark brown (219) with broad white tips. Greater primary coverts, black brown (119) with narrow white tips. Primaries, dark brown (219); bases of outer webs of p1–p6 mostly white. Outer secondaries, white with broad dark-brown (219) tips that reduce to subterminal spot on s7; inner secondaries, white. Tertials, black (89) with rufous-brown (38) to rufous (140) tips. Broad white wing-bar formed by tips of secondary coverts, and bases of remiges. **Underwing** All coverts, white; outer 1–2 greater primary coverts may have grey (84) central wedge. Primaries, light grey (85). Secondaries, pale grey (86).

Adult female breeding (Definitive alternate). Similar to adult male breeding but slightly duller, with less distinct markings. Both sexes vary greatly, so only possible to sex known breeding pairs. Differences from adult male breeding: **Head and neck** Crown, browner, with less white streaking (sometimes giving capped appearance); older brown (28) feathers mixed with black (89) feathers with narrow orange-rufous (132D) edges; with occasional varying white edges. Pattern of dark markings on head less distinct; black (89) feathers often finely tipped white. **Upperparts** Less rufous on mantle, upper back and scapulars; varies much between individuals. Black base of uppertail-coverts larger and exposed making black area on rump appear broader. **Upperwing** Rufous areas of tertials and lesser and median coverts less distinct and may be paler rufous (40) and interspersed with old feathers.

Adult non-breeding (Definitive basic). Differences from adult male breeding: **Head and neck** Crown, nape and hindneck, dark brown (119A) with narrow brown (28) fringes to feathers giving slightly scalloped appearance. Lores, light grey-brown (119C). Forehead, cheeks and ear-coverts, brown (28) with some white speckling in those areas that are white in breeding plumage, especially supercilium. Chin and throat, white. **Upperparts** Mantle, upper back and scapulars, dark brown (121); varying white to pale-buff (c123D) edges to feathers may be lost with wear. **Underparts** Breast often browner (dark brown 121) and may include scattered white feathers. Patches at side, light brownish-white. **Upperwing** Marginal and outer lesser secondary coverts, dark brown (121). Most median secondary coverts, dark brown (121) with paler margins.

Juvenile Differences from adult non-breeding: **Head and neck** Feathers of crown and nape have fine buff (124)



B C. Chappuis; *Sounds of Migrant and Wintering Birds —Western Europe*. Cassette 2: #65 edges. Cheek and ear-coverts, browner; some feathers fringed white. **Upperparts** Mantle, upper back and scapulars, dark brown (219), feathers fringed buff (124) giving scalloped appearance. **Underparts** Band across breast, dark brown (121) with fine white tips to most feathers, making it appear paler, especially in centre. **Tail** Central rectrices have buff (124) tips. **Upperwing** All median secondary coverts, inner four or five greater secondary coverts and tertials distinctly fringed buff (124) to orange-buff (118).

First immature non-breeding (First basic). Similar to adult non-breeding but retain some juvenile tertials and wing-coverts, which have worn pale-buff fringes. Most retain juvenile remiges.

First immature breeding (First alternate). Varies. Immature males can resemble breeding females; immature females often much duller than breeding females. Most have heavily worn juvenile feathers on back, wing-coverts and tertials, worn non-breeding plumage on head and body, and new breeding plumage on sides of head, parts of chest, mantle, scapulars, inner tertials and inner upperwing-coverts, giving patchy appearance overall. Contrast between new light-chestnut coverts and heavily worn grey-brown juvenile coverts marked. Remiges very worn, especially outer primaries.

BARE PARTS Based on photos (Pringle 1987; Aust. RD; NZRD; unpubl.: M.A. Barter). **Adult** Iris, dark brown (219). Bill, black (89), often with dark-brown (c121) base, especially in non-breeding season. Legs, orange (16) to burnt orange (116) in breeding season; burnt orange (116) to salmon (106), often with pink-brown (219D) joints, in non-breeding season. **Juvenile** Iris, dark brown (219). Bill, as adult non-breeding. Legs, cream (54) to pale salmon (c6). **Immatures** As adult.

MOULTS Based on information gathered both in the n. hemisphere (Dement'ev & Gladkov 1951; Boere 1976; Pienkowski *et al.* 1976; Ferns 1978b; Groves 1978; Summers *et al.* 1989; BWP) and Aust. (Houston & Barter 1990). **Adult post-breeding** (Third and subsequent pre-basic). Complete. Most seem to begin outwards moult of primaries on arrival in non-breeding areas; if moult begins at breeding grounds, arrested before migration. Moult of primaries starts earlier in nw. than in se. Aust.: in NW, late Sept. to early Oct.; in Vic., mid-Oct. (Houston & Barter 1990). Moult of body begins mid-July at breeding grounds; complete, Sept.–Oct.; amount of body-moult correlated with weight (Ferns 1978b). **Adult pre-breeding** (Second and subsequent pre-alternate). Partial moult of body; involves head, neck, breast, mantle, upper back, scapulars and wing-coverts. Begins, late Feb.; complete, May. **Post-juvenile** (First pre-basic). Partial moult of body; begins late Aug.; complete, Nov. **Post-juvenile moult of primaries** (First pre-supplemental). In nw. Aust., most moult primaries in late Mar.; by early Apr., median PMS 23 (n=11) with only three birds not moulting (Barter 1990); extent of moult not known but probably complete. In Vic., most do not undergo this moult. **First immature pre-breeding** (First pre-alternate). Partial; mostly occurs later than adult pre-breeding, between Apr. and June. Extent varies, but usually moult less than adult. Scattered feathers replaced on head, mantle, scapulars, tertials and wing-coverts, giving patchy appearance; may retain some juvenile feathers in wing-coverts. Some migrate to breeding grounds and then follow pattern of adult moult; others stay in non-breeding grounds. **Immature post-breeding** (Second pre-basic). Complete. Moult of primaries starts much earlier than in adults: late Aug. in nw. Aust., and mid-Sept. in Vic. Moult of body starts much earlier, often directly after first pre-alternate moult. Until moult complete, plumage often patchy, comprising juvenile, immature non-breeding, immature breeding and adult non-breeding feathers. Individuals returning from breeding grounds probably follow adult pattern of moult and may be indistinguishable from adults.

MEASUREMENTS Nominate *interpres*. (1) Aust., adults, skins (HLW, MV, SAM, WAM). (2) NW. Aust., adults, live; sexed on breeding plumage in Mar.–Apr. (Houston & Barter 1990).

		MALES	FEMALES	
WING	(1)	152.3 (4.38; 142–161; 17)	151.1 (4.75; 142–159; 19)	ns
	(2)	156.2 (3.23; 34)	157.7 (3.49; 45)	*
8TH P	(1)	103.1 (1.95; 100–105; 7)	100.3 (2.81; 96–105; 7)	*
TAIL	(1)	58.4 (4.17; 50–64; 20)	57.3 (3.16; 52–62; 21)	ns
BILL	(1)	21.57 (1.01; 19.9–24.6; 19)	21.89 (0.91; 20.2–23.1; 21)	ns
	(2)	21.7 (1.15; 26)	22.2 (0.95; 37)	*
TARSUS	(1)	25.59 (0.68; 24.5–26.9; 19)	25.62 (0.88; 24.4–27.7; 20)	ns
TOE C	(1)	24.58 (0.81; 23.4–26.4; 20)	24.99 (1.07; 23.6–27.7; 18)	ns

(3–5) Vic. and nw. Aust., live (Houston & Barter 1990; VWSG): (3) Adults; (4) Second-years, aged on wear of feathers before loss of juvenile p10; (5) First-years.

		UNSEXED		
		VIC.	NW. AUST.	
WING	(3)	157.2 (3.97; 298)	156.1 (4.34; 239)	**
	(4)	146.9 (4.76; 71)	142.0 (5.19; 3)	
	(5)	151.5 (3.95; 149)	147.5 (5.08; 6)	
BILL	(3)	22.0 (1.07; 159)	22.1 (1.02; 172)	ns
	(4)	22.1 (1.05; 34)	22.0 (1.00; 3)	
	(5)	22.1 (0.93; 49)	21.5	
THL	(3)	50.2 (1.23; 216)	50.2 (1.21; 134)	ns
	(4)	50.0 (1.79; 56)	50.2 (2.10; 3)	
	(5)	49.9 (1.73; 49)	50.5 (1.26; 7)	

Lengths of fresh adult wings, measured Vic., Mar.–Apr., significantly longer than those measured at same time in nw. Aust. Length of wing also differed significantly between first-year, second-year and adult birds from Vic., but bill and total length of head did not differ significantly with age.

WEIGHTS (1) NW. Aust., adults, live, sexed on breeding plumage, early Apr. (Houston & Barter 1990). (2) Aust., adults, museum labels (MV, SAM, WAM).

	MALES	FEMALES	
(1)	133.5 (10.25; 31)	137.9 (8.73; 32)	*
(2)	108.5 (5.45; 104–115; 4)	114.4 (14.9; 100–135; 7)	

In early Apr., females significantly heavier than males.

(3–5) Vic. and nw. Aust., live (Houston & Barter 1990; VWSG): (3) Adults (second-year or older); (4) First immature breeding (second-years aged on wear of feathers and pattern of moult); (5) Juveniles and first immature non-breeding (first-years).

		UNSEXED	
		VIC.	NW. AUST.
Aug.–Sept.	(3)	113.0	94.6 (7.95; 10)
	(4)	98.3 (11.22; 10)	–
	(5)	94.0	–
Oct.–Nov.	(3)	100.0 (7.75; 86–116; 119)	97.9 (7.77; 21)
	(4)	98.3 (8.61; 85–106; 72)	91.6 (1.50; 3)
	(5)	102.1 (10.63; 82–126; 117)	–
Dec.	(3)	99.9 (7.10; 88–107; 20)	–
	(4)	90.0	–
	(5)	91.5 (9.47; 80–108; 10)	–
Jan.–Feb.	(3)	98.8 (5.74; 91–107; 14)	–
	(5)	98.5 (3.11; 94–101;4)	–
mid-Mar.	(3)	117.8 (12.28; 102–154; 43)	–
	(5)	100.7 (6.71; 89–111; 11)	–
late Mar.	(3)	138.1 (13.13; 65)	127.6 (11.51; 204)
early Apr.	(3)	170.2 (12.96; 26)	136.4 (12.93; 258)
	(5)	–	136.6 (24.58; 9)
mid-Apr.	(3)	–	136.8 (8.70; 5)

In early Apr., before n. migration, adults in Vic. significantly heavier than those from nw. Aust. (Houston & Barter 1990).

(6) Qld, live, adults (ABBBS; R. Elvish & B.R. King).

		UNSEXED
Aug.	(6)	105.4 (6.10; 94–116; 10)
Mar.	(6)	97, 105, 119

Weight lowest on arrival in Aust. in Aug.–Sept., and similar to weight in early non-breeding period in Africa (Dick & Pienkowski 1979; Summers & Waltner 1979; Summers *et al.* 1989); slightly lower than weights recorded in Scotland (Summers *et al.* 1989). Weight increases from about late Feb. until pre-migration mass reached in Apr.: 170 g, in Vic., and 136 g, in nw. Aust. Difference in departure weight between se. and nw. Aust. possibly a product of distance flown from site of departure to staging areas, with birds from s. Aust. apparently not stopping in n. Aust. (see Movements). Similar relationship between departure weight and latitude is found between s. Africa (163 g) and Scotland (153 g) (Summers *et al.* 1989). Barter & Houston (1990) calculated flight-ranges (using the equation from Davidson 1984) which suggested Vic. birds could fly 5300 km to the Philippines; nw. Aust. birds could fly 3400 km, but would not be able to reach China in one flight. Summers & Waltner (1979) calculated that, with a full load of fat (70 g), could travel about 5000 km. Additional information on changes in weight during migration can be found in Morrison (1975), Thompson (1973) and Branson *et al.* (1978).

STRUCTURE Wing, long and pointed. Eleven primaries; p10 longest; p9 1–5 mm shorter, p8 5–15, p7 17–28, p6 29–41, p5 39–53, p4 50–62, p3 60–72, p2 69–81, p1 76–91; p11 minute. Fourteen secondaries including four tertials; tips of longest tertials fall between p6 and p8 on folded wing. Tail, short and square; 12 rectrices. Bill, short and sturdy, about same length as head; straight with slight lateral compression; culmen gradually slopes toward sharp point; lower mandible slender and rather flat, ending in sharp point; nostril, small and slit like; nasal groove shallow and about half length of bill. Tarsus, short and stout; scales, scutellate. Tibia, 3–7 mm bare. Outer toe 78–84% of middle, inner 76–79%, hind 25–29%. No webbing between toes.

AGEING Ageing based on plumage, moult and wear of primaries. Juveniles and first immature non-breeding can be identified by buff-fringes on coverts at least till Mar. Between Mar. and Sept., some start to moult to breeding plumage but still separable from adults by worn retained juvenile coverts and primaries (all fresh in adults).

GEOGRAPHICAL VARIATION Two subspecies that vary slightly in size and coloration. Subspecies *morinella* is more brightly coloured in breeding plumage than nominate *interpres*. Subspecies *morinella* differs from nominate *interpres* by: (1) adult male breeding has less black streaking on head and upperparts, and brighter rufous to orange-rufous mantle, scapulars, tertials and wing-coverts; (2) adult female breeding often similar to adult male breeding *interpres*; (3) slightly shorter wing and slightly longer bill and tarsus; ratios of wing:bill and wing:tarsus can be used to separate subspecies; wing:bill ratio <6.60 in most *morinella*, >6.60 in nominate *interpres*; wing:tarsus ratio <5.90 in most *morinella* (BWP). Differences in measurements between birds from Vic. and nw. Aust. indicate that populations from se. Aust. may come from different areas of the breeding range than those from nw. Aust. (Houston & Barter 1990), but both sets of measurements are consistent with nominate *interpres*. The extent and pattern of clinal variation within the breeding distribution of nominate *interpres* is not known.

REFERENCES

ABBBS. 1992. *Stilt* 20: 51–76.
Ali, S., & S.D. Ripley. 1980. *Handbook of the Birds of India and Pakistan*. 2. OUP, Delhi.
Amiet, L. 1957. *Emu* 57: 236–54.
Anon. 1963. *Notornis* 10: 303–5.
—— 1992. *Stilt* 20: 33–7.
AOU. 1983. *Check-list of North American Birds*. Am. Orn. Union, Lawrence, Kansas.
Ashby, R. 1991 *Stilt* 19: 44–9.
AWB. 1993. *A Status Overview of Shorebirds in the East Asian–Australasian Flyway*. Asian Wetland Bureau Int. Rep. 2.
Ausilio, E., & R. Zotier. 1989. *Cormorant* 17: 9–18.
Badman, F.J., & I.A. May. 1983. *S. Aust. Orn*. 29: 29–39.
Bayliss-Smith, T.P. 1972. *Bull. Br. Orn. Club* 92: 1–10.
Bergmann, H-H., & H-W. Helb. 1982. *Stimmen der Vogel Europas. Gesange und Rufe von uber 400 Vogelarten in mehr als 2000 sonagrammen*. BLV Verlagsgesellschaft, München.
Berruti, A., & M. Schramm. 1981. *Cormorant* 9: 133–5.
Blake, E.R. 1977. *Manual of Neotropical Birds*. Univ. Chicago Press, Chicago.
Boekel, C. 1976. *Aust. Bird Watcher* 6: 231–44.
Boere, G.C. 1976. *Ardea* 64: 210–91.
Bornman, A. 1985. *RAOU Newsl*. 64: 5.
Bransbury, J. 1985. *S. Aust. Orn*. 29: 180–7.
Branson, N.J.B.A., *et al.* 1978. *Bird Study* 25: 181–7.
Brown, I. 1979. *Aust. Birds* 13: 41–2.
Burger, A.E., *et al.* 1980. *J. Biogeogr*. 2: 305–10.
Carruthers, R.K. 1966. *Aust. Bird Watcher* 2: 211–14.
Chalmers, M.L. 1986. *Birds of Hong Kong*. Hong Kong Bird Watching Soc., Hong Kong.
Child, P. 1982. *Notornis* 29: 31–6.
Clapp, R.B. 1968. *Notornis* 15: 198–206.
Close, D.H., & N. McCrie. 1986. *Emu* 86: 145–55.

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

Congreve, D., & P. Congreve. 1982. *RAOU Rep.* 3: 28–43.

Cornelius, J. 1985. *Stilt* 6: 33–4.

— 1987. *Stilt* 10: 36.

Cox, J.B. 1991. *S. Aust. Orn.* 31: 76–7.

Davidson, N.C. 1984. *Ringing Migr.* 5: 49–64.

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

Deignan, H.G. 1964. *Rec. Am.–Aust. Scient. Exped. Arnhem Land* 4: 345–426.

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

Dick, W.J.A., & M.W. Pienkowski. 1979. *Ornis scand.* 10: 117–23.

Disher, P.A. 1962. *Aust. Bird Watcher* 1: 198–9.

Disney, H.J. de S., & C.N. Smithers. 1972. *Aust. Zool.* 17: 1–11.

Domm, J., & H.F. Recher. 1973. *Sunbird* 4: 63–86.

Draffan, R.D.W., *et al.* 1983. *Emu* 83: 207–34.

Edgar, A.T., *et al.* 1965. *Notornis* 12: 3–43.

Evans, P.R. 1975. *Sunbird* 6: 25–31.

Falla, R.A., *et al.* 1981. *The New Guide to the Birds of New Zealand.* Collins, Auckland.

Favaloro, N.J. 1981. *Aust. Bird Watcher* 9: 99–100.

Ferns, P.N. 1978a. *Auk* 95: 753–5.

— 1978b. *Bull. Br. Orn. Club* 98: 118–22.

Ford, J. 1965. *Emu* 64: 181–203.

Freeman, A.N.D. 1994. *Notornis* 41 Suppl.: 127–41.

Fullagar, P.J., *et al.* 1974. Appendix F **In:** Recher & Clark (1974).

Garnett, S. 1989. *RAOU Rep.* 58.

—, & R. Bredl. 1985. *Sunbird* 15: 6–23.

Gartshore, N.A. 1987. *Cormorant* 15: 48–58.

Gibson-Hill, C.A. 1949. *Bull. Raffles Mus.* 22: 212–70.

— 1950. *Ibis* 91: 221–43.

Gill, R.E. 1986. *Br. Birds* 79: 402–3.

Gore, M.E.J., & P-O. Won. 1971. *Birds of Korea.* R. Asiatic Soc., Seoul.

Green, R.H. 1989. *Birds of Tasmania.* Potoroo, Launceston.

Groves, S. 1978. *Auk* 95: 95–103.

Hachisuka, M. 1932. *Birds of the Philippine Islands. 1.* Witherby, Lond.

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

Hermes, N., *et al.* 1986. *Notornis* 33: 141–9.

Hewish, M.J. 1986. *Stilt* 9: 21–9.

— 1987a. *Stilt* 11: 18–22.

— 1987b. *Stilt* 11: 23–31.

— 1988. *Stilt* 12: 41–6.

— 1989a. *Stilt* 14: 14–20.

— 1989b. *Stilt* 15: 13–15.

— 1990a. *Stilt* 16: 23–35.

— 1990b. *Stilt* 17: 5–16.

Hicks, R.K. 1990. *Muruk* 4: 91–104.

Hindwood, K.A. 1940. *Emu* 40: 1–86.

—, & E.S. Hoskin. 1954. *Emu* 54: 217–55.

Hobbs, J.N. 1961. *Emu* 61: 21–55.

Hogan, J. 1925. *Emu* 24: 266–75.

Hornsby, P.E. 1978. *S. Aust. Orn.* 27: 280–4.

Houston, P., & M. Barter. 1990. *Stilt* 17: 17–23.

Hulsman, K. 1977. *Emu* 77: 49–60.

Hutton, I. 1991. *Birds of Lord Howe Island.* Author, Coffs Harbour, NSW.

Jaensch, R.P. 1982. *RAOU Newsl.* 52: 1, 4.

— 1986. *West. Aust. Bird Notes* 40: 2–3.

Jenkins, J.A.F. 1967. *Notornis* 14: 21.

— 1971. *Notornis* 19: 130–1.

— 1978. *Notornis* 25: 234.

Johnson, A.W. 1965. *The Birds of Chile and Adjacent Regions of Argentina, Bolivia and Peru.* Platt Establecimientos Graficos, Buenos Aires.

Joseph, L., & J. Reid. 1977. *S. Aust. Orn.* 27: 225.

Kinsky, F.C. 1969. *Notornis* 16: 225–36.

Kondratiev, A.Y. 1982. *Biology of Waders in Tundras of North-East Asia.* Moscow.

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

Lane, B.A., & A. Jessop. 1983. *National Wader Count, Summer 1983– Report to Participants.* Unpubl. Rep. RAOU.

— 1985. *Stilt* 6: 2–16.

Legge, R.W. 1933. *Emu* 33: 71–2.

Lindsay, C.J., *et al.* 1959. *Notornis* 8: 99–106.

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

Loyn, R. 1975. *Report on the Avifauna of Westernport Bay.* Rep. to Westernport Bay Environ. Study, Vic. Min. Cons., Melbourne.

Maclean, G.L. 1985. *Roberts' Birds of Southern Africa.* Trustees John Voelcker Bird Book Fund, Cape Town.

Magsalay, P., *et al.* 1990. *Stilt* 17: 54–6.

McKenzie, H.R. 1968. *Notornis* 15: 238–41.

McKeown, K.C. 1944. *Emu* 43: 188–91.

Mercer, A.J. 1966. *Br. Birds* 59: 307.

Merton, D.V. 1968. *Notornis* 15: 3–22.

— 1970. *Notornis* 17: 147–99.

Miller, E.H. 1992. *Acoustic Signals of Shorebirds. A Survey and Review of Published Information.* R. Br. Columbia Mus. Tech. Rep., Victoria.

Mills, K. 1984. *Aust. Birds* 18: 80–2.

Moore, J.L. 1981. *Notornis* 28: 50–6.

— 1985. *Notornis* 32: 311–18.

Morris, A.K., *et al.* 1981. *Handlist of Birds in New South Wales.* NSW Field Orn. Club, Sydney.

Morrison, R.I.G. 1975. *Bird Banding* 46: 290–301.

Nadler, T., & D. Königstedt. 1986. *Zool. Abh., Dresden* 42: 79–106.

Naismith, L. 1992. *Stilt* 21: 6–7.

Newman, O.M.G., *et al.*1984. *Tas. Bird Rep.* 13: 3–14.

Newton, I.P., *et al.* 1983. *Cormorant* 11: 35–8.

Nilsson, R.J., *et al.* 1994. *Notornis* 41 Suppl. 109–25.

Owen, K.L., & M.G. Sell. 1985. *Notornis* 32: 271–309.

Park, P. 1983. *Occasional Stint* 2: 15–33.

Parrish, G.R. 1984. *Tech. Rep. NZ Wildl. Serv.* 8.

— 1988. *NZ Dept. Cons. Sci. Res. Ser.* 2.

Pienkowski, M.W., *et al.* 1976. *Ibis* 118: 347–65.

Pierce, R.J. 1980. *Notornis* 27: 309–24.

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

Prendergast, H.D.V. *et al.* 1985. *Sunbird* 15: 80–3.

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

Ramsay, E.P. 1888. *Tabular List of All the Australian Birds at Present Known to the Author, showing the Distribution of the Species Over the Continent of Australia and Adjacent Islands.* Author, Sydney.

Recher, H.F., & S.S. Clark. 1974. *Environmental Survey of Lord Howe Island.* Aust. Mus., Sydney.

Robertson, H.A., & M.D. Dennison. 1979. *Notornis* 26: 73–88.

Saunders, D.A., & C.P. de Rebeira. 1986. *Aust. Wildl. Res.* 13: 225–44.

Schodde, R. 1976. *A Survey of the Fauna of the Lower McArthur River Region, Northern Territory.* CSIRO Div. Wildl. Res., for Mimets Dev't, Canberra.

—, *et al.* 1983. *Aust. Natn. Parks Wildl. Serv. Spec. Publ.* 8.

Schulz, M. 1985. *Vict. Wader Stud. Grp Bull.* 9: 27–9.

— 1993. *Stilt* 23: 24–5.

—, & K. Kristensen. 1994. *Aust. Bird Watcher* 15: 265–72.

Sibson, R.B. 1946. *NZ Bird Notes.* 2: 4–7.

Simpson, K. 1972. *Birds in Bass Strait.* Reed, Sydney.

Skegg, P.D.G. 1962. *Notornis* 10: 92.

Skinner, N.J. 1983. *Notornis* 30: 227–32.

Smith, F.T.H. 1964. *Aust. Bird Watcher* 2: 70–84.

— 1966. *Aust. Bird Watcher* 2: 246–66.

Smith, P. 1990. *NSW Natn. Parks Wildl. Serv. Species Mgmt Rep.* 9.

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

Stahl, J-C., *et al.* 1984. *Gerfaut* 74: 39–46.

Starks, J., & B.A. Lane. 1987. *Stilt* 10: 20–7.

Stokes, T., *et al.* 1984. *Emu* 84: 23–8.

Storr, G.M. 1965. *Emu* 64: 105–13.

— 1966. *Emu* 65: 209–21.
— 1967. *Spec. Publs West. Aust. Mus.* 4.
—, & R.E. Johnstone. 1988. *Rec. West. Aust. Mus. Suppl.* 28.
Sullivan, C. 1929. *Emu* 29: 39–44.
Summers, R.W., & M. Waltner. 1979. *Ostrich* 50: 21–36.
—, *et al.* 1989. *Ardea* 77: 145–67.
Sutton, J. 1927. *S. Aust Orn.* 9: 5–29.
Taylor, G. 1981. *OSNZ News* 19: 8.
Templeton, M.T. 1973. *Aust. Bird Watcher* 5: 61–2.
Thomas, D.G. 1968. *Emu* 68: 95–125.
— 1970. *Emu* 70: 79–85.
Thompson, M.C. 1973. *Living Bird* 12: 5–23.
Tikhonov, A.V., & S.Yu. Fokin. 1979. *Biol. Nauk.* 10: 33–40.
—, — 1980. *Biol. Nauk.* 10: 45–54.
—, — 1981. *Ornitologia* 16: 64–72.
Urban, E.K., *et al.* 1986. *The Birds of Africa.* 2. Academic Press, Lond.
van Marle, J.G., & K.H. Voous. 1988. *BOU Checklist* 10.
van Tets, G.F. 1983. **In** *Preservation of the Abbott's Booby on Christmas Island.* Aust. Senate Standing Comm. Sci., Tech. & Environ. Canberra.
Veitch, C.R. 1978. *Notornis* 25: 1–24.
Wakelin, H. 1968. *Notornis* 15: 156–76.
Wall, L.E. 1953. *Emu* 53: 80–6.
Warham, J. 1961. *Emu* 61: 77–93.
Watkins, D. 1993. *RAOU Rep.* 90.
Wheeler, R. 1955. *Emu* 55: 279–95.
White, C.M.N. 1975. *Emu* 75: 37–9.

Sponsors: Mr R Blick, Ms BE Williams

Volume 3, Plate 13

Ruddy Turnstone *Arenaria interpres* (page 194)
1 Adult male breeding; **2** Adult female breeding; **3** Adult non-breeding; **4** Juvenile; **5, 6** Adult

Wilson's Phalarope *Steganopus tricolor* (page 348)
7 Adult male breeding; 8 Adult female breeding; **9** Adult non-breeding; **10** Juvenile; **11, 12** Adult