

## 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	pratinoles, coursers, and Egyptian Plover; c. 15 species, widespread in Old World.
Stercorariidae	skuas and jaegers; about seven species, mostly in Arctic and Antarctic regions.
Rhynchopidae	skimmers; three species, pantropical.
Laridae	gulls; c. 47 species, cosmopolitan.
Sternidae	terns; c. 42 species, cosmopolitan.
Alcidae	auks; c. 20 species, Arctic and temperate regions of n. hemisphere.

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

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

Because the Order comprises so many species and adaptations are so diverse, few characters shared by all species; those that are shared are mostly anatomical features of the skull, e.g. most or all have schizorhinal nostrils, schizognathous palates, well-developed vomer, lachrymals fused with ectethemoid and pre-frontal bones, well-developed supra-orbital grooves; see Olson & Steadman (1981) for more information on osteological characters. Wings usually have 11 primaries, with p10 longest and p11 minute; 15–24 secondaries; diastataxic except in *Scolopax minor*, as far as is known. Usually 12 tail-feathers. Necks usually rather long with 15–16 cervical vertebrae. Oil-gland bilobed and tufted. Syrinx, tracheo-bronchial; two carotids (type A-1 of Glenny 1955); caeca present. Legs usually rather long; hind toe small or lacking in most but all toes greatly elongated in Jacanidae. Feathers with small thin afterfeathers. Normally two moults annually: complete post-

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

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

#### 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, 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. 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 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.

## 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. Liedon.  
 —, *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*. Uitgeverij 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.

## 28 Gallinagoninae

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 PHALAROPODINAE phalaropes

Small (18–24 cm) swimming scolopacids, with distinctive breeding behaviour and migratory habits. Three species in two genera: (1) *Phalaropus*, with two species (Red-necked Phalarope *P. lobatus*, Grey Phalarope *P. fulicaria*) that breed in Arctic and Subarctic and migrate to pelagic non-breeding areas in Tropics and farther S; and (2) *Steganopus*, with single migratory species (Wilson's Phalarope *S. tricolor*) in New World. All recorded HANZAB region; Red-necked Phalarope a rare summer visitor, the other two accidental. Studies of osteology (Campbell 1979), allozymes (Dittman *et al.* 1989) and mitochondrial DNA (Dittman & Zink 1991) have shown *Steganopus* to be generically distinct. Structure, behaviour, appearance, reversed sexual dimorphism, moults and aquatic adaptations are unusual and rather uniform, so they have long been regarded as a 'natural' unit (BWP) and often treated as a full family. However, some analyses of allozymes and mitochondrial DNA suggest *Steganopus* is no more closely related to *Phalaropus* than to some Calidridinae or Tringinae, and monophyly of group remains unproven (Dittman *et al.* 1989; Dittman & Zink 1991; Rubega & Obst 1993). Despite uncertainties about affinities, studies of osteology and jaw musculature (Lowe 1931; Strauch 1978; Burton 1974), allozymes and mitochondrial DNA (Dittman *et al.* 1989; Dittman & Zink 1991; Sibley & Ahlquist 1990) show phalaropes are clearly scolopacids, as do patterns of downy young, which are very similar to those of sandpipers in tribe Tringini (Jehl 1968; Fjeldså 1977).

Neck, slender; head, small, with narrow forehead; musculature of jaw, weak but that of tongue well developed, especially in Grey Phalarope. Bill, straight and needle-like in Wilson's and Red-necked Phalaropes; in at least latter species, fine bill structure associated with feeding mechanism in which zooplankton transported rapidly from bill-tip to mouth by forces resulting from surface tension of water surrounding prey (Rubega & Obst 1993). Grey Phalarope may have different filter-feeding mechanism; bill is broader and a few well-developed papillae at inside tip of lower mandible probably act as strainers (Olson & Feduccia 1980). Bodies, slim and sandpiper-like; underparts more densely feathered than other scolopacids, presumably for improved waterproofing and buoyancy while swimming. Wings, narrow, pointed; flight low, fast, and direct. Swim readily and well (but do not dive), with structure of short legs and feet modified accordingly: tarsi are strongly laterally compressed and front toes are lobate, each broadly fringed by independent, scutellate webs (arrangement of scales and webs differs in each species). Anterior toes also have small basal webs; hindtoe relatively long, raised.

Sexual dimorphism reversed: females larger with more brightly coloured breeding plumage than males. Breeding plumage attained in partial pre-alternate moult and is highly decorative, with various combinations of rufous or maroon and white, black, grey, and buff, making females among the most colourful waders. Attain non-breeding plumage in complete pre-basic moult; plumage pale grey above, white below. Juvenile plumage distinct, with dark upperparts scaled buff, and white underparts often washed grey to orange-buff on foreneck and breast. Pre-basic moults (post-breeding and post-juvenile) occur earlier than in most scolopacids, often beginning near breeding grounds and well advanced by early stages of s. migration. Adult post-breeding moult usually starts earlier in females than males; genuine moult-migration reported in Wilson's Phalarope (q.v.; Jehl 1987). Down of precocial young, soft and silky; mainly rich buff above, grading to white on centre of underparts. Dorsal pattern similar to striped type of Tringinae, with three bold black bands on upperparts; most down-feathers have fine, deep purplish-grey terminal filaments (Fjeldså 1977).

Breed in open habitats, usually with some pools, lakes or other standing water nearby, from Arctic tundra (most Grey Phalaropes) and Subarctic (most Red-necked Phalaropes) to temperate prairies and taiga (Wilson's Phalarope). Wilson's Phalarope spends non-breeding season in inland wetlands of South America; non-breeding *Phalaropus*, tend to be strictly pelagic, spending non-breeding season at sea in tropical or subtropical waters where upwellings occur (though can occasionally occur on inland wetlands, especially during migration).

Characteristically feed while swimming, picking invertebrate prey from surface of water or just below it; when doing so in still water, often spin rapidly in tight circles, presumably to bring food into view or within reach (e.g. Höhn 1971). Wilson's Phalarope spins less often than *Phalaropus*, and feeds more while swimming directly or wading. When breeding, all three species have more diverse feeding behaviours and may also feed on land (e.g. Kistchinski & Chernov 1973; Höhn & Barron 1963; BWP).

### REFERENCES

- Burton, P.J.K. 1974. *Feeding and the Feeding Apparatus in Waders*. Br. Mus. Nat. Hist., Lond.
- Campbell Jr, K.E. 1979. *Contrib. R. Ontario Mus. Life Sci.* 118: 1–203.
- Dittman, D.L., & R.M. Zink. 1991. *Auk* 108: 771–9.
- , *et al.* 1989. *Auk* 106: 326–31.
- Fjeldså, J. 1977. *Guide to the Young of European Precocial Birds*. Skarv Nature Publs, Strandgården, Tisvildeleje.
- Flint, V.E. 1973. *Fauna I Ekologiya Kukilov*. 1.
- Höhn, E.O. 1971. *Ibis* 113: 335–48.
- , & J.R. Barron. 1963. *Can. J. Zool.* 41: 1171–3.
- Jehl Jr, J.R. 1968. *Mem. San Diego Soc. nat. Hist.* 3.

348 Phalaropodinae

— 1987. *Ornis scand.* 18: 173–8.

Kistchinski, A.A., & Y.I. Chernov. 1973. Pp 51–2 **In:** Flint 1973.

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

Olson, S.L., & A. Feduccia. 1980. *Smithson. Cont. Zool.* 316: 1–73.

Rubega, M.A., & B.S. Obst. 1993. *Auk* 110: 169–78.

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

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

MALES

FEMALES



*Phalaropus fulicarius* Grey Phalarope

COLOUR PLATE FACING PAGE 369

*Tringa fulicarius* Linnaeus, 1758, *Syst. Nat.*, ed. 10 (1): 148, based on the Red Coot-footed *Tringa* of Edwards, 1750, *Nat. Hist. Birds* 3: text for Pl. 142 — Hudson Bay.

The specific epithet combines the Latin *fulica* (a coot) and *-arius* (relating to), referring to the coot-like lobes on the feet.

OTHER ENGLISH NAMES Red Phalarope, Flat-nosed Phalarope.

## MONOTYPIC

**FIELD IDENTIFICATION** Length 20–22 cm; wingspan 37–40 cm; weight c. 56 g. Distinctive, rather tubby swimming wader with small head; slender neck; short, straight, thick and blunt bill (appearing broad and flattened when viewed from above); very short legs; and feet with broadly lobed toes. Between Red-necked *Phalaropus lobatus* and Wilson's *P. tricolor* Phalaropes in size, appearing bigger and bulkier than former, with bigger head and thicker neck, slightly longer and fuller tail, and longer and slightly broader wings; smaller than Wilson's, with bigger, more rounded head, shorter and thicker neck and much shorter legs. In flight, all plumages show bold white wing-bar and much white on underwing. Grey and Red-necked Phalaropes the only waders occurring regularly at sea. Mainly winter at sea in Tropics, but vagrants reported from coastal and inland wetlands or found beachcast. Sexes separable in breeding plumage; similar in non-breeding and juvenile plumages. Marked seasonal variation. Juvenile distinct; immatures separable.

**Description Adult female breeding** Head, neck and underbody, chestnut-red, with bold oval-shaped white patch round eye and brownish-black patch on chin and round base of bill, extending over crown and narrowly down hindneck; occasionally have some white feathers on belly. Upperparts appear boldly and evenly striped: mantle, back, scapulars and tertials, black, with buff edges to feathers; usually with clearer buff stripes along edges of mantle. Most of rump, grey; central uppertail-coverts, black, with some pale rufous at sides. Tail, dark grey, with central rectrices, black. Upperwing: innerwing-coverts, grey, with fine white fringes, grading to black along leading-edge; primary coverts, black, and remiges dark grey grading to black on outer primaries; white primary shafts and broad white tips of greater coverts form bold wing-bar tapering outwards; white tips of inner greater coverts often exposed on swimming birds, showing as bold white strip along edge of folded wing. Underwing, white, with narrow dark leading-edge to primary coverts and grey trailing-edge. With wear, buff fringes of upperparts fade. Bill, bright yellow with black tip. Iris, brown. Legs and feet vary from greyish olive with yellow lobes, to yellow. **Adult male breeding** Generally duller version of female breeding, but plumage varies from nearly as bright to much duller. Best distinguished by brown streaks and flecks on dark of lores, forehead and crown. Also by: usually smaller and more buffish-white area on sides of head (in some, just a white supercilium); darker buff striping on upperparts; more heavily striped mantle, often with broader, clearer and paler buff stripes along sides of mantle; typically have more white below, often with much white on belly and some on

chin, and scattered white spots elsewhere; bill slightly duller yellow, with more black on tip. **Adult non-breeding** Differ from adult breeding by: head and neck, white, with squarish or oval-shaped black patch from in front of eye to rear ear-coverts, bending slightly downwards over rear ear-coverts in some; and dark-grey or blackish-grey patch on nape, usually continuing in narrow line down hindneck to mantle. Mantle, scapulars and tertials plain, pale grey, finely scaled white when fresh. Underbody, white, except for pale-grey patch at sides of breast and smudgy grey streaking along flanks. Flight-pattern as breeding, except: back and rump, pale grey as rest of upperparts; sides of rump and uppertail-coverts, white. Bill, black, usually with yellow or yellowish-brown tinge at base. **Juvenile** Pattern similar to non-breeding, but differs by: whole crown, nape, centre of hindneck, mantle, scapulars and tertials, darker, blackish brown, with buffish-brown edges to feathers, broadest on sides of mantle where forming clear lines. Innerwing-coverts, duller and darker grey; central coverts narrowly fringed with white and inner coverts with buff, all with narrow dark submarginal lines and shafts. Underbody as non-breeding, but with strong pinkish-buff to buff-brown wash to face, sides of neck, foreneck and upper breast, which usually fade quickly to off-white. Flight-pattern as non-breeding, but with dark cap; buff-striped blackish saddle; darker back and rump, and darker line through central uppertail-coverts contrasting with white sides. With wear, buffish-brown fringes of cap lost, and fringes on upperparts fade and are partly abraded. Birds in full juvenile plumage unlikely to occur in HANZAB area. Bill, black, but soon acquires paler brownish or yellowish base, as in adult non-breeding; rest of bare parts as adult non-breeding. **First immatures** Like adult non-breeding, but separable till late austral spring by retained worn juvenile plumage, showing as scattered dark feathering on cap, hindneck and mantle, worn blackish tertials, and varying number of worn juvenile innerwing-coverts, contrasting with otherwise fresh first-immature non-breeding plumage (adults usually in full, fresh non-breeding plumage, excepting remiges, by mid-Sept.). Also, retained juvenile primaries rather fresh in first spring–summer (worn or moulting in adults). Subsequent moult strategies and appearance of first-year birds little known (see Ageing).

**Similar species** Grey distinguished from other phalaropes by short thick blunt bill, which appears broad and flattened in head-on view; and in non-breeding plumages, by small pale area at base of black bill; some juveniles also have obvious pale patch at base of bill (bill all black in other phalaropes). For full differences from **Red-necked Phalarope**, see that text. In

flight, in juveniles and non-breeding plumages (pale, with strong wing-bar) can be confused with **Sanderling** *Calidris alba*, from which distinguished by: dark patches on ear-coverts; grey patch on nape (non-breeding) or blackish cap (juveniles); larger wings, tubbier body and broader tail; and habit of alighting on water, often in flocks; also, whereas Sanderlings seen over water usually show purposeful, rapid, direct flight, **Grey Phalarope** has distinctive side-to-side jinking flight or may fly slowly and erratically while moving only short distances.

Gregarious except when breeding. In non-breeding season, found mainly in zones of plankton-rich upwelling of tropical and subtropical seas. Mostly seen singly or in small flocks, typically smaller than those of Red-necked Phalarope, but occasionally in flocks of thousands. Often congregate along convergence lines, edges of kelp beds, round surfacing cetaceans or at schools of surfacing fish. At other times, and especially when storm-blown, on wide variety of coastal and inland wetlands, and occasionally along beaches. Often associate with other birds at sea, sometimes with flocks of Red-necked Phalaropes; on land, with other waders, such as small calidrids. Usually very tame and approachable. Very active; normally seen swimming. Foraging and swimming behaviour, appearance while swimming, and general habits very similar to those of Red-necked Phalarope, but actions more confident; reported to swim with back more level and tail higher than Red-necked. When swimming, often spin rapidly, pecking outwards at food; sometimes up-end. When swimming or standing, wing-tips level with or fall slightly short of tip of tail; primary projection short to none in breeding adults, moderate in juveniles. Occasionally leave water and walk slowly along edge of water, pecking at surface with tip of bill; or run slowly and awkwardly on very short legs along beach or muddy shore. Flight similar to that of Red-necked Phalarope but more powerful and with slower wing-beats and, over long distances, steadier, less erratic progress. Not very vocal; normal contact and flight call a shrill *wit* or *pit*, very similar to call of Red-necked Phalarope but slightly higher pitched and more musical; alarm call, chirruping *zhit*.

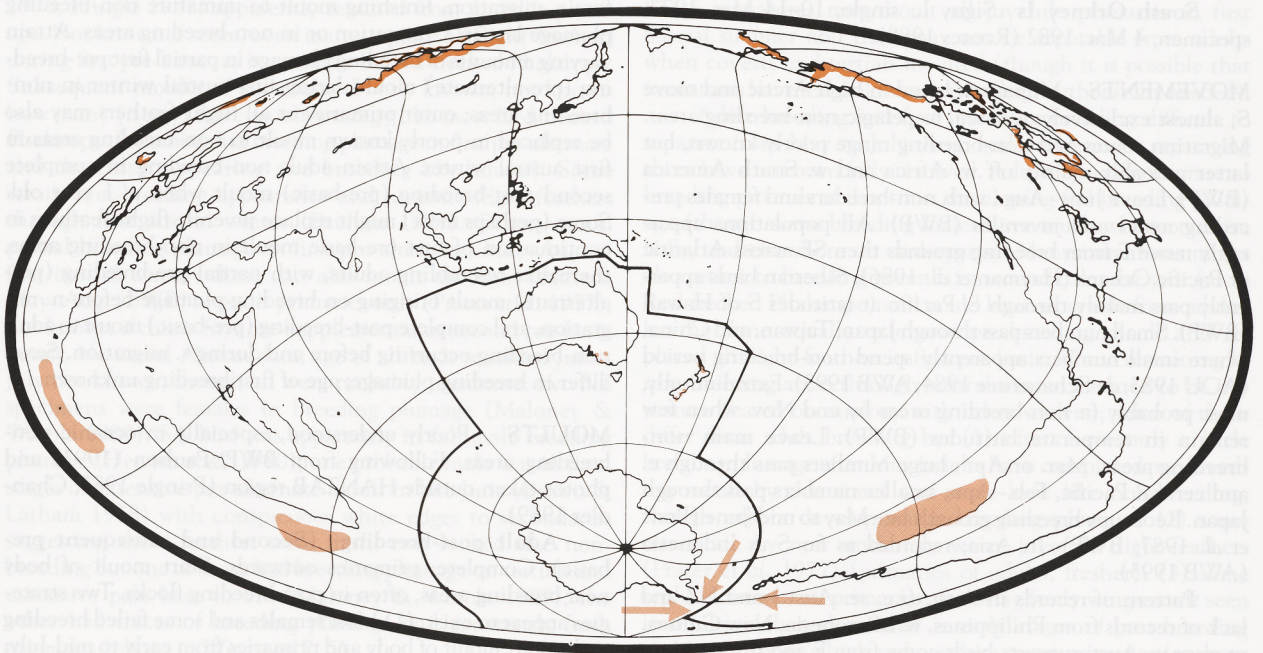
**HABITAT** In n. hemisphere, marshy, tussocky tundra and meadows. Occasionally round sewage farms and reservoirs. Avoid dense vegetation, and large bare areas. Leave breeding areas when lakes and shores freeze over; on return to breeding areas, wait at edge of sea-ice until wetlands thaw. Migration almost entirely over sea. Non-breeding period spent in offshore waters and open ocean at plankton-rich upwellings. Rarely inshore or inland (Bent 1962; Johnson 1965; Urban *et al.* 1986; Murphy; BWP).

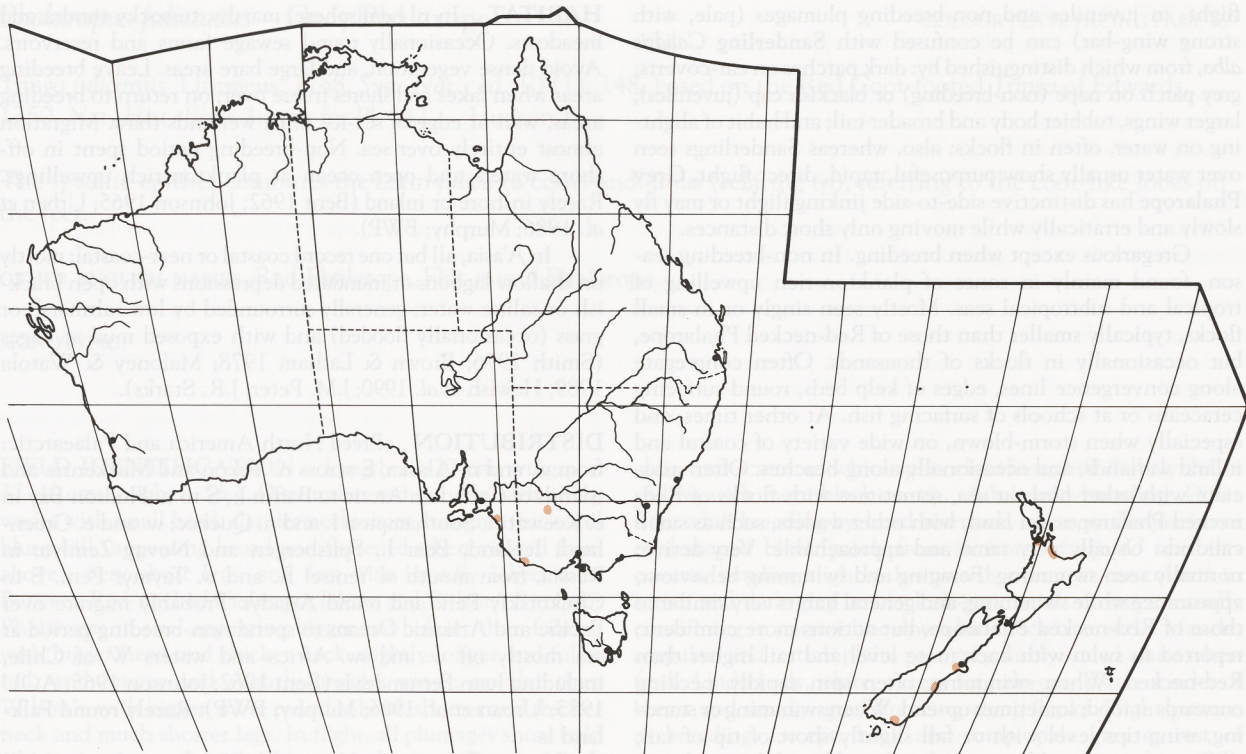
In A'asia, all but one record coastal or near-coastal; mostly on shallow lagoons or inundated depressions with open brackish or saline water; generally surrounded by low saltmarsh or grass (occasionally flooded) and with exposed mud at edges (Smith 1976; Brown & Latham 1978; Maloney & Watola 1989; Hewish *et al.* 1990; J.M. Peter; J.R. Starks).

**DISTRIBUTION** Breed North America and Palaearctic: from w. and n. Alaska, E across n. Yukon and Mackenzie and islands of Canadian Arctic to Baffin I., S to n. Hudson Bay in e. Keewatin, Southampton I. and n. Quebec; w. and e. Greenland; Iceland, Bear I., Spitsbergen and Novay Zemlya; in Russia, from mouth of Yenisei R. and w. Taymyr Pen., E to Chukotskiy Pen. and round Anadyr. Probably migrate over Pacific and Atlantic Oceans to spend non-breeding period at sea mostly off w. and sw. Africa and waters W of Chile, including Juan Fernandez Is (Bent 1962; Johnson 1965; AOU 1983; Urban *et al.* 1986; Murphy; BWP). Rarely round Falkland Is.

**Aust.** Four acceptable records (RAC or specimen), all singles: L. Woorinen, Vic., 22 Feb.–25 Mar. 1976 (Smith 1976); Magrath Flat, SA, 7–11 July 1989 (Hewish *et al.* 1990); beachcast, Discovery Bay, Vic., 30 May 1992 (Scofield 1992); Port Fairy, Vic., 12–15 July 1992 (Appleby *et al.* 1995). Unverified reports not submitted to the RAC (singles): L. Bolac, Vic., 1 Apr. 1986 (Vic. Bird Rep. 1986–87); Rottnest I., WA, 15 Oct. 1986 (Jaensch 1986); Eyre Bird Observatory, WA, 10 Sept. 1991 (Hunt 1991).

**NZ** Singles: L. Wainono (Waimate Lagoon), mid-June





1883 (Oliver), 21–22 June 1987 (Maloney & Watola 1989); L. Ellesmere, winter 1925 (Oliver); Hastings, early July 1934 (Oliver); mouth of Kaituna R., 19–25 June 1977 (Brown & Latham 1978); s. Manukau Harbour, 5–7 July 1992 (Onley 1992; RBC); Inch Clutha, 8–11 July 1993 (RBC).

**Antarctic Pen.** Specimen, off Anvers I., 12 Jan. 1970 (Riseborough *et al.* 1976).

**Prince Edward Is** Two, Marion I., 19 Jan. 1979 (Sinclair 1981; Gartshore 1987).

**South Orkney Is** Signy I.: single, 10–14 Mar. 1977; specimen, 4 Mar. 1982 (Rootes 1988).

**MOVEMENTS** Migratory; breed in high Arctic and move S, almost exclusively over sea, to pelagic non-breeding areas. Migration routes and non-breeding range poorly known, but latter probably mainly off w. Africa and w. South America (BWP). Leave June–Aug., with non-breeders and females preceding males and juveniles (BWP). All populations apparently move E from breeding grounds then SE across Atlantic or Pacific Oceans (Hayman *et al.* 1986); Siberian birds apparently pass mainly through e. Pacific at latitudes S of Hawaii (BWP). Small numbers pass through Japan, Taiwan, and China, where small numbers apparently spend non-breeding period (AOU 1983; de Schauensee 1984; AWB 1993). Extraliminally, most probably in non-breeding areas by end Nov. when few remain in temperate latitudes (BWP). Leave main non-breeding areas, Mar. or Apr.; large numbers pass through e. and central Pacific, Feb.–Apr.; smaller numbers pass through Japan. Reoccupy breeding grounds late May to mid-June (Pratt *et al.* 1987; BWP). In Asia, recorded as far S as Indonesia (AWB 1993).

Pattern of records in Aust. (i.e. se. Aust.) and NZ and lack of records from Philippines, w. Micronesia, New Guinea, or n. or w. Aust. suggests birds come from E and not via Asia

(Coates 1985; Pratt *et al.* 1987; AWB 1993; D. Onley). Most NZ and Aust. records are from breeding period (i.e. June–July); dated records from Prince Edward Is, South Orkney Is and Antarctic Pen. from non-breeding period.

**PLUMAGES** Prepared by R.P. Scofield and D.I. Rogers. Insufficient material in A'asian museums to provide full texts on plumages and related matters; see BWP for full details. Often begin post-juvenile (first pre-basic) moult of body before s. migration, finishing moult to immature non-breeding plumage late in s. migration or in non-breeding areas. Attain varying amounts of breeding plumage in partial first pre-breeding (pre-alternate) moult during first austral winter in non-breeding areas; outer primaries or all flight-feathers may also be replaced in poorly known moult in non-breeding areas in first austral winter. Attain adult non-breeding in complete second post-breeding (pre-basic) moult when c. 1 year old. Some (perhaps most) might replace juvenile flight-feathers in continuation of first pre-basic moult in non-breeding areas, thereafter resembling adults, with partial pre-breeding (pre-alternate) moult bringing on breeding plumage before n. migration, and complete post-breeding (pre-basic) moult to adult non-breeding occurring before and during s. migration. Sexes differ in breeding plumage; age of first breeding unknown.

**MOULTS** Poorly understood, especially in oceanic non-breeding areas. Following from BWP, Paulson (1993) and photos taken outside HANZAB region (Pringle 1987; Chandler 1989).

**Adult post-breeding** (Second and subsequent pre-basic). Complete; primaries outwards. Start moult of body near breeding areas, often in post-breeding flocks. Two strategies appear to exist. (1) Most females and some failed breeding males start moult of body and primaries from early to mid-July;

tail and secondaries begin from late Aug. to mid-Sept., when PMS 25; non-breeding appearance (except rump of some) attained when PMS 30–40, usually from late Aug. to mid-Sept., though a few in mostly grey plumage recorded in post-breeding flocks 15 July (Indigirka Delta) and 1 Aug. (New Siberian Is) (D.I. Rogers). Moulting either completed late Sept., before s. migration, or suspended with 1–3 retained outer primaries. (2) Some females and most males start moulting of body from late Aug. and migrate S with some non-breeding body-plumage, and old flight-feathers or with moulting of primaries suspended after only innermost feathers replaced. Rest of moulting occurs in non-breeding areas (or at least, after much of s. migration complete), some retaining traces of breeding plumage till Nov.; do not resume moulting of primaries till at least Nov., but moulting finished by Mar. Birds that migrate S with moulting of primaries suspended often show contrast between fresh inner and worn outer primaries on return to breeding grounds. **Adult pre-breeding** (Second and subsequent pre-alternate). Partial. Moulting head, body, tertials and, often, inner rectrices. Occurs mid-Mar. to early May, and usually complete before n. migration. BWP states that some complete moulting on breeding grounds and that others arrest moulting entirely; this does not accord with observations on n. migration (Paulson 1993). Confusion may have arisen because males tend to retain more white feathers in underparts than females; further, males with the most white ventral feathering may be in first immature breeding (Paulson 1993). **Post-juvenile** (First pre-basic). Partial in some, involving most or all feathers of body. Begins with scapulars soon after fledging, with many showing non-breeding feathers in upperparts on arrival off nw. USA in Aug.; apparently more gradual than body-moultings of adults, with many retaining juvenile cap and dark streaking on upperparts through Sept. and Oct. and some even retaining brown juvenile wash on foreneck till Oct. Date of completion not known; most have attained non-breeding appearance by late Oct.–Nov. (all by Dec.) but retain most juvenile tertials and coverts, though it is not clear whether these feathers replaced later in first pre-basic. In bird in Vic. in Mar., worn tertials among fresh non-breeding plumage (photos in Smith 1976, Pringle 1987) apparently retained from juvenile plumage. Not known if some, even many, replace all flight-feathers during first pre-basic, as is common in Red-necked Phalarope. **Subsequent moultings of subadults** Poorly known; not known how many (if any) have moulting-strategy like most Red-necked Phalaropes (attaining full breeding plumage in first pre-alternate and thereafter appearing and breeding like adults). Some retain non-breeding appearance and juvenile flight-feathers through first austral winter (Paulson 1993). Others attain partial breeding plumage in first pre-alternate, May–Aug. of first austral winter; these can also moulting all flight-feathers, May–Aug. (BWP) or outer primaries only (Prater *et al.* 1977); not known if this is first pre-supplemental or second pre-basic moulting. No useful A'sian data; age of all birds recorded June–July not known, though all were probably immature; two NZ specimens were females in breeding plumage (Maloney & Watola 1989); SA bird was apparently in full male breeding plumage (Hewish *et al.* 1990); one probable male was in final stages of extensive pre-alternate moulting in late June (Brown & Latham 1978) with conspicuous white edges to secondaries suggesting these feathers were fresh; two looked like non-breeding but one of these had breeding plumage on tertials and extensive pale base to bill (Maloney & Watola 1989), the other had traces of breeding plumage and apparently fresh primaries (photo in *Wingspan* 7: 5).

**MEASUREMENTS** (1–2) Throughout breeding range (wing only), North Atlantic breeding populations (other measurements), skins (combined data from BWP and MV): (1) Adults; (2) Juveniles; (3) Ages combined.

	MALES	FEMALES	
WING	(1) 129.0 (2.61; 124–135; 70) (2) 128 (2.89; 124–130; 9)	136.8 (3.33; 130–143; 57) 134 (5.59; 127–141; 8)	** *
TAIL	(3) 61.7 (2.12; 57–65; 15)	66.2 (4.14; 59–74; 19)	**
BILL	(3) 21.8 (1.12; 19–23.7; 14)	22.7 (1.39; 21–24; 19)	*
TARSUS	(3) 21.6 (0.64; 21–23; 15)	21.8 (1.11; 21–23; 19)	ns
TOE	(3) 22.6 (0.91; 22–24; 6)	22.3 (1.15; 21–24.7; 15)	ns

Juveniles not significantly different from adult except in length of wing of females. Additional measurements in Prater *et al.* (1977) and Murphy.

**WEIGHTS** Arctic migrants, late May to early June: males 42.4 (5.26; 37–50; 4); females 57.1 (7.09; 51–66; 4) (BWP). NE. Siberia, breeding adults, boreal summer: males 50.8 (4.37; 41–69; 69); females 61.0 (5.36; 49–73; 51) (Kistchinski 1975). Females significantly heavier ( $P < 0.01$ ) than males.

**AGEING** From Nov. to Mar.–Apr., first immature non-breeding can usually be distinguished from non-breeding adult by: (1) at least some retained, moderately worn juvenile tertials, which are dull black with narrow off-white fringes (adults usually only have fresh, grey non-breeding tertials; any retained breeding tertials, though coloured like those of juvenile, very worn); (2) some retained, dull black juvenile innerwing-coverts, with narrow pale fringes mostly lost, except for white tips to greater coverts and remnant buff tips of some innermost feathers (which are slightly lanceolate when worn) (in adult, coverts, fresh, grey, with narrow but distinct white fringes); (3) retained juvenile primaries of immatures, moderately and uniformly worn (primaries of adults moulting or fresh, often with outer primaries noticeably fresher than inner primaries because moulting was suspended on s. migration). Some immatures may moulting all juvenile primaries in first austral summer and then may not be separable from adults when coverts and tertials moulting (though it is possible that immatures have less yellow on base of bill; further study needed).

Adult breeding and first immature breeding difficult to separate from May to July–Aug. and problems in separating them have not been fully resolved. Adults typically migrate to breeding grounds at this time, developing full breeding plumage (though some breeding males have much white on chin, belly, and elsewhere on underparts). Many immatures might also return to breeding grounds in second calendar year (as in Red-necked Phalarope) and could be inseparable from adults, having done equally extensive pre-breeding moulting and replaced all flight-feathers in first pre-basic. Those remaining in non-breeding areas through austral winter assumed to be immature (based on analogy with other waders); some of these differ from adult breeding by: (1) often have only a little breeding plumage after May (adults have completed pre-breeding moulting by this time) and some look like non-breeding, though others develop much breeding plumage; (2) some retain all, by now uniformly worn, juvenile flight-feathers (Prater *et al.* 1977) (primaries of adults, fresher); (3) some replace outer or all primaries after May (only wing-moulting seen in adults in boreal summer is early stages of post-breeding moulting); in those which only replace outer primaries (perhaps

mostly females; Prater *et al.* 1977) there is likely to be a strong contrast between very worn juvenile inner primaries and fresh outer primaries, much more striking than the contrast seen in those adults that suspended moult of primaries in previous s. migration.

**GEOGRAPHICAL VARIATION** None.

#### REFERENCES

- AOU. 1983. *Check-list of North American Birds*. Am. Orn. Union, Lawrence, Kansas.
- Appleby, G., *et al.* 1995. *Aust. Bird Watcher* 16: 34–8.
- AWB. 1993. *A Status Overview of Shorebirds in the East Asia–Australasian Flyway*. Asian Wetland Bureau Internal Rep. 2.
- Bent, A.C. 1962. *Life Histories of North American Shore Birds*. Dover Publ's, New York.
- Brown, B., & P.C.M. Latham. 1978. *Notornis* 25: 198–202.
- Chandler, R.J. 1989. *The Macmillian Field Guide to North Atlantic Shorebirds*. Macmillan, Lond.
- Coates, B.J. 1985. *The Birds of Papua New Guinea*. 1. Dove, Alderley, Qld.
- de Schauensee, R.M. 1984. *The Birds of China*. OUP, Oxford.
- Gartshore, N.A. 1987. *Cormorant* 15: 48–58.
- Hayman, P., *et al.* 1986. *Shorebirds*. Croom Helm, Lond.
- Hewish, M.J., *et al.* 1990. *S. Aust. Orn.* 31: 23–5.
- Hunt, T. 1991. *West. Aust. Bird Notes* 60: 10.
- Jaensch, R.P. 1986. *West. Aust. Bird Notes* 40: 2–3.
- Johnson, A.W. 1965. *The Birds of Chile and Adjacent Regions of Argentina, Bolivia and Peru*. Platt Establecimientos Graficos, Buenos Aires.
- Kistchinski, A.A. 1975. *Ibis* 117: 285–301.
- Maloney, R., & G. Watola. 1989. *Notornis* 36: 88.
- Onley, D. 1992. *OSNZ News* 64: 9–10.
- Paulson, D. 1993. *Shorebirds of the Pacific Northwest*. Univ. Washington Press, Lond.
- Prater, A.J., *et al.* 1977. *Br. Trust Orn. Guide* 17.
- Pratt, H.D., *et al.* 1987. *A Field Guide to the Birds of Hawaii and the Tropical Pacific*. Princeton Univ. Press, Princeton.
- Pringle, J.D. 1987. *The Shorebirds of Australia*. Angus & Robertson, Sydney.
- Riseborough, R.W., *et al.* 1976. *Antarct. J. US* 11: 226.
- Rootes, D.M. 1988. *Br. Antarct. Surv. Bull.* 80: 87–119.
- Scofield, P. 1992. *Wingspan* 7: 18.
- Sinclair, J.C. 1981. *Ardea* 69: 217–18.
- Smith, F.T.H. 1976. *Aust. Bird Watcher* 6: 292–9.
- Urban, E.K., *et al.* 1986. *The Birds of Africa*. 2. Academic Press, Lond.



Volume 3, Plate 22

Red-necked Phalarope *Phalaropus lobatus* (page 352)

1 Adult male breeding; 2 Adult female breeding; 3 Adult non-breeding; 4 Juvenile; 5 First immature non-breeding; 6, 7 Adult

Grey Phalarope *Phalaropus fulicaria* (page 360)

8 Adult male breeding; 9 Adult female breeding; 10 Adult non-breeding; 11 Juvenile; 12, 13 Adult