

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

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

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

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

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

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

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Order CHARADRIIFORMES

Family SCOLOPACIDAE sandpipers and allies

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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Subfamily GALLINAGONINAE snipes

Small to medium-sized (17–33 cm) skulking, marsh-dwelling waders, with very long bills. About 18 species in three genera: (1) *Coenocorypha*, comprising two sedentary species of subantarctic NZ islands (NZCL), though specific recognition of some forms probably warranted (see those accounts); (2) *Limnocyptes*, single migratory species of Palaearctic; and (3) *Gallinago*, comprising c. 15 species, including three in HANZAB region (one regular non-breeding migrant and two accidentals); mostly migratory, breeding in Palaearctic, but with more sedentary species in Africa and South America. Genus *Gallinago* referred to as *Capella* in much early literature, and three South American species sometimes placed in separate genus *Chubbia*. Dowitchers often included in Gallinagoninae but treated in separate subfamily here (*Limnodrominae*, q.v.). Snipes sometimes combined with woodcocks in *Scolopacinae*, but kept separate here based on differences in downy young and dorsal vertebrae (Jehl 1968; BWP). Anatomy, downy young, internal feeding apparatus and studies of DNA hybridization suggest closest living relatives are *Scolopacinae* or *Calidridinae* (e.g. Jehl 1968; Burton 1974; Fjeldså 1977; Strauch 1978; Sibley & Ahlquist 1990) but conclusive biochemical and DNA studies needed.

Bill, long, usually straight but slightly decurved in some (especially *Coenocorypha*); tip, sensitive, with many Herbst's corpuscles; highly rhyndokinetic. Like woodcocks, have suborbital bar in skull, giving head rigid appearance, with eyes set higher and farther back than in most *Scolopacidae*; thus have very broad field of vision. Differ from woodcocks in having six unfused dorsal vertebrae (woodcocks have five unfused vertebrae and two fixed vertebrae in rigid *os notarium*) and larger pre-acetabular part of pelvis, giving horizontal crouching stance. Wings somewhat shorter and broader than in most *Scolopacidae*; fly strongly and most have explosive take-off and characteristic zigzagging flight when flushed. Tail, rather short; usually 14–28 rectrices in *Gallinago*, 12 in *Limnocyptes*, 14 in *Coenocorypha*. Outer rectrices usually stiff and strong; often also narrow. In most species they are splayed almost at right angles during display flights and their vibrations thought responsible for loud and species-specific drumming, whinnying or even fizzing noises that characterize such displays. However, mechanisms for production of such non-vocal sounds only known in a few species (Tuck 1972; Reddig 1978; Byrkjedal 1990; see account for Latham's Snipe *Gallinago hardwickii*). Non-vocal sounds of *Gallinago* snipe appear to differ structurally from those of Chatham Island Snipe *Coenocorypha pusilla* (q.v.). Legs and toes, moderately long; toes, unwebbed; hallux, short and raised.

Sexes similar, though females slightly larger and longer-billed (not *Limnocyptes* and *Coenocorypha*). Adult plumages, cryptic, intricately patterned in various shades of buff, brown and black; many species (especially *Gallinago*) have bold buff or rufous lines on scapulars and mantle, dark axillaries and underwing-coverts barred white, and large rufous patches on central rectrices. At least some species have partial pre-breeding moult, but none has seasonal changes in appearance of plumage. Juveniles very similar to adults, sometimes indistinguishable; moults of subadults poorly known and immatures not usually separable from adults after post-juvenile (first pre-basic) moult finished (e.g. Tuck 1972; Sæther et al. 1994; BWP; this volume). Downy young of most species, mainly dark chestnut-brown above and below; upperparts have black stripes overlain by small white powder-puffs, which are densely packed, short white barbules at tips of feathers. Unlike *Calidridinae*, powder-puffs do not tangle together, and are aligned in straight lines along back, rather than forming hour-glass pattern; number and density of powder-puffs varies much between species (Jehl 1968; Fjeldså 1977).

Typically birds of marshy habitats, with soft muddy soil and dense low vegetation, such as sedges and herbs; some species use dry moorlands and heathlands (including tundra) and several species use more forested habitats than any other waders other than woodcocks. Feed mostly on invertebrate prey, which is located by touch when probing; also pick invertebrates, seeds and other food from surface. Range from highly migratory (e.g. the three *Gallinago* species reaching Aust.) to sedentary (e.g. *Coenocorypha*).

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Coenocorypha pusilla **Chatham Island Snipe**

COLOUR PLATE FACING PAGE 65

Gallinago pusilla Buller, 1869, *Ibis* (2) 5: 41 — small rocky islet off Chatham Island.

The generic name is compounded from the Latin *coenum*, an incorrect form of *caenum* for mud or mire and *coryphaeus*, a leader (from the Greek, κορυφαίος, chief); the original specimens were obtained from a grassy bog. *Pusilla* (very small) refers to the small size of this species, compared with New Zealand Snipe *C. aucklandica*.

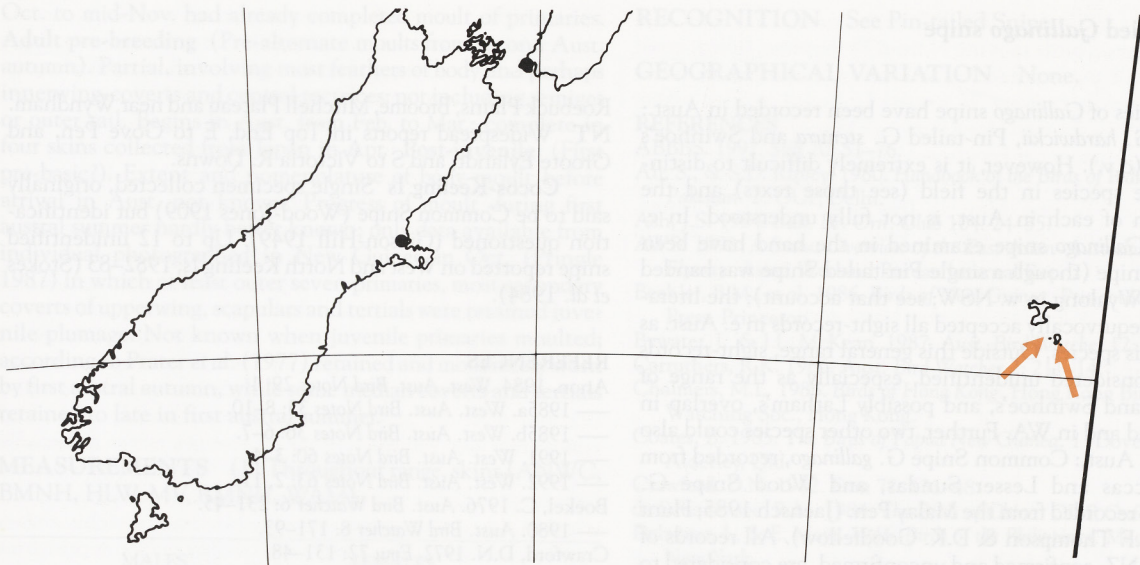
OTHER ENGLISH NAMES Little or Bush Snipe (see also New Zealand Snipe, with which often lumped).

MONOTYPIC

FIELD IDENTIFICATION Length 19–20 cm; wingspan 28–30 cm; weight: male 75 g, female 85 g. Small chunky snipe with long bill and short neck, wings, tail and legs. Confiding, though cryptically patterned and easily overlooked. Smaller than New Zealand Snipe *C. aucklandica* with much shorter bill; much smaller and stockier than *Gallinago* snipes. Females generally larger than males, with longer bills; difficult to distinguish in field. No seasonal changes. Juveniles separable.

Description Adult Crown, mottled brown and black, with indistinct buff stripe from top of crown to nape; narrow

black line extends from bill to eye, contrasting with pale-buff supercilium; fine buff eye-ring; cheeks, buff, with blackish spots and dark smudge on lower ear-coverts; chin, buff-white, with a few dark-brown streaks; nape and shoulders mottled buff and dark brown. Colour of upperparts varies; generally: wing-coverts, mantle and scapulars, rufous-brown, mottled black and with indistinct buff stripes; remiges and greater primary coverts, plain brown with fine buff leading-edge and tip. Back, rump and uppertail-coverts, rather uniform rufous-brown or with faint dark bars; coverts as long as rectrices.



Throat and breast, buff-white with heavy rufous-brown and blackish-brown streaks, forming indistinct gorget above clean buff-white abdomen; flanks, buff. Bill, pale pinkish-brown at base grading to grey and to black at tip. Iris, dark brown. Legs and feet, pale yellow but varying from grey with pink tinge to pale yellow-brown. **Juvenile** Like adult but duller and plainer, grey-brown; black blotches and buff edges to scapulars and wing-coverts much reduced; remiges have more extensive mottling along edges than in adult but of little use in field. Bill, more uniform pale-grey. Legs and feet, grey.

Similar species Unlikely to be confused with other species. Range of **New Zealand Snipe** does not overlap. **Latham's Snipe** *Gallinago hardwickii* has not been recorded from Chatham Is; it is much larger though more slender, with much longer bill, neck, wings and legs.

Sedentary; confined to Chatham Is. Occur singly; seen in twos during courtship or with chicks. Occur in forest, particularly among *Carex* sedges; less commonly in rank grass and bracken away from forest. Active day and night; often feed in open areas at night. Feed by probing, often using full length of bill; probe continually while walking except when disturbed or during interactions with other Snipe. Can run quickly, keeping to areas of dense cover. Adults disturbed while incubating or caring for young chicks sometimes face intruder and beat wings on ground while calling loudly. Flush more readily than do New Zealand Snipe, especially at night; rise vertically with whirring wings then fly towards cover (up to 70 m in open); do not call when flushed. Perform loud nocturnal aerial displays. Most frequent call is clear *terrk terrk terrk* or *queeyoo queeyoo queeyoo* or both, given day and night; also loud strident *chep* mainly at night.

HABITAT Information supplied by C.M. Miskelly. Occur from supralittoral fringe to summits of islands, up to 287 m asl. Most abundant in remnant forest of *Olearia traversi* and *Plagianthus regius*, especially among *Carex trifida* sedge; less numerous in rank introduced pasture grasses and bracken. On South East I., preferred nest-sites under *Carex*; occasionally under clumps of blackberry *Rubus fruticosus* or Yorkshire Fog Grass *Holcus lanatus* and bracken (Miskelly 1989). During day, usually seen probing in leaf-litter on forest floor. Often seen

among low exposed vegetation between forest and shore at night (C.M. Miskelly).

DISTRIBUTION AND POPULATION Information supplied by C.M. Miskelly. Endemic to Chatham Is. Between c. 1900 and 1970, confined to South East I.; formerly on Chatham (subfossils), Pitt and Mangere Is (to late nineteenth century). Reintroduced to Mangere I. in 1970 and 1972 (Bell 1974; Miskelly 1987a), where they have thrived. Also reported from Little Mangere I. (Miskelly 1990a), and Round I., Star Keys (first reported Nov. 1974). Single records from Glory Bay and n. Pitt I. in July 1986 (R.G. Chappell) may be birds that had flown from South East I. and Star Keys respectively (C.M. Miskelly).

Status Considered stable, but vulnerable to introduction of rats, cats or Weka *Gallirallus australis*, all of which are present on nearby islands (C.M. Miskelly). **Population** Conservatively 900–1100 pairs: South East I., 700–800 pairs, at densities of c. 5.6 pairs/ha under forest, and at c. 2 pairs/ha in open areas of introduced grasses, bracken and sedges. Possibly 200–250 pairs on Mangere I. and less than 50 pairs on Little Mangere I. and Star Keys (Miskelly 1990b; C.M. Miskelly). Probably exterminated by Feral Cats on Pitt and Mangere Is in the 1890s. Scarce on South East I. before removal of stock in 1961 (Bell 1955), probably as a result of loss of ground-cover through overgrazing and burning. South East and Mangere Is are now reserves and all introduced mammals have died out or been removed.

MOVEMENTS Sedentary. No evidence for regular movements within or between islands of Chatham Grp. May have flown 300 m from Mangere I. to Little Mangere I., and 2.5 km from South East I. to Pitt I. (Miskelly 1990a). Few band-recoveries, all within 200 m of banding site (C.M. Miskelly).

FOOD Information from C.M. Miskelly. Carnivorous. Soil-dwelling invertebrates especially earthworms, amphipods, adult beetles, and larvae and pupae of beetles and flies. **Behaviour** Diurnal and nocturnal; most active in early morning and at night; no quantified data. Feed almost entirely by probing soil and compacted vegetation. Twice observed picking prey

directly from surface of ground. Probe continuously during feeding bouts, often partially inserting bill then pausing to detect prey (C.M. Miskelly). Cock head to one side to listen for prey (Fleming 1939). In soft soil, probe to full length of bill. Swallow while probing; most prey swallowed without taking bill from soil. Mandibles and tongue, long and slender; tip of upper mandible overlaps lower. Can manipulate prey within soil using pliable mandibles. Distal end of upper mandible thought to contain Herbst's corpuscles, which are used to detect movement of prey within soil (C.M. Miskelly).

Adult On **South East I.** (seven faeces, Dec. 1983–Jan. 1984; C.M. Miskelly): Annelids: oligochaetes 57% freq. Crustaceans: amphipods 86. Insects: Coleoptera: Elateridae larv. 43; Diptera larv. 14.

Young As adult. Fed entirely by parent for first 17 days then partly by parent for at least another 12 days (Miskelly 1990b). On **South East I.** (five droppings, Nov. 1983–Jan. 1984; C.M. Miskelly): Crustaceans: amphipods 100% freq. Annelids: oligochaetes 40; Arachnids: spiders 20; mites 40. Insects: Coleoptera: ads 40; Diptera larv. 40. On **South East I.** (one gizzard, independent male, 13 Dec. 1983; C.M. Miskelly): Plants: Cyperaceae *Carex* sds 4. Animals: Annelids: oligochaete setae tr. Insects: Phthiraptera: *Quadriceps coenocoryphae* 1; 27 pieces of grit.

SOCIAL ORGANIZATION Not well known; studied on South East I. (Miskelly 1990b); account based on contribution by C.M. Miskelly. Solitary or in pairs of male and female or parent and chick. Pairs together during courtship, then each member cares independently for single chick. Do not flock.

Bonds Monogamous (n=10 pairs; Miskelly 1990b). Sex-ratio recorded in one season, 1:1. Members of pairs consort almost continuously before incubation; pair-bonds break down at hatching but re-form later in breeding season if both chicks die or when chicks become independent. However, no pairs seen during 9 days in middle of non-breeding season (Miskelly 1990b). **Parental care** Only male defends territory. Members of pair select nest-site and rearrange nesting material during incubation (building of nest not observed); both share incubation. Each parent raises one chick; two adults never seen to care for same chick (Miskelly 1990b), though one observation of two adults with three recently hatched chicks (H.A. Robertson). Chick does not interact with sibling or other parent; can fly by c. 21 days but stays with parent until 41 days old (5; 33–47; 12) (Miskelly 1990b). Also see Breeding.

Breeding dispersion Nest solitarily in territories. On South East I., occur at densities of c. 5.6 breeding pairs/ha under forest and at c. 2.0 pairs/ha in open areas, mainly introduced grasses, bracken and sedge *Carex* (Miskelly 1990b).

Territories All forested areas on South East I. divided into contiguous non-overlapping nesting territories of c. 0.18 ha. Main function of territory is defence of mate by male; female does not defend territory. During day, foraging confined to territory but at night sometimes forage outside territories, particularly along coastal fringe and edges of forest. Defence of territory stops at hatching and adults with dependent young often forage beyond boundaries of previously held territory. Defend territories in July (non-breeding season) but little response to play-back of taped calls compared to breeding season.

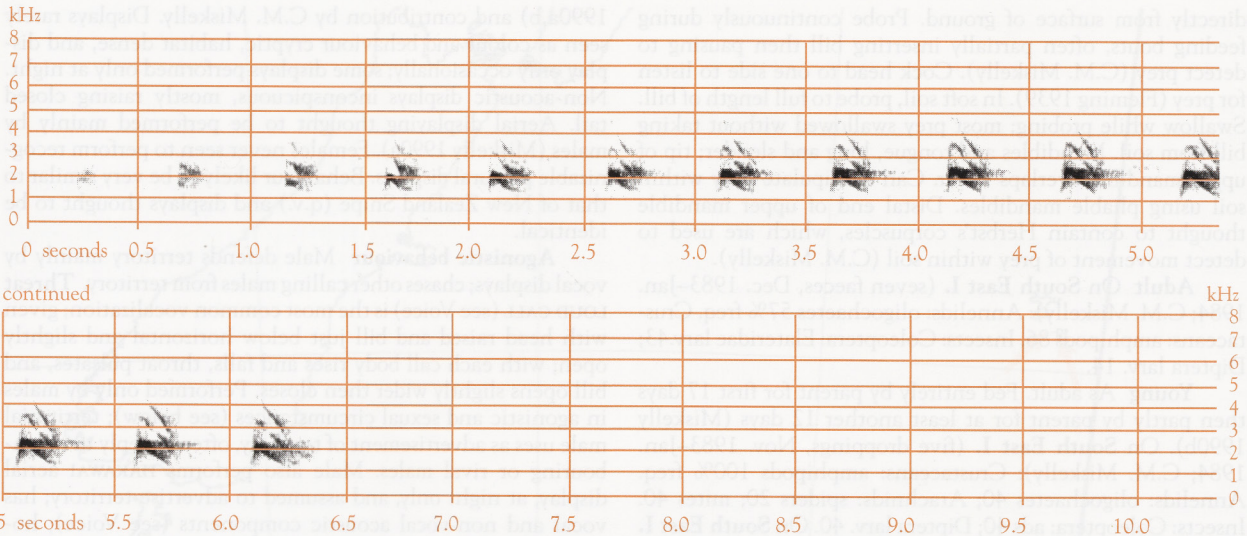
Roosting Active day and night.

SOCIAL BEHAVIOUR No detailed studies; account based on observations on South East I. (Miskelly 1984, 1987b, 1989,

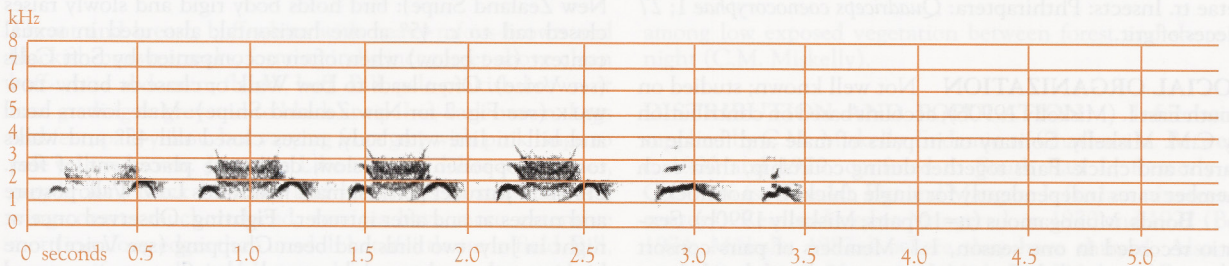
1990a,b) and contribution by C.M. Miskelly. Displays rarely seen as colour and behaviour cryptic, habitat dense, and display only occasionally; some displays performed only at night. Non-acoustic displays inconspicuous, mostly raising closed tail. Aerial displaying thought to be performed mainly by males (Miskelly 1990a). Females never seen to perform recognizable postural displays. Behaviour likely to be very similar to that of New Zealand Snipe (q.v.) and displays thought to be identical.

Agonistic behaviour Male defends territory mainly by vocal displays; chases other calling males from territory. **Threat** LOUD CALL (see Voice) is the most common vocalization; given with head raised and bill just below horizontal and slightly open; with each call body rises and falls, throat pulsates, and bill opens slightly wider then closes. Performed only by males in agonistic and sexual circumstances (see below); territorial male uses as advertisement of territory, often in reply to neighbouring or rival males. Male also performs HAWKAWAI aerial display, at night only, and assumed to advertise territory; has vocal and non-vocal acoustic components (see Voice); homologous to drumming-flight of *Gallinago* snipes. Most common aggressive display is PARTIALLY RAISED TAIL (see Fig. 1 for New Zealand Snipe): bird holds body rigid and slowly raises closed tail to c. 45° above horizontal; also used in sexual context (see below) when often accompanied by Soft Calls (see Voice). Often leads to Low Walk or chase or both. LOW WALK (see Fig. 2 for New Zealand Snipe): Male lowers head and bill in line with body, raises closed tail 45° and walks towards opponent with slow, deliberate placement of feet. CHASE: If intruder persists, male maintains Low Walk posture and rushes at and after intruder. **Fighting** Observed once at night in July: two birds had been Chepping (see Voice); one bird jumped on other and they tangled briefly; aggressor stayed and Chepped as other bird fled (J.R. Waas). **Appeasement**, **Escape** No displays noted. Bird flees from aggressor and becomes silent. **Alarm** Usually run to dense cover. If in open, crouch and freeze, or shuffle slowly toward cover. During daylight, stay under forest or among dense tussock-grass (Miskelly 1990a). Difficult to flush, though do so more readily than New Zealand Snipe, especially at night; males flush more often than females. When flushed, rise vertically with whirring wings and fly close to ground for 5–70 m towards cover; do not call.

Sexual behaviour **Advertising** Main display is Loud Call (see above) given by territorial males; females sometimes reply with Chur (see Voice). Males stop Loud Calling at or soon after hatching. No recognized difference between Loud Call displays given as advertisement or as threat. During courtship, pairs keep in close contact; male Loud Calls if female lost from sight, and female moves toward male or, if female replies with Chur, both may move towards each other. When male within 0.5 m of female he sometimes gives Partially Raised Tail (see Fig. 1 for New Zealand Snipe) with closed tail raised c. 45° and accompanied by Soft Call (see Voice). No display noticed for female. Pair may inspect potential nesting sites, where both give Soft Calls. **Courtship feeding** Male twice seen to pass food to female. One pair had just copulated, and other pair had two newly independent young. Food passed as in New Zealand Snipe (Miskelly 1990b). **Copulation** Observed once, Nov.: male performed Loud Call then approached female with Partially Raised Tail while giving Soft Calls, then began to HIGH STRUT, lifting legs above horizontal with each step and fluttering wings; female crouched, partially raised closed wings, and raised closed tail; male mounted from



A P.J. Fullagar; South East I., Chatham Is, NZ, Jan. 1974 (X039)



B R.J. Nilsson; South East I., Chatham Is, NZ, Nov. 1988

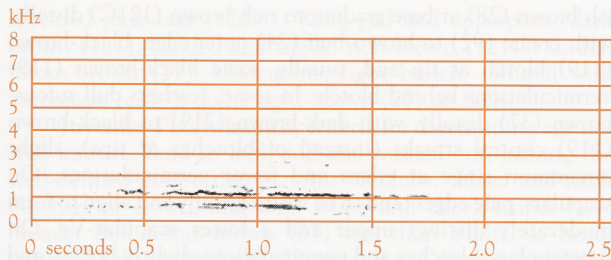
behind, gripping female's nape with tip of bill, and fluttering wings to maintain balance; male stayed on female for 45 s. Immediately after copulation, both birds preened; courtship feeding once observed after Copulation (Miskelly 1990b).

Relations within family group Each parent cares for one chick independently of mate: male takes first chick to leave nest, female cares for other (n=5; Miskelly 1990b). Brooding observed only on day of hatching. At first, each chick fed by attendant parent; first probing by chick seen at 18 days; partly fed by parent until at least 29 days (Miskelly 1990b). Chick stays close to parent; adult removes prey from soil and holds it 2–3 cm above ground, chick then moves forward and takes food from tip of parent's bill; adult does not carry food to chick or turn towards it. Adult and chick maintain contact with Soft Calls by parent and quiet twittering by chick; if chick separated from parent it gives loud Chick Call until reunited with parent (see Voice). Siblings do not interact. **Anti-predator responses of young** Young able to hide effectively, pushing among dense foliage or running down burrows of petrels; remain hidden until danger has passed and parent approaches giving Soft Call. **Parental anti-predator strategies** **Distraction displays** If disturbed suddenly on nest or with young chicks, adults face intruder and give Distress Call (see Voice); may also beat slightly flexed wings on ground at c. 2 beats/s. Do not attempt to lead intruder away from nest or chick. Adults approached too closely by people may **DISTRACTION PROBE**: rapid shallow probing of ground not accompanied by swallowing. No alarm call recognized but some adults give Distress Call or Chep while

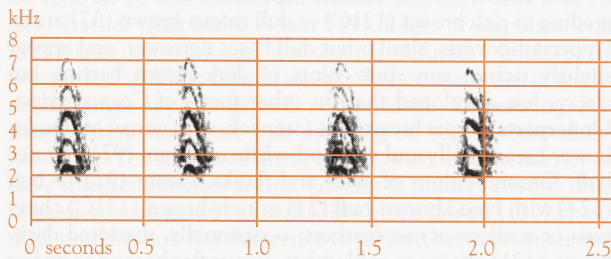
young chicks being handled (see Voice). Chicks stay with adults for c. 6 weeks.

VOICE No detailed studies; described by Fleming (1939) and sonagrams in Miskelly (1987b, 1990a); account based on information supplied by C.M. Miskelly and additional sonographic analyses (P.J. Fullagar). Most conspicuous call is Loud Call of territorial males: series of vibrant monosyllabic notes, often building to repeated disyllabic whistles; females call less often. Loud Calls heard throughout day in breeding season, but most often at dusk and on moonlit nights. Several calls made by both sexes; Loud Call and Hakawai given only by male, and Chur given only by female. Syllables of Loud Call of Chatham Island Snipe and subspecies of New Zealand Snipe (*meinertzhagenae*, *aucklandica* and *huegeli*) similar; call of subspecies *huegeli* has least structural clarity (P.J. Fullagar). Males give a nocturnal acoustic aerial display (Hakawai) that includes non-vocal drumming.

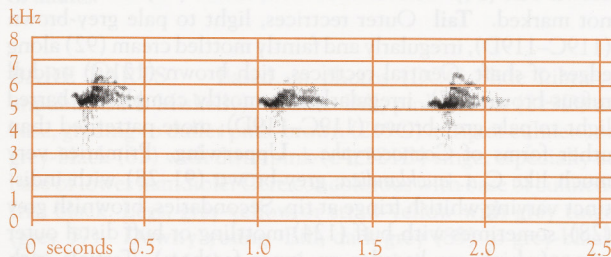
Adult male LOUD CALL: series of 5–15 monosyllabic notes, *trerk trerk trerk...*; each note 0.11–0.17 s long and uttered at c. 2.5 notes/s; (sonagram A). Sometimes preceded by soft low sibilant *chirrup*s, audible at close range (Fleming 1939); introductory notes resemble poorly formed versions of final call. The monosyllabic notes of the full call often build to a crescendo, then switch to a tuneful disyllabic whistle, *queeyoo queeyoo* (sonagram B), repeated 4–8 times at a rate of c. 2 notes/s; these notes may be followed by about four monosyllabic notes. Each disyllabic whistle lasts c. 0.4 s. **HAKAWAI**: aerial display begins with a series of about five disyllabic whistles (as in Loud Call)



C R.J. Nilsson; South East I., Chatham Is, NZ, Nov. 1988



D C.M. Miskelly; South East I., Chatham Is, NZ, July 1986



E C.M. Miskelly; South East I., Chatham Is, NZ, Jan. 1984

followed by a loud non-vocal roar, similar to the sound of a distant jet passing, and lasting c. 1.5 s. The non-vocal component (sonagram C) has a frequency range of 250 Hz–1.5 kHz and is thought to be produced by vibrating rectrices as the bird dives at speed; considered homologous with drumming or bleating of *Gallinago snipes* (Miskelly 1987b, 1990a; BWP). Often give 4–8 *queeyoo* calls while flying, without accompanying non-vocal roar (Miskelly 1990a). In small sample (n=11 calls), calls commonly have several tones, particularly at c. 400, 800, and 1.2 kHz, suggesting a harmonic series. However, the tones may be caused by independent vibrators because additional tones are evident in some sonagrams (six in one example). The tones are intermittent with some weak traces up to 2.8 kHz. Comparison with drumming of *Gallinago snipes* suggests drumming differs structurally (e.g. see sonagrams of *Gallinago gallinago*: Fig. 1, BWP; Fig. 7D, Glutz von Blotzheim *et al.* [1977]). **SOFT CALL:** soft throaty *chur chur* or *churr churr* given by male as he approaches female during courtship. Given by both sexes during change-over at nest and when tending young chicks; can be barely audible. Male sometimes begins Loud Call with series of Soft Calls. **THREAT:** give Loud Call with Partially Raised Tail when in sight of opponent. **DISTRESS CALL:** (see sonagram B, New Zealand Snipe), a plaintive *nyerr* given by either sex when disturbed on nest or with a young chick; each call c. 0.2 s long; frequency range, 1–4 kHz (main energy in three harmonics at 1–3 kHz), repeated about every 1.3 s. May punctuate Distress Call with audible beating of wings on ground. Adults occasionally call when

handled. **CHEP:** strident *chep* or *yip* given continuously every 0.8 s (sonagram D), or as irregularly spaced single calls. Frequency range, 2–7 kHz (main energy 2–5 kHz); duration, 0.9–0.14 s. Often infectious, up to six birds of both sexes calling together on ground. Call given when an observer with a torch walked nearby at night (n=6); in response to other birds giving Hakawai at night (n=4); by females, in response to Loud Calls by males during day (n=3); when chicks were handled (n=2); and when other adults were giving Distress Calls (n=2); also given in flight (Miskelly 1990a).

Adult female CHUR: (see sonagram C, New Zealand Snipe); louder version of Soft Call, rendered as *chur chur*; repeated 3–5 times, usually in response to Loud Call by mate.

Young Chicks with parent make incessant, very quiet *sisisisi*. If separated from parent, call gradually develops into **CHICK CALL:** piercing *peeyoo* (sonagram E) that can be heard up to 40 m. Chick calls are c. 0.3 s long, span 5.5–7 kHz and are repeated every 1.0–1.6 s.

BREEDING Poorly known. Account based on field studies by Miskelly (1984, 1989, 1990b) and contribution by C.M. Miskelly. Solitary; among dense ground vegetation, especially sedge.

Season Laying, Sept.–Mar.; on South East I., in 1983: clutches started 23 Sept.–26 Dec. (Miskelly 1989; C.F.J. O'Donnell). On Mangere I., young from 28 Sept. 1981 (M.D. Dennison).

Site On ground or in base of sedge or grass; under *Olearia* and *Plagianthus* forest on South East and Mangere Is. Of 14 nests found on South East I.: 12 were among *Carex* sedge, one under blackberry *Rubus fruticosus* and one under Yorkshire Fog Grass *Holcus lanatus* and bracken *Pteridium esculentum*.

Nest, Materials Shallow cup of *Carex* or *Holcus* (12 of 14) or, occasionally, *Plagianthus* leaves or unlined scrape (2 of 14).

Eggs Oval to blunt pyriform; smooth, slightly glossy; pale pinkish-brown, with fine spots of dark brown and larger blotches of mid-grey round widest part; sparsely marked elsewhere. **MEASUREMENTS:** 38.7 (1.5; 35.9–41.9; 28) x 28.1 (0.6; 27.1–28.9; 28). **WEIGHT:** average 16.1 g.

Clutch-size Usually two; C/2 x 49, C/3 x 1, C/4 x 1. Large clutches possibly laid by two females.

Laying No information.

Incubation By both sexes, continuously; sitting bird does not leave nest till relieved by mate; between 06:00 and 02:00, females on nest 67% and males 33% (n=58; Miskelly 1989). Hatching synchronous, at any time of day or night; eggs within a clutch hatched 7.6 h apart (2.5–18; 4) (Miskelly 1989). **INCUBATION PERIOD:** no precise determinations; >19 days (C.M. Miskelly). Egg-shells left in nest at hatching.

Young Precocial, nidifugous and ptilopaedic. Chicks leave nest within day of hatching; can fly at c. 21 days. Feathers first appear on scapulars and belly at 7–10 days; back, belly and flanks well feathered by 14–16 days; down mainly confined to head and rump by 20–23 days; fully feathered by 28–35 days; last traces of down on nape lost by 47 days (Miskelly 1989). **Growth** Average weight (g): at hatching, 11.0 (0.7; 10.0–12.0; 12); at 10 days, 28; 21 days (fledging), 48 (61% of adult); 30 days, 59; 41 days, 66. Average length of bill (mm): at hatching, 12.7 (0.6; 11.5–13.5; 12); at 10 days, 21; 21 days, 30; 30 days, 36; 41 days, 41. Average length of tarsus (mm): at hatching, 16.8 (0.6; 16.0–17.7; 12); at 10 days 19; 21 days, 22; 30 days, 23; 41 days, 23. **Parental care, Role of sexes** Young remain in nest for 7.2 h (1.3–11.3; 5); leave nest during

daylight (Miskelly 1989). Brood split at hatching, male caring for first young to leave nest, female caring for other (five broods of two chicks, at hatching). Young do not associate; no adult seen with two young and two adults never cared for same chick (7 broods of two and 1 brood of one), though one record of two adults with three recently hatched chicks (H.A. Robertson). Brooding only seen on day of hatching. Fed entirely by parents until 18 days old, and partly by parents until at least 29 days old. Fed bill to bill.

Fledging to maturity Able to fly at c. 21 days but not independent till 41 days old (5 days; 33–47; 12). Young and parent stay close together unless disturbed, maintaining contact with soft calls; young chicks call loudly if separated from parent. Age of first pairing and breeding unknown.

Success From nine nests, seven hatched both eggs, one hatched one egg and one failed. Of 18 eggs laid, 15 (83%) hatched; average, 1.7 eggs per nest, and 1.9 eggs per successful nest. One nest deserted day after addled egg was ejected from nest; one egg that failed to hatch was cracked and addled. Remains of three adults found in middens of Great Skua *Catharacta skua*; one fledgeling apparently killed by Swamp Harrier *Circus approximans* (Miskelly 1984).

PLUMAGES Prepared by D.J. James. Hatch in natal down. First signs of post-natal moult at 7–10 days, and fly by c. 21 days (C.M. Miskelly). Juveniles differ slightly from adults. After partial post-juvenile moult, immatures not distinguishable from adult. Adults undergo complete post-breeding moult each cycle, but no evidence of partial pre-breeding moults and no seasonal change in appearance. Sexes similar. Age at first breeding not known. Much individual variation compared with variation associated with age, sex or season. Most similar in plumage to *C. a. aucklandica* but smaller.

Adult (Definitive basic). Upperparts, rather brown and cryptically patterned; underparts, pale and plain. Ground-colour of upperparts varies from dull brown to paler and rather rufous. **Head and neck** Crown and nape, black-brown (119) with brown (121c) to rufous-brown (36) fringes to feathers causing irregular mottling; usually slightly paler than *C. a. aucklandica*. Narrow central stripe from forecrown (not forehead) to back of crown, cream (92), and always prominent; formed by two rows of cream feathers with either scattered blackish shaft-streaks, or black-brown (119) outer webs. Sides of face, buff (24), finely streaked and speckled dark brown (121), especially below eye. Clear buff (124) to cream (92) supercilium, emphasized by narrow dark-brown (121) loreal stripe, which continues behind eye. Dark-brown (121) crescent below eye and some ill-defined smudgy markings closer to bill; pale buff to cream (124–92) patch conspicuous on cheek above crescent (like *C. a. aucklandica*). Narrow buff (124) eye-ring. Chin and throat, white, with fine dark-brown (121) spotting along side of throat. Foreneck, cream (92) to off-white, with dark-brown (121) to reddish-brown (223B) centres to feathers forming gorget of streaks (which extends to upper breast); some have buff (124) or brown-buff (24) corners to feathers, which give a richer tinge and more complex mottled pattern. Hindneck and sides of neck, dark brown (121) with buff (124), rich-brown (121C) or rufous-brown (36) edges to feathers (about one-quarter width of feathers) giving more streaked appearance than on crown. **Upperparts** Vary; browner birds tend to have large blackish blotches; more rufous birds tend to be more streaked. Mantle and scapulars, brown, with blackish blotches and buff or cream streaks, or streaked dark brown and faintly rufous-brown; feathers, grey-

ish brown (28) at base grading to rich brown (121C) distally, with cream (92) to brown-buff (24) outer edge, black-brown (119) blotch at tip and, usually, some black-brown (119) vermiculations behind blotch. In some, feathers dull rufous-brown (37) distally, with dark-brown (219) to black-brown (119) central streaks (instead of blotches at tips), slight cinnamon tinge at edges and fewer vermiculations. On scapulars, pale edges tend to be white distally and align to form moderately distinct upper and a lower scapular-Vs. On subscapulars, blotches and vermiculations slightly bolder, and pale edges less distinct. Back and rump appear uniform brown to dull rufous-brown; feathers, greyish brown (28) at base grading to rich brown (121C) or dull rufous-brown (37) at tip. Uppertail-coverts, similar but dull bases narrower, and appear slightly richer; can show hints of dark-brown barring but always less developed than in other forms of *Coenocorypha*. **Underparts** Upper breast, like foreneck, with gorget of streaks. Lower breast, belly and vent, off-white or cream (92), but not buff. Ground-colour of sides and flanks, cream (92) to buff (124) with broad brown-buff (24) or rich-brown (121C) chevrons or scallops across feathers; occasionally, scattered dark-brown (121) chevrons or blotches. Lower flanks tend to be less clearly and less heavily marked, often just irregularly mottled brown-buff (24). Undertail-coverts, cream (92) to buff (124), not marked. **Tail** Outer rectrices, light to pale grey-brown (119C–119D), irregularly and faintly mottled cream (92) along edges of shaft. Central rectrices, rich brown (121C) or dull rufous-brown (37), irregularly but mostly completely barred light to pale grey-brown (119C–119D); more patterned than other forms of *Coenocorypha*. **Upperwing** Primaries very much like *C. a. aucklandica*; grey-brown (91–28) with indistinct varying whitish fringe at tip. Secondaries, brownish grey (28), sometimes with buff (124) mottling or buff distal outer edges (which are broader on inner feathers). Tertiaries, rich brown (121C) (rarely rufous-brown [37]) with irregular black-brown (119) barring (diamond-shaped bars with long axis across feather), surrounded by some finer black-brown vermiculations; distal (subterminal) black bar often larger and more rounded, forming blotch near tip of feather. Lesser and median coverts, like scapulars but duller; greyish brown (28) at base grading to rich brown (121C) distally, and finely speckled and smudged dark brown (219); black-brown (119) central streaks at tips of feathers do not form distinct blotches; outer edges of feathers, cream (92) to buff (124) at tips only and do not form bold stripes (as on scapulars). Outer greater secondary coverts, grey-brown (91) with rich-brown (121C) mottling and barring near tip; inner coverts more patterned, with rich-brown distal quarter vermiculated with black-brown (119). Alula and greater primary coverts, grey-brown (91–28) with narrow whitish outer edges to alula and white tips to coverts. **Underwing** Remiges and greater coverts, grey-brown to light grey-brown (119B–119C); other coverts, usually off-white, densely mottled with light grey-brown (119C) chevrons; lining appearing irregularly mottled or barred; sometimes, mostly light grey-brown (119C) with only a little off-white mottling and no distinct patterning. Subhumeral, off-white, with prominent light grey-brown (119D) chevrons or bars about as broad as interspaces.

Downy young Top of head, buff-brown (39) or cinnamon-brown with black-brown (119) central stripe from bill to nape. Loreal stripe and cheek-stripes (similar to those of adult), black-brown (119). Sides of face and throat, grey-brown (91) with faint, sparse buff-brown (24) and black-brown (119) speckling. Hindneck, brownish grey (28), finely

speckled pink-buff (121D). Wing-pad and upperparts, dark brown (121), banded and tipped rich brown (121C) to dull rufous-brown (37). Underparts, light brown, suffused with cinnamon (c239); duller light-brown (27) on belly.

Juvenile Poorly known; criteria for determining age not well known. Tend to look dull and washed out, lacking the well-defined contrasting patterns of adults. **Head and neck** Feathers of crown, and loreal stripe and cheek-stripes have broader dull rufous-brown (37) tips than adults, so head-pattern slightly obscured. **Upperparts** Considerably duller and plainer above than adult. Blotches on scapulars and mantle tend to be less developed, smaller and dark brown (121, 219) (rather than black-brown 119). Edges of scapulars, buff (124) (not whitish) and less sharply defined. **Underparts** Gorget less striking; central streaks do not reach tips of feathers, so gorget appears spotted, not streaked. **Upperwing** Primaries often show some pale mottling on edges (some adults may also). Tertiaries, more finely barred, with lesser tendency to have distinct blotches at tips. Greater secondary coverts tend to be more variegated but with fewer black-brown (119) markings; tend to show less difference in pattern between inner and outer coverts. One juvenile skin had distinctly broader whitish edges to alula and tips to greater primary coverts than typical of adults.

BARE PARTS Based on photos (DOC Slide Library; unpubl.: C.M. Miskelly). **Adult** Bill, pink-brown (219D) at base, grading to duller pink-brown (219C) at tip of culmen; or grey-black (82) with dirty-pink (c4, 221D) tinge, especially at base of lower mandible. Cere concolorous with base of culmen. Iris, black. Legs, grey-yellow or straw-yellow with grey tinge (grey 57). **Downy young** Bill, dark grey (83) to grey-black (82), becoming black towards tip, with brown-pink (221C–221D) basal half to lower mandible and along nasal groove. Iris, dark brown to black. Tarsus, feet and claws, brownish grey (c79) with slight dark-pinkish or purplish tinge. **Juvenile** Culmen, grey-black (82) distally, grading to pink-brown (219D) on basal half; lower mandible, dark grey with pink tinge at tip, grading through pink-brown to brown-pink (221D) at base. Mouth, brown-pink (c4). Iris, black. Legs, grey (84) with brown-pink (221D) tinge, especially on inside edges.

MOULTS Poorly known. Based on study of 86 skins, 26 with date, and information supplied by C.M. Miskelly. No evidence of pre-breeding (pre-alternate) moults. **Adult post-breeding** (Pre-basic). Complete; primaries, outwards. Primaries apparently begin late Jan. to Feb., completed by July. Moults of body begins late Nov.–Dec., and continues till June or July. Of 25 live birds handled June, eight were moulting, including five moulting primaries; no moult recorded on 50 adults handled Nov.–Jan. (C.M. Miskelly). **Post-natal** From Miskelly (1989, 1990b). Feathers first appear on scapulars and belly at 7–10 days. Back, belly and flanks well feathered by 14 days. By 20–23 days, down mainly confined to head and rump. Fully feathered at 28–35 days. Traces of down retained till c. 50 days old. **Post-juvenile** (First pre-basic). Probably partial moult of head and body as in *C. aucklandica*.

MEASUREMENTS (1) Adult, skins; sexing from labels and probably unreliable (AIM, CM, NMNZ). (2) South East I., live, adults (C.M. Miskelly).

	MALES	FEMALES	
WING	(1) 99.9 (1.78; 97–103; 35) (2) 102 (1.8; 99–108; 34)	100.5 (2.41; 96–108; 36) 103 (2.0; 99–108; 32)	ns ns
TAIL	(1) 34.9 (1.31; 33–38; 20) (2) 34.9 (1.5; 31.5–39.8; 35)	33.4 (1.76; 31–37; 15) 33.7 (1.0; 31.9–36.2; 34)	ns **
BILL F	(1) 43.6 (1.74; 40.2–47.1; 35) (2) 43.8 (1.5; 40.1–48.2; 35)	44.4 (1.71; 40.5–47.1; 33) 46.3 (1.2; 43.0–48.9; 34)	ns **
TARSUS	(1) 22.5 (0.87; 20.3–24.4; 28) (2) 23.0 (0.6; 21.9–24.3; 35)	22.9 (1.84; 20.8–24.6; 31) 23.8 (0.5; 22.7–25.1; 34)	ns **
TOE	(1) 23.2 (0.75; 21.7–24.5; 24)	23.2 (0.75; 21.8–25.0; 21)	ns
TOE C	(2) 30.7 (0.7; 28.7–32.0; 35)	31.4 (0.7; 30.0–32.5; 34)	*

Little difference between sexes; differences in length of bill, tarsus and toe with claw is reverse of that in tail for live sample. *C. pusilla* significantly smaller than all populations of *C. aucklandica* in all measurements ($P < 0.01$).

WEIGHTS South East I., live, adults (C.M. Miskelly): (1) Nov. 1983 to Jan. 1984; (2) July 1986. (3) Skins (AIM, CM, NMNZ).

	MALES	FEMALES	
(1)	75.9 (4.8; 69–85; 24)	85.4; 5.7; 77–94; 24)	**
(2)	72.3 (2.9; 69–78; 11)	79.6 (6.8; 68–90; 10)	*
(3)	47, 71, 80	78.6 (21.64; 61–110; 4)	

Differences in weights between summer and winter not significant. At hatching, chicks weigh 11.0 (0.7; 10–12; 12) (Miskelly 1990b); weight growth-curve in Miskelly (1990b).

STRUCTURE Very similar to New Zealand Snipe (q.v.). Eleven primaries; outer three longest; p7 4–6 mm shorter, p6 8–10, p5 12–15, p4 15–19, p3 19–23, p2 22–27, p1 27–30; p11 minute. Fourteen secondaries including four tertiaries; tips of longest tertiaries fall between p6 and p7 on folded wing. Tail, short; 14 rectrices, which are modified for audible display and are sometimes broken at tips, possibly through vibrational stress (Miskelly 1987b). Bill, much like that of *C. aucklandica*. Outer toe, 87–91% of middle, inner 73–82%, hind 24–33%.

AGEING Cannot be reliably distinguished from adults after partial post-juvenile moult. Contrast between worn primaries and fresh body-plumage may help immediately after post-juvenile moult.

GEOGRAPHICAL VARIATION None. Sometimes treated as subspecies of *C. aucklandica* (q.v.).

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Volume 3, Plate 2

New Zealand Snipe *Coenocorypha aucklandica* (page 54)
 1 Adult, Antipodes Is, subspecies *meinertzhagenae*; 2 Adult, Auckland Is, subspecies *aucklandica*; 3 Adult male, Snares Is, subspecies *huegeli*;
 4 Adult, islands off Stewart I., subspecies *iredalei*; 5 Downy young, Snares Is, subspecies *huegeli*; 6 Juvenile, Snares Is, subspecies *huegeli*;
 7, 8 Adult, Snares Is, subspecies *huegeli*

Chatham Island Snipe *Coenocorypha pusilla* (page 47)
 9 Adult; 10 Downy Young; 11 Juvenile; 12 Adult