Order CHARADRIIFORMES

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

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

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

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

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

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

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

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

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Family CHARADRIIDAE plovers and lapwings

Small to medium-sized, mostly terrestrial, waders of open habitats. About 65 species, placed in varying number of genera. Evidently monophyletic by behaviour and structural characters. Distributed worldwide and separable into two distinct sub-families: Charadriinae (plovers) and Vanellinae (lapwings), both of which are represented in HANZAB region and are discussed in more detail below. Most closely related to Recurvirostridae, Haematopodidae and possibly Burhinidae (Sibley & Ahlquist 1990; Christian *et al.* 1992).

Bodies, compact. Size differences between sexes negligible; sometimes males and sometimes females slightly larger. Necks, short and thick; 15 cervical vertebrae. Wings, long and usually pointed but rounded in some lapwings; 11 primaries, p11 minute; 14–19 secondaries. Tails, short to medium-long, square or rounded; 12 feathers. Bill, short, somewhat swollen at tip and narrower centrally; no sensitive nerve-endings at tip and prey located by sight rather than touch. Nostrils, holorhinal, impervious, slit-like. Head, rounded; forehead steep and broad. Legs, fairly short or medium in length; bare part of tibia short; tarsi, reticulated, rarely with some transverse scutes. Usually three, rather short toes, slightly webbed at base in some plovers; no hind toe in most plovers and in some lapwings; hallux, short and vestigial if retained. No crop. Caeca present. Eyes large. Supraorbital salt-glands, often large; size related to salinity of habitat and influences structure of skull and appearance of head. Plane of *foramen magnum* of occiput nearly horizontal.

Plumages generally boldly patterned in brown, olive-grey, black and white; markings often have cryptic disruptive effect. Bill, bicoloured in some species, especially plovers. Stance erect with head held high. Fast runners for good distances but often proceed in short bursts with halts, especially when feeding. Post-breeding moult complete; primaries outwards; pre-breeding moult varies considerably. Young, precocial, nidifugous and always feed themselves; down of pebbly-pattern type (Fjeldså 1977).

See accounts of sub-families (below) for additional details.

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Sub-family CHARADRIINAE plovers

Generally small birds, usually smaller than lapwings (Vanellinae). Apparently a monophyletic assemblage. About 40 species in five (Voous 1973; Strauch 1978; BWP) to 10 genera (Sibley & Ahlquist 1990; Sibley & Monroe 1990; Christian *et al.* 1992), with most species in two genera, *Pluvialis* and *Charadrius*, and varying number of genera composed of only one or a few species (e.g. *Anarhynchus*, *Phegornis*, *Thinornis*, *Elseyornis*). The affinities of *Phegornis* (Diademed Sandpiper-plover of South America) have not been resolved (Sibley & Monroe 1990). Recent studies of allozymes of Aust. plovers and lapwings (Christian *et al.* 1992) indicate that Red-kneed Dotterel *Erythrogonys cinctus* is a lapwing (Vanellinae; q.v.).

We recognize the following genera within the Charadriinae in HANZAB region:

Pluvialis. Two regular non-breeding migrants (*fulva*, *squatarola*), two doubtfully recorded (*dominica*, *apricaria*). We follow Connors *et al.* (1983, 1993) and treat *fulva* and *dominica* as full species.

Charadrius. Four breeding species (*obscurus*, *ruficapillus*, *bicinctus*, *australis*), six non-breeding migrants (*hiaticula*, *dubius*, *mongolus*, *leschenaultii*, *asiaticus*, *veredus*), one accidental (*tricollaris*); one doubtfully recorded (*alexandrinus*). Inland Dotterel *C. australis* is a typical *Charadrius* plover (Maclean 1976; Christian *et al.* 1992 *contra* Jehl 1968); we follow NZCL in placing New Zealand Dotterel in *Charadrius*.

Thinornis. Two endemic species: *novaeseelandiae* and *rubricollis*.

Allozymes of *rubricollis* form a cluster (with *Elseyornis melanops*) well separated from those of typical *Charadrius*; placed in *Thinornis* on basis of similarities in morphology (Christian *et al.* 1992) and behaviour (Phillips 1980).

Elseyornis. Single species *melanops*, endemic to Aust. Allozymes, with those of *Thinornis rubricollis*, well separated from *Charadrius* (Christian *et al.* 1992).

Anarhynchus. Single species *frontalis*, endemic to NZ.

Thus, in HANZAB region, eight breeding species, eight non-breeding migrants, and four accidental or not acceptably recorded.

General features of the sub-family are outlined under Charadriidae. The plumages of *Pluvialis* are spangled in white or gold and black above, black below when breeding, and never with white band across nape; plumages of *Charadrius* and other genera in general plain brownish above and white below, boldly marked with black on face and head, at least when breeding;

usually with one or two black or chestnut bands across breast and often with white band across nape. Two moults per cycle: complete post-breeding moult, primaries outwards; and partial pre-breeding moult, which often brings in much brighter breeding plumage; supplemental plumage occurs in at least one species (Eurasian Golden Plover *Pluvialis apricaria*). Down of pebbled pattern (Jehl 1968; Fjeldså 1977, 1988; BWP). Juvenile plumage duller than adults in most species, with pale dorsal scalloping. Adult plumage attained at 1–2 years. Most probably first breed at 1–2 years, maturity perhaps delayed further in some migratory species (e.g. Grey Plover *Pluvialis squatarola*).

Inhabit open places; when not breeding, many are typically birds of ocean beaches, coastal mudflats and estuaries; others use rivers and freshwater wetlands, often ephemeral; still others characteristic of dry habitats, including gibber plains, grasslands and steppes. Breeding may occur in any of these habitats, or in tundra or high-altitude moorlands. Most species probably migrate to some extent; about 15 species are long-distance transequatorial migrants. Diet consists of terrestrial and coastal invertebrates. When foraging, tend to spread out and feed separately over wide area, rather than feeding in flocks as do many scolopacids. In general, gregarious but less so than many scolopacids. Roost communally. Usually territorial when breeding; some species may defend feeding territories in wintering areas. Various mating systems recorded in different species: monogamy, polyandry (associated with sexual reversals), polygyny and polygamy. While breeding, generally rather aggressive, defending and advertising territories with displays on the ground and in the air, often with butterfly-like flights and song (long melodious trills). Courtship and mating behaviour often complex or stereotyped. Anti-predator strategies, injury-feigning and distraction displays generally elaborate and well developed. Most vocal during breeding season with variety of peeps, trills and mellow or liquid whistles.

Breed seasonally. Nest, a simple scrape on the ground, sparsely lined with plant stems, grasses and other objects; in open, often unvegetated places. Several scrapes may be prepared by male and one then selected by female. Eggs, oval, short oval or even somewhat pyriform; smooth, not glossy; ground-colour, buff, brown or grey, heavily blotched and spotted dark, well camouflaged. Clutch-size, 2–4, often consistently of one size in a species (e.g. two in *C. ruficapillus*). Laying at intervals of 24–60 h. Replacement laying, up to several times. Incubation by both sexes in monogamous species but share varies and is by male alone in Eurasian Dotterel *Eudromias morinellus*, the only plover in which female more brightly coloured than male. Incubation period, 24–31 days. Young hatched in natal down; precocial, nidifugous. Usually tended by both parents but feed themselves from hatching. Fledge in 3 (smaller species) to 5 (larger species) weeks.

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Pluvialis squatarola Grey Plover

COLOUR PLATE FACING PAGE 777

Tringa squatarola Linnaeus, 1758, *Syst. Nat., ed.* 10, 1: 149 — Europe; restricted to Sweden by Hartert.

Squatarola is the local Italian (Venetian) name for a kind of plover.

OTHER ENGLISH NAME Black-bellied Plover, Grey Sandpiper.

MONOTYPIC

FIELD IDENTIFICATION Length: 27–31 cm; wingspan: 71–83 cm; weight: c. 250 g. Medium-sized long-legged plover; larger and bulkier than Pacific Golden Plover *Pluvialis fulva*, with bigger head, larger eye, and thicker blunter bill. Plumage-patterns similar to Pacific Golden Plover but generally greyer. From below, diagnostic black wing-pit contrasting strongly against white underwing. Sexes similar; some females separable in full breeding plumage. Marked seasonal variation. Juveniles and first-years separable.

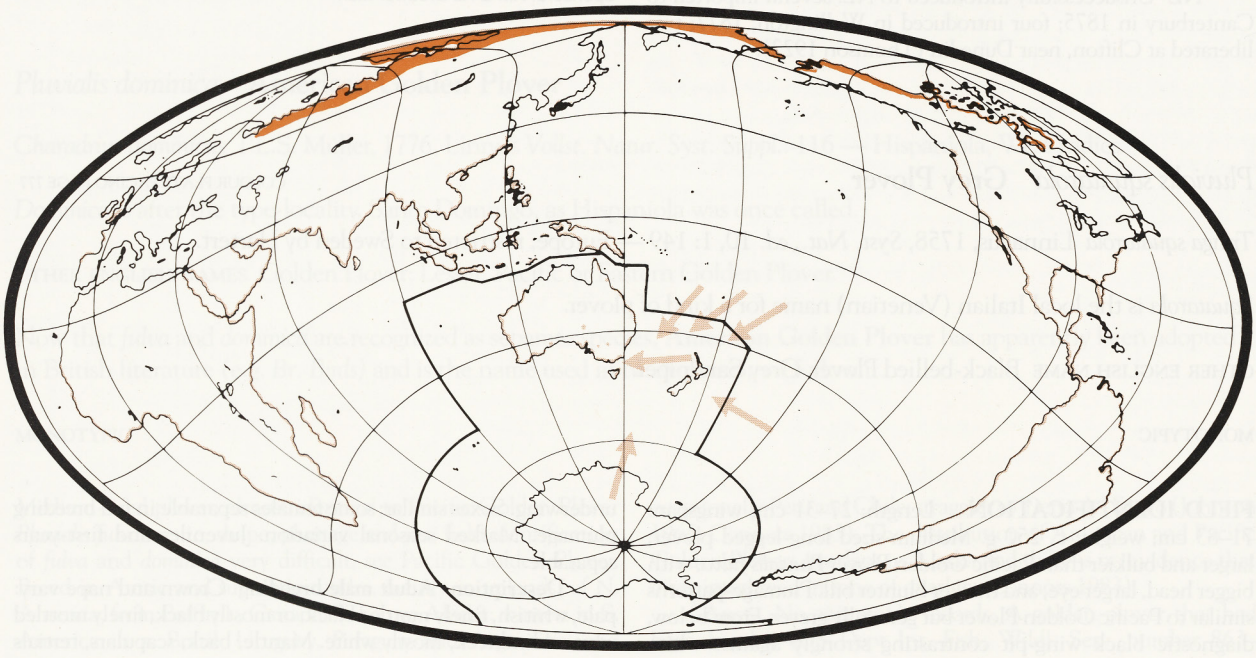
Description Adult male breeding Crown and nape vary: pale, whitish, finely mottled black; or mostly black, finely mottled white. Hindneck, mostly white. Mantle, back, scapulars, tertials

and wing-coverts, black, notched and tipped silvery white, giving spangled appearance to upperparts. Forehead and supercilium, white, continuing down sides of neck and broadening into patches on sides of breast; form broad white area between spangled upperparts and black face, foreneck, rest of breast, belly and flanks. Vent and under tail-coverts, white, with a few black bars at sides. In flight from above, squarish white area on rump and upper tail-coverts; white tail, narrowly barred black; and blackish primary coverts and remiges except for white bases of inner primaries and tips of greater coverts forming bold but diffuse wing-bar. In flight from below, axillaries, subhumerals and their coverts form diagnostic black wing-pit, contrasting with mostly white under wing-coverts and whitish undersides of remiges; greater primary coverts, dusky grey. Bill, black. Iris, dark brown. Legs and feet, dark grey or blackish. **Adult female breeding** In full breeding plumage, as adult male breeding except black of underparts tinged brownish and flecked white; upperparts sometimes browner. **Adult non-breeding** More variegated above than other grey waders. Upperparts and wing-coverts, pale brownish-grey, with white fringes and dusky subterminal notches throughout, and white notches restricted to scapulars, tertials and inner greater coverts. Forehead and lores, whitish. Sides of head and neck, whitish, finely streaked grey-brown, with pale whitish supercilium, small dark patch before eye, and dark patch on ear-coverts. Chin and throat, white. Foreneck, breast and flanks, lightly mottled and streaked brownish grey on white, to heavily streaked brownish grey. Rest of underparts, white. Rump, upper tail-coverts, tail, wing-bar and diagnostic black wing-pit as adult breeding. **Juvenile** Similar to adult non-breeding except: upperparts and inner wing-coverts, darker greyish-brown, with margins of feathers boldly spotted pale gold or yellowish white giving spangled appearance above; bolder pale spotting on scapulars and notching on tertials and inner greater coverts (contrasting more with darker, blackish centres of feathers), and coarser pale spotting on wing-coverts; darker crown and clearer whitish supercilium; foreneck, breast and flanks, buffy white (soon fading to whitish) with dense dusky-brown streaking; rest of underbody, white. Plumage usually distinct until Oct., sometimes Dec., by which time plumage very worn and faded, and upperparts, darker, more uniform blackish, with less pale spotting and notching. **First immature** Resembles adult non-breeding but usually with some contrasting darker worn juvenile feathers retained in upperparts, wing-coverts and tertials; primaries, worn, blackish brown (moulting or fresh, black in adults). **Second immature** May gain some black-spotted or black-tipped feathers in underparts and some black-barred feathers in upperparts; some show worn juvenile feathering as late as Mar.–Apr. First-year birds wintering in Tropics may become very whitish through wear and fading.

Similar species In flight, black wing-pit diagnostic. Wing-pit, bold white wing-bar and white rump distinguish from **Pacific Golden Plover** (q.v.). Call diagnostic.

Usually solitary or in small flocks but form large communal roosts, often with other waders such as Pacific Golden Plovers, Black-winged Stilts *Himantopus himantopus*, knots and godwits. Almost entirely coastal; forage on intertidal mudflats, and roost on sandy beaches and spits; occasionally occur in coastal saltmarshes and saltworks; rarely seen inland. Feed in typical stop-start plover fashion; enter water often, unlike Pacific Golden Plover. When feeding, hunched stance and lethargic behaviour give characteristic dejected appearance. Flight, strong, swift, less agile than Pacific Golden Plover but more powerful; often fly in loose flocks, typically in irregular lines. Usual flight call distinctive, loud, far-carrying, slurred trisyllabic whistle, the second syllable lower in pitch; a characteristically flat and melancholy sound.

HABITAT Almost entirely coastal, but occasionally recorded on inland wetlands. Mainly on marine shores, inlets, estuaries and lagoons where there are nearby large tidal mudflats or sandflats for feeding and sandy beaches for roosting; also rocky coasts, with wave-cut platforms or reef-flats (Serventy 1948; Thomas 1968; Serventy & Whittell 1976; Storr 1980; Fuller & Burbidge 1981; Morris *et al.* 1981; Johnstone 1983; Pegler 1983; Garnett & Bredl 1985; Bamford 1988; Jaensch *et al.* 1988). Sometimes on beaches with much seaweed (Storr 1987); also reefs within muddy lagoons (Thomas 1968). Away from coasts, margins of saltlakes and saltpans (Storr 1965, 1977; Frith & Calaby 1974; Storr & Johnstone 1988); occasionally near-coastal and inland freshwater



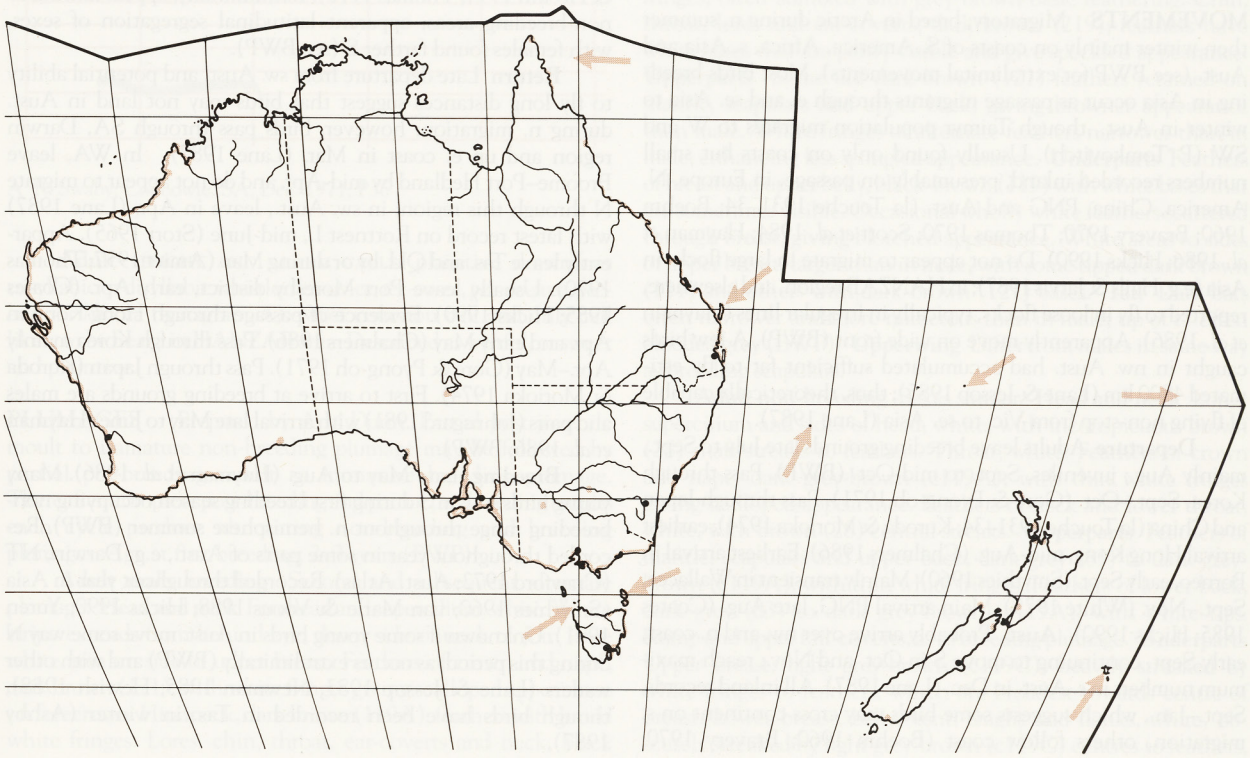
or brackish lakes, swamps, lagoons and dams, either drying or freshly flooded (Bravery 1964; Thomas 1968; Storr 1977, 1984; Jaensch *et al.* 1988; Storr & Johnstone 1988; Cox 1991). Very occasionally, at shallow sedge-swamps round inland artesian bores (Badman & May 1983). One record from margin of dam (Tinaroo Dam; Bravery 1964). In NZ, no records inland or at freshwater wetlands near coast (P.C.M. Latham).

Roost or loaf on unvegetated sandbanks or spits on beaches and in lagoons and estuaries (Pegler 1983; Jaensch *et al.* 1988); occasionally muddy margins of estuaries or reservoirs (Bravery 1964; Jaensch *et al.* 1988). Roost on island artificially created by dredge-spoil in Port Phillip Bay.

DISTRIBUTION AND POPULATION Breed in tundras N of 65°N, from W. Baffin I. through Arctic and subarctic Canada, n. and nw. Alaska, and from Anadyrskiy Zaliv, W to the White Sea; absent Scandinavia and Greenland (BWP). During non-breeding period, widespread on coasts of N. and S. America, Africa, Asia and A'asia; rare straggler to NZ; generally rather scarce in New Guinea, where may be present all year (Blake 1977; Coates 1985; Lane 1987; Root 1988; BWP).

Aust. Most coasts of mainland; most abundant on w. and s. coasts (Lane 1987). Few inland records (e.g. Dubbo, Griffith, Wentworth, NSW; L. Tyrrell, Vic.; Coward Springs, SA; Morris *et al.* 1981; Aust. Atlas), which are probably birds on passage across the continent (Aust. Atlas). **Qld** Large numbers recorded in se. Gulf of Carpentaria (Garnett 1989); sparse on e. coast (Lane 1987). **NSW** Uncommon; occasional coastal records; rarely inland (Morris *et al.* 1981). **Vic.** Few records E of Gippsland Ls; mostly recorded from between Jack Smith L. and Corner Inlet, Westernport and Port Phillip Bays and w. coast, W of Warrnambool (Vic. Bird Reps 1981–87; Vic. Atlas). **Tas.** Uncommon; mainly n. and e. coasts (Tas. Bird Reps); single record on w. coast, Strahan, 30 Sept. 1973 (Tas. Bird Rep. 3). Also Flinders I. (Tas. Bird Reps 2,3). Increased number of observations in late 1970s (Tas. Bird Rep. 10). **SA** Mostly from Fleurieu Pen. and Kangaroo I., through St Vincent and Spencer Gulfs to about Streaky Bay on w. Eyre Pen. (Lane 1987; Aust. Atlas). Single, near Mintabie, 15 Sept. 1990 (Cox 1991). **WA** Along coast from Eyre to King Sound; common in Kimberley Division (Storr 1980; Aust. Atlas). **NT** Regular visitor to Top End in small numbers (Thompson & Goodfellow in prep.).

NZ Rare but probably annual migrant; maximum sightings in any year, ten (1982). First recorded Firth of Thames, 1948, though possibly earlier sight records at Manukau Harbour in 1946 and 1947 (Sibson 1949); not recorded again till 1960–61; *c.* 60 individuals observed. Unsuccessfully introduced: two liberated by Otago Acclimatization Society in 1867 and eight released at Lauder Stn, Manuherikia in 1881 (Thomson 1922). Following records, all singles unless stated. **NI** Most n. harbours: Parengarenga Harbour: 31 Oct. 1974, Nov. 1977, 16 Nov. 1982, 30 Jan. 1982 (possibly same bird), 5 Nov. 1984, 25 Jan. 1987 (P.C.M. Latham); Houhora Harbour: seven, 23 Dec. 1982; Firth of Thames: between Miranda and Waitakaruru, 29 Aug. 1948; 29 Aug. 1948 to 16 Jan. 1949, 22 Feb. 1976, 14 Dec. 1980, 13 Jan. 1985, summer 1985–86, 18 Nov. 1986, 20 Jan. 1988, 3 Dec. 1988 (P.C.M. Latham); Manawatu R. estuary: 8 Jan. 1967; Manukau Harbour: Karaka, 27 Mar. 1982 (CSN 30); Kaipara Harbour: Tapora, 16 Apr. 1961 (CSN 9), 25 Mar. 1978 (P.C.M. Latham). **SI** Farewell Spit: 22 Jan. 1961 (Edgar 1962), 22 Jan. 1961, two 19 Sept. 1962, Dec. 1968, 5 Oct. 1971, four Jan. 1977, five Mar. 1978, Oct. 1978, 4 Apr. 1981, three 14 Nov. 1981, two 20 Nov. 1982, May 1991 (P.C.M. Latham); L. Grassmere: 20 Jan. 1961 (Brathwaite 1961); Waituna Lagoon: two 4 Jan. 1969, two 29 Jan.



1980, 2 Jan. 1982, 10 Dec. 1988 (P.C.M. Latham); Awarua Bay: 19 Apr. 1980 (CSN 28).

Lord Howe I. Three, Nov. 1959 (McKean & Hindwood 1965).

Macquarie I. Single, specimen, Buckles Bay, 24 Feb. 1964 (Simpson 1965).

Kermadec Is Single, N. Meyer I., 18 Dec. 1966 (Merton 1970).

Chatham Is Single, Chatham I., 1968 (NZCL).

Aust. population estimated *c.* 12,000 (D. Watkins). Important sites and maximum numbers of waders from summer and winter counts round Aust., 1981–85, were: Eighty Mile Beach, WA, 1650; SE Gulf of Carpentaria, Qld, 1550; Roebuck Bay, WA, 1300; w. coast Eyre Pen., SA, 1280; Spencer Gulf, SA, 740 (Lane 1987). Other important sites include: Corner Inlet and Port Phillip Bay (Vic. Bird Reps 1982–87); nw. Tas., including Robbins I., where recorded regularly, with up to 42 counted (Ashby 1987; Tas. Bird Rep. 18). Totals for summer and winter counts between 1986 and 1990 in Aust. summarized in Table 1 (Hewish 1986, 1987a,b, 1988, 1989a,b, 1990a,b; Anon. 1992).

Table 1.

DATE	NUMBER OF BIRDS	NUMBER OF SITES
summer 1986	2127	23
winter 1986	402	23
summer 1987	1943	22
winter 1987	123	23
summer 1988	1665	23
winter 1988	107	23
summer 1989	1163	22
winter 1989	33	21
summer 1990	930	21
winter 1990	19	21

MOVEMENTS Migratory; breed in Arctic during n. summer then winter mainly on coasts of S. America, Africa, s. Asia and Aust. (see BWP for extralimital movements). Most birds breeding in Asia occur as passage migrants through e. and se. Asia to winter in Aust., though Taimyr population migrates to W and SW (P. Tomkovitch). Usually found only on coasts but small numbers recorded inland, presumably on passage, in Europe, N. America, China, PNG and Aust. (la Touche 1931–34; Boehm 1960; Bravery 1970; Thomas 1970; Scott *et al.* 1984; Hayman *et al.* 1986; Hicks 1990). Do not appear to migrate in large flocks in Asia (e.g. Hails & Jarvis 1987); in HANZAB region, and elsewhere, reported to fly in loose flocks, typically in irregular lines (Hayman *et al.* 1986). Apparently move on wide front (BWP). A few birds caught in nw. Aust. had accumulated sufficient fat to fly estimated 4800 km (Lane & Jessop 1985); thus, theoretically capable of flying non-stop from Vic. to se. Asia (Lane 1987).

Departure Adults leave breeding grounds late July to Sept., mainly Aug.; juveniles, Sept. to mid-Oct. (BWP). Pass through Korea, Sept.–Oct. (Gore & Pyong-oh 1971). Pass through Japan and China (la Touche 1931–34; Kuroda & Morioka 1974); earliest arrival Hong Kong, mid-Aug. (Chalmers 1986). Earliest arrival in Borneo, early Sept. (Smythies 1960). Mainly transient in Wallacea, Sept.–Nov. (White 1975). Main arrival PNG, late Aug. (Coates 1985; Hicks 1990). **Aust.** Probably arrive over nw. and n. coast, early Sept. continuing to move S in Oct. and Nov.; reach maximum numbers in s. Aust. in Dec. (Lane 1987). All inland records, Sept.–Jan., which suggests some birds may cross continent on s. migration, others follow coast (Boehm 1960; Bravery 1970; Thomas 1970; Storr 1986; Aust. Atlas). **WA** Arrive Broome–Port Hedland, early Sept., staying till Apr. Reach sw. Aust., Oct.–Nov. (Lane 1987) though recorded at Swan R. and NW Cape, about mid-Sept. (Carter 1904; Serventy 1938); earliest arrival Rottnest I., late Aug. (Storr 1965); at Eyre, recorded spring 1978–81 but none seen autumn (Congreve & Congreve 1982). **NT** Arrive Darwin, early Sept. and move on (Lane 1987); single observed flying S, 27 Nov. 1980, near w. Gulf of Carpentaria (Carter 1983). **Qld** Transient on islands of Torres Str. (Draffan *et al.* 1983); apparently arrive on mainland during Sept. (Amiet 1957) with small numbers on e. coast of Aust. in Oct. **NSW** S. influx in Dec. **SA** Arrive at coast, Nov. (Lane 1987). **Tas.** Arrive Oct.–Nov. (Thomas 1970).

Non-breeding Unlike Pacific Golden Plover, uncommon in Pacific Ocean; rarely, spend n. winter in Hawaiian islands and Micronesia (Pratt *et al.* 1987); single record from Cook Is (Holyoak 1976); recorded once from Kermadec Is (Merton 1970). Small numbers spend n. winter in coastal China, Japan, Hong Kong, Burma, Thailand, Cambodia, Philippines, Borneo, Wallacea, PNG and islands of Torres Str. (Hachisuka 1931; la Touche 1931–34; Smythies 1960; Kuroda & Morioka 1974; King *et al.* 1975; Draffan *et al.* 1983; Chalmers 1986; White & Bruce 1986; Hicks 1990; Lekagul & Round 1991); however few in Asia, except on migration, indicating most Asian birds migrate to Aust. mainland (Lane 1987). **Aust.** Apparently more numerous in W (Wheeler 1960; Klapste 1974); concentrated in few areas, e.g. Broome–Port Hedland, Gulf of Carpentaria, Gulf country of SA, and Corner Inlet, Vic. (Aust. Atlas); sometimes on islands (e.g. Christmas I., Stokes 1988). In winter 1986, unusually high numbers led to increased use of regular sites and use of sites where rarely or never recorded (Hewish 1987a). **NZ** Origins of birds unknown: regular but uncommon (Sibson 1949; Brathwaite 1961); most records, mid-Aug. to mid-Apr. (P.C.M. Latham). Movements during non-breeding season, unknown, but some birds (assumed to be same birds) remain within particular bay for some months (Hindwood & Hoskin 1954; Thomas 1970). Extralimitally, appear faithful to non-breeding areas; apparent latitudinal segregation of sexes, with females found farther S (see BWP).

Return Late departure from sw. Aust. and potential ability to fly long distances suggest that birds may not land in Aust. during n. migration; however, birds pass through SA, Darwin region and up e. coast in Mar. (Lane 1987). In WA, leave Broome–Port Hedland by mid-Apr. and do not appear to migrate N through this region; in sw. Aust., leave in Apr. (Lane 1987) with latest record on Rottnest I., mid-June (Storr 1965). Apparently leave Tas. and Qld. by or during Mar. (Amiet 1957; Thomas 1970). Usually leave Port Moresby district, early Apr. (Coates 1985; Hicks 1990). Evidence of passage through Hong Kong in Apr. and early May (Chalmers 1986). Pass through Korea mainly Apr.–May (Gore & Pyong-oh 1971). Pass through Japan (Kuroda & Morioka 1974). First to arrive at breeding grounds are males and pairs (Johnsgard 1981) with arrival late May to June (Hayman *et al.* 1986; BWP).

Breeding Late May to Aug. (Hayman *et al.* 1986). Many young birds stay in S during first breeding season occupying non-breeding range throughout n. hemisphere summer (BWP). Recorded throughout year in some parts of Aust., e.g. Darwin, NT (Crawford 1972; Aust. Atlas). Recorded throughout year in Asia (Smythies 1960; van Marle & Voous 1988; Hicks 1990; Yuren 1991). Unknown if some young birds in Aust. move some way N during this period, as occurs extralimitally (BWP) and with other waders (Lane & Jessop 1983; Newman 1985; Hewish 1988), though birds have been recorded in Tas. in winter (Ashby 1987).

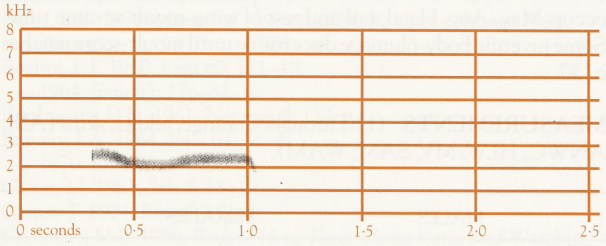
Banding Extralimitally, appear faithful to non-breeding area from year to year (see BWP). In HANZAB region, six retraps in Vic. at same location (AWSG).

FOOD Molluscs, insects, crustaceans, polychaete worms, and occasionally vegetation and seeds. **Behaviour** Mainly diurnal; only nocturnal if unable to obtain enough food during day (BWP). Glean and probe for prey on mudflats, beaches and occasionally pasture in HANZAB region. Feed with running, stopping and pecking action (see BWP for extralimital descriptions). Foot-trembling not recorded. Recorded washing prey. Locate and seize bivalves by siphon, tearing them out of shell. Large crustaceans pecked apart. Prey located mainly by sight. Cues used include water-flow, movement of sand and casts from holes of polychaete worms. Recorded stealing food from Whimbrels *Numenius phaeopus* and oystercatchers *Haematopus* (Zwarts *et al.* 1990).

Adult Non-breeding (Stomachs). Plants: mosses (Boehm 1964). Animals: Annelids (Gould). Molluscs: gastropods: Littorinidae: periwinkles (Lea & Gray). Crustaceans: crabs (Barker & Vestjens). Insects: ads, larv. (Gould); Isoptera: Termitidae: *Amitermes neogermanus* (Boehm 1964); Curculionidae: *Melanterius*; Cryptorrhynchinae; Hymenoptera: wasp; Formicidae: *Chalcoponera metallica*; *Pheidole* or *Aphaenogaster* (Boehm 1964).

Young, Intake No data.

VOICE No detailed studies in HANZAB area; few local recordings available. For descriptions of calls at breeding grounds see BWP. Generally silent. Flocks often silent, often flushing without calling (Witherby *et al.* 1940). Flight (Alarm) Call similar to that of Pacific Golden Plover but higher-pitched, with middle syllable shorter and lower than other two (P.C.M. Latham). No sexual differences reported.



A R. Swaby; Coobowie, SA, Dec. 1971; P36

Adult FLIGHT AND ALARM CALLS: plaintive drawn-out trisyllabic or disyllabic whistle: *tlee-oo-ee*, *tee-oo-ee*, *pee-oo-wee*, *pee-er-ee* or *kliooee* (sonagram A). Most common call and only call likely to be heard in HANZAB area. Described as wistful, or sweet and plaintive.

PLUMAGES Prepared by A.M.Dunn. Partial post-juvenile moult to immature non-breeding plumage may be followed by partial pre-breeding moult to immature breeding plumage. Thereafter, complete post-breeding and partial pre-breeding moults each cycle produce alternating non-breeding and breeding plumages. Age at first breeding, 2–3 years (BWP).

Adult male breeding Second and subsequent alternate plumage. **Head and neck** Forehead and supercilium, white. White stripe extends from behind eye, down side of neck to join large white area on side of upper breast. Feathers of crown and nape, dark brown (121), with white fringes giving scalloped appearance on forecrown. Hindneck, dark brown (119A), feathers with broad white fringes. Lores, chin, throat, ear-coverts and neck, black (89), fading to black-brown (119) with wear. **Upperparts** Mantle, upper back and scapulars, black-brown (119), boldly spangled by broad white tips to feathers. Feathers of lower back, dark brown (121), with white tips. Rump and upper tail-coverts, white, somewhat speckled by dark-brown (121) subterminal bands or spots on edges of feathers. **Underparts** Breast, flanks, axillaries and upper belly, mostly black (89), fading to black-brown (119) with wear. Sides of upper breast, white. Lower belly, vent and thighs, white. Under tail-coverts, white with brown (28) barring on lateral feathers. **Tail** White with heavy dark-brown (21) barring on central feathers; amount of dark brown decreases on outer feathers, and t6 mostly white with one or two bars. **Upperwing** All secondary coverts, dark brown (219) with white tips, broadest on longer feathers; median coverts also have large white lateral spots; greater coverts have indented white fringe on outer feathers and lateral spots on inner feathers. Innerwing thus looks boldly scalloped black and white, like scapulars. All primary coverts, dark brown (219) with narrow white tips. Primaries, black-brown (119), with white subterminal shaft-streak; p6–p10 have concealed white inner web, p1–p5 have concealed white bases and broad white subterminal patches on outer webs that meet white tips of secondary coverts to form prominent wing-bar. Inner primaries have fine white fringes. Secondaries, dark grey-brown (c121), with white fringes and concealed white bases. Tertials, dark brown (219), with white tips and paired white lateral spots along length of feather. **Underwing** Median and greater primary coverts, pale brownish-grey (c86). Other coverts, white; greater secondary coverts with pale brownish-grey (c86) wash on inner web; contrast sharply with black-brown (20) axillaries. Primaries, dark grey (83) with white subterminal inner web. Secondaries, pale grey (86).

Adult female breeding Second and subsequent alternate plumages, though retain much basic body-feathering throughout breeding period. Differences from breeding male. **Head and neck** Feathers of crown and nape, dark brown (219), with narrow white fringes, often admixed with grey-brown basic feathering. Chin, throat, lores and ear-coverts, dark brown (219); feathers have white bases that are partly visible and give speckled appearance. **Upperparts** Some old dark-brown (121) feathers retained on mantle, scapulars and upper back, giving browner appearance than male. White fringes of alternate feathers narrower than in male, enhancing less spangled appearance. **Underparts** Feathers of breast and upper belly, black-brown (119) with white bases that are sometimes visible. Occasional wholly white feathers scattered through breast, giving blotched appearance. White areas to sides of upper breast, larger than in male, with some tipped dark brown (121) and others with dark-brown (121) bases. **Tail** Dark bars often narrower and more numerous than in male; tip of t1 often clouded grey (BWP). **Upperwing** Differ from males in same way as breeding scapulars.

Adult non-breeding Sexes similar. **Head and neck** Lores, supercilium and sides of head, white, with inconspicuous brown (28) shaft-streaks to feathers. Throat, white. Feathers of crown and nape, dark grey-brown (c119A), with thin white fringes giving scalloped appearance. Feathers of neck and lower throat, white, with brown (28) central streaks. **Upperparts** Feathers of mantle, scapulars and upper back, dark grey (83) to dark grey-brown (c119A), with thin white fringes. Feathers of lower back, dark grey (83) to dark grey-brown (c119A), with white tips. Rump and upper tail-coverts, as in breeding plumage. **Underparts** Upper breast, light grey-brown (c119C), heavily streaked by white fringes to feathers, which are broadest towards centre of breast. Lower breast, belly, vent, thighs and flanks, white, obscurely streaked by light grey-brown (c119C) centres to feathers,

broadest on upper flanks. Axillaries, black. **Tail** As adult breeding. **Upperwing** Remiges and primary coverts as adult breeding male, except lesser primary coverts have dark-grey (83) ground. Lesser and median secondary coverts, dark grey (c83) with narrow white tips, black (89) shaft; median coverts have small white lateral spots; greater coverts, as adult breeding. Coverts fade to dark grey-brown (c119A). **Underwing** As adult breeding male. Female differs slightly (BWP): mantle, scapulars, tertials and upper wing-coverts of female, paler, more uniform dark grey with slight brown tinge; pale fringes, paler and more evenly curved; forehead, less white; dark bars on tail, narrower, more numerous; less often have black spotting on throat and breast.

Juvenile Orange-buff of head, neck and upperparts, fades to buff (124) or paler when plumage worn. **Head and neck** Forehead, orange-buff (153), with black-brown (19) shaft-streaks. Feathers of crown and nape, black-brown (19) with orange-buff (153) lateral spots; central tip of feather, dark, giving spotted rather than scalloped appearance. Feathers of throat, lores, ear-coverts and sides of neck, white with buff (124) wash and brown (119B) central streak. Feathers of hind-neck, brown (28) with off-white edges. **Upperparts** Mantle and upper back, black-brown (119) with orange-buff (153) lateral spots; central tip of feather remains dark. Lower back, brown (28), with orange-buff (153) lateral spots on end of feathers and concealed white lateral spots. Upper tail-coverts, mostly white with brown (28) barring and orange-buff (153) wash near tip. **Underparts** Feathers of upper breast, sides of lower breast and upper flanks, white, with buff (124) wash and brown (119B) central streak and tip. Central lower breast, belly, vent and thighs, white with cream (54) tinge. Under tail-coverts, mostly white but outer coverts have light grey-brown (27) edges. Feathers of lower flanks, white, with cream (54) tinge and light grey-brown (27) tips. **Tail** As adult but dark bars less regular and with orange-buff (153) wash over end of feathers. **Upperwing** Lesser and median secondary coverts, dark brown (119A) with large white lateral spots; centre of tip, dark. Greater secondary coverts, dark brown (119A) with jagged orange-buff (153) fringe on outer coverts and lateral spots on inner coverts. All primary coverts, dark brown (119A) with white tips, broken in centre of greater and median coverts. Primaries, as adult but with orange-buff wash on white areas. Tertials, dark brown (119A) with paired orange-buff (153) and white lateral spots along length of feather; tip, unspotted. Orange-buff (153) fades to white with wear; completely lost when very worn, resulting in indentations in side of coverts and tertials. **Underwing** As adult.

First immature First basic. As adult non-breeding but with juvenile remiges, rectrices and traces of juvenile body-plumage retained; particularly among median secondary coverts, tertials, rump and upper tail-coverts. Pale areas of wing-coverts and tertials fade to white and are first to wear away, resulting in pointed feathers. Primaries narrow, pointed and usually heavily abraded.

Second immature (First breeding). First alternate. As adult non-breeding but may show some dark-tipped feathers in underparts and some black-barred feathers in upperparts (BWP).

BARE PARTS Based on photos (Farrand 1983; Pringle 1987) and museum labels (HLW, MV, SAM). **Adult, Immature** Bill, black (89). Iris, black-brown (119). Legs, dark grey (83) to grey-black (82). **Juvenile** Like adult but bill tinged grey in Palaearctic autumn and feet often paler (BWP).

MOULTS Mainly from BWP (q.v.); Aust. data from skins (HLW, MV, SAM, WAM) and banding studies in Vic. (Vict. Wader Stud. Grp). **Adult post-breeding** Third and subsequent pre-basic moults; complete. Primaries, outwards; tail, irregular; body-moult intense during early stages of primary-moult and non-breeding appearance attained when only half primaries replaced. Most moult occurs in non-breeding areas or special staging areas; some may moult much body-plumage and 1–3 primaries before leaving breeding grounds (BWP). Some in Aust. (two skins, four live birds) suspend moult Sept.–Nov. after replacing 2–3 inner primaries, perhaps on breeding grounds or while staging *en route* to Aust. Records of active moult in Aust. from Nov. and Dec. apparently consistent with birds in tropical and subtropical areas mentioned in BWP, which begin moult in Sept.–Oct. and finished Dec.–Oct. Birds spending non-breeding period in cool areas of n. hemisphere (e.g. Britain) begin moult earlier (early Aug. to Sept.) and finish from early Oct.; if not completed by onset of poor weather, suspend or arrest primary-moult, generally resuming moult at point of interruption, between Mar. and early May. Females usually migrate farther S than males, so many more males show suspended moult. **Adult pre-breeding** Second and subsequent pre-alternate moults; partial, mainly early Apr. to mid-May. In males, most feathers moulted except for remiges, some coverts and scattered feathers on back and underparts. Moult less extensive in female, with many scattered old feathers retained on head, and upperparts, wing-coverts and underparts. **Post-juvenile** (First pre-basic). Partial; juvenile remiges, rectrices, median coverts, tertials, and tail-coverts, usually retained. No information on timing from Aust. birds; w. Palaearctic birds start Nov. (exceptionally Oct.) to Jan.; some mostly in first basic plumage by Jan. but some retain much juvenile plumage until at least Apr. (BWP). **Immature post-breeding** Second pre-basic; do not breed before completing this moult. Complete; takes place on non-breeding grounds. Primaries, outwards, usually beginning Mar. (occasionally Jan.) to June and finishing July–Oct.; most moult occurs May–Aug. Head, tail and rest of wing-moult at same time. Some juvenile body-plumage discernible until moult-score reaches *c.* 30.

MEASUREMENTS (1) Throughout range, adults, skins (AM, ANWC, HLW, MV, SAM, WAM).

	MALES	FEMALES	
WING	(1) 197.7 (4.80; 191–205; 6)	201.7 (5.78; 190–213; 20)	ns
8TH P	(1) 123.0 (2.16; 120–125; 4)	125.2 (3.77; 117–132; 15)	ns
TAIL	(1) 70.7 (2.36; 67–75; 7)	73.2 (3.34; 69–81; 21)	ns
BILL	(1) 29.5 (0.87; 28.3–30.8; 7)	30.4 (1.31; 28.4–33.2; 19)	ns
TARSUS	(1) 47.3 (1.94; 44.1–49.9; 7)	48.0 (1.88; 45.3–52.3; 21)	ns
TOE C	(1) 31.3, 32.6, 33.0	32.8 (1.35; 31.4–35.5; 10)	ns

(2) Vic., adults, live (Vict. Wader Stud. Grp, unpubl. data).

	UNSEXED
WING	(2) 207.2 (3.97; 199–216; 29)
BILL	(2) 31.5 (1.32; 28.6–33.6; 27)
THL	(2) 69.9 (1.61; 67.1–73.0; 32)

Additional measurements in BWP; their data also showed no difference in size between sexes.

WEIGHTS Few data available for HANZAB region. (1) Unsexed adults from Vic. (Vict. Wader Stud. Grp).

ADULTS	
1 Oct.	(1) 202.0 (10.59; 180–220; 10)
29 Oct.	(1) 223.0 (15.55; 215–245; 5)
19 Nov.	(1) 244.5 (10.85; 235–260; 4)
21 Feb.	(1) 307.3 (20.06; 270–330; 13)

Adults from throughout range, combined data from labels: one male, 166; females, 275.2 (63.7; 200–332; 4) (AM, ANWC, MV). Extralimital data summarized in BWP, Summers & Waltner (1979) and Zwarts *et al.* (1990).

STRUCTURE Wing, long narrow and pointed. Eleven primaries; p10 longest; p9 4–10 mm shorter, p8 16–23, p7 29–35, p6 42–49, p5 57–62, p4 72–75, p3 85–90, p2 95–101, p1 105–111, p11 minute. Sixteen secondaries including four tertials; tips of longest tertials fall on folded wing between p6 and p7. Tail, square; 12 rectrices. Bill, stout, rather short, slightly shorter than length of head (but proportionately longer than in Pacific Golden Plover); nasal groove, half length of bill; nostril, slit-like; distal half slightly bulbous. Tarsus, slightly laterally compressed; scales, reticulate. Outer toe 81–86% of middle, inner 71–76%, hind toe minute.

GEOGRAPHICAL VARIATION No subspecies. Slight variation in size only; assumed to be clinal but few data from breeding grounds (BWP).

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Volume 2, Plate 60

Grey Plover *Pluvialis squatarola* (page 811)
1 Adult breeding; **2** Adult non-breeding; **3** Juvenile; **4, 5** Adults, non-breeding plumage

Pacific Golden Plover *Pluvialis fulva* (page 800)
6 Adult breeding; **7** Adult non-breeding; **8** Juvenile; **9, 10** Adult non-breeding