

Order COLUMBIFORMES

Large homogeneous group of arboreal and terrestrial birds. The names pigeon and dove synonymous, though dove usually used for smaller species and pigeon for larger species, but distinction not consistently followed, and both sometimes used as alternative names for same bird. One extant family; dodos (Rhaphidae) and solitaires (Rhaphidae or Pezophapidae) extinct. Order monophyletic and easily distinguished, but affinities unclear. Columbiformes share a number of characters with Charadriiformes (shorebirds) including: schizognathous palate and schizorhinal nostrils; presence of small basipterygoid processes, tracheo-bronchial syrinx and usually diastataxic wings. However, differ in rigid vertebral column, large hindtoe, general biology, behaviour and type of young (see below). Also have anatomical similarities with Pteroclidiformes (sandgrouse), including structure of feathers, skull, shape of humeral head, sternum, pelvis and pectoral musculature. However, sandgrouse differ in several important ways: do not produce crop-milk, have large functional caecum and different syrinx. Sandgrouse often placed in Columbiformes (e.g. Bock 1994); or pigeons, sandgrouse and shorebirds combined in single order (e.g. Fjeldså 1977). However, studies of egg-white proteins (Sibley & Ahlquist 1972), composition of lipid oil-gland secretion (Jacob 1978) and DNA-DNA hybridization (Sibley & Ahlquist 1990) show no close affinities between pigeons and doves and other living birds; similarities to sandgrouse and shorebirds assumed to be convergence or retention of primitive characters. Best treated as discrete order Columbiformes (Sibley & Ahlquist 1990; BWP).

General features, moult, breeding and biology discussed below.

Family COLUMBIDAE pigeons and doves

Small to very large; from *Geopelia cuneata* (19–21.5 cm, 23–37 kg) to *Goura victoria* (70–80 cm, 1.7–2.9 kg). About 310 species in c. 40 genera (including 15 monotypic genera, and 14 genera with fewer than five species) (Campbell & Lack 1985; Sibley & Monroe 1990; Goodwin; BWP). Major genera include: (1) *Columba* (typical pigeons) with 54 species; (2) *Ptilinopus* (fruit-doves), 51 species; (3) *Ducula* (imperial-pigeons), 36 species; (4) *Treron* (green pigeons), 22 species; (5) *Gallucolumba* (Old World quail-doves), 19 species; (6) *Geotrygon* (American quail-doves), 15 species; (7) *Streptopelia* (turtle-doves and collared-doves), 15 species; (8) *Leptopila* (doves), 11 species; (9) *Macropygia* (cuckoo-doves), ten species. Family homogeneous, and attempts to group the 40–43 genera unsatisfactory. Bock (1994) recognized five subfamilies; none was recognized by BWP; most useful arrangement perhaps informal one of Goodwin (1967; Sibley & Ahlquist 1990; Goodwin).

Cosmopolitan, except Arctic and Antarctic. In HANZAB region, 32 species in 15 genera (28 breeding, two vagrant, two extinct): *Columba* (3 species: endemic *C. leucomela*; introduced *C. livia*; *C. vitiensis*, extinct HANZAB region); *Streptopelia* (3; introduced); *Macropygia* (1); *Chalcophaps* (1); *Phaps* (3; genus endemic); *Ocyphaps* (monotypic; endemic); *Geophaps* (3; genus endemic); *Petrophassa* (2; genus endemic); *Geopelia* (3); *Leucosarcia* (monotypic; endemic); *Gallucolumba* (1; extinct); *Ptilinopus* (4); *Ducula* (4); *Lopholaimus* (monotypic; endemic); *Hemiphaga* (monotypic; endemic).

Relationships within genera of HANZAB region complex; many have affinities with species in Indonesia, New Guinea and surrounding islands; others endemic (see Christides & Boles 1994; Frith). Many taxonomic problems involving pigeons and doves of HANZAB region unresolved, e.g. (1) whether or not Aust. species of *Geopelia*, *Macropygia* and *Ducula* should be combined with similar allopatric congeners of New Guinea and Indonesia; (2) which genera to recognize in the *Petrophassa*–*Geophaps*–*Ocyphaps* assemblage; (3) whether Chatham Island Pigeon *Hemiphaga (novaeseelandiae) chathamensis* merits species status. Taxonomic treatment here follows Christides & Boles (1994) and NZCL.

Bodies generally plump and compact, with small heads and short necks. In most species, males larger than females. Have 37–39 vertebrae (including fused pelvis and pygostyle). Wings usually broad, with rounded tips. Eleven primaries; p1 reduced. Ten to 15 secondaries, including tertials; most species diastataxic, some eutaxic. Remiges rigid, causing loud and characteristic clapping sound when bird flies away (also in display). Flight strong and direct; cannot soar, but most will glide, especially in display. Tail of most long and broad, with square or slightly rounded tip; very long and pointed in some species; 12–14, sometimes 16, rectrices (up to 18 in crowned pigeons *Goura* and pheasant pigeon *Otidiphaps*). In many species, juvenile rectrices (and, less so, remiges) narrower than in adults; in *Ptilinopus*, wing of juveniles shorter and more pointed than in adults, giving different wing-formula. Bill, short, weak and superficially plover-like (except in some tropical fruit-eating genera), usually with an expanded tip; tip hard and sometimes hooked, base soft. Nostrils obliquely placed under a thin operculum in cere at base of bill.

Tarsi usually short, with small hexagonal or rounded scales at sides and rear. Feet of perching type, with three front toes and large functional hindtoe. Oil gland absent or rudimentary, unfeathered; powder-down used for plumage maintenance. Caeca, absent or rudimentary; crop, large and bilobed, resulting in asymmetric extrinsic muscles on tracheo-bronchial syrinx; two carotids. During breeding, glandular lining of crop of both sexes produces nutritious secretion, crop-milk, for feeding small young. Gizzard, heavily muscled; intestines, long and narrow in most species, but not in some frugivorous species, in which stomach only rubs pulp or pericarp off fruits (rather than grinding seeds), and seeds pass intact through short, wide gut. No gall bladder or supra-orbital salt-glands.

Feathers unique, with dense plumulaceous bases and strong and broad shafts that taper abruptly to thin point. Inserted loosely in skin and readily lost. No aftershafts, though remiges, rectrices and their coverts might have small aftertufts. Primaries variously emarginated, particularly on one or more of p8–p10; emarginations possibly involved in sound production (see Crested Pigeon *Ocyphaps lophotes*). Have little down, restricted to lateral apteria of body and pelvic apterium. Feathers of body have downy barbs at base and basal edges. Growing feathers (down, semi-plumes and downy portions of most contour feathers) shed fine white powder, which is used when preening and maintenance of feathers. Mould powder-producing feathers more often than other contour feathers and powder supplied nearly continuously. Most powder produced on flanks, especially in front of thigh and in front of and behind tail (Lucas & Stettenheim 1972).

Plumage usually shades of brown, grey and cream, but brilliantly coloured in many species (e.g. some fruit-pigeons) with bright greens, reds, oranges, yellows, pinks, golds, blues and purples; iridescence often present in feathers of wings, tail, head, neck and upperparts. Several species crested (e.g. in Aust., *Ocyphaps lophotes*, *Geophaps plumifera*), have coloured facial skin or orbital rings (e.g. *Geophaps scripta*) or enlarged ceres, which may form caruncles (e.g. *Lopholaimus antarcticus*). In most, sexes differ only slightly in appearance, with males somewhat brighter or more patterned; in others, sexes alike or differ markedly. Bare parts often coloured. Bill, black, brown, yellow, white, grey, green, or blue; tip and base often of different colours. Iris, red, orange, yellow, green or brown. Legs and feet, red, pink or purple. Undergo a complete post-breeding (pre-basic) moult each cycle, with no pre-breeding (pre-alternate) moult and so lack an alternate plumage. Primaries moult outwards; often very slowly, replacing only one feather at a time, though some can have more than one active wave of moult in wing. Arrested and suspended moult of primaries occurs in most, possibly all, Aust. species. Young altricial, nidicolous and wholly dependent on parents for food. Blind at hatching; sparsely covered in yellow, brown or grey down, usually thickest on upperparts. Young develop rapidly, and in some (e.g. *Ptilinopus superbus*) leave nest when remiges only half grown. Juvenile plumage distinct; usually duller, with dark subterminal bands and pale edges to contour feathers; usually held only briefly. Adult plumage attained in complete post-juvenile (first pre-basic) moult, which starts 1–3 months after hatching; post-juvenile moult of head, body and wing-coverts takes 3–6 months, of remiges and rectrices, 4–14 months.

Occur in most habitats; from arid and semi-arid zones to tropical rainforest. Found singly, in pairs or small flocks; some species in large flocks (e.g. Flock Bronzewing *Phaps histrionica* of Aust.). Some species sedentary, many are nomadic; a few undertake regular migration. Many species arboreal (fruit-doves of HANZAB region); others at least partly arboreal (e.g. *Phaps*, *Geopelia*, *Streptopelia*, *Macropygia*, *Columba*); but few strictly terrestrial (e.g. *Geophaps*, *Pterophassa*).

Diet mainly fruit or seeds or both; some also eat flowers, shoots, young leaves and invertebrates (e.g. *Hemiphaga novaeseelandiae*). Feed in trees, on ground, or both. Arboreal species usually cling, hang, and clamber among slender branches, and have large distensible gapes for swallowing large fruit. Terrestrial species do not scratch for food; glean while slowly moving, with sideway flicking movements of bill. Swallow food whole; cannot bite, chew or dehusk food. Grasp items in bill and tug. All species must drink and do so characteristically by inserting bill and sucking up continuous draught of liquid (Goodwin).

Movements vary. In Aust., migratory (e.g. Pied Imperial-Pigeon *Ducula bicolor*) to irruptive and dispersive (e.g. Flock Bronzewing *Phaps histrionica*), resident (Banded Fruit-Dove *Ptilinopus cinctus*) and even sedentary (e.g. Bar-shouldered Dove *Geopelia humeralis* and New Zealand Pigeon *Hemiphaga novaeseelandiae*). Movements of many species poorly known (e.g. Squatter Pigeon *Geophaps scripta*). Some species move to temporarily suitable habitat (e.g. Flock Bronzewing), while many rainforest pigeons move to temporarily available supplies of food (e.g. Brown Cuckoo-Dove *Macropygia amboinensis*). Introduced species non-migratory (e.g. Spotted Turtle-Dove *Streptopelia chinensis*), even mostly sedentary (e.g. Laughing Turtle-Dove *Streptopelia senegalensis*). One species, Rock Dove (Feral Pigeon) *Columba livia*, has been focus of much research on biological basis of homing and navigation; also widely kept and raced for sport.

All except green pigeons (*Tetron*) of Africa and Asia, which whistle, give a variety of soft cooing calls. *Lopholaimus* unique in being nearly silent, giving only low grunts and squeaks. Commonest call generally Advertising Call. For general discussion of calls, see Goodwin.

Social organization of Aust. pigeons little studied in wild. During non-breeding season, many species loosely gregarious, moving in small groups, though some (e.g. Flock Bronzewing) can congregate in thousands. Larger numbers often associated with water or abundant food. Some species, such as Wonga Pigeon, solitary. Usually

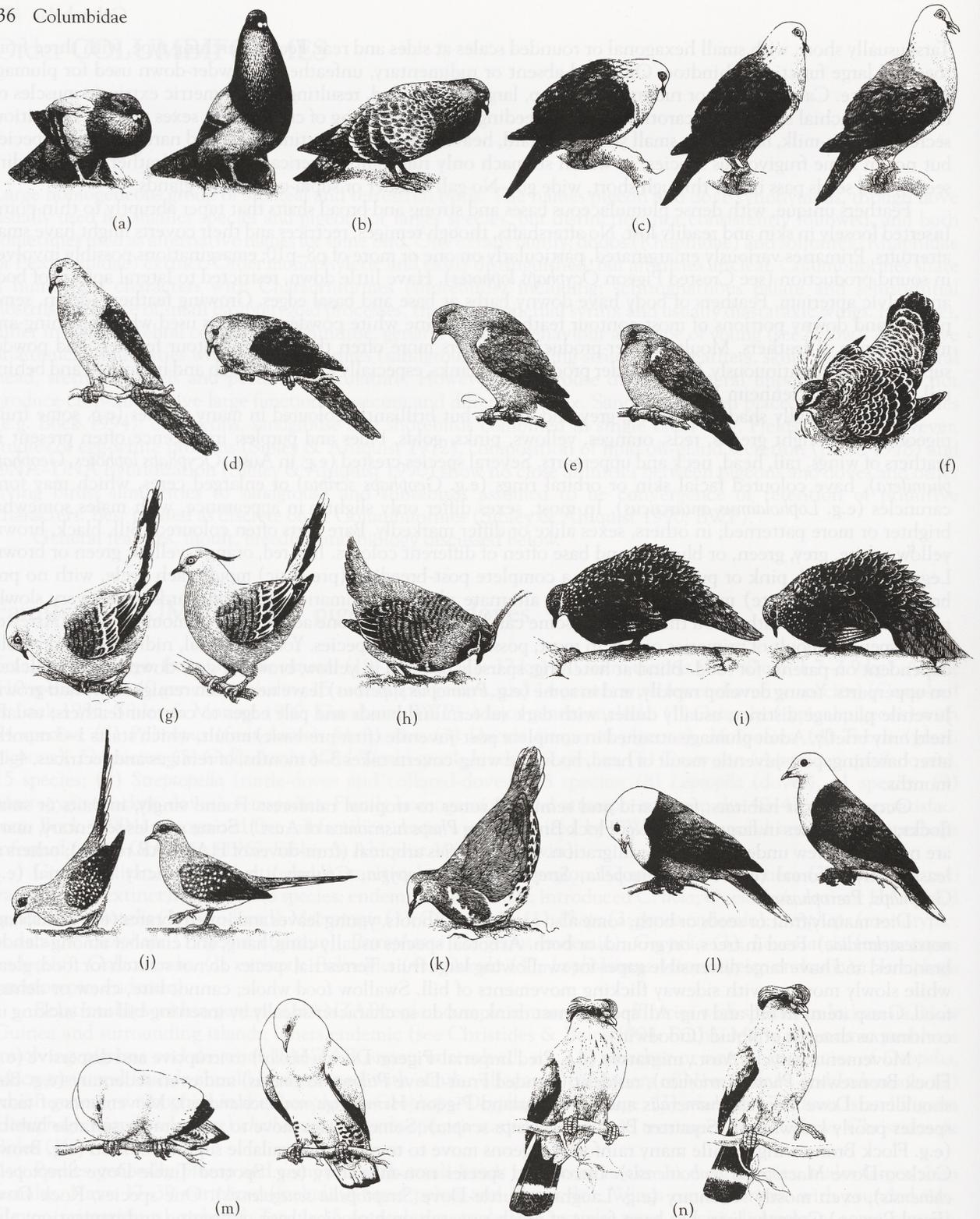


Figure 1 Bowing Displays; high and low points shown unless stated: (a) Rock Dove *Columba livia*, sexual form; (b) Rock Dove, assertive form (low point); (c) White-headed Pigeon *Columba leucomela* (figure on extreme right shows bird mandibulating at end of display); (d) Brown Cuckoo-Dove *Macropygia amboinensis*; (e) Emerald Dove *Chalcophaps indica*, Bobbing Display, a type of Bowing Display; (f) Common Bronzewing *Phaps chalcoptera* (low point); (g) Crested Pigeon *Ocyphaps lophotes*; (h) Spinifex Pigeon *Geophaps plumifera* (male, at low point); (i) Chestnut-quilled Rock-Pigeon *Petrophassa rufipennis*; (j) Diamond Dove *Geopelia cuneata*; (k) Wonga Pigeon *Leucosarcia melanoleuca* (low point); (l) Banded Fruit-Dove *Ptilinopus cinctus*; (m) Pied Imperial-Pigeon *Ducula bicolor*; (n) Topknot Pigeon *Lopholaimus antarcticus*.

monogamous, pairing at least for duration of nesting cycle; mostly breed as single pairs but some form colonies (e.g. Pied Imperial-Pigeon, Flock Pigeon).

Postures and displays of all Aust. pigeons have been studied and described by Frith (1977; Frith). Not all displays illustrated in Frith have been reproduced here but many of the common displays and postures are shown in Figures 1 to 10. In these, illustrations are usually presented for only one species in each genus. Some other displays, usually particular to a species, are illustrated within the species accounts. The term bronze-winged pigeons (in the texts and in Frith), refers to all species of Aust. pigeons with iridescent panels in the wing (i.e. *Phaps*, *Ocyphaps*, *Geophaps* and *Petrophassa*).

Displays used in threat and courtship often similar. Bowing Display and Display Flight two most common displays. Bowing Display (= Bow Coo) (see Fig. 1): Bird usually faces bird to which it is displaying, lowers head and calls, then raises head; in many species, tail is spread. Usually seen in sexual or aggressive circumstances. Most, possibly all, have postures that are homologous in appearance to a bow and often quite uniform within genera (see Frith). Display Flight (Fig. 10): Bird ascends in flight, often audibly beating wings then, at apex of ascent, spreads wings and tail and glides down. May be performed during normal flight or may start from, and return to, perch. In Aust., not recorded in *Ptilinopus*, *Geophaps*, *Petrophassa*, *Leucosarcia*, *Chalcophaps*, and Common and Flock Bronzewings and Bar-shouldered Dove. In species accounts, Display Flight placed under heading 'Aerial activity' because the function of display not studied in Aust. forms; assumed to advertise presence of sexually active male.

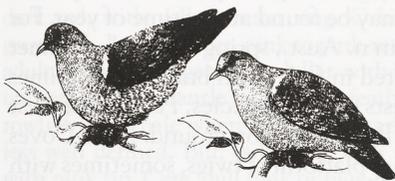


Figure 2 Tail-raising Advertising Display of Emerald Dove *Chalcophaps indica* (left – high point, right – low point).



Figure 4 Wing-raising, Bar-shouldered Dove *Geopelia humeralis*.

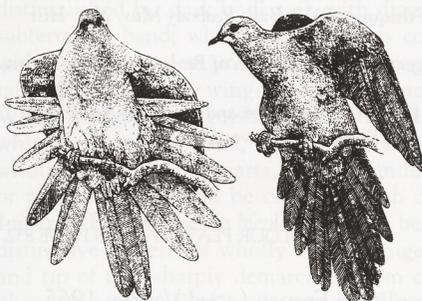


Figure 7 Mantling and Wing-stretching, Brown Cuckoo-Dove *Macropygia amboinensis*.

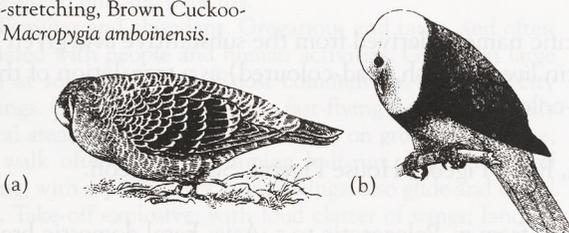
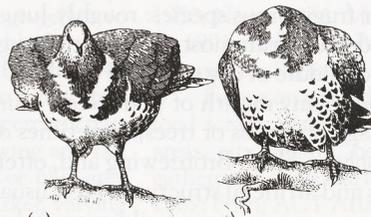
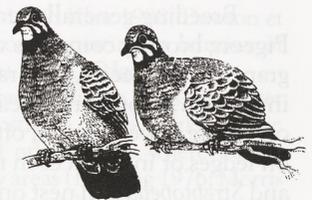


Figure 9 Advertising Call Posture: (a) Common Bronzewing *Phaps chalcoptera*; (b) Banded Fruit-Dove *Ptilinopus cinctus*.



(a)



(b)

Figure 3 Advertising Display: (a) Wonga Pigeon *Leucosarcia melanoleuca* (left – high point, centre – low point, right – rear view); (b) Squatter Pigeon *Geophaps scripta* (high and low points).

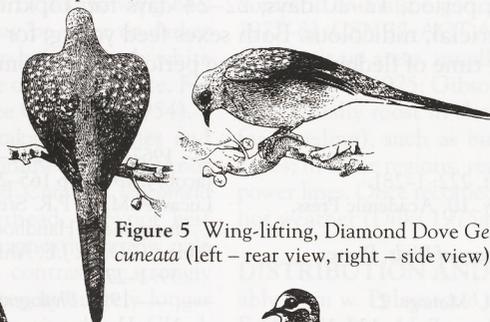


Figure 5 Wing-lifting, Diamond Dove *Geopelia cuneata* (left – rear view, right – side view).

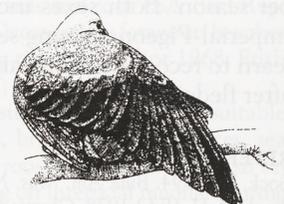


Figure 6 Mantling, Wompoo Pigeon *Ptilinopus magnificus*.

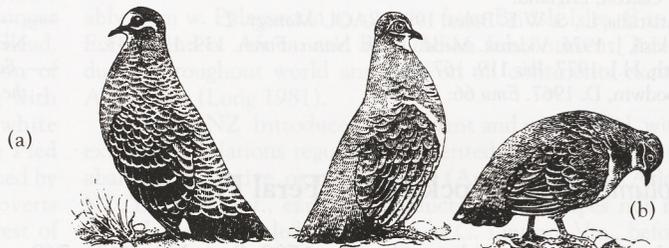


Figure 8 Post-copulatory Parade: (a) Common Bronzewing *Phaps chalcoptera*; (b) Partridge Pigeon *Geophaps smithii* (high and low points).



Figure 10 Display Flight, Rock Dove *Columba livia*.

Other displays include: other Advertising Displays (Figs 2, 3) and Advertising Call Posture (special posture when giving Advertising Call; see Fig. 9). Parade (Fig. 8), usually seen at times of sexual excitement, and often given as a post-copulatory display. Jump, seen in sexually excited or aggressive birds and often associated with Parade. Driving (an avicultural term), where male moves mate away from other males. Preening-Behind-the-Wing, assumed to be sexual. Nest Calling is a posture adopted by male seeking suitable nesting site, as he calls to female. Nodding, function unknown. Wing-stretching (sometimes called Mantling; see Figs 6, 7), a comfort behaviour but possibly also used in sexual circumstances. Wing-lifting (Fig. 5) seen in aggression and alarm but function not known. Wing-raising (Fig. 4), a defensive-threat display also seen in sexual and alarm behaviour. (For latter three, involving raising of wings, terminology, as suggested by Frith, has not been strictly used in literature, which sometimes leads to confusion as to which displays are being described.) Allopreening occurs throughout sexual cycle, at nest and elsewhere. Courtship feeding (sometimes called Billing), commonly associated with copulation.

When roosting, pigeons do not tuck head behind wing, but draw it into body; sometimes one leg drawn up into feathers of belly. When loafing, may also squat or lie down. Bathe by wading into shallow water and immersing themselves; Flock Bronzewings will alight directly on water to drink, and possibly to bathe. Most also bathe in rain, often crouching, leaning to one side, and raising and fully extending wing, exposing underwing to rain; plumage often ruffled. Sunning posture similar to that when bathing in rain; may only partly open one or both wings and partly or fully spread tail. For more details on behaviour, particularly relationship between behavioural characters and taxonomy of family, see Frith, Frith (1977), Goodwin and Goodwin (1967).

Breeding generally seasonal. For frugivorous species: roughly June–Feb. in Aust., Sept.–Apr. for New Zealand Pigeon; broadly coincides with period when fruit most abundant, though nests may be found at any time of year. For granivorous species, generally early to middle of dry season (Feb.–Mar. to July) in n. Aust., spring and early summer in s. Aust., though nests can be found in any month of year. Nests usually situated in fork or on branch, sometimes on tangle of vegetation; often in foliage of shrubs or trees, sometimes on old nests of other species; *Petrophassa* nest on ledges or in crevices in rocks; *Geophaps*, Flock Bronzewing and, often, Brush Bronzewing on ground. Rock Doves and *Streptopelia* will nest on buildings and artificial structures. Nest usually a flimsy platform of twigs, sometimes with tendrils of vines, rootlets or grass; some species may build more substantial nests. Ground-nesting species make scrape, usually lined with vegetation. Males usually collect material and females build. Most frugivorous species lay one egg per clutch; granivorous species, two. Eggs usually white, sometimes cream, and unmarked; may have pink tinge when fresh. Eggs laid on successive days, sometimes 2 days apart. Some species may lay more than one clutch per season. Both sexes incubate; period, 12–20 days; 22–24 days for Topknot Pigeons and 26–28 days for Pied Imperial-Pigeons. Young semi-altricial, nidicolous. Both sexes feed young; for first few days, on crop-milk. Parents learn to recognize young at about time of fledging. Fledging period ranges from 11 to 35 days. Young sometimes fed after fledging.

REFERENCES

- Bock, W. 1994. *Bull. Am. Mus. Nat. Hist.* 222: 1–281.
 Brush, A.H. (Ed.) 1978. *Chemical Zoology*. 10. Academic Press, Lond.
 Campbell, B., & E. Lack. 1985. *A Dictionary of Birds*. Poyser, Calton, England.
 Christidis, L., & W.E. Boles. 1994. *RAOU Monogr.* 2.
 Fjeldså, J. 1976. *Vidensk. Medd. dansk. Natur. Foren.* 139: 179–243.
 Frith, H.J. 1977. *Ibis* 119: 167–82.
 Goodwin, D. 1967. *Emu* 66: 319–36.
 — 1967. *Emu* 66: 237–51.
 Jacob, J. 1978. Pp 165–211 In: Brush 1978.
 Lucas, A.M., & P.R. Stettenheim. 1972. *Avian Anatomy — Integument*. Handbook 362; US Dept Agric. Washington, DC.
 Sibley, C.G., & J.E. Ahlquist. 1972. *Bull. Peabody Mus. Nat. Hist.* 39: 1–276.
 —, — 1990. *Phylogeny and Classification of Birds*. Yale Univ. Press, New Haven.
 —, & B.L. Monroe Jr. 1990. *Distribution and Taxonomy of Birds of the World*. Yale Univ. Press, New Haven.

Streptopelia chinensis **Spotted Turtle-Dove**

COLOUR PLATE FACING PAGE 848

Columba chinensis Scopoli, 1786, *Delic. Flor. Faun Insubr.*, fasc. 2: 94 — China = Canton (*apud* Stresemann, *Abh. Ber. Mus. Dresden* 16[2]: 67).

Specifically named after the type-locality.

OTHER ENGLISH NAMES Spotted Dove, Indian Dove, Indian, Malay or Burmese Spotted Dove, Indian Turtledove, Laceneck Dove, Necklace Dove.

POLYTYPIC Nominate *chinensis* e. China; subspecies *forresti* Rothschild, 1925, nw. Yunnan and ne. Burma; subspecies *formosa* (Kuroda, 1927) Taiwan; subspecies *hainana* (Hartert, 1910) Hainan; subspecies *suratensis* (Gmelin, 1789) India and Himalayas; subspecies *ceylonensis* (Reichenbach, 1851) Sri Lanka; subspecies *vacillans* Hartert, 1916, se. Yunnan; subspecies *tigrina* (Temminck, 1810) e. India, Burma, Malay Pen., Indochina, Palawan, Borneo and Sundas. Nominate *chinensis* and subspecies *tigrina* introduced Aust. (some hybridization occurs in Aust.); subspecies *tigrina* introduced NZ.

FIELD IDENTIFICATION Length 30–33 cm; wingspan 40–46 cm; weight 160 g. Large dove, with rather long, strongly graduated tail. Similar in shape to Laughing Turtle-Dove *Streptopelia senegalensis* but much bigger and bulkier, with plumper body, proportionately longer tail and shorter wings. Adult mostly grey-brown above and paler pinkish-brown below, with diagnostic black half-collar, spotted with white; mottled saddle and wing-coverts; and broad white tips to rectrices, prominent in flight. Sexes alike. No seasonal variation. Juvenile separable.

Description Adult Forehead, forecrown, lores, area round eye and malar region, light grey. Rest of head and neck, pink-brown, with: narrow blackish line from gape, reaching nearly to eye; white chin; and diagnostic black half-collar spotted with white on hindneck and sides of neck. Upperbody, dark grey-brown, with usually prominent dark shaft-streaks and pale fringes to feathers of mantle and scapulars, which combine to give mottled appearance above; some birds appear more uniform. Uppertail appears dark grey-brown when closed; when spread, central pair of rectrices wholly dark grey-brown, next pair have dusky subterminal band, and rest have broad black subterminal band and broad white tips, forming prominent white corners to tail in flight. Upperwing: most secondary coverts as mantle and scapulars; outer few lesser, median and greater secondary coverts and lesser primary coverts, light grey or blue-grey, forming narrow (often concealed) grey edge to bottom of folded wing and, in flight, pale band from carpal separating grey-brown forewing-coverts from blackish greater primary coverts and remiges; tips of outer primaries narrowly fringed cream when fresh. Underbody, pink-brown, grading to cream on belly and vent; flanks, light grey; undertail-coverts vary from off-white to grey. Undertail mostly white, with black at base partly concealed by undertail-coverts. Underwing mostly dark grey, with contrasting blackish band through central secondary coverts and light-grey leading-edge to innerwing. Bill, grey-black. Iris, orange-yellow, with black outer ring. Legs and feet, pink-red. **Juvenile** Differences from adult: Forehead, crown, nape, lores and area round eye, light grey, merging to light rufous-brown on rest of head and neck; lack half-collar. Feathers of upperparts and most secondary coverts have crisp narrow rufous-brown fringes giving neat scaly appearance when fresh. Remiges narrowly fringed rufous-brown or buff at tips. Underbody duller: foreneck and breast, light grey-brown, grading to pink-buff on belly, vent and flanks; undertail-coverts, off-white, with buff tips. Iris duller, brown-grey or grey-yellow, with black outer ring. Legs and feet, dark grey to pink.

Similar species Black half-collar spotted with white (in adult), diagnostic. Can be confused with **Laughing Turtle-Dove**, especially if seen at distance or in flight. Laughing Turtle-Dove much smaller, slimmer and more compact, with proportionately shorter tail (appearing more wedge-shaped, not strongly rounded) and slightly longer wing-points; adult

easily distinguished from adult Spotted by diagnostic rufous-brown gorget, spotted with black. At all ages, further distinguished by: (1) brighter rufous-brown saddle; (2) mostly blue-grey secondary coverts, which form darker larger and prominent blue-grey shoulder-patch at rest and forewing-patch in flight; (3) blue-grey (not brown) rump; (4) in flight, outer rectrices have much broader white tips and narrower black subterminal band; and (5) dark (not pale) iris. Flying birds could also be confused with **Bar-shouldered Dove** *Geopelia humeralis*, which is easily distinguished by mostly grey uppertail, only narrowly tipped white.

Common and familiar dove of city and suburban streets, parks and gardens, and country towns. Seen singly, in pairs or small groups. Feed mainly on ground. Roost in shady trees during middle of day, often calling softly. Tame and approachable. Gait as other doves; walk sedately with head bobbing, breaking into faster run if pressed. Flight, fast and direct, with rapid shallow wing-beats and occasional brief glides and dips; when startled, take off with loud clatter of wings, usually ascending at steep angle with tail partly spread before settling into level flight with tail closed; alight with tail well spread, then slowly raise and lower closed tail a few times while settling. Display Flight conspicuous: fly steeply up on clattering wings, then descend in slow circling glide with wings and tail well spread. Main calls melodious *coo-coo-crrrooo*, and louder more strident *coo coo-oo krook* or *croo-oo kook*.

HABITAT In Asia, usually occur on outskirts of towns and villages, in gardens and groves of trees; also cultivated land; occasionally in open forest or jungles (Frith).

In Aust. and NZ, mainly in urban and suburban areas and in towns in rural areas; in all habitats, especially parks, gardens, streets and schools (McGill 1944; Tarr 1950; Bourke 1957; Sedgwick 1973; Frith *et al.* 1976; Walters 1985; Dunn 1989; Frith; CSN); also reserves, creeks and golf courses with some remnant vegetation (Watson 1955; Lord 1956; Preston 1983; Gill 1989; Frith). Rarely far from developed areas (e.g. Longmore 1978; SA Bird Rep. 1975). Away from towns, occur in agricultural districts, round homesteads and farmyards, vegetable gardens, orchards, and in pasture and cane plantations (Shanks 1949; Sedgwick 1958; Dawson *et al.* 1991; Leishman 1994; Frith; CSN). Rarely in native bushland (Leishman 1994; Frith); occasionally in coastal heathland and scrub (Bell 1983; Preston 1983; Smith 1984; Pyke 1985; Morris 1989; Horrocks & Brown 1993), but rarely in coastal samphire (Highett & Gottsch 1963) or mangroves (Hindwood 1935; Sedgwick 1958). Occasionally in modified or disturbed habitats, such as pine plantations (Lord 1956; Holland 1964; Morris 1975, 1986; Traill 1985; Frith), or in ecotone between native bush and built-up areas (Lord 1956; Hindwood 1960; Preston 1983; Loyn 1985; Gill 1989). Round Auckland, recorded in mixed habitats of *Pinus* and native vegetation (CSN 34).

Usually nest in native or introduced trees, bushes or vines, usually with dense foliage. In urban, suburban and rural areas round towns or habitation (Lord 1956; Sedgwick 1958; Morris 1977; Frith); often in gardens (Wolstenholme 1929; Lord 1956; Hindwood 1960; Holland 1964; Jones 1981); in pockets of remnant native vegetation (Hindwood 1960; Bell 1983; Leach & Hines 1987); in orchards; in shrubland behind dunes on edge of grassland. Sometimes on artificial structures, including buildings, power poles and stationary railway carriages (Frith; CSN 21). Rarely, in mangroves (Hindwood 1935); in sparse vegetation, including *Casuarina* or other woodlands (Lawrence 1946; Ashton 1985).

Forage on ground in open; occasionally in low bushes (Sedgwick 1958; Frith). Usually in gardens, parks, picnic areas, streets, roadsides and farmland; also fowl-yards and zoos (Noonan 1966; Frith *et al.* 1976; Morris 1989; Kloot & McCulloch 1993; Frith). Once observed feeding on coastal sandflat (Stranger 1969).

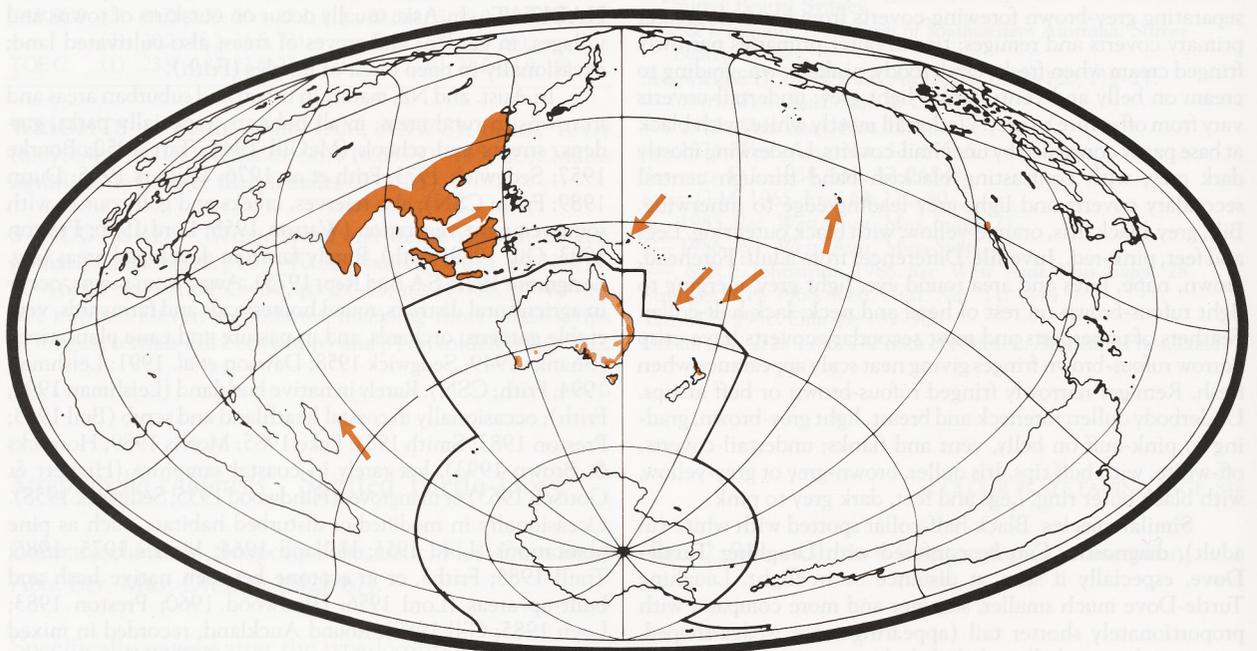
Prefer to roost among dense foliage of trees, but loaf in more open situations (Sedgwick 1958).

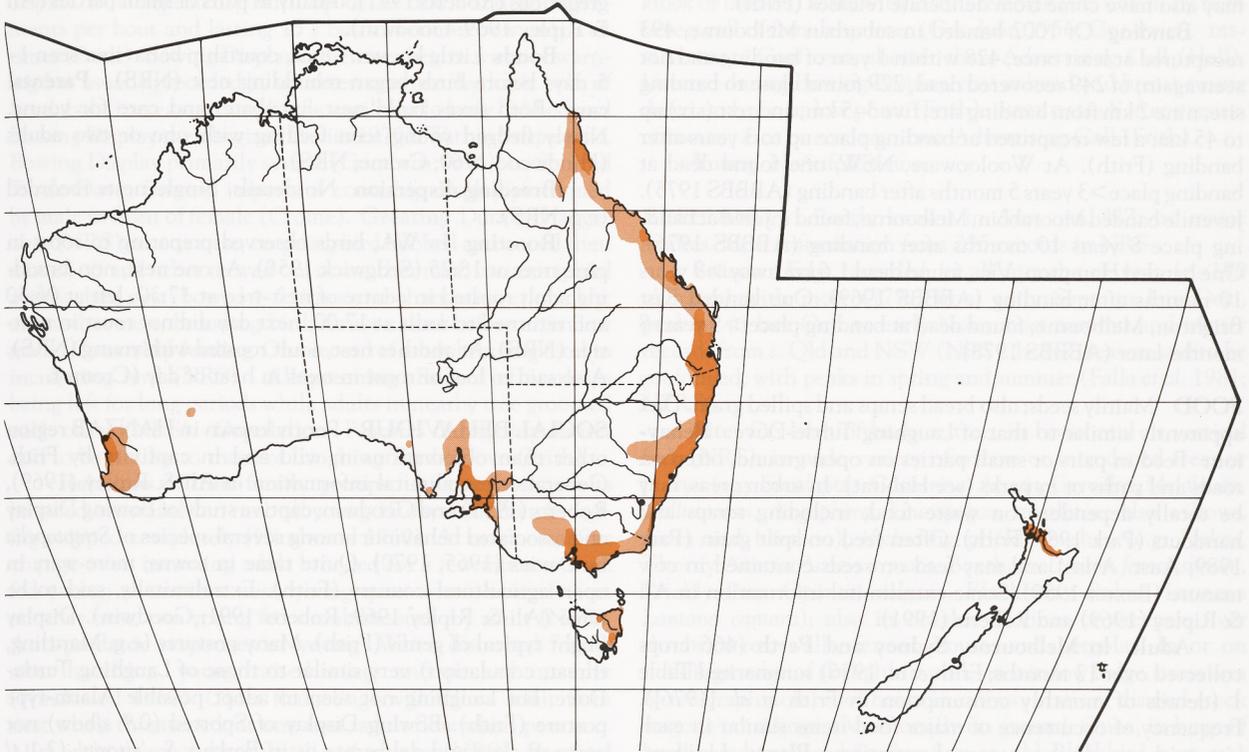
Railways probably facilitated spread of population in sw. WA (Sedgwick 1958).

DISTRIBUTION AND POPULATION S. and e. Asia, from Gulf of Khambhat in w. India, e. to Fukien Province in China, and Taiwan; through Indo-Malaya to Indonesia (Lesser Sundas, but not Sulawesi or Moluccas). Introduced to Hawaii, California, Mauritius, e. Indonesia, New Britain, New Caledonia, Fiji, Aust. and NZ (Long 1981; de Schauensee 1984; Goodwin; Frith).

Aust. Introduced and established in e., s. and sw. Aust., where populations have expanded (Frith & McKean 1975; Long 1981; Frith). **Qld** First introduced in early 1912, when 12 pairs successfully released from Brisbane Botanical Gardens, and four pairs unsuccessfully released at Gatton; established by 1919 (Chisholm 1919). By 1940s, widespread in SE, from North Stradbroke I., W to Toowoomba and N to Maryborough (Storr 1984). In n. Qld, released unsuccessfully in Townsville in 1926 (Frith). Released at Gordonvale in mid-

1940s and had spread to Innisfail and Cairns by 1945 (White 1946; Wheeler 1967); reached Townsville in 1965 (Storr 1984). Currently widespread from Cooktown, S to Townsville, and W to SW of Euremo, with scattered records S to Rockhampton; widespread in SE, S to NSW border, and W to Darling Downs, round Toowoomba (Storr 1984; Aust. Atlas). **NSW** Introduced Sydney, probably in nineteenth or early twentieth century; by 1926, numerous in w. suburbs and populations had expanded along n. and s. coast; populations in Northern Rivers Region thought to have spread from se. Qld, with a record from Boat Harbour (Richmond R. region) in 1935 (Frith 1952; Storr 1984; Frith). W of Great Divide: reached Bathurst in 1938; recorded Moree in 1943; reached Orange some time before 1946 (McGill 1944; Bourke 1957). Currently widespread E of Great Divide, from Qld border, S to Eden; also in W, in Central Tablelands round Mudgee, Orange and Cowra; and at Moree, Dubbo and Parkes (Morris *et al.* 1981; Frith; Aust. Atlas). Occasionally in Canberra (ACT Atlas). **Vic.** May have been released Melbourne in 1860s (Long 1981; Vic. Atlas); released at Melbourne Zoo in 1870, 1872 and 1874 (Ryan 1906); by c. 1950, restricted to 160 km radius round Melbourne (Tarr 1950). Currently widespread from w. Bellarine Pen., N to Kyneton and Kilmore, and SE through suburban Melbourne to w. Gippsland Plains and sparsely recorded to Lakes Entrance. Elsewhere, scattered records in East Gippsland, w. coast (e.g. Apollo Bay, Warrnambool), Bendigo and Castlemaine, Kerang, Yarrawonga and Wangaratta (Vic. Atlas). Vagrant recorded King R., SSE of Wangaratta, in 1948 (Shanks 1949). **Tas.** Released Beaumaris Zoo, Hobart, after 1895 (Sharland & Crane 1922; Park 1989); established (100s) in Hobart by 1910 and widespread in suburbs by 1930s. Currently widespread round Hobart, from Rosetta, S to Tarooma (and occasionally farther S to Blackman's Bay), and E to Howra, but less abundant than between 1910 and 1940 (Park 1989). Also recorded Launceston (Green 1989; Aust. Atlas). **SA** Unsuccessfully released from Adelaide Botanical Gardens in 1881, but established after birds escaped from aviaries at Adelaide Zoo during a severe storm in 1931 (Condon 1969); within two decades had spread N to Clare and S to Victor





Harbour (Tarr 1950; Boehm 1961). First recorded Kangaroo I. in May 1949 (Baxter 1989). About 12 released Port Lincoln in early 1970s (SA Bird Rep. 1975). Currently occur from Robe, N to Hawker and E along Murray R. Valley to Berri and Loxton, and W to s. Yorke Pen. and ne. Eyre Pen. round Whyalla and Kadina; also recorded Port Lincoln and Minnipa (Chapman 1966; SA Bird Reps; Aust. Atlas). **WA** Released from Perth Zoo in 1898 or 1899 (Sedgwick 1958); by 1920, plentiful in Perth (Alexander 1921; Sedgwick 1958). Also dispatched and released in regional centres (Long 1988). Range expanded after mid-1930s, reaching Rottneest and Garden Is in 1937 (Sedgwick 1958; Storr 1965; Storr & Johnstone 1988). By 1955, recorded N to Dongara and Winchester, S to Quindalup, and E to Katanning (Sedgwick 1958). First recorded Kalgoorlie, 1948 (Tarr 1950) and common by 1949; common in 1960 (Sedgwick 1958, 1965), but few records since 1962 (Storr 1986; Aust. Atlas). Currently occur in SW from Wanneroo S to Manjimup and Augusta (Long 1988; Storr & Johnstone 1988; Aust. Atlas). Isolated populations said to exist at Dongara and Katanning (Serventy & Whittell).

NZ Originated from cage-birds that escaped as early as early nineteenth century, with occasional deliberate introductions (Long 1981; NZRD). Mostly round Auckland, from Albany S to Pukehoke; small numbers recorded E to w. Firth of Thames, at Matingarahi, Wharekawa and Miranda; also at Papaaroa on Coromandel Pen. A few recent records farther E in Bay of Plenty, at Waikino, Te Puke, Kukamoia and Opotiki (CSN; NZRD).

Lord Howe I. Vagrant. Single, Apr. 1944 (Hindwood & Cunningham 1950).

Breeding Aust. In ne. Qld in Cairns–Innisfail region; Mackay; Rockhampton; and widespread from Maryborough, S to Tilba on NSW s. coast. In Vic., scattered records from Lakes Entrance to Latrobe Valley; widespread in central districts. In Tas., round Hobart and Launceston. In SA, from Murray Bridge N to Port Pirie, and W to Yorke Pen. In sw. WA, from

Perth S to Mandurah (NRS; Aust. Atlas). **NZ** Breed widely in suburbs of Auckland, from Albany S to at least Papakura and Karaka (Falla *et al.* 1981; NZCL).

Populations No estimates. Range in Aust. and NZ may be expanding (Frith; CSN), though abundance may be decreasing in some areas. At Burrewarra Pt, s. NSW, formerly resident and breeding, but now infrequently recorded (Whiter 1994); in suburban Hobart, populations apparently smaller now than in 1940s (Park 1989); surveys in Auckland Domain, 1986–87, recorded single bird, whereas large numbers recorded during mid-1960s (CSN 35).

Often killed by cats (Hindwood 1960; Ashton 1987; Park 1989) and occasionally by dogs (T. Peter). Occasionally shot (Lord 1956; CSN 19 Suppl.). Often fly into windows (Salter 1960). In urban areas, dependent on waste food, including scraps and handouts (Park 1989; Frith). Considered a pest by horticulturalists and silviculturalists because birds eat germinating seedlings (Long 1981, 1988; Park 1989). Occasionally killed with poisoned wheat; eggs occasionally collected in the past (Park 1989).

MOVEMENTS No regular long-distance movements known (Vic. Atlas). Banding study in Melbourne showed a few birds resident, but a large, locally dispersive, population (of mostly young birds) was continually moving through area. Regarded, without strong evidence, as sedentary (Green 1970) or mainly so (Long 1981), or resident (e.g. Storr 1965; Gill 1970; Dunn 1989; Hardy & Farrell 1990).

Present year-round in Aust. cities (Frith). However, in Hobart, possibly absent from at least some areas in winter (Park 1989) and, between 1966 and 1971, not recorded for several months in one year (1970) while otherwise resident (Thomas 1972). Can cross stretches of water to islands, e.g. Kangaroo I. (Chapman 1966; Abbott 1980). Isolated populations may have arisen from long-distance movements over large areas of unsuitable habitat (see Chapman 1966) but

may also have come from deliberate releases (Frith).

Banding Of 1002 banded in suburban Melbourne, 493 recaptured at least once, 428 within 1 year of banding and not seen again; of 249 recovered dead, 229 found close to banding site, nine 2 km from banding site, five 3–5 km, and rest (six) up to 45 km; a few recaptured at banding place up to 3 years after banding (Frith). At Woolooware, NSW, one found dead at banding place >3 years 5 months after banding (ABBBS 1975). Juvenile banded Moorabbin, Melbourne, found injured at banding place 8 years 10 months after banding (ABBBS 1976). One banded Hampton, Vic., found dead 1.6 km away >9 years 10 months after banding (ABBBS 1969). One banded East Brighton, Melbourne, found dead at banding place >5 years 8 months later (ABBBS 1978).

FOOD Mainly seeds; also bread scraps and spilled grain. Diet apparently similar to that of Laughing Turtle-Dove. **Behaviour** Feed in pairs or small parties on open ground, often on roads and paths or in parks (see Habitat). In urban areas, may be totally dependent on waste food, including scraps and handouts (Park 1989; Frith). Often feed on spilt grain (Park 1989; Aust. Atlas) and may feed on seeds contained in cow manure (Baxter 1980). Some extralimital information in Ali & Ripley (1969) and Roberts (1991).

Adult In Melbourne, Sydney and Perth (466 crops collected over 12 months; Frith *et al.* 1976) summarized Table 1 (details of monthly consumption in Frith *et al.* [1976]). Frequency of occurrence of major food items similar in each city, with no obvious seasonal variation. **Plants** Unident. 15% freq.; seeds of cultivated flowers 5.0; seeds of weeds (*Rumex*) 19.0; seeds of lawn grasses (*Poa*, *Cynodon*, *Hordeum*) 15.0; Poaceae: *Avena sativa* 8.7; *Sorghum vulgare* 5.8; *Triticum aestivum* 40.5; *Zea mays* 1.2; Asteraceae: *Helianthus annuus* 1.2; Caryophyllaceae: *Stellaria media* 3.2; Fabaceae: *Arachis hypogea* 3.0; *Cajanus cajan* 1.3; Mimosaceae: *Acacia* 0.5; Moraceae: *Ficus* 2.0. **Animals** 2.2. Bread 22.0; poultry pellets 3.8.

Table 1. Contents of crops in Aust. (Frith *et al.* 1976).

| Food | % Volume | | | Average |
|-----------------------|-----------|--------|-------|---------|
| | Melbourne | Sydney | Perth | |
| Animal feed | 47 | 44 | 46 | 46 |
| Bread | 18 | 24 | 12 | 18 |
| Garden and weed seeds | 35 | 32 | 42 | 36 |
| No. of crops | 167 | 80 | 219 | 466 |

Other records **Plants** Seeds of weeds^{7,8,9,10,13,14,15}; green shoots⁸. **MONOCOTYLEDONS**: Poaceae: *Poa annua*³; *Sorghum vulgare*¹¹; *Triticum aestivum*^{1,5,8,10}. **DICOTYLEDONS**: Asteraceae: *Arctotheca nivea*³; Fagaceae: *Quercus hispanica*²; *Q. palustris*³; Mimosaceae: *Acacia*⁶; Moraceae: *Ficus*¹²; Rosaceae: *Malus*². Bread^{5,8,10,14} (REFERENCES: ¹ Sedgwick 1958; ² Noonan 1966; ³ Stranger 1969; ⁴ Davies 1974; ⁵ Hall; ⁶ Fleming 1976; ⁷ Baxter 1980; ⁸ Long 1981; ⁹ Park 1989; ¹⁰ Crome; ¹¹ Miller & Naisbit 1994; ¹² Cleland; ¹³ Goodwin; ¹⁴ Aust. Atlas; ¹⁵ CSN 33).

SOCIAL ORGANIZATION Poorly known in HANZAB region; most information from Frith; some general or extralimital material included from Ali & Ripley (1969), Roberts (1991) and Goodwin. Found singly, in pairs or small parties, e.g. of 5–6, but larger congregations occur where food abundant (Sedgwick 1958; Crome; Frith; Aust. Atlas). Round Albury, often associate with Rock Doves *Columba livia* (Bedgood 1962). Extralimitality said not to be particularly

gregarious (Roberts 1991), usually in pairs or small parties (Ali & Ripley 1969; Goodwin).

Bonds Little known. Once, courtship behaviour seen 1–5 days before birds began rebuilding nest (NRS). **Parental care** Both sexes build nest, incubate, and care for young. Newly fledged young seen feeding with one or two adults (Hindwood 1960; Crome; NRS).

Breeding dispersion No details. Single nests recorded (e.g. NRS).

Roosting In WA, birds observed preparing to roost in pine trees at 18:25 (Sedgwick 1958). At one nest, non-brooding adult roosted in centre of nest-tree at 17:30, left at 06:30 and returned to roost at 17:00; next day did not roost in nest-tree (NRS). At another nest, adult roosted with young (NRS). Also said to loaf or roost in trees in heat of day (Crome).

SOCIAL BEHAVIOUR Poorly known in HANZAB region other than observations in wild and in captivity by Frith. General or extralimital information in Ali & Ripley (1969), Roberts (1991) and Goodwin; captive study of Bowing Display and associated behaviour among several species of *Streptopelia* by Davies (1965, 1970). Quite tame in towns; more wary in open agricultural country (Frith). Extralimitality, said to be tame (Ali & Ripley 1969; Roberts 1991; Goodwin). Display Flight typical of genus (Frith). Many postures (e.g. Mantling, threat, copulation) very similar to those of Laughing Turtle-Dove, but Laughing not seen to adopt possible Alarm-type posture (Frith). Bowing Display of Spotted (0.9 s/bow) not quite so slow and deliberate as in Barbary *S. 'risoria'* (2.1 s/bow) and Eurasian Collared *S. decacoto* (2 s/bow) Doves but slower than European Turtle-Dove *S. turtur* (0.7 s/bow) (Goodwin 1956; Davies 1965, 1970; Goodwin). Bowing, aerial-nuptial displays, agonistic and territorial behaviour, as described for Eurasian Collared-Dove (Ali & Ripley 1969). Frith mentions that MANTLING and WING-LIFTING occur; while function of latter not known, seen in situations of aggression and alarm. **Aerial activity** **DISPLAY FLIGHT**: Bird flies from perch at steep angle, clapping wings loudly, up to 30 m above ground (Crome); then fully spreads wings, spreads tail widely and glides down, often in curved path, to perch.

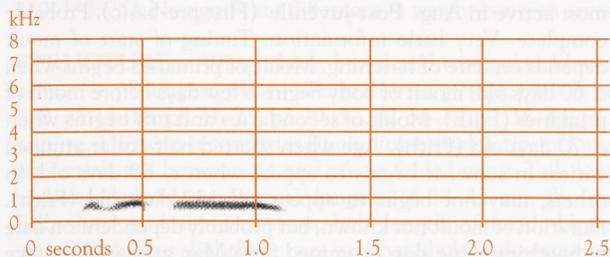
Agonistic behaviour Threat said to be very similar to that of Laughing Turtle-Dove (Frith). **Alarm** Possible **ALARM POSTURE**: if approached from behind by conspecific, perched bird draws itself erect, lifts folded wings away from body, and sometimes spreads tail slightly (also seen in Bar-shouldered *Geopelia humeralis* and Diamond *G. cuneata* Doves) (Frith). Flush with distinct clatter of wings, usually ascending at steep angle, with tail partly spread (Frith) and giving quick side-to-side rolling action (Ali & Ripley 1969); seldom fly far (Goodwin); often tower before gliding down to settle in tree or like (Roberts 1991). In open farm areas, flush easily, usually flying low and in direct line to nearest cover (Frith).

Sexual behaviour **ADVERTISING CALL**: No special posture adopted (Frith); see Voice. **BOWING DISPLAY**: From Frith, which is based on Davies (1965). Bird stands with body lifted above horizontal, tail more or less horizontal, neck fully extended vertically, and bill pointing down; bird rapidly tilts body well below horizontal, lowers tail, and bends legs; then returns to high position and, after a slight pause, repeats movement. Neck swollen and plumage of neck erect throughout display, showing white tips to feathers, but more so during upwards movement and depressed during downward movement. First *coo* of loud Display Call given as body swung down and second at low point; as bird swings up, opens bill and inhales but makes no sound. Wings and tail not spread in

display. Bow repeatedly, with up to 20 down-and-up movements per bout and lasting 15 s but sometimes bow only 1–2 times (Frith). Bowing Display sometimes begins without warning but usually preceded by up to ten or more rhythmic bobs of head; bobs increase in amplitude until whole body bobbed and Bowing Display then begins (Davies 1970). Within *Streptopelia*, Bowing Display primarily sexual (Goodwin 1956); in Spotted Turtle-Dove, Bowing important courtship display performed by male in front of female (Crome). **Greeting** During change-over (NRS): at one nest, outgoing bird bobbed and cooed then moved off and other moved on; at another nest, incoming bird approached nest, bowed 4–5 times and changed over quickly; at another nest, brooding bird always called before arrival of mate. **Courtship feeding** One record of adult bringing food to incubating bird (NRS). **Allopreening** Record of nestlings being left for long periods while adults in nearby tree groomed each other (NRS). **Copulation** Postures during copulation said to be similar to those of Laughing Turtle-Dove (Frith).

Relations within family groups At one nest, adults brooded constantly on nest till young 10 days old, then brooding stopped completely (Hindwood 1960). At one nest, after change-over, incoming adult brooded for a few minutes then fed young; at another nest, young quiet when being fed; at another nest, two young fed simultaneously by adult (NRS). **Anti-predator responses of young** When disturbed 7 days after hatching, young raised wings and pecked intruder (Hindwood 1960). Older fledgelings will follow adult from nest when threatened; at one nest, adult flew when person c. 11 m away, young did not fly till c. 4 m away (NRS). **Parental anti-predator strategies** As person approached nest, bird lowered head, till head and body horizontal, and stayed still. Perform DISTRACTION DISPLAYS when with eggs and young. At one nest with young, when observer close to nest, adult did not leave but puffed out feathers and spread wings (NRS). Extralimitally, said to perform Distraction Displays commonly (Goodwin 1956).

VOICE Not well known; some information in Frith (with sonagrams). In Sydney, very vocal in spring and summer (Frith); in Auckland, cooing occurs throughout year, with apparent peak in autumn and spring (Falla *et al.* 1981). At one nest, brooding bird always called before arrival of mate (NRS). Calls of Aust. birds said to be deeper than those of captive Indian and Sri Lankan forms (Goodwin), but Frith did not report any differences. Advertising Call louder and less melodious than that of Laughing Turtle-Dove (Frith). **Non-vocal sounds** Make loud wing-claps during Display Flight; wings make clattering sound when bird flushed (Frith).



A R. Buckingham; Melbourne, Vic., Aug. 1980; P39

Adult ADVERTISING CALL: 2–4 notes, varying in rhythm and emphasis: *croo-croo*, *cuck-croo-cuck*, *cu-cu-croo-croo* (Falla *et al.* 1981); or *coocoo*, *croo-oo* and *coo-oo*, *croo-oo-ook* (sonagram A) (Hall). Frith also describes two variants: *coo-oo*, *croo* or *coo*, *coo*, *croo*; and louder, more strident *coo coo-oo*

crook or *croo-oo*, *kook*, with last note emphatic. Given by both sexes; call of female quieter (Goodwin 1956; Goodwin). DISPLAY CALL: *Coo!* *croo*, shorter than Advertising Call (Hall). Uttered during Bowing Display, *coo!* as head and breast swung down and *croo* at low point (Frith). NEST CALL: Softer version of *coo-oo*, *croo* or *coo*, *coo*, *croo* Advertising Call (Frith).

Young No information.

BREEDING Poorly known in Aust. and NZ; no major studies. Most information from 295 records in NRS.

Season Eggs recorded in all months of year ($n=190$ clutches) with most (77%) from early Sept. to late Dec., peaking in late Oct. to early Nov.; most autumn and winter records from s. Qld and NSW (NRS). In NZ, season said to be prolonged, with peaks in spring and summer (Falla *et al.* 1981; NZRD).

Site On limb of bush or tree, in horizontal or vertical fork (NRS); in wide variety of native or introduced trees or bushes (e.g. *Eucalyptus*, *Casuarina*, *Acacia*, *Grevillea*, *Melaleuca*, *Callistemon*, *Angophora*, *Leucopogon*, mistletoe; also willows, pines and bamboo), including prickly bushes (e.g. *Hakea*, Thorny Acacia *Acacia armata*, Boxthorn *Lycium ferocissimum*, Prickly Pear *Opuntia vulgaris*, Blackberry *Rubus*, Lantana *Lantana camara*); also in tangles of vines or creepers over shrubs, trees, walls, fences, houses and pergolas. In or on buildings: edge of skylight in wall, on window ledge, cross arm of telegraph pole, roof beam in railway station, disused stock wagons on sidings. Occasionally on ground. Once, in heap of brushwood gathered for bonfire; in old Blackbird nest c. 1 month after it had been vacated; duck nesting box (Hindwood 1960; Frith; CSN 21; NRS). MEASUREMENTS (m): Height of nest, 2.6 (2.23; 0.6–20; 85); depth below top of vegetation, 2.6 (3.34; 0–20; 61) (NRS). Re-line old nests for successive and replacement clutches (NRS).

Nest, Materials Thin untidy platform, with eggs sometimes visible through structure; sometimes thick mat. Made of sticks, twigs, pine needles, rootlets, grass or straw, lined with feathers (NRS). As brooding proceeds, nest becomes cemented together by excreta (Serventy & Whittell). Material mostly gathered from ground near nest; one pair took 4 days to finish nest (Hindwood 1960). MEASUREMENTS: Diameter, 12.7–15.2 cm (Serventy & Whittell).

Eggs Elongate to oval; white, with slight gloss (Hindwood 1960; Frith). MEASUREMENTS: Two eggs, 28.5 x 22 and 28 x 21.5 (Hindwood 1960); two eggs, 27–31 x 22–23 (Serventy & Whittell).

Clutch-size Usually two, sometimes one; occasional nests with three eggs recorded; one nest had four eggs; average, 1.85: C/1 x 17, C/2 x 94 (NRS).

Laying Eggs laid 1 day apart; young hatch 1 day apart, though sometimes less (NRS). At one nest, first egg laid before 05:30, second between 07:00 and 16:00 on following day (Hindwood 1960). May lay up to three times in a season. Replacement clutches laid c. 1 week after failure; successive clutches laid 2–3 weeks after fledging of previous brood; for one pair, interval between first and second nests less than between second and third (NRS).

Incubation INCUBATION PERIOD: 14–16 days ($n=17$ clutches) (Frith); c. 14 days (NRS); 14 days for both eggs of a clutch (Hindwood 1960). Egg-shell found in nest with recently hatched young (NRS).

Young Semi-altricial, nidicolous. Hatch with hair-like khaki-coloured down and eyes closed (Hindwood 1960). At 6 days, feathers begin emerging from quills; at 9 days, primaries well grown and feathers emerging on most of body, except

throat and crown; at 12 days, well feathered; at c. 15 days, plumage virtually complete but traces of down remain and some quills present on much of body; full juvenile plumage attained at 30–35 days (Hindwood 1960; Frith). **Growth** For 11 chicks, weight and measurements at hatching and mean daily rate of increase from hatching to 13 days (Frith): weight, 6.4 g (5.0–8.0; 11) and 5.7 g/day; wing, 10.9 mm (10.8–10.9; 11), 6.9 mm/day; tarsus, 7.2 (6.9–7.3; 11), 1.2; culmen, 10.0 (9.7–10.4; 11), 0.8. **Parental care, Role of sexes** Young brooded constantly till 10 days old, after which brooding stopped (Hindwood 1960).

Fledging to maturity Young leave nest at c. 15 days (Frith).

Success For 59 nests: from 114 eggs, 64 (56.1%) hatched, 34 (29.8%) fledged; 1.08 young hatched and 0.58 fledged per nest (NRS). Eggs squashed by fallen orange; Pied Currawong *Strepera graculina* took young (NRS); two young disappeared from nest on stormy night (Hindwood 1960).

PLUMAGES Prepared by A.M. Dunn. Begin post-natal moult to juvenile plumage when c. 5 days old. Begin complete post-juvenile moult to adult plumage when 50–60 days old. Thereafter, undergo a complete post-breeding moult each cycle, without change in appearance. Sexes similar. Several subspecies; nominate *chinensis* and subspecies *tigrina* introduced Aust., *tigrina* introduced NZ. Nominate *chinensis* described below.

Adult (First and subsequent basic). **Head and neck** Forehead and lores, pale grey (86) to light grey (85) with narrow black (89) line running across lores from gape to eye. Crown and ear-coverts, light grey (85) to grey (84), often with pink-brown (221D) wash. Nape, pink-brown (221D–219C). Feathers of hindneck and sides of neck, bifurcated, black (89) with white tips, forming broad black half-collar finely spotted white. Feathers along lower edge of collar have light-brown (c223D) tips. Chin, white. Throat and neck, pink-brown (221C–221D). **Upperparts** Mantle and scapulars, dark brown (121) with light-brown (39) to brown (c121C) fringes to feathers. Back, rump and uppertail-coverts, dark brown (121) with slightly paler fringes to feathers. **Underparts** Breast, pink-brown (c221D). Belly, slightly paler than breast, pink-brown (c219D), grading to cream (c54) on lower belly and vent. Flanks, light grey (85), grading evenly to color of belly and vent. Undertail-coverts, light grey (85) to grey (84). **Tail** Central rectrices (t1), dark brown (121); t2, black-brown (119); t3–t6, black (89) with broad white tips, about one-third length of rectrix. **Upperwing** Most median, lesser and greater secondary coverts, dark brown (119A) with light grey-brown (c119D) fringes. Outer lesser and median secondary coverts, grey (87) to light blue-grey (c88). Outer greater secondary coverts, black-brown (119) with pale-grey (86) to light blue-grey (88) outer edges. Pale outer secondary coverts combine to form a light-coloured shoulder-patch on forward edge of folded wing. Alula, median and greater primary coverts and primaries, black-brown (119). Lesser primary coverts, brownish grey (c83). Secondaries and tertials, dark brown (121). **Underwing** Lesser primary coverts, pale grey (86). Lesser secondary coverts, grey (84). Median primary and secondary coverts, black (89). Greater primary coverts, dark grey (83). Greater secondary coverts, grey-black (82). Remiges, black-brown (119).

Downy young No specimens available. At hatching, covered in long sandy-coloured down, paler on underparts (Frith); down, thick, hair-like, khaki (Hindwood 1960).

Juvenile Differences from adult: **Head and neck** Forehead, crown and nape, light grey (85) with rufous-brown (136) wash. Chin, throat, cheek and ear-coverts, light rufous-

brown (139) with pale-grey (86) bases to feathers. Hindneck, brown (37) to rufous-brown (136) with concealed dark-grey (83) bases to feathers. **Upperparts** Mantle, back, rump and uppertail-coverts, dark brown (221, changing to 121 on uppertail-coverts) with rufous-brown (38) tips to feathers. Scapulars, dark brown (221) with narrow rufous-brown (38) fringes and ill-defined black-brown (119) shaft-streaks. **Underparts** Feathers of breast, light grey-brown (27) with light-brown (223C–30) fringes and concealed pale-grey (86) bases. Belly, vent and flanks, mixture of orange-buff (118), buff (124), pink-buff (121D) and salmon (6) feathers, all with pale-grey (86) bases. Undertail-coverts, off-white, with buff (123D) tips. **Tail** As adult but with rufous-brown (38) tips to rectrices. **Upperwing** All secondary coverts have buff (123D) fringes. Primaries, primary coverts and alula have narrow rufous-brown (38) fringes near tips. Secondaries have very fine orange-buff (c118) fringes near tips. **Underwing** Similar to adult but with pink-buff (c121D) fringes to all coverts.

Aberrant plumage In regions where olives grown, plumage can be stained darker by oil and dark pigments of fruit while feeding on olives in winter (Paton & Paton 1987).

BARE PARTS Based on photos (Crome; Aust. RD; unpubl.: J.N. Davies) and published descriptions (Frith). **Adult** Bill, black-brown (c119). Iris, salmon (106) to dull pink (c5); also reported as yellowish. Legs and feet, pink-red (c10) to rose (c9). **Downy young** (From Frith.) Bill, grey-pink, with dark-horn tip. Iris, grey, with brown inner ring. Legs and feet, pale flesh. **Juvenile** Bill, dark grey (83) to grey horn (–), the distal half grey-black (82) to black-brown (119). Iris, light brown-grey (c45); also grey-yellow. Legs and feet, dark grey (83) to flesh-pink (–).

MOULTS Based on examination of 40 adult skins, mostly from Melbourne, but also Sydney and Adelaide (AM, MV). **Adult post-breeding** (Second and subsequent pre-basic). Complete; primaries outwards. Moult of primaries not synchronous in population and timing probably dependent on timing of breeding. Most appear to moult conventionally, but seven skins appeared to have stopped moult of primaries. Most appear to begin moult of primaries between June and Oct., and finish between Feb. and June. Individuals with complete wing of feathers of same age were only recorded between June and Nov.; at other times, either moulting primaries or had stopped moult. Duration of moult probably varies individually; some probably suspend moult while breeding. Usually two, sometimes one, actively growing feathers in active moult-waves. Moult of body recorded in many months but appeared to be most active in Aug. **Post-juvenile** (First pre-basic). Probably complete. Very little information. Timing of start of moult depends on date of hatching. Moult of primaries begins when c. 60 days old; moult of body begins a few days before moult of primaries (Frith). Moult of secondaries and tail begins when c. 70 days old (Frith). Age when spotted half-collar attained varies: in some, it begins to appear when c. 60 days old, in others, may not begin to appear till 120 days old (Frith). Duration of moult not known, but probably dependent on date of hatching. One skin examined from Mar. appeared to have stopped primary-moult after replacing two primaries.

MEASUREMENTS (1) SE. Aust., adults, skins (AM, MV). (2–6) Adults, skins (Frith): (2) Melbourne; (3) Sydney; (4) Adelaide; (5) Perth; (6) Innisfail, Qld. (7) Subspecies *chinensis*: natural range, adults (Frith). (8) Subspecies *tigrina*: natural range, adults (Frith).

| | MALES | FEMALES | |
|--------|--------------------------------|----------------------------|----|
| WING | (1) 150.2 (4.35; 142–159; 20) | 146.9 (3.17; 139–154; 20) | ** |
| | (2) 154.1 (139–167; 263) | 150.2 (132–164; 211) | |
| | (3) 148 (n=115) | 145 (n=90) | |
| | (4) 149 (n=65) | 144 (n=50) | |
| | (5) 147 (n=137) | 144 (n=83) | |
| | (6) 143 (n=13) | 140 (n=6) | |
| | (7) 154.6 (152–164; 22) | 152.4 (150–160; 7) | |
| | (8) 144.8 (135–153; 31) | 143.1 (136–154; 29) | |
| TAIL | (1) 139.2 (5.50; 130–147; 19) | 134.1 (7.74; 119–149; 19) | * |
| | (2) 142.3 (115–192; 263) | 137.4 (115–162; 211) | |
| | (3) 141 (n=115) | 135 (n=90) | |
| | (4) 137 (n=65) | 134 (n=50) | |
| | (5) 139 (n=137) | 132 (n=83) | |
| | (6) 135 (n=13) | 127 (n=6) | |
| BILL | (1) 15.8 (0.80; 14.5–16.9; 17) | 15.3 (0.85; 13.2–16.6; 18) | ns |
| | (2) 16.7 (14.1–21.1; 263) | 16.3 (13.7–21.8; 211) | |
| | (3) 16.4 (n=115) | 15.9 (n=90) | |
| | (4) 15.8 (n=65) | 15.5 (n=50) | |
| | (5) 16.8 (n=137) | 16.3 (n=83) | |
| | (6) 17.2 (n=13) | 17.1 (n=6) | |
| | (7) 26.3 (1.18; 24.1–29.4; 20) | 25.9 (0.78; 24.2–27.2; 20) | ns |
| | (8) 26.9 (23.6–30.8; 263) | 26.1 (23.2–28.7; 211) | |
| TARSUS | (1) 25.6 (n=115) | 24.0 (n=90) | |
| | (2) 26.2 (n=65) | 25.3 (n=50) | |
| | (3) 27.1 (n=137) | 26.0 (n=83) | |
| | (4) 26.2 (n=13) | 25.2 (n=6) | |
| | (5) 24.8 (20.1–24.5; 22)* | 24.5 (22.6–29.1; 7) | |
| | (6) 23.8 (21.3–26.2; 31) | 23.2 (20.0–25.1; 29) | |
| | (7) 30.0 (2.57; 26.0–36.1; 19) | 29.4 (1.27; 27.5–32.4; 19) | ns |
| | (8) 30.0 (2.57; 26.0–36.1; 19) | 29.4 (1.27; 27.5–32.4; 19) | ns |

* Mean outside range, as published in Frith.

Subspecies *chinensis* tends to be slightly larger than *tigrina* in Wing and Tarsus (could not be tested statistically).
(9) Vic., live, unsexed (Rogers *et al.* 1990).

| | ADULTS | JUVENILES AND FIRST BASIC | |
|------|-------------------------------|----------------------------|----|
| WING | (9) 159.7 (4.47; 152–166; 5) | 154.5 (2.41; 151–159; 10) | ** |
| TAIL | (9) 111, 146 | – | |
| THL | (9) 46.9 (0.92; 45.8–47.6; 5) | 46.9 (0.84; 45.5–48.0; 10) | ns |

Juveniles and birds in first basic have significantly shorter Wing than adults.

WEIGHTS SE. Aust., adults, museum labels (AM, MV): males, 163.6 (21.31; 110–205; 27); females, 157.2 (20.05; 110–192; 25). No significant difference in weight between sexes.

STRUCTURE Wing, short, broad and triangular. Eleven primaries: p8 longest, p10 6–12 mm shorter, p9 0–1, p7 1–3, p6 5–8, p5 11–18, p4 21–25, p3 29–32, p2 34–37, p1 38–44; p11 minute. Thirteen secondaries (including tertials); tips of longest tertials fall between p4 and p6 on folded wing. Tail, long and rounded; 12 rectrices; t1 longest, t6 34–43 mm shorter. Bill, short and slender, about half length of head. Upper mandible bulges slightly at cere and has slightly downcurved maxillary unguis; lower mandible, straight and slender. Tarsus, short and stout; scutellate in front, reticulate at rear. Outer toe 70–77% of middle, inner 69–78%, hind 51–57%.

GEOGRAPHICAL VARIATION In Aust., most populations appear to be derived from two subspecies: nominate *chinensis* and subspecies *tigrina*; a third subspecies, *suratensis*,

may have been introduced into Brisbane, but no birds resembling this subspecies recorded (Frith & McKean 1975). Populations in Sydney, Melbourne, Adelaide and Perth are intergrades between the two subspecies (Frith & McKean 1975); a population in Innisfail closely resembles *tigrina* and appears to be descended principally from that subspecies (Frith & McKean 1975). Subspecies *tigrina* introduced to NZ (Oliver).

Subspecies *tigrina* differs from *chinensis* by (based on Frith & McKean [1975] and examination of skins [AM, ANWC, MV]): (1) outer lesser and median secondary coverts, pale grey (86) to light grey (85) (darker grey [87] to light blue-grey [c88] in *chinensis*); (2) most secondary coverts have black (89) shaft-streaks (none in *chinensis*); (3) scapulars have darker shafts and centres; (4) undertail-coverts, cream (c54) to off-white (light grey [85] to grey [84] in *chinensis*); and (5) less pink on underparts, grading to cream on lower breast (rather than lower belly), and breast appears slightly browner.

REFERENCES

ABBBS. 1969. *Aust. Bird Bander* 7: 40–4.
 — 1975. *Aust. Bird Bander* 13: 62–4.
 — 1976. *Aust. Bird Bander* 14: 76–9.
 — 1978. *Corella* 2: 60–1.
 Abbott, I. 1980. *West. Aust. Orn. Nat.* 14: 189–93.
 Alexander, W.B. 1921. *Emu* 20: 149–68.
 Ali, S., & S.D. Ripley. 1969. *Handbook of the Birds of India and Pakistan*. 3. OUP, Bombay.
 Ashton, C.B. 1985. *S. Aust. Orn.* 29: 169–79.
 — 1987. *Aust. Bird Watcher* 12: 73–82.
 Baxter, C.I. 1980. *S. Aust. Orn.* 28: 90–8.
 — 1989. *An Annotated List of the Birds of Kangaroo Island*. SA NPWS, Kingscote, Kangaroo I., SA.
 Bedggood, G.W. 1962. *Bird Obs.* 369: 4.
 Bell, H.L. 1983. *Aust. Birds* 18: 1–6.
 Boehm, E.F. 1961. *Emu* 61: 66.
 Bourke, P.A. 1957. *Emu* 57: 263–4.
 Chapman, F.R.H. 1966. *S. Aust. Orn.* 24: 111.
 Chisholm, A.H. 1919. *Emu* 19: 60–2.
 Condon, H.T. 1969. *A Handlist of the Birds of South Australia*. S. Aust. Orn. Assoc., Adelaide.
 Davies, R. 1974. *Bird Obs.* 513: 12.
 Davies, S.J.J.F. 1965. Unpubl. PhD thesis, Cambridge Univ.
 — 1970. *Behaviour* 36: 187–214.
 Dawson, P., *et al.* 1991. *Sunbird* 21: 93–111.
 Dunn, R. 1989. *Aust. Bird Watcher* 13: 44–9.
 Falla, R.A., *et al.* 1981. *The New Guide to the Birds of New Zealand*. Collins, Auckland.
 Fleming, A. 1976. *Aust. Bird Watcher* 6: 151–60.
 Frith, H.J. 1952. *Emu* 52: 89–99.
 — 1977. *Ibis* 119: 167–82.
 —, & J.L. McKean. 1975. *Aust. J. Zool.* 23: 295–306.
 —, *et al.* 1976. *Emu* 76: 15–24.
 Gill, B.J. 1989. *Notornis* 36: 81–7.
 Gill, H.B. 1970. *Emu* 70: 105–16.
 Goodwin, D. 1956. *Avicult. Mag.* 62: 17–33, 62–70.
 Green, R.H. 1970. *Birds of Tasmania*. Author, Launceston, Tas.
 — 1989. *Birds of Tasmania*. Potoroo Pubs, Launceston, Tas.
 Hardy, J.W., & J.R. Farrell. 1990. *Corella* 14: 1–15.
 Hightett, J., & M.D. Gottsch. 1963. *Aust. Bird Watcher* 2: 51–5.
 Hindwood, K.A. 1935. *Emu* 34: 181–9.
 — 1960. *Aust. Bird Watcher* 1: 112–14.
 —, & J.M. Cunningham. 1950. *Emu* 50: 23–35.
 Holland, L. 1964. *Aust. Bird Watcher* 2: 61–9.
 Horrocks, G.F.B., & G.W. Brown. 1993. *Aust. Bird Watcher* 15: 24–34.
 Jones, M.V. 1981. *Aust. Bird Watcher* 9: 1–13.
 Kloot, T., & E.M. McCulloch. 1993. *Aust. Bird Watcher* 15: 166–7.
 Lawrence, C.C. 1946. *Emu* 46: 234–5.
 Leach, G.J., & H.B. Hines. 1987. *Sunbird* 17: 65–95.
 Leshman, A.J. 1994. *Aust. Birds* 28: 14–26.
 Long, J.L. 1981. *Introduced Birds of the World*. Reed, Sydney.
 — 1988. *Introduced Birds and Mammals in Western Australia*. Agric. Prot. Board West. Aust. Tech. Ser. 1, Perth.
 Longmore, N.W. 1978. *Sunbird* 9: 25–53.
 Lord, E.A.R. 1956. *Emu* 56: 100–28.

864 Columbidae

- Loyn, R.H. 1985. *Emu* 85: 213–30.
- McGill, A.R. 1944. *Emu* 44: 50–63.
- Miller, M.A., & R. Naisbit. 1994. *Aust. Bird Watcher* 15: 320–1.
- Morris, A.K. 1975. *Aust. Birds* 9: 37–76.
- 1986. *Aust. Birds* 20: 65–81.
- 1989. *Aust. Birds* 23: 7–21.
- , et al. 1981. *Handlist of Birds in New South Wales*. NSW Field Orn. Club, Sydney.
- Morris, F.T. 1977. *Aust. Bird Watcher* 7: 67.
- Noonan, D. 1966. *Emu* 66: 313–4.
- Park, P. 1989. *Tas. Bird Rep.* 18: 14–24.
- Paton, D.C., & J.B. Paton. 1980. *S. Aust. Orn.* 28: 120–6.
- , & P.A. Paton. 1987. *Corella* 11: 111–15.
- Preston, I. 1983. *Aust. Bird Watcher* 10: 132–5.
- Pyke, G.H. 1985. *Emu* 85: 34–9.
- Roberts, T.J. 1991. *The Birds of Pakistan. 1*. OUP, Oxford.
- Rogers, K.G., et al. 1990. *RAOU Rep.* 67.
- Ryan, C.S. 1906. *Emu* 5: 110–9.
- Salter, B.E. 1960. *Aust. Bird Watcher* 1: 105–7.
- Sedgwick, E.H. 1958. *West. Aust. Nat.* 6: 92–100, 112–27.
- 1965. *West. Aust. Nat.* 9: 153–7.
- 1973. *West. Aust. Nat.* 12: 131–9.
- Shanks, D. 1949. *Emu* 49: 132–41.
- Sharland, M.S.R., & S.W. Crane. 1922. *Emu* 22: 127–33.
- Smith, P. 1984. *Emu* 84: 200–10.
- Storr, G.M. 1965. *Emu* 64: 172–80.
- 1984. *Rec. West. Aust. Mus. Suppl.* 19.
- 1986. *Rec. West. Aust. Mus. Suppl.* 26.
- , & R.E. Johnstone. 1988. *Rec. West. Aust. Mus. Suppl.* 28.
- Stranger, R.H. 1969. *West. Aust. Nat.* 11: 71.
- Tarr, H.E. 1950. *Emu* 49: 189–97.
- Thomas, D.G. 1972. *Tasm. Nat.* 31: 5–8.
- Traill, B.J. 1985. *Aust. Bird Watcher* 11: 74–9.
- Walters, I.N. 1985. *Aust. Bird Watcher* 11: 17–27.
- Watson, I.M. 1955. *Emu* 55: 224–48.
- Wheeler, W.R. 1967. *Aust. Bird Watcher* 3: 55–76.
- White, S.R. 1946. *Emu* 46: 81–122.
- Whiter, J. (Ed.) 1994. *Nature in Eurobodalla.* 8: 5–47.
- Wolstenholme, H. 1929. *Emu* 28: 183–91.

Sponsor: Mr T Cobcroft



Volume 3, Plate 49

Laughing Turtle-Dove *Streptopelia senegalensis* (page 852)
 1 Adult male; 2 Adult female; 3 Juvenile; 4, 5 Adult male

Spotted Turtle-Dove *Streptopelia chinensis* (page 856)
 Nominate *chinensis* 6 Adult; 7 Juvenile; 8, 9 Adult
 Subspecies *tigrina* 10 Adult