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) *Gallicolumba* (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); *Gallicolumba* (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. Taxomonic 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. Moult 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 *Ptilonopus 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.

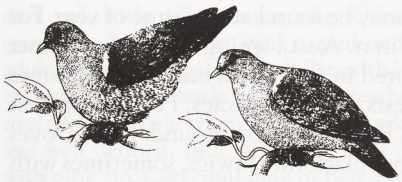

Figure 2 Tail-raising Advertising Display of Emerald Dove *Chalcophaps indica* (left – high point, right – low point).

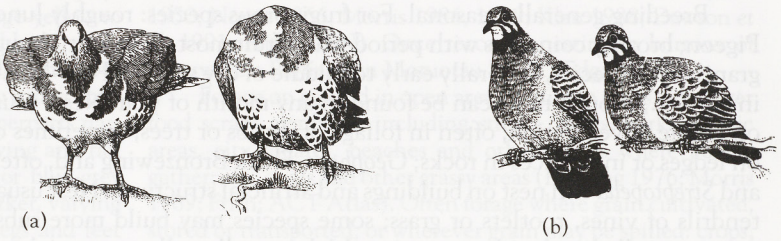

Figure 3 Advertising Display: (a) Wonga Pigeon *Leucosarcia melanoleuca* (left – high point, centre – low point, right – rear view); (b) Squatter Pigeon *Geophaps scripta* (high and low points).

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

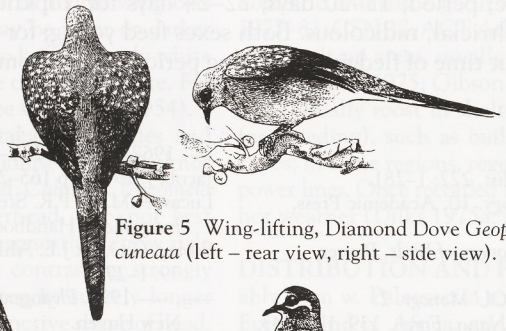

Figure 5 Wing-lifting, Diamond Dove *Geopelia cuneata* (left – rear view, right – side view).

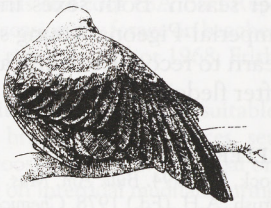

Figure 6 Mantling, Wompoo Pigeon *Ptilinopus magnificus*.

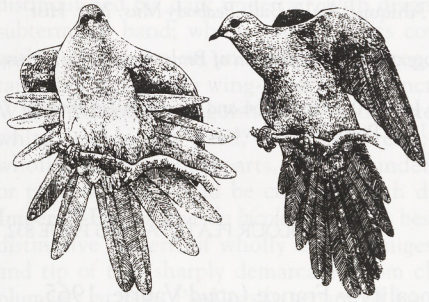

Figure 7 Mantling and Wing-stretching, Brown Cuckoo-Dove *Macropygia amboinensis*.

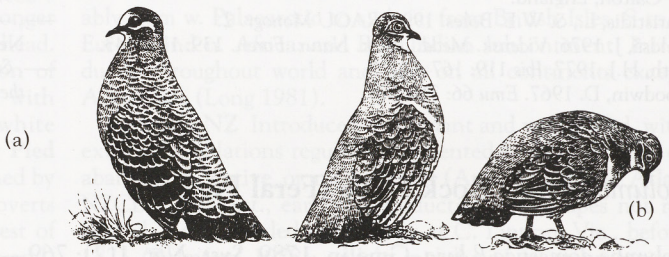

Figure 8 Post-copulatory Parade: (a) Common Bronzewing *Phaps chalcoptera*; (b) Partridge Pigeon *Geophaps smithii* (high and low points).

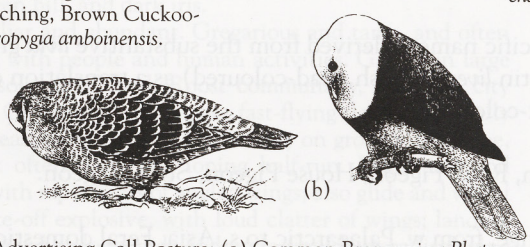

Figure 9 Advertising Call Posture: (a) Common Bronzewing *Phaps chalcoptera*; (b) Banded Fruit-Dove *Ptilinopus cinctus*.

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.

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Columba livia **Rock Dove (Feral Pigeon)**

COLOUR PLATE FACING PAGE 832

Columba domestica ß livia Gmelin, 1789, *Syst. Nat.* 1(2): 769 — No type-locality = France (*apud* Vaurie, 1965, *Bds Palearctic Fauna Non-pass.*).

The generic name is Latin for 'dove' or 'pigeon'. The specific name is derived from the substantive *livia* given to the Rock Dove by Gaza (1476, *Arist. de Nat. Anim.*) (Latin *livens*, bluish, lead-coloured) as a translation of the Greek ηέλεια, pigeon (thought to be from πέλλος, dark-coloured).

OTHER ENGLISH NAMES Domestic Pigeon, Homing Pigeon, Rock Pigeon, House Pigeon, Street Pigeon.

POLYTYPIC Fourteen subspecies extralimital in natural range, from w. Palaearctic to s. Asia. Feral domestic breeds descended from the Rock Dove of Europe introduced to HANZAB region and widely throughout world.

FIELD IDENTIFICATION Length 31–34 cm; wingspan 63–70 cm; weight 295–320 g. Large bulky pigeon, much bigger and bulkier than Spotted Turtle-Dove *Streptopelia chinensis* or Laughing Turtle-Dove *S. senegalensis*, with more angular, pointed wings and proportionately shorter, broader and square-ended tail. Plumages of feral populations vary greatly: many resemble ancestral Rock Dove, but intergradation with domesticated forms produces wide range of plumage colours and patterns. Sexes similar. No seasonal variation. Juvenile separable.

Description Adult ANCESTRAL TYPE: Head and neck, blue-grey, with broad band of iridescent purple or green on neck, upper mantle and breast. Rest of upperbody, light blue-grey, with square patch of white on lower back (can be grey as rest of upperparts) and broad blackish terminal tail-band. Upperwing, light blue-grey, with faint dusky trailing-edge and with two black bars across innerwing, prominent at rest and in flight. Lower breast, dark grey, grading to light blue-grey on vent and undertail-coverts. Undertail, silvery grey, with broad dark terminal band. Underwing: coverts, white; remiges, white to pale grey, with diffuse grey-black trailing-edge. Bill, grey-black to black. Cere, off-white, enlarged. Iris, orange-yellow to dark red, with yellow inner ring. Orbital ring, blue-grey to grey-pink. Legs and feet, pink to pink-red. **Juvenile** Similar to adult, differing by: generally duller, with little or no iridescence on neck, upper mantle and breast; feathers of upperparts narrowly fringed pale when fresh; and markings of wing and tail less well defined. Bill, dull pink, with dark tip, or blue-grey with pink tip. Cere, dull pink or blue-grey. Iris darker, varying from dark brown through pale grey to yellow. Legs and feet duller, varying from dark grey or grey-pink to similar to adult but with brown, pink or orange tinge. FERAL POPULATIONS: Plumage varies greatly. Many variants resemble or contain some elements of ancestral plumage, such as double wing-bars or dark tail-band; general coloration may be paler or darker blue-grey to nearly black, or red-brown to buff or nearly white or a mixture of these; some patchy white or wholly white. For detailed descriptions of main variants, see Goodwin (1954).

Similar species Normally unmistakable in cities and country towns. In some areas, could be confused with **Topknot** *Lopholaimus antarcticus* or **White-headed** *Columba leucomela* **Pigeons** in distance or seen flying overhead. Topknot best distinguished by: dark undertail, with diagnostic narrow pale subterminal band; wholly dark remiges contrasting strongly with pale coverts on underwing; and proportionately longer tail and wings, slower wing-beats and distinctive shape of head. White-headed distinguished by distinctive combination of white or pale-grey head, neck and breast, contrasting with wholly blackish upperparts, tail and underwing. Pure white or pied variants could be confused with distant flying **Pied Imperial-Pigeon** *Ducula bicolor*, which is best distinguished by distinctive pattern of wholly black remiges, primary coverts and tip of tail, sharply demarcated from clean white rest of plumage; at rest, Pied easily separated by neater black-and-white plumage, diagnostic black spotting on undertail-coverts, yellow-green bill, and dark iris.

Familiar and abundant. Gregarious and tame, and often associated with people and human activities. Gather in large flocks at sources of food. Roost communally, often on city buildings. Often seen in compact fast-flying flocks, especially in rural areas. Forage almost exclusively on ground. Gait free, with walk often becoming loping half-run. Flight fast and dashing, with rapid beats of angled wings; also glide and wheel often. Take-off explosive, with loud clatter of wings; landing often preceded by long glide ending in final flutter; displaying males clap wings, and glide with wings held in steep V. Usual call drawn-out deep rolling *coo*; also *coo-roooo-cu-cu*.

HABITAT In A'asia, mostly in urban areas, especially streets, parks and railway stations (Frith; CSN); and in agricultural regions, round towns, homesteads, farm buildings, and in crops and besides roads and railways. Sometimes in open woodlands and grasslands (Clarke 1967; Longmore 1978; Jones 1986), mostly near built-up areas (Longmore 1978; Preston 1983; Gill 1989). Vagrants or displaced racing birds may occur in almost any habitat, from coastal beaches and mudflats (Elliot 1968; Morris 1975; Gibson 1977; CSN) to at least 1370 m asl (CSN 41) and from tropical islands (Draffan *et al.* 1983; Qld Bird Rep. 1985) to arid inland, where recorded in disused quarries and mine shafts (Schmidt 1978; Klau 1988).

Often nest on buildings or other structures, such as wharves, bridges, power poles and traffic lights (Masters & Milhinch 1974; Rix 1976; Jones 1981; Bell 1994; Frith; CSN). Away from habitation, often nest on ledges and in holes or caves in steep cliffs or quarry walls; or on ground among boulders or beneath bushes; in hollow limbs of old trees (Tarr 1950; Norris 1966; Morris 1986, 1989; Klau 1988; Dawson *et al.* 1991; Frith; CSN). Once recorded nesting in burrows of shearwaters *Puffinus* on Motuotau I., NZ (Edgar 1978).

Forage on ground in open areas. In urban areas, wherever food scraps available, including streets, malls, parks, picnic areas, city squares, beaches and other places where people gather; also ovals and other grassy areas (Fleming 1976; Morris 1989; Frith; ACT Atlas). Often forage where grain cultivated, stored or transported, or wherever grain may be spilled: crops, mills, silos, roadsides, railway lines and wharves (Frith 1969; Cox 1973; Counsilman 1974; Dilks 1975a; Moeed 1975; Edgar 1978; Storr & Johnstone 1988; Frith). Also forage round domestic animals, e.g., in fowl yards and zoos (SA Bird Rep. 1977–81; CSN 37; ACT Atlas). Occasionally forage on beaches near built-up areas, usually along tide-line (Elliot 1968; Frith 1969; Morris 1975; Gibson 1977; CSN).

Usually roost in sheltered sites (which are also suitable for breeding), such as buildings, bridges, cliffs, crevices, sea caves; in some regions, regularly roost on islands. Also loaf on power lines. Once recorded loafing on intertidal mudflats during hot weather (Dilks 1975a; Edgar 1978; Morris 1989; CSN).

DISTRIBUTION AND POPULATION Originally, probably from w. Palaearctic to s. Asia: from British Isles, S to s. Europe and n. Africa, and E to Indian subcontinent. Introduced throughout world and now on all continents except Antarctica (Long 1981).

Aust., NZ Introduced. Abundant and widespread, with existing populations regularly augmented by lost, escaped or abandoned captive or racing birds (Aust. Atlas; NZ Atlas; NZCL). In Aust., earliest introductions or escapes not recorded. First recorded release was at C. Liptrap, Vic., before 1873 (Balmford 1978); widely introduced in many regions since nineteenth century (Long 1981; Aust. Atlas). First releases in NZ not recorded, though said to have been introduced in 1850s (Thomson 1922; Long 1981). Range in Aust. and NZ continues to expand.

Aust. Qld In Gulf Country, resident at Mt Isa; several records Karumba (Horton 1975; Aust. Atlas); vagrant to islands of Torres Str. (Draffan *et al.* 1983). Widespread in E, particularly in SE, from Cooktown to NSW border and extending into central regions, including Richmond, Longreach, and Charleville. Scattered records in SW, from Cunnamulla, NW through Quilpie and Davenport Downs to Bedourie and Birdsville (Aust. Atlas). **NSW** Widespread in all regions E of

c. 145°E; widespread in w. half of Lower Western Region, but sparsely scattered or absent elsewhere in W (Morris *et al.* 1981; NSW Bird Reps; Aust. Atlas). **Vic.** Widespread throughout, but less often recorded in mountainous areas in E. Most often in central and Mid-Murray Regions (Vic. Atlas). **Tas.** Widespread in all regions, including remote SW, but mostly found in regional centres; also on King and Flinders Is (White 1985; Green 1989; Aust. Atlas). **SA** Throughout, S of 29°S, with vagrants L. Eyre Drainage Basin; more often recorded to E rather than W of Eyre Pen. (SA Bird Rep. 1977–81; Aust. Atlas). **WA** Scattered records on Nullarbor Plain. Mostly recorded in SW, W of 121°E, and S of 30°S, with range extending N in near-coastal regions to Carnarvon, and occasionally farther inland to near Leonora and L. Wells; also scattered in Pilbara Region. Aust. Atlas shows records from Derby, Kununurra, Wyndham and Sturt Ck in Kimberley Div. **NT** Established Darwin, Nhulunbuy (since 1974), Katherine and Alice Springs (Boekel 1976; Thompson 1977; H.A.F. Thompson & D.K. Goodfellow; Aust. Atlas). Widely scattered elsewhere, including Pine Ck, Malapunyah Springs HS, Renner Springs, Tennant Ck and Tea Tree (Aust. Atlas).

NZ NI Scattered in many regions. NORTHLAND: occasionally recorded. AUCKLAND: many records, with occasional observations E to Coromandel Pen. BAY OF PLENTY: many records, S to n. VOLCANIC PLATEAU. EAST COAST: widespread, from Tolaga Bay, W to near Matawai, and S through Gisborne to Mahia Pen. HAWKE'S BAY: widespread in E, from N of Napier, S to near Waipukurau. WAIRARAPA: widely distributed in N. WELLINGTON: throughout. MANAWATU, WANGANUI: sparsely scattered. TARANAKI: many records at New Plymouth. WAIKATO: rare. **SI** NELSON, MARLBOROUGH: sparsely scattered records, except round cities of Nelson and Blenheim, where recorded more regularly. CANTERBURY, OTAGO: widespread, extending W to e. slopes of Southern Alps. SOUTHLAND: occur in N, with occasional records round Invercargill. WEST COAST: rare (CSN; NZ Atlas).

Lord Howe I. First recorded in 1869 (Hindwood 1940); apparently not recorded again till 1985, when five were observed (NSW Bird Rep. 1985). Said to have bred in recent years (Hutton 1991).

Norfolk I. First recorded in 1838; currently widespread and breeding (Schodde *et al.* 1983).

Snares Is Single, 10 Dec. 1976 to 3 Jan. 1977 (lost racing-pigeon, which had been released at Invercargill, 9 Dec. 1976, and had not returned to loft in Palmerston North by Mar. 1977) (Sagar 1977).

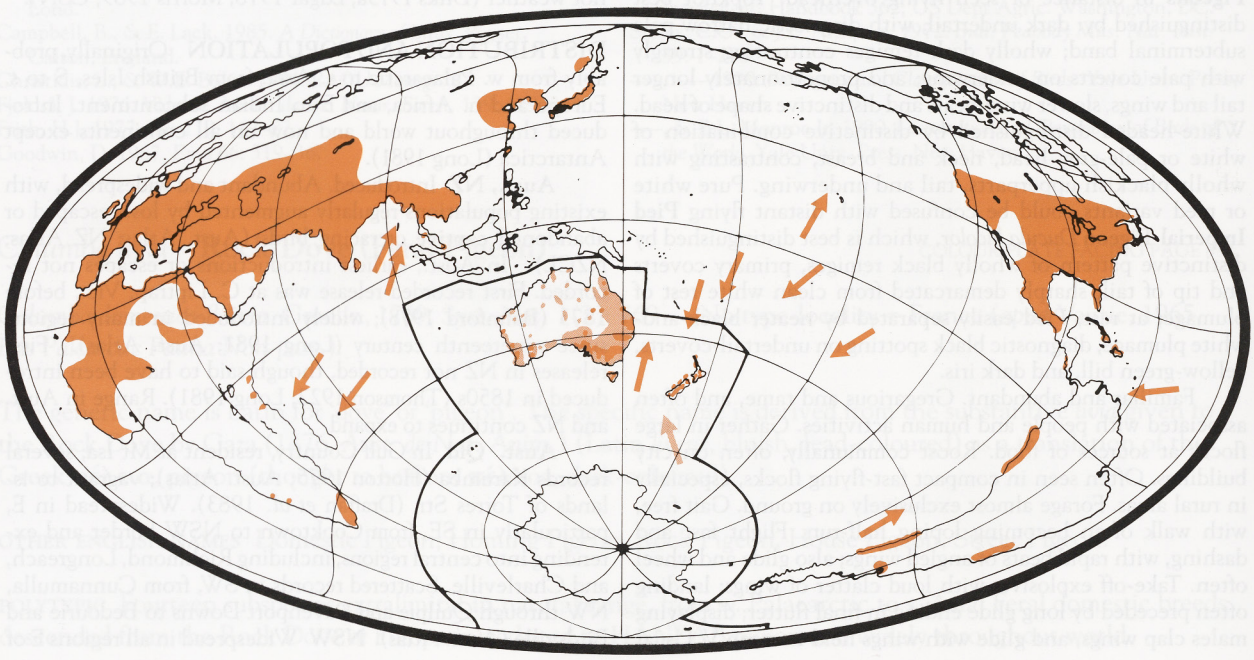
Breeding Likely to breed anywhere within range. Throughout se. and sw. Aust., with scattered records elsewhere throughout range. Widespread in NZ.

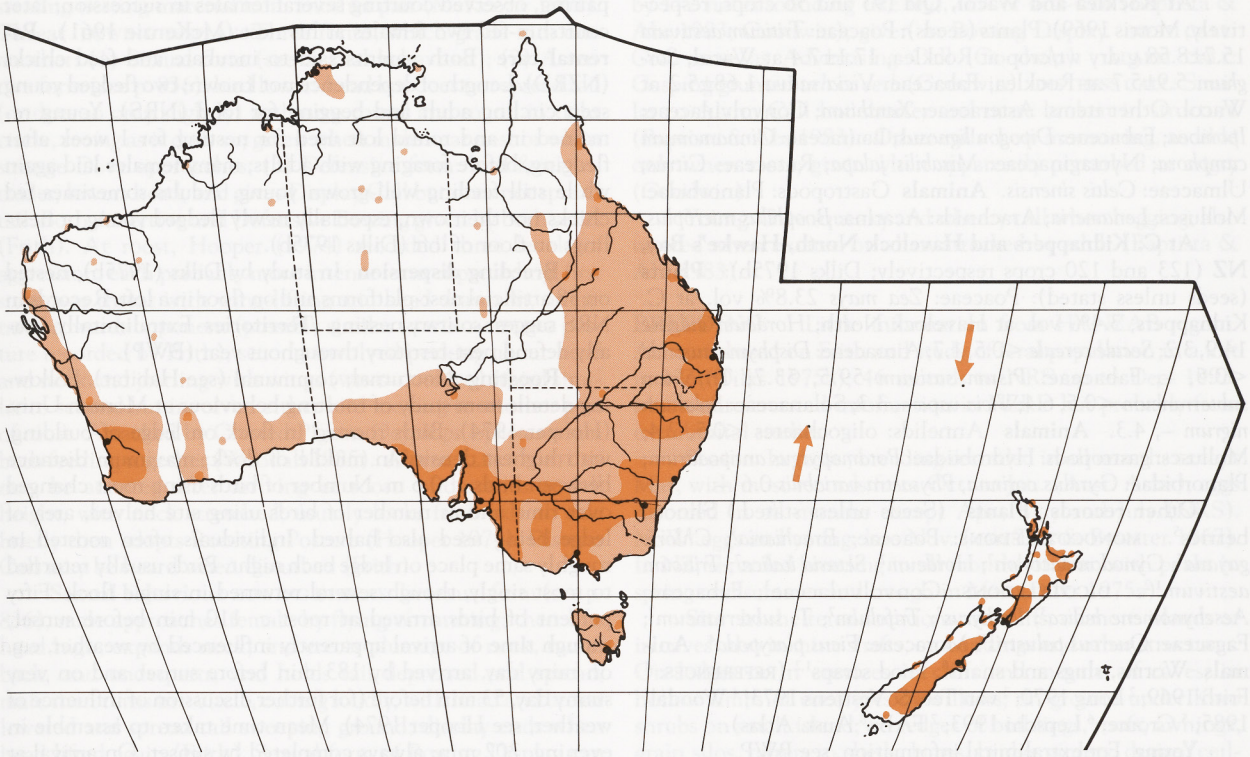
Status Pest. Abundant in urban areas and other sites of human habitation, where feed on scraps, rubbish and handouts, or where grain available. Nests and faeces disfigure buildings, block gutters and create health hazards, as they may carry diseases that can infect both humans and poultry. Also damage crops and gardens and cause wastage of animal food and stored grain. Sometimes shot (occasionally for food) or deliberately poisoned (Frith 1969; Counsilman 1974; Serventy & Whittell; Sharrock 1981; Walters 1985; Oliver; Frith; CSN).

MOVEMENTS Free-living extralimital populations, both wild and feral, considered resident or sedentary (BWP); some evidence for local migration (Goodwin). However, domesticated birds show strong homing ability over long distances, and often used in orientation studies (see for example Schmidt-Koenig & Keeton 1978). Only wild populations in Aust. and NZ considered here.

Movements in Aust. and NZ poorly known (van Tets 1966; Frith). No seasonal or regular long-distance movements apparent (Aust. Atlas; Vic. Atlas). In Aust., often considered resident (e.g. Bravery 1970; Gill 1970; Baldwin 1975; Horton 1975; Badman 1979). Considered resident on Norfolk I. (Schodde *et al.* 1983; Hermes 1985). Roost year-round at St Clair, NZ (CSN 9). Local movements also poorly known. In NZ, some fly to islands to roost e.g. Moturoa I., Sugar Loaf Grp (CSN 37), Motuotau I., Mt Maunganui, Bay of Plenty (Edgar 1978). In rural NZ, said to sometimes travel several kilometres between roosting and feeding places (NZRD).

Stray racing-pigeons join wild populations (Dilks 1975a). Resident population in Bribie I. area, s. Qld, constantly augmented by stray racing-pigeons (Durrant & MacRae 1994). At





Trialla and L. Coradgil, near Camperdown, sw. Vic., occasional records of Rock Dove said to be stray racing-pigeons (Hirth 1976). Sometimes not known whether stray birds are wild birds, racing-pigeons, or escapes from aviaries (e.g. at Wittenoom, WA, Howard 1986). Birds with racers' or fanciers' bands recovered in remote areas, such as Nullarbor Plain (Brooker *et al.* 1979), and birds released on NZ and Aust. mainlands recovered on islands, e.g. Dirk Hartog I., WA; Snares Is, NZ (Sagar 1977; Wells & Wells 1974).

Banding Adults banded Mallala, SA, recovered 38–485 km away (ABBBS 1969, 1970, 1977, 1978, 1981), including adult recovered 119 km away just over 1 year after banding (ABBBS 1975). Oldest Aust. bird, banded as immature in SA, found dead over 11 years after banding (ABBBS 1980). One recovered Riverwood, NSW, with band originally placed on Silver Gull *Larus novaehollandiae*; band was attached at Five Is, NSW, where both Silver Gulls and Doves breed and it is possible that nestling of Dove mistakenly banded as Gull (van Tets & Bywater 1967).

Reports of recoveries sometimes do not specify whether banded under auspices of ABBBS or by pigeon fancier or racer (e.g. Scarlett 1967; Draffan *et al.* 1983). Pigeon fanciers often use leg-bands (e.g. see Costello 1981), but results from such banding not considered in detail here. Finding of bands from racing-pigeons killed by Peregrine Falcons *Falco peregrinus* provides information on history of some eyries, e.g. pigeon bands dating from 1901 to 1960s found at one Vic. eyrie (White *et al.* 1980).

34S138E	06	1+	U	74	481	101	ABBBS
35S149E	09	1+	U	21	213	161	ABBBS
34S138E	05	1+	U	9	160	354	ABBBS
34S138E	05	1+	U	3	113	146	ABBBS
34S138E	05	1+	U	3	103	135	ABBBS

FOOD Mainly seeds of cereals and legumes; occasionally invertebrates. Also take human refuse and scraps. Reliant on artificial sources of food in many urban and rural areas in Aust. and NZ. **Behaviour** Little information for HANZAB region. Usually feed on ground, though will take food wherever available, e.g. feeding stations on ledges of buildings. Feed in pairs or small parties but gather in larger flocks where food abundant, e.g. grain silos. Feed by walking and pecking; also pull seeds directly from plants, twisting head to do so (Goodwin; Frith). Brief study of Pigeons feeding beneath fig trees in Brisbane, Qld (Woodall 1985): when feeding on seeds of figs, took 79.6±21.8 steps/min and made 32.6±10.8 pecks/min, or 0.46±0.22 pecks/pace (n=10 birds, 18 min obs.); fed on seeds of figs defecated intact by Figbirds *Sphecotheres viridis* and not on fallen fruit. Proportion of Pigeons feeding beneath figs (percentage of estimated local population) varied seasonally: highest Mar.–Aug., lowest Sept.–Feb. At Rocklea, Qld, ate grain fed to cattle; also took undigested grain in faeces of cattle (Morris 1969). Feeding behaviour of European birds described by Murton *et al.* (1972) and summarized in BWP.

Adults At **Aust. airports** (31 crops and stomachs; van Tets *et al.* 1977): **Plants** Seeds 100% freq.: MONOCOTYLEDONS: Cyperaceae 3.2; Iridaceae: *Romulea* 16.1; *R. rosea* 6.2; Poaceae: *Digitaria* 25.8; *D. sanguinalis* 19.3; *Echinochloa* 12.9; *E. crus-galli* 3.2; *E. utilis* 3.2; *Eleusine indica* 29.0; *Lolium* 3.2; *Panicum* 3.2; *Paspalum* 3.2; *Poa* 6.4; *Setaria* 9.6; *S. italica* 9.6; *Sorghum vulgare* 9.6; *Triticum aestivum* 70.9; *Zea mays* 16.1. DICOTYLEDONS: Asteraceae: *Silybum marianum* 6.4; Caryophyllaceae: 6.4; Chenopodiaceae: *Atriplex* 3.2; Fabaceae: *Pisum arvense* 16.1; *Trifolium* 32.2; *T. subterraneum* 22.5; *Vicia* 3.2; Linaceae: *Linum* 3.2; Malvaceae 3.2; Polygonaceae: *Polygonum* 9.6; plant material other than seeds 3.2. **Animals** MOLLUSCS: Pelecypodes 6.4. Scraps: bread 6.4; refuse 3.2. Grit 51.6.

In **Canberra, ACT** (163 birds; Frith): grain 40% vol. (mainly wheat [80% vol.]; also oats, maize, sorghum and Japanese millet); bread 20; seeds of garden plants and weed 31; other 1.

At **Rocklea and Wacol, Qld** (93 and 56 crops, respectively; Morris 1969): Plants (seeds): Poaceae: *Triticum aestivum* 15.7±8.58 g dry wt/crop at Rocklea, 17.1±7.4 at Wacol; *Sorghum* 5.9±5.7 at Rocklea; Fabaceae: *Vicia sativa* 1.68±5.2 at Wacol. Other items: Asteraceae: *Xanthium*; Convolvulaceae: *Ipomoea*; Fabaceae: *Dipogon lignosus*; Lauraceae: *Cinnamomum camphora*; Nyctaginaceae: *Mirabilis jalapa*; Rutaceae: *Citrus*; Ulmaceae: *Celtis sinensis*. **Animals** Gastropods: Planorbidae: Molluscs: *Lenameria*; Arachnids: Acarina: *Boophilus microplus*.

At **C. Kidnappers and Havelock North, Hawke's Bay, NZ** (123 and 120 crops respectively; Dilks 1975b): **Plants** (seeds unless stated): Poaceae: *Zea mays* 23.8% vol. at C. Kidnappers, 3.4% vol. at Havelock North; *Hordeum vulgare* 14.9, 3.2; *Secale cereale* <0.5, 1.7; Aizoaceae: *Disphyma australe* <0.5, –; Fabaceae: *Pisum sativum* 59.5, 53.7; *Trifolium subterraneum* <0.5, 6.4; *Vicia vapa* –, 3.3; Solanaceae: *Solanum nigrum* –, 4.3. **Animals** Annelids: oligochaetes <0.5, 2.4; Molluscs: gastropods: Hydrobiidae: *Potamopyrgus antipodarum*; Planorbidae: *Gyralus corinna*, *Physastra variabilis* 0.6 –.

Other records Plants (Seeds unless stated.) Shoots, berries[5]. MONOCOTYLEDONS: Poaceae: *Brachiaria*[3]; *Chloris gayana*[7]; *Cynodon dactylon*[7]; *Hordeum*[7]; *Setaria italica*[7]; *Triticum aestivum*[1,2]. DICOTYLEDONS: Convolvulaceae[3]; Fabaceae: *Aeschynomene indica*[3]; *Lathyrus*[7]; *Trifolium*[7]; *T. subterraneum*[7]; Fagaceae: *Quercus palustris*[6]; Moraceae: *Ficus platypoda*[4]. **Animals** Worms, slugs and snails[8]. Food scraps[1,2] (REFERENCES: [1] Frith 1969; [2] Long 1970; [3] van Tets & Vestjens 1973; [4] Woodall 1985; [5] Crome; [6] Lepschi 1993; [7] FAB; [8] Aust. Atlas).

Young For extralimital information, see BWP.

Intake Maximum number of seeds per crop, 1000 *Digitaria sanguinalis* and *Eleusine indica*; 250 *Trifolium* (van Tets *et al.* 1977). Maximum numbers of any one item in a crop: 128 maize, 1309 barley, 1089 ryecorn, 199 peas, 3950 subterranean clover and 328 black nightshade (Dilks 1975b). Mean daily intake of unknown number of Doves given in Morris (1969).

SOCIAL ORGANIZATION Within HANZAB region, no detailed studies other than of roosting behaviour on building at Monash Univ., Vic. (Hooper 1974); some material from Frith and from breeding study in loft in NZ (Dilks 1975b). Unreferenced statements in NZRD probably from extralimital sources. Detailed summary of extralimital work in BWP. Gregarious. Often recorded roosting, feeding, and nesting in flocks. Move between roosts and feeding areas in flocks, singly or in twos (Hooper 1974). Congregate wherever food available, especially where grain cultivated, stored or transported (Serventy & Whittell; Crome; Oliver; Frith; see Habitat). At Fremantle Harbour, large flocks of 60–100 congregated near wheat silos, and smaller flocks of 10–30 gathered along railway lines and nearby ocean beaches; usually seen singly, in pairs or in small flocks of 4–5 in native vegetation (Serventy & Whittell). At Monash Univ., average of 37–82 at one roost and 9–14 at another, though numbers fluctuated through year (Hooper 1974). Resident flock of *c.* 30, main street, Innisfail, Qld (Gill 1970). In NZ, 600–700 recorded in field near ripe maize crop (CSN 35); 500+ in maize stubble (CSN 39). In urban area of Auckland, two main flocks both of *c.* 300 birds; elsewhere in NI flocks of up to 12 (CSN 35); Mahia Pen., May, flock of 100 (CSN 41); at Napier, May, *c.* 600 were roosting in crevices (CSN 35). During study by Dilks (1975b), some birds possibly left flock because of overcrowding in loft used for roosting and breeding.

Bonds No details from HANZAB region. Extralimitally usually maintain pair-bond throughout year (BWP). In Aust., one male, who had built nest and appeared to be in process of pairing, observed courting several females in succession; later courtship-fed two females at his nest (McKenzie 1961). **Parental care** Both parents said to incubate and feed chicks (NZRD). Length of dependence not known; two fledged young seen circling adult and begging for food (NRS). Young remained in and round loft used for nesting for 1 week after fledging, before foraging with adults; many females laid again while still feeding well-grown young. Adults sometimes fed chicks not their own, especially newly fledged young or nestlings on floor of loft (Dilks 1975b).

Breeding dispersion In study by Dilks (1975b), nested on 38 artificial nest-platforms and on floor in a loft. Records in NRS suggest solitary nesting. **Territories** Extralimitally, usually defend nest-territory throughout year (BWP).

Roosting Nocturnal; communal (see Habitat). Following details from study of roosting behaviour at Monash Univ. (Hooper 1974). Birds roosted in flock on ledge of building, with highest density in middle of flock; maximum distance between birds *c.* 0.6 m. Number of birds using roost changed over time and as number of birds using site halved, area of ledge being used also halved. Individuals often roosted in roughly same place on ledge each night. Birds usually returned to roost singly, though several returned in single flock. Fifty percent of birds arrived at roost *c.* 110 min before sunset, though time of arrival apparently influenced by weather, e.g. on rainy day, arrived by 183 min before sunset and on very sunny day, 53 min before (for further discussion of influence of weather, see Hooper 1974). Mean time taken to assemble in evening, 202 min; always completed by sunset. On arrival at roost bird may adopt Alert Posture, and walk towards any Doves already present. Bowing Display (self-assertive form), with associated circling, a common interaction between roosting birds at any time but increased, along with aggressive behaviour, as number of birds gathering at roost increased; aggression most obvious in areas of highest densities at roost. First birds left roost about sunrise (from 20 min before to 15 min after); roosting flock dispersed rapidly (average 47 min); most left in one or two large flocks, though first four birds always left singly. Nankeen Kestrel *Falco cenchroides* often disturbed roosting Doves. ROOSTING POSTURE: Crouch with neck withdrawn and feathers of breast fluffed out (Hooper 1974).

SOCIAL BEHAVIOUR Within HANZAB region, little known other than observations by Frith; some details from study of roosting behaviour in Vic. (Hooper 1974; see Social Organization). Better known elsewhere, e.g. Heinroth & Heinroth (1949), Fabricius & Jansson (1963) and Goodwin (1956); see BWP for full descriptions. In urban areas, tame; in NZ, breeding adults can be wary (Dilks 1975b). Possible to see full range of display postures during one day, particularly in spring (Frith). **Flock behaviour** Sometimes seen in dense flocks (van Tets & Vestjens 1973); move between roosts and feeding areas singly or in flocks (Hooper 1974). Low murmuring notes heard from flocks probably have contact or mild warning function (Frith). **Aerial activity** DISPLAY FLIGHT (see p. 837): From ledge, or similar site, bird flies more or less horizontally, with slow noisy wing-beats, then partly spreads tail, sets wings upwards in V, and glides away, often swinging from side to side; after gliding a few metres, beats wings to restore momentum, then resumes gliding. Often seen over, and between, city buildings (Frith).

Agonistic behaviour Seen at nest and at roost (see below); once, before laying, two females at nest and being fed by male were aggressive to each other. One bird recorded

stealing nesting material from another pair (McKenzie 1961). **Threat** BOWING DISPLAY: Three forms, which grade into one another: (1) Sexual form (see Sexual behaviour); (2) Assertive form (see p. 836): bird lowers head but does not spread tail (or does so only slightly) and turns round and round in tight circle, *cooing* as it does so; given when male near nest or when strange Dove approaches. (3) Defensive form: bird faces intruder, lowers head, and gives Display Call but does not spread tail. Both Assertive and Defensive Bowing given by both sexes (Frith). At roost, Hooper (1974) recorded three levels of aggression, each probably more intense form of preceding; first stage was threat with wing-lifting and head drawn in, orientated towards opponent (possibly similar to WING-LIFTING posture recorded by Frith); second involved pecking about head and neck and jostling with wings (WING-CUFFING); third similar to second but involved either bird moving to another part of roost. Attacked by Crested Pigeon *Ocyphaps lophotes* when both feeding together (Woodall 1985). **Alarm** ALERT POSTURE may be adopted after arriving at roost: bird stands at full height, with neck stretched; usually looks from side to side briefly then adopts Roosting Posture (Hooper 1974). Distress Call may be heard when disturbed (Frith).

Sexual behaviour BOWING DISPLAY: In sexual form (see p. 836), male approaches female by flying or running; then lifts head high, expands neck, and erects plumage of neck, rump, back, and underparts, and holds tail depressed and spread; male then turns in a circle, cooing loudly, with head and breast lowered and spread tail sweeping ground; display ends when head lifted again (Frith). Sexual form of Bowing Display can be given by female. See Agonistic behaviour for other forms. DRIVING by males almost incessant in any flock (Frith). At one nest, unpaired male had built nest and was courting female; female entered nest-hole several times but birds not seen to copulate or collect nest-material; they courtship-fed several times then performed a courtship flight, followed by sunbathing; female then left and male courted all females nearby; when original female returned, courtship feeding took place. Same male seen to courtship-feed two females at once (McKenzie 1961). **Copulation** Usually much courtship feeding before copulation. After copulation birds strut or PARADE, each with feathers of neck and rump erect and tail and wings partly spread (WING-LIFTING of Goodwin [1956]); body can be erect or horizontal. Male often leaves in Display Flight, followed closely by female (Frith).

Relations within family groups Young beg from parents. Young place bill inside bill of adult and bow up and down and circle while feeding; nearly fledged young seen to flap wings vigorously as they begged and circled adult (NRS). At loft containing nests, returning adults, mobbed by begging chicks, would feed most persistent individual, not necessarily their own (Dilks 1975b). Young of successive broods observed begging from parents together (NRS). Dilks (1975b) noted losses to part of a brood were caused by competition between nestlings for food or by interference by other adults.

VOICE Well known extralimitally from study of Baptista & Abs (1983) and summary of earlier work in BWP (both with sonagrams). No information from HANZAB region (account in Frith based on Goodwin). Below is a brief summary of extralimital studies. **Non-vocal sounds** Wing-beats audible in Display Flight; clap wings when flying (Goodwin).

Adult (Calls transcribed by Goodwin use *u* as in put and *oo* as in boot.) ADVERTISING CALL: Long vibrant moaning *oorh* or *oh-oo-oor*; individually recognizable (Jellis 1977; Goodwin). DISPLAY CALL: *Oo-ru-cu t'coo*, sometimes preceded or followed by 1–2 notes sounding like *wut*, *wok* or *wok-wok* (Baptista & Abs 1983; Goodwin); given in Bowing Display. NEST CALL: *Coo*, same as Advertising Call (Goodwin). ALARM CALL: Gasping grunted *urh* or *eerh* (Goodwin). DISTRESS CALL: Similar to Alarm Call but shorter and more broken in structure (Baptista & Abs 1983). **Other calls** Low murmuring, audible only when close; given when apparently perturbed or angry (Goodwin).

Young Give squeaky and wheezy call when begging; also uttered when excited or when attacked by adult (Baptista & Abs 1983).

BREEDING Little information from HANZAB region. Account based on Frith and study of feral population in a loft in NZ (Dilks 1975a); 46 records in NRS up to Dec. 1993. Much unreferenced information in NZRD but probably from extralimital studies.

Season In Aust., breeding recorded in all months except May, with most records from Oct. to Jan. (Aust. Atlas); eggs recorded in all months except Apr., May and July (NRS). NSW: eggs and young, late Nov. (van Tets & Bywater 1967). In NZ, recorded breeding in all months of year, with peaks in spring and summer and trough in Mar. (Dilks 1975a).

Site In sheltered locations, on cliffs, offshore islands or in caves; also in mine shafts, on buildings and other structures. On ledges or in crevices in cliffs and mouths of caves; in hollow limbs of eucalypts or willows; on ground under Karo shrubs on small island; on ledges of buildings, roofs, awnings, grain silos, rafters in sheds, barns, bridge girders, drains, ceilings of houses, on telegraph poles, flag-poles, traffic signals, timber under wharfs, even on floor of fourth-floor room where window left open (van Tets & Bywater 1967; Dilks 1975a; Serventy & Whittell; Frith; CSN 37, 38; NRS). Second clutches usually laid in another nest (Dilks 1975a). MEASUREMENTS: Nests in mine shafts 2–6 m below top of shaft; those on buildings, up to 12.2 m high; 50 m high on girder in power station (NRS).

Nest, Materials Usually a simple platform made of a few twigs, sticks, dried grass or straw, feathers, stones; one nest in NZ composed almost entirely of pieces of wire; in urban areas sometimes do not build nest; faeces may accumulate in nest (Serventy & Whittell; Frith; NRS). *Eucalyptus* twigs measured 10.2–45.7 cm long (Serventy & Whittell).

Eggs Smooth, slightly glossy; white (Serventy & Whittell; Frith). MEASUREMENTS: Two eggs, 39 x 29 and 39 x 30 (Serventy & Whittell). Extralimitally, 39 (36–43; 80) x 29 (27–32) (BWP). WEIGHT: Extralimitally, 18 g (BWP).

Clutch-size Usually two. In Aust., C/1 x 3, C/2 x 16 (NRS). In NZ, average, 1.91: C/1 x 38, C/2 x 213, C/3 x 3, C/4 x 7 (Dilks 1975a).

Laying Interval between eggs of C/2, 48 h (NRS); 48 h extralimitally (BWP). Many females lay second clutches while still feeding well-grown young (Dilks 1975a). One nest-site used four times in 12 months, with maximum interval between clutches of 44, 91 and 177 days (NRS).

Incubation No information for HANZAB region. Extralimitally, by both sexes, beginning with first egg; hatching asynchronous. INCUBATION PERIOD: 17.4 days (17–19; 67) (Frith); *c.* 18 days (Dilks 1975a).

Young Semi-altricial, nidicolous (BWP). Hatch in down, with eyes closed; eyes open on Day 4. At 7 days, quills appear on wing and body; at 11 days, have feathers on underparts, back, tail, remiges and underwings; at 14 days, have feathers on head and some vestigial down on breast, rump and wings; at 16 days, completely feathered except for patches on head,

back and abdomen (Frith). **Growth** Weight and measurements at hatching and mean daily increase: weight 15.5–15.6 g, 10.4 g/day (5.2–22); wing 14–14.5 mm, 4.7 mm/day (1.0–7.6); bill, 12.5–13, 0.5 (0.3–1.2); tarsus, 9.3–9.4, 1.1 (0.7–2.7) (Frith). **Parental care, Role of sexes** Said that both parents feed young, at first on crop-milk, later on items softened in parent's crop (NZRD). Adults sometimes feed chicks other than their own (Dilks 1975a).

Fledging to maturity FLEDGING PERIOD: About 4 weeks (Dilks 1975a); leave nest at 30–35 days (Frith). Young spend another week near nest before leaving with parents (Dilks 1975a).

Success From 501 eggs, 299 (59.7%) hatched, 247 (49.3%) fledged; hatching and fledging success for clutches of different sizes given in Table 1 (Dilks 1975a). Hatching success significantly lower in C/1; fledging success significantly lower for C/1 and C/4; fledging success lowest in Mar. and July–Oct. (Dilks 1975a). Losses of part of broods caused by competition for food between nestlings or by interference by adults; complete brood failure probably results from death of one or both parents (Dilks 1975a). From NRS: from 28 eggs, 14 hatched (50%). Pied Butcherbird *Cracticus nigrogularis* took egg (Serventy & Whittell); many eggs and young destroyed by people (NRS).

PLUMAGES Prepared by A.M. Dunn. Begin post-natal moult to juvenile plumage when *c.* 4 days old. Then undergo complete post-juvenile moult to adult plumage, which is finished by *c.* 20 weeks old. Thereafter, a complete post-breeding moult each year produces successive adult plumages, without change in appearance. Sexes similar (see Sexing). Fourteen subspecies recognized worldwide; Aust. birds probably derived from nominate *livia*. Feral populations vary greatly in plumage. A form similar to wild ancestral forms and common in feral populations described below. Colour of iridescence varies with angle of light.

Adult Head and neck Forehead, crown, nape, chin, lores and ear-coverts, dark grey (83) with traces of iridescence. Feathers of hindneck, sides of neck and throat, bifurcated, with grey-black (82) bases and broad, strongly iridescent purple (2) or green (c62) tips; form glossy collar that extends to upper mantle and onto breast. **Upperparts** Upper mantle may have iridescent feathers as hindneck. Lower mantle, dark grey (83) grading to pale grey (86) on upper back. Lower back, white. Rump and uppertail-coverts, grey (c87). Scapulars, pale grey (c86). **Underparts** Upper breast, dark grey (83) with broad iridescent fringes to feathers. Lower breast, dark grey (83) to grey (84). Belly, flanks, vent and thighs, light grey (85). Undertail-coverts, grey (84) to dark grey (83). **Tail** Grey (c87) with broad black (89) terminal band. **Upperwing** Secondary coverts, light grey (c85) with broad black (89) subterminal band on greater secondary coverts, forming a black band *c.* 1 cm wide across central innerwing. Greater primary coverts and alula, grey (c84) with silvery-grey tinge to outer webs when fresh. Primaries, pale grey (86) grading to dark grey (c83) on outer edge and tips, and with silvery-grey tinge to outer edge when fresh. Outer secondaries, light grey to grey (84–85) with broad grey-black (82) tips *c.* 2 cm wide, forming trailing-edge. Inner secondaries and tertials, mostly grey-black (82) with light-grey (85) tips and concealed light-grey (85) inner webs to secondaries. **Underwing** Marginal coverts, grey (c84). Rest of coverts, white. Primaries and secondaries, white to pale grey (86) with broad grey-black (82) tips.

Downy young No specimens. Evenly covered in long thick down; usually yellow (Frith).

Juvenile When fresh, many feathers have downy projections. Often much paler than adult. Differences from adult. **Head and neck** Like adult but with little if any iridescence, and feathers of neck not bifurcated. **Upperparts** Lower mantle and scapulars slightly paler, often with white or pale buff-brown (c39) fringes to feathers. Lower rump and uppertail-coverts slightly duller grey, with faint brownish fringes to feathers when fresh. **Underparts** Like adult but with little if any iridescence on breast. Occasionally, some feathers narrowly fringed white or buff-brown (c39). **Tail** Black tip less sharply defined and can appear duller. **Upperwing** All lesser and median secondary coverts slightly paler and often narrowly fringed white or buff-brown (c39). Bands across greater secondary coverts, tertials and inner secondaries, duller, browner and less sharply defined. Remiges slightly browner and narrowly fringed white near tips.

BARE PARTS Based on photos (Crome; unpubl.: J.N. Davies) and published descriptions (BWP; Frith). **Adult** Bill, grey-black (82) to black (89); cere dusted white. Iris, orange-yellow (18) to dark red (c108) with a yellow (c55) inner ring. Orbital ring, greyish pink (greyish 5); bluish grey (BWP). Legs and feet, pink (c3) to pink-red (10). **Downy young** (From Frith; BWP.) Bill, bluish grey, with light-flesh tip; or flesh-pink, with brown subterminal band. Iris, reddish grey to dark brown. Legs and feet, leaden-flesh or greyish pink. **Juvenile** Bill, dull pink (c5) with dark-brown (c121) tip; leaden grey, with flesh tip (BWP). Cere, dull pink (c5); leaden grey (BWP); colour gradually lost as white dusting gradually develops. Iris, dark brown (219A); pale grey, ochre or yellow (BWP). Orbital ring, greyish pink (greyish 5); pale grey or dark grey (BWP). Legs and feet, dull greyish-pink (greyish 5); similar to adult with brown, pink or orange tinge (BWP).

MOULTS Based mostly on published information from n. hemisphere, but supplemented with information from 15 adult skins from Aust. cities (AM, ANWC, MV, QM, SAM). **Adult post-breeding** (Second and subsequent pre-basic). Complete; primaries outwards. Timing of start and finish of moult varies between individuals and locality. Duration of primary-moult probably varies; extralimitally, between 5.5 and 8 months

Table 1

Clutch-size	Number of Clutches	Number of Eggs	Number Hatched (%)	Average size of Broods (%)	Number Fledged (%)	Number Fledged/Nest
C/1	38	38	10 (26.3)	0.26	9 (23.7)	0.24
C/2	213	426	276 (64.8)	1.30	214 (50.2)	1.00
C/3	3	9	5 (55.5)	1.67	4 (44.4)	1.33
C/4	7	28	8 (28.6)	1.14	20 (7.1)	0.29
Total	261	501	299 (59.7)	1.15	229 (45.7)	0.88

(BWP). Extralimitally, secondaries, tail and body-moult begin when primary-moult about p5 and completed about same time as p10; tail starts with t1 or t2 and completed with t4 or t5; moult can slow considerably or be suspended during peak breeding period (BWP). In Aust., appear to begin moult of primaries about Sept. or later, and in final stages of primary-moult between Jan. and Mar. Several birds had stopped moult after replacing 3–5 primaries. Most birds were not moulting between June and Nov. **Post-juvenile** (First pre-basic). Complete. Can vary greatly between individuals (BWP). Extralimitally, begins with face, mantle, outer scapulars, and longer lesser upperwing-coverts (BWP). Moult of primaries usually begins at *c.* 10 weeks old and attain adult appearance by *c.* 20 weeks (Frith). Occasionally, attain adult body while all primaries still juvenile (BWP). Extralimitally, timing of start depends largely on hatching date, but activity of moult usually low in winter; some suspend moult of prim-aries (BWP).

MEASUREMENTS (1) Brisbane, Sydney, Canberra, Melbourne, Mildura and Adelaide, feral adults, skins (AM, ANWC, MV, QM, SAM). (2) Britain, adults, skins (BWP). (3) S. Europe, adults, skins (BWP).

	MALES	FEMALES	
WING	(1) 230.9 (7.76; 219–240; 7)	223.2 (5.89; 214–231; 9)	*
	(2) 228 (4.57; 220–235; 16)	219 (3.57; 214–227; 15)	**
	(3) 226 (5.37; 219–234; 11)	219 (4.03; 213–223; 6)	**
TAIL	(1) 111.0 (1.29; 109–113; 7)	107.4 (8.17; 95–125; 9)	ns
BILL	(1) 17.9 (0.96; 16.4–18.9; 6)	17.7 (1.53; 15.4–20.0; 9)	ns
TARSUS	(1) 32.6 (1.17; 31.0–34.0; 7)	32.4 (1.78; 29.2–35.4; 9)	ns
TOE C	(1) 35.4 (1.39; 33.9–38.0; 7)	34.3 (1.67; 32.5–36.4; 7)	ns

WEIGHTS Aust. cities (see Measurements), feral birds: adult males 295.0 (71.3; 219–388; 4), adult females 319.6 (56.1; 221–362; 5) (AM, ANWC, MV, QM, SAM). No significant differences between sexes.

(1–2) Qld, unsexed (Morris 1969): (1) Rocklea; (2) Wacol.

		UNSEXED
(1)	Mar.	299.8 (42.8; 99)
	July	299.1 (48.7; 173)
(2)	Oct.	324.2 (32.9; 56)

STRUCTURE Wing, long and broad. Eleven primaries: p9 longest, p10 3–4 mm shorter, p8 4–7, p7 19–23, p6 35–40, p5 50–56, p4 64–69, p3 77–81, p2 83–92, p1 90–99; p11 minute. Ten secondaries, including three tertials; tips of longest tertials fall between p2 and p4 on folded wing. Tail, square; 12 rectrices; t1 longest, t6 8–9 mm shorter. Bill, short and slender, about half length of head; upper mandible, slender, with downcurved maxillary unguis and bulging cere at base; lower mandible, straight and slender, tapering to tip from gonys. Tarsus, short, rounded and partly feathered; scutellate. Outer toe 75–80% of middle, inner 73–80%, hind 46–58%.

SEXING Sexes differ only slightly: males have more intense and often more extensive iridescence on neck; in some varieties, males have larger cere than females (Goodwin 1954).

GEOGRAPHICAL VARIATION Extensive, differing in size, colour of rump and depth of grey on rest of body (BWP). For summary of subspecies in natural range, see BWP, Goodwin and Long (1981).

Most common plumages of feral Rock Doves are ones that resemble ancestral forms. These show variations on plumage described above, with varying amounts of black spotting on wings and melanism in rest of plumage. A smaller proportion contains a mixture of colours from domestic breeds. Goodwin (1954) described eleven plumage types commonly found in feral populations: Blue, Blue Chequer, Velvet, Mealy, Red, Red-Chequer, Grizzle, Black, Pied, Silver and Barless Mealy; see Goodwin (1954) for full descriptions. Frith noted that long-established feral populations tended to have a larger proportion of birds that resembled the ancestral form than newer feral populations. In Canberra, more recently established populations included more birds that resembled various domestic breeds (over 50%) than did long-established populations of Sydney; in Sydney, of 600 Rock Doves, 64% were basically Blue-Chequer types, 21% Blue-bar types, and rest were heterogeneous groups of most colours known in domestic breeds. Feral Rock Doves also vary in size; in North America, significant variation with location, size tending to increase with increasing latitude (Johnston 1990, 1994).

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Barbary Dove *Streptopelia 'risoria'* (page 864)
1 Adult; **2** Juvenile; **3, 4** Adult

Rock Dove *Columba livia* (page 838)
5 Adult, ancestral type; **6** Adult, dark variant; **7** Juvenile; **8, 9** Adult, ancestral type