

Corvus orru Torresian Crow

COLOUR PLATE FACING PAGE 737

Corvus orru Bonaparte, 1850, *Consp. Gen. Av.* 1: 385 — New Guinea = Lobo, Triton Bay, West Papua.

No explanation or etymology is given for this epithet (Bonaparte 1851), but it was probably based on an onomatopoeic Papuan native name.

OTHER ENGLISH NAMES Crow or Australian, Intermediate, Large-billed, Orru, Papuan or Western Crow; Kelly.

POLYTYPIC Subspecies *ceciliae* Mathews, 1912, w., n. and e. Aust., from Murchison R., w. rim of Nullarbor Plain and Great Victoria Desert, N to Pilbara Region and Kimberley Div., WA (though largely absent Great Sandy Desert), and NE through centralian ranges, Tanami Desert, Barkly Tableland and lower Georgina R., Qld, to all Top End, NT, and central-s. Gulf of Carpentaria, NT-Qld; and coastal and subcoastal e. Qld-NSW from C. York Pen. S to about Hunter R., central coastal NSW, extending inland to w. drainages of Great Divide; nominate *orru*, islands of n. Torres Str. (Boigu, Dauan, Saibai), and all lowland New Guinea and its satellite islands, and Moluccas. Extraliminally, *latirostris* A.B. Meyer, 1884, Tanimbar, Babar I., e. Lesser Sundas; and *insularis* Heinroth, 1903, Bismarck Arch.

For this, and all, species of *Corvus*, text based mainly on literature published after 1970 when currently accepted species arrangements determined by Rowley (1970). However, where it is possible in earlier literature to identify species by the location of the records, we have included such observations.

FIELD IDENTIFICATION Length 49 cm (46–51); wing-span 105 cm (100–110); weight: male 580 g (470–670), female 520 g (440–650). Large crow: similar in size to Australian Raven *C. coronoides* and Forest Raven *C. tasmanicus*; slightly larger than Little Raven *C. mellori*, and larger again than Little Crow *C. bennetti*. However, differences in size slight and only useful in direct comparison. Very difficult to distinguish from other ravens and crows other than by call. Large crow with: long and powerful bill with decurved upper mandible, and slight hook to tip; long, thin legs, with fairly long toes and hooked claws, and short feathering on tibia and thighs, which emphasises skinniness of legs; and long wings, with tips of folded wings falling just short of tip of rather long tail; tip of tail wedge-shaped. In normal flight, head and neck project well forward of leading edge of wings, which appear fairly long and broad, with distinctly fingered tips; tips of three primaries (p4–p6) extend beyond line of trailing edge of wing. Adults wholly black, with white eyes; normally concealed bases to feathers, white (cf. pale-grey bases in ravens). Hackles on chin and throat only slightly longer than surrounding feathers, not forming conspicuous mound when sleeked or beard when raised. Sexes alike, though females smaller. No seasonal variation. Juveniles smaller and browner than adults, with blue-grey eyes. Immatures like adults but eyes brown and retain some juvenile plumage; attain adult coloration of eyes when 2 years old. Geographical variation slight, mainly in size. **Adult** Head, neck, upperparts, breast, flanks and undertail-coverts, glossy black with green sheen to ear-coverts and bluish-purple to bluish-green sheen to rest, intensity of sheen varying with light. Rest of underbody, undertail and underwing, black, lacking gloss. Bases of all feathers, white, sharply demarcated from broad black tips; bases normally concealed but can be exposed in strong winds or if plumage very worn. Hackles on chin and throat slightly longer than surrounding feathers, glossy black with, in strong light, bluish-purple or greenish sheen giving finely streaked appearance, and bifurcate tips imparting somewhat rough texture; when sleeked, hackles appear as small mound on chin and throat not quite extending to, or just reaching, upper breast; when hackles raised when calling, form short spiky beard with fine hair-like texture. Hackles do not move much when bird walks. Basal third of upper mandible, including nostrils, covered by long bristles that extend from lores. Bill, black. Iris, white with blue inner ring. Legs and feet, black. **Juvenile** Like adult but smaller, with shorter and narrower bill, and looser and fluffier texture

to plumage. Wholly brownish black with slight glossy bluish or greenish sheen on mantle, scapulars, upperwing and upper-tail (though less glossy than adult). Feathers of chin and throat, short and not specialized. Outer primaries and rectrices, narrower with more pointed tips to feathers. Bill, black. Gape, pink, conspicuous. Sides of throat, narrowly bare and pink (not as broadly pink as Australian Raven). Iris, blue-grey. Legs, black. **First immature** Very similar to adult but slightly smaller and with shorter bill. Retain juvenile remiges and rectrices, which slightly duller and browner than in adult, with primaries and rectrices also narrower and more pointed at tips. Also retain most greater coverts (all but innermost greater secondary coverts), none to a few median secondary coverts and alula, which more brownish and less glossy and contrast with new, adult-like, glossier black rest of coverts (contrast most noticeable between any fresh innermost and outer greater secondary coverts). Gape, flesh-pink, soon changing to black (though timing of change not known). Iris, brown. Rest of bare parts as adult. **Second immature** As adult except iris, light brown; attain adult coloration when 2 years old (see Bare Parts).

Similar species All Aust. *Corvus* very difficult to distinguish and great care needed to identify species; call the most reliable identification character, and in many circumstances identity cannot be confirmed without hearing calls. For discussion of differences from other *Corvus*, see Australian Raven: Separation of Aust. *Corvus*.

Usually occur singly or in pairs, or in small flocks of up to 20; occasionally in larger flocks of up to 150 or, exceptionally, thousands, usually during non-breeding season. Often forage with Little Crows and occasionally with Forest Ravens. Noisy and conspicuous, and call often when perched and in flight; usually wary of people, though often occur in large numbers at artificial sources of food, such as rubbish tips. Forage mainly on ground, in open habitats, including fields and paddocks. Feed mainly on insects, cultivated grains, fruit, small vertebrates, and much carrion and other scavenged food, including road-kills and human refuse where available. Usually fly with shallow wing-beats and short glides, with wings swept back. Has display flight (Currawong Flight) similar to undulating action of currawong or cuckoo-shrike, closing wings against body and missing a wing-beat while giving single call-note and dipping in flight. On alighting, birds almost always rapidly and exaggeratedly shuffle wings above back before folding them normally. Utter wide range of high-pitched and rather sharp

calls; main call (Territorial Call) a high-pitched, nasal, and staccato or clipped barking or honking (see Voice).

HABITAT Common in wide range of wooded habitats, mainly dry open forests and woodlands (Bravery 1970; Curry 1978; Morris *et al.* 1981; Garnett & Bredl 1985; Storr 1981; Storr 7, 16, 19; see below), and often riparian associations, especially in inland and w. Aust. (Rowley 1970; Moriarty 1972; Storr 1981; Coate *et al.* 1998; Burbidge 1999; Aust. Atlas 1; Storr 21, 22; G.S. Chapman; see below). Also commonly in agricultural and pastoral land, usually with scattered large trees or adjoining remnant patches of woodland or forest, including recently sown and standing crops; and attracted to other modified habitats or human activity where food abundant, such as roads, rubbish tips, airfields or ploughing; common in cities, suburbs, rural towns and round homesteads, including in parks and gardens (Rowley 1970; Curry 1978; Forshaw 1978; Griffin 1995; Secomb 1997; Burbidge 1999; Woodall 1999; Storr 11, 19; Aust. Atlas 1; see below). Also use other habitats, such as beaches, dunes and mangroves (Boekel 1976; Gosper 1981, 1983; Morris *et al.* 1981; Debus 1982; Secomb 1997). In inland and w. Aust., typically associated with ranges, major watercourses and other sources of permanent water (such as waterholes) where effective rainfall or availability of water greater than surrounding country and where there are taller trees, mainly eucalypts, for nesting and roosting; in n. and e. Aust., where overall rainfall greater, use wider range of habitats, including cultivated areas (Rowley 1970a; see below). While forage in closed-canopy forest, generally prefer more open habitats (Rowley 1973d), but will use artificial clearings in closed forests (see below). Occur in tropical and subtropical zones, extending into arid zone in n-central Aust. and WA (Rowley 1970, 1973d; Storr 11; Aust. Atlas 1, 2; see Distribution).

Commonly in low to tall **DRY OPEN EUCALYPT FORESTS**, often with other genera such as *Angophora* or *Lophostemon* present or co-dominant, a sparse to well-developed understorey of shrubs and small trees, commonly of acacias, but including *Lantana*, and ground-cover often dominated by grass, sometimes with rushes *Lomandra*, forbs or ferns, and often subject to grazing (Bravery 1970; Roberts & Ingram 1976; Leach & Hines 1987; Woinarski *et al.* 1988, 1989; Catterall *et al.* 1991; Gosper 1992; Leach & Recher 1993; Leach & Watson 1994; Slater 1995; see below); and commonly in dry open **EUCALYPT WOODLANDS**, often low, and usually with sparse to very sparse understorey of shrubs (including acacias and paperbarks), though sometimes clumped in thickets, and usually with dense, sometimes tall, ground-layer of grasses such as *Spinifex triodia*; sometimes with other genera such as Cooktown Ironwood, *Lysiphyllum cunninghamii* and Boab (Wieneke 1988; Woinarski *et al.* 1988, 1989; Tidemann & Wilson 1992; Slater 1995; Read 1998). Dominant eucalypts of such forest and woodland habitats include, in n. Aust., Darwin Woollybutt, Darwin Stringybark, Ghost Gum, Variable-barked Bloodwood, Darwin Box, Silver Box *Eucalyptus pruinosa* and Apple Gum *E. clavigera* (Woinarski *et al.* 1988, 1989; Tidemann & Wilson 1992; and references above); and, in e. Aust., Tallow-wood, Blackbutt, Spotted Gum, Forest Red Gum, Scribbly Gum, Pink Bloodwood, Grey Ironbark, Northern Grey Ironbark, Bastard Tallow-wood *E. planchonia*, Red Mahogany, Broad-leaved White Mahogany *E. umbra* and Bailey's Stringybark *E. baileyana* (Catterall *et al.* 1991; and references above). Rarely reported from mallee (Curry 1978). Also sometimes in variety of **NON-EUCALYPT SCLEROPHYLL FORESTS AND WOODLANDS**: in *Pandanus* forests, preferring stands dominated by Screw Palm *Pandanus spiralis* rather than those dominated by eucalypts (Verbeek *et al.* 1993); low woodland dominated by Silver-leaved Paperbark and Northern Swamp Box *Lophostemon grandiflorus* or *Lysiphyllum*

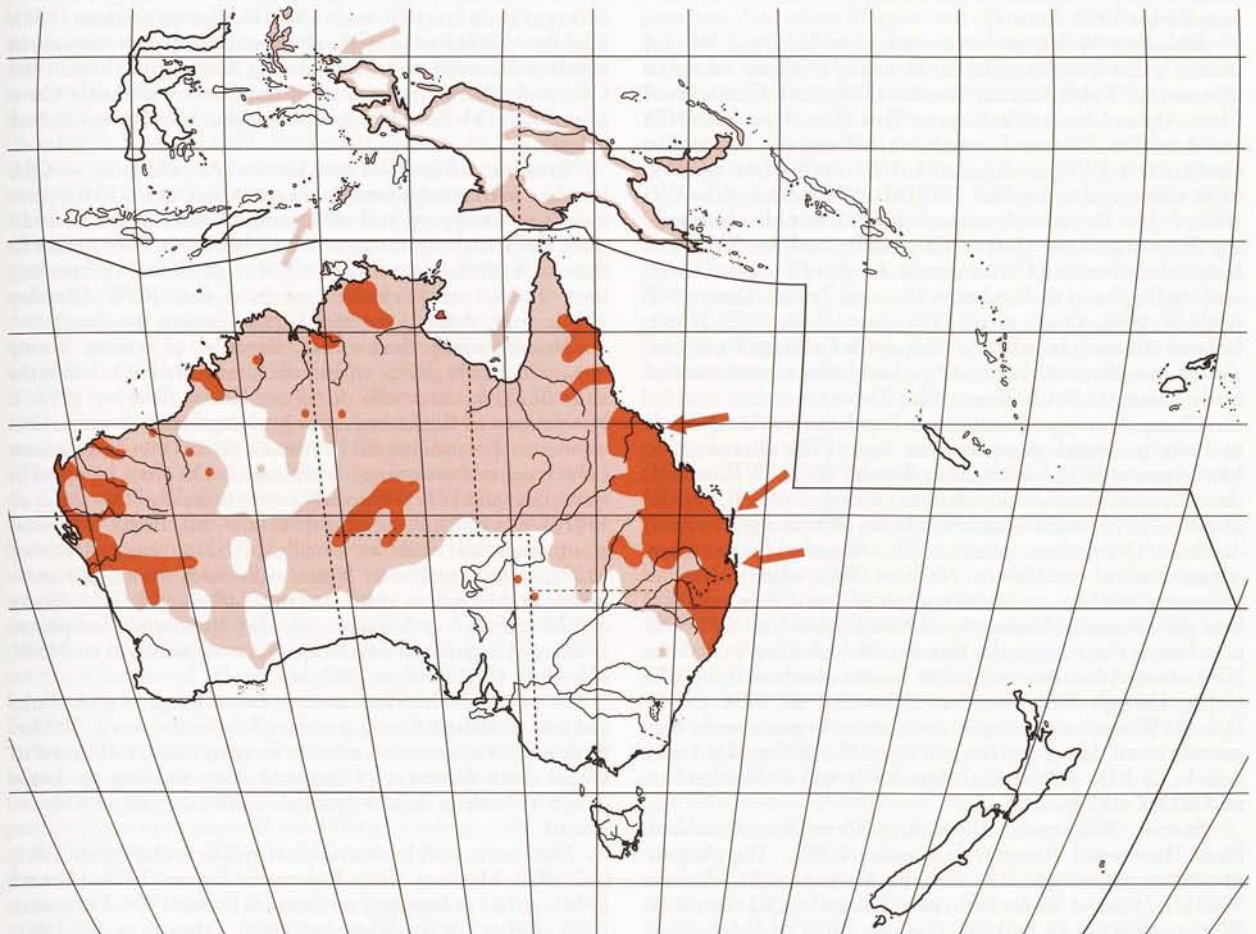
(Tidemann & Wilson 1992); in low coastal woodland and dense swamp forest dominated by casuarinas, including Black Sheoak (Roberts & Ingram 1976; Gosper 1981); low open forest dominated by Wallum Banksia, often with dense heath understorey (Roberts & Ingram 1976); and degraded, remnant low closed Brigalow forest (softwood scrub), along creeks, fence-lines and roadsides, and bordering grazed lands (Leach & Recher 1993; Leach & Watson 1994; Leach 1995). Occasionally in **ACACIA SHRUBLANDS** (Moriarty 1972; Roberts & Ingram 1976; Lane & Battam 1985; Tidemann & Wilson 1992). Often associated with **RIPARIAN SCLEROPHYLL WOODLANDS AND FORESTS** round waterholes, springs, lakes and along watercourses, especially in w. and inland Aust., where commonly associated with such habitats as they provide tall trees for nesting and roosting; riparian associations said to be less important in wetter parts of n. and e. Aust., but still used. Such associations often dominated by River Red Gums, Coolibahs or other eucalypts (e.g. Marble Gums *Eucalyptus gongylocarpa*) or paperbarks (e.g. Inland *Melaleuca glomerata* and Silver-leaved *M. argentea* Paperbarks), sometimes with other genera, such as *Lophostemon* (e.g. Northern Swamp Box) or *Nauclea* (e.g. Leichhardt Tree), dominant or co-dominant, and with understorey, or dense stands or thickets, of shrubs or small trees, often acacias (such as Mulga or Gidgee) or paperbarks (such as Yellow-barked Paperbark *Melaleuca nervosa*) (Rowley 1970; Moriarty 1972; Brooker & Estbergs 1976; Curry 1978; Storr 1981; Badman 1982; Gibson 1986; Coate *et al.* 1998; Tidemann & Wilson 1992; Burbidge 1999; Johnstone *et al.* 2000; Storr 16, 21, 22; Aust. Atlas 1; G.S. Chapman), e.g. in woodland of large River Red Gums, Coolibah and Gidgee round waterholes in open chenopod shrubland on gibber plain (Badman 1982). Also found in and round flood-plain freshwater meadows, seasonal freshwater swamps, and semi-permanent swamps (Gosper 1981). Also often in **COASTAL HABITATS**: foraging on estuarine and coastal mudflats and sandflats, on salt pans and saltflats (Gosper 1981; Wieneke 1988); on foredunes, beaches and, less often, rock platforms (Boekel 1976; Gosper 1983), though appear to be absent from this habitat in areas of NSW where range overlaps with that of Forest Raven (Debus 1982; Secomb 1997); and in mangroves (Roberts & Ingram 1976; Gosper 1981; Wieneke 1988), e.g. dominated by *Avicennia*, *Aegiceras* and *Bruguiera* (Gosper 1981). Sometimes in **RAINFORESTS** (Wieneke 1988): in NT, in monsoon rainforest, including semi-evergreen notophyll and semi-evergreen microphyll vine forests, dominated by *Allosyncarpia ternata* with Northern Cypress-pine *Callitris intratropica*, Slow-growing Mangarr *Pouteria sericea*, Carpenterian Palm *Carpentaria acuminata*, Weeping Denhamia *Denhamia obscura*, Velvet Mock Olive *Notelaea microcarpa*, Melville Island White Beech *Canarium australium* and Peanut Tree *Sterculia quadrifida* (Woinarski *et al.* 1989; Woinarski 1993); in ne. NSW, in low closed forest or dry (monsoon) rainforest 6–18 m tall, dominated by Lacebark, Deep Yellow-wood and White Cedar, with scattered emergents, and understorey of thorny shrubs or, at edges of rainforest, dense *Lantana*; and in tall closed subtropical rainforest, 25–40 m tall, dominated by Black Booyong, Purple Cherry and Yellow Carabeen, with fairly open subcanopy and sparse ground-cover of broad-leaved herbs (Gosper 1992). Occasionally in tall open **WET SCLEROPHYLL FOREST** with an understorey of small trees, palms (including Cabbage Tree Palm *Livistona australis*) and shrubs, dominated by rainforest species but including *Lantana*, and a ground-cover of ferns, herbs and forbs (Gosper 1992; Slater 1995), e.g. tall open, regenerating wet sclerophyll forest, 15–36 m tall, dominated by Tallow-wood, Blackbutt and Red Mahogany (Gosper 1992). Sometimes in clearings in rainforest (e.g. Griffin 1995) or other forests, such as for fire lookout-towers (Templeton 1991). Occur in wide variety of **MODIFIED HABITATS**. Common in **AGRICULTURAL**

AND PASTORAL LAND, usually with scattered large trees or remnant patches of woodland or forest (e.g. along roads or watercourses) for roosting and nesting (Rowley 1970, 1973a; Debus 1982; Wieneke 1988). Commonly forage in recently sown and standing crops, including Sorghum, Oats, Peanuts, Wheat and Maize (Rowley 1970, 1973a; Curry 1978; Debus 1982; Aust. Atlas 1; see Food); in orchards (Lord 1957; Goodwin 1986); round stockyards, fowlyards and poultry farms, slaughteryards (Anon. 1943; Storr 11, 16, 19; see Food); and other farming activities, such as ploughing and mowing (e.g. Nielsen 1962; Burnett 1996; Coate *et al.* 2001; Storr 21; see Food). Often attracted to other modified habitats or human activity where food abundant, such as rubbish tips, airfields and picnic grounds (Johnson & Hooper 1973; Boekel 1976; Curry 1978; Forshaw 1978; Thompson 1978; Goodwin 1986; Griffin 1995; Secomb 1997; Read 1998; Woodall 1999); and often forage on and beside roads and roadside verges (Rose 1999; Britton & Britton 2000; Johnstone *et al.* 2000; Storr 16, 21, 22; see Food). Also common in CITIES, SUBURBS RURAL TOWNS AND ROUND HOMESTEADS, in streets, gardens (including vegetable gardens), parks and reserves (Anon. 1943; Curry 1978; Johnstone & Smith 1981; Garnett & Bredl 1985; Walters 1985; McKilligan & McKilligan 1987; Green *et al.* 1989; Catterall *et al.* 1991; Woodall 1995; Burbidge 1999; Sinden 2002; Storr 11, 16, 19), including city centres (Britton & Britton 2000); also seen to forage in railway yards (Walters 1985). In Brisbane, showed significant preference for parks and edge-habitats (urban-forest interface) compared with forest or suburban habitats such as residential areas, shopping malls and university buildings and grounds (Everding & Montgomerie 2000). Also in Brisbane, abundance significantly

higher at edge of open eucalypt forest, abutting suburban gardens, or in front gardens and footpaths at the forest-suburb interface, than within open eucalypt forest or within suburbs away from forest remnants (Catterall *et al.* 1991). Also forage in recently burnt areas (Johnstone & Smith 1981; McFarland 1988), e.g. in se. Qld, occasional visitor to closed dry heathland after fire, with highest density straight after fire, numbers decreasing in subsequent years till not observed at all after 6.5 years (McFarland 1988).

DISTRIBUTION AND POPULATION From Wallacea, in n. Moluccas and e. Lesser Sundas, through lowlands of New Guinea (though not Kai and Aru Is), E to Bismarck and Louisiade Archs (White & Bruce 1986; Coates 1990; Coates *et al.* 1997; Mayr & Diamond 2001). Widespread in much of n. half of Aust.

Aust. Widespread in most areas of mainland except extreme SE, S and SW. **Qld** Widespread, though only very occasionally recorded, at scattered sites, in parts of South-western Region (Aust. Atlas 1, 2; Storr 19). **NSW** Mainly confined to NE, from Qld border S to lower reaches of Hunter R. (Debus 1982; Aust. Atlas 1, 2; NSW Bird Reps; A.K. Morris); and inland to Mungindi, Narrabri, Tamworth, Nowendoc and Gloucester (Costello 1981; Morris *et al.* 1981; Cooper & McAllan 1995; Aust. Atlas 1, 2; NSW Bird Reps; S.J.S. Debus). Outside this range, occasional reports from farther S (e.g. at unnamed site c. 80 km N of Sydney, Nov. 1980 [McGill 1981] and Burrendong SRA, near Wellington, 20 July 2001 [Aust. Atlas 2]) considered doubtful (S.J.S. Debus; A.K. Morris). Inland reports (e.g. near Mogil Mogil, Rexeen Stn, 20 km W of Lightning Ridge; Culgoa Floodplain



NP in ne. Upper Western Region; and still farther W at site c. 25 km NW of Yantabulla [Cooper & McAllan 1995; Aust. Atlas 2]) also considered doubtful, and probably misidentified Little Crows (Debus 1982; S.J.S. Debus). **SA** Mostly confined to N and NW, in area between s. Simpson Desert and e. Great Victoria Desert, W of line from Oak Valley to Witjira NP, where widespread (Badman 1979, 1982; Debus 1982; Close & Jaensch 1984; Aust. Atlas 1, 2; SA Bird Reps 1976, 1977–81). Outside this range, three unconfirmed reports of breeding in Cooper Ck Drainage Basin (at Camerons Corner, Yaningurie Pool and Strzelecki Ck [NRS]) considered doubtful and probably refer to misidentified Little Crows (G.S. Chapman; S.J.S. Debus). **WA** Widespread in belt from w. Eucla and South-East Interior Regions, NW through Gascoyne Region to Pilbara Region, in area W of 122°E, N and E of line joining Frank Hann NP and Nerren Nerren, and from 32°S N to 20–21°S; also widespread in Kimberley Div. Recorded at a few scattered sites in Great Sandy Desert, and widespread, though scattered, in parts of Gibson and Great Victoria Deserts (Brooker *et al.* 1979; Storr 1981; Start & Fuller 1983; Johnstone *et al.* 2000; Storr 11, 16, 21, 22; 26, 27, 35; Aust. Atlas 1, 2). Generally absent from Nullarbor Plain, though single record at Rawlinna accepted by Aust. Atlas 2, and once recorded near sw. edge of Nullarbor Plain, 26 km NW of Toolinna Rockhole (Storr 27); also generally absent from South-west Region, including Wheatbelt, though very occasionally recorded in extreme N of Region, where some spillover from Gascoyne Region, e.g. near Nerren Nerren, L. Narromyne, Rothsay and Mt Gibson (Saunders & Ingram 1995; Aust. Atlas 1, 2; Storr 35). **NT** Widespread throughout (Storr 7; Aust. Atlas 1, 2) including sandy deserts (e.g. Gibson 1986; Gibson & Cole 1988), *contra* claims of some (e.g. Parker 1969; Storr 7).

Breeding Widespread in e. Aust., from Lakefield NP and nearby Violet Vale Stn, Qld, S to Forster, NSW, and inland to line joining Walsh R. (near Wrotham Park Stn), Cumberland Dam, Alpha, Charleville, Cypress Tank (E of Thrushton NP) and Armidale. Scattered records in s. NT and nw. SA, and in Gascoyne and Pilbara Regions and Kimberley Div. of WA. More widespread in Top End, NT (Debus 1982; Aust. Atlas 1, 2; NRS; S.J.S. Debus). Occasional isolated records elsewhere, e.g. Karumba in se. Gulf of Carpentaria and, in WA, near Kalgoorlie, Gunbarrel Hwy near w. fringe of Gibson Desert, and Mt Brophy in se. Kimberley Div., and Tanami Desert, NT (Gibson 1986; Coate *et al.* 1998; Aust. Atlas 1, 2; NRS). Isolated claims of breeding in Cooper Ck Drainage Basin (see above) considered doubtful, and probably refer to misidentified Little Crows (G.S. Chapman; S.J.S. Debus).

Change in range, populations Populations in se. Qld said to have increased since at least late 1970s (Everding & Montgomerie 2000; Sinden 2002; Woodall 2002; P.F. Woodall), though, conversely, populations round Inverell, NSW (Baldwin 1975) and s. Carnarvon Basin, WA, thought to have declined (Johnstone *et al.* 2000). Autumn flocks often occurred round Armidale, n. NSW, in 1980s, when only a few pairs were resident; common resident by late 1990s, and first bred on campus of University of New England in 2001, and now breeds there annually; first recorded breeding in Imbota NR (where Australian and Forest Ravens also breed) in 2002 (S.J.S. Debus). First recorded at Inverell in 2004 (S.J.S. Debus). Range expanding S in Hunter Region, with first records round lower reaches of Hunter R., at Shortland and Ash I., in 2002 (NSW Bird Rep. 2002) and at Maitland in mid-2004 (A.K. Morris).

Status Nominate subspecies in Torres Str. considered Near Threatened (Garnett & Crowley 2000). **Populations RECORDED DENSITIES:** 0.17 birds/ha, Corinda, Qld (Walters 1985); 1.28 and 1.93 birds/ha, near Tallegalla, Qld (Leach & Watson 1994); 0.14 birds/ha, Cooloola NP, Qld (McFarland

1988); 0.08–0.16 birds/ha, Howards Pen., NT (Woinarski *et al.* 1988); mean of 0.01 birds/ha, Yinberrie Hills, NW of Katherine, NT (Woinarski & Tidemann 1991).

THREATS AND HUMAN INTERACTIONS Appear to have benefited from environmental modification and development (Dawson *et al.* 1991), e.g. a great increase in production of grain in Qld has probably increased area available to this species (Rowley & Vestjens 1973; Aust. Atlas 1). Often attracted to artificial sources of food, especially rubbish tips, road-kills, feeding tables and, in remote areas, homesteads (Boekel 1976; Gosper 1983; Thompson 1983; Griffioen 1995; Johnstone *et al.* 2000; Noske & Brennan 2002; Rollinson *et al.* 2003; Storr 11, 16, 21, 22). Sometimes attracted to farming activity, to feed on insects disturbed by machinery (Burnett 1996). Sometimes shot by farmers (Keast 1944). Occasionally killed on roads (Rix 1970; Taylor & Goldingay 2004). Very occasionally eaten (Chisholm 1945), apparently tasting 'just like duck' (G.S. Chapman).

MOVEMENTS Not well studied. Adult breeding pairs sedentary, defending territories year-round; independent juveniles, immatures and non-breeding adults form dispersive flocks (Rowley 1970, 1973b; Aust. Atlas 1). However, some geographical differences apparent: common generally in n. and e. Aust., with large flocks often observed, especially on cultivated lands; large flocks not recorded in arid central and w. Aust., possibly because density of birds lower (Rowley 1970). Broad-scale analysis of bird atlas and count data in e. Aust. found strong evidence for local movements (Griffioen & Clarke 2002), possibly reflecting movements of dispersive flocks. Movements in e. Aust. probably influenced by availability of grain crops (Rowley 1970; Rowley & Vestjens 1973); may also be influenced by flooding, with temporary increase in numbers observed in Brisbane during floods of 1983 and 1984 (Woodall 1986). Reported in mixed flocks with Little Crow (Aust. Atlas 1). Seen flying between islands in Torres Str. (see below).

Breeding adults Not well known. At Jandowae, se. Qld, breeding pairs occupy permanent territories, of c. 130 ha, year-round; and trapping and re-sighting of resident adults indicates that social organization of breeding adults very similar to that of Australian Ravens (q.v.), though timing of breeding later, at least at Jandowae and in coastal NSW (Rowley 1973b; Aust. Atlas 1; see Social Organization, Breeding).

Non-breeding flocks and dispersal of young Young remain in family groups within natal territory for 2–3 months after fledging, then join dispersive flocks (Rowley 1973d). Movements of flocks and timing of departure of immatures appear to be influenced by variations in breeding season (which centred on spring), with large flocks often reported in autumn–winter or non-breeding season generally (Dawson *et al.* 1991; see Social Organization). In e. Aust., flocks forage on grain crops and stubbles outside breeding season (Rowley 1970); round Jandowae, large flocks form during autumn–winter and forage on cultivated areas (Rowley 1973b); flocks of >30 recorded at Nanango, se. Qld, in winter (Templeton 1992); and large flocks seen feeding on army worms in ne. NSW, Mar–Apr. 1976 (Gosper 1981; see Food).

In suburban Brisbane, average home-range of four adults and one immature during non-breeding season was c. 700 ha. Birds tended to use roosts close to foraging areas, with trend to longer daily distances of dispersal after roosting in larger groups (Everding & Montgomerie 2000; see Social Organization).

Elsewhere, widely described as resident (Lindgren 1961; Gill 1970; Moriarty 1972; Roberts & Ingram 1976; Howard 1986), either as breeding resident (Schodde 1976; Longmore 1978; Debus 1982; Wieneke 1988; Dawson *et al.* 1991;

Bielewicz & Bielewicz 1996; NSW Bird Rep. 1980) or in resident flocks, e.g. round Atherton, ne. Qld (Bravery 1970) and Armidale, NSW (Debus 1982 *contra* Rowley 1970). Round Rockhampton, central-e. Qld, considered breeding resident, with flocks of up to 20 observed (Longmore 1978). Also said to occur year-round at some sites, e.g. Idalia NP, s.-central Qld (Sharp & Sewell 1995) and Keep R. NP, NT (McKean 1985). Present all year in littoral habitat around Ballina, ne. NSW, mostly in small groups up to six (Gosper 1983), with occasional flocks seen round head of Richmond R. in Sept. (Gosper 1981).

Some movements or seasonal occurrence also reported. Occasionally recorded at sites beyond normal range or considered sporadic visitor to some sites (e.g. Storr 27; also see Distribution). Seen flying from Saibai I. to Dauan I., n. Torres Str., Aug. 1978 (Draffan *et al.* 1983). Scarce dry-season or drought visitor to n. Cape York Pen. and coastal lowlands N of Townsville (Storr 19). A few birds sighted on coast round Innisfail, ne. Qld, most years, May–Oct. (Gill 1970). Described as visitor, mainly during summer and winter, and in pairs and groups, to recently burnt heathland at Cooloolo NP, se. Qld, with numbers decreasing with time since fire and not observed at all after 6.5 years (McFarland 1988; see Habitat).

Banding Of 699 banded in Aust. and PNG, 1953–June 2003, 23 recoveries (3.3%), of 15 birds: all <10 km from banding site (ABBBS). **LONGEVITY:** Adult banded at Griffith University, se. Qld, 26 June 1994, recaptured at Brisbane, 15 Sept. 1999, over 5 years 2 months after banding (ABBBS).

FOOD Omnivorous, but considered a specialist seed-eater (Rowley & Vestjens 1973). Feed on insects (particularly beetles and caterpillars) and other invertebrates; seeds, including cultivated grains, fruit and other plant material; small vertebrates, including small birds and their eggs and nestlings; and much carrion and other scavenged food, including road-kills and human scraps and refuse where available. Most larger mammals and many birds eaten are road-kills or other carrion, though sometimes attack weak, starving or stillborn lambs (Rowley & Vestjens 1973; Sinden 2002; Storr 11, 16, 21, 22; see below). **Behaviour** Fairly well known, but much information from modified farming and grazing habitats in e. Aust. and few details from natural habitats. Opportunistic, taking whatever food available; diet changes seasonally, reflecting changes in availability of main food categories: flesh, insects and seeds (Rowley & Vestjens 1973; see below). Forage predominantly on ground, in open habitats, and occasionally in trees or other sites above ground. Food taken mostly by gleaning (Glover & Schodde 1955; Rowley 1969, 1973b,d; Rowley & Vestjens 1973; Goodwin 1986; Woinarski & Tidemann 1991; Green 1993; Franklin 1999; Aust. Atlas 1; see Habitat; see below). **DETAILED STUDIES:** Of the ecology of Aust. *Corvus* and their impact on the sheep industry at Jandowae, se. Qld, 1966–67 (Rowley 1969, 1970, 1973d), including detailed studies of food and feeding behaviour (Rowley 1973b; Rowley & Vestjens 1973). However, most information in these studies on Australian and Little Ravens, with other species less well studied; further, many statements in these papers describe general behaviour of all Aust. *Corvus* without comment on differences between species. Such information mainly summarized in introduction to the Family Corvidae (q.v.). Also some information from study on ecology in urban Brisbane, Jan.–July 2002 (Sinden 2002). **FORAGING ASSOCIATIONS AND TERRITORIES:** Social organization, and territorial behaviour, said to be as Australian Raven (q.v.) but few details (see Social Organization). Usually forage in pairs or small parties, sometimes singly (Lord 1956a; Goodwin 1986; Coate *et al.* 2001; Sinden 2002; Hall) and said that often hunt in pairs (Lord 1956a). However, can occur in large numbers at sources of food, more so in non-breeding season and probably more often in e. and n. Aust. than in inland and w. Aust. (see

Habitat, Social Organization): large flocks congregate on grain crops and stubbles (Morgan 1929; Rowley 1970; Curry 1978) and at rubbish dumps or other sources of food (Goodwin 1986; see below); once, c. 30 seen at a carcass (Hall), and a similar number seen in a hay paddock during mowing (Coate *et al.* 2001); in Brisbane, 20 seen feeding at flowers of Silky Oak *Grevillea robusta* (M.S. O'Keeffe). At Casino, ne. NSW, large flocks arrive when swamps dry out during droughts (Irby 1933). Near Brisbane, numbers increased after rainfall, probably in response to insects being displaced by rain (Woodall 1999). In Brisbane, size of foraging flocks varied across urban gradient (no N; figures approximate, estimated from graph): in urban areas, 52% of foraging observations were of single birds, 15% of two, 20% of three, and 13% four or more; in suburbs, 51%, 27%, 9% and 13%; in parks (in urban and suburban areas combined), 36%, 38%, 4% and 22%; and in rural areas, 18%, 36%, 13% and 33% (Sinden 2002). Often forage in mixed-species flocks with Little Crows (Rowley 1970) and also forage with Australian and Forest Ravens at rubbish tips (G.S. Chapman); in ne. NSW, often forage with Forest Ravens, in townships and at rubbish tips, and occasionally on fore-dunes, but when foraging closely together, species segregate, and when one species outnumbers another, they would exclude other species from foraging area (Secomb 1997). Also seen to forage with White-faced Herons *Egretta novaehollandiae*, Masked Lapwings *Vanellus miles*, Laughing Kookaburra *Dacelo novaeguineae*, Noisy Miners *Manorina melanocephala*, Jacky Winters *Microeca fascians*, Magpie-larks *Grallina cyanoleuca*, Willie Wagtails *Rhipidura leucophrys*, Black-faced *Coracina novaehollandiae* and Ground C. *maxima* Cuckoo-shrikes, Grey *Cracticus torquatus* and Pied C. *nigrogularis* Butcherbirds, Pied Currawongs *Strepera graculina*, Australian Magpies and Common Starlings *Sturnus vulgaris* (Lord 1956b). **FORAGING HEIGHTS, SITES:** Mainly forage on ground (Glover & Schodde 1955; Rowley 1973d; Rowley & Vestjens 1973; Debus 1982; Sinden 2002), usually in open habitats, such as open woodlands and forests, pasture, cultivation, beaches and foreshore dunes, and, often, on or beside roads (White 1922; MacGillivray 1926, 1931; Mayo 1931; Chisholm 1932; Goodwin 1986; Secomb 1997; G.S. Chapman; see Habitat) taking items from in, or from surface of, ground or that can be reached from ground, up to c. 50 cm above surface (Rowley & Vestjens 1973). Sometimes forage above ground level, in trees (Aust. Atlas 1), including mangroves (White 1922), and crops (Rowley & Vestjens 1973; see Foraging methods below). Rarely forage in heavily wooded habitats but recorded foraging at edges of clearings in denser habitats and in forest (Templeton 1991; Aust. Atlas 1; see Habitat). Often associate with farming activities, e.g. often take invertebrates such as worms from freshly ploughed land (Nielsen 1962), and take insects disturbed by farm machinery (Burnett 1996; Storr 11); also eat much freshly sown grain (Curry 1978). Readily take food from wide variety of artificial sources in and close to cities, suburbs, rural towns and other human habitation or activities, including rubbish dumps (Thompson 1978; Goodwin 1986; Secomb 1997; Sinden 2002), poultry farms, gardens and orchards (Lord 1957); also see Pest status below. Most larger vertebrates eaten are road-kills or other carrion (Lord 1956a; Rowley & Vestjens 1973; Verbeek *et al.* 1993; Storr 11, 16, 21, 22). Take eggs and young from nests in waterbird colonies (Dorfman & Read 1996), e.g. in se. Qld in 1981–8, one pair took 54 eggs from nesting colony of Cattle Egret *Ardea ibis*, accounting for 46% of eggs lost that season (McLilligan 1987). **FORAGING METHODS:** Said to be as other Aust. *Corvus* (Rowley 1973b; Rowley & Vestjens 1973; see introduction to Family Corvidae). Most food obtained by gleaning while walking on ground, birds often turning debris over with bill while searching (Hood 1904; Rowley 1969, 1973a,b; Rowley & Vestjens 1973;

Burnett 1996). Food usually eaten where found (Rowley 1973b), though sometimes carry food to water to dunk before eating, or to cache (see below). Eat large quantities of seeds, including grain crops (Rowley & Vestjens 1973). Will also dig caterpillars from under ground with bill (Lord 1956b). Take much carrion, including road-kills (Rowley & Vestjens 1973; Stor 16, 21, 22) and beachcast fish, crustaceans and other marine life (Goodwin 1986). Adept at searching for nests of other birds, and eating eggs and nestlings (Rowley & Vestjens 1973); also said to chase small birds in flight and capture them when they become exhausted (Lord 1956a). Once seen to seize a Domestic Chicken *Gallus gallus*, fly straight up to considerable height, drop Chicken, then swoop down quickly and seize dead bird from ground (Irby 1933). In se. Qld, several birds seen snatching young Loggerhead Turtle *Caretta caretta* hatchlings from beach, flying 50 m from a perch to snatch Turtles in bill, then returning to tree; Crows not actually observed eating the Turtles (Limpus 1973). In Kakadu NP, NT, seen digging and probing deep into bases of foliage of *Pandanus* and snapping at small frogs (Verbeek *et al.* 1993). Only Aust. *Corvus* seen to land on a standing crop and feed from grain in the ear of Wheat and Corn; when feeding on Wheat, crop was very dense and several heads held together in claws to provide a perch (Rowley & Vestjens 1973). When feeding on fruit, usually crush fruit in bill and then swallow all or part (Green 1993; also see Intake). Occasionally seen to probe flowers, probably to obtain nectar (Franklin 1999; M.S. O'Keeffe). In captivity, used four methods to remove and eat eyeballs of dead lambs: picking, pecking, beaking and spreading (Rowley 1969, see introduction to Family Corvidae). KLEPTOPARASITISM: Steal crabs from White-bellied Sea-Eagles *Haliaeetus leucogaster* by harassing them till Sea-Eagles drop crab, or snatch them from Sea-Eagle as it alights on pier to eat them (Le Souëf 1915). CACHING: Will cache surplus food and recover it later (Goodwin 1986; Ley 1995). Seen to carry bread c. 100 m up rock-face and push it into holes (Chapman 1978). Near Katherine, NT, seen to place bread on loose heaps of soil and debris, and cover it with twigs, grass and leaves before wandering away; next day, a Crow (but not known if same one) seen to go to cache and retrieve bread (Ley 1995). In Brisbane, one covered pieces of cheese with leaves, dug a small depression in soil and placed piece of cheese in it, then covered cheese with a small clod and then picked up a stone and placed it over a small portion of the cheese still exposed (Walters 1979). In captivity, observed caching meat from dead lambs, packing it into gular pouches to move it round aviary (Rowley 1973b). SEASONAL VARIATION: At Jandowae, diet varied seasonally (see Table 1): invertebrates, mainly insects (such as cicadas, grasshoppers and beetles) largest component of diet in summer; in autumn, proportion of plant material (mainly grain seeds from stubble after harvesting) increases, and is main component of diet; in winter, carrion major part of diet, as insects less active and seeds either eaten or ploughed in; in spring, proportion of insects (mainly larvae) increases as their numbers increase, leading to a peak in summer (Rowley & Vestjens 1973). TIMES OF FORAGING: Usually forage early or late in day; most birds rest during middle of day, especially if hot. When food scarce, or days short in winter, resting may be shortened or omitted altogether (Rowley 1973b). In Brisbane, foraged more on natural food sources (c. 60% of foraging events) in morning than human food sources (c. 40%); in afternoon, foraged more on human food sources (c. 60%) than natural sources (c. 40%) (Sinden 2002). PEST STATUS: Widely regarded as a pest of agriculture (Lord 1956a; Rowley 1969, 1970), eating both recently sown grain (Curry 1978) and standing commercial grain crops (Harvey 1929; Morgan 1929; Irby 1933; Bravery 1970; Rowley 1970, 1973a,b; Rowley & Vestjens 1973; Debus 1982; Goodwin 1986; Rose 1999); commercial grains found in

stomachs in se. Qld were Sorghum (10.4% of 136 stomachs), Wheat (8.9%), Oats (6.7%) and Corn (4.5%) (Rowley & Vestjens 1973). Sometimes eat grain provided for sheep (Rowley 1969). Also take fruit from orchards and gardens (Lord 1957; Goodwin 1986). Can also damage peanut crops (Bravery 1970). Sometimes regarded as pest of sheep industry (e.g. Lord 1956a; Goodwin 1986), though this largely not supported by detailed studies (Rowley & Vestjens 1973); further, as little overlap between distribution of Crows and range of major sheep-farming areas, they are responsible for little lamb predation; what sheep are eaten are usually in form of carrion (Rowley & Vestjens 1973; see other *Corvus* accounts). Occasionally take poultry from farms and gardens, both live birds and eggs (Irby 1933; Lord 1957; Rowley & Vestjens 1973). In contrast, assist in control of insects damaging to agriculture (Bravery 1970; Rowley 1973d). DRINKING: Drink often in hot weather, especially when feeding on carrion (Rowley 1973b). Seen drinking in water tank (Cornwall 1916) and from garden hose (Walters 1979). INTERSPECIFIC COMPARISON, ADAPTATIONS: In captivity, hold meat in gular pouch to move it about aviary and hide it (Rowley 1973b). Torresian Crows said to forage less round human activity than Little Crow (Curry 1978). For some further notes, see introduction to Family Corvidae.

Detailed studies At JANDOWAE, SE. QLD (7694 items from 147 stomachs; * % no. = item detected in stomach contents but numbers could not be determined; Rowley & Vestjens 1973): **Plants** Unident. seeds 14.41% no., 16.33% freq.; unident. bark fragments *, 0.68; unident. fruit pulp *, 2.72. **MONOCOTYLEDONS**: Poaceae: sds 2.47, 4.08; stalks 0.12, 3.40; lvs *, 8.16; husks *, 0.68; *Avena sativa* 3.67, 6.12; *Enneapogon* 0.12, 1.36; *Panicum* 0.03, 0.68; *Sorghum vulgare* 19.59, 9.52; *Triticum aestivum* 6.38, 8.16. **DICOTYLEDONS**: Unident. leaves *, 0.68; Asteraceae: *Arctotheca calendula* 0.04, 0.68; *Calotis* 0.03, 0.68; *C. erinacea* 0.10, 0.68; Burseraceae: *Canarium australianum* 0.04, 0.68; Cactaceae: *Opuntia* 0.12, 1.36; Cariacae: *Carica papaya* 0.29, 0.68; Chenopodiaceae: sds 0.29, 2.04; *Chenopodium* 0.52, 2.72; *Enchylaena tomentosa* 1.55, 3.40; Cucurbitaceae: sds 0.21, 0.68; *Melothria maderaspatanus* 1.25, 0.68; Fabaceae: *Medicago* 0.04, 0.68; Lorantheae: sds 0.09, 0.68; Malvaceae: sds 0.04, 1.36; Mimosaceae: *Acacia* 1.34, 0.68; Myoporaceae: flowers 0.01, 0.68; Papaveraceae: sds 0.13, 0.68; Passifloraceae: *Passiflora* 0.81, 2.04; Phytolaccaceae: *Phytolacca octandra* 1.40, 0.68; Polygonaceae: sds 1.74, 0.68; Rosaceae: *Rubus fruticosus* 1.29, 1.36; Rubiaceae: *Coprosma* 0.77, 1.36; Rutaceae: *Geijera parviflora* 0.10, 0.68; Sapindaceae: sds 0.04, 0.68; Solanaceae: *Solanum* sds 2.18, 0.68. **Animals** ANNELIDS: Oligochaetes 0.01, 0.68. MOLLUSCS: Unident. shells *, 15.65. CRUSTACEANS: Isopods 0.01, 0.68; Decapods: *Cherax albidus* *, 1.36. SCORPIONS 0.03, 1.36. SPIDERS 1.51, 14.97, egg-sacs 0.03, 1.36. DIPLOPODS 0.13, 6.80. CHILOPODS 0.08, 4.08. INSECTS: Unident. *, 2.04:

Table 1. Proportion, by volume, of three main food-types over year (seasonal figures approximate, estimated from graph; n=136 stomachs). Invertebrates mainly insects (such as cicadas, grasshoppers and beetles), but also include some spiders, crustaceans and molluscs; flesh consists of carrion and some small mammals and lizards; plant material mainly seeds (from Rowley & Vestjens 1973).

	INVERTEBRATES	FLESH	PLANT MATERIAL
SUMMER	61%	22%	17%
AUTUMN	30%	19%	51%
WINTER	37%	33%	30%
SPRING	44%	30%	26%
OVERALL	43%	26%	31%

Blattodea 0.09, 4.76, eggs 0.03, 1.36; Coleoptera: unident. 0.69, 17.01, unident. larv. 0.62, 4.76; Carabidae 0.86, 8.84; Cerambycidae 0.01, 0.68; Chrysomelidae 0.73, 4.08; Curculionidae 1.42, 17.69; Elateridae 0.03, 1.36; Rutelinae 0.17, 2.04; Scarabaeidae 0.17, 7.48; Scarabaeinae 1.30, 6.80; Tenebrionidae 0.03, 1.36; Diptera: ads 0.45, 7.48, larv. 9.40, 8.84, pupae 2.16, 3.40; Hemiptera: unident. *, 3.40; Cicadidae 1.94, 6.12; Pentatomidae 1.94, 14.29; Psyllidae *, 1.36; Hymenoptera: Formicidae 1.31, 18.37; Ichneumonidae 0.10, 2.72; Tenthredinidae 0.08, 0.68; Isoptera *, 2.04; Lepidoptera: ads 0.06, 2.72, larv. 5.61, 29.93, pupae 0.31, 2.72; Mantodea 0.05, 2.04, eggs *, 3.40; Neuroptera: Myrmeleontidae 1.31, 1.36; Orthoptera: unident. 0.03, 1.36; Acrididae 5.91, 40.14; Gryllidae 0.04, 2.04; Gryllotalpidae 0.01, 0.68; Tettigoniidae 0.04, 2.04; Phasmatodea: ads 0.01, 0.68, eggs 0.08, 0.68; Phthiraptera 0.01, 0.68. **FISH** *, 0.68. **REPTILES**: Lizards *, 4.76; snakes *, 0.68. **BIRDS**: Unident. remains *, 4.08. **MAMMALS**: Unident. flesh (including Sheep, kangaroos, possums, rats, Rabbits and mice) *, 6.80, keratin *, 3.40. **UNIDENT. FLESH AND BONE**: Flesh *, 23.13; bone *, 23.13. **Other matter**: Bread *, 0.68; charcoal *, 0.68; sand and grit *, 38.10; glass *, 0.68; plastic *, 0.68.

In SUBURBAN BRISBANE, Jan.–July 2002 (n=74 obs. foraging on human foods; Sinden 2002): Biscuit (muesli bar, biscuit, chocolate) 8% no.; bread (bread and muffins) 34; chips (hot chips, potato crisps, onion rings) 24; fruit (lettuce, carrot, watermelon, orange) 6; meat (sausage, hamburger, bacon) 10; other (vanilla thickshake, 'popper' drink) 4; unident. rubbish 12.

Other records **Plants** Fruit^{8,9,13,22}; grain^{8,12,13}, seeds²⁷. **MONOCOTYLEDONS**: Poaceae: *Avena sativa*^{4,5,27}; *Sorghum*¹⁷; *Zea mays*^{6,27}. **DICOTYLEDONS**: Chenopodiaceae: *Enchylaena sds*¹⁴; Cucurbitaceae: *Cucumis*²⁸; Goodeniaceae: *Scaevola calendulacea* fru.²⁷; Moraceae: *Ficus coronata* fru.²³; *F. platypoda* fru.²³; Proteaceae: *Grevillea pteridifolia* nectar¹⁹; *Grevillea robusta* nectar³⁶; Sapindaceae: *Diploglottis australis* fru.²³; Urticaceae: *Dendrocinna photinophylla*²⁰. **Animals** Unident. carrion^{8,31,32,33,34}. **ANNELIDS**¹¹. **MOLLUSCS**: Bivalves (shell)^{30,35}. **CRUSTACEANS**: Crabs: *Brachyura*³. **TICKS**: Acarina: Ixodidae: *Boophilus microplus*¹; Araneida²⁷. **INSECTS**^{6,8,9,18,25,29,30}, larv.²⁹; Coleoptera^{1,18,27}; Curculionidae²⁹; Scarabaeidae¹; Hemiptera²⁷; Lepidoptera³⁵, larv.^{8,18}, cocoon²⁷; Mantodea³⁵; Orthoptera³⁰; Acrididae^{2,7,18,27}. **FISH**¹⁸. **AMPHIBIANS**: Frogs²⁴. **REPTILES**: Cheloniidae: Loggerhead Turtle *Caretta caretta*¹⁴; Lizards². **BIRDS**: Ads^{8,10,32,33,34}; nestling⁸; eggs^{8,35}; Domestic Fowl *Gallus gallus* eggs, young^{6,9}; Brown Quail *Coturnix ypsilophora* carrion²⁷; cormorant *Phalacrocorax* eggs, young²⁶; Pelican *Pelicanus conspicillatus* egg²⁷; Cattle Egrets *Ardea ibis* eggs²¹; Pale-headed Rosella *Platycercus adscitus* ads⁸; Noisy Miner nestling²⁷. **Other matter**: Bread¹⁷, eggshell¹⁵, sand and grit¹⁵, scraps of meat and other human food¹⁸.

REFERENCES: ¹ Cornwall 1908; ² Hill 1911; ³ Le Souëf 1915; ⁴ Harvey 1927; ⁵ Morgan 1929; ⁶ Irby 1933; ⁷ McGill 1935; ⁸ Lord 1956a, ⁹ 1957; ¹⁰ Thomas 1957; ¹¹ Nielsen 1962; ¹² Rowley 1969; ¹³ Bravery 1970; ¹⁴ Limpus 1973; ¹⁵ Rowley & Vestjens 1973; ¹⁶ Chapman 1978; ¹⁷ Debus 1982; ¹⁸ Goodwin 1986; ¹⁹ Estberg 1987; ²⁰ Holmes 1987; ²¹ McKilligan 1987; ²² McFarland 1988; ²³ Green 1993; ²⁴ Verbeek *et al.* 1993; ²⁵ Burnett 1996; ²⁶ Dorfman & Read 1996; ²⁷ Rose 1999; ²⁸ Coate *et al.* 2001; ²⁹ Lea & Gray; ³⁰ Hall; *Storr* 11, 32 16, 33 21, 34 22; ³⁵ FAB; ³⁶ M.S. O'Keeffe.

Young No information (but see Social Organization, Breeding for roles of parents).

Intake In se. Qld–ne. NSW, of 31 observations of feeding on fruit, c. 77% of feeding bouts lasted 0–4.9 min and the rest 5–9.9 min (Green 1993, which see for graphs of number of visits/h, duration of visits and frequency of removal of fruits by feeding birds for individual fruiting species of plant). In captivity, mean time taken to remove an eyeball of a dead

lamb was 9.80 min (2–22) (Rowley 1969; see introduction to Family Corvidae). In Brisbane, duration of foraging events varied depending on type of food: when foraging on natural food sources, mean duration c. 5 min; when foraging on human food sources, c. 2.5 min (Sinden 2002).

SOCIAL ORGANIZATION Not well known. Some information from studies at Jandowae, se. Qld, 1966–67, including information on dispersal and breeding dispersion (Rowley 1973a,b); and study of five banded and radio-tagged territorial birds in suburban Brisbane, 1991–94 (Everding & Montgomerie 2000). Adult breeding pairs sedentary, defending territories throughout year; independent juveniles, immatures and non-breeding adults tend to form dispersive flocks (Rowley 1970, 1973b; Aust Atlas 1). Flock-sizes vary with distribution: in arid inland and w. Aust., tend to be more solitary, occurring singly, in pairs and groups of up to eight, usually 1–3, and very rarely up to 20 (Rowley 1970; Moriarty 1972; Curry 1978; Badman 1982; Coate *et al.* 1998, 2001; Storr 11, 16, 21, 22, 26, 35); larger flocks may occur around locally abundant food sources (Curry 1978). In n. and e. Aust., more commonly in larger numbers (Rowley 1970); occur singly and in pairs, which probably sedentary adults (Roberts 1957; Lavery & Hopkins 1963; Crawford 1972; Baldwin 1975; Rowley 1973b; McFarland 1988), and flocks of up to 20 (Lavery & Hopkins 1963; Bravery 1970; Crawford 1972; Baldwin 1975; Boekel 1976; Longmore 1978; Gosper 1983; McKilligan & McKilligan 1987) or, occasionally, up to 150, usually after breeding (timing of which varies; see Breeding), generally summer–winter (Lord 1956a; Crawford 1972; Rowley 1973b; Gosper 1981; Dawson *et al.* 1991; Templeton 1992) and round food sources and cultivated land (Lord 1956b; Rowley 1970, 1973b; Gosper 1981, 1983). Occur and often forage in mixed flocks with Little Crow, and recorded foraging with Australian and Forest Ravens (Rowley 1970; Aust. Atlas 1; see Food); also observed foraging with a range of other species (see Food).

Bonds Monogamous; nest in simple pairs (Lord 1957; Rowley 1973b; Debus 1982; NRS). **AGE OF FIRST BREEDING**: May reach sexual maturity at 2 years old, but probably do not breed till at least 3 years old. Attain adult coloration of iris when c. 22 months old, and only birds with white irides noted breeding (Rowley 1973b; Rowley *et al.* 1973). **Parental care** Only female incubates and broods; both adults feed nestlings and fledglings (Lord 1957; Rowley 1973c; Rowley *et al.* 1973; NRS). **DISPERSAL OF YOUNG**: Young remain in family groups within natal territory for 2–3 months after fledging, then join dispersive flocks (Rowley 1973c,d). Timing of departure of immatures, and movements of flocks, likely to be influenced by variations in breeding season (which centred on spring) (Rowley *et al.* 1973). At Armidale, NSW, juvenile (from B/1) stayed with parents in natal territory through winter, till start of breeding activities next spring (S.J.S. Debus).

Breeding dispersion Nest solitarily (Rowley 1973b; Debus 1982; NRS). At Jandowae, nests average of 800 m apart (Rowley 1973b). **Territories** Breeding adults defend permanent territory throughout year, each pair defending an area round nest-tree from conspecifics. Pair probably feeds, breeds and roosts within territory. Estimated size of territories at Jandowae, 131 ha (Rowley 1973b). Where sympatric, Torresian Crow and Australian Raven defend territories from other pairs of both species, and do likewise with Forest Raven (Rowley 1970; Debus 1982; S.J.S. Debus); at Imbota NR (2 km²) near Armidale, NSW, where two pairs of Australian Raven, one pair of Forest Raven and one pair of Torresian Crows maintained interspecific territories, with nests 600–700 m apart (S.J.S. Debus). **Home-range** In suburban Brisbane, home-ranges of four adults and one immature (radio-tracked for 7–32 days in non-breeding season) averaged 706.2 ha (917.8;

5–2246; 432 radio-tracking fixes, with 31–146 fixes/bird), with most activity within two-thirds of range; home-ranges drifted from week to week. Birds roosted near the edge of range, and close to foraging areas (Everding & Montgomerie 2000).

Roosting At night. Up to 1000 birds have been recorded roosting in trees (at least once in eucalypts) (Durrant & MacRae 1994; Jones & Everding 1994; NSW Bird Rep. 1998). Birds foraged close to roosts used the previous night, and after change in roosting site foraged near new sites the next day (Everding & Montgomerie 2000; also see Movements). In Brisbane, some large permanent roosts used throughout year, though these roosts rather recent and not known 50 years ago (Everding & Jones In press).

SOCIAL BEHAVIOUR Not well known. Some information from studies at Jandowae, se. Qld, 1966–67, including details on agonistic behaviour (Rowley 1973a,b); and some details of flock and territorial behaviour from long-term casual observations in e. Aust. (Debus 1980, 1982). Said to be very wary of people (Jones 1981) and even where occurring in urban or rural areas appear to remain wary of human activity, e.g. at Wiluna, WA (Curry 1978), though often approachable in city parks in Brisbane, and on university campus at Armidale, n. NSW (S.J.S. Debus). Call often, when perched and in flight (Curry 1978). Warble usually given when alone and idle, such as during midday rest in hot weather (Rowley 1973b). **Displays** When giving Territorial Call, sometimes put great emphasis on last note, drawing it out like last syllable of Territorial Call of Australian Raven; birds adopt an exaggerated calling posture with neck extended and bill tilted up (Curry 1978). Two birds seen, probably this species, in an undescribed ceremonial flight, during which they grappled and tumbled downward, possibly clasp feet, before separating and flying on (Sedgwick 1952); function unclear, possibly fighting. **WING-SHUFFLING:** On alighting, birds almost always rapidly and exaggeratedly shuffle wings alternately, like cuckoo-shrike, above back before folding them normally (Rowley 1970; Curry 1978); appears to have a signalling function (S.J.S. Debus). **Flock behaviour** Flocks can be noisy, particularly in flight, with many birds calling together (Chisholm 1920; Dawson *et al.* 1991; see Voice). At nocturnal roosts, first birds to arrive in evening call, and calling increases as roost becomes full, sometimes with jostling and movement from tree to tree, accompanied by frantic calling; sometimes all birds fly up in a noisy mass before settling again; call when leaving roost in morning (Jones & Everding 1994). **CURRAWONG FLIGHT:** In flight, particularly if two birds close together, perform flight-sequence resembling flight of currawong *Strepera*, in which wings are closed to body, missing a wing-beat and dipping in flight, while giving single-note Oh-owoh call with head slightly raised and hackles visibly raised; distance can make it appear that bird calls as it dips but call uttered at peak while wings closed. Action may be repeated several times. Performed by territorial and flock birds and appears to function for contact and not aggression (Curry 1978; Debus 1980; cf. function in Little Crow). **REDUCED-AMPLITUDE FLIGHT:** As in Australian Raven (q.v.); occasionally performed by birds approaching perched members of flock (Debus 1980); also see Returning-home Display below. **WING-QUIVERING:** On alighting in tree occupied by other birds from flock, individuals from flock repeatedly flip both wings above back, rapidly and without calling. Appears to be a greeting ceremony, used for recognition of members of flock. Similar to Stationary Wing-flip of Little Raven, and used in same circumstances as Neck-extending of that species; used in same circumstances as Reduced-amplitude Flight of Little Crow; possibly distinct from Wing-shuffling described above (Debus 1980), though rapidity of movement makes it difficult to determine whether

wing-tips moved alternately or simultaneously and confirmation that Wing-quivering distinct from Wing-shuffling needed (S.J.S. Debus). **Maintenance behaviour** Apparently much as Australian Raven (q.v.; Rowley 1973b). Seen bathing in water tank (Cornwall 1916).

Agonistic behaviour Appears to be very similar to that of Australian Raven (q.v.; Rowley 1973b) but poorly described. Aggressive calling (including frenzied Antiphonal Pair-challenging, Angry Calling or Flying-attack Calling [see Australian Raven for descriptions and circumstances of use; also see Voice, below]) an important part of agonistic behaviour (Rowley 1973b; Debus 1982; S.J.S. Debus) and during Stationary Aggressive Calling, tail depressed during prolonged notes, as in Australian Raven (Debus 1980). Seen to fly hundreds of metres to repel intruding conspecifics (Debus 1982). **Threat, Fighting** Both sexes defend territory, males usually attacking males and females attacking females (Rowley 1973b). Intruders first challenged by Territorial Call given by territory-holder from a lookout post. Depending on effect of this, a chase may or may not follow (Rowley 1973b). Once seen fighting and grappling and falling into water (Stephens 1996). **AERIAL WING-FLICK:** In flight, add a pronounced flicking action to upward stroke of several successive wing-beats, usually accompanied by Strong Territorial Call and raising of hackles. Performed during territorial defence and when approaching a high lookout perch; flicking sometimes continues after alighting, but wings are not closed to body between each flick, and neck is extended (Debus 1980). **Mobbing** Mob and harass raptors, such as Ospreys *Pandion haliaetus* (HANZAB 2), Pacific Baza *Aviceda subcristata* (James 2004), and Square-tailed Kites *Lophoictinia isura* (Lutter *et al.* 2004). **Interactions with other species** Defend territories inter-specifically from Australian Ravens and Forest Ravens, and vice versa, in same manner as intraspecific defence (Rowley 1970, 1973b; Debus 1982; see above); suggested that Torresian Crow and Forest Raven may be more prone to physical aggression as they have very different Territorial Calls (Debus 1982) but can breed close to each other without conflict (Rowley 1973b). **INTERACTIONS WITH FOREST RAVEN:** Once, a resident pair repelled intruding pair of Forest Ravens that appeared to be prospecting persistently for a vacant territory; Ravens did not leave till one Crow grappled with one of Ravens in mid-air and both fell to ground. Also seen to act aggressively towards a Forest Raven that flew at a foraging pair, all three flying about giving aggressive calls before intruder returned to his territory giving Aerial Wing-flick display and calling (Debus 1982). In ne. NSW, also seen to repel groups of non-breeding Ravens. When foraging closely, maintain single-species flocks; when one outnumbered the other species significantly, they exclude the other. When flying through territory of a Forest Raven, Ravens seen to respond by calling or escorting Crows, or both, out of territory (Secomb 1997). **INTERACTIONS WITH LITTLE CROW:** At Ernabella, nw. SA, seen to repel Little Crows from immediate area of favourite trees along watercourse (Debus 1982).

Sexual behaviour **Greeting** **RETURNING-HOME DISPLAY:** Consists of Reduced-amplitude Flight (see above) accompanied by Returning-home Call. Given in same circumstances and with similar frequency to Australian Raven (Debus 1980), which is when one of a pair has left and is returning to territory, most commonly by male (see Australian Raven). **Courtship feeding** Male feeds incubating female on nest (Lord 1957; Rowley 1973c). **Allopreening** Members of pair seen allopreening (S.J.S. Debus); apparently as Australian Raven (Rowley 1973b).

Relations within family group Both adults feed nestlings and fledgelings (Lord 1957; NRS). After fledging, one young returned to nest to roost (NRS). **Parental anti-predator strategies** Female sits tight, and reluctant to leave nest,

particularly during incubation; once, female was handled by observer (Cornwall 1908; Barnard 1925). When disturbed at nest, sitting bird gave harsh calls as it left; both adults then perched nearby when nest inspected, calling occasionally, and did not return to nest straight after observers left. Parents can be very secretive when near nest and become aggressive towards other birds after nestlings hatch (NRS). Chase potential threats away from nest or young fledglings, including White-bellied Sea-Eagles, Whistling Kites *Haliastur sphenurus*, Australian Magpies and currawongs *Strepera* (Wheeler 1959; NRS); once harassed a dog that walked under nest-tree (NRS); and attacked person near fledglings (NRS); also see Mobbing above.

VOICE Quite well known from studies by Rowley (1970, 1973b) and Debus (1980, 1982), mainly in se. Aust., and Curry (1978) in WA. Utter wide variety of calls (Rowley 1970; Curry 1978). Flocks can be noisy (Chisholm 1920; Dawson *et al.* 1991). Respond to playback of calls (Rowley 1970). Birds call on arrival at nocturnal roosts in evening, and calling increases and can become frantic as roost becomes full and birds jostle and move from tree to tree; birds also call in morning when leaving roost (Jones & Everding 1994; see Social Behaviour). **REGIONAL VARIATION:** Calls of Torresian and Little Crows appear to be more easily distinguished where they breed sympatrically, perhaps partly because they can be compared directly rather than being actual regional differences. Warble of e. populations more subdued than those of nw. SA (Debus 1982; see below). **SIMILAR SPECIES:** Tonal quality as diagnostic as pitch and tempo: in territorial birds tone is very nasal, sometimes with a 'snarling' effect (Debus 1980); with Australian Raven, may be thought of as a tenor, though there is some overlap in range of pitch with the baritone, the Little Raven and Little Crow (Debus 1984). Returning-home Call more nasal than that of Australian Raven (Debus 1980, 1995). Compared with Little Crow, voice distinctive and seems best field character: the commonest calls have laughing or barking quality, but indeterminate notes often uttered alone or amid more typical calls, and may lead to confusion (Curry 1978). For further discussion, see Australian Raven: Separation of Aust. *Corvus*.

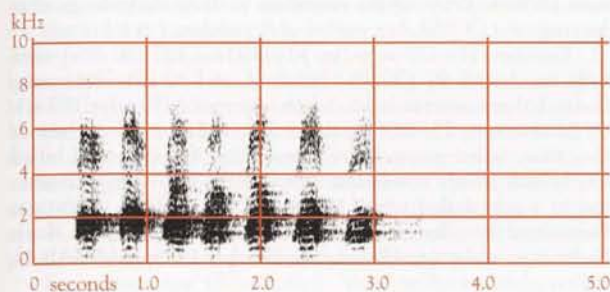
Adult TERRITORIAL CALL: A high-pitched, nasal, and staccato or clipped barking or honking (Rowley 1970, 1973b; Debus 1993, 1995), usually of 3–8 notes, and with sequences of calls tending to start with short notes but often ending with 1–3 lower, slower, and more mellow notes (Curry 1978), with last note sometimes stressed and drawn out, recalling dying terminal syllable of Territorial Call of Australian Raven (Curry 1978; Hall): *uk-uk-uk-uk-uk* or *ok-ok-ok-ok-ok* (sonagram A) (Rowley 1970, 1973b; Debus 1993, 1995); *ak-ak-ak-oak-oak-...oak*, or *ok-ok-ok-ok, owe-owe*, with the last note longer than the others (Curry 1978); *uck! uck! uck! aarck!* (Jones & Everding 1994); or, during territorial encounters, a harsh, snarling, nasal *arr...arr...arr...*, finishing with prolonged notes (Debus 1995). Also described as a harsh short *ahr, ahr*

(MacGillivray 1918). These various descriptions represent gradient from Mild to Strong Territorial Calls (as for Australian Raven [q.v.]). Territorial Calls can accelerate into frenzy of Antiphonal Pair-challenging, Angry Calling or Flying-attack Calling, as described for Australian Raven (q.v.; S.J.S. Debus). A final dying syllable (as above) also reported in W. Papua (Melville 1980). The most common call (Rowley 1970; Curry 1978). **RETURNING-HOME CALL:** A long nasal, descending call, *naark*, not tremulous, and which ends abruptly, given during Returning-home Display, when returning to territory (Debus 1980, 1995). **WARBLE:** A frog-like croaking, unlike call of a *Corvus*, usually uttered when alone and idle, such as when resting during middle of day in hot weather; also heard when a female was torn between flight and defence of her nest as observers approached (Rowley 1973b). In central WA, very un-corvid-like high-pitched laugh, consisting of accelerating spluttering notes, with an upward inflection as notes accelerate, and tailing off at the end *a-a-e-e-i-i-eyu* and which uttered when perched and in flight, by non-breeding birds and breeding pairs, and heard regularly in cooler months (Curry 1978) probably also Warble (Debus 1982). In Musgrave Ras, nw. SA, Warble has falsetto quality and downward inflexion, and usually given loudly from a perch and interspersed between bouts of Territorial Calls, often from late Jan. to late Feb. (Debus 1982). Warble in e. Aust. usually less strident than elsewhere, though at Armidale, n. NSW, given loudly by resident pair in late winter and early spring, before onset of breeding activities (S.J.S. Debus). (Also see other calls below.) **CREAKY CALL:** A call that sounds like a creaky door being opened, comparable to Creaky Call of Little Raven and Little Crow (Debus 1982). **PRUK:** A monosyllabic *pruk*, uttered in flight, similar to but deeper than Crock of Little Crow. A common call (Curry 1978). **OH-OWOH:** *Oh-owoh, ok* or *owk*, uttered in flight; a common call (Curry 1978). Given when performing Currawong Flight, by breeding birds or by travelling flock birds (Debus 1980; see Social Behaviour). **ALARM CALLS:** A short sharp *caa-caa* of apparent alarm (Hall). Harsh calls from female flushed from nest (NRS). Long *naark*, like 'urgent' Returning-home Call, in response to soaring raptor (S.J.S. Debus). **BEGGING CALLS:** Given by breeding females; deeper, harsher, hoarser and longer than usual adult calls (Debus 1995). **Other calls** Varying deep guttural calls and higher-pitched warblings, fading away with a deep gargling sound lasting 2–3 s, uttered by birds apparently at ease (Hall), possibly also Warble, but may include subdued whispering version of Mild Territorial Calls, which given by all species, especially juveniles (S.J.S. Debus). Longer caws than usual clipped notes of Territorial Call (Debus 1995).

Young BEGGING CALLS of flying young deeper and longer than typical calls of adults (Debus 1980). Juvenile call said to be slightly deeper than that of adult (D. Secomb).

BREEDING Fairly well known; some information from study at Jandowae, se. Qld, 1966 and 1967 (Rowley 1973c; Rowley *et al.* 1973); 77 records in NRS to Feb. 2004.

Season Throughout range, eggs recorded in all months (though no records June in e. Aust.); nestlings recorded June–Jan. and Mar. (NRS; see below). Unspecified breeding recorded all months, mostly Sept.–Jan. (Aust. Atlas 1, 2; see below). For detailed analyses of gonadal activity, see Rowley *et al.* (1973). **QLD:** Eggs, Aug.–May (Berney 1905; Rowley *et al.* 1973; Lavery 1986; NRS [n=2]); at Jandowae, 1966–67, laying from second week of Aug. to last week of Oct.; of 92 clutches: two (2.2%) in Aug., 31 (33.7%) in Sept. and 59 (64.1%) in Oct. (Rowley *et al.* 1973). Nestlings, Sept.–Jan. and Mar. (Berney 1905; NRS [n=17]). Fledglings and unspecified breeding recorded all months, unspecified breeding mostly Sept.–Dec. (Storr 19; Aust. Atlas 1, 2 [n=319 records of



A R. Buckingham; Mataranka, NT, Aug. 1988; P94

breeding]; NRS [n=11 records of fledgelings]). Season slightly later in N than in S (Rowley *et al.* 1973); combined Aust. Atlas (1, 2) data show: in N (n=49 records), 2.0% in July, 14.3% in Aug., 12.2% in Sept., 32.7% in Oct., 16.3% in Nov., 10.2% in Dec., 2.0% in Jan., 0 in Feb., 4.1% in Mar., 0 in Apr., 4.1% in May, and 2.0% in June; in S (n=268) 0.7% in July, 3.7% in Aug., 13.1% in Sept., 23.1% in Oct., 24.6% in Nov., 17.5% in Dec., 10.4% in Jan., 4.1% in Feb., 1.9% in Mar., and 0.7% in Apr. NSW: Eggs, July and Sept.–Dec. (Gosper 1981; Morris *et al.* 1981; NRS [n=2]). Nestlings, Aug.–Jan. (Irby 1933; NRS [n=10]). Fledgelings and unspecified breeding recorded July–Apr., unspecified breeding mostly Sept.–Jan. (Aust. Atlas 1, 2 [n=112 records of breeding]; NRS [n=8 records of fledgelings]). SA: Breeding recorded in Sept. and Feb. (Aust. Atlas 1, 2). No other information. S. WA: Eggs, June and Aug.–Sept. (Carter 1903; NRS [n=2]). Nestlings, Aug.–Oct. (NRS [n=4]). Unspecified breeding recorded July–Oct. and Apr. (Newbey & Newbey 1989; Johnstone *et al.* 2000; Aust. Atlas 1, 2; Storr 21, 22, 35). N. WA: Eggs, Sept. and Oct. (Coate 2001); nestlings, Aug.–Sept. and Nov. (Coate 2001; NRS [n=2]). Fledgelings and unspecified breeding recorded June–Feb. (Robinson 1939; Storr 1981; Storr 11, 16; Aust. Atlas 1, 2; NRS [n=1 record of fledgelings]). NT: Eggs, Sept.–Feb. and Apr.–June (Le Souëf 1902; Frith & Davies 1961; Rowley *et al.* 1973; NRS [n=1]). Nestlings, June–Sept. and Jan. (McKean 1985; NRS [n=7]). Fledgelings and unspecified breeding recorded all months of year (Rowley *et al.* 1973; Storr 7; Aust. Atlas 1, 2; NRS [n=1 record of fledgelings]).

Site Usually in multi-pronged, upright fork at end of upper branch of tall living tree, often a eucalypt; mainly round edge of or lower in crowns of tree (cf. Australian Raven, which mostly nests higher in crowns). Select sites that provide suitable shade but will also nest in exposed sites and in dead trees. Sometimes nest in mistletoes in trees (e.g. in *Amyema* in Yellow Box and Blakely's Red Gum), in mangroves, on top of low shrubs or on ledge of cliff on coast; also nest on artificial structures, such as power pylons, telephone poles, windmills, structures above wells; and occasionally nest over water (Carter 1903; Berney 1905; Irby 1933; Robinson 1939; Rowley 1973c; Gosper 1981; Coate 2001; NRS; S.J.S. Debus). Select site where unable to see other nesting conspecifics (Rowley 1973c). One pair built four nests on smooth wooden timber on top of a wool press; each time, nest blew off, one after another, till site abandoned (Carter 1903). Of 43 nests in trees: 34 (79.1%) in eucalypts, including River Red Gum, Spotted Gum, Ghost Gum and Manna Gum; two (4.7%) in each of acacia and casuarina; and single nests (2.3%) in Silky Oak *Grevillea robusta*, mangrove, Broad-leaved Paperbark *Melaleuca quinquenervia*, Cocky Apple *Planchonia careya* and Brush Box *Lophostemon confertus* (NRS). At Jandowae, 63% of nests (n=100) were in Bimble Box (Rowley *et al.* 1973). Occasionally re-use nests from previous season (Rowley 1973c). Recorded nesting 10 m from Pacific Baza, 20 m from Noisy Miner, and 40 m from Blue-faced Honeyeater *Entomyzon cyanotis* (NRS). **MEASUREMENTS** (m): Height of nest: in trees, 14.6 (8.05; 3–45; 57); in artificial structures, 12.3 (6.02; 7–20; 4) (NRS). Height of nest-plant: 18.8 (10.02; 5–48; 35) (NRS). At Jandowae, height of nests, 14 (Rowley 1973d), ranging from 6.0 to 27 (n=124), with c. 90% of nests 3–18 (Rowley 1973c; Fig. 1, which see for breakdown of nest-heights).

Nest, Materials Build bulky nest of sticks and twigs; usually lined with grass, or rootlets, shreds of bark, horsehair, wool and cotton waste; lining can appear felt-like (Le Souëf 1902; Irby 1933; Rowley 1973c; North; NRS). Unlike other Aust. *Corvus*, often dispense with platform of sticks and begin by building a nest-bowl of twigs, usually only 6 mm thick and often snapped from living or recently dead trees (Rowley 1973c). Two nests in mistletoe had most of nest made from mistletoe sticks (Irby 1933). Do not use clay (Robinson 1939)

cf. Little Crow. Both sexes collect material and build (NRS; S.J.S. Debus); during 3-h observation at one nest being lined, male made 11 visits and female 12. Nest-bowl shaped by building bird pushing its breast into nest-wall and gradually rotating. One nest comprised 90 sticks 3–6 mm thick; 50 sticks 1.5–3 mm thick, 60 sticks <1.5 mm thick, and a lining of grass 25 mm thick (Rowley 1973c). Sticks in another nest up to 37 mm diameter (NRS). **MEASUREMENTS** (cm): Average nest, external diameter, 38.1; external depth, 19.1; internal diameter, 15.2; internal depth, 10.2 (North); one nest: internal diameter, 20; and internal depth, 12 (NRS).

Eggs Vary, but indistinguishable in colour and markings from those of other Aust. *Corvus* (Rowley 1973c). Oval to elongate oval, sometimes compressed towards small end; smooth; slightly lustrous or glossy. Ground-colour varies from very pale to bright green, greenish grey or pale ashy-blue; speckled, spotted or blotched brown, greenish brown, olive-brown or blackish brown, mainly on large end, occasionally small end, and sometimes forming a zone or cap; markings light or sparse on some eggs (Le Souëf 1902; Robinson 1939; North). **MEASUREMENTS**: 42.9 (3.60; 36.1–48.3; 18) × 30.6 (1.32; 29.0–33.0) (Le Souëf 1902; North); e. Aust., 42.6 (36.8–51.8; 14) × 29.4 (25.8–32.0); w. and central Aust., 45.5 (41.2–52.0; 8) × 29.9 (28.0–32.8) (Rowley 1973c).

Clutch-size One to six, usually five (Robinson 1939; Rowley 1973c); two nests with seven eggs reported (Rowley 1973c). Mean 4.6 (1.24; 52): C/1 × 1, C/2 × 3, C/3 × 6, C/4 × 8, C/5 × 22, C/6 × 12 (Rowley 1973c [which gives overall mean as 4.75 based on these data]); in WA, 4.0 (1.34; 25): C/2 × 5, C/3 × 4, C/4 × 6, C/5 × 7, C/6 × 3 (Storr 21, 22); Qld: C/4 × 1, C/5 × 2, C/6 × 1 (Storr 19).

Laying Eggs laid on successive days, with interval of 2 days after second, third or fourth egg in C/5 and C/6 (Rowley 1973c). One pair laid a replacement clutch within 1 month of loss of first brood (Rowley *et al.* 1973).

Incubation By female only; female fed on nest by male, at intervals of c. 30 min. Unhatched eggs can remain in nest for up to 1 week (Rowley 1973c). **INCUBATION PERIOD**: 19 days × 2 eggs, 20 days × 2 eggs (Rowley 1973c).

Young Altricial, nidicolous. Hatch blind and naked except for sparse down (Rowley 1973c; NRS). By 12 days, pin-feathers starting to emerge through skin; by 18 days eyes open and feathers emerging from pins; by 25 days, feathered, and able to regulate own body-temperature; from 33 to 44 days, fully feathered, stand up and wander about nest; liable to fledge prematurely if disturbed (Rowley 1973c). **Parental care** Young brooded by female for first c. 2 weeks; male feeds female who then feeds young or allows male to feed young. Later, both sexes feed young (Rowley 1973c; NRS). Nest-sanitation by parents stops by 33 days after hatching (Rowley 1973c).

Fledging to independence **FLEDGING PERIOD**: 41.0 days (3.29; 38–48; 13): 38 days × 1, 39 days × 5, 40 days × 2, 41 days × 2, 42 days × 1, 48 days × 2 (Rowley 1973c). After fledging, nestlings may return to nest: sometimes first leave nest for only short periods then return for up to 2 days before leaving nest (NRS). Both adults continue to feed fledgelings after leaving nest (NRS), but period of dependence not known.

Success For 138 eggs, in 30 clutches, 127 (92.0%) were fully incubated, 97 (70.3%) hatched, and 30 (21.7%) young fledged; three nests failed to hatch any young (Rowley 1973c). Of 26 attempts, 22 (84.6%) successful, and four failed; three of the four failed nests were parasitized by Channel-billed Cuckoos *Scythrops novaehollandiae* (NRS). Two nests in mistletoe in a gum failed when tree felled (Irby 1933). **CUCKOOS**: Parasitized by Channel-billed Cuckoos and Common Koels *Eudynamis scolopacea* (Brooker & Brooker 1989; HANZAB 4).

PLUMAGES Prepared by J.S. Matthew. Nearly naked at hatching, with sparse covering of down. Fledge in juvenile

plumage. Undergo a partial post-juvenile (first pre-basic) moult to adult-like first immature (first basic) plumage. Attain adult plumage in complete first immature post-breeding (second pre-basic) moult, probably when c. 1 year old. Bare parts not adult till nearly 2 years old. After attaining adult plumage, a complete post-breeding (pre-basic) moult each cycle produces successive adult (basic) plumages with no change in appearance. Sexes alike. Subspecies *ceciliae* described below based on examination of skins of 11 adults, six first immatures and three juveniles (ANWC, HLW, MV).

Adult (Definitive basic). **HEAD AND NECK:** Entirely black with, in good light, glossy greenish-blue (ne) sheen to ear-coverts and hackles on chin and upper throat, and glossy bluish-purple (ne) sheen to rest of head and neck. All feathers have concealed and fairly sharply demarcated white bases. Feathers of chin and throat specialized, forming rather indistinct hackles, with roughly bifurcate tips (also see Measurements and Fig. 1, p. 693 in account for Australian Raven). Interramal area extensively feathered except on extreme distal part. Many rather long (to 35 mm) and rigid black bristles extend forward from base of forehead and anterior lores to conceal basal half of upper mandible and nares; many shorter bristles extend forward from anterior malar area to conceal extreme base of lower mandible; many short bristles also extend downward from below front half of eye, posterior lores and interramal area. **UPPERPARTS:** Entirely black, with glossy bluish-purple (ne) sheen in good light; tips of feathers duller with indistinct greenish-blue (ne) sheen; all feathers have concealed and sharply demarcated white bases. **UNDERPARTS:** Entirely black, with glossy bluish-purple (ne) sheen to most in good light; centre of lower belly and vent duller, brownish black (c119), lacking glossy sheen. **UPPERTAIL:** Black with: glossy greenish-blue (ne) sheen to t1; in good light, glossy bluish-purple (ne) sheen to outer webs of t2–t5; glossy bluish-green (ne) sheen to outer web of t6; and faint and duller greenish-blue (ne) sheen to inner webs of t2–t6. **UNDERTAIL:** As uppertail but duller, lacking glossy sheen. **UPPERWING:** Entirely black. All marginal and median coverts, basal half of tertials, and outer webs of greater secondary coverts, inner primaries and secondaries, have glossy bluish-purple (ne) sheen in good light. Inner webs and tips of remiges and greater secondary coverts duller than outer webs, with indistinct greenish-blue (ne) sheen. Feathers of alula, and outer webs of greater primary coverts and outer 4–5 primaries, have glossy greenish (ne) sheen, usually grading to bluish purple (ne) at tips. **UNDERWING:** Black; all marginal and median coverts and greater secondary coverts have glossy bluish-purple (ne) sheen in good light. Greater primary coverts and remiges, duller, blackish brown (c119), lacking glossy sheen. Curry (1978) states that some birds have irregular whitish band across bases of remiges; this difficult to see in skins given lack of spread wing material (this study) but possibly formed by pale shafts at base of remiges, visible through underwing-coverts (S.J.S. Debus).

Nestling No information.

Juvenile Similar to adult, from which differs by: (1) Top of head, mantle and all of underparts, slightly browner, brownish black (c119) and less glossy than in adult; (2) feathers of underparts and hindneck softer and more loosely textured; (3) bases to feathers of body duller, whitish-grey (ne) or light brownish-grey (c80), not unlike those of ravens; (4) lack hackles on chin and throat, feathers instead conventional in shape and rather soft; (5) rectrices slightly narrower and more acute at tips; (6) less feathering on sides of throat and malar area, and recently fledged birds have narrow, bare malar apertures; and (7) tips to outer primaries narrower and more pointed than in adult, particularly noticeable on p6–p8.

First immature (First basic). Very similar to adult; retain all juvenile rectrices, primaries, secondaries, greater primary coverts and alula; most birds also retain all juvenile tertials,

but one skin had replaced outermost tertial in post-juvenile moult. Retain all or most juvenile greater secondary coverts; some birds retain a few juvenile median secondary coverts. Retained juvenile feathers contrast slightly browner and duller than replaced adult-like coverts, particularly in worn plumage.

Second immature (Second basic). Plumage indistinguishable from adult but bare parts differ (see below).

BARE PARTS Based on photos (unpubl.: G.S. Chapman; standard sources), museum labels (ANWC, HLW, MV) and other sources as cited. Subspecies *ceciliae*: **Adult** Bill and gape, black. Palate and tongue, black (Rowley 1970); palate also described as bluish black (ANWC); or mottled black and pink (Hall), but not known if these fully mature birds. Interramal skin, black. Orbital ring, black. Iris, white with narrow pale-blue (168D) inner ring; also described as white with blue inner ring (Stresemann 1943; Rowley 1970), white (Frith & Calaby 1974; Hall; ANWC, HLW, MV) or pearl-grey with narrow blue inner ring (Hall). Studies of captive birds showed that do not attain adult coloration of iris till nearly 2 years old (Rowley 1970). Legs and feet, black. **Nestling** No information. **Juvenile** Differences from adult: Gape, palate and tongue, pink (Rowley 1970); palate also described as pink (ANWC) or reddish (Hall). Iris, blue-grey (Rowley 1970), brown or grey (ANWC). **First immature** Differences from adult: Palate and tongue described as more pink than black (Rowley 1970). Iris, brown (Rowley 1970; Hall; ANWC) or hazel (HLW); Hall also describes immature iris as mottled brownish and bluish, but age not certain. **Second immature** As adult, but iris, hazel (Rowley 1970); iris said to change from brown to hazel when c. 1 year old (Rowley 1970). One skin (ANWC) with adult plumage has iris described as white with brown flecking; this bird possibly 1–2 years old.

MOULTS Based on examination of skins of 46 adult, 15 first immature and two juvenile *ceciliae* (ANWC, HLW, MV), and other information as cited. **Adult post-breeding** (Third and subsequent pre-basic). Complete. Primaries outward, up to three primaries grow at once. From skins, active moult of primaries recorded from: Oct. (4 of 8; PMS 18.0 [9.56; 7–26]); Jan. (1 of 1; PMS 25); Feb. (4 of 4; PMS 11.3 [5.91; 4–17]); and June (1 of 6; PMS 36). Of 21 collected Apr.–July, 18 had all primaries new, and three in July had slight wear to primaries; All nine from Aug., Sept., Nov. and Dec., had worn primaries. One collected in June from Kimberley Div., WA, had nearly finished moult of primaries; two from nw. Qld had nearly finished moult in May (Hall). Three collected in Pilbara, WA, in July and Aug., had no active moult (Mees 1961). One nominate *oru* from s. New Guinea in late Sept. had no active moult (Mees 1982). Combined results suggest moult of primaries starts spring or early summer and finished by autumn, but possibly some geographical variation in timing. Moult of primaries possibly starts earlier in humid n. NT than in rest of Aust. range, but more data needed: all four birds collected n. NT in Oct. had active moult of primaries, while six collected e. Qld, NSW or WA in Oct.–Nov. had worn primaries; all four from e. Qld in Feb. in early to mid-stages of moult of primaries; one bird from C. York Pen., ne. Qld, in June, about halfway through moult of primaries. Moult of secondaries and tail starts when moult of primaries about halfway through. Timing of moult of body much as primaries, but not finished till after end of moult of primaries. **Post-juvenile** (First pre-basic). Partial. Involves all feathers of body, all marginal coverts, median primary coverts and all or most median secondary coverts. Some birds replace one or more inner greater secondary coverts. One first immature collected in May had replaced outermost tertial in post-juvenile moult. Two birds from central NT starting moult of body, one in Oct.,

other in Nov. First immature post-breeding (Second pre-basic). Few data. Complete. One first immature starting moult of body in Sept. In skins, active moult of primaries recorded in one from n. NT in Nov. (PMS 21). Immature from Inkerman, nw. Qld, with active moult (tracts not specified) in May (Hall) but not known if this refers to first or second pre-basic moult.

MEASUREMENTS SUBSPECIES *CECILAE*: (1–3) Qld, NSW, WA and NT, skins (ANWC, HLW, MV): (1) Adults; (2) First immatures; (3) Juveniles. (4) Qld, NSW, WA and NT, adults, skins (Rowley 1970). Hackle = Length of longest hackle on throat.

	MALES	FEMALES	
WING	(1) 354.9 (9.67; 342–380; 27) (2) 326.1 (12.11; 310–346; 11) (3) 270, 326 (4) 349.9 (315–382; 60)	337.6 (10.81; 320–363; 25) 315, 328, 338 330 341.1 (320–357; 64)	**
TAIL	(1) 200.0 (9.05; 179–214; 27) (2) 182.9 (10.86; 165–200; 11) (3) 170, 181 (4) 194.6 (166–216; 60)	188.9 (10.68; 176–221; 25) 170, 183, 199 175 188.6 (174–206; 64)	**
T1	(1) 61.9 (2.15; 57.5–66.1; 27) (2) 62.1 (2.39; 57.9–65.3; 11) (3) 54.9, 62.8	57.6 (2.68; 53.5–63.6; 25) 55.0, 57.3, 61.2 57.2	**
BILL S	(1) 38.0 (2.43; 30.1–41.3; 26) (2) 38.0 (1.89; 34.8–41.0; 11) (3) 34.9	36.1 (2.11; 32.9–40.4; 25) 32.1, 36.8, 39.0 34.2	**
BILL N	(1) 21.3 (1.28; 19.4–23.8; 25) (2) 21.2 (1.05; 18.8–23.0; 11) (3) 18.7	20.1 (1.12; 18.5–22.2; 23) 19.7, 20.6, 21.3 18.5	**
BILL D	(1) 54.0 (49.5–60.0; 60) (2) 63.2 (2.79; 57.4–69.6; 27) (3) 60.6, 63.5 (4) 62.5 (57.0–66.5; 60)	50.9 (47.0–58.5; 64) 61.1 (2.51; 57.6–66.8; 25) 60.1, 60.4, 64.5 59.0	**
TARSUS	(1) 27.2 (2.33; 23.6–32.7; 27) (2) 22.9 (1.22; 21.8–24.2; 9) (4) 27.1 (22.0–32.0; 60)	25.9 (2.49; 21.9–29.9; 23) 23.5, 24.3 26.8 (21.0–31.0; 64)	ns

NOMINATE *ORRU*: (5) New Guinea, adults, skins (Rowley 1970).

	MALES	FEMALES
WING	(5) 329.3 (325–348; 7)	314.2 (307–322; 5)
T1	(5) 176.6 (170–187; 7)	167.8 (162–174; 5)
BILL F	(5) 58.1 (57.0–60.0; 7)	55.4 (53.0–58.5; 5)
TARSUS	(5) 62.9 (61.0–64.0; 7)	60.3 (57.0–64.0; 5)
HACKLE	(5) 24.8 (23.0–27.0; 7)	24.0 (23.0–26.0; 5)

WEIGHTS SUBSPECIES *CECILAE*: (1–3) Qld, NSW, WA and NT, from museum labels and Hall: (1) Adults; (2) First immatures; (3) Juveniles. (4) Qld, NSW, WA and NT, adults, skins (Rowley 1970). NOMINATE *ORRU*: (5) New Guinea, adults, skins (Rowley 1970).

	MALES	FEMALES
(1)	580.9 (56.94; 470–670; 22)	521.1 (59.01; 440–650; 19)
(2)	523.0 (58.65; 430–603; 7)	347.2, 420.7
(3)	525, 550	410
(4)	566.3 (430–670; 60)	549.6 (430–650; 64)
(5)	644.3 (600–700; 7)	570.0 (500–630; 5)

STRUCTURE Wing fairly long and broad; tip of longest primary does not reach tip of tail when wing folded. Ten primaries; p7 usually longest (p6, p8 sometimes =); p10 118–133 mm shorter than p7, p9 23–50, p8 0–6, p6 0–7, p5 17–37, p4 59–78, p3 85–103, p2 106–124, p1 118–139. Emargination to outer webs of p6–p8, sometimes also p5; emargination to inner webs of p6–p10. Eleven secondaries, including four tertials; tip of longest tertial falls level with or slightly short of tip of p1 on

folded wing; tip of longest secondary falls between p1 and p3 on folded wing. Tail fairly long, slightly rounded or rather wedge-shaped at tip when folded; 12 rectrices; t1 or t2 longest (these varying by ≤ 4 mm), t3 4–10 mm shorter than longest, t4 7–15, t5 10–21, t6 17–37. Juvenile rectrices slightly narrower and more acute at tip than in adult. Bill-shape rather similar to that of Australian Raven, but tends to be deeper and more massive. Adults and immatures have fairly short and narrow bifurcate hackles on chin and throat (see Fig. 1, p. 693 in account for Australian Raven); these lacking in juvenile. Tarsus rather long, compressed laterally; scaling laminipilar. Tibia fully feathered. Interramal area extensively feathered except on extreme distal part. Feet large and powerful. Middle toe longest, mean length, including claw, 53.4 mm (2.38; 50.5–56.8; 5); inner and outer toes 70–80% length of middle; hindtoe 75–85%. Hindclaw 18–26 mm long.

RECOGNITION For separation of Torresian and Little Crows, see latter account.

AGEING As for Little Crow (q.v.).

SEXING No differences in plumage. Adult females said to be smaller in all dimensions (Rowley 1970), which largely supported in present study, but measurements overlap considerably between sexes (see Measurements). Changes in brood-patch much as described for Australian Raven (q.v.) (Rowley *et al.* 1973).

GEOGRAPHICAL VARIATION Not fully understood. Subspecies *ceciliae* occurs mainland Aust. (Rowley 1970; Mees 1982; Sibley & Monroe 1990; Peters; DAB). N nominate *orru* occurs from Moluccas, to New Guinea and its satellite islands, D'Entrecasteaux and Louisiade Archs, Trobriand and Woodlark Is (Coates 1990; Peters); populations from n. Torres Str. assumed to be nominate *orru* (DAB). Two other extralimital subspecies recognized: *insularis* from Bismarck Arch. (New Britain, New Ireland, New Hanover, Rooke and Vitu Is); and *latirostris* from Tanimbar and Babar Is (White & Bruce 1986; Peters). Some authors (Finch & McKean 1987; Smith 1991) suggest that birds from Bismarck Arch., formerly treated as *C. orru insularis*, have closer affinities with Bougainville Crow *C. meeki*. However, these suggestions based on calls and not morphology. Stresemann (1943) recognized another subspecies, *salvadorii*, from Port Moresby region, PNG, but this not accepted in later works (Rowley 1970; Peters). Most authors consider *ceciliae* as a subspecies of *C. orru* (Mees 1961, 1982; Rowley 1970; Peters; DAB), though Stresemann (1943) treated *ceciliae* as a full species occurring only in Aust., and Storr (26) treated WA populations as a full species.

Variation within Aust. not fully understood. Table 2 presents measurements of adults from Aust. (Rowley 1970), the data suggesting that e.-Aust. populations have slightly longer Wing and Tail, shorter Bill F, and weigh more than populations in central and w. Aust., though differences for females not as great as for males. These differences, however,

Plate 23

(K. Franklin)

White-winged Chough *Corcorax melanorhamphos* (page 775)

NOMINATE *MELANORHAMPHOS*: 1 Adult; 2 Juvenile;

3 First immature; 4 Second immature; 5, 6 Adult

Apostlebird *Struthidea cinerea* (page 797)

NOMINATE *CINEREA*: 7 Adult; 8 Juvenile;

9 First immature; 10, 11 Adult

SUBSPECIES *DALYI*: 12 Adult

are probably insufficient to warrant recognition of subspecies within mainland Aust. (Rowley 1970; DAB; this study).

Table 2. Measurements of adult skins; means and ranges estimated from Rowley (1970: Fig. 19). (1) WA and NT, W of c. 137°E; (2) E. Aust., from C. York Pen. S to ne. NSW.

	MALES	FEMALES
WING	(1) 346 (315–365; 16) (2) 353 (337–368; 44)	343 (330–355; 9) 341 (330–356; 55)
TAIL	(1) 188 (166–200; 16) (2) 198 (182–216; 44)	186 (175–194; 9) 189 (174–205; 55)
BILL F	(1) 55.5 (50–60; 16) (2) 53.5 (49.5–57.5; 44)	55 (52.5–58.5; 9) 50 (47–56.5; 55)
TARSUS	(1) 63 (60–65.5; 16) (2) 62.5 (57–66.5; 44)	63 (60–67; 9) 60.5 (56.5–65; 55)
WEIGHT	(1) 495 (430–575; 16) (2) 590 (510–670; 44)	485 (430–580; 9) 555 (460–650; 55)

NOMINATE ORRU: Probably identical to *cecilae* in gloss of plumage (DAB). Data in Rowley (1970; see Measurements) show adult nominate have shorter Wing, Tail and hackles, but longer Bill F, and weigh more, than subspecies *cecilae* (sexes compared separately).

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Plate 24

(N. Day)

Brown Shrike *Lanius cristatus* (page 818)

NOMINATE CRISTATUS: 1 Adult male breeding; 2 Adult female breeding; 3 Adult non-breeding; 4 Immature; 5 Adult male breeding

SUBSPECIES SUPERCILIOSUS: 6 Adult male breeding

Red-whiskered Bulbul *Pycnonotus jocosus*
(page 1589 [Part B])

NOMINATE JOCOSUS: 7 Adult; 8 Juvenile; 9, 10 Adult

Common Myna *Acridotheres tristis* (page 1937 [Part B])

NOMINATE TRISTIS: 11 Adult; 12 Juvenile; 13, 14 Adult

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Corvus splendens House Crow

COLOUR PLATE FACING PAGE 737

Corvus splendens Vieillot, 1817, *Nouv. Dict. Hist. Nat., Nouv. Éd., Paris* 8: 44 — Bengal.

Specifically named for the lustrous pearl-grey parts of the plumage, from the Latin *splendens*, lustrous, brilliant (from *splendere*, to glitter).

OTHER ENGLISH NAMES Asian House Crow, Ceylon or Colombo Crow, Indian, Indian Bazaar or Indian House Crow.

POLYTYPIC Nominate *splendens*, India S of Himalayas except NW; *zugmayeri* Laubmann, 1913, nw. India and Pakistan; *protegatus* Madarász, 1904, Sri Lanka and sw. India; *maledivicus* Reichenow, 1904, Laccadive and Maldivic Is; and *insolens* Hume, 1874, Burma, s. Yunnan and sw. Thailand. Identity of ship-borne vagrants in Aust. not known (see below).

No valid records for Aust. or NZ, with all birds assumed to have been ship-assisted (Christidis & Boles 1994; see Distribution).

FIELD IDENTIFICATION Length 41–43 cm; wingspan 76–85 cm; weight 320 g. Smaller and more slender than all Aust. corvids. Fairly small and slender crow, with weak breast; large and rather rounded head, with steep forehead and raised crown; long bill, with strongly curved upper mandible; long neck; long wings and tail; and long, sturdy legs but with rather spindly appearance. When perched, tips of wings fall well short of tip of tail. Adults, black, with varying glossy bluish-purple or greenish-blue sheen to head and upperparts, and brownish-grey nape, neck, mantle and breast. Sexes alike, though males slightly larger than females. Juvenile similar to adult but with no

or very little glossy sheen. Immature like adult but slightly duller and retains some juvenile plumage which contrasts markedly with new adult-like plumage. **GEOGRAPHICAL VARIATION:** Not known which subspecies has occurred in Aust. Subspecies *protegatus* occurs naturally in sw. India and Sri Lanka, and is most likely subspecies to have occurred in Aust. as some birds known to have been aboard ships from Sri Lanka (see Distribution); nominate *splendens*, of most of Indian subcontinent, is also possible. Other subspecies, however, very unlikely to occur here. Subspecies *protegatus* described below. **Adult** Most of head, black with glossy purple-blue to green-blue