Order CICONIIFORMES

Medium-sized to huge, long-legged wading birds with well developed hallux or hind toe, and large bill. Variations in shape of bill used for recognition of sub-families. Despite long legs, walk rather than run and escape by flying. Five families of which three (Ardeidae, Ciconiidae, Threskiornithidae) represented in our region; others — Balaenicipitidae (Shoe-billed Stork) and Scopidae (Hammerhead) — monotypic and exclusively Ethiopian. Related to Phoenicopteriformes, which sometimes considered as belonging to same order, and, more distantly, to Anseriformes. Behavioural similarities suggest affinities also to Pelecaniformes (van Tets 1965; Meyerriecks 1966), but close relationship not supported by studies of egg-white proteins (Sibley & Ahlquist 1972). Suggested also, mainly on osteological and other anatomical characters, that Ardeidae should be placed in separate order from Ciconiidae and that Cathartidae (New World vultures) should be placed in same order as latter (Ligon 1967).

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Family ARDEIDAE bitterns, herons

Medium-sized to large or very large wading birds with long necks and long legs. Variously placed in 61–69 species in 10–17 genera (Bock 1956; Curry-Lindahl 1971; Payne & Risley 1976; Hancock & Elliott 1978; Peters) according to choice between many, mainly monotypic genera and a few large genera. Treated here in few large genera, particularly merging *Egretta* into *Ardea* because there is no clear distinction between the two (Mock 1977; van Tets 1977). Two sub-families: Ardeinae (herons) and Botaurinae (bitterns). In our region, 19 species in four genera; all breeding except three accidentals.

Body, slim; neck, long with kink at sixth vertebra. Male larger than female. Wings, long and broad. Flight strong with regular wing-beats, neck retracted. Eleven primaries: p7–p10 longest, p11 minute. Fifteen to twenty secondaries; diastataxic. Tail, short, square or slightly rounded; 8–12 feathers. Under tail-coverts, nearly as long as tail-feathers. Bill, long, straight and sharply pointed, except in *Cochlearius*; often serrated with notch near tip. Nostrils, long slits. Lores, bare. Legs, long; lower part of tibia, bare. Toes, long; small web between middle and outer. Hind and inner toes, broadened at base; claw of middle, pectinate. Stance upright, neck retracted when at rest; gait striding. Perch in trees adeptly (herons) and climb about expertly in reeds (bitterns). Oil-gland small, often with short tuft (longer in night herons *Nycticorax*). Aftershaft well developed. Plumage, loose; feather tracts, narrow; down confined to apteria. Two to four pairs of powder-down patches; down soft and friable, producing fine particles used in care of plumage. Ornamental plumes on head, back or chest in many species; usually more highly developed in breeding season. Bare parts, yellow, brown or black; usually more colourful in season of display and pair-formation. Seasonal differences in plumage, small. Moults, poorly known; mostly two per cycle, but pre-breeding moult often restricted. Moult of primaries irregular or outwards. Young, semi-altricial and nidicolous; single coat of sparse down, white, grey or pale brown. Clamber out of nests when large but unable to fly. Except in *Nycticorax* and *Ixobrychus*, juveniles like adult or duller. Reach adult plumage when 2–4 years old.

Cosmopolitan, with main area of adaptive radiation in Tropics. Absent from Arctic and Antarctic areas; rare vagrants to subarctic and subantarctic regions. Adapted to catch medium-sized prey in shallow water and damp places with short grass, thus rather restricted in habitat. Avoid areas far from marine and inland waters. Otherwise widely distributed from temperate latitudes through Subtropics and Tropics wherever suitable feeding habitat occurs, including forest, mountain and agricultural areas. Usually found at water's edge, especially where gentle slopes and unobstructed bottom makes fishing easy, but some taller, longer-legged species may feed in deeper water. Some smaller species, however, largely arboreal: Cattle Egret *Ardea ibis* now mainly a commensal of large herbivores. Some species (e.g. reef herons *A. sacra* and *A. gularis*) adapted to littoral habitats; others (notably bitterns *Botaurus* and *Ixobrychus*) habitually haunt tall dense vegetation such as reedbeds.

Main breeding and roosting sites, reedbeds, islands, trees and shrubs along banks of rivers, billabongs and lakes (Fullagar & Davey 1983), from which they forage over wide areas. Formerly plumage trade almost annihil-

ated populations of egrets, which have recovered after protection. In Aust. and NZ mainly dispersive, especially those that depend on freshwater habitats.

Food mostly fish, amphibians and insects and their larvae; also, for some species, molluscs and crustaceans, reptiles, small birds and mammals, and their young. Indigestible material ejected as pellets. Prey grabbed by bill; sometimes speared. Feeding methods: (1) stand and wait for prey; (2) wade or walk slowly while stalking prey; (in both methods strike out with neck and bill when within range); (3) movements serving to uncover or startle prey (e.g. foot-shuffling accompanies method 2, at least in Ardeinae); (4) disturb-and-chase technique, in which bird runs and dashes about in shallow water, flushing prey; (5) swimming in deeper water and surface-diving; (6) hovering above water and plunge-diving; (7) plunge-diving from perch (Meyerriecks 1960). Feeding usually diurnal or crepuscular or both (e.g. *Ardea* spp); or crepuscular or nocturnal or both (e.g. *Nycticorax*). Most species solitary feeders, some territorially; where food plentiful may congregate in feeding flocks. Voice, mostly harsh guttural croaks or grunts, unspecialized. With partial exception of some Botaurinae, monogamous pair-bond typical; usually of seasonal duration and not evident away from nest-site or nearby; birds rarely if ever meeting as mates elsewhere. When breeding, both colonial and solitary species typically defend nest-site only. Most species roost communally, often conspicuously at traditional and protected sites; roosts mainly nocturnal but in some species diurnal.

Comfort-behaviour generally similar to other marsh and waterbirds. Bathe while standing in shallow water. Liberal use made of powder-down and oil-gland while preening, with frequent use of pectinate claw in scratching head, neck and bill. In some species, underwing preened by extending wing at right-angle to body. Heat dissipated by gular-fluttering; characteristic sunning posture with upright stance and wings held, shieldlike, out at sides but not fully spread.

In many, specially in colonial species, onset of breeding protracted. Seasonal breeders in coastal and temperate areas but prolonged in inland Aust. if wet conditions prevail. Nest in dense vegetation or in trees. Colonial, often with other Ciconiiformes and Pelecaniformes, or solitary. Displays when forming pairs use long neck and large bill in various distinct ways resembling those of long-necked Pelecaniformes, and birds bob up and down, bending and straightening long legs (Daanje 1950; Meyerriecks 1960). Nest, piles of available vegetation, in tree-nesting species of interlocked twigs; built wholly or mainly by female with material brought by male. Eggs blunt oval, light blue or green, smooth. Clutches 3–5 (1–10). Normally single brood. Replacements laid after loss of eggs or even young. Eggs laid at intervals of 1–3 days. Incubation, 22–30 days; typically by both sexes in roughly equal spells. Single median brood-patch. Incubation starts with first or second egg, so hatching asynchronic. Eggshells removed from nest. Young cared for and fed typically by both parents, by complete and partial regurgitation. Brooded continuously when small; then and later, sheltered from strong sun or rain by parents spreading wings. Older young often guarded by parents in turn. May leave nest before fledging, though often return to be fed. Nestling period 30–55 days; young may become independent soon after, but prolonged periods of post-fledging semi-dependence probably more typical, especially in larger species. Age of first breeding usually 1 or 2 years, occurring in some species before adult plumage attained.

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Botaurus poiciloptilus **Australasian Bittern**

Ardea poiciloptila Wagler, 1827, *Syst. Avium, Ardea no* 28, note — New South Wales.

The generic name is apparently a combination of two Latin words (*bos* and *taurus*) for an ox and a bull, related to the French *butor* (bittern, churle, buffoon) and since the sixteenth century attributed to the booming call of the bird. The specific name is compounded of the Greek ποικίλος (dappled, of varying colours) and πτίλον (plumage, feather).

OTHER ENGLISH NAMES Boomer, Bullhead, Bunyip, Black-backed or Brown Bittern.

All species of *Botaurus* are quite similar in plumage and each could be called generally brown, so that the epithet is not informative. Differentiation is better made on geographical grounds.

MONOTYPIC

FIELD IDENTIFICATION Length 66–76 cm; wingspan 1050–1180 cm; weight: males 1400 g, females 900 g. Large stocky thick-necked heron with mottled buff, brown and dark brown plumage that is very cryptic. Secretive; inhabiting freshwater swamps with dense reeds or rushes; more often heard than seen. Booming calls (in breeding season), behaviour and flight pattern distinctive, but immature Rufous Night Herons *Nycticorax caledonicus* can be confused. Dark and pale adults observed but variations in plumages not understood. Sexes similar but females slightly smaller. No information on seasonal differences in plumage. Immatures paler than most (even palest) adults but probably not separable in field.

DESCRIPTION ADULT. Crown, nape and hindneck, brown with pale mottling and some streaking; earcoverts, buff; prominent black-brown stripe from malar area down sides of neck, broadening behind ear-coverts; chin and upper throat, white, grading to yellow-brown on foreneck, with mottled brown stripe from base of bill to breast; two or three black-brown streaked stripes on lower neck; long hackles of foreneck usually overhang and conceal upper breast. Mantle, upperback and scapulars, dark brown to

black-brown with varying buff streaks, fringes and spots; lower back and tail, buff mottled brown; general appearance of mottled or streaked brown and buff plumage; paler markings sometimes absent on darkest birds, then appearing uniform black-brown at distance. Wing-coverts, readily visible when wing folded, have fine alternating bars of buff and dark brown. Remiges, dark brown, varyingly barred or spotted buff. Underparts, pale yellow-buff streaked with dark brown, paler than back and wings; off-white on belly and thighs. Under wing-coverts, buff-white; remiges, as upperwing. In flight, plumage appears mottled and vermiculated above and below, darker on back and pale on forewing. Bill, straight, pointed, straw yellow to buff, with dark grey culmen. Facial skin, pale- or pea-green (when showing narrow dark-olive line from eye to nostrils) or blue-grey (possibly in breeding male only). Iris, orange-brown or yellow. Legs and feet, light green to olive. No information on changes of colours of bare parts. JUVENILE. Paler than most adults with heavier buff flecking on back. Never have blue facial skin.

SIMILAR SPECIES Stocky build, thick neck, large size and cryptically brown and buff mottled plumage diagnostic in combination. Only likely to be confused (given poor views) with other bitterns or, possibly, night herons. Superficially similar to juvenile **Rufous Night Heron**; Australasian Bittern much larger, with heavier build, less hunched appearance and mottled plumage (not densely streaked and spotted) without rows of white spots on upperwings; mostly solitary (not reported in flocks or large groups), does not perch and roost in trees and flies more heavily; in flight, plumage appears mottled above and below and bird appears broader-winged and heavier than juvenile Rufous Night Heron; also, bill of Australasian Bittern, slightly shorter than length of head (slightly longer in Rufous Night Heron). **Black Bittern** *Ixobrychus flavicollis* is smaller, more gracile in general and has uniformly dark to black dorsum and can hardly be confused, at least when adult.

Mostly singly, sometimes in pairs or loose groups of up to 12, in beds of rush, reeds or sedge in freshwater wetlands. Most often seen standing motionless in shallows among reeds or rushes, or when flushed. When flushed, rise awkwardly on large broad bowed wings with rounded tips, usually with legs dangling; usually fly in one direction then plunge down to hide in vegetation; rarely circles. In travelling flight, legs and feet trailing, neck hunched and bill sometimes partly open; fly with steady, rather slow, shallow wing-beats. Flight, appears owl-like especially when flying away from observer; enhanced at dusk. Do not perch or roost in tall shrubs or trees, nor alight on exposed branches. Sometimes stand on platforms or banks at edge of water; stalk with great steaith through shallow water; habitual stance rather bent forward and horizontal, almost rail-like; move deliberately; climb adeptly in reeds and rushes. Occasionally pop head up above vegetation, but not when feeding. When alarmed, stand, sometimes swaying slightly, with plumage compressed, bill pointing vertically and eyes pointing downwards towards disturbance, making them more difficult to detect. During spring and summer, utter distinctive resonant bass booming with curiously breathy woodwind-like quality that carries far in still air; mainly at dawn and dusk; could be confused with other low-pitched calls heard in swamps, e.g. first part of thumping call of Purple Swamphen *Porphyrio porphyrio*, or even calls of distant cattle.

HABITAT Terrestrial wetlands and, occasionally, estuarine habitats; in Aust., mainly in temperate SE and SW (Aust. Atlas). Favour wetlands with tall dense vegetation, where forage in still shallow water up to 0.3 m deep, often at edges of pools or waterways, or from platform or mat of vegetation over deep water (Bright 1935; Whiteside 1989; R.P. Jaensch). Favour permanent fresh-waters, particularly those dominated by sedges, rush, reeds or cutting grass (e.g. *Phragmites, Scirpus, Eleocharis, Juncus, Typha, Baumea, Gahnia, Bulboschoenus*) growing over muddy or peaty substrate (Corrick & Norman 1980; Gosper 1981; Jaensch *et al.* 1988); in sw. WA, prefer beds of tall rush mixed with or near short fine sedge or open pools (Jaensch 1982); at Whangamarino wetlands, NZ, usually among mixed water purslane (*Ludwigia*) and willow weed (*Polygonum*), sometimes among sedges and rush (*Baumea, Juncus*) in winter (Whiteside 1989). Also in swamps, lakes, pools, rivers and channels fringed with lignum (*Muehlenbeckia*), canegrass (*Eragrostis*) or other dense vegetation, and in ricefields (Watson 1955; Hobbs 1961; Vestjens 1977; Corrick 1982); occasionally venture into areas of open water or onto banks (Corrick & Norman 1980; R.P. Jaensch). Use temporary pools when population density high (Hobbs 1961) or during movements (S. Marchant). Brackish water tolerated in estuaries and tidal wetlands, where birds inhabit beds of rushes or reeds in saltmarsh, especially near mouths of creeks or freshwater seepage (Owen & Sell 1985; M. Hewish); sea-coasts avoided.

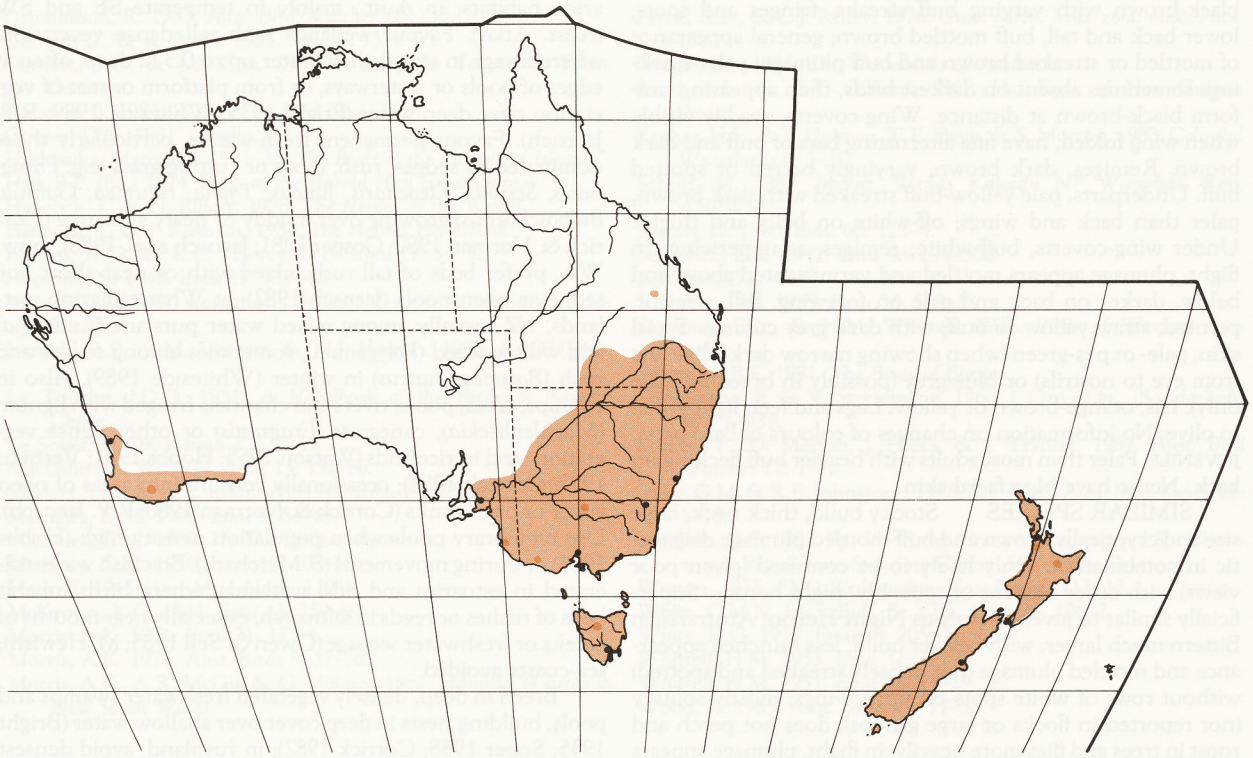
Breed in deep, densely vegetated freshwater swamps and pools, building nests in deep cover over shallow water (Bright 1935; Soper 1958; Corrick 1982); in rushland, avoid densest areas (Bright 1935). When population density high, may resort to open wetlands for nesting e.g. in stunted *Acacia* in swamps (Hobbs 1961).

Usually fly low over water or reeds (Jaensch 1982), but observed circling up to heights of 300 m (Hodgkin 1949).

Range retracted in sw. WA (Aust. Atlas) and in NZ; depend for breeding on deep freshwater swamps, many of which have been severely affected by drainage, increased salinity, increased inundation, grazing, clearing and peat digging since European settlement (Corrick 1982; R. Garstone; R.P. Jaensch). In WA, spread of *Typha orientalis* in disturbed wetlands has provided additional habitat, but useful mainly where areas of open water or short sedge remain (R.P. Jaensch).

DISTRIBUTION AND POPULATION Aust. and NZ. Extralimitally: New Caledonia, Loyalty Is (Ouvea).

AUST. SE and sw. Aust. and Tas.; vagrant to nw. Aust. **Qld**. SE, N to Baralaba and W to Wyandra, N of Cunnamulla. Two specimens (Sandgate and near St George). Few records (Storr 1984; Aust. Atlas): recorded during Field Atlas (1977–81) near Chinchilla, at St George, and on Gold Coast (Broadbeach-Hope I.). Records before Field Atlas (40) S from Ingham, E of long. 145°. **NSW**. Widespread, most numerous Murray-Darling basin, including large influx of breeding birds in sw. NSW, Aug. 1956; scarce elsewhere, though most often recorded in or near coastal areas (Hobbs 1961; NSW Bird Reps 1982, 1984; Morris *et al.* 1981; Smith & Chafer 1987; Wood 1985; Aust. Atlas). **Vic**. Widespread, most numerous s. coastal areas and Murray R. region of central n. Vic. (Wheeler 1967; Vic. Atlas). **SA**. SE, N to Murray R., W to Eyre Pen., also Kangaroo I.; regular and most numerous in swamps of se. SA (R.P. Jaensch). Breeding only in se. corner of SA; formerly Adelaide area (up to *c.* 1919), with few acceptable records elsewhere (Parker *et al.* 1979). **Tas.** Widespread, most numerous e. Tas.; also Bass Str. and other islands (Green 1977;



Thomas 1979; Sharland 1981; White 1985). **WA**. Formerly widespread in SW, N to Moora and E to near Mt Arid, but declining throughout this century (Masters & Milhinch 1974; Serventy & Whittell 1976; Storr 1987; Storr & Johnstone 1988); perhaps now only on w. coastal plain (Busselton to Lancelin) and locally in high-rainfall areas of s. coast to E of Albany; small isolated population in swamps from Esperance to C. Arid (R.P. Jaensch). Population in sw. WA probably <100 pairs (RAOU surveys, 1981–88; R.P. Jaensch). One vagrant record (specimen) from Argyle Downs, extreme ne. WA, 22 Oct. 1971 (Storr 1980). Type-specimen of unaccepted subspecies *westraliensis* [sic], Mathews, 1912, is adult male from Shark Bay, central w. WA, collected Dec. 1880, no other data, and considered a dubious record by Storr (1985), but in view of ne. WA record and worn condition of Shark Bay bird (Amadon & Woolfenden 1952), it is quite plausible this is genuine vagrancy record.

NZ. Widespread NI, SI and Stewart I. to 300 m asl, but numbers apparently declined in recent decades (estimated at 580–725 in 1985; NZ Atlas). Few breeding records: Omanula Lagoon, Tuapiro Estuary, Meremere, Awanui R., L. Rotongata (CSN 22,23,30,31,33). Occasional visitor to offshore islands, including Great Mercury, Mayor (resident?) and Kapiti Is (Falla *et al.* 1981; Oliver); on Great Barrier I. numbers apparently increased since the 1940s (Bell & Brathwaite 1964). Generally considered to be former resident of Chatham Is where last recorded in 1910 (Fleming 1939), but probably only another example of vagrancy in this Bittern when it was more numerous in NZ. Decline in resident Chatham Is avifauna was consequence of human colonization after 1841 when Dieffenbach visited (Forbes 1893), as already suggested for this bird by Finsch (1870); it could not be found during an eight-month survey (Hutton 1872; Travers & Travers 1872) and, if possibly resident early last century, occurrence after Travers' survey suggests vagrancy anyway.

LORD HOWE I. Vagrant; one received at AM, Aug. 1888, most probably collected, Nov. or Dec. 1887; no other data (Hindwood 1940).

BREEDING Almost no records, but assumed to breed widely throughout range, where habitat available.

MOVEMENTS Probably sedentary in permanent habitat but possibly regular short-distance movements during winter and occasional irruptions associated with wet years. Reporting rates in Vic. suggest no regular seasonal movements but possibly local migrant with numbers on lakes near Geelong increasing during winter (Vic. Atlas). Similar winter influx recorded L. George, ACT (Lamm 1965), and at swamps in NI, NZ (Whiteside 1989). At Bool Lagoon, SA, and in sw. Aust. recorded all months with no records of seasonal movement (R.P. Jaensch) although more likely to be recorded away from usual distribution outside breeding season (Parker *et al.* 1979). Also appears to be resident on swamps in sw. NSW but, in wet year 1956, large numbers recorded (Hobbs 1961). In dry season following 1956, an influx to Illawarra district reported (Sefton 1958; Sefton & Devitt 1962).

FOOD Medium-sized aquatic animals including eels, frogs and freshwater crayfish. BEHAVIOUR. When hunting, hold head and neck parallel to surface, swaying head from side to side, creating S-waves down back, or keep absolutely still for 10 min, lunging by pivoting on legs, keeping neck and back straight (Whiteside 1989). Also lunge from crouched position, sometimes lifting feet from surface to do so (Howard 1963; see Falla 1963), then swallowing prey whole or shaking and battering it until subdued, lifting head skywards to do so

(Potter 1950; Whiteside 1989). Also recorded baiting fish with small pieces of grass (Onians 1933) and establishing feeding platforms of flattened reeds where remains of prey found (Serventy & Whittell 1976). Most feeding apparently at night, dusk or dawn but has been seen feeding during day (Binns 1958; S. Marchant) and may do so throughout day in winter in NZ (Whiteside 1989).

ADULT No detailed studies. Recorded taking spiders (Oliver) incl. *Dolomedes minor* (Whiteside 1989); crustaceans (Oliver) incl. freshwater crayfish *Cherax quinquecarinatus* (Serventy & Whittell 1976); insects (Oliver) incl. orthopterans *Teleogryllus commodus* (Whiteside 1989), weevils (Cleland *et al.* 1918); fish (Cleland *et al.* 1918; Onians 1933; Oliver) incl., in NZ, eels (2 of 40 cm, Buller 1888; 1 of 60 cm, Potter 1950; ≤50 cm, five in one stomach ≤20 cm, Whiteside 1989); in Aust. *Carassius auratus* (North); frogs (Wheeler 1950; Oliver; Serventy & Whittell 1976); snake *Pseudechis nuchalis* (90 cm; Hobbs 1979), lizards; birds (Oliver) incl. Silvereye *Zosterops lateralis* (Buller 1888); rats and mice (Oliver); leaves and fruit (Cleland *et al.* 1918).

NESTLING Probably fed similar diet to adults. One adult observed regurgitating four frogs at nest in NZ (Soper 1958).

SOCIAL ORGANIZATION Poorly known in Aust. or NZ; probably very similar to Eurasian Bittern *B. stellaris* (see BWP; Hancock & Elliott 1978; Hancock & Kushlan 1984). Some information from R.P. Jaensch. Generally solitary, though loose congregations of up to 12 birds twice observed within 1 ha at Bool Lagoon, SA, in autumn; maximum of 23 birds recorded for whole wetland in Aug. (R.P. Jaensch).

BONDS Not known, though not colonial. Sex-ratio, age at pair-formation or age at first breeding, not known.

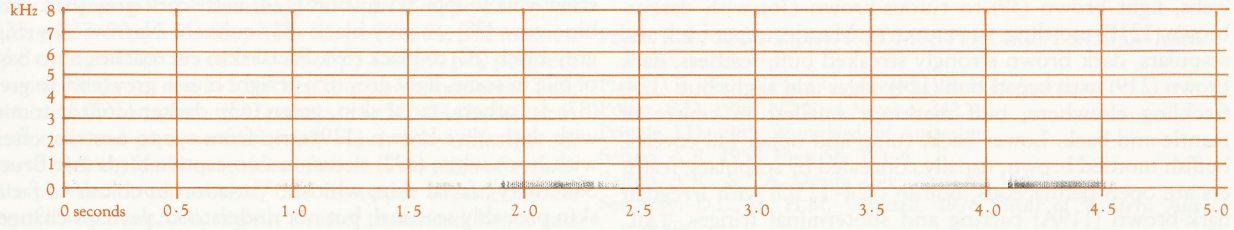
BREEDING DISPERSION Apparently solitary and territorial, though extent and type of territories, unknown. In many wetlands of varying size (5–10 up to 300 ha), one calling bird per swamp. At L. Pleasant View, WA, five calling birds in 200 ha; at L. Kulunilup, WA, four calling in 200 ha; equivalent of one pair every 40–50 ha (R.P. Jaensch).

ROOSTING No information.

SOCIAL BEHAVIOUR No studies in Aust.; displays and social organization (above) difficult to observe because generally shy and secretive in dense habitat. Possibly similar to Eurasian Bittern (which also little known; see BWP; Hancock & Elliott 1978; Hancock & Kushlan 1984). Birds most conspicuous when calling in spring and summer, which is probably associated with breeding. Calls possibly function in advertising and defence of territory. Possible courtship flight by two birds in late evening at Benger Swamp, WA: one bird closely followed the other, *c.* 5–10 m apart, slowly gaining height above reeds; each gave series of 6–8 slow flaps (not always synchronically) followed by sharp gliding rise in height before returning to previous height and flapping 6–8 times again; performed for about 5 min, then birds dropped down into reeds with feet outstretched and forward, without flapping (D.G. Watkins). No further information.

VOICE No detailed studies but much information collected in sw. WA during RAOU South-West Waterbird Project (Jaensch *et al.* 1988); information supplied by R.P. Jaensch. Birds give deep resonant booms preceded by short, barely audible gasps and said to give weak croaks when alarmed and in flight; mainly heard spring and summer; probably associated with breeding activities but little information; possibly calls late summer. Alarm Call probably all year. Calls heard up to 800–1000 m distance. Tend to call from one site on a particular night; not necessarily associated with nests. Often difficult to locate calls because volume and direction are deceptive. Sexual differences not known; possibly only male Booms; in NZ, males and females said to duet with distinctly differently pitched Booms (Hancock & Elliott 1978), but this may be neighbouring males answering each other. In NZ, female said to make bubbling call when returning to nest; in Eurasian Bittern, attributed to calls of young (Hancock & Elliott 1978). No information on individual differences. Could be confused with calls of Purple Swamphen *Porphyrio porphyrio* if unfamiliar with calls, a long way from calling birds, or in windy conditions. Purple Swamphens utter guttural squeal that sounds like deep grunt, almost a *boom*, trailing off in pitch and sharpening in tone, but always associated with squeal. Booms are like *oom* calls of Common *Phaps chalcoptera* and Brush *P. elegans* Bronzewings and some button-quail *Turnix* spp. Sounds like muffled or cut-off foghorn, especially if loud, and evening calm (reverberates). Geographical variation not known for Aust. Calls of NZ birds may differ from Aust. but no first-hand accounts. No non-vocal sounds reported.

ADULT **Boom**. Typically, up to four, almost inaudible, quick gasps or gulps (presumably of bird inhaling) followed immediately by loud booming *woomph* (as in 'good'), then repeated gasp and *woom* (as in'womb'), more resonant and longer than first boom; usually repeated 2–3 times. Sonagram A shows the sequence *gasp-gasp-gasp-boom-gasp-boom*. Each call typically of booms repeated three times, lasts *c.* 10 s. In WA, call repeated every 2–10 min (av. 5 min), though probably varies with stage of breeding and weather. Some birds become hoarse. In Eurasian Bitterns, Boom functions as Advertising Call and to defend territory (BWP); not known for A'asia. **Alarm Call**. Startled birds said to make hoarse *craak* (Pizzey 1980). **Flight Call**. In WA, birds often seen opening bills as they fly away after being flushed, but no associated call.



A J. Kendrick; L. Kaikokopu, NZ, Oct. 1973; P35

Bird may be giving hoarse or soft call; possibly Alarm Call.

ADULT FEMALE No information for Aust.; in NZ, females said to make *bubbling* call, sounding like straw being used to blow bubbles in a bottle; given by females returning to nest.

YOUNG No information for Aust. or NZ.

BREEDING No studies; little general information (three cards in Aust. NRS). Breed in simple pairs, solitarily.

SEASON Said to be from Oct. to Feb. (North; Campbell). Clutch of eggs at L. Pleasant View, WA, in Dec. (T.E. Bush). No adequate knowledge.

SITE Generally in stands of *Phragmites, Typha,* rushes (*Juncus, Baumea*) to 2.5 m tall, in swamps. During one season in Riverina, NSW, nested on stunted bushes, trees (boree) in area of short (30 cm) grass, unusually conspicuously (Hobbs 1961). Sometimes several nests close to one another (Hobbs 1961).

NEST, MATERIALS Usually about 30 cm above level of water, which may however fall during nesting cycle and leave nest higher. Well-constructed flat saucer of flat pieces of reeds or rushes broken off by bird and laid across and across. Structure about 35–40 cm across and 20–22 cm thick; may be protected by stems of growing reeds interwoven above nest (North).

EGGS Thick oval to oval; close-grained, smooth, glossy; pure olive.

MEASUREMENTS: 50.6 (49.0–53.8; 12) x 37.2 (34.3–39.9) (North; Campbell).

CLUTCH-SIZE No quantified data. Said to be 4–5.

LAYING, INCUBATION, NESTLING, GROWTH, SUCCESS No information.

PLUMAGES

ADULT Plumage varies, some birds (of both sexes) appearing paler than others; unknown if polymorphism, related to age or both. Pale and dark birds described separately here; gradation between plumage conditions occurs. **Pale birds**. HEAD AND NECK. Crown, nape and hindneck, dark brown (219); light grey-brown (119C) shafts give faintly streaked appearance. Some feathers on nape and all on hindneck have narrow buff (124) tips, widest on lower hindneck; feathers of lower hindneck also have buff (124) bands near ends, contributing to slightly barred appearance. Supercilium, buff-white. Ear-coverts, buff; feathers, buff (124) with fine dark-brown (219B) bars. Malar streak, dark brown near bill, merging to paler brown (219B) on sides of neck. Chin and upper throat, off-white with mottled brown central stripe in which feathers buff (124) with brown (121B) bases. Lower throat and foreneck, buff with brown streaks; feathers have buff (124) outer webs with brown (121B) freckling; inner webs, light brown (39) to rufous-brown (36) with darker-brown (121B) mottling. UPPERPARTS. Mantle, upper back and scapulars, dark brown strongly streaked buff; feathers, dark brown (219) with broad buff (124) edges and slight buff (124) freckling elsewhere; buff markings smallest in centre of mantle and back. Lower back, rump and upper tail-coverts, buffish mottled brown, usually concealed by scapulars; feathers are open pennaceous, buffish (124–123D) with irregular dark-brown (119A) barring and subterminal fringes. TAIL, mostly dark brown (119A); feathers have broad area of buff (124) freckling at fringes, heaviest on outer rectrices. UPPERWING. Primaries and secondaries, dark brown (119A–219) irregularly freckled or barred buff (124) to light brown (223D); buff markings often absent on outer webs of primaries. Differences in size and shape of buff markings perhaps vary individually. Inner secondaries and outer tertials, dark brown (219) with poorly defined buff (124) bars and buff (124) freckling. Inner tertials as scapulars. Primary coverts and alula, dark brown (119A); former have narrow off-white tips, and sometimes, narrow buff (124) subterminal band. Secondary, lesser and median coverts, buff (124) with freckled brown (119A) bars restricted to feather centres. Marginal coverts have pale-brown (223C) and dark-brown (219) chevrons. UNDERPARTS. Upper breast buff-white with dark-brown streaks; in centre, which is usually concealed by long foreneck feathers, feathers dark brown (219) with buff-white fringes. Lower breast and sides of upper breast as throat. Flanks, axillaries and under tail-coverts, buff (124), varyingly barred dark brown (119A). Belly and thighs, off-white. UNDERWING. All coverts, buff-white, with freckled brown (c129) bars restricted to centres of feathers; remiges as upperwing. **Dark birds**. Differences from pale birds: HEAD AND NECK. Moustachial stripe, dark brown (119A) merging to brown (119B) on sides of neck. UPPERPARTS. Mantle, back and scapulars, dark brown, sometimes with slight buff (124) freckling at edges of feathers; these areas appear uniform blackish at distance. Lower back, buffish (123A to 124) with dark-brown (219) bars. TAIL, usually entirely dark brown (119A); when present, buff freckling restricted to thin fringes.

NESTLING At hatching, down on upperside rather long and sparse; dark brown (c28). In older chicks, down is long and rather sparse, especially on underparts; buff (124) to yellow-brown (24) above, yellow-brown (123C) below with white chin and throat.

JUVENILE Similar to palest adults, but rump feathers semi-plumulaceous. Buff (124) frecklings and vermiculations on tail tend to be heavier; buff markings extend to centre of outer tail-feathers, and sometimes to centre of central rectrices. Unknown if there are immature plumages in which tail-pattern similar. Outer web of primaries has buff (124) freckling.

ABERRANT PLUMAGES Five skins from NZ and se. Aust. unusually reddish; similar to dark birds, but ear-coverts, cinnamon-buff (c39); pale markings of upperparts and outer wing-coverts, rufous-brown (38). Ground colour of underparts, buff-yellow (53). Dark streaks on throat, brown (121C).

BARE PARTS Based on photos in Pringle (1985), Aust. RD, NZRD and unpublished, labels and recently dead specimens (MV, NMNZ).

ADULT Iris, orange-buff (118–153) to brown (23–119B); yellow also recorded (MV; Mathews 1910–27). Bill, straw-yellow (56–57) to buff (124) with dark-grey (83), dark blue-grey (78) or grey-black (82) culmen. Narrow eye-ring, grey-black (82) to black (89). Facial skin encroaches onto base of bill; in some, light grey (85) or light bluish grey (c88) to grey (87). In others, facial skin, green (63); darker (262) at tomia, with dark olive-brown (129) strip from eye to nostrils, often with horn-white (c92) rictus; in two captive birds (Mt Bruce Sanctuary), facial skin, whitish. Variation in colour of facial skin probably seasonal, but not understood; perhaps changes similar to Eurasian Bittern, in which males develop powder-blue base to bill when breeding (Hancock & Kushlan 1984).

Legs and feet, mostly greenish yellow (56–57) or lime-green (59) to dark olive (49), with buff-yellow tinge inside. Soles, and varying amount of top of legs, whitish; usually only tibia and tibio-tarsal joint whitish, but in two captive birds, whole leg whitish. Claws, greyish brown to dark grey (83).

DOWNY YOUNG At hatching, iris, black-brown (119); bill, light pink (c5) with black (89) tip to culmen. Facial skin, pale bluish grey (c86). Feet and legs, light pink (c5). In older chicks, iris, orange (16); bill, pale grey (86) with black (89) tip to culmen. Facial skin, pale grey (86); feet and legs, pale greyish green (c162D); claws, whitish.

JUVENILE Iris, yellow. Bill, greenish yellow to olive-grey (c43), with dark greyish-brown culmen; younger birds have dirty pink (c4) mandibular rami, gonys and distal tomia. Facial skin, light green (63), greenish yellow (56) behind and below eye, with narrow black-green stripe from eye to nostrils. Soles and hind edge of tarsus, yellow-olive (52); soles have irregular brownish pink (brownish 4) tinge. Rest of feet and legs, dark olive (48); scutes have olive (50) edges.

MOULTS Based on skins (MV, NMNZ).

ADULT POST-BREEDING Probably complete; wing-moult present in skins collected in Mar., Apr. and May. Primaries outwards or irregular.

POST-JUVENILE Few data; tail-feathers, remiges and all greater coverts retained through first winter and probably replaced at time of prebasic adult moult. Heavy body-moult recorded in NZ specimen collected in Sept.

MEASUREMENTS NZ and se. Aust., adults, skins (NMNZ, MV).

	MALES	FEMALES	
WING	359 (11.98; 339–378; 17)	322 (12.95; 309–355; 13)	**
8TH P	238.2 (8.10; 226–255; 20)	217.5 (8.09; 205–233; 14)	**
TAIL	123.6 (6.98; 110–135; 12)	111.6 (6.82; 102–121; 9)	**
BILL	71.1 (2.20; 67.4–74.6; 17)	65.7 (2.21; 63.0–70.9; 14)	**
TARSUS	105.9 (3.23; 100.1–111.7; 16)	97.3 (4.30; 89.2–104.6; 15)	**
TOE	127.1 (4.69; 118.3–134.9; 14)	112.6 (7.50; 100–126.4; 13)	**

WEIGHTS Combined data from se. Aust. and NZ, adults (MV, NMNZ): males: 1353 (307.9; 875–2085; 15); females: 867.7 (220.8; 571–1135; 10); one female, weighing 632 g, was emaciated; no other information on fat condition of adults. Three emaciated juveniles 373, 532, 545.

STRUCTURE Wings, broad. Eleven primaries, p8 usually longest, p10 1-8 shorter, p9 0–9, p7 0–6, p6 13–26, p5 27–35, p4 37–50, p3 51–65, p2 68–86, p1 77–101; p11 minute. Slight emargination on outer web of p8 and p9, p10 pointed. Eleven secondaries and 3–5 tertials; four short humerals. Tail, short, slightly rounded, ten feathers; t1-t5 2–14. Lores, skin round eye, and gape, unfeathered. Hindneck, unfeathered, covered by long feathers at sides of neck. Two pairs of cream-white powder-down present, one on upper breast, one on sides of lower back. Bill, slightly shorter than head, heavy and broad at base. Upper mandible slightly decurved; underside of lower mandible almost straight. Upper three-quarters of tibia, feathered; tarsus, scutellate. Outer toe *c.* 65% of middle, inner toe *c.* 75%, hind toe *c.* 40% (BWP gives *c.* 65% fo· Eurasian and American *B. lentigonosus* Bitterns); small web between base of outer and middle toes. Middle claw pectinate, except in youngest juveniles.

GEOGRAPHICAL VARIATION None (e.g. Keast 1961; Ford 1978). All species of *Botaurus* much alike and allopatric; have been considered one superspecies (Bock 1956). For further discussion, see Payne & Ripley (1976) and McKean (1979).

DIR

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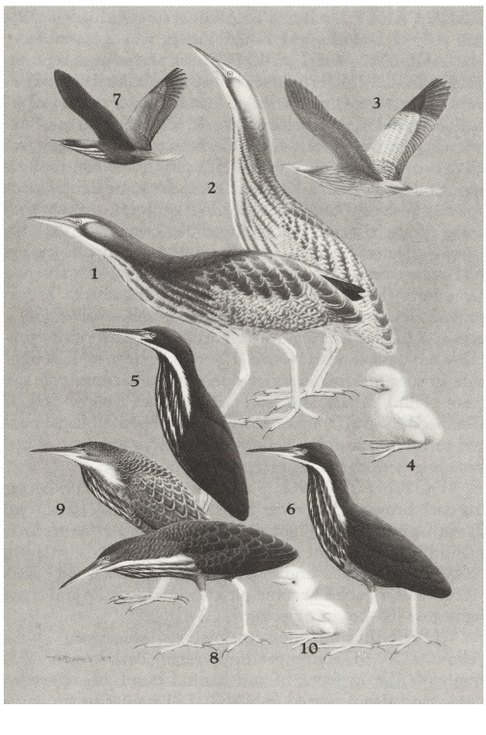

Volume 1 (Part B), Plate 76

Australasian Bittern *Botaurus poiciloptilus*
1. Adult, dark phase
2. Juvenile
3. Adult (flight)
4. Downy young

Black Bittern *Ixobrychus flavicollis*
5. Adult male
6. Adult female
7. Adult female (flight)
8. Juvenile, dark phase
9. Juvenile, tawny phase
10. Downy young