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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 PLATALEIDAE ibises, spoonbills

Medium-sized to large wading and terrestrial birds. About 30 species in about 15 genera, divided into two sub-families: ibises (*Threskiornithinae*) and spoonbills (*Plataleinae*); five species in three genera breeding in our region. Body elongated, neck long. Male larger and with longer bill than female. Wings rather long and broad; 11 primaries; p8 and p9 longest, p11 minute. About 20 secondaries; diastataxic. Fly with strong wing-beats, often soaring; neck and legs extended. Tail short, square or slightly rounded; 12 feathers. Bill long: decurved in ibises, straight with flattened end in spoonbills; nostrils slit-like. Varying extent of bare skin on head and in *Threskiornis* on head and neck. Legs rather long, lower half of tibia bare; toes of medium length, with small webs basally, hind toe or hallux slightly elevated, middle toe pectinate only in *Plegadis*. Carriage of body upright, gait striding. Oil-gland, feathered. Feathers with aftershaft. Down on feather-tracts and apteria; no powder-down patches. Plumage, white, red, red-brown or black; dark colours often glossy. Sexes alike. In some species, notably *Threskiornis* and *Platalea*, breeding plumage differs from non-breeding by occurrence of ornamental feathers. Bare parts, especially of face, coloured black, brown, red or yellow; colour may intensify during pair-formation, such as red patches under wing in *Threskiornis molucca*. Two moults per cycle; pre-breeding moult may involve only small part of plumage. Moult of primaries in staffelmauser (outwards). Young semi-altricial, nidicolous. Two downs: white, grey or black; first sparse, growing from follicles of later contour-feathers and soon overgrown by dense second down, growing from follicles of later down. Juveniles, similar to adults, but often darker with bare areas of head smaller.

Cosmopolitan in tropical, subtropical and temperate areas. Marine intertidal and inland aquatic birds of warm and temperate continental climates, preferring standing or slow-flowing fresh water, marshes, floodlands and tidal flats. Ibises feed also in drier habitats. In our region species nomadic, with wide post-fledging and post-breeding dispersal. Move diurnally; usually roost in trees and bushes over water at night; fly in formation; often soar. Eat many sorts of invertebrates, especially insects and their larvae, molluscs and crustaceans, and small vertebrates, particularly fish, reptiles and amphibians. Feed mostly in shallow wet areas where typically probe in soft mud (ibises) or sweep bill from side to side in water (spoonbills). Some ibises feed much on insects in dry habitats, often probing in cracks in soil, and on insects flushed from pastures by irrigation; scavenge at garbage tips, poultry farms and in public parks. Gregarious when foraging and when roosting at night. Typically colonial breeders, pairs defending only nest-territory. Spoonbills may nest in small groups or singly. Monogamous pair-bond, of seasonal duration so far as known. Pair-formation appears to be as in other Ciconiiformes but not widely studied; displays include similar essential elements such as Twig-grasping and Stick-passing. Voice, mainly harsh, guttural, wheezing or grunting, with some bill-snapping sounds. Vocalization most apparent during pair-formation, nest-building and nest-occupation. Away from colony or roost, generally silent except when flocks alarmed. Nestlings more vocal than adults, with shriller sound. Comfort-behaviour similar to that of other waterbirds; stand in shallow water, often rapidly beating wings; crouch on nest or roost with wings outstretched and bare patches exposed in hot weather. Heat dissipated by gaping and gular fluttering, adults and unfledged young often stand with one wing lowered; eggs and nestlings sheltered by drooping wings of adult.

Annual, seasonal breeders in temperate parts of range, with local variation influenced by rainfall and flooding. Nest in trees or dense vegetation, almost invariably over water; occasionally stumps or small islands in marshes. Colonies of ibises and spoonbills often mixed, occasionally with cormorants. Nests large, interwoven from available vegetation, usually of sticks and rushes. Built largely by female with material brought by male. Eggs oval, white and smooth, except *Plegadis* (deep greenish-blue and slightly rough). Clutch-size 2-5 (1-5). One brood. Replacement clutches after loss. Eggs laid at intervals of 1-2 days. Incubation period 21-29 days. Incubation starts with first egg; hatching asynchronous. Both sexes incubate, changing over at least once in 24 hours. Single median brood patch. Eggshells discarded over side of nest. Young cared for by both sexes; nestlings brooded continuously when small. Fed mainly by partial regurgitation. May leave nest site at 2-3 weeks, often forming crèches but returning to nest to be fed. Nestling period 4-7 weeks, young becoming independent 1-4 weeks later. Age at maturity unknown, but breeding may occur in *Threskiornis* at 18 months-2 years.

Platalea flavipes Yellow-billed Spoonbill

COLOUR PLATE FACING PAGE 1101

Platalea flavipes Gould, 1838, *Syn. Birds Aust*, 4: append. 7 — New South Wales.

Specifically named for the colour of legs and feet (*flavus*, yellow and *pes*, foot).

OTHER ENGLISH NAME Yellow-legged Spoonbill.

MONOTYPIC

FIELD IDENTIFICATION Length 76–92 cm, of which body less than half; weight 1.9 kg. Large white or creamy-white waterbird with long pale-yellow spatulate bill and yellow legs; similar in appearance to Royal Spoonbill *P. regia* though Yellow-billed larger with slightly longer bill. Sexes mostly alike in plumage but male larger and usually separable in field; seasonal plumage, and bare parts colour, changes. Juveniles separable.

DESCRIPTION **ADULT MALE BREEDING.** Plumage entirely white or very pale yellowish-white except for cluster of stiff pale yellow plumes (65–75 mm long) at base of lower foreneck and upperbreast which may be erected during displays. Bare facial skin, pale, extending from forehead to just behind eye then forward to chin. In close views, wispy filamentous grey to black scapulars visible against lower back; possibly darker in males. Some birds at L. Cowal showed bright fleshy-pink on underwing (possibly patagial skin as in Royal Spoonbill) and a few had primaries finely tipped black. Bill, dull pale-yellow with small crescent-shaped red patches at base in front of eyes. Loral and facial skin, pale white-yellow faintly tinged blue; thin black line extends round border of bare facial skin where skin meets feathering. Iris, pale white-yellow to blue. Legs and feet, pale greyish yellow or green-yellow with band of pinkish bare skin at top of tibia. **ADULT FEMALE BREEDING.** Smaller than male with shorter bill and legs; plumage similar to adult breeding male but plumes at base of neck not so long or shaggy, and scapulars usually appeared

paler than in males (Kahl 1988). **ADULT NON-BREEDING, SUB-ADULTS.** Sexes alike other than size. Scapular plumes and plumes at base of neck, less developed or absent. Facial skin, duller; black line round face, thinner or absent; no red patches at base of bill; legs and feet, dull pale-grey. **JUVENILE.** Smaller than adult; plumage like adult non-breeding but with sooty-black distal third or tips of primaries. Bill, shorter with smaller spoon, apricot coloured; eye-colour much darker than in adult and legs dusker.

SIMILAR SPECIES Yellow-billed Spoonbill of any age readily distinguished from **Royal Spoonbill** by yellow bill and legs and pale facial skin (all black in Royal) and lack of nuchal crest (obvious in breeding Royal). In flight, care sometimes needed to distinguish bill and leg colour, especially in poor light; absence of nuchal crest in silhouette ought to distinguish species. In flight, separated from herons by head and neck extended in spoonbills, retracted in herons.

Mainly found on fresh or brackish inland waters, including claypans and river pools in arid zone, preferring shallow wetlands. Visit small swamps and dams and pools more often than Royal Spoonbill. Occur singly or in small flocks. Often stand on one leg. Gait, sedate deliberate walk but may make loping runs after prey. Feed in shallow wetlands with soft substrates; wade slowly, sweeping bill slowly from side to side through water with bill slightly open; also move more rapidly, moving bill from side to side quickly, searching for disturbed prey and probing for and grabbing at prey. In flight, similar to

Royal Spoonbill, with neck and legs extended, bill held horizontal or slightly lifted. Travelling flight consists of regular wing-beats broken by short glides. Most breeding in s. Aust. in trees in or overhanging water, often *Eucalyptus*. Often rest and roost on branches of trees overhanging water; also loaf or roost on banks and sandbars of waterbodies. Outside breeding season, birds usually quiet; when breeding, both sexes utter loud coughing-hiss, usually only round nest-site.

HABITAT Terrestrial wetlands, wet grasslands and, rarely, sheltered marine habitats. Structure of bill limits feeding to shallow water <0.4 m deep over substrate of sand, mud or clay; birds forage in open water, or near emergent vegetation or submerged logs that shelter prey (Vestjens 1975). Use smaller areas of water than Royal Spoonbills (Badman 1979). Mainly inland at fresh or brackish wetlands with sparse or low vegetation; prefer shallow swamps with abundant aquatic flora, pools, watercourses, billabongs, farm dams and channels; also on pastures flooded by rain or irrigation, wet meadows, and shallow parts of lakes or deeper swamps, either in open water or among tall emergent vegetation (*Phragmites*, *Scirpus*, *Eleocharis*, *Typha*), lignum (*Muehlenbeckia*) or trees (*Melaleuca*, *Eucalyptus*). Rarely coastal; at estuaries, where feed on intertidal mudflats, or on open saltpans, swamps and meadows vegetated with saltmarsh, or saltfields (Goodrick 1970; Vestjens 1975; Corrick & Norman 1980; Corrick 1981, 1982; Gosper 1981; Lowe 1981; Fjelds  1985; Jaensch *et al.* 1988).

Breed mainly in s. part of range; usually inland at freshwater wetlands (lakes, swamps, watercourses, flooded pasture) vegetated with trees, lignum or reeds, in which nests are built (Bailey 1934; Vestjens 1975; Corrick & Norman 1980; Lowe 1983; Jaensch *et al.* 1988). In Booligal, NSW, nesting generally in swamps with high levels of organic mat-

ter, complex flora and diverse invertebrate population, in early stages of succession after drying and refilling (Crome 1988).

Use all levels of airspace, soaring to high altitude. Roost on live or dead trees or stumps, or on ground on banks and shores; usually near water (K.W. Lowe).

Intolerant of disturbance. Irrigation and construction of farm dams and channels has provided additional feeding habitat, but natural freshwater wetlands used for feeding and nesting have been destroyed or modified by drainage, clearing, grazing, increased salinity, burning and groundwater extraction (Riggert 1966; Goodrick 1970; Corrick & Norman 1980; Corrick 1981, 1982; Jaensch *et al.* 1988).

DISTRIBUTION AND POPULATION Endemic to Aust.; vagrant to NZ and Lord Howe and Norfolk Is.

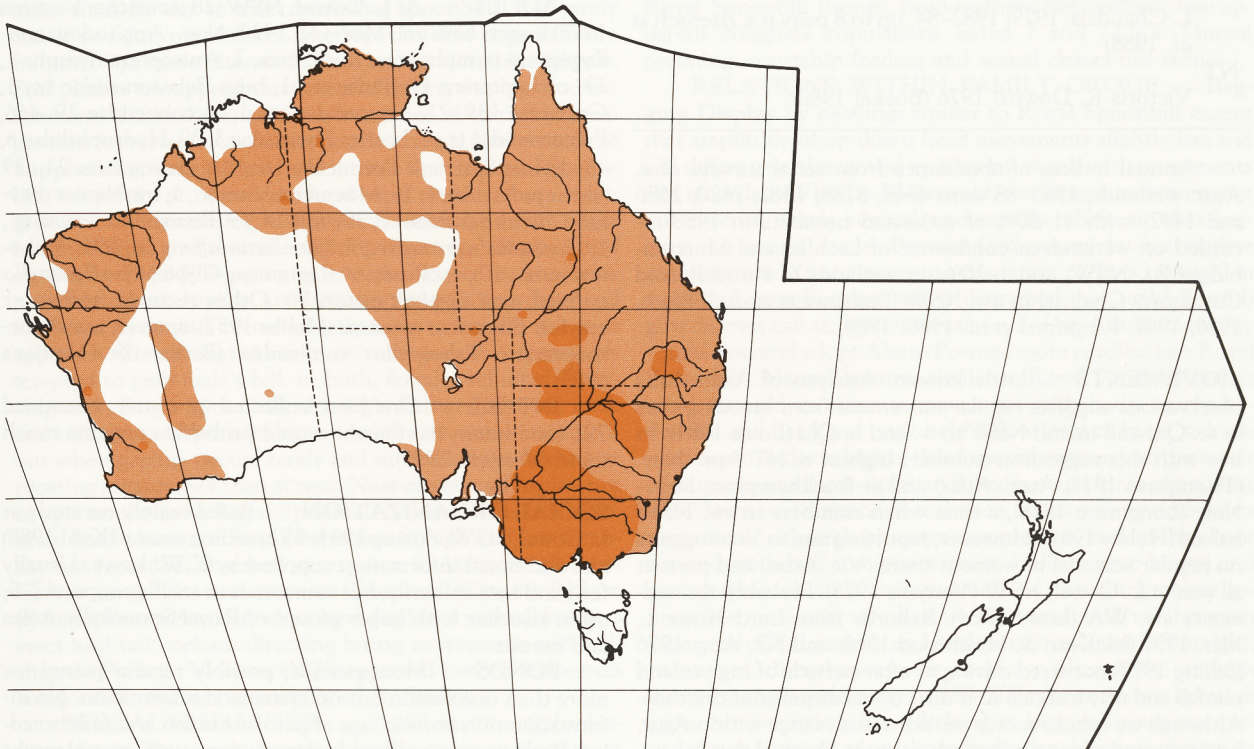
AUST. Mainly E of line from Adelaide to Broome, and in sw. WA. Regularly reported singly or in pairs throughout Qld, NSW, Vic., e. SA, sw. WA and n. and e. NT. Rare visitor to Tas. about 10–12 records of 1–2 birds since 1965 (Wall 1977; *Tas. Bird Reps*). Occasionally reported elsewhere along waterways including desert areas (Gibson 1986).

NZ Vagrant to NI. First recorded Kaitaia, Rangaunu Harbour, Aug. 1976 (Billing 1977); possible earlier sighting nearby, at L. Ngatu, 12 May 1976 (CSN 24). Subsequent records: singles (possibly same bird) in same area, Aug.–Sept. 1977 (CSN 24), 19 Aug. 1978 (CSN 25), 20 Oct. 1978 (CSN 26), Aug. 1979 (CSN 28); single, Te Whiti, 22, 24 Dec. 1981 (CSN 31).

LORD HOWE I. Vagrant, Mar. 1957 (McKean & Hindwood 1965).

NORFOLK I. Vagrant: single, late 1960s (Hermes *et al.* 1985).

BREEDING Stronghold evidently in s. NSW and



Vic. but perhaps breed sparsely throughout range. Recent records, all from Aust. Atlas and Aust. NRS unless otherwise referenced. Number of nests given unless otherwise stated:

Qld

Birdsville: 1974, 2
Cloncurry: 1967, 1
Goondiwindi: 1976, 1
Muncoo Waterhole: 1974, 2

NSW

Barham: 1973, 7
L. Cowal 1984, 28
Paroo R: 1973, c. 50 pairs (NSW Bird Rep. 1973)
Tongo L.: 1982, a few pairs (NSW Bird Rep. 1982)
Walla Walla: 1983, 1
Willandra NP: 1973, 3

Vic.

Clunes: 1968, 6
Dingee: 1973, 13
Kaladbro: 1981, 5
L. Lalbert: 1981, 17
Lawrence: 1987, 4
L. Mundi: 1981, 10
Mystic Park: 1981; 1982, 29; 1983, 47; 1984; 1987, 9

SA

L. Alexandrina: 1970, large numbers (Glover 1971)
Langhorne Ck: 1967, several pairs (Glover 1968)
Loxton: 1983, 1
Naracoorte: 1971, a few pairs (Attwill 1972)
Pellaring Flat, Mannum: 1976, 6 (Reid 1980)

WA

Toolibin L.: 4 pairs (Jaensch *et al.* (1988)
Pinjarrega L.: 1981 (Jaensch *et al.* 1988)
Breberle L.: 1984, 2
Carnegie: 1973
L. Chandala: 1979; 1982–84, up to 8 pairs p.a. (Jaensch *et al.* 1988)

NT

Victoria R. Downs: 1976 (Boekel 1980)

Annual indices of abundance from aerial surveys of e. Aust. wetlands, 1983–88 were 4849; 8785; 1482; 7320; 2386 and 1492; with 41–80% of estimated numbers in 1988 recorded on wetlands at confluence of Lachlan and Murrumbidgee Rs, NSW, and 1–20% on wetlands of Paroo R. and Cuttaburra Channel in nw. NSW (Braithwaite *et al.* 1985a,b, 1986, 1987; Kingsford *et al.* 1988, 1989).

MOVEMENTS Little known. Analysis of Aust. Atlas observations suggests regular movement from breeding sites in se. Qld and inland NSW to w. and n. Qld (Lowe 1984). In line with this suggestion numbers highest n. NT Apr.–Nov. (Thompson 1977; Aust. Atlas) and at Rockhampton, Mar.–Nov. (Longmore 1978), a time when numbers in sw. NSW halved (Hobbs 1961). However, reporting rate in Vic. suggests no regular seasonal movement there (Vic. Atlas) and present all year at L. Cowal, NSW (Vestjens 1975). Probably also sedentary sw. WA (Lowe 1984). Records from Lord Howe I., Mar. 1957 (McKean & Hindwood 1965) and NZ, Aug. 1976 (Billing 1977) occurred during or after periods of high inland rainfall and may indicate non-directional dispersal at this time. Although no other records outside Aust., range within Aust. has increased during twentieth century (Aust. Atlas).

BANDING 35S142E 05 P U 1 265 184 ABBBS.

FOOD Mainly aquatic insects, particularly back swimmers, with smaller numbers of freshwater crayfish, freshwater shrimps and fish. **BEHAVIOUR.** All descriptions from Vestjens (1975) unless stated. Five methods of feeding described: **Slow Sweeping.** Bill swung slowly through 120° arc with bill held at about 60° from horizontal and open 2–4 cm at tip; when bill at extremity on one side of body leg on opposite side moved forward, disturbing food items in substrate. **Intensive Search.** Bill moved rapidly from side to side as bird wades slowly, quickly or even runs with aid of wings; usually attempting to relocate food encountered by Slow Sweeping; usually successful. **Dragging.** In very shallow water bill dragged first on one side, then the other; usually unsuccessful in locating food. **Probing.** Bases of waterplants or submerged logs explored with rapid side to side movements. **Grabbing.** Food items grabbed from shallow water, plants or ground with bill tip. Apart from that captured by grabbing, all food located by feel, bill closing only on objects touching inside of bill. Food must therefore be floating or swimming within water column, benthic species or those living on vegetation rarely encountered in stomachs. Captured food transferred to throat by lifting bill rapidly to about 60° above horizontal. Has been observed cracking hard shells of crayfish against some hard object before eating (Hobbs 1957). Feeding intensity and success rate varied with season: Apr.–Aug. mean 32.2 sweeps/min (21–48), 1–3 food items/min (0–6); Sept.–Mar. 26.1 (12–34), 7.1 (8–19; 20 min observation/month, 3–7 birds/observation). Juveniles (five birds, 20 min observations, 0–3 items/min) much less successful than adults (4–17 items/min). Differ from Royal Spoonbill by feeding more slowly with longer narrower bill that has fewer papillae in spoon so catches smaller, slower prey. Most feeding by day but also by bright moonlight (Berney 1907; Lord 1956).

ADULT At L. Cowal, NSW (28 stomachs; Vestjens 1975) insects 65% vol. May–Oct., 42% Nov.–Apr. (odonatans: Zygoptera nymphs trace/bird, max. 2, Anisoptera nymphs 1, 13; orthopterans Gryllidae tr., 1; bugs Belastomatidae tr., 1, Corixidae 139, 21, Naucoridae tr., 1, Notonectidae 29, 466, Pentatomidae tr., 1; beetles Dytiscidae 3, 30, Hydrophilidae 6, 48; hymenopterans Formicidae tr., 1), crustaceans 21, 39 (shrimps Atyidae 1, 16, *Macrobrachium* tr., 1, freshwater crayfish *Cherax destructor* 7, 39), fish 14, 19 (*Retropinna semoni* tr., 1, *Carassius auratus* tr., 3, *Gambusia affinis* 26, 294, *Philyponodon* tr., 10), molluscs tr. (*Lymnaea*, *Glyptophysa/Isidorella* tr./bird, max. 2), plant material tr. **Other records:** freshwater crayfish *Euastacus armatus* (Hobbs 1957), spiders, insects orthopterans *Teleogryllus commodus* (Barker & Vestjens 1989).

INTAKE One bird, collected in winter, contained 792 food items; in summer would probably consume much more (Vestjens 1975).

SOCIAL ORGANIZATION Based mainly on study at L. Cowal, NSW, during 1984–85 breeding season (Kahl 1988) and additional information supplied by K.W. Lowe. Usually feed and nest solitarily, but sometimes in small groups of 2–5; often associate with larger groups of Royal Spoonbills, ibises and herons.

BONDS Monogamous; possibly remain paired for more than one season but no systematic information. No information on sex-ratio, age at pair-formation and first breeding. Both parents incubate and tend young until several weeks

after fledging.

BREEDING DISPERSION Solitary or semi-colonial; often two or three nests within 30–50 m of each other; frequently single nests within 50–75 m of other pairs. Sometimes nest in association with other waterbirds such as ibises, cormorants and herons. Nesting territory probably only few metres round nest. Territories established at beginning of breeding season. Range widely to feed, although often foraging within 500 m of nest. Non-territorial at feeding grounds.

ROOSTING Outside breeding season unknown, probably in trees. During breeding season, off-duty parent often roosts in tree near nest; typical site in River Red Gum in or over water. Roost any time when not feeding; often feed at night. Rest and loaf in tree near nest. Roosting posture similar to Royal Spoonbill; on one occasion nestling seen to sit with feet grasping onto horizontal branch and body at 90° to branch.

SOCIAL BEHAVIOUR Reasonably well known from detailed studies of behaviour at L. Cowal, NSW (Kahl 1988), on which account based. Little known of pair-formation because studies began when birds appeared already paired. **Flight Intention Display** like Royal Spoonbill; call with growling grunt similar to that given in Alarm Posture (see below); width of gaping and frequency of calling not recorded. Little difference between Royal Spoonbill in **Autopreening**, **Scratching**, **Shaking**, **Stretching** and **Yawning**. When **Autopreening**, appear to preen all round neck-ruff but rarely stiff spiky feathers of ruff itself. When **Scratching**, do not erect head feathers; when **Shaking**, nearly at end of shake, erect feathers of head and neck and sometimes give head-neck shake alone rather than with wing-shake; when **Yawning**, do not erect head feathers; rate of yawning not recorded.

AGONISTIC BEHAVIOUR Generally peaceful at nest; often fly out to meet intruding spoonbills, but rarely attack or fight; presence of interloper at nest triggers more frequent and more intense displays between established pair. Stiff plumes on upper breast erected during displays and excitement. Establishment and maintenance of territory, competition for mates, role of sexes poorly known. Few records of **Supplanting**; less ritualized and intense than in Royal Spoonbill; simply fly at opponent, head- and neck-feathers erect; gape bill without raising it above horizontal; land with some wing-woofing, give several coughing-hisses and displace bird on perch. Brief Bill-gaping at conspecifics in feeding areas probably threat-display. **APPEASEMENT DISPLAY** as described for Royal Spoonbill; recorded only twice in females trying to approach already mated male; on one occasion female attempted to grab male's bill; in both, females rebuffed. **Spar-ing** as in Royal Spoonbill, although feathers of head, neck and ruff erect and pink lining inside bill and mouth conspicuous when gaping; occurs rarely and more likely at feeding or roosting areas rather than at nest. **Nest-covering Display** not so spectacular as in Royal Spoonbill because birds lack elaborate head plumes of Royal; variations at high and low intensity not recorded; observed in response to Australian Ravens *Corvus coronoides* and once to Diamond (Carpet) Python *Python spilotes* near nest, when bird displayed with all feathers erect and tail cocked, directing biting movements and bill-snaps at Python. Vestjens (1975) reported herons and egrets antagonistic towards spoonbills when feeding.

SEXUAL BEHAVIOUR Pair-formation and selection of nest-site poorly known. Usually arrive at nest-site as

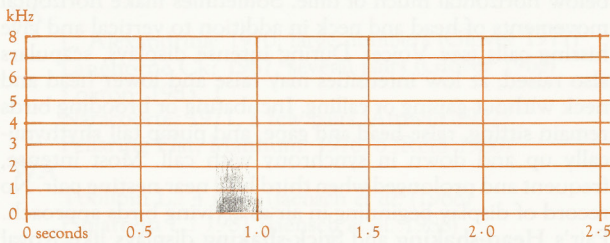
pair, pair-formation presumably having occurred earlier at feeding or roosting areas; Kahl (1988) found 80% (n=20) in loose pairs before nesting, feeding within 10–20 m of each other and flying together; may choose nest-site together. **Display Flight** like Royal Spoonbill but only given by female attempting (unsuccessfully) to approach mated pairs at established nests. Several times, male returned to nest with stick and was followed by one or more birds (not mate). Display series of Display Shake and Display Preen (Front or Rear), similar to that of Royal Spoonbill, although **Display Shake** much more ritualized with wings held nearly half open and shaken vigorously; at high intensity, head- and neck-feathers and scapulars strongly erect. **Display Preen (Front)** slightly less ritualized and less frequent probably because most observed pairs already firmly mated. **Display Preen (Rear)** recorded only once, by female attempting to approach mated pair. In **Display Sleep**, pale reddish spots in front of eyes may function similarly to yellow spot in Royal Spoonbill; no information on occurrence at pair-formation; presence of conspecific near nest seems to stimulate bouts of display in pair. **Head-quiver Display**, as for Royal Spoonbill but more difficult to detect because no large crest to magnify movement. **GREETING**. **Greeting Display** similar to Royal Spoonbill though feathers of head and neck strongly erect, head and bill below horizontal much of time. Sometimes make horizontal movements of head and neck in addition to vertical and give hissing calls (see Voice). During intense displays, scapulars also raised; at low intensities may raise and lower head and neck without gaping or calling. Incubating or brooding birds remain sitting, raise head and gape, and pump tail rhythmically up and down in synchrony with call. Most intense, frequent and prolonged when third bird near nesting pair. No record of display beginning in air as arriving birds approach. Pair's **Head-shaking** and **Stick-shaking** displays like Royal Spoonbill but, in latter, neck ruff erect. **COPULATION** as in Royal Spoonbill though head-feathers not erected; two apparent complete copulations lasted 7 and 12.5 s. Mutual preening, courtship feeding and sexual chases not seen.

RELATIONS WITHIN FAMILY GROUP **Begging Display** by nestlings similar to Royal Spoonbill except that amplitude of up-down head movements slightly less and call differs (see Voice) and synchrony of call with movements not recorded. When c. 30 days old, nestlings sometime point bill upward, nearly vertical, and rapidly nibble air after begging; no sound made. Parents feed young by incomplete regurgitation. Young appear to recognize parents up to 50 m away and start Begging; when distressed (hot, cold, fearful) give distress call at rapid intervals (c. 2–4/s). Adults more shy round nest and adopt Alarm Posture more readily than Royal Spoonbill. **Alarm Posture**: similar to Royal Spoonbill; often bend forward in sinuous movement with body nearly horizontal and head and neck held below level of back, as birds peer down at disturbance; this forward version may be result of more elevated nest-site than Royal because birds often must look down on threat or disturbance; appears as up-and-down movement; although plumage compressed, back of head not flat and neck-ruff sometimes erect. Calls (coarse hisses) and gaping more obvious and ritualized; as disturbing object approaches, intensity of display increases, interval between gapes and calls decreases and birds turn head from left to right, peering at disturbance with each eye alternately; at high intensity, gape widely, up to 150–200 mm at tip but speed of gapes not recorded; wing-flicking at high intensity not recorded nor reaction of nestlings to display. Version of posture

also given by incubating birds, which sit upright with neck stretched vertically up, often with bill raised nearly to horizontal. Adults and nestlings preen each other in same manner as Royal Spoonbill. Chicks defecate over side of, and in, nest. Young often forage with one or both parents for several weeks after fledging.

VOICE No detailed studies; reasonably well known from studies of behaviour at L. Cowl, NSW (Kahl 1988), on which account based. Generally quiet outside breeding season (K. W. Lowe; M.P. Kahl); at other times, heard infrequently, mainly during breeding season and mostly at nest. Calls consist of variations of loud repeated coughing-hiss; generally as greeting or when disturbed at nest. Non-vocal sounds: birds Bill-snap and make loud *woofing* noises with wings. No sexual or individual differences noted. No information on geographical variation.

ADULT No sexual differences reported. **Coughing-hiss.** Loud repeated hoarse or wheezy coughing-hiss. Given in several circumstances, varying slightly in each: (1) When threatened or alarmed (Alarm Call) call of 0.3–1.0 s duration and repeated at 1–15 s intervals; as intensity of display increases, calls given more rapidly until bird takes flight; a shorter version is shown on sonagram A. (2) Sometimes given



A R. Swaby; Blanchetown, SA, Dec. 1966; P35

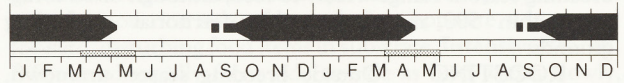
when preparing to fly from nest (Flight-intention Call) though bird may not depart (display and calls then stopping); calls similar to Alarm Call; display and calls may be given for several minutes. (3) Given when Supplanting another bird. (4) At nest as Greeting (Nest-relief) Call: coughing-hisses more explosive, in series of 4–10 calls of 0.3 s duration and at intervals of 2–3/s. Often initiated by bird on nest while mate still several seconds away, but not given to conspecifics other than mate; functions in recognition of mates. **NON-VOCAL SOUNDS:** **Bill-snap.** Several Bill-snaps given during Shaking and Sparring. Single, spaced bill *snaps* heard once during Threat (Nest-covering) Display directed at Diamond (Carpet) Python within 1 m of nest. **Wing-woofing.** Exaggerated wing noise, a repeated low-frequency *woofing* made during Display Flights and when Supplanting; given only by unmated females approaching mated pairs.

YOUNG Small young beg with repeated high-pitched weak *peeping* or *chittering* given in synchrony with up-and-down head movements. Older chicks beg with louder lower-pitched chirping *trill*, each of 1 s duration and composed of 4–5 notes; sounding like coughing-sneeze and similar to adult coughing-hiss. Young gave calls when parents up to 50 m away. **Distress Call.** Rapidly repeated, monosyllabic high-pitched ticking *chit chit chit*; repeated 2–4 times/s.

BREEDING Not well known. Studies at Kerang (two seasons) and Tungamah (one season), Vic., by K.W. Lowe, who supplied information. Breed in simple pairs, solitary or

colonially, with herons, egrets, ibises, other spoonbills.

SEASON Oct.–Apr., Vic. Earlier in NSW: eggs, 8 Sept. (North); Sept.–Apr., L. Cowl (Vestjens 1977); first nests early Oct. and eggs still seen in late Jan. (Kahl 1988). Claimed to be from (July) Aug. to Nov. generally in s. Aust. and Mar.–May in n. Aust. (Beruldsen 1980). Probably varies greatly inland according to flooding, drought.



(L. Cowl)

SITE At L. Cowl singly, mostly in River Red Gums (Kahl 1988). In vertical side-branches, sometimes in crowns of trees over water, 2–8 m high (Kahl 1988); often many nests in one tree (North); at Kerang, Tungamah always in *Eucalyptus* but also *Casuarina* (North) and *Melaleuca* (Serventy & Whittell 1967) recorded. Re-use from year to year suggests site fidelity. No measurements.

NEST, MATERIALS Large shallow platform of loosely woven sticks, twigs with slight (considerable: North) central depression; rarely lined with decayed bark (North). When among reeds, of live and dead stems of rushes, reeds, other vegetation. Material gathered from ground nearby, also taken from old nests. Building practice, measurements not known. Nests often fall to bits during occupation.

EGGS Oval, symmetrical, elongate, sometimes tapering to one end; chalky, coarse-grained, finely-pitted, not glossy; dull chalky white to yellowish white with a few brown blotches at larger end. **MEASUREMENTS:** 71.2 (66.5–78.2; 13) x 45.9 (43.9–48.3) (North); av. 69 x 47 (n=12) (Vestjens 1977).

CLUTCH-SIZE Kerang (two seasons): 3xC/2, 56xC/3, 4xC/4 (av. 3.01); Tungamah (one season): 1xC/2, 10xC/3, 4xC/4 (av. 3.2 ± 0.6); C/3x10 (Vestjens 1977). Number of broods per year, replacement layings: not known.

LAYING No information.

INCUBATION By both sexes, starting before clutch complete because hatching asynchronous. No further information. **INCUBATION PERIOD.** 26–31 days (four determinations).

YOUNG Semi-altricial, nidicolous. Fed by both parents by incomplete regurgitation. No further details of growth, development. Young defecate over edge of, and in, nest. **NESTLING PERIOD.** Perhaps c. 5 weeks but not clearly determined. Fledgelings fed by parents away from nest for several weeks after departure from nest.

SUCCESS Kerang (two seasons): 103 young fledged from 54 of 75 nests started (av. 1.37 chicks reared per pair); Tungamah (one season): 12 young fledged from seven of 16 nests started (av. 0.75 chicks/pair). Losses apparently mostly by starvation but North blames falling from nests, attacks by crows and Whistling Kites *Haliastur sphenurus*.

PLUMAGES

ADULT BREEDING Almost entirely white. **HEAD AND NECK.** Lores, chin, narrow anterior margin of forehead, and interramal space, bare. **UPPERPARTS,** white; rachis white on most feathers; distal halves of rachis, black-brown (119) on some broad subcapulars; barbs on outer web at tip, slightly parted and dark olive-brown (129). **UPPERWING.** Inner webs of tertials, white; outer webs, black-brown (119); barbs detached, long well-spaced and strongly recurved, giving lacy appearance. Distal halves of rachis on remiges, black-brown (119).

P9-p2, tipped dark olive-brown (129). UNDERPARTS, white; long (65-80 mm) lanceolate cream (54) straw-like nuptial plumes extend round base of foreneck and upper breast.

ADULT NON-BREEDING Similar to adult breeding, but lacks nuptial plumes on lower foreneck and upper breast.

NESTLING Protopile sparse, white, with silky tips; sparse but present round lores. Mesoptile short, dense, and cream-white; sparse but present round lores.

JUVENILE Similar to adult non-breeding; differs in: rachis of all scapulars entirely white; distal halves of rachis on remiges, dark olive-brown (129); on p4-p1, dark olive-brown (129) on rachis, ends sub-terminally; tip white; p10-p8 distally edged on outer webs, dark olive-brown (129); slight on inner webs; tertials white with no detached barbs.

IMMATURE Similar to juvenile; differs in: distal halves of rachis on scapulars, black-brown (119); adjacent to this, small varying patches of dark olive-brown (129) on webs; tertials similar. Primaries and secondaries, tipped dark olive-brown (129).

BARE PARTS Based on photos in Frith & Frith (1985), NZRD, Pringle (1985), Aust. RD and Slater (1987).

ADULT BREEDING Iris, cream (92). Naked facial skin, round lores, chin and base of bill, including eye-ring, dull white with faint shade of light blue (168D). At border to feathers, narrow line of black (89) skin; next, on outer margin, narrower light-blue (168D) line. Bill, buff (123D); culmen, buff (53), basally with rufous (40) patch next to facial skin in front of eyes; almost cream-white distally. Between transverse ridges on sides of culmen, colour varies from light brown (39) to dark brown (119A). Legs and feet, cream (54); dark olive-brown between scutes and at joints. Claws, grey-black (82).

ADULT NON-BREEDING Similar to adult breeding, but lacks narrow light-blue (168D) line adjoining facial skin and light blue (168D) shade of facial skin.

NESTLING Birds in mesoptile described: iris, dark brown (219); facial skin, including eye-ring, light grey (85) with pink (7) shade; chin and interramal space, pale pink (7) with pale-grey (86) shade; culmen, dark olive-brown (129), tip light grey-brown (119D); lower mandible similar, but at base light blue-grey (88); legs and feet, light grey (85); front portions with pink (3) shade.

JUVENILE No data.

IMMATURE Iris, dark brown (119A). Facial skin similar to adult non-breeding, but black (89) line, grey-black (82); not lacking as claimed (NZRD). Bill, cream (54); base of culmen, light brown (223C). Legs and feet, light brown (123A). Claws similar to adult.

MOULTS Largely undescribed. Based on skins from se. Aust. (MV).

ADULT POST-BREEDING Presumably complete; primaries presumably moult outwards about Mar.-May; sequence, exact timing and duration unknown.

ADULT PRE-BREEDING Partial, about Aug.-Sept. Involves development of nuptial plumes on neck and breast; probably also involves renewal of body-feathers on underparts.

POST-JUVENILE Presumably complete.

SUBSEQUENT MOULTS Undescribed.

MEASUREMENTS (1) L. Cowal, NSW; techniques unknown; SPOON W = width of spoon (Vestjens 1975). (2)

SE. Aust., adult skins (MV, SAM).

	MALES	FEMALES
WING	(2) 424	
8TH P	(2) 238, 271	238
BILL	(1) 231 (225-238; 5)	205 (186-231; 8)
	(2) 221.3, c. 214.9	
SPOON W	(1) 47 (46-49; 5)	46 (44-49; 8)
TARSUS	(2) 130, 138.1	
TAIL	(2) 152, 134	131
TOE	(2) 90.4, 90.2	87.6

WEIGHTS Label data from skins (MV, SAM), se. Aust.: male: 1928, 1814; female: 1814.

STRUCTURE Wing, long and slightly pointed. Eleven primaries: p9 longest, p10 20-28 mm shorter, p8 0-6, p7 7-10, p6 27-39, p5 57-71, p4 83-89, p3 99-106, p2 119-121, p1 129-135, p11 reduced, concealed by primary coverts. Inner webs of p10-8 and outer p9-8 emarginated. Tail, short, square in adults, slightly forked in juveniles; 12 broad rectrices; t1 longest, t6 c. 6 mm shorter. Bill long, flat and spoon-shaped: maximum 17 mm wide at middle, 47-48 at widest portion of rounded tip; tip of upper mandible very flat, outer margin slightly decurved, more so at tip. Dorsal surface of basal and central portions of culmen, and basal sides of lower mandible, corrugated in adult, smooth in juveniles. Narrow elliptical nostrils basally in groove of culmen (see plate in Vestjens [1975]). Lower half of tibia, bare. Outer toe c. 83% of middle, inner c. 72%, hind c. 48%. Outer, middle and inner toes basally connected by webs.

RECOGNITION Confusion possible between nestling Royal Spoonbill as birds nest in same trees. Nestling Royal distinguished by having dark-grey (83) eye-ring and lores; light-grey (85) in Yellow-billed.

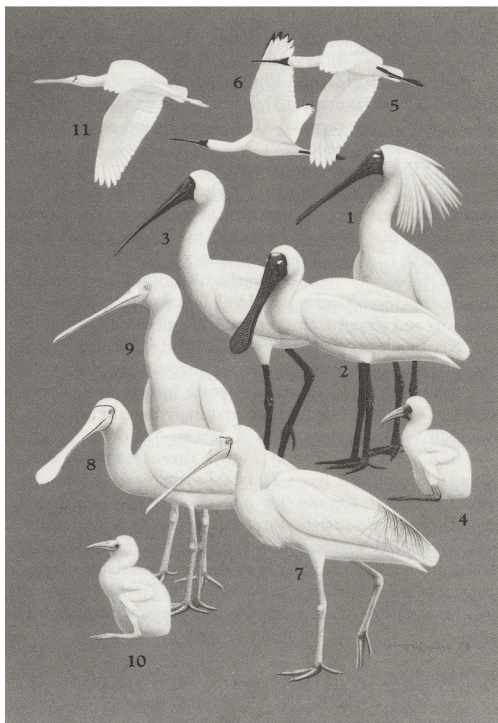
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Volume 1 (Part B), Plate 80

Royal Spoonbill *Plegadis regia*

- 1. Adult breeding
- 2. Adult non-breeding
- 3. Juvenile
- 4. Downy young
- 5. Adult
- 6. Juvenile

Yellow-billed Spoonbill *Plegadis flavipes*

- 7. Adult breeding
- 8. Adult non-breeding
- 9. Juvenile
- 10. Downy young
- 11. Adult breeding

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