

## Order PELECANIFORMES

Medium-sized to very large aquatic birds of marine and inland waters. Worldwide distribution. Six families all breeding in our region. Feed mainly on aquatic animals including fish, arthropods and molluscs. Take-off from water aided by hopping or kicking with both feet together, in synchrony with wing-beat. Totipalmate (four toes connected by three webs). Hind toe rather long and turned inwards. Claws of feet curved and strong to aid in clambering up cliffs and trees. Body-down evenly distributed on both pterylae and apteria. Contour-feathers without after shaft, except slightly developed in Fregatidae. Pair of oil glands rather large and external opening tufted. Upper mandible has complex rhamphotheca of three or four plates. Pair of salt-glands or nasal glands recessed into underside of frontal bone (not upper side as in other saltwater birds) (Schmidt-Nielson 1959; Siegel-Causey 1990). Salt-glands drain via ducts under rhamphotheca at tip of upper mandible. Moist throat-lining used for evaporative cooling aided by rapid gular-flutter of hyoid bones. Tongue rudimentary, but somewhat larger in Phaethontidae. Throat, oesophagus and stomach united in a distensible gullet. Undigested food remains are regurgitated. Only fluids pass pyloric sphincter.

Sexually dimorphic plumage only in Anhingidae and Fregatidae. Selection of nest-site and initiation of pair-formation by male, but in Pelecanidae female first leads several males in a male-selection (or persistence) chase as in ducks. Nest built by female with material brought to nest-site mainly by male. Copulation normally on nest-site. Both sexes take turns guarding nest-site, incubating eggs, and brooding and feeding chicks. Eggs unicoloured with chalky finish except for Phaethontidae. Webbed feet used to warm eggs. Chicks hatch naked (except in Phaethontidae) and blind. Later fully covered with down for several weeks. Newly hatched chicks take fluid food from tip of parental bill. Older chicks take partly digested food from parental gullet, except in Phaethontidae, in which parent inserts bill into gullet of chick. Chicks become independent usually within a few weeks after fledging and at fledging in gannets *Sula* spp. At nesting colonies severe loss of eggs and chicks may result from human disturbance, parents being forced off nests, so that eggs and chicks become cold or overheat or are taken by predators.

Anatomical and behavioural similarities suggest close phylogenetic affinities between Pelecaniformes and Ciconiiformes, which could perhaps be united. Cottam (1957) found skeletal characters that suggest that the Shoe-billed Stork *Balaeniceps rex*, only member of the African family Balaenicipitidae, ought to be in Pelecaniformes rather than Ciconiiformes. Linnaeus (1758) included all pelecaniform birds known to him, except those in *Phaethon*, in the genus *Pelecanus*, from which Brisson (1760) removed the genera *Sula*, *Anhinga*, *Phalacrocorax* and *Fregata*. Subsequently these genera became the bases of six families in the order Pelecaniformes, formerly known as the Steganopodes. Over the last 200 years there has been debate about whether *Phaethon* and even *Fregata* ought to be included, and whether *Anhinga* ought to be in the same family as *Phalacrocorax*. There is ample behavioural (van Tets 1965), osteological and palaeontological (Olson 1985) evidence to demonstrate that there are six distinct extant families in the Pelecaniformes.

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## Family PHALACROCORACIDAE cormorants and shags

Medium-sized to large aquatic birds of marine and freshwater habitats. Worldwide, 30–40 species, depending on recognition of forms as full species or subspecies. Many isolated insular forms are sensibly regarded as full species. Here we recognize 19 species occurring in our region; after Peters, placed in a single genus *Phalacrocorax*. However, latest arrangements (Siegel-Causey 1988; G.F. van Tets) are more elaborate and divide the family into two sub-families: Phalacrocoracinae (cormorants) with two genera (*Phalacrocorax* or macrocormorants and *Microcarbo* or microcormorants) and Leucocarbininae (shags) with three genera (*Stictocarbo* or cliff-shags, *Nannopterum* or island-shags and *Leucocarbo* or trek-shags). The genus *Phalacrocorax* has two sub-genera: *Phalacrocorax* (s.s.) of two species, *carbo* occurring in our region, and *Hypoleucos* of five species, *varius* and *sulcirostris* occurring in our region. *Stictocarbo* has seven species, *punctatus* and *featherstoni* forming a superspecies in our region. *Nannopterum* has 15 or more species, 12 of which belong to our region; their distribution and association in superspecies is most easily shown on Fig. 1. *Leucocarbo* has six species but only *fuscescens* occurs in our region. Long broad head with patterns of tuft-like crests, which are the origin of the term 'shag'; rather long serpentine neck; broad elongate body; wings broad at base, less broad in outer part, with 11 primaries (p8 and 9 longest) and 17–23 secondaries, diastataxic; stiff wedge-shaped tail, short in shags and long in cormorants, 12–14 feathers. Bill, sub-conical, strong, medium-long, hooked, laterally compressed, without serration; nostrils closed. Gular skin, bare, varying in extent and colour in different species. Tarsus, thick; long toes with outermost longest, totalpalmate; middle toe, pectinate. Tibia, feathered. Oil-gland, feathered. Plumage, black, often with metallic sheen, or black above and white below. Sexes similar with some seasonal changes, mostly affecting crests and facial colours. Juveniles recognizable by colour-patterns of plumage; attain adult plumage when 1–4 years old.

Stance upright; gait waddling, legs being set far back towards tail; cormorants, but not shags, able to perch in trees, on wire and similar thin perches. Swim well, body low in water and even partly submerged, tail flat on water; on surface use feet alternately but under water use both feet together in unison. Plumage is permeable under water and sheds air so that buoyancy is reduced; out of water, plumage repels the water, traps air and increases thermal insulation. Thus, swimming in cold water limited to less than 30 min, otherwise hypothermia sets in. Some species reduce buoyancy further by swallowing pebbles (van Tets 1968, 1976). Indigestible matter regurgitated as pellet about once a day with repetitive *gock-gock-gock...* sound that attracts gulls *Larus* spp for scavenging. In some species, distinctive posture held with wings spread on either side of body during loafing when out of water; thought to be mainly for drying wings but plumage is thoroughly waterproof and oil gland often used when preening. Some hours each day may be spent flying between colonies or roosts and feeding areas. Flight powerful with alternating periods of wing-beats and gliding as in gannets; adopt V-formation in travelling flight. Where colonies far from feeding areas, females leave to feed in mornings, males in afternoon. Much of day spent loafing and so plenty of time for courtship rituals, which take up a major part of activities all year in some species. Feed mostly on fish, caught by surface-diving or pursuit-swimming; sometimes co-operatively and often in dense flocks. Migratory and dispersive; movements probably usually by day. However, island shags seem to be entirely sedentary.

Pair-bond monogamous, maintained mostly or entirely at nest-site. Male selects site and advertises for mate; once accepted, female builds nest with material brought by male. Copulation takes place on nest. Advertising displays by male specially well developed. Movements by both sexes associated with ritualized take-off, landing and locomotion postures and include Pre- and Post-take-off postures, Kink-throating, Circle-flying, Hopping with Pre- and Post-hop postures, and Penguin-walking, which is particularly noticeable in females in search of mate and in males seeking nesting material. Allopreening and entwining of necks occur, probably to maintain pair-bond. Calls are mostly unspecialized; males generally give a variety of croaks, grunts, and groans, whereas females hiss or are relatively silent; calling usually confined to breeding colonies. Bathing in groups may be spectacular and has been misidentified as display (van Tets 1965). Comfort-behaviour consists of gular fluttering to dissipate heat; direct head-scratching; true yawning and jaw-stretching.

Typically breed colonially. Defend small nest-territory. Nests often densely packed and associated with other species such as herons, ibises and spoonbills. Season extended but least so in temperate latitudes. Nests on ground, on cliffs and in trees; used from year to year; built of any available plant material, seaweed and debris to form substantial heap but sometimes nothing more than a scrape in the ground. Tend to continue building during incubation and nestling periods. Eggs, elongate oval, pale blue or green with white chalky coating. Clutch-size, usually 2–4 (1–7 extremes); single-brooded but replacements laid after loss. Incubation by both sexes in approximately equal shares; change-overs at least once or twice a day. Incubation starts with first egg; eggs incubated on feet. Incubation period, 27–31 days. Eggshells removed from nest. Hatching asynchronous. Young

altricial, nidicolous; hatched naked but develop a single coat of dense white, brown or black down. Cared for by both parents; brooded continuously while small; fed by incomplete regurgitation; in cormorants, but not in shags, adults may bring water to young in hot weather. Nestling period, c. 70 days at most but usually 48–53 days. Young attended and fed by both parents for 2–3 months or more after fledging.

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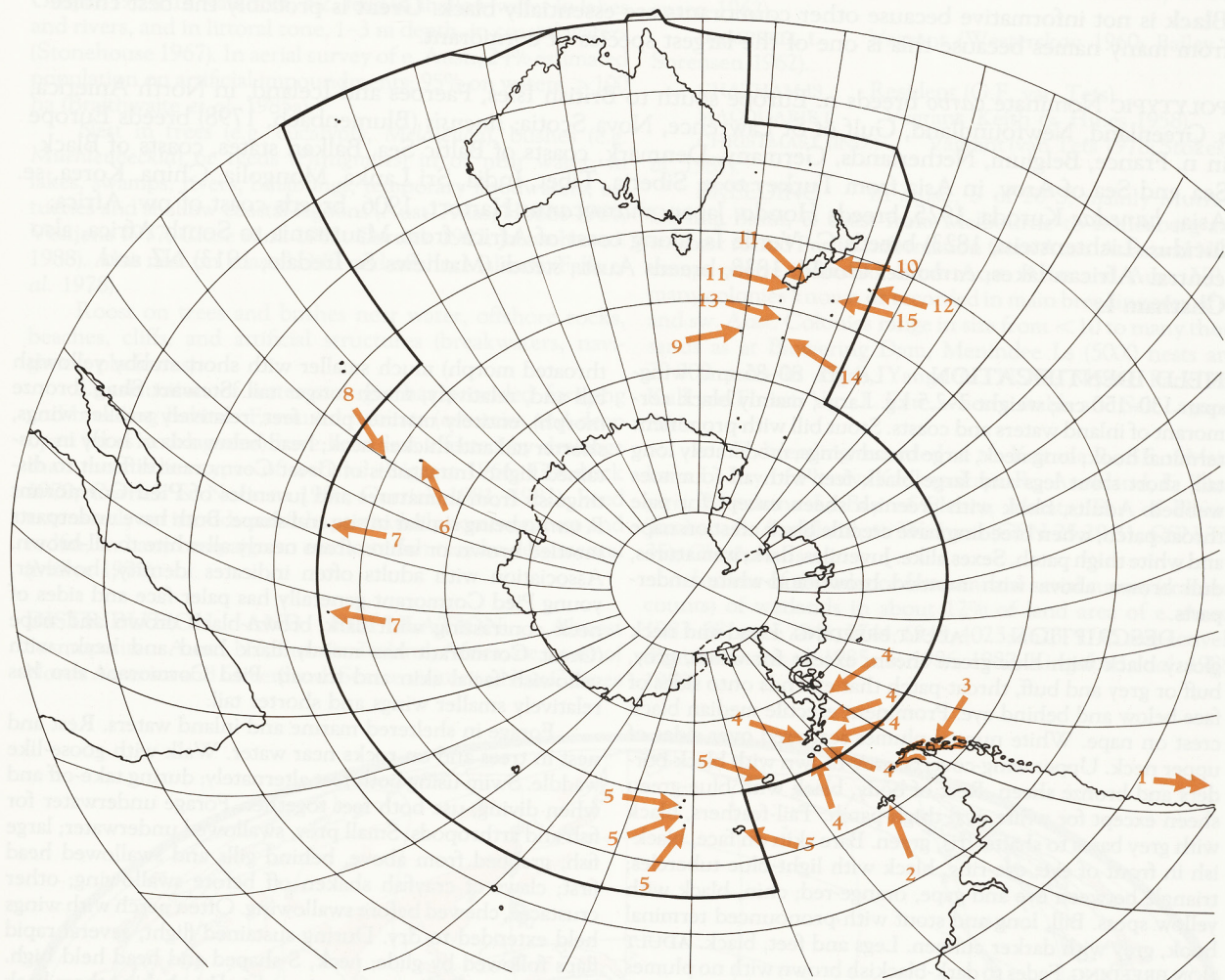


Fig. 1. Distribution of island forms of *Phalacrocorax*.

- |    |                               |    |                  |
|----|-------------------------------|----|------------------|
| 1  | <i>harrisi</i> (Galapagos Is) | 12 | <i>onslowi</i>   |
| 2  | <i>albiventer</i>             | 13 | <i>colensoi</i>  |
| 3  | <i>atriceps</i>               | 14 | <i>campbelli</i> |
| 4  | <i>bransfieldensis</i>        | 15 | <i>ranfurlyi</i> |
| 5  | <i>georgianus</i>             |    |                  |
| 6  | <i>nivalis</i>                |    |                  |
| 7  | <i>melanogenis</i>            |    |                  |
| 8  | <i>verrucosus</i>             |    |                  |
| 9  | <i>purpurascens</i>           |    |                  |
| 10 | <i>carunculatus</i>           |    |                  |
| 11 | <i>chalconotus</i>            |    |                  |

*Phalacrocorax carunculatus* **King Shag**

COLOUR PLATE FACING PAGE 885

*Pelecanus carunculatus* Gmelin, 1789, *Syst. Nat.*, 1: 576; based on 'Carunculated Shag' of Latham, 1785, *Gen. Syn. Birds* 3: 603 — Queen Charlotte Sound, New Zealand.

The Latin *carunculatus* means 'with small bits of flesh', thus 'adorned with fleshy excrescences'.

**OTHER ENGLISH NAMES** Carunculated, Marlborough Sound or Rough-faced Shag, Cook Straits Cormorant.

**MONOTYPIC**

**FIELD IDENTIFICATION** Length 76 cm; 2.5 kg. Large black-and-white shag, typically cormorant-like with long stout bill, prominently hooked; long neck, heavy body, short broad wings and short legs and tail. Sexes alike; seasonal differences in plumage. Immatures separable.

**DESCRIPTION** **ADULT BREEDING.** Head and hind-neck, black with metallic blue sheen. Black starts at sides of chin, making whole head appear dark. Black crest on forehead

(only seen at start of breeding; G.F. van Tets); no crest on nape. Upper wing-coverts, mantle and scapulars, dark purple-brown with green sheen and indistinct black borders. White alar and scapular patches prominent on some birds, poorly developed or absent on others. Pair of white patches on back prominent on some birds. Lower back, rump and upper tail-coverts, black with metallic blue sheen. Tail, black with white bases of shafts. Chin, throat, foreneck and rest of underparts,

white. Underwing, black with white along humeral area. Bill, grey-pink. Prominent pair of orange caruncles above base of bill. Eye-ring, blue; facial skin in front of eye and gular pouch, blue-grey. Mouth-lining, red. Iris, hazel-grey. Legs and feet, grey-pink. **ADULT NON-BREEDING.** Forehead crest, absent. Dorsal plumage and soft parts, dull and faded. Caruncles, dull yellow. **JUVENILE, IMMATURE.** Brown with green sheen above, white below. No alar, scapular or back patch. No caruncles. Upper mandible, brown; lower, white. Facial skin, legs and feet, pale or whitish-flesh coloured.

**SIMILAR SPECIES** Within range, can only be confused with **Pied Cormorant** *P. varius*. Pied has much whiter face and neck, lacks white patches on upperwing and back, and has black legs and feet. Cormorants have larger wings and longer tails; in sustained flight, necks S-shaped and head held high. Cormorants frequently perch in trees and spread wings to dry. King Shag appears to have large head and thick neck in flight, with short wings and tail and does not perch in trees or spread wings to dry. Plumages of **Chatham Shag** *P. onslowi* and pied morph of **Stewart Shag** *P. chalconotus* very similar but they are much smaller and ranges do not overlap.

Forage in sheltered marine inlets and bays. Rest and nest on bare rocks and small rocky islands. Walk with fairly rapid

high-stepping gait, upright body leaning slightly forward. Swim using feet alternately, but during take off and when diving, use both feet at same time. Forage underwater. Flight, bat-like; in sustained flight, head held below axis of body. Fly, feed, rest and nest in small groups.

**HABITAT** Marine. Mean annual sea surface-temperature round breeding islands 12 °C, indicating presence of subantarctic water (Falla 1933). Forage in sheltered inlets and bays (G.F. van Tets). Nest on small islets, rocks and stacks. Occupy pinnacles, plateaux or sloping rock faces (up to 45°); usually nest out of reach of high seas, but also on bare, storm-swept rocks down to 1 m asl. Some sites protected by *Coprosma repens* scrub (Nelson 1971). Birds breeding on bare islands visit nearby vegetated islands to gather nest material; plants brought in for nest-building may lead to establishment of vegetation (Falla 1933). Feed on bottom-living fish (Nelson 1971), but depth of diving not known; depth of water round White Rocks 25–80 m (Falla 1933).

Probably has never been numerous or widespread in historical times, and does not seem to be declining. However, birds very timid when nesting, and studies should not involve landing on breeding islands or handling. Status ought to be watched (Nelson 1971).

**DISTRIBUTION AND POPULATION** Endemic to NZ in Marlborough Sounds, Cook Str. No verified records NI. Most northerly species of pink-footed, blue-eyed subantarctic shag.

Generally restricted to Marlborough Sounds (NZ Atlas; CSN). Few records elsewhere: Farewell Spit (NZ Atlas); three, Oamaru Breakwater, 16 Nov. 1981; 1–5, winter 1978–80 (CSN 30). Once, very doubtfully, L. Horowhenua, Manawatu, NI, 2 July 1966 (CSN 19).

**BREEDING** Only five (or six) known colonies, in Marlborough Sounds; sites of colonies can change over time (Nelson 1971).

**Duffers Reef:** pre-1951, 0; 1951, 40; 1956, 160; 1961, 136; 1962, 94; 1964, 80; 1965, 104; 1967, 40; July 1979, 24; 1983, 52 (Nelson 1971; CSN 28, 31).

**D'Urville Pen.:** 1957, 14; 1958, 14; 1960, 0 (Nelson 1971).

**North Trio I.:** 1948, 50; 1949, 66; 1950, 56; 1951, 30, 1954, 94; 1959, 26; 1960, 58; 1961, 48; 1962, 22; 1964, 12; 1965, 34; 1983, 80 (Nelson 1971; CSN 31).

**Sentinel Rock:** 1951, 8; 1959, 4; 1961, 8; 1962, 16; 1964, 24; 1965, 24; 1966, 36; 1983, 20 (Nelson 1971; CSN 31).

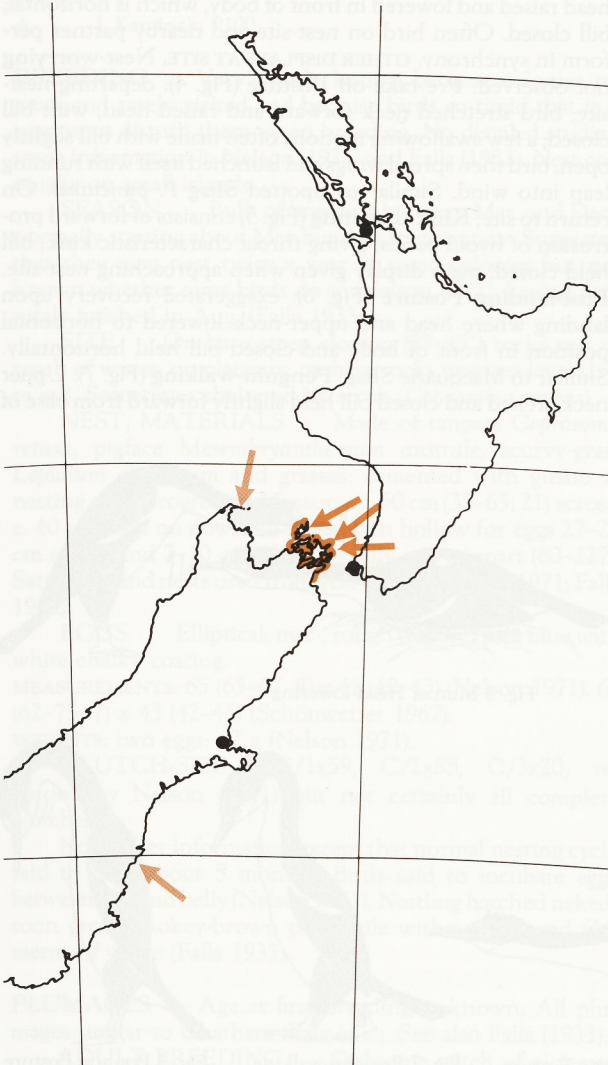
**Te Kuru Kuru I.:** 1960, 12; 1961, 10; 1962, 12; 1964, 20; 1965, 26 (Nelson 1971).

**White Rocks:** 1773, 160; 1891; 80; 1932, 80; 1948, 50; 1950, 80; 1951, 44; 1956, 50; 1961, 58; 1963, 28; 1964, 46 (Hutton 1878; Buller 1891; Falla 1933, unpubl.; Nelson 1971).

**POPULATION** Total population less than 300 birds; estimated 260 birds in 1961, 245 in 1964, 192 in 1965. Population probably always small (Nelson 1971). Early collecting by ornithologists, hunting for fashion trade and, more recently, illegal shooting to protect fisheries have no doubt affected numbers.

**MOVEMENTS** Sedentary, no records away from Cook Str. and Marlborough Sound area.

**FOOD** Apparently benthic fish and crustaceans. BE-



**HAVIOUR.** Food taken by diving. Dives averaged 46.5 s (max. 95 s; 22 dives by 6 birds; Nelson 1971).

**ADULT** Stomachs and remains regurgitated at breeding colonies include fish: *Gonorynchus greyi* (Nelson 1971), *Parapercis colias* (Falla 1932, 1933), *Peltorhamphus novaezeelandiae* (Nelson 1971), red rock-fish (Falla 1932), pilchard, red cod; crustaceans: whale food (Oliver), crayfish, crabs (Falla 1932, 1933).

**SOCIAL ORGANIZATION** Little known; no detailed studies; based mainly on Nelson (1971) and information supplied by G.F. van Tets. Solitary or form small groups for foraging, breeding and roosting; nest in colonies on small islets, rocks and stacks.

**BONDS** Probably sustained monogamous; no systematic information from banded birds. Both parents incubate and tend young until contact is lost some time after fledging. Breeding season said to vary from year to year and from colony to colony; breeding cycle about five months; usually nests once a year but on rare occasions some colonies nest twice; whether same birds involved unknown.

**BREEDING DISPERSION** Nest in small colonies of 2–80 nests; on rocks usually out of reach of high seas. Nests about 1 m apart but varies, possibly depending on density of population, slope of site and pecking distance. Older chicks reported to form groups within colony but this behaviour may be result of human disturbance (Falla 1933). Territorial; defend nest-site only.

**ROOSTING** Solitary or in small roosts on bare rocks. May have separate diurnal and nocturnal roosts, depending on locations of food and shelter. Roosts may develop into breeding colonies in some years. No systematic information on times of arrival at, and departure from, roosts.

**SOCIAL BEHAVIOUR** Little known; no detailed studies; some observations by G.F. van Tets (from distance and too far away to distinguish calls associated with displays). Displays obvious but birds timid; will fly off and sometimes regurgitate when disturbed. Approaching boat can alarm

colony and eggs can be tumbled from nests as birds rush away, or be taken by Silver Gulls *Larus novaehollandiae*. Nelson (1971) advises observation from as far away as possible. Integrated flocks not seen. In both sexes, feathers of neck, below prominent nape-line, raised when bird on or beside nest-site, making black feathers on hindneck look like broad ruff.

**AGONISTIC BEHAVIOUR** Individual distance just out of pecking reach of each other. Defend nest-sites against intruders. **THREAT.** Bird displays open bill and moves head back and forth and sideways with irregular sinusoidal movements. Similar to threat of Great Cormorant but bill open less than 30°.

**SEXUAL BEHAVIOUR** **ADVERTISMENT** by males consists of Gargling; **COURTSHIP** displays, occupying much time during nest building (Falla 1933). **Gargling** (Fig. 1): head swung back through vertical arc until head touches rump; head may bounce on rump a few times before being brought forwards; no rotation of head on rump as seen in some other shags and cormorants; bill may be open or closed during backwards and return movements. Similar to Macquarie Shag *P. purpurascens*, but body horizontal. **RECOGNITION** consists of Gaping and Head-lowering. **Gaping** (see Fig. 2): similar to Macquarie Shag; bill held wide open. **Head-lowering** (Fig. 3): head raised and lowered in front of body, which is horizontal; bill closed. Often bird on nest-site and nearby partner perform in synchrony. **OTHER DISPLAYS AT SITE.** **Nest-worrying** not observed. **Pre-take-off Posture** (Fig. 4): departing nest-site, bird stretched neck forward and raised head, with bill closed; a few swallowing motions often made with bill slightly open; bird then spread wings and launched itself with running leap into wind. Similar to Spotted Shag *P. punctatus*. On return to site, **Kink-throating** (Fig. 5) consists of forward protrusion of hyoid bones, giving throat characteristic kink; bill held closed; main display given when approaching nest-site. **Post-landing Posture** (Fig. 6): exaggerated recovery upon landing where head and upper-neck lowered to horizontal position in front of body and closed bill held horizontally. Similar to Macquarie Shag. **Penguin-walking** (Fig. 7). Upper neck arched and closed bill held slightly forward from base of

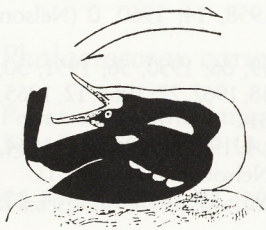


Fig. 1 Gargling

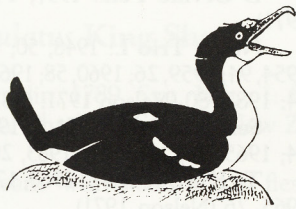


Fig. 2 Gaping

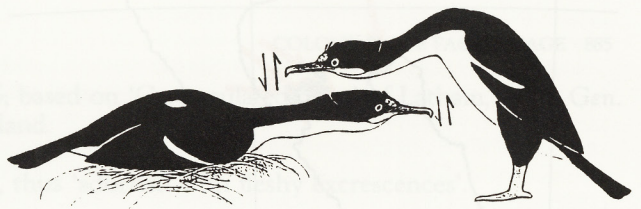


Fig. 3 Mutual Head-lowering



Fig. 4 Pre-take-off Posture



Fig. 5 Kink-throating



Fig. 6 Post-landing Posture



Fig. 7 Penguin-walking

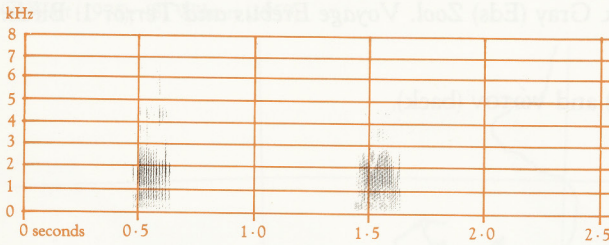


Fig. 8 Pre-hop Posture

neck; performed while walking in vicinity of nest-site. Similar to Crozet *P. melanogenis* and Macquarie Shags, but bill held farther in front of body. Similar **Pre-hop Posture** (Fig. 8) differs from Pre-take-off Posture by arched neck and closed or partly closed bill directed downwards.

**RELATIONS WITHIN FAMILY GROUP** Little known. Eggs brooded between feet and belly (Nelson 1971). Adults on nest reported to lunge at passing adolescents (Falla 1933).

**VOICE** Not described. Only recording available contains sequence of single and repeated *ergh-ergh-ergh*. . .; probably male threat calls (G.F. van Tets). Sonagram A shows two such calls. Chicks call, *tju*.



A J. Kendrick; P100

**BREEDING** Very poorly known because colonies remote and rarely visited and because birds so timid that it is unwise to disturb them when breeding. No detailed studies; some information in Nelson (1971) and Falla (1933). Nest colonial on small islands.

**SEASON** Bulk of breeding between Mar. and Dec., normally starting about May but data fragmentary. Suggested that they may nest twice a year at some colonies but not known whether same birds do so (Nelson 1971). Laying definitely finished in Aug. (Falla 1933).

**SITE** On bare steep sloping (37–45°) rocks out of reach of waves; on plateaux; on bare rocks near sea level (1–2 m asl). Sometimes sheltered by scrub (*Coprosoma repens*).

**NEST, MATERIALS** Made of tanpata *Coprosoma retusa*, pigface *Mesembryanthemum australe*, scurvy-grass *Lepidium oleraceum* and grasses; cemented with guano as nesting cycle progresses. Measures c. 50 cm (35–65; 21) across, c. 40 cm high on downhill sides, with hollow for eggs 27–28 cm across and 7–10 cm deep. Usually c. 1 m apart (60–227). Same sites and nests used from year to year (Nelson 1971; Falla 1933).

**EGGS** Elliptical; mat, rough texture; pale blue with white chalky coating.

**MEASUREMENTS:** 65 (63–67; 8) x 41 (40–43) (Nelson 1971). 68 (62–75; 7) x 43 (42–45) (Schönwetter 1967).

**WEIGHTS:** two eggs: 62 g (Nelson 1971).

**CLUTCH-SIZE** C/1x59, C/2x88, C/3x20, recorded by Nelson (1971) but not certainly all complete clutches.

No further information except that normal nesting cycle said to take about 5 months. Birds said to incubate eggs between feet and belly (Nelson 1971). Nestling hatched naked; soon grow smokey-brown protopile without tips and filaments of white (Falla 1933).

**PLUMAGES** Age at first breeding unknown. All plumages similar to Chatham Shag (*q.v.*). See also Falla (1933).

**ADULT BREEDING** Only one patch of elongate

crest feathers on front of crown; no short black crest on nape *contra* NZRD.

**BARE PARTS** Based on photos in NZRD and at NZDOC library, except where stated. See also Falla (1933).

**ADULT BREEDING** Iris, dark-brown (219A); hazel-grey also recorded (Oliver). Eye-ring, violet (170B). Loral skin, bare in front of malar region; gular pouch, grey-black (82). Bill, dark-brown (119A); culminicorn, black-brown (119); tip, light grey-brown (119C). Caruncles, small and buff (123D); NZRD states caruncles, orange at start of breeding; probably colours lose intensity as breeding progresses. Legs and feet, dull pink (5) with brown-grey (79) joints, webs, and hind tarsus.

**ADULT NON-BREEDING** Similar to adult breeding, but colours not intense; latericorns, light grey-brown (119C); size of caruncles may be reduced slightly, but further study needed.

**DOWNY YOUNG** Oliver states: forehead, face and throat, jet black; bill, brownish black, lower mandible except at tip, bluish white. Gular pouch, bluish white and feet, dark grey. NZRD gives: iris, green-grey; legs and feet, brown. Photos indicate bare skin of forecrown, lores, anterior malar and upper mandible, grey-black (82); lower mandible, pearl-grey (81) with mandibular unguis, brown-grey (80). Gular pouch, pink-buff (121D). Legs and feet, dark grey (83).

**JUVENILE** Few data; NZRD states upper mandible, brown; lower mandible, white. Face, legs and feet, flesh-coloured.

**MOULTS** See Campbell Shag.

**ADULT** Crest attained about Mar.–Apr., if breeding season Mar.–Dec. as stated in Nelson (1971).

**POST-JUVENILE** Occurs at c. 15 months-old (Falla 1933).

**MEASUREMENTS** (1) NZ, skins; methods unknown (AM, NMNZ, AWMM, CM; G.F. van Tets). (2) NZ, adult skins (AM, NMNZ).

	MALES	FEMALES
WING	(1) 312 (10; 306–323; 9)	298 (2; 284–307; 10)
TAIL	(1) 123 (8; 111–132; 9)	116 (7; 109–129; 9)
BILL	(1) 66 (2; 63–68; 9)	64 (3; 62–69; 10)
TARSUS	(1) 74 (2; 72–77; 7)	70 (2; 68–74; 9)
TOE	(2) 103.8 (9.85; 94–113.7; 2)	85.5

Additional measurements in Oliver and Lalas (1983).

**WEIGHTS** Few data. Label data of adult male skin at NMNZ: 2655 g. G.F. van Tets notes label data of female skin 2.5 kg. No data on seasonal changes. Males usually heavier than females (Lalas 1983).

**STRUCTURE** Wing, broad. Eleven primaries: p8 usually longest, p10 3–20 mm shorter, p9 0–10, p7 0–28, p6 9–45, p5 25–62, p4 40–69, p3 51–82, p2 65–87, p1 73–88, p11 minute. Adults have rounded tips to remiges; pointed in juveniles. Tail, long and wedge-shaped; 12 rectrices, t1 longest, t6 20–41 mm shorter. Bill, long and slender maxillary unguis, hooked at tip. Upper mandible extends to gape, where sharply ridged. At base of upper mandible, some fine striae. Caruncles, small and in rounded mass on both sides of base of

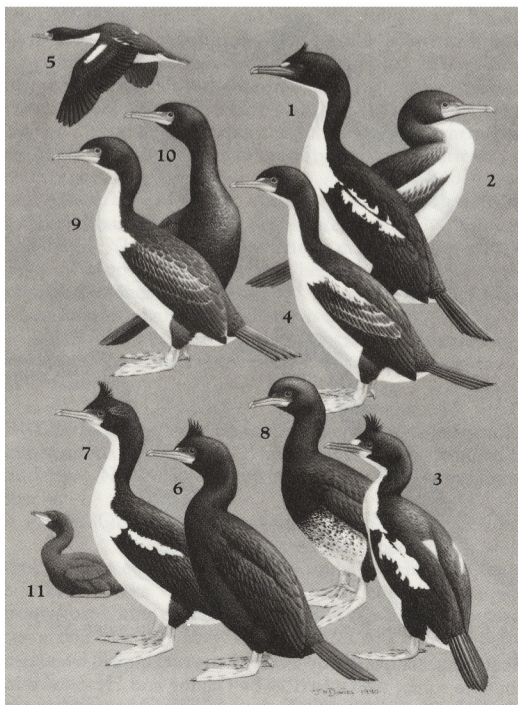
culmen; for comparison of size of caruncles with similar species, see L alas (1983). Bill flaky in juveniles, smoother in adults. Middle claw, serrated. Feet, totipalmate. Tarsus, short and rounded in cross-section. Outer toe longest c. 140% of middle, inner c. 64%, hind c. 40%.

**SEXING, AGEING** Juveniles have flaky bills and pointed remiges; adults have smooth bills and rounded tips to remiges. RMO

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Volume 1 (Part B), Plate 64

King Shag *Phalacrocorax carunculatus*  
 1. Adult breeding  
 2. Juvenile

Chatham Shag *Phalacrocorax onslowi*  
 3. Adult breeding  
 4. Juvenile  
 5. Adult non-breeding, dorsal

Stewart Shag *Phalacrocorax chalconotus*  
 6. Adult breeding, bronze morph  
 7. Adult breeding, pied morph  
 8. Adult non-breeding, intermediate morph  
 9. Juvenile, pied morph  
 10. Juvenile, bronze morph  
 11. Downy young

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