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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 pteryiae 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 *Leucocarbinae* (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 *Hypoleucus* 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, totipalmate; 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-goek-goek...* 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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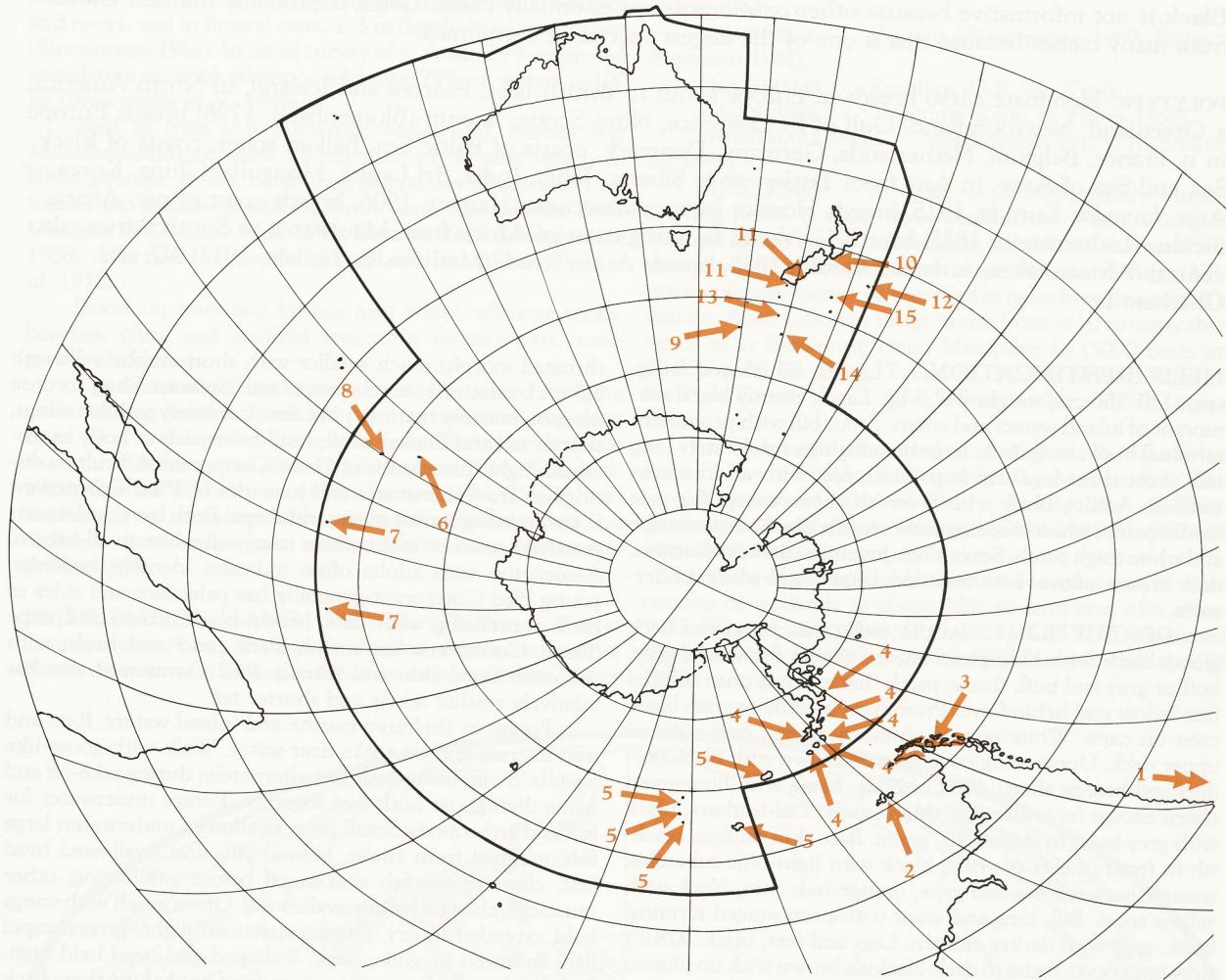


Fig. 1. Distribution of island forms of *Phalacrocorax*.

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>melanogenys</i>		
8	<i>verrucosus</i>		
9	<i>purpurascens</i>		
10	<i>carunculatus</i>		
11	<i>chalconotus</i>		

Graculus chalconotus G.R. Gray, 1845, in Richardson & Gray (Eds) Zool. Voyage Erebus and Terror 1: Birds: 20, Pl. 21 — Otago, South Island, New Zealand.

Specific name compounded of the Greek χαλκός (brass) and νώτον (back).

OTHER ENGLISH NAMES Bronze or Gray's Shag.

MONOTYPIC

FIELD IDENTIFICATION Length 65–70 cm; weight 2.3 kg. Large dimorphic shag of rocky coasts round Stewart I. and se. coast of SI, NZ. Bill, long and stout with prominent terminal hook; long neck, heavy body, short broad wings and short legs and tail. Adults of pied morph, black with blue sheen above, white below. Bronze morph, entirely black with metallic bluish-green sheen. Sexes alike. Immatures duller with no facial papillae. Marked N-S cline in size: on Stewart I., birds small; on Otago Pen., larger with larger facial papillae.

DESCRIPTION **ADULT BREEDING.** **Pied morph.** Head and hindneck, black with blue sheen; black and white border starts at sides of chin, making whole head appear dark. Long black crest on forehead. Long white filoplumes in tufts on sides of crown and scattered elsewhere on head and neck. Upper wing-coverts, mantle and scapulars, dark brown with green sheen and indistinct black borders. White patches on upperwing, scapulars and back, prominent on some birds, poorly developed or absent on others. Lower back, rump, thighs and upper tail-coverts, black with blue sheen and white bases to shafts. Tail, black. Chin, throat, foreneck and rest of underparts, white. Underwing, dark. Bill, pale brown, pink or grey with dark culmen. Red-orange caruncles above base of bill. Eye-ring, iridescent purple-blue; facial skin in front of eye, dark purple-brown; gular pouch, dark purple-brown to shiny light red. Mouth-lining, red. Iris, dark golden-brown. Legs and feet, pink. **Bronze morph.** Plumage entirely dark with blue sheen on body and metallic green sheen on wings; white filoplumes and soft parts, as for pied morph. A few intermediate birds with mixed white and black on underparts. **ADULT NON-BREEDING.** Both morphs similar to breeding adults but crests and filoplumes absent; plumage and bare parts, dull and faded; facial papillae, orange-yellow; eye-ring, blue; mouth-lining, orange. **JUVENILE.** Also dimorphic, similar to non-breeding adults but duller. Upperparts, dark brown glossed with green; a few birds show white patches on upperwing and back, but usually absent. Underparts, white or dark brown; latter birds sometimes with scattered white feathers. Bill, light grey or sandy with dark culmen. No facial

papillae; facial skin, dark brown with some yellow at gape; eye-ring, grey. Iris, pale brown. Legs and feet, flesh-coloured.

SIMILAR SPECIES Within range, pied morph could be confused with Pied Cormorant *P. varius* and the bronze morph with Great Cormorant *P. carbo*. However, Cormorants have black feet, relatively larger wings and longer tails; in sustained flight, their necks are held in S-shape with head high. Cormorants frequently perch in trees and spread their wings to dry. Pied Cormorant has more white on face and neck than pied morph of Stewart Shag, which 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. Differs from King Shag *P. carunculatus* in being dimorphic and smaller. Chatham Shag *P. onslowi* smaller with bright-orange facial skin, prominent caruncles.

Forage in sheltered marine inlets and bays. Rest and nest on bare rocks of headlands and small islands. Walk with fairly rapid high stepping gait, upright body leaning slightly forward. Swim on surface using both feet alternately; during take-off and diving, use both feet together. Flight bat-like; during sustained flight, head held below axis of body. Fly, feed, rest and nest in small groups, often containing both morphs. At nest-site, males utter bark-like calls; females silent.

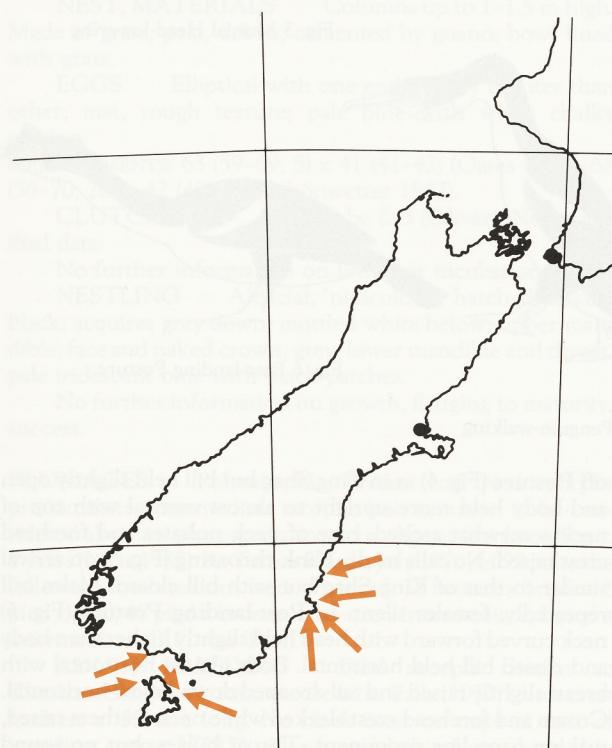
HABITAT Marine. Forage in coastal waters, in sheltered inlets and bays (G.F. van Tets). Nest on rocky headlands and islands. Breeding colony on small granite island with some low vegetation of *Mesembryanthemum* and moss; high terraces (12–15 m asl) occupied by experienced breeders; low, smooth slabs on s. edge by inexperienced breeders; immature birds gather on crags and ledges on nw. side (Guthrie-Smith 1914).

DISTRIBUTION AND POPULATION Endemic to NZ. Ranges round Stewart I. and se. SI from about Oamaru extending S along e. and se. coasts to Te Waewae Bay, W of Invercargill (NZ Atlas).

Table 1.

Codfish I.	1935, 1948, Dec. 1966,	120, -, 128	1,2,5
Goat I. (Moeraki Otago)	1962, 1974	220	7
Green I. (Dunedin)	1968	100-200	7
Gull Rock (Sandfly Bay, Otago Pen.)	1966	120	7
Jacky Lee I.	1955-56	44	7
Kane-te-toe I.	1911, 1932, 1968	800-1000, 300, 30	3,7,8
Kuru-Kuru (Centre I.)	1955	1200	4
Papa-Kaha (Bluff Harbour)	1955	180	4
Tairoa Head (Otago Pen.)	1967, 1973,	400, 620	7
Whero I.	1967, 1974	-, 200-300	6,7
Zero Rock	1968	38	7

References: (1) Blackburn (1968); (2) Dell (1950); (3) Guthrie-Smith (1914); (4) Sansom (1956); (5) Stead (1935); (6) Thoresen (1969); (7) Watt (1975); (8) Wilson (1959).



BREEDING Localities and populations listed in Table 1.

MOVEMENTS Apparently sedentary, no records away from Stewart Is and s. shores of SI.

FOOD Fish, supplemented with marine invertebrates, principally crabs, octopus and polychaete worms. All information from C. Lalas. BEHAVIOUR. All food taken by diving from surface to feed near bottom at depths of 1-30 m; from inshore waters to 10-15 km offshore. Dive using feet kicked in unison, searching at bottom using bill to probe round rocks and prod soft material, especially seaweed, to flush concealed prey. Tend to zig-zag across bottom within a few metres of where they dived, locating food by sight and feel. Dive time (in seconds) determined by function $27.2 + 3.85x$, where x = water depth in metres ($n=3681$ dives; $r=0.84$; $SD_{yx}=9.43$; $8-169$ s; $n=4560$ dives) with time between dives (in seconds) determined by function $-2.3 + 0.49x$, where x = duration of dive in

seconds ($n=4381$ dives; $r=0.64$; $sd_{yx}=9.93$). Diving bouts vary from about 2 h in water 5 m deep to 45 min in water 25 m deep; rest for up to 2 h either drifting at sea, or ashore. Always dive alone and always diurnal, leaving roosts at sunrise, returning between midday and sunset. Diving appears unaffected by sea conditions but unable to fly in tailwinds >20 m/s or headwinds >15 m/s.

ADULT In Otago Harbour (regurgitated pellets: 28 000 prey items; C. Lalas) fish 70% wt., crustaceans 25 stomatopods *Heterosquilla* and *Pterygosquilla* mean 4 g, max. 10 g; crabs *Cancer*, *Nectocarinus* and *Ovalipes* 25, 160, cephalopods 5 (*Robsonella* 4.5% wt., mean 30 g, 2-90 g; *Sepioloidea* 0.5, 15, 0.5-5). Of fish, *Tripterygion* 35% wt., 61% no. (mean length 4 cm, max. 9 cm, mean wt. 1 g) *Arnoglossus tenuis* 23, 31 (4, 24, 1), *Rhombosolea plebeia* and *R. tapirina* 25, 7 (7, 26, 8). In summer, at Otago Harbour, fish consisted of: *Pseudophycis* 2% wt.; at Green I., fish consisted of: 26, *Leptoscopus* 5, 10, *Tripterygion* 47, 4, *Arnoglossus* 0, 6, *Pelotretis* 1, 27, *Peltorhamphus* 17, 18, *Rhombosolea* 22, 4; differences reflect availability. Fish most important in spring (85% weight), least important in winter (45% weight) when crustaceans 40% and cephalopods 15%. Crustaceans least important in autumn (15%); cephalopods least important in summer (1%).

INTAKE Daily intake 330 g (110-760), no. prey items 180 (5-535; 78 pellets; C. Lalas).

SOCIAL ORGANIZATION Not well known; information mainly from Guthrie-Smith (1914) and observations by G.F. van Tets. Solitary or gregarious; congregate when feeding and roosting; nest colonially on rocky headlands and nearby rocky islands.

BONDS Probably sustained monogamous; no systematic information from banded birds. Both parents incubate and tend young until contact lost some time after fledging. Breeding season varies from year to year and between colonies; in Oct., all stages from nest-building to fully fledged young recorded (Guthrie-Smith 1914), eggs and young in Dec. (Wilson 1959).

BREEDING DISPERSION In small to large colonies on rocky outcrops. At one colony, high terraces occupied by experienced breeders; low smooth slabs by inexperienced breeders and immatures gather on crags and ledges; nests more densely packed towards centre of colony; deserted and half-constructed nests on edge of colony (Guthrie-Smith 1914). At Kane-te-Toe, colony of 400-500 nests reported in Oct. (Guthrie-Smith 1914). Nests spaced equally, just outside pecking reach; corridors allow Shags to walk round colony with less risk of attack from sitting birds. Fledglings form



Fig. 1 Gargling



Fig. 2 Gaping

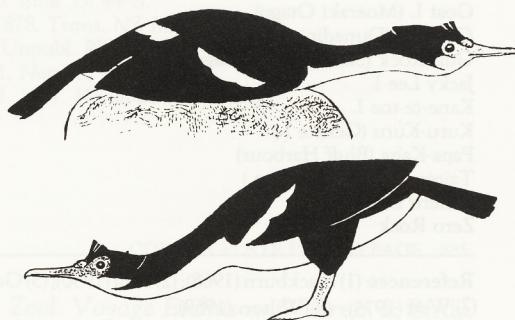


Fig. 3 Mutual Head-lowering



Fig. 4 Pre-take-off Posture

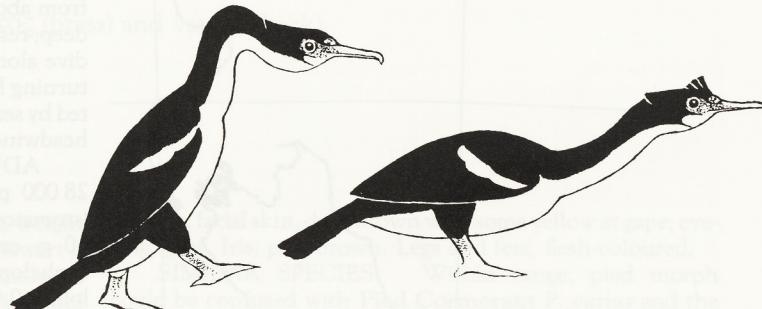


Fig. 5 Kink-throating



Fig. 6 Post-landing Posture

Fig. 7 Penguin-walking



groups away from centre of colony. Territorial; only nest-site defended.

ROOSTING Solitary or small roosts on bare rocks. May have separate diurnal and nocturnal roosts, depending on locations of food and shelter. No systematic information on times of departure and arrival.

SOCIAL BEHAVIOUR Little known; based mainly on information supplied by G.F. van Tets from observations at Tairoa Heads. Displays obvious, but care needed not to disturb displaying birds. Integrated flocks not observed. Nest material often stolen from unguarded nests, even if young present, or from half-built ones. One bird claimed to remove eggs from nest with bill, cast them aside, and move on (Guthrie-Smith 1914).

AGONISTIC BEHAVIOUR Individual distance just out of pecking reach of each other. Threat display as in King Shag. Vocal when defending nest (Guthrie-Smith 1914).

SEXUAL BEHAVIOUR ADVERTISING. Male performs Gargling display. **Gargling** (Fig. 1): as in King Shag but body held upright and bill usually closed; usually silent, but occasionally bill slightly open and bird calls. **RECOGNITION** consists of Gaping and Head-lowering. **Gaping** (Fig. 2): as in King Shag but bill held wide open and angle varies from being pointed forward to upward; head moves slowly back and forth in front of body; breast pressed down, body held horizontal and rump raised with tail about 45° above horizontal. Male calls softly; female silent. **Head-lowering** (Fig. 3): as in King Shag but flash of red as throat bulges when head down. Mutual Head-lowering between birds also occurs. **Pre-take-**

off Posture (Fig. 4) as in King Shag but bill held slightly open and body held more upright to almost vertical with top of neck somewhat arched; base of neck pulsates and forehead crest raised. No calls made. **Kink-throating** (Fig. 5) on arrival similar to that of King Shag but with bill closed. Males call repeatedly, females silent. In **Post-landing Posture** (Fig. 6) neck curved forward with head held slightly higher than body and closed bill held horizontal. Body almost horizontal with breast slightly raised and tail drooped down below horizontal. Crown and forehead crest sleeked while neck-feathers raised, making nape line prominent. Throat bulges, but no sound made. **Penguin-walking** (Fig. 7) similar to King Shag, but bill varies from being horizontal to pointing down. Hop not observed. According to Guthrie-Smith (1914) birds walk away from nest rather than fly, but this depends on terrain (G.F. van Tets).

RELATIONS WITHIN FAMILY GROUP Virtually no information. Feeding adults return late in afternoon; fly to edge of nest and feed young from edge (Guthrie-Smith 1914). One-week-old chicks beg for food with a squeaky call (G.F. van Tets). Older chicks still in nest, attack adults passing too close to nest-site.

VOICE Very poorly known and no detailed studies; limited information supplied by G.F. van Tets from observations at Tairoa Heads. No reports of calling away from breeding colonies; males give a few soft calls and slightly louder barking calls; females are silent. Not known if call outside breeding season. Sexual differences in vocabulary; females apparently do not call. No information on individual differences.

ADULT MALE. **Gargling Call:** sometimes utter a *borr* sound. **Gaping Call:** a soft, repeated *eh-eh-eh...* **Kink-throating Call:** repeated barking *corr-corr-corr...* No further information.

YOUNG Chicks about 1 week old beg with a squeaky *ah-whee-ah*.

BREEDING Very poorly known; no detailed studies; observed by G.F. van Tets at Tairoa Heads, Dunedin and information supplied by him. Colonial nester, not mixing with other species, on rocky coasts and small islands.

SEASON Laying may start at almost any time throughout year, varying annually and from colony to colony, depending on weather and availability of food.

SITE On bare sloping rocks.

NEST, MATERIALS Columns up to 1–1.5 m high. Made of grass, peat, debris, cemented by guano; bowl lined with grass.

EGGS Elliptical with one end slightly blunter than other; mat, rough texture; pale blue with white chalky coating.

MEASUREMENTS: 63 (59–69; 5) x 41 (41–42) (Oates 1902); 66 (56–70; 20) x 42 (40–44) (Schönwetter 1967).

CLUTCH-SIZE Said to be 2–3 (Oliver). No quantified data.

No further information on laying or incubation.

NESTLING Altricial, nidicolous; hatched naked, black; acquires grey down, mottled white below; upper mandible, face and naked crown, grey; lower mandible and throat, pale iridescent blue with black patches.

No further information on growth, fledging to maturity, success.

PLUMAGES Polymorphic; bronze and pied morphs predominate; intermediate morphs (too common to be considered aberrant plumages) also occur. Age at first breeding c. 3 years (Lalas 1983). At Tairoa Heads, July 1976, of 90 pairs the following combinations were observed: 38 bronze x bronze, 2 pied x pied, 48 pied x bronze, 1 bronze x intermediate, 1 pied x intermediate (G.F. van Tets).

ADULT BREEDING **Pied morph.** Similar to Chatham Shag (*q.v.*). **HEAD AND NECK.** Falla (1932) states crest feathers c. 55 mm long. No black crest on nape at start of breeding *contra* NZRD. Above and behind eye, long thin white nuptial plumes lie horizontally. **UPPERPARTS.** Rectangular patch of white feathers in tuft on back c. 35 mm wide; may or may not occur (Falla 1932). **Bronze morph.** **HEAD AND NECK,** glossy black-green (162) with blue-black (90) and dark-olive (49) sheen. Small erectile crest on forecrown; feathers glossy black-green (162) with blue-black (90) sheen and c. 45 mm long (Falla 1932). Above and behind eye, several long, thin, white nuptial plumes lie horizontally. Anterior margin of malar and loral skin, bare. On either side of proximal upper mandible, small rounded mass of caruncles; caruncles vary in extent (see Geographical Variation). Gular pouch, naked. Feathers on throat extend on to basal quarter of gular pouch, in sharp inverted V. Feathers of head and neck have silky texture. **UPPERPARTS.** Feathers of mantle, glossy black-green (162) with blue-black and dark-olive (49) sheen, narrowly fringed black-green (162); fringes appear dark blue (170A) in some lights. Fringes on mantle become progressively broader towards lower and outer margins. Narrow central margin of lower mantle and rest of upperparts, glossy blue-black (90) with dark-olive (49) sheen. No white feathers on back.

Scapulars, fringed black-green (162); subscapulars lack fringes. **TAIL.** Rectrices, black-brown (119) with black-green (162) gloss on webs; rachis grey-black (82). Base of shaft, white. **UPPERWING.** Coverts largely similar to feathers of mantle, except fringes lacking on greater coverts and alula. No alar bar. Primaries, black-brown (119); rachis, grey-black (82). Tertiaries and secondaries similar, but edge of outer webs, glossy black-green (162). **UNDERPARTS,** glossy black-green (162) with blue-black (90) and dark-olive (49) shade. Lateral breast feathers moderately long. Tibio-tarsal feathers similar to outer mantle-feathers. Axillaries, dark-brown (121). **UNDERWING.** Greater primary coverts and greater coverts, glossy brown (119B) with brown-grey (79) shade. Rest of coverts, dark-brown (121), fringed slightly darker; fringes appear glossy black-green (162) in some lights. **Intermediate morphs.** Three types of plumage: (1) most common, similar to bronze morph but has scattered white feathers on abdomen (Falla et al. 1981; Lalas 1983); (2) also similar to bronze morph except underparts more extensively covered with white patches or scattered white feathers from breast to vent; these birds typically lack white patch of feathers on back and alar bar (Lalas 1983); (3) rare, similar to pied morph, but differ in having middle of foreneck scattered with blue-black feathers (almost forming 'neck-band') and elongate elliptical white throat patch, superficially resembling Auckland Shag *L. colensoi* (Lalas 1983).

ADULT NON-BREEDING **Pied morph,** similar to Chatham Shag. **Bronze morph,** similar to adult breeding, during late stage of breeding season; lacks long white nuptial plumes; differs largely in bare parts. **Intermediate morph.** No information.

DOWNTY YOUNG **Pied morph,** similar to Chatham Shag. **Bronze morph,** naked at hatching. Down as in Campbell Shag. **Intermediate morph.** No information.

JUVENILE **Pied morph.** As in Chatham Shag. **Bronze morph.** **HEAD AND NECK.** Feathers of crown, dark brown (119A), tipped black-brown (119) or glossy black-green (162) in some lights. Rest of head and neck, dark brown (119A). Gular pouch, naked. Feathers of throat extend on to basal quarter of gular pouch in inverted V. **UPPERPARTS.** Mantle and scapulars, dull glossy black-green (162) with dark-olive (49) shade, fringed black-green (162); fringes broader towards outer and lower margins of mantle. Subscapulars similar to feathers of mantle and lack fringes and have pointed tips to webs. Scapulars, dull glossy black-green (162) with dark-olive (49) shade, fringed black-green (162). When worn, fringes dark brown (119A), with tips dull white. Back and rump, black-brown (119). Upper tail-coverts, short, dull glossy black-green (162). **TAIL,** black-brown (119); when worn, tips dark brown (119A) to dull white. **UPPERWING.** Marginal coverts and alula, dull glossy black-green (162) with dark-olive (49) shade. Rest of coverts, dark brown (119A) with dull black-green (162) gloss on webs; feathers tipped dull white. Remiges, black-brown (119) with pointed dark-brown (119A) tips to webs; tips, dull white when worn. Humerals, short and black-brown (119). **UNDERPARTS,** black-brown; concealed bases of feathers, dark brown (119A) and sometimes exposed giving slight mottled appearance. Lateral breast and tibio-tarsal feathers similar to outer mantle-feathers. Thighs, black-brown (119) with dull blue-black (90) gloss. Axillaries, dark brown (119A). **UNDERWING.** Greater primary coverts and greater coverts, glossy brown-grey (79) with dark-brown (119A) shade. All other coverts, dark brown (119A). **Intermediate morph.** No information.

BARE PARTS Based on photos in NZRD, NZDOC library, information from C. Lalas except where stated. All morphs.

ADULT BREEDING Iris, dark brown (219A); brown also recorded (Oliver). Eye-ring, violet (170B). Loral skin and bare anterior malar region, grey-black (82). Gular pouch, red (13). Mouth lining, red (NZRD). Bill, dark brown (119A); culminicorn, black-brown (119); tip, light grey-brown (119C); skin at base of lower mandible, red (13). Caruncles, small and buff (123D) to orange (17). Legs and feet, dull pink (5) with brown-grey (79) joints, webs, and hind tarsus. As breeding progresses, particularly after courtship, colours of bare parts lose intensity; unknown to what extent caruncles regress, if at all.

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

NAKED YOUNG Few details; skin black (NZRD).

DOWNTY YOUNG Bare skin of forecrown, lores, anterior malar region and upper mandible, grey-black (82); lower mandible, pearl-grey (81), with grey-black (82) line along middle portion, tipped grey-black (82). Gular pouch, pink-buff (121D). Legs and feet, dark grey (83).

JUVENILE Few data. Iris, yellow-brown (24). Lalas (1983) states: iris, face and gular pouch, brown. NZRD states: iris, pale brown; eye-ring, grey; bill, light grey or sandy, with dark culminicorn; face, dark brown; gape, yellow; legs and feet, flesh-coloured.

MOULTS Poorly known; see moult section for Auckland Shag. In addition, at Otago, adult birds in pre-nuptial plumage June–Sept. (Lalas 1983).

MEASUREMENTS (1) Adult skins from Auckland Museum; methods unknown (Falla 1932). (2) Skins (AWMM, CM, OM, AM; G.F. van Tets). (3) Adult skins (AM, NMNZ).

	MALES	FEMALES
WING	(1) 286.6 (22.11; 260–330; 6) 292.1 (10.98; 277–311; 9) (2) 293 (10; 278–310; 10) 287 (10; 269–314; 22)	
BILL	(1) 56.8 (3.43; 53–63; 6) 57.8 (5.80; 51–69; 9) (2) 54 (3; 49–59; 10) 53 (3; 48–60; 22)	
TARSUS	(1) 59.5 (4.31; 56–68; 6) 58.5 (2.45; 55–64; 9) (2) 66 (2; 62–70; 9) 65 (3; 61–72; 18)	
TAIL	(1) 126.5 (8.61; 116–140; 4) 121.6 (10.25; 109–142; 8) (2) 113 (7; 105–123; 10) 112 (6; 104–122; 21)	
TOE	(3) 89.7 (4.45; 84–96.5; 8) 84.4 (4.46; 76–89.2; 10)	

Additional measurements in Lalas (1983). Pied and bronze morphs of similar size (Lalas 1983).

WEIGHTS Label data from skins at NMNZ: males 2717.0 (622.60; 1797–3875; 6); females 1813.6 (294.11; 1447–2356; 8). At Otago, adults: 2800 (2500–3100; 8), juveniles 2400 (2100–2700; 8) and emaciated birds 1500–2100 (Lalas 1983). No data on seasonal changes.

STRUCTURE Wing, broad. Eleven primaries: p8 usually longest, p10 3–18 mm shorter, p9 0–13, p7 2–30, p6 9–45, p5 25–62, p4 40–69, p3 52–82, p2 63–87, p1 71–88, p11 minute. Tips of remiges, rounded in adults, pointed in juveniles. Tail, long and wedge shaped; 12 rectrices, t1 longest, t6 23–40 mm shorter. Bill, long and slender; maxillary unguis hooked at tip. Upper mandible extends to gape, where sharply ridged. At base of upper mandible, small rounded mass of caruncles. For comparison of size of caruncles with similar species in NZ see Lalas (1983). Bill, flaky in juveniles, smoother in adults. Tarsus, short and rounded in cross-section. Middle claw serrated. Feet, totipalmate. Outer toe longest c. 140% of middle, inner c. 64%, hind c. 42%.

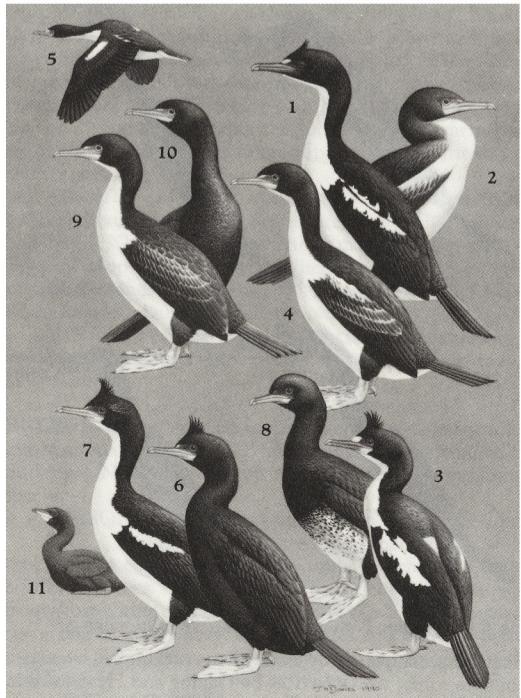
SEXING, AGEING Juveniles have flaky bills and pointed remiges; adults have smooth bills and rounded tips to remiges.

GEOGRAPHICAL VARIATION Regarded as one of three subspecies of *P. carunculatus* by some (Peters; Lalas 1983). Here, treated as full species after Falla (1932). Polymorphic; mating occurs between all morphs non-assortively as suggested by Blackburn (1968). Lalas (1983) found regional variations in populations: birds from Otago were larger than birds from Foveaux Str. and at Otago birds had more carunculation (resembling King Shag) than southernmost birds; birds in Foveaux Str. had carunculation reduced to 'papillae' (see Lalas [1983] for full details).

RMO

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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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