

Order **PODICIPEDIFORMES**

Family **PODICIPEDIDAE grebes**

Small to medium-large, foot-propelled diving birds. Single family in order. Morphology and egg-white protein suggest no close relationship with any other group of waterbirds (Sibley & Ahlquist 1972). Evidence from DNA hybridization (Sibley *et al.* 1988) implies that grebes diverged from a lineage that gave rise to penguins, petrels, pelicans and storks. Formerly considered closely related to Gaviidae (divers) but similarities due to convergence (Stolpe 1935; Storer 1960, 1971). Twenty species in six genera, worldwide; four species in three genera in our region.

Aquatic specialists, mostly in temperate climates. Main centre of adaptive radiation in New World, especially South America. Generally avoid ice, snow and cold waters. During breeding season, inhabit standing fresh water, particularly shallow eutrophic lakes with muddy, clayey or sandy bottoms and emergent, submerged or floating vegetation. Readily colonize newly flooded or excavated areas. Dispersive, capable of long-distance movements, probably normally at night. In winter, tend to form non-breeding flocks on permanent water, including sheltered bays and estuaries.

Body elongated (in larger fish-eating species) or rotund; feet placed far back, and high on sides of body. Neck rather long. Wings small and narrow; remiges curved; when folded, fitting closely to body, concealed by feathers of flanks and back; 12 primaries, p10 usually longest, p12 minute; 15-22 secondaries; usually diastataxic. Some species have never been seen to fly. Tail-tuft short, downy; lacks stiff rectrices. Shape of bill from long and pointed to short and stout; generally larger in males. Nostrils usually narrow slits. Feet large: used in propulsion and steering. Tarsi strongly laterally compressed. Toes broadly lobed, front three connected by small webs at base; hind toe raised, flattened, with small lobe. Nails broad and flat, those of middle toe pectinate. Joints of tibiotarsus and toe extremely flexible, conferring manoeuvrability while swimming. Clumsy on land but can run for short periods, often falling over. Oil-gland feathered.

Plumage dense and waterproof; looser on upperparts, more downy towards rump. Feathers of underparts directed perpendicularly from body and strongly curved towards tip (Chandler 1916), giving breasts distinctive satiny texture. Before diving, feathers pressed against body, decreasing buoyancy; assumed to be the way in which grebes adjust their level of swimming; often swim with only head and neck above water. Adults are generally dark brown above, white below. Most have a colourful or ornate breeding plumage, often with chestnut markings on neck or crests and head-plumes; also yellowish-green patch of swollen skin on gape and base of lower mandible. Chicks covered by short dense down, usually with longitudinal striping on upperparts and complex patterning on head. Strands of down attached to tips of individual barbs of emergent juvenile feathers and wear off gradually, especially on head. Juveniles, otherwise similar to non-breeding adults, can be recognized for some time, even months, on basis of remnant striped pattern on head.

Moult of remiges simultaneous; flightless period of about 3 weeks. Moult of wings usually follows breeding, but pre-breeding moult in some species, or wing-moult may be inserted between first and second broods. Body-moult (Storer & Nuechterlein 1985; Piersma 1988a,b,c, 1989) extremely complex; some tracts, especially flanks, in almost continuous moult, which may provide continuous source of ingestible feathers used in pellet formation.

Feathers usually found in stomachs of adults and young, especially in fish-eating species. Habitually eat own feathers, preferring those from flanks, while preening; given to young from day of hatching. Eating of feathers believed to assist in formation of pellets, reducing chances of gastric parasites building up (Piersma 1989). Breast-pelts ('grebe fur') were once used for making women's muffs, capes and hats, but now grebes are of no direct commercial use.

Usually monogamous, bonds probably lasting for only one season. Elaborate and complex displays when breeding. Territorial and usually well dispersed, but some species truly colonial nesters. Nest is usually a floating mass of sodden water-weed, attached to submerged or emergent vegetation. Both sexes build. Eggs, white, characteristically pointed at both ends; quickly become stained brown. Clutch-size of 2-6 eggs. Laying at intervals of about 48 h. Lost clutches and perhaps broods replaced. Two or three broods may be raised in one season. Both sexes incubate and rarely leave the nest but cover eggs when they do so. Incubation lasts for 3-4 weeks. Young precocial but depend on parents closely for about 3 weeks; when small often carried on backs of parents. Fledging period in some species 6-7 weeks, in others 10-12. Juveniles may help to feed and tend young of subsequent broods.

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Poliiocephalus rufopectus New Zealand Dabchick

COLOUR PLATE FACING PAGE 113

Podiceps (Poliiocephalus) rufopectus Gray, 1843, in Dieffenbach, *Travels NZ*, 2: 198 — North Island, New Zealand.

The specific name is compounded from the Latin *rufus* (red, reddish) and *pectus* (breast).

MONOTYPIC

FIELD IDENTIFICATION Length: 30 cm; weight: males: 271 g, females: 232 g. Small dark grebe; dumpy and short-necked, with body sloping to water at rear. Breeds on small freshwaters, preferably with dense emergent vegetation. Congregates on larger waterbodies after breeding season. Largest of three small species of NZ grebe. Probably extinct in SI, apart from stragglers from NI. Sexes alike, male averages

larger; if pair together, male may be distinguished by larger bill. Juveniles separable. Seasonal plumages occur though changes and timing of changes not understood. Plumage described below as adult non-breeding may be an immature plumage or both immature and non-breeding adult.

DESCRIPTION ADULT BREEDING. Crown and nape, glossy black; sides of head and neck, dark brown; head

and cheeks, tinged grey by fine white filamentous feathers; rest of upperparts, glossy blackish-brown; upperwings, grey-brown with broad white patch on inner primaries and all but tips of secondaries, forming obvious broad white patch in flight; chin and throat, dark brown; foreneck and upper breast, rich dark-chestnut grading to streaks and blotches of brown on lower breast, flanks and rear; abdomen, silvery white streaked brown; underwing, grey brown or whitish. Tail, black, short, narrow and filamentous; white patches on each side of tail, conspicuous when displayed. Bill, black, short and tapering. Iris, yellow and conspicuous. Legs and feet, olive-grey with yellow on inner surface of legs and edges of feet. **ADULT NON-BREEDING.** Nondescript, duller than breeding plumage. Dorsally, dull dark brown including head; face, chin and throat, whitish; foreneck and breast, fawn to pale brown with little or no chestnut; upperwing, as breeding birds. Underparts, silvery white, lacking streaks and blotches of brown on lower breast and abdomen; flanks, pale brown, paler than breeding. Bill varying, dark brown or horn with upper mandible often black. Iris, brown to pale yellow and inconspicuous. **JUVENILE.** Forehead, crown and nape, black; an irregular broad buff-white stripe extends over eye to nape and down side of neck; a second, similar stripe extends from gape, below eye to cheek and down sides of neck in front of and parallel to other stripe; black stripe through eye; rest of upperparts, plain grey-brown; chin and throat, white; foreneck and upper breast, pale buff to pale chestnut; abdomen and flanks, dull white, mottled buff. Bill, horn with dark patches or bars on both mandibles across the middle and near the tip. Iris, cream or pale yellow. Otherwise as adult. Development of plumage with age needs study; juveniles may moult to adult breeding plumage (B.D. Heather; Storer 1987), retaining juvenile striping on sides of head at first.

SIMILAR SPECIES Similar in size to **Hoary-headed Grebe** *Poliiocephalus poliocephalus*, which in breeding and non-breeding plumages is grey dorsally, white below and in breeding plumage has head strongly streaked silvery white, making eye inconspicuous, and lacks dark-chestnut foreneck and chest; in non-breeding plumage, Hoary-headed very pale grey and white with conspicuous black stripe from crown down hindneck. **Australasian Grebe** *Tachybaptus novaehollandiae* noticeably smaller with high-sterned appearance and furtive behaviour; in breeding plumage, Australasian Grebe distinguished by dark-brown dorsal coloration (not glossy black), by pale foreneck and chest (not chestnut), by chestnut stripe down sides of neck and by distinctive yellow spot between base of bill and eye; in non-breeding, whitish spot at base of gape, white chin and foreneck and smaller size ought to distinguish it. Unlikely to be confused with other waterfowl.

General behaviour similar to that of other small grebes; feed by diving, sliding smoothly beneath the surface. When alarmed, birds move away from threat by swimming, diving or sometimes by flying; fly low above surface with rapidly beating wings striking the water, feet trailing and neck outstretched, giving somewhat hunch-backed silhouette. Fly between wetlands at night; rapidly colonize new habitat such as hydroelectric dams and farm ponds. When alarmed may hold neck erect, jerking head backwards and forwards, and raise tail, exposing white patches on either side to observer. Silent, except during breeding, when quiet calls sometimes heard between a pair. When breeding, strongly territorial, in pairs or family groups; when not breeding, many congregate on larger lakes or sewage ponds though some pairs remain in breeding

territory. Age-structure of autumn-winter flocks not clear.

HABITAT Freshwater lakes and lagoons, favouring small waterbodies to 2 m deep with areas of dense emergent vegetation; commonly on sand-dune lakes and lagoons (Northland and s. NI) and larger inland lakes with shallow sheltered inlets (Volcanic Plateau); also on shallow farm dams and ponds with dense emergent or fringing vegetation (Oliver). Avoid estuarine and coastal waters, even if sheltered (B.D. Heather). Altitude unimportant; highest suitable lakes occupied e.g. Rotorua lakes (280 m), L. Taupo (357 m), L. Rotoaira (560 m), L. Rotopounamu (760 m). On larger Volcanic Plateau lakes (Taupo, Tarawera, Rotoiti) confined to sheltered w. or sw. shores and to shallow sheltered ends of arms; exposure to wave wash may limit distribution (J.G. Innes).

After breeding, flocks form on certain large, open waters, mainly wide, shallow lakes and sewage ponds in s. NI (Stidolph & Heather 1978) and lakes with geothermal input on Volcanic Plateau (J.G. Innes). In s. NI, large and small sewage ponds used in winter. In 1972, in Wairarapa district, birds used sewage ponds in summer when ponds under construction had sufficient emergent vegetation to provide cover for breeding; influx in summer during dry period, when other wetlands dry; few birds used sewage ponds in very wet winter (Stidolph & Heather 1978) but this pattern not repeated in later years after construction completed (B.D. Heather). If more than one pond, birds concentrate on pond furthest from intake (B.D. Heather). Thought to favour sewage ponds because depth of water remains constant (Stidolph & Heather 1978) but may be because water temperature slightly higher than elsewhere (B.D. Heather). In s. NI, farm dams and ponds little used in winter. In Manawatu, some dune lakes are used year-round; others support large or small flocks only in autumn-winter; but at Pukepuke Lagoon, birds absent Feb. to Apr.-May, probably because water level falls (Stidolph & Heather 1978). Winter flocks on Volcanic Plateau lakes concentrate in bays with geothermal input, which may increase food supply (J.G. Innes).

Breed in sheltered parts of open lakes or on smaller dams and ponds, preferably with dense emergent vegetation, especially *Typha orientalis*, *Elaeocharis sphacelata*, *E. acuta* and *Scirpus lacustris* and often willows (Sibson 1963; Lusk & Lusk 1981; Ogden & Caithness 1982; B.D. Heather). On L. Rotoiti, distribution determined by need for shallow water for feeding and shoreline cover for nests, especially protection from waves; highest numbers along indented rocky coastline with willows and emergents to protect against waves and give cover; few birds along steep or open shores (Lusk & Lusk 1981).

Feed in open water from well offshore to shallow waters close inshore; mainly underwater (B.D. Heather), also from surface (Storer 1971). Depth and length of diving not measured; appears positively correlated with depth of water (B.D. Heather).

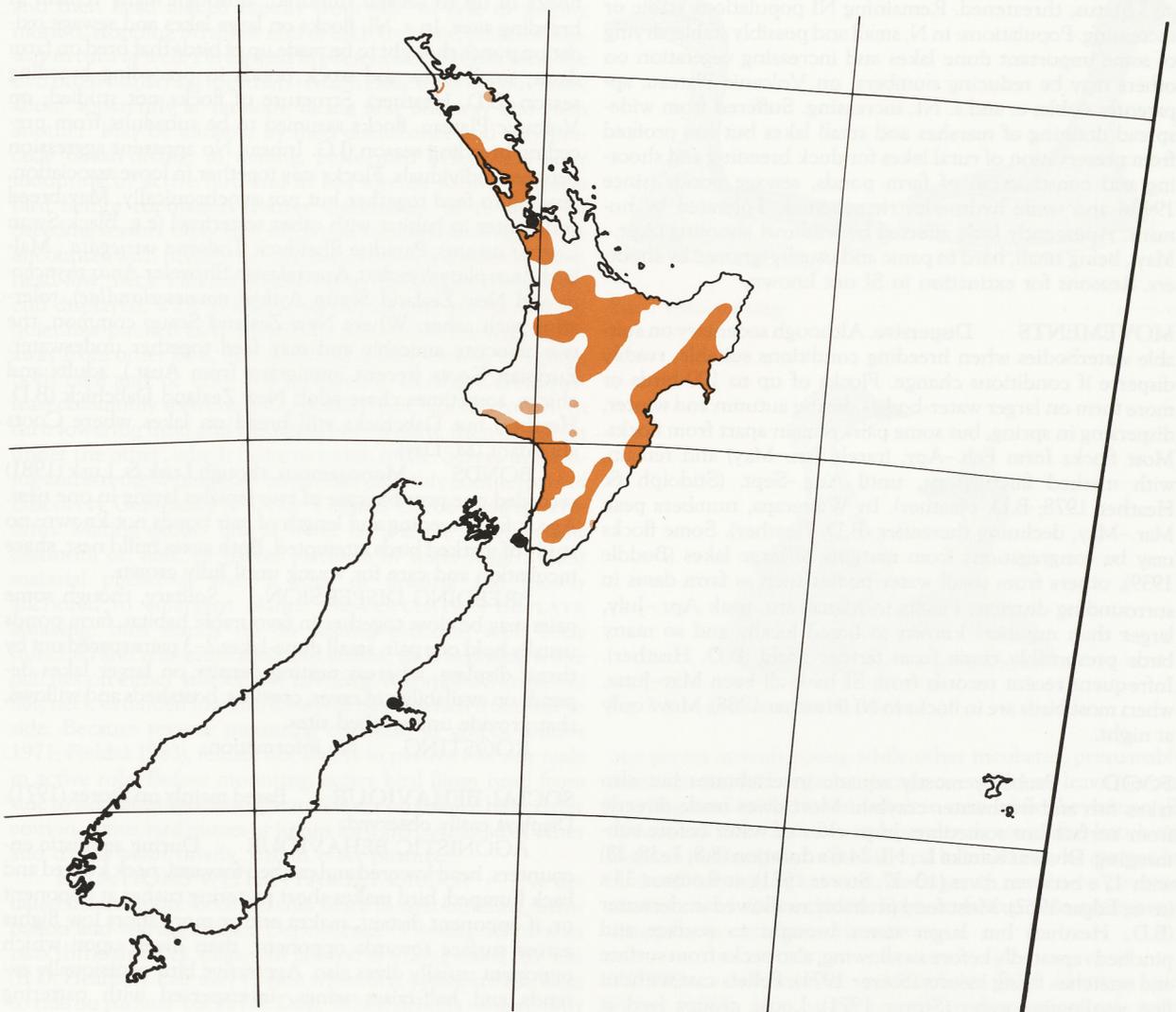
Population stable in NI; numbers increased in some districts (Stidolph & Heather 1978). Though some natural open-water swamps and lakes have been drained, artificial dams and ponds for duck-hunting and stock provide new breeding habitat, especially e. and s. NI. Recently constructed sewage ponds have probably expanded winter range and improved chances of survival (Stidolph & Heather 1978). Destruction of willows round one dam followed by desertion (Stidolph & Heather 1978); at L. Rotoiti, planting of willows may have

improved habitat for nesting and modification of catchment may have improved food supply (Lusk & Lusk 1981). Nests swamped by wash from power-boats. In S. Taranaki-Wanganui, Dabchicks occur only on lakes not used for power-boats (B.D. Heather). Introduced rats *Rattus norvegicus* destroy nests at L. Rotoiti (M. Day). Birds may become tame where human activity is regular (B.D. Heather; J.G. Innes).

DISTRIBUTION AND POPULATION Endemic to NZ; now confined to NI; formerly in SI. Scattered distribution in suitable habitat across NI; breeding and wintering distribution alike, apart from local movements.

NI. Most abundant on Volcanic Plateau and e. and s. NI (Hawke's Bay, Wairarapa, Manawatu). NORTHLAND: breed n. and w. coastal lakes from Aupouri Pen. and Karikari Pen., S along Dargaville coast to N. Kaipara Head; S. Kaipara Head to Muriwai; in E, occasional records including breeding Te Arai and Waiwera (G.J.H. Moon). S. AUCKLAND: breeds from Awhitu Pen. to Pokeno, occasionally E to Kaiiua (Firth of Thames). WAIKATO, BAY OF PLENTY: apparently does not breed N of Te Kuiti and Awaiti Wetland Reserve (near Whakatane). VOLCANIC PLATEAU: breed and winter on most

lakes in Rotorua district: (in order of decreasing numbers) Ls Rotoiti, Okareka, Tarawera, Rotoma, Okataina, Rotomahana, Rotoehu, Okaro, Rerewhakaaitu, Rotokawa; rarely breed L. Rotorua (J.G. Innes); breed L. Taupo and Ls Rotoaira, Rotopounamu and Rotokuru round Tongariro NP. S of Tongariro NP to Wanganui and Hunterville, status not known. Found E of main ranges from East Cape almost to Cook Str. EAST COAST: breed Gisborne district, E of Raukumara Ra. (G. Rasch) and Wairoa district (inland in Hangaroa Valley and Tiniroto Ls); some winter Whakaki Lagoon; not known to occur Ls Waikaremoana and Waikareiti (G.A. Foreman). HAWKE'S BAY: small numbers breed lakes and farm ponds from L. Tutira to Dannevirke and Porangahau. WAIRARAPA: breed farm ponds n. and central Wairarapa district and remaining wetlands near L. Wairarapa (OSNZ surveys). MANAWATU: breed dune lakes from Paraparaumu to Bulls (S of Marton) and inland near Hunterville and lagoons adjacent Manawatu R. near Opiki (OSNZ surveys). WANGANUI, TARANAKI: a few breed from Turakina to Hawera especially Ls Kaitoke and Westmere; stragglers occur W of Hawera to Opunake; no records central and n. Taranaki, N to Waikato. SI. Considered extinct (NZ Atlas; Heather 1988).



Widespread up to late nineteenth century but apparently nowhere common (Potts 1869; Travers 1871; Smith 1888; Douglas c. 1899) despite Buller's (1888) comment that it was abundant in all the freshwater lakes and lagoons of the SI. Museum specimens few, some doubtfully from SI (Heather 1988). In second half of nineteenth century sharp decline, particularly in Canterbury (Stead 1927). In first half of twentieth century, small numbers persisted in Fiordland and on several West Coast lakes; thereafter, records few and none since mid-1960s; some or most possibly stragglers from NI (Heather 1988). One bird seen at L. Elterwater, Marlborough, in June 1987 (Heather 1988).

POPULATION Estimated total numbers: Northland: probably <200 birds (OSNZ surveys; McKenzie 1980; D.E. Crockett; G.A. Pulham); Volcanic Plateau: possibly up to 500 birds (J.G. Innes), which represents over one-third of estimated total population; Hawke's Bay: winter flocks of up to 25 at Westshore and L. Runanga, up to 55 at L. Roto-o-kiwa (K.V. Todd); Wairarapa: on 47 wetlands, 127 birds, Apr. 1989 (OSNZ survey; T.C. Dennison) though earlier surveys counted <100 (B.D. Heather); Manawatu: 250-280 birds (OSNZ surveys). Total population estimated between 1200 and 1500 birds (B.D. Heather).

Status, threatened. Remaining NI populations stable or increasing. Populations: in N, small and possibly stable, drying of some important dune lakes and increasing vegetation on others may be reducing numbers; on Volcanic Plateau, apparently stable; e. and s. NI, increasing. Suffered from widespread draining of marshes and small lakes but has profited from preservation of rural lakes for duck breeding and shooting and construction of farm ponds, sewage ponds (since 1940s) and some hydro-electric schemes. Tolerated by humans. Apparently little affected by wildfowl shooting (Apr.-May), being small, hard to panic and usually ignored by shooters. Reasons for extinction in SI not known.

MOVEMENTS Dispersive. Although sedentary on suitable waterbodies when breeding conditions suitable, readily disperse if conditions change. Flocks of up to 100 birds or more form on larger water-bodies during autumn and winter, dispersing in spring, but some pairs remain apart from flocks. Most flocks form Feb.-Apr. (rarely Jan.-May) and remain, with marked fluctuations, until Aug.-Sept. (Stidolph & Heather 1978; B.D. Heather). In Wairarapa, numbers peak Mar.-May, declining thereafter (B.D. Heather). Some flocks may be congregations from margins of large lakes (Buddle 1939), others from small water-bodies such as farm dams in surrounding districts. Flocks in Manawatu, peak Apr.-July, larger than numbers known to breed locally and so many birds presumably come from farther afield (B.D. Heather). Infrequent recent records from SI have all been May-June, when most birds are in flocks in NI (Heather 1988). Move only at night.

FOOD Probably mostly aquatic invertebrates but also takes fish and freshwater crayfish. Most dives made directly from surface but sometimes leaps clear of water before submerging. Dives at Karaka L., NI, 24.8 s duration (8.8; 7-38; 28) with 17 s between dives (10-37; Storer 1971), at Rotorua 33 s (n=6; Edgar 1962). Most food probably swallowed underwater (B.D. Heather) but larger items brought to surface and pinched repeatedly before swallowing; also pecks from surface and snatches flying insects (Storer 1971). Pellets cast without first swallowing water (Storer 1971). Loose groups feed at

same time but not synchronically (B.D. Heather).

No detailed study but casting of pellets probably indicates an invertebrate diet. Of hundreds of dives observed at Ls Rotoiti and Taupo, only twice have small fish been seen brought to the surface (B.D. Heather). Otherwise birds surfaced without food and did no swallowing, presumably because food small enough to be swallowed underwater. Seen taking hatching midges from water surface and from air and once recorded surfacing with a small fish (Storer 1971). Adult female seen capturing a fish *Gobiomorphus gobioides* and several large freshwater crayfish *Paranephrops* that were broken up with difficulty (Buddle 1939). Three stomachs collected by Buller (1888) were filled with pale yellow leeches about 2.5 cm long. Buller (1888) thought molluscs an important part of diet. Unusually for grebes, not recorded eating feathers.

Recorded taking fish and crayfish to young, some of which were first dismembered. A chick also seen catching crayfish (Buddle 1939). Observed food items probably biased against small items; nearly all food passed to chicks is too small to identify (B.D. Heather).

SOCIAL ORGANIZATION During breeding season, form pairs that defend territory. Outside breeding, form flocks of up to several hundred, although many remain at breeding sites. In s. NI, flocks on large lakes and sewage oxidation ponds thought to be made up of birds that bred on farm dams, small lakes and stock ponds in preceding breeding season (B.D. Heather). Structure of flocks not studied; on Volcanic Plateau, flocks assumed to be subadults from preceding breeding season (J.G. Innes). No apparent aggression between individuals. Flocks stay together in loose association, tending to feed together but not synchronically. May breed and winter in habitat with other waterfowl (e.g. Black Swan *Cygnus atratus*, Paradise Shelduck *Tadorna variegata*, Mallard *Anas platyrhynchos*, Australasian Shoveler *Anas rhynchos* and New Zealand Scaup *Aythya novaeseelandiae*), tolerating each other. Where New Zealand Scaup common, the two associate amicably and may feed together underwater. Eurasian Coots (recent immigrant from Aust.), adults and chicks, sometimes chase adult New Zealand Dabchick (B.D. Heather) but Dabchicks still breed on lakes where Coots abundant (M. Day).

BONDS Monogamous, though Lusk & Lusk (1981) recorded one possible case of two females laying in one nest. Age at first breeding and length of pair bonds not known; no study of marked birds attempted. Both sexes build nest, share incubation and care for young until fully grown.

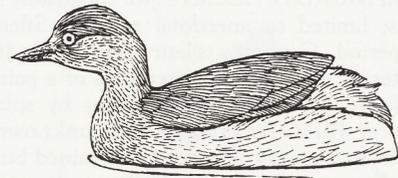
BREEDING DISPERSION Solitary, though some pairs may be close together in favourable habitat; farm ponds usually hold one pair, small dune-lakes 2-3 pairs spaced out by threat displays, whereas nesting density on larger lakes depends on availability of caves, crevices, boatsheds and willows, that provide undisturbed sites.

ROOSTING No information.

SOCIAL BEHAVIOUR Based mainly on Storer (1971). Displays easily observed.

AGONISTIC BEHAVIOUR During agonistic encounters, head lowered and pushed forward, neck kinked and back humped; bird makes short pattering rushes at opponent or, if opponent distant, makes one or more short low flights across surface towards opponent, then dives, upon which opponent usually dives also. Aggressive bird occasionally extends and half-raises wings, interspersed with pattering

rushes; may signify intention of flying towards opponent (B.D. Heather). Fighting rare. Main APPEASEMENT DISPLAY, jerky head-bobbing, up and down, side to side, and sometimes backwards and forwards. When threatened, retreats by skidding across surface, head and neck held forward and rear-end below surface. When greatly threatened, dives, apparently as ultimate form of escape. Main ALARM reactions are Crash-diving and Stern-on Posture. **Crash-diving:** bird dives breast-first, sending up jet of water to one metre high, as extreme alarm response when Marsh Harrier *Circus aeruginosus*, or even Welcome Swallow *Hirundo neoxena*, dives at Dabchick (Storer 1971). In **Stern-on Posture** (Fig. 1) bird sits in high-sterned posture, tips of folded wings raised and rear-end feathers fluffed out, revealing white eye-like pattern on each side of tail. Commonly used by birds within territory when in sight of others; by both members of single pair on small pond or by birds in winter flocks on appearance of human observer; at all times of year probably conveys mild alarm but presumably also acts as territorial advertisement (B.D. Heather).



Normal posture on territory

SEXUAL BEHAVIOUR COURTSHIP. Formation and maintenance of pair-bonds include Head Turning, Patter Ceremony and Diving Ceremony. **Head Turning:** (Fig. 2, 3) head stretched up, neck sleeked, body-feathers compressed, and then head flicked rapidly from side to side in jerking motion, stopping briefly at end of each turn and at times midway in turn as well. Performed in presence of another bird, the two often displaying together; remain close together but move about apparently at random, facing first one way and then another. May be initiated by mild disturbance and may precede Crash-diving; in mating, performed before and after mounting by active bird and in less intense form by passive bird before copulation. **Patter Ceremony:** at all stages of breeding season, especially when pair reunited after aggressive encounter with neighbour; the two birds mill about together, head low, neck kinked, folded wings held high, white rear-end displayed, with jerking head movements and occasional quiet low-pitched calls. Suddenly, one rushes through water away from other bird, feet splashing loudly, ending in a glide; both take part or only one repeatedly. **Diving Ceremony:** least commonly seen courtship display; pair face each other, in turn lowering head and thrusting bill forward, then one dives under the other, which turns to watch it rise. Serves in forming and strengthening pair-bond, and probably counterpart of Discovery Ceremony of Great Crested Grebe *Podiceps cristatus*. Mating occurs out of water on a stone or other low platform, on nest, or partial platform of water-logged plant material placed at water's edge or floating and loosely anchored to emergent plants. **PRE-COPULATION DISPLAYS:** **Rearing:** bird stands up on mating platform with body hunched and rear-end raised and fluffed, thus exposing white patches on either side of tail; **Inviting:** rearing bird crouches flat, neck extended low and forward, head turned from side to side. Because reverse mounting common in grebes (Storer 1971; Fjeldså 1983), female not always in passive role nor male in active role. Before mounting, active bird flings head from side to side; after mounting, stands erect on passive bird. After coition, active bird moves or jumps forward over head of other and treads water briefly, still in erect posture.

RELATIONS WITHIN FAMILY GROUP No detailed information. Both parents share in nest-building, incubation and rearing chicks. Dependence of young on parents lasts through chick stage, but falls off as young reach full size (B.D. Heather). Pair may re-nest when first young are too large to ride on parents' backs (M. Day). When parents re-nest, only

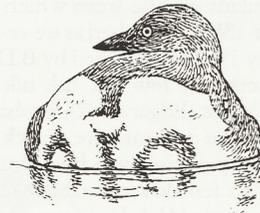


Fig. 1 Stern-on Posture

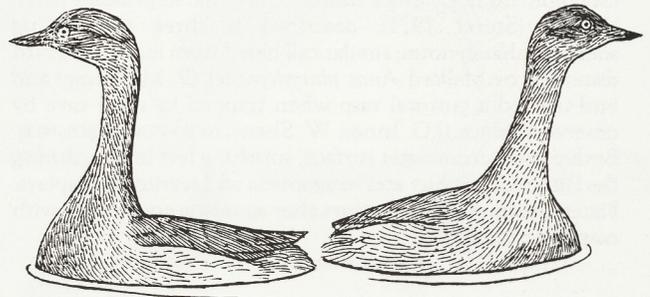


Fig. 2 Head-turning

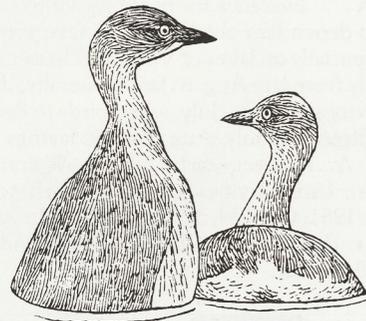


Fig. 3 Post-copulatory Head-turning

one parent attends young while other incubates; presumably care of young exchanged at change-overs. Young leave nest on hatching and carried by one adult in turn while they are small. Chicks can swim and dive independently soon after hatching. Because hatching asynchronous, first hatched may be carried by bird still incubating on nest. Young may remain on parents' territory for 2-3 months (M. Day); on farm ponds, young may disappear in autumn-early winter.

VOICE Information provided by B.D. Heather and Storer (1971). Not heard to call in observations of many

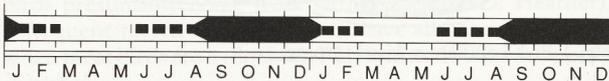
hundreds of birds (B.D. Heather). Not adequately studied but rarely calls; limited to anecdotal records. Silent in non-breeding period. Generally silent during breeding; rarely, quiet chattering calls between members of a pair; a sibilant whistle. Non-vocal sounds: birds patter by splashing feet loudly (Storer 1971). Function of calls unknown. Circumstances of behaviour not adequately examined but no vocalizations during most displays or during territorial establishment (B.D. Heather).

ADULT Differences between sexes, if any, not known. (1) A shrill sibilant whistle from which Maori name *Weweia* derived (Buller 1888), described as *we-ee-ee* (Falla *et al.* 1981; Moon & Lockley 1982). Not heard by B.D. Heather or Storer (1971). (2) A series of low *tuk tuk tuk* notes given between pair building a nest (Edgar 1962); probably the same as *kra kra kra* not unlike a miniature quack with a trill (Stidolph 1971) and *qua qua qua* given by a female (Stidolph 1971). (3) In response to female's call (above-2), a male responded with a feeble *croak*. [4] A low four-note call of low amplitude like a guttural chatter given during Patter Ceremony (Storer 1971); probably equivalent to the subdued bubbling note frequently heard during Patter Ceremony (Stidolph 1971). (5) Once heard to utter harsh *grraaaa* when alarmed (Storer 1971); described as three soft rolling somewhat harsh notes; similar call heard from incubating bird disturbed by Mallard *Anas platyrhynchos* (P. McKenzie) and bird uttered a guttural rasp when trapped in small cave by observers' canoe (J.G. Innes; W. Shaw). **NON-VOCAL SOUNDS.** Birds patter across water surface, splashing feet loudly, during the Patter Ceremony and in agonistic and territorial displays. Patter Ceremony often occurs after agonistic encounters with neighbouring birds.

YOUNG No information.

BREEDING Not well known. No detailed field studies. Information supplied by B.D. Heather. Breed as single territorial pairs on inland waters; not associated with other species of bird.

SEASON Evidence for breeding activity (from nuptial displays to dependent chicks) can be seen somewhere in any month, especially on lakes of Volcanic Plateau, but start of clutches mostly from late Aug. to Jan. Generally, displays and territorial activity start June-July, when birds in flocks in s. NI start to pair, dispersing July-Aug. Earliest layings: early June (Moon 1967; A. Palliser); early July in Wairarapa (W.L. Clinton-Baker). Latest layings calculated: early to late Mar. (Lusk & Lusk 1981; CSN 24, 30). At Rotorua Ls, peak breeding Sept.-Mar. (J.G. Innes). Chicks and dependent young seen mostly Oct.-Mar.



SITE Usually among emergent vegetation at margins of inland waters; floating but anchored to *Typha* (raupo), other water plants or overhanging branches (often willow); well concealed by plant growth. Or on ledge at water's edge, at base of clump of niggerhead *Carex secta*, under overhanging bank, in small cave and even in boatshed (Buddle 1939; Biddle 1961; Edgar 1962; Sibson 1963; Lusk & Lusk 1981; CSN 22, 31). Recorded in old tyres used as boat fenders on jetties at L. Taupo (Moon & Lockley 1982; B.D. Heather). On small waters same sites may be used in successive seasons, probably

fortuitously (W.L. Clinton-Baker); on large waters, favoured sites may be used repeatedly in one season (Buddle 1939).

NEST, MATERIAL A pile of water-logged decomposing plant material, especially *Typha* and *Elodea* with some twigs, leaves, grass, c. 30 cm diameter. Merely heaped together loosely, easily swamped by rising water or broken up by wave action and surges caused by power-boats. Shallow depression in centre top for eggs, c. 15 cm in diameter (one nest; C.H. & J.R. Lusk). If material is constantly added for second nests or to counter rising water, may come to rest on bottom and reach a thickness of c. 1 m (Buddle 1939; Moon 1967); Lusk & Lusk (1981) found seven of 24 nests thus resting on bed of lake. Both sexes collect material under water, bring it to surface 20-30 m from nest and swim with it underwater to nest; only female puts it in place (Buddle 1939). Building may take as little as 3 days and laying usually starts as soon as nest suitably large (Buddle 1939; W.L. Clinton-Baker). Birds silent while building (B.D. Heather).

EGGS Elliptical, pointed at both ends; rough texture, with scattered tubercles; bluish white, becoming stained brownish during incubation.

MEASUREMENTS:

L. Rotoiti: 43.3 (41.0-45.5; 9) x 29.1 (28.2-29.6) (Buddle 1939)
43.2 (41.0-44.6; 15) x 29.5 (28.6-29.6) (M. Day)

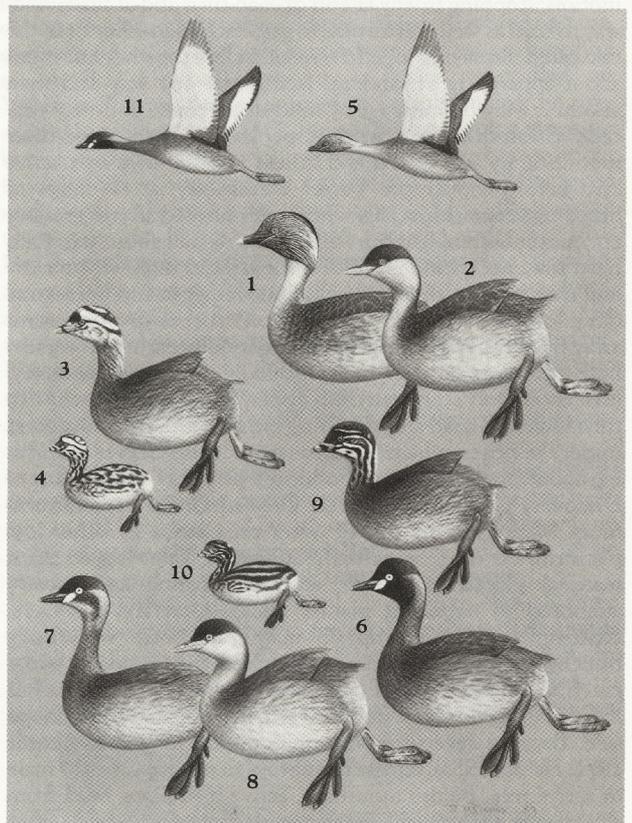


Plate 5

Hoary-headed Grebe
Poliiocephalus poliocephalus
1. Adult breeding
2. Adult non-breeding
3. Juvenile
4. Downy young
5. Adult breeding, flight

Australasian Grebe
Tachybaptus novaehollandiae
6. Adult breeding
7. Adult autumnal
8. Adult non-breeding
9. Juvenile
10. Downy young
11. Adult breeding

L. Taupo: 46.9 x 30.5, 45.3 x 30.3 (NMNZ).

WEIGHTS: L. Taupo: 1.9, 1.85 g fresh (NMNZ).

CLUTCH-SIZE Not fully quantified. Usually 2-3, two being more common. At L. Rotoiti, av. 2.2 (0.79; 2-3; 10) (Lusk & Lusk 1981); av. 2.5 (2-4; 8) (M. Day). At Wairarapa, possibly same pair during three seasons laid 4 x C/2, 3 x C/3 (W.L. Clinton-Baker). Though Buddle (1939) said that 'frequently only one [egg] is laid', no confirmed records of C/1. On a farm dam, as many as four successful broods in one season between July and Feb. (W.L. Clinton-Baker). Buddle (1939) and Lusk & Lusk (1981) suggested 5-6 replacement layings at L. Rotoiti, where predation high.

LAYING Apparently at 24-h intervals (Biddle 1961; W.L. Clinton-Baker) but Lusk & Lusk (1981) claimed 48 h or 'may be irregular'. Four eggs in nest once recorded (Lusk & Lusk 1981), probably by two females. At L. Rotoiti, new nests built within 5-6 days of losses. After success, later nests started when young of previous brood 2-3 weeks old (Buddle 1939) but on farm dam in Wairarapa, later clutches laid when young of previous brood 4.5-7.5 weeks old (W.L. Clinton-Baker).

INCUBATION By both sexes but details of sharing not known. **INCUBATION PERIOD:** 22-23 days, twice reasonably well determined by W.L. Clinton-Baker. Assumed to

start with first egg or before clutch complete because hatching of C/3 asynchronous, taking 2-3 days (W.L. Clinton-Baker). Buddle (1939) found eggs covered only once in c. 25 observations but Lusk & Lusk (1981) and Moon (1979) found covering usual; probably habitual when leaving nest voluntarily but not when surprised and flushed.

YOUNG Precocial, nidifugous. Downy when hatched; heavily striped with white, rufous and black. Growth, no information. Can swim as soon as hatched. Both parents care for young but roles not known in detail. Chicks carried by adults for most of first week and may stay on parent's back while diving; are in water independently for longer in second week and begin to feed on surface in third week; too big to be carried after c. 3 weeks but still fed by parents; at 4 weeks, still being fed by parents, dive when alarmed; after c. 5 weeks, diving for food but also fed by adults; mostly left alone when second nest is built but may be attended by non-incubating adult (W.L. Clinton-Baker). Fed by both parents but at times, especially if only one chick, one adult brings food, passes it to mate, which then passes it to chick (B.D. Heather; W.L. Clinton-Baker). Items of food passed directly, bill to bill, but, if items large, may be broken up by adult (Buddle 1939). Three apparent adults once reported feeding a fully fledged young bird (CSN 24).

FLEDGING TO MATURITY Total to partial dependence on parents lasts c. 70 days, when first flights, skimming over water, recorded; once, young left natal pond by 81 days from hatching (W.L. Clinton-Baker).

SUCCESS At L. Rotoiti, no young hatched from 12 nests (Buddle 1939); from 29 eggs in 13 nests, five (17%) hatched (Lusk & Lusk 1981); from 28 nests (probably 70 eggs), c. 13 young (19%) hatched (M. Day). These results suggest poor success on large waters. Elsewhere, general information from smaller waters (CSN) records broods: 13 x 1, 12 x 2 and 2 x 3. During three seasons at Wairarapa farm dam: 17 eggs laid (six nests), 15 (88%) hatched, 14 (82%) young fledged (W.L. Clinton-Baker). Thus, success on dune lakes and farm dams may be much better than on large waters, where fluctuation in water level, wave action and disturbance by other species of bird (M. Day) may be more serious dangers. Rats and eels have also been blamed for loss of eggs and chicks respectively, without good evidence.

PLUMAGES Adult breeding plumage distinctive and well described; described below. Adult non-breeding is not well understood or documented. The description of Adult non-breeding is based on museum skins (n=10) and complemented with composite descriptions from field observations by B.D. Heather; this plumage may represent a combination of immature and non-breeding plumages. It has also been suggested this may be an eclipse plumage as it appears to be held only for a short period between late Mar. and early July in s. NI (B.D. Heather).

In s. NI, birds remaining on breeding wetlands generally retain breeding plumage; but those congregating on large wetlands after breeding season mostly have faded breeding plumage Feb.-Apr., in non-breeding plumage only briefly, from late Mar. to mid-Apr. and by late Apr. to late May are almost in breeding plumage again.

ADULT BREEDING HEAD AND NECK. Forehead, dark brown (221). Crown to lower neck, black-brown (119) with very faint gloss of pale black-green (162); gloss most noticeable at hindneck. Distal rami of feathers of head, long and white; profuse on crown, outer edges of throat and face.

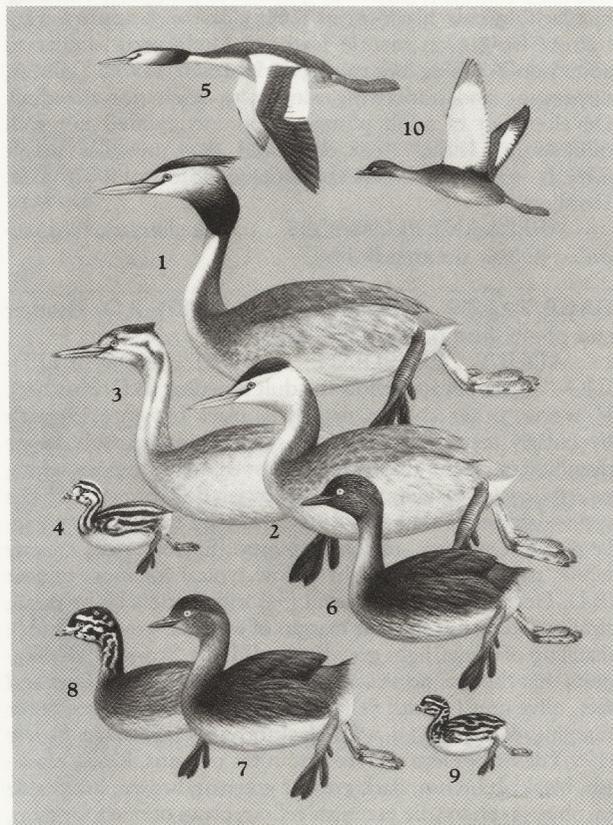


Plate 6

Great Crested Grebe
Podiceps cristatus

- 1. Adult
- 2. Immature
- 3. Juvenile entering post-juvenile moult
- 4. Downy young
- 5. Adult

New Zealand Dabchick
Poliiocephalus rufopectus

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

Lores, auricular area, chin, and lower throat, brown (119B); sometimes light grey-brown (119C) in males. Both sexes have small patches of light grey-brown (119D) feathers on chin to lower throat. Base of neck, light brown (123A). **UPPERPARTS.** Upper mantle, dark olive-brown (129); rest of mantle, dark brown (221); feathers narrowly fringed dull white with narrow brown (223B) subterminal fringe. Back, dark brown (221). Concealed feather bases on mantle and back, light grey-brown (119D). Scapulars, dark brown (221); inner scapulars, long, open pennaceous with pale black-green (162) gloss. Most upper tail-coverts and rump, light brown (123A). Outer upper tail-coverts, white; form white patch on either side of tail-tuft; some feathers have pink-buff (121D) shade. **TAIL-TUFT,** short, dark brown (221). **UPPERWING.** All remiges, dark brown (119A) with varying amount of white on webs. All upper wing-coverts, and alula, dark brown (121); from median to marginal coverts, colour progressively lighter. Inner webs of primaries, progressively whiter distally, from p11 to p1; at p1 reaches maximum of three-quarters length of feather, leaving dark-brown (119A) tip. Outer webs of primaries, whiter distally from p7 to p1; at p1 reaches maximum of half length of feather. Rachis, dark brown (119A) merging to white. Secondaries, white; outer webs, edged dark brown (119A), but white at base; inner webs have dark-brown (119A) tips. Most of outer web of s11, dark brown (119A). See illustration in Storer (1987). **UNDERPARTS.** Breast, brown (121C); rachis, dark brown (121) basally. On some birds, breast appears mottled because base of rachis exposed. Lower breast to abdomen, entirely white or irregularly blotched brown (121C) and pale pink-buff (121D). Lower abdomen, vent and thighs, pale dark-brown (121). Flanks, dark brown (121), with dull-white fringes; rami, brown (121C) at base of fringes; flank-feathers nearest abdomen, long and open pennaceous; rachis, conspicuous, dark brown (221). Axillaries, white; longest axillary has small dark-brown (119A) tip; second longest, pink-buff (121D) shade at tip. **UNDERWING.** All coverts, white.

ADULT NON-BREEDING HEAD AND NECK. Forehead, dull white. Crown to base of hindneck, dark brown (221); very faint pale black-green (162) gloss on hindneck. Chin, white. Face and throat, light grey-brown (119C) to white; white particularly beneath eye and round ears. Distal white rami of feathers of head, mainly absent; if present, short and on hindcrown. Base of neck, light brown (123A). **UPPERPARTS.** Upper mantle, dark olive-brown (129) with very faint pale black-green (162) gloss; feathers narrowly fringed dull white with narrow brown (223B) subterminal fringe. Back, dark brown (221). Concealed feather-bases on mantle and back, light grey-brown (119D). Scapulars, dark brown (221); inner scapulars, long, open pennaceous with pale black-green (162) gloss. Most upper tail-coverts and rump, light brown (123A). Outer upper tail-coverts, white; form white patch on either side of tail-tuft; some feathers have pink buff (121D) shade. **TAIL-TUFT,** short and dark brown (221). **UPPERWING,** like breeding. **UNDERPARTS.** Upper breast, light brown (123A). Breast to abdomen, entirely white, with no mottled or blotched appearance. Flanks and thighs, pale dark-brown (121); feathers of flank nearest abdomen, long and open pennaceous; rachis conspicuous, dark brown (221). Axillaries, white; longer axillary has small dark-brown (119A) tip; second longest, pink-buff (121D) shade at tip. **UNDERWING,** like breeding.

DOWNY YOUNG Entire down, short, longest on back. Forehead and crown, black brown (119) with small single spot of rufous brown (136) either side of hindcrown. No

bare patch on crown (Storer 1967, 1987). Down at sides of head striped longitudinally; stripes of black-brown (119), interspersed with white. Chin to lower throat, white with two narrow circular stripes of dark-brown (119A) down. For details of head pattern see Storer (1987). Hindneck, broadly striped black-brown (119) interspersed with light brown (123A). Lower throat to base of neck, light brown (223D), heavily striped dark brown (119A). Down on dorsum, predominantly black-brown (119), with longitudinal stripes of light brown (123A) from mantle to rump. Upper breast to abdomen, white. Flanks, vent and thighs, light grey-brown (119C), interspersed with streaks of black-brown (119) down. **Upperwing,** black-brown (119). **Underwing,** light brown (223D).

JUVENILE Retains head pattern of downy young. Forehead and crown, dark brown (221); tips of feathers at forehead, light brown (123A). Chin and throat, white; irregular dark-brown (119A) smudgy stripes on lower throat. Sides of head, dull white, with irregular smudgy stripes; broader dark-brown (221) stripe through eye and narrow dull-white superciliary stripe extending from above eye to ear. From gape, dark-brown (119A) stripe extends to eye. Lower throat to base of neck, light brown (123A); sides of neck, brown (119B); hindneck, dark brown (119A) with a few dull-white feathers mixed. Rest of dorsum, similar to adult non-breeding but lacking pale black-green (162) gloss on scapulars; very narrow fringes on mantle feathers. Underparts similar to adult non-breeding, but thighs, dark brown (119A). Tail-tuft, upperwing and underwing, similar to adult non-breeding. Development of adult plumage not documented nor well understood. It has been suggested that juveniles moult directly to adult breeding plumage (Storer 1987; B.D. Heather).

ABERRANT PLUMAGES One albinistic bird recorded (Oliver quoting Buller).

BARE PARTS Based on Storer (1987), B.D. Heather and photo (bird on nest; NZRD).

ADULT BREEDING, ADULT NON-BREEDING Iris, always yellow in adult breeding (B.D. Heather). However, other colours recorded: black-brown (119) with irregularly scattered cream (54) specks, progressively larger distally from pupil (NZRD); in 11 specimens: creamy white; pale yellow (n=6); light yellow; yellowish buff; brown; red; the red is erroneous (Heather 1988). No data to indicate correlation with sex, age, region or season (Storer 1987); creamy white, pale yellow and light yellow typical for most of year (B.D. Heather). Narrow cream (54) iridal ring adjoins pupil; similar wider ring at outer margin of iris. Bill, grey-black (82); distal tip of tomia, light grey-brown (119D); Storer (1987) suggests that there is no seasonal change in bill colour. Legs and feet, olive grey (-) with yellow shade on inner margins; outer margins, dark olive (-), with black-brown (119) shade. Storer (1987) describes legs and feet as; outer margins, black, blackish, blackish brown, dark grey or greenish brown; inner side as, olive-green to pale greenish yellow; claws of one specimen, dark grey horn.

DOWNY YOUNG Few data. Bill, horn with two blackish cross stripes (NMNZ; NZRD).

JUVENILE Iris, cream or pale yellow. Bill, horn-yellow with dark streaks on both mandibles, one across middle and the other near tip. Tip becomes pale and bill becomes darker basally while birds still have striped head (Storer 1987).

MOULTS Few data. All moults require study. Breeding season protracted; no moult period can be defined.

ADULT POST-BREEDING. Complete; remiges moult simultaneous. Body moult presumably gradual; involves loss of white rami associated with head-feathers.

ADULT PRE-BREEDING Probably partial; involves acquisition of head feathers and associated white rami; moult rapid; duration unknown. Breeding plumage mostly recorded in July in s. NI (B.D. Heather).

POST-JUVENILE Gradual; includes loss of patterning on head. Subsequent moult before adult plumage attained, not known.

MEASUREMENTS (1) Adult skins (Storer 1987; Table 2); separation of NI and SI specimens invalid as SI specimens of doubtful origin (Heather 1988). (2) Museum skins (F.C. Kinsky). (3) 8TH P, skins (NMNZ).

	MALES	FEMALES
WING	(1) 120.5 (2.95; 115-126; 28) (2) 122.4 (4.57; 117-127; 5)	116.4 (2.85; 110-122; 32) *
8TH P	(3) 74.0 (1.61; 72-76; 10)	69.8 (2.28; 66-73; 9) *
BILL	(1) 24.4 (1.09; 22.5-27; 31) (2) 25.7 (1.97; 23-28.2; 5)	20.2 (0.64; 19.0-22.2; 28) * 20.8 (1.28; 19.5-23.2; 6) *
TARSUS	(1) 40.5 (1.35; 37.6-42.9; 28) (2) 42.8 (1.42; 41.1-44.3; 5)	39.4 (1.38; 36.8-42; 30) * 41.6 (1.47; 39.5-43.3; 6)
TOE	(2) 50.7 (1.39; 49.3-52.7; 5)	50.4 (2.07; 49.2-54.6; 6)

WEIGHTS Few data. No information on seasonal weight changes. (1) Adult skins (Storer 1987); (2) F.C. Kinsky; as above.

	MALES	FEMALES
(1)	245.6 (40.3; 170-291; 7)	251.9 (32.9; 210-291; 8)
(2)	271.4 (20.03; 250-295; 5)	231.7 (28.80; 198-270; 6) *

STRUCTURE Wing, short and narrow. Twelve primaries: p9 longest, p11 1-7 mm shorter, p10 0-3, p8 2-4, p7 7-11, p6 12-15, p5 15-19, p4 19-24, p3 22-28, p2 25-30, p1 28-34, p12 minute. P11 emarginated on inner web; p10 and p9 on outer web; slight on p8. Short hair-like tail-tuft. Bill, short, deep at base, pointed; deep nasal groove. Nares,

elongate oval in shape. Feathered borderline of culmen and frons, concave. Tarsus, laterally compressed; less so in downy young. Feet, lobed. Middle claw pectinate; slight on outer claw. Outer and middle toes about equal, inner c. 68% of middle, hind c. 20%.

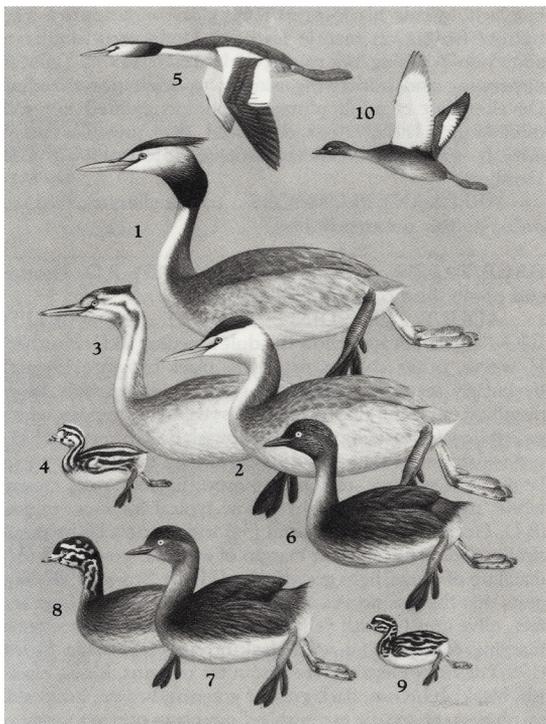
SEXING, AGEING Adults, sexed on bill length, males >22.5 mm, females <22.5 (Storer 1987). Double row of separated scutes on hind edge of tarsus, serrated in adult and possibly fused in juvenile. This character could possibly be used to separate adult non-breeding and immature plumages (if distinction exists); see criteria given in Kop (1971).

GEOGRAPHICAL VARIATION Forms superspecies with *P. poliocephalus* (Peters). Variation slight between birds of NI and SI (Storer 1987), though source of SI specimens doubtful (Heather 1988).

RMO

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Volume 1 (Part A), Plate 6

Great Crested Grebe

Podiceps cristatus

- 1. Adult
- 2. Immature
- 3. Juvenile entering post-juvenile moult
- 4. Downy young
- 5. Adult

New Zealand Dabchick

Poliiocephalus rufopectus

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

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