Display inventory of the Blue Duck

JAN L. ELDRIDGE

Introduction

Blue Ducks *Hymenolaimus malacorhynchos* inhabit mountain streams in New Zealand. Pairs are thought to be monogamous, long term and highly territorial. These are unusual traits among most Anatidae but are found among those specialising on river environments (c.f. African Black Duck *Anas sparsa*, McKinney *et at.* 1978; Torrent Duck *Merganetta armata*, Johnsgard 1966, Moffett 1970, Eldridge 1979; and Salvadori's Duck *Anas waigiuensis*, Kear 1975). Previous studies comparing Blue Duck morphology, biochemistry, and behaviour to other waterfowl species suggest that it is taxonomically distinct. Presumably then, the behavioural similarities observed between anatid river specialists result from convergence on similar habitats.

The purpose of this paper is to review and supplement the species' behavioural inventory emphasising ritualised displays – those peculiarly standardised and often exaggerated performances including all vocalisations and many movements and postures, which have become specialised as social signals (Moynihan 1955). These are listed to address the basic premise that ritualised Blue Duck behaviour is distinct from that of other Anatidae.

Methods

This study was conducted on the Manganui a te ao River near Tongariro National Park on the North Island of New Zealand from 1 January to 20 February 1978. The river originates in the snow fields of Mt. Ruapehu and is characterised by swift, highly oxygenated, clear water that moves over a substratum of rock, stones, and gravel with only limited areas of sand or silt. The study area was two kilometres of stream that cut through a steep, densely vegetated gorge in alternating white-water rapids and pools. Native forest surrounded the upriver half of the study area while sheep paddock bordered the gorge on the lower half.

Six individuals, four adults and two fully fledged juveniles, were captured with mist nets or by night-lighting and were marked with coloured leg bands during the first week in January. Subsequent observations were made primarily on these individuals. The four adults were territorial members of three pairs and the juveniles were from one brood.

The following display descriptions are based on a total of 486 hours of observation. Display performance was recorded in context by cassette tape recorder, super -8 mm and 16 mm cinematography and 35 mm photography. Sonograms and drawings of all observed displays are based on these records.

Display inventory

Territorial and aggressive displays

The male Blue Duck's piercing whistle prompted the Maori name "whio", and has been described as the main territorial call by most investigators (Johnsgard 1965; Williams 1967; Kear & Steel 1971). The vocalisation is variable and consists of one or two syllables described as "whio" by Johnsgard (1965) and "whi-whio" by Williams (1967). The call rises above the sound of the rapids with frequencies of 2 to 6 kHz (Figure 1). The female equivalent is a prolonged (up to two seconds), low frequency, rattling growl (Williams 1967) stressing frequencies below 2 kHz and often a two part call with increasing emphasis on the second part "grrr-grrRRrr" (Figure 2).

Both male and female call from the *Extended Neck* posture on rocks or in the water. The display, described originally by Williams (1967), is a rigidly held posture with horizontal alignment of the body, neck and head. The bill is held slightly open, the primaries are lifted, and the tertiaries are fanned. Males appear to have more neck feather erection, particularly around the base of the neck and the gular region of the chin (Figure 3). Females usually assume the posture only while calling but males often hold the pose for extended periods of time on rocks or in the water (Figure 4). Members of a pair often perform together when confronted by an intruder or spontaneously at dawn and dusk in vocal duets (Figure 5).

Wildfowl 36 (1985): 109–121

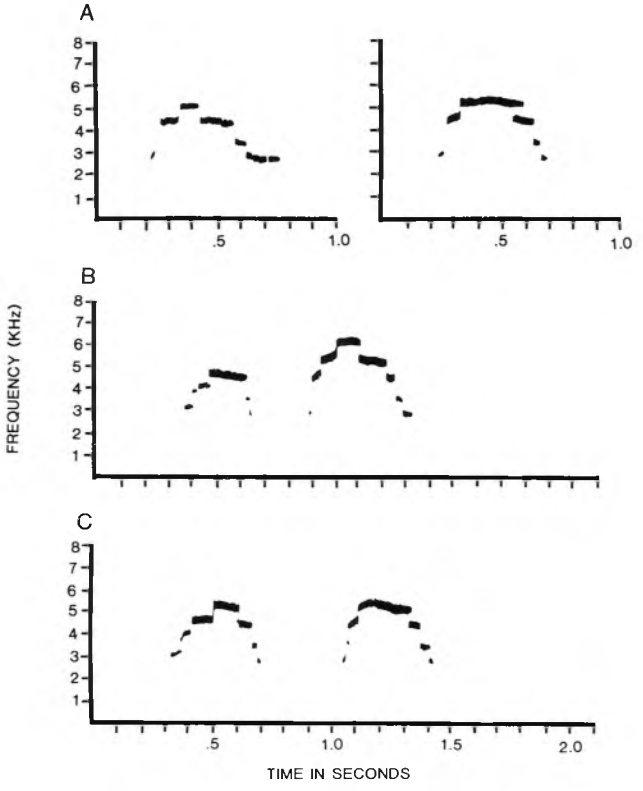

Figure 1. The "whio" call of the male (A) is highly variable and often has two parts that sound like "whi-whio" (B) or "whio-whio" (C).

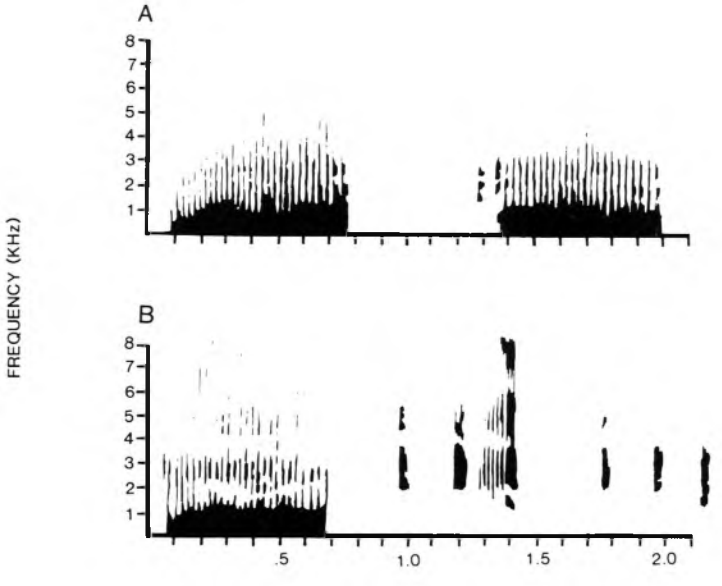

Figure 2. The growl of the female usually has two parts that sound like "grrr-rrrRrr" (A). The "gak-gak-grrak" call (B) is given by territorial females when confronting intruders.

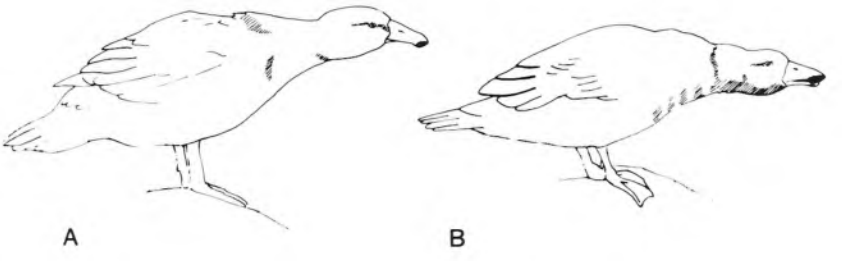

Figure 3. The Extended-neck of the male (B) appears to have more neck feather erection than that of the female (A).

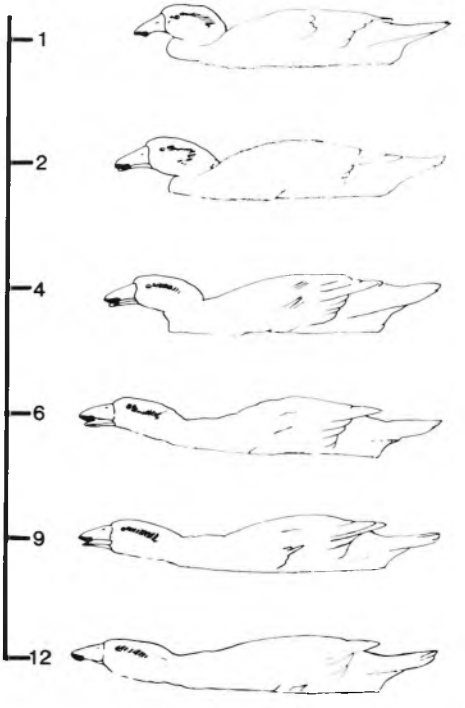

Figure 4. A male performs the Extended-neck in the water lateral to the female.

During the time period of this study, males performed more commonly than females and often when a male neared his mate he performed laterally and slanted his tail toward her.

Head-bobbing was performed with varying intensity on rocks or in the water by both members of a pair, spontaneously or in response to intruders. The display begins with head raised and bill pointing above horizontal before descending into a forward scooping pump. Unlike vertical pumps typical of dabbling ducks, the circular movement is pronounced as the head returns to an elevated position (Figures 6 and 7). The primaries and tertiaries are lifted and fanned, the tail is elevated, and secondaries exposed revealing the soft,

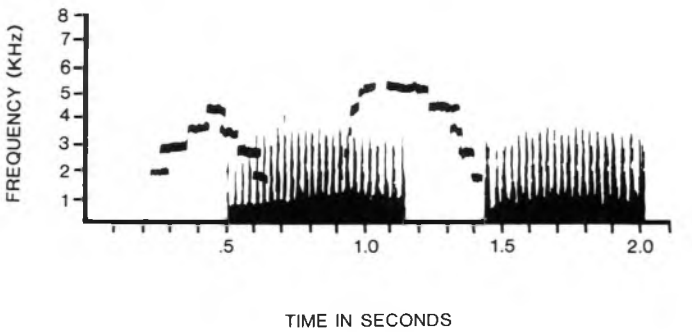

Figure 5. Example of vocal "duetting" by male and female of a pair commonly heard at dawn and dusk.

white edging described by Kear (1972) as a remnant speculum.

When confronting intruders, territorial males head-bob with a rising series of whistles from 2.5 KHz to 6 KHz. Females call in sharp, staccato bursts with frequencies lower than 3 KHz ending in a partial growl, "gak-gak-graak" (Figure 8). Both Johnsgard (1965) and Williams (1967) describe the head movements of this display as rapid "chin-lifts" with male vocalisation described by Johnsgard as "zwee" and Williams as "wi". Kear & Steel (1971) describe this display as rapid "head-flicking" with the "head-flicking call". Kear & Steel (1971) distinguish between head-flicking in newly formed pairs and head-pumping before copulation. I could not detect a difference in head-bobbing observed during pair forming, pair maintaining and pre-copulatory situations.

When an intruder was discovered the territorial pair often charged head-bobbing and calling synchronously. As they approached, the female alternated head-bobs from side to side at a slight angle; a variation that may correspond to inciting observed in other anatids (Figure 9).

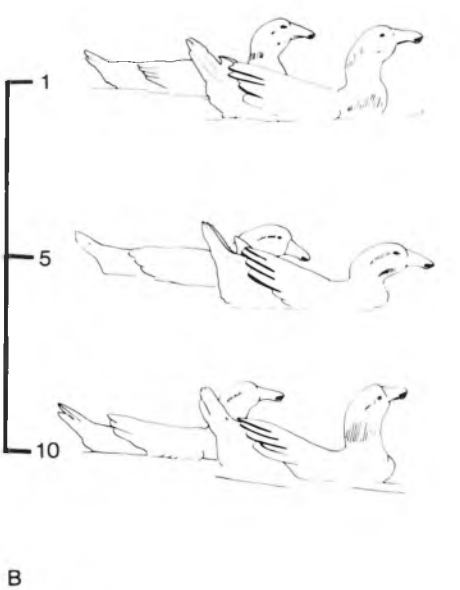

Figure 7. Head-bobbing performed by a pair. The numbered line indicates frames of film exposed at 24 frames per second.

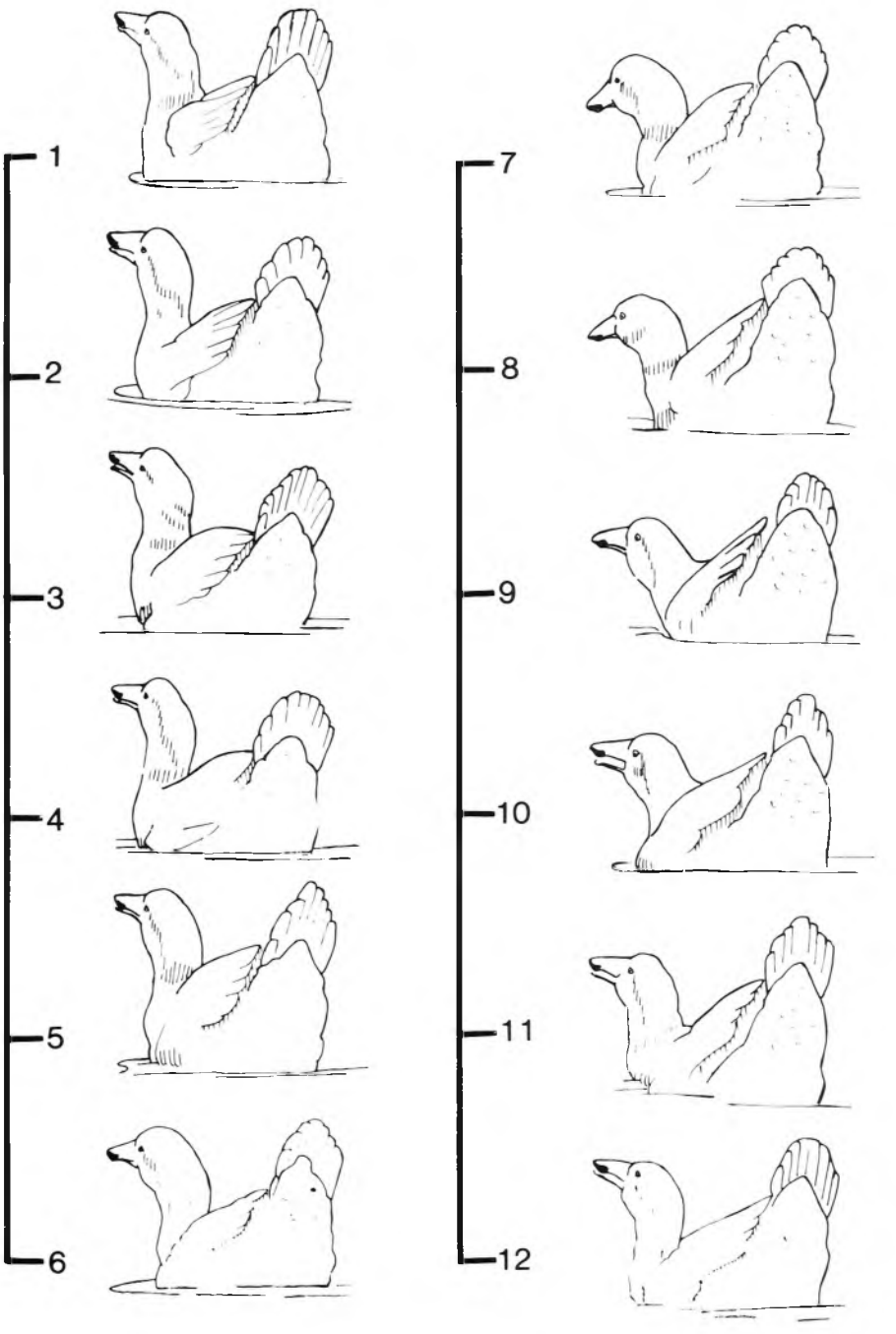

Figure 6. Head-bobbing with call performed by a male. The numbered line indicates frames of film exposed at 24 frames per second.

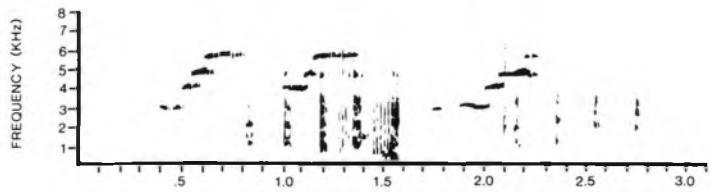

Figure 9. When the pair approached an intruder the famale (leading bird) appeared to alternate head-bobs from side to side. The numbered line indicates frames of a film exposed at 24 frames per second.

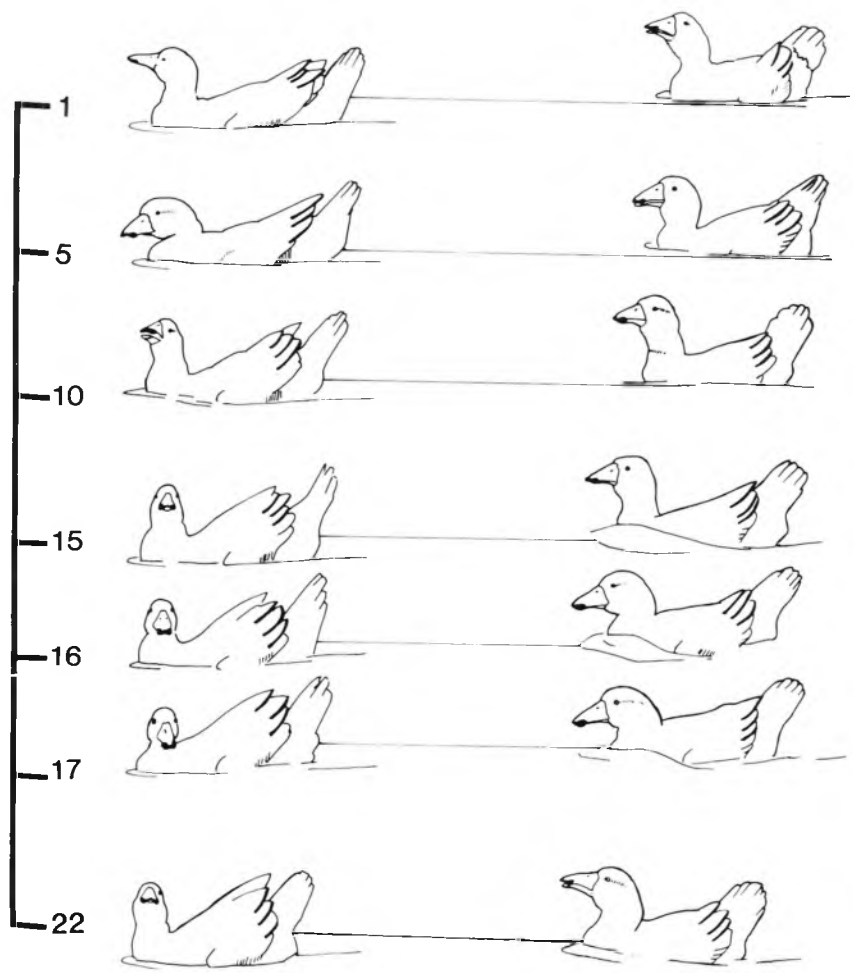

Figure 8. During aggressive confrontations pair members call loudly as they head-bob. The male vocalisation is the repeated "wi" and the female's is the "gak-gak-grrak" call.

Intruders responded to the call or sight of a territorial bird with a characteristic *sneak* posture (first described by Kear & Steel 1971). Intruders flattened on a rock with neck extended, tail lowered and wings drooped. In the water birds swam partially submerged with neck stretched over the surface and wings held slightly open. Often they swam in this posture until they were out of sight or until their heads pointed into the rocks on the river's edge where they remained motionless. Territorial birds also assumed this posture when surreptitiously approaching an intruder.

When alert, especially when confronting intruders, territorial birds of both sexes assume an *Upright* stance. The stance of the male is vertically erect with neck extended, bill horizontal and breast prominently projected forward while that of the female appears more strained with neck extended forward at a slight angle, bill horizontal, and feathers sleeked. This posture is useful in distinguishing sexes at a distance (Figure 10). A male's stance when confronted by a conspecific male indicates territorial status. Territorial males stand upright with neck vertically erect and often with tail raised while non-territorial males stand with body horizontal and head and neck withdrawn. In the water, elements of the upright posture are apparent in the tail elevation of alert birds as first observed by Kear & Steel (1971).

Interactions with intruders were usually long, low-key confrontations involving slow swim-offs and repeated displacement by the territorial pairs. *Siphon-feeding* was a common display as territorial birds followed intruders in the water. A siphon-feeding bird holds its bill in the water, moves the lower mandible rapidly and siphons through the bill spraying water from the commissures on either side (Figure 11). The display differs from surface dabbling because the birds do not forage among the rocks (Kear & Burton 1971), or appear to feed; instead, they follow the intruder siphoning water vigorously.

Intruders avoided territorial birds by moving onto the rocks but pair members usually followed and repeatedly displaced the intruder with forward scooping movements of the head and neck alternating with bill tucked against neck and breast. Often all participants would assume sleeping poses that resembled pseudo-sleeping (Cornwell & Bartonek 1963). The birds were obviously not sleeping because any movement by the intruder would result in rapid displacement by the territorial pair.

Throughout an interaction both intruding and territorial males quietly made clear-toned "chirps", groups of three to four notes with frequencies of 2.5 to 3 KHz (Figure 12B). Kear & Steel (1971) described similar calls and considered them hostile – an interpretation that is consistent with my observations. These "chirps" are very similar to the calls of Blue Duck downy young as recorded by Pengelly & Kear (1970).

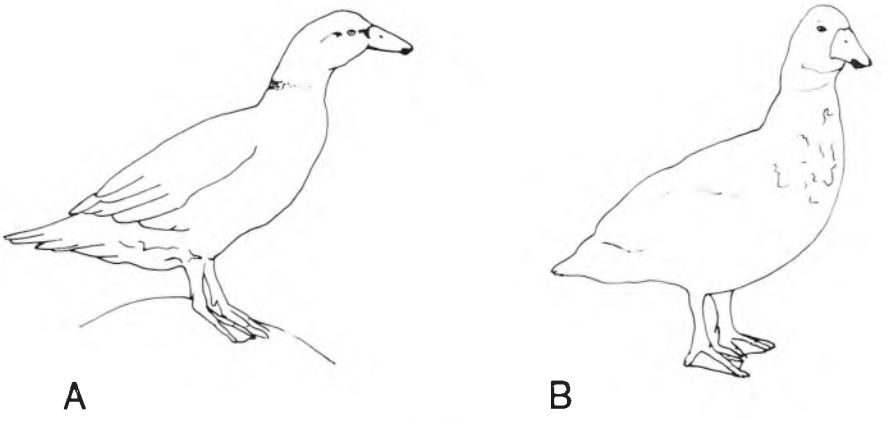

Figure 10. The female Upright (A) is strained with neck positioned slightly forward compared to the male (B).

Normally, adult Blue Ducks have white bills but when they are handled or frightened their bills turn bright pink (Blackburn 1963, 1967; Williams 1967). During aggressive interactions the bill of adult birds appeared to grow pinker. The bill of one flightless territorial male turned bright pink when he tried to expel a neighbouring territorial male that was intruding.

Occasionally intruders challenged territory holders and assumed upright and extended neck postures with calls when confronted. Territorial males reacted by attacking with strident "wi" vocalisations (Figure 12C) in *Head-low-flight* with feet spread to each side and head and neck scooped (Figure 13). Attacks resulted in

Figure 13. A male attacking an intruder in Head-low flight.

Figure 11. Siphon-feeding is used by a territorial female when approaching an intruder.

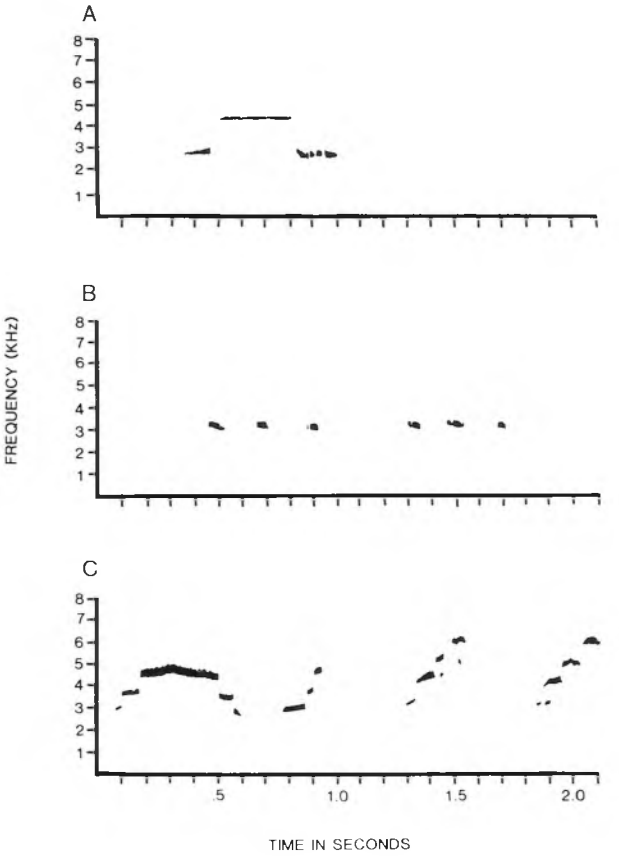

Figure 12. The plaintive "weee" performed by a male when left by his mate (A). "Chirping" performed by males during aggressive interaction (B). Repeated "wi" vocalisations of a male attacking an intruder (C).

either aerial chases or fights. Fights were vigorous and contestants often grappled for several minutes striking each other with their well developed metacarpal wing spurs (Kear & Steel 1971).

Pair bond maintenance displays

This study was conducted after the breeding season when fully fledged young were dispersing. Adult Blue Ducks demonstrated a strong tendency to remain paired and, because competition for mates was high, pair maintaining activities were common. Many of the displays observed during territorial interactions may serve pair-bond maintenance, for example, mutual calling in the extended neck posture, mutual head-bobbing spontaneously or in response to intruders, and cooperation during aggressive interactions.

Territorial pairs usually remained together throughout the day and coordinated flights with pre-flight *Chin-lifting* described by Kear & Steel (1971). Often the signals were simple bill lifts (Figure 14) but individuals differed and some performed elaborate rotating bill flips for 5 to 10 minutes before the flight.

Territorial males often initiated casual

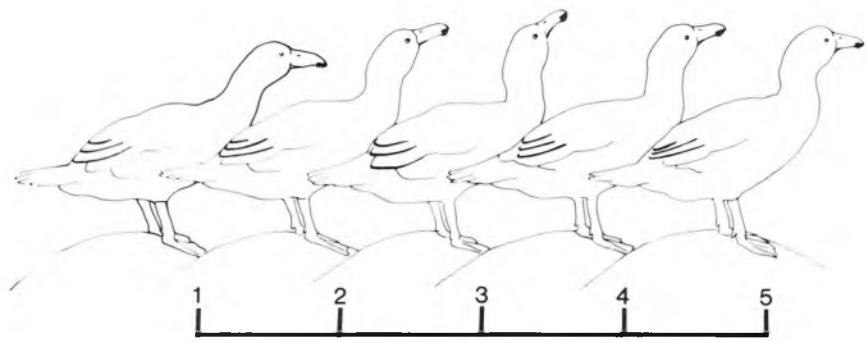

Figure 14. Chin-lifting varied in intensity from a high rotary flip to a slight bill lift. The numbered line indicates frames of a film exposed at 24 frames per second.

head-bobbing without vocalisation while feeding. When the territorial female was absent or out of sight the male assumed an elevated head-bobbing stance without actual bobs and performed a plaintive clear "whee" (Figure 12A).

Head-bobbing was particularly common between newly formed pairs. During the study three copulations were observed between new pair members involving subdued head-bobbing by the male and a *Prone* position typical of *Anas* by the female. As Kear & Steel observed, no post-copulatory displays were evident.

While actual copulations were rare, apparently pre-copulatory interactions were common, almost daily, events between individuals of established but stressed pairs. The same type of interaction was also observed regularly between individuals in newly formed pairs. The interactions were dynamic and involved three main displays performed by the male: the head-low rush, lateral, and dip-shake.

The *Head-low Rush* is performed by rushing over the water with head and neck scooping forward, wings tucked, primaries lifted and tertiaries fanned to display feathers edged in black. Males performed the display more than females, often repeatedly and with vigour covering distances of 1 to 10 metres of water (Figure 15A).

Usually the rush was performed when pair members were reunited after a separation or when other intruding males were present. I also observed a male performing repeatedly to his female when a Black Shag *Phalacrocorax carbo*, a White-faced Heron *Ardea novaehollandiae*, and sometimes

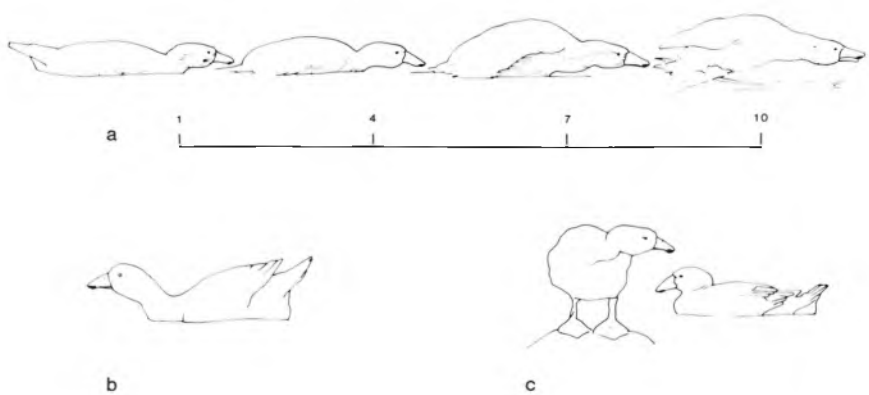

Figure 15. Head-low Rush performed by a male (A). Sleeked posture of a female during pre-copulatory interactions and fights between males (B). Lateral performed by a male near his mate (C).

even when people disturbed the pair. The display looks superficially similar to swimming attacks of territorial males against intruders and to dashing and diving reported by Kear & Steel (1971). They differ by lacking the scooped head and neck and fanned tertials of the display.

Display interactions between pair members appeared pre-copulatory and on numerous occasions males of stressed or newly formed pairs rushed females and attempted copulation. In most instances, females dived to escape. Occasionally, females appeared to solicit rushes by dashing and diving near the pair male and returning to the surface in an extended, sleeked posture (Figure 15B)

If the female left the water and stood on an emergent rock, the male often rushed across the water and climbed onto the rock beside her in a subtle *Lateral* posture. Movements toward the female in this posture were slow and deliberate with head slightly bowed and crest feathers depressed (Figure 15C). Kear & Steel (1971) describe quiet vocalisations between pair members and males in this posture often appeared to be vocalising.

Males often followed a rush with a *Dip-shake* performed in the water, laterally to the female (Figure 16). As in the rush, primaries and tertials are lifted and fanned. The head is bowed slightly with nape feathers erect and crest sleeked. Rapid cursory bill dips and shakes are directed at the female, each with an accompanying rustle of tail and/or wing feathers. Bill-dip-head-shake comfort movements were common during pair-maintaining and aggressive interactions but they lacked the lateral positioning, the fanned tertials, and the feather rustle.

The display is probably the same as that described by Kear & Steel (1971) as an introductory shake.

Figure 16. Dip-shake body position performed by a male lateral to his mate. Unlike the other displays illustrated in this paper, this drawing is from field notes and memory.

Discussion

The evolutionary relationship of the Blue Duck to other members of the family Anatidae is not clear. In their phylogenetic revision of the Anatidae, Delacour and Mayr (1945) included the Blue Duck in the tribe Anatini. Johnsgard (1965) noted that since little was known about the species, its status could not be ascertained. He suggested that it might be a primitive form of Anatini that shared Anatini and Cairinini features. After observing them in the field, Kear and Steel (1971) and Kear (1972) agreed with this conclusion. Woolfenden (1961) noted that their postcranial osteology was, for the most part, distinct, suggesting Anatini and possibly Tadornini association. Kear and Burton (1971) found Blue Duck bill and cranial osteology distinct from the Mallard *Anas platyrhynchos*. Tracheal anatomy has been used in anatid taxonomy (Johnsgard 1961), and Kear (1972) noted the Blue Duck trachea was similar to that of Anatini, Cairinini, and Tadornini. Brush (1976), in an electrophoretic analysis of feather protein, concluded that the Blue Duck pattern was distinct and impossible to place.

Displays have often been used to indicate taxonomy and Kear and Steel (1971) compared Blue Duck displays with those of other anatids and placed them in Anatini with affinities to Cairinini ancestors. Head-bobbing with associated calls observed during this study resembled mutual displays by wigeon (Anatini) pairs (Johnsgard 1965; Williams 1967), but also appeared similar to mutual displays and duetting observed in a number of Anserini and Tadornini (Johnsgard 1965). Bill-tossing is similar to the pre-flight display of Aythyini, Tadornini, and some Cairinini (Johnsgard 1965; Kear & Steel 1971).

The head position in the head-low rush is similar to the head-low-and-forward posture of Dendrocygnini and the threat posture of the Radjah Shelduck *Tadorna tadornoides* in Tadornini. The dip-shake bears some resemblance to displays of Anatini, Cairinini, and Tadornini; specifically the grunt-whistle and Introductory

shake of *Anas*, double-whistle-shake of *Aix* and whistle-shake of *Tadorna*. Of these, the dip-shake probably most closely resembles the double-whistle-shake of *Aix* with the fanned tertials and head movement. Displays similar to the lateral are performed by many species of Anatidae (Johnsgard 1965). Bill tossing is similar to the pre-flight display of Aythyini, Tadornini, and some Cairinini (Kear & Steel 1971).

The vocalisations appear particularly adapted to the fast water stream environment in which Blue Ducks live. The whistled vocalisation of the male carries well over the sound of the rapids and is similar to that of other river specialists such as the African Black Duck, Salvadori's Duck, and the Torrent Duck. The female "growl" and "gak-gak-grrak" vocalisations are similar to the "ga-ga-brrr" of female Torrent Duck (Eldridge 1979) and to vocalisations of the Cape Barren Goose *Cereopsis novaehollandiae* (Veselovsky 1973).

In summary, the ritualised behaviour I observed was quite distinct. A comparison of displays within the family Anatidae suggests potential relationships, but clearly homologous displays are notably lacking. Johnsgard (1965) and Kear and Steel (1971) could be correct in concluding that the Blue Duck derives from an early stage in the evolution of dabbling ducks. Biochemical evidence is likely to be more helpful in testing this hypothesis than are comparative studies of displays.

Acknowledgements

I am indebted to Robert Dye and Sheridan Stone for their significant contributions to data collection and field research. I am grateful for assistance given by members of Ducks Unlimited of New Zealand: Neil Hayes, Peter McLeod, Bruce Wilde, William and Diane Pritt; New Zealand Wildlife Service: Murray Williams and Brian Williams; Waimarino Ward of the Central North Island Wildlife Conservancy; Titch Todd and John Dobson. I would like to extend my special appreciation to Harry and Joan Brown for their generosity and interest during this research.

The study was conducted on land owned by Jeff Fayhe and was funded by Ducks Unlimited of New Zealand, the New York Zoological Society, and an Alexander Bach Fellowship of the National Academy of Science. Transportation to New Zealand was provided by the U.S. National Science Foundation Polar Programs.

I am indebted to Harrison B. Tordoff, Frank McKinney, Milton W. Weller, and Nathan R. Flesness for reviewing various stages of the manuscript. I would like to thank Northern Prairie Wildlife Research Center, Jamestown, North Dakota, for allowing me to use their facilities to draw the illustrations, and especially Ray Thielman for his assistance in preparing the final copy.

Summary

Observations on the display inventory of territorial Blue Ducks *Hymenolaimus malacorhynchos* in New Zealand support the view that the Blue Duck displays are distinct from those of other Anatidae. Blue Ducks may derive from an early stage in the evolution of dabbling ducks but biochemical comparisons will provide the best evidence. Described and illustrated displays include: Extended-neck, Head-bobbing, Upright, Siphon-feeding, Head-low-flight, Chin-lifting, Head-low Rush, Lateral, Dip-shake, and associated vocalisations. None of these displays can be homologised with confidence with displays of other Anatids.

References

Blackburn, A. 1963. Does the Blue Duck blush? *Notornis* 10: 356.
Blackburn, A. 1967. New Zealand's Blue Duck. *Animals* 9: 620–3.
Brush, A. H. 1976. Waterfowl feather proteins: analysis of use in taxonomic studies. *J. Zool. Lond.* 179: 467–98.
Cornwell, G. W. & Bartonek, J. C. 1963. Pseudo-sleeping attitude of the Canvasback. *Condor* 65: 444–6.
Delacour, J. & Mayr, E. 1945. The family Anatidae. *Wilson Bull.* 57: 3–55.
Eldridge, J. L. 1979. Display inventory of the Torrent Duck. *Wildfowl* 30: 5–15.
Johnsgard, P. A. 1961. Tracheal anatomy of the Anatidae and its taxonomic significance. *Wildfowl* 12: 58–69.
Johnsgard, P. A. 1965. *Handbook of waterfowl behavior*. Cornell University Press, Ithaca, N.Y.
Johnsgard, P. A. 1966. The biology and relationships of the Torrent Duck. *Wildfowl* 17: 66–74.
Kear, J. 1972. The Blue Duck of New Zealand. *Living Bird* 11: 175–92.
Kear, J. 1975. Salvadori's Duck of New Guinea. *Wildfowl* 26: 104–11.
Kear, J. & Burton, P. J. K. 1971. The food and feeding apparatus of the Blue Duck *Hymenolaimus*. *Ibis* 113: 483–93.
Kear, J. & Steel, T. H. 1971. Aspects of social behaviour in the Blue Duck. *Notornis* 18: 187–98.

McKinney, F., Siegfried, W. R., Ball, I. J. & Frost, P. G. H. 1978. Behavioral specializations for river life in the African Black Duck (*Anas sparsa* Eyton). *Z. Tierpsychol.* 48: 349–400.
Moffett, G.M. 1970. A study of nesting Torrent Ducks in the Andes. *Living Bird* 9: 5–27.
Moynihan, M. 1955. Remarks on the original sources of displays. *Auk* 72: 240–6.
Pengelly, W. J. & Kear, J. 1970. The hand rearing of young Blue Duck. *Wildfowl* 21: 115–21.
Veselovsky, Z. 1973. The breeding biology of Cape Barren Geese, *Cereopsis novaehollandiae*. *Int. Zoo Yearb.* 13: 48–55.
Williams M. 1967. Observations on the behaviour of New Zealand Anatidae in captivity. Unpublished B.Sc. (Hons.) Thesis, University of Wellington.
Woolfenden, G. W. 1961. Postcranial osteology of the waterfowl. *Bull. Fla. State Mus., Biol. Sci.* 6: 129 pp.

Jan L. Eldridge[1], Bell Museum of Natural History, 10 Church St., S.E. Minneapolis, Minnesota 55455, U.S.A.

[1]Present address: U.S. Fish and Wildlife Service, Minnesota Valley NWR, 4101 East 78th Street, Bloomington, Minnesota 55420, USA.