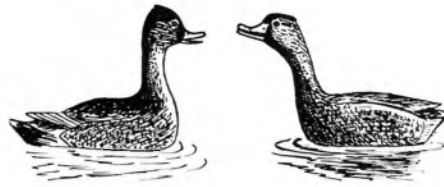


Social behaviour of the Freckled Duck *Stictonetta naevosa* with particular reference to the Axle-grind



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We describe a display posture and call, the axle-grind, of the Freckled Duck. We observed it only in males and it was usually, but not always, directed towards females. The display was first observed in young males reared in captivity when they were five months old. The development of the call was studied and our findings are illustrated by sonagrams. We confirm that a typical duck-like pre-flight signal occurs in the Freckled Duck and discuss other social signals and interactions seen in this aberrant duck.

It has been suggested that "the waterfowl family of today passed, in evolution, through duck-like ancestors before differentiating into swans, geese and others" (Frith 1982). There is evidence that the unique filter-feeding bill mechanism, which characterises the whole group, might have been derived from some primitive wader-like stock (Olson & Feduccia 1980a, Olson 1985). The Freckled Duck *Stictonetta naevosa* of Australia is possibly the closest living species to that ancestor (Frith 1982).

Although Frith (1982) made the point that the Freckled Duck is not so rare as is sometimes suggested, it is one of the least common and most peculiar of Australian ducks. Surveys indicate that numbers have fluctuated enormously in recent years (Martindale 1984, 1988, Braithwaite *et al.* 1987, Hewish 1988, Kingsford *et al.* 1988, Jaensch & Vervest 1988a,b) but an estimate of 19,000 in February 1983 (Martindale 1984) ranked it as one of the world's rarer waterfowl.

Not many years ago there was little knowledge of the general behaviour of the Freckled Duck (Johnsgard 1965a,b, 1978), and much of its biology was poorly known (Frith 1982). Systematic observations by us have spanned a ten-year period during which we have concentrated on the behaviour of captive birds held in near-natural conditions, but we have also watched Freckled Duck in the wild on numerous occasions, including one at a breeding locality.

We take this opportunity to describe some general observations on their social behaviour and to describe a particular, but otherwise unremarkable, advertising signal which is accompa-

nied by a soft call. We believe it has not been reported previously, and refer to it as the axle-grind.

Birds and methods

Ten wild-caught Freckled Duck (eight males and two females) were kept in a large flight aviary, 30 x 25 m with an internal height between 4 m and 6 m. Almost all of the area within the aviary was open water, but nesting platforms surrounded by water and shaded with brush were distributed throughout. The birds were caught in 1979 and have been maintained wing-clipped for most of the time. Early in 1984, 15 hand-reared Freckled Duck (six males and nine females) were added to the initial flock, but two 'pairs' were sent to Slimbridge in October 1985, leaving 21 birds (12 males and nine females) in captivity at Gungahlin, Canberra. They did not begin to breed until 1986, up to which time there had been no signs of pair formation. They have bred and reared several broods in each of three seasons between 1986 and 1989.

We watched Freckled Duck in the wild at several localities in New South Wales and Victoria and in particular at a site where they were breeding on the Paroo River System in the northwest of New South Wales in spring and summer (July to November) of 1983.

Behaviour sequences have been filmed in captivity and in the wild using a Leicina Special super-8 camera. Most material was shot at 36 frames/s and the film analysed frame by frame using a Eumig 610 D projector.

Most of the calls were recorded on TDK MA or Sony HF-ES tape using a Sony-Walkman WM-D6 cassette recorder and a Sennheiser MDH-816T directional microphone. Some 1965 recordings were made using a Nagra 111 at 19 cm/s with a Beyer M100 dynamic microphone. Sound signals were analysed and sonagrams printed using a Kay Digital Sona-Graph 7800. All sonagrams were made using the 0.8 kHz range and a 150 Hz filter and the illustrations are taken from original prints.

General social behaviour

Freckled Duck are typically gregarious especially outside the breeding season and in non-breeding areas. At breeding sites they associate in well dispersed pairs or small groups of males with fewer females. Feeding activity occurs mainly at dusk and through the night but sporadically during the daytime.

A seasonal short-term, sequential, monogamous pair-bond is probably normal but, in captivity, a continuing loose association of pairs after breeding and frequent reformation of pairs in succeeding seasons is common. We have observed polygamous matings in captivity with suggestions of a similar pattern in the wild. The attempted copulation of receptive females by several males in captivity suggests simultaneous polyandry but this is less likely to occur in the wild. Copulation occurs on water with no elaborate pre- or post-copulatory signals: the female adopts a semi-submerged posture with head stretched forwards and tail raised; in mounting, the male grasps the female low on the neck, and coitus is followed by dismounting during which the exceedingly long pseudopenis may connect partners temporarily as they move apart at a wide angle. The female bathes and the male is seen to be trailing a long spiral intromittent organ which is slowly retracted during the preening activity that follows. Pair-bonds are formed briefly with receptive females during the pre-laying stage and maintained until the clutch is laid. The pair-bond then breaks down completely, and males play no part in rearing but females are very defensive of their broods.

Males defend a small area around a potential nest site which is used as a focal point for pair-bond formation. They perform nest-building movements exactly like those of females; twigs, or other similar objects suitable for nest building, are grasped in the bill or broken off adjacent vegetation and passed to the side before being

dropped. This fixed action pattern can take place on water or more commonly when standing or sitting at the site of nest construction. Males can fashion a presentable nest structure and often they do this in captivity before a female adopts the site.

Freckled Ducks have an essentially unmonstrative disposition which could be described as "dour and irascible". They have few, rather cryptic signal gestures and occasional interactions between individuals are often of a querulous nature.

The axle-grind

The *axle-grind* is almost invariably given by males in breeding condition. Sexual maturity and the presence of active gonads in male Freckled Duck is indicated by the base of the bill becoming bright blood-red (Frith 1982, Norman & Norris 1982). An additional feature of breeding males is the blackening of the dark plumage around the face and cheeks, an effect heightened by the luminosity of the red bill. Occasionally, captive males with less than fully red bills have given the *axle-grind* display. These have been individuals either beginning to assume red colouration, or starting to lose colour. The *axle-grind* display is almost always given while swimming but has been observed on land very rarely.

The *axle-grind* is most often given by one or more males in the presence of a female, and is usually directed towards her but it has been observed in situations in which no special orientation was apparent. Often it has been seen following a disturbance of our captive birds, either when they are being fed or simply by reason of our presence in the aviary. We believe it is given by dominant males as a gesture towards other males, and therefore not solely as an advertising signal towards females. We have noted that in both sexes a vigorous tail-wag is a clear gesture of dominance. It is interesting to find this action incorporated as an integral part of the *axle-grind* performance. The female will respond with a *Head-raised chin-lift*, the only known female advertising display, in which the head is raised by stretching the neck upwards, followed by a succession of slow irregular bill-lifting or tilting actions accompanied by a distinctive throaty chuckle.

Male Freckled Duck 'guarding' at nest sites in the wild have been seen moving away on our approach while repeatedly performing the *axle-grind* display. If a male joins a female as she

leaves the nest site during incubation, he will invariably direct several *axle-grinds* towards her as they swim off. Males have even been seen giving *axle-grinds* in response to disturbance caused by a low-flying aircraft (M. Maher pers. comm.). There are no other social displays given in association with the *axle-grind*.

1. *The call.* Once we became aware of the call we likened it to the squeaking of a dry metal axle in a toy - hence the name - but before we had first noted the *axle grind* display we had attributed the sound to creaking of the metal and wire fabric of the aviary! The vocalizations characteristic of the *axle-grind* are so soft that the sounds cannot travel far. Under ideal conditions an experienced observer would be unlikely to detect the call at more than 100 m.

with strong overtones at 7 kHz. These overtones are responsible for our perception of the call as high pitched and "squeaky". There is a final low frequency "moan" that is difficult to hear, but sounds like a drawn out expiration of air.

Sonagrams of calls by adult birds recorded in captivity have been compared with calls of breeding adults recorded in the wild. They show remarkable uniformity in pattern, though most of the lower frequency details are missing unless the acoustic environment is ideal. Most recordings did not reveal the detail shown in Figure 1. From our limited material we have not been able to demonstrate convincing evidence for differences between the calls of individuals, but suspect they do occur, especially in the pitch of the "buzz" and "squeak".

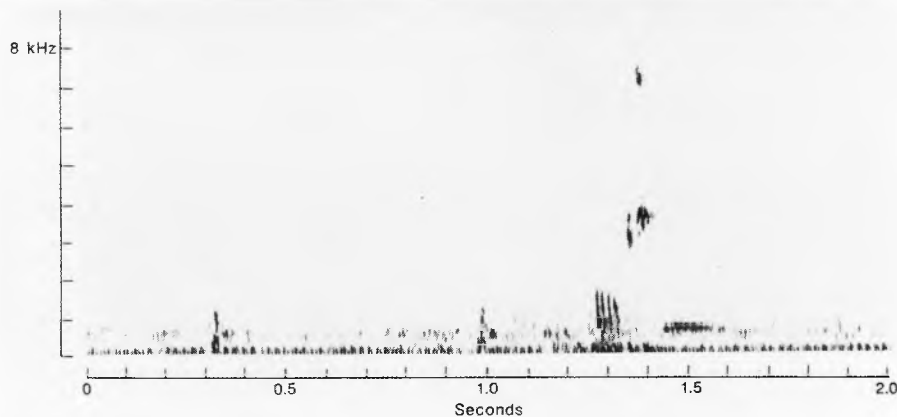


Figure 1. Sonagram of *axle-grind* call of adult male Freckled Duck. Ambient noise, mostly water splash, causes some confusion at frequencies below 800 Hz, but the two low frequency introductory notes, the 'buzz' and 'squeak', and the soft 'hooo' can be seen (see text). Note the energy present at low frequency below some of these segments of the call. Recordings made by F.N. Robinson, October 1965 of a captive bird, Canberra (CSIRO tape catalogue B95).

Some indication of the structure of the call is given by the sonagram in Figure 1. The fully developed call sounds like a rapid double note in which a low "buzz" is followed by a brief "squeak". In fact careful examination of recorded calls and sonagrams reveals that it is usually preceded by two soft and low frequency grunt-like notes. These occur at about 1 second and 0.3 of a second ahead of the main part of the call. The audible "buzz" is caused by four sharp pulses of sound centred on 1 kHz, but at this time there is some very low frequency energy (under 100 Hz) in the call. This can be seen on the sonagram, masked to some extent by ambient noises. The "squeak" is a concentration of energy at about 3.5 kHz forming a double note

Several of the hand-reared Freckled Duck began *axle-grinds* in late March and early April 1984, when they were about five months old. Their postures closely resembled those of adult males, but the display was accompanied by calls that were altogether different and lacked any squeaky component. They gave a choking "geroo...gerook-gerook-gerook-gerook" sound. The bill of these birds first showed signs of redness a month later in May. Sonagrams of these first calls show a concentration of energy below 2 kHz and a three part structure to each of the repeated segments of the call (Fig. 2a). These calls were sometimes given singly, but often in groups at evenly spaced intervals of about 0.4 seconds (as shown in Fig. 2a).

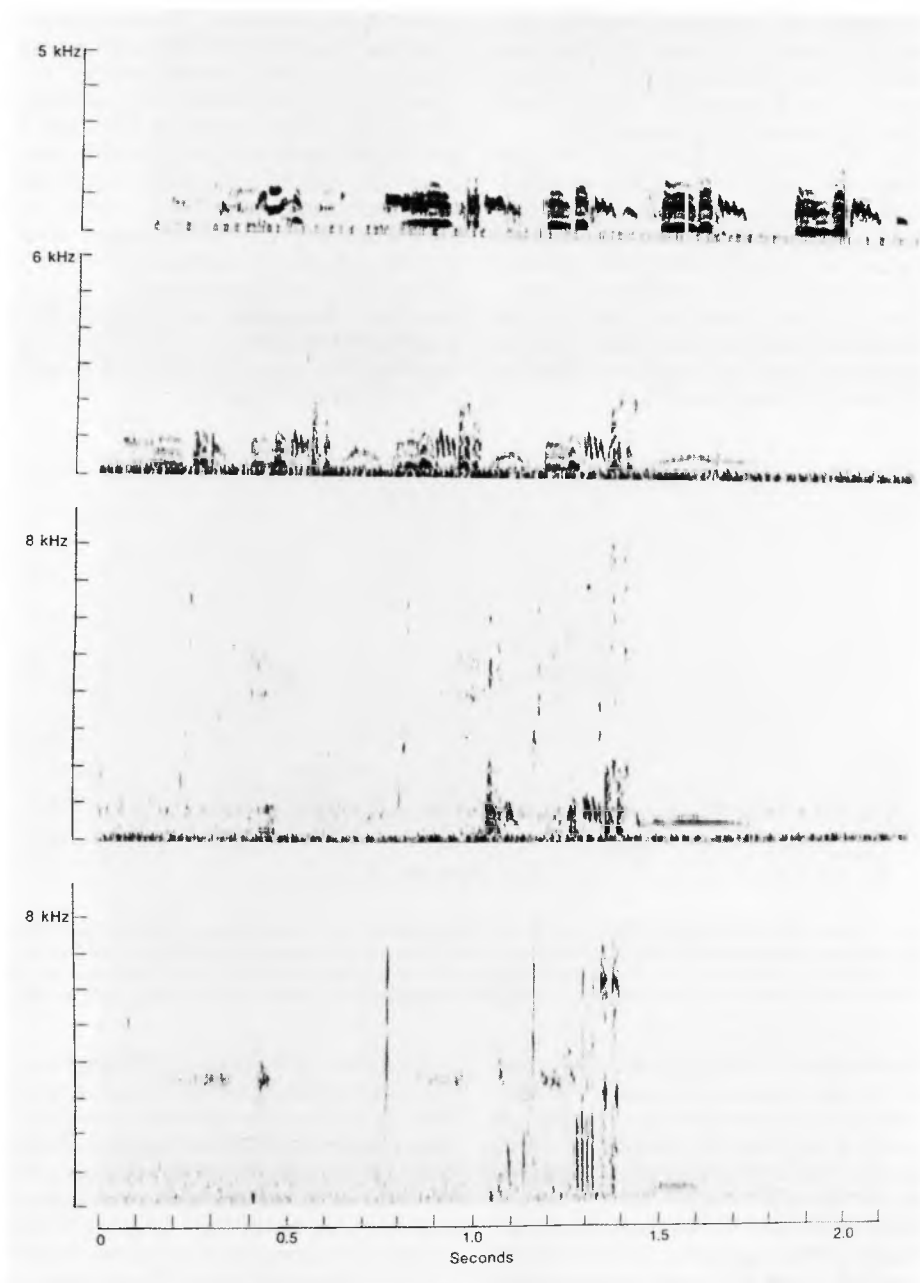


Figure 2. Sonograms of calls of a young male Freckled Duck (a) April 1984; (b + c). Two calls of same male June 1984, compared with (d) the call of a 2.5 year old, October 1986. Ambient noise confuses most frequencies below 1 kHz. Sonograms have been aligned vertically at the point we suggest represents the 'buzz' segment of a call in the top sonogram.

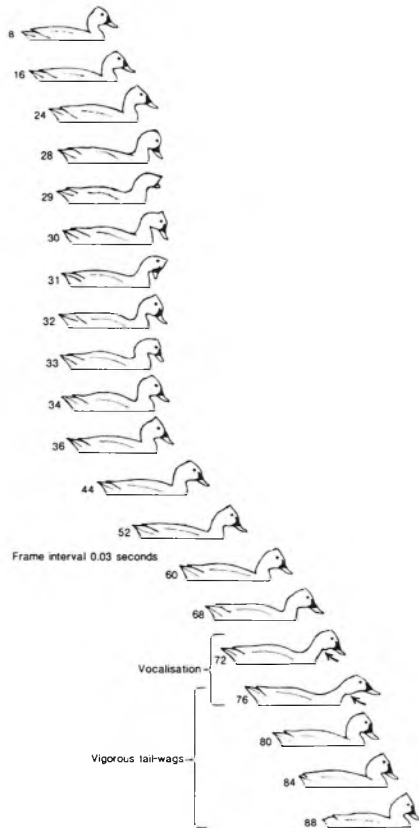


Figure 3. The axle-grind display of Freckled Duck illustrated by selected frames (numbered) drawn from a film sequence. Frame interval 0.03 seconds.

By June the calls of these young males were showing features which more closely resembled the fully mature *axle-grind* sounds. They were still not 'squeaky' and might be rendered in the form "geruk...geruk...gruk-gra-hooo" (see Fig. 2b). There is an indication of the "buzz" sound, but this portion of the call also resembles the last part of the triple call structure heard in April. A strongly exhaled sound or "moan" completes the call. Of two recordings made on the same day from the same male, one (Fig. 2b) is more like the earlier call (Fig. 2a), whilst the other (Fig. 2c) resembles more closely the fully developed call (Fig. 1). A recording of the call from a 2.5 year old male (Fig. 2d) matches closely this adult version. The low frequency introductory notes are poorly developed but they are represented by strong signal at about 3 kHz. Sharp clicks just before the main part of the call are revealed by higher resolution recordings.

These recordings and their sonagram analyses suggest the manner in which the full call is derived from the earliest attempts at vocalizations in the *axle-grind* display. They show the gradual perfection of the call over a period of several months. If this is a correct interpretation of the development of the call, then we see deletion of some segments of the earliest call, development of energy in new positions in the time sequence and modification of the frequency (pitch) of one of the new segments. The introductory portions of the final call may be the degraded "relics" of the first two of the four part sequence often given by younger males. There is also an associated change in rhythm.

2. *The posture.* In Figure 3, the display is depicted in profile as revealed in frame by frame analysis of film. The performance takes a little under 2.5 seconds and is characterised by an initial head-shake from side to side with the bill pointed downwards, followed by the forward thrust of the head, which is accompanied by the soft squeaky vocalization. The display always ends up with vigorous lateral tail-wagging.

The whole sequence may start or finish with the bill being dipped deep in the water. However, two elements may be omitted from high-intensity episodes of *axle-grinding*: the initial head-shake and bill-dipping. Throughout the display the forehead and crown feathers are raised; increasing the distinctly peaked appearance of the head; a feature so typical of Freckled Ducks. When displaying the head position is distinctive. The bill is inclined downwards at a steep angle, thus enhancing the frontal aspect by contrasting the red of the bill against the blackness of the face.

Pre-flight signal

Because there has been some confusion in the past about the existence of a pre-flight signal in the Freckled Duck (Johnsgard 1965a) we have included a description of it here for completeness. The pre-flight signal of the Freckled Duck is shown in Figure 4. The head is raised fast and lowered more slowly. Often this action is repeated many times. It is generally given silently. Sometimes before these pre-flight signals are given birds will gather together and some of them call using a harsh, barking version of the typical raucous roar described by Frith (1982). This call is now known to be given only by females.

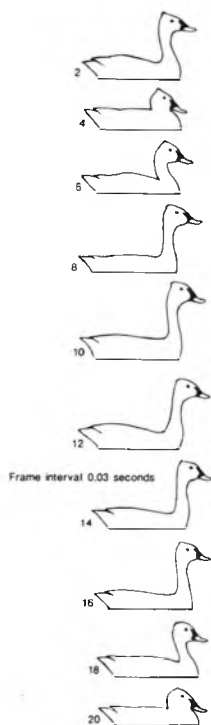


Figure 4. The pre-flight display of Freckled Duck (see Figure 3 for further details).

Discussion

Most calls of the Freckled Duck are feeble. Frith (1982) reported that they are rarely heard in the wild, but he provided some sonagrams to illustrate the repertoire of calls known to him. It is clear that he failed to perceive our *axle-grind*. Frith's description of a soft flute-like pipe "wheeyu" as an alarm call delivered with the head and neck erect and the bill extended vertically is unknown to us and does not occur. We have examined sound recordings in the CSIRO tape collection and conclude that this call was wrongly identified. The vertical bill posture described by Frith has never been seen by us, nor anything resembling such a posture in spite of long periods of observation of Freckled Duck in the wild and especially in captivity. However, our colleague Dr L.W. Braithwaite has drawn our attention to some observations made by him in February and March 1965; from his unpublished notes it is clear that he saw *axle-grind* displays given by captive Freckled Duck held at that time by Dr H.J. Frith at Gungahlin,

Canberra. We have traced some 16 mm colour film, undoubtedly exposed at that time, which records several *axle-grind* displays. A tape recording made by F.N. Robinson in October 1965, evidently of the same birds observed by Braithwaite, includes several clear examples of the *axle-grind* call. Indeed, we have made use of these recordings in this study. Apparently these early observations were overlooked by Frith when preparing his account of Freckled Duck calls and displays (Frith 1982).

The 'raucous roar' mentioned by Frith (1982) is the common sound given by both sexes during confrontations. Its intensity is greatly increased when fighting breaks out between individuals. A loud sharp version is given by females, often at dusk.

When alarmed, Freckled Duck stretch their long necks into an elevated head posture as do most wildfowl. The distinctive pre-flight posture is given without vocalization and is similar to signals given by other waterfowl preparatory to take off, especially those of *Anas* species (McKinney 1965).

Johnsgard (1965b, 1978) described a social display which consisted of "a rapid and extreme vertical neck-stretching, associated with gaping (and probably calling) performed by one bird towards another while facing it, and to which the other responds in the same manner". He suggested that he was watching hostile encounters between birds because each performance was preceded by a forward neck-stretching. Johnsgard interpreted these observations as a mutual threat display. We have observed many hostile actions between Freckled Duck that resemble Johnsgard's description and often they end only when the contestants have reared up 'roaring' at each other, while staring almost bill tip to bill tip. Contestants may give forward neck-stretches towards one another, again roaring and holding the position in a protracted mutual stare with bills almost touching. In the most aggressive encounters, one bird will jab or try to 'ride-down' the other in a flailing of wings and twisting of necks. Vigorous lateral tail-wags are almost always given by the victor following any of these confrontations.

There is strong evidence that the *axle-grind* display indicates elevated sexual condition and is not given by males in the non-breeding state. The display may therefore be equivalent to the *Grunt-whistle* in *Anas* ducks.

It has been suggested that *Stictonetta* might be distantly related to the stiff-tail ducks, the Oxyurini (Johnsgard 1965 b), and some similarities can be seen between the Freckled Duck

axle-grind and the *toad-call* of the male Black-headed Duck *Heteronetta atricapilla*. The *toad-call* includes a head pump associated with a soft but complex call, tail and wing-lifting movements and a final tail wag. A sideways head shake often precedes the display. *Toad-calls* are usually given on water (see Johnsgard 1965a, Weller 1968, Carbonell 1983 for more detailed descriptions). This simple and often repeated

of the displaying male Musk Duck *Biziura lobata* have been described in detail (see Fullagar & Carbonell 1986), but an example of the associated call is shown by the sonagram in Figure 6. Again, some similarities between the male displays of Musk Duck and Freckled Duck are apparent, specially when comparing the structure and rhythm of their calls. Added weight to the idea of an oxyurine affinity for the Freckled

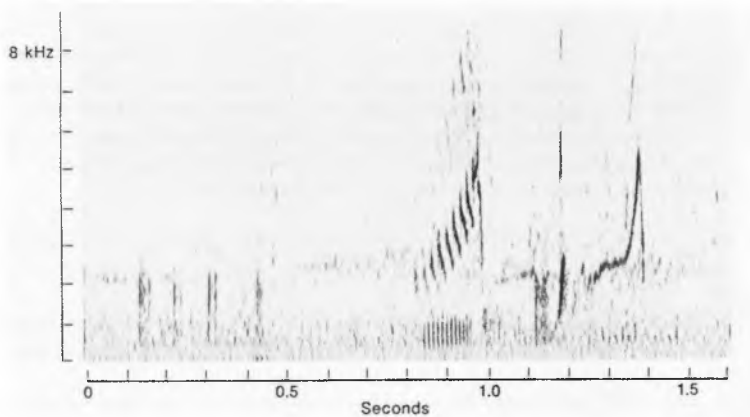


Figure 5. Sonagram of toad-call of adult male Black-headed Duck *Heteronetta atricapilla*. Sharp 'click' notes in pairs (4 in this version) are followed by a 'buzz' (at ca 0.9 s), a liquid 'plop' (at ca 1.15 s) and a final flourish. The call might be rendered as: 'dud-dud-dud-dud.....dree-WHIT-drer', ('gr-rump-freet' according to Weller 1968). Recorded at the Wildfowl and Wetlands Trust, Arundel, May 1986.

display seems to be the only signal given in courtship by male *Heteronetta*. A sonagram of the call is given in Figure 5. The bizarre postures

Duck is given by the findings from DNA hybridization studies (Madsen *et al.* 1988), which also suggest an early separation of these ducks

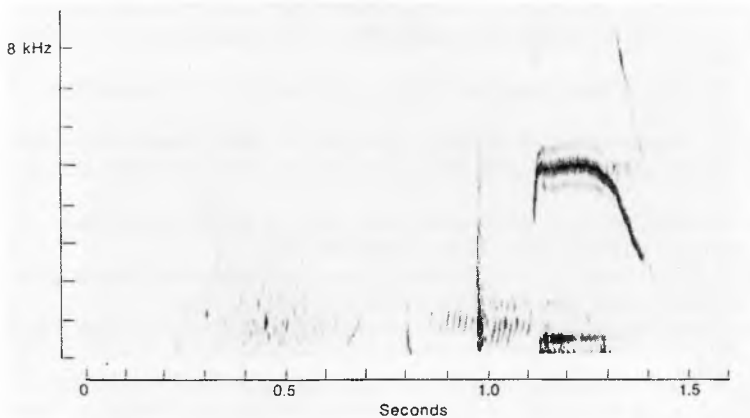


Figure 6. Sonagram of a call of adult male Musk Duck *Biziura lobata*. The foot splash is followed by a sharp 'cuc' (at ca 0.8 s) then a whirring sound during which a second but louder 'cuc' is given (at ca 1.0 s) before the high intensity whistle. Note the exhaling 'moan' shown by the low frequency component simultaneous with the whistle. A high frequency overtone on the whistle and some echo effects following the whistle can be seen on this print. Recorded Tidbinbilla near Canberra, August 1986.

during wildfowl evolution.

The cryptic posture and soft call of the *axle-grind* indicate that it is a short distance visual and aural advertising display. It seems to be given only by males in breeding condition, if we assume that red bases on bills are an indication

of sexual activity. It is performed in a range of situations, indicating that it has a broad function from advertising towards females, assertion of dominance between birds and possibly defense of the nest site. We have not observed any other male display.

We thank our colleague Dr Wayne Braithwaite for bringing to our attention his unpublished notes on the behaviour of Freckled Duck made in 1965. Sound recordings made by Norman Robinson in October 1965 and by David Fullagar in June 1984 were of special importance in this study. Andrew Dawney (Wildfowl and Wetlands Trust, Arundel, U.K.) and Bruce Lambie (Tidbinbilla Nature Reserve, Australia) gave invaluable assistance during the recording of calls of some of the waterfowl in their care. We are most grateful to Frank Knight for preparing final versions of Figures 3 and 4 from our draft outlines and to Ederic Slater who prepared the photographic versions of the sonagrams. The Kay Digital Sona-Graph at the Division of Wildlife and Ecology CSIRO was purchased by means of a generous donation from Sir Frederick White F.R.S.

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Three young Freckled Ducks in captivity.



An Adult feeding (suzzling) Fort Grey Basin, New South Wales.



Captive immature male stretching.



Captive adult Freckled Duck taking off.



Freckled Duck nest site, Tongo, New South Wales.



Captive Duckling about five weeks old.