NORTH ISLAND BROWN KIWI VOCALISATIONS AND THEIR USE IN CENSUSING POPULATIONS

By ROGAN COLBOURNE and RUUD KLEINPASTE

ABSTRACT

Vocalisations of the North Island Brown Kiwi *(Apteryx australis mantelli)* were monitored from March 1981 to July 1982 in Waitangi State Forest, Northland. Calling rates were found to be seasonally cyclic and correlated with breeding. Males called more often than females. Four categories of kiwi sounds are described and their possible functions discussed. A census of kiwis based on counts of calls underestimates the population; a banding study in a small area gives a much better indication of kiwi numbers. An estimated 800-1000 kiwis inhabit Waitangi State Forest. Calling rates are density dependent and so can be used for comparison of kiwi population densities between two areas.

INTRODUCTION

Because kiwis produce a variety of sounds and because they have large ear apertures, it is inferred that vocal communication is important and the sense of hearing is well developed. This aural sense, together with the bird's keen sense of smell, may compensate for its reputed near-lack of vision.

At present a census based on calls is the only practical way to estimate a kiwi population on a large scale, and yet very little information on kiwi calls is available. Robson (1947) stated that calling occurred more often in the mating season, and some authors (Buller 1888, Clark 1952) reported that kiwis are particularly active and noisy on dark wet nights whereas on moonlit nights they are generally silent. Moreover calling was found to cease during the incubation period (Buller 1888, 1905). No suggestions were given as to the purpose of kiwi calls.

In 1978 Corbett surveyed the kiwi population in Waitangi State Forest by means of a vocalisation census, and his report included a map showing the locations of kiwi pairs and single birds (Corbett *et al.* 1979). He estimated the population to be 444-520 birds. During our study of kiwis in this exotic forest, it quickly became apparent that a vocalisation census underestimates actual kiwi numbers. This paper records our observations on vocalisations and calling behaviour and evaluates the use of call counts for kiwi census purposes. For a description and map of Waitangi State Forest and the study area, see Colbourne & Kleinpaste (1983).

NOTORNIS 31: 191-201 (1984)

METHODS

From March to June 1981, we monitored kiwi calls from a network of listening stations spaced evenly throughout the forest along roads and firebreaks in compartments 5, 6, 7, 8, 9, 25, 26, 27, and 31. Listening stations were visited for at least 1 hour, and up to 3 hours at a time if the station commanded a good acoustic advantage. Listening, done mainly on wind-free nights, started 40 minutes after sunset, and data on weather conditions, degree of darkness, and phase of the moon were noted on field sheets. Each observer recorded the following information: position of listening station, time of call, sex of calling bird, number of cries per call, direction (compass bearing), and estimated distance of calling bird. The locations of calling birds, often obtained from cross bearings, were plotted on to detailed maps. It took us 3-7 nights to survey each compartment.

From June to December 1981, we duplicated exactly Corbett's listening schedule of 1978 (Corbett *et al.* 1979) for the above compartments to determine any changes in calling rates. The maximum number of calls per hour was noted for each month throughout the study.

From May 1981 to July 1982, we banded 79 kiwis in our study area (compartments 5-9). Resightings and recaptures of these individually colour-coded birds and knowledge of the positions of unbanded birds enabled us to determine accurately the number and distribution of kiwis in the study area.

RESULTS AND DISCUSSION

During our study four categories of kiwi sounds were distinguished:

1. Loud calling (song);
2. Sniffling and grunting;
3. Mewing or purring; and
4. Billsnapping, hissing, squealing, and growling.

CALLS

The loud call of the North Island Brown Kiwi consists of a series of cries, a throaty *ah-eh* of the female and a shrill *ah-eel* of the male. While calling, a kiwi often attains an erect posture, throws its head upwards, uttering a cry when the beak is held vertical. It then quickly bows its head in preparation for the next cry. A call can comprise 1-42 continuously repeated cries, but a series of about 20 cries per call, lasting about 30 seconds, is the average. Some kiwis uttered a short series of cries while others called longer, but individuals could not be identified reliably by this means alone. Apart from some alterations of cries in a series most calls sounded very similar. One male's call had a vibrato reminiscent of a Little Spotted Kiwi *(Apteryx owenii)*. As many birds appear to have a finer time perception than

humans and are hence able to distinguish notes that, to our ears, would merge into a uniform sound (Thorpe 1964), the monotonous calls may mean more to kiwis than they convey to us. Sonograms of kiwi calls might reveal finer aspects of the structure of calls and the function of calling in social structure and behaviour.

Territory and pairbonding

Colbourne & Kleinpaste (1983) showed the kiwi to be a strongly territorial bird, and hence it is likely that the function of kiwi calls is closely analogous to that of passerine song. In passerines, singing is widely used to proclaim occupancy of a territory and is particularly important in enclosed habitats where contact is seldom visual. Typically, when a kiwi of either sex called it was answered almost immediately by its mate. The initial calls were usually by males and often birds from the neighbouring territories (mostly males) responded shorty afterwards.

Of 1032 calls recorded, 75.3% were from males, a ratio of three male calls to one female call. However, the higher-pitched sound of a male carries further than the hoarse cries of a female, causing a bias towards males in the calling ratio. To eliminate this bias, we excluded all calls estimated to be further away than 200 m — a distance inside which the female's call is always heard. The result was a male: female calling ratio of 2.54:1, still a considerable male dominance. As males defend the territory, their frequent calling and loud shrill voice facilitate this task: a male bird can be heard anywhere in a territory of 3-5 ha.

Thorpe (1964) stated that singing can be a substitute for fighting and that it probably plays an important role in preventing the development of actual physical combat. During our study only two kiwi fights were seen, but we often observed that a trespassing kiwi hastily retreated to its own territory after excited and repeated calling by the male of the territory it was in (Colbourne & Kleinpaste 1983).

Often the male and female of a kiwi pair called simultaneously or shortly after each other, and we believe that this "duetting" helps to maintain the pair bond. Duetting often occurred early in the evening when a pair emerged from different, widely spaced burrows ("contact calls" or "waking-up calls") but it also occurred when the male and female were very close together. When a bird was displaced or chased out of its territory, e.g. for banding purposes, the displacement sometimes initiated a burst of calls, which was often answered by the bird's mate and sometimes by its neighbours. These reply calls may guide the displaced kiwi back to its own territory and mate. On many occasions kiwis were observed to stop and call while we were chasing them.

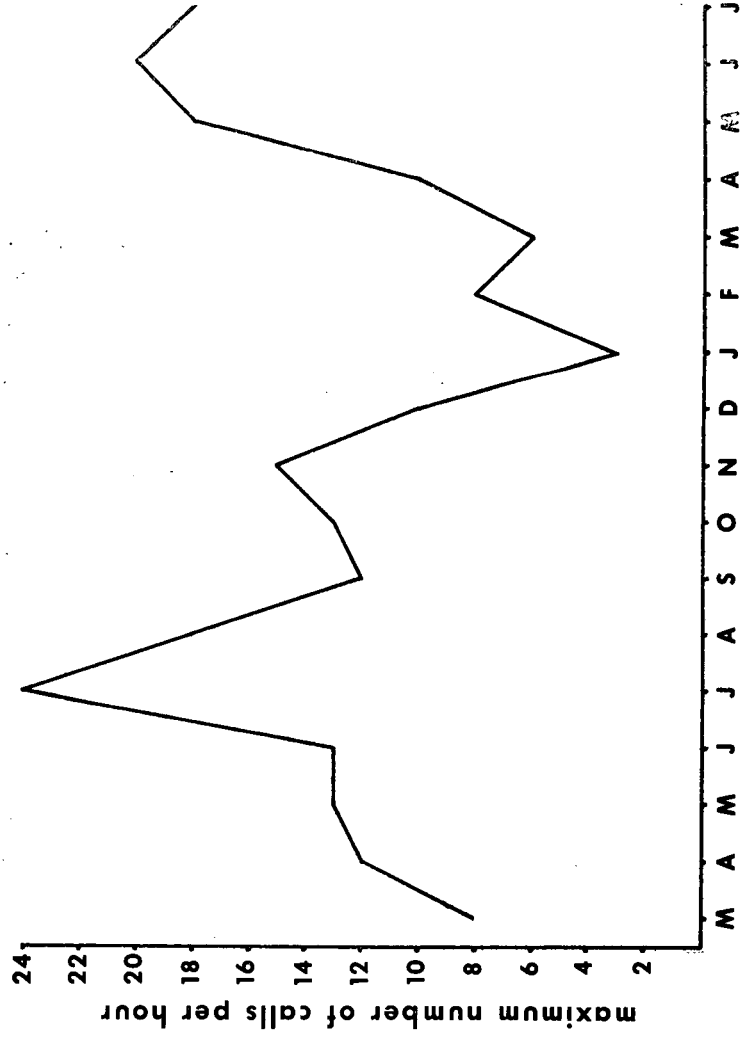

FIGURE 1 — Kiwi calling rates in Waitangi State Forest, May 1981-July 1982

Breeding

Song is primarily under the control of sex hormones and is generally linked to the reproductive cycle (Thorpe 1964). A rise in the level of testosterone in the blood produces a dramatic increase in the aggressiveness of many birds, often involving the defence of a territory (Marler 1964). Probably the kiwi is the same as other birds in this regard. Calling rates were highest from June to August (Fig. 1), which coincides with the main mating period in Waitangi State Forest (Colbourne & Kleinpaste, in prep.). Kiwis called least in mid-summer.

Nightly fluctuations

Kiwi calling rates fluctuated not only seasonally but also nightly. On two consecutive nights with identical weather the number of calls per unit time could vary greatly. Occasionally kiwis were heard calling during heavy rain or with high winds, but, under those conditions, increased levels of background noise considerably reduced the receiving distance and hence the area monitored by the observer.

Of all factors, the brightness of the moon was found to affect calling rates most. In the period from first quarter through full moon to last quarter, the forest could be absolutely silent, especially when the moon was high overhead. Usually kiwis could be heard feeding (sniffling) and moving through the undergrowth, but they seemed very wary. On some nights with a very bright full moon, the complete absence of any kiwi sounds made us wonder if the birds remained in their burrows. Dark moonless nights in general gave the highest calling rates, but on very black nights the calling rates were often reduced.

Juveniles

In captivity juveniles do not make the adult call until their first year (Robson 1947). Reid & Rowe (1978) found that the male adult starts calling when about 14 months old and that the female starts calling when about 2 years old.

Eighteen juveniles were banded: however, none were subsequently heard calling when subadults later in the study. Juveniles are tolerated within their parents' territory for at least one year (Colbourne & Kleinpaste 1983), after which they leave or are evicted and can be found roaming randomly through the forest. Until a roaming subadult male finds itself a vacant territorial area it would gain by remaining relatively silent as calling could court trouble from territory owners.

On one occasion a chick under parental care was heard to call. This was very distinct and sounded intermediate between male and female calls but with longer intervals between cries. Occasional chick calls may help maintain the family unit.

Surveying

On a few occasions kiwis were heard calling only 5 minutes after sunset, but usually calling began 45 minutes after sunset with the maximum calling frequency occurring during the first 1-3 hours of darkness. During the rest of the night, until dawn, irregular bursts of vocal activity revealed the kiwi's presence. Dense vegetation was found to muffle kiwi calls, whereas certain topographical features such as certain valley configurations amplified them. In general, in flat forest with still conditions, calls could be heard up to a distance of 350 metres; over clearfelled areas they could be heard faintly about 1 km away.

Cross bearings and estimated distance were usually accurate when a kiwi called from within 200 metres of both observers. Calls from further afield were often misinterpreted, resulting in inaccurate compass bearings and/or wrongly estimated distances. When the two observers were too far apart confusion arose sometimes when two neighbouring birds called simultaneously and were plotted as one. These errors occurred most in steep dissected terrain. We found a distance of 100-200 metres between listening stations to be ideal.

On windy nights listening became very difficult as the source of the calls appeared to change with each gust and often the first cries seemed to come 180° away from the true direction.

OTHER SOUNDS

Sniffling and grunting

These sounds are associated with feeding. While searching for food in soil and litter, kiwis rely on their well-developed sense of smell and the sniffling noises, which are also made when clearing the nostrils of dirt after probing, can be audible for up to 15 metres. Nasal grunts were mainly produced when a pair was feeding close together and so grunting may serve to maintain contact between birds at close range.

Mewing and purring

Reid & Rowe (1978) suggested that these sounds may precede mating. In all observed cases the pair were very close together and the mewing, often culminating in loud purring, was audible up to 50 metres away. These noises could be heard from May to November, but most frequently in June. On one occasion we heard a copulating kiwi produce rhythmical purring sounds.

Billsnapping, hissing, squealing and growling

When handled, both sexes could produce a range of sounds which varied from hissing to a deep guttural growling. Loud bill-snapping noises were predominantly made by males, whereas females tended to utter more pig-like squeals and growls. The sounds produced

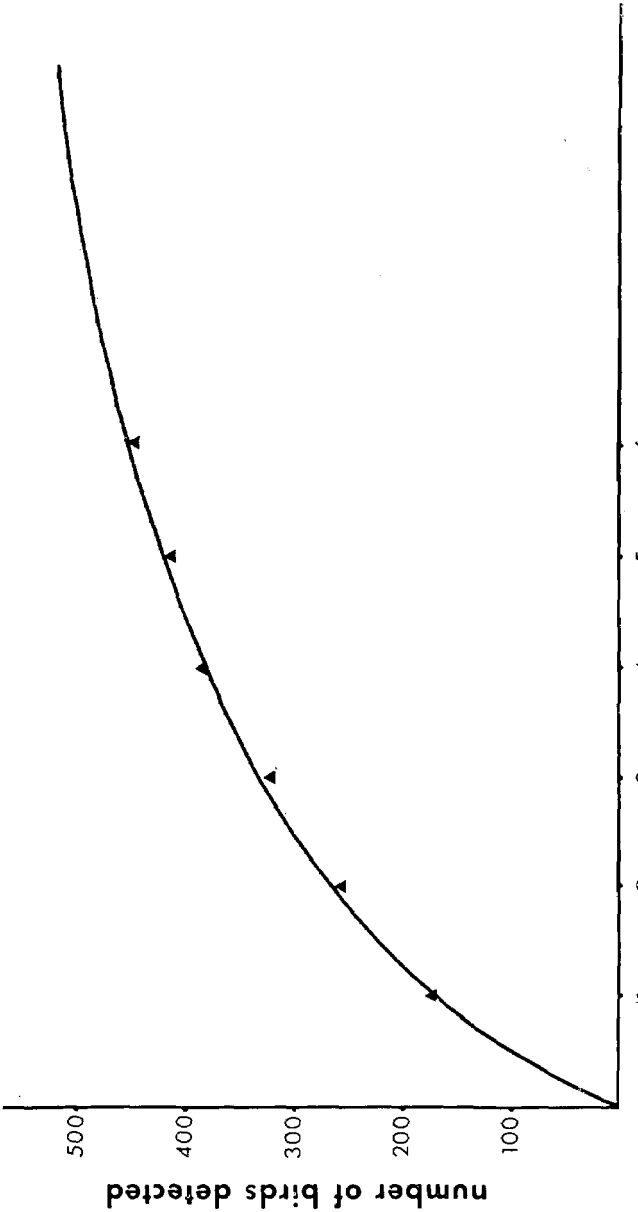

FIGURE 2 — Estimation of Brown Kiwi population (520 birds) by extra-polation of data from a 1978 *vocalisation census* (*after Corbett et al.* 1979)

differed between individual kiwis and possibly reflected differences in 'personality and moods.' Billsnapping and growling were heard several times when two males were fighting, which suggests that these sounds are associated with aggression or submission.

THE VALUE OF CALLS FOR CENSUS WORK

Comparison of 1978 and 1981 vocalisation censuses

The 1978 survey of Corbett *et al.* (1979) to estimate the population size and distribution in Waitangi State Forest was based solely on kiwi calls. Corbett monitored the whole forest from June to December 1978 by systematically following a listening schedule. His 112 listening stations were spread evenly and gave as much coverage of the forest as possible. Each station was visited six times during the 7-month period for an average of 12 minutes per visit. The population size was estimated from the data by accumulating the number of new birds found. The rate of finding new birds decreased with increasing number of visits to listening stations. When the number of kiwis was plotted against the number of visits on a graph, the curve approximated an asymptote: the estimated population size of 520 birds. See Figure 2.

As a result of a detailed listening census of the population in five compartments in two major forest areas from March to June 1981, we arrived at figures exceeding those found by Corbett (Table 1). The discrepancy was especially large in compartment 6: our census method, however, differed from Corbett's method because we visited many more and more closely spaced listening stations, each for a longer period of time. Moreover, the possibility of taking cross bearings of calls greatly enhanced the accuracy with which each bird could be plotted. By applying Corbett's criteria to our census results, we could estimate that 600 kiwis live in Waitangi State Forest.

TABLE 1 — Comparison of estimated numbers of Kiwis in certain parts of Waitangi State Forest, as revealed by vocalisation census methods in 1978 (Corbett et al. 1979) and 1981 and by a banding study in 1981-1982.

Compartment	Area (ha)	Census Jun-Dec 1978	Census Mar-Jun 1981	No. Banded 1981-82	Total Birds (est.)
5	54	10	14	15	35-40
6	84	1	18	19	30
7	84	12	15	13	19
8	88	18	27	22	30
25	93	4	3	-	-

The exact duplication of Corbett's census methods, with identical listening stations, sequences of visits and listening periods (June to December 1981), yielded a 1% increase in the number of calls from the western compartments (25-27 and 31) and a 1% decrease in the number of calls in the eastern compartments (5-9). Both differences were not significant.

Banding study and vocalisation census

The ideal way to know the size of a kiwi population is to band as many birds as possible until no unmarked kiwis are caught or seen over a long period. Soon after starting the banding programme in the study area, it became apparent that our census of calls (March to June 1981) was greatly underestimating the number of birds present but that we could reliably estimate the number of kiwis in our study area when we thoroughly knew the positions and territories of banded and unbanded birds.

To evaluate the accuracy of a vocalisation census, we intensively monitored compartment 6 for calls from April to June 1982, using five listening stations that gave complete coverage of that compartment. Banding (Colbourne & Kleinpaste 1983) revealed the presence of 30 resident kiwis: 24 adults (12 pairs) and 6 juveniles. In addition, some transitory females and roaming subadults were known to visit this compartment, but these birds were not considered to be long-term inhabitants. By listening for a total of 15 hours, knowing the positions of permanent territories, we could differentiate 16 birds (9 males), but without this knowledge only 13 kiwis (7 males) could be plotted with confidence. Therefore, our vocalisation census, done in a medium-to-good calling period of the year (Fig. 1), revealed only 54% of the adults, that is, 43% of the kiwi population. A similar survey in a 25 ha strip of mature *Pinus elliottii* in compartment 7 identified three pairs of kiwis, whereas banding revealed the presence of ten birds. That is, detection was only 60%.

These results and similar observations in compartments 2, 5, 8 and 9, suggest that substantial numbers of kiwis in the population do not call as frequently as others. Combining these findings with the March-June 1981 vocalisation census results, we could estimate the kiwi population in Waitangi State Forest at 800-1000 birds, giving an overall density of one kiwi per 2.9-3.6 ha. When allowances are made for areas which are unsuitable as kiwi habitat (deep swamps, clear-felled and recently planted compartments) and areas which have few kiwis (compartments 16, 24 and 25), these figures are comparable to the reported territory size of about 5 ha per pair (Colbourne & Kleinpaste 1983).

Problems with vocalisation census

Preferably, kiwis should be counted by calls when the birds are calling most; summertime appears to be the least and winter the most suitable period for surveys (Fig. 1). At Waitangi, an average

visit of 12 minutes per listening station is not long enough to pick up all the response calls from neighbouring birds. We recommend one hour per station as a reasonable length of time. Visits much longer than an hour compound the problem caused by kiwis changing position within their territory. Similarly, if a survey is extended over several nights, confusion may arise as to whether a bird, plotted on a particular site, is the same bird as was recorded 100 metres further away on a previous night. Only knowledge of the exact location and shape of territories can resolve these problems.

Obviously, juveniles are not picked up during a vocalisation census and apparently some adults call very infrequently or not at all. As calling rates are correlated with the breeding cycle, the presence of silent adults could indicate that not all adult kiwis breed every year.

Use of calling rates as a population index

Establishing calling rates by counting kiwi calls on several successive nights would be a relatively simple method (and far less time consuming than a banding study) to index the kiwi population density in a certain forest compartment. Calling rates were found to differ from area to area. In compartment 5 the kiwi population density was one and a half times greater than in compartment 6, and yet the calling rates were generally about three times higher. Recent clear-felling on each side of compartment 5 had probably caused a build-up of kiwi numbers there as the population density (1 kiwi per 1.5 ha) proved to be higher than elsewhere. With smaller territories the chance of border encounters by kiwis increases and hence the frequency of vocal display is likely to increase.

On the basis of this observation, we surveyed four Northland forests, Puhipuhi, Glenbervie, Waipoua and Puketi State Forests. By comparing the calling rates in these forests with the calling rate in the control area (compartment 6 of Waitangi State Forest), we could gain an impression of the relative kiwi population densities (higher calling rates, higher kiwi population density; lower calling rates, lower population density). Puhipuhi and Waipoua State Forests had higher calling rates than the control area, Glenbervie State Forest had about the same rate, and Puketi State Forest had a lower rate. These results were supported by the level of probing sign found in these forests.

Calling data should be interpreted very carefully. When comparing calling rates between two forests it is important to monitor calls in each forest for several successive nights to get an average calling rate for that forest. This reduces the effects of erratic calling by kiwis on some nights. It would be desirable to obtain much more data, linking kiwi population densities with calling rates, so that calling rate comparisons can be more reliable.

ACKNOWLEDGEMENTS

We would like to thank the New Zealand Forest Service for funding our kiwi study, for the use of their equipment and facilities, and for permission to use the 1978 survey results of Harold Corbett, Brian Reid and Peter Thode.

We are grateful to Anne Grace, Barrie Heather and John Innes for improving earlier drafts of this paper and to Mrs Marjorie Davidson for typing these various drafts.

LITERATURE CITED

BULLER, W. L. 1888. A history of the birds of New Zealand (2nd ed.) Vol. 2. London: The author.
BULLER, W. L. 1905. Supplement to the birds of New Zealand. Vol. 1. London.
CLARK, J. D. 1952. Random notes on the kiwi. Notornis 4 (8): 211.
COLBOURNE, R. M.; KLEINPASTE, R. H. 1983. A banding study of North Island Brown Kiwis in an exotic forest. Notornis 30 (2): 109-124.
CORBETT, H.; THODE, P.; REID, B. 1979. A survey of kiwis within an exotic forest. Unpubl. Report NZFS.
MARLER, P. R. 1964. Aggression in Thomson, A. L. (ed.). A new dictionary of birds. *London: Nelson.*
REID, B.; ROWE, B. 1978. Management of kiwis in captivity. Otorohanga Zool. Soc. Prog. Rep. 27 pp.
ROBSON, F. D. 1947. Kiwis in captivity. Bull. Hawkes Bay Art Gall. Mus. Napier.
THORPE, W. H. 1964. Singing in Thomson, A. L. (ed.). A new dictionary of birds. London: Nelson.

ROGAN COLBOURNE, *Wildlife Service, Department of Internal Affairs, Private Bag, Wellington;* RUUD KLEINPASTE, *Ministry of Agriculture & Fisheries, Mount Albert Research Centre, Auckland*

★

SHORT NOTE

SWALLOWS AT SEA AND ESTABLISHED ON THE KERMADEC ISLANDS

Welcome Swallows have been reported at sea to the north-east (Jenkins 1978), the north-west (Lovegrove 1978), and the west (Syms 1978) of mainland New Zealand. In a recent trip from Auckland to Raoul Island, we saw Welcome Swallows out to sea and on the Kermadecs.

On 16 March 1984 at 0812 h one Welcome Swallow briefly circled our yacht and then disappeared. Our position was 179°15'E 32°20'S, which is about 470 km NNE of Great Barrier Island and 200 km SSW of L'Esperance Rock. Later the same day at 1430 a pair of Welcome Swallows flew close to the yacht and stayed with us for minutes. We were then 160 km SW of L'Esperance Rock. All were flying strongly. Our route took us between Curtis and Cheeseman Islands in broad daylight, but no more swallows were seen till we were ashore on Raoul Island.

On Raoul, swallows were seen daily feeding over the paddocks near the Meteorological Station. The greatest number seen foraging