# ESTIMATING THE FRESH WEIGHT OF THE EGGS OF BROWN KIWI (*Apteryx australis mantelli*)

By BRIAN REID

## INTRODUCTION

Land development schemes in recent years have 'unearthed' a surprising number of Brown Kiwi eggs. The artificial incubation of these eggs might have been more successful if the stage of development of the embryos had been known. Some information on weight loss during incubation is available from studies at Mt Bruce and Otorohanga, but this is of only limited value when the fresh weight of recovered wild eggs is not known.

An approximate measure of 'freshness' can be obtained from the buoyancy of an egg — if fresh it sinks rapidly but with continuing embryonic development it floats progressively higher in water. Barry Rowe of the Otorohanga Zoological Society was introduced to another technique of considerable value when delivering kiwis to Dr R. Faust of Frankfurt Zoo. This technique has long been used by German gamekeepers. It involves placing a light (dry) grass stalk or feather transversely across the top of the egg. Any slight, and otherwise undetectable, movements of the embryo are magnified in the readily visible vibrations of the stalk — even heart-beats may be seen as a series of slight but regular see-saw movements. This method also has the important advantage of showing whether the embryo is alive, but it shares the limitations of the immersion method in not showing the approximate age of the embryo, although the patterns and vigour of the stalk's movements may indicate that the embryo is an early one or at a more active late stage.

Estimations of age should be possible if patterns of weight loss during incubation are similar for all Brown Kiwi eggs and, also, if there is a fairly precise relationship between the linear dimensions and the weight of these eggs. Investigations on changes in weight during incubation are continuing at present. This paper is confined to aspects of the size/weight relationship of fresh eggs.

Reid (1971, *Notornis* 18 (4): 245-249) reported that in a sample of only two eggs the fresh weights agreed to within 1% of the weights obtained from the expression $W = 0.565\ ab^2$, where $a$ is the length and $b$ the maximum transverse diameter.

TABLE 1 — Actual and calculated fresh weights of Brown Kiwi eggs

| Source of Eggs* | Dimensions Lth x Diam | L : D Ratio 100: | Weight (g) Actual Fresh | Calc $.565ab^2$ | Difference g | % |
|---|---|---|---|---|---|---|
| Wild | 127.1 x 78.2 | 61.526 | 429.8 | 439.1 | +9.3 | +2.16 |
| Wild | 123.7 x 77.2 | 62.409 | 408.6 | 416.5 | +7.9 | +1.93 |
| M.B. | 98.5 x 68.6 | 69.645 | 258.5 | 262.1 | +3.6 | +1.39 |
| W.Z. | 113.2 x 74.6 | 65.901 | 347.3 | 352.0 | +4.7 | +1.35 |
| M.B. | 122.5 x 75.0 | 61.224 | 384.2 | 389.3 | +5.1 | +1.33 |
| M.B. | 116.7 x 72.4 | 62.039 | 341.7 | 345.5 | +3.8 | +1.11 |
| W.Z. | 118.3 x 75.7 | 63.990 | 379.0 | 383.0 | +4.0 | +1.06 |
| O.Z. | 125.0 x 74.0 | 59.200 | 383.0 | 386.7 | +3.7 | +0.97 |
| M.B. | 125.4 x 81.6 | 65.071 | 467.2 | 471.7 | +4.5 | +0.96 |
| M.B. | 118.1 x 75.3 | 63.760 | 374.9 | 378.3 | +3.4 | +0.91 |
| Wild | 129.0 x 75.0 | 58.140 | 406.5 | 410.0 | +3.5 | +0.86 |
| M.B. | 105.3 x 69.0 | 65.527 | 281.0 | 283.2 | +2.2 | +0.78 |
| Wild | 125.4 x 78.6 | 62.679 | 434.6 | 437.7 | +3.1 | +0.71 |
| Wild | 126.4 x 83.0 | 65.665 | 488.8 | 492.0 | +3.2 | +0.65 |
| M.B. | 109.5 x 69.4 | 63.379 | 296.8 | 298.0 | +1.2 | +0.40 |
| O.Z. | 130.8 x 73.3 | 56.040 | 396.5 | 397.1 | +0.6 | +0.15 |
| W.Z. | 112.2 x 75.3 | 67.112 | 360.0 | 359.5 | -0.5 | -0.14 |
| O.Z. | 120.0 x 77.0 | 64.167 | 402.6 | 402.0 | -0.6 | -0.15 |
| Wild | 122.2 x 81.2 | 66.448 | 457.2 | 455.0 | -2.2 | -0.48 |
| M.B. | 118.0 x 71.0 | 60.169 | 340.0 | 338.1 | -1.9 | -0.56 |
| O.Z. | 124.1 x 75.2 | 60.596 | 400.0 | 397.1 | -2.9 | -0.72 |
| W.Z. | 121.0 x 71.7 | 59.256 | 354.6 | 351.5 | -3.1 | -0.87 |
| M.B. | 118.6 x 69.4 | 58.516 | 326.2 | 322.7 | -3.5 | -1.07 |
| W.Z. | 116.5 x 75.0 | 64.378 | 374.7 | 370.2 | -4.5 | -1.20 |
| M.B. | 115.3 x 64.1 | 55.594 | 271.1 | 267.7 | -3.4 | -1.25 |
| O.Z. | 114.2 x 73.5 | 64.361 | 353.0 | 348.4 | -4.6 | -1.30 |
| O.Z. | 112.3 x 73.3 | 65.271 | 346.0 | 340.9 | -5.1 | -1.47 |
| M.A.C. | 94.9 x 66.0 | 69.547 | 238.6 | 233.6 | -5.0 | -2.10 |
| O.Z. | 114.4 x 73.5 | 64.248 | 357.0 | 349.1 | -7.9 | -2.21 |
| Wild | 124.3 x 71.9 | 57.844 | 371.7 | 363.1 | -8.6 | -2.31 |
| O.Z. | 112.5 x 69.5 | 61.778 | 315.0 | 307.0 | -8.0 | -2.54 |
| M.B. | 105.1 x 66.2 | 62.988 | 268.5 | 259.9 | -8.6 | -3.20 |
| W.Z. | 119.0 x 73.5 | 61.760 | 389.0 | 363.0 | -26.0 | -6.68 |

M.B. = Mt Bruce Native Bird Reserve  O.Z. = Otorohanga Zoo Soc.
M.A.C. = Maori Arts Centre, Rotorua  W.Z. = Wellington Zoo

TABLE 2 — *Percentage error of calculated weights for eggs in different 'size' or 'shape' classes*

| | Egg 'Class' | Percentage Error + | | | Percentage Error − | | | |
|---|---|---|---|---|---|---|---|---|
| | | 3-2 | 2-1 | 1-0 | 0-1 | 1-2 | 2-3 | 3+ |
| Weight (g) | 450-500 | | | 2 | 1 | | | |
| | 400-450 | 1 | 1 | 2 | 2 | | | |
| | 350-400 | | 2 | 3 | 2 | 2 | 2 | 1 |
| | 300-350 | | 2 | | 1 | 2 | 1 | |
| | 250-300 | | 1 | 2 | | 1 | 1 | 1 |
| | N°. eggs | 1 | 6 | 9 | 6 | 5 | 4 | 2 |
| L : D Ratio | 1: 68-70 | | 1 | | | | 1 | |
| | 1: 65-67 | | 1 | 3 | 2 | 1 | | |
| | 1: 62-64 | 1 | 3 | 3 | 1 | 2 | 2 | 2 |
| | 1: 59-61 | | 1 | 1 | 3 | 1 | | |
| | 1: 56-58 | | | 2 | | 1 | 1 | |
| | N°. eggs | 1 | 6 | 9 | 6 | 5 | 4 | 2 |

As kiwi eggs are remarkably inconsistent in size and shape, and variations in dimensions may influence the size/weight relationship, a further 31 were measured to see whether this formula is useful for Brown Kiwi eggs in general.

## MATERIALS AND METHODS

Of the 33 eggs tested; 7 were laid in the wild and 26 in captivity. The sample included 12 fresh eggs (less than 12 hours old) without air spaces and 21 clean empty shells. The specific gravity of the contents was determined for two fresh eggs (1.0288 and 1.0293), and the fresh egg weights for the 21 shells were obtained by filling each with water, multiplying their internal volumes by the specific gravity (1.029) and adding the shell weight.

## RESULTS

Table 1 lists the measurements and shows that, notwithstanding a wide range in both shape (as defined by the length : diameter ratio) and size, most eggs had a true weight that closely approximated their calculated weight. In 15% of the sample the difference between true and calculated weight was less than 0.5%, in 45% it was less than 1.0%, in 75% the error was less than 1.5% and in 90% of the sample the calculated weight was within 2.5% of the true weight.

The density of Brown Kiwi egg shell (2.42) is nearly 2½ times that of the egg contents. Because smaller (or more elongated) eggs have a proportionately larger surface area than bigger (or wider) eggs, the shell : content ratio changes through the range of egg sizes. As a result, the expression 0.565 $ab^2$ may overestimate the fresh weight of larger eggs and understate that of smaller (or elongated) eggs.

Table 2 suggests such a tendency, but any skew effect is small. This method thus provides a useful, and at times precise, estimation of fresh egg weights.

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# SHORT NOTE

## KNOTS ATTENDED BY GODWIT

At the Heathcote-Avon estuary, Christchurch, the Knot *(Calidris canutus)* is a rather rare and brief visitor (a few days to a few weeks) compared with the Bar-tailed Godwit *(Limosa lapponica)*, which ranges from about 100 birds in winter to about 1000 in summer. Consequently, the Knot is of some interest locally.

We have noticed that, when a small party of Knot, say, fewer than five, is present with the godwit flock, they seem to hide deliberately in the centre of the godwit flock at the high tide roosts. Whenever the godwits have been displaced temporarily, the Knots carefully take up the same relative positions, often being almost completely out of sight.

Late one bitter afternoon, an unusually large (for this estuary) flock of 11 Knot came in, flying low, landed nearby, and huddled together in a tight group, standing in the shallow low-tide water close to a straggle of godwit that were feeding at the tide's edge. Immediately, the two nearest godwits stopped their probing and walked over to the Knots and seemed quietly but deliberately to break up the bunch. This behaviour was not aggressive, and the Knots were evidently not afraid; meanwhile, the godwits began to rake with their feet, and probe tentatively into, the muddy sand, apparently inducing the tired Knots to feed, which they did briefly.

Soon after the godwits had moved away to continue their own probing, the Knots stopped feeding and bunched up again. For a second time, one of the godwits returned, broke up the group again, apparently persuading the reluctant Knots to resume feeding. We could see this whole episode very clearly.

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