Oikos 19: 149–151. Copenhagen 1968

A balance for weighing eggs of smaller birds in the field

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1. Introduction

As a part of extensive field ornithological investigations in the Ammarnäs area of Swedish Lapland (Enemar 1966) the breeding biology of some smaller passerine species has been studied. In this connection the influence of environmental factors on production capacity, i.e. clutch size, was studied. The simple counting of the eggs, however, does not give an accurate measure of the production capacity; the size of eggs can vary within the clutch and even more so between clutches. The production capacity of the laying bird is thus best assessed by weighing the eggs.

An examination of commercial balances showed that these were either too sensitive to disturbances occurring in the field, or too inaccurate for our purposes.

2. Demands on the balance

Since eggs of smaller passerines usually weigh between 1.0 and 2.5 g, the working range should be at least 3 g.

Since the weight variations under consideration are rather small, the balance must be accurate to within 0.01 g. In order that this accuracy may be attained, reproducibility must be very good. Further the instrument must be linear; any calibration curve giving lower accuracy. Calibration should be made in absolute units, i.e. with standard weights.

Durability and ability to function at variable temperature and moisture are important attributes of a field instrument. It should not need any elaborate supporting device and should be easy to handle and light in weight.

3. The construction of the balance

On the basis of these requirements the electromagnetic weighing principle was chosen. The weighing pan was mounted on the pointer of a horizontal moving coil meter. When the pan is weighted down by the sample the torque is exactly compensated by an electric current through the moving coil. At equilibrium, the current is an equivalent to the sample weight. Details will be found in a brochure of a commercial instrument (Gram Electrobalance, Cahn Instrument Company, Paramount, Calif., USA, Bulletin No 107B) which however did not have sufficient capacity for the present purpose. The circuit of the balance is shown in Fig. 1.

The current is supplied by a rechargeable nickel-cadmium battery via two transistors connected as emittor followers. The base of the first transistor is steered from a coarse and a fine voltage divider, thus determining the voltage across the two moving coil meters. One of the meters is the electromagnetic balance, the other which measures the current is graduated directly in grams by means of suitable shunts. Part of the shunts is adjustable to permit calibration against standard weights.

For the balance moving coil meter an old precision instrument was found. This instrument had strong bearings and a large specific torque. Modern instruments seem to have smaller torque which is made possible by less friction in the bearings. For our purposes the bearings had to be quite robust.

The balance is mounted in a steel case with the dimensions 298 × 210 × 155 mm (Fig. 2). It weighs 5.2 kg. Care was taken to mount

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Manuscript accepted December 1967.

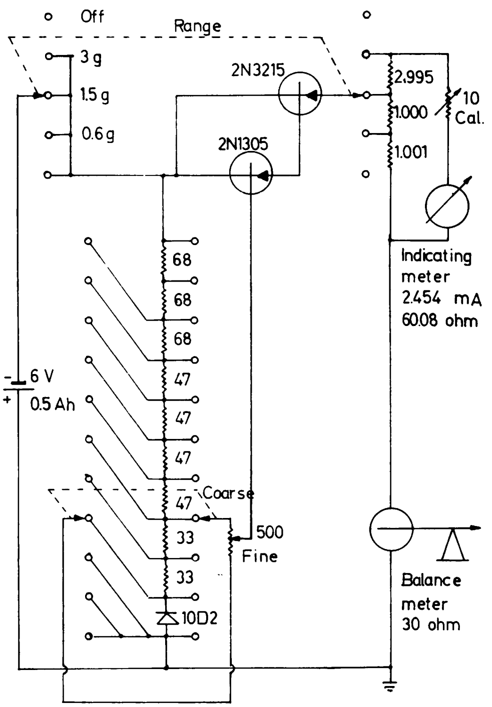

Fig. 1. Schematic diagram of the electromagnetic balance. All resistor values in ohms.

the balance moving coil meter as rigidly as possible to obtain maximum reproducibility and stability.

The balance is calibrated as follows:

1) With the range switch in position "off" the mechanical zero of the balance is adjusted until the pointer is opposite an index.
2) Range switch in position 1.5 g.
3) A 1 g weight is placed on the weighing pan.
4) The pointer is adjusted to the index again with the coarse and fine current controls.
5) The potentiometer (cal) is turned until the indicator shows exactly 1 g.

An unknown weight can now be balanced and read off directly on the indicator. The calibration on the 1.5 g range is also valid on the 0.6 g and 3 g ranges.

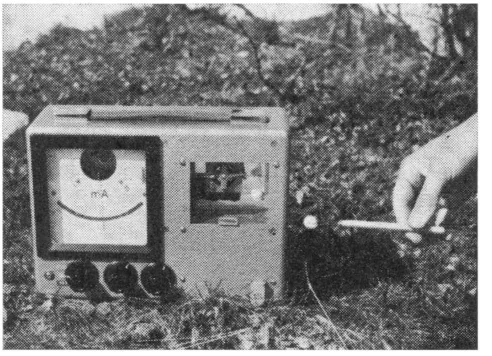

Fig. 2. The balance in use in the subalpine birch forest, far away from camp. The hand is holding an egg manipulator.

4. Performance of the balance

After assembly the balance was tested in the laboratory. The balance moving coil meter was tested with weights in the range 50 mg to 3 g. Reproducibility and linearity were both within 0.1 %. The indicator had a minor linearity correction of up to 0.5 %. With these corrections taken it was possible to weigh with an error of less than 0.2 % of full scale deflection. Temperatures of +4° C to +30° C had no influence on the results, provided the calibration was performed at the same temperature. Moderate tilting had no influence.

In the summer of 1965 the balance was extensively used in field studies in Lapland. It functioned well throughout and several hundreds of eggs were weighed (Hansson, Lennerstedt, Myhrberg and Nyholm 1966). The accumulator had to be charged about every fourth day by a simple charging unit.

After this period the balance was tested again in the laboratory. It was found that the balance still had the same accuracy as before the summer.

In Fig. 2 and in detail in Fig. 3 is shown a practical single-hand-operated egg mani-

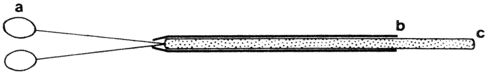

Fig. 3. A practical single-hand-operated egg manipulator. a. Steel wire loops. b. Socket. c. Piston.

pulator for placing the eggs on the weighing pan. It was also useful for removing eggs from the nest, particularly when these were situated in deep and narrow excavations, e.g. nest-boxes. The risk of damaging the nest or the eggs is minimal. The egg is placed between the two loops and when the socket is pressed downwards the egg is gently compressed and can be lifted.

5. Acknowledgements

The construction of the balance has been made possible by a grant from the Royal Physiographic Society of Lund, Sweden. The field work was supported by grants from the Swedish Natural Science Research Council (2180–13, 17).

References

ENEMAR, A. 1966. Ornitologisk populationsekologi i alpina och subalpina miljöer. Något om fältarbetets metoder och problem. – Svensk Naturvetenskap 1966: 169–184.

HANSSON, S. Å., LENNERSTEDT, I., MYHRBERG, H. and NYHOLM, E. 1966. Holkstudier vid Ammarnäs 1965. (Summary in English). – Fauna och Flora 61: 225–254.

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