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A NEW TECHNIQUE FOR READING OTOLITHS

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The interpretation of growth structures on otoliths has been widely accepted as one of the more reliable methods for ageing fish. For some fish - notably young plaice and other flatfish with thin otoliths - the structures are readily visible and no preparation is necessary for reading the otoliths. Many other species - most of the gadoids, other roundfish and very old flatfish - have much thicker otoliths in which, because of their thickness, the structures cannot be easily viewed directly. For these otoliths the usual method of reading is to break or cut the otolith through its centre, mount the half-otolith with the broken surface horizontal, and count the rings that are revealed on it. The surface may be illuminated either by direct (reflected) light or by transmitted light entering the otolith from the side. Reading is usually facilitated by viewing a good flat surface and techniques for cutting and polishing otoliths have been described by a number of authors.

The preparation of each otolith singly by such methods is a slow process and recent work at Lowestoft has been aimed at finding a method whereby sections of a number of otoliths may be made quickly at one time. Such a method, by which thin (approximately 1 mm) slices through the centre of otoliths are set in a lamina of black polyester resin of the same thickness, has been developed and is described here.

Preparation and mounting of the otoliths

Each otolith is first broken and polished to produce a good flat surface in the lateral plane and through the centre of the nucleus. This can be done quickly and accurately using the small grinding machine described by Bedford (1964). Either the forward (head end) or rear (tail end) half of the otolith may be used, the only important consideration being that the section be square, flat and through the centre of the nucleus. No further preparation of the otolith is necessary before it is placed in a mold in which the lamina will be formed.

The mold is simply a flat plate of ground steel 175 mm long by 100 mm wide by 5 mm thick. A 2 mm thick rectangular frame of the same outside dimensions as

the plate and 12.5 mm wide is screwed to one face of the plate to create an internal mold of 150 mm x 75 mm x 2 mm depth. Each otolith is placed in the mold standing vertically on its previously prepared flat surface. It is often convenient to arrange samples in regular columns by length groups and a typical arrangement for a sample of coalfish otoliths is shown in Figure 1.

The plastic used is a clear polyester resin normally used for mounting specimens or making jewellery. An appropriate black dye is thoroughly mixed into the clear liquid before addition of the hardener. The resultant black liquid is immediately ready to pour. Approximately 25 ml is sufficient to fill each mold of the size described. Care is needed when pouring the plastic to avoid knocking over the otoliths and an effective method is to use a pipette to distribute the liquid gently around the otoliths. Hardening is fairly rapid and molds prepared one day are ready for machining the next.

The grinder and grinding

The machine used in this work is a simple commercial workshop surface grinder normally used for grinding flat surfaces on metals. The machine's table has a 16 inch, back and forward movement below a 7 inch diameter by $\frac{1}{2}$ inch wide carborundum wheel driven at 3800 r.p.m.: mechanical adjustment of the height and lateral position of the table is also provided.

To prepare the mold for grinding the 2 mm thick frame is first removed from the steel plate which is then clamped to the surface of the table. Fixing the plate on the table is more rapid and simple by using an automatic magnetic chuck as a fixture on the table.

The crude black plastic mold with the otoliths embedded and projecting above the surface of the mold is now ready to grind. The adhesion of the plastic to the steel plate is powerful and the lamina remains securely fixed while grinding takes place. Care should be taken to raise the table so that the first cut with the wheel removes the tops of the otoliths only. Successive cuts can now proceed until all the projecting otoliths and the plastic are reduced to a uniform thickness. In tests so far the heaviest cuts made have been of approximately 0.15 mm but it is believed that heavier cuts could be made. It is extremely important that the whole surface be kept flooded with coolant during the grinding process.

After the lamina has been reduced to the required thickness it can be removed from the steel plate. This is done by placing the whole assembly in boiling water for about 10 minutes and then plunging it in cold water. The adhesion of the plastic to the plate is reduced and the lamina can be prised gently free.

Lighting the otoliths for reading

Both transmitted and reflected light are equally effective to light the otoliths. It is a simple matter to switch from one form of lighting to the other and it has been found that some difficulties of interpretation by one method can be resolved by changing to the alternative form of lighting. It has also been found that viewing the nature of the edge of the otolith is much improved by being embedded in the black plastic.

Trials have been carried out so far with otoliths from various cod stocks, haddock, coalfish, whiting, blue whiting and plaice and the method has been satisfactory for all of these.

Storage

The thin plastic lamina is moderately fragile and care should be taken in handling. Lamina of the size described could be easily stored in a filing cabinet and the advantage in space saving over conventional storage methods such as envelopes or tubes, is considerable.

Direct projection of otoliths

As an extension of this work trials have been carried out aimed at producing lamina sufficiently thin that enlarged images of otoliths might be projected directly on to a screen. These trials have been successful and small (2 inch x 2 inch) lamina with 12 otoliths embedded have been made and projected with good definition using a 35 mm slide projector. The small lamina were made by following the method described above to produce thicknesses of approximately 1 mm. The embedded otoliths and the plastic immediately surrounding them was then further reduced in thickness to about 0.5 mm by carefully removing more material by hand using a $\frac{1}{2}$ inch diameter grinding wheel driven by a dentist's drill. This method is effective but time-consuming and great care and judgement are needed to avoid damaging the otoliths during the hand grinding. A more precise mechanical method is being sought.

Reference

BEDFORD, B. C., 1964. Two mechanical aids for otolith reading. ICNAF Research Bulletin No. 1 pp. 79-81.

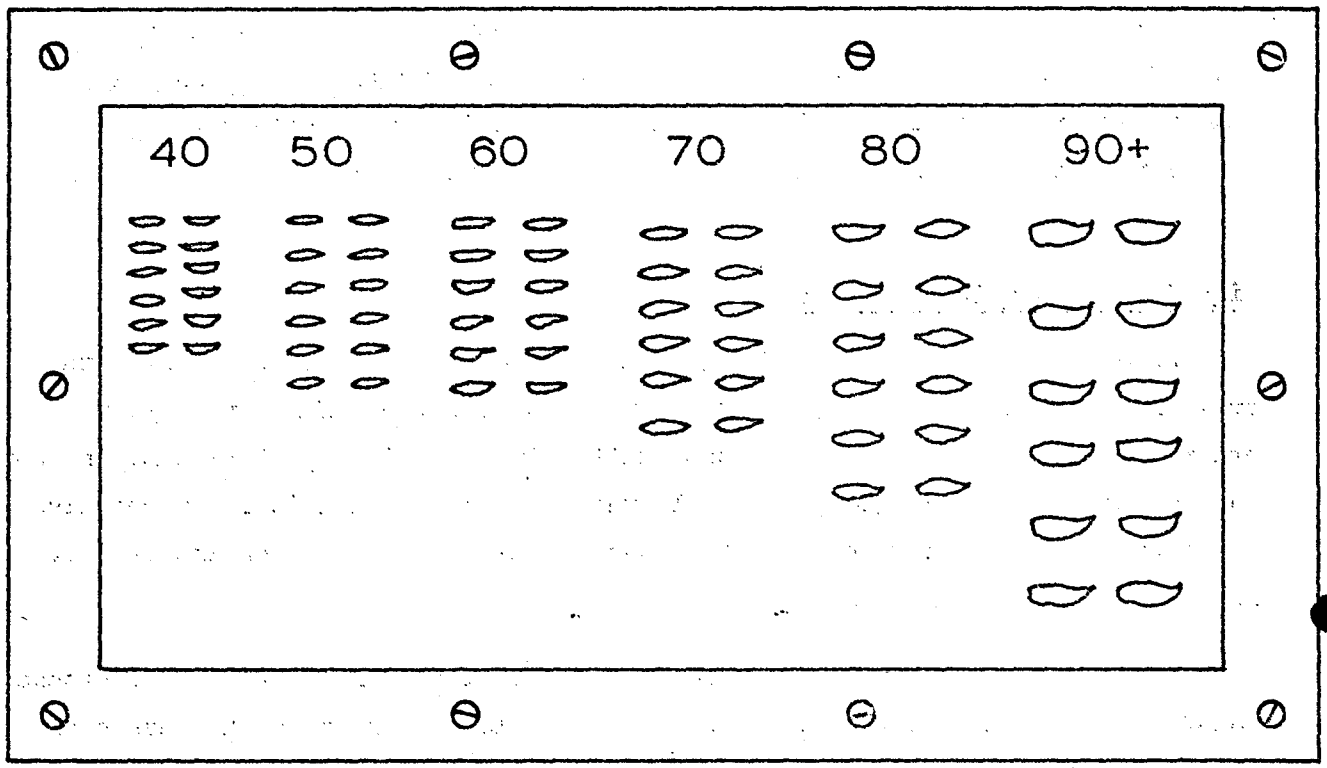

Figure 1. A typical arrangement of a sample of otoliths