A METHOD OF THIN-SECTIONING FIN RAYS AND SPINES

Gary Shepherd

and

Fred Nichy

National Marine Fisheries Service
Northeast Fisheries Center
Woods Hole Laboratory
Woods Hole, Massachusetts 02543

March 1984
Age determinations of fishes, derived from examining growth rings formed in bony skeletal parts, are vital basic data needed by fishery biologists in evaluation of population age compositions (Jearld 1983). Scales and otoliths are more commonly examined than other bony structures and the technology of preparing them has greatly improved over the past century. Nevertheless, these methods are not practical if the otoliths are inaccessible or the scales and otoliths have an incomplete or undecipherable growth record. Such a dilemma occurs when age data are needed for rare, very small, or commercially valuable species. Fin rays and spines are alternative structures that can contain viable age marks, but these are seldom examined because their preparation is considered too difficult.

Holzmayer (1924) introduced the idea of aging fin rays or spines which was further expanded upon by Chugunov (1925) and Boyko (1946). Early specimen preparation involved boiling or drying the rays or spines, then cutting a cross-section using a small fret saw. The section produced was usually crude, if it could be found at all after the cut was completed. Because of these difficulties, rays and spines have not become generally accepted for routine use in age and growth studies.

The technique developed here involves a fast, easy and accurate method of sectioning rays and spines with a low speed saw (Fig. 1). The saw, an Isomet low speed saw produced by the Buehler Co., has been described for sectioning otoliths (Nichy 1977) and chondrophores of the surf clam Spisula solidissima (Ropes and O'Brien 1979).

The ray or spine may initially require a superficial cleaning before it is mounted for sectioning. A brief immersion (several minutes) in household bleach is sufficient for the softening and removal of tissue. The distal end of the ray or spine is not needed and can be clipped off. The remaining
portion is laid crossways on a 24 x 35 x 0.4 mm paper tab bearing cross line marks and tape with adhesive on both sides to hold the specimen (Fig. 2). The marks on the tab indicate the cutting plane of the saw for pre-determining the position of the cut and aligning the saw blades using the micrometer arm adjustment. The mounted structure is covered with hot paraffin wax, calcium oxide and decolorizing carbon mixed to a thick consistency. The hardened wax mixture holds the specimen firmly during the cutting process and enhances contrast during examination of the section.

To section spines or rays, a pair of 76 mm diameter x 0.15 mm thick metal blades with diamond cutting edges, separated by a 64 mm diameter spacer are mounted on the saw arbor (Fig. 1). Spacers from 0.15 mm to 0.30 mm thick can be used, depending on the thickness of the section necessary (Fig. 1). A specially designed aluminum chuck is attached to the arm of the saw at a right angle to the blades (Fig. 2). This chuck holds the paper tab with the mounted ray or spine. The mounted specimen is slipped into a slot in the chuck and the entire unit is lowered onto the blades. The machine can be adjusted to stop automatically upon completion of the cut. During the cutting process, the blades are lubricated in a water bath containing approximately 20 cc of common liquid household detergent.

Sectioning is completed in about 1 to 2 minutes and the tab is removed. The embedded thin-section is easily removed by bending the tab and separating the section with a single-edge razor blade. The thin-section of wax may be handled easily, which is especially helpful when working with small rays or spines.
Mounting the spine or ray onto the tab is a critical procedural step. It is important to be consistent with the angle and position of the cut. If the cut is made too close to the distal end, the center may appear hollow and the earlier growth zones may be missed, whereas if the cut is made too close to the proximal end, the earlier growth zones may again be disrupted. In some species of fish, the spine or ray has a protuberance or groove which may be used as a marker in positioning the structure for sectioning (Fig. 3).

Aging procedures for the section follow standard methods used for otoliths. Figure 4 shows an example of a cross-section from the fortieth dorsal fin ray of a 5 year old summer flounder, Paralichthys dentatus. The growth layers appear as alternating wide opaque and narrow hyaline zones which correspond to annual growth (Shepherd 1980). In this species, the fin ray proved to be more suitable for aging than the otolith. Depending on the species, it may be necessary to validate the ages so determined against other age structures, as well as determine which ray or spine would prove most useful.

Use of this technique should minimize problems associated with cutting spines and rays and make these structures more suitable for aging. The same sectioning methods may also be applicable in other areas of research, such as mammology and paleontology.
ACKNOWLEDGEMENTS

The authors would like to thank John Ropes, Louise Dery and Ambrose Jearld for their helpful comments and all the people over the years who have helped perfect the sectioning methods.


Figure 1. Low-speed saw used for sectioning and the arrangement of the diamond edged blades.
Figure 2. Design of chuck device used for holding tabs with mounted fin rays or spines during sectioning. Measurements in mm.
Figure 3. Position of spine for mounting onto a tab (A = proximal end, B = distal end) and position of cut (C).
Figure 4. Photograph of dorsal fin ray section of a summer flounder, Paralichthys dentatus, age 5. Hyaline zones appear as black rings, opaque zones as white rings.