



Differences in Otolith Morphology Between *Oncorhynchus mykiss* and *Lepomis macrochirus*

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Background

Rainbow trout (*Oncorhynchus mykiss*) are fish that typically live in cold, well oxygenated lakes and streams, whereas bluegills (*Lepomis macrochirus*) are generalists that live in a wide range of water conditions. The differences in the living conditions of these two types of fish can be studied using stones, called otoliths, found in the inner ear of the fish, most often in the semicircular canals. Otoliths help the organism to sense gravity, linear acceleration, and maintain orientation and balance. Fish otoliths are often studied, and becoming increasingly important as they can provide insight into things such as a fish's age, growth, lifestyle, and even origin.

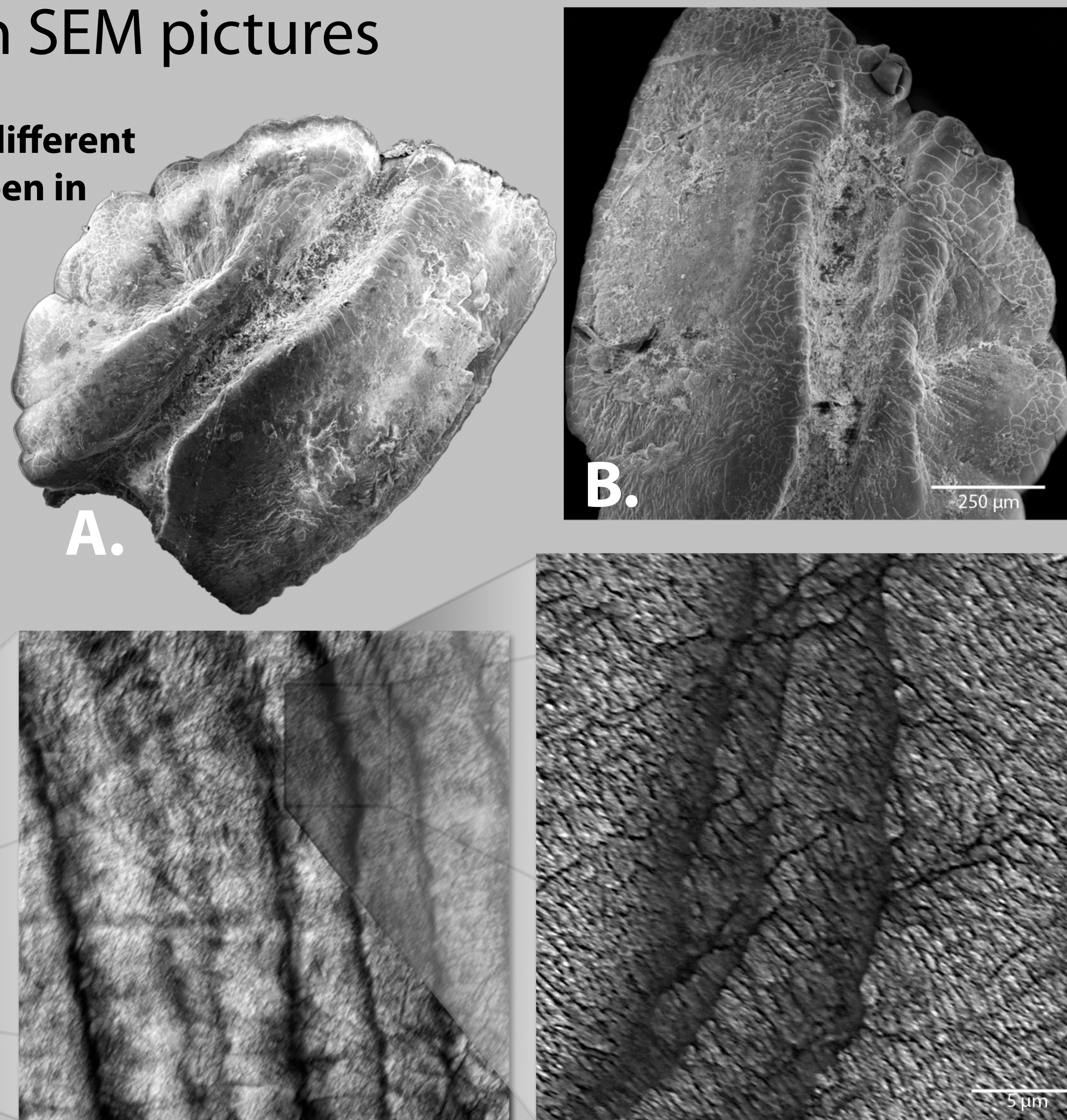
As a fish ages, it adds layers of calcium carbonate and organic matrix to the exterior of its otolith. When viewed in section, these layers appear as concentric rings similar to what one would see in a tree section. The thickness of individual rings is directly proportional to the growth of a fish. Environmental stresses can change the morphology of rings which becomes evident when observed using either light microscopy or scanning electron microscopy (SEM).

The purpose of this study was to examine the subsurface morphology of sagittal otoliths from *O. mykiss* and *L. macrochirus* using scanning electron microscopy (SEM). SEM provides many advantages over light microscopy, as it allows for more precise and accurate measurements, ability to see much greater detail and to discern exceptionally delicate microstructures.

Image Data

Rainbow trout otolith SEM pictures

The surface topography of two different Rainbow trout otoliths can be seen in (A) and (B). Progressively closer views of the incremental ring structures can be seen in (C), up to 3000x magnification. The intervals most likely represent one day of calcium carbonate accretion.



Methods

Sagittal otoliths were removed from the head of rainbow trout and bluegills by standard dissection methods.

Each whole otolith was mounted on a specimen stub with double sided tape, sputter coated with gold, and viewed using a Hitachi S-510 scanning electron microscope .

After viewing the surface of each otolith, they were remounted in a specimen stub with superglue, and polished down to the center of the stone using aluminum polishing paper. The center section of polished otoliths were etched with 1% HCl for one minute to enhance the differences between increments. Again they were sputter coated with gold, and viewed with the SEM.

Conclusions

The surface and subsurface morphology between otoliths from bluegills and rainbow trout appear to have consistent differences. These differences include overall shape of the stones, as well as proportionate composition of increments.

We observed that Rainbow trout otoliths consistently had a fissure along the length of the stone and were generally oblong. Also, rainbow trout otoliths most often seemed to have disproportionate distribution of mass on either side of the fissure. In contrast, bluegill otoliths were observed to be consistently more round with a crest along one edge.

Differences in subsurface microstructure were also observed. Rainbow trout appear to have a larger percentage of organic matrix, and bluegills a larger percentage of calcium carbonate.

We were also able to refine etching and mounting techniques, enhancing the ability to view detailed structures and differentiate between increments.

Image Data

Bluegill otolith SEM pictures

The surface topography of a bluegill otolith can be seen in (D). (E) shows the etched center of (D) at 100x. Progressively closer views of the incremental ring structures seen in (E) can be seen in (F), up to 3000x magnification. The intervals most likely represent one day of calcium carbonate accretion.

