Determining fish age using inner ear structures

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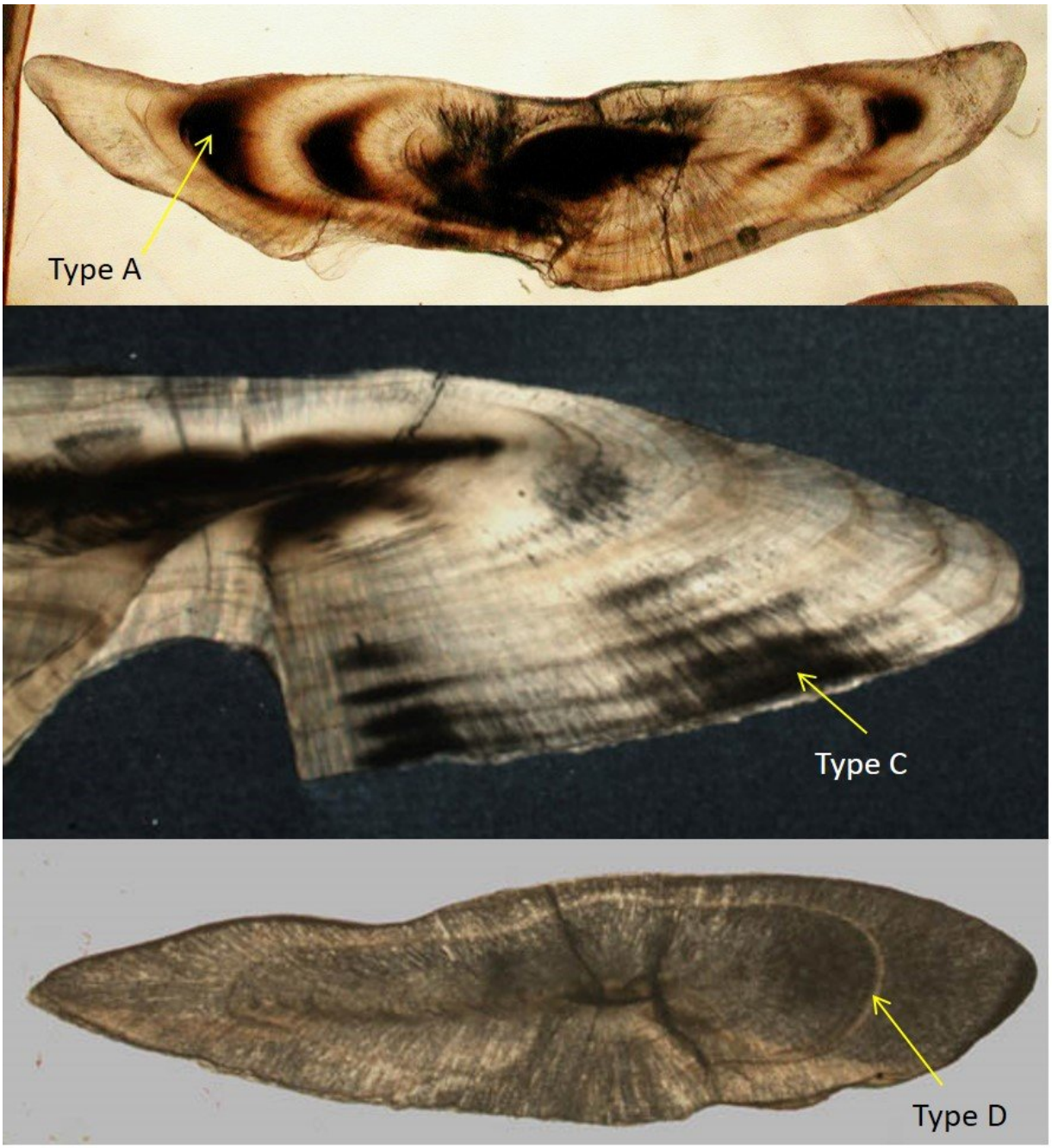


Otolith opaque zones of Type A (Japanese flounder), C (Japanese horse mackerel), D (Dog tongue sole). Credit: S Katayama

Biologists in Japan have identified four distinct zones in the otolith, a

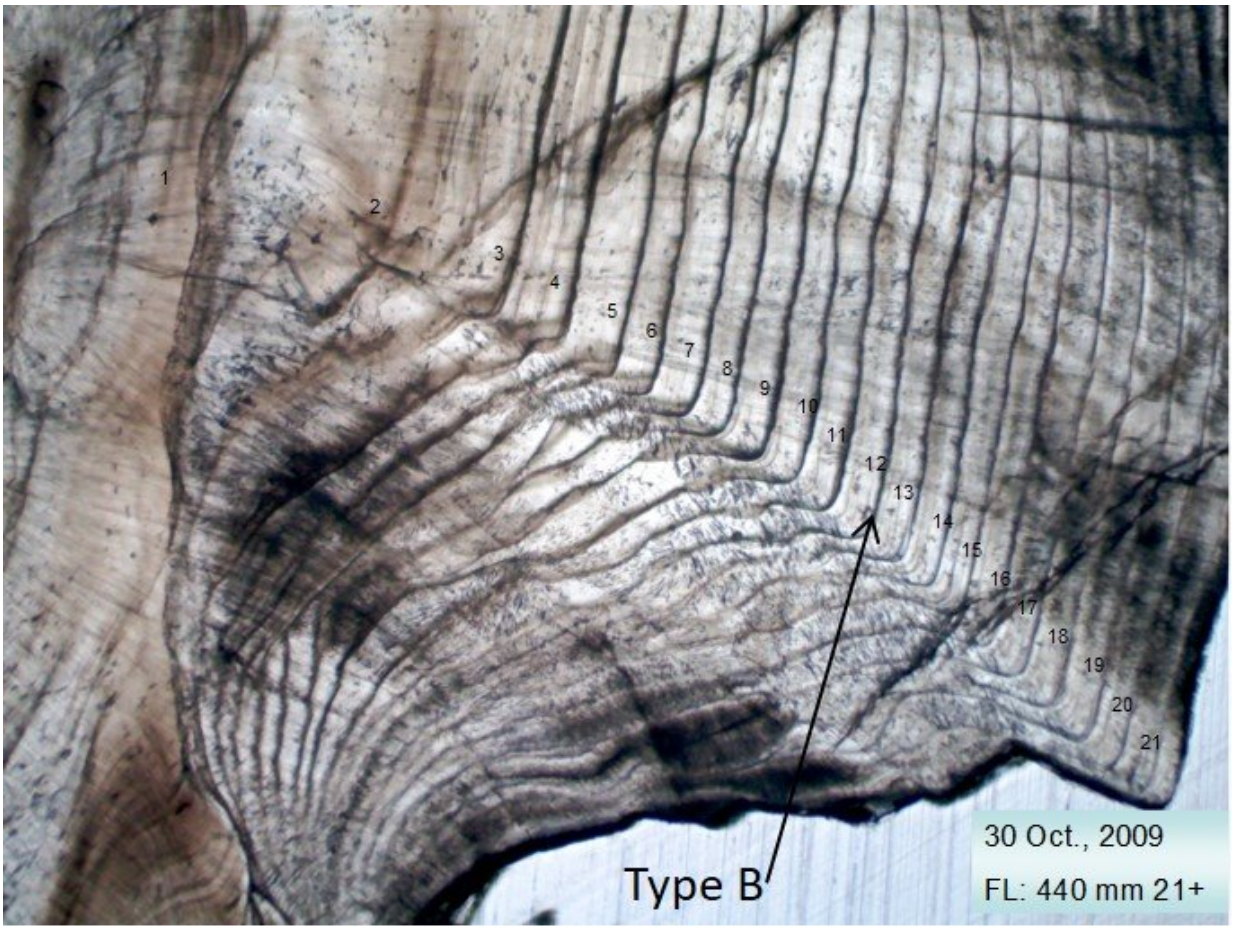
calcium carbonate structure in the inner ear, which can be used to determine age in fish.

"Age determination is very important for fishery management and fish population analysis, as well as improving our understanding of fish life cycles," says Satoshi Katayama, biologist at Tohoku University and lead author of the study published in *Fisheries Science*.

Otoliths are composed of alternating opaque and translucent zones—in young fish, otoliths look like they are covered in zebra stripes. Counting the annual growth rings on the otoliths is a common technique for estimating fish age, with the number of opaque zones widely considered to represent fish age in years.

However, in some species, it is difficult to count the opaque zones. In these cases, greater understanding of the structural characteristics and formation patterns of the opaque zones is needed to improve age estimation accuracy.

The researchers analysed the features of the opaque zones in otoliths from a number of fish species. They used scanning electron microscopy to examine characteristics of the whole otolith, sections of the inner otolith structure, and the crystal structure of the otolith.



Otolith opaque zones of Type B (Black porgy). Credit: S Katayama

They showed that the opaque zones can be classified into four distinct types.

Type A is a dark opaque zone, displaying minute, dense crystals, and is typically formed early in life. Type B consists of grooves and discontinuous crystals. Type C can be described as a washy black zone that looks like it has been smeared with ink. Type D has deep grooves and appears luminous in transmitted light.

The four zones reveal important information about fish age. Types A and C are typical of younger fish and are formed during growing periods. In contrast, types B and D are formed during periods of stagnant growth or during the spawning seasons—they are more typical of older fish, which generally lack type A.

The next step is to publish a manual explaining how to determine the age of fish using the four opaque zones. The researchers hope that fisheries and scientists will be able to use this information to determine fish age more easily and accurately, leading to improvements in fishery management practices.

More information: Satoshi Katayama. A description of four types of otolith opaque zone, *Fisheries Science* (2018). DOI: 10.1007/s12562-018-1228-z

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