Age Determination of YOY Lake Sturgeon Using Otoliths

Timothy J. Wilson, Nancy A. Auer, and *Edward A. Baker
Biological Sciences Department, Michigan Technological University, Houghton, MI 49931, *Michigan Department of Natural Resources, 488 Cherry Creek Road, Marquette, MI 49855

Introduction

Being able to determine the age of young-of-year (YOY) fish allows hatching times, growth, and mortality rates to be calculated (Isely and Noble 1987). The presence of daily growth rings in otoliths has been reported for juvenile temperate and tropical fishes, and the counting of daily otolith growth rings has become the most frequently used aging method for YOY fishes (Campana 2005, Megalofonou 2006).

Growth rings have been found in the otoliths of adult Russian sturgeon, *Acipenser gueldenstaedti* (Arai and Miyazaki 2002). However, daily growth rings have not been documented in otoliths of YOY sturgeons. This is the first reported attempt to validate daily growth rings in sagittae otoliths of YOY lake sturgeon. This is also the first reported attempt to age YOY lake sturgeon through otolith total length (TL). Aging through otolith TL is thought to provide suitable age estimations for juveniles of slow growing fishes (Fletcher 1991), and has been shown to accurately age poor cod, *Trisopterus minutus* (Metin and Ilkyaz 2008).

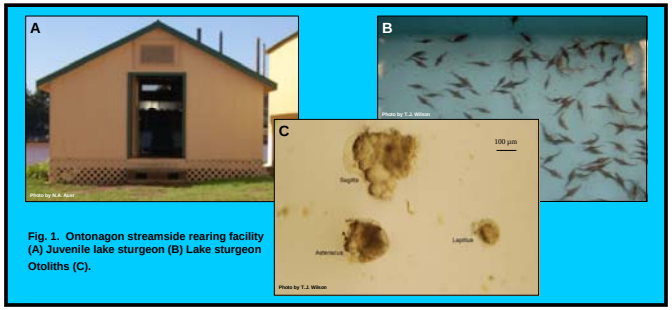

Fig. 1. Ontonagon streamside rearing facility (A) Juvenile lake sturgeon (B) Lake sturgeon Otoliths (C).

Hypotheses

•Counts of visible daily growth rings in sagittae otoliths are used to age most YOY temperate and tropical fishes, and will provide accurate age estimations for YOY lake sturgeon reared in the Ontonagon SRF

•Sagitta otolith TL for YOY lake sturgeon is strongly correlated with fish age and TL.

Methods

•**Fish Sampling:** Fish were sampled from the Ontonagon SRF from 8 June to 4 September 2008.

- Up to five dead fish were collected daily.
- Two living fish were collected twice a week.
- Total length was measured and fish were then stored in a 95% ethanol solution.

• **Otolith Removal:** An attempt to remove both sagittae otoliths was made on all 298 sampled fish using the methods of Secor et al. (1991).

- All otoliths were mounted concave side down on a microscope slide with CrystalBond™.

• **Growth Ring Counts:** Attempted to count the number of increments in sagittae otoliths removed from YOY lake sturgeon.

- Polished 10 otoliths using 2000 grit sandpaper until the core was clearly visible.
- Examined each otolith using 400 and 1000 times magnification.

•**Otolith Images:** Photographed otoliths using Nikon D50 camera attached to a compound microscope .

• **Otolith Measurement:** Otoliths total length, posterior to anterior, was measured from the digital images using SigmaScan Pro 4.

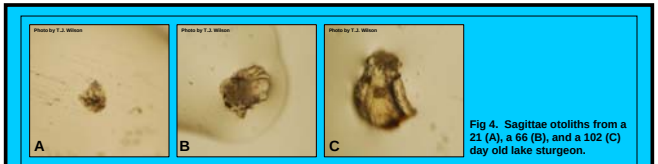

Fig 4. Sagittae otoliths from a 21 (A), a 66 (B), and a 102 (C) day old lake sturgeon.

Results

• A single intact otolith was removed from 87 individuals and two intact otoliths were removed from 169 individuals.

• Fish were sampled from 13 to 102 days post hatch and ranged from 20 to 102 mm total length.

•Otolith total length ranged from 110 to 646.2 µm and no statistical size difference between left and right otoliths was detected using a paired t-test (P= 0.1029).

• Daily growth rings were not visible in examined otoliths.

• An exponential relationship was observed between otolith total length and fish age.

• A linear relationship was observed between otolith total length and fish total length.

• The total length of otoliths removed from living fish showed the strongest correlation to both fish age and fish total length.

•The correlation between otolith total length and fish age (R^2=0.7557) is stronger than the correlation between otolith total length and fish total length (R^2=0.6987).

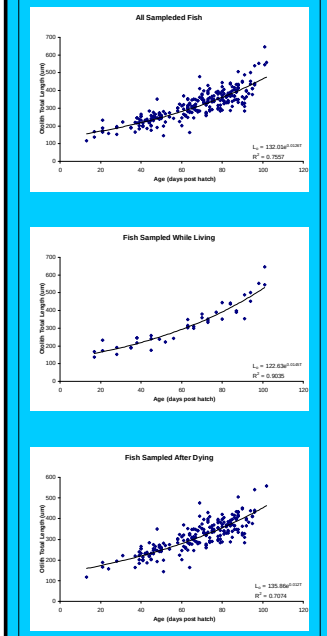

Fig 2. Relationship between fish age and otolith total length for lake sturgeon sampled from the Ontonagon SRF, Ontonagon, Michigan.

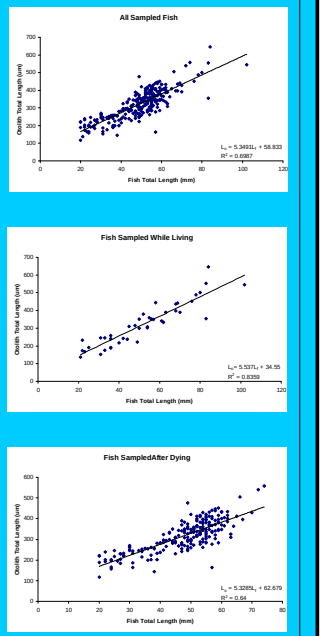

Fig 3. Relationship between fish total length and otolith total length for lake sturgeon sampled from the Ontonagon SRF, Ontonagon, Michigan.

Discussion

•This research is the first to describe a model for aging YOY lake sturgeon, and demonstrates that otolith TL, of either the left of right sagitta otolith, can be used to determine a fish's age.

• The aging technique described in this study allows fisheries managers to estimate the age of known size YOY fish while in the field.

•The lack of visible growth rings in otoliths of fishes has only been reported when fish were reared in extreme temperatures (Brothers 1978, Marshall and Parker 1982), were reared in an altered photoperiod (Tanaka et al. 1981), or were starved (Geffen 1982).

•The lack of visible daily growth rings in examined lake sturgeon otoliths was unexpected because growth rings are common in temperate and tropical fishes and because fish were reared in near natural conditions in the Ontonagon SRF.

• A new aging method may be required to age lake sturgeon older than age-0 because age determination based on length has been shown to only be suitable for rapidly growing species or juveniles of slow growing species (Fletcher 1991).

•Aging YOY lake sturgeon through otolith total length would reduce the amount of expertise and time needed to age fish and would provide an objective rather than subjective measurement for aging lake sturgeon.

Acknowledgements

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Literature Cited

Arai, T. and N. Miyazaki. 2002. Microstructural growth in otoliths of Russian sturgeon, *Acipenser gueldenstaedti*. Journal of Applied Ichthyology 18: 363-367.

Brothers, E.B. 1978. Exogenous factors and the formation of daily and subdaily increments in fish otoliths. American Zoologist 18: 631.

Fletcher, W.J. 1991. A test of the relationship between otolith weight and age for the pilchard *Sardinops neopilchardus*. Canadian Journal of Fisheries and Aquatic Sciences 48: 35-38.

Campana, S.E. 2005. Otolith science entering the 21st century. Marine and Freshwater Research 56: 485-495.

Geffen, A.J. 1982. Otolith ring deposition in relation to growth rate in herring (*Clupea harengus*) and turbot (*Scophthalmus maximus*) larvae. Marine Biology 71: 317-326.

Isely, J.J. and R.L. Noble. 1987. Use of daily otolith rings to interpret development of length distributions of young large mouth bass. Pages 475-481 in Summerfelt and Hall (1987).

Marshall, L.S. and S.S. Parker. 1982. Pattern identification in microstructure of sockeye salmon (*Oncorhynchus nerka*) otoliths. Canadian Journal of Fisheries and Aquatic Sciences 39: 542-547.

Megalofonou, P. 2006. Comparison of otolith growth and morphology with somatic growth and age in young-of-the-year bluefin tuna. Journal of Fish Biology 68: 1867-1878.

Metin, G. and A.T. Ilkyaz. 2008. Use of otolith length and weight in age determination of poor cod (*Trisopterus minutus* Linn., 1758). Tübitak 32: 293-297.

Secor, D.H., J.M. Dean, and E.H. Laban. 1991. Manual for otolith removal and preparation for microstructural examination. University of South Carolina, Belle W. Baruch Institute for Marine Biology and Coastal Research, Technical Publication 1991–01, Columbia.

Tanaka, K., Y. Mugiya, and J. Yamada. 1981. Effects of photoperiod on feeding and daily growth patterns in otoliths of juvenile *Tilapia nilotica*. U.S. National Marine Fisheries Service Fishery Bulletin 79: 459–466.