

Workshop to Standardize Otolith-based Ageing Protocols for Atlantic Bluefin Tuna

Chesapeake Biological Laboratory
University of Maryland Center for Environmental Sciences
Solomons, MD; 16-18 January 2013

Workshop Outcomes

Participants, Venue and Activities: Principal experts in developing and applying otolith-based ageing protocols for bluefin tuna. These included,

Dr. Patricia Lastra Luque, Instituto Español de Oceanografía
Mr. Dheeraj Busawon, Fisheries and Oceans Canada, St. Andrews Biological Station
Dr. Walter Golet, Gulf of Maine Research Institute
Ms. Elise Koob, Gulf of Maine Research Institute
Mr. Ben Gahagan, Massachusetts Division of Marine Resources
Dr. Dave Secor, University of Maryland Center for Environmental Science
Mr. Matt Siskey, University of Maryland Center for Environmental Science
Mr. Mike O'Brien, University of Maryland Center for Environmental Science
Ms. Alex Atkinson, University of Maryland Center for Environmental Science
Dr. Robert Allman, Panama City Laboratory, National Marine Fisheries Service

Meetings, interpretation trials, and discussions were undertaken during the 2.5 day meeting. The trials were designed to (1) promote discussion and test for errors associated with preparation techniques (Y v. V section types), lighting (transmitted v. reflected) and interpretation of annuli; and (2) initiate development of a reference otolith set to test reader precision. An electronic white board allowed participants to mutually discuss otolith age assignments. Participants were provided image sets on thumb drives to conduct trials using PhotoShop (Adobe ©). The workshop agenda, background reading, presentations, datasets, and workshop reports were (will be) posted at the website <http://fishconnectivity.cbl.umces.edu/2013-ageing-workshop>.

Outcomes: Agreed upon outcomes include,

1. Consensus views on otolith preparation and interpretations
2. Collaborative projects related to evaluating the timing of annulus formation in otoliths, first annulus formation, otolith dimensions during the first three years of life, and interpretation of edge types (opaque v. translucent zones).
3. Development of an annotated bluefin tuna otolith ageing reference set.

4. Presentation and SCRS paper on a workshop summary at the Tenerife Bluefin Tuna Biological Parameters Meeting (7-13 May).
5. Presentation and SCRS paper on results of completed collaborative projects and summary of otolith reference set at the Madrid Species Group Meeting (September 23-27, 2013).
6. Development of a paper based on SCRS reports to ALR.

Consensus Views:

1. Section type: V or Y
 - Workshop trials showed a definite bias of approximately one additional annulus in Y sections than in V sections. Although there is no basis for selecting one section over the other (no way to determine if higher or lower age is correct), precedence in publications (Hurley and Iles 1982; and Neilson and Campana 2008) would favor use of the Y section for the purpose of consistency.
 - Participants agreed that future studies should rely on the Y section. Further, it was noted that past practices of choosing between V and Y sections for the same fish (based on their relative readability) as is done for Southern bluefin tuna likely introduces ageing bias and should be avoided.
 - Individual laboratories must decide for themselves if they should re-age past samples that were based on V-sections.
2. Light type: Transmitted or Reflected
 - Workshop trials indicated nil effects due to light type. In general participants agreed that light type, when sufficiently matched with a standardized image enhancement procedure, was a matter of preference.
 - Due to different preferences among laboratories, the group decided that the reference set of bluefin tuna otoliths (see below) should include annotated images under both reflected and transmitted light.
 - There remains ambiguity in assigning opaque and translucent zones under the different light types. Additional standardization of terms should be pursued in conjunction with marginal increment and edge type analyses (see below).
3. Acceptable precision levels and assignment of age from annuli
 - In trials on a test reference set, APE was ~6% regardless of preparation and section type. Given the moderate longevity of bluefin tuna and inherent difficulty in consistently identifying annuli, the group thought 10% was a reasonable APE in terms of quality control.
 - Although participants felt that it would be advantageous to make adjustments to final age based upon month of collection, insufficient information exists on the seasonal timing of opaque and translucent zone deposition to do this. Until such information exists, age should equal the number of annuli.
4. Quality Control Procedures
 - In concordance with Campana 2001 and the experience of some participants, ages are best assigned using a single reader that is calibrated against a reference set.
 - The group discussed other quality control procedures, but determined that these were best left to individual laboratory needs.

Tasks:

1. Marginal increment analysis for tuna < 150 cm
 - Principals: Matt Siskey and Patricia Luque
 - Purpose: Determine seasonal timing of translucent zone deposition for fish age 1-4.
 - Activity: Measure marginal increment (last translucent zone) among seasons; the two preceding annuli should be measured as well to index marginal increment measures (i.e., marginal increment/mean of two preceding increments). Samples should be stratified by size (age) and month as much as possible. The Y section type should be used. Collaborators should share measured images to insure consistency.
2. Radial arm measures for tuna < 150 cm
 - Principals: Matt Siskey and Patricia Luque
 - Purpose: (1) Test whether modal patterns in otolith dimension correspond to expected sizes (CFL) at age. (2) Test whether modes exist at annuli 1, 2, and 3, which can be useful as guidelines for assignment of annuli.
 - Activity: For Y sections, measure longer (ventral) arm length from core region to tip of arm on medial side. Also measure from core region to each of the first three annuli.
3. Edge type interpretations for older tuna >150 cm
 - Participants: Walter Golet, Elise Koop, Dheeraj Busawon, Robert Allman
 - Purpose: (1) Test to determine if edge type can be consistently identified; (2) Test whether edge type varies seasonally.
 - Activity: For Y sections, identify samples of fish >150 cm across as many seasons/months possible. Score edge (opaque or translucent zone) and test for consistency between readers. Test score assignments against season of collection.
4. Development of Reference Set
 - Participants: All Workshop Experts
 - Purpose: Compile an annotated set of Y section otoliths of varying ages, and evaluate reading precision by workshop participants
 - Activities
 - Goal is a set of 100 annotated otolith sections (Y section) viewed under both reflected and transmitted light (200 images)
 - Dheeraj Busawon will serve as the expert reader against whom other age assignments will be compared
 - Each of four laboratories will submit images to Dheeraj 30 otolith sections under reflected and transmitted light (60 images total). Images will be annotated according to measure of approximate first annulus (first opaque zone). No annuli should be specifically annotated. Images should rank 3 or 4 in readability code.
 - CBL (D. Secor) and IEO (P. Luque) will stratify samples for tuna approximating sizes of individuals 2-8 years of age.
 - GMRI (W. Golet) and DFO (D. Busawon) will stratify samples for tuna approximating sizes of individuals 8-20+ years in age.
 - These four groups will provide a total of 120 otoliths and 240 images from which D. Busawon will select 100 otoliths and 200 images.
 - After receipt of images, D. Busawon assigns age, readability, and edge type and post on his ftp site.

- All participants then read the reference set (single blind). Age estimates will be compiled and analyzed for precision (age bias plots and APE estimates by lighting type and reader).
- If the reader set trial achieves an APE <10% it will be made freely accessible to those interested in undertaking ageing studies on Atlantic bluefin tuna.