TESA Workshop proposal for early 2023

**Best practices in age determination in marine organisms and in the use of ageing data in stock assessments**

Leads: Daniel Ricard (Gulf), Peter Comeau (Maritimes) and Stephen Wischniowski (Pacific)

The use of an age-based population model is often lauded as the “gold standard” in stock assessment. Age-based models are favored over simpler population models because of their ability to convey biological realism and to provide a more nuanced understanding of population dynamics, including the effects of fishing on harvested populations. As the name implies, an age-based model requires information about the age of individuals in the population, which provides scientists with a foundation for analyzing the demographics of a population as it evolves over time. Ageing information, in conjunction with other observations, can inform us on the growth of individuals, on the age-at-maturation of individuals, on the age structure of a population and on other vital factors necessary to understand variations in numbers and biomass.

While the use of age-based models is common and the software available to implement such assessments are available and evolving, the manipulation of the input data that feeds into those models is often done in an ad-hoc fashion particular to the lab or agency in charge of the assessment. While these ad-hoc methods are most likely defensible and appropriate, the details that go into the computation of catch-at-age matrices are often poorly documented making results hard to reproduce by someone outside a given lab or agency. This workshop will provide an opportunity for scientists using age-based assessments, and those involved in the analyses of age and length information to share ideas and develop better methods to use ageing data in assessments.

**Objectives:**

The objectives of this workshop is to create a forum for discussion and for exchanging ideas among DFO scientists that use age-based models and that are involved in ageing activities. In particular, the workshop should provide:

- guidance on otolith collection and on the sampling design for collecting otoliths

- guidance on age determination using otoliths, best practices for annuli validation, reference collections, ager calibration, archival of otoliths, digital imaging of otoliths and data warehousing

- guidance on going from length frequency samples and age-length keys to catch-at-age matrices that feed into age-based population models

**Proposed format:**

A virtual workshop that does not require physical travel and that can be held to accommodate time zones spanning a good portion of the globe. Either 2-3 complete days or 5 mornings or afternoons.

The workshop leads will develop a program where a number of breakout groups will be identified and that will be led by people with a shared topic of interest. Potential topics that could be covered are presented below.

The workshop will also include the presence of two participants external to DFO that will be asked to provide plenary presentations on a topic of their expertise that relates to ageing and age-based assessments. The two external participants will also be asked to provide a summary presentation at the end of the workshop to provide their feedback on the activities.

**Topics to be covered/discussed:**

* Sampling design of otolith collection from research surveys and from commercial sampling: how many otoliths to collect, from where, from what lengths, …?
* Best practices for ageing, and archival/storage/preservation of otoliths: developing a reference collection, ager calibration, …
  + Stochiometric description of calcium carbonate seasonal deposition in otoliths
  + Use of ethylene glycol to enhance contrast
* Exchange of otoliths between labs, external validation methodologies
* Analysis of ageing information and length frequencies to calculate catch-at-age matrices
  + methodological details of how to go from lengths to ages
* Annotation of otolith images and capture of growth increment measures
  + SmartDots software
  + Analysis of growth increment measurements
* Trade-offs between age-length pairs and growth increments
* Use of empirical age-length keys versus smoothed age-length keys: detection, bias, errors, ...
* General theory for age-length keys (forward, inverse and hybrid forward-inverse methods)
* Length-based vs. age-based vs. integrated analyses: exploring the continuum of modelling approaches available when information on lengths and ages are available
* Use of other biological structures for ageing: scales, vertebrae, spines, …

**Expected outcomes:**

- git repository for code sharing, breakout groups, workshop report, etc.

- R package providing the tools necessary to go from length frequency samples to catch-at-age matrices using ageing information.

**Potential external participants:**

Olaf Jensen, University of Wisconsin, Madison, WI, USA

Coílín Minto, GMIT, Galway, Ireland

Lisa Ailloud, NOAA NMFS, USA

Stephen Campana, University of Iceland, Reykjavik, Iceland