

**LARGE PELAGICS RESEARCH CENTER
PROGRESS REPORT – DEADLINE 5/30/2008**



Project Title: Assessment of natal homing and mixing of Atlantic bluefin tuna using $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ signatures in otoliths

Principal Investigator(s): Jay R. Rooker, David H. Secor

1. Purpose of the Project:

Management of Atlantic bluefin tuna is based on the two-stock hypothesis (“east” versus “west”), with spawning occurring east (Mediterranean Sea) and west (Gulf of Mexico) of the 45°W management boundary. Although trans-Atlantic migration of members from both populations has been documented, fidelity to natal areas is assumed, justifying the two-stock hypothesis used by the International Commission for the Conservation of Atlantic Tunas (ICCAT). Still, the relative magnitude of trans-Atlantic movement and mixing, and the timing and extent of natal homing are unresolved. Here, we build on previous research to assess natal homing and population connectivity of Atlantic bluefin tuna. Objectives of the current investigation are threefold: 1) quantify stable $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ isotopes in whole otoliths of yearling Atlantic bluefin tuna from eastern and western nurseries to complement the current set of reference samples or birth certificates; 2) determine trans-Atlantic mixing and natal homing tendencies of adult bluefin tuna collected from the two known principal spawning regions (Gulf of Mexico and Mediterranean Sea) by comparing $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ isotopic signatures in otolith cores of adults to yearling signatures (reference samples); 3) predict the natal origin of adult bluefin tuna sampled from mixed stock fisheries in the U.S. Atlantic (Mid-Atlantic Bight, Gulf of Maine) and Canada (Gulf of St. Lawrence).

2. Progress to date:

Efforts during the first year of this project centered on the collection of otoliths from yearling and adult bluefin tuna. To date, otoliths from over 400 bluefin tuna have been obtained and analyzed. In addition, otoliths of giant bluefin tuna from Gulf of St. Lawrence over the past three decades have been obtained from Dr. Neilson. In the second year of the study, we increased our collection of giants from both the Mediterranean Sea and western Atlantic and completed analytical runs. In addition, we drafted two papers and submitted both for publication.

Overview of work completed in year 2 of project:

1) Expanded library of $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ values in otoliths of yearling bluefin tuna by analyzing new year classes of bluefin tuna collected last fall as well as otoliths from the bluefin tuna otolith archive in J. Rooker’s Lab. We now have yearling values from both the eastern and western Atlantic over a 6 year period.

2) Assessed variability between stable isotope facilities at the University of Arizona and the University of Maryland by running otolith powder from the same individual bluefin tuna at each lab (Table 1). Paired t-tests indicated that $\delta^{13}\text{C}$ values did not differ significantly between labs ($P > 0.05$); however, $\delta^{18}\text{O}$ values were significantly more enriched. Since in-house standards were used at both facilities, we will use these results to standardize stable isotopes values between labs.

3) Compared $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ signatures in whole otoliths of yearlings to transverse sections of the other paired otolith. This test was required because cored regions of otoliths from giant category bluefin tuna are being used to represent the yearling signature. Paired t-tests showed no significant difference between cores from transverse sections and whole otoliths in either $\delta^{13}\text{C}$ or $\delta^{18}\text{O}$ ($P > 0.05$), indicating that our micro-milling protocol did not deplete or enrich the core values. Mean error between core and whole otoliths for $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ was similar to the estimated precision of replicated runs.

4) Isolated core material from giant bluefin tuna collected in the Mediterranean and western Atlantic Ocean. Milled cores of otoliths were used to represent the yearling period of school (<60 kg), medium (60-140 kg), and giant (>140 kg) category bluefin tuna and maximum likelihood estimates were generated using a mixed-stock algorithm to assign individuals to eastern or western nurseries. Natal homing rates were documented for bluefin tuna from both eastern and western spawning regions. Estimates of natal origin were also estimated for adolescents in the U.S. Atlantic (Mid-Atlantic Bight) and indicated significant trans-Atlantic movement. Finally, the origin of giant category bluefin tuna collected from U.S. Atlantic (Gulf of Maine) and Canadian (Gulf of St. Lawrence) were determined and indicated they fish were almost exclusively of western origin.

6. Dissemination

Publications:

Rooker JR, Secor DH, DeMetrio G, Kaufman, JA, Belmonte Rios A, Ticina A (2008) Evidence of trans-Atlantic mixing and natal homing of bluefin tuna. *Marine Ecology Progress Series** (In press)

Note: Draft of paper attached—do not make public at this time

Under Review

Rooker JR, Secor DH, DeMetrio G, Schloesser R, Block BA, Neilson JD (Submitted) Natal homing and connectivity in Atlantic bluefin tuna populations. *Science*

Workshops:

D. Secor presented our work at an informal NOAA sponsored bluefin tuna workshop in St. Petersburg, FL.

Conferences:

Rooker JR, Secor DH, R Schloesser (2008) Trans-Atlantic mixing and site fidelity of Atlantic bluefin tuna: evidence from stable isotopes in otoliths. ASLO summer meeting, St. John's Newfoundland

Schloesser R, Neilson JD, Secor DH, Rooker JR (2008) Natal origin of Atlantic bluefin tuna in the Gulf of St. Lawrence using $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ in otoliths, 59th Annual Tuna Conference, Lake Arrowhead, CA

Secor DH, Rooker JR, Schloesser R, Neilson JD (2008) Contribution of western and eastern origin populations to US bluefin tuna (*Thunnus thynnus*) fisheries: evidence from otolith stable isotope analysis. 59th Annual Tuna Conference, Lake Arrowhead, CA

Schloesser R, Neilson JD, Rooker JR (2008) Using stable isotopes in otoliths to determine the origin of bluefin tuna in the Gulf of St. Lawrence, Texas A&M University Student Symposium (*Student Award-1st Place*)

Manuals, Protocols:

Outreach Activities:

Patent, Copyright, Invention Disclosure Activity:

7. Collaborators and Personnel:

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8. Students: (list students receiving funding, degree type, anticipated graduation date, thesis or dissertation title)

Ryan Schloesser, B.S. (M.S. Candidate; expected graduation date 10/08), Department of Wildlife and Fisheries Sciences, Texas A&M University, 5007 Ave U, Galveston, TX 77551

Thesis title: Contribution rates of bluefin tuna recruits from eastern and western spawning grounds to mixed stock fisheries of the northwestern Atlantic Ocean