



UNITED STATES DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
NATIONAL MARINE FISHERIES SERVICE  
Northeast Fisheries Science Center  
166 Water Street  
Woods Hole, MA 02543-1026

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MEMORANDUM FOR: NRCC  
FROM: *Russell W. Bean*  
William A. Karp, Ph.D. *for*  
Science and Research Director

**SUBJECT: Justification and Recommendations on Monkfish Assessment Options in 2016**

In response to our discussions at the NRCC meeting in November on monkfish assessment and management needs, we have prepared a summary of relevant current research on monkfish (see Appendix) and evaluated various options for assessments in 2016.

### Summary

Progress is being made toward better understanding monkfish growth, an essential underpinning to the analytic assessment. However, we are currently in the position of being fairly sure that the vertebral aging method is not valid (and therefore the growth curves used in the past are not valid), but not yet having a replacement for the previous growth curve. Further details on the research are provided at the bottom of this message.

Given the current state of knowledge, developing a benchmark assessment that includes an age-structured model is not appropriate. Similarly, producing an operational assessment using the now-discredited growth curve is clearly inappropriate. Alternatively an index-based assessment could be produced and used to provide guidance for catch adjustments if deemed necessary. This could be provided directly to the SSC or be vetted through the Operational Assessment process. We would plan to build on the methodology applied to Georges Bank cod at the recent Operational Assessment of the 20 groundfish stocks. A benchmark assessment should be postponed until the issues with the growth model are resolved. We recommend using an Operational Assessment approach to develop a formal Plan B for monkfish catch limits.

### Justification

We considered four feasible options for meeting the regulatory requirements of the NEFMC and GARFO in 2016. In view of the current uncertainty about monkfish growth rates, we could not identify an advantage of conducting a benchmark assessment in 2016. External investigators (Steve Cadrin, Graham Sherwood) agreed that the work on a new growth curve needs further development before application to assessment.



Options	Advantages	Disadvantages
1. Apply index method adjustment used for GB cod at Operational Assessment and send to SSC for review.	SSC would review approach sometime in the spring. Relies on previously approved methods.	Limited ability to discuss alternative approaches. Less inclusive of analysts and industry.
2. Use Operational Assessment to vet an appropriate index method	Would include greater participation and consideration of alternative methods for empirically adjusting catch. Could lead to methods with some generality.	More costly in terms of time.
3. Operational Assessment with existing growth curve	Maintains continuity with recent assessments.	Will discredit assessment science by turning the crank on assessment based on a faulty growth curve. Costly in terms of staff time and resources.
4. Benchmark Assessment with new, but very provisional growth curves		Risk of producing false results. Research uses novel methods and has not been reviewed. See detail below.

### Recommendation

In light of the above, we propose that an Operational Assessment (Option 2 above) be conducted during spring of 2016 to provide advice for adjustments to the monkfish TAC for 2017. We would include external investigators as well as input from industry as part of the process. We would recommend using the existing Advisory Panel for monkfish as a way of obtaining relevant information from a representative sample of industry members.

Candidate Terms of Reference are as follows:

1. Review index-based methods for adjustments to catch advice as applied to other species.
2. Apply index-based adjustment methods to monkfish for northern and southern management areas.
3. Provide advice on appropriate adjustments to existing monkfish TACs.

An approximate schedule is as follows:

- January: Appoint working group members
- Late January: Assessment Oversight Panel meeting
- March: NEFMC Advisory Panel meeting to provide industry input
- May 24-25: Assessment review

We look forward to hearing from you about this proposal and hope you agree that it represents an appropriate balance of risks associated with the alternative assessment options.

#### **Appendix: Summary of Research in Progress**

1) Validation of monkfish aging methods using chemically-marked vertebrae, otoliths and illicia (Crista Bank MS research in progress, SMAST student under Dr. Steve Cadrin). Results indicate that the vertebral aging method is not accurate - rings are not consistently deposited annually. Conclusion (pending thesis defense): the growth curve currently used in the monkfish assessment is invalid. [report attached]

2) Growth estimates from conventional tagging (Graham Sherwood, GMRI, lead). Based on length increment data from recaptures of tagged fish, growth slows in larger fish, suggesting a non-linear growth curve. A growth curve is provided in the report, but the authors point out that it is for heuristic purposes only because of low sample sizes, and the simplistic assumptions currently used to generate the curve from increment data. Further work is in progress and a manuscript in preparation, but this work has not yet been submitted for peer review.

3) Growth estimates (age validation) from chemical signatures on otoliths (Graham Sherwood, GMRI, lead). Otoliths were sampled using a laser probe to reveal the thermal history of the fish as recorded on the otolith. The pattern of peaks and lows in temperature is thought to reveal the number of years of life, and thus provide an age estimate. This is an intriguing approach, but the research has not yet progressed to the stage of providing a definitive growth curve. Presumed annuli on otoliths were used to guide decisions on which patterns in the chemical signatures constituted annuli. The authors point out that the aging from this approach is experimental and that no independent verifications were performed. In order to be useful, an aging method must be repeatable and not rely on ancillary information such as fish length and/or number of expected annuli. Therefore this research, although promising, does not in its current form provide a growth curve that could be used for assessment purposes. Further work is expected followed by submission of a manuscript to a journal for peer review.

4) Potential use of illicia (first dorsal spine): Preliminary results from C. Bank's thesis (S. Cadrin, thesis advisor) suggest that illicia could possibly be used for aging monkfish, as is done for some European species. Bank has been working with NEFSC's age and growth unit to test the potential utility of illicia. Results to date are not encouraging - annuli counts are not repeatable between investigators or the same investigator at different times. However, work continues towards resolving the sources of error. A cross-Atlantic blind test is in preparation, in which illicia will be sent to readers in Europe who routinely age using illicia. This will not be completed until at least summer of 2016.