Comparison of ages determined by using an Eberbach projector and a stereo microscope to read scales from Atlantic menhaden (*Brevoortia tyrannus*) and Gulf menhaden (*B. patronus*)

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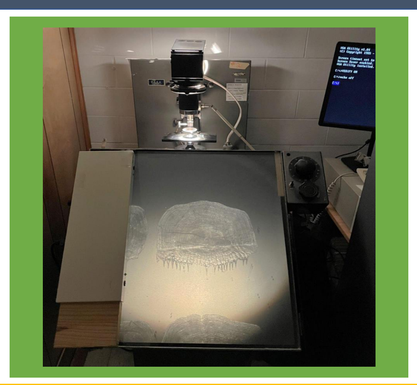
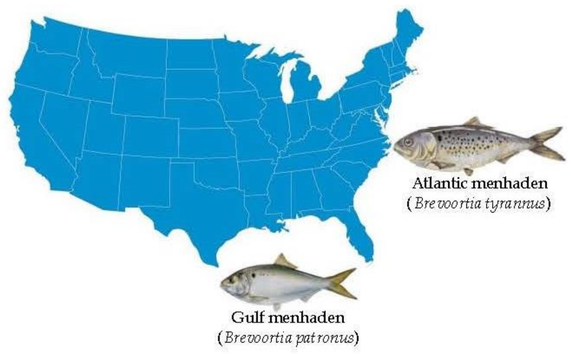
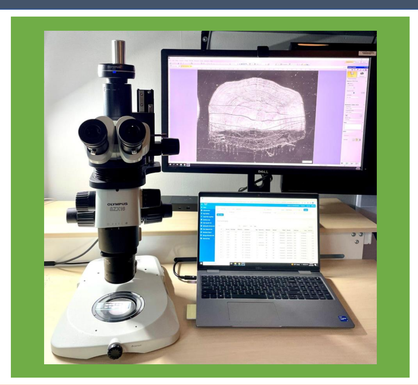




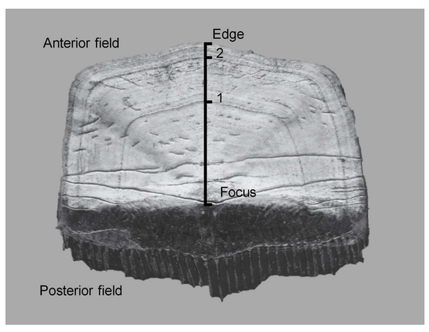


INTRODUCTION

- **Fish age determination is crucial in stock assessments** for estimating productivity and status.
- **Atlantic and Gulf menhaden** fisheries together compose the 2nd largest fishery by volume in the USA (NMFS[1]) and have been aged since 1955 by viewing their scales on an Eberbach projector (c. 1930).
- **As staff and technology change, ageing techniques should be continually evaluated** for precision and bias to maintain consistency.

QUESTION

Will age estimates from a novel stereo microscope be equivalent to those from the historically used Eberbach projector for Atlantic and Gulf menhaden scales?



2 year old Atlantic menhaden scale.

METHODS

- Atlantic and Gulf menhaden scale collections (N=1317, 1569 respectively) were created using samples from two years each (Atlantic: 2013, 2017, Gulf: 2005, 2017) and their respective reference collections. Next, a subsample set was created for each species from these samples (N=200).
- **Full and subsampled scale collections were aged on both devices** (Eberbach=Eber, microscope=scope) and the resulting age sets were **compared** across devices (Eber vs scope) and within reader (Eber vs Eber & scope vs scope) and **evaluated for:**
  - **1) precision or repeatability** using percent agreement (PA), average percent error (APE), Chang's average coefficient of variation (ACV) [Threshold: APE=5%]
  - **2) bias** using 3 bias tests (Bowker's, Evans and Hoenig's and McNemar's)
  - **3) age compositions by device** for assessment continuity (simultaneous multinomial confidence intervals).

ACKNOWLEDGEMENTS

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REFERENCES

- [1] NMFS (National Marine Fisheries Service). 2018. Fisheries of the United States, 2017. NOAA, Natl. Mar. Fish. Serv., Curr. Fish. Stat. 2017, 142 p. [Available from fisheries.noaa.gov]
- [2] Nesslage et al., 2022: Fish. Res. 249, https://doi.org/10.1016/j.fishres.2022.106255

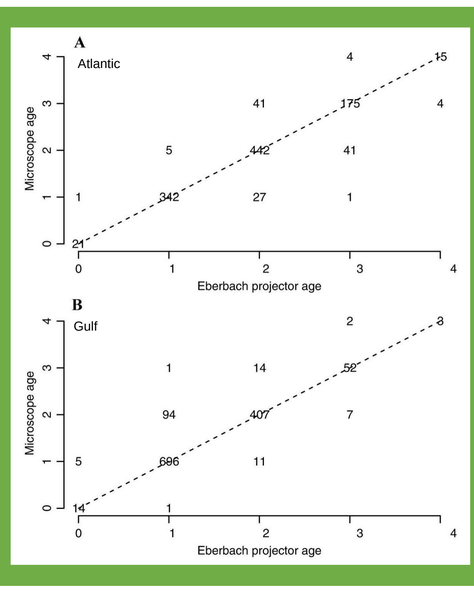
RESULTS

Precision/Repeatability: **Overall, age variations were within standard, accepted levels (APE<5%). Higher APEs (>5%)* in subsampled Gulf were due to reader experience and sample readability on projector. (Eberbach Projector=Eber, Stereo microscope=scope)**

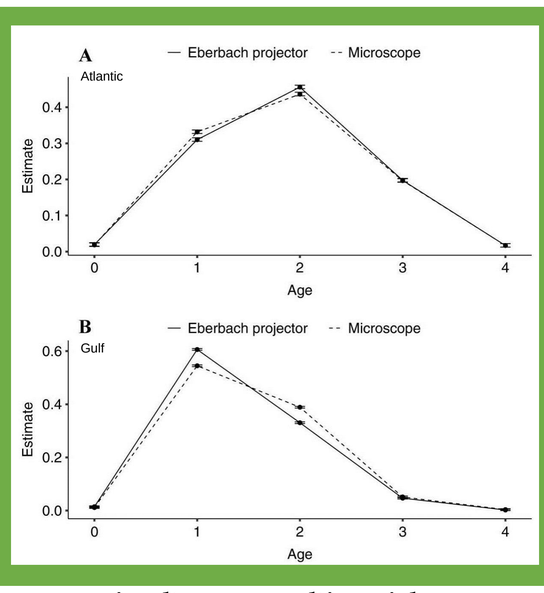
All Samples-Eber vs scope	N	n	APE (%)	ACV (%)	PA
Atlantic	1,317	1,119	2.7	3.8	88.9%
Gulf	1,569	1,307	3.5	5	89.7%
Atlantic Subsamples	**N**	**n**	**APE (%)**	**ACV (%)**	**PA**
Read 1-Eber vs scope	200	186	2.9	4.2	89.3%
Read 2-Eber vs scope	200	185	3.1	4.4	89.2%
Eber vs Eber	200	176	3.1	4.4	88.6%
scope vs scope	200	176	3.7	5.2	86.4%
Gulf Subsamples	**N**	**n**	**APE (%)**	**ACV (%)**	**PA**
Read 1-Eber vs scope	200	177	*9.7	13.8	83.6%
Read 2-Eber vs scope	200	173	0.7	1.0	97.1%
Eber vs Eber	200	157	*8.7	12.3	84.7%
scope vs scope	200	157	4.1	5.8	92.4%

Bias: **Only age comparisons with bias shown here (*P*-value <0.05)*. All comparisons are between Eberbach projector (Eber) and microscope except for within reader comparisons labeled Eber vs Eber. Bias detected in age comparisons between the two devices was attributed to compromised scales and poor image quality on the projector. Bias within reader was due to reader experience and poor repeatability on Eberbach projector.**

Data	n	Bowker	Evans Hoenig	McNemar
Atlantic all	1,119	*17.1 (<0.01)	4.6 (0.10)	3.9 (0.05)
Atlantic 2013	605	*17.8 (<0.01)	2.8 (0.25)	2.0 (0.15)
Gulf all	1,307	*73.7 (<0.01)	*69.8 (<0.01)	*69.70 (<0.01)
Gulf 2005	759	*74.4 (<0.01)	*72.1 (<0.01)	*72.1 (<0.01)
Atlantic subsample read 2	185	*16.8 (<0.01)	*16.2 (<0.01)	*16.2 (<0.01)
Gulf subsample read 1	177	*19.78 (0.006)	*12.56 (0.002)	*12.45 (<0.001)
Gulf subsample read 2	173	5.0 (0.08)	*5.0 (0.03)	*5.0 (0.03)
Atlantic subsample Eber vs Eber	176	10.27 (0.07)	*9.89 (0.007)	*7.20 (0.007)
Gulf subsample Eber vs Eber	157	*11.49 (0.02)	*6.0 (0.014)	*6.0 (0.014)



Bias plots for all samples: Represents number of samples of each estimated age using both devices. 1:1 line represents agreement.



Overall simultaneous multinomial confidence intervals were slightly different for ages 1 and 2 in both species, but age composition data will not be affected by microscope ageing.

CONCLUSIONS, BUT WAIT!

- **Stereo microscope WILL provide equivalent age estimates for Atlantic and Gulf menhaden scales AND maintain the continuity of the assessments.**
- ➢ **Sample size and number of age classes can affect ageing error results which was further investigated in Nesslage et al [2].**