Evaluations of daily and annual increment counts from otoliths of bigeye tuna captured in the eastern tropical Pacific

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Introduction

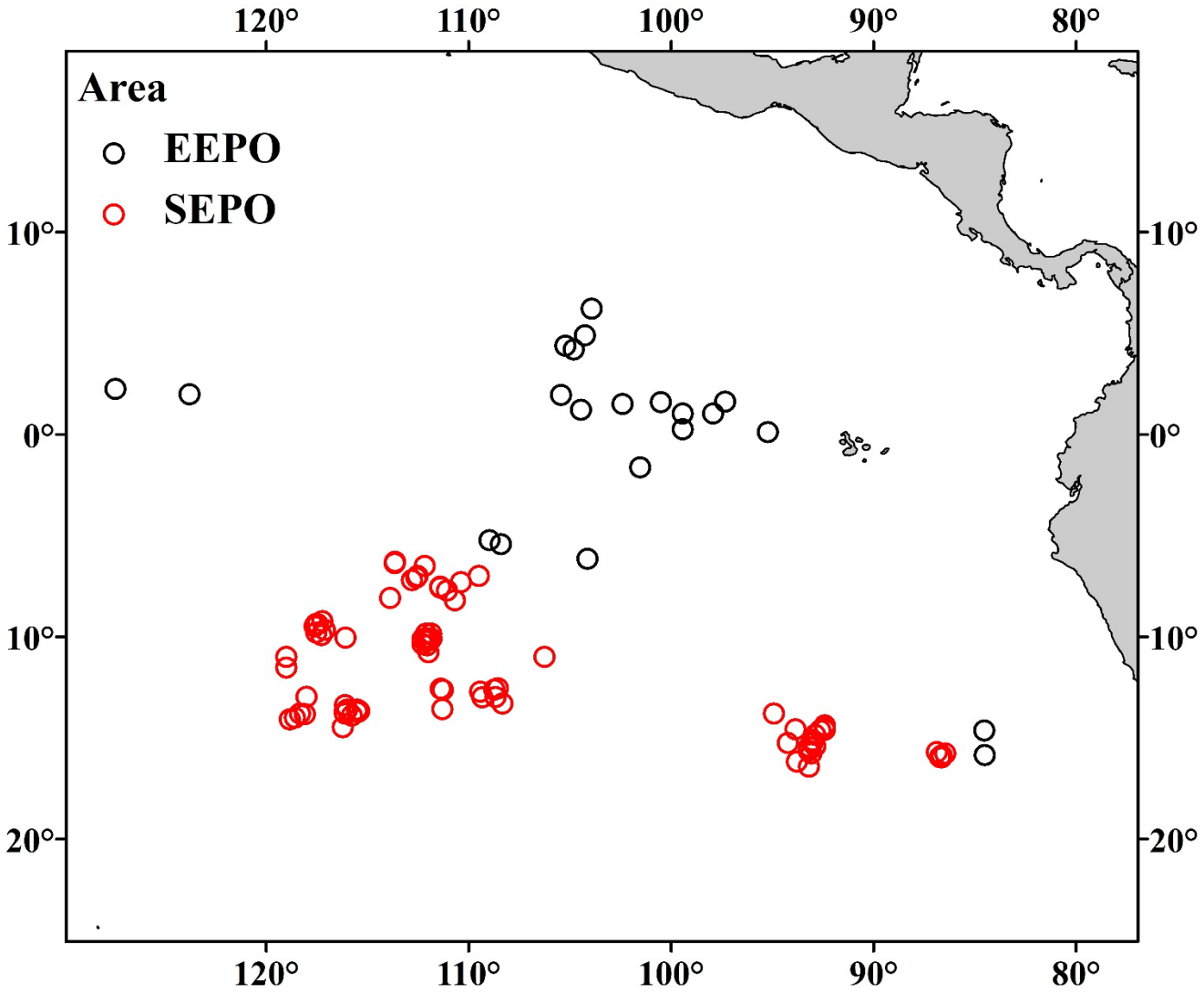
- An investigation of age at length estimates, provided by FAS, from counts of annual zones in otoliths from larger BET (112-207 cm) captured in the EPO was undertaken to compare to age at length estimates derived from daily increment counts and high confidence tagging data to evaluate their usefulness within an integrated growth model for BET in the EPO
- Considering the substantial discrepancies between the BET growth models for the EPO and WCPO it is also prudent to compare and evaluate the age at length estimates, obtained from counts of daily and annual increments, since those age estimates provide the foundations for those growth models
- The objectives of this investigation are to evaluate the apparent differences in age estimates derived from daily and annual increment counts from BET otoliths, including paired otolith samples from the EPO, to help elucidate the basis for the discrepancies in the BET growth models for the EPO and WCPO

Materials and Methods

- The methodologies employed by each laboratory for obtaining counts of daily and annual increments, and the resulting age at length estimates, were described in previous presentations
- A direct comparison was conducted of the annual versus daily increment counts using the same 70 otolith pairs from BET ranging from 80-150 cm FL, collected in the EPO, primarily between 2N to 6S and 95W to 130W, during December 2000 to December 2001. Comparisons of the daily increment counts were made with the annual zone counts and with the estimated decimal ages
- A comparison was also conducted of the otolith annual increment counts, adjusted to decimal ages, for 133 BET (112-207 cm) captured in the SEPO primarily between about 6S to 16S and 86W to 119W, during July 2012 to January 2016, to the otolith daily increment counts for the 70 BET (80-150 cm FL), captured in the EEPO. The estimated decimal ages for BET greater than 150 cm FL were compared with an integrated growth model for BET from the EPO, which includes high confidence tagging data for fish from 150-201 cm.

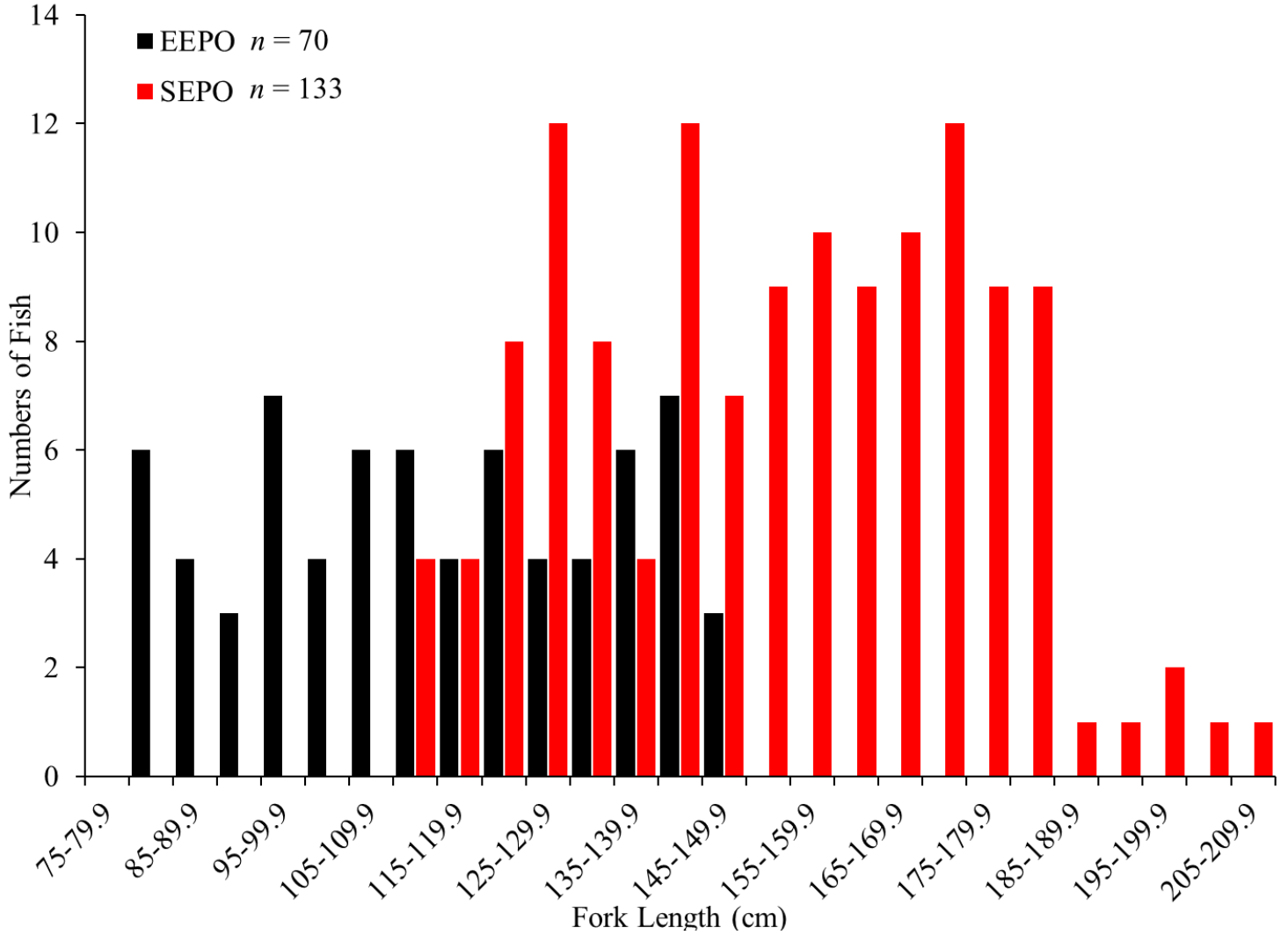
Materials and Methods

Sample locations



Materials and Methods - Sampling

Length Frequencies



Materials and Methods

- Comparisons of the decimal ages from annual counts for the 133 BET otolith samples from the SEPO, and the 70 BET otolith samples from the EEPO, were made with the entire set of daily increment counts for the 254 BET otolith samples from the EEPO, along with the EPO BET integrated growth model; based on the 254 BET age estimates and high confidence tagging data
- In each of the above comparisons, where the annual increment zone counts were adjusted to decimal ages, the algorithm of Farley et al. (2017) was used to account for birthdate relative to a universal spawning date and otolith edge type.

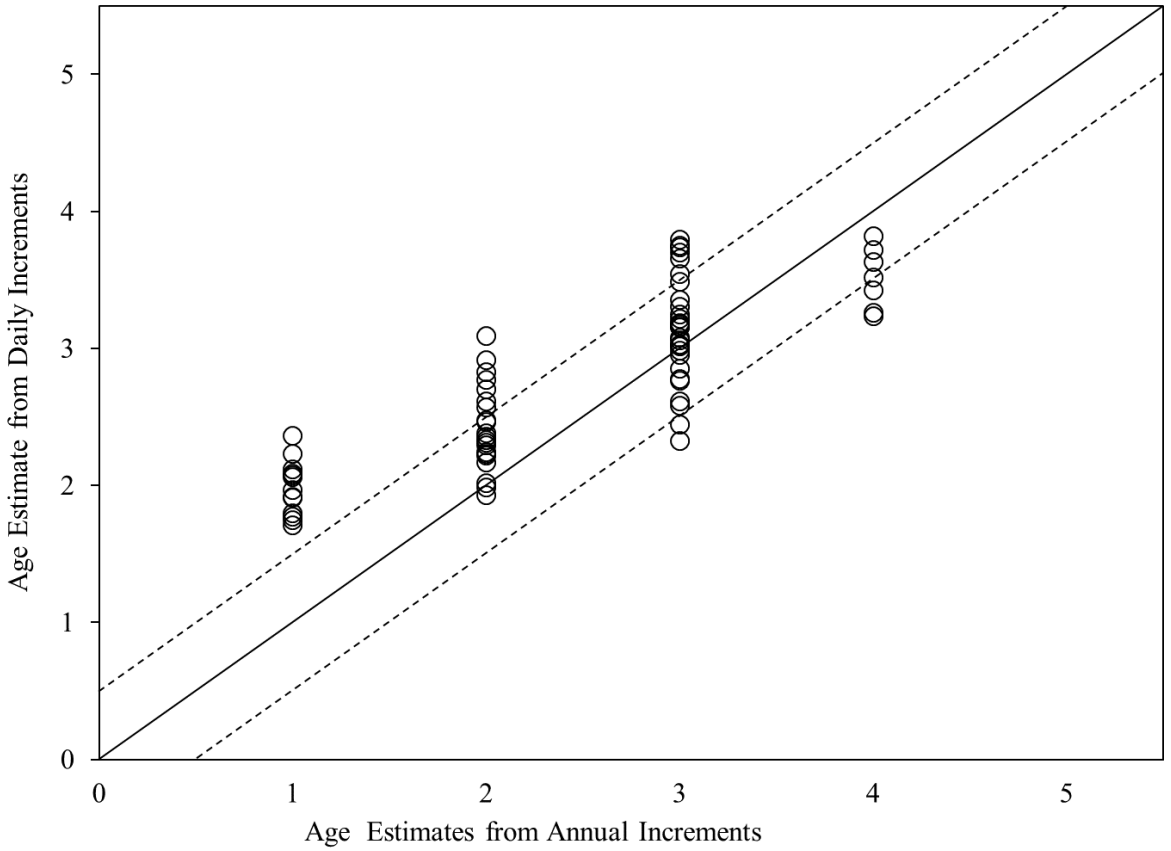
Results

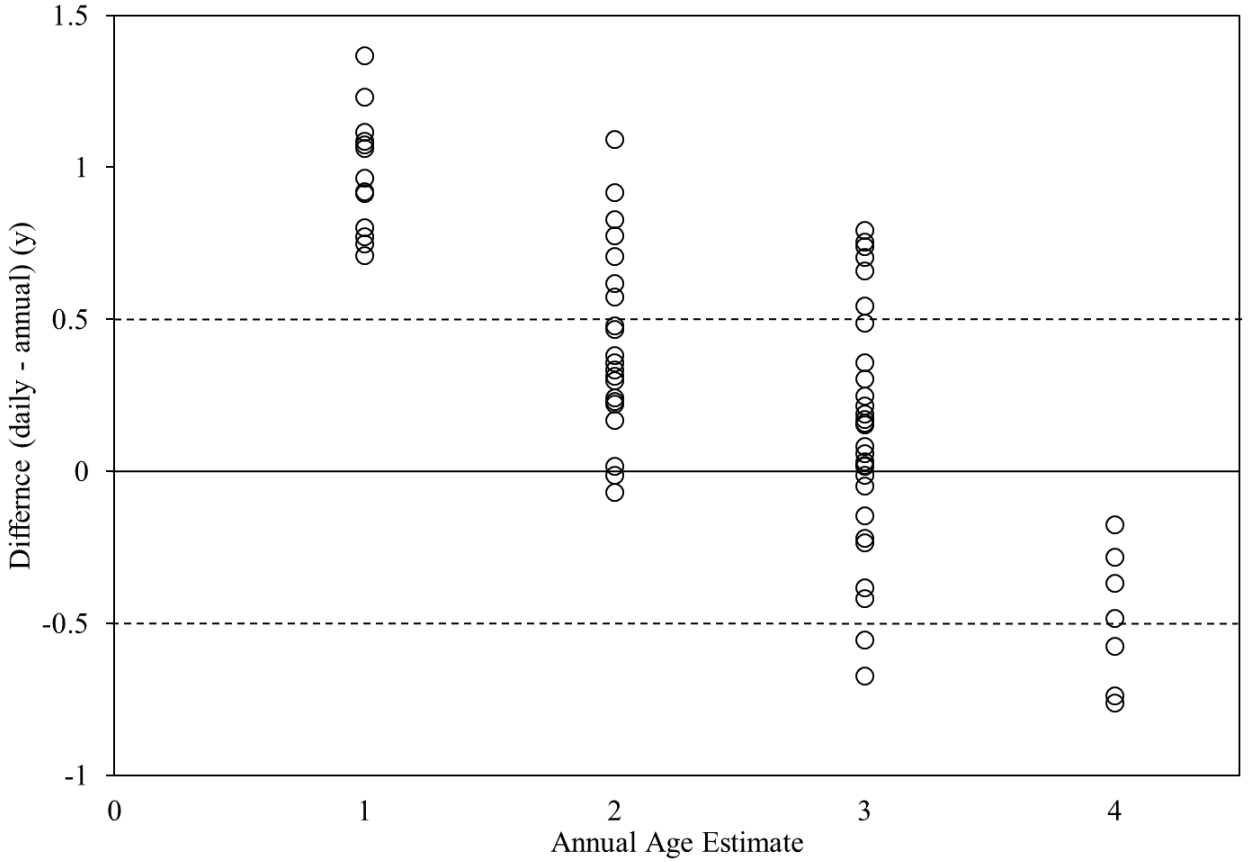
- Comparisons of daily and annual age estimates from the 70 BET otolith pairs, shows an apparent systematic underestimation of the ages for fish 80-110 cm, from the zone counts but not the decimal ages, compared to estimates from daily increment counts

- Comparisons of daily and annual age estimates from the 70 BET otolith pairs, shows an apparent systematic overestimation of the ages for fish 130-150 cm, from the decimal ages compared to estimates from daily increment counts

Results

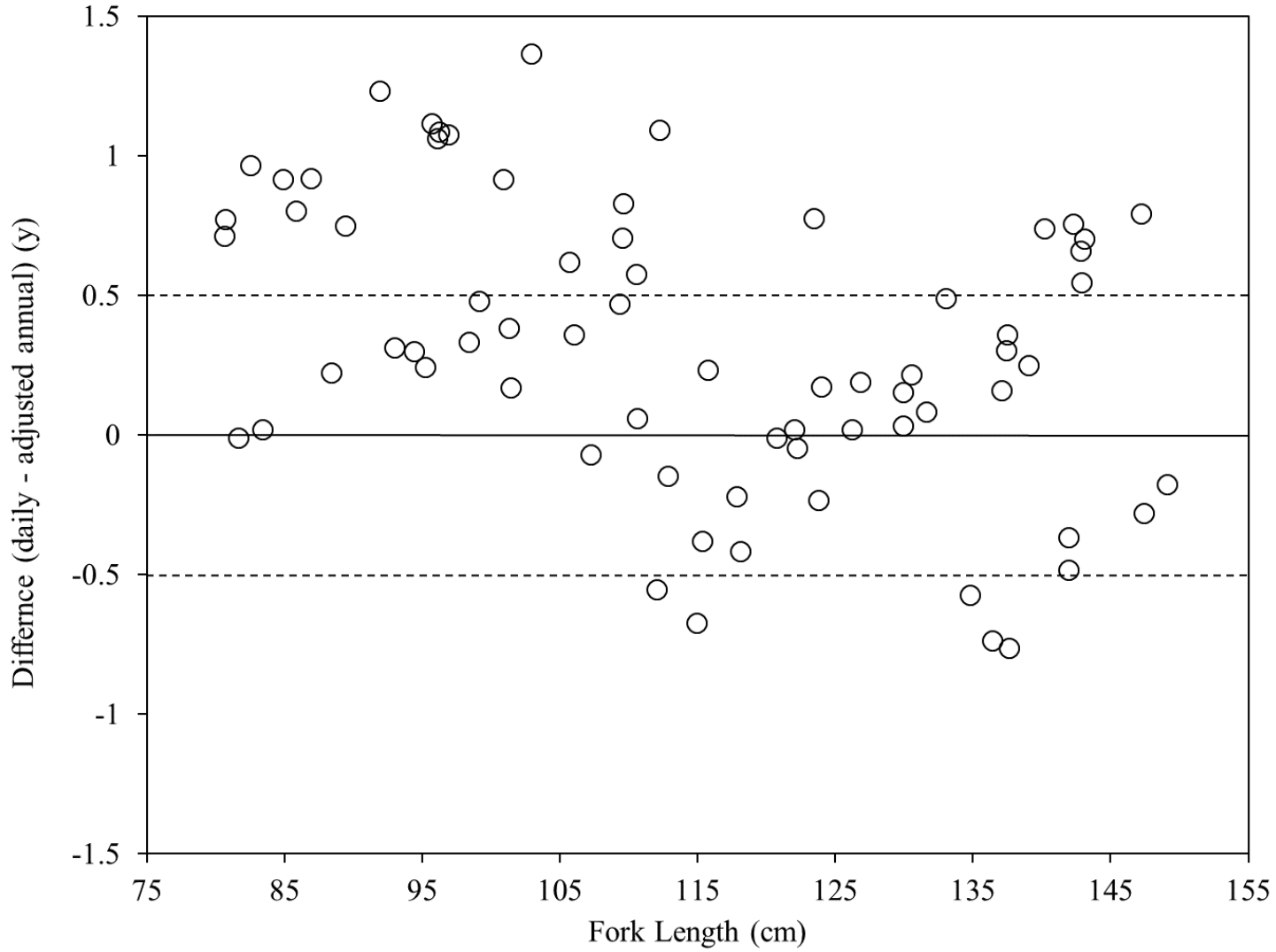
Differences between ages estimated from daily and annual increment counts.





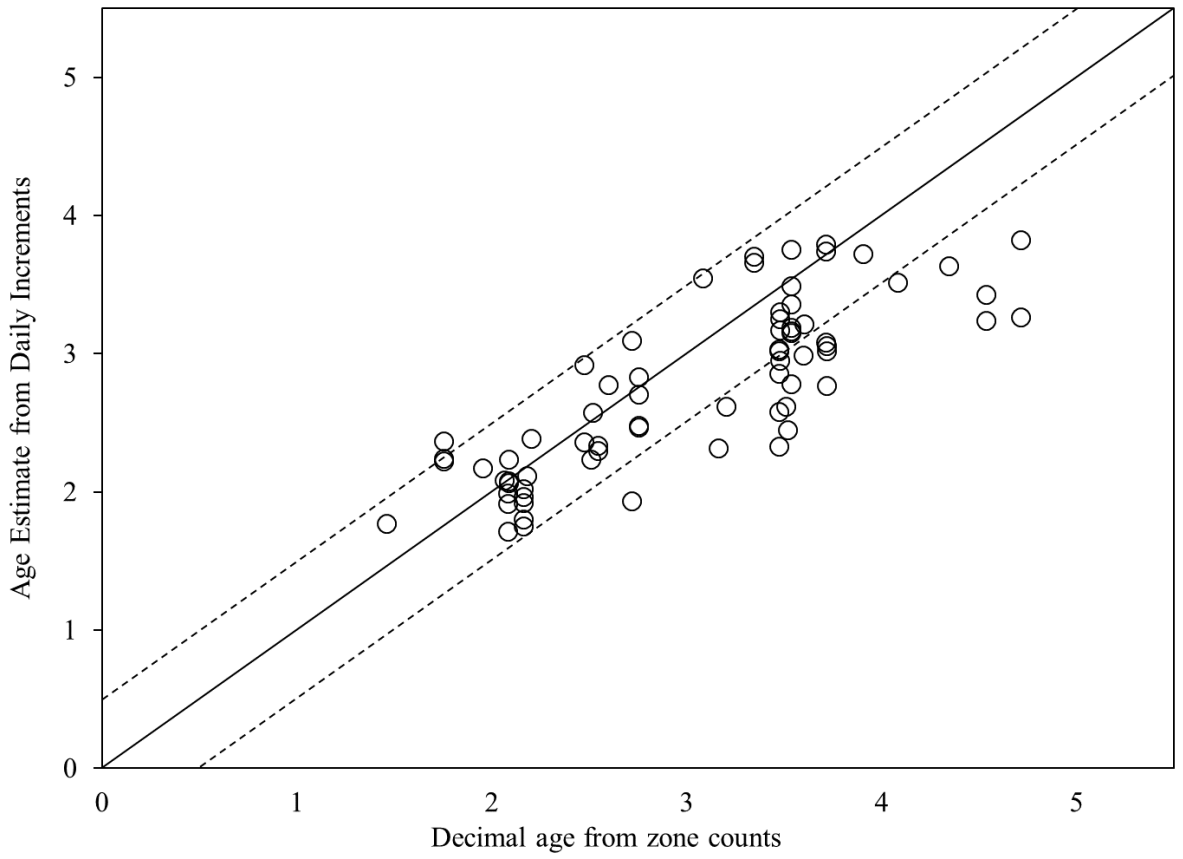
Results

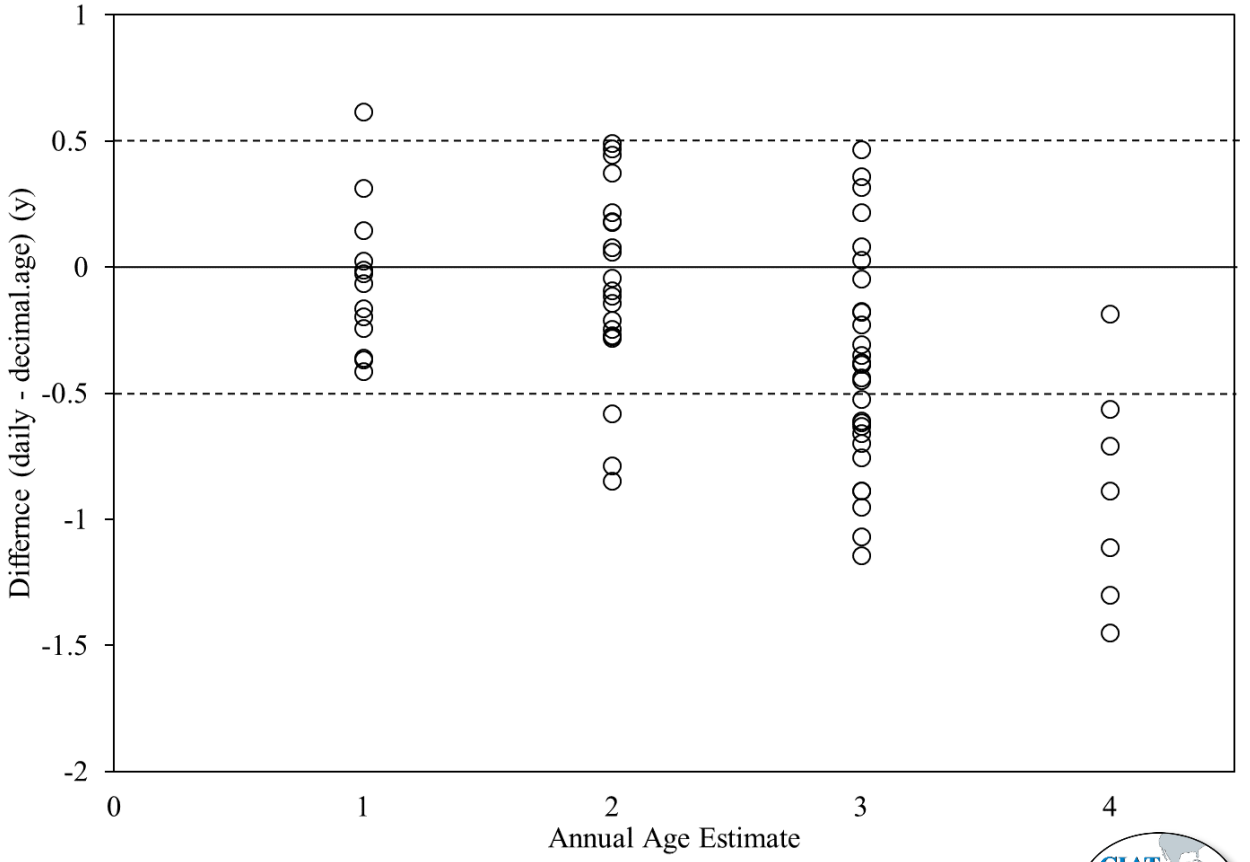
Differences between ages estimated from daily and annual increment counts by fork length.



Results

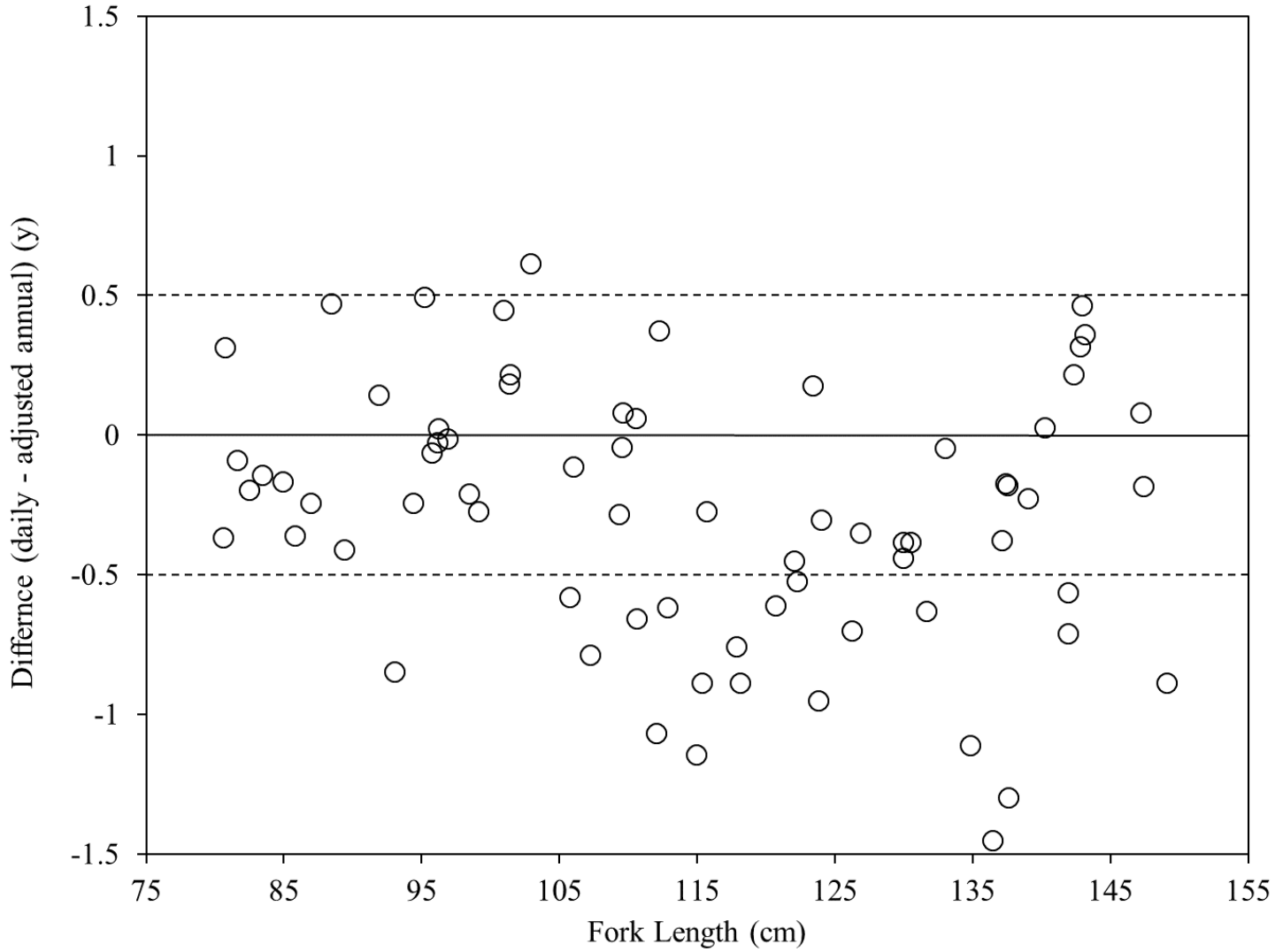
Differences between ages estimated from daily and decimal ages.





Results

Differences between ages estimated from daily and decimal ages by fork length.

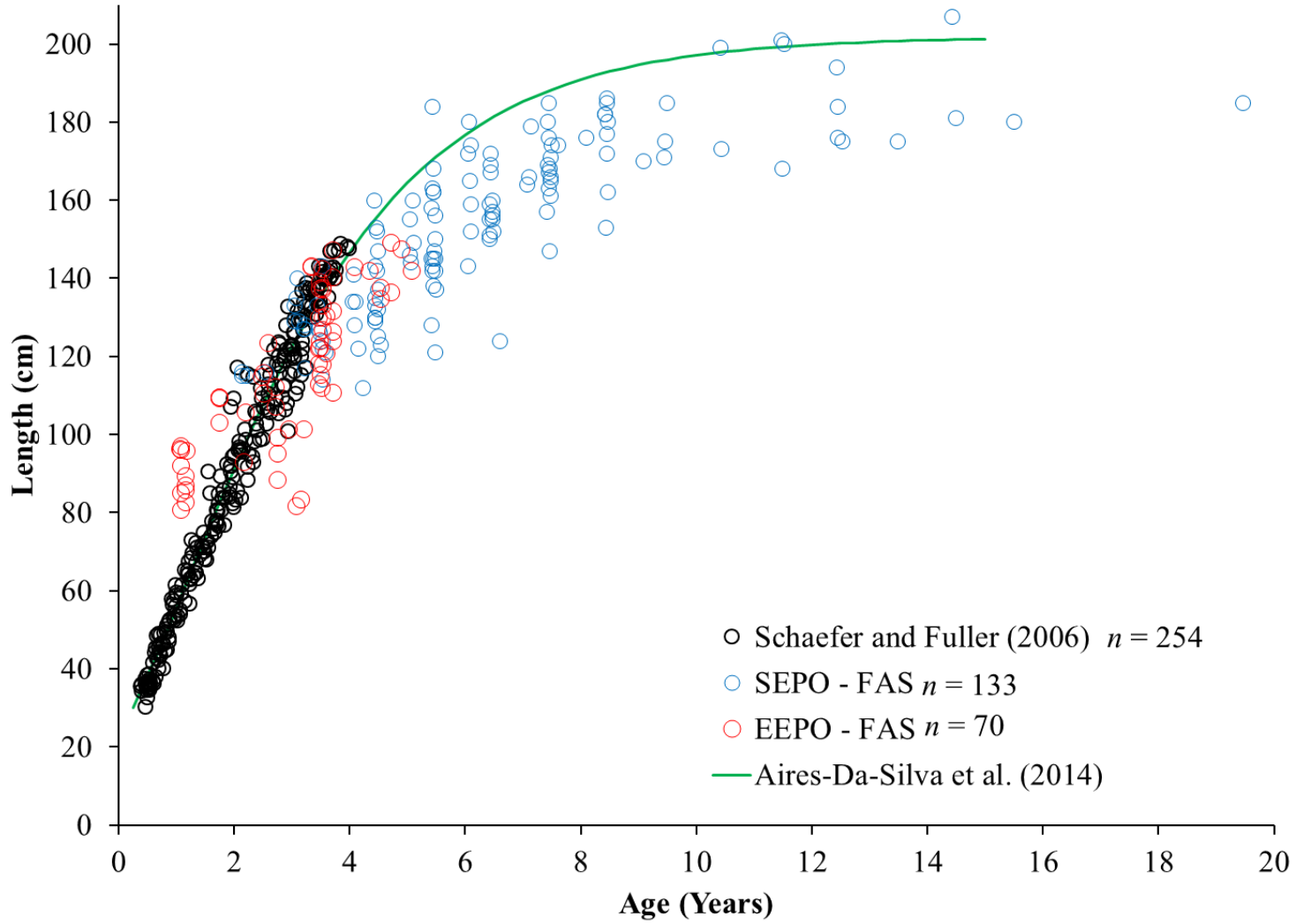


Results

- For BET from 120-150 cm, the decimal age estimates from the SEPO are on average 1.3 year (range: -0.3-3.6 years) older compared to the estimated age at length for BET from the EEPO based on the integrated growth model.
- For BET 150-200 cm from the SEPO, the decimal age estimates are on average over estimating age at length by 2.4 years (range: -2.6 to 12.5 years) compared to the estimated age at lengths from the EPO BET integrated growth model.

Results

Age estimates from daily and decimal age estimates from BET otoliths from the EPO

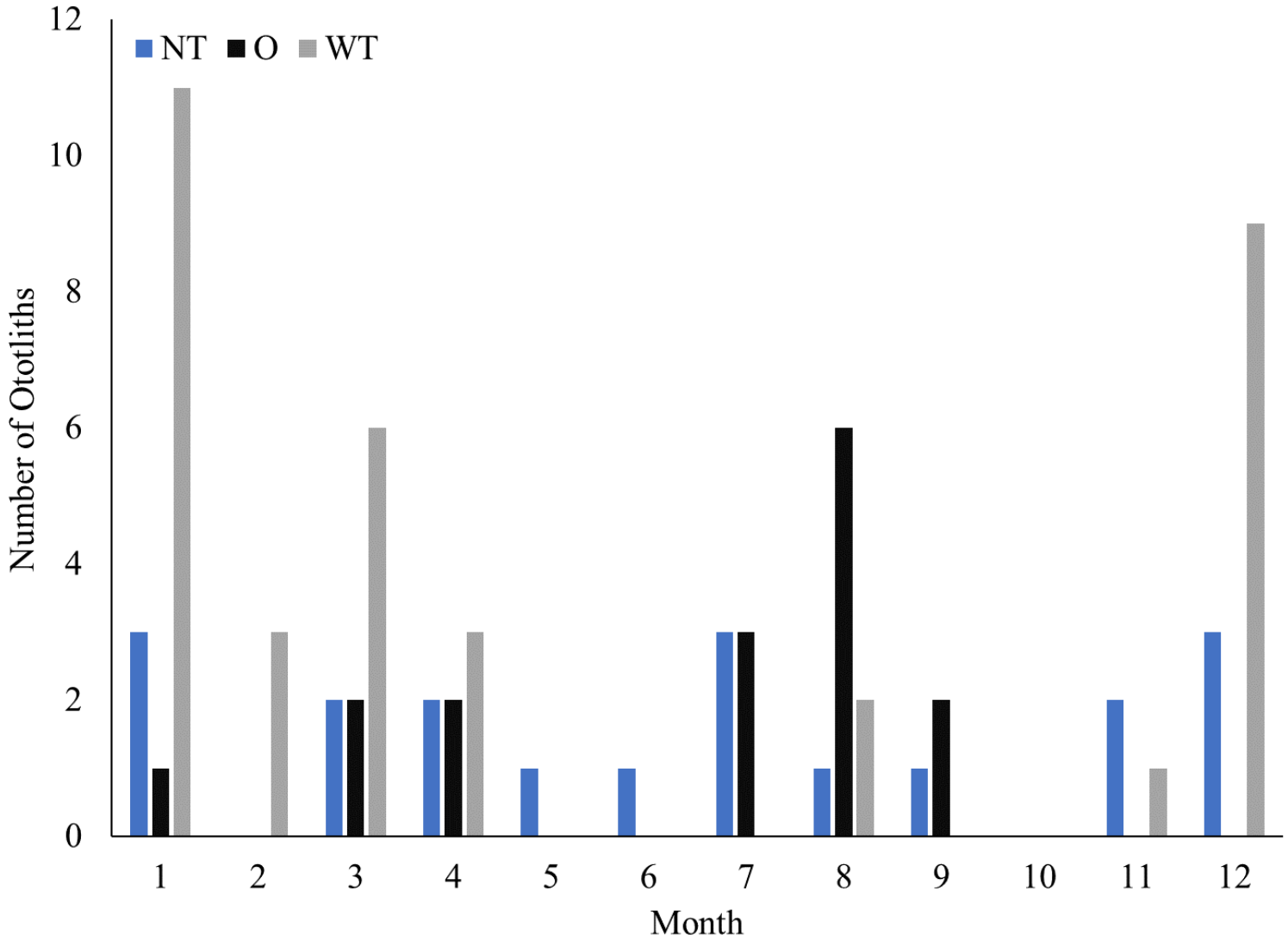


Conclusions

- There appears to be fundamental issues in the objective discrimination of annual increments based on the comparative evaluations from 70 pairs of otoliths from BET 80-150 cm from the EPO.
- Apparently there are no discernable annual increments in the otoliths of BET less than 2 years of age and about 110 cm. It also appears annual increments in larger BET are difficult to discriminate, which compounds the inaccuracy in age estimation of BET using annual increments.
- Assumptions associated with the algorithm used by Farley et al. (2017) for adjustments of annual zone counts to decimal ages, including monthly periods of increment formation and opaque zone completion, based on marginal increment and edge type analyses, are suspect as are the adjustments of zone counts to decimal ages based on a universal birthdate and catch date.

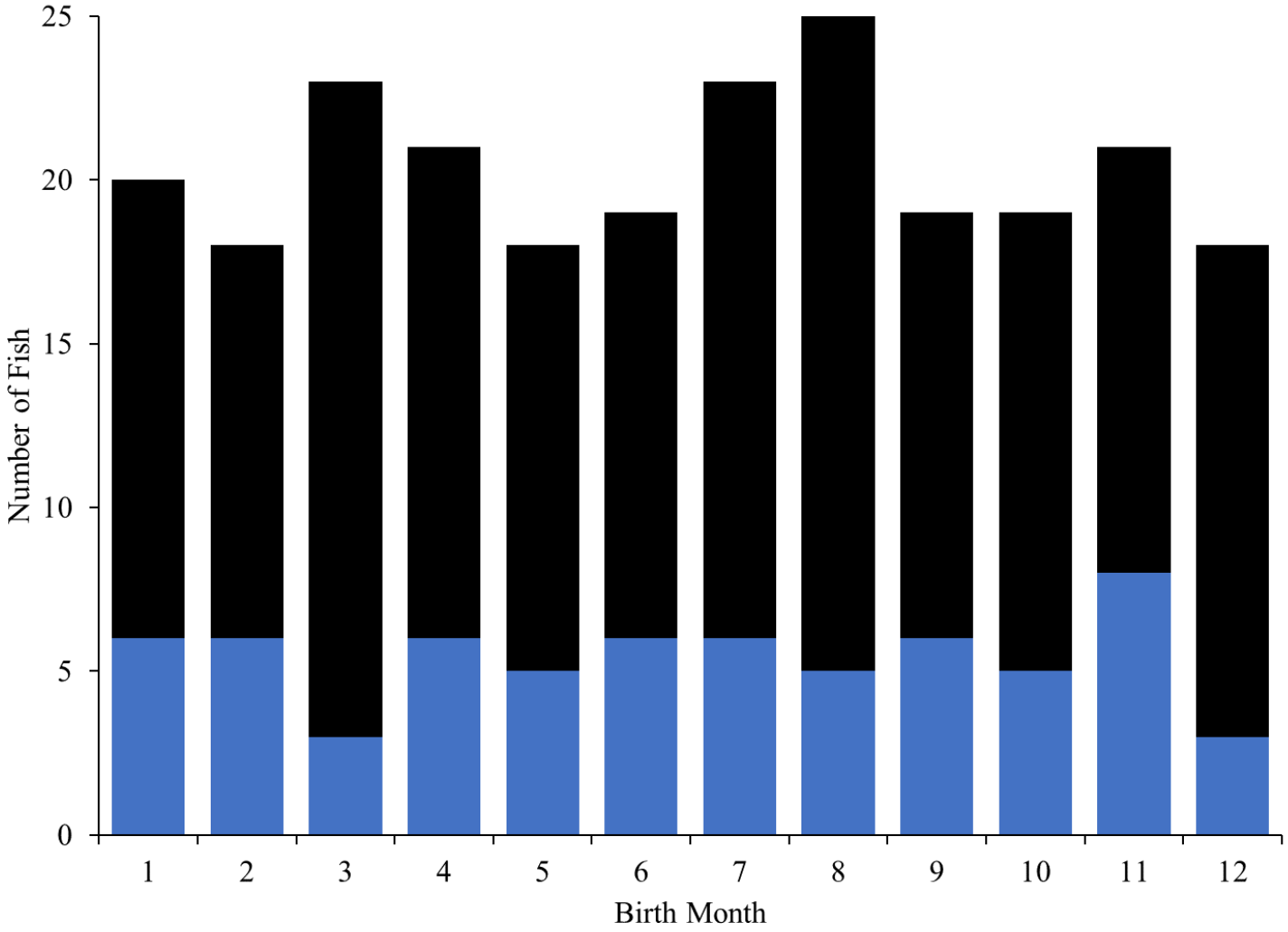
Conclusions

Month of edge formation based on edge analyses provided by FAS



Conclusions

Back calculated birth months derived from daily increment counts from 254 otoliths (Schaefer and Fuller, 2006). The 70 paired otoliths are shown in blue.



Conclusions

- The results of these evaluations are not surprising considering there is very little seasonal variability in BET habitat in the EPO, most likely resulting in a lack of seasonal variation in growth, and thus no environmental or physiological basis for formation of otolith annual increments
- There are more than likely spatiotemporal differences in ages at length throughout the Pacific, including latitudinal variation. However, it is unlikely the observed differences in the annual age estimates from the SEPO and EPO BET data sets are derived from spatiotemporal variability.
- There appears to be a systematic bias in overestimation of ages from the decimal age estimates, compared to the daily increment counts for fish ranging from 120-150 cm, and up to 200 cm when compared with the EPO integrated growth model.

Acknowledgements

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Questions