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DRAFT METHODS FOR PREDICTING INDICES OF STOCK ABUNDANCE OF ATLANTIC BLUEFIN TUNA FROM ASSESSMENT PROJECTIONS

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SUMMARY

We calculated predicted indices of abundance of Atlantic bluefin tuna from assessment projections to evaluate the recent trends in observed indices compared to the expectations from the stock assessment. This paper documents the methods applied and the provisional results of the analysis.

RÉSUMÉ

Nous avons calculé les indices prédits de l'abondance du thon rouge de l'Atlantique à partir des projections d'évaluation pour évaluer les tendances récentes des indices observés par rapport aux attentes de l'évaluation des stocks. Le présent document documente les méthodes appliquées et les résultats provisoires de l'analyse.

RESUMEN

Se han calculado los índices predichos de abundancia de atún rojo del Atlántico a partir de proyecciones de evaluación para evaluar las tendencias recientes en los índices observados en comparación con las previsiones de la evaluación de stock. En este documento se documentan los métodos aplicados y los resultados provisionales del análisis.

KEYWORDS

Atlantic bluefin tuna, catch/effort, stock assessment methods

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1. Introduction

This paper documents the methods applied during the SCRS working group to evaluate indicators of stock abundance for Atlantic bluefin tuna based on prediction intervals from stock assessment projections (6-yr average recruitment from 2007-2012). The working group evaluated the recent trends in fishery dependent and independent relative abundance indices, and compared those to the expected trends from VPA projections given recent catches for 2016 to 2018.

2. Materials and Methods

Predicted indices of relative abundance were calculated from the expected numbers-at-age from stock projections as the product of fleet/survey catchability and the vulnerable abundance or biomass.

$$I_A = \sum_{a=1}^{16+} (q \cdot N_a \cdot s_a)$$

where
$I_A = expected\ index\ of\ abundance$
$q = catchability\ coefficient$
$N_a = numbers\ at\ age$
$s_a = selectivity\ at\ age$
$a = age$

and

$$I_B = \sum_{a=1}^{16+} (q \cdot N_a \cdot s_a \cdot w_a)$$

where
$I_B = expected\ index\ of\ biomass$
$q = catchability\ coefficient$
$N_a = numbers\ at\ age$
$s_a = selectivity\ at\ age$
$w_a = weight\ at\ age$
$a = age$

For comparison with observed standardized abundance index trends, the predicted indices were centralized to the mean of the series. This was necessary to account for differences in scaling of updated indices compared to assessment inputs (i.e. a change in estimated q from the assessments). The residual error (log-e scale) of the model fit was calculated for each index using the following equation:

$$\varepsilon = [log_e(I_o) - log_e(I_e)]^2$$

$where$
$\varepsilon = lognormal\ residual\ error$
$I_o = observed\ index\ of\ abundance$
$I_e = expected\ index\ of\ abundance$

and the lognormal standard error was calculated as follows:

$$\sigma_I = \sqrt{\left(\frac{1}{n}\sum \varepsilon\right)}$$

$where$
$\sigma_I = index\ lognormal\ standard\ error$
$n = sample\ size$

Uncertainty in abundance/biomass estimates was approximated from the assessment terminal year abundance/biomass standard deviation, based on bootstrap iterations of the VPA. The working group noted that the error in estimated abundance from the assessment was relatively small compared to the residual error associated with model fit to the indices, and therefore, the group decided to use the lognormal standard error of the model residuals for each index for estimating the prediction interval (80% intervals) using the following equation:

$$80\%\ PI = log_e(I_A) \pm 1.28 \cdot \sigma_I$$

The predicted and observed indices were plotted (on a log-e scale) for comparison between trends, along with the 80% prediction intervals. Additionally, the updated indices were compared to the assessment model inputs to evaluate differences in fishery or survey data or standardization model structure since the last assessment.

3. Results

The residual errors in assessment model fit to indices for the West Atlantic stock are presented in **Figure 1**, and the error distributions are shown in **Figure 2**. The observed and prediction indices are plotted with the 80% prediction intervals in **Figure 3**. The residual errors in assessment model fit to indices for the Easy Atlantic stock are presented in **Figure 4**, and the associated error distributions are shown in **Figure 5**. The observed and prediction indices of East Atlantic bluefin tuna are plotted with the 80% prediction intervals in **Figure 6**.

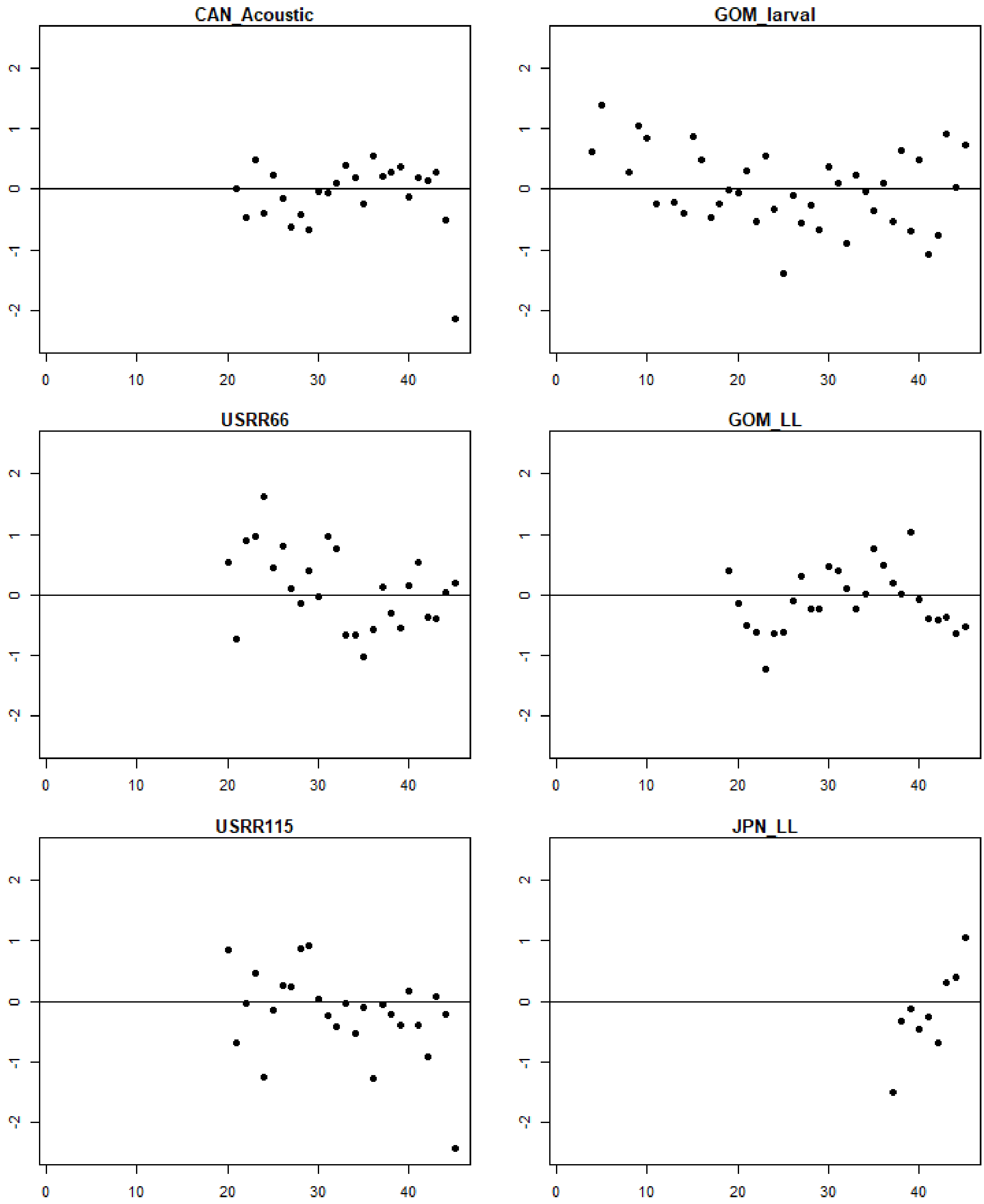

Figure 1. Observed minus predicted indices of stock abundance for West Atlantic bluefin tuna, based on the 2017 VPA assessment. The residuals are shown on the log-e scale.

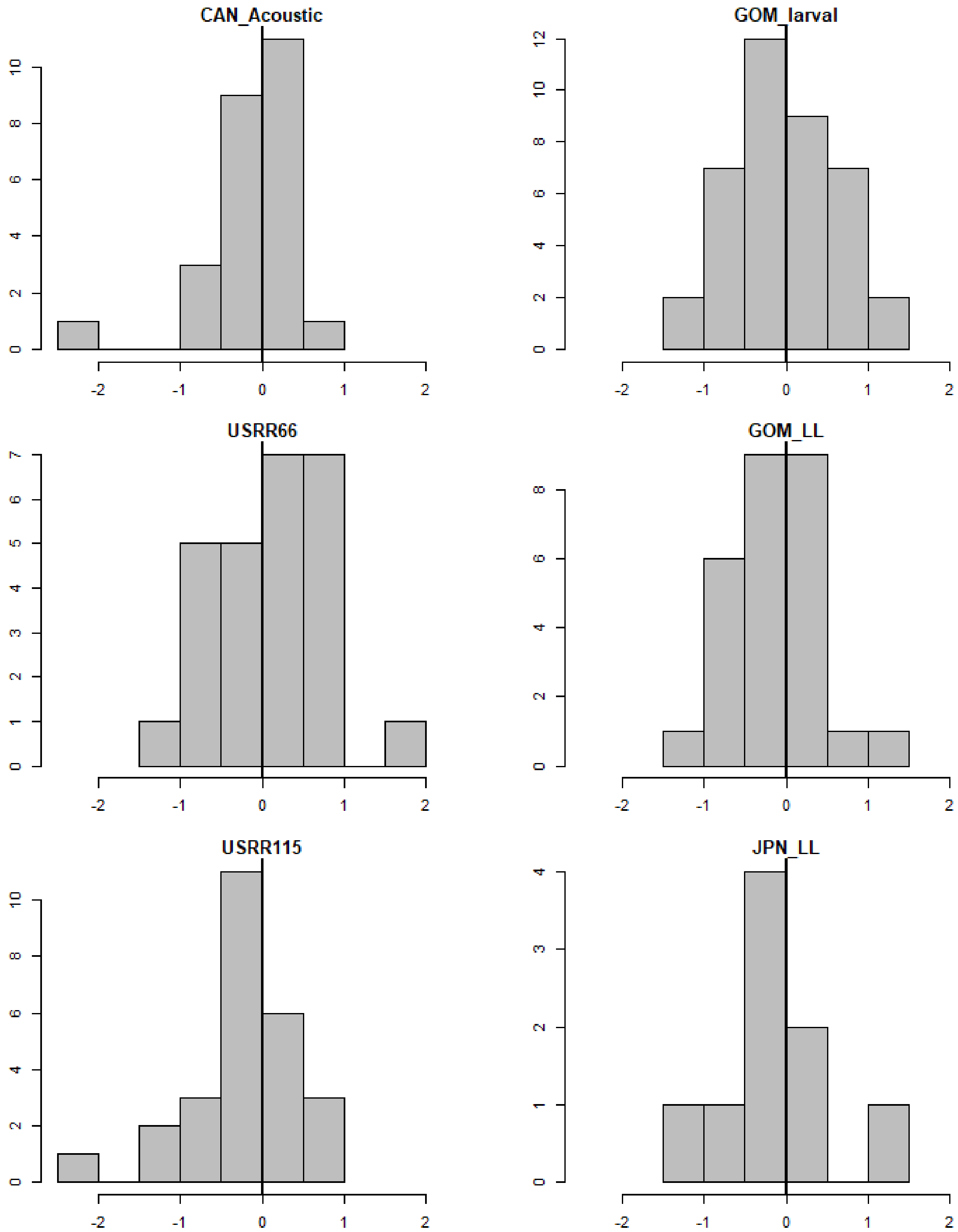

Figure 2. Index residual error (log-e scale) distributions from the 2017 VPA assessment.

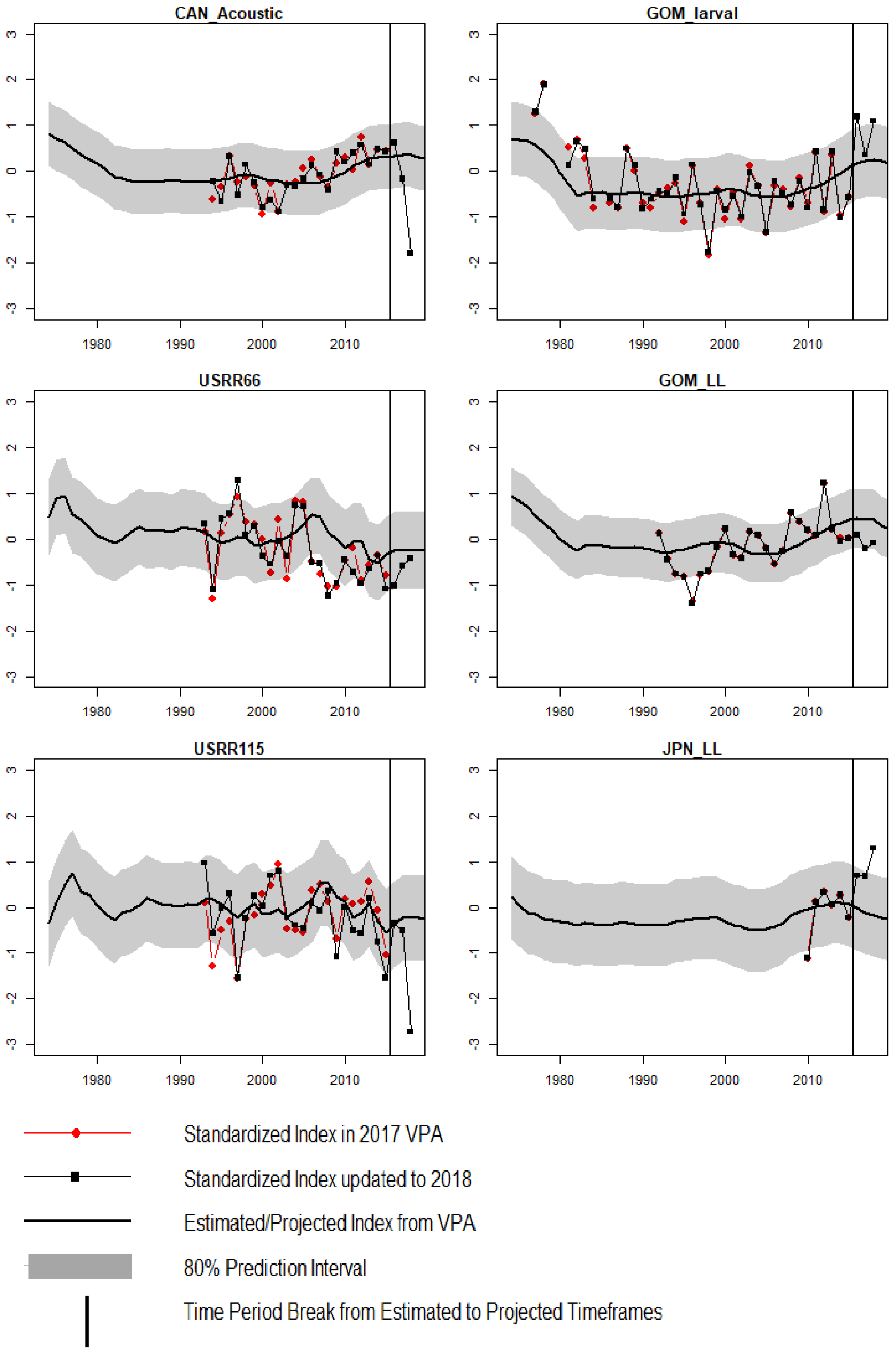

Figure 3. Relative abundance indices prediction intervals from VPA estimated/projected abundance and biomass-at-age of West Atlantic bluefin tuna, assuming average recruitment from the period 2007 to 2012. The Gulf of Mexico larval survey index was compared to the late spawning fraction-at-age scenario model from the 2017 assessment.

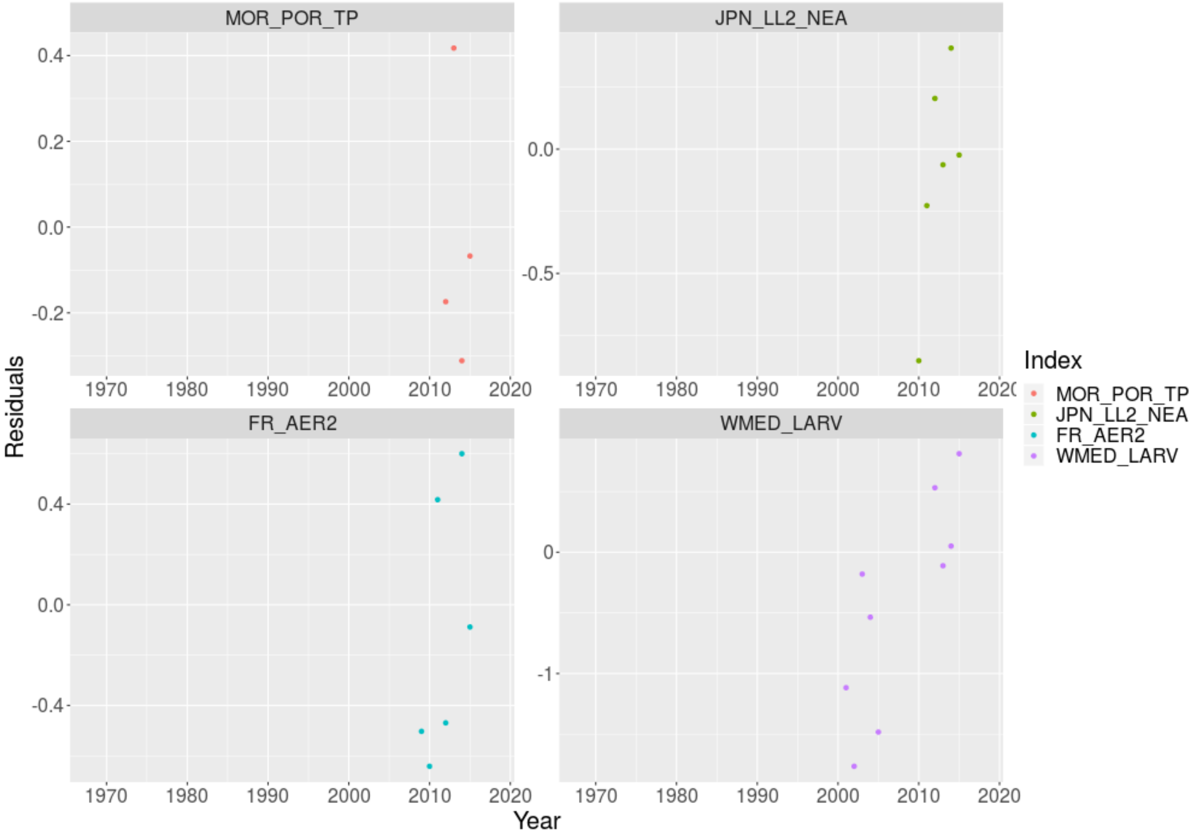

Figure 4. Observed minus predicted indices of stock abundance for East Atlantic bluefin tuna, based on the 2017 VPA assessment. The residuals are shown on the log-e scale.

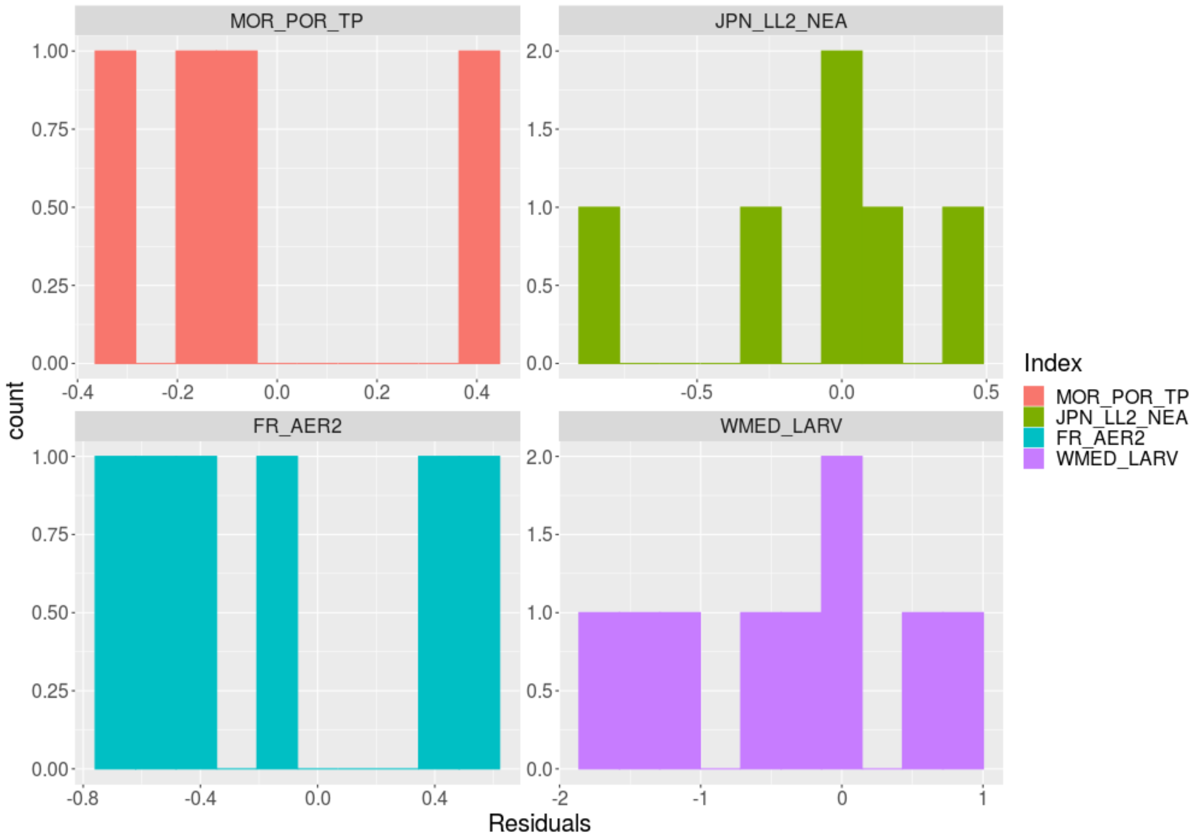

Figure 5. Index residual error (log-e scale) distributions from the 2017 East Atlantic bluefin tuna VPA assessment.

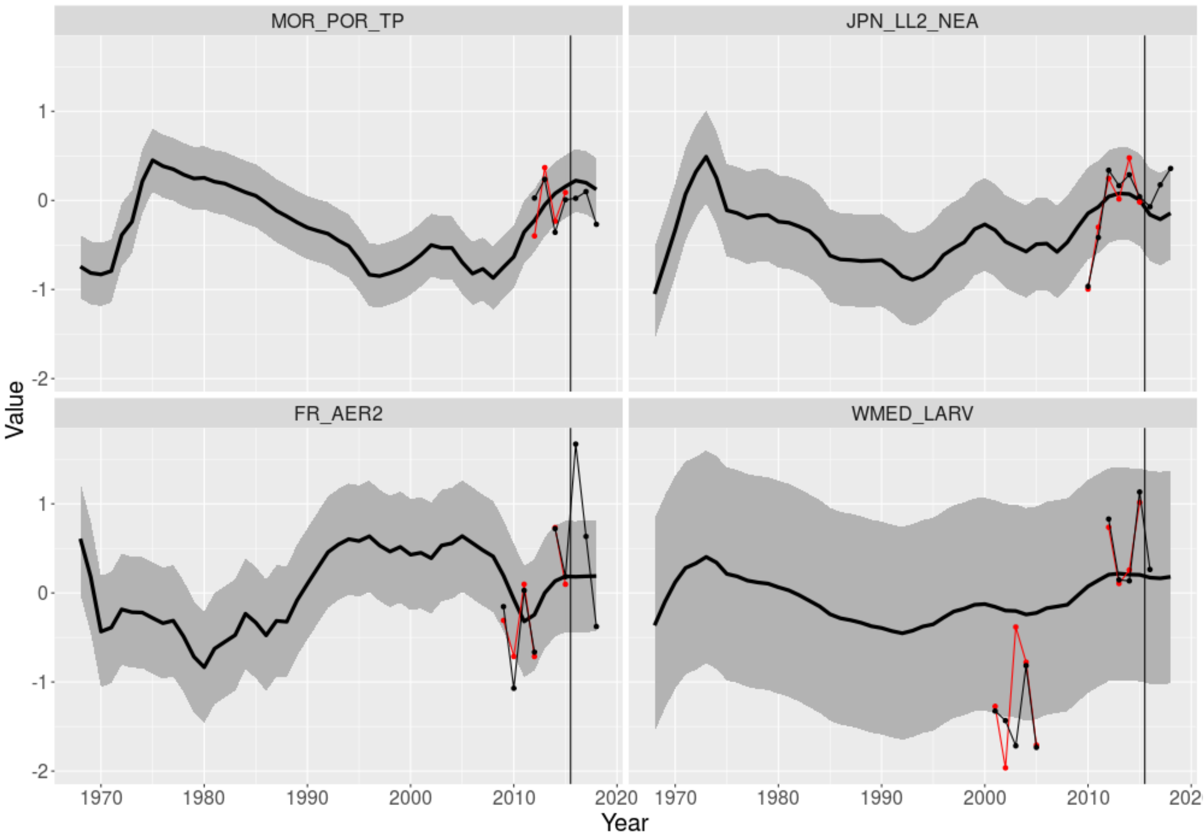

Figure 6. Relative abundance indices prediction intervals from VPA estimated/projected abundance and biomass-at-age of East Atlantic bluefin tuna.