Supplement to: Contributions of species and harvest asynchrony to the stability of regional fishing harvest portfolios in Chesapeake Bay, USA

**Methods S1.**

Additional information regarding SPDE mesh creation and biomass index model diagnostics

*sdmTMB* integrates SPDE matrices from R-INLA (Lindgren & Rue, 2015) with marginal log likelihood calculations and random effect integration via the Laplace approximation with TMB (Kristensen et al., 2015). Our ‘mesh’ for the SPDE calculations was constructed in R-INLA with an inner mesh near the data and an outer mesh further away from the data to reduce boundary effects (Lindgren & Rue, 2015). Our inner and outer meshes had an ‘offset’ of 3 km and 8 km from the data, maximum triangle edge lengths of 3 km and 15 km, and a minimum triangle edge length of 3 km.

We assessed model convergence by checking that the maximum absolute gradient of the marginal log likelihood with respect to all fixed effects was < 0.001 and the Hessian matrix was positive definite. We used Markov Chain Monte Carlo (MCMC) randomized quantile residuals to evaluate residual patterning using QQ-plots. These residuals are samples of the random effects drawn from the joint posterior distribution of the fitted model while fixed effects are held at their maximum likelihood estimates (Anderson et al. 2022).

**Table S2.** Statistics from linear models evaluating interannual temporal trends in estimated Atlantic croaker, spot, and striped bass annual biomass (summed across months) in the Virginia portion of Chesapeake Bay over 2002-2018.

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Species** | **Trend (kg year-1)** | **Std. error** | **T statistic** | | **P value** | | **Error structure** |
| Atlantic croaker | -1,130,825 | 162,802 | -6.946 | <0.001 | | iid | |
| spot | -169,460 | 46,445 | -3.649 | 0.003 | | iid | |
| striped bass | -36,926 | 15,175 | -2.433 | 0.03 | | iid | |

**Table S3.** Statistics from linear models evaluating interannual temporal trends in within-year species and harvest statistical averaging (SAESpecies and SAEHarvests) and within-year species and harvest compensation effects (CPESpecies and CPEHarvests) in the Virginia portion of Chesapeake Bay over 2002-2018.

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| --- | --- | --- | --- | --- | --- |
| **Term** | **Trend (SAE/CPE year-1)** | **Std. error** | **T statistic** | **P value** | **Error structure** |
| SAESpecies | 0.029 | 0.007 | 4.458 | < 0.001 | iid |
| CPESpecies | 0.018 | 0.006 | 3.055 | 0.008 | AR(2) |
| SAEHarvests | -0.005 | 0.005 | -0.994 | 0.336 | iid |
| CPEHarvests | -0.024 | 0.013 | -1.887 | 0.079 | AR(1) |

**Table S4.** Statistics from linear models evaluating interannual temporal trends in within-year weighted-average month of harvest, where weights are monthly harvests in the Virginia portion of Chesapeake Bay over 2002-2018.

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| --- | --- | --- | --- | --- | --- |
| **Species** | **Trend (month year-1)** | **Std. error** | **T statistic** | **P value** | **Error structure** |
| Atlantic croaker | 0.089 | 0.014 | 6.241 | <0.001 | iid |
| spot | -0.001 | 0.011 | -0.092 | 0.928 | iid |
| striped bass | -0.129 | 0.019 | -6.694 | <0.001 | iid |

**Table S5.** Statistics from linear models evaluating interannual temporal trends in within-year portfolio harvest stability (SPortfolio,L) in Maryland and Virginia regions of the Chesapeake Bay over 2002-2018.

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| --- | --- | --- | --- | --- | --- | --- |
| **Region** | **Term (stability year -1)** | **Trend** | **Std. error** | **T statistic** | **P value** | **Error structure** |
| Maryland | SPortfolio, L | -0.002 | 0.014 | -0.158 | 0.877 | iid |
| Virginia | SPortfolio, L | -0.043 | 0.008 | -5.130 | 0.000 | iid |

References

Anderson, S. C., Ward, E. J., English, P. A., & Barnett, L. A. (2022). sdmTMB: an R package for fast, flexible, and user-friendly generalized linear mixed effects models with spatial and spatiotemporal random fields. *bioRxiv*, 2022–03.

Lindgren, F., & Rue, H. (2015). Bayesian spatial modelling with R-INLA. *Journal of Statistical Software*, *63*(19).

Kristensen, K., Nielsen, A., Berg, C. W., Skaug, H., & Bell, B. (2015). TMB: automatic differentiation and Laplace approximation. *arXiv Preprint arXiv:1509.00660*.