

Summary of results for LLSIm BUM by trip, with 5% observer coverage including observed catch in totals April 17 2022 for Blue marlin (*Makaira nigricans*),

2022-10-02

Table 1. Input data summary for each year. Columns are the observed bycatch, observed effort, observed sample units (trips), observed mean CPUE and standard error of CPUE, count of outliers defined as data points more than 8 SD from the mean, observed positive sample units, fraction positive, total trips from the logbooks, total effort, fraction of effort observed, fraction of sample units observed, and estimates of total bycatch and its standard error from a simple ratio estimator stratified only by year

| Year | Eff | Units | OCat | OEff | OUnit | CPUE | CPse | Out | Pos | OCatS | OEffS | Cov | PFrac | EFrac | UFrac | Cat |
|------|-------|-------|------|------|-------|------|------|-----|-----|-------|-------|-----|-------|-------|-------|------|
| 2011 | 54272 | 1096 | 191 | 2996 | 53 | 0.08 | 0.01 | 0 | 37 | 5 | 54 | 168 | 0.70 | 0.06 | 0.05 | 3459 |
| 2012 | 55771 | 1079 | 127 | 2857 | 55 | 0.05 | 0.01 | 0 | 40 | 2 | 40 | 13 | 0.73 | 0.05 | 0.05 | 2479 |
| 2013 | 47228 | 920 | 95 | 1877 | 44 | 0.04 | 0.01 | 0 | 20 | 6 | 31 | 136 | 0.45 | 0.04 | 0.05 | 2390 |
| 2014 | 45602 | 867 | 73 | 2238 | 45 | 0.02 | 0.01 | 0 | 18 | 3 | 36 | 60 | 0.40 | 0.05 | 0.05 | 1487 |
| 2015 | 40476 | 836 | 52 | 1761 | 37 | 0.02 | 0.01 | 0 | 15 | 3 | 28 | 40 | 0.41 | 0.04 | 0.04 | 1195 |
| 2016 | 38227 | 783 | 79 | 1871 | 39 | 0.05 | 0.02 | 0 | 24 | 3 | 28 | 15 | 0.62 | 0.05 | 0.05 | 1614 |
| 2017 | 42997 | 850 | 90 | 2007 | 43 | 0.04 | 0.01 | 0 | 20 | 5 | 23 | 43 | 0.47 | 0.05 | 0.05 | 1928 |
| 2018 | 44844 | 929 | 89 | 1991 | 46 | 0.04 | 0.01 | 0 | 31 | 3 | 34 | 103 | 0.67 | 0.04 | 0.05 | 2004 |

Table 2. Formula of BIC best model, along whether models were fit successfully. A dash (-) means the model converged. Failure to converge may be from data (not all years had a positive observation for delta models), fit (models did not converge) or CV (bycatch estimates had very large CVs). If cross-validation was done, mean RMSE and mean ME across folds is shown (near zero is better).

| model | formula | RMSE | ME | Failure |
|----------|-----------------|------|----|---------|
| TMBgamma | area + 1 + Year | 0.07 | 0 | - |
| Gamma | area + 1 + Year | 0.07 | 0 | - |

Table 3. DHARMa residual tests, where significant P values may indicate poor model specification. Tests are a Kolmogorov-Smirnov(KS) test on whether the scaled residuals are uniform, a dispersion test based on comparing the ratio of the observed and simulated residuals (>1 is overdispersed), a zero inflation test based on the ratio of observed to expected zeros, and the number of outliers, defined as data points outside the range of the simulations

| | TMBgamma | Gamma |
|------------------|----------|-------|
| KS.D | 0.17 | 0.17 |
| KS.p | 0.00 | 0.00 |
| Dispersion.ratio | 1.81 | 1.81 |
| Dispersion.p | 0.00 | 0.00 |
| ZeroInf.ratio | NaN | NaN |
| ZeroInf.p | 1.00 | 1.00 |
| Outlier | 10.00 | 10.00 |
| Outlier.p | 0.00 | 0.00 |

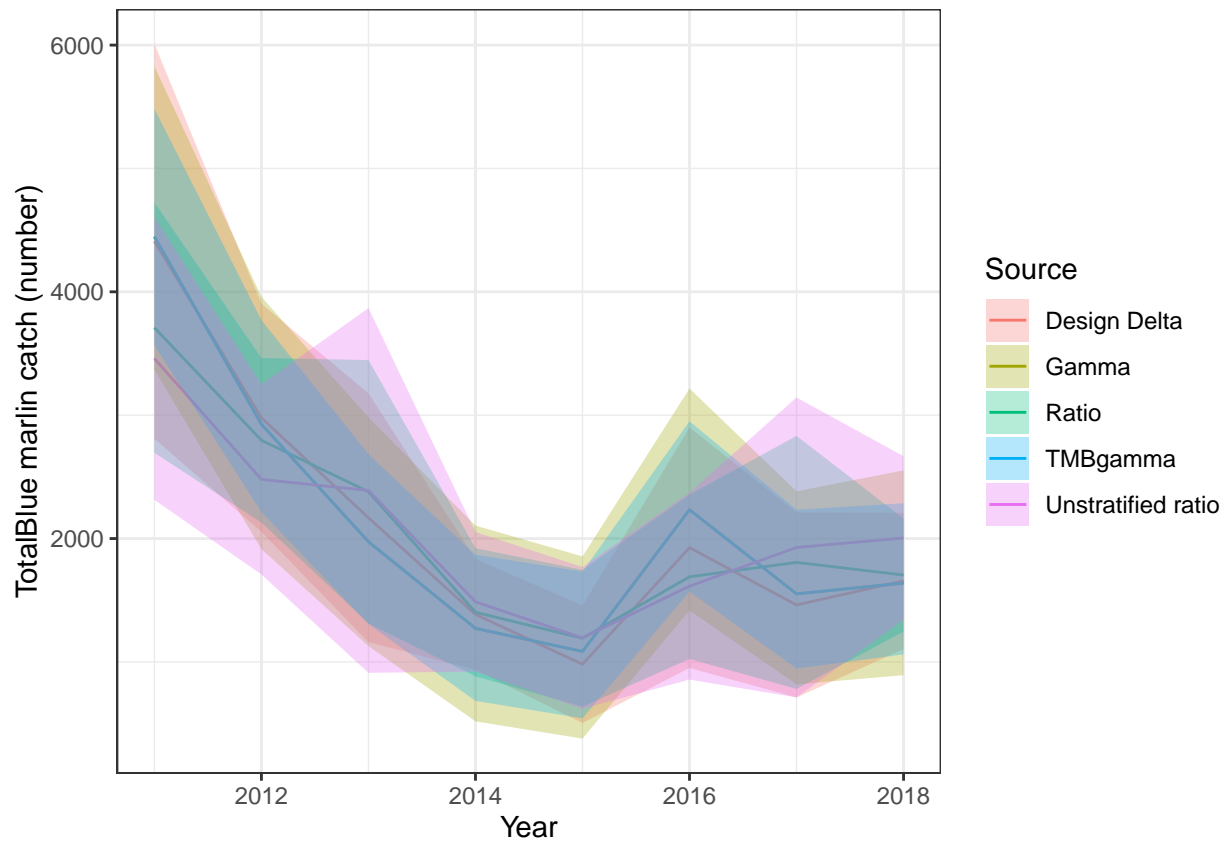


Figure 1. Total bycatch estimates for all valid models and desgin-based methods, for Blue marlin, with 95% confidence interval calculated by Monte Carlo simulation. Catches are predicted for unobserved effort and added to the observed catches.

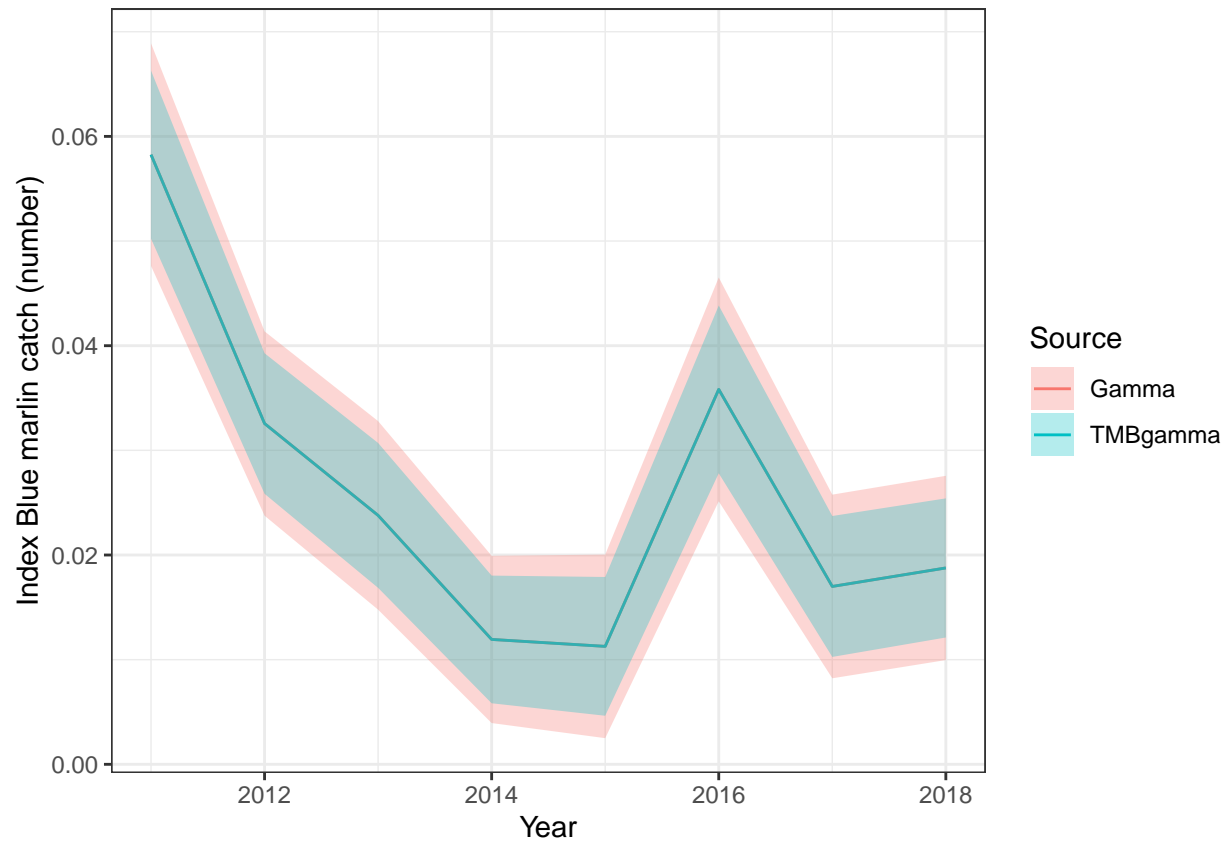


Figure 2. Abundance indices from all valid models for Blue marlin, plus and minus one standard error.

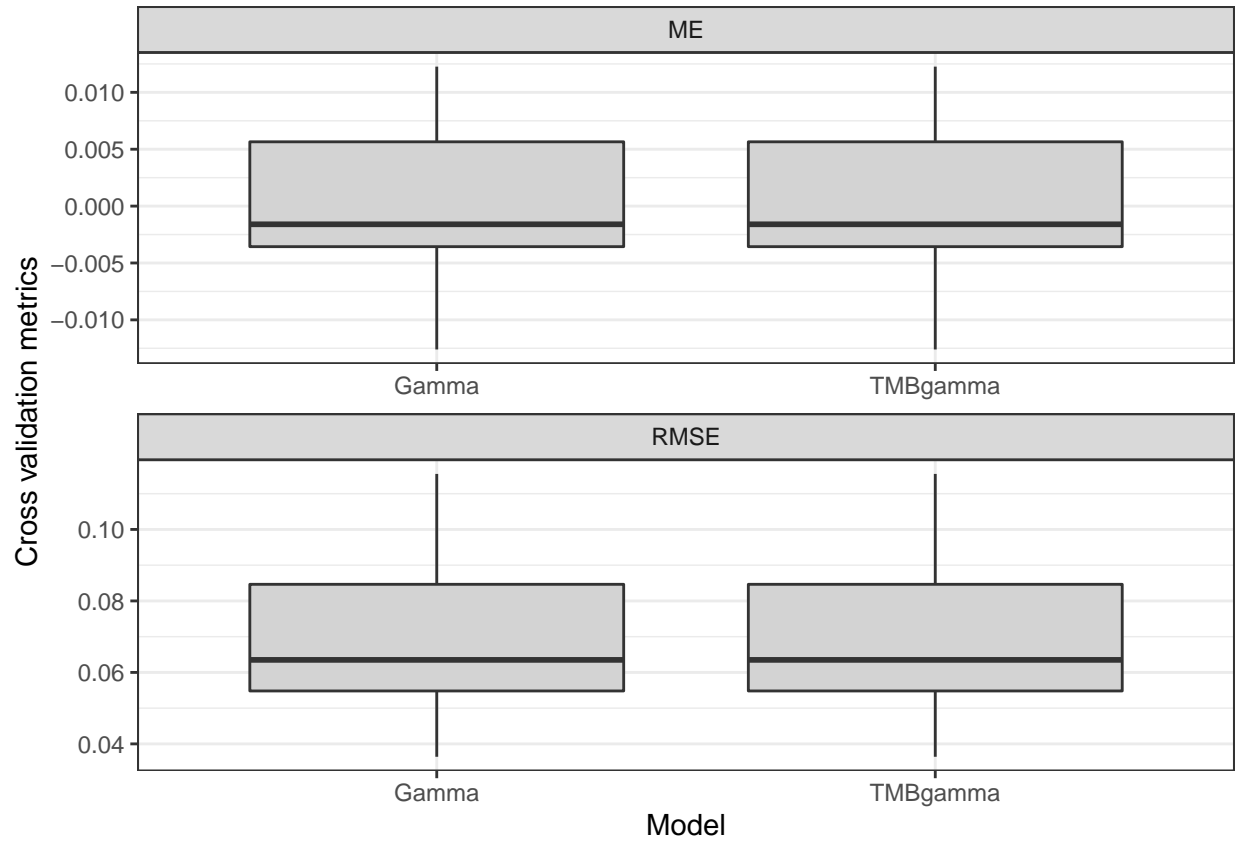


Figure 3. Boxplots of Root Mean Square Error and Mean Error, across 10 cross- validation folds for Blue marlin. Lowest RMSE model is Gamma.

Table 4. Model selection table for TMBgamma. Weights are calculated based on BIC.

| | cond..Int.. | disp..Int.. | cond.area. | cond.Year. | AICc | AIC | BIC | df | logLik | selectCriteria | delta | weight |
|---|-------------|-------------|------------|------------|---------|---------|---------|----|--------|----------------|-------|--------|
| 1 | -1.6 | + | + | + | -1142.5 | -1143.1 | -1104.2 | 10 | 581.5 | -1104.2 | 0.0 | 1 |
| 0 | -1.7 | + | NA | + | -1089.6 | -1090.1 | -1055.1 | 9 | 554.1 | -1055.1 | 49.1 | 0 |

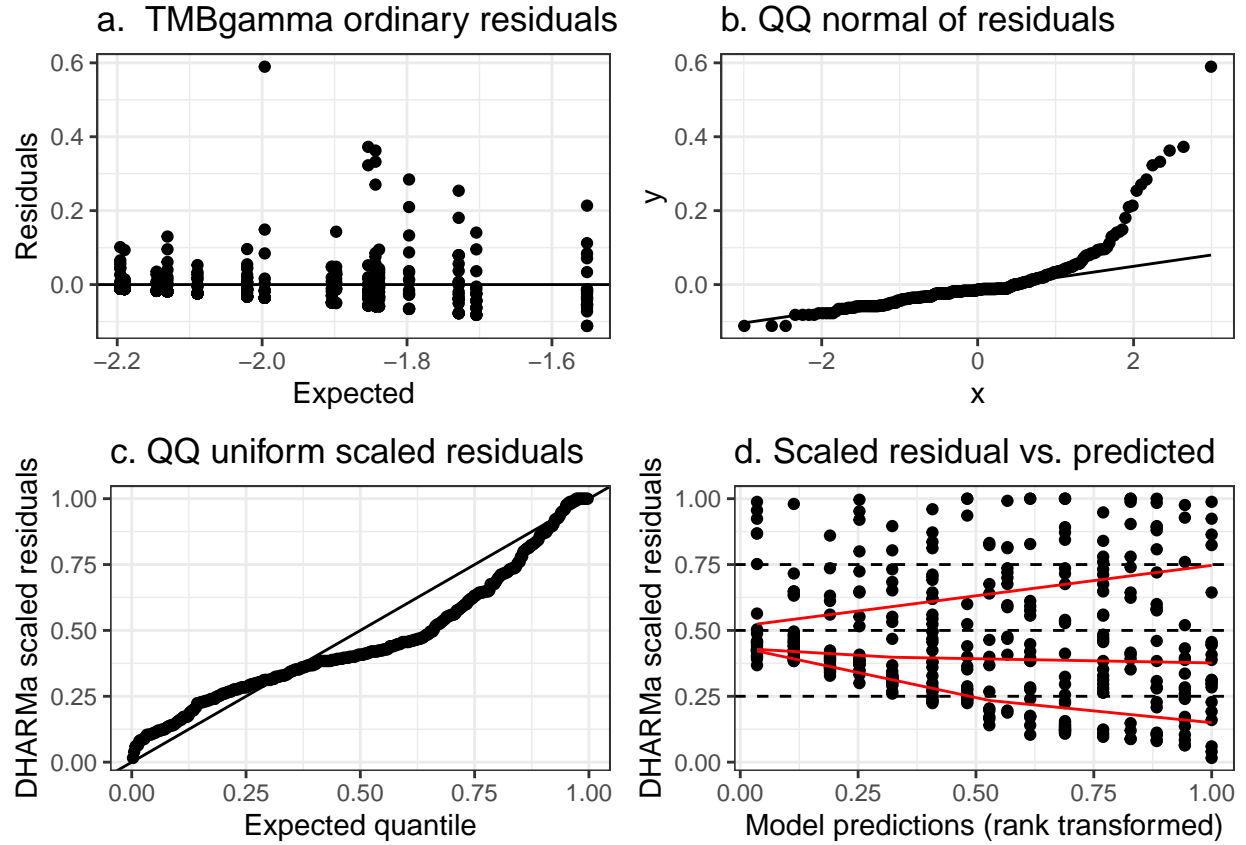


Figure 4. Residuals for the BIC best model for TMBgamma, showing the ordinary residuals (a,b) and DHARMA scaled residuals (c,d).

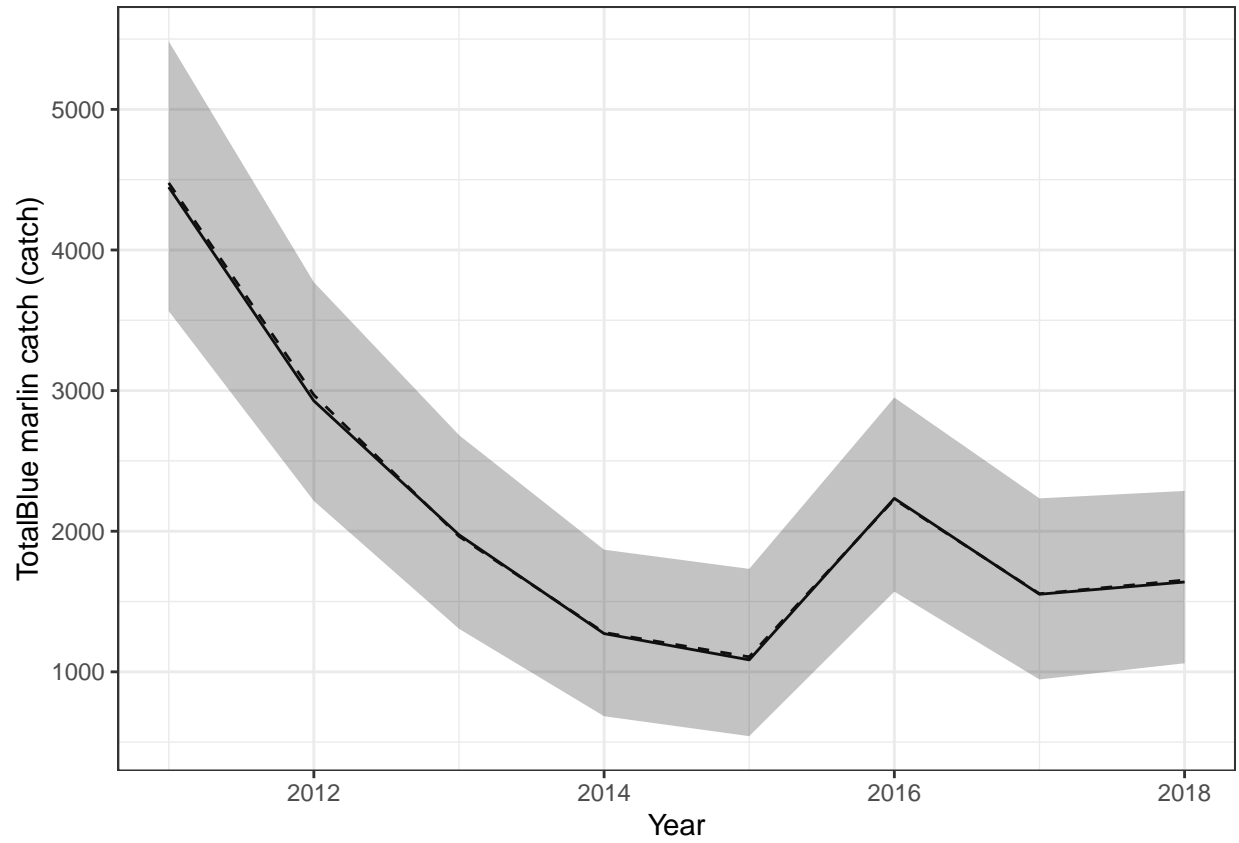


Figure 5. Estimated total bycatch from TMBgamma, with 95% confidence interval calculated by Monte Carlo simulation. Catches are predicted for unobserved effort and added to the observed catches. Solid line is the best estimate and dashed line is the mean across simulations.

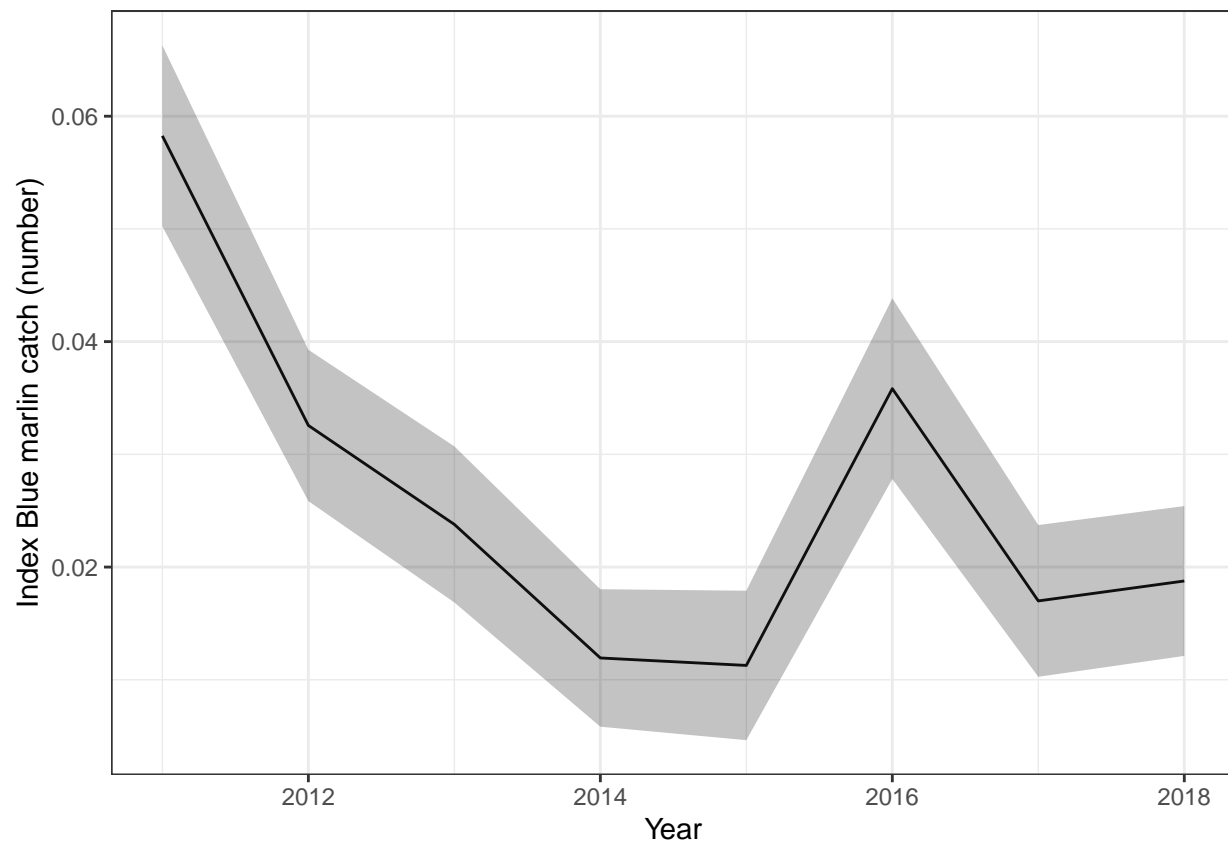


Figure 6. Estimated relative index from TMBgamma plus and minus one standard error.

Table 5. Model selection table for Gamma. Weights are calculated based on BIC.

| | X.Intercept. | area | Year | AICc | AIC | BIC | df | logLik | selectCriteria | delta | weight |
|---|--------------|------|------|---------|-------|---------|----|--------|----------------|-------|--------|
| 1 | -1.6 | + | + | -1142.4 | -1143 | -1104.1 | 10 | 581.5 | -1104.1 | 0.0 | 1 |
| 0 | -1.7 | NA | + | -1089.5 | -1090 | -1055.0 | 9 | 554.0 | -1055.0 | 49.1 | 0 |

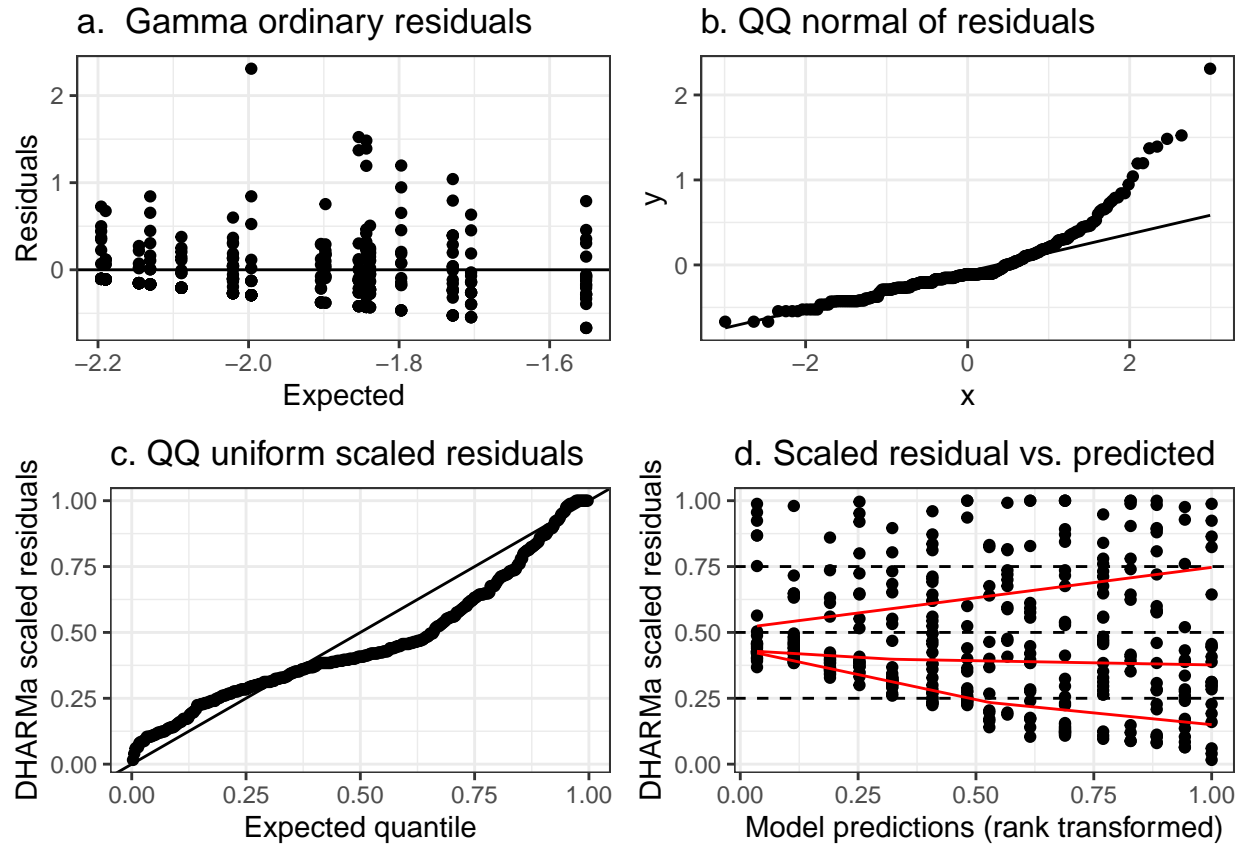


Figure 7. Residuals for the BIC best model for Gamma, showing the ordinary residuals (a,b) and DHARMA scaled residuals (c,d).

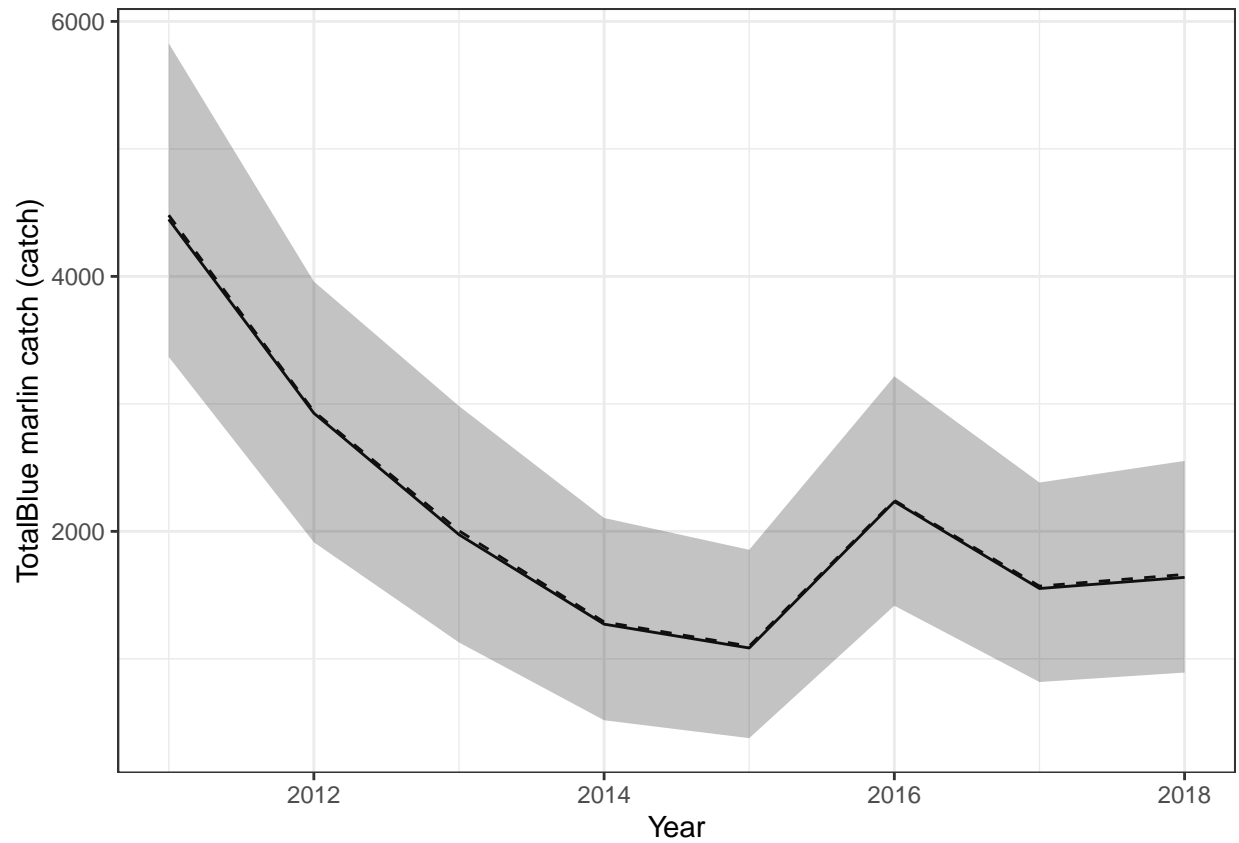


Figure 8. Estimated total bycatch from Gamma, with 95% confidence interval calculated by Monte Carlo simulation. Catches are predicted for unobserved effort and added to the observed catches. Solid line is the best estimate and dashed line is the mean across simulations.

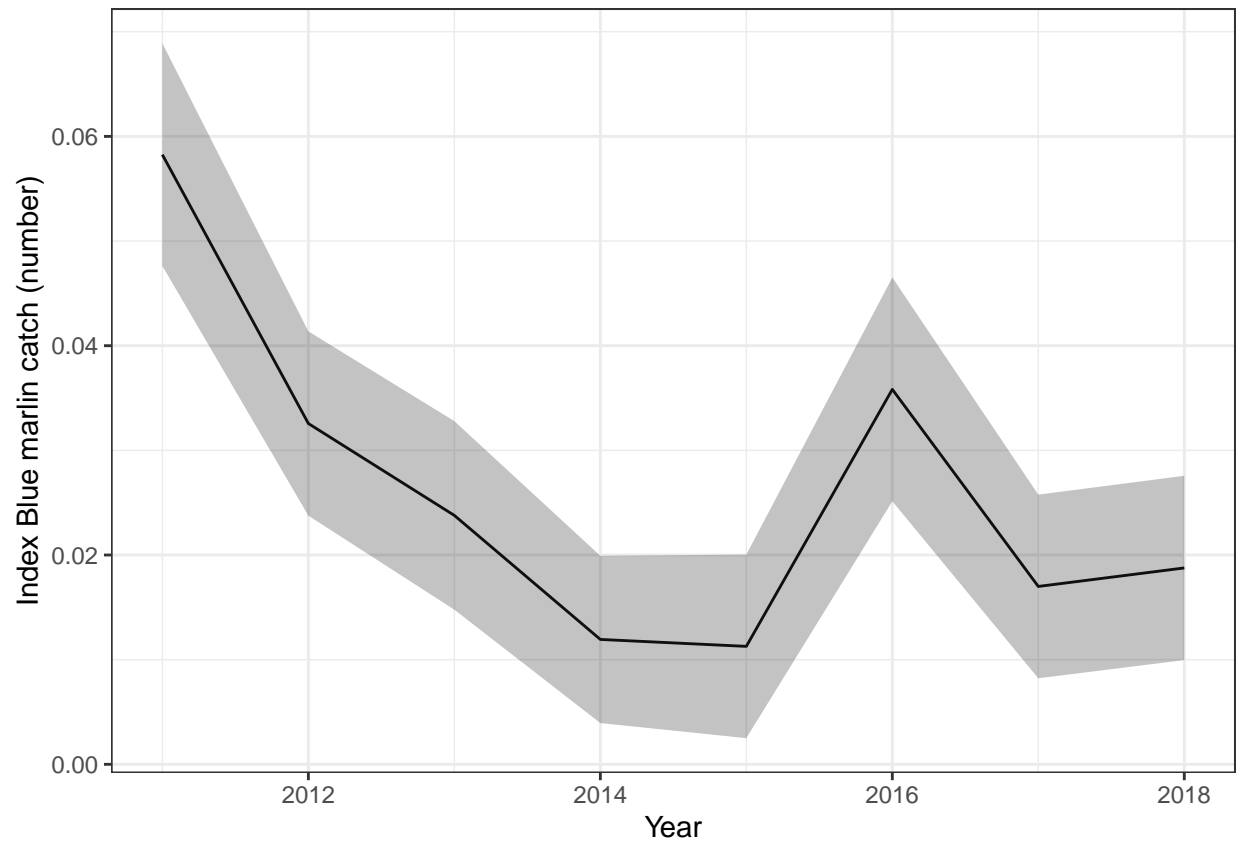


Figure 9. Estimated relative index from Gamma plus and minus one standard error.