each year estimate. However, upon greater consideration it was determined that the appropriate approach is to back-transform the latitude bin results and then sum across latitudes within each year, to produce the annual index in arithmetic space. The use of log(C+1) as a response variable also introduces minor complications with respect to back-transformation to obtain means on the arithmetic scale.

As a consequence of the conflicting time series produced by these two slightly different approaches, we also developed indices based on the well-established delta-GLM model (Lo et al. 1992, Stefánsson, 1996) for these four stocks (as done in earlier assessment cycles as well as Ralston et al. 2013). This model has the greatest potential, in our view, to provide a stopgap approach to developing a YOY index until a deeper modeling exploration can be conducted. The delta-GLM components (binomial and positive models) both contained categorical covariates as described for the ANOVA, above. The delta-GLM was fit using the "rstanarm" package in R to obtain Bayesian posterior distributions of the delta-GLM index. Finally, we also report the resulting indices developed when using the VAST software package (Thorson et al. 2015) on the same data.

Results

We report results of the four modeling approaches (past implementation of the ANOVA approach, "corrected" ANOVA approach, delta-GLM, and VAST) for bocaccio (update assessment) and blue/deacon and yellowtail rockfish (full assessments). We also report results for shortbelly rockfish as this species is the most frequently encountered rockfish in the surveys, has a broad spatial distribution, and thus should provide a better basis for understanding differences in modeling results among these species.

These results are shown in Figure 2, and Table 2 provides the numerical values and the associated CVs. Importantly, upon making the correction to the calculation of the ANOVA indices, the indices for several species appear unusually "flat," particularly for bocaccio but for other species as well, suggesting that even this corrected approach is far less than an ideal means of deriving these indices. Most likely it is the log(catch+1) transformation, which is used to address the issue of large numbers of zeros in the data, that is leading to poor performance of this modeling approach, which was masked by the increased variability in the indices when the summation was done inappropriately.

Relative to the corrected ANOVA, both the delta-GLM and VAST approaches show considerably greater variability in the indices, with high and low values typically ranging from one to several orders of magnitude among different years. Differences in interannual variability between indices derived from the ANOVA and delta-type models (delta-GLM and VAST) also depend on the number of zeros in the data. For example, the corrected ANOVA approach is extremely flat relative to the other two approaches for bocaccio, a species that is fairly rare in these surveys (present in 8.5% of hauls in the nominal range during the 2001-2016 period). However, the ANOVA begins to resemble both the Delta-GLM and the VAST indices for shortbelly rockfish, a species present in a far greater fraction of hauls (34% of hauls in the nominal range during the 2001-2016