Overview of Approach for TORs 4-6

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TOR4 Approach

- One of the primary goals of the WG was to get all three stocks into WHAM
  - CCGOM: VPA → WHAM
  - GB: Limiter → WHAM
  - SNEMA: ASAP → WHAM
- Environmental covariates were considered for all three stocks
  - Inclusion (or not) based on the following model evaluation criteria

TOR4 Model evaluation criteria

- **Convergence**: Initial model acceptance focused on the requirement that the model converge on a solution.
  - Models passed first order convergence criteria when the maximum gradient change was less than a software-specific threshold (e.g., e-10 for WHAM, e-3 for ASAP).
  - Models met the second order convergence criterion when the Hessian matrix was invertible.
  - Jitter analysis (rerunning models with randomized starting values for estimated parameters) to confirm convergence on a global solution was done for candidate model runs

TOR4 Model evaluation criteria

- **Residuals**: Goodness of fit was evaluated by examining whether predicted values were within confidence bounds.
- One-step ahead (OSA) residuals were also used to judge model fit for WHAM.
- OSA residuals should be uncorrelated and normally distributed for models that appropriately describe the system

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TOR4 Model evaluation criteria

- **Retrospective patterns**: Retrospective patterns were evaluated for all model runs and measured using Mohn's ρ for spawning stock biomass and fully selected fishing mortality.
- For candidate models a visual inspection of the terminal year of recruitment was done to insure that one peel was not driving the ρ value

TOR4 Model evaluation criteria

- **Akaike's Information Criteria**: AIC was used to compare models fit to the same data and comparable statistical distributions (see below). Smaller AIC scores indicated model improvement when data inputs are identical, and scores within ± 2 were considered equivalent across comparable models, in which case the more parsimonious of the two models was selected
  - Dirichlet and logistic normal are comparable
  - Multinomial and Dirichlet-multinomial are comparable

TOR4 Model evaluation criteria

- **Model performance**: Model performance was evaluated using simulation self-tests for candidate model runs.
- Each model run was used to generate up to 100 datasets with parameters fixed at their estimated values.
- Simulations then refit the model to these generated datasets to evaluate relative error in F, SSB, R, and catch estimates and model convergence rates

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TOR5 Approach

- $F_{40\%}$ was used as an F_{MSY} proxy when F_{MSY} could not be estimated
  - Standard for groundfish in the region
  - CCGOM & SNEMA used $F_{40\%}$
  - GB used F_{MSY}
- Natural mortality based on Cadrin WP
  - 0.4 for CCGOM & GB
  - 0.5 for SNEMA

TOR5 Approach

- Long-term projections were used to generate SSB-based reference points when R in the projected period is environmentally influenced (GB &SNEMA)
  - WHAM can use analytic approach when using environmental covariate as long as the entire time series is used when deriving the reference point
  - WG decision that the environment has changed that led to the analytical approach in WHAM not working
  - CCGOM uses the standard WHAM analytical approach since it does not have an environmental covariate

TOR6 Approach

- Projections done in WHAM
- Inputs consistent with BRPs
- Recruitment in projections varied by stock
  - GB & SNEMA had Ecov linked to R

TORs 4-6 Approach

- Modeling, BRPs and projections did not always proceed in a linear fashion
    - For example, the original "best" model for CCGOM based on diagnostics (m304) was subsequently found to give an $F_{40\%}$ = 3.0, which the WG deemed unacceptable; modeling was then revisited, leading to m452 as the preferred model
    - Another example: not all combinations of age composition error distributions were used when examining selectivity due to the factorial explosion that results when trying to do every possible combination

Questions?

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