Longspine Thornyhead

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NOAA Fisheries
Northwest Fisheries Science Center
Hatfield Marine Science Center
Newport, Oregon

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Overview

The STAR Panel received a presentation by the stock assessment author, Mr. Gavin Fay, that included an overview of distribution, evidence for geographic population diversity along west coast, and a review of the difficulties in ageing and past efforts to estimate M, growth and maturity information. The model assumed one coastwide stock (Conception to U.S. Vancouver areas), with one coastwide trawl fishery. Fishery independent survey data was a single index based on a GLM of the AFSC and NWFSC slope surveys, which produced abundance indices and length compositions. Prior stock assessments for longspine thornyheads include Jacobson (1990, 1991), Ianelli et al. (1994), and Rogers et al. (1997).

In reviewing the history of the fishery, an important issue was how spatial effort shifts and changes in market behavior (acceptance of smaller thornyheads over time) may have altered the interpretation of length at age information from the fishery, and the author presented a range of plausible scenarios for estimating discards (include using just observer data, using time-varying restrictions in retention curves, and size based discard time series). The STAT and STAR panel discussed the fact that because the West Coast observer program only reports average weight data, estimating length-based discard variation for recent years is not feasible. This was particularly problematic as there was some indication of a decline in the mean lengths of the retained catch, which could be consistent with either changes in discard behavior or declines in mean size of population.

The STAT also gave the management history for the stock, illustrating that management performance has historically been quite good for this species from a biological perspective, with landings much lower than OY levels for most years. It was also noted that landings for the early years of the fishery included a significant amount of landings under the "mixed thornyhead" market category, and therefore the amount attributed to shortspine and longspine thornyheads were estimated jointly for consistency between the two assessments and the historical records.

The initial model presented by the STAT used a standard Stock Synthesis II (SS2) format. The model had an M fixed at 0.1 (based on previous assessments and estimates of maximum documented ages), an h of 0.75, a q fixed at 1, and time-invariant double logistic selectivity (on size) for both the fishery and the survey (with varying retention rates based on discard scenarios). The base model suggested that survey information (length comps) were driving recruitment in the model, such that the model estimated slightly higher recruitment in the early 1990s, dropping in the mid to late 1990s. The base model suggested that the spawning biomass in 2005 was approximately 80% of SB_0. There were a number of model simulations that bracketed some of the areas of uncertainty in catchability, selectivity, mortality and steepness that formed a basis for considering and discussing major areas of uncertainty and avenues for investigation. The Panel commends the high quality of the draft assessment, and appreciated Mr. Fay's patience and efficiency in responding to the many requests for further analysis.

Requests for analyses by the STAR Panel

1. Design a run that allows for two natural mortality rates, blocked in the region above and below 15 or 20 cm. Rationale- the M estimated by Pearson and Gunderson (2003), as well as the dome shaped selectivity curve, could reflect lower mortality rates for mature adults relative to juveniles. Food habits data would support this as well, as there is high predation on longspines up to ~15 to 20 cm by sablefish and shortspine thornyheads, and lower predation rates for larger longspines (these species are apparently two of the most significant predators of settled longspines).

Results were presented for several runs with M fixed at 0.2 to 0.1 for younger thornyheads (age 12, corresponding to length of ~18cm and approaching the age at full maturity), and 0.015 to 0.05 for older individuals. When these values were freely estimated, the model suggested values of 0.18 and 0.027 for young and old LST, respectively. In general, the results improved model fits, with most of this improvement coming from better fits to fishery and survey length comps. However a major issue that did arise was that with estimates of catchability (q) free, the model tended to suggest very high (generally considered unrealistic) biomass levels. Results were later generated for similar runs with q fixed at 1. In these runs the improvement in fit was considerably less than in earlier runs, and the STAT reported that the model had trouble converging. There was general agreement that while this was still an interesting approach, the two-M model was not a viable candidate for the base model at this time. The lack of age data to support or validate the approach was a particularly important constraint.

2. Evaluate differences in slope survey catch rates for the Conception area north and south of Point Conception itself. Rationale- an evaluation of the NWFSC survey data suggests that catch rates are higher in the northern part of the Conception area. Densities of longspine thornyheads in the Conception area north of Point Conception ranged from 2 to 3 times greater (on average) than those in the southern area for 2002-2004, the period in which the area south of Point Conception was surveyed. The approach for the data prior to 2002 assumes that densities are similar in the northern and southern areas, a particularly sensitive assumption given that more than 70% of the stratum area is south of Point Conception, and the area is large relative to other strata in the survey. Consequently the overall biomass estimates in this area were biased for years prior to 2002.

The STAT reported on the results of the assessment model with the corrected survey indices, which showed that the corrections to the previous indices did have a substantial impact on the inferred survey trends and assessment results. Length frequency composition data were also re-evaluated to be consistent with the new estimates. The model seemed unable to fit the increasing abundance trend suggested by the revised survey data.

3. Run with a prior of 1 on q with a 30% CV. Try this with and without Conception. If feasible, profile across q both with and without the Conception data. Rationale -

without fixing q at 1, q would like to drift towards a value of 6, which both the STAT team and the STAR panel agreed were unrealistic for this species/gear combination. Given that model estimates for other slope species, and empirical estimates (camera-sled survey and trawl survey comparison, Lauth et al. 2004) suggest that q is likely to be close to or less than 1, it was agreed that the use of a prior for q would likely be appropriate. The request to do this with and without the Conception area was made based on the slope survey biomass estimate shortcomings noted in request #2.

4. Consider looking at the early slope survey length composition data, to evaluate whether there is contrast between this and more recent slope survey data. Rationale- the point was made that the lack of contrast in length frequency data in the recent survey data could reflect that these data were collected following the major period of fishing effort. As the complications of markets, gear and depth of fishing effort in the fishery would mask any changes in length composition from fisheries data, evaluation of early slope survey data may be useful in determining whether there were changes in size structure of the population.

Although the early survey length comps (1992, 1996 AFSC surveys) were not readily comparable to more recent data, due to different spatial coverage, evaluating these data did not indicate a significant shift in size distribution.

Following the evaluation of these results, there was considerable discussion about the observation that the model tended to estimate values for q above 1, coupled with the knowledge that the slope survey index was now known to be relative rather than (possibly) absolute (as the index no longer included a large fraction of the biomass in Conception area). Based on the known ratio of slope survey biomass in the Conception area south of Point Conception to coastwide areas north of Point Conception (U.S./Canada border to Point Conception) from the 2002 to 2004 period, it was felt that a reasonable expectation for q would be about 0.7. There was some general agreement that the use of a prior to address the issue would be appropriate, more so than fixing q in the model. To better inform the STAT and the Panel, several more requests were made to attempt to resolve the issue.

5. To evaluate a reasonable approach for estimating q, two runs were requested using an informative prior on q for 0.5 and 0.7 (30% CV). In both, M was considered a free parameter (estimated without constraints), with the caveat that if the model did not converge, M could be fixed at 0.07 (based on earlier runs with M estimated without constraints). For recruitment, a base run going back to 1980 seemed reasonable to the panel. Rationale: these are likely to be the final candidates for the base runs.

The results of simulations with an informative prior on q (0.7 with CV of 0.2) were interesting, as the model estimated a q of 1.03 in this scenario. With the same prior but a CV of 0.3 the model estimated a q of 1.5. In both of these models, the model estimated M declined from the (uninformative) prior of 0.1, to 0.06 with former scenario, 0.055 with the latter. It was recognized that the model did consistently seem to want to fit a natural mortality rate lower than the values used in previous assessments.

Final base model description

Selection of a base model and design of a decision table. After some discussion of the merits of various permutations, the improvement (or lack thereof) in fit, and consideration about which model best reflects uncertainty in parameter estimations, there was agreement among both the assessment author and the STAR Panel that an appropriate base model would be that with an informative prior on q at 0.7 (20% CV), with the model estimating M (result was 0.06). A key factor in making this choice was the desire to have the model try to estimate the parameters wherever possible, while balancing the observation that there was relatively little data (particularly little reliable age data) to determine plausible estimates for many of these parameters. The Panel recognized that this was a case of using informative priors with uninformative data, however it was also noted that there was relatively little change in depletion levels among these models. The final base model had a depletion of 71%.

Discussions about how to represent uncertainty with respect to a decision table began with consideration of steepness. However the Panel agreed that given the apparent optimistic assessment of stock status, this might not be the most appropriate parameter to evaluate. A proposal was made to consider alternative values of M and q, and have the decision tables represent the base run, the most optimistic, and the most pessimistic of these four scenarios. The values of M and q would bracket the base case by look at 10th and 90th percentile masses on either end of the mean, and use those as the high or low scenarios for the decision table. For ten year projections, it was generally agreed that the high harvest levels that would be associated with the most optimistic projections were not likely to be achieved due to management constraints on other deepwater complex species. Consequently, the catch trajectories used in projections would include the OY that would result from the base case scenario under the F_{50} harvest rate policy, and the recent (5 year average) catch history.

Technical merits and deficiencies

Although there was general agreement that this assessment is relatively data limited, the model was agreed to be technically sound.

Unresolved problems and major uncertainties

The problems associated with the NWFSC slope survey data, in particular the assumption that densities were similar north and south of Point Conception (in the Conception area), were identified as one of the key areas of data uncertainty, and addressing these problems should be a high priority for future consideration. The stock assessments for DTS all used survey time series with biomass estimated using the Delta-GLMM approach developed by Helser et al. (2005). In the NWFSC survey series coverage the Conception Stratum off of California prior to 2002 had been limited to the area north of Point Conception. Biomass estimates for the whole Conception stratum for surveys prior to 2002 were calculated by using the density from area north of Point Conception for the whole stratum area. This approach assumes that densities are similar in the north and south areas. This assumption is particularly important given that more than 70 percent of the stratum area is south of Point Conception (see below) and this area is large relative to the other strata in the survey.

	Area in hectares	**(Proportion)**
Conception Stratum	**Depth stratum of 100 – 300 fm**	**Depth stratum of 300 – 700**
South of Point Conception	929817.92 (0.73)	2730276.50 (0.79)
North of Point Conception	347458.64 (0.27)	719819.88 (0.21)

A comparison of the longspine thornyhead densities north and south of Point Conception from surveys for 2002 to 2004 when both areas were sampled indicated that densities in northern area ranged from 0.15 to over 10 times the density in the southern area for that time period. The panel concluded that it was inappropriate to assume that the densities north of Point Conception could be used to represent the whole Conception stratum for the surveys prior to 2004. Tom Helser recalculated the survey indices using the Delta-GLMM approach limiting the Conception stratum and the survey tows to be the area north of Point Conception. All of the DTS assessments except for shortspine thornyhead were revised for these new indices. The survey length compositions should also be corrected for these changes in stratum definition but there wasn’t time to make this change during the meeting.

The tendency of the model to estimate very high values of q for slope surveys was also an area of considerable concern.

Although the selectivity curves for both the survey and the fishery were the topics of considerable discussion (for both thornyhead species), there was accepted to be empirical evidence that the shape of these curves were very unlikely to be asymptotic (Lauth et al. 2004), and that the model approach for estimating these curves was acceptable given the limited available data. However there remains considerable uncertainty about the true shape of the selectivity curves for both the survey and the fishery.

The STAT has iterated the simulations with small perturbations around model starting parameters for most of the runs discussed here, and found no substantive problems in model convergence.

Areas of disagreement

There were no significant areas of disagreement within the STAR Panel or between the Panel and the STAT.

Research recommendations

1. Resolving uncertainties about longevity, and improving the confidence of age data in particular, would be helpful in resolving many of the major issues of uncertainty (length at age, natural mortality). Questions of whether a strong seasonal signal in temperature or food availability might actually produce growth rings (annuli or false annuli) in the otoliths of deep-dwelling slope species, or whether false annuli may be formed following predation events, were discussed, as were reasonable research approaches for addressing this issue.

2. Length compositions of discards would be more informative with respect to both evaluating variability in retention and estimating recruitment.

3. More empirical/extensive investigations of both catchability (q) and selectivity of the slope surveys (for all of the deepwater species) would be useful for resolving uncertainty around these parameters, as would improved knowledge about habitat associations. There is also a need to investigate abundance and habitat associations in habitats deeper than the current extent of the slope survey (using trawls, towed cameras, or other means).

4. Investigation of the implications of alternative mortality rate scenarios with age and/or size. Possible approaches including two-stage or multiple mortality rates, including time series of predator (sablefish, shortspine thornyhead) abundance as environmental time series that drive natural mortality, or more generally developing multispecies modeling approaches for the slope complex.

5. A more critical evaluation of the significance of q values for surveys of absolute abundance when they are far from 1, particularly those greater than 1.

References

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