Longnose Skate STAR Panel Report

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Reviewers

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1 Minutes of STAR Panel meeting

1.1 Name and affiliation of STAR Panel members

Martin Dorn, Scientific and Statistical Committee (SSC) Representative, STAR Panel Chair
Patrick Cordue, Center for Independent Experts (CIE)
Vivian Haist, Center for Independent Experts (CIE, Rapporteur)

1.2 Analyses requested by STAR Panel

An iterative process was used for the longnose skate STAR Panel review, alternating between written requests for additional analyses and evaluation of results of these requested analyses. Some additional model runs were conducted while meeting with the STAT, as runs could be conducted quickly and this facilitated the review process.

A summary of key results and decisions resulting from the Panel review of longnose skate is presented in section 1.2.1. The STAR panel requests for longnose skate analyses (Series 1 through Series 5) are provided in section 1.2.2.

The primary objectives of the STAR Panel requests were to: 1) simplify the model parameterization where appropriate, and 2) develop an objective basis for characterizing the uncertainty in this data-poor assessment.

The longnose skate assessment scientist responded to all requests from the STAR panel, providing results from requested analyses and often bringing in additional information that was relevant to the deliberations. The STAR panel acknowledges the hard work of this scientist whose dedication and enthusiasm made the review a productive and enjoyable experience.

1.2.1 Summary of results from STAR Panel requests

1. The base model was simplified to have one sex and constant recruitment. There are no apparent differences between males and females in their size-at-age or in their fishery and survey length frequencies, so a sex-specific parameterization adds model complexity without adding information. There is no discernable year-class signal in the length frequency data, so there is little information to support estimation of year-class strength.

2. Modifications were made to the selectivity parameters estimated for the slope surveys: asymptotic selectivity, estimate peak parameter, and no estimation of

descending width parameters. The asymptotic assumption was made because the slope survey covers the entire depth range of the species and estimation of the descending limb did not influence on the model fits.

3. In response to questions raised during the meeting about historical skate landings from Washington State, the stock assessment scientist reviewed additional documents about these landings. The 1951-1979 Washington State skate recorded catch was primarily landed in Puget Sound. These catches were likely caught either in Puget Sound or in Canadian waters. It was decided to remove these landings from the catch statistics used in the assessment as it was unlikely that they came from the assessed stock.

4. The estimated biomass in the 2004 AFSC triennial survey appears anomalous, being twice as high as any other estimate in the survey series. Efforts were made to obtain data for flatfish species captured in this survey to see if they also showed anomalous abundance in the 2004 survey. It was not possible to obtain the additional data in the time available, so the 2004 AFSC triennial survey data point was retained in the analysis.

5. The size-at-age data used to estimate growth parameters in the assessment suggest almost linear growth for the longnose skate. The STAT provided estimates of longnose skate growth parameters from four sources, for populations ranging from California through Alaska. Growth parameters estimated in this assessment are similar to those from B.C. and Alaska (although L_∞ is lower for the B.C. study).

6. The STAT suggested the *M* might be higher than the 0.1 value assumed in the initial stock assessment. Using methods that calculate *M* based on maximum age results in estimates around 0.2 (Hoenig 1983, Frisk et al. 2001). The STAT agreed 0.2 was a better estimate of *M* for the longnose skate assessment. Using this higher *M* value resulted in better estimation of growth parameters. That is, all three growth parameters could be estimated (previously one parameter had been fixed) and the estimate of L_∞ was lower and more consistent with the maximum observed size.

7. The estimate of length at 50% maturity used in the assessment (Thompson 2006) suggest delayed maturation, and the estimate is significantly higher than the estimate from a B.C. study (McFarlane and King 2006). Josie Thompson met with the Panel and described the methodology used in her study. The criteria used to distinguish mature from immature individuals was more conservative (i.e. more likely to err in the direction of underestimating the proportion mature) than those used in the B.C. study. The Panel did not feel that one approach was necessarily superior to the other and concluded that use of the Thompson (2006) estimates in the assessment is appropriate. The McFarlane and King (2006) estimates can provide a useful sensitivity analysis.

8. The longnose skate model was run under two scenarios for initializing the population; 1) at unfished equilibrium in 1916 with a ramp-up of the catches, and 2) at

equilibrium in 1980 under a constant prior fishing mortality rate (tuned to average catch). The rationale for this comparison was to determine if the two approaches provided equivalent results. The model had a better fit when initialized in 1916 (objective function value of 708.38 versus 723.49). The reason for this was not clear. Fitting to a longer catch time series allows the recruitment to decrease over time (given the assumption of low stock recruitment steepness), whereas initializing at equilibrium under constant F does not (in the SS2 code). Because the ramp-up in historical catch is a more realistic assumption, this approach was adopted for further runs.

9. Alternative longnose skate catch (landings plus discard mortalities) were developed to reflect the uncertainty in the catch time series. The catch histories were constructed "outside the model" (i.e., the discard rate in the model was set equal to 0) to allow easy comparison of assumed catch history. The landings series developed for the assessment (minus the Washington State landings as noted in 3 above) were taken to be the "best" available time series. Alternative high and low catch scenarios were developed that reflect uncertainty in the discard rate, the discard mortality rate, and the proportion of longnose skate in the combined skate landings. All three uncertainties are assumed to affect the catch for the pre-1995 period (table below). For 1981 through 1984 discard mortality and discard rate (with lower uncertainty because there is one discard estimate for this period) are assumed to affect the catch. For 1995 onward only uncertainty in the discard mortality rate is assumed. The table below summarizes the "best", low and high values assumed for the three sources of uncertainty.

	pre- 1981			1981-1994			1995-present		
	"best"	low catch	high catch	"best"	low catch	high catch	"best"	low catch	high catch
Proportion longnose	0.62	0.50	0.75	Annual estimates			Annual estimates		
Discard rate	0.93	0.85	0.97	0.93	0.91	0.95	0.53	0.53	0.53
Discard mortality	0.50	0.30	0.70	0.50	0.30	0.70	0.50	0.30	0.70
Longnose landings relative to "best" estimates	1.00	0.81	1.21	1.00	1.00	1.00	1.00	1.00	1.00
Discard mortalities relative to longnose landings	6.64	1.37	27.38	6.64	3.03	13.30	0.56	0.34	0.79
Total "catch" (landings + morts) relative to "best" landing estimates	7.64	2.18	28.59	7.64	4.03	14.30	1.56	1.34	1.79

The longnose landings relative to the "best" estimates adjust for the proportion longnose skate in the total skate catch for the pre-1981 period when annual estimates are not available. The discard mortalities relative to longnose landings adjust for the discard rate and discard mortalities. Finally, the table above provides the ratios of total catch (landings and discard mortalities) to the "best" landings estimates.

10. Model runs were conducted using the low catch, best catch and high catch time series resulting in depletion estimates of 0.71, 0.61, and 0.40, respectively.

11. The draft longnose skate assessment assumed a NWFSC shelf-slope trawl survey proportionality constant, *q*, of 1. During the review a prior for *q* was developed based on consideration of the availability of longnose skate to the survey gear and the probability that a skate in the path of the gear would be caught and retained by the gear. The methodology for developing the prior involves specifying the potential range in the proportion of fish that are available to the gear and the potential range in the vulnerability to the gear, and "best guesses" for the individual probabilities. These values are translated into a lognormal prior where the median of the lognormal is the "best guess" and the range of plausible values covers 99% of the lognormal distribution.

The NWFSC shelf-slope survey covers the full latitudinal range of longnose skate modeled in the assessment so a latitudinal availability of 1 was assumed. The survey coverage appears to exceed the maximum depth distribution of longnose skate but may not fully cover the shallow end of the skate distribution. A range of 95% to 100% was assumed for the depth availability. A range of 75% to 95% was assumed for vertical availability on the basis that longnose skate are known to bury in the mud and therefore some may be unavailable to the bottom trawl gear. The largest bounds were place on the probability of capture, given a fish is in the net path. It is known that flatfish can be herded by trawl gear, and it is possible that this could also occur for skate. But it is also possible that skate could avoid the trawl nets. For capture probability, a range of 75% to 150% was assumed. "Best guess" estimates were set at the mid-point of the range for individual factors, except for the probability of capture which was given a best guess of 1. The overall best guess for the survey *q* was 0.83 (table below).

	minimum	maximum	best guess
Depth availability	0.95	1.00	0.975
Latitudinal availability	1.00	1.00	1.00
Vertical availability	0.75	0.95	0.85
Probability of capture given in net path	0.75	1.50	1.00
Product of all factors	0.53	1.43	0.83

The consequent bounds on *q* and the best guess are: (0.53, 1.43) and 0.83. The best guess was equated to the median of a lognormal distribution and the bounds to 99% of that distribution. This gave a normal prior on log(*q*): mean = -0.188, sd = 0.187.

Additional runs were conducted using the low catch, best catch and high catch time series but with a prior on *q* rather than a fixed *q*. Results from these runs showed highly variable estimates of *q* (from 0.3 to 0.8) and relatively constant estimates of stock depletion (from 0.69 to 0.75). There was not time to do profiles on *q* to see how well determined these estimates are. Because the objective of evaluating results with the different catch series is to see how this uncertainty affects estimates of current stock status, fixed *q* runs are considered more useful at this time. The normal prior on log(q) was used to provide three *q*s for model runs with nominal weights of 25%, 50%, and 25%. A random sample of size 10,000 was generated from the normal distribution and the mean of the samples below the 25th percentile (of the normal distribution) was exponentiated to provide the "low *q*". Similarly, the mean of the samples above the 75th percentile was exponentiated to provide the "high *q*". The median of the prior (0.83) was used to represent the mid 50% of the range of uncertainty.

12. The iterative re-weighting of length (and age) sample sizes was redone using the procedure of updating weights by data series rather than individual points within each data series. As in the sablefish assessment, initial trials showed a "flip-flop" between each successive set of weightings, and averaging between two successive sets was required to obtain stability in the re-weighting process.

13. A full Bayesian analysis (MCMC) was performed on a model formulation that could be used as a base model (prior on *q*, prior on M, no recruitment deviations, best catch series). An MCMC chain of 1 million was run. Results were unsatisfactory, indicating a lack of convergence. Also, the range of *q* sampled in the posterior was small relative to its prior, which is unacceptable given there is little information in the data about absolute abundance. Problems with the MCMC are likely the result of the selectivity parameterization. A short MCMC chain was run with all selectivity parameters fixed, and this run showed better behavior (good convergence properties and *q* posterior similar to its prior). However, there was not enough time during the review to fully investigate whether an MCMC approach could be used to characterize uncertainty in the assessment.

14. The major axes of uncertainty in the longnose skate assessment are the uncertainty in the catch history and the uncertainty in the NWFSC shelf-slope survey *q*. To capture the full range of uncertainty three runs were conducted: low *q* with low catch history; mid *q* with mid catch history; and high *q* with high catch history. These runs resulted in depletion estimates ranging from 0.39 to 0.80.

1.2.2 STAR Panel requests

STAR panel requests for longnose skate analyses (Series 1)

Modify base model (from current formulation):

- One sex model
- No recruitment deviations
- Use F45% proxy for MSY
- Do not assume discards on historical catch estimates, rather adjust the catch series to account for discarding, proportion of longnose skate in skate catch, discard mortality, etc.

A. Do fits using the base model formulation as adjusted above, with the equilibrium non-zero catch initialization (in 1980) to:

    1. The "best" historical catch (same as current)
    2. The low historical catch (see below)
    3. The high historical catch (see below)

   For these three series we are interested to see the biomass trajectories and a summary of the likelihood components.

B. Do a fit initializing the population at equilibrium conditions in 1915, with catches ramping up from 0 to the high historical catch between 1915 and 1950 and constant at the high historical level from 1951 to 1980. Show a comparison of the estimated 1980 age structure from this run and from run A3 above. This run is formulated the same as the runs "A" above, other than in how the population is initialized.

C. Based on run A1 above: Modify selectivity for the two slope surveys to be asymptotic. Do a profile on *q*.

D. AFSC triennial survey data. Jim Hastie is getting summary information so that potential bias in catchability in the 2004 survey can be investigated.

STAR panel requests for longnose skate analyses (Series 2)

The updated base model continues from changes made under the Series 1 requested changes (One sex model, no recruitment deviations). Additional changes to the new update base model will include:

- Washington State 1950-1979 catches will be removed
- *M*=0.2 (subject to evaluating basis for this)
- Population to be initialized at equilibrium in 1916
- Re-do the iterative re-weighting of fishery sample sizes using the output from SS2 (i.e., rescale a series, rather than individual samples)
- Slope surveys selectivity parameters; asymptotic selectivity, estimate peak parameter, and no estimation of descending width parameters (because it had no influence on the fits)

For this new base model:

A. Fit to the "best" catch data series

B. Separate fits to the "low catch" and "high catch" series

C. Profile on *q* (NWFSC shelf-slope survey) for the "best" catch series run

D. Do a fit using the B.C. estimates of maturity at length ("best" catch series)

E. Provide supporting information for *M*=0.2

F. For one run (e.g., base model with "best" catch series) try different techniques to see if you find alternative minima (jittering or other method to begin with different initial parameter estimates and different phases for the parameters).

STAR panel requests for longnose skate analyses (Series 3)

New base model:

- fix one parameter (descending limb) of fishery selectivity
- add priors for *q* and *M*
- finish iterative re-weighting for sample sizes
- keep the Thompson estimates of maturity for base model
- add extra error to AFSC shelf survey (so that the RMSEs are similar to SEs)

1) Run base model with "best" catch series. Produce R graphics for this run.
2) Run base model formulation with low catch series
3) Run base model formulation with high catch series
4) Run model with B.C. maturity estimates (otherwise same formulation as base case)

STAR panel requests for longnose skate analyses (Series 4)

Base model as defined in previous request:

1) Run base model formulation using the low catch series but fixing the shelf-slope survey *q* at the value estimated for the base model run (using the "best" catch series)
2) Run base model formulation using the high catch series but fixing the shelf-slope survey *q* at the value estimated for the base model run (using the "best" catch series)

STAR panel requests for longnose skate analyses (Series 5)

Base model as defined in previous request, except that M is fixed 0.2 and the NWFSC shelf-slope survey *q* is fixed at 0.83. Three runs:

1) Low *q* (0.654) and low catch history
2) Mid *q* (0.83) and mid catch history
3) High *q* (1.046) and high catch history

1.3 Description of base model and alternative models

The selected base model formulation for the longnose skate assessment has the following characteristics:

- Single sex
- No recruitment deviations
- *M* fixed at 0.2
- Estimate 3 von Bertalanffy growth parameters, fix growth CV parameters
- NWFSC slope-shelf survey *q* fixed at median of the prior (0.83)
- NWFSC shelf-slope survey selectivity modeled as asymptotic
- Population initialized at equilibrium in 1916
- Use Thompson (2006) maturation estimates (McFarlane & King 2006 estimates for sensitivity)
- Washington State 1951-1979 landings estimate removed
- Use "data series" rather than "data point" approach for iterative re-weighting
- Use "best" catch time series

The major axes of uncertainty for the longnose skate assessment are the catch history and the NWFSC shelf-slope trawl survey proportionality constant *q*. Two runs, reflecting best guesses of the mean of the lower quartile and the mean of the upper quartile, are proposed to bracket uncertainty. These runs have the same characteristics as the base model except for:

- Low *q* (0.654) with low catch history
- High *q* (1.046) with high catch history

2 Technical merits and/or deficiencies in the assessment

The longnose skate stock assessment was as comprehensive as possible; given it is a data poor stock.

The use of "total skate" landing statistics may not be the best approach for recreating the stock's catch history. The "total skate" landings may contain erroneous information (as assumed for the Washington State 1951-1979 landings), and assumptions about proportion longnose skate and discard rates are required to re-create the time series. An alternative approach would be to use effort statistics to develop "best" estimates (and the plausible range for these estimates) based on available data for longnose skate catch per unit effort (CPUE) for different target fisheries. Other assumptions would be required to apply this approach and an estimate of discard mortality rate would still be needed, but least a comparison would be possible between alternative methods for reconstructing the catch history.

3 Areas of disagreement regarding STAR Panel recommendations

3.1 Among STAR Panel members

There were no areas of disagreement among the STAR Panel members.

3.2 Between STAR Panel and STAT

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

4 Unresolved problems and major uncertainties

The total fishery-induced mortality of longnose skates is unknown. Components of this include; the landings history, the proportion of longnose in total skate catch, the discard rate and the discard mortality. For recent years the data on longnose skate landings and discards are reasonably good, however because the discard rate is high and discard mortality unknown there is still considerable uncertainty about the level of fishery-induced mortality.

Four published studies of longnose skate ageing provide similar estimates of growth and maximum age. However, none of these studies have included ageing validation so there is uncertainty about the accuracy of the methodology.

Estimates of the longnose skate maturation ogive used in this assessment differ substantially from those reported for B.C., and suggest that only a small fraction of the female population is mature.

Analyses using an MCMC algorithm to estimate model posterior distributions and quantify uncertainty in the longnose skate stock assessment were conducted. Results were not useable because of lack of MCMC convergence, likely the result of the complex selectivity parameterization. Further investigation of this problem is warranted, as MCMC simulation is a useful approach for quantifying uncertainty.

5 Management, data or fisheries issues raised by GMT or GAP representatives during the STAR Panel.

There were no concerns raised by the GMT or GAP representatives that were not addressed elsewhere by the STAT.

6 Prioritized recommendations for future research and data collection

The following list summarizes the STAR Panel's research recommendations for longnose skate. Items 1 through 3 are considered high priority.

1) Re-create catch history (best estimates plus uncertainty) based on fishing effort.
2) Investigate anomalous 2004 AFSC triennial survey longnose skate (and possibly other flatfish) catches.
3) Ageing (validation) studies and maturation rate studies.
4) Continue skate species identification in the fishery.
5) Continue discard monitoring.
6) Studies to estimate discard rates and discard mortality.

7 References

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