Summary of Aleutian Islands Pollock and Atka Mackerel CIE Review Reports

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Summary

During June 9-13, 2008 three external reviewers from the Center of Independent Experts (CIE) were contracted to review the assessments of Atka mackerel and pollock for the Aleutian Islands region. Their statement of work requested that they note the strengths and weaknesses of the modeling efforts for Aleutian Islands Atka mackerel and pollock assessments and harvest recommendations. Specifically, the review shall evaluate:

- The analysts' use of fishery dependent and fishery independent data sources in the assessments;
- Gaps or inconsistencies in the population dynamics modeling methodology or logic;
- If uncertainties in assessment model results are appropriately applied to management advice; and
- Whether the assessments provide the best available science.

Additionally, the review shall (to the extent practical) evaluate and provide advice on:

- The determination of appropriate sample size for the multinomial distribution used for survey and fishery catch-at-age in both models.
- The incorporation of differential growth parameters for Atka mackerel
- The incorporation of abundance and movement information from tagging studies of Atka mackerel
- The potential pitfalls and possible solutions to the use of pollock summer bottom-trawl abundance index for a fishery that primarily occurs in the winter on a pelagic spawning population.
- For pollock assess the appropriate spatial delineation of fisheries and survey data.

The following is intended for review during the 2008 NMFS/NPFMC assessment cycle. All comments and suggestions have been tabulated with responses noted. Issues common to both Aleutian Islands pollock and Aleutian Islands Atka mackerel are presented in the next section, followed by species-specific issues in subsequent sections. A detailed list of comments and issues extracted from the individual CIE reports is presented in Appendix 1.

Both stocks

Spatial issues

- Requested analysis of fishery and survey age composition data by area
  - *As time permits (data compilation issues)*
- Suggested comparing historical exploitation rates by areas
  - *Will do and will evaluate further (e.g., area-apportionment schemes for Atka mackerel)*
- Develop and incorporate separate age length keys by area and length-weight relationships by area
  - *Will attempt, as time permits*
- Adopt area specific weight-at-age vectors for modeling
  - *As time permits (data compilation issues)*

AMAK software implementation

- Penalty on departures between log-RO and mean-log-R should be inactive in last phase
  - *This has been checked*
- Include an age-misclassification matrix
  - *Have added*
- Replace RMSE statistic with standard deviation of the normalized residuals (SDNR)
  - *Now available*
- Normal-log likelihood for survey biomass estimates should be replaced by the true lognormal likelihood
  - *Will evaluate, one fits to the median (common in most models) whereas the other fits to the mean*
- Simplify and make more robust the calculations of profiles from AMAK
  - *Completed*
- Make the objective function in AMAK more clearly Bayesian and less ad hoc. This would involve removing most/all of weighting parameters and allowing for priors for all estimated parameters.
  - *Will do*

Selectivity

- Does not agree with approach used to model fishery selectivity and pollock survey selectivity (age & time-varying selectivity with smoothers), suggests to use current approach to form hypotheses for best parametric form for selectivity and blocks of years with unchanging selectivity
  - *Will evaluate alternative approaches*
- Then test these hypotheses with tools (e.g. AIC) on models with no smoothers (parametric selectivity curves and blocks of years with constant selectivity)
  - *Will do*
- Justify and provide mechanism(s) for dome-shaped selectivity
  - *Will do*

Survey catchability (q)

- Suggests profiles of q be in each document which would give some justification for fixing q. The uncertainty about survey catchability should be clearly communicated. Need to state a clear hypothesis as to why q was so poorly determined. Reference historical analyses.
    - *Will do*

Sample size, eff N, CVs

- Look at alternative estimates of effective N and CVs for data components.
    - *Will do*
- "Spread" parameter of assumed error distribution (sample size-multinomial, CV-lognormal) must include both observed and process error. For trawl survey biomass use a process-error CV of 0.2
    - *Will evaluate as an alternative*
- For multinomial at-age data suggested effective N calculations and suggest using lognormal error (See Appendix 5 for multinomial sample size)
    - *Will evaluate as an alternative (possibly next year)*
- In addition to reporting average effective N for at-age data sets, also report ratio to input N ("correction factor")
    - *Will do*

Documentation

- Need to have more thorough documentation of AMAK
- List of items unclear in one or both assessments:
    - weightings (multinomial sample sizes, CVs), and likelihood weights applied to data sets
    - rationale for restricting some data sets to subareas
    - which primary parameters (not derived parameters) were estimated for each model
    - which model results (including CVs and CIs) were from point estimates and which were from MCMCs, and if from MCMCs, were estimates means, medians, or modes of posterior
    - reasons for preferring one model over another
- Include a table of catches by region
- Mention sex ratio of catch and ratio used to estimate female spawning biomass
- Stock assessment edits listed in KT's report
    - *Will address documentation issues*

Longer-term research

- Use temperature at depth data and other similar data to refine abundance estimates and possibly the areal expansion factor. Idea here intended to account for volume of habitat relative to surveyed areas.
- Consider the potential for AFSC to conduct a small dedicated but widespread AM and pollock survey using smaller boats and different gear to better access area

- Conduct retrospective analyses to see if there are patterns and if so, do simulations to see if SSL closures could be generating a retrospective pattern
- For Atka mackerel, it would be interesting to tag juveniles found in Bering Sea to see where they end up.
- Use otolith chemistry to see if individuals return to their natal site and if so, what are the implications for stock stability and management?
- Continue the type of modeling per Doug Kinzey and use results to provide context in individual assessments

Atka mackerel

Modeling

A summary of modeling suggestions included:

- As an initial step towards incorporating spatial heterogeneity, run model excluding eastern area to see impacts to biomass estimates
    - *Possible this year, likely next*
- The Bering Sea fishery catches are included, but Bering Sea survey biomass estimates are excluded. Should include all biomass estimates for consistency
    - *Will evaluate and ensure that a consistent approach is used*
- Does not agree that 1986 biomass estimate should be used given that it is not comparable. Less concern about using 1986 age data.
    - *Will reevaluate with and without 1986 survey data for model selection*
- Evaluate the use of a lower plus group in the fitting. Decrease to 11 or 12 years or bin with roughly 5% of the year's individuals in it
    - *Will do this year*
- Incorporate spatial information by using area-specific fishery and survey selectivities. That is, a separate fishery for each area
    - *Possible this year, likely next*
- Investigate why recruitment estimates of 1 and 2s (Fig 15.19) are consistently over-estimated (Possibly related to smoothness penalty between ages).
    - *Will do*
- Evaluate sensitivity of *q* estimates to different data sources
    - *q profile will be included in forthcoming assessment*
- Investigate possible pattern in residuals of model fit to survey biomass (last 4 years under-estimated, previous 3 years over-estimated). Can this pattern be removed?
    - *Will investigate*

Pollock

- Examine survey data for trends in abundance by age
  - *Will do*
- Analysis of sources of variability of survey catch rates may help to standardize survey indices
  - Most likely variance is a function of increased patchiness at low population sizes. To address this issue we would need to better understand pollock preferred habitat at low population sizes. These studies are on-going, but will likely be long-term endeavors.
- Use radiometric validation of pollock to estimate bias in annulus-count ages (fit a line through open circles in Fig. 1 of Kastelle and Kimura (2006))
  - *Will evaluate in medium term*
- Shift the age range used to normalize selectivities to only include fully-selected ages
  - *Will do*
- Do not include inter-annual variability in survey selectivity parameters
  - *Will include as a model alternative*
- Include an ageing error matrix
  - *Will include as a model alternative*
- Try running the model out to 1998 and look at contribution of each data set to the likelihood and compare with the model run to 2007 (or maybe for every year)
  - *Will include as a model alternative*
- Suggests including the 1978 year class as there isn't sufficient justification to exclude it
  - *Will re-evaluate (done previously)*
- Perform profile of *q* and evaluate impacts from different data sources
  - *Will do*
- Survey selectivity should not be allowed to vary from year to year
  - *Will include as a model alternative*
- Eastern area (ENRA) was excluded for catches but included for survey data without a rigorous conceptual model that justified treatment of the data in this way
  - *Will add rationale and re-evaluate*
- Does not seem sensible that mean of prior on *M* differs from the fixed value in Models 1 and 2A
  - *Will compare impact of prior*
- Does not agree with choice of selectivity vector for projections. Supports the use of the 2007 selectivity
  - *Agree with suggestion and will include*
- Explore why *M* goes up when age composition data fit degrades
  - *Will examine residual patterns and add paragraph describing result*
- Reasons for model selection were not well substantiated
  - *Will include history of previous model selection process*

Long-term/large research projects

- Continue stock structure studies
- Continue cooperative acoustic survey to assess local biomass estimates
- For small-scale management recommendations, develop a decision rule based primarily on the local abundance estimates to smooth out the inter-annual variability in acoustic estimates
- Conduct more studies on pollock movement
- Consider modeling Aleutian Islands pollock as a sub-component of the Bering Sea or Gulf of Alaska. If Aleutian Islands pollock are a satellite population dependent on input from

neighboring populations, the stock-recruitment relationship and management related reference points could be misleading
- Evaluate if Aleutian Islands pollock trends are linked to trends in other regions, and if advice could be modified by trends in other regions
- A spatially explicit model should be developed to evaluate such linkages
- Conduct maturity studies to develop appropriate and current maturity ogive for Aleutian Islands pollock

Tagging studies

There was some contradiction in the application of the present Atka mackerel tagging study for stock assessment purposes. One report suggested making a model modification to allow predicted probabilities of recovery whereas the other two reports (CF and AP) noted that the scale of the tagging study would need to be expanded to be useful for assessment purposes.

Our response is that we agree that the tagging should be expanded for Atka mackerel assessment application. However, we also agree that some smaller spatial disaggregated model of the population may be able to accommodate the present tagging information.

There was also concern about using summer survey to assess abundance from pollock fished in the winter and can only be resolved with seasonal movement data (tagging).

Appendix 1, Comment/recommendation list

The following table compiles the main comments and recommendations for the CIE reports using the following abbreviations for authorship: AP Ana Parma, KT Kurtis Trzcinski , CF Chris Francis.

Atka mackerel

Source	Page	***Comment***
AP	3,12	Continue analysis of tagging data to assess large-scale movements with emphasis on movements between regions
AP	3	Investigate spatial heterogeneity in age composition data in connection to large contrasts in past exploitation rates among areas
AP	3	Investigate model performance using smaller areas to evaluate feasibility of a spatially-stratified model that incorporates tagging data
AP	10	Further exploratory analyses of age-composition data by region in connection to differential historical harvest rates
AP	10,11	As an initial step towards incorporating spatial heterogeneity, run model excluding eastern area to see impacts to biomass estimates
AP	11	Analysis of survey age composition data by region. Question as to whether differences in age composition contribute to spatial gradients in size and age
AP	11	Include a table of catches by region
AP	11	Sensitivity analysis to downweighting age composition data (fishery?) to explore impacts to q and fits to survey data
AP	11	Evaluate the use of a lower plus group in the fitting
KT	3	Develop and incorporate separate age-length keys by area and length-weight relationships by season
KT	3	Put more effort into tag recovery
KT	3	Test to see if incorporating tagging data improves model estimates and performance
KT	6	Have some dedicated trips to recapture fish especially in areas where fish were not tagged. Could be done in conjunction with mini-survey for pollock and Atka mackerel
KT	6	Tag juveniles found in Bering Sea to see where they end up
KT	6	Use otolith chemistry to see if individuals return to their natal site and if so, what are implications for stock stability and management
KT	6	Suggests a model run where probability of recapture is estimated and incorporated into the overall likelihood of the stock assessment model
KT	6	Model seems to consistently over-estimate recruitment of 1 and 2s (Fig 15.19). Possibly related to smoothness penalty between ages?
KT	9	Try a lower plus group with roughly 5% of that year's individuals in it.
KT	9	Investigate possible pattern in residuals of model fit to survey biomass (last 4 years under-estimate, previous 3 years over-estimate). Can this pattern be removed?
KT	9	Mention sex ratio of catch and ratio used to estimate female spawning biomass
CF	8	Survey q=1.5 troublesome. Q>1 is conceivable, but not likely. Need to profile q properly as a starting point
CF	9	Bering Sea fishery catches are included, but Bering Sea survey catches are excluded. Should include all Bering Sea catches to be consistent
CF	9	Does not agree that 1986 biomass estimate should be used given that it is not comparable. Less concern about using 1986 age data.
CF	10	Incorporate spatial information by using area-specific fishery and survey selectivities. That is, a separate fishery for each area
CF	10	Use area-specific weight-at-age relationships to convert catch weights to numbers of fish.
CF	10	Does not agree that current available estimates from tagging data are useful for the assessment as they refer to spatial scales that are too small Interest would be in using existing and future returns to make preliminary estimates of movement over larger distances. In the context of the assessment, tagging study's main value is as a pilot study for a larger-scale experiment to estimating abundance for the whole stock
CF	10	Decrease plus age group to 11 or 12 years

Pollock

Source	Page	***Comment***
AP	3	Continue stock structure studies
AP	3,9	Continue cooperative acoustic survey to assess local biomass estimates
AP	8	Provide further rationale for the spatial delineation of fisheries and survey data in the face of uncertain stock structure info
AP	8	Examine survey data outside the model to look for trends in abundance by age
AP	8	Analysis of sources of variability of survey catch rates may help to standardize survey indices
AP	9	Continue with 2-prong approach to evaluate abundance on a global scale (age-structured model) and local scale (acoustic surveys)
AP	9	Develop a decision rule based primarily on the local abundance estimates to smooth out the inter-annual variability in acoustic estimates
AP	9	Shift the age range used to normalize selectivities to only include fully-selected ages
AP	9	Do not include inter-annual variability in survey selectivity parameters
AP	9	Include an ageing error matrix
AP	9	Better rationalization of selectivity ogive for future projections in connection type of future fishery and whether targeting on spawning aggregations
KT	3	Conduct more studies on pollock movement
KT	4	Consider modeling AI pollock as a sub-component of the Bering Sea or GOA (long-term research goal)
KT	5	Try running the model out to 1998 and look at contribution of each data set to the likelihood and compare with the model run to 2007 (or maybe for every year)
KT	5	If AI pollock are a satellite population dependent on input from neighboring popns, SR relationship could be "dangerously" misleading and reference points and fishing mortality "nonsensical"
KT	6	If AI pollock trends are linked to trends in other regions, advice could be modified by trends in other regions
KT	6	In the long term, more formal spatial modeling should be a goal
KT	11	Assessment should note sex ratio in catch and impacts due to fishing on spawning aggregations and how assessment accounts for changes in fishing practices
KT	11	Conduct maturity studies to develop appropriate and current maturity ogive for AI pollock
KT	11	Explore why *M* goes up when age composition data are de-weighted
KT	11	Suggests including the 1978 YC as there isn't sufficient justification to exclude it
CF	5	Use radiometric validation of pollock to estimate bias in annulus-count ages (fit a line through open circles in Fig 1 of Kastelle and Kimura (2006))
CF	11	Concern with fixing *q* at 1.0. Profiling of *q* showed lower *q* improved fit to at-age data sets. Explore lower values of *q* that are still conservative but more consistent with age data
CF	11	Survey selectivity should not be allowed to vary from year to year
CF	12	Eastern area (ENRA) was excluded for catches but included for survey data without a rigorous conceptual model that justified treatment of the data in this way
CF	12	Concern about using summer survey to assess abundance from pollock fished in the winter can only be resolved with seasonal movement data (tagging)
CF	12	Reasons for model selection were not well substantiated
CF	13	Does not believe that there is a good rationale for excluding 1978 yc
CF	13	Does not seem sensible that mean of prior on *M* differs from the fixed value in Models 1 and 2A
CF	13	Does not agree with choice of selectivity vector for projections. Supports the use of the 2007 selectivity

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Source	Page	***Comment***
AP	5	Penalty on departures between log-*RO* and mean-log-*R* should be inactive in last phase
AP	5	Conduct a sensitivity analysis to determine the amt of year-to-year variability appropriate for the selectivity parameterization by looking at alternative estimates of eff n and CVs for other components.
KT	4	Use temperature at depth data and other similar data to refine abundance estimates and possibly the aerial expansion factor
KT	4	Consider the potential for AFSC to conduct a small dedicated but widespread Atka mackerl and pollock survey using smaller boats and different gear to better access area
KT	5	Conduct retrospective analyses to see if there are patterns and if so, do simulations to see if SSL closures could be generating a retrospective pattern
KT	6	Concerns with annual changes in fishery and survey selectivity, especially survey selectivity. Suggest estimating selectivity in 2 or 3 time blocks based on changes in fishery or survey (parsimony)
KT	6	Justify and provide mechanism(s) for dome-shaped selectivity
KT	7	Serious technical concern about why *q* cannot be estimated and fixing *q*
KT	7	Suggests profiles of *q* be in each document which would give some justification for fixing *q*
KT	7	Continue the type of modeling per Doug Kinzey and use results to provide context in individual assessments
CF	2	The uncertainty about survey catchability should be clearly communicated. Need to state a clear hypothesis as to why *q* was so poorly determined
CF	2	Unclear that catchability had been fully explored for both stocks
CF	3	"Spread" parameter of assumed error distribution (sample size-multinomial, CV-lognormal) must include both observation and process error
		For trawl survey biomass use a process-error CV of 0.2
		For multinomial at-age data suggested eff N calculations and suggest using lognormal error (See Appendix 5 for multinomial sample size)
CF	3,4	Does not agree with approach used to model fishery selectivity and pollock survey selectivity (age & time-varying selectivity with smoothers)
		Suggests use current approach to form hypotheses for best parametric form for selectivity and blocks of years with unchanging selectivity
		Then test these hypotheses with tools (e.g. AIC) on models with no smoothers (parametric selectivity curves and blocks of years with constant selectivity)
CF	4	Include an age-misclassification matrix
CF	5	AMAK's main lack is thorough documentation
CF	5	In addition to outputting Ave Eff N for at-age data sets, also output correction factor *f*, where $N_{corr,y} = fN_{init,y}$
CF	5	Replace RMSE statistic with standard deviation of the normalized residuals (SDNR)
CF	6	normal-log likelihood for survey biomass estimates should be replaced by the true lognormal likelihood
CF	6	Simplify and make more robust the calculations of profiles from AMAK
CF	6	Make the objective function in AMAK more clearly Bayesian and less ad hoc. This would involve removing most/all of weighting parameters and allowing for priors for all estimated parameters
		List of items unclear in one or both assessments:
		weightings (multinomial sample sizes, CVs), and likelihood weights applied to data sets
		rationale for restricting some data sets to subareas
		which primary parameters (not derived parameters) were estimated for each model
		which model results (including CVs and CIs) were from point estimates and which were from MCMCs, and if from MCMCs, were estimates means, medians, or modes of posterior
CF	7	reasons for preferring one model over another