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Proceedings of the PSARC Pelagic Subcommittee Meeting

Compte rendu de la réunion du CEESP sur les poissons pélagiques

May 30-31, 2006
Pacific Biological Station
Nanaimo, BC

30 et 31 mai 2006
Station biologique du Pacifique
Nanaimo, C.-B,

M. Potyrala

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Fisheries and Oceans Canada
Pacific Biological Station
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PACIFIC SCIENTIFIC ADVICE REVIEW COMMITTEE (PSARC)
PELAGIC SUBCOMMITTEE MEETING

SUMMARY

The Pacific Scientific Advice Review Committee (PSARC) Pelagic Subcommittee met May 30-31, 2006 at the Pacific Biological Station in Nanaimo, B.C. The Subcommittee reviewed three working papers relating to British Columbia herring biology, distribution and assessment.

Working Paper P2006-01: A risk assessment framework for Pacific herring stocks in British Columbia

The working paper presented a risk assessment framework to evaluate the effect of alternative harvest rules on performance measures. A series of performance indicators was used to evaluate the impacts of alternative harvest policy options. The working paper was accepted subject to revisions. The Subcommittee recommended that: 1) the model be used as a general framework for assessing the sensitivity of performance indicators to alternative harvest rules, and 2) the existing harvest rule (25% unfished biomass fishery cut-off and 20% exploitation rate above the cut-off) should remain the default harvest rule until an alternative harvest policy is shown to be optimal given stock-specific inputs and agreed to performance measures.

Working Paper P2006-02: Catch-age models for Pacific herring: Evaluation of alternative assumptions about fishery and stock dynamics and alternative error distributions

The working paper presented a herring catch-age model (HCAM) that incorporates the structure and assumptions of both the existing age structured model (EASM) and the new age structured Model (NASM) used in the risk assessment framework (Working Paper #1). The purpose of the assessment was to determine which assumptions resulted in better performance based on residual patterns in a retrospective analysis. The implementation of the HCAM, which considered size-based selectivity by gillnet fisheries, (estimating ageing error, age-dependent and time-varying natural mortality, deviations from selectivity functions for seine and gillnet fisheries, increased weighting of the spawn data and assuming one time series for the spawn index) reduced the retrospective residual bias evident in the EASM and NASM. The Subcommittee accepted the paper subject to revisions. The Subcommittee recommended that: 1) the HCAM should be the primary model used for future scientific advice and that this approach be implemented for the 2006/07 stock assessment; and 2) the HCAM approach should be incorporated into the risk assessment framework (Working Paper P2006-01).

Working Paper P2006-03: Area 9 Herring: a review of available information for stock assessment purposes

Currently, DFO recognizes five major and several minor herring stocks for management purposes. Annually, PSARC recommends a total allowable catch (TAC) for each of the five major stock assessment areas stocks. The Wui'kinuxv First Nation are interested in harvest opportunities in Area 9 and DFO committed to a scientific review of available information. The Working Paper and the PSARC review examine the available data but are unable to reach consensus on stock status in the area. The paper was accepted with minor revisions. The Subcommittee recommended further DNA and biological sampling and that spawn surveys in Statistical Area 9 be continued before a harvest recommendation can be considered.

SOMMAIRE

Le Sous-comité des poissons pélagiques du Comité d'examen des évaluations scientifiques du Pacifique (CEESP) s'est réuni les 30 et 31 mai 2006 à la Station biologique du Pacifique, à Nanaimo (C.-B.). Il a passé en revue trois documents de travail portant sur la biologie, la répartition et l'évaluation du hareng de la Colombie-Britannique.

Document de travail P2006-01 : Cadre d'évaluation du risque pour les stocks de hareng de Colombie-Britannique

Le document de travail présente un cadre d'évaluation du risque permettant de déterminer les effets d'autres règles de récolte sur la mesure du rendement. Une gamme d'indicateurs de rendement a été utilisée pour évaluer les répercussions d'autres mesures de gestion de la pêche. Le document de travail a été accepté sous réserve de certaines révisions. Le Sous-comité a recommandé ce qui suit : 1) que le modèle soit utilisé comme cadre général pour l'évaluation de la sensibilité des indicateurs de rendement aux autres règles de récolte; 2) que la règle de récolte existante (seuil de pêche de 25 % de la biomasse non exploitée et taux d'exploitation de 20 % au-delà du seuil) continue d'être la règle par défaut jusqu'à ce qu'on ait pu démontrer la valeur optimale d'une autre mesure de gestion de la pêche, compte tenu d'intrants propres au stock et de mesures de rendement convenues.

Document de travail P2006-02 : Modèles des prises selon l'âge pour le hareng du Pacifique : évaluation d'autres hypothèses à propos de la pêche et de la dynamique des stocks et d'autres distributions de l'erreur

Le document de travail présente un modèle des prises selon l'âge pour le hareng (MPAH) qui tient compte de la structure et des hypothèses du modèle de structure d'âge existant (MSAE) et du nouveau modèle de structure d'âge

(NMSA) utilisé pour le cadre d'évaluation du risque (document de travail 1). L'évaluation visait à déterminer quelles hypothèses donnent le meilleur rendement, en se basant sur les tendances résiduelles dans le cadre d'une analyse rétrospective. L'application du MPAH à l'examen de la sélectivité des pêches aux filets maillants par rapport à la taille (évaluant les erreurs de détermination de l'âge, la mortalité naturelle selon l'âge et variant dans le temps, les écarts par rapport aux fonctions de sélectivité pour les pêches à la senne et aux filets maillants, une pondération accrue des données sur la ponte et tenant compte d'une série chronologique de l'indice de ponte) a permis de réduire le biais résiduel rétrospectif évident dans les MSAE et NMSA. Le Sous-comité accepte le document sous réserve de certaines révisions. Il recommande ce qui suit : 1) que le MPAH soit le principal modèle utilisé pour les avis scientifiques futurs et que cette méthode soit adoptée pour l'évaluation des stocks de 2006-2007; 2) que le MPAH soit intégré au cadre d'évaluation du risque (document de travail P2006-01).

Document de travail P2006-03 : Hareng de la zone 9 : examen de l'information disponible aux fins de l'évaluation des stocks

Présentement, aux fins de la gestion des stocks, le MPO reconnaît l'existence de cinq grands stocks de hareng et de plusieurs petits. Chaque année, le CEESP recommande un total autorisé des captures (TAC) pour chacun des stocks des cinq grandes zones d'évaluation des stocks. La Première nation Wui'kinuxv est intéressée par les possibilités de pêche dans la zone 9 et le MPO s'est engagé à procéder à un examen scientifique de l'information disponible. Le document de travail et l'examen du CEESP ont porté tous deux sur les données disponibles, mais il n'y a pas de consensus sur l'état des stocks dans cette zone. Le document est accepté moyennant quelques révisions mineures. Le Sous-comité a recommandé d'autres échantillonnages biologiques et d'ADN et le maintien des relevés de géniteurs dans la zone statistique 9 avant qu'une recommandation puisse être envisagée au sujet de la pêche.

INTRODUCTION

The PSARC Pelagic Subcommittee met May 30-31, 2006 at the Pacific Biological Station in Nanaimo, British Columbia. External participants from industry, academia, First Nations and conservation groups attended the meeting. The Subcommittee Chair, M. Potyrala, opened the meeting by welcoming the participants. During the introductory remarks the meeting objectives were reviewed, and the Subcommittee accepted the meeting agenda.

The Subcommittee reviewed three Working Papers which are summarized in Appendix 1. The meeting agenda appears as Appendix 2. A list of meeting participants and reviewers is included as Appendix 3

DETAILED COMMENTS FROM THE REVIEWS AND SUBCOMMITTEE DISCUSSION

Working Paper P2006-01: A risk assessment framework for Pacific herring stocks in British Columbia.

J.F. Schweigert, C. Fu, C.C, Wood, T.W. Therriault **Accepted subject to revisions**

The Working Paper presented a risk assessment framework to evaluate the effect of alternative harvest rules on performance measures developed through a stakeholder consultation process. The existing harvest rule has a fishery threshold or cut-off at 25% of the estimated unfished biomass for each of five stocks and a 20% exploitation rate of forecast biomass estimates above the cut-off. Performance of alternative cut-off values and exploitation rates above the cut-off was evaluated using estimation-simulation analysis. Bayesian estimates of key population dynamics parameters were derived from a variant (NASM) of an age-structured model previously reviewed by PSARC. Performance measures were evaluated by simulating the uncertain dynamics and effect of fishing over a 15-year projection period.

Both reviewers and the Subcommittee thought the analysis was adequately described and a step forward in the development of risk assessment framework for Pacific herring. The Subcommittee agreed that key technical issues highlighted by both reviewers need to be addressed in revisions to the paper before the framework can be used to inform management decision making. The reviewers noted that the results using the modeled population dynamics were inconsistent with the historical catch and recruitment estimates. In particular, the authors' choice of using a constant natural mortality rate M in the projections was questioned by one reviewer and in subsequent discussion gave evidence that annually varying M improves model performance. One reviewer was not

convinced that model convergence had been achieved based on examination of posterior parameter distributions. He noted that the paper did not provide any documentation on what diagnostics were used to test for convergence. He suggested that Markov Chain Monte Carlo (MCMC) trace plots should be included in a revised paper to provide evidence that global solutions were indeed being achieved.

The results presented indicate that the projected spawning stock biomass was more sensitive to variations in harvest rate than to alternative fishery cut-off values. One reviewer noted that this is not surprising given that the fixed exploitation rate is applied over a much broader biomass range compared to the biomass range ($0 < B <$ cut-off). This prompted the reviewer to suggest that the analysis be framed in the context of the historical literature on the broad suite of alternative harvest policies (fixed escapement versus fixed harvest rate) and resource management objectives.

Discussion ensued on the choice of the 12 performance indicators used in the analysis. Both reviewers commented that the information in the numerous contour plots showing the effect of varying exploitation rates and cut-offs was difficult to understand. Both reviewers thought that some of the performance indicators are likely redundant. One meeting participant noted that none of the performance indicators measured the benefits of fishery cut-offs to ecosystem function. The authors agreed to review the indicator choices and how to communicate the results in a way that better informs decision makers on the effect of alternative cut-offs and exploitation rates.

The Subcommittee discussed the potential implications of including different data sets in the analysis. For example, should the analysis include data for the early reduction fishery that was more of a multi-stock interception fishery compared to the current commercial roe fishery? Participants agreed that the sensitivity of data choices could be evaluated to assess the impact of the apparent retrospective bias in biomass estimates. Some participants thought that including the early reduction fishery data is likely less of a concern than other input variables (i.e. variants of M) since those cohorts have long since passed through the fishery. The Subcommittee noted that the weight-at-age data should be reviewed to account for the recent decline in mean weight-at-age compared to the historical average.

One participant questioned the parameterization of the steepness parameter in the stock-recruitment function noting that it is likely biased high. This bias would result in a positive bias in the estimate of optimal exploitation at MSY. The effect could explain why the current default fixed exploitation rate of 20% is sub-optimal in the simulation results. The authors agreed to review the formulation of the steepness parameter given the potential serious implications for assessing harvest control rules.

The Subcommittee discussed the next steps in the application of the risk assessment framework. Given the outcome of the review, there was a notable apprehension to accept the framework as a tool to determine stock-specific harvest rules. The Subcommittee agreed that while the assessment is a worthwhile generic framework, a more thorough sensitivity analysis that includes alternative model structures and data and parameter inputs is required. This will be necessary for each stock before moving away from the current harvest rule and may require a subsequent PSARC review of proposed changes before finalizing science advice.

In summary, the authors agreed to consider alternative model structures and data/parameter inputs to resolve the apparent inconsistencies in the simulation results. In particular, the following revisions need to be included before acceptance of the working paper:

- Re-visit the natural mortality assumption assumed for projections and consider using the M estimated during the estimation phase.
- Include MCMC trace plots to test for convergence in Bayesian posterior parameter estimates.
- Assess the effects of only using recent weight-at-age data in the analysis.
- Re-evaluate the parameterization for stock-recruitment steepness.

Subcommittee Conclusions

- The working paper was accepted subject to the revisions specified above.

- The model represents a broad-scope, general framework for evaluating the effect of alternative fishery cut-off values and exploitation rates on selected performance indicators.

- The model is a useful tool that can be used to test the sensitivity of harvest rules (fishery cut-offs and exploitation rates) to assumptions about population dynamics.

- The specific model inputs will depend on the particular stock (management area) and will help inform clients (fishery managers and other clients) on the consequences of alternative harvest policies given uncertainty and assumptions.

- The current harvest rule with a fishery cut-off at 25% of the unfished biomass and a 20% exploitation rate above the cut-off is precautionary given uncertainty and remains the default harvest rule.

Subcommittee Recommendations

1. Following acceptance of the paper that includes the revisions specified by the Subcommittee, use the model as a general framework for assessing the sensitivity of performance indicators to alternative harvest rules.

2. The existing harvest rule (25% unfished biomass fishery cut-off and 20% exploitation rate above the cut-off) should remain the default harvest rule until an alternative harvest policy is shown to be optimal given stock-specific inputs and agreed to performance measures.

Working Paper P2006-02: Catch-age models for Pacific herring: Evaluation of alternative assumptions about fishery and stock dynamics and alternative error distributions.

V. Haist and J. Schweigert **Accepted subject to revisions**

The working paper presented a herring catch-age model (HCAM) that incorporates the structure and assumptions of both the existing age structured model (EASM) used in previous herring assessments and a new age structured Model (NASM) used in the risk assessment frameworks (Working Paper P2006-01). The HCAM can re-create either of the EASM or the NASM with the added flexibility to investigate alternative assumption about the fishery, data inputs, stock dynamics and error distributions.

The two reviewers and meeting participants agreed that the approaches and results from the analyses demonstrated a thorough understanding, representation and utilization of data for BC herring. It was generally agreed that HCAM (Run 13) reduced the residual bias evident in the EASM and NASM approaches and is therefore superior. This implementation considered size-based selectivity by gillnet fisheries, estimating ageing error, age-dependent and time-varying natural mortality, deviations from selectivity functions for seine and gillnet fisheries, increased weighting of the spawn data, and assuming one time series for the spawn index). The Subcommittee agreed that it would be prudent to implement it for annual stock assessments.

One reviewer thought that outliers in the residual pattern for some stocks could possibly be further explained by ancillary information (i.e. the influence of unreported catch or predator abundance). The authors agreed to examine the residual pattern in relation to other sources of information to assess whether residual performance indicators could be better explained.

Reviewers disagreed on whether a meta-analysis as suggested by the authors would be useful for developing informed Bayesian priors. One reviewer thought data from other populations are not as good as data from BC herring. The other reviewer suggested that a hierarchical modeling structure, where some

parameters are shared in a meta-analysis (i.e. stock-recruitment steepness parameter, natural mortality rates, etc.) among the five major stocks of BC herring, would be useful in future research and might reduce the problem of local minima in parameter estimation.

One Subcommittee member questioned whether alternative stock-recruitment (S-R) assumptions would significantly affect the outcome of the analysis. The authors and one reviewer indicated that the outcome, in terms of the choice of model run or the retrospective analysis, would not be affected by assumptions about the S-R relationship.

There was debate about whether a complete stock assessment model replacement for the upcoming 2006/07 assessment should occur or whether two comparable model runs should ensue. One reviewer reiterated that the HCAM can re-create the EASM and the NASM as special cases but with greater flexibility on the choices of assumptions and performance evaluation. Some participants argued for a cautious approach when considering changes to the assessment methods for recommending total allowable catch (TAC). Other participants supported the use of the HCAM approach in future assessments (ie. Run 13) and for the provision of science advice for 2006-07 management. DFO staff conducting annual stock assessments and other participants questioned whether time and other resources are sufficient to implement the HCAM model for the 2006/07 assessment. Similar consideration would also be required to use the HCAM in the risk assessment framework (Working Paper P2006-01).

One reviewer suggested that future model evaluation should assess model performance with simulated (known) inputs. The authors and other participants questioned the utility of such an approach given that many of the inputs can be subjectively affected and wouldn't directly address the causes of the observed residual pattern.

Subcommittee Conclusions

- The Subcommittee accepted the paper subject to revisions which include:
    - presentation of results related to fishing opportunity impacts (hypothetical changes to TAC from NASM and EASM using an HCAM approach) to identify how results would be useful for making recommendations to managers;
    - clarification in text on several points highlighted by reviewers and acknowledged by authors (ie. catch data and likelihood function, process error explanation, elaborating on incorporation of multinomial sample sizes and prior distributions);
    - clarification on, or presentation of, results related to bias in stock-recruitment parameters derived from NASM.

- The HCAM-Run 13 resulted in smaller residuals for all stocks and for most years in retrospective analyses compared to the EASM or NASM and therefore is superior to previous assessment approaches.

Subcommittee Recommendations

1. The HCAM approach should be the primary model used for developing future science advice and HCAM (Run 13 in the working paper) should be implemented for the 2006/07 stock assessment subject to available resources and competing priorities.

2. The HCAM approach should be incorporated into the risk assessment framework for evaluating the performance of alternative harvest rules, again subject to available resource and other priorities.

Working Paper P2006-03: Area 9 Herring: a review of available information for stock assessment purposes

T.W. Therriault **Accepted subject to revisions**

Subcommittee Discussion

Currently, DFO recognizes five major and several minor herring stocks for management purposes. Annually, PSARC recommends a total allowable catch (TAC) for each of the five major stock assessment areas stocks. The Wui'kinuxv First Nation requested harvest opportunities for herring in Statistical Area (SA) 9 and DFO committed to a scientific review of available information.

The Subcommittee discussed the adequacy of available biological, DNA and spawn survey information for SA 9 noting that the amount of data is limited and some of the data is of questionable value. One reviewer questioned the validity of catch information obtained during the reduction fishery, stating the fish could be from outside SA 9. The Subcommittee debated the implications of fishing SA 9 herring given the status of uncertainty about genetic differences between SA 9 and the Central Coast (CC) stock. If SA 9 herring are genetically similar to the CC stock then it should be included in the CC assessment and the management scheme and future harvest of the stock would be an allocation issue. If genetically different from the CC stock then the SA 9 stock should be managed as a minor stock. However, some participants were concerned about using the minor stock harvest rule (i.e. 10% of the previous year observed spawn biomass, which is used for the minor stocks of Areas 2W and 27). The Subcommittee acknowledged the risk of over-harvesting the stock using this rule given the uncertainty in stock status.

The DNA analysis from Goose Bay (2002) and Rivers Inlet (2001) was presented in a November 18, 2003 PSARC update. The Subcommittee noted that additional DNA samples, taken during herring tagging surveys, still need to be analyzed. The Subcommittee noted that continued DNA sampling may help to address the uncertainty of whether SA 9 herring constitute a genetically distinct stock.

Spawn data has been collected following the dive spawn survey protocol since 1999 and permanent dive transects exist for Moses Inlet and the head of Rivers Inlet. The CC dive spawn charters have surveyed Rivers Inlet (SA 9) as part of the CC sampling regimen since 2000. However, this was done on an opportunistic basis, as SA 9 is outside the major stock assessment area. Biological data has not been collected in a consistent manner or in sufficient quantity to be useful for statistical analysis. In 2006, biological samples from SA 9 were not collected. Some members suggested the need for a minimum fishery cutoff rule but acknowledged that the available data is not sufficient to establish cutoff levels, or to assess the impact of alternative cutoffs on conservation risk and sustainable harvest opportunities. One reviewer suggested that if a spawn-on-kelp opportunity is permitted, consideration should be given to minimize the chance of introducing VHS infections to the population.

The Subcommittee requested several revisions be made before the paper is accepted. The absence of raw data concerned some participants. The author agreed to include the raw biological data in tabular form. The Subcommittee would like to see the SA 9 sample data treated as one unit (Sections 91 to 93) rather than as two units. Consequently, Figure 2 of the Working Paper should be changed to show total spawn biomass for all of SA 9, as presented by one reviewer. A map of SA 9, with clearly delineated Sections 91 to 93 boundaries and associated documented spawn locations, has also been requested.

Subcommittee Conclusions:

- This paper was accepted with minor revisions.

- The paper was a good review of the available data on SA 9 herring but the data needs to be included in the Working Paper appendix. Furthermore, the Subcommittee recognizes there are deficiencies in the data for SA 9 and that further DNA, spawn, and biological sample data needs to be collected subject to available resources and competing priorities.

- The issue of whether SA 9 herring are genetically distinct or similar to the CC stock needs to be determined to assess whether potential SA 9 herring fishery impacts should be evaluated as part of the CC population or as a separate minor stock.

Subcommittee Recommendations:

1. Further DNA sampling should be conducted in SA 9. At this time, a minimum of one more year of DNA sampling is recommended to allow a comparison with other data. DNA samples should be collected from Goose Bay, Moses Inlet and the head of Rivers Inlet. The DNA samples collected from the herring tagging surveys should also be analyzed.

2. Biological samples should be collected at the same time as the DNA samples.

3. The Subcommittee recommends spawn surveys be continued in SA 9 if possible.

APPENDIX 1: Working Paper Summary

Working Paper P2006-01: A risk assessment framework for Pacific herring stocks in British Columbia

J.F. Schweigert, C. Fu, C.C. Wood, T.W. Therriault

Pacific herring (*Clupea pallasi*) has been one of the most important components of the British Columbia commercial fishery with catch records dating from 1877. A reduction fishery began in the 1930s and collapsed in the late 1960s. After a four- year fishery closure, a roe fishery began in 1972 and has continued to the present time. Since 1983, the herring roe fisheries have been managed to achieve a constant harvest rate with the quota for each stock set at 20% of forecast spawning biomass. In 1986, a threshold spawning stock biomass or "Cutoff" level was introduced for each stock to restrict harvest at low stock abundance. The harvest policy adopted at that time was supported by an extensive series of studies conducted in British Columbia, Washington, and Alaska at a time when fisheries harvest controls and reference points were relatively unknown.

For the past two decades, the herring stocks in British Columbia have sustained a relatively stable harvest under this policy. However, recent declines in two of the five major British Columbia herring stocks have raised concerns about the status and management of Pacific herring by some stakeholders, including First Nations. As a result, Fisheries and Oceans Canada (DFO) committed to a science-based review of the stock assessment and fishery management framework for Pacific herring to address these concerns. In early 2002, DFO also embarked on the Objectives Based Fisheries Management initiative (OBFM) as a basis for developing Integrated Fisheries Management Plans that are required under the Ocean's Act. The OBFM initiative identified two pilot species for the Pacific Region, Pacific herring and sablefish. For this OBFM initiative, DFO's Science Branch was tasked with determining conservation limit reference points for each of the five major herring stocks. To address this requirement and the science-based review, a risk assessment framework was developed for potential application to a variety of species. In conjunction with this, DFO also committed to review the existing harvest policy for Pacific herring. To implement the risk assessment a population model of Pacific herring that reflected current understanding of herring biology and data uncertainty was required. Accordingly, a series of assessment models were developed to address concerns about data discontinuity over the period 1951 to 2003, to incorporate flexibility in model structure that account for temporal variations in survival rate; model and environmental uncertainties; and to provide a framework for evaluating conservation limit reference points for harvest levels relative to the existing management policy. An evaluation of these alternative models has been completed, and the stage is now set for the next step – risk assessment.

The objective of this paper is to apply the risk assessment framework to Pacific herring using the best available knowledge of stock status and herring population dynamics, as recently reviewed and documented by PSARC (http://sci.info.pac.dfo.ca/PSARC/resdocs/wp-lst.htm). A stock projection model was developed to compare the probable outcomes of alternative proportional threshold harvesting policies under a series of different scenarios. Outcomes are summarized in twelve "performance indicators" developed in consultations with stakeholders and First Nations and designed to reflect various aspects of biological, social, and economic well-being.

Working Paper P2006-02: Catch-age models for Pacific herring: Evaluation of alternative assumptions about fishery and stock dynamics and alternative error distributions

V. Haist and J. Schweigert

B.C. herring stock assessments have been based on statistical catch-age model analyses since the early 1980's. The catch-age model used in the assessments was specifically designed for the Pacific herring stocks and thus has assumptions and resulting parameterizations that are unique to these stocks. The model has been revised over the years, but the basic structure and assumptions remain the same. This model, which recently was given the name EASM (existing age-structured model), uses maximum likelihood estimation.

Recently, an alternative age-structured model was developed and used to reconstruct the B.C. herring stocks. The purpose of the new model was to function as an operating model for an objective-based fishing management evaluation of B.C. herring stocks. This new model, called NASM (new age-structured model) adopts some structural assumptions that differ from the EASM and allows investigation of alternative assumptions about herring dynamics. A major difference between the EASM and the NASM is the estimation of annual natural mortality rates. Additionally, NASM incorporates stock-recruitment functions and estimates deviations from average selectivity functions. The NASM is based on Bayesian estimation, which allows a consistent method to estimate uncertainty of both the estimated and derived parameters. Simulation-estimation experiments suggest that in certain circumstances NASM provides more consistent parameter estimates. Catch-age analyses provide the basis for setting annual herring TACs, so it is imperative that the best possible analytical methods be used. It is likely that there are aspects of both the EASM and the NASM that will result in superior model performance. Evaluation of model performance should be based on objective criteria, to the extent possible.

The purpose of the work presented in this paper is to develop a generic model (ie. the computer code) for analyses of the herring fisheries data, and to determine which assumptions of the EASM and NASM models result in better performance. To the extent possible, objective criteria are used to assess

improvements in performance. The new model, HCAM for herring catch-age model, can replicate the dynamics modeled by EASM and NASM, and allows for some additional assumptions to be investigated. The first part of this paper provides a general description of the HCAM model. Then results from an EASM-like and a NASM-like implementation of the model are presented. Finally, alternative model assumptions are evaluated to find those that result in consistent analyses of the B.C. herring fisheries data. Some additional structural options in the HCAM model (i.e. multi-region and two sex analyses) are not investigated here.

Working Paper P2006-03: Area 9 Herring: a review of available information for stock assessment purposes

T.W. Therriault

Area 9 is located outside of the Central Coast major herring stock assessment region and includes most of Rivers Inlet. Pacific herring (*Clupea pallasi*) often are observed in this area but have not been harvested from this area since the reduction fishery that ended in the late 1960s. Some stakeholders have requested harvest opportunities in this area and a review of available information was conducted to provide scientific advice on the feasibility of this request. A review of the population genetic information suggested potential differences from the Central Coast stock but additional years of data are required to confirm this possibility. A review of the catch information was relatively uninformative because all landings were from the reduction fishery period when herring were fished almost year round, often off their spawning grounds. Also, this fishery was plagued by mis-reporting of landing locations that further compromises the limited information available. A review of the spawn data showed the patchiness of this time series and high variability. Average biomass based on observed spawn was around 500 tonnes with a median less than 250 tonnes, a level unlikely to sustain any directed fishery. Also, the distribution of spawn was variable among Sections and Beds in Area 9 such that resolution of stock structure was not possible based on spawn. Thus, based on the limited data currently available, it was not possible to recommend harvest opportunities be entertained at this time. With the collection of additional spawn and biosampling data future harvest might be considered in this area if the population genetics confirms Area 9 herring are genetically different from the Central Coast herring population and escapement information suggests a sustainable level of biomass exists in Area 9 that could support a harvest.

APPENDIX 2: PSARC Pelagic Subcommittee Meeting Agenda

PSARC PELAGICS SUBCOMMITTEE MEETING
May 30-31, 2006
Seminar Room - Pacific Biological Station
Nanaimo, BC

Tuesday, May 30

8:30	Introductions and Opening Remarks.
9:00-12:00	Review of Working Paper: *Objective based fisheries management model*
12:00	Lunch
1:00-4:00	Review of Working Paper: *Pacific Herring- meta-stock population dynamics model*

Wednesday, May 31

9:00-12:00	Review of Working Paper: *Pacific Herring – Area 9*
12:00	Adjournment

APPENDIX 3: List of Attendees & Reviewers

Subcommittee Chair: Mark Potyrala
PSARC Chair: Al Cass

NAME	TUESDAY	WEDNESDAY
EXTERNAL PARTICIPANTS		
Aday, Christine	✓	✓
Burrows, Bruce		✓
Chalmers, Dennis		✓
Guuduniia, La Boucan	✓	✓
Haist, Vivian	✓	
Halverson, Sabrina	✓	
Innes, Keith	✓	✓
Jones, Russ	✓	✓
Korman, Josh	✓	
Lane, Jim	✓	
Martell, Steve	✓	
Taylor, Greg	✓	
Webb, Lloyd	✓	✓
Internal Participants		
Cass, Al	✓	
Daniel, Kristen	✓	✓
Flostrand, Linnea	✓	✓
Fort, Charles	✓	✓
Fu, Caihong	✓	
Gill, Harpreet	✓	✓
Hamer, Lorena	✓	✓
McCarter, Bruce	✓	✓
Rusch, Bryan	✓	✓
Schweigert, Jake	✓	✓
Tanasichuk, Ronald	✓	✓
Therriault, Tom	✓	✓

Reviewers for the PSARC papers presented at this meeting are listed below, in alphabetical order. Their assistance is invaluable in making the PSARC process work.

Cox, Sean	Simon Fraser University
Fort, Charles	Fisheries and Oceans Canada
Groves, Steven	Fisheries and Oceans Canada
Korman, Josh	Ecometric Research
Martell, Steve	University of British Columbia
Tanasichuk, Ron	Fisheries and Oceans Canada