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**Proceedings of the PSARC Pelagic  
Subcommittee Meeting**

**September 5-6, 2007**

**Mark Potyrala**

**Compte rendu de la réunion du sous-  
comité du CEESP sur les poissons  
pélagiques**

**Septembre 5-6, 2007**

**Mark Potyrala**

Fisheries and Oceans Canada  
417-2<sup>nd</sup> Avenue West  
Prince Rupert, BC V8J 1G8

**March 2008**

**Mars 2008**

## **Foreword**

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings include research recommendations, uncertainties, and the rationale for decisions made by the meeting. Proceedings also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

## **Avant-propos**

Le présent compte rendu a pour but de documenter les principales activités et discussions qui ont eu lieu au cours de la réunion. Il contient des recommandations sur les recherches à effectuer, traite des incertitudes et expose les motifs ayant mené à la prise de décisions pendant la réunion. En outre, il fait état de données, d'analyses ou d'interprétations passées en revue et rejetées pour des raisons scientifiques, en donnant la raison du rejet. Bien que les interprétations et les opinions contenus dans le présent rapport puissent être inexacts ou propres à induire en erreur, ils sont quand même reproduits aussi fidèlement que possible afin de refléter les échanges tenus au cours de la réunion. Ainsi, aucune partie de ce rapport ne doit être considéré en tant que reflet des conclusions de la réunion, à moins d'indication précise en ce sens. De plus, un examen ultérieur de la question pourrait entraîner des changements aux conclusions, notamment si l'information supplémentaire pertinente, non disponible au moment de la réunion, est fournie par la suite. Finalement, dans les rares cas où des opinions divergentes sont exprimées officiellement, celles-ci sont également consignées dans les annexes du compte rendu.

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**PACIFIC SCIENTIFIC ADVICE REVIEW COMMITTEE (PSARC)  
PELAGIC SUBCOMMITTEE MEETING**

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## **SUMMARY**

The Pacific Scientific Advice Review Committee (PSARC) Pelagic Subcommittee met September 5-6, 2007 at the Pacific Biological Station in Nanaimo, B.C. The Subcommittee reviewed three working papers.

### **P2007-01: Stock Assessment for British Columbia Herring in 2007 and Forecasts of the Potential Catch in 2008**

*J. Schweigert and V. Haist*

Evidence from time series data related to the West Coast Vancouver Island (WCVI) offshore surveys and from the Strait of Georgia (SOG) juvenile surveys suggest that extremely low recruitment is expected in the SOG in 2008. Managers are advised to consider this information when setting a harvest target in the SOG.

Reduced coverage and intensity of biological sampling and spawn surveys may hinder performance of the herring catch-at-age model (HCAM), therefore sampling should continue to be widely distributed in time and space within each stock assessment area.

The forecasts of abundance for the Queen Charlotte Islands (QCI), Central Coast (CC) and WCVI assessment areas are below cutoff and no harvest is recommended but fisheries in Prince Rupert District (PRD) and SOG are consistent with the commercial harvest rule.

The forecasts of abundance for the minor assessment areas of Area 27 and Area 2W allow for conservative potential harvests.

As in previous years, the Subcommittee recommended that sampling (test sets, commercial fishery samples, spawn surveys) be adequate for stock assessment. This recommendation is particularly important at current times because fluxes in environmental and ecosystem conditions are causing considerable variability in natural mortality and stock productivity.

The area-specific advice is in Appendix Tables 4 to 10.

The HCAM estimates of spawn index, spawning biomass and pre-fishery biomass indicate that the abundance of all stocks except QCI declined dramatically in 2007. The estimated spawning biomass in 2007 for the WCVI stock was less than the previous year's low and at a level not seen since the collapse in the late 1960s. Except for the Strait of Georgia and Prince Rupert, the forecast abundance for all stocks in 2008 is near or below the commercial fishery cutoff. The QCI stock has remained below the fishery cutoff in 7 of the last 8 years. Science advice in the

form of yield recommendations are provided in Appendix Tables 4 to 10 and summarized as follows:

- Queen Charlotte Islands, Central Coast and west coast Vancouver Island – as in 2006 the forecast abundance is below the commercial fishery cutoff and commercial harvest at any level is inconsistent with the intent of the harvest rule.
- Prince Rupert District - Forecast abundance is above the cutoff with a potential commercial yield of 4,014 tonnes.
- The Strait of Georgia - Forecast abundance is above the cutoff with a potential commercial yield of 13,470 tonnes. Managers are advised that the recruitment classification rule is likely to over-forecast the true 2008 biomass in the SOG.
- Area 2W - A potential commercial yield of 244 tonnes is consistent with the 10% harvest rule for Minor Areas.
- Area 27 - A potential commercial yield of 274 tonnes is consistent with the 10% harvest rule for Minor Areas.

**P2007-02: Investigation of potential impacts of reductions in spawn survey bio-sampling program effort on herring stock assessments and management advice**

*V. Haist and J. Schweigert*

There is merit to the paper but there is no basis for providing advice on sampling levels in support of the stock assessment.

There is a need for ongoing documentation of the effects of changes in sampling effort and sample collection methodology on management advice.

A Request for Working Paper (RFP) should be developed to support the development of a full operating model to better quantify the sampling levels required to support the herring assessment.

Documentation of the level of effort, and any reductions or changes in sampling and dive survey effort in the assessment program should be gathered into a PBS database. This metadata will allow future users of the data to interpret whether changes in stock status are real, or are a reflection of reduced collection effort.

There was serious erosion of stock assessment (i.e. spawn survey and biosampling) coverage in 2007 because of the *Larocque* and *APPFA* court decisions. It is critical that the level of coverage increase in 2008. Until appropriate analysis is done to determine the adequate level of sampling required, coverage should continue at pre-2007 levels. The survey coverage in 2008 should be evaluated for adequacy post season.

**P2007-03: Ecology of the British Columbia herring roe fishery: Part one - Spatial and temporal distribution of the fishery, Part two - Potential impacts on the spatial and temporal distribution of herring spawn: examination of the serial depletion hypothesis**

*D.E. Hay, P.B. McCarter, and K.S. Daniel*

The results of this paper provide further support for continuance of the current conservative herring fishery management policy.

The Subcommittee acknowledged the significant conclusion of the paper that based on these analyses there was no evidence of serial depletion of herring stocks as a result of concentrating fisheries in individual sections.

## **SOMMAIRE**

Le sous-comité sur les poissons pélagiques du Comité d'examen des évaluations scientifiques du Pacifique (CEESP) a tenu une réunion du 5 au 6 septembre 2007 à la Station biologique du Pacifique, à Nanaimo en C.-B. Trois documents de travail ont été passés en revue au cours de cette réunion.

**P2007-01 : Évaluation des stocks de hareng de la Colombie-Britannique en 2007 et prévisions sur les prises potentielles en 2008**

*J. Schweigert et V. Haist*

Les séries temporelles établies à partir de relevés effectués au large de la côte ouest de l'île de Vancouver (COIV) et de relevés des juvéniles menés dans le détroit de Georgia (DG) laissent entrevoir que le recrutement sera extrêmement faible dans le DG en 2008. Les gestionnaires doivent donc tenir compte de cette information lorsqu'ils établiront une cible pour la pêche dans le DG.

Comme la réduction de la couverture et de la fréquence de l'échantillonnage biologique et du relevé des géniteurs peuvent altérer le rendement du modèle des captures à l'âge pour le hareng, il faut poursuivre l'échantillonnage à grande échelle dans le temps et dans l'espace et ce, dans chaque zone d'évaluation des stocks.

Les prévisions de l'abondance dans les zones d'évaluation des îles de la Reine-Charlotte (IRC), de la région centrale de la côte (RCC) et de la COIV sont inférieures au seuil ; aucune récolte n'y est recommandée, mais les pêches menées dans le district de Prince Rupert (DPR) et dans le DG sont conformes à la règle sur la pêche commerciale.

Les prévisions de l'abondance dans les zones statistiques mineures de la zone 27



et de la zone 20 permettent une pêche de conservation.

Le sous-comité recommande de nouveau que l'échantillonnage (ensembles de tests, échantillonnage des prises commerciales, relevés les géniteurs) soit adéquat pour l'évaluation du stock. Cette recommandation est particulièrement importante à l'heure actuelle du fait que les flux dans les conditions environnementales et écosystémiques provoquent une variabilité importante dans la mortalité naturelle et la productivité des stocks.

L'avis formulé pour chaque zone est présenté dans les tableaux 4 à 10 en annexe.

Les estimations de l'indice des géniteurs, de la biomasse reproductrice et de la biomasse antérieure à la pêche établies par le modèle des captures à l'âge pour le hareng indiquent que l'abondance de tous les stocks, à l'exception de celui des IRC, a décliné de façon marquée en 2007. La biomasse reproductrice estimée en 2007 pour le stock de la COIV était inférieure au faible niveau établi l'an passé et à un niveau qui n'a pas été vu depuis l'effondrement survenu à la fin des années 1960. À l'exception du détroit de Georgia et de Prince Rupert, l'abondance indiquée par les prévisions pour tous les stocks en 2008 se situe près ou en-dessous du seuil relatif à la pêche commerciale. Le stock des IRC est resté sous le seuil relatif à la pêche au cours de 7 des 8 dernières années. L'avis scientifique formulé sous forme de recommandations sur le rendement est présenté aux tableaux 4 à 10 en annexe et est résumé ci-après.

- Îles-de-la-Reine-Charlotte, région centrale de la côte et côte ouest de l'île de Vancouver – Comme en 2006, l'abondance prévue est inférieure au seuil relatif à la pêche commerciale et toute pêche commerciale va à l'encontre de la règle sur la pêche.
- District de Prince Rupert – L'abondance prévue est supérieure au seuil, et le rendement commercial potentiel est de 4 014 tonnes.
- Détroit de Georgia – L'abondance prévue est supérieure au seuil, et le rendement commercial potentiel est de 13 470 tonnes. On souligne aux gestionnaires que la règle de classification du recrutement est susceptible d'amener une surévaluation dans la prévision de la biomasse réelle en 2008 dans le DG.
- Zone 20 – Un rendement commercial potentiel de 244 tonnes est conforme à la règle sur la pêche de 10 % pour les zones statistiques mineures.
- Zone 27 – Un rendement commercial potentiel de 274 tonnes est conforme avec la règle sur la pêche de 10 % pour les zones statistiques mineures.

**P2007-02 : Étude des impacts potentiels des réductions de l'effort consenti dans le programme de bioéchantillonnage du relevé des géniteurs sur les évaluations des stocks de harengs et les avis aux gestionnaires**

*V. Haist et J. Schweigert*

Il s'agit d'un document valable, mais qui ne donne aucun fondement pour formuler

un avis sur les niveaux d'échantillonnage nécessaires afin de soutenir l'évaluation des stocks.

Il faut indiquer de façon continue les effets des changements dans l'effort d'échantillonnage et dans la méthodologie de collecte des échantillons dans l'avis aux gestionnaires.

Une demande de document de travail doit être élaborée pour soutenir l'élaboration d'un modèle entièrement opérationnel qui quantifiera mieux les niveaux d'échantillonnage requis pour soutenir l'évaluation des stocks de hareng.

Le degré d'effort et les réductions ou changements touchant l'effort en matière d'échantillonnage et de relevés en plongée dans le cadre du programme d'évaluation doit être consignée dans la base de données de la SBP. Ces métadonnées permettront aux utilisateurs futurs des données de déterminer si les changements dans l'état des stocks sont réels ou s'ils sont le reflet d'un effort de collecte réduit.

On a constaté une grave érosion de la couverture dans l'évaluation des stocks (c.-à-d., relevé des géniteurs et bioéchantillonnage) de 2007 à la suite des décisions *Larocque* et *APPFA*. Or, il faut absolument que le niveau de couverture augmente en 2008. Jusqu'à ce qu'une analyse appropriée soit effectuée pour établir le niveau adéquat d'échantillonnage requis, la couverture devrait être maintenue au niveau d'avant 2007. Après la saison, il conviendrait de vérifier si la couverture du relevé de 2008 est adéquate.

**P2007-03 : Écologie de la pêche au hareng rogué en Colombie-Britannique : Partie un – répartition spatiale et temporelle de la pêche; Partie deux – impacts potentiels sur la répartition spatiale et temporelle du frai chez le hareng : examen de l'hypothèse de l'épuisement progressif**

*D.E. Hay, P.B. McCarter et K.S. Daniel*

Les résultats de ce document viennent appuyer l'actuelle politique de gestion de la pêche de conservation au hareng.

Le sous-comité reconnaît la conclusion importante de ce document selon laquelle, à la lumière de ces analyses, aucun signe d'épuisement progressif des stocks de hareng n'a été relevé à la suite de la concentration des pêches dans des sections particulières.

## **INTRODUCTION**

The PSARC Pelagic Subcommittee met September 5-6, 2007 at the Pacific Biological Station in Nanaimo, British Columbia. External participants from industry, 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 objectives of the meeting 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. Appendices 4 to 10 contain stock specific yield recommendations.

## **DETAILED COMMENTS FROM THE REVIEWS**

### **Working Paper P2007-01: Stock Assessment for British Columbia Herring in 2007 and Forecasts of the Potential Catch in 2008**

*J. Schweigert and V. Haist*

#### **Subcommittee Discussion**

The report documents recent Pacific herring stock assessment results from a herring catch-at-age model (HCAM). No formal reviews of the paper were required because the HCAM model was adopted for the herring assessment by the Subcommittee at the May 2006 PSARC meeting.

Details regarding model design and performance were discussed. One Subcommittee member noted the apparent autocorrelation (cyclic patterns) of residuals for the model fit to the Strait of Georgia (SOG) spawn data (Figure 15 trace plots and Figure 7 residual patterns in the working paper). Results of SOG retrospective analyses (Figure 14 in the working paper) were also discussed in terms of having the widest uncertainty (apparent over-forecasting of spawning biomass) in recent years.

It was also suggested that estimates for conversion of egg numbers to grams of fish (fecundity) may not accurately represent current stock dynamics related to the observed decreasing size at age trends. It was noted that in Table 1 in the working paper the “2007 4+” value for the west coast Vancouver Island (WCVI) was greater than the “2007 SB” which appears to be biologically unrealistic. The authors explained the “availability-at-age” parameters for age 3 and age 4 fish in 2007 were low enough to result in significant initial recruitment of age 4 and 5 fish in 2008. The authors explained that poor estimates of availability-at-age parameters could result from reduced datasets used to run the model, namely poor representation

from biological sample data (i.e. from the WCVI in 2006) and/or missed spawn (i.e. in 2006 and 2007). Subcommittee members were concerned that reduced coverage and intensity of biological sampling and spawn surveys will impact future modeling of herring population and ecosystem dynamics as well as the stock assessment models. There was confusion about the numbers of fish reported to have been aged from biological samples of Strait of Georgia fall/winter fisheries during the last few years (listed in Appendix 1 of the working paper). The authors indicated that it was a reporting error and will be corrected in the revised document.

The topic of recruitment forecasting for the SOG and WCVI generated considerable discussion, especially related to an allowable harvest in the SOG. A presentation showed observations specific to the 2005 year class from the 2007 summer WCVI offshore trawl survey together with results from the entire WCVI summer offshore survey time series. Another presentation showed estimates of the 2005 and 2006 juvenile herring SOG surveys in relation to results from the entire SOG juvenile herring fall survey time series. Participants agreed that results relating to the 2005 year class from the two independent time series are consistent with each other and suggest that the 2005 year class will be extremely small. Both sets of independent survey results suggest that recruitment to the 2008 spawner population will be considerably less than represented by a “poor” recruitment classification, which is equivalent to the mean of the lower 33% of the stock assessment time series. Participants agreed that managers should be aware of the evidence that a “poor” recruitment classification in the SOG will likely over-forecast stock abundance and could result in a harvest rate of greater than 20% at a time when the stock is decreasing (i.e. if an allowable harvest of 13,470 mt ensues). Using a worse case scenario of zero recruitment to the SOG would result in a slightly reduced forecast to the area in 2008 of 49,200 mt, which remains above the commercial fishery cutoff of 21,200 mt. Participants agreed that the low recruitment forecast for 2008 does not represent a conservation concern, noting that the SOG remains the most productive stock on the coast.

### **Subcommittee Conclusions**

- Evidence from time series data related to the WCVI offshore surveys and from the SOG juvenile surveys suggest that extremely low recruitment is expected in the SOG in 2008. Managers are advised to consider this information when setting a harvest target in the SOG.
- Reduced coverage and intensity of biological sampling and spawn surveys may hinder performance of the HCAM, therefore sampling should continue to be widely distributed in time and space within each stock assessment area.
- The forecasts of abundance for the QCI, CC and WCVI assessment areas are below cutoff and no harvest is recommended but fisheries in PRD and

SOG are consistent with the commercial harvest rule.

- The forecasts of abundance for the minor assessment areas of Area 27 and Area 2W allow for conservative potential harvests.

### **Subcommittee Recommendations**

1. As in previous years, the Subcommittee recommended that sampling (test sets, commercial fishery samples, spawn surveys) be adequate for stock assessment. This recommendation is particularly important at current times because fluxes in environmental and ecosystem conditions are causing considerable variability in natural mortality and stock productivity.
2. The area-specific advice is in Appendix Tables 4 to 10.
3. The HCAM estimates of spawn index, spawning biomass and pre-fishery biomass indicate that the abundance of all stocks except QCI declined dramatically in 2007. The estimated spawning biomass in 2007 for the WCVI stock was less than the previous year's low and at a level not seen since the collapse in the late 1960s. Except for the Strait of Georgia and Prince Rupert, the forecast abundance for all stocks in 2008 is near or below the commercial fishery cutoff. The QCI stock has remained below the fishery cutoff in 7 of the last 8 years. Science advice in the form of yield recommendations are provided in Appendix Tables 4 to 10 and summarized as follows:
  - Queen Charlotte Islands, Central Coast and west coast Vancouver Island – as in 2006 the forecast abundance is below the commercial fishery cutoff and commercial harvest at any level is inconsistent with the intent of the harvest rule.
  - Prince Rupert District - Forecast abundance is above the cutoff with a potential commercial yield of 4,014 tonnes.
  - The Strait of Georgia - Forecast abundance is above the cutoff with a potential commercial yield of 13,470 tonnes. Managers are advised that the recruitment classification rule is likely to over-forecast the true 2008 biomass in the SOG.
  - Area 2W - A potential commercial yield of 244 tonnes is consistent with the 10% harvest rule for Minor Areas.
  - Area 27 - A potential commercial yield of 274 tonnes is consistent with the 10% harvest rule for Minor Areas.

## **Working Paper P2007-02: Investigation of potential impacts of reductions in spawn survey and bio-sampling program effort on herring stock assessments and management advice**

*V. Haist and J. Schweigert*

### **Subcommittee Discussion**

*This paper was accepted with revisions.*

The reviewer's of the paper had no substantive concerns about the scientific aspects of the simulations or the conclusions of the study. There were suggestions for expanding the description of the underlying model and aspects of the data treatments. One reviewer expressed some concern about the potential impacts of retrospective bias on the results of the analysis but it was unclear how this could be modelled. During Subcommittee discussion debate ensued about the scope and intent of the working paper and consequently whether or not it should be accepted. The authors reiterated that the study was not intended to guide the use of limited resources for biological or spawn survey data collection in upcoming fisheries but some Subcommittee members were concerned about the potential misinterpretation of the results. The authors maintained their intent was for illustrative purposes only and that any detailed analysis would involve the development of a full operating model of the data collection, stock assessment, and fishery for this species. It was suggested that the title of the working paper be revised to reflect the exploratory nature of the paper and the objectives should highlight the more limited scope of this paper. The Subcommittee asked the authors to clarify that the conclusions are suggestive and limited in scope and intended for exploratory purposes only. The paper does not suggest changing sampling effort nor does it address what level of sampling should be considered sufficient for stock assessment purposes. Issues like data quality versus quantity, the loss of fishery-independent data, and where to focus limited resources were discussed by the Subcommittee but were beyond the scope of this paper.

The authors state that they adopted a simpler, pragmatic approach to addressing reduced sampling effort by examining how different the 2006 stock assessment would have been if sampling had been reduced in the past. However, the reviewers and Subcommittee noted the need for additional documentation. For example, assumptions should be clearly stated; e.g. assume all spawning events are observed and how biological sampling data are re-sampled, treatment of seine versus gillnet samples. Also, limitations to this approach need to be clearly stated. For example, retrospective bias could influence model results, the model will necessarily underestimate spawning biomass because of assumptions about the prior, and analyses are limited in that they only consider uncertainty in model terminal estimates. There was considerable discussion about the importance of compensation among parameters in the analysis but it was difficult to evaluate its possible impact on the results.

The Subcommittee discussed the validity of assuming the 2006 stock assessment was a “true” view of each herring stock given the reduced abundance levels for some areas. However, there was no basis for dismissing this assumption. Analysis with a full operating model would provide a more quantitative evaluation of the effects of degrading data quality. Hence, some members of the Subcommittee felt it was difficult to make specific conclusions based on this exploratory analysis. Also, there was general debate about potential impacts on industry that was outside the realm of the paper. Subcommittee members felt that reduced sampling effort would suggest greater uncertainty in stock assessments, increasing the possibility of reduced fisheries opportunities. The only cost to reduced sampling would appear to be borne by industry. However, it may not be this simple. The current stock assessment of herring is scientifically-based and there was concern by members of the Subcommittee, First Nations, industry, ENGOs and other stakeholders that this base is being eroded. In addition to its value of establishing fisheries, herring stock assessment data have great value for ecosystem based management and monitoring the health and productivity of associated species.

A specific concern was the accuracy of the data in Table 1. The authors noted that this appears to be a reporting error that will be corrected in the revisions. The Subcommittee requested some clarification with respect to changes in sampling effort between 2005 and 2006. In particular, was the positive bias for the Strait of Georgia stock related to the large residual in the spawn data? Increased variance was noted but there was little discussion of the potential impact of this increased variance.

### **Subcommittee Conclusions**

- There is merit to the paper but there is no basis for providing advice on sampling levels in support of the stock assessment.
- There is a need for ongoing documentation of the effects of changes in sampling effort and sample collection methodology on management advice.
- A Request for Working Paper (RFP) should be developed to support the development of a full operating model to better quantify the sampling levels required to support the herring assessment.

### **Subcommittee Recommendations**

1. Documentation of the level of effort, and any reductions or changes in sampling and dive survey effort in the assessment program should be gathered into a PBS database. This *metadata* will allow future users of the data to interpret whether changes in stock status are real, or are a reflection of reduced collection effort.
2. There was serious erosion of stock assessment (i.e. spawn survey and

biosampling) coverage in 2007 because of the *Larocque* and *APPFA* court decisions. It is critical that the level of coverage increase in 2008. Until appropriate analysis is done to determine the adequate level of sampling required, coverage should continue at pre-2007 levels. The survey coverage in 2008 should be evaluated for adequacy post season.

**Working Paper P2007-03: Ecology of the British Columbia herring roe fishery Part one - Spatial and temporal distribution of the fishery, Part two - Potential impacts on the spatial and temporal distribution of herring spawn: examination of the serial depletion hypothesis**

*D.E. Hay, P.B. McCarter, and K.S. Daniel*

**Subcommittee Discussion**

*This paper was accepted with revisions.*

The paper presented the historical summaries of the extent and location of herring fisheries in part 1 and an evaluation of the congruence of fisheries and spawn distribution in part 2. There was general agreement that these papers have consolidated a significant amount of information and as such make an important contribution to the Subcommittee's deliberations.

1. Technical review

The lead author stated Part 1 should not necessarily be considered as a Working Paper but perhaps instead could be appended to Part 2 of the submission. He indicated that the first part did contain a vast amount of information related to historic commercial hauled and landed herring catches and catch distribution and was a valuable resource available to future managers and researchers. He expressed thanks to both co-authors for their contribution to completion of the document.

Two formal reviews of the Working Paper were presented. The reviewers and other meeting participants agreed that the papers make a useful contribution to understanding herring populations. One reviewer was concerned that Part One of the two part submission did not adequately describe the herring fishery to allow for valid evaluation of the effects of fishing on spawning but that, with proper analysis of the available data, the potential to obtain the required information exists. Concern was expressed about the continuity and comprehensiveness of the available data for all the herring sections that were being analyzed. There was some discussion of how complete the spawn survey coverage was historically relative to the present and the possible resulting biases in the data analysis. Similar concerns were expressed regarding the catch data since there was some difficulty in assigning catches to specific locations. Moreover, there was discussion



about the accuracy of the reporting of historical catches during the reduction fishery given that fish harvested at that time could not be accurately assigned to appropriate future spawning locations. In addition, including spawn timing in the analysis was deemed irrelevant when evaluating the impacts of the herring reduction fishery. The reviewer questioned the ability to compare sections with and without fisheries and the resulting changes in spawn distribution. Furthermore, the reviewer did not think that describing fishing on the basis of time and duration was appropriate and suggested using section and landed catch as descriptors of the fishing events.

There was considerable debate about how the analysis conducted in the paper could affect the view about stock structure for herring and the conclusions that fisheries should be broadly spread throughout the areas to minimize the possibility of serial depletion of subcomponents. Additional concern was expressed regarding the difficulty in separating shifts in spawn distribution though environmental variation from possible fishery effects. Overall, there was agreement that the recommendations resulting from this working paper should be useful to fisheries managers by providing further support for the continuance of a conservative roe fishery (i.e. as a portion of a TAC, representing harvest rates of 20% or less).

It was noted that a similar analysis might be appropriate for the SOK fishery given the concerns around the prevalence of VHSV and Ichthyophonus in some areas. Increased ponding in the bait fishery could exacerbate this issue over time. The paper was accepted with revisions and the suggestion that any inferences about stock structure should be limited. Figures 6-12 in the working paper should be updated to improve their legibility. For revisions, it was proposed that Part I be treated as an Appendix to Part II to make one long and comprehensive document.

### **Subcommittee Conclusions**

- The results of this paper provide further support for continuance of the current conservative herring fishery management policy.

### **Subcommittee Recommendations:**

1. The Subcommittee acknowledged the significant conclusion of the paper that based on these analyses there was no evidence of serial depletion of herring stocks as a result of concentrating fisheries in individual sections.

## **APPENDIX 1: Working Paper Summary**

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### **Working Paper P2007-01: Stock Assessment for British Columbia Herring in 2007 and Forecasts of the Potential Catch in 2008**

*J. Schweigert and V. Haist*

The Herring Catch Age Model (HCAM) methodology for assessment of Pacific herring was adopted by the PSARC Pelagics Subcommittee in May, 2006, and Haist and Schweigert (2006) provides a full description of the model. In answering to minor revision recommendations resulting from the original Subcommittee review, further model development and analysis with this implementation were conducted and the results presented in the subsequent assessment (Schweigert and Haist (2007)). The following submission primarily follows the assessment framework described in Schweigert (2005), and stock assessments, forecasts and resulting yield recommendations are presented for the five major migratory stocks and for two minor stocks (Areas 2W and 27).

Estimates of spawn index, spawning biomass and pre-fishery biomass from the HCAM model indicate 2006 abundances declined significantly for all major stocks, except in the Queen Charlotte Islands, where the stock has remained below cutoff for 7 of the past 8 years. Of particular concern is the estimated 2006 WCVI spawning stock biomass, which represents a record low. Meanwhile, the forecast abundance for all stocks in 2007 is near or below cutoff for the west coast Vancouver Island, Central Coast and QCI stocks. The Subcommittee accepted yield recommendations are provided in Appendix Tables 4 to 10 and summarized as follows:

- Queen Charlotte Islands, Central Coast and west coast Vancouver Island – As in 2006 the forecast abundance is below the cutoff and commercial harvest at any level is inconsistent with the intent of the harvest rule.
- Prince Rupert District - Forecast abundance is above the cutoff with a potential commercial yield of 4,014 tonnes.
- The Strait of Georgia - Forecast abundance is above the cutoff with a potential commercial yield of 13,470 tonnes.
- Area 2W - A potential commercial yield of 244 tonnes is consistent with the 10% harvest rule for Minor Areas.
- Area 27 - A potential commercial yield of 274 tonnes is consistent with the 10% harvest rule for Minor Areas.

## **Working Paper P2007-02: Investigation of potential impacts of reductions in spawn survey and bio-sampling program effort on herring stock assessments and management advice**

*V. Haist and J. Schweigert*

B.C. herring stock assessments are supported by a rich database that encompasses surveys of spawning stock abundance and biological data that span over a 56-year history. While responsibility for data collection has changed over time, recent changes may affect the ability to maintain herring data acquisition programs at previous levels. This has raised concern about the potential impact of degradation in the herring data collection systems on stock assessments and management advice.

This paper uses simulation methods to investigate how different levels of sampling effort in the biological sampling spawn surveys program might impact herring stock assessments. Specifically, the question of how different the 2006 stock assessments would have been if data collection programs had changed some time in the recent past is addressed.

Results of the simulations allow some general conclusions about the potential impacts of reductions in bio-sampling and spawn survey program effort on herring stock assessments and management advice. Program changes that affect only the bio-sampling data would likely have relatively minor impact on estimates of spawning stock biomass but would have greater effects on stock forecasts and estimates of potential yields, though without obvious bias. Reduced effort for spawn survey programs introduces a negative bias to the spawn survey data, which translates to comparable levels of negative bias in estimates of spawning abundance. The use of a model that synthesizes both the spawn and age-composition data allows some compensation in stock forecasts, particularly when there are only a few years of biased spawn data. For simulations that included both the bio-sampling and spawn survey data quality effects, stock forecast estimates were more strongly affected and had larger negative biases than when only reduced spawn survey data quality was simulated.

Results of the simulations are primarily intended for illustrative purposes and do not quantify the direct effect of various levels of sampling effort on stock assessments and management advice. Evaluation of the trade-offs between sampling effort (and associated costs) and stock assessment precision and accuracy is beyond the scope of this analysis. Analyses to pursue those objectives would require development of a fully prescribed operating model.

## **Working Paper P2007-03: Ecology of the British Columbia herring roe fishery: Part one - Spatial and temporal distribution of the fishery**

*D.E. Hay, P.B. McCarter, and K.S. Daniel*

The British Columbia herring roe fishery is conducted near inter-and sub-tidal spawning locations. The areas open to fishing may change slightly each year but, since the late 1970's, always occur *within* the much larger 'Assessment Areas' used for determination of spawning stock biomass. We used a GIS approach to construct a database on the geographical location and total area (km<sup>2</sup>) of annual fishery openings for both gears used in the fishery: gill nets and purse seines. We include data on the dates, time-of-day and durations of fishery openings (hours). The BC roe fishery is conservative, taking a maximum of 20 percent of the spawning biomass in any of the five major Assessment Areas. However the Assessment Areas are large and may contain a number of different spawning and fishing sites. The Assessment Areas are divisible into 'Statistical Areas' that are further divisible into 'Sub-Management Areas' or SMA's. As a rough approximation, each Assessment Area consists of about 10-20 SMA's. We examine temporal (dates and duration) and geographical variation in fishing. In general, most changes in timing and duration reflect policy changes in fishery management, not changes in herring biology or population dynamics. Our analyses distinguished between sites of fishing opportunities (called 'openings') and 'catch' locations, although these are related. In most years the fishery is conducted in less than twenty percent of the available area of the British Columbia coast, a much smaller area than the sum of the 'Assessment Areas'. The identification of the fishing locations is useful for coastal zone planning, consideration of potential Marine Protected Areas and also to provide a basis for avoiding conflicts with other fisheries, mariculture, and other shore-based activity.

This report is the first of a two-part series that examine the impacts of the BC roe herring fishery, describe the spatial and temporal activity of the fishery, and comments on structural changes that have occurred in the development of the fishery. The title of the second part is "Potential impacts on the spatial and temporal distribution of herring spawn: examination of the serial depletion hypothesis". This second part examines the issue of potential impacts of the roe fishery on herring spawn distribution and the management implications of the fishery for population structure. Although both reports are related, both were prepared to be used as 'stand alone' documents. Both contain extensive Appendix Tables.

**Working Paper P2007-03: Ecology of the British Columbia herring roe fishery: Part two - Potential impacts on the spatial and temporal distribution of herring spawn: examination of the serial depletion hypothesis**

*D.E. Hay, P.B. McCarter, and K.S. Daniel*

The British Columbia herring roe fishery is conducted on, or near inter- and sub-tidal spawning locations. It is a conservative herring fishery, taking a maximum of 20 percent of the spawning biomass in any of the five major 'Assessment Areas' in the Province. The assessment areas are large and may contain a number of different spawning and fishing sites. As a rough approximation, each assessment area consists of about 5-10 smaller geographical units, called Sections, a geographical unit used almost exclusively by the Fisheries and Oceans Canada Science Branch. In most years the fishery may be concentrated in a few Sections, so the Section-specific catch rates sometimes exceed twenty percent. Some observers suggest that these localized intense fisheries may lead to serial depletion of unique spawning components of the populations. This report addresses the hypothesis that, since its inception in the early 1970's, the herring roe fishery has led to systematic reduction in the number of distinct spawning locations. We examined the spatial-temporal patterns of spawning by comparing the frequency of section-specific spawning between two periods: a 31-year period between 1940 and 1970 (prior to the roe fishery, when catch rates were very high in most years) and a 36 year period corresponding to the roe fishery, from its initiation to the present. There was no evidence of a decrease in the frequency of spawning between the two periods. We also compared the temporal pattern of catch and spawn data for each of the approximately 100 geographic Sections. Using the annual assessment estimates (from 2006) we scaled spawn data units to metric tonnes and then examined the temporal history of spawn and catch in each Section. We found three instances where a cessation of spawning coincided approximately with a roe fishery. In each instance, however, more detailed analyses showed that none represented a clear example of depletion following a fishery. Instead these examples represented fisheries that occurred in locations where spawning activity was not consistent in time or space in years prior to the fishery, or where the geographic dimensions of the Section were exceptionally small. The geographical range of each Section is arbitrary, and not based on biology. We show that in one case, in the central coast of BC, the simplest explanation is a slight shift in spawning between adjacent spawning sites in Sections that are much smaller than others on the BC coast. The report concludes that there is no evidence to support the hypothesis of serial depletion during the roe fishery, but we note that several of the herring assessment areas consist of geographical spawn distribution patterns that may represent more population structure than is assumed to exist in the present assessment methodology. In these instances we discuss the tradeoffs and associated risks between the managerial and logistical benefits and of taking the TAC in a fewer number of larger 'openings' in small areas (few Sections) versus the preferable biological goal of spreading the TAC and fishing effort to a larger number of smaller openings over

a broad geographic area (many Sections).

This report is the second of a two-part series that examines the impact of roe the BC roe herring fishery on herring spawning. The title of Part One is “Spatial and temporal distribution of the fishery”. Part one also discusses the technical limitations to geo-referencing herring roe catch data and comments on structural changes that have occurred in the development of the fishery. This report (Part two) focuses on the issue of potential impacts of the roe fishery on herring spawn distribution and the management implications of the fishery for population structure. Although both reports are related, both were prepared to be used as ‘stand alone’ documents. Both contain extensive Appendix Tables.

## **APPENDIX 2: PSARC Pelagic Subcommittee Meeting Agenda**

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### **DRAFT AGENDA PSARC PELAGICS SUBCOMMITTEE MEETING September 5-6, 2007 Seminar Room - Pacific Biological Station Nanaimo, BC**

#### **Wednesday, September 5**

- 9:00 Introductions and Opening Remarks.
- 9:30-12:00 Review of Working Paper: *Annual herring assessment and recruitment forecasts*
- 12:00 Lunch
- 1:00-3:00 Continue review of Working Paper: *Annual herring assessment and recruitment forecasts*
- 3:00-4:00 If time permits, review of Working Paper: *Investigation of potential impacts of reductions in spawn surveys and bio-sampling program effort on herring stock assessments and management advice*

#### **Thursday, September 6**

- 9:00-12:00 Continue review of Working Paper: *Investigation of potential impacts of reductions in spawn surveys and bio-sampling program effort on herring stock assessments and management advice*
- 12:00-1:00 Lunch
- 1:00-4:00 Review of Working paper: *Ecology of herring fishery – with focus on evidence – or lack of – on serial depletion*

### APPENDIX 3: List of Attendees & Reviewers

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Subcommittee Chair:  
PSARC Chair:

Mark Potyrala  
Al Cass

| <b>NAME</b>            | <b>Wednesday</b> | <b>Thursday</b> |
|------------------------|------------------|-----------------|
| Bolton, John           | X                | X               |
| Chalmers, Dennis       | X                | X               |
| Christensen, Line Bang | X                | X               |
| Gale, Rupert           | X                | X               |
| Haist, Vivian          | X                |                 |
| Hay, Doug              | X                | X               |
| Jones, Russ            | X                | X               |
| Lewis, Russell         | X                | X               |
| Moody, Reg             | X                | X               |
| Newman, Earl           | X                | X               |
| Safarik, Ed            | X                | X               |
| Taylor, Greg           | X                | X               |
| Wallace, Scott         | X                | X               |
| Webb, Lloyd            | X                |                 |
| Witzke, James          | X                | X               |
|                        |                  |                 |
| <b>DFO MEMBERS</b>     |                  |                 |
| Cass, Al               | X                | X               |
| Daniel, Kristen        | X                | X               |
| Flostrand, Linnea      | X                | X               |
| Fort, Chuck            | X                | X               |
| Gill, Harpreet         | X                | X               |
| Hamer, Lorena          | X                | X               |
| McCarter, Bruce        | X                | X               |
| Potyrala, Mark         | X                | X               |
| Schweigert, Jake       | X                | X               |
| Spence, Brenda         | X                | X               |
| Tanasichuk, Ron        | X                | X               |
| Therriault, Tom        | X                | X               |
| Thomas, Greg           | X                |                 |
| Thompson, Matt         | X                | X               |
| Wong, Cindy            | X                | X               |



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.

|                        |                                   |
|------------------------|-----------------------------------|
| Benson, Ashleen        | Simon Fraser University           |
| Christensen, Line Bang | University of British Columbia    |
| Gustafson, Rick        | National Marine Fisheries Service |
| Rusch, Brian           | Fisheries and Oceans Canada       |
| Tanasichuk, Ron        | Fisheries and Oceans Canada       |

**Appendix 4: Criteria for assessment of stock status in 2007 and yield recommendation for 2008: Queen Charlotte Islands**

| Criteria  | Status  |              |                   |              |          |       |   |        |       |
|---|---|--------------|-------------------|--------------|----------|-------|---|--------|-------|
| <p><b>1. Data Quality</b></p> <p>a) All catch reported<br/>b) All spawn surveyed</p> <p>c) Good sample coverage</p>   | <p>a) No commercial harvest in 2007<br/>b) Yes, only 7 km surveyed by divers, rest surface surveyed<br/>c) No. Limited to 6 samples</p>   |              |                   |              |          |       |   |        |       |
| <p><b>2. Stock status and trends</b></p> <p>a) HCAM<br/>b) Spawn indices</p>  | <p>a) Slight increase from 2005 and 2006<br/>b) Difficult to compare due to change in survey protocol. Length and width increased slightly in 2007.</p>   |              |                   |              |          |       |   |        |       |
| <p><b>3. Perceptions of Stock Status</b></p> <p>a) Charter skippers comments</p> <p>b) Management staff</p>   | <p>a) Spawn slightly better than past few years and improving in 2E and 2W over past few years. Difficult to cover entire area adequately with single vessel.<br/>b) Abundance estimate close enough to cutoff that projections should be based on dive surveys, not surface surveys, in future. Abundance estimate does seem to reflect observed abundance.</p>                                  |              |                   |              |          |       |   |        |       |
| <p><b>4. Recruitment</b></p> <p>a) HCAM</p>   | <p>a) Recruitment poor in 2005, and average in 2006, and 2007</p>   |              |                   |              |          |       |   |        |       |
| <p><b>5. Forecast Abundance</b></p> <p>Recruitment Assumption</p> <ul style="list-style-type: none"> <li>• Poor</li> <li>• Average</li> <li>• Good</li> </ul> | <table border="0"> <tr> <td>a) Abundance</td> <td>Potential Harvest</td> </tr> <tr> <td style="text-align: center;"><b>6 891</b></td> <td style="text-align: center;"><b>0</b></td> </tr> <tr> <td style="text-align: center;">8 869</td> <td style="text-align: center;">0</td> </tr> <tr> <td style="text-align: center;">15 191</td> <td style="text-align: center;">3 038</td> </tr> </table> | a) Abundance | Potential Harvest | <b>6 891</b> | <b>0</b> | 8 869 | 0 | 15 191 | 3 038 |
| a) Abundance  | Potential Harvest   |              |                   |              |          |       |   |        |       |
| <b>6 891</b>  | <b>0</b>  |              |                   |              |          |       |   |        |       |
| 8 869   | 0   |              |                   |              |          |       |   |        |       |
| 15 191  | 3 038   |              |                   |              |          |       |   |        |       |
| <p><b>6. Additional Information</b></p>   |   |              |                   |              |          |       |   |        |       |
| <p><b>7. Cutoff</b></p>   | <p><b>10 700 tonnes</b></p>   |              |                   |              |          |       |   |        |       |
| <p><b>8. Yield Recommendation</b></p>   | <p>No yield</p>   |              |                   |              |          |       |   |        |       |

**Appendix 5: Criteria for assessment of stock status in 2007 and yield recommendation for 2008: Prince Rupert District**

| Criteria  | Status  |              |                   |        |       |               |              |        |       |
|---|---|--------------|-------------------|--------|-------|---------------|--------------|--------|-------|
| <p><b>1. Data Quality</b></p> <p>a) All catch reported<br/>b) All spawn surveyed</p> <p>c) Good sample coverage</p>   | <p>a) Yes<br/>b) No. Constant problem throughout survey with spawn hatching. Missed Finlayson Island spawn 4-5 km long. Most of Area 3 covered at 1 transect every 350m. Rest of Areas 3 and 4 covered at transects every 700m or more. Significant hatching Big Bay South. Area 5 good coverage with some hatching on 900m on Dolphin Is. One transect of active spawn on Gurd Island not surveyed.<br/>c) Yes, 24 samples</p> |              |                   |        |       |               |              |        |       |
| <p><b>2. Stock status and trends</b></p> <p>a) HCAM<br/>b) Spawn indices</p>  | <p>a) Steady decline 2003-2006. 2006 and 2007 similar.<br/>b) Decline since 2003, with marked decline in 2006, and an increase in 2007</p>  |              |                   |        |       |               |              |        |       |
| <p><b>3. Perceptions of Stock Status</b></p> <p>a) Charter skippers comments<br/>b) Management staff</p>  | <p>a) Stocks were not strong in Area 5, but good in Area 4. Felt Area 4 coverage was adequate but not so in Area 5.<br/>b) Concern that not all spawn was adequately surveyed. Concern over reduction in management presence, most notably in Area 5.</p>   |              |                   |        |       |               |              |        |       |
| <p><b>4. Recruitment</b></p> <p>a) HCAM</p>   | <p>a) Recruitment poor in 2004 and 2006. Recruitment average in 2005 and 2007.</p>  |              |                   |        |       |               |              |        |       |
| <p><b>5. Forecast Abundance</b></p> <p>a) Recruitment Assumption</p> <ul style="list-style-type: none"> <li>• Poor</li> <li>• <b>Average</b></li> <li>• Good</li> </ul> | <table border="0"> <tr> <td>a) Abundance</td> <td>Potential Harvest</td> </tr> <tr> <td>15 757</td> <td>2 815</td> </tr> <tr> <td><b>20 072</b></td> <td><b>4 014</b></td> </tr> <tr> <td>29 834</td> <td>5 967</td> </tr> </table>   | a) Abundance | Potential Harvest | 15 757 | 2 815 | <b>20 072</b> | <b>4 014</b> | 29 834 | 5 967 |
| a) Abundance  | Potential Harvest   |              |                   |        |       |               |              |        |       |
| 15 757  | 2 815   |              |                   |        |       |               |              |        |       |
| <b>20 072</b>   | <b>4 014</b>  |              |                   |        |       |               |              |        |       |
| 29 834  | 5 967   |              |                   |        |       |               |              |        |       |
| <p><b>6. Additional Information</b></p>   | <p><b>12 100 tonnes</b></p>   |              |                   |        |       |               |              |        |       |
| <p><b>7. Cutoff</b></p>   | <p>Maximum potential yield of 4014 tonnes.</p>  |              |                   |        |       |               |              |        |       |
| <p><b>8. Yield Recommendation</b></p>   | <p>Maximum potential yield of 4014 tonnes.</p>  |              |                   |        |       |               |              |        |       |

**Appendix 6: Criteria for assessment of stock status in 2007 and yield recommendation for 2008: Central Coast**

| Criteria  | Status  |              |                   |               |          |        |   |        |       |
|---|---|--------------|-------------------|---------------|----------|--------|---|--------|-------|
| <p><b>1. Data Quality</b></p> <p>a) All catch reported</p> <p>b) All spawn surveyed</p> <p>c) Good sample coverage</p>  | <p>a) Yes</p> <p>b) No. Good coverage, but missed 1.5 km spawn at Wilby Point (bad weather).</p> <p>c) Yes, 26 samples</p>  |              |                   |               |          |        |   |        |       |
| <p><b>2. Stock status and trends</b></p> <p>a) HCAM</p> <p>b) Spawn indices</p>   | <p>a) Decreasing since 2004</p> <p>b) Decrease since 2002, 2006 and 2007 similar</p>  |              |                   |               |          |        |   |        |       |
| <p><b>3. Perceptions of Stock Status</b></p> <p>a) Charter skippers comments</p> <p>b) Management staff</p>   | <p>a) Stocks down in general. Fish dispersed over the area. Difficult to cover entire area with single vessel when there is a fishery.</p> <p>b). Stocks low in Central Coast</p>   |              |                   |               |          |        |   |        |       |
| <p><b>4. Recruitment</b></p> <p>a) HCAM</p>   | <p>a) Recruitment good in 2005 and poor in 2006 and 2007.</p>   |              |                   |               |          |        |   |        |       |
| <p><b>5. Forecast Abundance</b></p> <p>a) Recruitment Assumption</p> <ul style="list-style-type: none"> <li>• <b>Poor</b></li> <li>• Average</li> <li>• Good</li> </ul> | <table border="0"> <tr> <td>a) Abundance</td> <td>Potential Harvest</td> </tr> <tr> <td><b>11 124</b></td> <td><b>0</b></td> </tr> <tr> <td>15 634</td> <td>0</td> </tr> <tr> <td>27 397</td> <td>5 479</td> </tr> </table> | a) Abundance | Potential Harvest | <b>11 124</b> | <b>0</b> | 15 634 | 0 | 27 397 | 5 479 |
| a) Abundance  | Potential Harvest   |              |                   |               |          |        |   |        |       |
| <b>11 124</b>   | <b>0</b>  |              |                   |               |          |        |   |        |       |
| 15 634  | 0   |              |                   |               |          |        |   |        |       |
| 27 397  | 5 479   |              |                   |               |          |        |   |        |       |
| <p><b>6. Additional Information</b></p>   |   |              |                   |               |          |        |   |        |       |
| <p><b>7. Cutoff</b></p>   | <p><b>17 600 tonnes</b></p>   |              |                   |               |          |        |   |        |       |
| <p><b>8. Yield Recommendation</b></p>   | <p>No yield</p>   |              |                   |               |          |        |   |        |       |

**Appendix 7: Criteria for assessment of stock status in 2007 and yield recommendation for 2008: Strait of Georgia**

| Criteria   | Status   |              |                   |               |               |        |        |         |       |
|--|--|--------------|-------------------|---------------|---------------|--------|--------|---------|-------|
| <p><b>1. Data Quality</b></p> <p>a) All catch reported<br/>b) All spawn surveyed</p>   | <p>a) Yes<br/>b) No. Significant hatching problems. Missed surveying early Parksville and Hornby Island spawns. Spawns north of Qualicum Beach surveyed 1 transect every 700m. Area 17 completely surveyed.</p>                                      |              |                   |               |               |        |        |         |       |
| <p>c) Good sample coverage</p>   | <p>c) Yes, 104 samples</p>   |              |                   |               |               |        |        |         |       |
| <p><b>2. Stock status and trends</b></p> <p>a) HCAM<br/>b) Spawn indices</p>   | <p>a) Decline from peak in 2003<br/>b) Decline from peak in 2003</p>   |              |                   |               |               |        |        |         |       |
| <p><b>3. Perceptions of Stock Status</b></p> <p>a) Charter skippers comments<br/>b) Management staff</p>   | <p>a) Stocks down and spawn was narrow. Overall the spawn was below average.<br/>b) Good over-flight coverage in Areas 14, 17 and 18. Stocks down and spawn was narrow. Overall the spawn was below average. Weak spawning pattern was observed.</p> |              |                   |               |               |        |        |         |       |
| <p><b>4. Recruitment</b></p> <p>a) HCAM<br/>b) Offshore Trawl Survey</p>   | <p>a) Poor to average in 2006 and average in 2007 (Model has tendency to over-forecasted returning biomass in recent years).<br/>b) Poor (Lowest forecast since forecasting began in 1998)</p>   |              |                   |               |               |        |        |         |       |
| <p><b>5. Forecast Abundance</b></p> <p>a) Recruitment Assumption</p> <ul style="list-style-type: none"> <li>• Poor</li> <li>• Average</li> <li>• Good</li> </ul> | <table border="0"> <tr> <td>a) Abundance</td> <td>Potential Harvest</td> </tr> <tr> <td><b>67 350</b></td> <td><b>13 470</b></td> </tr> <tr> <td>85 484</td> <td>17 097</td> </tr> <tr> <td>104 843</td> <td>20969</td> </tr> </table>               | a) Abundance | Potential Harvest | <b>67 350</b> | <b>13 470</b> | 85 484 | 17 097 | 104 843 | 20969 |
| a) Abundance   | Potential Harvest  |              |                   |               |               |        |        |         |       |
| <b>67 350</b>  | <b>13 470</b>  |              |                   |               |               |        |        |         |       |
| 85 484   | 17 097   |              |                   |               |               |        |        |         |       |
| 104 843  | 20969  |              |                   |               |               |        |        |         |       |
| <p><b>6. Additional Information</b></p>  | <p>Georgia Strait juvenile survey in 2005 lowest observed by order of magnitude since survey started in 1991.</p>  |              |                   |               |               |        |        |         |       |
| <p><b>7. Cutoff:</b></p>   | <p><b>21 200 tonnes</b></p>  |              |                   |               |               |        |        |         |       |
| <p><b>8. Yield Recommendation</b></p>  | <p>Maximum potential yield of 13470 tonnes</p>   |              |                   |               |               |        |        |         |       |

**Appendix 8: Criteria for assessment of stock status in 2007 and yield recommendation for 2008: West Coast of Vancouver Island**

| Criteria  | Status  |           |                   |               |          |        |      |        |      |
|---|---|-----------|-------------------|---------------|----------|--------|------|--------|------|
| <p><b>1. Data Quality</b></p> <p>a) All catch reported</p> <p>b) All spawn surveyed</p> <p>c) Good sample coverage</p> <p><b>2. Stock status and trends</b></p> <p>a) HCAM</p> <p>b) Spawn indices</p> <p><b>3. Perceptions of Stock Status</b></p> <p>a) Charter skippers comments</p> <p>b) Management staff</p> <p><b>4. Recruitment</b></p> <p>a) HCAM</p> <p>b) Offshore trawl survey</p> <p><b>5. Forecast Abundance</b></p> <p>a) Recruitment Assumption</p> <ul style="list-style-type: none"> <li>• <b>Poor</b></li> <li>• Average*</li> <li>• Good</li> </ul> <p><b>6. Additional Information</b></p> <p><b>7. Cutoff</b></p> <p><b>8. Yield Recommendation</b></p> | <p>a) No commercial fishery in 2007. FSC fishery took place</p> <p>b) No. Most spawn surveyed in Areas 23 and 24. Late deep spawn in Area 23 not surveyed. Deep spawn found, but not surveyed in Area 25.</p> <p>c) No. Only collected 7 samples</p> <p>a) Decreasing since 2003</p> <p>b) Decline from 1999 and 2006 worst in time series. Slight increase in length in 2007</p> <p>a) Stock down overall. Herring and spawn were deep. Not able to assess deep spawn and not possible to cover area with single vessel.</p> <p>b) Herring and some spawn were found in the deep. Concern about single vessel not being able to provide adequate coverage of such a large area.</p> <p>a) Recruitment good in 2003, poor or average from 2004 to 2007. Based on retrospective performance of the model, the forecast may be optimistic.</p> <p>b) Poor (Lowest forecast since forecasting began in 1994)</p> <table border="0" data-bbox="873 1480 1331 1627"> <thead> <tr> <th>Abundance</th> <th>Potential Harvest</th> </tr> </thead> <tbody> <tr> <td><b>11 690</b></td> <td><b>0</b></td> </tr> <tr> <td>19 117</td> <td>317*</td> </tr> <tr> <td>35 418</td> <td>7083</td> </tr> </tbody> </table> <p>See discussion re: Model performance</p> <p><b>18 800 tonnes</b></p> <p>No yield</p> | Abundance | Potential Harvest | <b>11 690</b> | <b>0</b> | 19 117 | 317* | 35 418 | 7083 |
| Abundance   | Potential Harvest   |           |                   |               |          |        |      |        |      |
| <b>11 690</b>   | <b>0</b>  |           |                   |               |          |        |      |        |      |
| 19 117  | 317*  |           |                   |               |          |        |      |        |      |
| 35 418  | 7083  |           |                   |               |          |        |      |        |      |

**Appendix 9: Criteria for assessment of stock status in 2007 and yield recommendation for 2008: Minor stock Area 2W**

| Criteria  | Status  |              |                   |       |     |              |            |       |     |
|---|---|--------------|-------------------|-------|-----|--------------|------------|-------|-----|
| <p><b>1. Data Quality</b><br/> a) All catch reported<br/> b) All spawn surveyed<br/> c) Good sample coverage</p> <p><b>2. Stock status and trends</b><br/> a) HCAM<br/> b) Spawn indices</p> <p><b>3. Perceptions of Stock Status</b><br/> a) Charter skippers comments<br/> b) Management staff</p> <p><b>4. Recruitment</b><br/> a) HCAM</p> <p><b>5. Forecast Abundance</b><br/> Recruitment Assumption</p> <ul style="list-style-type: none"> <li>• Poor</li> <li>• <b>Average</b></li> <li>• Good</li> </ul> <p><b>6. Additional Information</b></p> <p><b>7. Cutoff</b></p> <p><b>8. Yield Recommendation</b></p> | <p>a) No commercial roe harvest in 2007. Some SOK activity.<br/> b) Yes, but all surface surveyed<br/> c) No. Limited to 6 samples</p> <p>a) Increasing in recent years<br/> b) Difficult to compare due to change in survey protocol. Length and width decreased.</p> <p>a) and b)<br/> As per 2 East comments above</p> <p>a) No recruitment forecast</p> <table border="0" data-bbox="883 1262 1463 1409"> <tr> <td>a) Abundance</td> <td>Potential Harvest</td> </tr> <tr> <td>2 252</td> <td>225</td> </tr> <tr> <td><b>2 444</b></td> <td><b>244</b></td> </tr> <tr> <td>4 198</td> <td>420</td> </tr> </table> <p>10 % harvest rule consistent with minor stocks</p> <p><b>No cutoff</b></p> <p>244 tonnes</p> | a) Abundance | Potential Harvest | 2 252 | 225 | <b>2 444</b> | <b>244</b> | 4 198 | 420 |
| a) Abundance  | Potential Harvest   |              |                   |       |     |              |            |       |     |
| 2 252   | 225   |              |                   |       |     |              |            |       |     |
| <b>2 444</b>  | <b>244</b>  |              |                   |       |     |              |            |       |     |
| 4 198   | 420   |              |                   |       |     |              |            |       |     |

**Appendix 10: Criteria for assessment of stock status in 2007 and yield recommendation for 2008: Minor stock Area 27**

| Criteria   | Status   |              |                   |       |     |              |            |       |     |
|--|--|--------------|-------------------|-------|-----|--------------|------------|-------|-----|
| <p><b>1. Data Quality</b><br/> a) All catch reported<br/> b) All spawn surveyed<br/> <br/> c) Good sample coverage</p>   | <p>a) Yes. No roe fishery but SOK activity<br/> b) No. Weather hampered survey. Insufficient dives and rake to properly document spawn bed.<br/> c) No, 5 SOK samples collected</p>  |              |                   |       |     |              |            |       |     |
| <p><b>2. Stock status and trends</b><br/> a) HCAM<br/> <br/> b) Spawn indices</p>  | <p>a) Relatively stable<br/> b) Slight increase</p>  |              |                   |       |     |              |            |       |     |
| <p><b>3. Perceptions of Stock Status</b><br/> a) Charter skippers comments<br/> <br/> b) Management staff</p>  | <p>a) No vessel in Area 27<br/> b) No Area 27-specific information</p>   |              |                   |       |     |              |            |       |     |
| <p><b>4. Recruitment</b><br/> a) HCAM</p>  | <p>a) No recruitment forecast</p>  |              |                   |       |     |              |            |       |     |
| <p><b>5. Forecast Abundance</b><br/> Recruitment Assumption<br/> <ul style="list-style-type: none"> <li>• Poor</li> <li>• <b>Average</b></li> <li>• Good</li> </ul> </p> | <table border="0"> <tr> <td>a) Abundance</td> <td>Potential Harvest</td> </tr> <tr> <td>2 606</td> <td>261</td> </tr> <tr> <td><b>2 743</b></td> <td><b>274</b></td> </tr> <tr> <td>3 593</td> <td>359</td> </tr> </table> | a) Abundance | Potential Harvest | 2 606 | 261 | <b>2 743</b> | <b>274</b> | 3 593 | 359 |
| a) Abundance   | Potential Harvest  |              |                   |       |     |              |            |       |     |
| 2 606  | 261  |              |                   |       |     |              |            |       |     |
| <b>2 743</b>   | <b>274</b>   |              |                   |       |     |              |            |       |     |
| 3 593  | 359  |              |                   |       |     |              |            |       |     |
| <p><b>6. Additional Information</b></p>  | <p>10 % harvest rule consistent with minor stocks</p>  |              |                   |       |     |              |            |       |     |
| <p><b>7. Cutoff</b></p>  | <p><b>No cutoff</b></p>  |              |                   |       |     |              |            |       |     |
| <p><b>8. Yield Recommendation</b></p>  | <p>274 tonnes</p>  |              |                   |       |     |              |            |       |     |