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**Proceedings of the PSARC
Pelagic Subcommittee Meeting**

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

**September 7-8, 2005
Nanaimo, BC**

**Thomas Therriault
Pelagic Subcommittee Chair**

Fisheries & Oceans Canada
Pacific Scientific Advice Review Committee
Pacific Biological Station
Nanaimo, British Columbia V9T 6N7

October 2005

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200, rue Kent Street
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K1A 0E6

<http://www.dfo-mpo.gc.ca/csas/>

CSAS@DFO-MPO.GC.CA



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PACIFIC SCIENTIFIC ADVICE REVIEW COMMITTEE (PSARC) PELAGIC SUBCOMMITTEE MEETING

SUMMARY	ii
Working Paper P2005-03: Using an Eulachon Indicator Framework to Provide Advice on Fraser River Harvest Opportunities for 2006.....	ii
Working Paper P2005-04: An Assessment Framework for Pacific Herring (<i>Clupea pallasii</i>) stocks in British Columbia	ii
SOMMAIRE	iv
INTRODUCTION	1
DETAILED COMMENTS FROM THE REVIEWS	1
Working Paper P2005-03: Using an Eulachon Indicator Framework to Provide Advice on Fraser River Harvest Opportunities for 2006.....	1
Working Paper P2005-04: An Assessment Framework for Pacific Herring (<i>Clupea pallasii</i>) stocks in British Columbia.	4
APPENDIX 1: WORKING PAPER SUMMARIES	8
APPENDIX 2: PSARC PELAGIC SUBCOMMITTEE MEETING AGENDA SEPTEMBER 7-8, 2005.....	11
APPENDIX 3: LIST OF ATTENDEES & REVIEWERS.....	12
APPENDIX 4. CRITERIA FOR ASSESSMENT OF STOCK STATUS IN 2005 AND YIELD RECOMMENDATION FOR 2006: QUEEN CHARLOTTE ISLANDS.....	13
APPENDIX 5. CRITERIA FOR ASSESSMENT OF STOCK STATUS IN 2005 AND YIELD RECOMMENDATION FOR 2006: PRINCE RUPERT DISTRICT.....	14
APPENDIX 6. CRITERIA FOR ASSESSMENT OF STOCK STATUS IN 2005 AND YIELD RECOMMENDATION FOR 2006: CENTRAL COAST	15
APPENDIX 7. CRITERIA FOR ASSESSMENT OF STOCK STATUS IN 2005 AND YIELD RECOMMENDATION FOR 2006: STRAIT OF GEORGIA.....	16
APPENDIX 8. CRITERIA FOR ASSESSMENT OF STOCK STATUS IN 2005 AND YIELD RECOMMENDATION FOR 2006: WEST COAST OF VANCOUVER ISLAND	17

SUMMARY

The Pacific Scientific Advice Review Committee (PSARC) Pelagic Subcommittee met September 7-8, 2005 at the Pacific Biological Station, Nanaimo, British Columbia to review scientific information relating to British Columbia herring and Fraser River eulachon.

Working Paper P2005-03: Using an Eulachon Indicator Framework to Provide Advice on Fraser River Harvest Opportunities for 2006

Although considered a relatively minor fishery since the 1950s, the Fraser River eulachon fishery has an important cultural significance, especially to local First Nations. In 1993/1994, a sudden and synchronous population decline among several major eulachon-bearing rivers and a continued low returning biomass to the Fraser River prompted a review of research and management considerations. A traffic light approach for making management decisions was adopted in 2003. After compiling and interpreting each of four indicators, each of the four indicators suggests conservation concerns are warranted, especially the SSB estimate that has been below a response point of 150 tonnes in each of the past two years. In fact, the 2005 SSB estimate was only 16 tonnes. Other indicators also suggest concern including record low catches in the test fishery (less than 900 pieces), no or negligible commercial catches in the Columbia or Fraser Rivers in 2005 due to low abundance, and continued low abundance in offshore waters. Thus, the Subcommittee recommended that all eulachon returning to the Fraser River in 2006 should be allowed to spawn to allow stock rebuilding and therefore recommend no harvest of Fraser River eulachon in 2006. Also, we suggest in light of these extremely low indicators that careful consideration be given to any potential harvest opportunities in 2007.

Working Paper P2005-04: An Assessment Framework for Pacific Herring (*Clupea pallasii*) stocks in British Columbia

The assessment framework for British Columbia Pacific herring is described including assumptions about stock structure, available biological data such as total catch and biological sampling information. The methodology for converting spawn survey data into total estimated spawning biomass and derivation of the spawn index is described. The age-structured model formulation and assumptions are presented together with some model diagnostics and residual plots. The rationale and process for developing abundance forecasts and the harvest policy and decision rules for determining allowable harvest levels are described and presented.

Working Paper P2005-04 ANNEX: A stock assessment for British Columbia herring in 2005 and forecasts of the potential catch in 2006

The five major herring stocks in BC are managed by a fixed harvest rate policy in conjunction with a fishing threshold or cutoff level. Cutoff levels are set at 25% of the estimated unfished equilibrium biomass. Biomass forecasts are provided for three levels of recruitment assumption: poor, average and good. Decision rules are provided for determining the appropriate recruitment assumption in the absence of additional information. An offshore mid-water trawl survey provides information to determine the appropriate recruitment strength assumptions for the West Coast Vancouver Island and Strait of Georgia stocks. Yield recommendations are set at 20% of the forecast annual biomass unless the forecast is near or below cutoff levels (in which case a modified harvest rule is used).

Assessments of major stocks in 2005 were conducted using the age-structured model adopted for the 2003 assessment (see framework paper above). The paper was accepted with minor revisions and the Subcommittee accepted yield recommendations as outlined in Appendices 4-8 for 2006.

The estimated harvestable surplus in 2006 (20% of the 2006 forecast herring run) based on forecast abundance to the five assessment regions is 32,190 tonnes for the BC coast assuming no removals from the Queen Charlotte Island and West Coast Vancouver Island stocks which are both below their respective Cutoff levels.

SOMMAIRE

Le sous-comité des poissons pélagiques du Comité d'examen des évaluations scientifiques du Pacifique (CEESP) s'est réuni les 7 et 8 septembre 2005 à la station de biologie du Pacifique de Nanaimo (Colombie-Britannique) afin d'examiner des données scientifiques sur le hareng de la Colombie-Britannique et sur l'eulakane du fleuve Fraser.

Document de travail P2005-03 : Utilisation d'un cadre d'indicateurs de l'eulakane pour donner des avis sur les possibilités de pêche dans le Fraser pour 2006

Bien qu'elle soit considérée comme une activité d'assez peu d'envergure depuis les années 1950, la pêche de l'eulakane du fleuve Fraser a une importance culturelle notable, surtout pour les Premières nations locales. En 1993-1994, une baisse soudaine et synchrone des populations dans plusieurs des principaux cours d'eau où vivent des eulakanes et les retours continuellement faibles de la biomasse dans le Fraser ont suscité la tenue d'un examen des facteurs de recherche et de gestion. En 2003, la technique des feux de circulation a été adoptée pour la prise des décisions de gestion. Après compilation et interprétation de quatre indicateurs, on s'est rendu compte que chacun de ceux-ci confirmait que les inquiétudes à l'égard de la conservation étaient justifiées, surtout l'estimation de la biomasse génitrice, qui avait été inférieure à un point d'intervention de 150 tonnes au cours de chacune des deux années antérieures. De fait, l'estimation de la biomasse génitrice de 2005 était de seulement 16 tonnes. Les autres indicateurs semblent aussi soulever des préoccupations, notamment les prises les plus basses jamais enregistrées au cours de la pêche expérimentale (moins de 900 captures), les prises commerciales inexistantes ou négligeables dans les fleuves Columbia ou Fraser en 2005 à cause de la faible abondance, et une abondance continuellement faible en mer. Ainsi, le Sous-comité recommande de laisser frayer tous les eulakanes qui retournent dans le Fraser en 2006, afin de permettre au stock de se rétablir et, par conséquent, il recommande d'interdire les captures d'eulakane dans le Fraser en 2006. de plus, nous proposons, compte tenu de ces indicateurs extrêmement faibles d'examiner avec soin toute possibilité de pêche éventuelle en 2007.

Document de travail P2005-04: Cadre d'évaluation pour les stocks de hareng du Pacifique (*Clupea pallasii*) en Colombie-Britannique

On donne une description du cadre d'évaluation du hareng du Pacifique en Colombie-Britannique, ainsi que des hypothèses au sujet de la structure du stock, des données biologiques disponibles, par exemple sur le total des prises et l'échantillonnage biologique. La méthode utilisée pour la conversion des données issues du relevé de la ponte en une estimation de la biomasse génitrice et une déduction de l'indice de frai est également décrite. On présente les formules et les hypothèses utilisées pour le modèle de la composition par âge, ainsi que certains des diagnostics et les positions résiduelles du modèle. On expose aussi la justification et le processus d'établissement des prévisions d'abondance, ainsi que la politique de pêche et les règles décisionnelles qui déterminent le niveau de captures autorisé.

Document de travail P2005-04 ANNEXE : Évaluation des stocks de hareng de la Colombie-Britannique en 2005 et prévisions des prises potentielles en 2006

Les cinq principaux stocks de hareng de la C.-B. sont gérés selon une politique de taux de capture fixe, en association avec un seuil de référence ou niveau limite. Les niveaux limites sont fixés à 25 % de la biomasse à l'équilibre non pêchée. Les prévisions de la biomasse sont présentées pour trois hypothèses de recrutement : faible, moyen et bon. On expose les règles décisionnelles permettant de déterminer l'hypothèse de recrutement appropriée en l'absence d'information additionnelle. Un relevé au chalut pélagique en mer fournit des données qui servent à déterminer les hypothèses appropriées de recrutement pour les stocks de la côte ouest de l'île de Vancouver et du détroit de Georgia. Les recommandations de rendement sont établies à 20 % des prévisions de la biomasse annuelle à moins que les prévisions soient près des niveaux limites ou y soient inférieures (dans ce cas, on se sert d'une règle de pêche modifiée).

Les évaluations des principaux stocks en 2005 ont été effectuées à l'aide d'un modèle de la composition selon l'âge adopté pour l'évaluation de 2003 (voir le document sur le cadre ci-dessus). Le document a été accepté avec quelques révisions mineures et le Sous-comité a accepté les recommandations sur le rendement établies dans les annexes 4-8 pour 2006.

Le surplus exploitable estimatif en 2006 (20 % des prévisions de la remonte de hareng de 2006) établi selon les prévisions d'abondance dans les cinq régions d'évaluation est de 31 190 tonnes pour la côte de la C.-B. en supposant qu'il n'y ait aucun prélèvement d'individus des stocks des îles Reine-Charlotte et de la côte ouest de l'île de Vancouver qui sont inférieurs à leur niveau limite respectif.

INTRODUCTION

The PSARC Pelagic Subcommittee met September 7-8, 2005 at the Pacific Biological Station in Nanaimo, British Columbia. External participants from industry and First Nations attended. The Subcommittee Chair, T. Therriault, 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 PSARC chair, A. Cass, provided a brief overview of the “evolving” PSARC process that is meant to ensure more open participation by those attending the meetings. Also, the revamped process is intended to provide a more streamlined process for assessments, especially mature assessment frameworks such as Pacific herring. For these mature assessments, a framework document is prepared and reviewed with the intent of re-review approximately every five years unless substantial changes are made in the interim. Annually, scientific advice will be provided in the form of a Science Advisory Report. This will reduce the annual burden related to full assessments for both authors and reviewers.

The Subcommittee reviewed two Working Papers. The Working Paper summaries are presented 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 8 contain stock specific yield recommendations.

DETAILED COMMENTS FROM THE REVIEWS

Working Paper P2005-03: Using an Eulachon Indicator Framework to Provide Advice on Fraser River Harvest Opportunities for 2006

T.W. Therriault and P.B. McCarter

This paper was accepted with minor revisions.

Subcommittee Discussion

The Subcommittee was alarmed at the state of Fraser River eulachon and asked for the status of eulachon stocks coastwide. It was noted that a status report is being prepared for COSEWIC by D. Hay with a draft expected sometime late in 2005. It is possible that eulachon populations in the Central Coast and the Fraser River could be recommended for listing. Based on a recent genetic analysis, it appears that there may be several designatable units for eulachon in BC. Further, it was noted that currently, DFO does not have any monitoring efforts for eulachon on rivers other than the Fraser River. This could pose future challenges under SARA and the Subcommittee discussed the need for better science-based information for other BC eulachon populations.

Although not an indicator, one reviewer raised the continued concern about eulachon bycatch, especially in shrimp trawl fisheries. It was recommended that

discussion of eulachon bycatch be included in the revised paper. Although not included in the paper, the Subcommittee discussed the merits of bycatch reduction devices. The Subcommittee concluded that there is little Science can say about bycatch reduction devices without further study. Furthermore, the Subcommittee felt this was a management issue, especially for the shrimp trawl fishery from which these claims arise. Clearly, if conservation is an issue continued reduction of bycatch is essential but the Subcommittee does not have the science-based information available to set an appropriate, defensible level. Because of the very short life cycle of eulachon (3 years) and the multiple age classes encountered in offshore waters (age-1+ and age-2+), it is imperative to understand bycatch in terms of "adult equivalents". The Subcommittee noted the potential dilemma of a zero harvest for Fraser River eulachon, including First Nations, and the allocation of eulachon as bycatch in the shrimp trawl fishery.

The Subcommittee discussed the usefulness of the four indicators. The authors noted that the egg and larval survey in the Fraser River provides the most meaningful information with respect to assessment and provision of advice. Although not a forecast of abundance, this indicator provides a quantitative measure of eulachon spawning stock biomass following the spawning season. The offshore biomass index from the shrimp trawl survey is confounded by mixed stock concerns and age class differences and has not shown significant correlation to Fraser River eulachon returns. Recent genetic analysis of an offshore sample collected from the West Coast of Vancouver Island in 2000, indicated a ratio of Fraser River to Columbia River eulachon was about 40:60. However, how stable these ratios remain from year to year or over larger spatial scales remain unknown. Furthermore, it is unclear if the Fraser River and Columbia River populations have the same population dynamics. The Subcommittee agreed with the authors and reviewers that the Columbia River commercial catch as an indicator is not very useful. The Columbia River fishery might provide some indication of coastwide abundance but has little utility as an indicator. Similarly, the test fishery was intended to provide management with an in-season assessment tool and is not a preseason indicator.

The Subcommittee discussed the meaning/basis of the Response Points discussed in the working paper. The authors noted the Response Points were set in previous documents but agreed to provide more background in the revisions to the Working Paper. These Response Points differ from Action Levels commonly used in Fisheries Management. Action Levels *per se* were developed in the 1990s by fisheries managers as guidelines to be used under various harvesting strategies. For example, in the Invertebrate PSARC process Action Levels are employed to allocate eulachon as bycatch to the shrimp trawl fishery. When the Action Level is exceeded a predetermined action is triggered. Since this working paper did not deal specifically with Action Levels for the shrimp trawl fishery this issue is beyond the scope of the current paper. It was noted that conservation reference points are to be provided for any assessment when possible but the authors indicated that such reference points have not been

developed for eulachon hence they are not considered in this paper. The Subcommittee concluded that both the Fraser River fishery and bycatch in shrimp trawl or other fisheries is a management issue and beyond comment by the Subcommittee.

The Subcommittee debated whether or not the current working paper represented a forecast. Some Subcommittee members felt that such inferences implied a forecast. The authors maintained that no forecasts are being made, rather a series of indicators are evaluated to provide advice to managers.

In 2003 the Subcommittee recommended a retrospective analysis be conducted in the future to provide a better understanding of the functionality of each of the indicators over time. Although the authors did not see the value of such an analysis, the authors did agree to include a retrospective analysis in the revised working paper. The authors reiterated that the egg and larval survey is currently the best indicator for Fraser River eulachon biomass and should be the primary indicator used to make science-based decisions with respect to Fraser River eulachon. Based on evidence in the Working Paper the Subcommittee concluded there was no evidence for a strong year class of eulachon in the Fraser River in 2006. Previously above average year classes in 1996 and 1999 dissipated with the weakest return noted for 2005. The 2003 run was weak and therefore there should be no expectation of a strong run in 2006.

Conservation concerns appear justified for Fraser River eulachon. Each of the four indicators presented was at or near historic lows. The strongest evidence lies in the egg and larval survey data that show Fraser River eulachon spawning biomass was 36 mt in 2004 and 16 mt in 2005, almost an order of magnitude lower than the 150 mt Response Point. All sources of mortality should be reduced, including directed removals and bycatch. Furthermore, since spawning stock biomass has been extremely poor over the past two years the 2006 year class represents the last cohort to allow stock rebuilding based on the 3-year eulachon life cycle.

Subcommittee Conclusions

1. This paper was accepted with revisions and the inclusion of a retrospective analysis and clarification of the Response Points. In addition, the retrospective analyses should be undertaken in future iterations to determine if the usefulness of indicators changes over time.
2. Based on the Subcommittee discussions, it is clear that the shrimp trawl fishery encounters Fraser River eulachon off the West Coast of Vancouver Island, which is an area of mixed stocks, and it is not clear what percentage of the WCVI eulachon are Fraser River eulachon. The Subcommittee would like to see additional research aimed at better understanding the mixed stock dynamic. Additional years of genetic analyses should be undertaken to determine if the mixing ratio of Fraser River and Columbia River eulachon is consistent from year to year. Also,

understanding how the age-specific biomass changes from year to year should be determined and this information may be used to further evaluate the usefulness of the offshore eulachon index.

3. Based on the data provided from the egg and larval survey, there is no evidence to suggest the 2006 Fraser River eulachon returns will be strong. This reiterates the conservation concern about Fraser River eulachon following two years of poor recruitment and priority needs to be directed to stock rebuilding.

Subcommittee Recommendations

1. The Subcommittee recommended the egg and larval survey in the Fraser River be continued in 2006.
2. Due to conservation concerns, the Subcommittee recommends suspension of the test fishery in 2006 since the test fishery is partially funded by landed eulachon.
3. Additional research should be directed at better understanding offshore eulachon dynamics, both with respect to stock mixing and age-specific biomass.
4. The Subcommittee recommends no eulachon removals in 2006. There should be no fishery in the Fraser River and other sources of mortality should be minimized.

Working Paper P2005-04: An Assessment Framework for Pacific Herring (*Clupea pallasii*) stocks in British Columbia.

J. Schweigert

This paper was accepted with minor revisions.

Subcommittee Discussion

Both reviewers were impressed with the herring assessment framework and had only minor concerns. This reflects the mature nature of this assessment framework that has been peer-reviewed several times with only minor changes identified.

A concern was raised that there is no mention of offshore work being done to forecast recruitment. It was noted that this should be included in the framework. Also, there was considerable discussion about including the rules for selecting a recruitment level in the absence of other science-based information. The rationale for this was documented in the Pelagic Subcommittee Advisory Document from 2004 along with a retrospective analysis of what would have resulted had the rule been applied in the past. The discussion centered on when it was appropriate to assume GOOD recruitment. Under a precautionary approach it is harder to justify a good recruitment assumption than to assume a poor or average recruitment assumption. However, it was pointed out that on the basis of the retrospective analysis good recruitment would only have been used

twice, both times following rapid stock increases. Some individuals were concerned that assuming good recruitment implied a harvest rate greater than 20% but the Subcommittee noted that as long as stock size is greater than the Cutoff Level, harvest rates for the five major herring stocks are set at a maximum of 20%. For stocks near Cutoff a modified harvest rule is implemented that effectively reduces harvest levels to less than 20%. Clearly forecasting recruitment continues to be an issue for Pacific herring. An offshore trawl survey is currently used to forecast recruitment strength for the two southern herring stocks (SOG and WCVI) but no such mechanism is in place for the three northern stocks (although an offshore trawl survey is under development). It was noted that a stock-recruitment relationship was a component of an earlier version of the age-structured model but it was dropped because of the difficulty of obtaining accurate recruitment forecasts. The author agreed that it would be useful to re-introduce the stock-recruit function to allow for future investigation of environmental and predation factors in the population assessments.

The Subcommittee had considerable discussions about the difference between removals by spawn on kelp operations and herring usage that could involve additional, unaccounted for removals. Currently, there is a calculation used for spawn on kelp use which takes into consideration egg removals and incorporates some estimate of mortality. However, stock assessment does not have good data on the number of fish seined for spawn on kelp operations, the number of herring held in pens or the associated long and short term mortality in the assessment framework. The assessment assumes a fixed tonnage for each SOK operation, but the values are based on weak and out-dated data. There was some discussion that the difference between the assumed and actual utilization could account for the lack of recovery of the QCI stock.

Working Paper P2005-04 Annex: A stock assessment for British Columbia herring in 2005 and forecasts of the potential catch in 2006

Under the revised format only the framework paper was reviewed, the provision of advice was presented and discussed by the Subcommittee.

During the last herring assessment in 2004, it was noted that a sensitivity analysis should be undertaken to determine the minimum number of samples that need to be aged for each assessment area without compromising model performance. It is critical that sufficient samples are collected and aged to ensure adequate model performance and provide confidence of yield recommendations and stock sustainability. It should be noted that due to limited resources this analysis has yet to be undertaken. Subsequent discussion identified a possible bias associated with inclusion of fall food fishery samples in the analyses. It was noted these samples represent only a small fraction of the total number of samples used in the analyses and possible biases would be negligible.

It was noted that there appears to be an ongoing retrospective over-estimation of herring biomass for some stocks, notably West Coast Vancouver Island herring. The Subcommittee recommended that this issue be investigated further as time and resources permit.

The Subcommittee entertained considerable discussion regarding the minor herring stocks in BC. Some participants questioned the rationale behind the 10% harvest rule for minor stocks. Currently, there is infrequent and variable sampling for age composition limiting the utility of an age-structured model for these stocks so biomass is determined by an escapement methodology based on observed spawn. Given the interannual variability in the spawn assessments and uncertainty about the completeness of these assessments, the Subcommittee is unable to develop a recruitment forecast for these stocks and consequently feels that an exploitation level of 10% is defensible and precautionary. It was noted that to some degree, the spawn-based estimates will be minimum estimates because all spawning locations may not be observed or surveyed. For example, overall vessel coverage in Area 2W for 2005 may have been better than previous years due to the spawn on kelp fishery operating in this area but given the large spatial area and variability in spawn timing, it is still probable estimated spawn represents an underestimate of actual spawning stock biomass. The Subcommittee discussed the possibility of exploring alternate methodologies to index abundance. Although no research has been conducted in BC, hydroacoustic estimates of biomass have been derived for other herring stocks (e.g., Atlantic Canada, Alaska, and Baltic Sea). It's not clear that this would be a viable option for Area 2W but is a potential area of future research. If this option was explored, it would NOT be used for in-season management but rather to provide a measure of current abundance that could be used to forecast returning biomass similar to the forecast made based on observed spawn deposition.

A representative of the Oweekeno First Nation re-iterated a request to establish a total allowable catch for Area 9 herring (Rivers Inlet). This initiated a general discussion on what constitutes a minor herring stock in BC as Area 9 has not been identified as a minor stock assessment area as have Area 27 or Area 2 West. However, it was noted that the spawn on kelp fishery currently operates in Area 10 without science-based advice and the proponent suggested that DFO follow the same procedure to establish a total allowable catch for Area 9. As the Subcommittee had no prior knowledge of the request there was little action that could be taken at this time. It was noted that any potential harvest would have to be in accordance with the 10% Harvest Rule currently in place for minor stocks. The Subcommittee decided there was little to be done without a formal Working Paper and suggested the proponent work with Fisheries Management and Science to initiate the process. The highest priority will be to determine if Area 9 herring represent a separate population. Genetic analyses have been conducted in the past but need to be reviewed to determine if Area 9 herring can be considered a separate, minor stock. Also, the consistency of the spawn

deposition and age composition data need to be evaluated to determine whether an adequate spawning biomass exists to support a sustainable fishery in this area. It is anticipated that the Subcommittee will review available information at a future meeting, assuming managers submit an explicit request.

Subcommittee Conclusions

1. The Subcommittee noted the continued tendency for the retrospective over-estimation of biomass, especially for the WCVI and QCI stocks. This issue should be examined further.
2. The Subcommittee is extremely concerned that the QCI stock has not recovered despite several years of roe fishery closures. Additional research on this stock is needed urgently to determine what factors are suppressing recovery. An analysis of Spawn on Kelp (SOK) mortality and associated herring usage should be a high priority in this area.

Subcommittee Recommendations

1. The Subcommittee recommended the maximum potential yields for each major stock assessment area as outlined in Appendices 4-8. Both QCI and WCVI are below Cutoff and no harvest is recommended.
2. A maximum potential yield of 160 tonnes (based on the 10% harvest rule for the minor stock areas) is recommended for Area 27.
3. A maximum potential yield of 54 tonnes (based on the 10% harvest rule for the minor stock areas) is recommended for Area 2 West.
4. A spawn survey should be continued in 2006 in Area 2 West.
5. A sensitivity analyses should be undertaken to determine the minimum acceptable number of samples needed for the stock assessment. This research should be completed as soon as possible due to the potential impacts on model performance. Further, no additional reduction in the number of herring samples aged by the aging lab is acceptable until this issue is resolved.
6. Analyses should be undertaken to determine why there is a tendency for the retrospective "over-estimation" of stock biomass for some stocks.
7. Analyses should be undertaken to assess herring usage and mortality associated with SOK operations in all areas.

APPENDIX 1: Working Paper Summaries

Working Paper P2005-03: Using an Eulachon Indicator Framework to Provide Advice on Fraser River Harvest Opportunities for 2006.

T.W. Therriault and P.B. McCarter

Although considered a relatively minor fishery since the 1950s, the Fraser River eulachon fishery has an important cultural significance, especially to local First Nations. These small anadromous smelt return annually to the Fraser River to spawn and are targeted by First Nation, recreational and commercial fishermen at this time. In 1993/1994, a sudden and synchronous population decline among several major eulachon-bearing rivers and a continued low returning biomass to the Fraser River prompted a review of research and management considerations. A traffic light approach for making management decisions was adopted in 2003. This approach considered four independent measures of stock status: 1) spawning stock biomass (SSB) based on the Fraser River egg and larval survey; 2) an offshore biomass index derived from the shrimp research survey off the south-west coast of Vancouver Island; 3) Columbia (and Fraser) River catch; and 4) the Fraser River test fishery catch. After compiling and interpreting each of these indicators, we recommend no harvest of Fraser River eulachon in 2006. Each of the four indicators suggests conservation concerns are warranted, especially the SSB estimate that has been below a response point of 150 tonnes in each of the past two years. In fact, the 2005 SSB estimate was only 16 tonnes. Other indicators also suggest concern including record low catches in the test fishery (less than 900 pieces), no or negligible commercial catches in the Columbia or Fraser Rivers in 2005 due to low abundance, and continued low abundance in offshore waters. Thus, we recommend that all eulachon returning to the Fraser River in 2006 should be allowed to spawn to allow stock rebuilding. Also, we suggest in light of these extremely low indicators that careful consideration be given to any potential harvest opportunities in 2007.

P2005-04: An Assessment Framework for Pacific Herring (*Clupea pallasii*) Stocks in British Columbia

J. Schweigert

The assessment framework for British Columbia Pacific herring is described including assumptions about stock structure, available biological data such as total catch and biological sampling information. The methodology for converting spawn survey data into total estimated spawning biomass and derivation of the spawn index is described. The age-structured model formulation and assumptions are presented together with some model diagnostics and residual plots. The rationale and process for developing abundance forecasts and the harvest policy and decision rules for determining allowable harvest levels are described and presented.

P2005-04 ANNEX: Stock Assessment for British Columbia Herring in 2005 and Forecasts of the Potential Catch in 2006

J. Schweigert

The five major herring stocks in BC are managed by a fixed harvest rate policy in conjunction with a fishing threshold or cutoff level. Cutoff levels are set at 25% of the estimated unfished equilibrium biomass. Cutoff levels have been established through stock-recruitment curves or bootstrapping of the observed recruitment time series. Biomass forecasts are provided for three levels of recruitment assumption: poor, average and good. The recruitment levels are calculated as the mean of the lowest 33%, the mid 33%, and the highest 33% of the estimate of historic age-2+ fish abundance as estimated by the age-structured model. Decision rules are provided for determining the appropriate recruitment assumption in the absence of additional information. An offshore mid-water trawl survey provides information to determine the appropriate recruitment strength assumptions for the West Coast Vancouver Island and Strait of Georgia stocks. Yield recommendations are set at 20% of the forecast annual biomass unless the forecast is near or below cutoff levels (in which case a modified harvest rule is used). The Subcommittee also reviews other criteria such as spawn survey information, perceptions of test fishing skippers and managers, age-structured model information, and biological data in formulating a decision on the stock forecast.

Assessments of major stocks in 2005 were conducted using the age-structured model adopted for the 2003 assessment (see framework paper above). The paper was accepted with minor revisions and the Subcommittee accepted yield recommendations as outlined in Appendices 4-8 for 2006.

The estimated harvestable surplus in 2006 (20% of the 2006 forecast herring run) based on forecast abundance to the five assessment regions is 32,190 tonnes for the BC coast assuming no removals from the Queen Charlotte Island and West Coast Vancouver Island stocks which are both below their respective Cutoff levels.

Queen Charlotte Islands – The pre-fishery biomass forecast for 2006 is 7,120 tonnes assuming poor recruitment. This stock remains well below the Cutoff level. Thus, there is no surplus identified.

Prince Rupert District – The pre-fishery biomass forecast for 2006 is 32,030 tonnes assuming average recruitment. The forecast of returning biomass is above the Cutoff level of 12,100 tonnes. Application of the 20 percent harvest rule to the forecast results in a potential harvest of 6,410 tonnes.

Central Coast – The pre-fishery biomass forecast for 2006 is 31,630 tonnes assuming average recruitment. The forecast of returning biomass is above the Cutoff level of 17,600 tonnes. Application of the 20 percent harvest rule to the forecast results in a potential harvest of 6,330 tonnes.

Strait of Georgia – The pre-fishery biomass forecast for 2006 is 97,300 tonnes assuming average recruitment. The forecast of returning biomass is well above the Cutoff level of 21,200 tonnes. Application of the 20 percent harvest rule to the forecast results in a potential harvest of 19,460 tonnes.

West Coast Vancouver Island – The pre-fishery biomass forecast for 2006 is 18,380 tonnes assuming poor recruitment. The forecast of returning biomass is below the Cutoff level of 18,800 tonnes. Thus, there is no surplus identified.

Minor Stocks – Potential harvest for minor stocks are identified as 10% of observed spawning biomass in the previous year. The Subcommittee identified a potential harvest of 160 tonnes for Area 27 and a potential harvest of 54 tonnes for Area 2 West.

**APPENDIX 2: PSARC Pelagic Subcommittee Meeting Agenda
September 7-8, 2005**

**DRAFT AGENDA
PSARC PELAGICS SUBCOMMITTEE MEETING
September 7-8, 2005
Seminar Room - Pacific Biological Station
Nanaimo, BC**

Wednesday, September 7

- 8:30 Introductions and Opening Remarks.
9:00-12:00 Herring Assessment Framework (J. Schweigert)
- 12:00 Lunch
- 1:00-2:00 Formulation of Subcommittee Conclusions and Recommendations
for Herring Assessment Framework
2:00-4:00 Review of Science Advice for 2006 (Science Advisory Report for
Herring)

Thursday, September 8

- 9:00-12:00 Review of Science Advice for 2006 (Science Advisory Report for
Herring)
Formulate Subcommittee Conclusions and Recommendations
- 12:00 Lunch
- 1:00-2:00 Using an Eulachon Indicator Framework to Provide Advice on
Fraser River Harvest Opportunities (T. Therriault and B. McCarter)
- 2:00-4:00 Formulation of Subcommittee Conclusions and Recommendations
for Eulachon Indicator Framework

APPENDIX 3: List of Attendees & Reviewers

Subcommittee Chair: Tom Therriault
 PSARC Chair: Al Cass

DFO Participants	
Cass, Al (PSARC Chair)	
Coutu, Jean-Maurice	
Daniel, Kristen	
Flostrand, Linnea	
Fort, Charles	
Gill, Harpreet	
Hamer, Lorena	
McCarter, Bruce	
Midgley, Peter	
Mueller, Barbara	
Potyrala, Mark	
Rusch, Bryan	
Schweigert, Jake	
Sneddon, Debra	
Stocker, Max	
Tanasichuk, Ron	
Therriault, Tom (Chair)	
Thompson, Matt	
Wright, Steven	
External Participants:	Affiliation
Ashcroft, Chuck	Sport Fish Advisory Board
Benson, Ashleen	Simon Fraser University
Bolton, John, Sr.	Heiltsuk Tribal Council
Burrows, Bruce	Oweekeno Nation
Chalmers, Dennis	Ministry of Environment, Land and Parks
Haist, Vivian	Canadian Sablefish Association
Jacobs, Mike	Nuu Chah Nulth Tribal Council
Jones, Russ	Haida Fisheries
Korman, Josh	Ecometric Research
Newman, Earl	Heiltsuk Tribal Council
Safarik, Edward	Ocean Fisheries
Webb, Lloyd	Fishing Vessel Owners Assoc.
Wilson, Ken	Fraser River Aboriginal Fisheries Research Council

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.

Clark, Bill	Pacific Halibut Commission
Funk, Fritz	Alaska Fish and Wildlife
Hay, Doug	DFO emeritus, PKU
Rusch, Bryan	DFO, South Coast

Appendix 5. Criteria for assessment of stock status in 2005 and yield recommendation for 2006: Prince Rupert District

Criteria	Status								
<p>1. Data Quality</p> <p>a) All catch reported</p> <p>b) All spawn surveyed</p> <p>c) Good sample coverage</p> <p>2. Stock status and trends</p> <p>a) ASM-2q</p> <p>b) Spawn indices</p> <p>3. Perceptions of Stock Status</p> <p>a) Charter skippers comments</p> <p>b) Management staff</p> <p>4. Recruitment</p> <p>a) Age-structured model</p> <p>5. Retrospective Analysis</p> <p>a) Consistency</p> <p>6. Forecast Abundance</p> <p>a) Profile Likelihood</p> <p>b) Recruitment Assumption</p> <ul style="list-style-type: none"> • Poor • Average • Good <p>7. Additional Information</p> <p>8. Cutoff</p> <p>9. Yield Recommendation</p>	<p>a) No. Only part of FSC harvest reported for Area 3/4. Area 5 reports complete.</p> <p>b) Yes</p> <p>c) Yes</p> <p>a) steady since 2003</p> <p>b) slight decline from 2003</p> <p>a) Area 3/4 slightly better; Kitkatla slightly poorer. Large early spawn in Kitkatla</p> <p>b) Downward trend in Kitkatla spawn; Fish are mature when they appear on grounds. Stocks declining in Area 3/4, and decline in size at age</p> <p>a) Recruitment good in 2003, poor in 2004 and average in 2005</p> <p>a) slight tendency to over-forecast</p> <p>a) Between 30 000 and 33 000 tonnes</p> <table border="0" data-bbox="873 1409 1406 1556"> <tr> <td>b) Abundance</td> <td>Potential Harvest</td> </tr> <tr> <td>29 000</td> <td>5 800</td> </tr> <tr> <td>32 030</td> <td>6 410</td> </tr> <tr> <td>41 150</td> <td>8 230</td> </tr> </table> <p>12 100 tonnes</p> <p>Maximum potential yield of 6 410 tonnes</p>	b) Abundance	Potential Harvest	29 000	5 800	32 030	6 410	41 150	8 230
b) Abundance	Potential Harvest								
29 000	5 800								
32 030	6 410								
41 150	8 230								

Appendix 6. Criteria for assessment of stock status in 2005 and yield recommendation for 2006: Central Coast

Criteria	Status						
<p>1. Data Quality</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, outside Wilby Pt missed, No reports for Mathieson Ch. (traditional area)</p> <p>c) Yes</p>						
<p>2. Stock status and trends</p> <p>a) ASM-2q</p> <p>b) Spawn indices</p>	<p>a) increasing since 2002</p> <p>b) slight decrease from 2004</p>						
<p>3. Perceptions of Stock Status</p> <p>a) Charter skippers comments</p> <p>b) Management staff</p>	<p>a) Similar to 2004. Abundance improving in fringe areas.</p> <p>b) Average stock with average recruitment</p>						
<p>4. Recruitment</p> <p>a) Age-structured model</p>	<p>a) Recruitment good in 2003 and 2005 but poor in 2004</p>						
<p>5. Retrospective Analysis</p> <p>a) Consistency</p>	<p>a) small tendency to over forecast</p>						
<p>6. Forecast Abundance</p> <p>a) Profile Likelihood</p> <p>b) Recruitment Assumption</p> <ul style="list-style-type: none"> • Poor • Average • Good 	<p>a) Between 29 000 and 32 000 tonnes</p> <p>b) Abundance Potential Harvest</p> <table border="0" style="margin-left: 40px;"> <tr> <td style="padding-right: 20px;">28 920</td> <td>5 780</td> </tr> <tr> <td style="padding-right: 20px;">31 630</td> <td>6 330</td> </tr> <tr> <td style="padding-right: 20px;">39 180</td> <td>7 840</td> </tr> </table>	28 920	5 780	31 630	6 330	39 180	7 840
28 920	5 780						
31 630	6 330						
39 180	7 840						
<p>7. Additional Information</p>							
<p>8. Cutoff</p>	<p>17 600 tonnes</p>						
<p>9. Yield Recommendation</p>	<p>Maximum potential yield of 6 330 tonnes</p>						

Appendix 7. Criteria for assessment of stock status in 2005 and yield recommendation for 2006: Strait of Georgia

Criteria	Status								
<p>1. Data Quality a) All catch reported b) All spawn surveyed c) Good sample coverage</p>	<p>a) Yes b) Ladysmith surveyed late, substantial underestimate c) Yes</p>								
<p>2. Stock status and trends a) ASM-2q b) Spawn indices</p>	<p>a) decline from peak in 2003 b) decline from peak in 2003</p>								
<p>3. Perceptions of Stock Status a) Charter skippers comments b) Management staff</p>	<p>a and b) Stock status was good, and likely comparable to recent years but the very early maturity resulted in early fisheries and spawning, and subsequently less pre-season assessment.</p>								
<p>4. Recruitment a) Age-structured model b) Offshore Trawl Survey</p>	<p>a) Recruitment average to good since 1996 b) AVERAGE</p>								
<p>5. Retrospective Analysis a) Consistency</p>	<p>a) slight tendency to over-forecast</p>								
<p>6. Forecast Abundance a) Profile Likelihood b) Recruitment Assumption</p> <ul style="list-style-type: none"> • Poor • Average • Good 	<p>a) Between 100 000 and 120 000 tonnes</p> <table border="0" data-bbox="787 1333 1372 1480"> <tr> <td>b) Abundance</td> <td>Potential Harvest</td> </tr> <tr> <td>84 710</td> <td>16 940</td> </tr> <tr> <td>97 300</td> <td>19 460</td> </tr> <tr> <td>112 960</td> <td>22 590</td> </tr> </table>	b) Abundance	Potential Harvest	84 710	16 940	97 300	19 460	112 960	22 590
b) Abundance	Potential Harvest								
84 710	16 940								
97 300	19 460								
112 960	22 590								
<p>7. Additional Information</p>									
<p>8. Cutoff:</p>	<p>21 200 tonnes</p>								
<p>9. Yield Recommendation</p>	<p>Maximum potential yield of 19 460 tonnes</p>								

Appendix 8. Criteria for assessment of stock status in 2005 and yield recommendation for 2006: West Coast of Vancouver Island

Criteria	Status						
1. Data Quality a) All catch reported b) All spawn surveyed c) Good sample coverage	a) Most catch reported b) Yes c) Yes						
2. Stock status and trends a) ASM-2q b) Spawn indices	a) decreasing since 2003 b) decline from 2003						
3. Perceptions of Stock Status a) Charter skippers comments b) Management staff	a and b) Overall, WCVI not great. Barkley, Clayoquot and Nootka were poor. Esperanza looked good but in-season observations not supported by spawn deposition. Early spawn in Barkley.						
4. Recruitment a) Age-structured model b) Offshore trawl survey	a) Recruitment poor in 2004 and average in 2005 b) POOR						
5. Retrospective Analysis a) Consistency	a) tendency to over-forecast						
6. Forecast Abundance a) Profile Likelihood b) Recruitment Assumption <ul style="list-style-type: none"> • Poor • Average • Good 	a) Between 18 000 and 23 000 tonnes b) Abundance Potential Harvest <table style="margin-left: 40px; border: none;"> <tr> <td style="padding-right: 20px;">18 380</td> <td>0</td> </tr> <tr> <td style="padding-right: 20px;">23 020</td> <td>4 220</td> </tr> <tr> <td style="padding-right: 20px;">35 710</td> <td>7 140</td> </tr> </table>	18 380	0	23 020	4 220	35 710	7 140
18 380	0						
23 020	4 220						
35 710	7 140						
7. Additional Information							
8. Cutoff	18 800 tonnes						
9. Yield Recommendation	No yield						