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**Proceedings of the Pacific Scientific  
Advice Review Committee (PSARC)  
meeting for the assessment of  
scientific information to estimate  
Pacific sardine seasonal migration  
into Canadian waters**

**Compte rendu de la réunion du Comité  
d'examen des évaluations  
scientifiques du Pacifique (CEESP)  
sur l'évaluation de l'information  
scientifique à l'appui de l'estimation  
de la migration saisonnière de la  
sardine du Pacifique dans les eaux  
canadiennes**

**April 2, 2009  
Nanaimo, BC**

**Le 2 avril 2009  
Nanaimo, C.-B.**

**Linnea Flostrand**

**Linnea Flostrand**

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3190 Hammond Bay Road  
Pacific Biological Station  
Nanaimo, BC V9T 6N7

**October 2009**

**Octobre 2009**

## **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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## **SUMMARY**

The Pacific Scientific Advice Review Committee (PSARC) Pelagics Subcommittee met April 2, 2009 at the Pacific Biological Station in Nanaimo, B.C. The purpose of the meeting was to review a working paper presenting the application of results from a fishery-independent trawl survey to estimate Pacific sardine seasonal migration into Canadian waters. The PSARC review was requested by DFO Fisheries and Aquaculture Management to guide development of the 2009 Pacific Sardine Integrated Fishery Management Plan. Two formal reviews of the working paper were presented and twenty-one Subcommittee participants attended the meeting, consisting of representatives from DFO, industry and First Nations. The paper was accepted subject to minor revisions. Additional meeting recommendations and conclusions relate to future work.

## **SOMMAIRE**

Le sous-comité sur les poissons pélagiques du Comité d'examen des évaluations scientifiques du Pacifique (CEESP) s'est réuni, le 2 avril 2009, à la Station biologique du Pacifique, à Nanaimo, en C.-B. Le but de cette réunion était de passer en revue un document de travail qui présente l'application des résultats dérivés d'un relevé au chalut indépendant de la pêche afin d'estimer la migration saisonnière de la sardine du Pacifique dans les eaux canadiennes. L'examen, qui a été demandé par Gestion des pêches et de l'aquaculture, orientera l'élaboration du Plan de gestion intégrée de la pêche à la sardine du Pacifique de 2009. Deux examens officiels du document de travail ont été présentés. Les vingt-et-un participants du sous-comité qui ont assisté à la réunion comprenaient des représentants du MPO, de l'industrie ainsi que des Premières nations. Le document a été accepté, sous réserve de modifications mineures. Certaines recommandations et conclusions se rapportent à de futurs travaux.

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## INTRODUCTION

The PSARC Pelagics Subcommittee met April 2, 2008 at the Pacific Biological Station in Nanaimo, British Columbia and external participants from industry and First Nations attended the meeting. The Subcommittee Chair (L. Flostrand) opened the meeting by welcoming participants, reviewing the agenda and referring to the terms of reference. The Subcommittee reviewed one Working Paper titled "Pacific sardine (*Sardinops sagax*) biomass and migration rates in British Columbia" by Jake Schweigert, Sandy McFarlane, and Vanessa Hodes. Appendices contained in these proceedings present information of the content of the working paper (summary), the meeting agenda, the terms of reference and the list of meeting participants.

## DETAILED COMMENTS FROM THE REVIEW

### **Working Paper 2009-001: Pacific sardine (*Sardinops sagax*) biomass and migration rates in British Columbia**

*J. Schweigert, S. McFarlane, and V. Hodes.*

*Paper accepted subject to revisions.*

The main objective of the working paper was to investigate current estimates of Pacific sardine migration rates into BC waters to provide advice applicable to fisheries management. Formal reviews were conducted by Jaclyn Cleary (DFO) and Robert Emmett (NOAA, NMFS) and both reviewers found that the paper met its objective. Both reviewers identified that the report should include additional information to describe survey design, catch data and derivation of estimates, which the authors and other members of the Subcommittee were agreeable to. The authors also agreed to address minor editorial points which are not included in the summary below.

J. Cleary presented her review first, covering topics related to: 1) the selection of analytic methods associated with sampling design, catch variability and distributions; 2) the incorporation of incomplete survey years and expansion factors into derivation of estimates; 3) the use of an average statistic versus a 95% upper confidence bound for spatial representation, and 4) questioning the recommendation of using a 3-year rolling average if there are years without surveys (i.e. year 2007). She made specific suggestions regarding survey design and the treatment of sample data where the variance can be summed over transects and transect data can be weighted based on the spatial representation of the survey (i.e. two-stage standardized design where transects are assumed to be random and fishing sites are placed systematically within each transect). The authors appreciated her input and agreed that future work should present more background on the methods and apply her suggestions to explore the data differently. The authors also stated that expansion factors using incomplete survey data could be removed from results. The

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authors agreed that their recommendation to apply 3-year rolling average migration rates to management decisions is compromised by incomplete survey years and they stated that other options should be considered when three consecutive years of complete survey data are not available.

The review by B. Emmett was presented by L. Flostrand, covering suggestions to include more information on day/night calibrations; size and age biological data and oceanographic data. His review also noted implications associated with US harvest guidelines that do not account for changes in Canadian harvest strategies. The authors were agreeable to including more information on day/night calibrations but indicated that information pertaining to biological and oceanographic data and US harvest guidelines is beyond the scope of the paper.

### **Subcommittee Discussion**

John Lenic of the Canadian Pacific Sardine Association gave a presentation and provided a handout to identify points not treated in the analysis. His presentation included information on potential limitations of the surface trawl surveys to estimate sardine abundance and he provided some considerations for future sardine research in BC waters. Specific points from his presentation related to the lack of sonar in the surveys, the ability of schools to avoid the path of the vessel and net (disturbance from noise and turbulence) and the catchability of the trawl gear. He stated that without sonar the amount of fish present in the area cannot be effectively observed and compared to the amount of fish caught, therefore blind sets provide no information on avoidance and catchability. He cited examples for other species where trawl catchability was estimated to range from 10-90%. He suggested that future science should include undertaking studies that cross-reference trawl survey observations with sonar observations from a seine vessel and with aerial observations. He also suggested that minimum abundance estimates from the trawl survey data be used to forecast abundance, such as based on rolling averages. Subcommittee members acknowledged that gear avoidance and catchability associated with the trawl survey would provide conservative estimates but it was noted that trawl catchability has not been adequately characterized for most pelagic species (varying by vessel, gear, etc), therefore trawl surveys generally provide relative abundance trends instead of absolute abundance data. There was some general discussion on the potential use of aerial surveys and LIDAR in detecting sardines to relate to catchability and distribution observations for future work. On the topic of using rolling abundance estimates from the survey to forecast stock size in BC, it was emphasized by the authors and other Subcommittee members that would pose greater risk of overharvesting compared with using a rolling average of local migration and that transboundary dynamics (population size and composition) from US information on the main spawning population need to be considered. Another industry participant (Don Pepper) spoke and provided a handout on harvest outcome scenarios from relying on US assessment data versus incorporating BC observations and how several policies affect stock and economic sustainability.

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It was noted that some of the results presented in Table 1 for 1997 and 1999 biomass estimates appeared to be erroneously calculated. It was determined that it was due to a typographical resulting from numbers being accidentally transposed in the table, and the discrepancy was resolved.

There was discussion as to what process (or statistic) should be selected for recommending a preferred migration rate for fisheries management. It was made clear that there would not be enough time to effectively reanalyze the data using suggested alternatives and to apply conclusions from those results for management advice within the current year's operational time constraints. Several Subcommittee members, a reviewer and both authors felt that the range in annual migrations rates from the current paper's set of results would likely be similar to the range resulting from updated analyses and they promoted using currently available information for the coming season. Several possible migration rate values were discussed but the consensus was to use the average of the individual average migration rates representing years when complete trawl surveys were conducted (1997, 1999, 2001, 2006 and 2008 Table 4b). This statistic (migration estimate of 18.3%) received general support because it represented current migration patterns (compared to an estimate of 10% derived from historical catch records, Ware 1999), and used average estimates (instead of upper confidence bounds) from the trawl survey data.

### **Subcommittee Conclusions**

- The Subcommittee accepted the working paper subject to revisions and concluded that its results be used to provide management advice for the 2009 fishing season. Revisions should provide more information on data analysis, variability in sampling effort, catch distribution day/night calibration and other relevant editorial changes (as outlined by reviewers).
- The Subcommittee concluded that for setting harvest limits for the coming 2009 fishing season an estimated migration rate of 18.3% should be applied instead of 10% (from Ware 1999). It was noted that this is a more current yet still precautionary estimate of sardine migration into BC waters. This estimate is based on results presented in the working paper for the average of the five complete survey years (1997, 1999, 2001, 2006 and 2008 Table 4b).
- The Subcommittee concluded that management advice for the 2010 season should be based on an updated working paper presenting analyses of the trawl survey data using different analytic approaches (i.e. based on different sampling design and catch distribution assumptions as recommended by one of the reviewers).
- The Subcommittee acknowledged that abundance estimates derived from the WCVI trawl survey are conservative since gear catchability, fish avoidance and areas outside of the survey region are not accounted for.

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### **Subcommittee Recommendations**

The Subcommittee recommends that future work related to estimating sardine biomass abundance and distribution in BC waters be conducted, such as related to sonar and aerial survey observations (vessel and gear avoidance/ trawl catchability) and day/night trawl catch conversions. The Subcommittee endorses cooperation between DFO and industry to undertake relevant investigations.

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## APPENDIX 1: WORKING PAPER SUMMARY

### Working paper P2009-1: Pacific sardine (*Sardinops sagax*) biomass and migration rates in British Columbia

*J. Schweigert, S. McFarlane, and V. Hodes.*

Pacific sardine (*Sardinops sagax*) migrate from southern California in spring to coastal Vancouver Island, returning south in the fall. The California sardine population has rebuilt over the past decades, and the abundance of fish migrating into BC waters has increased, as has interest in harvesting them. However, there is considerable uncertainty in the annual migration rate of the coastwide stock into Canadian waters. A trawl survey has been conducted off the west coast of Vancouver Island (WCVI) since 1992 to monitor sardine abundance and distribution in Canadian waters and to provide updated estimates of sardine migration rate. The trawl survey provides a minimal estimate of the probable sardine biomass in Canadian water as its survey design does not include inshore or northern areas where sardines are prevalent in some years. Biomass estimates were calculated according to the method described in Beamish et al. (2000) from cruise data collected in summer months from 1997 to 2008. Total abundance for each survey region was determined from numbers of sardines in the swept volume, extrapolated to the total volume. Minimum and maximum abundance estimates were determined using the 95% confidence interval for the calculated average swept volume within each of the six major areas. Annual migration rate estimates were calculated from the ratio of estimated biomass off the WCVI and the total biomass estimate for the coastwide population as presented in the annual US sardine assessment (Hill et al, 2008). The overall average migration rate estimate from all survey years (complete and incomplete surveys) is 13.0% and the overall average migration rate estimate from the five complete survey years (1997, 1999, 2001, 2006, and 2008) is 18.3%. The overall maximum migration rate estimate (upper 95% confidence bound) from all survey years is 16.1.0% and the overall maximum migration rate estimate from the five complete survey years is 23.4%. The fraction of the estimated total population biomass from the US assessment that the WCVI trawl survey biomass comprises should approximate the migration rate into B.C. Thus, we can consider a precautionary update to the migration rate of sardines into Canada in the range of 15% to 20%. The migration rate estimate could be updated annually, similar to the harvest rate, based on a 3 year running average determined by the results of the annual trawl survey.

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## APPENDIX 2: PSARC PELAGIC SUBCOMMITTEE MEETING AGENDA

### DRAFT AGENDA PSARC PELAGICS SUBCOMMITTEE MEETING April 2, 2009

Pacific Biological Station,  
Seminar Room,

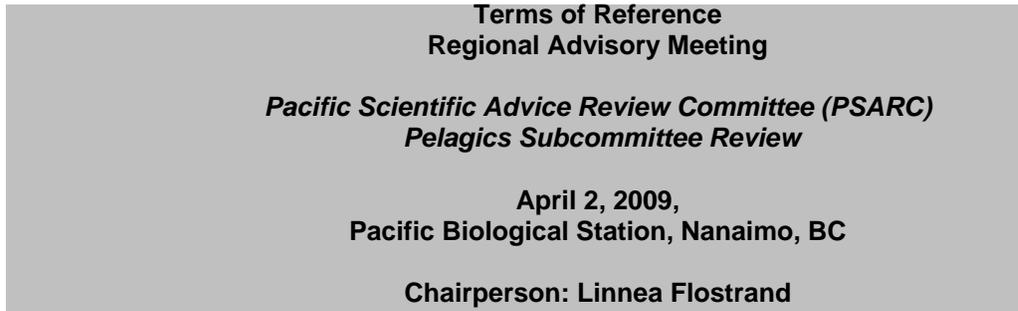
*Nanaimo, BC*

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|------------|--|
| 9:00       | Introductions and Opening Remarks.   |
| 9:30-12:00 | Review of Working Paper: Pacific sardine ( <i>Sardinops sagax</i> )<br>biomass and migration rates in British Columbia |
| 12:00-1:00 | Lunch  |
| 1:00-4:00  | Continue review of Working Paper (if time required)  |

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## APPENDIX 3: MEETING TERMS OF REFERENCE



### **Background**

Based on historical landings, a migration rate of 10% has been applied to Pacific sardine moving into B.C. waters for use in developing harvest quotas. Results from recent trawl surveys off the west coast of Vancouver Island suggest that local abundance (or migration) may be significantly different than what has been applied in recent years. The PSARC Pelagics Subcommittee will review a working paper that describes an approach that uses data collected from a summer west coast of Vancouver Island surface trawl survey to estimate local abundance and migration of Pacific sardine into B.C. waters. Results from the assessment may be used to provide advice on harvest levels for sardine fisheries in 2009.

### **Objectives**

1. Peer review the draft working paper, "Pacific sardine (*Sardinops sagax*) biomass and migration rates in British Columbia";
2. Specifically review the methods and results from this work relative to recently applied assessment guidelines and ensure that the methods and results are scientifically sound.
3. Peer review results from the sardine biomass and migration rate estimation procedures for offering scientific advice regarding precautionary harvest levels for 2009.

### **Products**

- CSAS Proceedings summarizing the discussion.
- CSAS Research document

### **Location and Date**

Seminar room, Pacific Biological Station, Nanaimo, BC, April 2, 2009.

### **Participants**

Participants (approx. 25) will include internal DFO representatives and invitees from First Nations, NGO's and industry.

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## APPENDIX 4: LIST OF ATTENDEES AND REVIEWERS

Subcommittee Chair: Linnea Flostrand  
PSARC Chair: Al Cass

Reviewers: Robert Emmett (NOAA, not present)  
Jaclyn Cleary (DFO)

<b>EXTERNAL PARTICIPANTS</b>		<b>AFFILIATION</b>
Bill	Bird	Canadian Pacific Sardine Association
Dennis	Chalmers	BC Ministry of Environment
Lorena	Hamer	Herring Conservation and Research Society
Larry	Johnson	Huu-ay-aht First Nation
Jim	Lane	Nuuchahnulth Tribal Council
John	Lenic	Canadian Pacific Sardine Association
Brent	Melan	Canadian Pacific Sardine Association
Ken	Miller	McMillans / Pacific Seafoods
Don	Pepper	Canadian Pacific Sardine Association
Louie	Savourd	North Delta Seafoods
David	Schmidt	Quatsino First Nation
<b>DFO PARTICIPANTS</b>		
Al	Cass	
Jaclyn	Cleary	
Linnea	Flostrand	
Harpreet	Gill	
Vanessa	Hodes	
Cynthia	Johnston	
Sandy	McFarlane	
Jake	Schweigert	
Brenda	Spence	
Ron	Tanasichuk	