



Government of Canada  
Fisheries and Oceans

Gouvernement du Canada  
Pêches et Océans

Received in DMO

JUL 05 2011

MECTS #: 2011-507-00073  
EKME #: 2389778

To:  
A: Claire Dansereau, Deputy Minister

Date: JUN 16 2011 JUL 05 2011

Subject:  
Objet:

**UPDATE ON FACTORS AFFECTING  
THE 2009 FRASER RIVER SOCKEYE RETURN**  
(For Information)

Via: Siddika Mithani, Assistant Deputy Minister, Oceans and Science Sector (D)

From: Sue Farlinger, Regional Director General Pacific Region JUN 16 2011

☐ Your Signature  
Votre signature

☒ Information

☐ For Comments  
Observations

☐ Material for the Minister  
Documents pour le Ministre

Remarks: Laura Richards, Regional Director Science, Pacific Region - Approved  
Remarques: Paul Macgillivray, Pacific Region, Team Lead, Cohen Commission pm JUN 16 2011

**DISTRIBUTION**

Sharan Johal, A/Team Leader, Executive Secretariat

  
David Balfour  
Senior Assistant Deputy Minister  
Ecosystems & Fisheries Management

Drafting Officer / Rédacteur: Laura Richards (250) 756-7177

JUN 22 2011

  
Jean Landry / Dave Gillis

JUN 22 2011

SEEN BY DM

JUL 05 2011



Fisheries and Oceans  
Canada

Pêches et Océans  
Canada

Assistant  
Deputy Minister  
Oceans and Science

Sous-ministre  
adjointe  
Océans et sciences

Your file      Votre référence

MECTS#: 2011-507-00073

Our file      Notre référence

EKME#: 2389779

## MEMORANDUM FOR THE DEPUTY MINISTER

### **UPDATE ON FACTORS AFFECTING THE 2009 FRASER RIVER SOCKEYE RETURN**

(Information Only)

#### **SUMMARY**

- In a previous briefing note prepared in 2009, ten factors were listed which could have contributed to the poor returns of Fraser sockeye in 2009. This note updates the work conducted since 2009 to clarify the potential role of each factor in both the 2009 return and the longer term decline.
- Based on the most recent analyses, the poor return in 2009 was most likely related to poor conditions throughout the ocean migration of sockeye which entered the ocean as juveniles in 2007, compounded by as yet unidentified disease(s).
- Climate/ocean conditions are also thought to be the most likely factors associated with the longer term decline in Fraser sockeye, although a number of additional factors (disease, delayed density-dependence, competitive interactions with Pink salmon and contaminants) could also contribute.

#### **Background**

- A previous briefing note (2009-507-00143, Tab 1) identified 10 possible factors which could have contributed to the poor returns of Fraser sockeye in 2009, based on an internal workshop held in September 2009. These factors were:
  - Most likely – toxic algal blooms in the Strait of Georgia, low food abundance in Queen Charlotte Sound, disease;

.../2

- Possible – predation by Humboldt squid, interception by US fisheries, sea lice from farms in Discovery Passage; and
- Unlikely – pollution in Fraser River, Canadian fisheries, predation on juvenile salmon in the Strait of Georgia, low food abundance in the Strait of Georgia.
- In June 2010, the Pacific Salmon Commission convened an expert panel led by Dr. Randall Peterman (Simon Fraser University) to examine both the poor 2009 return as well as the overall decline in sockeye productivity. According to the workshop report (2010-501-00293, Tab 2), physical and biological conditions inside the Strait of Georgia and freshwater/marine pathogens (viruses, bacteria and/or parasites) were considered as contributors to the poor return in 2009 and to the overall decline of Fraser sockeye.
- Work has continued in Pacific Region to assess each of these factors, along with factors contributing to the long term decline in Fraser sockeye and the strong return in 2010.
- This note describes the current state of knowledge regarding the factors identified in the 2009 briefing note and the 2010 Pacific Salmon Commission report, following an internal workshop of approximately 45 Fisheries and Oceans Canada staff held April 14-15, 2011.

#### **Analysis / DFO Comment**

- Based on the most recent analyses, the following factors are unlikely to have contributed to the poor 2009 return:
  1. **Pollution/contaminants in the Fraser River.** There is no record of any Fraser Basin wide environmental incident that could have impacted juvenile sockeye. Similarly, there is no evidence related to environmental conditions in the Fraser Basin.
  2. **Capture by Canadian fisheries.** In 2009, the Canadian fishery was minimal and did not contribute to the poor return.
  3. **Predation on juvenile salmon in Strait of Georgia.** There are no known shifts in predator abundance that could explain increased predation in 2007.
- Based on the most recent analyses, the following factors may have contributed to sockeye mortality, but not at a magnitude sufficient to explain the poor 2009 return:
  1. **Predation by Humboldt squid.** Humboldt squid is a voracious predator which can feed on sockeye. Humboldt squid were abundant in Canadian waters from 2007 to 2009 but were absent in 2010. Washington –California sockeye returns from the 2007 ocean entry year suggest that Humboldt squid did not have a significant effect.

2. **Capture by U.S. fisheries.** Fraser sockeye are intercepted in U. S. Gulf of Alaska and Bering Seas fisheries. The level is not well documented (2011-507-00025, Tab 3) but appears to be very low.
  3. **Mortality attributed to sea lice.** Sea lice from farms in the Discovery Passage area could have contributed some mortality of juvenile sockeye in 2007, although the levels of lice present on the farms in 2007 were similar to levels in 2008 associated with the strong 2010 sockeye return.
- Based on the most recent analyses, the following factors most likely led to sockeye mortality at the scale observed in 2009:
    1. **Low food abundance in the Strait of Georgia.** This factor was initially considered as unlikely to have contributed to the poor 2009 return. Following additional analyses in 2010, evidence now points to extremely poor conditions for juvenile sockeye entering the Strait of Georgia in 2007, as reported at the June 2010 Pacific Salmon Commission workshop.
    2. **Low food abundance in Queen Charlotte Sound and Gulf of Alaska.** Strong evidence now indicates that the timing and intensity of extreme weather in the spring of 2007 led to poor ocean conditions for food production for juvenile sockeye in Queen Charlotte Sound as well as in the Strait of Georgia. Subsequent winter feeding conditions in the high seas region of the Gulf of Alaska in 2007 – 2008 were also poor. In contrast, juvenile sockeye entering the ocean in the spring of 2008 experienced good conditions throughout their ocean migration period.
    3. **Disease.** Many diseases affect sockeye salmon and mortality from disease could have increased in 2007 when the fish were stressed by low food abundance. Of some specific interest is a genomic signature associated with premature mortality of returning adult sockeye. Accumulating evidence suggests that this genomic signature may be associated with a negative impact on performance throughout the salmon life-cycle. The responsible pathogen has not yet been confirmed. A novel salmon Parvovirus has recently been identified and studies are ongoing to determine whether it is linked to the genomic signature.
    4. **Toxic algal blooms in the Strait of Georgia** – Although data are limited, additional analyses by a US researcher support the presence of extensive blooms of toxic algae in the Strait of Georgia in 2007 when juvenile sockeye were present.
  - Climate/ocean conditions are also thought to be the most likely factors associated with the longer term decline in Fraser sockeye, although a number of additional factors (disease, delayed density-dependence, competitive interactions with Pink salmon and contaminants) could also contribute.

.../4

**Recommendations / Next Steps**

- Staff presentations prepared for the April 2011 workshop are expected to be entered as evidence before the Cohen Commission.
- Staff are continuing to assemble data and analyze the key hypotheses in preparation for upcoming testimony.
- Studies on the link to a potential disease are proceeding, although given the complex investigation, we cannot provide a firm timeline on resolution.

**Attachments: (3)**

- (1) Factors Affecting the 2009 Fraser Sockeye Return (MECTS # 2009-507-00143)*
- (2) The PSC Workshop Report "Synthesis of Evidence from a Workshop (MECTS # 2010-501-00293)*
- (3) First Evidence of Canadian Sockeye Salmon Rearing in the Bearing (MECTS # 2011-507- 00025)*



Government of Canada  
Fisheries and Oceans

Gouvernement du Canada  
Pêches et Océans

MECTS # 2009-507-00143  
EKME # 1084753  
FILE / FICHER #ABJ-8350-S2-4

To: Claire Dansereau  
Pou

Date:

Object: **FACTORS AFFECTING THE 2009 FRASER SOCKEYE RETURN**

From / De: Barry Rashotte

Via: *David Balfour* DEC 01 2009

☐

Your Signature  
Votre signature

☐

Information

☐

For Comments  
Observations

☐

Material for the Minister  
Documents pour le Ministre

Remarks:

Remarques: RDG Pacific and ADM Science have approved and signed the incoming

**DISTRIBUTION**

*H. James*  
H. James (993-5045) / B. Rashotte / D. Balfour

NOV 27 2009



DEC 03 2009

MECTS#: 2009-507-00143

EKME#: 1084753

FILE#: ABJ-8350-S2-4

MEMORANDUM FOR THE MINISTER

**FACTORS AFFECTING THE 2009 FRASER SOCKEYE RETURN**

(Information Only)

**SUMMARY**

- Sockeye salmon returns to the Fraser River in 2009 are significantly below the pre-season forecast. While the explanation for the poor 2009 Fraser return is not known, a number of factors could be important.
- Viral disease, toxic algal blooms and/or low food availability in Queen Charlotte Sound could have led to sockeye mortality at the level observed.
- Sea lice from fish farms, Humboldt squid predation and U.S. fisheries could have contributed to the sockeye mortality but are likely insufficient in themselves to explain the poor return.
- Staff continue to assemble data and analyze the key hypotheses which could inform a post-season review.

**Background**

- Sockeye salmon returns to the Fraser River in 2009 are significantly below the pre-season forecast. The actual return is now estimated to be on the order of 1.4 million fish, whereas more than 6 million fish<sup>1</sup> were expected. One exception is Harrison sockeye, which returned to the Fraser system significantly above expectation.
- Unlike other recent years when returns to the Fraser were poor, sockeye returns to Barkley Sound and the Columbia system were above expectations. However, returns to the Skeena were also poor.

.../2

<sup>1</sup> Fisheries and Oceans Canada provided a range of forecasts for the abundance of Fraser River sockeye in 2009, from 3.6 million to 37.6 million fish. The most commonly reported forecast is the 50% probability estimate at 10.6 million; i.e. there was a 50% probability that the return would have been greater than 10.6 million sockeye. The 75% probability estimate referenced above was 6.0 million.

- While the explanation for the poor 2009 Fraser return is not known, staff have now considered factors which could have impacted sockeye at different stages of their life cycle as they migrated from their lake-rearing habitats to the Strait of Georgia (spring/early summer 2007), on to the Gulf of Alaska and the Bering Sea and back again to spawn.

#### Analysis / DFO Comment

- The following factors are unlikely to have contributed to the poor 2009 return:
  1. **Pollution in the Fraser River.** There is no record of any Fraser Basin wide environmental incident that could have impacted the fish.
  2. **Capture by Canadian fisheries.** In 2009, the Canadian fishery was minimal and did not contribute to the poor return.
  3. **Predation on juvenile salmon in Strait of Georgia.** There are no known shifts in predator abundance that could explain increased predation in 2007.
  4. **Low food abundance in the Strait of Georgia.** Juvenile sockeye feed on krill. A krill fishery takes place in Jervis Inlet, but it removes a small amount of krill relative to the total krill biomass. Staff will review survey data for any evidence that juvenile sockeye were food deprived.
- The following factors may have contributed to sockeye mortality, but not at a magnitude sufficient to explain the poor return in 2009:
  1. **Predation by Humboldt squid.** Humboldt squid is a voracious predator that has increased dramatically in abundance in Canadian waters since 2007. Salmon have not been identified in their diet. Surveys in 2009 will be analyzed to assess any possible link to salmon.
  2. **Capture by U.S. fisheries.** Fraser sockeye are intercepted in U.S. Gulf of Alaska fisheries and Bering Sea fisheries. The level is not well documented but appears to be very low.
  3. **Mortality attributed to sea lice from fish farms in Discovery Passage.** While sea lice from farms could have contributed some mortality of juvenile sockeye, sea lice from natural sources could also be a factor. Staff are assessing the lice loads on farms at the time of the 2007 migration.
- The following factors could possibly have led to sockeye mortality at the scale observed:
  1. **Toxic algal blooms in the Strait of Georgia.** Extensive blooms of toxic marine algae were identified in the Strait of Georgia during 2007 when juvenile sockeye were present. Staff are working with Vancouver Island University and the aquaculture industry to assess any possible link.
  2. **Low food abundance in Queen Charlotte Sound.** Poor food supply may have impacted the survival of juvenile sockeye in Queen Charlotte Sound in the spring of 2007.






3. **Viral disease.** Preliminary evidence suggests that Fraser sockeye may be infected with a virus that could lead to mortality throughout the salmon life cycle. Staff are conducting further tests to confirm whether or not a virus could be present.

**Next Steps**

- Staff are continuing to assemble data and analyze the key hypotheses which could inform a post season review.
- Studies on the link to a potential viral disease are proceeding and more information is expected within the next month.

  
Claire Dansereau

   DEC 01 2009  
H. James / B. Rashotte/ D. Balfour  
NOV 27 2009



Government of Canada  
Fisheries and Oceans

Gouvernement du Canada  
Pêches et Océans

MECTS # 2009-507-00143

EKME #

FILE / FICHIER # 4910

To: Mme. Claire Dansereau, Deputy Minister  
Pour: Date: **NOV - 2 2009**

Object:

**FACTORS AFFECTING THE 2009 FRASER SOCKEYE RETURN**  
(For the Minister's Information)

From: Paul Sprout, Regional Director General, Pacific Region

*PS* **NOV - 2 2009**

Via: Wendy Watson-Wright, Assistant Deputy Minister, Science

*Sgt Paul for W.W.* **NOV 10 2009**

Via: David Barbour, A/Assistant Deputy Minister, Fisheries and Aquaculture Management

☐ Your Signature  
Votre signature

☒ Information

☐ For Comments  
Observations

☐ Material for the Minister  
Documents pour le Ministre

Remarks: Laura Richards, Regional Director, Science  
Sue Farlinger, Regional Director, Fisheries & Aquaculture Management

*Susan Farlinger* **OCT 08 2009**

**DISTRIBUTION**

Sharan Johal, A/Team Leader, Executive Secretariat

Drafting Officer: L. Richards 250-756-7177

I approve,

*Sgt Paul for W.W.*  
Sylvain Paradis, DG-ESD

**NOV 10 2009**

ACTION REQUEST / FICHE DE SERVICE

From/De:

Allison Webb  
Regional Director  
Policy Branch

Subject/  
Objet:

THE PSC WORKSHOP REPORT "SYNTHESIS OF EVIDENCE FROM A WORKSHOP ON  
THE DECLINE OF FRASER RIVER SOCKEYE"

Docket No. \ N° Dossier:

2010-501-00293

File Code\Indicatif:

Topics:

Pacific Salmon Treaty

Action Sec. resp. :

PAC - RDG Pacific

Info. Sec(s) Informée(s) :

Dated/En date du

2010/09/21

Input/Entrée

2010/09/21

Deadline/Échéance

2010/09/21

ACTION REQUIRED/ SUITE A DONNER

Reply/Réponse	Other/Autre				
( ) for DM's signature/ pour la signature du SM	( ) For info or necessary action/ Pour information ou suite à donner				
	Action Required \Tâches requise	Action Date \ Date d'assign.	Deadline \Échéance	Completed \Complété	
ChargeTo/Délégué à: RDG - PAC/Ivings, Juanita Assignee/Assigné à:	ASSIG	2010/09/21	2010/09/21	2010/09/21	
<div><div>Assigned/Assigné à:</div><div>Action Date/Date d'assign.: 2010-September-21</div><div>Comments/Commentaires: For Melissa's worklist</div></div>					
<div><div>Assigned/Assigné à:</div><div>Action Date/Date d'assign.: 2010-September-21</div><div>Comments/Commentaires: September 21, 2010 - Approved by the RDG, S. Farlinger. To M. Bloom &amp; S. Mithani for approval and forwarding up for the DM's information. E-mailed to M. Chenier, D. Wallace, P. Banville &amp; S. Johal.</div></div>					
ChargeTo/Délégué à: RDG - PAC/Warnock, Melissa Assignee/Assigné à: Warnock, Melissa	ASSIG	2010/09/21	2010/09/21		
ChargeTo/Délégué à: Strategic Policy / Politiques stratégiques Assignee/Assigné à: Strategic Policy / Politiques stratégiques	APP	2010/09/22	2010/09/21	2010/09/27	
<div><div>Assigned/Assigné à:</div><div>Action Date/Date d'assign.: 2010-September-22</div><div>Comments/Commentaires: Received and submitted to EA. OSS, please note that ADM-SPS will approved first and we will forward the docket to ADM-OSS for approval. (pb)</div></div>					
<div><div>Assigned/Assigné à:</div><div>Action Date/Date d'assign.: 2010-September-22</div><div>Comments/Commentaires: SPP: please review/comments prior to ADM's approval - due by cob today in ADMO. Printed document in your folder for pick up. (pb)</div></div>					
<div><div>Assigned/Assigné à:</div><div>Action Date/Date d'assign.: 2010-September-23</div><div>Comments/Commentaires: received and submitted to EA. (pb)</div></div>					
<div><div>Assigned/Assigné à:</div><div>Action Date/Date d'assign.: 2010-September-27</div><div>Comments/Commentaires: OSS: will be hand delivered shortly to your folder in DMO for ADM's approval for today if possible. (pb)</div></div>					
ChargeTo/Délégué à: Oceans and Science / Océans et Science Assignee/Assigné à: Oceans and Science / Océans et Science	APP	2010/09/21	2010/09/21		



Government of Canada  
Fisheries and Oceans

Gouvernement du Canada  
Pêches et Océans

MECTS # 2010-501-00293  
EKME # 2223150  
FILE / FICHIER #

To: Claire Dansereau, Deputy Minister  
Pour:

Date: **SEP 21 2010**

Object: **THE PACIFIC SALMON COMMISSION  
WORKSHOP REPORT "SYNTHESIS OF EVIDENCE FROM  
A WORKSHOP ON THE DECLINE OF FRASER RIVER SOCKEYE"**

Objet:

From / De: Susan Farlinger, Regional Director General

*Susan Farlinger* **SEP 21 2010**

Via: Mitch Bloom, ADM Policy

**SEP 27 2010**

Via: Siddika Mithani, ADM Science

**SEP 27 2010**

☐ Your Signature  
Votre signature

☒ Information

☐ For Comments  
Observations

☒ Material for the Minister  
Documents pour le Ministre

Remarks:

Remarques: Paul Macgillivray, Associate Regional Director General  
Laura Richards, Regional Director Science

*pm*  
*see attached*

**DISTRIBUTION** Sharan Johal, Team Leader - Executive Secretariat

Drafting Officer/ Rédacteur: M. Saunders/L. Richards



SEP 21 2010

Your file      Votre référence

2010-501-00293  
Our file      Notre référence  
EKME # 2223150

BRIEFING NOTE FOR THE DEPUTY MINISTER

**THE PACIFIC SALMON COMMISSION  
WORKSHOP REPORT “SYNTHESIS OF EVIDENCE FROM  
A WORKSHOP ON THE DECLINE OF FRASER RIVER SOCKEYE”**

(Information Only)

**SUMMARY**

- The Pacific Salmon Commission (PSC) convened a workshop in June 2010 to examine the decline of Fraser River sockeye.
- An expert panel of eleven scientists, chaired by Dr. Randall Peterman (Simon Fraser University), listened to evidence from 25 invited experts who gave presentations on the Fraser sockeye situation and possible explanations.
- The workshop report was released on the PSC website on September 2, 2010.
- The report includes an examination of the plausibility of causes examined and recommends future research and monitoring. Physical and biological conditions inside the Strait of Georgia and freshwater/marine pathogens (viruses, bacteria and/or parasites) are considered to be major contributors to the poor return in 2009 and to the overall decline of Fraser River sockeye.
- Canadian and United States Commissioners will discuss the workshop report at the PSC Executive Session in Kamloops, October 19-21, 2010.

.../2

## **Background**

- Canada and the United States have established a close working relationship under the PSC and during the past decade have worked collaboratively to address issues related to Pacific salmon management.
- During the PSC Executive Meeting, October 20-21, 2009, Commissioners from both sides recognized the 2009 sockeye salmon decline as an important issue requiring further investigation. The United States pledged resources to support a review.
- Between February and May 2010, Canadian and United States representatives developed the review process, including terms of reference for a workshop, invited speakers and an expert panel tasked with preparing a summary report. The PSC Secretariat agreed to provide administrative support.
- The workshop was held in Nanaimo, June 15-17, 2010, with an expert panel of eleven scientists (one from DFO) chaired by Dr. Randall Peterman (Simon Fraser University) and 25 invited experts. The workshop was structured around possible alternative hypotheses for the decline in abundance of Fraser River sockeye. Fisheries and Oceans Canada (DFO) staff gave ten of the 18 presentations which described the evidence for/against these various hypotheses.
- Observers from the Cohen Commission, First Nations, Environmental Non-governmental organization's (ENGO), and commercial and recreational fish interests attended the workshop but did not participate in the dialogue.
- The expert panel report, entitled "Synthesis of Evidence from a Workshop on the Decline of Fraser River Sockeye", was released on the PSC website on September 2, 2010.

## **Analysis / DFO Comment**

- According to the workshop report it is very likely that physical and biological conditions inside the Strait of Georgia and freshwater/marine pathogens (viruses, bacteria and/or parasites) are major contributors to the poor return in 2009 and to the overall decline of Fraser River sockeye.
- Other mechanisms that were considered to be contributing factors to both the poor return in 2009 and the overall decline include harmful algal blooms in the southern Strait of Georgia; delayed density-dependent mortality (poorer survival of offspring from larger returns of spawners); and competition between pink salmon and Fraser River sockeye.
- Other factors were also assessed and are summarized in the attached chart.

**Recommendations / Next Steps**

- DFO will continue to build on the findings of the PSC workshop, incorporating the results of the strong 2010 Fraser sockeye return and 2010 research results. In addition, DFO will develop a research plan, supplementing some of the suggestions in the report with other knowledge gaps related to an improved understanding and forecasting ability.
- Canadian and United States Commissioners will discuss the workshop report at the PSC Executive Session in Kamloops, October 19-21, 2010.

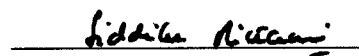
*Sue Farlinger*  
Regional Director General  
Pacific Region

We approved,



SEP 27 2010

Mitch Bloom  
Assistant Deputy Minister, Strategic Policy



SEP 27 2010

Siddika Mithani  
Assistant Deputy Minister, Oceans and Sciences

**Attachment (1)**

- Table E-1 from the Report on the Pacific Salmon Commission's Workshop on the Decline of Fraser River Sockeye Salmon

M. Saunders/L. Richards

**Table E-1.**

The Expert Advisory Panel's judgment of the relative likelihood that a given hypothesis was either a major factor in, or merely contributed to, the observed spatial and temporal patterns in productivity of Fraser River sockeye populations. These likelihoods are based on evidence presented at the workshop, during subgroup discussions, and Panelists' background knowledge. The top row for each hypothesis reflects conclusions with respect to overall productivity patterns (i.e., over the long term). Shading of multiple cells reflects a range of opinions among Panel members. The second row considers just the 2009 return year. The colour of shading reflects the Panel's conclusion about the degree of importance: **black** = major factor; **grey** = contributing factor. The strength-of-evidence column reflects the quantity and quality of data available to evaluate each hypothesis/stressor. Panel members made their best judgments of the relative likelihood of each hypothesis, given the available evidence.

Hypothesis	Time Period	Strength of evidence	Relative likelihood that each hypothesis caused observed changes in productivity during the indicated time period				
			Very Likely	Likely	Possible	Unlikely	Very Unlikely
1a. Predation by marine mammals is an important contributor to the Fraser sockeye situation (Section 4.1).	overall	Fair					
	2009	Fair					
1b. Unreported catch in the ocean outside of the Pacific Salmon Treaty area is an important contributor to the Fraser sockeye situation (Section 4.1).	overall	Good					
	2009	Good					
2. Marine and freshwater pathogens (bacteria, parasites, and/or viruses), are important contributors to the Fraser sockeye situation (Section 4.2).	overall	Fair					
	2009	Fair					
3a. Ocean conditions (physical and biological) <u>inside</u> Georgia Strait are important indicators of contributors to the Fraser sockeye situation (Section 4.3).	overall	Fair					
	2009	Good					
3b. Ocean conditions (physical and biological) <u>outside</u> Georgia Strait are important indicators of contributors to the Fraser sockeye situation (Section 4.3).	overall	Fair					
	2009	Fair					
4. Harmful algal blooms in the Strait of Georgia and/or northern Puget Sound/Strait of Juan de Fuca are an important contributor to the Fraser sockeye situation (Sec 4.4).	overall	Fair					
	2009	Fair					
5. Contaminants in the Fraser River and/or Strait of Georgia are an important contributor to the Fraser sockeye situation (Section 4.5).	overall	Poor					
	2009	Poor					
6. Freshwater habitat conditions in the Fraser River watershed are an important contributor to the Fraser sockeye situation (Section 4.6).	overall	Fair					
	2009	Fair					



Hypothesis	Time Period	Strength of evidence	Relative likelihood that each hypothesis caused observed changes in productivity during the indicated time period				
			Very Likely	Likely	Possible	Unlikely	Very Unlikely
7. Delayed density dependent mortality is an important contributor to the Fraser sockeye situation (Section 4.7).	overall 2009	Fair					
		Fair					
8a. En-route mortality during upstream migration is an important contributor to the Fraser sockeye situation (Section 4.8). En-route mortality is already considered in estimates of total recruits, so while potentially strongly affecting <i>spawner abundance</i> , this hypothesis cannot explain declines in <i>recruits per spawner</i> .	overall 2009	Good					
		Good					
8b. The effects of en-route mortality on fitness of the next generation is an important contributor to the Fraser sockeye situation (Section 4.8).	overall 2009	Poor					
		Poor					
9. Competitive interactions with pink salmon are important contributors to the Fraser sockeye situation (Section 4.9).	overall 2009	Fair					
		Fair					



Government of Canada  
Fisheries and Oceans

Gouvernement du Canada  
Pêches et Océans

MECTS #: 2011-507-00025

EKME #: 2346573

To: Claire Dansereau, Deputy Minister  
A:

Date:

MAR 08 2011

MAR 10 2011

Subject:  
Objet:

**FIRST EVIDENCE OF  
CANADIAN SOCKEYE SALMON REARING IN THE BEARING SEA**  
(INFORMATION ONLY)

Via M. Pearson, Director General, International Affairs

MAR 08 2011

Via S. Mithani, Assistant Deputy Minister, Oceans and Science

MAR 07 2011

From: S. Farlinger, Regional Director General, Pacific Region

MAR 04 2011

☐ Your Signature  
Votre signature

☒ Information

☐ For Comments  
Observations

☐ Material for the Minister  
Documents pour le Ministre

Remarks:  
Remarques: L. Richards, Regional Director Science, Pacific Region - Approved

**DISTRIBUTION**

S. Johal, A/Team Leader, Executive Secretariat

MAR - 9 2011

I approve,

Mitch Bloom, ADM, Strategic Policy

SEEN BY DH  
MAR 21 2011

Drafting Officer / Rédacteur: Laura Richards (250) 756-7177



Government of Canada  
Fisheries and Oceans

Gouvernement du Canada  
Pêches et Océans

MECTS #: 2011-507-00025  
EKME #: 2346573

To:  
A: Claire Dansereau, Deputy Minister

Date:

MAR 02 2011

MAR 10 2011

Subject:  
Objet:

**FIRST EVIDENCE OF  
CANADIAN SOCKEYE SALMON REARING IN THE BEARING SEA**  
(INFORMATION ONLY)

Via M. Pearson, Director General, International Affairs

Via S. Mithani, Assistant Deputy Minister, Oceans and Science

From: S. Farlinger, Regional Director General, Pacific Region

MAR 02 2011

☐ Your Signature  
Votre signature

☒ Information

☐ For Comments  
Observations

☐ Material for the Minister  
Documents pour le Ministre

Remarks:  
Remarques: L. Richards, Regional Director Science, Pacific Region - Approved

**DISTRIBUTION**

S. Johal, A/Team Leader, Executive Secretariat

Drafting Officer / Rédacteur: Laura Richards (250) 756-7177



Fisheries and Oceans  
Canada

Pêches et Océans  
Canada

Assistant  
Deputy Minister  
Oceans and Science

Sous-ministre  
adjointe  
Océans et sciences

MAR 08 2011

Your file      Votre référence  
MECTS 2011-507-00025

Our file      Notre référence  
EKME # 2346573

MEMORANDUM FOR THE DEPUTY MINISTER

**FIRST EVIDENCE OF  
CANADIAN SOCKEYE SALMON REARING IN THE BERING SEA**

(INFORMATION ONLY)

**SUMMARY**

- New research by Fisheries and Oceans scientists demonstrating that some Canadian-origin sockeye salmon rear as juveniles in the Bering Sea will be published in the journal *Transactions of the American Fisheries Society*.
- Although the sample size is very small (17 fish), the majority of Canadian-origin sockeye were from stocks of concern. The link to stocks of concern is not made in the paper itself but could be inferred by knowledgeable readers.
- The presence of Canadian-origin sockeye in the Bering Sea is not surprising given that salmon are expected to extend their migrations northward with global warming.
- The dominance of stocks of concern in the sample was unexpected, and could lead to speculation that environmental factors in the Bering Sea play a role in their production and recovery. These sockeye could also be vulnerable to harvest in Alaskan fisheries.
- A communication plan is being developed.
- We will continue to improve the engagement of the United States on the implications of these results.

...2

2011-507-00025 FIRST EVIDENCE OF CANADIAN SOCKEYE SALMON REARING IN THE BERING SEA

### **Background**

- New research by Fisheries and Oceans scientists demonstrates that some Canadian-origin sockeye salmon rear as juveniles in the Bering Sea.
- A paper detailing the findings will be published in the journal *Transactions of the American Fisheries Society*, likely in May or June.
- The researchers obtained genetic samples from 450 juvenile sockeye caught during a 2009 Japanese research cruise in the Bering Sea and found that 17 (3.8%) of the sockeye were of Canadian origin. The paper is a straight forward report of these results.
- Although the sample size is very small, the majority of Canadian-origin sockeye were from stocks of concern, including Babine Lake, River's Inlet, Cultus Lake and Early Stuart. The link to stocks of concern is not made in the paper itself but could be inferred by knowledgeable readers.

### **Analysis / DFO Comment**

- The presence of Canadian-origin sockeye in the Bering Sea is not surprising given that salmon are expected to extend their migrations northward with global warming.
- The dominance of stocks of concern in the sample was unexpected, and could lead to speculation that environmental factors in the Bering Sea play a role in their production and recovery. These sockeye could also be vulnerable to harvest (both directed and bycatch) in Alaskan fisheries.
- The Cohen Commission of Inquiry, the Pacific Salmon Commission, First Nations, Non-Government Organizations and salmon fishing sectors are all expected to have a strong interest in these speculations.
- No data are currently available to examine these questions further, largely because Canada has been unsuccessful to date in obtaining DNA samples from Alaskan domestic fisheries. Analyses conducted by Alaskan scientists have not provided sufficient resolution to identify Canadian-origin sockeye.
- Staff have similarly been unsuccessful in obtaining DNA samples for stock identification of Canadian-origin chum and Chinook stocks in Alaskan domestic fisheries.

### **Recommendations / Next Steps**

- DFO Science will identify the highest priority samples required to improve our understanding of the impact of Alaskan domestic fisheries on Canadian-origin sockeye, chum and Chinook salmon.

- Pacific Region will work with International Directorate to improve a strategy for the engagement of the United States on sample collection and potential issues around bycatch for northern salmon fisheries.
- Communications materials are being prepared to put this study in context.

*Siddika Mithani*

Siddika Mithani

*Michael Pearson*

MAR 08 2011

Michael Pearson

Mark Saunders/Laura Richards/Susan Farlinger