

**From:** Saunders, Mark  
**Sent:** Wednesday, December 9, 2009 12:33 AM  
**To:** Hargreaves, Brent <Brent.Hargreaves@dfo-mpo.gc.ca>  
**Cc:** Tompkins, Arlene <Arlene.Tompkins@dfo-mpo.gc.ca>  
**Subject:** FW: Revised Ministerial Memo  
**Attach:** Revised FINAL per ADMO Dec7\_ms.doc

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Brent,

Here is the disease BN.

Mark

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**From:** Saunders, Mark  
**Sent:** December 8, 2009 11:49 AM  
**To:** Richards, Laura  
**Cc:** Luch, Gloria  
**Subject:** RE: Revised Ministerial Memo

Laura,

Modified first bullet in summary and background.

Your thoughts?

Mark

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**From:** Luch, Gloria  
**Sent:** December 8, 2009 10:13 AM  
**To:** Saunders, Mark  
**Subject:** FW: Revised Ministerial Memo

As requested.

[gloria](#)

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**From:** Saunders, Mark  
**Sent:** November 30, 2009 4:38 PM  
**To:** Ivings, Juanita  
**Cc:** Gwin, Judy; Richards, Laura; Ross, Cheryl; Luch, Gloria  
**Subject:** Revised Ministerial Memo

Hi Juanita,

Attached is the revised memo. Judy received clarification from the DM's office. Laura has approved these changes.

Mark

UNCLASSIFIED

2009-507-00157  
EKME # 1005010v2

MEMORANDUM FOR THE MINISTER

**BRAIN LESIONS FOUND IN SOUTHERN BC SALMON STOCKS**

(Information Only)

**SUMMARY**

- In a previous briefing note, disease was suggested as one of many possible factors which could have led to the poor returns of Fraser sockeye in 2009. This note describes one emerging disease factor.
- Over the past five years, Pacific Region Science staff have conducted genomic studies on Fraser sockeye. These studies documented an association between poor survival of adult migrating sockeye salmon and a particular pattern of gene responses which control physiological responses and could indicate viral activity.
- In 2009 research studies, sockeye salmon were also found to exhibit brain lesions. Lesions were first detected for samples from 2006, a year when 13 million sockeye returned to the Fraser River.
- In subsequent examinations, DFO staff found lesions in the brains of southern BC coho, chinook, and sockeye salmon across a range of life stages and sample years. The gene response pattern has also been observed across species.
- The gene response pattern and the presence of lesions have not been directly linked, but are thought to be related to a viral infection. Molecular screening to date has not yielded a positive identification. Parasitic infections are also likely present.

- Analysis is ongoing. However, given its widespread distribution, the disease agent is thought to be endemic.
- Disease usually acts in combination with other factors (e.g., warm water conditions) rather than cause mortality directly.

## **Background**

- In a previous briefing note, disease was suggested as one of many possible factors which could have led to the poor returns of Fraser sockeye in 2009. This note describes one emerging disease factor. Work is continuing in the Region to assess the other factors and information will be provided as it becomes available. Two forthcoming notes will describe the progress on studies into the potential impacts of sea lice and changes in food availability for juvenile sockeye.
- Disease is likely to act in combination with other factors, rather than cause mortality directly. The virulence of pathogens can depend upon the level of stress of the fish (for example, chronically stressed because of high river temperatures). Also, non-lethal infections can weaken immunity and increase the susceptibility of fish to other pathogens and to predation.
- In the context of earlier Fraser sockeye studies using biotelemetry and genomics, DFO staff associated poor survivorship of adult migrating salmon with a particular pattern of gene responses which is consistent with a viral infection. Sockeye salmon carrying this signature pattern in 2006, a year of high sockeye returns, experienced 30-60% higher en-route and pre-spawning mortality in the river than salmon that did not show the gene response pattern. The pattern was detected in 2006 sockeye sampled up to 300 km seaward of the Fraser River and has been observed in gill, liver and brain tissue.
- Staff then examined older samples, beginning with 2003, and found the gene response signature in return migrating sockeye salmon. A variable proportion of fish were affected each year. In 2005, the brood year for the 2009 return, 75% of the sampled adults contained this signature.
- Subsequently, brain dissections (in 2009) revealed that 30-40% of adult migrating sockeye salmon in 2006 contained lesions in their optic lobe. The cause of the gene response patterns and the lesions is still under investigation, but could be associated with tumors and/or viral infections.
- For 2008 samples, (brain dissections undertaken in September 2009) revealed similar lesions in 50-60% of adult sockeye salmon in the marine approaches and lower Fraser River, but in only 20% of fish at the spawning grounds, suggesting an association between the presence of lesions and en-route mortality. For 2009 samples, brain dissections revealed lesions in over 70% of the sockeye salmon in the marine approaches, in 50% in the lower river, and in less than 30% at the spawning grounds.
- Given these results, additional samples of juvenile sockeye collected in 2008 were examined in September 2009. Based on these samples, 50% of Chilko smolts and

80% of Cultus Lake smolts leaving the natal rearing areas in May displayed the gene response pattern. Brain dissections revealed a similar incidence level of lesions.

- Lesions and the brain response pattern were also observed in southern BC coho, chinook, and sockeye smolts sampled in the ocean in June and September/October of 2008 and 2009. For each species in each year, there was a notable decline in incidence between June and September/October (average 40% incidence in June, 10% in September/October), indicating an association with early ocean mortality in all three species.

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

- The widespread observations of lesions and gene response pattern across different species, stocks, life history stages, and sample years suggest that any disease agent is endemic and has been present in salmon populations for some time. In 2006, 13 million salmon returned to the Fraser River despite a high incidence of brain lesions.
- The higher frequency of lesions in 2009 samples is not understood. It could reflect a real increase or be related to stock composition or sample biases. Aquaculture operations are not a factor since lesions and the gene response pattern were found in sockeye smolts before they enter the marine environment.
- The gene response pattern is thought to be related to a virus. A virus from the retroviral family would be consistent with the gene response pattern. However, few retroviruses are described in salmon and no conclusive identification of a specific retrovirus has been made..
- A myxosporean (parasitic) infection has also been found in the brains of sockeye salmon. A few adult sockeye salmon brains were sent to the Animal Health Centre of the BC Government Ministry of Agriculture and Lands for additional review and they found myxosporean spores in 11 of the 12 samples they examined. Myxosporean infections are known to have a significant impact on swimming performance of sockeye smolts.
- The presence of a virus or parasite may not manifest itself as a disease or cause mortalities. Confirmation would require isolation of the disease agent along with a demonstration of infectivity in controlled experiments.
- Although there are no regular disease/fish health screening programs on wild salmon, several different parasites are known to infect adult sockeye salmon as they migrate up the Fraser River.
- The evidence of brain lesions is new and it will take some time to document the geographic extent and to understand a relationship (if any) between a disease agent and mortality.

#### **Recommendations / Next Steps**

- More samples are being analyzed to determine the extent of the pattern observed, for example, whether or not lesions or gene response patterns can be detected in sockeye salmon originating outside of southern BC. Additional research is also attempting to clarify which disease agents might be present.

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Claire Dansereau



Government of Canada  
Fisheries and Oceans

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Pêches et Océans

MECTS # 2009-507-00157

EKME # 1005010v2

FILE / FICHER 2550-2

To: Claire Dansereau, Deputy Minister Date:  
Pour  
Object:

**Brain Lesions Found in Southern BC Salmon Stocks**  
(for the Minister's Information)

From: Paul Sprout, Regional Director General, Pacific Region

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

☐

Your Signature  
Votre signature

☒

Information

☐

For Comments  
Observations

☒

Material for the Minister  
Documents pour la Ministre

Remarks: L. Richards, Regional Director Science, Pacific Region

**DISTRIBUTION:**

S. Johal, A/Team Leader, Executive Secretariat

Drafting Officer : Laura Richards 250-756-7177