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To: Mme. Claire Dansereau, Deputy
Pour: Minister

Date: **DEC 30 2009**

Object:

**POTENTIAL CAUSES OF POOR RETURNS OF FRASER
RIVER SOCKEYE SALMON; WITH FOCUS ON SEA LICE IMPACTS**

(for the Minister's Information)

From: Paul Sprout, Regional Director General, Pacific Region *JSW* **DEC 30 2009**

Via: Sylvain Paradis, A/Assistant Deputy Minister, Science

Via: David Balfour, A/Assistant Deputy Minister, Fisheries & Aquaculture Mgmt.

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☒ Information

☐ For Comments
Observations

☒ Material for the Minister
Documents pour la Ministre

Remarks: L. Richards, Regional Director Science, Pacific Region - *approved*
Sue Farlinger, Regional Director FAM, Pacific Region *BA* **DEC 30 2009**

DISTRIBUTION:

S. Johal, A/Team Leader, Executive Secretariat

Drafting Officer : Laura Richards 250-756-7177

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MEMORANDUM FOR THE MINISTER

**POTENTIAL CAUSES OF POOR RETURNS OF FRASER
RIVER SOCKEYE SALMON; WITH FOCUS ON SEA LICE IMPACTS**

(Information Only)

SUMMARY

- In a previous briefing note, ten factors were listed which could have led to the poor returns of Fraser sockeye in 2009. This note elaborates on one of those factors: the potential impacts of sea lice.
- The most likely time when sea lice could have impacted the survival of these sockeye was in 2007, when the juvenile sockeye first entered the ocean.
- Analyses of preliminary data DFO recently obtained from fish farms in the Discovery Islands region indicates that sea lice impacts likely did not contribute significantly to the low return of Fraser sockeye in 2009.
- Recently, DFO has requested sea lice and fish disease data from the fish farms operating in all areas of the BC coast.
- DFO staff will analyze these additional data to assess if either sea lice or disease from fish farms in any location in BC could have significantly contributed to the low returns of Fraser sockeye in 2009.

Background

- A previous briefing note (2009-507-00143, copy attached) identified a number of possible factors which could have contributed to the poor returns of Fraser sockeye in 2009. These factors were:
 - Most likely – toxic algal blooms in the Strait of Georgia, low food abundance in Queen Charlotte Sound and disease,
 - Possible – predation by Humboldt squid, interception by US fisheries, **sea lice from farms in Discovery Passage**,
 - Unlikely – pollution in Fraser River, Canadian fisheries, predation on juvenile salmon in the Strait of Georgia, low food abundance in the Strait of Georgia.

- Work is continuing in Pacific Region to assess each of these factors and further information will be provided as it becomes available. Science teams have been formed to focus on each of three high profile and/or likely causes; a disease-related event, interactions with aquaculture (sea lice), and low food abundance in Queen Charlotte Sound (as well as in the Strait of Georgia).
- This note describes the potential impacts of sea lice. A previous note (MECTS 2009-507-00157) considered one emerging disease factor, and a forthcoming note will describe the progress on food abundance.
- Various groups including environmental organizations have speculated that sea lice from commercial fish farms are a major contributing factor to the low return of Fraser sockeye in 2009.
- In a letter to The Globe and Mail, in August 2009, Paul Sprout, RDG Pacific Region, stated: "Sea lice from fish farms are not the explanation for this year's extremely poor marine survival of Fraser River sockeye."
- More recently, one of the main conclusions from a two-day "think tank" meeting of salmon experts, organized by Simon Fraser University and the Pacific Fisheries Resource Conservation Council, was that a better understanding was still required of the potential for transmission of sea lice and disease from farmed salmon to wild salmon.
- Sea lice naturally infect all species of Pacific salmon. Historically, and long before any fish farming began in BC, most adult salmon that returned to spawn throughout BC have been infected with sea lice. Infection of the adult fish by sea lice has rarely resulted in any mortality or fish health concerns.
- The most likely time when sea lice from fish farms could have impacted the survival of the Fraser sockeye that returned in 2009 was in 2007, when the juvenile sockeye first entered the ocean.
- To examine this possibility DFO focused on fish farms in the Discovery Islands region of BC, because this area was identified by various environmental groups as the area of most concern for juvenile Fraser sockeye.
- Under BC Provincial regulations all fish farms in BC have been required since 2003 to regularly monitor and report sea lice infection levels of farmed salmon.
- Independent audits (fish sampling) of sea lice infections on all fish farms are routinely conducted by the BC Government to validate the sea lice infection data that are provided by the fish farm companies.

Analysis / DFO Comment

- With assistance from the Province of BC, DFO obtained sea lice data from the companies that operate fish farms in the Discovery Islands region.

- The data were compared for sea lice infection levels that occurred on the fish farms in the Discovery Islands from 2004-2008, for the period from April – June when most juvenile sockeye from the Fraser River were likely migrating past the fish farms in this region.
- The sea lice levels on age-1 farmed fish in 2007 were the lowest observed from 2004 - 2008.
- The sea lice levels on age-2 farmed fish in 2007 were similar to the levels that occurred in 2006, and substantially lower than the levels that occurred in 2004, 2005 and 2008.
- Overall, these results indicate that nothing unusual occurred regarding sea lice infections on the fish farms operating in the Discovery Islands region during April – June in 2007.
- While we cannot rule out the possibility that sea lice contributed to some mortality of juvenile sockeye in 2007, analysis of these preliminary data indicates that any mortality should have been similar to previous years. Thus, sea lice on fish farms operating in the Discovery Islands region likely cannot account for the unusually poor return of adult sockeye to the Fraser River in 2009.
- The sea lice data DFO used for this preliminary analyses represent the averaged results for all the fish farms that were operating in the region. However, the sea lice levels on some individual fish farms may have been higher than these averaged results indicate.
- The current DFO results are restricted to fish farms in the Discovery Islands region, and do not provide any information about sea lice levels on fish farms located in other regions of BC that might have impacted Fraser sockeye.

Recommendations / Next Steps

- DFO has requested more extensive sea lice and fish disease data from industry for all fish farms in BC.
- DFO staff will analyze these additional data to assess if either sea lice or disease from fish farms in any location in BC could have significantly contributed to the low returns of Fraser sockeye in 2009.

Claire Dansereau
Deputy Minister

Attachment (1) - MECTS 2009-507-00143

B. Hargreaves/ M. Saunders/ A. Tompkins / L. Richards/ A. Thomson/ P. Sprout

(Attachment)

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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 fish¹ 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.

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- While the explanation for the poor 2009 Fraser return is not known, staff have now

¹ 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.

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.

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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

H. James / B. Rashotte/ D. Balfour