

2009 Fraser Sockeye Summary of Hypotheses/ Issues

		Hypothesis	Where?	Life stage	When? (calendar)	Evidence for/supporting	Evidence against	Likelihood?	Next steps/ comments
FW	H1	growth/survival failure in nursery lakes	interior lakes	Fry / smolt	2006 / 2007	Quesnel fall fry size smaller than usual	Chilko Lake shows massive outmigration and 2009 SR returns close to target suggested by escapement	NO - inconsistent with direct measurements	Robie warns of lake exposure that manifests itself later - c.f Fairchild et al
	H2	Exposure to pollutants in freshwater / downstream migration	Fraser River - PG - Steveston	smolt(?)	Spring 2007	1) other sockeye population with long FW migration (Skeena; possibly Nass) have done poorly 2) Fraser early & summer stream type chinook have performed poorly in recent years (2006 & 2007 sea entry)	Okanagan lake sockeye did fine,		Peter Ross looking at some contaminants issues in the Fraser basin
SoG	H3	High mortality in SoG - SoG disease		early juvenile	June / July 2007	1) Very low abundance in Beamish survey	1) Harrison Lake sockeye that entered SoG one month later did great		
	H4	High Mortality in SoG - SoG HAB		early juvenile	June / July 2007	1) Very low abundance in Beamish survey 2) High phytoplankton biomass in June 2007 SoG cruise (Pena) 3) "red -water" reported May - June 2007 4) Rensel and Tynan hypothesized that heterosigma (and others) blooms could kill wild fish 5) SoG coho that went to sea in spring 2007 did poorly 6) Puget Sound and coastal Stocks are below projections	1) Harrison Lake entered SoG later, large catches in juvenile surveys in Sept These stocks primarily migrate north along WCVI	species - Noctiluca, Heterosigma, Chaetoceros? look at sediment trap data?	
	H5	High mortality of SoG - SoG predators		early juvenile	June / July 2007	1) Very low abundance in Beamish survey	1) Harrison lake sockeye that entered SoG one month later did great		not sure anyone has actually suggested this
	H6	High mortality (food web related) in SoG	SoG	early juvenile	June / July 2007	1) Very low abundance in Beamish survey			
Discovery Islands	H7	sea lice loads picked up in Discovery Passage caused subsequent marine mortality	Discovery Passage - on exit from SoG	early juvenile	July / Aug?	CAA reports juvenile sockeye with sea lice in 2007 & 2008	1) Jones et al research on pinkis(?) suggest lice are not particularly harmful to fish of this size 2) pink declines observed in 2008 (sea entry 2007) were coast wide to Alaska with exception Adani, Quinsam & Phillips R. (migration timing may be earlier than SX) 3) Beamish reports all juvenile salmon sampled in spring 2008 in S SoG were infected with Caligus diemensi		
QC Sound	H8	High mortality (food web related) along marine migration route (outside of SoG)	QC Sound/Hecate Strait		month?	1) Very poor seabird survival at Triangle island - correlated with plankton/forage fish in QC sound 2) also explains failure of Fraser River sockeye returns in 2007	1) Not observed for Harrison Lake, Barkley Sound, Smith Inlet/Long Lake, Quatse, Nimpkish or Heydon. These stocks may have migrated elsewhere 2) other oceanographic conditions (biased to WCVI) appear favourable to salmon survival 3) WCVI sockeye stocks did fine 4) data from Trudel indicate that Fraser sockeye stocks are intermingled with Barkley and Smith Inlet sockeye on the North Coast by fall.	Any information on migration route of Harrison sockeye? Are Fraser sockeye in QC sound at the right time?	
Alaska	H9	High mortality (food web related) along marine migration route (SEAK and GoA)				Possible competition with Bristol Bay Sockeye and Asian chum stocks, which are in very high abundance	would require differential impacts on stocks that are thought to be mixed together in this area		
	H10	interception in US (Alaska) Fisheries		returning adults		1) Fraser Sockeye ARE know to be intercepted in AK fisheries. 2009 North Peninsula fishery was 2.24M. South Peninsula was 1.62M. 1.13M Chignik and 1.57M (?).	requires a much higher than normal percentage catch by AK(?)	sockeye salmon samples from 2009 - Bering and Chukchi Seas - to be analysed by Beacham to determine Canadian component	
BC	H11	caught in canadian fisheries		returning adults			no directed Canadian commercial or recreational fisheries for Fraser sockeye in 2007 or 2008. Minimal FSC harvest	none	
FW	H12	warm river waters delays entry of returning adults to the Fraser River, exposing them to HABs	Fraser Plume	returning adults		presence and timing of Heterosigma (and other HAB species) that are known to have impacts of fish	test fisheries previously determined that very few adults were returning/getting to the mouth of the Fraser.	very low	NA in this case, mortality occurring earlier
	H13	warm river waters resulted in high en route in-river mortalities	Fraser River	returning/ spawning adults		FR Environmental Watch has good tracking/measurements	test Fisheries previously determined that very low marine abundance		NA in this case, mortality occurring earlier

Identified Issues:

- 1 Existing Ocean indicators are relatively weak at tracking Chilko marine survival
 - 2 why are there no longer returning jacks?
 - 3 pattern of poor returns is NOT similar to 2007/2008 returns . These low returns tended to be BC coast wide. We are not seeing a coast-wide pattern
 - 4 survival estimates for Chilko and Quesnel are so much lower than the long term average estimates (0.2% compared to 9%) suggest a "one-time" mortality event, occurring before stocks are mixed (spring and summer); which in turn, suggests geographic locations in the river, lower estuary, SoG or QC sound
 - 5 Need to identify age & brood year for Harrison Lake returns in 2009
 - 6 Harrison Lake sockeye populatons are a bit of an enigma. They have been increasing in the 1990s when other Fraser popultions have done poorly.
 - 7 Our HAB information is very weak.
 - 8
- more/better ocean indicators, including SoG?

Things that might be worth looking into:

1 Robie M./Peter Ross - a contaminant exposure in the lake (endocrine disruptors?) might NOT manifest itself until the smolts (try) to go through some hormonal transformation (hit salt water?) . There is a model for this in Atlantic salmon - Wayne Fairchild's work on nonyl phenol ethoxylates used as an adjunct vehicle for aerial spaying of NB forests. Can't rule out a lake exposure that showed up as later mortality.

2 Robie/Sophie - sediment trap data in the SoG. HAB (cells or pigments?)

3 Svein/Dave Patterson/ Jeremy Hume: anything useful from moorings in Quesnel lake?

4 stock specific migration routes & timing

5 stock-specific growth rates & condition

6 fish health observations (diseases, parasites, toxins)

