July 15, 2012

Larry Rutter
NOAA, National Marine Fisheries Service
Northwest Regional Office
7600 Sand Point Way NE,
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Re: Written comments in response to the Effects of Salmon Fisheries on Southern Resident Killer Whales: Draft Report of the Independent Science Panel

Dear Mr. Rutter,

Please accept this letter as comments from the Raincoast Conservation Foundation on the draft science panel report. Raincoast is a BC based NGO that has been working to protect salmon dependent species and ecosystems of British Columbia's coast for over 15 years. We continue to call on Canada's Department of Fisheries and Oceans to implement a recovery plan that addresses the threats to the southern resident killer whales and maintain our position that this needs to become a priority for Canada's federal government.

Our comments fall into two categories.

1. Conclusions of the panel we believe are not supported by available data, including:

    - the discounting of evidence linking body condition and nutritional stress with Fraser River Chinook abundance,
    - deduction that exploitation rates on Fraser Chinook populations are low (i.e. 20%),
    - deduction that stopping all Chinook fisheries would have a negligible effect on prey availability,
    - deduction that pinnipeds compete with whales for Chinook, but fishermen don't.

2. Important considerations not addressed by the panel including:

    - characterizations of the baseline state of Chinook density and abundance
    - the role of competitive exclusion
    - role of recovering long-depressed Chinook populations
    - Importance of chum salmon in the recovery of southern residents

Correlative and Causal Relationships

The science panel relies heavily on the notion that the relationship between Chinook abundance and SRKW mortality rates is purely correlative. The panel states a lack of evidence to link poor body condition to nutritional stress and expresses skepticism over the use of thyroid hormones to represent nutritional stress without confounding factors. We believe that the weight of evidence from nutritional and stress analysis undertaken on all three pods between 2007 and 2009 clearly suggests that food availability is an important limiting factor in SRKW recovery. Findings from Ayres et al. (2012)[1] show that fecal thyroid hormones exhibit a short-term glucocorticoid (GC) response and a more long-term T3 response to prey availability. Specifically, the temporal pattern in GC concentrations, which rise in response to nutritional and other psychological stressors, closely correspond to relative Fraser River Chinook abundance (using CPUE at Albion test fishery) from the time the SRKWs arrive in the Salish Sea.

Results from GLMs show Chinook CPUE was the only significant main effect, however less variance was explained if other parameters (like vessel traffic) were removed. The authors concluded that physiological correlations with prey overshadowed impacts of vessels (raised by the panel as a confounding factor in interpreting GC concentrations), as GC was lowest during the peak in vessel abundance, which also coincided with the peak in salmon availability. The authors concluded that prey availability ultimately had a greater physiological impact than vessel traffic.

Although some of this information was presented at workshop I, ancillary information in the paper shows the authors considered age, sex, pod, and individual animals, which expounds on issues raised by the panel. The only strong pattern observed when examining these variables was that females have higher T3 levels (on average) than males, likely due to lactation and pregnancy.

Ayres et al. identify the end of 2007 through 2008 as the poorest overall nutritional state during the study period. The whales left the Salish Sea in 2007 following the most precipitous T3 decline and GC elevation over the three-year period. Their T3 concentrations upon arrival in late spring 2008 were the lowest observed for that time of year and remained low throughout 2008. This period corresponds with the highest number of deaths and lowest number of births and surviving calves observed during the study period. Eight whales went missing from December 2007 through October 2008, two of which were reproductive age females and included a visually emaciated pregnant female.[2]

While all science is provisional and rarely in ecology are causal agents unambiguous, the findings by Ayres et al. provides important and rigorous ancillary information that visual evidence of malnutrition, stress response of thyroid hormones and increased mortality in

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[1] Ayres, K.L., R.K. Booth, J.A. Hempelmann, K.L. Koski, C.K. Emmons, R.W. Baird, K. Balcomb-Bartok, M. B. Hanson, M.J. Ford, and S.K. Wasser. 2012. Distinguishing the Impacts of Inadequate Prey and Vessel Traffic on an Endangered Killer Whale (*Orcinus orca*) Population. PLoS One. Vol. 7:6

[2] in Ayres et al. 2012; Paper In review.

SRKWs have a strong probability of being due to low prey availability. Exposure to POPs and other pollutants may further contribute to poor body condition, as food deprivation promotes fat metabolism and puts stored contaminants into circulation.

Historic abundance of Fraser Chinook

Runs from the upper, middle, lower and Thompson portions of the Fraser watershed have been identified as comprising more than 80% of SRKW diet between May and September (Ford et al. 2010, Hanson et al. 2010, Ford 2011).[3]

Historic abundances of Fraser and other Georgia Strait populations are generally acknowledged to be much higher than contemporary levels. However, an exhaustive analysis by Argue and Sheppard (2005),[4] which scrutinized all Canadian fish processing records from 1823 to 1950, reveals that Canadian returns to the Salish Sea alone were substantially larger than estimates suggested at the workshop (and often elsewhere[5]).

Using figures from Argue and Sheppard (2005), the peak of the Fraser Chinook fishery generally occurred between 1910 and 1920 before a century long decline. When Fraser catches from this 10-year period are combined with those from Georgia Strait and Juan de Fuca, the average Canadian catch from the Salish Sea was about 845,000 Chinook. In 1919, almost 1 million Chinook were taken from the Fraser alone.

Although exploitation rates at this time are purely speculative, a generous 70% harvest would still translate to double the workshop-estimated abundance of Canadian Chinook in the Salish Sea a century ago. It is likely that the density of these populations (mixed with US populations), was an equally important factor (with abundance, staggered run/migration timing and nutritional value) in the dependence that SRKWs developed on Fraser Chinook. Reliable and historical baseline estimates are important context for understanding the potential food availability and prey ratios that southern residents evolved with.

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[3] M. Bradley Hanson, Robin W. Baird, John K. B. Ford, Jennifer Hempelmann-Halos, Donald M. Van Doornik, John R. Candy Candice K. Emmons, Gregory S. Schorr, Brian Gisborne, Katherine L. Ayres, Samuel K. Wasser, Kenneth C. Balcomb, Kelley Balcomb-Bartok, John G. Sneva, Michael J. Ford. 2010. Species and stock identification of prey consumed by endangered southern resident killer whales in their summer range. Endang. Species Res. 11: 69–82

[4] Argue, A.W., and Shepard, M.P. 2005. Historical commercial catch statistics for Pacific Salmon *(Oncorhynchus* spp.) in British Columbia, 1828 to 1950. Can. Tech. Rep. Fish. Aquat. Sci. 2601: 595 p

[5] A substantial percentage of the historic Chinook catch was processed through means other than canning (ie frozen, smoked, brine, salted) which), which distorts catch reconstructions that only examine the cannery pack.

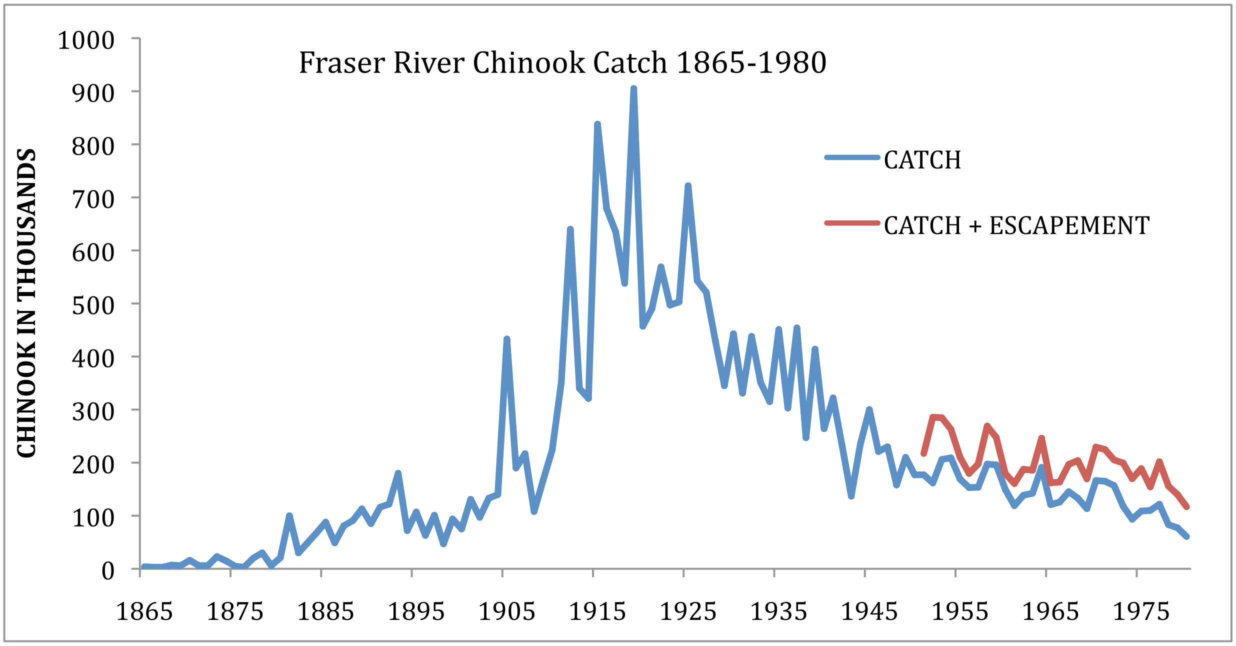

Figure 1. Fraser River Chinook catch 1865 -1950 from records compiled by Argue and Sheppard (2005) and 1950 to 1980 from records compiled by Fraser et al (1982)[6].

As the panel has acknowledged, the abundance and role of other piscivores complicates the picture of predator prey dynamics, as this period also corresponds with the rise of predator control programs on pinnipeds. Between 1913 and 1968, over 55,000 sea lions were killed in BC, reducing the breeding population to about 30% of its previous size.[7] From 1879 to 1968 more than half a million harbour seals were also killed in BC.[8] Since 1970, when the culling programs stopped, the harbour seal population has grown and stabilized at about 110,000 animals coast wide.[9] In the Salish Sea, the recovery of pinnipeds has in turn increased the presence of transient killer whales.[10] Abundance (and frequency) of transients in Georgia Strait increased from less than 50 in 1970s to more than 200 since 2000.[11]

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[6] F.J. Fraser, P.J. Starr, and A.Y. Fedorenko. 1982. A Review of the Chinook and Coho Salmon of the Fraser River. Canadian Technical Report of Fisheries and Aquatic Sciences No. 1126

[7] Bigg, M.A. 1985. Status of the Steller sea lion (*Eumetopias jubatus)* and California sea lion *(Zalophus californianus)* in BC. Spec. Pub. J. Fish. Aq. Sci. No. 77. 20pp; Bigg, M.A. 1988. Status of the Steller sea lion, *Eumetopias jubatus,* in Canada. Can. Field Nat. 102:315-336.

[8] Heise, K.A., N.A. Sloan, P.F. Olesiuk, P.M. Bartier and J.K.B. Ford. 2003. Living marine legacy of Gwaii Haanas. IV: Marine mammal baseline to 2003 and related marine mammal management issues throughout the Haida Gwaii region. Park. Can. Tech Rep in Eco. Sci. 38: 150 p.

[9] Olesiuk, P.F. 1999. An assessment of the status of harbour seals (*Phoca vitulina*) in British Columbia. CSAS Res. Doc. 99/033:

[10] Ford, J.K.B., G.M. Ellis, J.W. Durban. 2007. Recovery potential analysis for west coast transient killer whales using coastal waters of British Columbia. Canadian Stock Assessment Secretariat Research Document 2007/088: 35 p.

[11] Strait of Georgia Ecosystem Research Initiative. 2011. Blueprint for Synthesis and Integration. http://www.pac.dfo-mpo.gc.ca /science/oceans/detroit-Georgia strait/documents/SofG%20ERI%20Blueprint%20for %20Integration %20REVISED% 202011jul06.pdf

The Georgia Strait Ecopath with Ecosim model emulates the timing, direction and magnitude of changes in species like herring, seals, killer whales and salmon. According to Preikshot and Perry[12], shifts in pinniped predation are captured in EwE modeling of Georgia Strait, which suggests that as Chinook exploitation rates by fishermen declined in recent years the force of natural mortality from pinnipeds replaced fishing pressure as the primary mortality. They suggest (under the highest pinniped impact scenario) that consumption by harbour seals and sea lions may be on par with killer whales. This translates to upwards of 100,000 Chinook being eaten in the Salish Sea by pinnipeds. This is also in the neighborhood of the average *marine* catch between 2000 and 2009 of Chinook destined for the Canadian side of the Salish Sea (~130,000).[13] Terminal exploitation within the Fraser adds to this figure.

Even if predation rates from recovering pinnipeds in the Salish Sea have doubled in the last decade, these levels of predation cannot be considered significant and a potential limiting factor for whale recovery while equal to higher levels of fishing exploitation is dismissed as insignificant. It cannot be reasonably concluded that seals and sea lions compete for Chinook and fishermen do not.

Exploitation rates on Fraser River Chinook populations

The panel characterizes the exploitation rates on Chinook as being quite low (20%) and thus subjectively concludes fishery closures would do little to increase Chinook abundance. We find this completely unsubstantiated and are deeply concerned that the panel would narrow the scope of "harvest impacts" to only the marine exploitation of some populations as they move through the Salish Sea. Considering the panel's willingness to examine much larger predator prey dynamics, this is unmistakably a selective extraction of available harvest data and related impacts.

Diet studies show that SRKW summer food is constituted largely of Chinook from the upper, middle, lower and Thompson portions of the Fraser watershed.[14] The river-types of these populations stagger their Fraser entries across spring, summer and fall run timings that include Spring 5_2 and 4_2, Summer 5_2 and Fall 4_2 management units. The ocean- type populations (sub one) return in the summer and fall. Over the last eight years returns of the spring and summer stream-types have (further) declined, in some cases steeply. Marine and terminal exploitation rates on spring and summer river-type Chinook in the last decade were between 50% and 60%.[15] Despite objectives to lower this, the conservation based Management Zone 2 (currently in effect), still allows a total

[12] Presentation at Workshop II: Interactions between marine mammals and Chinook salmon in a Strait of Georgia ecosystem model. Vancouver BC

[13] Using the marine catch component for stocks returning to Georgia Strait and the Fraser taken from Lavoy, L. 2011. Chinook Salmon Fishery Profiles Supplement to the Bilateral Scientific Workshop to Evaluate Effects of Salmon Fisheries on Southern Resident Killer Whales.

[14] M. Bradley Hanson, Robin W. Baird, John K. B. Ford, Jennifer Hempelmann-Halos, Donald M. Van Doornik, John R. Candy Candice K. Emmons, Gregory S. Schorr, Brian Gisborne, Katherine L. Ayres, Samuel K. Wasser, Kenneth C. Balcomb, Kelley Balcomb-Bartok, John G. Sneva, Michael J. Ford. 2010. Species and stock identification of prey consumed by endangered southern resident killer whales in their summer range. Endang. Species Res. 11: 69–82

[15] DFO. 2011. Fraser River Chinook Management Plan

exploitation rate of over 40%[16] on populations of serious conservation concern. If Chinook returns are above Zone 2 (i.e. Zone 3, greater than 60,000 spawners) exploitation rates can rise above 50%. Although marine exploitation does represent less than one third on these runs, the total harvest pressure on these beleaguered populations cannot be overlooked or dismissed as insignificant.

Exploitation rates on later timed ocean-type Chinook (summer and fall) are even higher than the depressed stream-types, having ranged between 40 and 80% in the last decade. Under current exploitation goals, roughly 35% exploitation is occurring in marine fisheries and 10% is terminal.[17]

Zone 1, a harvest management zone for river-type Fraser populations that sets exploitation rates below 30%, is considered *the most extreme measure* and has yet to be implemented even for the early stream-types. Stream-type Fraser Chinook survival rates have averaged 1.3 R/S in recent years. At these survival rates, harvests above 30% keep these populations depressed. To sustain harvests of 40%, survival rates greater than 1.7 R/S are needed. Unfortunately, if/when survival does improve, the fishery is structured to exploit any surplus in recruitment rather than put extra production into population rebuilding and increasing spawner abundance.

Slot limits, in place through the Juan de Fuca to lower impacts on endangered populations without restricting fishing on other "healthier" populations, might only provide minor mitigation. In addition to inherent problems with slot limits, recent UBC studies[18] undertaken on the success of sockeye survival in non-retention or catch and release fisheries showed that less than 36% of salmon released by anglers were likely to survive to spawn. These figures are far below the mortality estimates currently used, which generally assume 80- 85% survival in Chinook angling. In *beach* seine net fisheries less than 50% of released fish survived to spawn. No estimates were done for gill or seine net releases.

Given this context, a goal by DFO/PSC to double the escapement from the baseline period needs to be viewed in terms of a truly adequate recovery objective. Further, the panel should be conducting a much deeper examination of fisheries management if it is going to conclude that harvest exploitation is not a problem. Despite a growing consensus that we can no longer exploit single resources without considering trophic interactions at an ecosystem scale, this remains the management priority. Stepping outside this lens reveals the health of Chinook populations to be overexploited (still) and in dismal condition. It also highlights the problem of shifting baselines.[19]

DFO and the PSC use the 1979 to 1982 period of Chinook abundance as a "baseline"– when actually, this is the nadir state of Chinook escapement at a time when Fraser populations

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[16] DFO. Letter to IHPC stakeholders from Rebecca Reid May 25, 2012
[17] Pers. comm. R. Bailey; PSC Joint CTC. 2011. Exploitation Rate Analysis and Model Calibration Report TC Chinook (12)-2; and DFO. 2011. Fraser River Chinook Information Document.
[18] Donaldson, M.R., S.G. Hinch, D.A. Patterson, J. Hills, J. O. Thomas, S J. Cooke, G.D. Raby, L. A. Thompson, D. Robichaud, K.K. English, A.P. Farrell. 2011. The consequences of angling, beach seining, and confinement on the physiology, post-release behaviour and survival of adult sockeye salmon during upriver migration. Fisheries Research 108: 133–141
[19] Pauley, D. 1995. Anecdotes and shifting baselines. Trends in Ecology and Evolution 10:430

were probably one-tenth of their former abundance. Shifting baselines describe the incremental lowering of standards with each new generation, as stock health is assessed only in the context of one's own lifetime. It explains our inability to recognize ailing ecosystems, as our only reference is what preceding generations left behind. For this reason, an historical baseline such as the one provided in the 19th century is important and would represent the earliest time from when reliable sources of evidence can be established.

It is unfortunate that higher survival rates before 2000 were not rigorously capitalized upon in terms of putting the extra production into increased escapement and population rebuilding, rather than catch. Many of the stream-type Chinook escapements are at a small fraction of their estimated habitat capacity (e.g. < 10%).[20] Given current survival, a harvest closure would allow rebuilding at roughly 30% per generation, with a doubling period of 12-15 years. Higher survival rates would mean faster rebuilding.

The opportunity now is to acknowledge that single-species fisheries exploitation models, which continue as the cornerstone of Chinook management, are not serving killer whales or Chinook conservation. Human harvest is a factor in the depressed state of these populations. Even if curtailing harvest does not translate to *immediate* increases in available food supply for whales (as the panel concludes), **the importance of rebuilding populations for future increased abundance is being completely ignored.**

Furthermore, the abundance of other Chinook populations in the Georgia Basin and Puget Sound must be recovered if the overall density of Chinook is to increase. Regardless of the current stock composition in the diet of the southern residents, this is a key aspect of killer whale recovery. The rebuilding of all Salish Sea populations (Georgia Strait, Puget Sound, Juan de Fuca, etc.) could have a substantial effect on the prey ratios, especially at critical nutritional periods (i.e. spring and early summer) for southern residents.

Competitive Exclusion

The principle of competitive exclusion states that two species competing for the same limited resources cannot coexist sympatrically if other ecological factors are constant. If one species has even the slightest advantage over another, the less advantaged will ultimately be excluded, which can lead to extinction of the disadvantaged competitor or a shift towards a different ecological niche. Evidently, past levels of Chinook consumption by pinnipeds were not sufficient to exert competitive exclusion, or the distribution and abundance history of all these marine mammals would be different. However, given massive removal of Chinook over the last century, it is possible that fishing pressure has been and continues to be substantial enough to exert forces of competitive exclusion. In addition to direct competition, indirect competition through alterations that lower the productivity of marine and freshwater habitats makes harvest pressure even more significant and increases resource competition among all species.

[20] DFO. 2011. Fraser River Chinook Information Document.

Recommendations

Available evidence suggests that the extensive decline in historic density and abundance of Chinook populations in the Salish Sea is affecting the survival of SRKWs. Although fishing pressure significantly reduced the abundance of Fraser and other Salish Sea Chinook populations, other factors now conspire to inhibit their recovery. If credible recovery goals are to be established for whales and Chinook, now is the time to identify and act on a scale commensurate with the problem. The implementation of comprehensive Chinook rebuilding plans is essential. The following recommendations are appropriate responses if earnest recovery efforts to address killer whales, and the salmon they depend on, are implemented.

1. Closure of Chinook commercial and sport fisheries and severe constraints on First Nations FSC fisheries.

Harvests from the troll and recreational sectors in SE Alaska and WCVI fisheries, troll in Northern BC, recreation in Georgia Strait and Juan de Fuca, and Fraser River terminal fisheries, including First Nations, all act cumulatively on Fraser and Georgia Basin Chinook populations to exploit any surplus in recruits per spawner. Exploitation rates range from 20% to 60%, but are typically above 40%. Fishing is also occurring on some populations that are below replacement levels. Given that the escapements of many river-type populations are at a fraction of their estimated habitat capacity, substantial opportunity for increased spawner abundance and stock rebuilding now exists.

Additional benefits would result from a full Chinook closure. Given the uncertainty in exploitation, catch and escapement data, a Chinook closure would allow assessments of the coded-wire tag recovery program, the accuracy of the Albion test fishery, and the reliability of the CTC and FRAM management models. The following problems could be examined and addressed;

- accuracy of the CWT system to asses catch, escapement and exploitation,
- inconsistent CWT recoveries,
- discrepancies with other indicators (i.e., Albion test fishery derived escapement estimate for South Thompson in 2010 was about one-half that produced when using data from the NBC troll fishery),[21] and
- poor catch monitoring and license enforcement, especially in sport fisheries, which lower confidence in catch data.

2. Identify the specific threats to Chinook survival including water extraction, other habitat impacts and disease and virus transfer from open net cage salmon farms that intersect Chinook migration routes. Disease and habitat issues have been identified at Canada's Cohen Inquiry[22] and elsewhere.

[21] PSC Joint CTC Annual Report of catch and escapement for 2011. Report TC Chinook (12)-3

[22] see evidence of DFO Molecular biologist Dr. Kristi Miller, testimony to Cohen Commission Exhibit 1517; see Dill, Lawrence. 2011. Tech. Rep. 5D: Impacts of salmon farms on Fraser River sockeye salmon. Prep. for the Cohen Commission; see Evidence of the Aquaculture Coalition submitted Aug 2011 Exhibit 1976; Also see Cohen Commissioned Reports 1A, 1B, and 5A on disease. These documents can be viewed at http://www.cohencommission.ca

3. Implement recovery plans on Fraser River, WCVI and Inner South Coast Chinook populations.

4. Increased Chinook production from salmon hatcheries is not a prudent, long-term solution for killer whales. A growing body of scientific literature suggests hatcheries pose a host of risks to wild salmon and only replace wild fish with those having less resilience and adaptability to survive in the future.[23] Georgia Strait studies specifically show that hatchery produced coho already have a lower survival rate than wild coho salmon.[24]

5. Identify the need for recovery plans on Fraser River, WCVI and Inner South Coast chum populations. As acknowledged by the panel, chum salmon play an important role in the diet of southern residents especially over the fall and will be important in killer whale recovery. Preliminary assessments underway by Raincoast examining the health of BC chum populations using COSEWIC criteria show that, while status varies, several populations warrant immediate action. Both the *Lower Fraser* and the *Southern Coastal Streams* Conservation Units trigger the *Endangered* criteria of COSEWIC and the *South Western Vancouver Island* CU triggers COSEWIC's *threatened* criteria.[25] Analysis is underway to examine current chum abundance in a historical perspective. Historical analysis from the North Coast shows chum populations in the Skeena are a fraction of their historic abundance.[26]

There is no question that the recovery of two endangered species, one of which eats the other, and both of which inhabit threatened ecosystems, presents a human management challenge.

I sincerely appreciate the time, thought and analysis the panel has given this issue to date.

Misty MacDuffee
Wild Salmon Program Director
Raincoast Conservation Foundation

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[23] Special Issue on Ecological Interactions between Wild and Hatchery Salmonids, Env. Bio. Fishes, Volume 94(1): 1-361.

[24] R. J. Beamish, R. M. Sweeting, K. L. Lange, and C. M. Neville. 2008. Changes in the Population Ecology of Hatchery and Wild Coho Salmon in the Strait of Georgia. Transactions of the American Fisheries Society 137:503–520

[25] Review of the 2012 Public Comment Draft Report for the Marine Stewardship Council Certification of British Columbia Chum Salmon Fisheries May 17 2012. Prepared by Raincoast Conservation Foundation, SkeenaWild Conservation Trust, David Suzuki Foundation, and Watershed Watch Salmon Society http://www.raincoast.org/wp-content/uploads/ENGO-comments-on-BC-chum-MSC-PCDR-2012-05-17-FINAL.pdf

[26] Price, M.H.H., Gayeski, N., and J. Stanford, J. *In review* Historical abundance of chum salmon (*Oncorhynchus keta*) returning to the Skeena River watershed.