PROCEEDINGS
OF

THE COWICHAN TRIBES ESTUARY WORKSHOP

9am-4.30pm May 25 2010
Oceanfront Grand Resort & Marina, 1681 Cowichan Bay Road, Cowichan Bay

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Cowichan Tribes Estuary Workshop Agenda

9am-4pm May 25 2010
Oceanfront Grand Resort & Marina, 1681 Cowichan Bay Road, Cowichan Bay

9am: Welcome by Larry George, Lands and Governance Manager, Cowichan Tribes

Session 1: The Changing State of the Cowichan Estuary & Importance to First Nations

9.15 am. Arvid Charlie, Cowichan Tribes Elder. "A Historical Perspective of Cowichan Bay"
9.45 am. Tim Clermont, Land Securement Coordinator, The Nature Trust of BC. "Conservation and Restoration of the Cowichan Estuary"
10.00 am. Maureen Tommy, Cowichan Tribes TseWulTun Health Centre. "Traditional foods and their importance to Cowichan Tribes health & lifestyle"
10.30 am. Tim Kulchyski, Cowichan Tribes Biologist. "What are the issues around safe shellfish use? Shellfish and contaminant issues in Cowichan Bay"

10.45 am. Coffee

Session 2: Chinook Early Marine Life History and Estuary Utilization

11.00 am. Rusty Sweeting, Biologist, DFO. "Lessons Learned Beach Seining in Cowichan Bay"
11.20 am. Elisabeth Duffy, WA Cooperative Fish & Wildlife Research Unit, University of Washington. "Early marine life: A critical period for chinook salmon in Puget Sound"
11.40 am. Greg Ruggerone, Senior Scientist, NRC. "Growth, life history, and survival of chinook salmon"
12.00 pm. Wilf Luedke, Chief of Stock Assessment for South Coast Area, DFO. "Update on the current status of Cowichan chinook"

12.15 pm. Lunch (provided by Cowichan Tribes)

Session 3: Estuary Restoration

1.00 pm. Louis Druehl, Professor of marine botany, SFU and President of Canadian Kelp Resources Ltd. "Kelp conservation and farming"
1.20 pm. Diane Sampson, Nile Creek Enhancement Society. "Kelp Restoration Strategies"
1.40 pm. Nikki Wright, Co-chair, Seagrass Conservation Working Group. "Restoration of Eelgrass Habitats in the Cowichan Estuary"
2.00 pm. Rob Russell, Rob Russell Biological Consultant. "Biophysical assessment of the Kokish River estuary with suggestions for restoration, by the BC Conservation Foundation and Castor Consultants Ltd."

2.20 pm. Coffee

Session 4: Estuary Management

2.35 pm. Shannon Anderson, Biologist, DFO. "Campbell River Estuary- Planning, Protection and Restoration"
2.55 pm. Rodger Hunter, Vis-a-Vis Management Resources. "An Overview of the Cowichan Estuary Management Plan"

Open Discussion

3.15 pm. Panel and open discussion facilitated by Rodger Hunter. "What are the key issues in Cowichan Estuary? What do we need to do and what questions need to be answered to assist with chinook recovery?"

4.00 pm. Close & Thank You

Thanks to Living Rivers - Georgia Basin/Vancouver Island for assisting with funding for this event.

Background

Cowichan Tribes (CT) and DFO have entered an agreement that supports Cowichan Tribes in becoming more active in fisheries related co-management.

DFO is providing this support under their objectives of:

i) reforming the BC fisheries with First Nations more engaged in the fishery. This is called the Pacific Integrated Commercial Fishing Initiative (PICFI) and

ii) implementing the federal Wild Salmon Policy and the need to address declining salmon stocks, especially in the Cowichan River and more broadly, southern BC.

Cowichan Tribes have entered this agreement with the intent of taking a leadership role in rebuilding Cowichan chinook, of engaging in comprehensive planning for fish and fisheries in this region, and facilitating collaboration with other interests.

As an initial and important step in this process, Cowichan Tribes, with the assistance of external consultants, began a process to develop community visions and strategic plans for the fish, the fisheries, and the ecosystem they require. During the course of this project, the significance of changes and declines in the estuarine habitat of the Cowichan system was repeatedly discussed by many Tribes members, particularly the Elders.

Thus, Cowichan Tribes contracted the services of Dr. I. Pearsall, to organize a workshop on the Cowichan Estuary. The aim of the workshop was to discuss the changes in state of the estuary over time, the current state of the estuary, work done in Cowichan and elsewhere on early rearing of salmon, with special focus on chinook, and work that is being done and could be done in estuary restoration. Overall, the aim of the workshop was to identify gaps in knowledge and identify what we need to know to assist us in chinook recovery.

Summary, Key Themes and Recommendations

85 people attended the Cowichan Estuary workshop. Talks covered a broad range of issues, including an examination of the changing state of the Cowichan estuary, the importance of the estuary to Cowichan Tribes, chinook early life history, estuary restoration and management. The workshop was funded by Cowichan Tribes (PICFI funding) and by Living Rivers. A general discussion with a panel (from Cowichan Tribes, DFO, CVRD, and Cowichan Valley Naturalists) followed the scheduled talks.

Key themes from the workshop may be summarized as follows:

- The estuary and its resources are of great value and importance to Cowichan Tribes. The loss of resources, and contamination of many traditional food resources, has led to negative impacts on many First Nations members. First Nations lived in harmony with their resources, and were taught from an early age the wisdom of conservation, and to “take only

what you need, share the rest". They also played an important role as stewards of the rivers, side channels, creeks and the estuary.

- Although the estuary has been impacted since the 1800s, with dyking for flood protection, logging and log rafting, railway building, sawmills, sewage discharge and pollution, there have been many recent positive developments e.g. the Pacific Estuary Program; production of the first BC Estuary Management Plan; and many partnerships e.g. with Canadian National Railway, BC Hydro, Ducks Unlimited, Habitat Conservation Trust Fund and the Nature Trust of BC that have resulted in a number of restoration and protection projects.

- Growth and survival of chinook salmon during the first few months of life appears to be the critical stage. Brood year strength (leading to adult return rates) appears to be determined in the first four months of ocean existence. The most important factor appears to be insufficient feeding conditions in the rearing area, which limits the potential for early growth.

- More needs to be known about early rearing in the lower river and estuarine areas so that bottlenecks to production can be clearly identified.

- Cowichan Bay chinook salmon have shown changes in their residence within the Strait of Georgia. They no longer appear to utilize the Strait of Georgia to any great extent, but appear to remain within the local Gulf Islands area throughout the summer and into the fall.

- We need to continue to do and learn from good science. It is important that we do not approach the chinook recovery issue in a haphazard way, but rather, let good science inform our actions. It is the time for experimentation, replication of studies, and careful analysis of the bottlenecks to production of chinook.

- Recovery of chinook will likely take a multifaceted approach:
    - Reduce level of harvest. This could involve reductions and/or closures for sensitive stocks, or increases for abundant competitors (such as pinks or herring).
    - Make changes to hatchery production to reduce or mitigate the hatchery-wild interaction. Manipulations could be around timing and size of release, or an overall reduction in production.
    - Habitat Restoration/Protection which could involve areas both nearshore and offshore. What is required here is a better understanding of the key links between the habitat and salmon prey production.

- Volunteers are crucial to the success of any restoration program. There is a strong support base in the Cowichan region and people are interested in what they can do to help. Suggestions include volunteering for beach surveys (to examine spawning sites of forage fish) and restoration of estuarine habitat, in the form of planting eelgrass and kelp.

- Learn from other models e.g. Campbell River Estuary restoration, where there has been a great deal of success in raising funds, developing partnerships, gaining support and restoring and protecting habitat in Campbell River. We can look to the ways that they were able to do this, and follow their lead.

- Communication and partnerships are required and further sources of external funding need to be identified.

- Celebrate the successes so far. Continue to communicate, become informed, plan a vision for the estuary and move forward.

Workshop Overview

Session 1: The Changing State of the Cowichan Estuary & Importance to First Nations

The Estuary Workshop was begun with a prayer by Wayne Charlie and followed by a welcome and general introduction by Larry George, Lands and Governance Manager at Cowichan Tribes.

Arvid Charlie, Cowichan Tribes Elder. "A Historical Perspective of Cowichan Bay"

Luschiim, aka Arvid Charlie, was born in Quamichan, one of the Cowichan Villages, in 1942. He has lived in the Duncan area all of his life. The Cowichan language, Hul'qumi'num, is his first language.

His 'formal education' ended after grade 8, but for years, he spent his spare time traveling to every Elder he could for language and cultural knowledge, and to document, clarify and learn proper use of the Hul'qumi'num language. In 1995-96, he took a one time course offering at Malaspina College to learn how to write Hul'qumi'num. He has trained and become a speaker, often being asked to speak at community gatherings, including the Big House and at ceremonies such as namings, memorials and funerals.

In 2008 he received an honorary PhD from Vancouver Island University for his dedication to the Hul'qumi'num language, knowledge of his culture and environment.

Luschiim talked about the many different species of birds, fish and plants that were commonly found around the estuary when he was a young man.

He discussed how he had been taught at an early age to only take what he needed and to share the rest, the harmony and understanding that he and his people have with the environment and its resources. He noted the abundance of chinook, coho and chum when he was young, and the presence of sockeye and pink salmon in the area too. He noted the changes in availability of many different species in the estuary, including herring, clams, crab, eelgrass and kelp. He recounted tying up their boats in the past to kelp when fishing for sea urchins in the Bay. As well as changes in abundance and distribution, there have also been changes in timing. For example, his grandfather was able to preserve his full requirement of dried fish by mid-May, but now the fish are not even available until June, one month later.

Tim Clermont, Land Securement Coordinator, The Nature Trust of BC. "Conservation and Restoration of the Cowichan Estuary"

Tim has over 25 years experience in fisheries and wildlife management and the restoration of aquatic and terrestrial habitats. For 15 years he coordinated the Vancouver Island Wetlands Management Program and was responsible for the management of over 50 conservation areas - mostly coastal wetlands and estuaries. Today Tim works with First Nations, local governments and stewards to garner support for the designation of Wildlife Management Areas throughout BC.

Tim Clermont spoke about the changing state of the estuary since the 1970s. His talk was entitled "Conservation, Restoration, and Stewardship of the Cowichan Estuary". The total watershed area of the Cowichan and Koksilah Rivers is 30,658 acres or 1241 sq km. The Cowichan Bay estuary is located on the southeast coast of Vancouver Island, approximately 45 km north of Victoria (Figure 1).

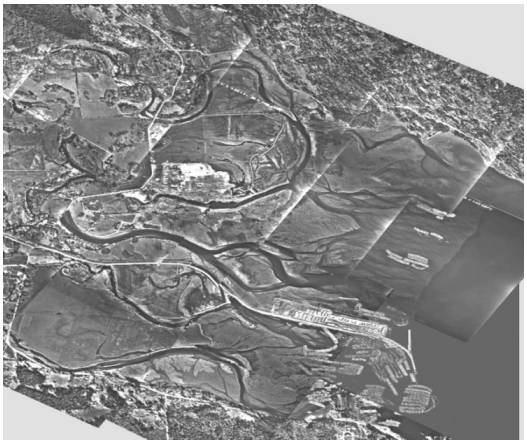
Figure 1. Location of Cowichan Bay Estuary

Tim discussed some of the changes to the estuary since the 1800s including the following:

Decade	Activity resulting in loss of habitat
1860s	dyking for agriculture and flood protection
1880s	logging and log rafting
1920s	railway in tidal flats to connect with inland logging
1960s	sawmill and capacity to ship forest products
1980s	sewage discharge from urban development
1990s	changing summer flows, non-point source pollution from winter runoff

He showed a series of aerial photographs that clearly display the changing land use within the estuary:

1973



1985

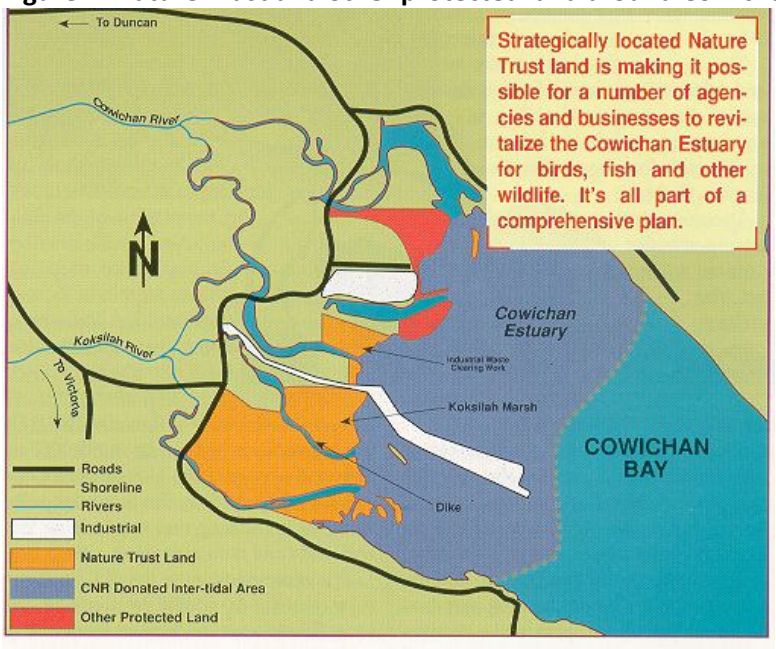
2002

He discussed the reasons for why the Cowichan estuary is an important estuary to protect and restore:

- It is the 4th largest estuary on Vancouver Island (approx 1,215 acres or 492 hectares)
- Approx 50% of the estuary had been modified or impacted for industrial activities and agriculture
- There has been a noticeable reduction in fish and wildlife species abundance
- It provides habitat for up to 229 bird species throughout year (Critical winter habitat for thousands of waterfowl)
- It provides an important rearing habitat for all seven Pacific salmon species
- Cowichan estuary has been ranked among the top 10 estuaries in BC for conservation values and habitat restoration potential
- Vegetation monitoring and bird use studies have been conducted on naturally breached agricultural lands

In the 1980's the Nature Trust of BC acquired some key parcels of estuary lands. In 1987, they formed a partnership with other organizations, including BC Ministry of Environment, Ducks Unlimited Canada, Habitat Conservation Trust Fund, The Land Conservancy, Nature Conservancy of Canada and Environment Canada (CWS) and formed the "Pacific Estuary Conservation Program". This group worked with local community and industry in the Cowichan valley and were able to secure 9 parcels in the estuary totalling 770 acres over the course of 5 years (Figure 2).

Figure 2. Nature Trust and other protected land around Cowichan Estuary

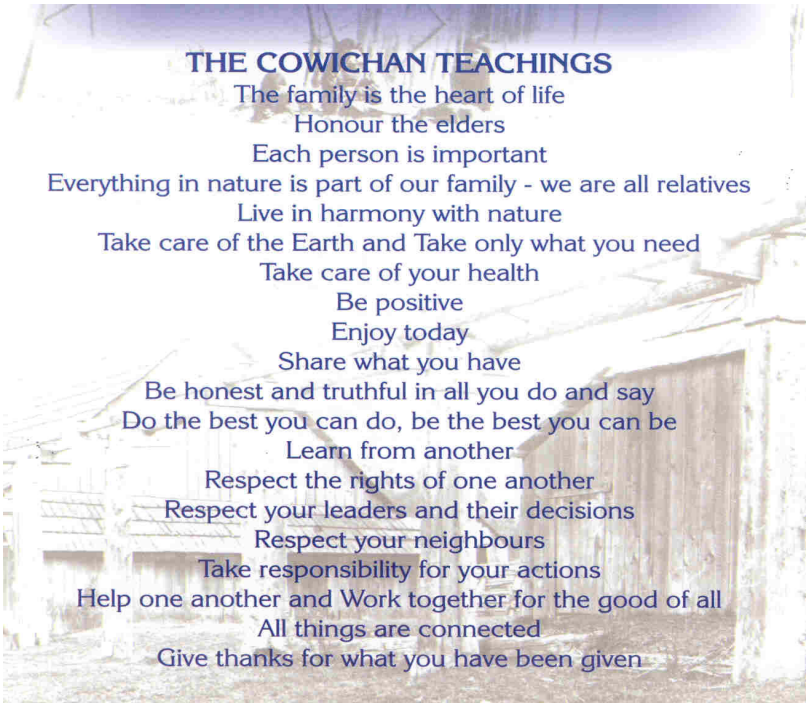


The partnerships have also resulted in a large number of restoration and protection projects. For example: the Canadian National Railway intertidal wetlands (Lot 160) were transferred to the provincial government for fish and wildlife protection; BC Hydro buried a major powerline, Ducks Unlimited carried out a number of restoration projects including removal of dykes and wetland enhancement on agricultural lands. Other projects have included swale enhancement for water control, and development of dyke breaches on the Koksilah Marsh.

There appear to be some positive impacts of these activities. Bird use of the estuary (by dabblers, swans and geese) is up 100% from 1992-1997, and there are higher waterfowl densities than most other BC estuaries. The Cowichan estuary is one of the top 10 critical wetlands on coast of British Columbia for wintering waterfowl and Pacific salmon habitat.

Maureen Tommy, Cowichan Tribes TseWulTun Health Centre. "Traditional foods and their importance to Cowichan Tribes health & lifestyle"

Maureen Tommy from the Cowichan Tribes TseWulTun Health Centre provided the following teachings, which clarify many of the principles by which Cowichan Tribes members aim to adhere to.



She discussed the importance of salmon to Cowichan Tribes, and how various Cowichan Tribes Departments or partnering organizations host a Sacred Salmon Ceremony every year, during which time people come together and pray for the salmon's safe return home to the Cowichan River. She discussed the key relationship that CT members have with nature and everything in it, and how physical, mental, emotional and spiritual health is brought into balance by engaging in activities with nature, having a sense of being in balance with nature, as well as having the opportunity to consume traditional foods including salmon. Harvesting foods also brings Tribes members together, and makes for emotional wellness. It is important for the older men to have the opportunity to train the younger boys how to fish, hunt and gather. She mentioned that in the past, when CT people were in canoes in the Bay, that the water was so clear that they could see to the bottom of the estuary: this is no longer the case.

She commented further on the health aspects of eating traditional foods. She noted that salmon bones, as well as clams and oysters traditionally provided Cowichan people with adequate iron stores, important for healthy brain development and particularly for pre-natal and postnatal mothers. She also discussed how chronic illness is prevalent in the Cowichan community, and thus the dietary intake of traditional foods is crucial to spiritual, mental, emotional and physical health. Omega-3 fatty acids, contained in many of their traditional foods, are important for lowering the risk of heart disease, strokes, cancers, high blood pressure, diabetes, lupus, depression, bipolar, ADHD, skin disorders, asthma, menstrual pain etc. She sees higher prevalence of these diseases among the Cowichan Tribes people and believes it is related to the lack of their traditional diet. She noted that her people no longer have the opportunity to harvest many of the traditional foods and the young people do not get to dig for clams.

Maureen is involved in a number of different programs at the Health Unit, including Women and Wellness, how to cut salmon for smoking, canning salmon etc. She would like to document some of the traditional food preparation methods by video as this is an ideal educational tool for their people.

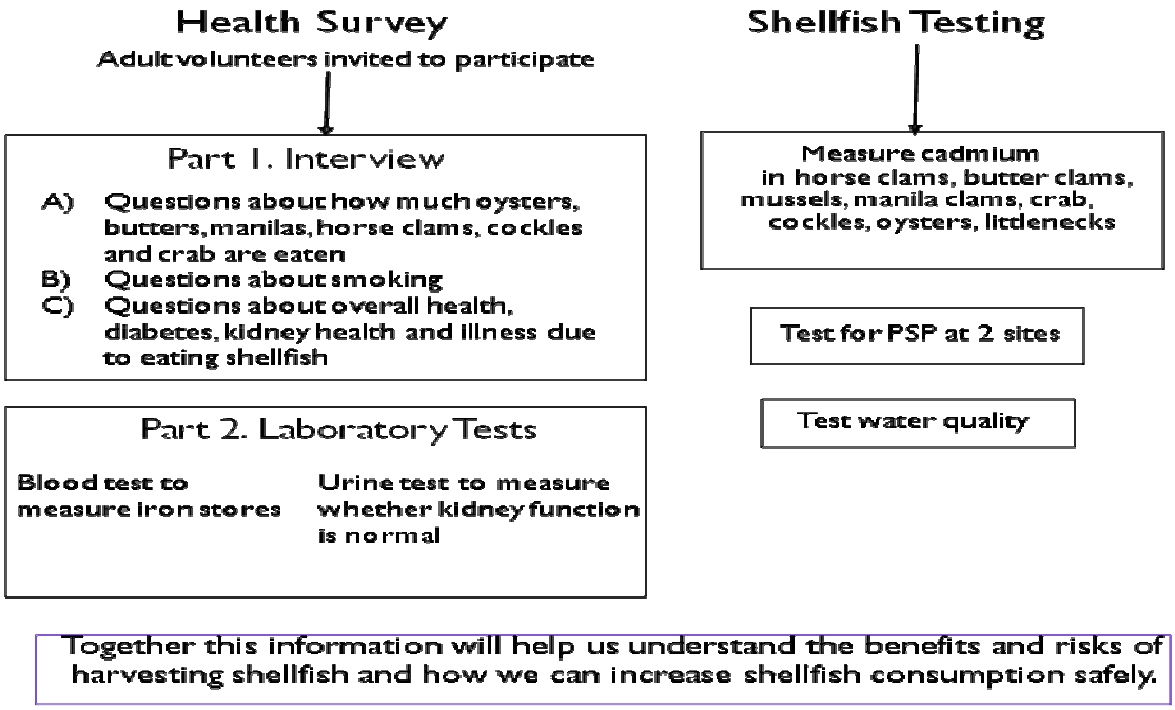
Tim Kulchyski, Cowichan Tribes Biologist. "What are the issues around safe shellfish use? Shellfish and contaminant issues in Cowichan Bay"

Tim is Cowichan and has interests in many subjects from language and culture to scuba diving and environment. Tim has worked with a variety of clients assessing upland, freshwater and marine ecosystems for over 15 years. His work often involves examining the impacts of development on cultural values. Recently he participated in a program to control invasive plants in the watershed. Tim has travelled extensively studying the interaction between resource issues and cultural heritage. Over the past five years he was involved in a major Hul'qumi'num language revitalization initiative. He is currently working as a biologist for Cowichan Tribes.

Tim discussed a collaborative project between Health Canada, First Nations and Inuit Health, Environmental Health. This study was carried out to determine the levels of cadmium, PSP, and organochlorines in the shellfish that First Nations consume, as well as to determine what would be safe consumption levels of shellfish, and to increase the knowledge about contamination issues in shellfish in both First Nations fisheries staff and community members. The flow charts below

summarize the study methodology (Figure 3). As part of the health survey, adults were interviewed to determine their regular intake of shellfish (including oysters, butter clams, manila clams, horse clams, cockles and crab) and methods of preparation, and health issues. Laboratory tests were carried out to determine kidney function and iron stores (as assessed using urine and blood tests, respectively). Samples of shellfish from harvest sites were tested for cadmium levels, PSP and water quality analysis was also performed. Figure 4 below shows the location of the various sampling and testing sites.

Figure 3. Flow chart summarizing study methodology for the Shellfish Safety Project.

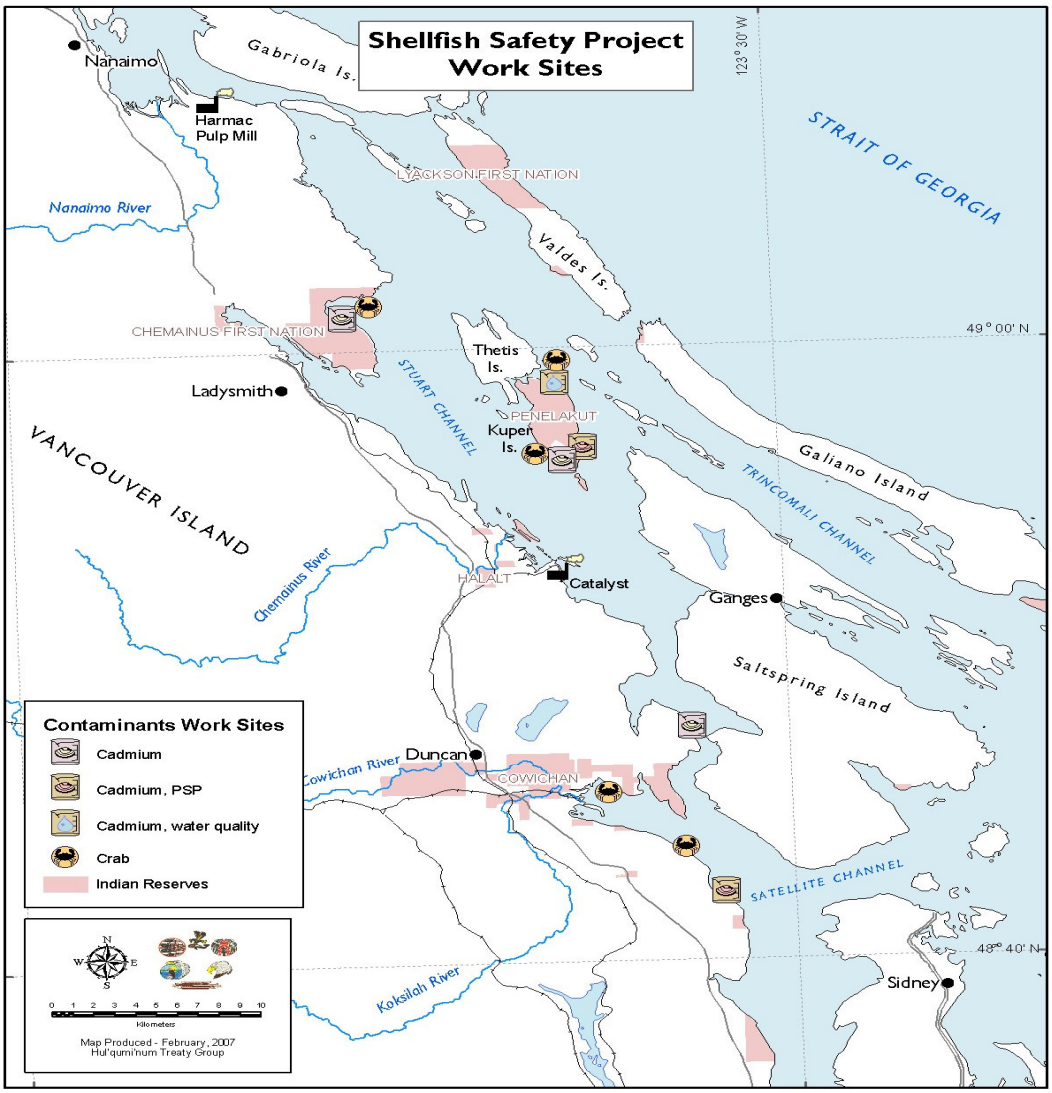


Results showed that cadmium levels were generally lower in oysters taken from Hul'qumi'num territory than elsewhere in BC. It was also determined that adults could safely ingest 1 cup of shucked oysters harvested locally each week, which amounted to a safe level of 4-5 oysters weekly or 200 oysters per year. Mussels were sampled for PSP over the course of one full year at two different sites (Kuper Island, Cherry Point). The PSP levels at Cowichan Tribes' site at Cherry Point were similar to the CFIA site for the area, while PSP levels at Kuper were consistently lower than those at the CFIA site. Meanwhile, they did not find significant levels of organochlorines in clams, oysters or crabs we sampled from our harvesting locations.

Overall, their results showed that shellfish are an important source of iron for First Nations, and that clams were generally low in cadmium levels, but oysters do contain some cadmium. Thus, the one cup per week limit is required and important for oysters. It appears that when people ingest cadmium, it results in lower iron uptake, so many of the issues are with respect to low iron levels. Testing showed that many females appeared to have low iron stores, which can result in higher

uptake of cadmium. Recommendations included eating iron rich food for First Nations in the area, particularly females. They noted that the PSP closures did appear to be accurate for shellfish harvesting in the Cowichan Bay area.

Figure 4. Shellfish Safety Project Work Sites



It was clear that First Nations people wanted to be able to obtain more information on harvesting shellfish. A number of different education materials were produced to help educate First Nations about shellfish safety. These included:

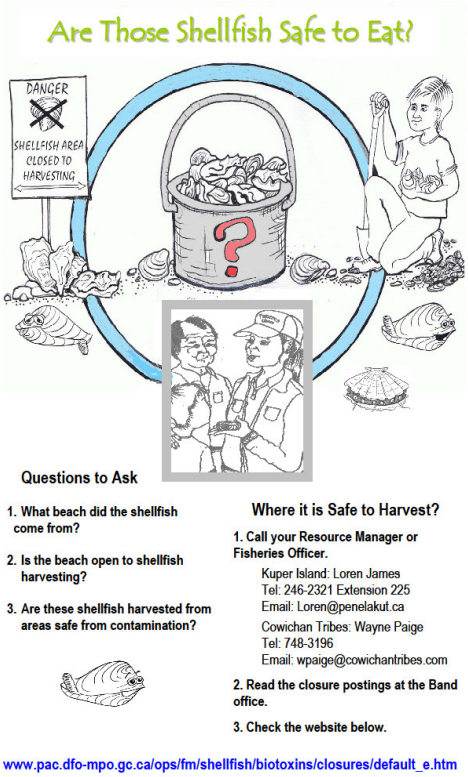
- Shellfish Safety Technical Manual for Fisheries and Health staff

- Maps for Fisheries and Community members to identify open/closed areas

- Poster/Brochures to guide community members about what kinds of questions to ask about wild clams/oysters

- Poster for youth/adults to promote eating shellfish and Fisheries Guardians as knowledgeable community members for open/closed areas information

- Activities for teachers/fisheries/health staff to teach children and youth about shellfish safety (beach walk, Hul'qumi'num mix/match, mapping exercise, colouring book)



Session 2: Chinook Early Marine Life History and Estuary Utilization

Rusty Sweeting, Biologist, Pacific Biological Station, DFO. "Lessons Learned Beach Seining in Cowichan Bay"

Rusty received both his Masters and PhD from Simon Fraser University in Burnaby, coming out from Saskatoon, Saskatchewan in 1980. He started working for DFO, and Dick Beamish, in 1995. He is the author or co-author on over 50 refereed papers. He has been Chief Scientist on their Strait of Georgia program for over 10 years.

Rusty talked about the objectives of the Cowichan Bay Beach Seine Project, which are to sample juvenile chinook from near shore areas of Cowichan Bay from early spring to summer to assess their movement, growth, and survival in these very early weeks in the marine environment. They also aim to determine whether there are any differences in hatchery and wild chinook at this time, to assess by-catch, and to provide a general idea of ecosystem health.

The project is currently funded by PSF, and is dependent on a number of partnerships and volunteer support, namely:

- Volunteers: South Coast
  - Leroy Hop Wo
  - Ted Carter/Steve Baillie
  - many others
  - Beamish group

    - Krista Lange, Dave Preikshot, Chrys Neville, Elysha Gordon
    - other DFO personnel
- First Nations
    - Tribal council
    - Cowichan hatchery
- CVNS (Eric Marshall)
- Local DFO (Tom Rutherford)
- other Locals
    - Val Tansley (sst)
    - Dave Aldcroft (avian surveys)
    - Paul Rickard

This program is being carried out concurrently with a number of other programs from the Beamish lab, including:

- Beach seining in early April to early June
- Purse seining from May, June and July
- Midwater trawling June, July, Sept. & Oct.
- CWT analyses
- DNA studies
- RNA studies
- growth and diet studies

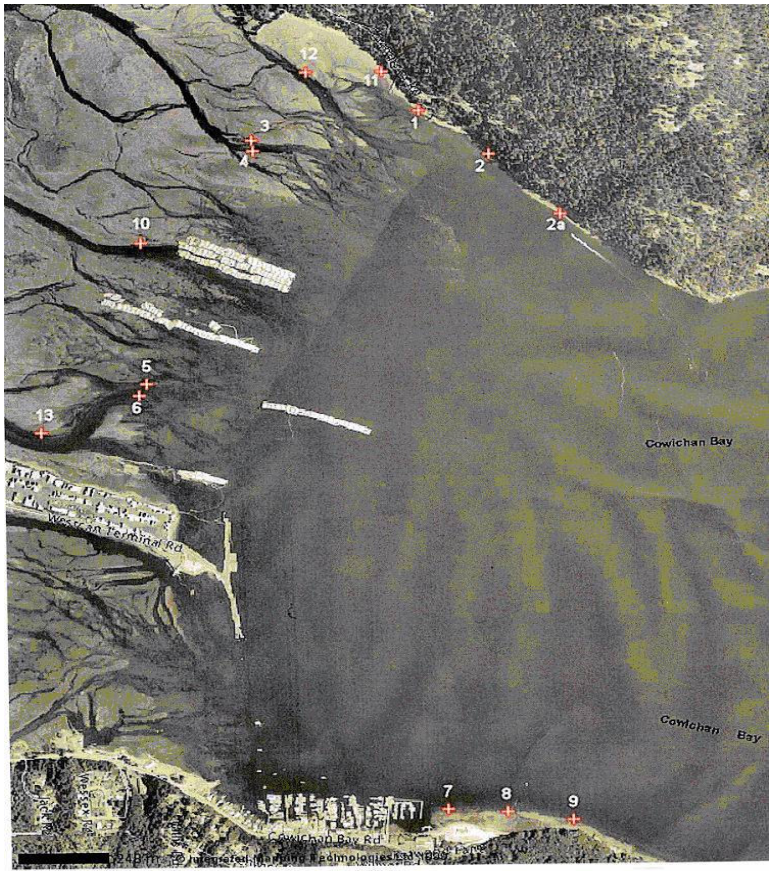
Figure 5 below shows the locations that beach seining has been carried out between 2008 to the present. Seining is done from early April every two weeks throughout May and then continues for a week or two into June. Seining picks up both wild fish and hatchery fish: the latter are generally released in mid-May. For 2008-9 they utilized two boats, two nets, and sampled four sites plus the estuary. In 2010 they have been working with one boat, one net and have sampled three sites plus the estuary.

In 2008 and 2010, fewer than 500,000 chinook were released from the hatchery and were all clipped and tagged with coded wire tags (CWTs). There were also high populations of juvenile pink during those two years. In 2009, over 2.8 million chinook were released, a proportion of them were clipped and tagged, and there was a very low interaction level that year with juvenile pinks.

The 100% clipping and tagging from first year (2008) provided a method to determine both abundances and survival rates. They were unable to do this analysis in 2009, but will be able to repeat this year (2010) with resumption of the 100% clip/tag rate of the hatchery fish. Their initial results have suggested that wild chinook survival rates were substantially greater than the hatchery chinook, at least in 2008.

DNA and CWT analysis have confirmed that Cowichan Bay chinook salmon do not appear to utilize the Strait of Georgia to any great extent, but appear to remain within the local Gulf Islands area throughout the summer and into the fall (into November). However, the actual departure times and/or migration routes for Cowichan Bay chinook are still not confirmed.

Figure 5. Locations of Beach Seining in Cowichan Bay 2008-2010.



Their data so far appear to support and confirm their hypothesis that brood year strength (leading to adult return rates) is determined in the first four months (maybe less) of ocean existence. They do not think that predation *per se* is a key factor, although the young fish may be dying due to other reasons (stress, illness, lack of food, poor growth etc), making them more vulnerable to predation. Indeed, the most important factor does appear to be insufficient feeding conditions in the rearing area, which limits the potential for early growth. Thus it is quite feasible that the current conditions in the Gulf Islands region appear to be insufficient to support the Cowichan Bay chinook population. This appears to result in very poor survival in the early marine phase, which may possibly extend into the first winter. The latter point is not fully clear, but is assumed due to the lack of detection of these fish in any other areas.

Rusty suggests that there are different options that can be taken to deal with this situation.

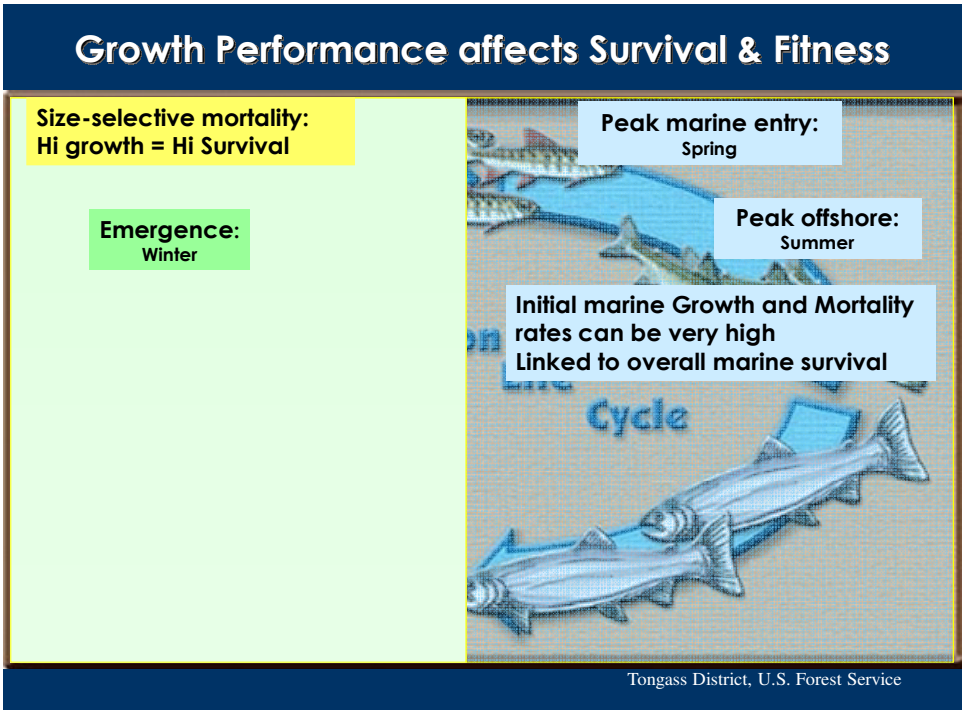
- Accept what is and do nothing
- 'Improve' near shore habitat
- Reduce or mitigate the hatchery:wild interaction. This may mean changes in release numbers, sizes and/or timing.

Rusty stated that this is the time to be experimental, and to find ways to finally understand the complex interaction between the early marine environment and both hatchery and wild fish. This way, the scientists will be best able to provide the proper advice to managers and strategists. It is quite apparent that the current procedures under current conditions are not providing the intended results!

Elisabeth Duffy, WA Cooperative Fish & Wildlife Research Unit, University of Washington. "Early marine life: A critical period for chinook salmon in Puget Sound"

Elizabeth Duffy has been working on chinook salmon early marine life history in Puget Sound. She received her B.A. (1997) in Biology from Amherst College and then worked at marine biology labs in Woods Hole, Australia, and the Bay Area before moving to Seattle for graduate school. She completed her M.S. (2003) and her Ph.D. (2009) on the early marine ecology of juvenile salmon in Puget Sound and is currently a post-doc at the University of Washington's School of Aquatic and Fishery Sciences under the supervision of Dave Beauchamp.

She noted that feeding and growth performance at any life history stage of chinook can affect survival and growth of all the subsequent stages. In general, high growth tends to lead to higher survival.

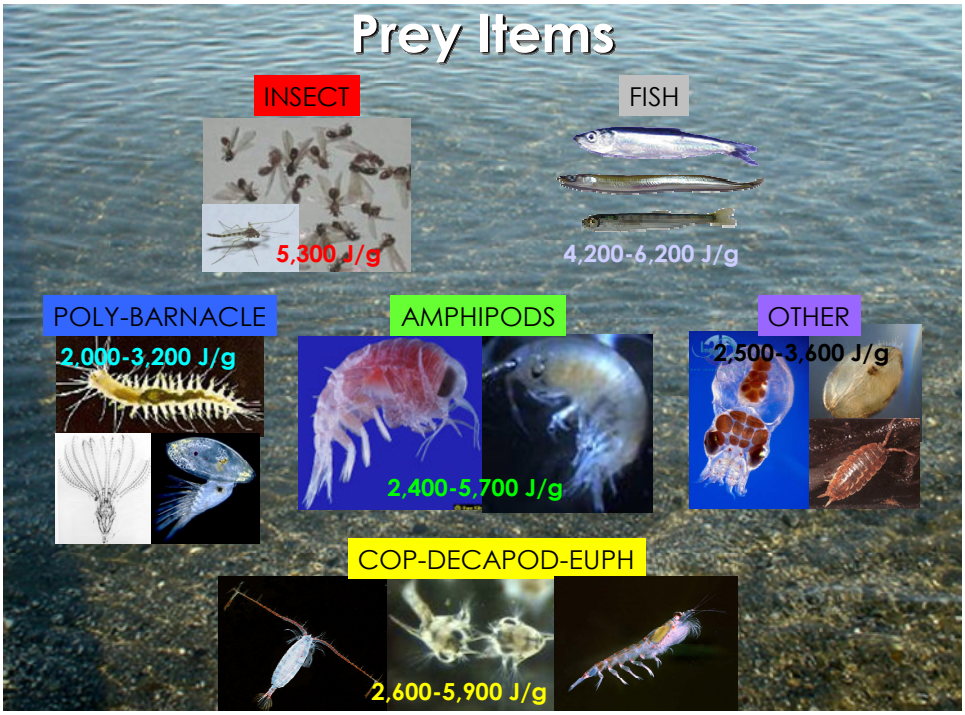


Her work has focussed on the early marine rearing period and has addressed key basic questions such as:

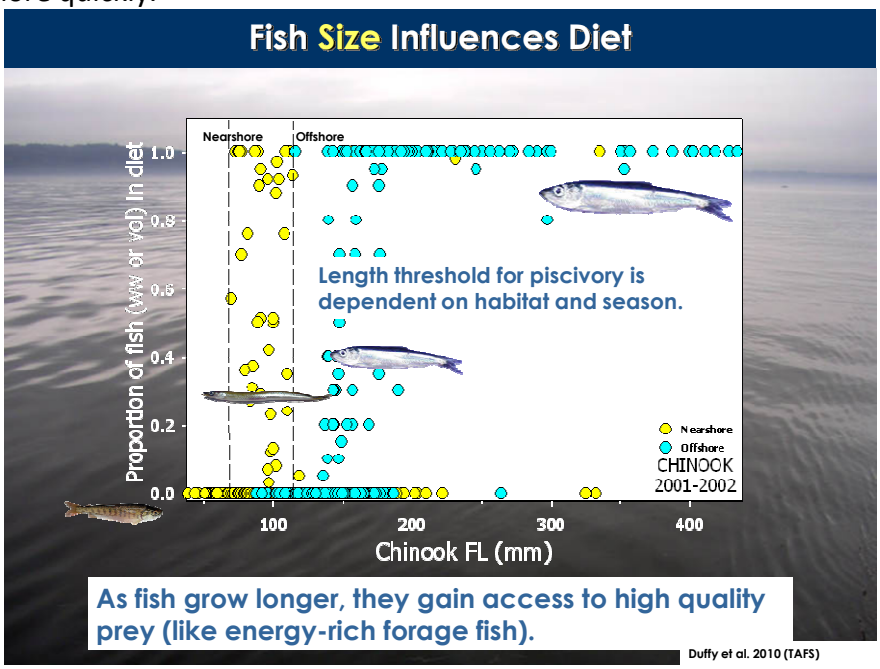
- **Background and Basics:**
  When are juvenile chinook in Puget Sound?
  Where in PS are they?
  How big are they?
  What are they eating?
  Who is eating them?
- **Links to Marine Survival:**
  What are the stage-specific links to marine survival?
  What are the factors affecting these stages?
- **Implications for Recovery:**
  How do these findings inform recovery priorities?
- **Next Steps**
  Where do we go from here?

Her work has involved conducting nearshore surveys for juvenile chinook between April and September and offshore surveys in different areas of Puget Sound during July and September/October. The basic information collected includes abundance (CPUE), origin of fish (are they hatchery or wild fish?), their size (fork lengths, wet weights and age classes are recorded) as well as diet (assessed by gastric lavage, and stomach removal).

Key diet components of the juvenile chinook are shown below. She noted seasonal and spatial shifts in diet, with higher incidence of terrestrial insects in the nearshore diets and higher incidence of marine crustaceans (crab larvae, euphausiids, and amphipods) in fish feeding offshore.

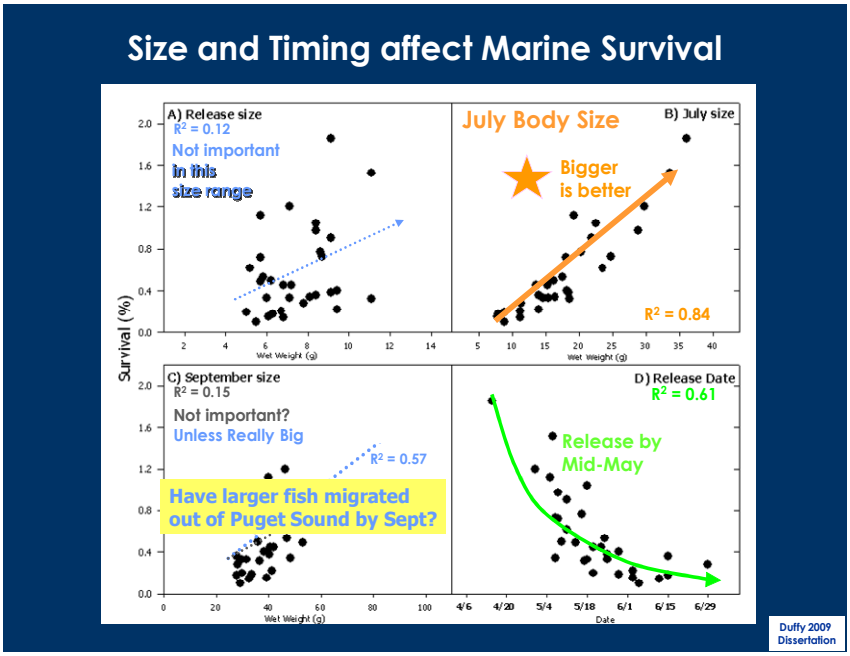


It is apparent that the size of the fish affects the type of diet. Between the summer and fall, fish shift to higher levels of piscivory- the fish prey include sand lance, larval/juvenile fish, smelt, and bay pipefish. As the chinook get bigger and eat these forage fish, their diet is of higher quality and they can grow more quickly.



She examined the relationship between marine survival of hatchery fish and a number of different factors including size at release, average size offshore in July and September, and the release date from the hatchery (which varied between April and June). She found that there does appear to be a strong relationship between size of fish in July and marine survival. The body size in July is directly

related to the rearing conditions in the estuary and this factor explained 85% of the ability of a fish to return as an adult. The September body size did not appear to be so important, but this relationship could be more difficult to discern if the larger fish had already left the region by this time. She noted that the body size in August *could* be of importance, but this is not assessed as they do not sample at sea in August.



In general, higher feeding rates were associated with higher survival. chinook smolts increase their weight 3-4 fold by feeding offshore over the 2 months between their peak use of nearshore marine habitats in early-mid May and when sampled offshore in mid-July.

She examined the possible predators of the chinook and noted the following predators:

- Salmonids
- Adult chinook & Coho Salmon
- Juvenile chinook & Coho salmon
- Coastal Cutthroat Trout
- Bull trout
- Staghorn Sculpin
- Pacific Hake
- Spiny Dogfish
- Birds
- Marine Mammals

In general, she noted that fish predators were able to feed on salmon that were less than or equal to 40% of their body length. This was related to the size of the gape (mouth opening). Cutthroat trout tended to eat smaller salmon in the neashore regions.

Overall, her data suggest that the early marine period of life in Puget Sound is critical for chinook salmon. Evidence for this includes:

- Juvenile chinook spend at least 2-4+ months in Puget Sound
- Marine survival (SAR) is tightly correlated with body mass in July for Puget Sound chinook
- Body mass increases 2-5x from marine entry in May to July
- chinook must feed (& grow) at a high rate to minimize size-selective ocean mortality
- Higher feeding, growth, and survival rates were associated with higher contributions of crab larvae & insects in early marine diet

In terms of recovery, she suggests that there are certain key factors that we can control including:

1. The level of harvest. This could involve reductions and/or closures for sensitive stocks, or increases for abundant competitors (such as pinks or herring).
2. Hatchery Production. Manipulations could be around timing and size of release, or an overall reduction in production.
3. Habitat Restoration/Protection which could involve areas both nearshore and offshore. What is required here is a better understanding of the key links between the habitat and salmon prey production.

She noted that the development of forecasting ability with respect to marine survival would be very useful, but difficult to accomplish. Work is being done to examine the relationships between July size, physical and biological factors (e.g. plankton and fish availability) and climate indices and marine survival in Puget Sound.

Other key issues that need to be clarified include an understanding of the key mechanisms affecting feeding, growth and survival. They wish to determine the factors that affect the spring-summer feeding rate, the food supply and productivity, and competition (e.g. with other species of salmon, forage fish, and the hatchery-wild competitive interactions). More work needs to be done to examine agents and the specific timing of mortality from predation, disease or starvation.

Greg Ruggerone, Senior Scientist, NRC. "Growth, life history, and survival of chinook salmon"

Dr. Greg Ruggerone has been conducting research on salmon in Alaska and the Pacific Northwest since 1979. Most of his research involves factors affecting salmon survival and approaches to improve management. Recently, he has examined relationships between chinook salmon growth, life history, and survival. He has also developed habitat restoration approaches for juvenile chinook salmon in Puget Sound estuaries.

His key hypotheses are that:

- chinook growth is dependent on prior growth (i.e. the previous year's growth). The implication here would that it is most important to protect freshwater & estuarine habitat
- Survival is dependent on life history, which is related to early life growth & gender.
- Puget Sound chinook survival is influenced by pink salmon & climate.

The 3 drainages supporting the largest runs of chinook in western Alaska are the Yukon, Kuskokwim and Nushagak Rivers. He has been examining the chinook runs on the first two of these 3 drainages.

By examining the scales, he was able to look at the growth characteristics of Yukon chinook and found that there was relatively high growth prior to the 1976/77 regime shift, intermediate from the mid 1970s through early 1980s, then typically below average after the mid-1980s until rebounding in 1999 or 2000. The period of low growth preceded the chinook decline.

However, he noted that the most striking pattern was the trend in growth between each life stage. This is clear in the figure below, showing growth patterns for one year in freshwater FW1, and then for increasing numbers of years in salt water (SW1- SW4) (Figure 6). Thus, growth appeared to depend on the previous year's growth. He noted that scale growth did not clearly reflect climate shifts and there did not appear to be any obvious growth-abundance relationship. When he examined growth in freshwater and growth in the ocean, he noted that there was a clear relationship (Figure 7). This relationship was consistent for both Yukon and Kuskokwim chinook.

Figure 6. Annual Yukon Scale Growth

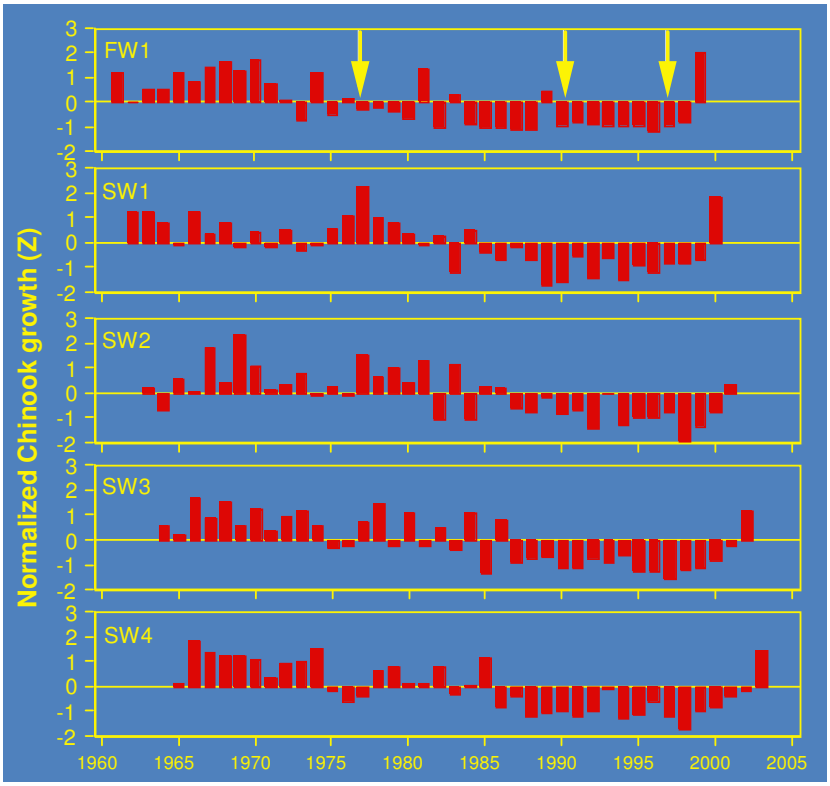
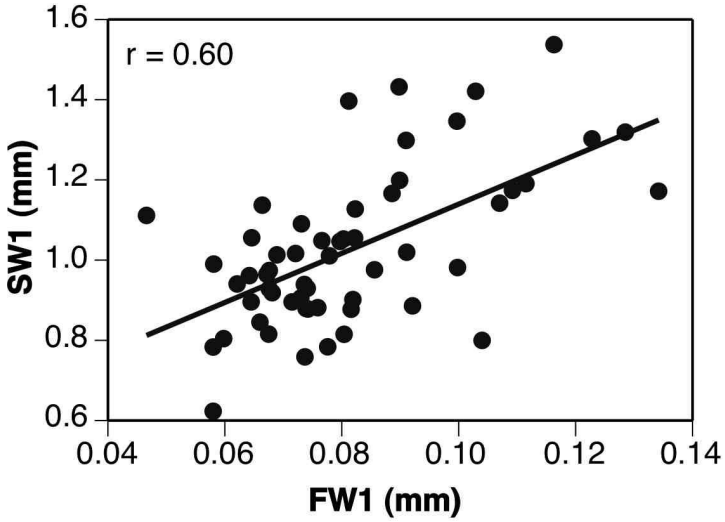
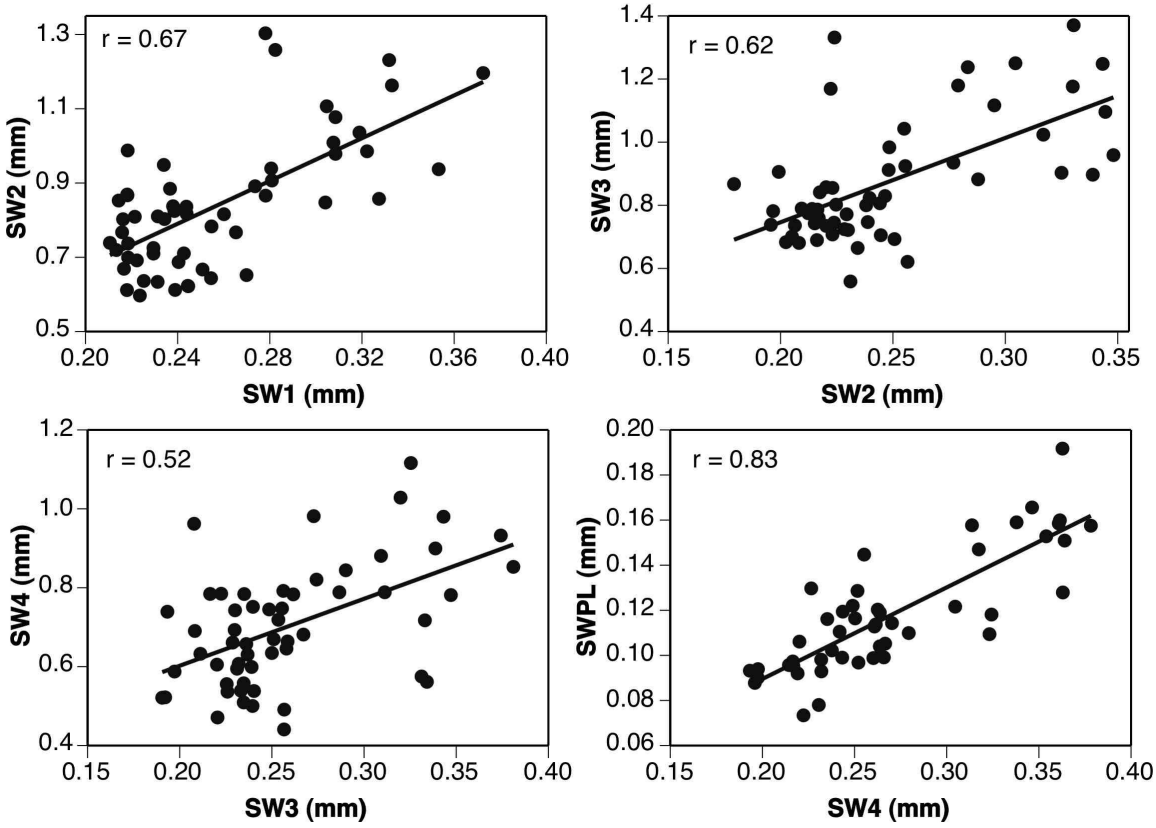


Figure 7. 1991: chinook Ocean Growth is Dependent on Freshwater Growth



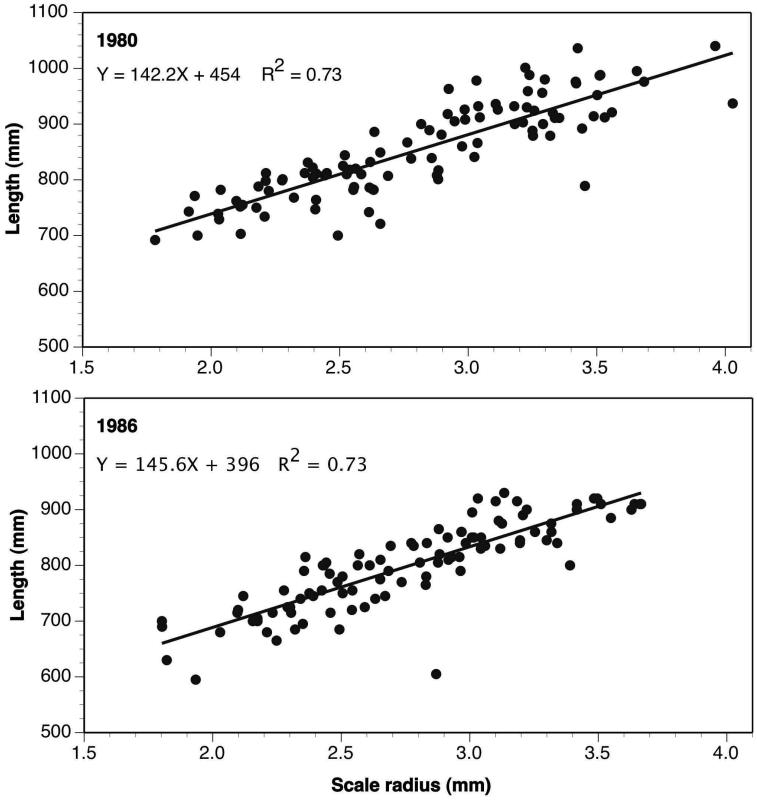
The dependence of growth on previous growth was apparent during each year of life. Therefore, growth during the first year at sea (SW1) appeared to be dependent on FW growth, 2nd year at sea depended on 1st year growth, 3rd year at sea growth depended on 2nd year and so on. These relationships are shown below (Figure 8).

Figure 8. Relationships between chinook growth in each year at sea and the previous year's growth.



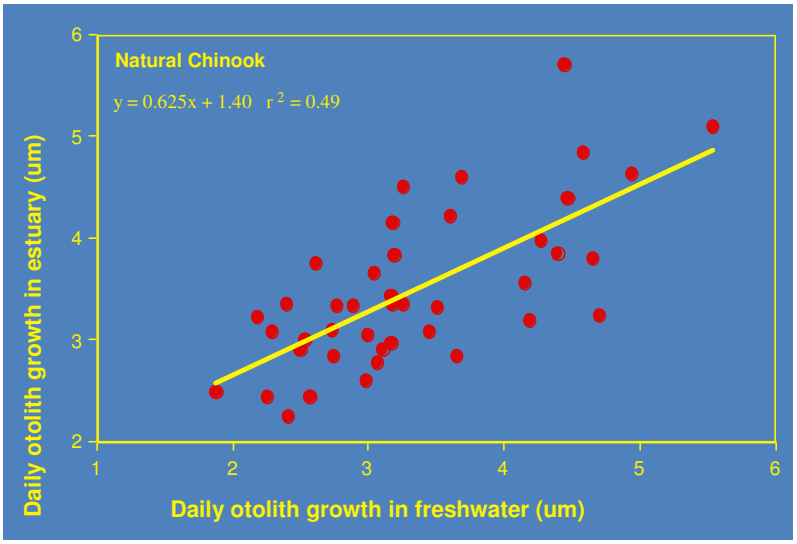
He found that adult length was correlated with scale growth (top graph of Figure 9), and weakly correlated with freshwater scale growth.

Figure 9. Correlations in adult length with scale growth among salmon returning in 1980 and 1986.



Greg also showed that estuarine growth is dependent of FW growth (Figure 10). The implication of this work, that growth depends on previous year's growth, given that this relates directly to survival (Elizabeth Duffy's work), is that we need to protect and restore freshwater and estuarine habitat to maximize growth potential at sea. This will be especially important when ocean productivity is low, as is currently believed to be the case.

Figure 10. Relationship between freshwater growth and estuary growth (as assessed using otoliths).



He also looked at size differences by sex. There are differences by species. For example:

- Sockeye male > female at age.
- Chum male > female at age.
- Coho male < = female (Holtby & Healey 1986).

For chinook, he found that there were more older females than males (Figure 11) and that females were longer than males for all given ages except for fish that spend 5 winters in ocean (Figure 12). It appeared that females started to grow faster than males in the freshwater stage, so very early on in the life history.

Figure 11. Age structure of the chinook populations in A) Yukon and B) Kuskokwim, by sex.

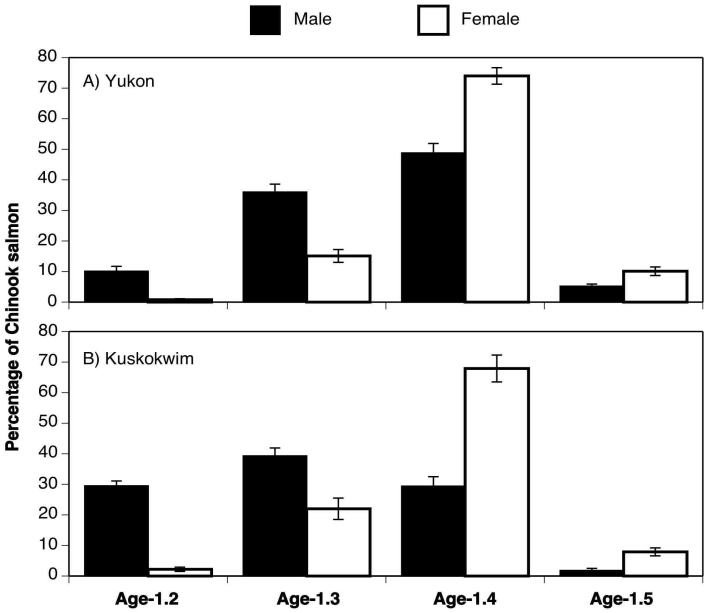
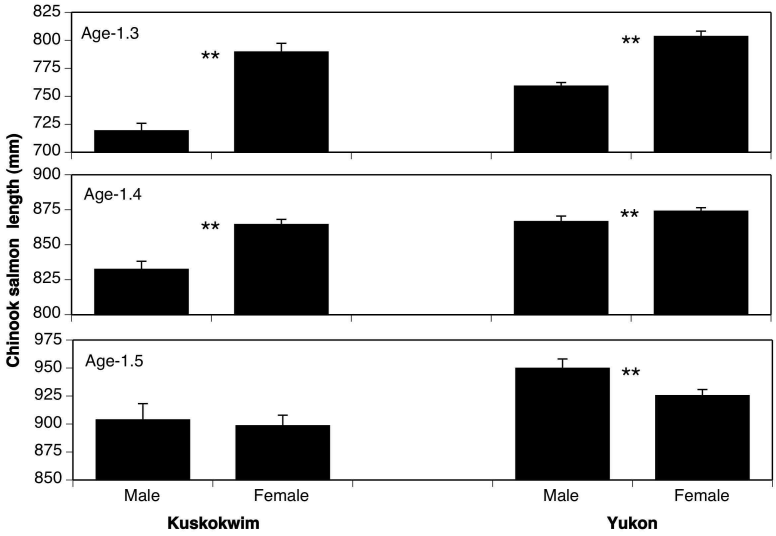


Figure 12. Length of chinook males and females by age.



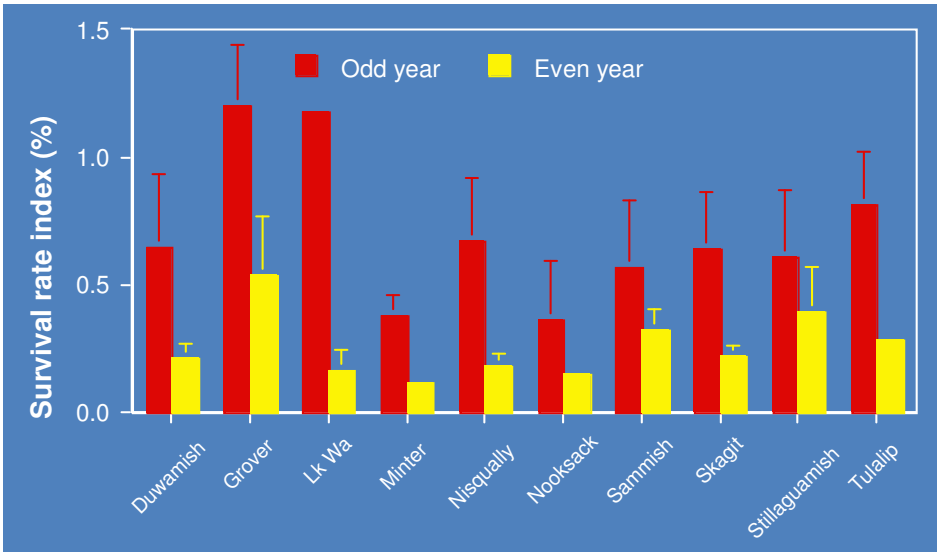
One interesting find was that there appear to be fewer adult female chinook as compared to adult male chinook (Table 1). This would imply that there is some kind of trade-off. Females mature at an older age and have overall greater mortality than males, and they also grow faster than males. So, they trade off survival for a greater size at maturation (in length and age). This would suggest that fast and successful growth may be particularly important for female chinook.

Table 1. Percentage of females in a number of river systems in Yukon and Kuskokwim.

Stock	% female	SE	df	P-value
Yukon watershed				
Yukon mainstem	47.5%	1.0%	33	0.021
Gisasa R	31.8%	3.5%	9	< 0.001
Andreafsky R	36.4%	3.4%	10	0.003
Anvik R	40.8%	2.2%	24	< 0.001
Salcha R	42.8%	1.8%	27	< 0.001
Chena R	45.6%	2.8%	21	0.13
Kuskokwim watershed				
Kuskokwim mainstem	32.8%	3.1%	20	< 0.001
Kogrukluk R	33.7%	1.8%	29	< 0.001

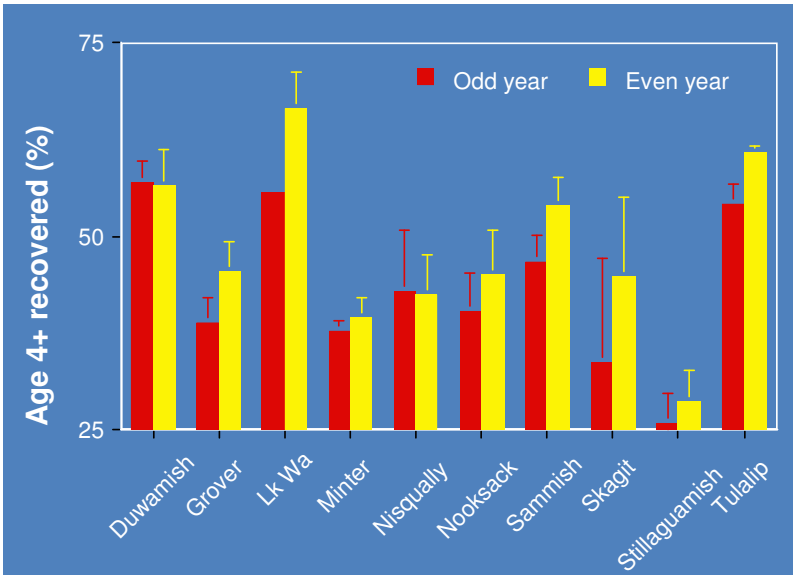
Greg also examined closely the relationship between chinook survival in Puget Sound during years of higher and lower pink abundance. He found that chinook survival, based on coded-wire tags, was 62% lower when the chinook were migrating in even years (when juvenile pinks are abundant). The graph below shows patterns for 10 stocks between 1984-97 (Figure 13) (Ruggerone & Goetz 2004).

Figure 13. Chinook survival rate index between 1984-97.



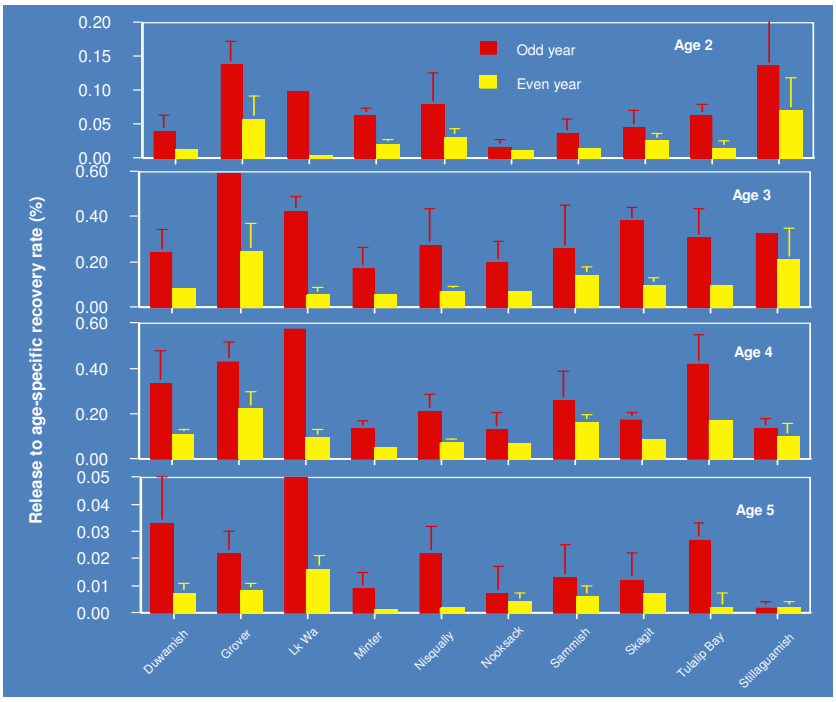
It appeared that the possible competition with pinks led to a delay in the age at maturation of chinook (Figure 14). The fish that were migrating with the large numbers of pink fry appeared to grow more slowly and therefore ended up delaying maturation as a result.

Figure 14. Percentage of Age 4+ chinook recovered in even and odd years.



This even-year mortality appeared to be established during the very first year at sea (Figure 15).

Figure 15. Release to age-specific recovery rate (%) in odd and even years.



Greg summarized his key findings and added the following new comments based on his estuarine research in the industrialized Duwamish River, Puget Sound (Ruggerone et al. 2006):

- Subyearling chinook density and residence time appear to be greatest in estuarine "transition zone" overall.
- Density greater in off-channel habitats as compared to mainstem habitats in the lower river/upper estuary.
- In the lower estuary and nearshore marine areas, densities were generally lower (as the fish appear to be migrating more than holding).
- It is necessary to restore habitats to provide opportunity for prolonged growth, refuge from predators, and adequate transition to sea.
- The density and residence time data suggested that the "transition zone" would provide the greatest benefit to chinook if it underwent restoration.

Wilf Luedke, Chief of Stock Assessment for South Coast Area, DFO. "Update on the current status of Cowichan chinook"

Wilf is the Chief Assessment Biologist for the South Coast Area of DFO. He has been working on southern BC salmon issues for 25 years and is currently coordinating DFO efforts in developing rebuilding options for Cowichan chinook. Wilf provided an update and review of Cowichan chinook planning. He noted that in 2009, the Cowichan chinook abundance declined to the lowest in river spawner abundance on record, with approximately 1000 fish total return in 2009 including about 600 spawners, 300 broodstock, and reported 200 FSC (Figure 16). Figure 17 shows the key identified threats to Cowichan chinook, which include sedimentation issues affecting egg incubation, lack of lower river rearing areas, predation, lack of estuarine habitat, high ocean mortality in the first summer, ocean predation and fisheries, terminal mortality (seals and fishing), and loss of spawning habitat. One of the key factors that has led to decline of chinook is the current low level of marine survival, which showed steep declines after 1991 (Figure 18).

Figure 16. Cowichan Freshwater Escapement (including FSC catch and broodstock removals)

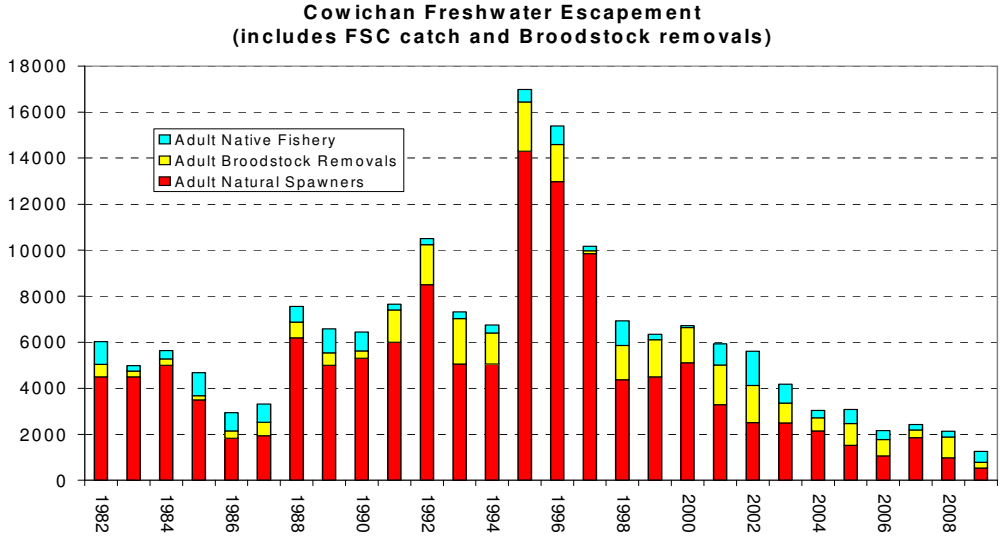


Figure 16. Key identified threats to Cowichan chinook for the different life history stages.

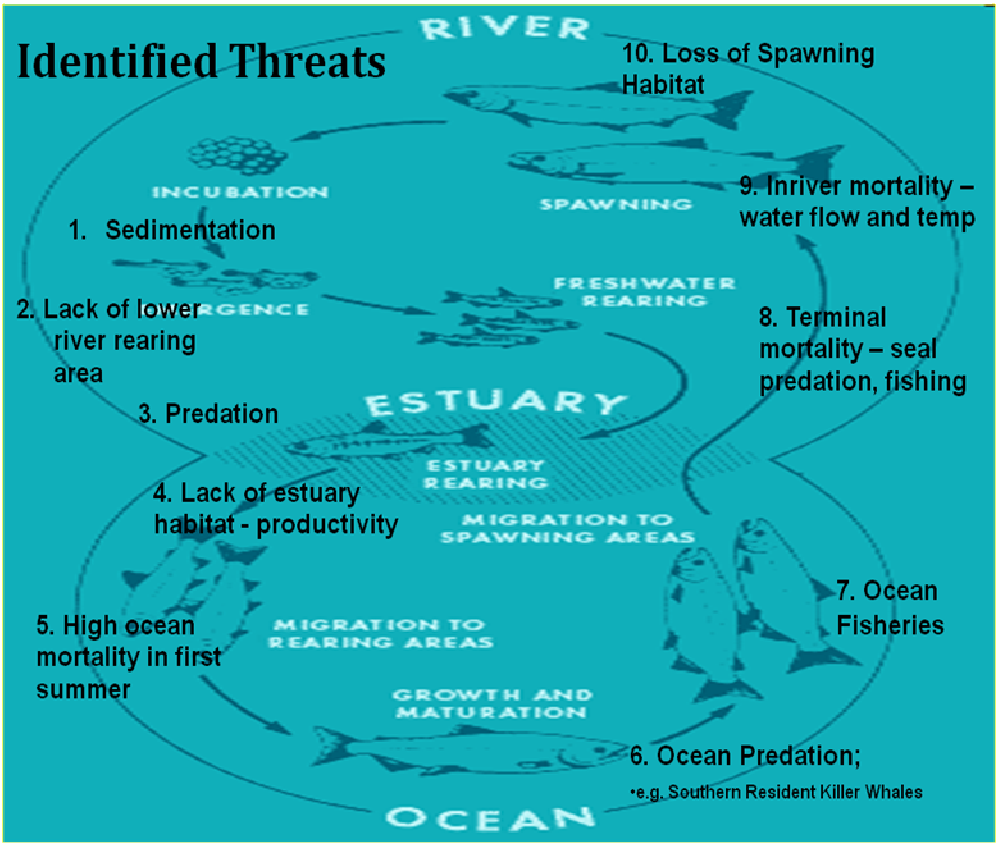
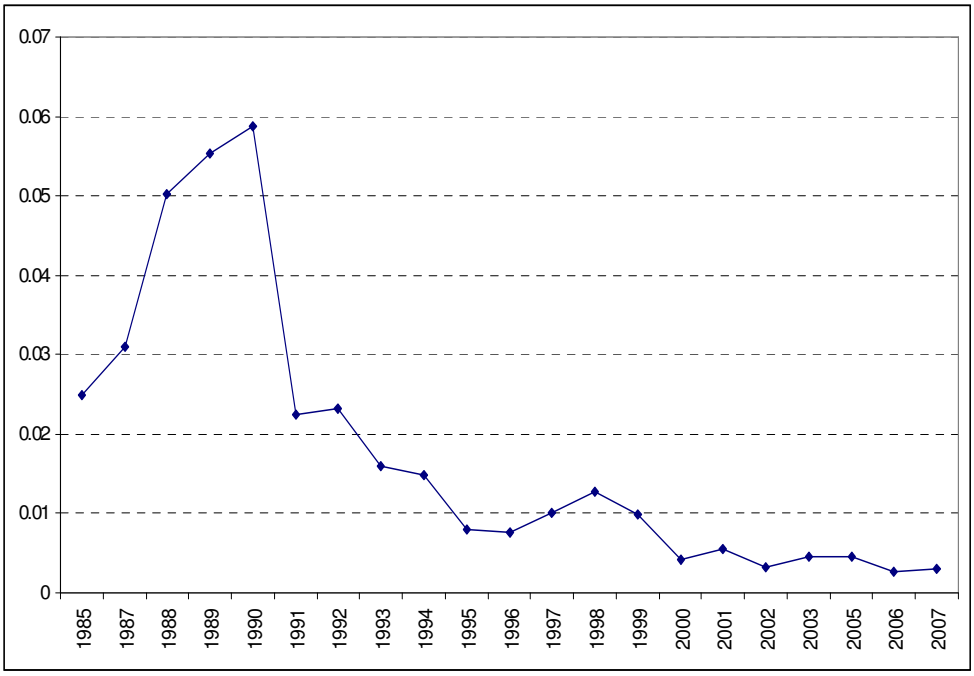


Figure 17. Early Marine Survival shown in survival to age 2 fish (as assessed using Cowichan hatchery chinook.



Rebuilding Cowichan chinook is a priority in the DFO Salmon Integrated Fishery Management Plan and is linked to the development of a southern BC plan for chinook. Within this broader plan, a comprehensive approach to rebuilding Cowichan chinook will focus rebuilding effort between harvest, hatchery, habitat, and ecosystem related issues.

There is also a strong First Nation, stakeholder, and community interest in rebuilding Cowichan chinook. At a meeting last November the community suggested a strong desire to continue to try new things to improve the hatchery return rate. There has been significant work in restoring habitat in the river, including Stoltz remediation, upper river spawning gravel replenishment, lower river rearing improvement through side channel development, etc. Additional planning is progressing through the Cowichan Watershed Board, First Nations workshop on the estuary, CVRD State of the Environment Reporting, and more.

There have been a number of fishery management actions along with habitat restoration undertaken to date and these are shown in Table 2. Wilf believes that these actions likely increased the rate of return to the Cowichan River probably in the order of 20-30%.

Table 2. A summary of benefits (increased return to the river) from recent years:

Category of impact	Risk Level	Actions taken to date	Likely Benefit in return to river
Harvest	High -> remains high with some debate over accuracy	-Terminal sport closures; - Victoria area sport closures; -WCVI AABM troll reduction; -MSF in Puget Sound sport.	Currently estimated at 10%+
Hatchery Infrastructure and Operational procedures	High -> Now lower risk	-significantly improved infrastructure around power and water supply has reduced risk of failure; -Additional changes being considered such as river water intake.	Not applicable.
Hatchery release strategy	High	- experimental release in September to avoid early summer period of high mortality. Evidence from other areas suggests this could increase survival rate up to 3-5 times current.	Could be up to 10% increase to river, but not until 2012.
Habitat restoration and management	High -> Now likely much lower	-Reduced suspended sediment -Improved spawning gravel - lower river rearing channels TBD: improved water flows TBD: lower river rearing TBD: improved estuary TBD: improved governance	Total difficult to measure, likely in order of 10% and should increase as new measures adopted.
Total			About 20-30%

Harvest:

Fishery related mortality in ocean fisheries has been reduced in recent years. Action was taken in 3 biggest fisheries (50% reduction in harvest in WCVI (West Coast Vancouver Island) troll, closures in GST (Georgia Strait) sport, and expanding Mark Selective Fishery in Washington State). Figure 18 shows the rates of fishery mortality from 1990 to the present, while Figure 19 shows the proportionate contribution of the different fisheries to the current catches.

Figure 18. Total mortality rate of Cowichan chinook in ocean fisheries (as assessed from CWTs of hatchery chinook).

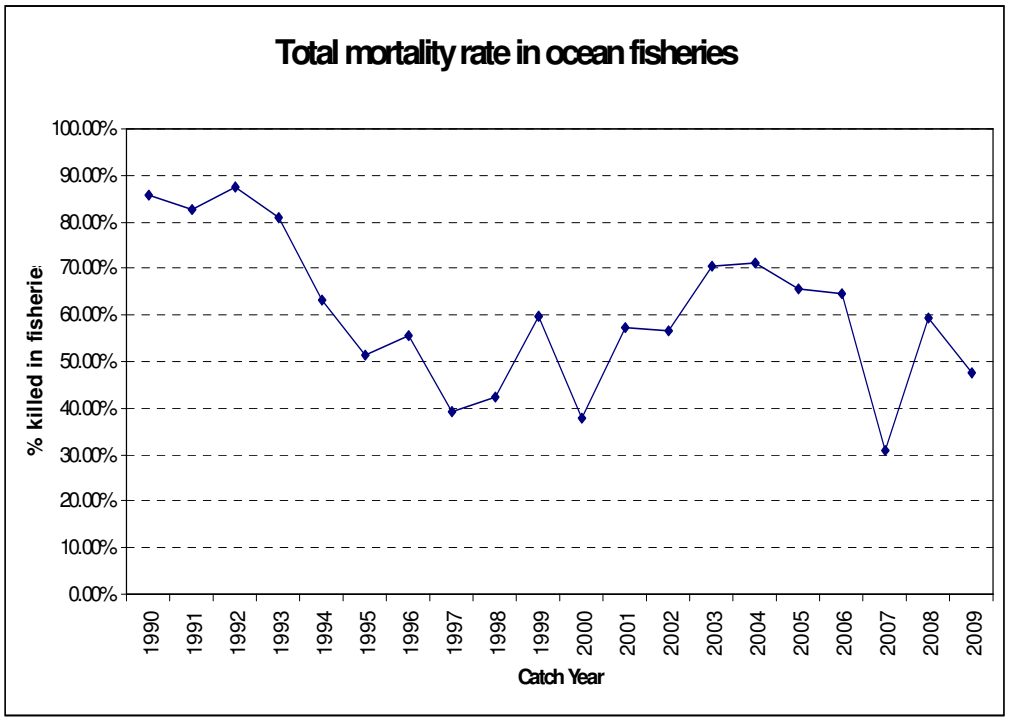
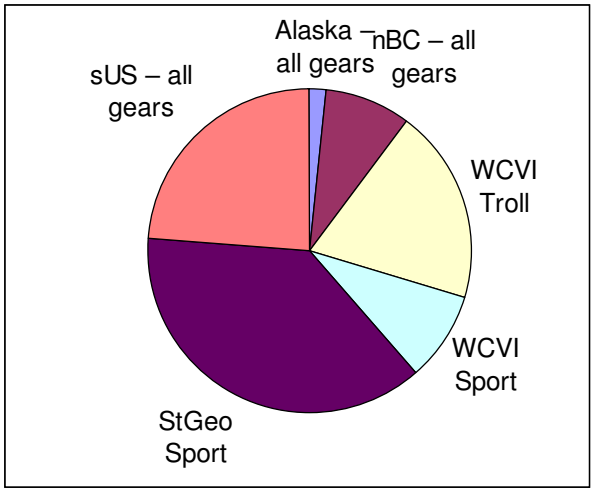


Figure 19. Proportionate contribution of the different fisheries to the current catches of Cowichan chinook.



Wilf suggests that there has been an approximate benefit to date of about 10% increase in proportion of chinook returning to river as a result of management actions in marine fisheries. The WCVI troll fishery has been reduced by 50% as per reductions in the Pacific Salmon Treaty agreement and access limitations under the DFO Allocation Policy. The WCVI troll fishery impact averaged about 15% in recent years, so he believes that the 50% reduction should provide an average reduction of 7-8% for Cowichan chinook. The recreational fishery has been closed for chinook fishing in the Gulf islands from August 1 to October. In addition, actions have been taken in the Victoria area sport fishery and there are spot closures (chinook non-retention and RCAs) throughout the northern Strait of Georgia.

In addition the impact on unmarked Cowichan chinook is likely a few percentage points less than marked hatchery fish due to mark selective fisheries (MSF) in Washington State waters.

Cowichan chinook continue to be distributed throughout the southern BC area from upper Johnstone Strait around to Brooks Peninsula and in Washington State waters. The degree of inside distribution relative to outside distribution is variable. Moreover, this distribution pattern is significantly different from the historic pattern prior to about 2000 of mostly inside the Strait of Georgia, Puget Sound, and Juan de Fuca Strait.

The broad and variable distribution of the remaining catch creates risk and high uncertainty in the likelihood that further actions (using current management tools) would reduce the exploitation rate (ER). The current ocean ER is likely in the 30-60% range (under review). Evaluation of new management tools such as MSF will provide the potential to reduced ER significantly.

Habitat:
The benefit of restoration to date is hard to measure but local expert opinion (Sheng, Wightman, Rutherford pers comm) suggests that these actions may have resulted in a approximately 10% increase in productivity.

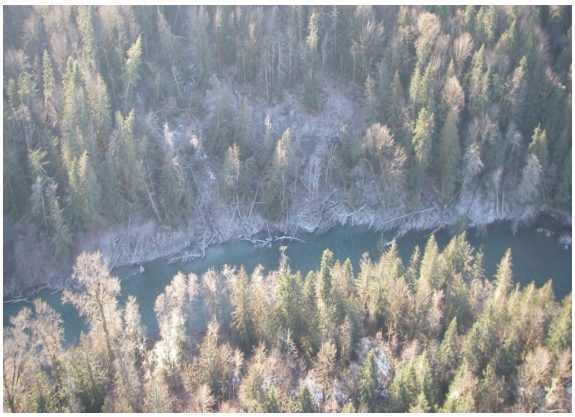
Over the past 5 years several projects, worth more than $1.5M have:

- reduced suspended clays in the water and so improved lower river spawning and rearing,
- improved spawning gravel in upper river,
- created side channels for rearing, and
- removed blockages in the fishway.

These have included:

Lower River Habitat Projects e.g.:

- Cowichan Estuary – Eelgrass transplants
  - With the Cowichan Community Land Trust/Seachange Marine Conservation Society as lead partners
- Lower River Off Channel
  - With MOTH as lead partner



Mid River Habitat Projects e.g.:

- Sedimentation Projects: Living Rivers/BCCF Lead Partners
- Stoltz Follow up
- Point Source monitoring
- Sedimentation research

Upper river habitat projects e.g.:

- Lake outflow spawning habitat
- Trestle side channel
- Living Rivers/BCCF Lead Partners

There is potential for improved water flow and quality if a pilot approach called the Cowichan Watershed Board is successful. Work is also underway to examine additional potential actions such as improving lower river and estuary habitat, providing more rearing channels, etc., however, these are likely longer term options.

Hatchery infrastructure:

Significant improvement in infrastructure includes new back up systems and alarms, rejuvenation of water flow/wells, and improved operational protocols. These actions have significantly reduced risk of failure such as occurred in 2005, but do not result in improved productivity of the stock.

Other infrastructure proposals may increase overall productivity. In addition, experimental hatchery release strategies may provide improvement in the return rate. In recent years Cowichan Hatchery chinook appear healthy on release and are surviving at rates comparable to other hatcheries on the east coast of Vancouver Island (ECVI). In the past few years, there have been experiments with sea pens, lake pens, off-site rearing (in 2009 50% of the production was reared at Nitinat hatchery), and timing of release. For some of these trials it is too early to estimate impact on return rate.

The 2009 brood will be released in two components; 1) the majority in May, and 2) a small experimental release of about 25,000 chinook in September. There is some evidence that late timing into the Strait of Georgia may significantly improve survival.

Next Steps

Efforts continue on several fronts.

- In the river, planning and work continues toward a community objective of a healthy watershed. A healthy river ecosystem is a critical component for chinook rebuilding. The Cowichan Watershed Board is undertaking water related issues. Habitat restoration work and protection continues on several fronts mainly through the Cowichan Stewardship Roundtable.
- In the near shore marine environment of the Strait of Georgia, DFO with help of the PSC, PSF, Living Rivers, and others are working on assessing and understanding juvenile chinook mortality through projects such as understanding plankton and ecosystem interactions, distribution of juvenile chinook and other salmon, assessing interactions of southern resident Orcas and chinook salmon, etc.
- In the ocean fisheries, increased coded wire tagging, from 200,000 per year to levels as high as 600,000 per year will provide increased certainty and resolution of adult Cowichan chinook.

Summary

- In 2009 Cowichan chinook abundance continued to decline to the lowest inriver spawner abundance on record.
- A comprehensive approach to rebuilding Cowichan chinook is being undertaken which will address threats and limiting factors for chinook production in the watershed, enhancement, the near shore marine environment, and in the fisheries. Priority issues have been identified and options are being developed.
- In the short term, the comprehensive approach is distributing rebuilding effort between harvest, hatchery, habitat, and ecosystem related issues. It is likely that actions taken in recent years will increase returns to the Cowichan River by about 20-30%, with roughly equal distribution between marine harvest, enhancement, and watershed habitat restoration.
- Additional threats and opportunities are being investigated, including improved understanding of natural mortality, fishing mortality, watershed productivity, and accuracy of the assessment program. Sources of natural mortality could be in the river, estuary, near shore marine, ocean, as either juveniles or adults.

Session 3: Estuary Restoration

Louis Druehl, Professor of marine botany, SFU and President of Canadian Kelp Resources Ltd. "Kelp conservation and farming"

Louis Druehl has taught marine botany at Simon Fraser University and various marine stations for over thirty years. His ongoing research advances understanding of kelp ecology, evolution and cultivation.

Louis and his wife Rae Hopkins have operated Canadian Kelp Resources (www.canadiankelp.com) for over twenty-five years. CKR has a line of sea vegetables (Barkley Sound Kelp), provides kelp for pharmaceutical and cosmetic companies, and champions kelp farming and the development of kelp-based cottage industries locally and abroad.

Louis discussed the concept and practicalities of kelp farming as both a conservation tool and economic opportunity. His company, CKR, has developed a kelp product with a high unsaturated fatty acid profile for a Vancouver homeopathic company, special kelp blends for a Chicago distributor of health foods, a sea vegetable salad blend for AMIQ Institute of Russia, and they are currently working on custom feeds for abalone and sea urchin culture.

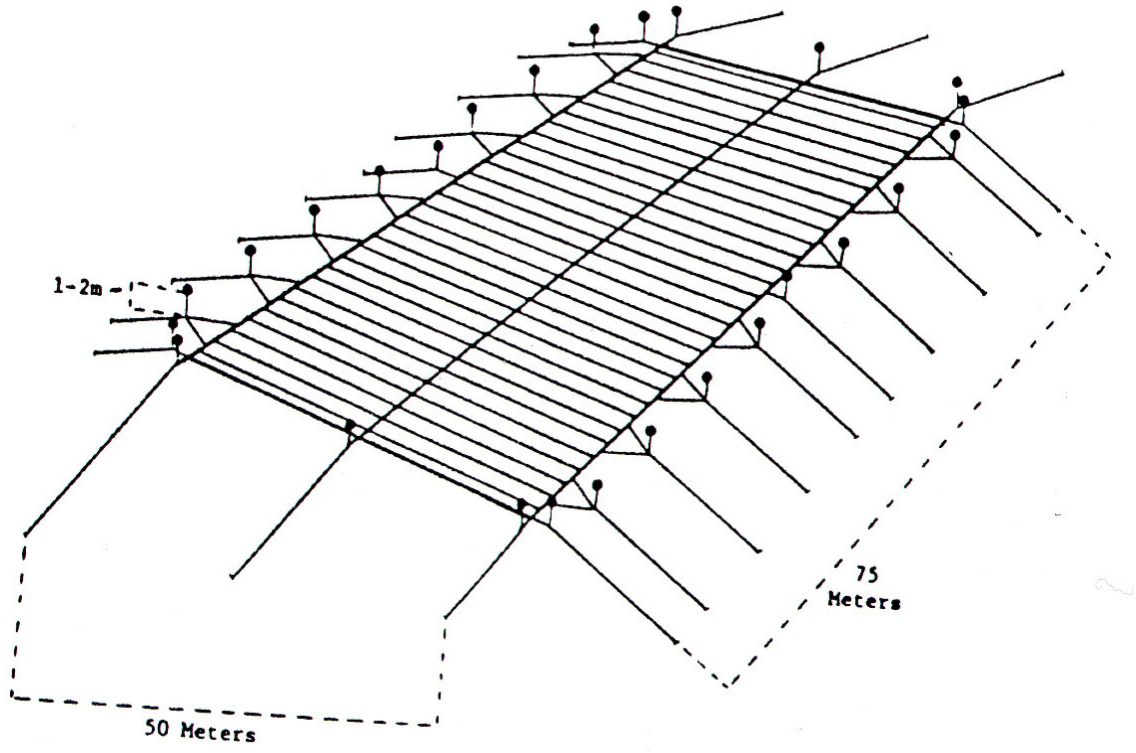
The kelp products are produced at their commercial kelp farm in Bamfield. CKR has operated this commercial kelp farm for the past ten years and has consulted on kelp farm construction and operation (British Columbia, Quebec, Northwest Territories, Newfoundland), farming giant kelp for methane gas production (California) and advising on wild kelp harvest impact (British Columbia, Northwest Territories, Russia).

As part of their work, they have designed a method to enhance impoverished giant kelp beds for the Huu Ay Aht First Nation (Vancouver Island) and seeding techniques for shores disrupted by oil spills and other unnatural events. This technology is of great interest for those of us concerned about the loss of kelp in the Cowichan estuary.

Figure 20 on the next page shows the suggested layout of a standard 1 acre kelp farm.

Louis discussed the different stages of kelp farming, and showed pictures of a “kelp spool” which is a length of seeded rope. This is planted in the kelp farm and tethered down with weights. Figure 21 shows a typical product- this is farmed *Saccharina latissima* (or sugar kelp), providing a yield as high as 8 kg kelp per meter of rope! Louis discussed that they have been able to achieve yields as high as 24 kg per meter rope, so this method is highly effective, as long as the salinity and temperature of the water is adequate. Figure 22 shows some of the different species of kelp that he has been able to farm.

Figure 20. Suggested layout of a standard 1 acre kelp farm



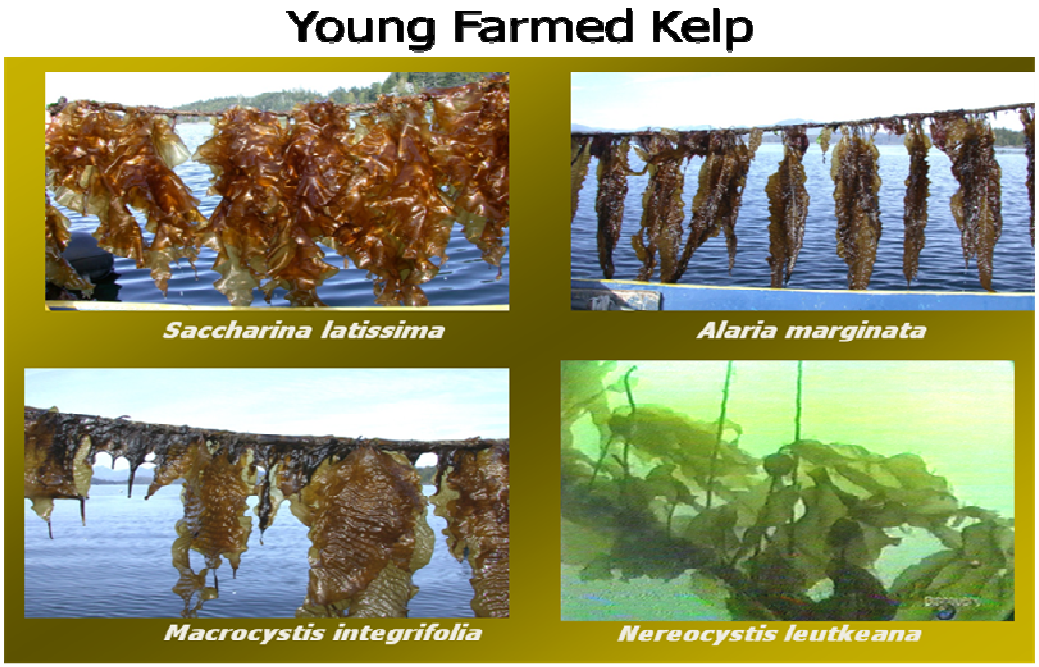
Merrill and Gillingham 1991: NCRI-T-91-011

Seed Spool

Seed Planting

Figure 21. A typical product of mature kelp grown on the seed spool: farmed *Saccharina latissima* (sugar kelp) with a yield of 8 kg kelp/meter rope

Figure 22. Different species of kelp that can be farmed using seeded rope.



Diane Sampson, Nile Creek Enhancement Society. "Kelp Restoration Strategies"

Diane Sampson has been a member of the Nile Creek Enhancement Society for about six years. She was originally a board member and is now the administrator for the society. The society began by restoring Nile Creek in Bowser, which was done with the aim of bringing back pink salmon that had originally existed there in very large numbers. The group is now working on the restoration of 6 other creeks.

The restoration of creeks and rivers need to be accompanied by restoration of marine and estuarine areas too. The Bowser area, like other areas in the Georgia Strait, had vibrant bull kelp beds in the mid-1900s. Diane discussed the fact that fishermen used to tie up to the kelp beds and fish from their boats. Kelp, or rainforest of the sea, is an important habitat for many species, including salmon, rockfish, herring and invertebrates. It also provides a critical carbon sequestration function, and provides nutrients for many species that feed off it.

One of the key questions is to determine what happened to the kelp and why did it disappear from so many different areas within the Strait? There are a number of different theories. She noted that Louis Druehl has suggested that development is likely one key reason. Kelp beds are more healthy on the west coast, but not along the east coast of Vancouver Island, where factors such as temperature and logging history are similar, but the overall development rates are much higher on the east coast. We are also in a warm phase of the Pacific Decadal Oscillation, which is a phenomenon that causes ocean temperatures to change every 20 to 30 or more years. This warm phase began in the late 1970, but we are now apparently moving into a cold phase. The warm phase may have also resulted in a decline of kelp beds as bull kelp needs cool water, which is high in nutrients, to thrive. Another key cause of kelp decline in some areas is associated with grazing by sea urchins.

Diane believes that further research and test planting will have to be done to better understand what factors, or combinations of factors, may be the cause of its decline and what contributes to its return.

Diane and Ken Kirkby, the President of the Nile Creek Enhancement Society, began a kelp restoration project in the Bowser area and did their first planting in the fall of 2006, with advice from Louis Druehl. Diane continues to be involved with the local project and has also been working with other groups to support their kelp restoration efforts. The collected sori (or spore patches) from a kelp bed in Campbell River were sent to Louis Druehl in Bamfield, who used them to produce small kelp plants on string (photograph to the right).

Volunteers tied sections of the line to bags filled with rocks (photograph below), which were taken out and dropped to depths of about 30 or more feet.

They also used a long-line method (photograph below) where the seeded line was wrapped around a larger line that was suspended using pressure buoys and anchored on the bottom with concrete blocks.

They were not able to determine if using the netted bags with rocks was successful, but the long-line method was covered in kelp. There were some issues in the Bowser area due to high levels of sand, which is not an ideal substrate for the attachment of the holdfasts.

Diane held a strategic workshop in April, which resulted in the production of a report outlining an initial strategy for planting kelp at Bowser, Gabriola Island, Lasqueti Island and Hornby Island, where kelp beds existed historically. They believe that it is very important to have controlled test planting sites and collection of scientific data so that planting success/failure can be fully evaluated. They hope to use Quadra Island as a control site, as there are already very healthy beds of kelp there. They also feel that the plantings should be concentrated in a small area to facilitate monitoring and data collection.

They are going to utilize a variety of different methods for planting including:

Stake Culture Method (photograph to the right) – this is beneficial in areas with sea urchins and other herbivores, as it keeps the kelp above the bottom. Young sporophytes (plants) are grown on plastic rings which are attached to a one meter rebar stake that is nailed into the substrate.

The **long-line method** will also be used, and in Bowser, they plan to use **concrete artificial reefs and concrete blocks** (photograph to left) which are useful as they can be placed over the sandy substrate.

In areas with natural rock, such as Gabriola, Lasqueti and Hornby Island, and the artificial reefs in Bowser, **Sori transplants** (photograph to right) will be used. This method requires cutting mature plants well below the bulb and moving them to the ponds at a facility near Bowser prior to release of the spore patches. When the patches are ripe and ready for release, individual patches would be placed in mesh bags with rocks and dropped at the test site locations. This will determine if natural sori release by kelp plants is effective in plant production compared to laboratory-cultured plants.

They will be collecting information on substrate composition, biological information (invertebrates, fish, marine plants), and on water characteristics (e.g. temperature, salinity, turbidity and pH) for both the test and the control sites.

Nikki Wright, Co-chair, Seagrass Conservation Working Group. "Restoration of Eelgrass Habitats in the Cowichan Estuary"

Nikki Wright has had experience with community organizing for over thirty years, marine education for the last seventeen years, and has acted as the Executive Director of a marine community based non-profit society since 1998. She has helped organize 27 coastal conservation groups on the BC coast to map eelgrass habitats as the Co-Chair for the Seagrass Conservation Working Group. The SCWG is a consortium of provincial and federal agencies, First Nations, conservation groups and consultants working together since 2001 for the protection of seagrasses in B.C. She has successfully coordinated twelve eelgrass restoration projects in collaboration with the Department of Fisheries and Oceans, BC Parks and other community, federal and provincial organizations.

Nikki noted that Burns and Tutty (1962) stated that the estuarine habitat was very patchy in the Cowichan estuary, primarily as a result of exposure to waves, log abrasion etc. By 2003, at the workshop "Eelgrass Restoration Strategies for the Cowichan Estuary", water quality and habitat loss were defined as the two key issues that needed to be addressed. In 2005, the Cowichan Community Land Trust began to look at eelgrass mapping and restoration, and planted the first test plots. There were 4 plots, each with 100 shoots, but two of these plots did not persist long term as they were planted too far in the intertidal zone and were harvested by geese and swans. The other two showed a 70-80% increase in shoot density and therefore, they decided to do some larger scale transplants.

Nikki presented data on this project and the other eelgrass restoration projects that have been done in the Cowichan estuary between 2005 and 2010 (Tables 3 and 4). Figure 23 shows the location of the two different trials done in 2008 and 2009. The trials show significant differences in effectiveness, as assessed by the % increase in shoot density. All were successful, except for the planting done in April 2006. This planting had been done in a site that had been released from a log lease and thus they had believed it to be an appropriate site. However, boats were still out there even though the log lease had been retired, and their props had resulted in churning action that had damaged the eelgrass. She noted that the choice of site is crucial for these studies.

Nikki stated that the success of these eelgrass transplant projects were entirely dependent on excellent partnerships and funding and a very strong volunteer base. Her work would not be possible without the Cowichan Community Land Trust, Cowichan Tribes, Cynthia Durance, Precision Identification, Department of Fisheries & Oceans, Environment Canada (EcoAction), Habitat Conservation Trust Fund, Ministry of Environment, Pacific Salmon Commission, Pacific Salmon Foundation, Public Conservation Assistance Fund and the Vancouver Foundation.

Table 3. Results of eelgrass plantings done between 2005 and 2006

Date	# eelgrass shoots	Planted Area (m2)	Monitoring Results (% Increase in shoot density
July 2005	400	4 test plots of 100 shoots each	70-80% increase in 2 sites (Sept '05)
April 2006	3,128	313 m 2	< 13% (2007)
July 2006	2,720	272 m 2	> 250% (2007)

Figure 23. Location of eelgrass planting sites in Cowichan Bay 2008-2009

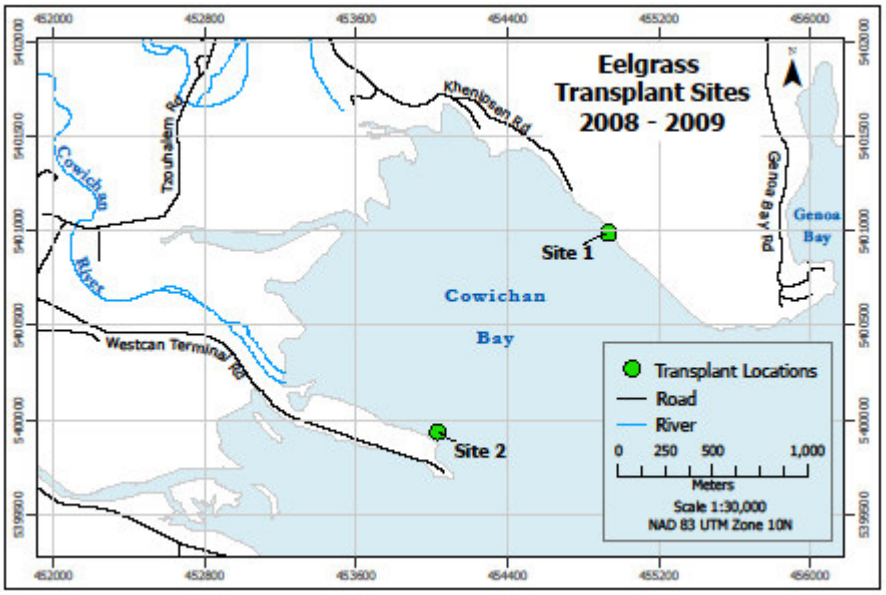


Table 4. Results of eelgrass plantings done between 2005 and 2006

Date	# of eelgrass shoots	Area coverage (m 2)	Monitoring Results (% increase in shoot density
June 2008	3,000	> 2,950 m 2 (08-09)	70 % increase
June 2009	2,450		

Rob Russell, Rob Russell Biological Consultant. "Biophysical assessment of the Kokish River estuary with suggestions for restoration, by the BC Conservation Foundation and Castor Consultants Ltd."

Rob Russell is the principal consultant of Rob Russell Biological Consultants, an environmental consulting firm specializing in marine and estuarine habitat assessments. He has more than 33 years experience in fish and fish habitat related research, project management and compliance and effectiveness monitoring. Rob worked extensively in habitat management with Fisheries and Oceans Canada (DFO) for thirty years and is well versed in marine regulatory agency concerns relating to projects such as industrial docks and wharves, and associated marine facility planning and development.

Rob discussed work that he and Rob Waters (Castor Consultants) have been involved to restore the Kokish estuary, which used to be a strong steelhead and salmon producing system. Recent escapements have been much lower than they appeared to be in the 1950s (Table 5).

Table 5. Kokish River Historic Salmonid Escapements

	1950s	1970s	2010
Coho	15,000	800	200?
Chum	3,500	500	unk
Chinook	400	75	unk
Pink	3,500	400	unk
Steelhead	3,500	178	350
Dolly Varden	unk	800	unk
Cutthroat	unk	36	unk

The reasons for restoring this system were given as follows:

- It has had historically good salmon and steelhead escapements
- There has already been a significant investment in up-river enhancement and restoration
- There is a great deal of potential to improve lagoon circulation, increase area of salt marsh in the estuary and produce more salmonids
- There is the potential to work with First Nations and Western Forest Products to improve water quality and reduce the industrial footprint

Rob discussed how they approached the restoration work. Initial steps were to collect background reports and old aerial photos to get a sense of how the estuary used to look. Next, they conducted a biophysical assessment of the estuary, e.g. they used GPS to document the salt marsh vegetation plots, conducted water quality analysis, and carried out a complete habitat inventory. They established intertidal transects and dug quadrats to determine relative macro-invertebrate numbers across the estuary. Water quality was sampled at representative stations throughout the watershed in order to determine possible sources of organic or chemical contamination.

Much of this work was done by the Namgis First Nation, who collaborated on this project.

By super-imposing the 2009 Kokish estuary vegetation plot datasets on earlier (1983) vegetation survey plots (M.M. Wayne, 1984) they were able to determine relative changes in the surface area of dominant salt marsh species.

Finally, historic and present day aerial photos were examined to determine the changes over time.

Upon completing the data collection and analyses, they were able to put forward a number of restoration options. These included:

- Excavate additional breach sections in the causeway dyke to increase freshwater circulation in the inner estuary and allow sediments and wood debris to flush out of the lagoon, increase salt marsh habitat
- Lower the sill elevation on the existing breach to improve tidal circulation into the inner estuary
- Use soils excavated from the causeway to build new islands in the outer estuary to facilitate salt marsh establishment
- Discuss changes to industrial use with Western Forest Products

The restoration work has not begun as yet. This year, they are carrying out beach seining studies with Namgis First Nation to determine juvenile salmonid use of the estuary, and water quality sampling is being continued in the watershed, while water and sediment quality sampling will be undertaken in the estuary.

Session 4: Estuary Management

Shannon Anderson, Biologist, DFO. "Campbell River Estuary- Planning, Protection and Restoration"

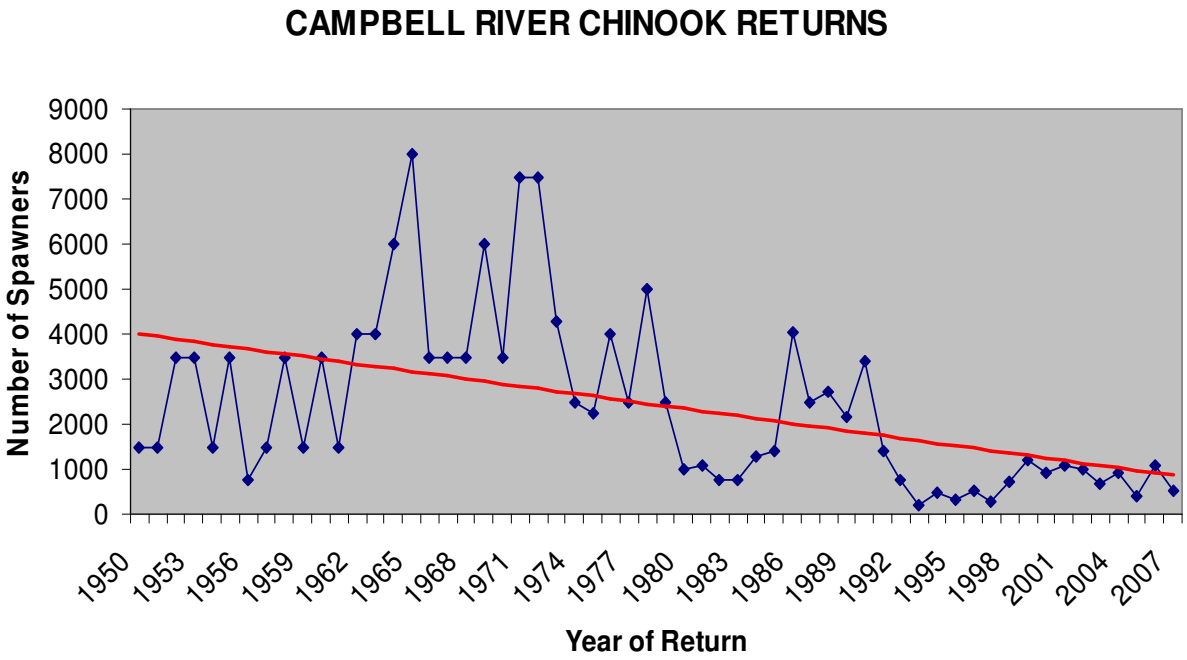
Shannon Anderson has been a Biologist with the Resource Restoration Division (RRD) of the Oceans and Habitat Enhancement Branch with Fisheries & Oceans Canada in Campbell River for over 10 years. In the mid 1980s she began working in the Campbell River estuary while working for the Quinsam River Salmon Hatchery, beach seining and sampling juvenile salmonids in the estuary, then again in the mid 90's through to the present. She has been a member of the Campbell River Estuary Management and the Environmental Advisory Commissions, as well as working with the many partners on the restoration projects in the estuary.

Shannon discussed the work that has been done to protect, plan, restore and assess the Campbell River estuary. From the early 1900's until the mid-90's, the Campbell estuary was used for intense industrial activity such as log handling and storage, which negatively impacted the estuary habitat which was important to the early life history and rearing of juvenile salmon. As well as impacts to the estuary, there were also a very large number of environmental impacts to the Campbell River and watershed. The main one has been BC Hydro development in the watershed. There are 3 dams with generating stations and 4 river diversions that supplement the Campbell reservoirs. These facilities became operational between 1953 and 1958 and greatly affected flow management, and downstream habitat. The community in CR started to take notice when chinook began to decline.

Figure 1P. E. Ballou of Portland, Oregon, U.S.A. Catch 57½ lb Registered Tyee Club of BC on August 11, 1959

Campbell chinook have an ocean type life history with 90 days of fresh rearing. They return between 3-7 years, with the age 4 and 5 year classes predominant. Historical escapement reached about 4000 but is now less than 1000 (Figure 24). Quinsam River Salmon Hatchery has been enhancing Campbell chinook for over 30 years, however most of the returns are back to the Quinsam. All the hatchery chinook production is thermal otolith marked, with a small percentage adipose fin clipped and coded wire tagged. A variety of strategies are used at the hatchery, including seapen releases, unfed fry and hatchery releases.

Figure 24. Campbell River Chinook Returns 1950-2008. Does not include Quinsam River Chinook escapements.



There have been a number of initiatives addressing planning and protection of the estuary and watershed, including:

- Estuary Management Plan
- Flow management strategy BC Hydro
- Water lot leases, Fish and Wildlife preserve
- Tyee Spit Park Plan
- WMA in progress
- NCC Baikie Island Covenants, biophysical inventory and management plan
- BC Heritage River designation
- Smart Growth Development Plan for North Campbell River

A number of restoration projects are also underway including watershed plans and whole system assessments to determine what the bottlenecks to productivity are. The aim is to support all the key ecosystems and life histories and aim to determine how and which upstream impacts are affecting the estuary –e.g. bed load, water extraction, flows, OCPs etc. The approach is to try and maintain habitat diversity. Similarly to the work done by Rob Russell at the Kokish, they also examined how the estuary functioned historically, and documented the changes that have occurred in total area, connectivity, water quality, hardened shorelines, listed or rare species or communities, marsh etc.

With respect to chinook recovery, the approach has been two-pronged, to keep a certain number of enhanced chinook entering the system (unfed Chinook fry are released from incubation boxes

placed in the Campbell River, upstream of the Quinsam confluence, to encourage returns to the mainstem Campbell, further up river) and to improve the habitat to increase capacity. One of the major identified issues in the river was a lack of gravel- which had resulted in a decrease of capacity to only 177 pairs of chinook, despite a target of 2000. Because of low natural recruitment levels over many decades, due to the series of dams on the system, the river was mostly large cobble and boulders and thus work on the spawning beds has been made a major priority. The focus is to rebuild the chinook spawning population in the Campbell, back to original levels and this is being achieved by habitat restoration and "low tech" fish culture and assessment (in-stream incubators, otolith marking).

Other restoration projects include purchases, such as that of: Tyee Spit (purchased by the city of Campbell River), the Baikie Island Reserve (a land acquisition led by NCC and funded by Government agencies and the local community), and the Ocean Blue Cedar shake mill site (a NCC purchase). Key restoration activities in the estuary have included:

- Intertidal Island construction 1980s
- Marsh Benching. Location/elevation/donor stock
- Fencing Geese Grazing protection
- Bank Stabilization -river
- Public access: Education, walking trails, interpretative signage, stewardship
- Purple Martin nesting poles
- Breaching & Tidal Freshwater channels -Improve/restore connectivity
- Riparian planting
- Support upstream life history
- Marine beach stabilization – Greenshores Tyee Spit
- Invasive plant removal
- Eelgrass planting

Ongoing assessment monitoring in the Campbell systems includes:

- Beach seining for juvenile salmonid usage
- Temperature, oxygen, salinity profiles and some sediment sampling
- Required compensation monitoring – vegetation and marsh bench integrity
- NCC monitoring
- Mapping habitat
- DNA sampling nearshore chinook to determine if they are local or other migrating stocks

In general, she notes that their measures of success have been more qualitative than quantitative and include increased habitat use in the estuary and spawning beds, improved water quality tracking, stability of benches and vegetation (both planted and naturalized), increased public awareness and stewardship, increased funding opportunities and partnerships and a general increase in habitat, accompanied by decreases in impacted, hardened shorelines.

There are also ongoing studies with the A-Tlegay Fisheries Society and the Centre for Aquatic Health Sciences which are focussed on the early marine life history of chinook and the relationship

with marine productivity. These studies are assessing plankton by sampling both phytoplankton and zooplankton, to determine the species abundance and timing of blooms, the response of the juvenile salmon, and how these conditions possibly affect future returns. Figure 25 shows the zooplankton blooms between 2007 and 2009. These have been generally strong in the spring, particularly in the spring of 2008, and tend to maintain high levels through to the summer. We have an opportunity to assess the possible links of Chinook returns to marine conditions as Quinsam Hatchery has staggered releases in the spring, with specific coded wire tags that we can compare to plankton density information we get from this sampling.

Figure 25. Zooplankton blooms 2007-2009 in the marine environment at Campbell River.

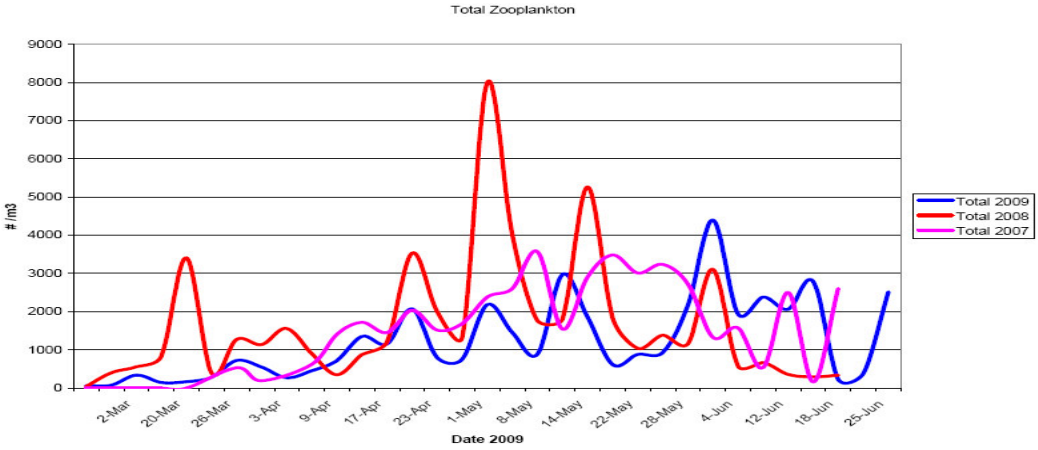


Figure 4 Zooplankton blooms from 2007-2009

For the past three years, zooplankton blooms (Fig.4) have been fairly strong in the early spring and densities have maintained high levels through to early summer. 2008 appears to a particularly strong year for densities.

Shannon noted that the key features of success in Campbell River have been vision, money and expertise. It has been possible to focus on solutions in the Campbell River estuary because of the identification of limits and key bottlenecks. Focus on solutions has resulted in development of plans, designs and the creation of increased capacity, which in turn has assisted in securing funding and increasing partnerships. Engaging the public and communicating the vision for the Campbell System has been one of the prime drivers for moving forward on the Campbell, which is both a high profile system and Heritage river, and also has the benefit of a very involved community. Some of the partners that have been involved in the protection and restoration projects include:

- Fisheries and Oceans Canada
- Ministry of Environment, - Fish And Wildlife and Parks
- Ministry of Transportation and Highways
- City of Campbell River
- A-Tlegay Fisheries Society and CR First Nations
- BC Hydro BCRP
- Pacific Salmon Foundation
- Pacific Salmon Commission
- Tyee Club of BC
- Nature Conservancy of Canada
- BC Centre for Aquatic Health Sciences
- Greenways Land Trust

- Campbell River Salmon Foundation
- Haig-Brown Institute
- Habitat Conservation Trust Fund
- BC Conservation Federation
- CR Fish and Wildlife Club
- Tide Guide Association
- Steelhead Society
- North Island Fisheries Initiative (NIFI)
- Ducks Unlimited
- Rotary Clubs of CR
- TimberWest
- Catalyst Paper
- Haig-Brown Kingfisher Creek Society

She summarized the key lessons from this work as:

1. Know your history – estuaries have had some major industries and activities and there are sometimes unpleasant surprises.
2. Protect the habitat – get conservation designations but allow limited public access to water and land.
3. Industry relocation was a cornerstone of the original Estuary Management Plan (although the Provincial money expected to fund this never materialized).
4. Be proactive and prepared for opportunities – e.g. land purchase, accessing funds for restoration.
5. Acquire water lot leases as they become available to protect your investment in restoration.
6. Publicize your activities – from broom bashes to major projects – and celebrate them all.

Rodger Hunter, Vis-a-Vis Management Resources. "An Overview of the Cowichan Estuary Management Plan"

Rodger began with an overview of the Cowichan Estuary noting that it is one of the largest estuaries in BC (approx 1,215 acres or 492 hectares), with over 30,000 people living within watershed. This area is an important habitat for up to 230 bird species throughout the year and a critical winter habitat for thousands of waterfowl. It is also important for rearing salmon species and 3 trout species.

He discussed the general history of the watershed, including the First Nations traditional use of the area harvesting crabs, clams, geoducks, waterfowl, cod roe, urchins, and salmon, and the land use changes leading to loss and degradation of habitat since the 1800s.

He noted that the estuary and watershed saw a great deal of land use conflicts beginning in the 1970s as there were increasing numbers of proposals for new industries, requests from existing industries to expand and public protests against development. Key issues of concern were the overlapping government jurisdictions, private ownership of intertidal land and rezoning issues. As a way to address many of these issues, the Cowichan Estuary management plan was put together in 1987 by the provincial government of BC. This plan was the result of 13 years of analysis and discussion with stakeholders and was the first Estuary Management Plan in BC.

Key elements of the plan included:

- Designation of mapped zones to guide land use for:
    - Industrial/commercial
    - Agricultural
    - Habitat management
    - Mixed use
    - Conservation/recreation
    - Log storage
- Agreements with four major industrial landowners (forest licensees) to reduce log storage requirements to 19 per cent from 49 per cent of intertidal areas
- Environmental review process was established
- Restoration of impacted sites was encouraged

In 2005, Rodger was involved in a review of the plan. The Ministry commissioned Vis-à-vis Management Resources to provide information about the successes and shortcoming of the plan after 20 years and to assess the adequacy and appropriateness of the plan for addressing contemporary issues.

With respect to habitat protection and restoration, he noted that there are many positive results in such as reduced log handling and storage, land acquisition for conservation, limited further development and reductions in environmental impacts as a result of the assessment process. However, negative findings were that there was limited improvement of water quality, and that the plan was reactive in nature, with limited habitat improvement and except for the recent Land Trust initiative (eel grass), there has been little activity since the early 1990s.

In general, stakeholders expressed different sentiments. Environmentalists acknowledged many of the gains, but were critical of progress made and impacts from upstream. First Nations valued the plan although there were also some frustrations.

A major finding was that the plan was not well linked with other initiatives. Stakeholders and others felt that the plan could not be effective unless it was better integrated with other planning/management initiatives for the watershed, and possibly nested within a watershed plan.

In summary, Rodger noted that the plan has reduced conflict, provided certainty, and limited further environmental degradation in the estuary. However, improvements are needed including:

- A clear vision, goals, principles, objectives, and prioritized activities
- Clear and effective leadership
- A full watershed approach
- Funding improvements and implementation
- A secretariat supporting the project e.g. to review administering, communicating, reviewing and banking
- Linkages to other plans i.e. CWBMP
- Consultations would be required to amend plan
- Better focus and timing

There are 3 options for moving forward. These include: 1) stay with the current status quo; 2) improve the plan in the short term and transition over a longer term to a new plan and governance model; or 3) amend the Plan to remove village, streamline responsibilities, and improve the management processes.

The recommendations were for Option 2. Although little progress has been made to date the opportunities still exist.

Workshop Discussion with panel members, Kate Miller, Wilf Luedke, Dick Beamish, Eric Marshall and Larry George.

Key issues regarding the watershed and estuary discussed included issues regarding water leases, lack of side channels and creeks, concerns over sediment issues in the lower river (an area not covered by the Estuary Management Plan), loss of ecosystem balance (loss of herring, needlefish etc), concern over damage to forage fish spawning habitat, sewage outflow, and lack of information. Some key comments were as follows:

- Forage fish are important as food for salmon. Cowichan naturalists are starting surveys of Cowichan beaches to see where the sand lance and surf smelt spawn (former spawn in winter and latter in the summer). They have found sand lance at Cherry point, Mile Bay, and Bamberton and surf smelt at Maple Bay and it is important that these beaches are protected. Eric Marshall distributed a leaflet about the BC Shore Spawners Alliance (BCSSA) at the workshop and more details about their projects are available from Foragefish.bc@gmail.com or EmeraldSRC@gmail.com

- Loss of kelp in the estuary is a major concern. Arvid noted that they used to tie up to kelp in the 1940s and earlier to harvest sea cucumbers. Paul Rickard took Dick Beamish and Rusty Sweeting to the Bay and they looked at loss of kelp. He noted that there used to be dense kelp beds in the Bay along Sampson Narrows, for example, and that given that there is ideal substrate, there should be focus on restoring those original beds.

- Although declines are seen in many different species, or changes in distribution (e.g. of herring), the Strait is clearly productive for pink and chum, which are doing exceptionally well. They enter earlier than coho and chinook and perhaps lots of food is still available to them.

- There are many common threads in the different studies (Cowichan, Puget Sound and Alaska, as discussed in this workshop) and all point to the first few months in the ocean as the critical period. It appears that Cowichan chinook do not leave the Gulf Island for over 4 months, and Dick Beamish speculates that this is the period of time that the brood year strength is determined. Rate of growth appears to be crucial, and this is related to how much food is available. This prompted questions about whether we can be more experimental with hatchery fish (i.e. in time or size at release) or can we somehow produce more food for them to eat during the early rearing period? Dick has seen an interaction

between pink salmon and Cowichan chinook, with lower numbers of chinook in those years when there are large numbers of pink salmon in the Strait, as mentioned by Greg Ruggerone in his talk. This might suggest that seals are not the only culprit for the low returns.

What can we do?

Much of the discussion turned to examine possible options and things that people could do in the estuary to make it more conducive to salmon.

Dick Beamish noted that we need to determine what is happening in the Strait of Georgia that is limiting to coho and chinook survival and what can be done to mitigate the impacts. It is likely related to nearshore environments, hardening of shorelines etc. People are frustrated watching this happen over the past 20 years.

People suggested that there should be greater focus on kelp and eelgrass planting. Louis Druehl said that a large-scale planting would be possible, but easier to achieve in a smaller estuary. He noted that hundreds of acres of planting would be required in the Cowichan estuary and it might be too large an area to see a measurable impact. He stated that to actually seed the Cowichan with kelp would cost about $600K and entails a great deal of volunteer labour. It was suggested that perhaps we could try just 2 acres of planting.

Brian Riddell cautioned that we are where we are now due to short term, unstructured programs, and too many studies lacking replication and long term analyses. What we need to do is to determine what we know, and then make a structured plan based on accumulated evidence, carry out tests, and think and learn as we go i.e. the approach should be methodical, not trial and error.

A key focus is to determine more about ichthyoplankton and small pelagic fishes. If food is limiting, we need to understand the status for these food resources of salmon, and how to restore them. We also need to focus more on the status of the lower river. Fish must be holding in the lower river and estuary for about 6 weeks so it is crucial to examine this period of the life history and these habitats in detail. Either of these habitats could be bottlenecks to production.

Elizabeth Duffy summarized it nicely when asked what she would do. She noted that as a public citizen, one needs to take on the environmental ethic of only taking what you need and protecting the estuary (just as we heard earlier from Arvid). She stated that we should aim to reverse some of the damage done to wetlands and estuaries, and reacquire land and restore it (as we heard from Shannon Anderson in her talk). We should also address pollution issues such as sewage outflows, contaminated shellfish etc. She stated that we need to understand why submerged vegetation habitats of kelp and eelgrass have disappeared, and determine if this is due to sedimentation, flow, substrates, nutrients etc. She also suggested that carrying out large scale controlled manipulations e.g. of hatchery practices would be a useful approach.

Another comment was that we should incorporate more TEK (Traditional Ecological Knowledge) from Cowichan Tribes and other First Nations into management regimes.

Larry George said it is time to make decisions. Cowichan Tribes and HTG have made their position available on how they see the Bay and estuary and want to have a say in the process. He is happy that there is movement now to acknowledge a 1st Nations position and agreed that it would be excellent to incorporate TEK. Many of their people spend their life on the water and learn about it and understand it in a way only possible for those whose lives are intimately related to the watershed and estuary.

Kate Miller noted that the local government has been working on issues of land use and that now it is the time to use science-based information to inform policy and practices, and to ensure informed land use practices.

A key comment made by many individuals is that we need to celebrate what is already being done well. Paul Rickard noted that although they may have done a good job collecting data and charting the decline of chinook, there has not been the same focus on examining their successes. For example, the Stewardship Roundtable, a synergy of many people, is a great success. He stated that now that there is increasing science directed at the Strait of Georgia, people need to get together and start to plan a vision for the estuary and focus on what they can do. Paul asked if it would be possible to link science and management and DFO, and move away from the status quo of always doing things in the same ways that they have always been done.

Craig Wightman and Eric Marshall also discussed the ways that we can celebrate what is being done well e.g. the recovery plan, the Stoltz bluff work, the Stewardship Roundtable, which they agreed are all excellent achievements.

Brian Riddell noted that for the Pacific Salmon Foundation, it is largely the prevailing negativity that results in less fiscal support on this coast. Realistically, politicians need to look at the number of volunteers e.g. 35000 working for PSF alone on salmon issues. We do have to celebrate salmon and what salmon mean to B.C. e.g. their proposed "Year of the Salmon" initiative. B.C. needs to find its voice and elevate concern and focus to another level.

Connections and learning from other systems and management plans

We can learn a lot by looking at other models. For example, Shannon showed that they had been very successful in raising funds, developing partnerships, gaining support and restoring and protecting habitat in Campbell River. We can look to the ways that they were able to do this, and follow their lead.

How can community be involved beyond individual responsibility?

Eric Marshall suggested that if the opportunity comes up, volunteer your services, e.g. they need volunteers to assist with the beach surveys for forage fish spawning habitat. Additionally, if you hear something you do not agree with, take the time to write to the Minister and express your concerns.

Kate Miller stated that it is important for everyone to “think big and dream wild”. Visions need to be broad in scope- not just about the estuary but also about the entire watershed. She noted that the roundtable has developed a 100 year vision. She says that everyone should look back and celebrate some of the successes, and meanwhile, open the door for the community. This might include doing tours, letting people come and inspect restoration plots, allowing forums so that people can ask questions e.g. can we double the number of side channels between Duncan and the estuary?

Dick Beamish spoke about the importance of new methods such as genomics, the utility of novel and large scale experiments with the hatchery programs, and stressed that science does need to communicate effectively with communities about what is and is not understood.

Wilf Luedke stated that DFO is able to design large scale projects, but not always fund them. Volunteers and community help are paramount to the success of many of the programs and this will increasingly be the case. He noted that people in the Cowichan Valley have clearly shown that they do think big, for example, they found $1million to work on the Stoltz Slide issue. There are many other projects that this community could assist with in terms of monitoring and assessment.

Larry George said that many of the people attending the meeting are important contacts involved in most of the ongoing projects in the Bay. Thus, this is the community to which people need to turn to discuss things, to ask what is being done and to express their concerns. Many of the projects are large scale and require a lot of resources- thus partnerships are crucial. He stated how important a tool communication is and that everyone needs to sit at the same table and keep talking.

The workshop was closed with a prayer by Wayne Charlie.

Acknowledgements

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Many thanks to all the speakers for their excellent presentations. Some of you had travelled some distance to attend the one-day workshop. We are grateful to Rodger Hunter for facilitating the event.

And thanks to all the workshop participants for asking questions and for actively participating in the discussions in an open, respectful and enthusiastic way.