PENELAKUT TRIBE WRITTEN SUBMISSION

RBT2 REVIEW PANEL

I. OVERVIEW

The Vancouver Fraser Port Authority's ("VFPA") Robert's Bank Terminal 2 Project ("RBT2" or "the Project") is situated within the core marine territory of the Penelakut Tribe. The Penelakut Tribe uses an area comprised of and resources located in the Project Area, the Local Assessment Area (LAA) and a significant portion of the Regional Assessment Area (RAA) associated with RBT2.

In Information Request 10-06, the Review Panel sought additional information from the VFPA about Project effects on the current use of land and resources for traditional purposes. This submission provides some of the information sought by the Panel in that information request. Due to financial constraints, however, the Penelakut Tribe is not able to provide all the information the Panel asked the VFPA to provide.

The Penelakut Tribe has a rich history of use and occupation of the Roberts Bank area and is actively pushing for the recognition of its rights. The Project will undeniably impact the Penelakut Tribe's access to resources for current and future use in the Roberts Bank area.

As a result of the accumulation of impacts on the Penelakut Tribe and its territory, the impacts resulting from RBT2 are more extensive than the VFPA has concluded in its EIS. The mitigation measures proposed by the VFPA are not adequate to address these impacts.

II. THE PENELAKUT TRIBE

1. Historically

The Penelakut Tribe, along with other Halkomelem speaking groups, traditionally utilized the lands and waters on both sides of the Salish Sea. The traditional territory of the Penelakut Tribe generally includes parts of south-eastern Vancouver Island, the southern Gulf Islands, a portion of the Lower Mainland, and the waters of the Salish Sea to the Sunshine Coast, including the lower portion of Howe Sound, Haro Strait, the Strait of Juan de Fuca and the South Arm of the Fraser River up to Yale and the Roberts Bank area.

The Penelakut Tribe is part of the historic Cowichan Nation, which was an Aboriginal people, nation or group at the assertion of Crown sovereignty over British Columbia in 1846.

Locations of importance to the Penelakut Tribe and other Cowichan Nation peoples along the South Arm of the Fraser River in the vicinity of the Project include but are not limited to *Tl'uqtinus*, spanning the north shore from approximately opposite Tilbury Island and downstream towards Deas Island, and *Hwlhits'um or Xwulit'sum*, on Canoe Pass. Both of these areas are ancestral village and resource sites of the Cowichan Nation Alliance peoples, including the Penelakut Tribe.

The peoples making up the Cowichan Nation had a village on the South Arm of the Fraser River, which they accessed regularly via Canoe Pass. In addition, they used a camp at *Hwlhits'um or Xwulit'sum* (place for cutting [cattails]) on the south side of the entrance to Canoe Pass, just below Brunswick Point to fish for sockeye, salmon, and sturgeon.

The Penelakut Tribe is one of the named Cowichan Nation communities that occupied lands at the south shore of Lulu Island on the main (South) arm of the Fraser River, before, at, and after 1846. The Lulu Island village, named *Tl'uqtinus*, was exclusively occupied by the Cowichan Nation peoples at all relevant times for establishing Aboriginal rights and title on the South Arm of the Fraser River.

Further, the Cowichan Nation peoples, including the Penelakut Tribe, regularly engaged in traditional use in the Roberts Bank, Fraser Delta and Fraser River area at European contact in 1790, included but not limited to:

- Fishing (including sockeye, sturgeon, shellfish)
- Plant harvesting (including berries and wapato)
- Trapping (beaver)
- Hunting (ducks, geese)

They also sold resources such as salmon, potatoes, berries and shellfish to Hudson's Bay Company representatives upon contact, extending their traditional practice of trade to the new arrivals.

2. Currently

The Penelakut Tribe is a 'Band' as defined in the *Indian Act*. The Penelakut Tribe currently has reserves located on the central side of Vancouver Island, including on Penelakut Island, Galiano Island, and Tent Island, and the Tsussie Reserve at the

Bonsall Creek estuary on Vancouver Island. The Penelakut Tribe's current Reserve nearest to Roberts Bank is approximately 27 kms directly across the Salish Sea from Roberts Bank.

The Penelakut Tribe has approximately 950 members, living both on- and off- reserve, including in and around the Richmond and Delta areas. Penelakut Tribe members continue to harvest and eat traditional foods, such as fish, shellfish, herring on kelp and marine birds, more than most other communities.

2.1 Penelakut Tribe Governance

The Penelakut Tribe is governed by ten elected Councillors, one of whom is Chief Councillor. A group of Penelakut Elders, acting as knowledgeable advisors, meets regularly to be informed of and provide their views to the elected government, to the treaty team and to resource and economic development managers about various historic and ongoing land and resource matters affecting the Penelakut Tribe.

In recent years the Penelakut Tribe has developed a number of plans to guide it as it moves into the future. These include a Comprehensive Community Plan, a Land Use Plan, and, more recently a Marine Use Plan.

The Penelakut Tribe is actively involved in discussions with both the federal government regarding the proposed Gulf Islands National Park Reserve and a proposed Southern Strait of Georgia National Marine Conservation Area and with the provincial government regarding private moorages, strategic engagement and a stewardship.

2.2 Rights Recognition

The Penelakut Tribe and the other Cowichan Nation peoples are working to re-establish a permanent land base at *Tl'uqtinus* for residential and/or commercial purposes. As part of the Cowichan Nation Alliance, the Penelakut Tribe is actively seeking a declaration of Aboriginal title to *Tl'uqtinus* and a declaration of Aboriginal fishing rights in the South Arm of the Fraser River.

Further, the Penelakut Tribe and the other Cowichan Nation peoples are actively engaged in land and fishing rights recovery with the reasonable expectation that their use of the *Tl'uqtinus* and Fraser River area for fishing, harvesting, and sea mammal and bird hunting, will be even greater in the near future than it is today, as these rights are recognized and respected.

2.3 Marine Use Planning

The Penelakut Tribe is developing a community based Marine Use Plan which identifies the community's vision, goals and strategies for the protection, conservation and development of Penelakut's marine environment. To achieve sustainable management of marine resources, the community identified the following key goals:

- Increase the availability of marine resources in the Penelakut community to ensure that food and ceremonial needs are met;
- Strengthen and restore ties between marine resources and the Penelakut diet, culture and way of life;
- Promote sustainable commercial harvesting of marine resources in support of Penelakut Tribe's food needs and economic development; and
- Maintain and restore the productivity and diversity of native marine species.

3. Penelakut Tribe Traditional Practices

The Penelakut Tribe engages in a number of traditional practices, including the use of marine resources for food. The historical use of these resources is summarized in the paper titled *Contemporary & Desired Use of Traditional Resources in a Coast Salish Community: Implications for Food Security and Aboriginal Rights in British Columbia* submitted to the Panel by the Cowichan Nation Alliance.[1]

The importance of marine resources to the Penelakut Tribe is further emphasized in the enclosed *Risk Assessment of Shellfish Consumption in Coastal Communities in British Columbia* report prepared for the Penelakut Tribe.[2]

While this paper focused on concerns relating to contaminants in shellfish, it provides relevant information about the role of seafood in the diets of Penelakut Tribe members and shellfish consumption rates.[3]

Another important part of the Penelakut Tribe traditional culture is the hunting of marine birds to create 'duck soup', a standard staple food in the Big Houses in Penelakut and other Salish communities, along with other traditional foods. The Roberts Bank area is one of the areas where marine birds can be, and are, harvested, from November through March.

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[1] Fediuk, Karen and B.Thom, B. *Contemporary & Desired Use of Traditional Resources in a Coast Salish Community: Implications for Food Security and Aboriginal Rights in British Columbia*, presented at the 26th Annual Meeting of the Society for Ethnobiology, Seattle, WA, may 27, 2003, CEAA Registry Doc # 1108.

[2] Fediuk, Karen. *Risk Assessment of Shellfish Consumption in Coastal Communities in British Columbia (AKA Shellfish Safety Project) – Report Prepared for Penelakut First Nation, December 2015*. This was part of a larger report involving a number of communities. This version was prepared specifically for the Penelakut Tribe, but references which may identify third parties have been redacted. The copy provided is the best quality copy we could obtain.

[3] We have identified an error in Table 14: the total of the grams/day figures listed in the table is 76g, not 61g.

4. Penelakut Fish and Crab Harvesting Information

The Penelakut Tribe has provided information to this Panel regarding its fish and crab harvesting.[4]

This included information about its current use of the Roberts Bank area provided to the VFPA in January of 2016, as a result of the VFPA's failure to capture these practices in the EIS.[5]

The Penelakut Tribe intends to provide additional information about its fishing practices at its community hearing.

5. Penelakut Tribe Shellfishing and Aquaculture

The Penelakut Tribe is involved in shellfish harvesting for food, social, cultural and ceremonial purposes.

The Penelakut Tribe holds a total of 23 commercial fishing licences for clams, all for DFO Area E. In addition, the Penelakut Tribe holds a coast-wide prawn and shrimp commercial fishing licence. The Penelakut Tribe owns one commercial fishing vessel.

The Penelakut Tribe is involved in aquaculture through Penelakut Seafoods Inc. The company currently holds four commercial aquaculture licences and operates with a depuration facility.

III. THE RBT2 PROJECT IN PENELAKUT TRIBE TERRITORY

1. Penelakut Territory and Location of Project

The Penelakut Tribe traditional territory coincides with the Hul'qumi'num Treaty Group Asserted Traditional Territory, as shown on the map included in the RBT2 EIS at Figure No. 32-5.[6]

The areas used by the Penelakut Tribe and other Cowichan Nation peoples include the Project Area, the Local Assessment Area (LAA) and a significant portion of the Regional Assessment Area (RAA) associated with RBT2.

2. Impacts of Project on the Penelakut Tribe

2.1 Overview

[4] Letters and submissions from Penelakut, CEEA Registry Doc # 2120, 396, and 615 and 916.
[5] Letter from the Penelakut Tribe to Port Metro Vancouver re: Roberts Bank Terminal 1 – Port Metro Vancouver Assessment of Project Impacts to Penelakut Resource Use and Aboriginal Rights, January 4, 2016, CEAA Registry Doc # 396.
[6] EIS, CEAA Registry Doc # 181, p 5.

The Penelakut Tribe stands to be impacted by all elements of the Project: construction, operations and accidents/malfunctions. In addition, the Penelakut Tribe stands to be impacted by operations and accidents/malfunctions from the marine shipping component.

RBT2 will displace the Penelakut Tribe from an important crab fishing area, both during construction and operation, as a result of footprint impacts.[7]

In addition, the vessel traffic associated with construction and operation of the terminal will increase navigational conflicts for Penelakut Tribe members engaged in marine harvesting and fishing at Roberts Bank.[8]

The marine shipping traffic will also increase navigational conflicts for Penelakut Tribe members travelling to marine harvesting sites at Roberts Bank, as this requires crossing the Salish Sea and the shipping lanes.

An accident or malfunction at the terminal could result in additional impacts on substrates, marine vegetation and marine invertebrates.

2.2 Project Impacts

The EIS has identified the following potential impacts on Indigenous groups:

- Changes in preferred current use locations;
- Changes in availability of preferred current use resources;
- Changes in quality of preferred use resources; and
- Changes in quality of current use experience.[9]

The Penelakut Tribe will experience all these effects as a result of the Project.

The Penelakut Tribe is particularly concerned about impacts to:

- Crab populations and access to crab fishing opportunities;
- Southern Resident Killer Whale Populations;
- Food, Social and Ceremonial Fishing;
- Commercial Fisheries;
- Effects of Increased Vessel Traffic; and
- Impairment of cultural experiences as a result of these impacts.

2.2.1 Crab Populations and Access to Crab Fishing Opportunities

[7] EIS, CEAA Registry Doc # 181, pp 32-102 to 32-104; 32-116.
[8] EIS, CEAA Registry Doc # 181, pp 32-102 to 32-103.
[9] EIS, CEAA Registry Doc # 181, Table 32-6.

The Penelakut Tribe is concerned that its Aboriginal right to harvest crab at Roberts Bank will be infringed by the Project. The EIS clearly identifies that there will be a reduction in the availability of crabbing area as a result of the new project footprint, and puts this at 186.0 ha.[10] This will cause a reduction in the area available for current use and a reduction in the quality of the current use experience.

The VFPA proposes to mitigate this impact by supporting Aboriginal crabbing for domestic or FSC purposes in the navigational closure extension area. The Penelakut Tribe does not accept this as an adequate mitigation measure.

The Penelakut Tribe is supported in its concerns regarding crab habitat by a report filed by the Tsawwassen First Nation, the *Dungeness Crab Abundance and Movement Study, Roberts Bank Terminal 2 Project Area*.[11] The covering letter summarizing this report states that high quality habitat will be lost to the Terminal 2 footprint and that there will be a 50% reduction in optimal depth FSC crab fishing area and a 20% reduction in accessible FSC crab fishing area.

The VFPA has sought to characterize the potential impacts to Penelakut's crab fishery as minimal, compared to the Musqueam First Nation and the Tsawwassen First Nation.[12] Yet the impact of the reduced and/or compromised crabbing area will be significant on Penelakut, as a result of other constraints on access to marine resources and habitat in Penelakut Territory, as discussed in the context of cumulative impacts, below. The VFPA has identified accommodation as mitigation for the change in access to preferred current use locations for Musqueam First Nation and the Tsawwassen First Nation, but not for the Penelakut Tribe.

2.2.2 Southern Resident Killer Whales

The Southern Resident Killer Whale is associated with the concept of "family". The Penelakut Tribe has grave concerns about the potential impact of the Project on the Southern Resident Killer Whales and the effects that a population level extinction may have on the balance of the remainder of the ecosystem. In addition, population level extinctions will have lasting impacts on the whale-watching based tourism operations

The Southern Resident Killer Whale population is listed in Schedule 1 of the *Species at Risk Act* as an endangered species. The shipping traffic associated with the Project

[10] EIS, CEAA Registry Doc 181, s 32.2.7.1, p 32-116.
[11] Tsawwassen First Nation Independent Study on Crab and Crab Habitat, July 12, 2017, CEAA Registry Doc # 997.
[12] EIS, CEAA Registry Doc # 181, p 32-104; Response to Information Request IR10-07, CEAA Registry Doc # 1275.

intersects with habitat of the Southern Resident Killer Whales and results in underwater noise which has been identified as a key threat to whales.[13]

The VFPA EIS concluded that:

> Due to their Endangered status and lack of recovery of the population, southern resident killer whales are assumed to be already significantly adversely affected; therefore, cumulative effects to southern resident killer whales are expected to remain significant.[14]

The VFPA, however, has not proposed any mitigation in its assessment of Project,[15] although the Marine Shipping Addendum commits to:

> [working] with stakeholders, Aboriginal groups, regulators, and the ECHO Program to monitor the distribution and abundance of marine mammals within the LAA to identify, prevent, and adaptively manage potential effects of underwater noise and vessel strikes on marine mammals, if they occur.[16]

The VFPA provides financial incentives to encourage voluntary use of quieter vessels,[17] but this does not go far enough. The VFPA recognizes this when it states that "[t]here are currently no technically feasible mitigation measures under the care and control of the VFPA that can be implemented during Project operation."[18]

The National Energy Board's recent reconsideration report for the Trans Mountain Expansion Project concluded:

> Pursuant to the Canadian Environmental Assessment Act, 2012 (CEAA 2012) the Board is of the view that the designated Project is likely to cause significant adverse environmental effects. Specifically, Project-related marine shipping is likely to cause significant adverse environmental effects on the Southern resident killer whale, and on Indigenous cultural use associated with the Southern resident killer whale. This is despite the fact that effects from Project-related marine shipping will be a small fraction of the total cumulative effects, and the

[13] Technical Document requested by Review Panel ECHO Haro Strait Slowdown Trial Summary, October 17, 2018, CEAA Registry Doc # 1330, p 1.
[14] EIS, CEAA Registry Doc # 181, p 14-1.
[15] *Ibid*, p 14-82.
[16] Marine Shipping Addendum to the Environmental Impact Statement, October 26, 2015, CEAA Registry Doc # 316, p 8.2-63.
[17] Response to Information Request IR5-50, CEAA Registry Doc # 1172, pp 3–4.
[18] *Ibid*, p 5.

> level of marine traffic is expected to increase regardless of whether the Project is approved.[19]

The NEB recommended:

> The Governor in Council should develop an Offset Program to offset both the increased underwater noise and the increased strike risk posed to Species at Risk Act-listed marine mammal and fish species (including Southern resident killer whale) due to Project-related marine shipping, at each relevant section of the marine shipping route (i.e., Strait of Georgia, Boundary Pass, Haro Strait, Strait of Juan de Fuca, and out to the 12-nautical-mile territorial sea limit), and at the relevant times of year. Each offset measure should apply to all appropriate vessels for that measure (i.e., not limited to Project-related vessels), to be determined on a case-by-case basis according to the type of measure and the type(s) of vessels it is targeted at. The Offset Program should be developed and implemented in consultation with Indigenous peoples, other marine users, the Province of British Columbia and local governments, VFPA, and other relevant stakeholders.
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> The Offset Program should include any further research and data collection that is necessary to successfully undertake it, including consideration of whether further information on the number of vessel strikes on marine mammals can be gathered. There should be periodic public reporting that provides, at the appropriate times, the information necessary to demonstrate a robust Offset Program. This should include measured or estimated underwater noise and strike risk due to Project-related marine shipping, and the extent over time to which that additional noise and strike risk has been offset in each section of the route, including the monitoring/modelling used to demonstrate that.[20]

Greater consideration needs to be given to measures to reduce the impacts of shipping on the Southern Resident Killer Whales, including from the current VFPA shipping traffic.

2.2.3 Fishing - Food, Social and Ceremonial and Commercial

The Penelakut Tribe engages in Food, Social and Ceremonial (FSC) fishing in the Roberts Bank area. The VFPA has concluded that the effects of the Project on marine fish will be negligible, after mitigation.

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[19] National Energy Board reconsideration of aspects of its OH-001-2014 Report as directed by Order in Council P.C. 2018-1177, MH-052-2018, February 2019, p 1 - http://www.neb-one.gc.ca/pplctnflng/mjrpp/trnsmntnxpnsn/index-eng.html .
[20] *Ibid*, p 45.

The proposed mitigation includes the marine habitat offsetting measures. Until the offsetting is undertaken, it is not known how effective it will be. There will also be time delays between when habitat is lost and the time when this loss may be effectively offset.

The Penelakut Tribe continues to be concerned that the Project will have adverse impacts on its FSC fishery at Roberts Bank.

The Penelakut Tribe and Penelakut Tribe members are already involved in and have aspirations for greater involvement in the commercial fishery. To the extent that the Project may result in adverse effects to commercial fisheries, these effects will be felt by the Penelakut Tribe and on community members who hold commercial licences.

2.2.4 Effects of Increased Vessel Traffic

In addition to the effects resulting on the environment, ecosystems and resources, the Project will increase the shipping traffic in the shipping lanes in the Salish Sea and in the Roberts Bank area. This will impact the Penelakut Tribe's current use. The VFPA describes this as a "minor incremental adverse impact"'.[21] For the reasons set out in the submissions on cumulative impacts, below, the Penelakut Tribe disagrees that the impact will be minor.

2.3 Cumulative Impacts of the Project on the Penelakut Tribe

The VFPA EIS includes an assessment of cumulative impacts based on EIS guidelines issued by the Canadian Environmental Assessment Agency ("CEAA"). The EIS has not assessed the cumulative effects of the Project on the ability of Indigenous groups to exercise their asserted or established Aboriginal or Treaty rights.[22]

Further, the spatial boundaries used for the assessment of cumulative effects in the EIS do not consider the cumulative effects on access to resources by Indigenous people. The effects of past and existing projects and activities on access to resources by Indigenous people within their traditional territories are relevant to the assessment of significance of impacts.

As a result of cumulative impacts throughout the Penelakut Tribe's core marine territory, the impacts of the Project on the Penelakut Tribe are amplified beyond what is concluded in the EIS.

[21] Response to Information Requests IR9-01 to IR9-04, IR10-01, IR10-27, IR10-28, IR11-06, IR11-24, IR12-08, and IR12-12, October 5, 2018, CEAA Registry Doc # 1322, Appendix IR10-01-C10, p 60 of 108.
[22] *Ibid*, p 19 of 108.

Like many Indigenous groups in British Columbia, the Penelakut Tribe has been marginalized and subjected to limitations on use of lands and resources as a result of the systematic denial of aboriginal rights and government actions which have resulted in the taking of lands and resources. The denial of the existence of Aboriginal rights coupled with the impacts of European settlement which included the spread of disease, endeavours of missionaries, the Indian reserve system, preemption of land, and the residential school system contribute to the context in which the Penelakut Tribe exists today.

An important element of that context is the number of constraints which prevent the Penelakut Tribe from accessing marine resources in Penelakut Tribe core marine territory. These systematic barriers are documented in the paper titled *Contemporary & Desired Use of Traditional Resources in a Coast Salish Community: Implications for Food Security and Aboriginal Rights in British Columbia*.[23]

Each new project in the Penelakut Tribe's core marine territory creates additional barriers to access to resources.

2.3.1 Existing Constraints - Prohibitions

The Penelakut Tribe's core marine territory is already subject to a number of constraints, including prohibitions:

- Shellfish Closures: Environment Canada has filed a marine atlas showing the uses of the area which comprises the Penelakut Tribe's core marine territory which shows shellfish closures.[24]

- Sponge Reef Closures: Fisheries and Oceans Canada has established fishing restrictions to protect sponge reefs, some of which are within Penelakut Tribe's core marine territory. The closures prohibit commercial, recreational or Indigenous Food, Social and Ceremonial bottom-contact fishing activities, including fishing for prawn, shrimp, crab and groundfish (including halibut). [25]

- Rockfish Conservation Area: Environment Canada's marine atlas shows the rockfish conservation areas, in which certain types of fishing is restricted, in the Penelakut Tribe's core marine territory.[26]

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[23] Fediuk, Karen, *supra* note 1.
[24] Orientation Session Undertaking #5: Marine Atlas Information, June 28, 2016, CEAA Registry, Doc # 500, chapter 4.
[25] Fisheries and Oceans Canada – Sponge Reef Closures – Strait of Georgia - http://www.dfo-mpo.gc.ca/oceans/ceccsr-cerceef/closures-fermetures-eng.html
[26] Orientation Session Undertaking #5: Marine Atlas Information, June 28, 2016, CEAA Registry Doc # 500, chapter 4.

The impact of all of these prohibitions is to reduce the area of the Penelakut Tribe's core marine territory in which the Penelakut can access resources.

2.3.2 Existing Constraints – Competing Uses

In addition to regulatory restrictions on the Penelakut Tribe's use of its core marine territory, there are a number of other industrial, commercial and recreational uses which compete with and constrain the Penelakut Tribe's use:

- Shipping Lanes
- Log Booms
- Numerous anchorages in Nanaimo Harbour, Trincomali Channel, Houston Pass and Ladysmith Harbour.[27]

  In addition, the Pacific Pilotage Authority is contemplating five new anchorages on the east side of Gabriola Island. According to an Environmental Overview Assessment conducted by Tetra Tech EBA for the Pacific Pilotage Authority, the purpose of these anchorages is "accommodate increased traffic and vessel size in Vancouver", due to increased shipping coupled with decreased pilotage assignments resulting in an increase in vessels anchoring outside Port Metro Vancouver. [28]

  The Environmental Overview Assessment acknowledges that the new anchorages may result in residual adverse effects in the form of physical presence of vessels causing the displacement of fisheries and reduction in the quantity and quality of fish and aquatic habitat.[29] These effects are considered not significant in the context of the proposed anchorages because they are characterized as temporary or unlikely. These effects would also exist with respect to the existing anchorages, and are amplified as a result of the cumulative impacts of the large number of anchorages in the Penelakut Tribe's core marine territory.
- Recreational use: Environment Canada has filed a marine atlas showing the uses of the area which comprises the Penelakut Tribe's core marine territory

[27] Chamber of Shipping, Interim Protocol for the Use of Southern BC Anchorages p 6 - www.cosbc.ca/index.php?option=com_docman&view=download&alias=485-interim-anchorage-protocol-2018&category_slug=anchorages&Itemid=355
[28] Response to Information Requests issued by the Review Panel on September 27, 2017, CEEA Registry Doc #1067, hardcopy p 1.
[29] *Ibid*, hardcopy p 50-51.

which confirms significant use and shows various specific recreational activities, including marinas, recreational boating and recreational fishing.[30]

This atlas shows the high number of marinas and docks in the Penelakut Tribes' core marine territory and the extent of recreational boating. It is illegal to harvest bivalves within 125m or marinas and ferry docks.

- Commercial Fishing: Environment Canada has filed a marine atlas showing the uses of the area which comprises the Penelakut Tribe's core marine territory which shows commercial fisheries.[31]

2.3.3 Conclusion on Cumulative Impacts

The Penelakut Tribe's core marine territory has been subject to a number of constraints which decrease access to fishing and shellfishing grounds, often displacing the Penelakut Tribe from high value resource areas. These are impacts which have accumulated on the Penelakut Tribe over time as a result of settlement and industrialization of their territory and are important context for understanding the impacts of the Project on the Penelakut Tribe.

The increase of impacts to the Penelakut Tribe's core marine territory flowing from the Project, and particularly the impacts to crabbing area and marine ecosystems will be significant due to the existing state of the Penelakut Tribe`s core marine territory.

Further, Figure 24 of the Shellfish Study demonstrates the already dense shipping traffic in the Penelakut Tribe's core marine territory. The increase in shipping traffic will exacerbate the already significant impact of shipping traffic within the Penelakut Tribe's core marine territory. The Penelakut Tribe disagrees with the VPFA's assessment that this impact will be minor.

IV. PROPOSED MITIGATION

The VFPA has set out its proposed mitigation for impacts on Indigenous groups in its response to IR10-09.[32] The Penelakut Tribe has reviewed the table of proposed mitigation measures and submits that the proposed mitigation is not adequate to offset impacts on the Penelakut Tribe.

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[30] Orientation Session Undertaking #5: Marine Atlas Information, June 28, 2016, CEAA Registry Doc # 500, chapter 4.
[31] Orientation Session Undertaking #5: Marine Atlas Information, June 28, 2016, CEAA Registry, Doc # 500, chapter 5.
[32] Response to Information Requests IR5-01a, IR7-28, IR7-29, IR10-02, IR10-06 to IR10-09, IR10-11 to IR10-26, IR11-07, IR11-22, IR11-23, IR12-03, IR12-06, IR13-01, and IR13-19, September 28, 2018, CEAA Registry Doc # 1275, Appendix IR10-09-A.

1. Reduction in Crab Fishing Area

The sole proposal to mitigate the reduction in the crabbing area as a result of the terminal footprint is to allow Indigenous domestic and FSC crabbing in the navigation closure area. As set out in the study submitted by the Tsawwassen First Nation, this is not effective to mitigate the effects:

> The gain in area available to FSC crab fishing from the expanded NCA comes at the expense of high quality habitat that will be lost to the footprint of Terminal 2 and the ITP, both of which are preferred crab fishing locations for FSC fishermen. Within the Terminal 2 and ITP footprints, the optimal FSC crab fishing depth (2–20 m) percentages, by area, are 60% and 100%, respectively.
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> Therefore, a large proportion of the Terminal 2 and ITP footprints are within the optimal water depths for crab fishing and these areas will not be available for fishing due to project development. To quantify the crab fishing area gain versus loss due to the proposed expanded NCA and project footprint development, a crab fishing area balance calculation was conducted. The results show that there will be a 50% reduction in optimal (2–20 m) FSC crab fishing area, and a 20% reduction in accessible (2–50 m) FSC crab fishing area due to the project. Therefore, the proposed configuration of the expanded NCA does not appear to adequately offset the loss in FSC fishing opportunity and catch as more fishing area will be lost than gained.[33]

And:

> The Terminal 2 footprint and proposed expanded NCA will negatively impact the ability for FSC fishermen to access preferred harvest areas. There was a general consensus that the Terminal 2 development would have a negative impact on FSC harvest, and the development would result in a loss of high quality crab habitat due to 1) increased boat traffic that will cause a displacement of traps to lower quality areas; 2) the fact that the majority of the proposed expanded NCA is in very shallow (50 m) that cannot be fished due to gear limitations; and 3) the proposed expanded NCA along the northern edge of Deltaport and the causeway is low quality crab habitat due to silt deposition. Therefore, the Terminal 2 footprint and expanded NCA will impact FSC fishermen harvest, and the expanded NCA as proposed will not sufficiently offset for the impact.[34]

[33] Tsawwassen First Nation Independent Study on Crab and Crab Habitat, July 12, 2017, CEAA Registry Doc # 997, p ii. Although the Intermediate Transfer Pit is no longer being proposed, this area comprised less than 25% of the area assessed in the Tsawwassen Report.
[34] *Ibid*, p 18.

The other proposed mitigation, consisting of communication protocols, does not actually mitigate the reduction in available crab fishing area.

In the absence of mitigation, this impact must be addressed through meaningful accommodation.

2. Habitat Offsetting

The VFPA has stated that project related effects on marine biophysical VC's that cannot be mitigated through avoidance will be addressed through offsetting, and has identified the intention to offset five habitat types: intertidal marsh, sandy gravel beach, mudflat, subtidal rock reefs and eelgrass. [35]

There is significant uncertainty associated with the effectiveness of habitat offsetting. As a result, relying on this mitigation as if successful underestimates the potential significance of effects.

3. Time Lag

The Panel requested information about the potential effects of the Project on availability of preferred traditional resources taking into account the time lag required for the establishment of functioning ecosystems.[36]

In its response, the VFPA referred to its response to IR7-27, which states that timing of most habitat offsetting measures is dependent upon the completion of construction of the relevant portion of the Project. The VPFA further explained that the majority of onsite habitat offsetting construction is proposed to begin in the second half of construction year 3 and that onsite intertidal marsh offsetting habitat planting will begin in construction year 4.[37] The VFPA did not provide the requested quantification of time lags between the impacts of the Project and the functioning of habitat.

The times for commencement of offsetting, however, suggests the time lag will be 2.5 years to 4 year, at a minimum,[38] but likely much longer.

The VFPA has failed to consider the effects of the Project on current use of traditional resources which will result from the time lag between impacts and restoration of access to and availability of resources in its assessment of the impacts of the Project on Indigenous peoples and on the Penelakut Tribe.

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[35] Response to Information Request IR10-01, Appendix IR10-01-C10, CEAA Registry Doc # 1322 p 913.
[36] From the Review Panel to Vancouver Fraser Port Authority re: Information Request Package 10, CEAA Registry Doc # 1130, IR 10-10.
[37] Response to Information Request IR 7-27, CEAA Registry Doc # 1360.
[38] Presuming immediate restoration of habitat functionality.

V. CROWN CONSULTATION

1. Penelakut Tribe Aboriginal Rights and Title

The Penelakut Tribe asserts both Aboriginal title to and Aboriginal right in the Roberts Bank area.

Canada assessed the Penelakut Tribe's strength of claim to Aboriginal rights in the context of the Trans Mountain Expansion Project and reached a preliminary determination that the Penelakut Tribe has a strong *prima facie* claim to asserted rights within portions of the marine shipping route. This was described in more detail as "pre-contact traditional territory of the Penelakut and where there is information of their historic use as part of their traditional seasonal round, including areas in the Strait of Georgia proximal to, and with the southern reaches of, the southern arm of the Fraser River…" [39]

Further, the BC Environmental Assessment Office has assessed the strength of the Penelakut Tribes claim of Aboriginal rights to fish, gather and hunt in areas in proximity to the proposed George Massey Tunnel Replacement project, including the South Arm of the Fraser River, as strong.[40]

The Penelakut Tribe is currently seeking a declaration of Aboriginal Title to the *Tl'uqtinus* Lands on Lulu Island and of Aboriginal fishing rights to the South Arm of the Fraser River.

2. Depth of Consultation Required

In correspondence to Penelakut, CEAA advised the Penelakut Tribe that it had initially determined that the scope of consultation required with Penelakut was moderate.

After considering additional information the Penelakut Tribe provided about its historic use and occupation of the Roberts Bank area, CEAA has committed to consulting with Penelakut at the deeper end of the consultation spectrum:

> Taking into account our preliminary understanding of the strength of claim and potential seriousness of adverse impacts of the Project and associated shipping set out below, the Agency has made a policy decision to revise its preliminary

[39] Canadian Environmental Assessment Agency "CEAA" letter to Penelakut Tribe, September 15, 2016, CEAA Registry Doc # 911.
[40] BC EAO Assessment Report, George Massey Tunnel Replacement Project, p 200 - https://projects.eao.gov.bc.ca/p/george-massey-tunnel-replacement/docs.

depth of consultation assessment and to consult with Penelakut at the deeper end of the consultation spectrum.[41]

3. Consultation to Date

The Penelakut Tribe has met with CEAA to discuss the impacts of the Project on Penelakut Aboriginal title and rights and the depth of consultation required.

Since the commencement of the review of the Project, CEAA has revised is approach to consultation. In addition to confirming that it is required to consult with the Penelakut Tribe at the deeper end of the consultation spectrum, CEAA has included the goal of reconciliation in its proposed approach to consultation on the basis of the ten *Principles Respecting the Government of Canada's Relationship with Indigenous Peoples*. One of these principles is to seek the free, prior and informed consent of Indigenous peoples when the government is proposing to take an action which will impact them and their rights to lands, territories and resources. The approval of the Project will have impacts on Penelakut Tribe Aboriginal title and rights and on lands and resources relied on by the Penelakut Tribe.

4. Outstanding Issues

In February of 2019, CEAA provided the Penelakut Tribe with a summary of what it has heard from the Penelakut Tribe regarding the Project and offered to meet with the Penelakut Tribe. CEAA stated it would provide an updated summary table of the concerns identified by Penelakut with CEAA's preliminary input or responses in mid-March, but at the time of this submission the table had not yet been provided (and the proposed meeting has not yet taken place).

The preliminary table provided by CEAA confirms the Penelakut Tribe's view that a number of the Penelakut Tribe's concerns have not been addressed by the VFPA.

VI. CONCLUSION

The Penelakut Tribe views the RBT2 area as one of the most productive, non-contaminated, crab fishing areas remaining within Penelakut territory; however, it is highly constrained fishing area, given the numbers of aboriginal fishers utilizing the area. The loss of habitat at RBT2 will have an enormous impact on the Penelakut Tribe's ability to access crab, as well as other species fished in this area, effectively and safely.

[41] Exchange of letters between the Canadian Environmental Assessment Agency and the Penelakut Tribe on updated consultation approach, December 6, 2016, CEAA Registry Doc # 911.

The Penelakut Tribe's core marine territory has already been subject to significant impacts both in terms of regulatory limitations on locations where traditional practices can be continued and as a result of pollution. As a result, the Penelakut Tribe is even more dependent on those areas where they can still harvest, such as Area 29-7 and the LAA of RBT2.

By not considering the current state of the Penelakut Tribe's core marine territory to support traditional practices, the VPFA's EIS underestimates the impacts that the Project will have on the Penelakut Tribe's use of land and resources for traditional purposes and on the Penelakut Tribe's ability to achieve its aspirations for continuing and future use of lands and resources.

VII. INDEX OF SUPPORTING DOCUMENTATION

In addition to the documentation in the CEAA Registry for the RBT2 Review, this submission relies on the following:

BC EAO draft Assessment Report, George Massey Tunnel Replacement Project, p 200 - https://projects.eao.gov.bc.ca/p/george-massey-tunnel-replacement/docs.

Chamber of Shipping, Interim Protocol for the Use of Southern BC Anchorages p 6 - www.cosbc.ca/index.php?option=com_docman&view=download&alias=485-interim-anchorage-protocol-2018&category_slug=anchorages&Itemid=355

Fediuk, Karen, et al, *Risk Assessment of Shellfish Consumption in Coastal Communities in British Columbia (AKA Shellfish Safety Project) – Report Prepared for Penelakut First Nation*, December 2015.

Fisheries and Oceans Canada –Sponge Reef Closures, Strait of Georgia - http://www.dfo-mpo.gc.ca/oceans/ceccsr-cerceef/closures-fermetures-eng.html

National Energy Board reconsideration of aspects of its OH-001-2014 Report as directed by Order in Council P.C. 2018-1177, MH-052-2018, February 2019, p 1 file:///C:/Users/jennifer/Downloads/A98021-1%20NEB%20-%20NEB%20Reconsideration%20Report%20-%20Reconsideration%20-%20Trans%20Mountain%20Expansion%20-%20MH-052-2018%20-%20A6S2D8.pdf.

RISK ASSESSMENT OF SHELLFISH CONSUMPTION IN COASTAL COMMUNITIES IN BRITISH COLUMBIA (AKA SHELLFISH SAFETY PROJECT) – REPORT PREPARED FOR PENELAKUT FIRST NATION. DECEMBER 2015

Modified Report Prepared for Penelakut First Nation. **Prepared by** Karen Fediuk (December 15, 2015)

Original Report Prepared for Health Canada, National Environmental Contaminants Program, First Nations and Inuit Health Branch

Prepared by: K. Fediuk, L. Chan, M. Parker, T. Kulchyski, J. Sylvester, Robert Sam, Guuduniia La Boucan, Audrey Henry, William Zhang

2006/07 Project Team Members: Penelakut First Nations (Robert Sam, Councilor), Cowichan [redacted] Dr. Laurie Chan, Karen Fediuk (Registered Dietitian), Mia Parker (Shellfish Biologist), Tim Kulchyski (Project Coordinator).

2005/06 Project Team Members: Penelakut First Nations (Robert Sam, Councilor), [redacted] Dr. Laurie Chan, Karen Fediuk (Registered Dietitian), Mia Parker (Shellfish Biologist), [redacted]

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Foreword

The original report for two communities was submitted to Health Canada in 2007. The research team has not yet published the results in journals or shared the results with any organizations or individuals who are not members or staff of the individual communities or [redacted]

This report has been modified and community level results here are presented for Penelakut First Nation only. These results were based on research undertaken from 2005 to 2007. Only community members living on reserve were included.

Summary

Traditional food remains central to the lifestyle of many First Nation communities on the British Columbia (BC) coast. Shellfish is harvested and consumed for subsistence and cultural uses. Unfortunately, these stocks are ever more subject to contamination from a variety of sources including faecal bacteria, toxins from harmful algal blooms (HABs) such as saxitoxin (PSP) and domoic acid (ASP), persistent organic pollutants (POPs), and heavy metals such as cadmium.

The ultimate goal of this project has been to identify suitable, accessible areas for safe harvest and provide recommendations for safe consumption of shellfish for FIRST NATION communities, including the Penelakut First Nation and [redacted] on the Strait of Georgia.

This report presents activities and results for 2 years of a funded project (July 2005 – March 31st, 2007). In the first year, shellfish sampling for contaminants including organochlorines, cadmium, PSP and faecal coliforms has been performed and a health survey of Penelakut and [redacted] members has been undertaken. In the second year, sampling for cadmium, PSP and water quality continued and technical and education materials were designed and distributed.

Except in oysters, Cd concentrations in all shellfish sampled were generally low (less than 1 ug/g). The average Cd concentration in oysters is 1.4 ug/g with the maximum concentration at 2 ug/g. Shellfish intake by Penelakut community members is 61 g/day. Oyster was the major shellfish species consumed at the time of the study. Estimated Cd intake from shellfish consumption in Penelakut is 38 ug/day. There is no significant correlation between body burden of Cd as measured in urine samples and Cd intake from shellfish consumption. Clinical biochemistry data showed no significant risk on renal function from shellfish consumption. Sixty-seven percent of female participants had serum ferritin levels below 30ug/L, indicating high risk of iron deficiency.

Shellfish remains an important contributor of nutrients in spite of a limited contribution to calories. Shellfish pack a mighty nutritional punch and are major contributor to protein, iron and zinc intakes. The intake from shellfish alone provide 99% of the Estimated Average Requirement for iron in the diet. While food security was not directly measured, observations, clinical results and secondary data confirm that the population is highly vulnerable population and food insecure. Shellfish are acting as a

critical buttress against financial and nutritional food insecurity, although they cannot fill the gap adequately.

The results from the year 1 were discussed with the Chief and Council of Penelakut and accepted as an interim report of a 2year project. The results from year 2 were discussed with community members and councilors who attended community meetings in March 2007. The members of this project will continue to provide information as requested by bands.

Communication and education materials, such as posters, maps, and information pamphlets, have been produced in consultation with the communities.

Background

Communities and Concerns

Shellfish have important social, cultural and nutritive value to the traditional and current diet of many First Nation communities. Shellfish are the first solid traditional food to cross the lips of Vancouver Island Coast Salish infants. Ninety percent of the pre-contact diet was marine-based (Chisholm *et al.* 1983). On southeast Vancouver Island, south of Nanaimo and north of Victoria and on the Gulf Islands are 6 Coast Salish communities, who collectively form part of the Hul'qumi'num Treaty Group (Hul'qumi'num identifies the language spoken in this region). These communities include the: [redacted] Penelakut, [redacted] and [redacted]. The desire for access to traditional foods remains high in Hul'qumi'num communities with almost every Hul'qumi'num household still having at least one harvester (Fediuk & Thom, 2003). Yet use of these resources falls far below stated desirable levels. Nearly all of the shellfish growing areas in Hul'qumi'num territory (Figure 1) are closed for sanitary reasons and the marine substrate remains contaminated with old dioxins that are taken up by Dungeness crabs. The number of open beaches is further reduced by urban growth and aquaculture farms.

At the time of the project there were approximately 800 registered members of Penelakut First Nation and [redacted] members of [redacted]. The largest community of Penelakut members is on Penelakut (formerly Kuper) Island (formerly called Kuper) Island. There is a heavy reliance on traditional food due its' abundance, cultural value, the lack of a grocery store on the island and the relatively remote location and isolation of community members within the densely populated region of Vancouver Island. [redacted] members primarily live in the [redacted]. Much of their traditional shellfish gathering areas, the major location being [redacted] are under permanent closure. To access shellfish, band members need to journey to harvesting areas on Penelakut (formerly Kuper) Island or out to other beaches in the Gulf Islands.

Penelakut and [redacted] have expressed concern about lack of access to safe shellfish for community members. Factors contributing to the isolation of community members from traditional resources include and are not limited to: presence of contaminants, the over-management of local resources, restrictive government regulations, access limiting upland owners, high harvesting and equipment costs, alienation through tenured beaches, lack of time, harvest restrictions in parks (Fediuk & Thom, 2003).

The communities question whether the closure notices issued indicate an accurate representation of the danger to consumers or whether these closures are too precautionary. If the closures are accurate, the concern is that, without alternatives and a good understanding of the short and long term health effects, community members will harvest closed product anyway.

Unlike other shellfish user groups, First Nations are likely to directly harvest shellfish both collectively and individually for reasons beyond engaging in the market economy or indulging a recreational lifestyle. Harvesting traditional food is an important mechanism by which individuals remain embedded in place, connected to the local landscapes in which their deeply rooted culture and sense of personhood and identity has evolved. Shellfish use remains a critical means of reinforcing ties to place and is an important aspect of social and cultural events – from extended family gatherings, to ritual burnings for the dead, to the feasts held during the winter-long longhouse ceremonial - all of which center traditional food as an important aspect of being Coast Salish. In these cultural areas, the phrase 'you are what you eat' would take a local meaning of if you eat shellfish, you are Vancouver Island Coast Salish.

The disenfranchising effects of land loss and residential schools have had predictable results in terms of poverty. Whereas Hul'qumi'num people represent 9% of the local population, they make up 30% of the local food bank population. Given the current median monthly income of $680 per Hul'qumi'num person over 15 years of age (Thom 2005:70), there is little money left after shelter costs to afford the basic cost of eating for a family of 4 which has been calculated at $654.00 per month in BC (Cost of Eating Report, 2005). Only half of First Nation adults report eating protein rich foods daily (Aboriginal Peoples' Survey, 1991). Chronic food insecurity increases health risk and has significant costs. Approximately 23% of current healthcare costs are due to nutrient-related conditions (Health Canada, 2002).

In addition to the apparent cultural preference and the positive security of subsistence harvested foods, access and use of shellfish that are 'safe' can have a positive impact on a community's overall well-being. Shellfish can be an important source of protein, zinc and iron in an otherwise often inadequate diet. Many First Nations are exploring shellfish aquaculture methods to enhance wild harvesting and as an economic initiative: the presence, type and level of contaminants found in shellfish can negatively impact any health and economic gains.

Contaminants

PSP

Algal blooms and their effects on fish and relation to shellfish poisoning are not new phenomena on the West Coast. First Nations in British Columbia (BC) have been aware of toxins contained within shellfish for centuries if not since the beginning. Some of the sailors on Captain George Vancouver's ship in 1793 died after ingesting shellfish at Poison Cove. Their deaths were attributed to shellfish poisoning after learning that First Nations did not take shellfish during red tides from this area.

Paralytic shellfish poisoning (PSP) occurs when a species of dinoflagellate (a phytoplankton) of the genus *Alexandrium* grows rapidly and produces a toxin, contaminating shellfish. This harmful toxin, known as saxitoxin, attacks the nerves of humans and animals when ingested. Symptoms include tingling, numbness, drowsiness, fever, and in the most severe cases, respiratory arrest and death within 2-12 hours if untreated. The poison contained within one clam can kill a human. *Alexandrium* species can also kill fish, birds, and marine mammals. Other non-fatal effects of shellfish poisoning include gastrointestinal illness, respiratory problems, confusion and memory loss.

PSP occurs along more coastline in North America than any other harmful algae event. In recent years however, blooms of *Alexandrium* spp (PSP) are occurring more frequently on the BC coast and are often of longer duration than historically noted.

Chronic effects are unknown due to lack of data and inadequate surveillance. Low-level exposure to PSP toxin in some shellfish that have slow depuration rates after beach openings may have long-term impacts on human health. At present, there are no published data on long term health effects of PSP. There is some published data available on the effects of ASP (see below). Like many contaminants, PSP is odourless and colourless and is not destroyed by cooking. Removing the siphon can reduce the amount of toxin, although it is not known if this can always bring the level of toxin below acceptable limits. Some harvesters have told community members that by removing the siphon from the shellfish, the risk of PSP poisoning is reduced significantly.

Notices to inform the public of fishery and shellfish closures are generally sent directly to First Nation administrations. Unfortunately, many community members will not receive the information; nor is the content in the notices presented in an appropriate format for the end-user

to easily understand. In addition to the basic lack of understanding of the monitoring process and lack of faith in the motives and activities of DFO, this lack of communication could have serious human health consequences. Community members continue to harvest clams, especially butter clams regardless of open or closed status.

Amnesic Shellfish Poisoning (ASP) is due to the toxin domoic acid produced by dinoflagellates of the *Pseudo-nitzschia* genus. ASP has been found from Barkley Sound all the way to the Queen Charlotte Islands. Symptoms include: severe nausea, vomiting and diarrhea, coma, short term memory loss, disorientation and confusion. Recovery time is a few days if the poisoning is not severe and the individual does not have a chronic illness or health problem such as kidney dysfunction. Long term effects include inability to concentrate, difficulty learning and lesions in the brain. One study has found that 3-6 months of shellfish avoidance is necessary to reverse some of the effects (Grattan et al., 1998).

In spite of beach closures and communication to the general public, each year, there are a number of admissions in local Vancouver Island hospitals due to PSP (personal communication, CFIA). Although the Department of Fisheries and Oceans (DFO) closes large areas of beaches due to bloom occurrences: there remains a level of disbelief, misunderstanding and disregard for closures which affect the majority of traditional shellfish harvesting areas. Part of this issue is perceived to be due to the current communication format and style, which is considered not consumer friendly.

Environment Canada (EC) and Fisheries and Oceans Canada (DFO) carry out a toxin monitoring program however, declining budgets have necessitated a reduction in the number of sampling sites serviced. As a result, monitoring sites affect the status of increasingly larger areas. In effect, access to 'open' shellfish is greatly reduced. Access is also impacted by the slow depuration rate of Butter clams which remain closed long after a particular area is opened there is a blanket closure on butter clams in effect as these species can retain a high level of PSP toxin for over a year. Openings are only allowed if there has been sufficient testing in the areas to assure that butters have a low level of toxin, however, for reasons above, this is not occurring. Due to the importance of shellfish, and butter clams in particular to First Nation communities, they continue to be harvested for consumption and community gatherings.

Cadmium

Cadmium (Cd) is an element belonging to group IIB in the periodic table. It is found in the earth's crust and is widely spread by human activities. Volcanic activities and erosion also give rise to the presence of cadmium in air, land, and water. Major sources of contamination are the industrial production and consumption of cadmium and other non-ferrous metals and the disposal of wastes containing cadmium (WHO 1992). During the 20th century, cadmium production has increased, resulting in increased concentrations in the general environment and particularly in air and water. Because of its adverse toxicological and environmental effects some countries have recently banned many uses of cadmium. An important toxicological property of cadmium is its exceptionally long biological half-life of 10-30 years in humans (Nordberg 1992; WHO 1992). Absorption of cadmium in humans in the gastrointestinal tract is around 5%, and depends on dietary composition and on the total dose (Nordberg *et al.* 1985; Andersen *et al.*1992). A number of factors, e.g., low iron stores may increase absorption by a factor of up to 4 compared to humans with normal iron stores. Other factors that give rise to an increased uptake of Cd are low intakes of protein, vitamin D, calcium, and trace elements such as iron, zinc and copper. Intake of fibre can decrease the absorption of cadmium. Once absorbed, cadmium accumulates throughout the lifetime, and renal dysfunction may develop if a critical concentration is reached in renal tissue. With low-level exposure to cadmium, 30–50% of the body burden of cadmium is found in the kidney. Other adverse health effects seen following exposure to

cadmium include bone effects, e.g., osteoporosis and more severe forms such as the osteomalacia found in itai-itai patients. With low-level exposure, cadmium is accumulated in the kidney, which is the critical organ in long-term exposure to cadmium. More recent studies, such as Cadmibel and PheeCad (Buchet *et al.*1990; Staessen *et al.* 1999, 2000; Holz *et al.* 1999) show that tubular damage may develop at lower exposure levels than previously believed. Environmental epidemiological studies e.g., Cadmibel, PheeCad and several studies from Japan (Suwazano *et al.* 2000) have reported a relationship between Cd exposure in the general population and renal dysfunction. Recent work by Satarug et al. (2003) suggests that the current PTWI may be too high for women. She has reported that non-smoking women have a greater exposure and accumulation of cadmium than male smokers; this has been due to their smaller body size and lower iron stores.

In late 1999 and early 2000, several shipments of BC oysters were rejected by the Hong Kong Food and Environmental Hygiene Department as being in excess of their 2 ppm (wet weight) cadmium (Cd) import limit Kruzynski (2004). A subsequent shellfish processor survey by the CFIA (Canadian Food Inspection Agency) established that these shipments were not anomalous and reported a mean Cd value of 2.63 ppm (wet weight basis) for BC oysters cultured over a broad geographic area (Schallie, 2001). Sixty percent of the 81 samples were in excess of 2 ppm. Kruzynski (2001) calculated that a single meal of oysters at the CFIA-determined BC mean value could easily exceed the FAO/WHO provisional tolerable weekly intake (PTWI). To put these figures in health risk perspective, CFIA requested that Health Canada (HC) conduct a formal Health Risk Assessment based on the CFIA mean Cd value. A recommendation for a limit of a dozen 40 g oysters per month per adult and one oyster per child was subsequently published (CFIA, 2003).

The Health Canada risk assessment made no adjustment for sex differences and nutritional status. Neither cadmium intake from smoking nor sex of oyster consumers were factored into the calculation of the consumption advisory, although Health Canada did acknowledge that both were important factors in the consideration of Cd uptake from all sources and its partitioning in the body. Furthermore, the lack of specific oyster consumption data precluded an accurate determination of intake and therefore dose.

It is important to ensure protection of susceptible populations, e.g. FIRST NATION populations, women, children, those suffering from poor nutrition, anemia, diabetes, elevated high blood pressure, obesity, etc. and who may frequently consume organ meats known to be high in Cd and/or who may be smokers. At the present time few of these important factors are receiving attention notwithstanding that many of these factors occur concurrently in some BC First Nations as well as in those who might qualify as "frequent consumers" in the oyster growers' community. Specific recommendations pertaining to the issue of Cd in oysters were presented by New Zealand Ministry of Health (2000) as part of the 1997/98 New Zealand Total Diet survey. Among these were: (a) a suggested limit in consumption to ensure dietary Cd remains within safe levels, (b) the need to more accurately determine what percentage of oyster-eaters may be exceeding the dietary PTWI, and (c) given the small safety margin, that susceptible populations be studied more carefully. Furthermore, these authors utilized a consumption level of 35 g of oyster per 14 days in their calculations. In BC, where consumption in some sub-populations could be 10 20 times this intake, there is a clear need for such a comprehensive approach.

Sewage - Bacteria and Viruses

The shellfish harvesting areas closed for sanitary purposes have grown to 124,000 hectares or 20%. The area closed has doubled in the last 10 years (Ministry of Environment, Lands and Parks & Environment Canada, 1993). The most productive shellfish growing areas

occur within the Georgia Basin where the majority of closures occur. Once an area is closed or prohibited for sanitary purposes, it is unlikely to be re-tested and/or re-opened unless there are other parties interested in taking on the water quality sampling costs for food enhancement or commercial purposes. Currently EC only has funding to carry out 3 samples per site every 3-5 years. A site requires at least 15 data points per sampling station every 2-3 weeks before being re-evaluated for re-classification.

Figure 1 illustrates the separation of Hul'qumi'num people from traditional marine foods. The map shows the extensive location of shellfish closures (sanitary and PSP). For Penelakut community members, where access to a grocery store requires a ferry, beach closures severely impact food security. Currently there are only 2 open beaches fronting Penelakut's reserve. These are heavily harvested and many community members indicate they cannot attain what they desire (Fediuk & Thom, 2003). Prohibited from using their own beaches, Cowichan Tribes members are reliant on declining amounts of shellfish from Penelakut's beaches.

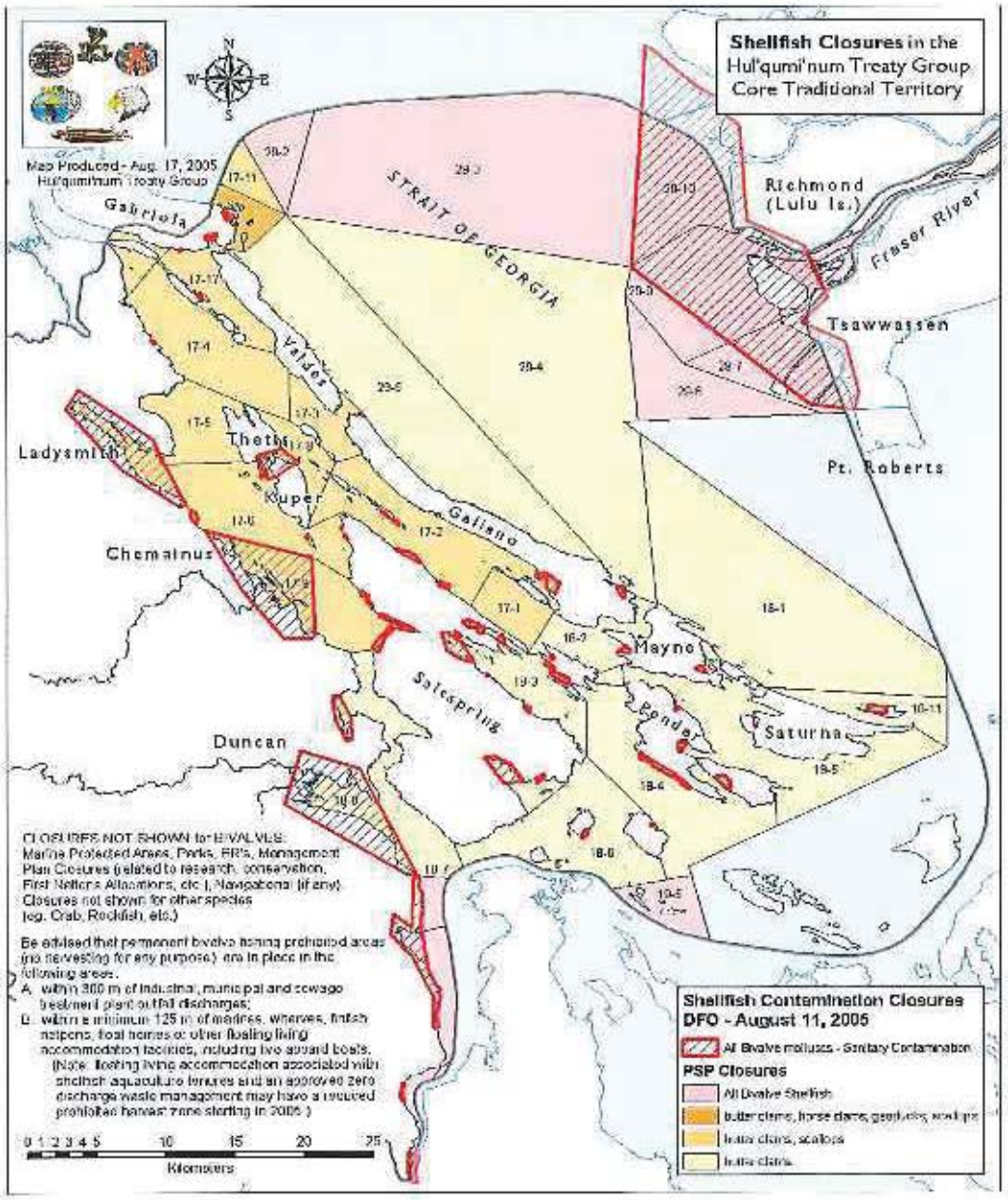

Figure 1 Map of Closures - Summer 2005

Organochlorines

In the Hul'qumi'num traditional territory, historic discharges of dioxins from one mill continue to keep many areas in Hul'qumi'num territory closed to commercial crab harvesting and consumption advisories in place. People are to consume no more than 105 g/week of crab hepatopancreas harvested from Deer Point to Kulleet Bay and no more than 40 g/week of hepatopancreas from crab harvested from Ladysmith to Cowichan Bay: this requires the removal of the hepatopancreas before cooking to prevent dioxins from moving into the meat or broth. Figure 2 illustrates crab closures and location of First Nation reserves.

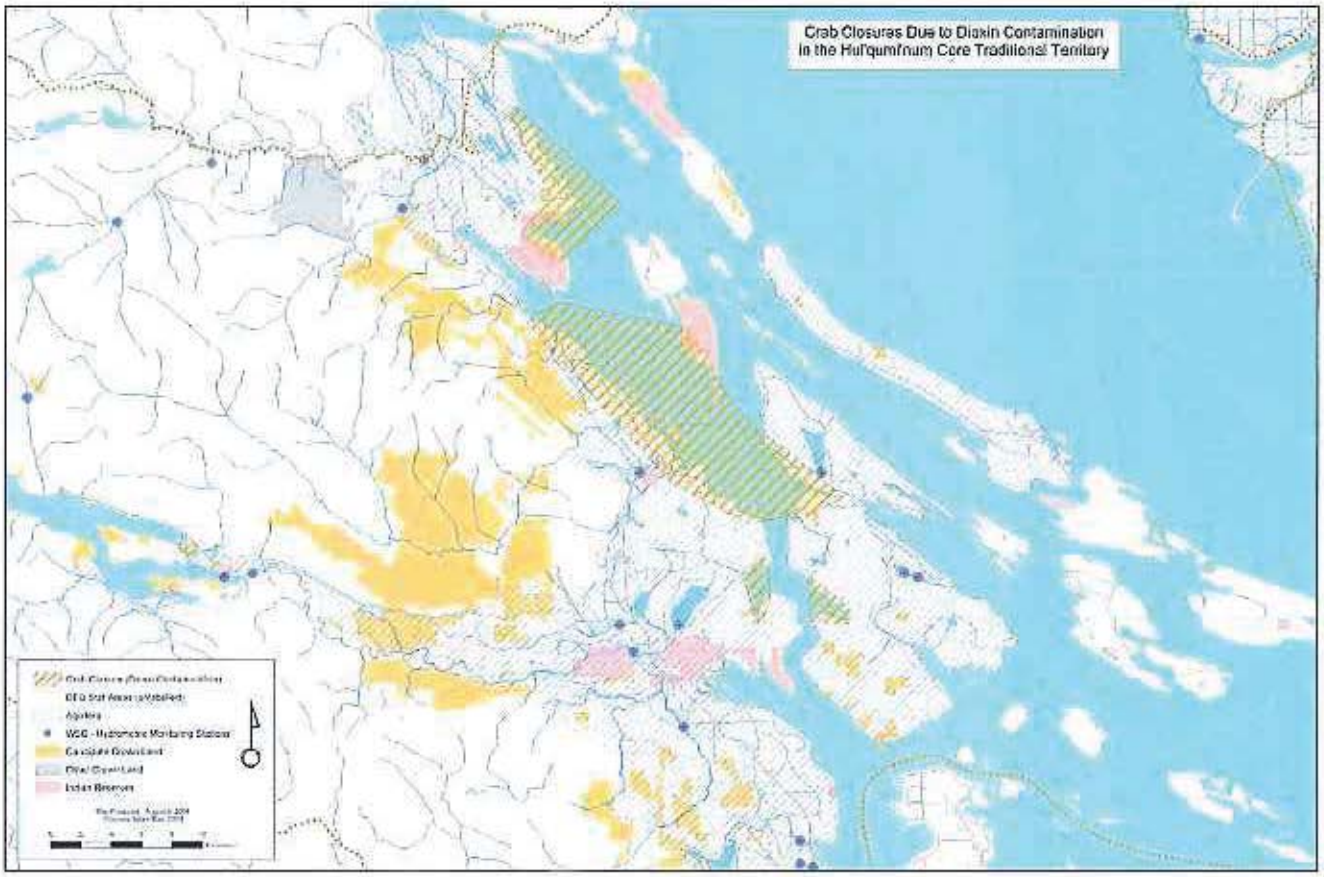

Figure 2 Crab Closures in Hul'qumi'num Territory

Effluent from the mill located at Crofton is discharged to Stuart Channel and is subject to strong diurnal tidal currents which extend the plume northwards to a line crossing from Penelakut (formerly Kuper) Island west to Ladysmith Harbour, and southwards, through Sansum Narrows to the southern bottom of Saltspring Island. The sediments here are often mixed by strong waves and currents, or even by burrowing marine animals. These processes keep "old" dioxins and furans at or near the sediment surface; as crabs live and feed on this surface, exposure to these chemicals continue. In the most recent year of testing (2003), chlorinated compounds were detected in all samples collected from the Stuart Channel study. Levels of dioxins at five of the

eight stations surveyed reveal that current Health Canada advisory consumption levels for hepatopancreas in this area are too high (currently sit at 40g/week) (Hatfield Consultants, 2004).

Bivalve shellfish are of nutritive value and comprise a significant proportion of diet, especially in some First Nations communities in BC. However, few employment opportunities have led to chronic poverty on many reserves. In several coastal regions there is a new initiative for First Nations to become involved in aquaculture to complement their traditional harvest of wild clams and other bivalves. The Cd and HAB issue brings up a dilemma: how to balance the nutritional benefits of eating shellfish that might have elevated Cd levels and the presence of toxins that may cause acute and long term health effects? What should be done until appropriate bioavailability data and other chronic disease (e.g. diabetes, hypertension, neurological disorders) interactions are studied? At the present time, there are no such studies underway in coastal BC, although the roles of chronic Cd intake in hypertension (Satarug et al., 2000), carcinogenesis (Jin et al., 2003 and Stoica et al., 2000) and endocrine disruption (Johnson et al., 2003) are becoming evident. A biomarker-of-exposure study among BC oyster growers is underway (Dr. R. Copes and co-workers, BC Ministry of Health and University of British Columbia) but First Nations are not included. As for the role of hazardous algal blooms on health, there is primarily data available on the short term effects of HAB's. It is largely unknown whether there are any long-term effects from habitual use of shellfish that may have levels of toxin that have no acute effect. One researcher at the University of Maryland, Lynn Grattan has performed a short term study on the effects of domoic acid on memory impairment (Grattan et al., 1998). She is leading a long term study (in the Pacific Northwest) on the chronic effects of exposure to domoic acid but the results have not been made public yet.

Purpose

The ultimate goal of the project is to identify accessible areas for safe harvesting of shellfish and provide recommendation for safe consumption of shellfish for participating and other First Nation communities harvesting shellfish in the southern Gulf Islands, the south-eastern and west coasts of Vancouver Island. Subordinate goals include testing existing harvest areas, definition of community consumption of shellfish, assessment of health effects from consumption of species identified as potential sources of HAB toxins, cadmium and POP's, and development of an ongoing monitoring program for identified sites.

Objectives as per Submission to the National Environmental Contaminants Program.

1. To assess the importance of shellfish resources in diet, lifestyle, health and quality of life in at least two communities on the Southern Gulf Islands.
2. To monitor the concentrations of PSP, cadmium, and persistent organic pollutants (POPs) including polychlorinated biphenyls (PCBs), dioxins (PCDDs), furans (PCDFs), and polybrominated diphenyl ethers (PBDEs) in oyster, mussel, butter clam, horse clam, littleneck, manilas and crab collected from water bodies that are commonly used by the two communities.
3. To quantify the acute health effects of HAB (PSP/ASP) by frequency of symptoms, degree of effect (nausea, vomiting, diarrhea)
4. To access the effects of cadmium (Cd) on kidney function by measuring Cd, calcium (Ca)) and protein in the urine of the participants as well as serum ferritin, as a biomarker for iron status (the level of iron stores is known to have an effect on cadmium absorption) to adjust for cadmium intake.
5. To bring information on the balance between health benefits and health risks associated with shellfish consumption in relation to the total diet.
6. To increase research capacity in the communities by training local workers to conduct the study.
7. To implement intervention, education and resources management by combining local knowledge and scientific data generated from the study.

In year 1, we carried out parts of all of the objectives listed. In year 2, we focused on completing objective 2, 5 and 7.

YEAR 1 PROJECT ACTIVITIES

Implementation of the first year of this project has been carried out in the following manner:

1. Consultation and Communications
2. Data Collection (August – March 31, 2006)
3. Data management, analysis and report writing (December 2005 – June, 2006)
4. Education outreach program

Consultation and Communications

Community Meetings

[redacted] Health Advisory Committee Meeting-May 3, Tsewultun Health Centre,

[redacted] Chief and Council presentation - May 10, 2005

Community meeting August 18th,2005, Siem Lelum Duncan, BC

Penelakut (formerly Kuper) Island Community meeting August 25th, 2005, Penelakut Island Gymnasium

Cowichan Tribes Community update March 30 th,2006, [redacted]

Penelakut Island Community update March 29th, 2005, Penelakut Island Gymnasium

Working Group and Team advisory board Updates

May 16, 2005 -Shellfish Safety Project Team., [redacted] Boardroom (Karen Fediuk, [redacted] Laurie Chan, [redacted], Audrey Henry, Mia Parker)

May 16, 2005 –Shellfish Safety Meeting with Health Director, [redacted]

May 17, 2005 - Shellfish Safety Project–Penelakut Island. (Laurie Chan, Robert Sam, Mia Parker, Karen Fediuk)

July 5, 2005 - Shellfish Safety Meeting-Tsewultun Health Centre (Karen Fediuk, [redacted] Research Agreements)

July 20, 2005 – Update (Karen Fediuk, Audrey Henry, Karen Fediuk, Tim Kulchyski) on sampling design, invoicing

August 9, 2005 - Meeting (Tim Kulchyski, [redacted] Karen Fediuk, Dr. [redacted] to bring physician on board.

August 24, 2005 -Shellfish Safety Project Team advisory meeting of advisory board (Tim Kulchyski, Karen Fediuk, Robert Sam, [redacted] Laurie Chan, Audrey Henry, [redacted] Mia Parker) to discuss logistics of sampling, design of study

September 27, 2005 - Shellfish Safety Project Working group meeting,
December 9, 2005 - Shellfish Safety Project Working group and advisory update

January 27, 2006 - Shellfish Safety Project Working Group meeting [redacted]

Conferences

November 26-27, 2005 - Youth Treaty Conference, [redacted]

February 7-8, 2006 - First Nations' Environmental Contaminants Conference. FIRST NATION IHB, HC, Kamloops, B.C.

March 23, 2006 - Aboriginal Policy Research Conference, Ottawa

Data Collection (August – March 31, 2006)

Shellfish Sampling Schedule

PSP

October 17, 2005
October 24, 2005
October 31, 2005
November 7, 2005
November 21, 2005
December 5, 2005
December 12·2005
January 3, 2006
January 9, 2006
January 16, 2006
January 30, 2006
February 14, 2006
February 27, 2006
March 13, 2006
March 27, 2006

Cadmium

Beach Sampling

August 18-20, 2005 – 6 sites
March 15-23, 2006 - Crab Sampling
March 31, 2006– 6 sites

Raft Sampling

September 2005 – Placed oysters from beach onto suspended tray system - Kulleet Bay, Clam Bay, Big Rock, Lamalchi, Sansum Narrows, Boatswain Bank

November 16, 2005-Oyster sampling – 6 sites

January 17, 2005 – Oyster sampling – 6 sites

March 5, 2006 – Oyster sampling – 6 sites,

Organochlorine Sampling

February 15, 2006- Crab Sampling- Kulleet Bay, Clam Bay, Big Rock, Lamalchi, Boatswain Bank

March 15, 2006 - Crab sampling, Cowichan Bay

March 31, 2006-Shellfish- Kulleet Bay, Clam Bay, Big Rock, Lamalchi, Sansum Narrows, Boatswain Bank

Water Quality Sampling

February – March, 2006 – Water Quality Sampling Protocols and Training by Environment Canada Shellfish water quality testing program, Bert Kooi Project Manager.

Health Survey and Testing of Iron Stores, Kidney Function, Cadmium Levels in Body

September, 2005 – Discussion and revisions to Health Survey Tool

October 20, 2005- Health Survey training. Hul'q'umi'num' Treaty Office, Ladysmith

October – February 2006 – Health Survey Interviews

January – March 2006 – Blood and Urine Testing

Data management, analysis, report writing (December 2005 – Ongoing)

November – March 31, 2005 – CFIA laboratory –PSP analysis

December 2005 – June 2006 – Data entry and analysis

January – April, 2006 – MDS metro labs – biochemistry, CINE-cadmium in urine

April-May, 2006-CANTEST-organochlorine analysis

Education outreach program

February – March 2005- Graphic design of images and draft education module

YEAR 2 PROJECT ACTIVITIES

Implementation of the second year of this project has been carried out in the following manner:

1. Consultation and Communications
2. Data Collection (April 2006 March 2007)
3. Data management, analysis and report writing (April-May 2007)
4. Education outreach program (April-May 2007)

Consultation and Communications

Community Meetings

[redacted] Aboriginal Day Community Event, June 21, 2006 [redacted] project awareness and progress

[redacted], project reporting and consultation, June 27, 2006, [redacted]

Penelakut Chief and Council, project reporting and consultation, June 29, 2006, Council meeting, Chemainus BC

Penelakut Elders Advisory meeting, Consultation meeting on developing the education component and update, November 15, 2006, Hul'q'umi'num' Treaty Office, Ladysmith BC

[redacted] General meeting, Community project awareness, November 8, 2006 at [redacted]

([redacted] Consultation meeting on developing the education component and update, November 20, 2006, [redacted]

[redacted], Consultation meeting on developing the education component and update. November 23, 2006, [redacted]

Penelakut Community Meeting. Final study results. Penelakut (formerly Kuper) Island School. March 29, 2007.

[redacted] Final study results. March 26, 2007. [redacted]

[redacted] meeting. Final Results Presentation, January 7, 2008.

Community and project member updates and meetings

Project member consultation meeting, advisory for project implementation, June 23, 2006, [redacted]

Project member development and project review, [redacted] and research department, August 2 2006, [redacted]

Project member planning session, shellfish safety staff planning for community meetings, September 5, 2006, [redacted]

Internal Working Group meeting, project update and planning session, October 17, 2006, [redacted]

Training sessions and workshops

Community/staff sampling methodology training session August 7, 2006, Pacific Biological Station Labs, Nanaimo BC

Community/staff principles and data entry training, August 14, 2006, Pacific Biological Station Labs, Nanaimo BC

Water Quality Sampling Protocols and Training for staff and community members by project staff, September 19, 2006 Penelakut Island, BC

Data Collection (April 2006 – March 31, 2007)

Shellfish Sampling Schedule

PSP

April 10, 2006
April 24, 2006
May 8, 2006
May 15, 2006
May 22, 2006
May 30, 2006
June 5, 2006
June 13, 2006
June 20, 2006
June 27, 2006
July 4, 2006,
July 6 mussel collection for samples
July 10, 2006
August 7, 2006
August 15, 2006
August 21, 2006
August 28, 2006
September 11, 2006
September 18, 2006
September 25, 2006
Sept 29, 2006 (mussel sample collection Sooke)
October 2, 2006,
October 11, 2006
October 16, 2006
November 6, 2006

Cadmium

Beach Sampling

April 1, 2006, Kulleet Bay, Clam Bay, Big Rock, Lamalchi, Sansum Narrows, Boatswain Bank
June 9,11,12 Kulleet Bay, Clam Bay, Big Rock, Lamalchi, Sansum Narrows, Boatswain Bank
July 14, 2006, Kulleet Bay and Clam Bay
July 20, 2006, Boatswain Bank and Sansum Narrows

Raft Sampling
August 8, 2006, Chemainus Bay, Clam Bay, Big Rock, Lamalchi Bay
August 22, 2006, Boatswain Bank and Sansum Narrows
Crab samples
July 12, 2006 Cowichan Bay

Water Quality Sampling
September 19, 2006 Clam Bay
November 7, 2006 Clam Bay

Data management, analysis, report writing (April 2006 – May 2007)

April-October 2006 – CFIA laboratory –PSP analysis

March-May 2007 Data entry and analysis

October 2006-March 2007- North Island Labs-water quality

Education outreach program

April 2006-March 2007 – development of a suite of materials with reviews by project team members and Health Canada.

Methods

Overview

The first year of the project has derived data through shellfish sampling for fecal coliforms, organochlorine pesticides and PCB congeners, cadmium and HAB toxins (PSP/ASP) as well as individual interviews, measurement of body weight and serum and urine biochemistry. The method for this study were developed in consultation with community members, researchers at the [redacted] and members of the project team. The present project was approved by Health Canada's Human Ethics Review Committee in the Summer of 2005.

The second year of the project has derived data through additional shellfish sampling for cadmium, fecal coliforms and HAB toxins (PSP/ASP). In the second year, additional data analysis was performed on the first year's data set and educational materials were developed in consultation with project team members and community members.

Community Data

In each community, after negotiation of a research agreement (Appendix A) with community leaders, the community was informed about the project through door to door visits and accompanying brochures and posters (Appendix B). Initial meetings with community members to announce the project were held in August 2005. Shellfish sampling began in August 2005. Interviews with community members began in October 2005.

Shellfish Sampling and Contaminant Analysis

Cadmium

Sample Collection/Processing/Analysis

The following species were measured for cadmium levels at the 6 locations. The table indicates the number of times each species was scheduled for collection. Shellfish were collected from the beach at 3 time points (August 2005, March 2006, June 2006). If samples were not collected at each beach, this was due to lack of availability at a particular site. At each site, the aim was to collect a minimal sample of n=5. Oysters were also collected from the rafts at 6 time points.

Table 1 Species and Sampling

Species	Sample frequency	
	Beach	Suspended Trays
Oyster (Crassotrea gigas)	4	6
Butter clam (Saxidomus giganteus)	4	0
Horse clam (Tresus capax)	3	0
Cockle (Clinocardium nuttali)	4	0
Manila clam (Tapes philipinarium)	4	0
Littleneck (Protothaca staminea)	4	0
Mussel (M. galloprovincialis)	0	4
Dungeness crab (Cancer magister)	2 (taken in waters near beach)	

During the winter months, the low tides would have required sampling during the night. As the six sites are distant from each other, night time boat travel between the sites carries an unacceptable risk. By transferring oysters to trays located on site, samples could be obtained during the day with considerably less risk. Ultimately, weather and the availability of vessels suitable to the marine conditions still impacted the timing of sampling. Sample sites are shown in Figure 3. Additional intertidal sample tray samples were carried out in the summer months of year (2006).

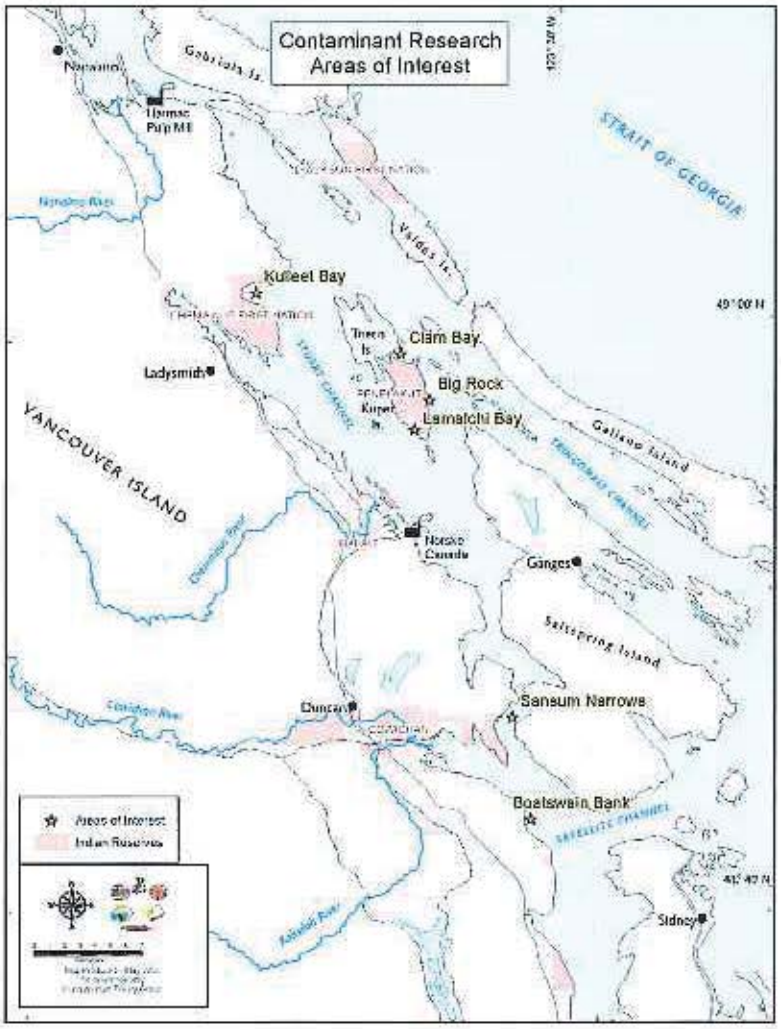

Figure 3 Map of Test Sites

As both communities have expressed interest in pursuing economic development through aquaculture and the Hul'qumi'num' Treaty Group is leading a joint aquaculture venture, juvenile mussels were added to the trays along with the oysters. The mussels, *Mytilus galloprovincialis*, were purchased from a commercial grower and originally came from Cortez Island. The initial small size of the mussels prevented bimonthly sampling, but sample frequency increased as they grew.

Shellfish samples taken from the beach and rafts were frozen until processing could occur. To process, shellfish were carefully scrubbed to dislodge any attached worms, barnacles, etc. Any clumped shellfish were carefully split and laid out to defrost. The length and total weight were taken after samples were defrosted and before shucking. Samples were shucked; all meat was removed and transferred onto parafilm for weighing. All samples were then placed into Ziploc bags and kept frozen until analysis at CINE labs.

At CINE lab, shellfish samples were homogenized in an Oster blender. Homogenates were weighed and freeze dried in a Flexi-Dry MP bench top lyophilizer to calculate moisture content. Freeze dried samples were milled until homogeneous. All sample pools were thoroughly mixed. Aliquots (0.6 g) of each freeze dried sample were weighed into glass boiling tubes. To each tube was added 4.0 mL concentrated nitric acid. Samples were predigested at room temperature overnight, then transferred to a dry bath where the temperature was raised slowly over 2 hours to120°C and held for 5 hours. After the digests cooled to room temperature, the volume was brought to 40 mL with nanopure water (final acid concentration ~10%). All samples were filtered through a 0.45 µm Millex-HV syringe filter. The trace metal content is measured on a Varian ICP-MS UltraMass 700 after a 5-fold dilution with nanopure water (final acid concentration 2%).

Organochlorine

Sample Collection/Processing/Analysis

A variety of shellfish (n=23) were set aside for organochlorine analysis from the beach samples gathered for cadmium analysis. As shellfish have a habit of extruding their siphon, the shellfish were wrapped whole in tinfoil and sent to CanTest labs in Burnaby for analysis. Crab traps were set for 6 locations for a 24-hour soak. At 2 additional community harvesting locations, a string of traps was pulled from the water and crabs were set aside for organochlorine analysis. Crabs were kept frozen until they could be dissected. Thawed crab was weighed, measured, identified as male/female and dissected using stainless steel forceps. Hepatopancreas tissue was removed and placed inside tinfoil which was then placed in a marked Ziploc bag and kept frozen until arrival at CanTest labs in Burnaby.

Samples were analysed for PCBs (the sum of 28 congeners) and chlorinated pesticide (aldrin, alpha-BHC, beta-BHC, lindane, chlordane, DDD, DDE, DDT, fenchlorophos, heptachlor, heptachlor epoxide, hexachlorobenzene, mirex, oxychlordane). Analysis was performed on homogenates of shellfish species/site whereas analysis was performed on individual crab samples/site. Ten grams (wet weight) of each sample of crab was extracted. Analysis was performed using ethyl acetate extraction, deactivated Florisil clean-up, and quantification by Gas Chromatography with Mass Spectrometric Detection.

PSP

Two sampling sites were selected (Big Rock and Boatswain Bank). These are in addition to bio-toxin monitoring stations within the project area already established by Environment Canada (EC). California mussels (*Mytilus californianus*) were provided by the Canadian Food Inspection Agency (CFIA) and hung from the tray systems at Big Rock (east side of Penelakut (formerly Kuper) Island) and at Boatswain Bank (south of Cowichan Bay). The project team followed established CFIA sampling protocols with biweekly sampling from November 1 2005 to April 30 2006 and weekly samples are being collected from May 1 2006 until November 6, 2006. Analysis of the samples was carried out at the CFIA Burnaby Laboratory using the mouse bioassay method for Saxitoxin (PSP) and HPLC for Domoic Acid (ASP).

Water Quality

The Project Coordinator and research assistant received training by Bert Kooi, Environment Canada, in water quality sampling protocols in March 2006. Subsequently, water quality samples were gathered following the EC sampling protocols. This consists of a series of 3 sampling events of 5 samples each within 48 hours of a significant rainfall event. Samples were collected on a falling (daylight morning) tide and transported to North Island Laboratories (Courtenay) within 6 hours of time of collection for faecal coliform analysis.

Health Survey

A health survey was created to gather baseline information on community consumption of shellfish over a year. This information was planned to be incorporated into the development of an education module; ensuring health (risk/benefit) messages can be placed in relevant and appropriate context.

The survey instrument was finalized in September. (Appendix B). It included questions on: consumption of 8 species of shellfish (oysters, butter clams, manila clams, littleneck clams, cockles, horse clams, mussels, crab) and organ meats (kidney and liver) over the past year, current harvesting practices, current shellfish safety concerns and participants' perspectives on methods to reduce risk, past exposure (symptoms of tingling, numbness, hospitalization) to PSP or other pathogens (nausea, vomiting, cramps, diarrhea, etc) and age. Individuals who agreed to undergo blood and urine testing were asked to provide additional information on height, weight, medical history and tobacco use and exposure to second hand smoke.

In each community, a random sample of 50 HH's was drawn from current band housing lists (on-reserve). One man and one woman were invited to participate per household in the interview and blood and urine testing. Prior to commencement of an interview, informed consent was obtained. Anonymity and confidentiality of respondents are maintained through use of coded interview forms and oaths of those involved in the data collection process.

Community members were trained to conduct the interviews. The quantitative food frequency questionnaires were designed to assess individual use of 8 species of shellfish over the past year. Using Nasco 3-dimensional generic portion size models, individuals were asked to describe: the usual amount of shellfish they ate at a meal or sitting; its prepared state (cooked, raw, fried); and frequency of consumption for each species over the past year on a seasonal basis (from 1-90 x).

Data collection took place in the community of Penelakut from October to January and in Cowichan communities from October to March 2006. The data collection period for Cowichan members was longer than expected for a variety of reasons including: illness, cultural activities (Big House season), holidays.

Blood and urine samples were collected by MDS technicians at a mobile clinic on Penelakut Island and at MDS labs in Duncan and Ladysmith. MDS performed analysis for serum ferritin, protein, creatinine, calcium and urine creatinine, albumin. Urine samples were shipped to CINE where they were measured for cadmium concentrations using ICP-MS and adjusted for creatinine concentrations.

Interviews were reviewed by the Project Manager and the Research Assistant and then entered into Excel spreadsheets. The Project Manager coded blood and urine results and forwarded cadmium in urine results to the project physician (Dr. Stephen Faulkner). Summary statistics were performed in Excel and files were sent to Laurie Chan and transferred into SAS for further analysis. A GLM model (General Linear Model) was run to test whether smoking, cadmium from oyster intake, gender, ferritin levels, age and the interaction between age and smoking contributed to cadmium in the body. One-way ANOVA was done to look at the relationship between urine cadmium and smoking, oyster intake, ferritin and gender for each community.

Results

Shellfish Sample Analyses

Contaminant Concentrations

Cadmium

Table 2 Average Amount of Metals (ug/g) in Clams Sampled at Six Beaches (August 2005)

Species	n	Cadmium	Lead	Zinc	Iron	Cobalt	Manganese
Cockles	29	0.07	0.055	12.64	56.39	0.11	3.21
Butters	31	0.08	0.06	12.71	26.98	0.10	0.82
Horse Clams	26	0.21	0.10	9.64	135.85	0.16	4.63
Littlenecks	30	0.40	0.02	11.89	64.09	0.08	0.98
Manilas	32	0.34	0.04	14.23	50.92	0.14	1.31

Table 3 Average Amount of Metals (ug/g) in Oysters from Six Sites (n=5)

Table 3. Average Amount of Metals (ug/g) in Oysters From 6 Sites (n=5 per site) (august-beach, November – trays)							
Location	Site	Cadmium	Lead	Zinc	Iron	Cobalt	Manganese
Kulleet Bay	Tray	1.13	0.05	146.80	22.70	0.02	1.84
Kulleet Bay	Beach	1.12	0.09	212.59	26.25	0.02	1.77
Clam Bay	Tray	1.52	0.05	152.92	27.21	0.03	1.74
Clam Bay	Beach	0.89	bdl	96.47	23.21	0.02	2.27
Lamalchi Bay	Tray	1.25	0.05	196.34	26.04	0.02	1.48
Lamalchi Bay	Beach	1.70	0.03	252.31	19.12	0.03	8.23
Big Rock	Tray	1.38	0.04	258.41	33.31	0.03	2.42
Big Rock	Beach	0.99	bdl	133.70	31.59	0.02	1.73
Sansum Narrows	Tray	2.00	bdl	215.34	17.17	0.04	12.85
Sansum Narrows	Beach	1.26	0.03	62.15	21.72	0.02	1.89
Boatswain Bank	Tray	1.29	0.04	201.47	37.03	0.03	2.13
Boatswain Bank	Beach	1.76	bdl	206.35	35.55	0.03	4.97

Results from August sampling (beach) and November (oysters only in suspended trays) reveal at many locations cadmium levels in oysters are above 1 ug/g with levels highest at Sansum Narrows. Levels of cadmium in other bivalves are below 1 ug/g. All 6 sites are still being sampled until Fall 2006 when we expect to have a complete year of results.

PSP

Algal blooms tend to occur during periods when nutrients in the water and available light promote rapid phytoplankton growth. The low levels of biotoxin detected to date are not unexpected. However, it should be noted that toxin levels at Big Rock were generally below the action limit of 80µg during the project sampling period and consistently below the levels reported at the official sampling station at Coffin Point. But the larger area was closed to harvesting based

on PSP monitoring results from the Coffin Point sampling station. This indicates that the impact of the bloom event is not uniform over the management area.

Organochlorines

Organochlorine pesticides and PCB congeners were below detection limits. See Appendices for raw data.

Water Quality - Fecal coliforms

Environment Canada has a stringent permitting process that requires supervised (annual) training of sample collectors and a signed agreement between the First Nation and EC. Scheduling difficulties with EC representatives delayed the completion of the training and consequently the optimum season for sampling passed in year 1 without sampling taking place. However, project technicians collected preliminary background data from the Clam Bay sampling location. There is currently a sanitary closure of Clam Bay due to historic levels of fecal coliform bacteria. This is a popular harvest site for Penelakut members due to easy beach access. It is also the location of two aquaculture investigatory pilot projects. Results below are from samples taken at Clam Bay April 18, 2006. They show low levels of bacteria present in the water. Formal sampling will resume later in the year once the fall rains have begun. [redacted]

Table 4 Background Fecal Coliform Results Clam Bay

Date	Sample station	Fecal coliform bacteria results Most Probable Number per 100ml (MPN/100ml)	Salinity ppt
18 Apr 06	01	<2	26
	02	5	26
	03	2	26
	04	<2	26
	05	<2	27
24 May 06	01	50	25
	02	13	25
	03	22	26
	04	33	26
	05	79	26
19 Sep 06	01	<2	26.8
	02	14	26.9
	03	5	26.9
	04	23	26.6
	05	79	26.7

Health Survey

Sample Characteristics

The aim was to invite at least 50 people per community to participate in a food frequency survey and blood testing to determine current exposure to cadmium from seafood resources and current body burden of cadmium. In each community, a random list of 50 households (HHs) was drawn from existing band house lists. One man and one woman (aged 19 or older) were invited to participate within each household. For Penelakut Tribes, 27 HHs of the initial 50 HHs randomly chosen were successfully contacted; 18 females and 13 males were interviewed. An additional 6 HHs were randomly sampled. Five HHs asked to be included and a further 6 HHs where heavy shellfish consumers resided were approached to participate. In total, 45 Penelakut community members completed a dietary survey and 31 agreed to complete both the dietary survey and blood tests to measure iron stores, kidney function and body burden of heavy metals. Below are presented in Tables 4 – 8, community profile and household information.

In Penelakut First Nation, there was a high non-response rate of 41%. Half of the non-response was due to an inability to find anyone at home over the data collection period (research assistants made 3 attempts by personal visit, as many homes do not have telephones, on different days and weeks). Reasons that were given for refusal to participate were a perception that they did not eat a lot of shellfish.

Table 5 Penelakut Population and Number of Individual Interviews

Community	Total Registered Population	Population on reserve	Number of individual interviews
Penelakut	805	451	45 (26 Females, 19 Males)

Table 6 Percentage of Adult Population Living on Reserves and Sample by Age Group (Using Statistic Canada's Age Groups)

Age Group	Penelakut Adult Population n=140	Penelakut Study Sample n=45
20-24	18	4
25-44	57	60
45-54	25	22
55-64	7	11
65-74	7	2
75-84	0	0

Table 7 Number of Penelakut Individual Interviews by Gender and Age Group

Age group	20-40	41-60	61+
Male	11	7	1
Female	13	13	0
Total	23	20	1

Table 8 Penelakut Community Sample Profile (Penelakut Island and Tsussie Reserves)

No of household units on-reserve	120
No. of households surveyed	**67**
No. of households randomly sampled	**56**
No. of households added (heavy consumers)	**6**
No. of households who asked to be included	**5**
No. of households who accept to participate	**39**
1 Participant/HH	33
2 Participants (male and female)	6
Non-response	**28**
Empty house/away	6
Refused	11
Not home during interview period	11
Household Response rate (HH participating/Eligible HH)	**58.2%**
Household participation rate (HH participating/contacted)	**78.0%**
No. of Interviews Completed	**45**
No. of individuals who completed both FFQ and blood tests	31
No. of individuals who completed FFQ only	14
No. of individuals who completed blood work only	1
No. of females who participated	26
No. of females who completed both FFQ and blood tests	18
No. of females who completed FFQ only	8
No. of males who participated	19
No. of males who completed both FFQ and blood tests	12
No. of males who completed FFQ only	7

Shellfish Consumption

In the following summary tables are presented the mean, minimum and maximum yearly shellfish intake for 8 species (Table 9-12). Data are presented for the consumption intake of the entire sample and for consumers only. Please note that these numbers are to be treated cautiously and serve as a guide for our risk assessment only rather than a true assessment of the average consumption of these species. We appear to have caught a variety of light, medium and heavy consumers in this survey but we cannot say with certainty that the average reported here truly is representative of the population given our small sample size and high non-response rate. People have repeatedly told us in community workshops and during the survey that they are not able to get what they need.

The average yearly consumption of oysters among this sample of Penelakut consumers was in excess of 8.9 kg with a maximum yearly reported intake of 72 kg. The data is skewed and 50% of people reported yearly intakes of oysters at 3.5 kg.

Harvesting of shellfish occurs year round, however more frequent harvesting occurs with the arrival of daylight tides in late spring and summer.

Table 13 describes changes in use and percent of sample who considered current availability adequate. These numbers reflect communities whose access to shellfish is severely constrained by limited access due to upland owners and beach closures. The majority of participants considered that current consumption levels of shellfish are inadequate. This is similar to what was found in a Harvest Study carried out in 5 Hul'qumi'num communities in 2001 (Fediuk, 2002). The median intake among people who are discontent with current levels appears is much lower than the amount of shellfish consumed by Penelakut participants who consider current shellfish consumption adequate. People were asked to explain why they were not using more shellfish. The top 5 reasons in ranking order given by Penelakut participants to explain why people (n=31) are not using more shellfish were:

- Closures
- Time/work
- Not enough shellfish
- Lack of equipment
- Not enough money to buy shellfish

Table 9 Penelakut FFQ (n=45) Yearly Shellfish Consumption (grams). Calculations from entire Sample, not just consumers.

	Oysters	Butter	Manila	Littleneck	Cockle	Horse	Mussel	Crab
Total amount Consumed	384111.60	169704.00	146982.10	25510.40	160920.00	214416.00	686.08	127785.60
Average Yearly Consumption	8535.81	3771.20	3266.27	566.90	3576.00	4764.80	15.25	2839.68
Standard Error of the Mean	2065.01	1369.82	845.31	391.63	1143.00	1813.05	7.00	963.36
Min	864.00	0.00	0.00	0.00	0.00	0.00	0.00	345.60
Max	72576.00	51840.00	25920.00	17280.00	25920.00	51840.00	245.76	31104.00

Table 10 Penelakut - Yearly Shellfish Consumption (grams) for Consumers only from FFQ

	Oysters	Butter	Manila	Littleneck	Cockle	Horse	Mussel	Crab
Total Amount Consumed	363251.00	169704.00	146982.10	25510.40	160920.00	214416.00	686.08	127785.60
Number of consumers	n=43	n=33	n=32	n=11	n=22	n=24	n=5	n=39
Percentage of Sample who Consumed Shellfish	95.5	73.3	71.1	24.4	48.9	53.3	13.3	86.7
Average Yearly Consumption	8922.78	5142.54	4593.23	2319.13	7314.54	8934	16.96	3276.55
Standard Error of the Mean	2143.56	1816.01	1108.88	1534.38	2072.89	3189.27	8.85	1096.47
Min	1512.00	864.00	252.00	102.40	468.00	540.00	24.00	518.40
Max	72576.00	51840.00	25920.00	17280.00	25920.00	51840.00	245.76	31104.00

Table 11 Penelakut FFQ (n=45) Yearly Total Shellfish Consumption

	Total Shellfish (grams)
Total amount Consumed	1230116.00
Average Yearly Consumption	27335.91
Standard Error of the Mean	5711.76
Min	288.00
Max	146722.60

Table 12 Penelakut Percentage of Sample (n=45) Consuming Shellfish and Frequency by Year and Season

	Total		Fall		Winter		Spring		Summer	
	Percentage Reporting Consumption	#/Year	Percentage Reporting Consumption	#/Season	Percentage Reporting Consumption	#/Season	Percentage Reporting Consumption	#/Season	Percentage Reporting Consumption	#/Season
Oysters	97.7	14.3	45	2.0	36	2.69	43	5.37	91	10.8
Butters	73.3	10.1	41	1.5	19	2.89	14	3.79	16	10.6
Manila	71.1	15.3	31	2.6	34	2.36	47	6.1	72	13.7
Littleneck	24.4	12.7	18	2	36.4	1.67	36.4	3.25	54.5	18
Cockle	22	8.9	18	2.5	9.1	1.5	6	4.83	90.9	13
Horse	48.9	13.2	21	4.4	25	2.83	29	5.71	75	13.2
Mussel	13.3	2	16	3	33	1	16	1	33	3
Crab	86.7	9.8	56	3.55	41	2.1	53.8	2.95	71.8	7.43

Table 13 Changes in Frequency of Shellfish Use among Penelakut participants

	Penelakut Change in Frequency of Use (n=45)	
	Participants who Consider Shellfish Level Adequate	Participants who Consider Shellfish Levels Inadequate
	14	31
Age Group		
20-40	11	13
41-60	3	16
61+		1
Gender		
Males	5	14
Females	9	17
Perceived change in consumption since 1995		
No change	4	6
Eat more now	9	5
Eat less now	1	19
Don't know		1
Median Intake	19901.76	6821.12

Shellfish remains an important contributor of nutrients in spite of the fact that intake is about ¼ cup a day (Table 14) and they contribute less than 10% of calories (Table 15) based on results reported for First Nation adults on reserve in the First Nations Food, Nutrition and Environment Study (www.fnfnes.ca) undertaken in 21 First Nation communities in 2008/2009 (Chan et al. 2011). Shellfish pack a mighty nutritional punch and are major contributor to protein, iron and zinc intakes. The intake from shellfish alone provide 99% of the Estimated Average Requirement for iron in the diet (Table 16). Shellfish remain critical for better health and prevention of iron deficiency especially in a population highly vulnerable to food insecurity and limited healthy food options.

In FNFNES, undertaken in 21 First Nation communities in 2008/2009, 1103 participants completed a dietary survey and dietary recall. FNFNES reported that the diet was inadequate but was more likely to meet nutrient needs n days when traditional food was present. It also found that 41% of households were food insecure (struggled to feed their families). FNFNES reported that the total energy intake on days with traditional food was 2018 kcal compared to 1833 kcal on days without traditional food intake. Overall, traditional food contributed about 9% of overall calories and was an important source of many nutrients including iron and zinc. In the FNFNES, clams and seafood contributed less than 5 grams/day among average consumers and less than 12 grams/day among heavy consumers.

While the study here did not directly measure food security, observations show a highly vulnerable population, struggling to afford food. It is evident that shellfish are acting as a critical buttress against financial and nutritional food insecurity. The data in the next section reveal however, that the population remain highly vulnerable to nutrient deficiencies (iron) in spite of the regular use of shellfish.

Table 14. Average Daily Intake of Shellfish by Penelakut members

Species	Grams/day
Cockle	16
Oyster	23
Littleneck	1
Butter	11
Manila	3
Horse	14
Mussel	0
Crab	8
Total	61

Table 15. Shellfish nutrient contribution for Penelakut participants

Nutrient	Penelakut
Energy (kcals)	137
Protein (g)	13
Fat (g)	6
Carbohydrate (g)	7
Fibre (g)	0
Cholesterol (mg)	59
Total SFA (g)	<1
Total MUFA (g)	<1
Total PUFA (g)	<1
Calcium (mg)	37
Iron (mg)	8
Zinc (mg)	9
Potassium (mg)	385
Sodium (mg)	129
Vitamin A (µg)	77
Vitamin C (mg)	8

Table 16. Percent of Estimated Average Requirement (EAR) or Adequate Intake (AI) Provided by Shellfish for Selected Nutrients

Nutrient	Penelakut
Carbohydrate (g)	7
Protein (g)	12
Calcium (mg)	3
Iron (mg)	99
Zinc (mg)	96
Sodium (mg)	9
Vitamin A (ug)	12
Vitamin C (mg)	11

Biochemistry -Iron Stores, Kidney Function, Cadmium Body Burden

In Table 17 - 20 are the summary statistics of the biochemistry data. Column headers include 'normal' levels for each of the lab tests. Ferritin levels ≥30 ug/L were considered normal as research has found that levels below 30 ug/L are correlated to increased absorption of cadmium. Thirty –two Penelakut members consented to providing a blood and urine sample and answering a brief health survey which included questions on smoking, age, height, weight, chronic disease.

Analysis reveals that the mean level of cadmium in urine in males and females combined is below 1 ug (normal), however the mean level of cadmium in urine is > 1ug/g creatinine for Penelakut females. The maximum level of cadmium in urine was 3.58 ug/g creatinine. Data reveal that this individual is a higher shellfish consumer. Preliminary analysis indicates that age is significantly correlated with cadmium (.382 with p-value =0.0057) in urine but not with cadmium from shellfish (.135 with p-value .344). A General Linear Model was run to test whether community, smoking, cadmium from shellfish, gender, ferritin, the interaction between age and smoking, and the interaction between community and each of the variables contributed to the cadmium levels in urine. Only age (p-value 0.0008 and gender (p-value .009) were significant. The fact that smoking was not a significant contributor to cadmium was unexpected, however data reveal that all participants were either currently smoking or had a history of smoking and exposure to second hand smoke.

Table 17 Penelakut Biochemistry (n=32) Male and Female Respondents Combined

	Ferritin ≥30 ug/L	Total Protein 60-80 g/L	Calcium 2.1-2.55 mmol/L	Creatinine 50-100 umol/L female	Creatinine 70-120 umol/L males	eGFR >=60 ml/min	U-Creatinine >=60 ml/min	Cd <1 ug/g creatinine
Geometric mean	32.70	73.10	2.29	67.01	88.41	91.14	6.73	0.77
Stdev	47.03	3.11	0.07	13.02	12.03	12.05	5.96	0.76
median	3	72	2.27	68.50	90.00	92.50	6.95	0.91
Min	8	68	2.18	38	72	69	0.70	0.06
Max	189	80	2.45	88	109	115	22.70	3.56

Table 18 Penelakut Biochemistry Female Respondents (n=18)

	Ferritin ≥30 ug/L	Total Protein 60-80 g/L	Calcium 2.1-2.55 mmol/L	Creatinine 50-100 umol/L female	eGFR >=60 ml/min	U-Creatinine >=60 ml/min	Cd <1 ug/g creatinine
Geometric mean	24.79	72.87	2.28	67.01	91.21	7.40	1.17
Stdev	27.02	3.43	0.06	13.02	14.85	4.78	0.77
median	23	71.5	2.26	68.5	92	7.40	1.21
Min	8	68	2.20	38	69	2.50	0.49
Max	104	79	2.42	88	115	19.60	3.56

Table 19 Penelakut Biochemistry Male Respondents (n=12)

	Ferritin ≥30 ug/L	Total Protein 60-80 g/L	Calcium 2.1-2.55 mmol/L	Creatinine 70-120 umol/L males	eGFR >=60 ml/min	U-Creatinine >=60 ml/min	Cd <1 ug/g creatinine
Geometric mean	47.97	73.41	2.31	88.41	91.02	5.83	0.41
stdev	60.29	2.76	0.08	12.03	6.86	7.63	0.53
median	44	73	2.32	90	92.5	6.1	0.38
min	10	70	2.18	72	80	0.7	0.06
max	189	80	2.45	109	100	22.7	1.89

Table 20 Summary Statistics for Cadmium in Urine Samples and Average Daily Intake from Shellfish

	Penelakut community	
	Urine Cadmium (ug/g creatinine)	Cadmium from Shellfish intake
Mean	1.05	45.51
Stdev	0.75	59.54
Min	0.06	0.94
1st quartile	0.48	8.78
median	0.91	20.39
3rd quartile	1.43	78.35
Max	3.59	243.74

Exposure to contaminants

In this study, all of the participants either smoked or previously smoked. Table 21 below illustrates the current daily intake from cadmium from the 8 shellfish species studied. If we are to assume that the average cadmium intake from all food is 14 ug, then currently Penelakut non-smokers are consuming 52 ug/cadmium per day which is close to the WHO recommendation of 55 ug/day of cadmium for adults.

Table 21. Cadmium intake from shellfish (ug/day)

Shellfish	Penelakut
Cockle	0
Oyster	32
Littleneck	0
Butter	1
Manila	1
Horse	2
Mussel	0
Crab	1
Total	38

PSP and Shellfish Illness

As part of the health survey people were asked about their experiences of shellfish illness. People were given a list of symptoms commonly associated with PSP (see Table 22) and asked to indicate the number of times they had experienced these symptoms and the year. People were also asked about other episodes of shellfish illness. A similar number of Penelakut and [redacted] participants in this survey reported experiencing at least 1 symptom of PSP. Tingling and numbness of lips were the two most commonly described symptoms. In both communities, more people had episodes of shellfish illness and symptoms that are commonly associated with viral or bacterial pathogens (abdominal pain, cramps, diarrhea). Members from both communities reported experiencing symptoms of PSP in 2004, 2005. In general, most Penelakut participants harvested their own shellfish and appear to have a greater confidence in the safety of shellfish than members from other bands, who reported having to rely on the 'good practices' of a small group of clam diggers.

Table 22 PSP and Shellfish Illness Episodes

Symptoms **Number Reporting and Year**	**Number of Penelakut Reporting 1 or more symptom of PSP (n=45)** 6 (2005, 2004, 2002, 1998, 1995, unknown)
Tingling on lip	5
Tingling of fingertip	2
Tingling on skin	0
Numbness of lip	4
Numbness of fingers	1
Hospitalization	0
Number of People Reporting Shellfish Related Illness	7
Symptoms Described	Abdominal pain, cramps, nausea, vomiting
Perception of Cause	Inadequate cooking of manilas, littlenecks, crab, restaurant

Table 23 Perception of Risk

	Penelakut (n=45)
Harvest Themselves	39
Buy from Harvesters	25
Concerned about PSP	26
Concerned about Shellfish Illness	21
Consumption has declined since 1995	18
Most Common Reasons for Reduced Consumption	Require more qualitative interviews to understand changes in use

Butter clams are the primary clam of concern with respect to PSP as they have a high cultural value and are closed year round due to PSP blooms. Due to their cultural importance, people continue to harvest and consume butter clams. According to traditional knowledge, the toxins from butters can be removed by forcing the clam to purge the contents of its stomach and by cutting off the edge or nose of the siphon. Many community members also indicate that they keep track of closure notices. Currently the official monitoring stations for the area surrounding Penelakut Island are located at Coffin Point and in Sansum Narrows. Community members perceive that monitoring at these locations is unreliable and are excited that CFIA has allowed an additional monitoring station at Big Rock.

Table 24 Common Practices to Reduce Risk of PSP

	Penelakut (n=45)
Remove siphon/stomach	28
Read and follow notices	14
Watch water	7
Observe if seagulls and crows are eating shellfish	4
Harvest in colder weather (winter, spring) not summer	2
Soak in fresh water for 2 days	1

Resources

This project created a suite of products for outreach to community members and children. We have printed limited copies of the manuals and posters. Our goal is to provide the Hul'qumi'num communities with copies and post these resources online for now, unless additional funding comes available to support their printing and distribution to interested bands.

Technical Manual

A technical manual (previously created for a smaller project for [redacted] and Penelakut First Nations) was revised and expanded. This manual is meant to be used by band technical staff and health staff to assist in understanding and communicating the benefits and risks related to shellfish use.

Poster

This project commissioned a poster by Aboriginal Healthy Network to promote continued use of shellfish as a good source of nutrition, link to continued cultural practices and the importance of relying on fisheries guardians or band technical staff to understand where and when it is safe to harvest.

Education Activities Manual

The education manual was created to support the technical manual and offer educators culturally appropriate education materials that would support skill and knowledge acquisition about the local environment. There are 4 activities: Who is a Happy Clam (laminated map and reusable stickers for children to identify local areas and local sources of contaminants); This is My Beach (activities to support hands on knowledge acquisition about beachlife); What is My Name (matching names of shellfish in Hul'qumi'num and English to their image); Is it Safe to Eat (Contacts and Questions to ask about Locally Harvested Clams).

Colouring Book

The PSP Colouring Book, previously created for a smaller project for [redacted] and Penelakut First Nations was reprinted and provided to children of both [redacted] and Penelakut bands.

Logo and Bags

As part of our outreach activities and to support awareness of the project, a logo and 200 bags were made. These bags have been distributed throughout Hul'qumi'num communities.

Conclusions

Nutrient Intake

Shellfish remains an important contributor of nutrients in spite of the fact that intake is about ¼ cup a day. Shellfish pack a mighty nutritional punch and are major contributor to protein, iron and zinc intakes. The intake from shellfish alone provide 99% of the Estimated Average Requirement for iron in the diet. Shellfish remain critical for better health and prevention of iron deficiency especially in a population highly vulnerable to food insecurity and limited healthy food options. There are a significant number of female participants (67% in Penelakut) who had serum ferritin less than 30ug/L, indicating high risk of iron deficiency. While the study here did not directly measure food security, clinical results and other observations show a highly vulnerable population, struggling to afford food. It is evident that shellfish are acting as a critical buttress against financial and nutritional food insecurity.

Risk Assessment

Cadmium

Except in oysters, Cd concentrations in all shellfish sampled were generally low (less than 1 ug/g). The average Cd concentration in oysters is 1.4 ug/g with the maximum concentration at 2 ug/g. Shellfish intake by Penelakut community members is 61 g/day). Oyster is the major shellfish species consumed. Estimated Cd intake from shellfish consumption in Penelakut is 38 ug/day. There is no significant correlation between body burden of Cd as measured in urine samples and Cd intake from shellfish consumption.

Clinical biochemistry data show no significant risk on renal function from shellfish consumption in both communities.

All species except for oysters pose no risk on cadmium exposure. Assuming a provisional weekly tolerable intake of 400-500 ug, it is reasonable for Hul'qumi'num members to consume up to 225 g (4-5 oysters) of local oysters on a weekly basis as our study found on average 1.43 ug/g of oysters. Consuming 225 g of local oysters/week would result in a cadmium intake of 46 ug/day. In Canada, the average intake of cadmium from all foods is approximately 10 ug/day. Together this level would approach 55 ug/day.

PSP

Consumer access to the bivalve shellfish resource is limited through a risk management perspective, primarily by CFIA. Unfortunately, the risk is assessed from the perspective of the broader, non-First Nations, culture and fails to account for cultural values, higher

use rates, and subsistence requirements. In addition, testing results and closures are poorly communicated to the general public. Monitoring is poorly understood, and where harvesters are aware of the program, there continues to be a lack of confidence in the information. As a result, First Nation consumers continue to experience a higher than average risk of illness due to consumption of shellfish contaminated with biotoxins.

Organochlorines

There are no detectable organochlorines in the shellfish sampled and therefore no risk of exposure.

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