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12,000+ Years of Change: Linking traditional and modern ecosystem science in the Pacific Northwest[1]

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ABSTRACT

Recent archaeological evidence documents that people lived on the Pacific Northwest coast at least 12,000 years ago. As the ice retreated, some 10,000 stocks of salmon colonized 3,600 rivers and streams in what is now British Columbia. Over the same period, First Nations developed sophisticated political and legal systems linked to resource management and harvest technologies. This social and cultural richness has so far been ascribed to the year round availability of abundant natural resources. Recent research indicates that First Nations contributed to the spread of salmon throughout the Pacific Northwest and to increasing the complexity of habitats throughout their extensive tribal territories. This in turn, created a more stable food supply contributing to social and cultural development. This has significant implications for the 'new' science of ecosystem management. The interdependence of human communities and the ecosystems that sustained them for 1000s of years is central to a new 'ecosystem philosophy' grounded in creative and restorative justice. We explore how First Nations' traditional knowledge and values and new ways to integrate the piecemeal knowledge accumulated over the 19th and 20th centuries can build a greater collective understanding of natural and human-induced ecological change and build support for ecosystem restoration goals based on levels of productivity enjoyed by Aboriginal peoples at the time of first contact with Europeans.

[1] Originally presented at 2004 Society for Ecological Restoration International conference, Victoria BC, August 24, 2.30PM.

Dedication

We would like to dedicate this paper to the late Percy Walkus of Wuikinuxv Nation, friend and teacher of Nigel Haggan and to the late Cyril Carpenter of the Heiltsuk Nation in recognition of their dedication to traditional ethics of stewardship and commitment to conserve and restore past abundance. In the hope that this brief glimpse into the past will lead to a shared journey of exploration into the full extent of their stewardship of the Central Coast of BC.

12,000 Years of Change: Linking traditional and modern ecosystem science in the Pacific Northwest

Introduction

This paper focuses on the pivotal role of salmon in shaping culture and landscape and introduces examples of the conservation and enhancement of other species. The term 'stewardship' used by Jones (2002) encompasses a spectrum of marine and terrestrial resource management and enhancement activities. Stewardship is based in culture and belief and is informed by traditional ecological knowledge and wisdom. The validation of First Nations' stewardship requires that two assumptions be addressed and questioned. First, that year-round abundance was so great that pre-contact people could gather up whatever they needed without effort. Second, that there were too few people to affect the 'inexhaustible' resources encountered by the first explorers.

The summary presented of First Nation stewardship of Pacific salmon and other resources draws on significant multi-disciplinary research by and with the Heiltsuk Nation in the central coast of BC, (Carpenter *et al.* 2000; Jones 2002) research into Tsimshian Nation stewardship and selective fishing technology (Menzies and Butler *unpublished manuscript*[2]) and examples of salmon, marine and terrestrial resource stewardship from numerous other First Nations. The weight of evidence supports a largely theoretical economic analysis of the success of First Nations at managing salmon in the Pacific Northwest compared with other early peoples who depleted or exterminated resources (Johnsen 2001). Johnsen's conclusion, that the US and Canada should outlaw saltwater fisheries and return to a terminal harvest system is considered in light of current recommendations on the salmon fishery (McRae and Pearse 2004) and suggestions of transferring access from large corporations, primarily, but not exclusively to First Nations in the interest of conservation, social justice and economic benefit (Haggan and Brown 2003).

> *'I could not possibly believe any uncultivated country had ever been discovered exhibiting so rich a picture. Stately forests... pleasingly clothed its eminences and checquered its vallies; presenting in many places, extensive spaces that wore the appearance of having been cleared by art'.*
> (Captain George Vancouver 1798: 227-229, cited in Lutz 1995).

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Lutz (1995) notes that Captain George Vancouver who mapped the west coast in the 1790s omitted native villages from his otherwise meticulous charts and that James Douglas later chose Victoria as the site for the Hudson Bay Company fort and colonial capital because the open country resembled English country estates. The landscape he found so appealing was, in fact, the result of landscape burning and long cultivation by the Coast Salish people. Human influence on landscape has long been acknowledged on the east coast of North America (Cronon 1983). Lutz (1995) and others (Boyd 1999; Pyne 2001) show how indigenous people managed the landscape of southern British Columbia Could the same be true of the wild, wet, wilderness of north and central BC?

Social sophistication is normally associated with the ability to store surplus production from agriculture and so support bureaucrats, armies, doctors, clergy, lawyers, economists, bankers, scholars and other necessities of civilized life. The complex societies and rich artistic traditions of Pacific Northwest tribes are seen as a 'one off' case, where the superabundance and year round availability of natural resources enabled a stratified society to arise with seemingly little effort. This paper challenges the myth of abundance and leisure by collecting evidence suggesting that the 'inexhaustible' resources described by early explorers were, to a surprising extent, the result of active management and enhancement of multiple resources (Johnsen 2001; Jones 2002; Deur and Turner 2005). In short, the 'wilderness' described was no such thing. Individually, the cases are suggestive. In aggregate, they make a compelling case for further research. The fisheries, in particular, need further examination.

Similarly, the notion that the first people crossed a land bridge from Siberia and migrated down an ice free corridor, while the coast was locked up in ice, is being challenged (e.g., Dixon 2001, 2002; Hetherington *et al.* 2004; Jackson and Wilson 2004). The competing view suggests the early coast was dotted with glacial refugia throughout the last Wisonsinan glaciation, much like modern Greenland, with green tundra-covered headlands and coastal plains backed by glaciers. Undoubtedly, in some places the glaciers reached the sea, just as they do today in eastern Greenland, but there is compelling archaeological evidence that there were enough ice free regions to support fairly diverse faunas (Heaton *et al.* 1996; Mandryk *et al.* 2000). Current evidence indicates that the coastal corridor was open for human traversal by at least 13,500 BP (Hetherington *et al.* 2004; Lacourse and Mathews 2005, Ramsey *et al.* 2004). Sea level is now 120 – 150 m higher than the ancient coast; so much evidence would now be found underwater (See Figure 1).

The early coastal habitat could be quite suitable for salmon. Pink salmon (*Oncorhynchus gorbuscha*), chum (*O. nerka*) and coho (*O. Kisutch*) in particular are extremely opportunistic in their use of spawning habitat and pink and chum have relatively short freshwater residency (Mike Healey, University of British Columbia Fisheries Centre *pers. comm.*). Salmon have been shown to rapidly recolonize tectonically uplifted areas in Alaska (reviewed in Mackie and Sumpter 2005) and to have been present during rapid sea level rise in Haida Gwaii (formerly known as the Queen Charlotte Islands), as discussed below.

A pollen record at Cape Ball on NE Haida Gwaii extends back to ~19,000 calendar years before present (16,000 radiocarbon years[3] (rcyBP) (Lacourse and Mathews *in press*), with the best evidence suggesting a non-forested terrestrial plant ecology including herbaceous plants, sedges, grasses and mosses. Until recently, the Cape Ball evidence was interpreted as an early postglacial environment that may not have been very productive. However, recent, preliminary analysis of early post-glacial bear bones recently

[3] For explanation of the relationship between radiocarbon years and calendar years, please see http://www.geotimes.org/feb04/feature_Revisited.html (Hetherington and Jackson - box in Jackson and Wilson 2004).

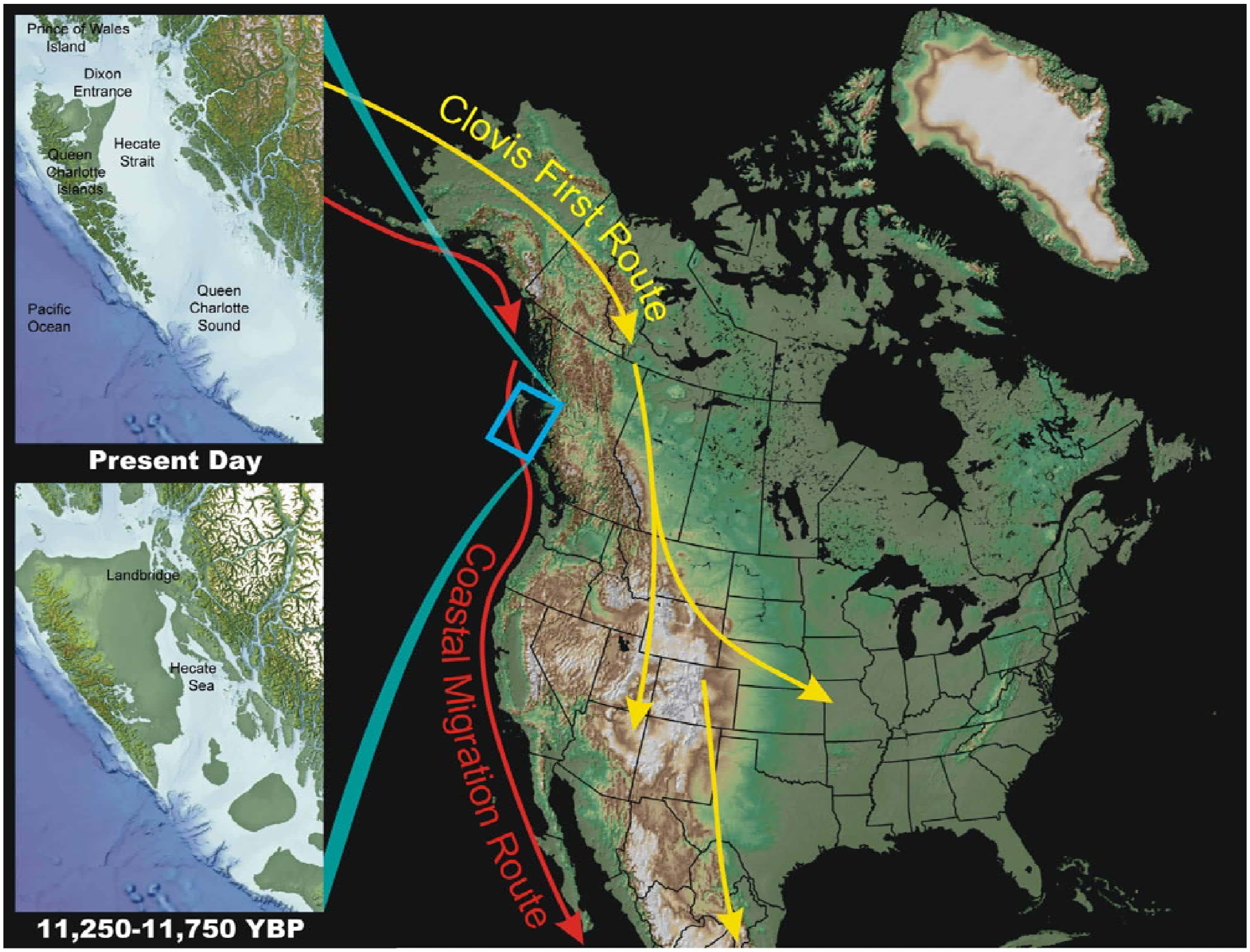

Figure 1: Map of the north and central coast of British Columbia showing configuration of the Haida Gwaii/Hecate Strait area today and between 11,250-11,750 BP (Hetherington *et al.* 2004).

discovered in Haida Gwaii, reveals that their diet was largely terrestrial, at least by 13,000 BP (11,000 rcyBP). The two oldest specimens, dated to between 17,350 and 14,060 BP (14,500 and 12,000 rcyBP) show a delta-13C signature consistent with a somewhat more mixed terrestrial-marine diet (Fedje *et al.* 2004a). The younger of those two specimens is confirmed as brown bear, a species not previously known to have lived on Haida Gwaii (Fedje *et al.* 2004a; McLaren *et al.* 2005; Wigen 2005).

Behavioural differences between black and brown bears may account for temporal differences in isotopic signatures, a pattern which has been noted in southeast Alaskan limestone caves which contain diverse faunal remains spanning at least the last 50,000 years (Heaton and Grady 2003).

The combination of ice free areas, salmon and other fish and seafood resources (Hetherington *et al.* 2004) supports a growing scientific consensus that human migrants to North America may have come by sea down the coast[4]. The fact that the Heiltsuk words for ‘ice’ and ‘shore’ have the same root is intriguing. The earliest generally-accepted record of human habitation in the Americas is 14,850 BP (12,500 rcyBP) from the Monte Verde site in Chile. This site predates the earliest opening of the ice-free corridor at around 13,000 BP (11,000 rcyBP) (Jackson *et al.* 1997). Numerous sites in the 12,200 to

[4] First Nations histories, while they document human movement across the land, do so from the perspective that people have been here since before Raven brought light to the people – Charles Menzies.

13,530 BP (10,500 to 11,500 rcyBP) range are found in coastal California and coastal Peru (see Fedje *et al.* 2004b), suggesting that if people had come down a coastal corridor from Northeast Asia, that they were on the Northwest Coast considerably earlier.

However, even early coastal colonizers would have exploited upland resources. The earliest known evidence of human habitation on the NW coast consists of two spearpoints found in a limestone cave on Haida Gwaii dated between 12,300 to 12,900 BP (10,400 to 10,900 rcyBP) (Fedje *et al.* 2004, Fedje *in press*). At this time sea level was about 60 m lower than today and the cave would have been about 8 km from the ocean, much more than it is today. Salmon bones from another cave in southern Haida Gwaii have been directly dated to 10,500 rcyBP and contextually dated to over 12,000 rcyBP (Fedje *et al.* 2004). The latter date would calibrate to ca. 14,500 BP (Daryl Fedje Parks Can and Quentin Mackie, Coasts Under Stress pers comm.). The earliest definitive evidence for human use of salmon is found at the Richardson Island site in southern Haida Gwaii, where burnt salmon bones have been found along with other marine taxa in a series of hearths dating to ca. 10,450 BP (9200 rcyBP) (Mackie *et al.* 2004). On the Fraser River, the Milliken site near Yale is situated at rapids in the river conducive to netting salmon, and is highly suggestive of human use of Fraser salmon. The earliest dates on the Milliken site are about 11,000 BP (9700 rcyBP) and the site was continuously occupied throughout the Holocene (Mitchell and Pokotylo 1996).

On the Columbia, archaeological evidence suggests humans were exploiting salmon by at least 9,000 years ago at the Dalles (Butler and O'Connor 2004). Salmonid bones dating to between 17,940 to 21,390 BP (15,000 and 18,000 rcyBP) have also been found at Lake Kamloops in the BC interior, with unknown, but likely profound implications for the history of salmon on the Fraser-Columbia Plateau (Carlson and Klein 1996), while pre-glacial salmon are known from the Nootka sound area. Human occupation of Namu in Heiltsuk Nation territory on the central coast has been traced back to 11,200 BP (9700 rcyBP) (Cannon 1991), while nearby sites have produced dates as early as 11,300 BP (9990 rcyBP) (Cannon 2000). It is thought that earlier traces may have been erased in the time it would take for clamshells to accumulate sufficiently to neutralize the soil and so preserve artifacts.

Most tantalizing of all is the interpretation of submerged landscapes to predict the likely sites for earlier habitation. High resolution swath bathymetry in Juan Perez Sound on Haida Gwaii mapped an intact postglacial terrestrial landform dating between 9500 and 12,500 BP (Figure 1). On this landform numerous terrestrial plant macrofossils have been found, including a rooted spruce tree in growth position at 55 m below sea level dating to 12,200 BP (10,500 rcyBP), and a pine tree in similar context at 143 m below sea level dating to 12,500 BP. Dredging on a submerged river terrace 53 m below sea level, which appeared suitable for an ancient camp site, recovered a single stone tool, probably used as a knife (Fedje and Josenhans 2000). While this tool could have fallen from a canoe, it must have been done in ancient times as it is stylistically from the early Holocene at least. Its presence at a likely camp site is also suggestive of actual human occupation of this ground surface which was last exposed to air about 11,700 BP (10,200 rcyBP).

Salmon, an ecological and cultural keystone species

While we do not know for certain when people or salmon first arrived in the Pacific Northwest coast, we do know that people and some salmon stocks were established before sea levels reached modern levels and all ice had retreated from the mainland. In the last 13,000 years, many thousands of stocks of Pacific salmon and sea-run cutthroat trout colonized the lakes, rivers and streams. Slaney *et al.* (1996) estimated some 9,700 stocks in 3,600 rivers, lakes and streams in British Columbia and the Yukon.

This is certainly an underestimate as it does not account for some 40% of small stocks that would have been driven to extinction in the early days of the commercial fishery (Prof. Carl Walters, UBC Fisheries Centre *pers. comm*.). The entire range and scope of First Nation societies and rich cultures, and the entire rainforest ecosystem came into being. Recent work shows a vital link between marine nutrients from salmon carcasses and enhanced growth and productivity of trees and wildlife for as much as 1 km back from the banks of salmon-bearing streams (Reimchen 2001; Stockner 2003; Watkinson 2001). Salmon are thus an ecological keystone species (Paine 1969; Power *et al.* 1996). The link between land and ocean that the salmon represent, described, in recent research is much more simply and eloquently captured in the First Salmon ceremony (Claxton and Elliott 1994; Bouchard and Kennedy 1983; Hill-Tout 1978; Gunther 1926 and 1928; Swezey and Heizer 1993). Each year, returning salmon are welcomed, consumed at a feast, and the bones and inedible portions returned to the stream, while the rest passes, sooner or later back to the land.

Salmon are also a cultural keystone species (*sensu* Garibaldi and Turner 2004) in that they are vital to the existence and identity of Aboriginal people and a major conduit for the intergenerational transfer of traditional knowledge and values. If it can be shown that Aboriginal people contributed to the presence and abundance of salmon, this would suggest that the fish, forests and wildlife of the Pacific Northwest may have been as dependent on Aboriginal people as people were on them.

The 'First Generation' stories in which ancestors linked to the spirit world interact to create salmon take on a whole new meaning (e.g. creating lakes and rivers, carving alder bark into the shape of small salmon) and throwing these into the sea at the mouth of the river, as in the following quotes from the Heiltsuk Ts!u'mqakaqs story of one of the four children of the ancestress of the Wolf clan at Hauyat, Hunter Island (Boas 1923:33-41, cited in Carpenter et al. 2000:24):

> ‘*Now..you shall become sockeye salmon. Every season you shall come to be caught by my Mother's people.’*
>
> And,
>
> *‘Now I have made a lake in the woods and a river that runs out of the lake to which I gave the name [TEnk.e]. Then I made many sockeye salmon to go up the river and I built a salmon trap which I know is full now.’*

The name *[TEnk.e]* has been translated as referring to the sound lots of salmon make in the river (Basil Carpenter, Heiltsuk Nation, *pers. comm*.). Sound is often cited as an indication of abundance. The Nuu-chah-nulth name for La Perouse Bank on the west coast of Vancouver Island means the sound of halibut slapping their tails on the surface (Lucas 2004). Tribal Elders interviewed by Russ Jones of the Haida Nation tell how they used to be kept awake at night by the roaring of sea lions and the sound of killer whales pursuing vast shoals of herring through Burnaby Narrows (Jones 2000 and *in press*).

When was the wilderness?

Jones (2002) paints an exciting picture of the coast, relieved of the enormous weight of ice 5,000 years ago, ‘bounding with isostatic uplift’, ‘like a log-barge relieved of its load’. Small wonder that salmon, finding their way up wild, new rivers charged with meltwater and cedar trees that started to arrive on the BC coast about 5,000 years ago took on the aspect of supernatural beings. Now that *was* a wilderness! Jones (2002) explores the predominant idea of ‘wilderness’ as something unchanged by human agency, and its persistence in slogans such as 'Supernatural BC' and 'Great Bear Rainforest' adopted by NGOs to win support for conservation. The wilderness designation supported the idea of '*Terra Nullius*' or empty land ripe for 'discovery' and development' (Jones 2002 and references therein).

Pacific Salmon

As noted above, the number of salmonid stocks prior to commercial fishing might have approached 14,000 (Carl Walters, UBC Fisheries Centre, *pers. comm.*). Today, with some 9,500 remaining (Slaney *et al.* 1996), 50% of the commercial catch by weight and some 70% by value, comes from 8 sockeye stocks (5 Fraser, 2 Skeena and Rivers Inlet, now in deep trouble). The distribution of First Nation reserves throughout the coast and interior mirrors a pre-contact fishing pattern radically different from the present day commercial fishery that takes place in saltwater and estuaries (Harris 2001).

Given their much higher productivity, harvesting Fraser and Skeena sockeye stocks at a rate that is sustainable for them will over-harvest smaller and weaker stocks migrating at the same time. Fishery closures to protect smaller stocks account for the annual fury of commercial fishers who have to remain tied up while tonnes of sockeye swim by. This can only get worse, McRae and Pearse (2004) note that precautionary management dictates a reduction from a previous harvest rate of 75-80% to 45%. The option of reverting to terminal fisheries is resisted by the processing industry who have a huge investment in canneries and fishplants geared to the saltwater fleet, and the utter conviction of both processors and commercial fishers that the only marketable salmon is one caught in the saltwater. The Pacific salmon fishery is thus a triumph of 19th century technology and a failure of the imagination[5].

Biodiversity in general and the diversity of Pacific salmon stocks in particular, is an insurance against catastrophic failure of individual stocks or stock complexes. Hilborn *et al.* (2003) note that the complex of sockeye salmon stocks that sustains Alaska's Bristol Bay fishery today is quite different from the complex that sustained the same fishery 20 years ago.

Precontact Population and Salmon Consumption

Jones (2002) reviews pre-contact population estimates ranging from 100-400,000 and the methods used to arrive at them. He concludes that Hebda and Whitlock's (1997) figure of 300,000 is reasonable, but notes that academic estimates are 'almost always conservative'. Gordon Hewes (1947 and 1973) calculated that average annual consumption of salmon near the beginning of the 20th century was still about 250 kg even though many were already consuming foods previously unavailable such as flour, rice and potatoes. This is very close to an 1879 estimate of 500 lbs (227 kg) by Canada's Department of Marine and Fisheries (Canada 1880) and may well be an underestimate. Newell (1993) reports that 'boat brigade crews' during the fur trade consumed 9lbs (4 kg) of salmon per day, so would have gone through 230 kg in two months. Both estimates are likely to be well below pre-contact requirements, considering the harsh BC winter and the fact that chum salmon, most suitable for preserving, have the lowest caloric value (Jones 2002).

Rounding the Marine and Fisheries' estimate up to 230 kg (still below Hewes' conservative figure of 250 kg), a population of 200-300,000 would have required 46-69,000 t an amount that brackets the

[5] The extraordinary success of the Alaskan Copper River Fishery, where Copper River sockeye command a premium price compared to the pennies offered to US and Canadian fishers for their sockeye is just one example of what could be done.

1901-2000 average commercial catch of 64,000t with no allowance for spoilage, food for dogs and bait (Jones 2002). Yet, today's commercial catch is deemed to be 'unsustainable' (McRae and Pearse 2004). We also have to bear in mind that today's salmon fishery preferentially targets sockeye, chinook and coho. Chum and pink command such a low price that fishing for them is often not economically viable[6]. Contrast this with the probable pre-contact preference for chum because the lower oil content made them easier to preserve and later run timing required less storage for winter food. The enormous abundance and small size of pink salmon may also have made them desirable for preservation. This goes to the 'failure of the imagination' argument. First Nations throughout BC make a stunning variety of recipes and staple foods from salmon. The Hagwilget people were less than enchanted with canned salmon provided by DFO in compensation for dynamiting their only fishing station in the interests of conservation (Haggan and Brown 2003).

Given that salmon productivity was subject to ocean conditions beyond their control, it made sense for Aboriginal people to conserve and enhance a 'portfolio' of resources. The diversity of salmon species and stocks contributed to the diversity of the portfolio, but not sufficiently to ensure survival. Other resources were needed.

Ownership as a Precondition of Stewardship

Ownership, or security of tenure, is an essential precondition for the successful management of natural resources. We use the term 'stewardship' to represent the synergy between access rights, management responsibilities and the traditional ecological knowledge and wisdom resulting from 1000s of years of interdependence. Building and maintaining the infrastructure for First Nations harvest and management was arduous. Skilled hydrological engineering was needed to enhance spawning and rearing habitat by creating back eddies for fish to rest (Evelyn Windsor, Wuikinuxv Nation and John Bolton, Heiltsuk Nation, cited in Jones 2002) or directing a flow of freshwater to flush silt and oxygenate spawning gravel. Writing in 1947, BC Fisheries Inspector Charles Lord drew attention to a serious situation in Rivers Inlet where the Machmell River was about to break through into the nearby Genesee with potentially dire consequences for sockeye salmon. He was unable to secure resources for a repair, but found on his return, that a number of trees had been felled into the river at precisely the right place to create a back eddy and deposit material to reinforce the weakened bank, according to Lord 'a most impressive repair' (BC Archives 1947 cited in Jones 2002).

Salmon and eulachon fisheries required a great deal of preparation. Early fisheries officers noted and made regular use of access trails that had been constructed beside salmon rivers. These trails had to be cleared annually of fast growing undergrowth (Jones 2002). Cyril Carpenter of the Heiltsuk Nation (cited in Jones 2002) reported that it took a crew of 12 people two weeks to clear logjams on one creek and 5½ days to clear 300 yards on another after a period of neglect since DFO took over management.

> *'Our ancestors knew this, they saw this and they were part of the manpower that kept all these rivers clear so they could guarantee that the salmon would come back. They had a farming system in place. . . . I was always told by the old people that we have to look after the river.'*
>
> Cyril Carpenter, Heiltsuk Nation, in Jones (2002)

[6] In fact, the United Fishermen and Allied Workers Union mounted a fishery on pink salmon for the food bank (John Radosevic, UFAWU President, *pers. comm.*)

Sometimes the situation required a heroic response. Turner (2005) draws on Laforet and York (1998) in a vivid retelling of how the Nlaka'pmx Nation saved the Fraser River sockeye from extinction after the Spuzzum rockslide of 1913 and the even more serious Hell's Gate slide of 1914 blocked passage to returning spawners:

> *'The Nlaka'pmx men, who understood the peril to not only themselves but also to all the nations upriver in both the Fraser and Thompson drainages if the salmon were prevented from continuing on their journey, built a long rickety wooden flume around the worst stretch of white water. Then they carefully dipnetted the salmon from below and carried them in buckets and baskets to the flumeway so they could proceed upriver.'*
>
> *'There'd be no Adams River sockeye run to enthrall tourists and school kids every fall if those long-dead aboriginal men hadn't set up their frantic bucket brigade to save the Fraser River's salmon 86 years ago'.*
>
> (Hume 2002)

Consider that all this prevention and maintenance work had to be done *before* any fishing could take place. The fishing technology itself, e.g. the very large and complex stone fish traps of the central coast (Carpenter *et al.* 2000) and the Babine Barricades (Harris 2001) required a lot of engineering and labour to construct and maintain. The technology was so powerful that a great deal of restraint had to be exercised to ensure that sufficient fish got through to spawn. Maximizing the productivity of salmon runs also required detailed knowledge of salmon biology and genetics. The following examples indicate the depth and geographic scope of stewardship as practiced in the Pacific Northwest.

Heiltsuk Stewardship and Fishtraps

> *'In the context of worldwide resource failures, and seemingly of western management systems, some attention is shifting toward more detailed and respectful understanding of Indigenous (non-western) systems of resource management'* (Carpenter *et al.* 2000).

Carpenter *et al.* (2000) is notable as a multi-disciplinary approach to fishtraps that included a substantial traditional ecological knowledge (TEK) component. The approach to TEK is novel and thorough, starting with explanations of some of its unique characteristics and complexity. TEK is, 'Encoded in distinctive forms of communication and social customs, and is highly specific to local environments and ecosystems' (Cruikshank). To begin to access and communicate this from a western perspective requires a multi-disciplinary approach that combines tools of linguistics, archaeology, history, archival research, GIS, ecology and Heiltsuk 'Intuition' with respect to interpreting physical remains and reconnecting with knowledge inherent in ancient practices (Carpenter *et al.* 2000).

The addition of 'Heiltsuk intuition' is insightful, as the past casts a subtle but pervasive light on the gestalt of belief, culture, knowledge and practice of Heiltsuk stewardship that cannot be perceived by someone raised outside the tradition. The dialectic here is with archaeologists and other scientists, who need to acknowledge that oral traditions and local empirical knowledge are valid parts of scientific inquiry, which, when combined with of archaeology and other disciplines, can provide and enrich insights into past history that would otherwise be limited by their academic training and cultural constructs. 'Heiltsuk intuition' in interpreting 'physical remains' comes from a number of quite concrete contributions: the likelihood of having physical features such as fish traps pointed out to them when out fishing, food gathering, etc., with elders, observing salmon habits throughout their life; what species run where and when, how they behave in this bay or channel as opposed to another, what they taste like, how well they preserve per species, still harvesting the same resources in the same places / areas as ancestors as evidenced in ancient midden remains, a community and tribal history of communal works, leadership requirements, that would lead Heiltsuk to intuit how ancestors might have organized to construct and maintain fish traps, strategies for intergenerational transfer of knowledge, to name but a few. Returning to collaborative research, it is the synergy or 'critical mass' when different knowledge systems communicate, after decades of silence or conflict that leads to quantum jumps in knowledge. The juxtaposition of 'Heiltsuk intuition' with 'ecosystem science' is no accident.

Stone fish traps in Heiltsuk territory have been researched by Apland (1974), Hobler (1968; 1977; 1988), Pomeroy (1976;1980), Millennia Research (1997), Jones (2002), Carpenter *et al.* (2000) and are the subject of ongoing research by the Heiltsuk Cultural Education Society (HCEC) and of a SFU Masters programme in archaeology by Heiltsuk Nation member Elroy White. Pomeroy (1976) reported 109 traps and by 1980 reported 140 traps. Millennia (1997) raised the total to 214. The multi-disciplinary approach of Carpenter *et al.* (2000) raised the number to 230, distinguishing the central coast as having the highest concentration of stone fish traps on the Northwest Coast. One quarter are close to middens, although documentation of middens has not focused on fishtraps. It is therefore likely that closer scrutiny of middens and further multi-disciplinary research will increase the number.

We note here that while some stone fishtraps incorporated stakes and woven panels, others like the Babine Barricades (Harris 2001) relied on stakes driven into the river or lakebed and woven panels. Some, in high-energy river environments may have disappeared without trace (Carpenter *et al.* 2000). It is also notable that fishtraps are not limited to known salmon streams, but are found in bays and on periodic streams. Some however will be diagnostic of salmon presence at an earlier time in streams no longer bearing salmon (Carpenter *et al.* 2000). We note here that Slaney *et al.* (1996) document 142 stocks known to have gone extinct. Research into coho stock genetics in Heiltsuk territory by the Raincoast Conservation Society also indicates the presence of significantly more stocks than listed by DFO (John Nelson University of Victoria, Department of Biology, *pers. comm.*).

Figure 2: Intertidal Fish Trap at FaSw3 [Evans Inlet, King Island]. Anthony Pomeroy photograph collection, Department of Archaeology, Simon Fraser University.

Linguistics provide interesting insights. The Heiltsuk word for "story, legend, history" is *nuyem*; this has the same root as the word for 'glacier' *nuyemma* (Lincoln and Rath 1980:122; Rath 1981:444). Consider also the following from a 'first generation' story about the origin of the Killerwhale Clan of the Nulawitxv Heiltsuk (Farrand 1910):

'In the beginning there was nothing but water and ice and a narrow strip of shore-line'

Carpenter *et al.* (2000) note that the Heiltsuk word [Ckva'] translates as 'salmon weir made out of stones on the beach (Rath 1981:198), see Figure 2, while [Gvu'la'yu] translates as 'salmon trap in the creek' (Rath 1981:258). Interestingly, [gvu'la'yu] shares the same linguistic root as [gvu'lhla'] "gathering and preserving staple food; gathering and smoking salmon" (Rath 1981:258). For more discussion on the information content of First Nation terms relating to fisheries see Jones (1999), Jones *et al.* (2001) and Watkinson (1999).

Jones (2002) conducted his University of Victoria School of Environmental Studies masters research on traditional Heiltsuk management of salmon and salmon streams in collaboration with the Heiltsuk Cultural Education Centre, with the permission of the Heiltsuk Tribal Council by means of a formal research agreement between the University of Victoria and the Heiltsuk Nation. His research illuminated the pivotal role of stone fish traps and a wide range of traditional Heiltsuk enhancement strategies in salmon stewardship. The collaboration raised important questions of research ethics and research design that are addressed in Jones (2002) and Carpenter and Turner (1999). The result of this exploration has profound and beneficial implications for future collaboration between First Nations and universities. One major recommendation is that best efforts be made to provide First Nations with complete information on past and present management activities by outside agencies in their traditional territory. This is not just as a *quid pro quo* for knowledge of First Nation management, but as a major mechanism for increasing the sum of knowledge and resource management capability.

The Glenrose cannery site on the Lower Fraser River contains the oldest dated fishing technology within the age range of 4,450 and 5,200 BP (3950 to 4590 rcyBP) (Bernick 1998:182). Moss and Erlandson (1998:189) reported dates of 4,490 BP (4,000 rcyBP) for SE Alaskan sites. Mobley and McCallum (2001:28) documented a unique combination of wooden features with stone wall alignment also in the Southeastern Alaskan region. They radiocarbon dated wooden stakes within the age range of about 1000 to 2300 years ago. Carpenter *et al.* (2000) conclude that, 'It is probable that weirs will eventually be found and dated to the late Pleistocene or early Holocene epochs, which would be in accord with the First Generation stories.'

1n 1996, Heiltsuk divers Mitchel Vickers and Ross Wilson found a stone alignment '10M below sea level' (Jones 2002). Further description of location and configuration is desirable to determine , also based on sea level or C14 if it could be determined that the stone alignment was intended to serve as the foundation for a wooden weir.

Many studies assume that the target species for all fish traps is salmon. Literature reviewed in Carpenter *et al.* (2000) indicates that stone rock alignments on the Northwest Coast have been associated with a range of marine species from small fish such as herring (*Clupea pallasi*) and and eulachon (*Thaleichthys pacificus*) to sea mammals such as dolphins (Delphinidae) porpoise (Phocoenidae) and seals (Phocidae) and secondary target species. Monks (1987) proposes a "prey as bait" explanation for a range of species represented in the midden associated with a herring trap at Deep Bay. These include sea lion (*Eumetopias jubatus*), seal (*Phoca vitulina*), greater scaup (*Aythya marila*), bald eagle (*Haliaeetus leucocephalus*), gulls (Laridae), ducks (Anatidae), herring, salmon (*Oncorhyncyhus* spp.), dogfish (Squalidae) and lingcod (*Opohiodon elongatus*), all predators of herring and herring spawn.

Anderson (1996) notes that pre-contact indigenous technology was fully capable of wiping out natural resources many times over, and did so from time to time at a local level (see also Johnsen 2001, Jones 2002, Trosper 1998, 2003). He proposes that long before contact, coastal societies evolved strategies to mitigate against over-harvesting, and suggests, for example, that stratified social organization:

> *"…seems to have been a cultural elaboration on the requirement of salmon management. Salmon had to be conserved. Except for the groups at the lower reaches of the large rivers, fishing out a stream could be done quite easily with Native technology. Human populations were high enough, and lavish enough with their fish (at potlatches and feasts), to decimate the smaller stocks of salmon and other anadromous or freshwater fish. There were few great rivers and hundreds of small streams…Many myths ward against the evils of too-efficient weirs, and the like"*
>
> (Anderson 1996)

Traps share challenges with modern technology. They are very efficient at catching fish, but someone has to be in charge. The knowledge and work involved in trap construction and operation has led some authorities to consider that trap construction and operation may well have had a reciprocal effect on social organization (Carpenter *et al.* 2000, Johnsen 2001; Jones 2002).

The startling conclusion is that these traps are not just museum pieces, but bear witness to a viable culture with a sophisticated system of resource management, as or even more important in today's context of increasing commercial fishing and other anthropogenic pressure and environmental threat (Lackey 2001; 2003; Welch *et al.* 1998).

Community-based Use and Gitxaała (Kitkatla) Conservation Principles

During the last two decades, the resource management value of TEK systems has been increasingly recognized as a way to counteract resource management failures. One of the major failures of twentieth century fisheries management has been the lack of attention to long-term effects of industrial resource extraction. TEK has the potential to be a crucial tool in efforts towards both long-term sustainability and immediate resource conservation. TEK provides a storehouse of knowledge, not always easily assessable, but important in making sense of long term historical processes (Menzies *in press*; Nadasdy 1999). Fisheries scientists have begun to see considerable value in integrating fisher's knowledge with biological science (Haggan *et al.* 2003).

TEK can positively inform resource management because sustainability and conservation are inherent to traditional harvesting (Osherenko 1988; Kuhn and Duerden 1996). Furthermore, because TEK is locally developed and oriented, it provides highly specified and detailed information that can create more appropriate and successful management systems (Ruddle 1994, Neis *et al.* 1999; Berkes 1999). TEK is associated with a long history of resource use in a particular area (Berkes 1999; Inglis 1993; Johnson 1992) and is thus the cumulative and dynamic product of many generations of experience and practice. The value of TEK is located in its historical and local nature, providing an alternative to dominant management structures which are relatively new, externally-formulated, and rarely site-specific.

While TEK has begun to be integrated into resource management in general and fisheries management in particular, the focus has been on linking traditional knowledge of marine resources with biological science. There has been scant attention paid to traditional fishing techniques and technologies and the ways in which they might contribute to sustainable harvesting and species conservation. Traditional knowledge of salmon production may be of significant value in the current search for successful selective fishing techniques for the British Columbian salmon fisheries.

The Tsimshian community of Gitxaała is one of the oldest continuously-inhabited sites in Canada. Surrounded by small and large islands, the rich local resources have sustained the Gitxaała for countless generations. The following account of Tsimshian Nation stewardship is informed by the words of community members interviewed during research to evaluate the management and conservation potential of traditional Tsimshian ecological knowledge (Menzies and Butler *unpublished manuscript*). The project involved field trips with Gitxaała community members to traditional fishing sites to determine historic use patterns and assess the potential of traditional Tsimshian technology for 'new' selective fisheries.

Tsimshian people have a long history of using site specific and locally appropriate fishing gears to harvest a variety of fish species. Individually and as a Nation, the Tsimshian people engage in commercial, subsistence, social and ceremonial fisheries within their traditional territories, and in experimental communal fisheries in the Skeena River estuary. Many Tsimshian members still practice and maintain traditional customary fishing sites.

Gitxaała traditions reflect several millennia of site and species-specific harvesting. Fishing at creek mouths allows the targeting of specific, healthy stocks of fish. Traditional technologies are selective, and the rate of harvest is controllable. Non-target species can be released, and spawning requirements met. A well-developed system of territorial and resource stewardship has structured harvesting, processing and distribution to maintain fish stock health as well as meeting community needs for food and commerce. The system of ownership encourages habitat restoration and closely-managed harvesting. While colonial disruptions to traditional patterns of use and systems of ownership have impacted Gitxaała resource use during the last century and a half, Gitxaała ethics, knowledge and technology persists as a viable alternative to current management and fishing methods.

During the first half of the twentieth century when most families harvested the bulk of their food themselves, there was a structured distribution that allowed for a balanced diet. Harvesting was thus community-based, with families and houses harvesting particular resources to distribute throughout the village. This community-wide system is typically identified as being of one heart, *syt güülm goot.*

A house group would not take their entire supply of a particular resource, such as fish from one single source or run, but rather, would harvest smaller amounts from variety of sources. Thus, families caught specific runs of fish for different processing methods. There was also a larger aspect of this harvesting approach, which involved community distribution.

> *'Certain fish camps caught certain fish – some pinks, some dogs etc. Back in the village they would barter with each other so their diet was balanced. So they just took so much out of each creek'*. (I.K.[7])

The community-wide system of distribution ensured both household survival and nutritional balance, but also encouraged sustainable harvest. The geographical scope of the Gitxaała territories, and the

[7] Community members are identified by coded initials pending final community review and approval of materials as per the Forests and Oceans for the Future project research protocols.

varying abundances and varying species within those territories were maximized through this ethic of being of one heart, *syt güülm goot*.

Need-based resource use, harvesting the minimum required for food, trade, and sale for a reasonable livelihood, has allowed the Gitxaała people to sustain themselves in their territory for millennia. Community members do not approach a harvesting activity without first estimating their required amount of that particular resource. They do not harvest everything that is available at a particular moment, but fulfill their minimum needs. I.C. describes fishing for salmon for his household, for family, and for those without the means to fish for themselves: *'We have numbers in our heads of what we can handle – there's no waste.'* (C.I)

Goal-oriented harvesting, rather than 'stockpiling' results in small-scale seasonal harvesting of diverse resources over the course of the year. The result is a comprehensive system of controlled, conservative resource use. Furthermore, integrated, community-based resource ensures widespread provisioning without excessive pressure on any species.

Today, those with the means to fish and harvest other resources provide family and other community members with food. Those who regularly harvest traditional foods share with a network of up to a dozen other households. These contemporary distribution networks parallel the community distribution that occurred early in the century when all Gitxaała families were engaged in subsistence harvesting. In addition to encouraging sustainability, this system also provided an adaptation to seasons of scarcity. This system is the premise of need-based harvesting, providing a structure of community support that negates a need to stockpile, or harvest the totality of available resources at any given moment. The ethic of *syt güülm goot* is an example of a local system of resource use that prevents the 'tragedy of the commons'. Gitxaała people were never in competition with each other for resources. Their resource use was territorialized, but flexible to adapt to regional and seasonal scarcity. Furthermore, the ethic of sharing and community-wide distribution prevented an accumulation-oriented approach.[8]

Boundaries and Prohibition

Daisy Sewid-Smith describes a moratorium on salmon fishing just before Captain Vancouver arrived on the coast. Salmon were very scarce, so the Chiefs from all the villages all along the Nimpkish river got together and decided to move all the people down to the mouth of the river and use seafood until the salmon returned (Sewid-Smith *et al.* 1998).

Chief Adam Dick holds the hereditary position, represented by his name, *Kwaxsistala*, or river guardian for eulachon on the Kingcome river. It was the responsibility of his ancestor to watch for the eulachon to arrive and ensure that enough got up to spawn before giving permission to fish the eulachon; also to prevent pollution (*pers. comm*. to Nancy Turner, ca 1997). McIlwraith (1948, cited in Jones 2002) describes the role of river guardian in Nuxalk (Bella Coola) territory. Polluting the river before or during salmon or eulachon runs was punishable by death. The Wuikinuxv (Oweekeno) people in Rivers Inlet have very strict rules on silence and staying out of the water during eulachon season (Clifford Hanuse, Wuikinuxv Nation *pers. comm*.).

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[8] The concept of *syt güülm goot* is elaborated in more detail in the project reports and documents that form part of the Forests and Oceans for the Future research project coordinated by Charles Menzies and Caroline Butler in collaboration with the Gitxaała Nation. For further details see www.ecoknow.ca or contact the project coordinators directly.

The Kwakwa'ka'wakw and Haida Nations also employed river guardians (Jones 2002). The Haida reactivated this role in the 1981 in the 'Haida Gwaii Watchmen' program. The original "watchmen" are three human figures wearing high hats, often perched on the top of Haida poles. Legend says that the role of the watchmen is to alert the pole's owner to the approach of an enemy or any other happenings of which he should be aware. The Haida adopted this symbol to represent the Haida Gwaii Watchmen Program www.virtualmuseum.ca/Exhibitions/Haida/java/english/gh/gh1f.html. The Heiltsuk also had a traditional watchman role (Steve Carpenter, Heiltsuk Nation, *pers. comm.*).

Controls on harvest

In their description of W̲SANEC' (Saanich) reefnet technology, Claxton and Elliott (1994) record that the Saanich people see all the salmon as families that have to survive, so their reefnets are designed to allow some to escape.

The Origin of Salmon

This story begins at a time when there were people on the Earth, but they had no salmon to eat; the salmon were in their own land, far away. The W̲SANEC' (Saanich) were facing starvation because the seals, elk and other game they relied upon had disappeared. There were two brave young men who said to each other, "Let us go and see if we can find any salmon." Embarking in their canoe, they headed out to sea, in no particular direction. For three-and-a-half months, they journeyed until finally they came to a strange country. When they landed, a man came out of a house and spoke to them as if he expected them, saying, "You have arrived." The youths had no idea where they were, but they answered, "We have arrived." They stayed with their host, who fed them and looked after them. He told the youths to look around, and they noticed that smoke rose from the aromatic seeds of ***qex̲mín*** (*Lomatium nudicaule*, Indian celery, also known as Indian consumption plant), which everyone was burning in their houses. It turned out that these were all salmon people—steelhead, chinook, sockeye and the other kinds of salmon—and the smoke from the ***qex̲mín*** was their food.

After about a month, their kind host said to the youths, "You must go home tomorrow. Everything is arranged for you. The salmon that you were looking for will muster at your home and start off on their journey. You must follow them." So, the next day the youths left, following the salmon. They travelled with the fish, day and night, for three-and-a-half months. Following the instructions of their host, they burned ***qex̲mín*** seeds every night, "that the salmon might feed on its smoke and sustain themselves." After a long time, they reached Discovery Island (T̲C´A´S), off the coast of Oak Bay in Victoria. Here, they burned ***qex̲mín*** all along the beach, as they had been instructed. They had been told, "Burn ***qex̲mín*** along the beach when you reach land, to feed the salmon that travel with you. Then, if you treat the salmon well, you will always have them in abundance."

From the area around Discovery Island, the salmon went on to other places, including around Nanaimo on the east coast of Vancouver Island, and up the Fraser River. In the story it was explained that, because the journey from the land of the salmon people had taken them three-and-a-half months, the salmon are absent from the coast for that period of time each year. In the story, too, the coho said to the other salmon, "You can go ahead of us, for we have not yet got what we wanted from the lakes," and that is why the coho are generally the last of the salmon to appear.

As well as providing the W̲SANEC' people with salmon, the "leaders of the salmon," who had the forms of a man and a woman, taught them how to construct the reefnets to catch the salmon and all the proper ways or protocols to ensure that the salmon would always return. They told the young men how their people should dress when they caught the salmon, and that they should start to use their nets in July, when the berries were ripe. "So today," Jenness recorded in his manuscript, "when the Indians dry their salmon they always burn some ***qex̲mín*** on the fire (or on top of the stove), and they put a little in the fish when they cook it. Also, when they cut up the salmon, before inserting the knife they pray to the salmon, that they may always be plentiful."

(Jenness *ca*. 1930 cited in Turner 2005)

Heiltsuk fishtraps had a similar provision, or were partially dismantled at the end of the day and at the end of the season to let fish through (Jones 2002). We note here that 'ghost fishing' by lost or abandoned gear is an increasing global problem. All technologies were selective, i.e., fish could be inspected, then retained or released (Jones 2002; Menzies and Butler *unpublished manuscript*). Johnsen (2001) notes that habitat use and run timing are readily observed. Hence it is likely that First Nations would have transplanted eggs to maximize productivity and manipulated run timing by use of fishtraps. Knowledge of salmon genetics would be harder to come by, because the natural thing would be to maximize catch per unit effort by catching large fish and letting small ones swim by[9]. The following examples indicate that First Nations were well aware of the basic principles of genetic selection.

Salmon transplants and genetic selection

Gilbert Sproat (1868) writes of the 'Nootka' (more properly the Nuu-chah-nulth) that:

> *'It is a common practice among the few tribes whose hunters go far inland, at certain seasons, to transport the ova of the salmon in boxes filled with damp moss, from the rivers to lakes, or to other streams.'*

Irwin (1984) also reports that the 'Nootka' 'transported salmon eggs from one stream to another to create a salmon run in a stream that had none, or only a small migration'. More recently, Nuu-chah-nulth Hereditary Chief Earl Maquinna George describes the transplanting of salmon from the Fraser to create a run in the Esperanza River (George 2003). Similar accounts emerge from Nuu-chah-nulth oral history (Traditions Consulting unpublished Ms. 2004), as follows:

> *'The Natives could transfer, or transplant different species of fish. Into a certain river they could transplant species from one river to another. I heard about these people that could do it.'*

Carpenter *et al.* (2000) describe how the Heiltsuk would carry live fish in baskets during a dry year and how stone fishtraps were used to enhance resources thorough selective harvest and stock management. The late Cyril Carpenter (cited in Carpenter *et al.* 2000) describes the middle of stone fish traps as having:

> *'a door that could be opened to let the fish in or drive them back out. Weak and small salmon would be harvested allowing the more robust ones to spawn.'*

Arvid Charlie of the Halkomelem Nation talks about how people would establish new salmon runs when they moved from place to place, or when a woman married into a community and wanted to bring her own fish with her (Jones 2002). Barnett (1995) speaks of construction of 'spawning dams'. John Thomas of the Nitinaht Nation also describes the role of salmon weirs as ways to monitor and select fish and make sure enough get up the river .

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[9] Johnsen (2001) appears to be correct, as far as the BC sportfishing industry is concerned as they are fixated on catching the largest fish, without any thought of long-term influence on genetic composition.

In a European example, Spens (*in press*) describes an innovative use of linguistics, specifically the occurrence of the root '*Rö*', an old term for brown trout, to identify lakes which had supported brown trout before they were extirpated by acid rain. Research into lake names indicated the, 'genesis of a fisheries related name-complex in the heart of the study area 1,900 years ago' (Edlund 1997(). Current work indicates than many lakes known to have had populations of brown trout must have been stocked by people in prehistoric times, as they would have been totally inaccessible to fish (Johan Spens Department of Aquaculture, Sveriges lantbruksuniversitet, Umeå, Sweden *pers. comm*.)

Other marine resource enhancement

Recent years have turned up an increasing number of examples of intensive pre-contact clam culture or 'clam gardens'. Harper *et al.* (1995) reported 350 'clam terraces' covering a 14km of shoreline in the Broughton Archipelago. All were 'typified by highly-productive clam beds' in a substrate composed largely of fragments of clam and barnacle shell (Harper *et al.* 1995). At the time, they were unclear whether the terraces were natural or deliberately constructed. Later interviews and discussion with Chief Adam Dick, Daisy Sewid-Smith and Kim Recalma-Clutesi revealed that these were deliberately constructed (Glavin 2003). The collaboration has now revealed 400 of the features stretching from the Broughton Archipelago to Quadra Island, there is also a report of clam gardens on Orcas Island (John Harper *pers. comm*.).

Carpenter *et al.* (2000) confirm the existence of "clam gardens" in Heiltsuk territory. We propose that fish traps came first and then as they silted in, folks noticed that they were good substrates for clams and other shellfish. However community members have noted stone rock alignments containing very productive clam beds nowhere near any streams, salmon or otherwise. Carl Humchitt of the Heiltsuk Nation noted that a large freshwater flow as from a salmon spawning river would not be a conducive environment for clams. John Harper (University of Victoria, *pers. comm*.) notes that:

> '*…the elevation (of silted fishtraps) will not be the same as for clam gardens. The Broughton clam gardens have sill heights around +1m above tide datum and are concave towards the water. All the fish traps we saw are higher and generally concave towards the land.*'

The substrate in both the Heiltsuk and Broughton examples which is almost entirely comprised of fragments of clam and barnacle shells, may also indicate that sedimentation is less likely. Posing research questions and strategies to identify, inventory, document and analyze 'clam gardens' in Heiltsuk territory is an exciting but only provisionally explored topic.

Clam gardens have also been reported from Hesquiaht on the West coast of Vancouver Island (Clayoquot Scientific Panel 1995). Jones (2002) reports that Haida and Manhousaht (a Nuu-chah-nulth group) elders, working with David Ellis discussed 'semi-cultivation' of clams and mussels. (Ellis and Swan 1981; Ellis and Wilson 1981). Luke Swan describes 'clam drying time,' when huge quantities of butter clams were gathered and dried by groups of men and women who moved from clam bed to clam bed as each location was harvested (Ellis and Swan 1981).

The Nuu-Chah-Nulth owned and managed terrestrial and marine resources including salmon, herring, clam beds and root gardens (Bouchard and Kennedy 1990; E. Sapir *unpub notes*; Clayoquot Scientific Panel 1995). Farming of marine resources is also mentioned by Ahousaht, Nuu-chah-nulth elder Stanley

Sam (Bulbulian and Vallée 1992). Helen Codere (1990:364) characterized the Kwakwaka'wakw as being "agriculturists", farming 'the woods, the shores, and salmon streams and the sea.'

The coastal Tsimshian relied, and continue to rely, extensively on marine ecosystems (Port Simpson Curriculum Committee 1983; Turner and Clifton in press). Stewardship practices for invertebrates such as abalone (*Haliotis kamschatkana*), clams (*Saxidomus giganteus* and other spp.), chitons (Chitonidae), and crab (*Cancer* spp.) include careful, respectful treatment of abalone and clam beds; protection of abalone from excess noise; selective harvesting of shellfish by size, leaving the small ones to grow; seasonal harvest and leaving some areas for several years without harvesting. These and other practices, as described by Gitga'at elders Helen and Chief Johnny Clifton, Tsawataineuk elder Chief Adam Dick (Kwaxsistala) and others, are reported in Turner (2005), Hood and Fox (2003 and Woods and Woods (2005). Marine plants, notably red laver (*Porphyra abbottiae*), giant kelp (*Macrocystis* spp.) and eelgrass (*Zostera marina*) are similarly harvested with care and attention to seasonality, conservation and sustainability (Turner and Clifton in press; Turner 2004; Chief Adam Dick, pers. comm.).

Undoubtedly more research will turn up additional examples but the farming of invertebrates in the Pacific Northwest has parallels elsewhere, Nicholas (1999) reports on oyster 'gardening' in prehistoric Boston. Hickey (*in press*) reports on the semi-cultivation of giant clams in Vanuatu.

Terrestrial resource enhancement

Turner (1999) reviewed the use of fire throughout BC to enhance productivity of at least 12 species of berries, bulbs and roots and increase deer populations which thrive on the new growth after forest fires. Fire was used by the Stl'atl'imx, Nlaka'pmx, Secwepemc, Ktunaxa (Kootenai) and others, as one would properly expect, given summer conditions in the southern interior. In fact, the regular, controlled burns practiced by interior peoples are now being 'rediscovered' as a way to avert the catastrophic forest experienced in 2003 and anticipated for 2004. We will return to the ironic concept of 'rediscovery' in the latter part of the paper. Fire was also used by the Gitxsan-Wet'suwet'en in the central interior, but there are also well-documented examples from the Northwest Coast including the Haida, Tsimshian, Haisla, Kwakwa̱ka̱w'akw, Nuu-chah-nulth and Nuxalk (Turner 1999).

Other practices people applied to maintaining and enhancing their resources include tilling the soil around root vegetables (e.g. camas, springbank clover, Pacific silverweed, and northern riceroot), both during digging and at other time. Weeding and clearing away competing shrubs and grasses from root harvesting beds was also undertaken for these and other species. Berry bushes of several types were pruned after harvesting the fruit for the season; the tops were broken off during or after the fruit was picked. Salmonberries, gray currants, red huckleberries, blueberries and soapberries were managed in this way. Pacific crabapple trees were especially carefully tended. In some cases they were marked with sticks or stakes to indicate a family's ownership of individual trees or stands. The branches were also sometimes pruned and groomed. Some species were transplanted from one site to another: stinging nettles, cattails, highbush cranberries, blueberries, wild lily-of-the-valley (for medicinal use), camas bulbs and springbank clover have all been documented specifically as having been transplanted (Turner 2004). Another technique used to maintain plant resources was selective harvesting, in which part of the plant—in all cases perennial species—was left behind to live or regenerate itself. Thus, cedarbark and plants were removed from standing, living trees, roots and branches for basketry were harvested from living individuals, and basket "grasses" like slough sedge and "tree-square," as well as cattail and tule for mats, and stinging nettle stalks for twine, were harvested late in the season, before the leaves or stems had died back for winter, but so as not to disturb the production and reproductive structures of the plants. In most cases, the non-flowering individuals were those harvested; flowering and fruiting stalks were left intact. Greens like cow-parsnip stalks, horsetail and fireweed, all of which were used as spring vegetables, were also harvested from living plants, in a similar manner to asparagus. Ultimately, these plants continued to live, grow and reproduce. There are instances of some trees (Sitka spruce, grand fir) being used as pitch-producers for medicine for many decades and even over several generations. People simply burned or cut a patch of the bark until pitch seeped out, and as the tree healed, another cut would be made from time to time to keep a continuous supply (Turner and Peacock 2005).

Animals and animal products, too, were harvested sustainably in most cases. As well as the salmon, other fish, seabird eggs and the birds themselves, mountain goat, deer, and sea mammals were hunted and harvested selectively, either from certain places or at certain seasons, with care being taken always to leave some behind. There is a Nuu-chah-nulth term - "7uh-mowa-shitl " – that means "keep some and not take all" (George 2003).

Traditional First Nations Salmon Stewardship

Johnsen (2001) uses economic arguments to underpin a case for the development of exclusive, private property rights by Northwest Coast tribes. Such rights are inherently difficult to define and enforce, and can only persist where the benefits outweigh the costs. The nature of salmon lends itself to the creation of such rights, in that they return to the stream of origin. Coastal tribes would have had first access to all six species, enabling them to derive a broader and more dependable flow of benefits than upriver tribes. Differences in habitat utilization and run timing between species and stocks would enable stream owners to enhance their 'portfolio' of assets by transplanting stocks that would maximize productivity. The literature and oral history cited above indicate that such transplants did indeed take place. Stream owners with superior knowledge of salmon biology would be able to maximize productivity at a time when other stocks in the region would be at a low ebb, thus maximizing value received for surplus transferred to 'have nots' and minimizing what they would have to give for surplus when their stocks were in a 'down' cycle, but most others produced a surplus.

The assumption of selective harvest and enhancement puts a premium on knowledge. Johnsen (ibid) articulates both 'strong' and 'weak' hypotheses relating to the level of knowledge held by stream owners. In the 'weak' scenario, First Nations had some knowledge of salmon biology, but did not understand genetics, i.e., would have harvested big fish to maximize food/unit of effort. In the 'strong' scenario, First Nations acquired knowledge of salmon biology and genetics, i.e. using trap and weir technology to select for desirable characteristics, so enabling a rapid transition from an egalitarian hunter-gatherer society to a 'corporate' model where streams were owned and knowledge became extremely valuable intellectual property that to be jealously guarded. Salish chiefs who were successful had secret knowledge of 'good behaviour' while lesser chiefs were 'without advice' (Suttles 1960, cited in Johnsen 2001).

Johnsen (2001) concludes that Canada and the US should outlaw the saltwater fisheries and restore a system of stream ownership in the interest of conservation, sound science and good economics. Jones (2002) concurs, while Haggan and Brown (2003) suggest an interim approach.

Conclusion, implications and future research

The evidence suggests a lot more people eating a lot more salmon than most of us ever considered. With fishing technology that could 'wipe out salmon runs many times over' (Anderson 1996, Jones

2002; Johnsen 2001) on all but the bigger rivers, an effective form of conservation was essential. During the past 200 or so years, we have lost sight of this culture based system of stewardship and its collective ethics. Our population/food ratios are reaching ever nearer crash point as we continue to ignore all the signs of immanent widespread disaster. We need to relearn and live stewardship as the lifestyle it once was. In order to successfully steward any and all resources, we have to understand the most basic requirement for success: exclusive right of harvest.

Who would plant and tend a garden if anyone might come along at any time and harvest the crop? Yet ‘stewardship’ continues to be a romantic word attracting multitudes of volunteers to restore and maintain various natural sites. Bravo to the volunteers, but they have no rights. If industry, through government decides to do anything that threatens to damage the work, the stewards have no way of stopping it short of activism has been dealt with harshly in recent times.

For example, during First Nations’ traditional times they had nested tenure systems where the Nation held exclusive rights over its territories. Within that, there may have been several tribal territories which were in turn divided up into family and even personal holdings. In the case of salmon, this could be a number of rivers and adjacent geography held by the Nation, individual rivers held by tribes, smaller streams and tributaries looked after by families and fishing stations by individuals. Each group had obligations to steward the resource as well as protection of their rights through affiliation to the larger group. Salmon harvesting *then* made so much more sense than the way we do it now. The salmon raised themselves wild in the ocean[10] and swam home to the natal stream when mature. No need to chase them on the ocean at all, saving on fuel and boat maintenance, never harvesting immature fish, easy to select individual fish for harvest, easy to make sure that enough salmon get to the spawning beds, the benefits are legion.

A 20th century proposal for a 19th century industry

There are hundreds of streams on the BC coast alone that once had healthy salmon stocks, now all but extinct (Slaney *et al.* 1996). Lackey (2001 and 2003) concludes that, over the next 100 years, salmon from southern BC to California will continue to decline due to anthropogenic and environmental factors. A recent review of the BC salmon fishery commissioned by DFO (McRae and Pearse 2004), concluded that the answer to the genuine problems in the commercial, processing, sportfishing and support industries can best, indeed only, be addressed by privatizing the resource. The first critique is that McCrae and Pearse (2004) have no sense of history, beyond the inception of the western commercial fishery. The (very real) problems of the last decade and the financial well-being of the existing industry are the prime motivation. Salmon just ‘appear’ in the water to be harvested by the most ‘economically efficient’ units in a system of area licensing that bears no relation whatsoever to salmon stocks, the ecosystems in which they are embedded or the human communities that these ecosystems called into being and sustained for 100s to 1000s of years (Haggan and Brown 2003). The flow of benefits from salmon stocks is seen as purely economic with no reference to ecosystem services (Costanza *et al.* 1997; Daily 1997 and chapters therein), existence values or ‘7th generational thinking’ (Clarkson *et al.* 1992; Haggan *et al.* 2004; Lucas 2004) or the management of resources for future generations as required under all Canadian environmental and resource management legislation and by the dictates of intergenerational equity (Coward *et al.* 2000 and chapters therein). This is a more subtle and dangerous repetition of the infamous ‘Mifflin Plan’ sold to the public under the guise of

[10] Net-pen aquaculture is not required – the world can live without year-round fresh salmon in grown to order sizes. Salmon is just another one of our numerous seasonal foods, perhaps better for the anticipation as we wait for the new “crop”

conservation, but actually designed to transfer management to those who could afford to pay for it and the science that goes along with it. The Mifflin plan caused widespread unemployment and loss to fishing communities up and down the coast as documented by two reports of the BC Job Protection Commissioner (Gislason *et al.* 1998 and 19998). The end result of this is, though they deny the possibility, is transfer of ownership to interests driven by the immediate return on capital (Clark 1973) rather than long term cultural and ecological survival. It is, in short, a 20th century proposal for a 19th century industry.

The long term view

What if we put a moratorium on ocean fishing for salmon and created stewardship resource centers in existing resource dependant communities (Native and non-Native) then established interested families on all the old streams where they would get busy and encourage the resumption of healthy salmon stocks and runs in "their" streams? They would have exclusive right of harvest and decision making, with obligations to steward salmon as necessary (clear log jams; transplant required species, maintain spawning beds, etc.), and could process the salmon for their own use (or participate in a cooperative community processing plant) as well as commercial sale of fresh fish to others. This is the primary reason for the legendary abundance 200 years ago (Johnsen 2001; Jones 2002).

There is been much discussion about the technology used in First Nations' traditional fisheries and stewardship of the past. We know this was extensive and successful and we can certainly learn a lot from these practices, but I think that what will be essential in re-establishing former abundance through stewardship is to adopt the cultural ethics of respect and assisting rather than managing nature. The nested tenure systems of old created the bite-sized holdings where small groups dedicated to their own survival could watch the workings of nature in their own place and find ways to enhance resources to suit their needs. We will need a blend of old and new practices as well as old and new ethics to overcome the old and new problems.

There is something beyond the purely romantic in taking care of the natural world, using wisely and respectfully, knowing that all things are connected – maybe it is the sense that it is the real natural order of the world to be so.

Future research directions

- A major research initiative to flesh out the entire scope of marine and terrestrial stewardship – principles, ethics, conservation, management, genetic selection and enhancement - throughout the Pacific Northwest (not just BC);

- Networking with indigenous researchers globally;

- A major international conference to present research results;

- Full analysis of past scientific and management activities by colonial, federal and provincial agencies including access (and where necessary preservation and digitizing of archives) to maximize the value of traditional and 'modern' approaches;

- Reconstruction and operation of fishtraps by young First Nations people and students under the direction of Elders and in collaboration with archaeologists, salmon scientists and ecologists;

- Research into ecosystem and GIS models and platforms capable of handling information from the numerous disciplines (e.g. Ardron 2003 and 2003);

- Dating fishtraps, including submerged example in Heiltsuk territory – also association between traps and middens;

- Development of ecological tools and approaches integrated with school, college and university curricula;

- History of salmon should be investigated empirically through palaeontological, archaeological and ancient DNA means;

- Archaeological research to confirm long term resource management strategies;

- Ecological-social-economic analysis of the value and validity of radically different management structures and options for Pacific salmon and other fisheries that take genuine account of ecosystem, precautionary and other social and cultural criteria including management for the benefit of future generations.

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