



## **Changing the Climate around Estuarine Root Garden Management with the Kwakwaka'wakw**

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### **Abstract**

The Kwakwaka'wakw First Nation members have been historical creators and stewards of estuarine root gardens within Kingcome Inlet since time immemorial. Rapid changes to sea level have been shown to negatively impact coastal estuarine plants, which are often grown within specific ecological conditions for cultural use and consumption. As sea level continues to change due to isostatic rebound and climate change impacts, we explore possible changes within the traditional root gardens of Kingcome Inlet, and suggest mitigation strategies for future research within these sites. We conclude that changes in management regimes and an inclusion of the Kwakwaka'wakw within participatory research is vital for the survival of these culturally important sites.

Keywords: Ethnoecology, Root Gardens, Sea Level Change, Cultural Keystone Place

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### **1. Introduction**

Since the beginning of the Industrial Revolution over 200 years ago, humans have been inputting greenhouse gases into the atmosphere at unprecedented levels. As a result, we have been witnessing rapid global warming climate trends, which are of great concern in terms of the well-being of humans and other lifeforms. Sea level rise, one of the results of a warming climate, is of particular concern to coastal communities who are at risk from increased storm surges and coastal inundation.

The Kwakwaka'wakw peoples of British Columbia inhabit northern Vancouver Island and the adjacent mainland coast and islands (Woods, D. et al., 2007). They are composed of 17 First Nations, and their traditional language, Kwak'waka, with four recognized dialects, is classified as part of the Wakashan language family. The Kwakwaka'wakw are traditional stewards of the diverse ecosystems within their territories, among which are estuarine salt marshes where some of the key indigenous root vegetables are grown in traditional root gardens known as t'aki'lakw (lit. 'place of manufactured soil'). Through creation of rock and wood terraces and human management, the Kwakwaka'wakw created complex estuarine root gardens that expanded the natural ranges of salt marsh plants in order to increase the abundance and productivity of culturally important food and medicinal species. Details of the resource management methodologies of the Kwakwaka'wakw peoples are visible within the book

Keeping It Living (Deur and Turner 2005), with major input from Clan Chief Adam Dick (Kwaxsiſtalla), including several chapters which focus on root vegetable management through case studies and records of historical changes within the gardens themselves.

The Kwakwaka'wakw are overcoming past influences of colonialism imposed on their traditional way of life, and are now faced with modern day climate impacts, such as sea level rise, which are threatening their traditional food production, including their estuarine management systems. With the combined effects of multiple stressors, there is global and local uncertainty in managing against climate-related effects (Peirson et al., 2015, 217-220). On a local scale, there is uncertainty on the effects of impending sea level rise on Kwakwaka'wakw estuarine root gardens. By identifying past and present ethnoecological significance of Kwakwaka'wakw root gardens, and considering ecological sensitivity of root plants to changing sea level rise and increased salinity, we argue that sea level rise induced by climate change will heavily impact these gardens. We propose that changes in management strategies within these estuarine root gardens is paramount in order to prevent further loss of these culturally important sites to the Kwakwaka'wakw and other coastal First Nation groups.

## **2. Acknowledgement of Knowledges from the Authors**

Specifics of traditional root garden management within this document are limited to published literature. The knowledge we have summarized here was shared by Kwaxsiſtalla, Clan Chief Adam Dick, of the Qawadiliqalla Clan, of the Dzawada ēnuxw tribe, a subgroup of the Kwakwaka'wakw. We, as students and writers, would like to acknowledge that the information on indigenous plant management discussed within this paper is not our own, and reflects the knowledge and experiences of Kwaxsiſtalla and the Kwakwaka'wakw peoples. We will explore the traditional root garden management of Kwaxsiſtalla and his family as described within the original writings sourced from Deur and Turner (2005); Deur et al. (2013); T.A. Lloyd (2011); Cullis-Suzuki (2007); and Turner and Turner (2007) and others in order to broaden the contextual understanding of rising sea level impacts within these areas. Our goal is to view estuarine root garden stewardship through a cultural lens and an environmental lens, as previously described within publications by Cullis-Suzuki (2007, 3), in order to formulate suggestions for participatory research with the Kwakwaka'wakw to mitigate the environmental impacts of climate change.

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## **3. History of Indigenous Root Gardens**

Estuarine root garden sites of the Kwakwaka'wakw and other Northwest Coast Indigenous Peoples are held as property by the rules of inheritance and are demarcated using stonewalls or wooden stakes or pegs (Deur and Turner, 2005, 311-316). Women, with the help of children, were the primary cultivators of the garden plots and were managed under the guidance of clan chiefs (Deur et al. 2013, 11-13). Harvesters found shelter in Digging Houses along the estuaries (Deur and Turner, 2005, 310-312). Social gatherings associated with these gardens include traditional root feasts with special clan songs and naming ceremonies to acknowledge the labour of root harvesters. Elders, through teaching and storytelling, orally passed down traditional knowledge through generations. In the fall, the Kwakwaka'wakw would harvest the fleshy and flavourful bulbs, rhizomes and roots of a variety of plants by digging with pointed sticks, tilling the soil at the same time (Deur and Turner, 2005, 119, 329). The anthropogenic disturbance of the soil is beneficial to the productivity of root crops which

include texwsus/*Trifolium wormskioldii* (springbank clover), xukwem/*Fritillaria camschatcensis* (northern riceroot), tleksem/*Potentilla pacifica* (Pacific silverweed) and q'weniy' / *Lupinus nootkatensis* (Nootka lupine) (Deur and Turner, 2005, 157). The Kwakwaka'wakw, through the creation of terraces using rock and wood walls, created flattened raised areas akin to rice garden beds. These terraces expand the area suitable for estuarine root plants to proliferate along their preferred tidal gradient while being inundated at various tidal heights. Specifically managed tidal boundaries allow for the intensification of root plant growth, through transplanting of propagules, weeding, and tilling (Deur and Turner, 2005, 119, 329). These plants are highly susceptible to rapid sea level changes due to living along specific ecological gradients required for proliferation and narrow ranges of saline and moisture tolerance.

Management practices for these root gardens involve specific harvesting techniques and timing in terms of both tides and seasons. Pointed digging sticks used by the Kwakwaka'wakw, called k'ellákw, were made from the tough wood of *Taxus brevifolia* (western yew) and their use helped to aerate the soil and efficiently harvest the roots (Deur and Turner, 2005, 128, 329). Estuarine garden management practices also included selective harvesting, soil amendment, aeration, weeding, in situ replanting of roots, harvesting during seed release times, and transplanting of roots, bulblets and rhizome fragments between sites (Deur et al. 2013, 2-3). Estuarine root gardens are a representation of sophisticated agroecological practices by Indigenous Peoples and are highly embedded in their way of life. Unaltered ranges of culturally important plants, without the extension from terracing and building up the soil, are relatively restricted, with the plants limited by sunlight, and reactive to specific salinity profiles within estuaries (Deur and Turner, 2005, 326). Estuarine terraces instead expanded the range and productivity of edible plants, by increasing proliferation of edible rhizome plants along specific intertidal gradients (Deur and Turner, 2005, 326).

#### 4. Recent Historical Management in the Kingcome River Delta

The Kingcome River Delta, also known as Okwunalis or Gwa'yi in Kwak'wala, is located on the central mainland coast of British Columbia, opposite the coast of northeastern Vancouver Island. It is within the traditional territory of the Dzawada'enux or Tsawataineuk tribe of the Kwakwaka'wakw peoples, who maintain the modern Gwa'yi Village (Deur et al., 2013, 8). The estuary of the Kingcome River is an important cultural keystone place for the Dzawada'enux peoples, being both the site of highly productive estuarine root gardens, and a place for harvesting crabapples, hunting geese and other game, and fishing for salmon and other species. It is thus both a vital source of food and a site of many cultural teachings, interactions with other groups, and the focus of cultural practices and the working of cultural institutions. Cuerrier et al (2015, 428-430) define a "cultural keystone place" as a locale that is critical to the cultural identity within a community, a place that allows for continuation of cultural practices, ritual, and growth. Clan Chief Kwaxistalla within an unedited communication in Deur (2013, 11) stated:

*Everybody had their own [ gardens ] ... They have poles [approximately three meters] ... on the four corners of the garden. And they tied the knots on there, the cedar bark. Yeah, at the marker. And we got to have at least one fathom in between the next one, so you can be able to work on the garden. And we go there, you know, in the early fall [to harvest the roots]. And the early spring we were there to clean them up. What they call sixa [weeding] ... They sure left it... just nice and clean. If you see something else coming up [weeds or grasses] you pick it up, root and all, so you don't want it there.*

Loss of the complex knowledge pertaining to stewardship of these traditional root gardens occurred widely upon arrival of colonial officials and settlers, who failed to recognize the importance of the

t'aki'lakw gardens for people's well-being and health (Deur et al, 2013, 19; Turner and Turner, 2007, 61-62). Failure to recognize these places as cultivated sites was systematic within most colonial parties (Deur et al., 2013, 13-18; Turner and Turner, 2007, 61-62). Root gardens represented some of the only available arable lands to colonists and, as such, were taken from traditionally managing communities to enclose as pasture and colonial farmlands and orchards (Deur et al., 2013, 5-8). As summarized by Deur (2013, 13), colonial impacts involved the historical destruction of estuarine root gardens as a method of enforcement for laws and treaties. Clan Chief Kwaxistalla within an unedited communication in Deur (2013, 11) states:

*The Hallidays took over everything ... They built a dike right around there. They claimed the whole flats ... And they covered the [traditional root] gardens that the old people used to have ... It was all gardens all over that field there. And they put a dike around it. They took the whole flat.*

Colonialist influences removed Indigenous Peoples' access to their traditional lands, and removed people – the children who would have learned about the traditional cultivation – through the Residential School system, impacting Knowledges passed through generations severely. However, Clan Chief Kwaxistalla was hidden away from the Residential School system, and hence received the teachings and experiences that enabled him to carry forward the ancestral knowledges of the Kwakwaka'wakw people (Deur et al., 2013; Lloyd, 2011; Woods, D. et al., 2007).

The current day status of the root gardens continues as contested space (Deur et al., 2013, 17). Control of the estuarine root gardens at Kingcome shifted from privatized farmland to international buyers, and now resides under the B.C. Nature Trust as a wetland wildlife preserve (Deur et al., 2013, 18). Government management continues within the Kingcome Inlet estuaries (Deur et al., 2013, 17-19) and the managers have almost universally failed to recognize the importance of such culturally managed landscapes as a powerful preservation tool for both environmental factors and cultural identity.

## **5. Climate Change and Salt Marshes**

Due to the ecological specialization of salt marsh plants, they can be highly susceptible to changes in sea level change (Roman et al., 1984, 143-147). Rising sea levels and storm surges have already been submerged marshes and wetlands in Louisiana Bay and Chesapeake Bay. Closer to Kingcome, marshes on Westham Island in the Fraser River delta have maintained their morphology and vegetation characteristics, and should continue to do so under lower level scenarios of sea level rise. Under a more rapid scenario of sea level rise, the marshes on Westham Islands will not be able to maintain their morphology and vegetation characteristics and the vegetation will slowly migrate inland and lead to a loss of biomass productivity (Kirwan & Murray, 2008, 481-482). As sea levels rise, vertical land movement and natural accretion processes differ under different scenarios in any given area. Impacts in a marsh will therefore vary between sites. Recent observations suggest that sea level rise may result in economic and ecological losses to salt marshes as well, if natural accretion processes cannot keep up with sea level rise (Kirwan & Murray, 2008, 471-473).

Climate change and a warming earth are threatening to accelerate global sea level rise. In more recent times, the global sea level rise has been dictated by the freezing and thawing of glaciers with the last major change in sea levels a result of the rapid deglaciation following the last Glacial Maximum approximately 21,000 years before present (Bornhold 2009, Sec. 6). During this period, sea level rise of up to 14 mm per year was not uncommon, but these rates eventually levelled off around 2,000 to 3,000 years before present (Bornhold. 2009, Sec. 6). With our earth's atmosphere warming, we are seeing an

increase in deglaciation and an increase in thermal ocean expansion that is contributing to an acceleration of sea level rise. Current sea level rise estimates represent a range of values as these estimates put our technology to their limits. Church and White (2006, Sec.3.) estimate global sea levels rose at a rate of about  $1.7 \pm 0.3$  mm per year in the last (20th) century, while Nerem et al. (2010, 8) estimated an increase of  $3.4 \pm 0.4$  mm/year. These values will differ regionally as glacial isostatic rebound of Earth's crust (variation in land mass rise caused by removal of glacial ice sheets during the last glacial period) is variable between regions. Low-lying coastal areas such as estuaries and river deltas are vulnerable to minimal changes.

Anticipated rates of occurrence and severity of sea level change for the Kingcome River delta are difficult to estimate because the area has received little geological monitoring. Comparing data of surrounding areas is equally difficult. There is a large amount of variation within short distances around Kingcome Inlet due to differences in isostatic rebound. Coastal B.C. Beaver Cove on Vancouver Island is one of the closest locations to Kingcome Inlet and sea level rise estimates for this location have large variance depending on whose data used. Based on the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment report, Vadeboncoeur (2016) estimates a high emissions scenario relative sea level rise by 2100 of 70 - 80 cm for Beaver Cove, which is the closest available geographical equivalent. Mazzotti et al. (2008, 2), based on the IPCC Fourth Assessment report, estimate a relative sea level rise of 0-10 cm. These two estimates demonstrate the conflicting values and make it difficult to estimate values for the Kingcome Inlet area. However, Vadeboncoeur's data(2016) are most current data so we will assume it more accurate. Although we did not find a firm value for projected sea level rise in the Kingcome Inlet area, it is probable sea level rise will occur to a degree that will detrimentally affect the estuarine root gardens along the coast of Kingcome Inlet and will require adaptive management for future use.

## **6. Mitigating Cultural Losses by Sea Level Change**

When accounting for sea level rise, cultural management and identities are important to consider when identifying at-risk areas within Kingcome Inlet. Species of cultural importance – such as tleksam/*Potentilla pacifica* (Pacific silverweed) and the other edible root vegetables – within terraced areas could be lost on a large scale if rising sea levels inundate the root gardens and destabilize the fertility of the soil. As stated previously, salt marsh plants are often living at their biological extremes in terms of salinity tolerances, and increasing saltwater levels can cause displacement at local and regional scales. Changes to sea level, including reduction of sea levels due to coastal rebound effects, can alter ecological regimes in the area drastically. Large-scale ecosystem flips within estuaries can often negatively affect humans relying on those ecosystems and might not be reversible (Peirson et al., 2015, 215). Exploring implementation of mitigation strategies, and barriers are important if these root gardens are to survive sea level changes.

Methods to mitigate the impacts should focus on adding ecosystem resilience through anticipation of ecosystem changes, and long-term consequences from an economic, social and environmental point of view (Peirson et al., 2015, 215-220). As such, community involvement of the Kwakwaka'wakw peoples is vital to the maintenance of a healthy root garden estuary system, as their traditional knowledges reflect, as well as coping with short-term changes, dealing with long-term consequences, and taking steps that can add ecosystem resilience to these systems. Community involvement can return generational long-term management to traditional knowledge holders, through the involvement of Kwakwaka'wakw children and community members in weeding, tilling, and terracing activities. Community involvement can be a tool to restore a sense of place to students, as has been seen through previous community

involvement projects (Isaac, 2010, 56). Climate-related community responses would be a strong initial tool to begin improving the condition of estuary systems degraded (Peirson et al, 2015, 219) due to previously mentioned colonial imposition. Community involvement can also increase the ability of the Kwakwaka'wakw to guide these root gardens properly through various sea level change scenarios.

## **7. Conclusion**

Barriers to root garden management involve current contestation of land occurring within Kingcome Inlet by environmental non-governmental organizations (eNGOs) and provincial government. The government of British Columbia needs to be prepared to work with traditional knowledge holders of the Kwakwaka'wakw to allow for successful navigation to alleviate impacts from sea level changes within Kingcome Inlet. Allowing traditional stewardship roles to continue within the Kwakwaka'wakw traditional territories is paramount in order to prevent habitat loss and associated cultural loss. This is demonstrated through previous writings discussing increased biodiversity and density of food plants when managed by people (Cullis-Suzuki, 2007, 79-87; Lloyd, 2011, 109) and is supported by written statements of elders within the community (Deur & Turner, 2005, 310). We suggest that it is the responsibility of provincial and federal government to support the communities within Kingcome Inlet in response to increasing sea levels and climate change. To restrict access by the Kwakwaka'wakw in any capacity will only continue the historical colonialist destruction of these fragile ecosystems. An alternative, which works towards reconciliation of these regions, would be working to document and research large-scale historical and present-day management within communities and with western allies, in a similar framework seen with B.C. clam garden networks. We suggest that an increase in the scale of the projects, designated by Kwakwaka'wakw knowledge holders and community leaders, would be important in order to document the present state of estuarine root gardens. Researchers should conduct future studies through community-involvement projects, to study the degradation of estuaries since the removal of the Kwakwaka'wakw by colonial forces. Consideration of community-integrated methodologies also apply to the various First Nation coastal food systems, such as clam gardens, present in British Columbia. Methodologies with combined rhizome and tilling effects have been studied previously (Lloyd, 2011, 90-101), but have been at a relatively small scale.

With increasing ecogeomorphic-modelling techniques undertaken within estuarine habitats, we conclude that a large-scale study of the various managed and degraded sections of Kingcome Inlet and long-term community involvement would be beneficial to avoid losses within this culturally important location. We caution current governments that restrictions to these sites, and lack of pre-emptive action to mitigate against sea level rise, could result in the loss of the entire estuarine root garden system over time. Actions should be taken to protect these culturally important habitats and plants, and to re-introduce cultural management by the Kwakwaka'wakw in the region. Otherwise, Canada risks losing a culturally important and long-managed system, which would be a huge loss to the Kwakwaka'wakw and British Columbia.

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