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Cultivation of Salmon and other Marine Resources on the Northwest Coast of North America

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Abstract We present evidence for cultivation of marine resources among aboriginal peoples of the Northwest Coast of North America. While such evidence has been marshalled for plant cultivation, we argue that similar cultivation techniques developed around salmon and other critical marine resources of which they had intimate knowledge, and that such interventions helped regularize supplies, ameliorate disruptions, accommodate shifts, and even reverse declines in species populations by recreating or strengthening conditions for sustaining species in dynamic ecological systems. The plants, fish, and wildlife of the region were resilient, and often pre-adapted to cyclic or stochastic disturbance regimes, but, like the aboriginal populations themselves, also vulnerable to environmental shocks and scarcities. We suggest that Northwest Coast indigenous people observed the effects of both gradual and rapid environmental change on key species over generations, and adjusted their behavior accordingly. The effects of human enhancement, human over-exploitation, or natural perturbations were often rapidly apprehended, allowing for feedback mechanisms that became integral to the technologies and social mechanisms for resource management. These practices are best conceptualized as cultivation techniques rather than restrictive conservation practices, designed to optimise resource supplies and harvest conditions, thus reducing risk and vulnerability and increasing social-ecological resilience.

Keywords Resource management · Marine environments · Salmon · Traditional ecological knowledge · Hunter-gatherers · Pacific Northwest Coast

Introduction

Debates over whether or to what extent indigenous peoples were conservationists have become well-worn (Berkes 2012; Hames 2007; Harkin and Lewis 2007; Turner and Berkes 2006; Deur and Turner 2005; Hunn et al. 2003; Smith and Wishnie 2000; Diamond 1986) and perhaps even detrimental to anthropology's voice in contemporary environmental issues (Milton 1996). Still, there is no doubt that indigenous people the world over employed a wide range of environmental cultivation techniques in an attempt to enhance the productivity of landscapes and sustain supplies of key animals, plants, and other resources. Such techniques are integral to the so-called traditional ecological knowledge (TEK) and resource management traditions of indigenous peoples, and many remain relevant today in the understanding of relict landscapes and biomes, or as part of on-going land use practices. The study of these resource enhancement strategies, especially as they appear within hunter-gatherer societies, has contributed significantly to debates regarding the genesis of agriculture and social complexity (Winterhalder and Kennett 2006; Suttles 2005; Smith 2001; Harris 1989). In some settings, indigenous cultivation techniques also may hold potential for restoring biological productivity and diversity to landscapes that have been degraded by industrial exploitation or neglect, or in sustaining the cultural integrity of indigenous peoples.

This potential is particularly high on the Northwest Coast of North America, home to many of the world's most complex and enduring hunting and gathering peoples (Ames 2003; Suttles 1990). Yet, this region has proven enigmatic. Classic ethnographic and archaeological literatures generally dismissed the presence of plant cultivation and other resource

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management strategies throughout this culture area. In doing so, researchers typically cited the natural abundance of food resources, especially its iconic and bountiful runs of Pacific salmon (*Oncorhynchus* spp.), and summarily dismissed the presence of cultivation methods based upon a presumed absence of environmental motivations (Ames and Maschner 1999). Nonetheless, there has long been an appreciation among certain scholars that the resource superabundance of the region "has been somewhat overestimated and its significance misinterpreted" (Piddocke 1965: 247). Localized food shortages due to environmental shifts or other stressors were not uncommon and could impact human communities significantly – a phenomenon that could be complicated by patterns of resource and territorial ownership that were somewhat more fixed than in most hunter-gatherer societies (Suttles 1968; 1974).

Accordingly, in the last two decades there has been a significant re-evaluation of the degree to which the indigenous peoples of the Northwest Coast of North America managed resources - plant resources in particular (Turner et al. 2013; Deur and Turner 2005; Boyd 1999; Thornton 1999). Practices such as selective harvesting, burning, weeding, and even the transplanting and seeding of culturally important plants are now understood to have been widespread within the region in a way only thinly documented by earlier generations of researchers. These techniques traditionally operated at multiple scales, from individual plants or plant communities to entire biomes. Original ethnographic research with aboriginal knowledge holders has been an essential ingredient within this re-evaluation, revealing similar patterns of resource management among Northwest Coast consultants separated by considerable time and distance. In turn, ethnographic findings have been tentatively substantiated by archaeological and paleoecological research demonstrating specific measurable outcomes of long-term plant community management (Lepofsky and Lertzman 2008; Lepofsky et al. 2005; Deur 2000; Boyd 1999). Running parallel to this revisionist turn in the literature and prompted in some part by it, there has been growing attention to aboriginal management of marine resources – a topic addressed in this set of articles (Lepofsky and Caldwell 2013; Caldwell et al. 2012; Thornton and Kitka 2010; Langdon 2006a, 2006b).

Sustainability through Cultivation and Social Learning

In the discussion of the practices addressed here, we prefer the term cultivation to "resource management" or "conservation," as the latter terms are too strict, too narrow, and too ethnocentric to accommodate indigenous concepts and practices. The myth of "green primitivism" (Milton 1996; Ellen 1986) and the "indigenous conservationist," or what some have called the "Long Shadow of an Ecologically Noble Savage" has been largely laid to rest in academic circles as an overgeneralization at best (Borgerhoff Mulder and Coppolillo 2005:96; see also Hames 2007; Ellingson 2001; Buege 1996). Even where indigenous resource strategies and practices have proven adaptive and sustainable, there is the question of whether this "conservation" is intentional (Krech 1999), by design (Smith and Wishnie 2000), epiphenomenal (Hunn 1982; Posey 1998), or even representational (Brosius 1999). The relevant question from the perspective of social science is not whether indigenous people as a category were or were not conservationists, but rather under what circumstances we might expect a society to develop an ethic of caring, conservation, or cultivation of keystone species and habitats so as to sustain them (Anderson 1996, 2014; Thornton 2008; Deloria 2000).

From the literature it is clear that there are numerous factors relevant to the development of a conservation ethic, including: intimate local and intergenerational knowledge and ecological understanding of resources and their environs, topophila (love and care for places), recognition of the depleteability of resources, effective control over resource access and use (including sanctions), resilience of resources to human exploitation, concepts of intergenerational or interspecific obligation, relatively distinct and stable human and natural resource populations, and low future discounting (Berkes 2012; Thornton and Kitka 2010; Trosper 2009; Thornton 2008; Hames 2007; Turner and Berkes 2006; Hunn et al. 2003; Smith and Wishnie 2000). Of course, not all of these factors need be present for a conservation ethic to evolve, but a significant number often occur in combination. Furthermore, when key institutions break down, such as aboriginal tenure systems under colonial usurpation, or a social-ecological system is subject to sudden perturbations or changes, conservation principles can swiftly degenerate into a tragedy of the commons (Hardin 1968) or other unsustainable situations, as happened to the Tlingit salmon fisheries under Alaska territorial rule (Arnold 2009; Thornton 2008; Langdon 1989).

Complicating the situation further is the fact that it can be difficult to isolate a simple conservation "ethic" within a society, since societies are heterogeneous and often informed by, or enmeshed within, epistemologies and world views with ontological principles, or ethnometaphysics (Hallowell 1960), that do not readily equate with concepts such as "conservation" and "management" (Ross et al. 2011; Nadasdy 2005). Like most hunter-gatherers, Northwest Coast indigenous groups do not have simple translations for these concepts in their languages. As a Tlingit elder told Thornton about salmon: "We didn't really 'manage' them; we just took care of them by looking after the streams and making sure we handled them properly." This is often summed up as "respect" in Tlingit (see Thornton and Kitka 2010). Likewise, Kwakwaka'wakw elders, notably Clan Chief Kwaxistalla Adam Dick, can identify myriad terms for specific conservation activities and the biological and ethical precepts they are said to manifest, but struggle to come up with single unifying terms that can account for these

phenomena as a unit. The term *qwaqwala'owkw*, "keeping it living" may be the closest approximation, a term that carries connotations, largely lost in translation to English, of purposive behaviour in multiple arenas in order to achieve the biological, social, and spiritual conditions required for enduring, respectful and mutualistic relationships between human communities and particular biota or landscapes (Deur and Turner 2005). Similar concepts can be found in other indigenous languages (see Thornton, this issue, for Tlingit).

Respect is a social concept involving both trust and reciprocity (Ingold 2000). It is the cultivation of these intersubjective values through proper relations that "conserves" productive material exchange. Thus, the cultivation of relationships, rather than the management of resources, becomes the critical matrix for sustainability behavior (Thornton 2008). In so-called animistic societies these relationships are inherent in the very constitution of "natural resources" as moral beings with immortal souls or spirits that require specific protocols for respectful engagement. Respectful engagement underlies what Langdon (2007) has termed for Tlingit and Haida "relational sustainability" and Fienup-Riordan for Yupiit "collaborative reciprocity" (1994:46ff; see also Brightman 1993) as moral-ecological paradigms. These paradigms can be highly developed, including stories and observations from the past, personal negotiations with non-human species, and a range of practical techniques for effective interaction developed from experiment and trial and error, which, in turn, are transmitted intergenerationally (see Turner and Berkes 2006). However, they do not necessarily crystallize into a clear "conservation ethic," especially if resources are not experienced as limiting or depleted (Berkes 2012; Burch 2007). Instead, the emphasis remains on cultivating and regulating respectful relationships with local species towards a goal of "keeping it living," rather than curtailing or restricting resource use. If resources are experienced as limiting or depleted, our research suggests that this is understood not solely as a material phenomenon, but as a moral and cosmological crisis associated with the lack of appropriate "respects" shown between human communities, other species, and cosmological forces that inhere in the landscape. From this foundation, corrective behaviours are prescribed that might contribute, through (re)cultivation or restoration of proper relations, to a range of "conservation" outcomes. Thus our choice of the term cultivation, so often opposed to hunting-gathering by its exclusive association with agricultural peoples, is deliberate.

In its broadest sense, cultivation is *any conscious effort to create specific conditions for advantageous engagement and relations with another being*. The term can have a more restricted meaning in agriculture (see Smith 2005:55), as a bridge between foraging and domestication. Among hunter-gatherers the term has been used more guardedly, if not controversially, in part because the category of hunter-gatherer (or forager) militates against it.

The range of cultivation techniques employed on the Northwest Coast is substantial and varied, including not only practical material interventions, but also social and spiritual activities that seek to align human and non-human beings within a moral-ecological web of mutuality and interdependence. Whether such relations among hunter-gatherers are termed progenerative animism (Brightman et al. 2012; see also Fienup-Riordan 1994; Brightman 1993; Scott 1989; Tanner 1979), collaborative reciprocity (Fienup-Riordan 1990), relational sustainability (Langdon 2007), or simply respect (cf. Thornton and Kitka 2010), the root metaphor and mode is, at base, one of cultivation. Cultivation in this light is not merely a practical enhancement technique, harvest strategy, or an aspect of tenure or world view, though it often involves these dimensions of human culture. Rather, cultivation is an integrated paradigm of relating physically, socially, spiritually to non-human species and their habitats of interest to humans (Deur 2009; Turner and Berkes 2006).

The fact that it has been anathema to think of so-called hunter-gatherers as "cultivators" is a problem of anthropological categories rather than indigenous capacities (Barnard 1983). Ellen (2006) and others (e.g., Williams and Hunn 1982) have pointed out that the issue is not with the term cultivation, but with the restrictiveness of the category "hunter-gatherer." All human societies are *cultivators* in the sense that they possess *cultures* (the terms derive from the same root) that seek to develop or improve productive relations with constituent elements of their environments. Not all societies seek to maximize production, however; for some it is a matter of stabilising or optimising productivity amid fluctuating conditions to reduce risk or stress on social groups. Examples of each of these motivations can be found on the Northwest Coast, reflecting variegation of both the environmental and socioeconomic contexts of resource production. Areas of vital but fluctuating or shifting resource populations were a particular focus of aboriginal cultivation regimes. Interventions in such settings had the potential to regularize supplies, ameliorate disruptions, accommodate shifts, and even reverse declines in species populations by recreating or strengthening conditions for sustaining species. The spatial and temporal variability of Northwest Coast resources is a function not only of human harvesting activities, but of the environment itself, among the most dynamic of any region in the North America, with glaciers advancing and retreating, isostatic and tectonic changes is shoreline elevation, landslides and accompanying pulses in river-borne sediment, earthquakes, volcanoes, tsunamis, floods, and other environmental shocks and hazards, and decadal (e.g., Pacific Decadal Oscillation, or PDO) and centennial fluctuations (Rogers et al. 2013) to which many species had to respond. The plants, fish, and wildlife were resilient and often pre-adapted to cyclic or stochastic disturbance regimes, but, like the aboriginal peoples, also vulnerable to such shocks. Further, Northwest Coast

indigenous people observed the effects of both gradual and rapid environmental change on key species over generations and adjusted their behaviour accordingly. The effects of human enhancement, human overexploitation, or natural perturbations were often rapidly apprehended, allowing for feedback mechanisms and social learning that seem to have become integral to the technologies and cultural institutions for engaging these species.

On the Northwest Coast, sites for cultivation included most areas of potential resource use: the intertidal zone (e.g., seaweeds, see Turner and Clifton 2006; herring spawning beds, see Thornton et al. 2010a, b; Thornton and Kitka 2015; and Thornton, this issue; and clam "gardens", see Williams 2006; Deur et al. this issue), instream fisheries (especially salmon, e.g., Gunther 1928; Langdon 2006a; 2006b), bird and marine mammal rookeries (Hunn et al. 2003; Braje and Rick 2011), offshore fishing banks (especially for halibut; Emmons 1991), both estuarine and upland habitats for plants (e.g., Turner et al. 2013; Deur and Turner 2005; Thornton 1999) and animals (see Suttles 1951, 1968). Methods of enhancement commonly involve tenure systems, selective harvests within a prey population, limitations on the geographical or temporal scope of harvests, the intentional elimination of competing species, habitat cultivation, and occasionally transplanting of species from naturally-occurring sites to places more proximate or suitable to settlements or within defensible territorial control.

Salmon Cultivation

The regional staple, Pacific salmon, was central to a complex of traditional practices that only now are subject to focussed investigation as "management." Tenure systems at salmon fishing stations – giving individuals, families, clans or villages exclusive or usufruct claims on resource harvesting sites - occur widely along the coast (Suttles 1990; Schalk 1997). With fixed and typically multigenerational community linkages to particular salmon fishing locations, Northwest Coast communities had strong motives to avoid overexploitation; in certain contexts, they may have had incentives, if not always the opportunities or technologies, to enhance salmon output through cultivation. Typically, the sharing of access to fishing stations with outside communities was only within specific socioeconomic parameters - to repay debts, secure reciprocal resource rights, cement economic, social and ceremonial bonds between communities, or acknowledge kinship or fictive kinship between communities for example (cf. Mitchell and Donald 2001). With sufficient time, tenure at productive fishing sites appears to have allowed certain communities to maintain not only food security but also a kind of socioeconomic security through these mechanisms. Reflecting this phenomenon, researchers have suggested that there are positive correlations between salmonid productivity within certain aboriginal territories and the socioeconomic rank of the inhabitants possessing fishing stations (cf. Richardson 1982; Schalk 1997; Piddocke 1965; Suttles 1968, 1960, 1951).

Within this context, we find various traditional proscriptions on fish overharvest and strategies for salmonid intensification. Various sources, our own ethnographic consultants among them, allude to traditional salmon harvesting restrictions, such as net gauges to avoid capture of small and juvenile fish, allowing for partial escapement of particular runs, the partial dismantling of weirs when they are not in use to avoid inadvertent catches, and the discontinuation of the season's net fishing when catches reached a threshold that was perceived as inviting risk of "offending the fish" (Losey 2010; Deur 2005). A variety of sources also describe "stream-scaping" to facilitate or cultivate salmon passage (e.g., removing beaver dams or stone obstructions, or creating resting pools) and other habitat enhancements (Menzies 2012, 2007; Langdon 2006a, b; Jones 2002). Menzies (2012:174), for example, elaborates on the degree of habitat cultivation achieved by Gitxaała (Tsimshian) through "creek-scaping:" "In no way can Kxooyax [a stream] be thought of as a 'natural' space; it is totally creek-scaped. The path of the stream—from the high tide mark to the lowest low tide mark—shows clear evidence of human modification." Some stream modification was dedicated to facilitating selective harvest, such as creating points of access where salmon could be targeted individually, with gaffs or other equipment, while others might be devoted to enhancing reproduction, such as through the creation or maintenance of redds. While Menzies emphasizes modification for human production of salmon, there is also the belief that a well-tended stream can attract salmon and assist them on their journey towards reproduction, just as careful post-mortem treatment of salmon, through the ritualized return of the skeletal bones, helped point the way for future runs. On the other hand, an ill-cultivated stream with too much deadfall or man-made obstructions (such as blockading fish weirs) could insult salmon, causing them to not return to their natal stream (Thornton 2008).

These ideas were the product of social learning from Native peoples having built weirs that occasionally were too obstructive to salmon (perhaps as much as 5500 BP, according the archaeological evidence; Moss and Cannon 2011:16), thus harming salmon runs, sometimes to the point of extinction in a particular stream. Notions of insufficient escapement have also fuelled modern protests against non-Native management of salmon fishing, which often deploys tidal weirs that block salmon passage upstream (Kawaky 1981). Oral traditions of certain indigenous communities, including those on the fringes of the Northwest Coast culture area, document clear proscriptions against producing such impediments in the process of stream-scaping, depicted as divinely ordained and

required for the maintenance of interspecific and inter-village respect that, in turn, facilitates community resource availability (e.g., Deur 2007, 2011).

Transplantation as an Exemplar of Salmon Cultivation

Transplantation, the transfer of a plants or animals from one place to establish them in another, was well developed on the Northwest Coast for both keystone plants (e.g., berries and crabapples) and animals (e.g., salmon and herring). The transplantation of salmon exemplifies the intellectual, social, and practical elements of cultivation. There is evidence of transplantation of salmon eggs, smolts, and even adult fish between streams to address localized shortages, or to add temporal and species diversity to particular streams within a community's direct control (Thornton et al. 2010a, b; Thornton 2008, 1997; Langdon 2006a, b; Jones 2002; Bouchard and Kennedy 1990; Kennedy and Bouchard 1983; Sproat 1868). These cases of transplantation, mentioned only infrequently in the classic literatures of anthropology, were formerly treated as isolated and potentially idiosyncratic post-contact phenomena (Suttles 2005). However, these references continue to appear in focussed investigations in widely separated contexts – among the Tlingit, Nuu-chah-nulth, and Coast Salish for example – allowing an emerging consensus that active salmon cultivation was a characteristic practice of the pre-contact coastline, even if its manifestations were highly variegated along the Coast, reflecting a variety of cultural and environmental variables.

In the course of our research on the Northwest Coast, elders have sometimes described traditional limits on fishing duration and quantity of catch based on thresholds that might "offend" the fish and cause them to not return abundantly (Deur 2009; 2007; 2000; Langdon 2007; Chief Adam Dick, pers. comm. to Deur). "Disrespectful" behavior – including but not limited to overharvest – was depicted by these consultants as cosmological grounds for the fish to not return. As Drucker (1955:155) emphasized, "All the Northwest Coast Groups had long lists of regulations and prohibitions referring to the Salmon-people in order to continue to maintain good relations with these important beings" and to ensure they returned in abundance. Significantly, good relations always involved engagement and use, rather than long-term closures to fishing, which, like overharvesting, could offend and alienate salmon from returning to streams (Herman Kitka Sr. pers. comm. to Thornton 2007). Accordingly, shows of interspecific respect and reciprocity appear to have been key to "first fish ceremonies" – ceremonies performed not only for salmon, but for herring, eulachon, and other staple species on which communities have traditionally depended –to enhance fish productivity or, minimally, to reduce the chances of fish scarcity (Amoss 1987; Kennedy and Bouchard 1983; Swezey and Heizer 1977; Gunther 1926, 1928).

Encountering such assertions in multiple tribal contexts within the Northwest Coast, it is reasonable to conclude that these communities shared some prior experiences of fish scarcity that were perceived to be at least partially anthropogenic and ameliorated through ceremonial and other means. Such ceremonial efforts were (and in some cases, continue to be) a focal point of community ceremonial life. In our research along the full geographical span of the coast – from the Tlingit in the north, to the mid-coast Kwakwka'wakw, to the southern Coast Salish and Tillamook – there is evidence of a traditional "stream master" or "salmon chief" who oversaw human-fish relations both materially and ceremonially – monitoring harvests, enforcing proscriptions on overharvest (Thornton and Kitka 2010; Thornton 2008; Deur 2005; Treide 1965), and leading the first salmon ceremony for his counterpart, the chief of the salmon (Gunther 1928:150). Similar practices have been noted in bordering regions, including California and the Plateau (Hewes 1998; Swezey and Heizer 1977; Roberts 1935). In some cases, these were the responsibility of a clan chief, occasionally with the guidance of shamans or other advisors; in others they appear to have been undertaken by a specific individual within the community brought into service not only during fish harvests but at other times of the year when there was a need to mediate human-fish relations.

While the suite of ceremonial activities described here may have had ecological effects, their detection through means other than ethnographic research remains challenging, as their archaeological and genetic footprints are often faint at best. The same is true of most of the more mechanical resource management methods traditionally applied to salmon. Still, there is some tantalizing if thin evidence that certain first salmon ceremonies had demonstrable biological impacts that may have contributed to the robustness of salmon runs within individual streams. In certain contexts, ethnographic consultants have recalled what are understood to be pre-contact oral traditions, suggesting that unused portions of fish carcasses were conventionally placed back into their material streams. This was said to help the fish reconstitute themselves and effectively reincarnate so that they might return the following year (Chief Kwaxistalla Adam Dick pers. comm. to Deur). While recollections of fish cultivation practices along the Northwest Coast arguably have eroded to the point that systematic assessments of this claim are impossible at this date, elders' accounts provide anecdotal evidence that such practices were especially applied to oligotrophic or borderline oligotrophic river systems, such as within recently glaciated watersheds. This is indeed compelling, as recent developments in fish biology suggest that decomposing salmonid carcasses are often essential to maintain nutrient loads and trophic linkages that support salmonid productivity within such systems – where the very survival of the next generation of juvenile salmonids is, in effect,

contingent on their consumption of macro-invertebrates that subsist either directly or indirectly on the carcasses (Wipfli et al. 2003; 1998; Cederholm et al. 1999). Indeed, the placement of salmon carcases in streams has increasingly become a *de rigueur* component of salmon stock restoration strategies among biologists. This may have been a form of adaptation via niche construction among Northwest Coast groups in these more marginal environments (see Smith 2011; Thornton and Manasfi 2010). Further investigation of this point, and the degree to which aboriginal salmon ceremonies may have responded to these biological parameters, is clearly warranted.

While most studies of Northwest Coast resource management have focused on salmon, the full complex of salmon cultivation techniques from spiritual and ceremonial relations, tenure systems, stream-scaping, predator control, harvest strategies, to transplantation has yet to be fully analysed in a single integrated ethnographic study. Indeed, it remains unclear whether all of these practices occurred together over much of the region, or even if they would have been useful throughout the region. This may be partly due to the fact that the life-cycles and habitats of the five major species of Pacific salmon themselves are quite complex and varied along the coast (Groot and Margolis 1991; Richardson 1982). In addition, there are many ways that different Northwest Coast groups interacted and related to salmon, of which some, such as transplantation of salmon eggs, do not appear to be widely shared. Admittedly, incentives for the transplantation of salmon are limited; in an apparently genetic response to cycles of natural disturbance, a certain small proportion of salmonids seek out new streams at the end of their life cycle and populations are likely to rebound at a rate that, in most settings, would seem difficult to measurably enhance through human intervention. In this light, one might contrast the management strategy of transplantation – arguably a "restoration" or "enhancement " strategy in select streams where salmon populations (perhaps limited or depressed by natural disturbances) are deemed augmentable by new inputs– with carcass replacement – arguably a steam "maintenance" strategy for those watersheds that are being actively harvested. Especially in those streams where there were no prior catastrophic disturbances to salmon production, carcass placement may have been a more impactful practice than transplantation.

Simultaneously, other fish species do appear to have been transplanted to replace diminished populations. Kwakwaka'wakw (Kwakiutl") (interviewed by Deur) and Tlingit (interviewed by Thornton) elders recall oral traditions of transplanting Pacific eulachon (*Thaleichthys pacificus*) from robust populations to depleted streams, while Thornton has recorded Tlingit transplantation of herring (*Clupea pallasii*) (Thornton et al. 2010a, b, and this issue). Kwakwaka'wakw elders, such as Chief Kwaxistalla [Adam Dick] and Myanilth [Daisy Sewid-Smith], for example, suggest that the transplantation of eulachon occurred between rivers when natural shocks caused shortages on the receiving river, facilitated by kinship ties, inter-territorial resource access rights, and other structured associations between villagers from the rivers of fish origin and dispersal. Some of the foundational oral narratives from the Northwest Coast mention mythic beings, such as Raven and other transformers, transplanting eulachon as well as salmon to rivers as a way of preparing the land for human occupation, suggesting a widespread and deeply-rooted appreciation of the potentialities of this practice (e.g., Curtis 1915: 247), even as the environmental and socioeconomic incentives for the technique varied considerably between locations and between species.

One composite sketch of a transplantation of dog salmon (*Oncorhynchus keta*) in the mid-twentieth century from a mainland river in northern Southeast Alaska to an island stream at Deep Bay, near Sitka, illustrates the depth of Tlingit salmon knowledge and the nuances of cultivation and transplantation in a particular context. Frank Kitka (b. 1889) provided the expertise, which he attributed to his elders, or what the "Old Indians used to say." This account of the procedure is based on several interviews with Frank Kitka's son, Herman Kitka Sr. (b. 1914), between 1990 and 2008.

1. Select and capture appropriate salmon from a suitable mother stream. "You know the dog salmon from there [the mainland] are different from the ones here [the islands]. The local ones when they dry they're hard, and the ones from the mainland are really oily, almost like cohos. It made pretty good dryfish. That's how come the people used to praise the ones that came out of Klukwan [mainland community]. They're fatter than the ones we get down here. … When the Klukwan people taste my dryfish [from dog salmon transplanted from the mainland at Excursion Inlet] they say it's like you got the fish from Klukwan. 'No that's Deep Bay salmon!' It's [the source stream is] just a small stream that enters Excursion Inlet on the flats [where we got the fish]. Not very big. It was full of fish."
2. "We used a beach seine. My dad would pick each [salmon] up and the ones he threw to us we'd cut it open. I don't know how he knew. He never made a mistake. All the ones he handed us were all loose [i.e., ripe or ready to spawn]. And he instruct[ed] us to be careful, just cut enough to run the loose eggs out. Not to get too much blood in there was part of his instructions. He told us not to squeeze any of the milt, but leave it until we get to Deep Bay, then we'll stir it with Deep Bay water. So we didn't squeeze the milt onto the eggs, just let it run off into the bucket. [Thornton: How many salmon did you take for transplant?] Not very many, maybe 10 or 11, because the milt from the male also went in. It didn't take too many."

3. Keep the eggs and milt cool, covered and moist for transport. "[Dad] told us to throw everything together and keep it in [on] ice, cold, until we add water from Deep Bay to germinate it. He was right. He said they used to transport them a long time ago, cover them with [macrocystis] kelp when they're transporting them to another area…We brought two [five-gallon] buckets [full] of eggs [and milt]. We buried the buckets in ice. We didn't put any ice on the eggs, just on the outside. [Thornton: How long did it take you to transport them?] One day [to Deep Bay, about 70 miles away from the source stream]."
4. At the destination stream add local stream water and stir delicately. "We stirred [in the stream water from Deep Bay], and when we stirred it, [Dad said] just use our hands. He told us to be careful, to stir it gently. You don't go in there and swish it around (just enough to circulate it). My dad said it's very delicate. You can kill the eggs by moving them around too fast. When we add water from Deep Bay [river it] germinates it."
5. Let sit for half hour to germinate. [This is to ensure germination and to allow the fertilized eggs to acclimate to the local waters]. "Not very long [is needed], only about a half hour, anyway."
6. Create suitable habitat, and lay the eggs in "nests" (or redds) where you want the fish to return for spawning. "We made a strainer to pick it up [the eggs from the buckets], that's how we put them in the nest, so we didn't grab them and throw them in there. We were pretty careful, like he [my dad] instructed. We put them all in back eddies; we never put them where the water is running. [Did you dig a redd or nest?] Yeah…we pile rocks around them, and from the river, put the gravel over them … That's when I found out that sawbills [merganser ducks] that I used to shoot, that they were helpers. When they come to the [salmon] nests with eggs in it, the ones that look like they're cooked, the dead ones, that's the only ones they take out of the nest. They leave the transparent ones alone. So they keep the nests clean, so the dead ones don't contaminate them. That's when I stopped shooting them. I thought they ate everything; they didn't. We put the nests near the smokehouse too…Even in the big rivers, like in Nakwasina, the run goes all the way up. But when people were using all the loose eggs [i.e., collecting them from cleaned fish,] they plant them right in front of the smokehouse, so they keep building up the run there. Those that were hatched out by the smokehouse, they don't go up with the rest, they come back to where they came out of the gravel. That's the way with Deep Bay too, just around the bend, and they didn't go way up[stream]; way up is empty. Just the summer run goes all the way up. The fall run we put up there is staying around the smokehouse. Jim Parker when he was the local [Alaska Department of Fish & Game] biologist [late 1960s–1970s], he used to come out there [to Deep Bay] in the helicopter. He told me he wanted to take some way up[-stream]. He said they would fly the eggs for me way up. I told him I wouldn't do it. I told him they come right where we want it" [i.e., right by the smokehouse].
7. Wait 2–5 years for salmon to return. "When they [the first returns] came back, it looked like almost a thousand came back [from what was transplanted]… And I found out from that one [spawning of] dog salmon, 2 years later, part of them returned. So after they returned we never caught any more [for transplant]. And the [fisheries] professor from Sheldon Jackson [College] says they all come [back] one time [i.e., the same year]. Oh no, they don't! From one salmon [year], 2 year olds, 3 year olds, 4 year olds come; 5 year olds are the end of the run from that one particular group of [dog] salmon. They said I don't know what I was talking about. But they found out from tagging them, that the 2 year olds returned, and then the next year the 3 year olds returned. I already observed it, how they returned, so I argued with them. Then the biologists started using terms that I didn't understand. I told Schaeffer, Dr. Schaeffer, that I wanted to attend the night class to learn the scientific terms you folks is using. He said if I entered the class, he's gonna resign, that's what he told me" [laughs].
8. Take care of your stream. "We done that in the 1940s. And this is the 2000s, and they still come to the same place! Well, the old people studied it for thousands of years, you know…actually looking at the fish; I done that too… I watch what they're doing. The biologists say they just lay their eggs and the male would germinate [fertilize] them by squirting the sperm. And I told them that they germinate one egg at a time. And they asked me how I know. 'I watched it,' I told them. When the male and female come together, then the female goes and lays the egg. Then they germinate it together. Watching my [Deep Bay] salmon do that is how I learned… We were pretty careful, like he [my dad] instructed. This is where I had a lot of arguments with the professor from Sheldon Jackson who was on the [salmon] hatchery [board] with us. Everything I said was correct. That's why I say when you actually do it, it really stays with you. A lot better than reading it out of a book. When you read about it you forget about it when you turn around."

Was there a Tlingit term to describe the transplant? According to Mr. Kitka, "When they asked my dad about the dog salmon, he always told the Fish & Game that the dog salmon was his. In Tlingit he always say *Wudas[?] yík héendei xáat áwé* 'We're the ones that raised it [i.e., cultivated it] and put it in the river,' he said. And the whole community knew we put the fish there, and they always used to ask me if they could take some of my fish." This suggests

that cultivation was carried out by those with rights to a stream, under the supervision of a "stream master" (*Héen s'aatí* in Tlingit), and that those rights were recognised by other users as part of stream tenure. Cultivation and enhancement of streams and salmon also appears to have supported claims of individual, social group, and territorial status, as outsiders recognised that the wealth generated from cultivation was a product of skilled stewardship.

According to Mr. Kitka, other species of salmon were also transplanted. Of the five Pacific salmon, dog salmon were the most versatile to work with because, according to Tlingit ichthyology, they are the oldest salmon, from which other salmon evolved. Thus a dog salmon's eggs could be fertilized by any other salmon's milt and still hatch. But the reverse was not necessarily true for other salmon species' eggs. Herman Kitka sees salmon transplantation as a logical product of Tlingit place intelligence (Thornton 2008), of knowing, cultivating, and taking care of your stream. The impetus to transplant salmon was born of the desire to make Deep Bay both more productive for salmon and more conducive to its inhabitants' schedules of use in the emerging mixed wage and subsistence fishing economy. However, as he also makes clear, the transplantation practices were not new, but established techniques according to traditional ecological knowledge honed over centuries, if not millennia, for salmon as well as other species.

Transplantation was depicted as an "old Indian" means of enhancing food security and reducing livelihood risk by cultivating a salmon stream to optimize its abundance, predictability and spatiotemporal distribution of fish for human use. The prototype for cultivation may well have been the larger, multi-species (and perhaps eulachon possessing) mainland rivers, such as the Nass and Stikine, from whence Tlingit ancestors migrated. Indeed, the desire among island Tlingit to draw from mainland salmon streams of greater diversity and longer runs than theirs probably dates back some 5000 years or more, perhaps to when the Islands of the Southeast Alaska's Alexander Archipelago were first settled. It may have started with enhancing salmon spawning nests through "stream-scaping" and seeding them with loose eggs from salmon harvested from the same stream (as also practiced by the Kitka family at Deep Bay), and then developed into full inter-stream transplantation over time. Transplantation probably also was facilitated by trade and intercourse whereby indigenous peoples could experience, evaluate, and appreciate other species and their ecological conditions. Exactly when and how stream cultivation came to include transplantation is difficult to estimate, but the oral history and widespread, diverse nature of the practices, suggests an antiquity and duration well beyond the historical period.

In light of this evidence, and recent broader developments in scholarly attention to Northwest Coast mariculture, the ethnographic studies that follow focus on two less-studied resources in the coastal zone, herring and shellfish, cultivated among two separate Northwest Coast groups: the Tlingit of Southeast Alaska (with some reference to Haida) and the Kwakwaka'wakw of British Columbia. Like salmon, both are keystone species upon which people and marine ecosystems were dependent, providing not only food at critical times of the year when salmon were not available in quantity (Thornton et al. 2010a, b; Moss 1993), but also other vital "ecosystem services" (MEA 2005). Although not apprehensible throughout their lifecycles, both herring and shellfish were concentrated in accessible near-shore areas of the coastline more than ocean-migrating salmon. Indigenous knowledge of both species was thus detailed, and this intimate knowledge, combined with a willingness to experiment and ecologically engineer, seems to have facilitated the development of an elaborate mariculture complex around these species, perhaps unrivalled anywhere in the Americas. These mariculture traditions likely contributed to species presence and stability over long periods of time, and probably also enhanced resource abundance. By institutionalising cultivation practices, Northwest Coast peoples were able to bolster their stewardship, tenure, and control over critical coastal resource bases within their territories and seasonal rounds. It is clear from the Deep Bay salmon transplantation that these practices also contributed to social-ecological resilience (Resilience Alliance 2010) by extending the productivity and temporal availability of salmon resources for Tlingit families reliant on this ecological system, thereby improving their ability to cope with ecological and socioeconomic stress, changes and uncertainties.

These techniques, largely overlooked by Euroamerican observers until recently, are still known and, if not practiced among indigenous groups, hold relevance to contemporary management, enhancement, and restoration of these species in areas where they have thrived and arguably co-evolved alongside aboriginal populations. Such cases augment our understanding of the trajectories of resource intensification and niche construction on the Northwest Coast especially, and among "complex hunter-gatherers" generally. They may help to illuminate the ways in which resource "cultivation" has played out within multiple domains, at once motivated by considerations that are biological, dietary, social, economic, and spiritual. So too, it is our hope that these case studies will aid Native communities within this region seeking to better understand, conserve, and perhaps revitalize the cultivation practices of their ancestors.

In addition, we propose that a shift in orientation towards the concept of cultivation rather than the cumbersome, ethnocentric concepts of "conservation" or "resource management" also proves useful in improving our understanding of the historical ecology (cf. Balée 2006) of Northwest Coast landscapes and seascapes, which are too often wrongly assumed to be wholly "pristine" or "wilderness." In fact they manifest generations of interaction and co-evolution between human communities and the biotic systems within which they

are situated. Similarly, cultivation, with its emphasis not merely on "resources" but also interspecific relations within a social-ecological "knowledge-practice-belief complex" (Berkes et al. 2000), brings to the fore what Ingold (2000:11) and others have termed a "poetics of dwelling." Such a poetics represent not merely another technique or "alternative science" for controlling supply and demand of salmon or other culturally significant species, but a foundational way of sensing, responding, and being alive in the world. Anthropologically based studies of human ecology are uniquely equipped to capture the full range of human-environmental interactions that inform the origins, development, and contemporary variation of cultivation practices around the world in a manner that expands considerably on more mechanistic interpretations of human-environment relationships, accentuates the position of human agency, and illuminates the ways in which social and cosmological principles are commonly causative and mediative in human relationships with landscapes and other species.

Finally, as the two articles that follow seek to demonstrate, through such a holistic approach to cultivation ideologies and practices, local and traditional knowledge (LTK) studies on the Northwest Coast will certainly continue to illuminate aspects of human-environment relationships largely overlooked by earlier generations of researchers, who were conditioned to see these groups as hunter-gatherers rather than cultivators capable of "ecosystem stewardship" (Chapin et al. 2010) and sustainability strategies on a significant scale. Moreover, these studies will likely garner greater support from local tribes and First Nations which seek not only to contribute to scientific enquiry but also to maintain their poetics of dwelling and stewardship relations with key species and coastal ecosystems that their ancestors honed and cultivated from time immemorial.

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