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## "The Heartbeat of Our People": Identifying and Measuring How Salmon Influences Quinault Tribal Well-Being

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### ABSTRACT

Incorporating human well-being metrics into natural resource management (NRM) is a critical component to maintaining social-ecological systems, especially with tribal nations that are deeply connected to natural resources. The Quinault Indian Nation's well-being, for example, relies on blueback sockeye salmon populations, and is thus an important factor in determining appropriate salmon restoration strategies. Based on 18 interviews with key informants, we identified six domains of well-being related to salmon (Psychological, Social, Cultural, Physical, Governance, and Economic) and 23 interrelated attributes that could be measured to explore and monitor restoration options to provide the most culturally, economically, and biologically sound restoration decision. We demonstrate that salmon is directly tied to QIN subjective definitions of well-being in ways that include yet transcend material benefits. The multitude and magnitude of values associated with salmon furthers the importance of restoring salmon populations and provides additional benchmarks against which to make decisions and measure success.

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The field of natural resource management (NRM) is actively exploring ways to incorporate human well-being (HWB) indicators to more comprehensively assess the health of social-ecological systems (Millennium Ecosystem Assessment 2005; Collins et al. 2011). This trend is a response to the recognition that NRM decisions are often based solely on economic or ecological data (Campbell and Vainio-Mattila 2003; Christie 2011; Collins et al. 2011). While this can be an efficient way to make some natural resources decisions, it is not the most holistic consideration of human health in social-ecological systems (Chan et al. 2012; Russell et al. 2013), especially in tribal contexts where cultural values, spirituality, and social relationships are deeply intertwined with natural resources (Berkes and Folke 1998; Loring and Gerlach 2009; Tipa 2009; Donatuto, Satterfield, and Gregory 2011). HWB refers to the subjective and objective assessment of whether human needs are being met (Kahneman, Diener, and Schwarz 1999), including from both material and nonmaterial sources.

The identification and valuation of ecosystem services is one way environmental management has been linked to HWB (Millennium Ecosystem Assessment 2005; Collins

et al. 2011). Many initiatives, however, rely on monetary or ecological measures to represent the status of ecosystem services, rarely considering nonmaterial services such as culture (Chan et al. 2006). This problem likely stems from the facts that few natural resource managers have the tools to understand the cultural aspects of well-being embedded in tribal NRM (McLain et al. 2013) and few scientific studies identify components of culture in a format translatable to resource decision making (Satterfield et al. 2013).

Several frameworks attempt to assist natural resource managers in considering diverse aspects of well-being associated with nature (e.g., Tipa 2009; Britton and Coulthard 2013; Loring and Harrison 2013; Biedenweg et al. 2014). These frameworks often take observational data and build indicators useful for the evaluation, selection, design, and implementation of appropriate natural resource management strategies. Such indicators include both natural metrics (such as levels toxics in shellfish) and constructed measures (such as an experience of awe) (Satterfield et al. 2013). While the compartmentalization of frameworks and indicators may detract from the holistic symbolism commonly attributed to natural resources within resource-based communities, the ability of holistic symbolism to merge with existing NRM processes may be critical.

Specifically related to small-scale natural-resource-based communities, Tipa (2009) developed a cultural health index that allows the Maori worldview of streams to be considered in river flow management (Tipa 2009). Loring and Harrison (2013) applied a three-dimensional framework to evaluate the social and cultural importance of the opening day of salmon fisheries in Cook Inlet, Alaska. This framework has been used by others (e.g., Britton and Coulthard 2013) and includes material, relational, and subjective assessments of the impacts of management actions on fishers and fishing communities. Native American values have also been used to characterize community well-being related to natural resources. For example, the Swinomish in Washington State defined tribal health to include food security, ceremonial youth, knowledge transmission, and community cohesion, each with associated indicators such as abundance, access, and sharing (Donatuto, Satterfield, and Gregory 2011). In a mixed-demographic study, Biedenweg et al. (2014) identified six domains of HWB related to the environment based on a review of scientific literature (Psychological, Social, Economic, Cultural, Physical, and Governance) and then tested their relevance in a watershed made up of three counties and two tribes. Compared to other natural resource management frameworks, these place-based studies may provide a fuller notion of well-being by including diverse aspects of cultural and psychological health, rather than the standard inclusions of economic well-being, toxics, and recreation opportunities (e.g., Halpern et al. 2012). In spite of this potential, however, these hypothetically generalizable HWB frameworks have rarely been tested outside the regions where they were developed to explore external validity. More importantly, they are rarely applied to develop metrics that easily integrate into NRM processes.

This article presents the results of a case study in the Quinault Indian Nation (QIN) in Washington State that focused on two questions: (1) What are the diverse attributes of tribal well-being associated with salmon?; and (2) How might we measure them to develop indicators to influence NRM? We specifically focused on values associated with salmon, as this is a resource of great importance to the tribes in the Pacific Northwest for which significant resource management decisions are being made. As described by the late Billy Frank, Jr., former Chairman of the Northwest Indian Fisheries Commission: “Salmon are

the measuring stick of well-being in the Pacific Northwest" (Smithsonian National Museum of American History 2013).

## Background of the Quinault Indian Nation

Significant evidence ties Pacific Northwest tribal well-being to salmon. Rickert (2007) describes "the near-symbiotic relationship between the Northwest Indian tribes and the fish that were the backbone of their diet and culture," and Colombi (2005) argues that salmon is integral to tribal culture, particularly the Nez Perce, in saying:

Since time immemorial the Nez Perce revered anadromous fish and healthy watersheds as a paramount symbol to their cultural and religious identity. This several- millennia-old relationship was built upon three main elements: salmon as food, salmon as an object of trade, and salmon represented as a necessary component of traditional religious expression. (Colombi 2005, 576)

The QIN exemplifies this relationship. It is the largest reservation on the Olympic Peninsula in Washington State and is made up of descendants of the Quinault, Queets, Hoh, Quileute, Chinook, Cowlitz, and Chehalis (Storm and Capoeman 1990). Currently the reservation encompasses 208,000 acres of land and is adjacent to the Olympic National Forest, Olympic National Park, Washington State Department of Natural Resources, and private timber industries (James and Chubby 2002). Within the reservation lies the 68-mile Quinault River, which flows from its headwaters in Olympic National Park through Quinault territory down to the Pacific Ocean.

To the QIN, the Quinault River is the vital habitat for the blueback salmon (*Oncorhynchus nerka*), a genetically distinct type of sockeye (Storm and Capoeman 1990). Along with elk, deer, sea lions, shellfish, and a variety of plants, blueback has been a primary source of food for the QIN people (Storm and Capoeman 1990). Historically, they fished with a variety of methods including river traps, trolling, line fishing, nets, and spearing (Storm and Capoeman 1990). While salmon are generally important to the Quinault, when speaking of valued salmon, tribal members are often referring specifically to the blueback. Blueback are smaller than most sockeye at only 2–4 kg and return primarily to the Quinault River system, where spawning occurs from late winter to early spring in Lake Quinault (Storm and Capoeman 1990). Historical estimates of blueback numbers run into the millions, but in 2007 the National Park Service estimated that the number of blueback returning to the Quinault was less than 5,000 (National Park Service 2013). Probably the biggest cause of decline has been clear-cutting of forests that caused log jamming and other water quality issues, reducing the capability of streams to support fish habitats (James and Chubby 2002).

The case of *United States v. Washington* established the QIN and other tribes as co-managers of Washington State fisheries. The QIN, through the Quinault Department of Natural Resources (QDNR), co-manages the Quinault River with state agencies (Washington Department of Natural Resources and Washington Department of Fish and Wildlife), federal agencies (U.S. Forest Service, U.S. Fish and Wildlife, and National Oceanic Atmospheric Administration), and other neighboring tribes such as the Makah or Quileute. The multiple levels of collaboration have resulted in conflicts; tribes often have different perspectives about how to manage rivers that are not understood by federal and state agencies or neighboring tribes. The QDNR promulgates policies regarding harvest

management, hatcheries, and monitoring of fisheries. Additionally, the Tribal Council determines the distribution of fishing grounds to tribal members.

The QIN is working to revitalize salmon populations, using policies developed since the 1990s by the tribe and approved by Bureau of Indian Affairs (BIA) management. These include a variety of fish enhancement projects, including two hatcheries owned by the QIN and one run by the U.S. Fish and Wildlife Service (James and Chubby 2002). The QIN produces 5–10 million juvenile salmon and steelhead annually (Ruby et al. 2010), but blueback populations are still low. To enhance blueback populations, the QIN has collaborated with a nonprofit conservation nongovernmental organization (NGO) to create salmon habitat through engineered logjams and shoreline stabilization.

## Methods

The research team included the QIN's Cultural Resource Specialist, who assisted in the design of the most culturally appropriate research methods for exploring diverse values related to salmon. He served as a collaborating researcher throughout the entire process, providing background materials, commenting on the research materials and methods, setting up interviews, clarifying tribal views of salmon, and co-authoring this article.

The Cultural Resource Specialist identified key informants who represented three broad age groups (20–50, 51–80, 80+ years), as well as diverse economic and cultural relationships to salmon. We targeted the three age groups to focus on those holding the most traditional knowledge, while still exploring the perspectives of younger generations. We conducted interviews until the research team subjectively assessed theoretical saturation of the attributes of HWB associated with salmon. We confirmed theoretical saturation during the analytical process described in the following paragraphs. Our final sample was 18 interviews, which fits within ranges from similar studies that demonstrated theoretical saturation for cultural domains from 6 to 18 informants (e.g., Struthers and Hodge 2004; Gerwing and McDaniels 2006) and is reasonable considering the fairly homogeneous, long-held relationships between Quinault culture and blueback salmon. Eleven interviewees were men and seven were women. The majority of people interviewed were between the ages of 50 and 80 years ( $n=11$ ); 3 were over 80 years old and 4 were under 50.

Interviews ranged from 15 minutes to more than 2 hours (3 at 15–25 minutes, 5 at 45–60 minutes, 11 at 60–90 minutes, and 1 more than 2 hours), and all were conducted within the QIN. The Cultural Resource Specialist was present for all interviews to make the interviewees more comfortable and to assist with navigating cultural appropriateness. We prepared four general questions, pertaining to (1) the interviewee's role in the community pertaining to salmon, (2) how or why salmon was important to them and the community, (3) how salmon influenced QIN culture, and (4) the interviewee's vision of a healthy river. The latter was to understand tribal member associations between healthy rivers and fish. Five interviews focused primarily on these questions. Due to the frequent mention of the economic values of salmon and logging as additional income-generating activities, we added specific questions about how salmon is important to the tribal economy and how logging affects salmon. Each interviewee gave his or her consent to be interviewed, and all interviews were recorded on a digital audio recording device. The identities of the interview subjects were kept confidential from everyone outside the research team.

**Table 1.** Domains, attributes, example quotes, and potential metrics for human well-being related to salmon in the QIN.

Domain	Attribute	Example quote	Potential survey question
Psychological	Nostalgia	I still feel bad because my children won't see what I saw.  So that's the best fish that I've ever ate. Ours is the native fish. And so that's like the best fish. Native.	Sometimes I feel sad about the current status of salmon populations. (5-point scale: strongly disagree-strongly agree) Currently I am proud of my tribes' relation to salmon. (5-point scale: strongly disagree-strongly agree)
	Pride	I'm my own boss when I'm fishing, even though it gives you... I don't know, well you don't have to answer to somebody.	My work with salmon makes me satisfied with life. (5-point scale: strongly disagree-strongly agree)
	Satisfaction	I got some friends out there that have been, you know, they were fishermen, but they never set money aside for when they get old, so what do you do when you don't have an income anymore?	I feel that a career in salmon fishing is a financially secure job. (5-point scale: strongly disagree-strongly agree)
	Security	That's a sad situation.	In the past year, I participated in a community event with salmon as the main dish (yes/no).
Social	Communal events	When people have their family dinners that's this time of year and later in the spring and early summer you know that is the fish that we go to. They want to put their best foot forward and have a nice family community dinner.	I share or donate salmon within the community. (frequency on a 4-point scale: everyday during harvest season, several times a week during harvest season, a couple times during harvest season, rarely or never).
	Giving	Most of the time I get fish and just give to the elders down here. They'll either smoke it or can it or just munch on it.	The percentage of salmon I eat that comes from Quinault territory is ... (range of fixed options to select from). The percentage of my income that comes from salmon is: (range of fixed options to select from).
		That is the life the way we survive there without having hardly any jobs. Fish and clams were our life. Well a lot of them make their living off it. You got fish guides up the river who fish. This is how they survive.	I barter salmon for other goods. (frequency on a 4-point scale)
Economic	Consumption	We traded fish. Our closest neighborhood was 5 or 6 miles. So we would trade, barter, only take what you need.	I believe you should give away your first catch. (5-point scale: strongly disagree-strongly agree)
	Income	Yeah, that's just how the tradition is. You have to give away your first catch.	In the past year I prepared or participated in a first salmon ceremony. (yes/no)
	Trade	If you don't [practice the first salmon ceremony] then your greed is taken over and then you seem you don't catch as much fish	In the past year I prepared or participated in the traditional way. (yes/no)
		You get to smokehouses and smoke them, but you don't see a lot of people drying them, taking the racks and drying it out.	My tribal identity depends on the abundance of salmon. (5-point scale: strongly disagree-strongly agree)
Cultural	Traditional beliefs	If we didn't have salmon we wouldn't have us.	Because of salmon, I am able to live my preferred lifestyle. (5-point scale: strongly disagree-strongly agree)
	Ceremonial traditions	It gives me a little more time in the summertime with my family and my kids.	I prefer to eat salmon over other sources of protein. (5-point scale: strongly disagree-strongly agree)
	Food preparation	My family and friends try to get them to eat salmon whenever we get it.	

(Continued)

**Table 1.** Continued

Domain	Attribute	Example quote	Potential survey question
Physical Governance	Traditional knowledge and practices	I think it's probably just how that person's been raised and taught how they are fishermen.  Ours is the native fish. And so that's like the best fish. Native.	In the past year, I have taught children or youth about salmon fishing. (frequency on a 4-point scale)
	Nutrition	But that is another fish that our elders use for medicine and stuff.	There is no cultural difference between wild and hatchery salmon. (5-point scale: strongly disagree-strongly agree)
Governance	Access	See each one of them on this river is about 125 fishing locations and each one of them locations continues to be passed down the family. That is changing.  You can see the stats and the changing of the river, and they have set boundaries in the tribal lots, but they don't enforce them. Well they change it [rules] whenever they want and however they want.	On average, salmon contributes to % of my diet. (range of fixed options to select from)
	Enforcement	So most of the problem from these gill-nets right here. And the problem comes from our committee there, fish and game committee.	I am able to fish my traditional fishing locations. (5-point scale: strongly disagree-strongly agree)
Transparency	Trust	It's very important on the work that we do to keep that fish alive.	I believe that fishing regulations are adequately enforced. (5-point scale: strongly disagree-strongly agree)
	Stewardship	The current salmon fisheries management incorporates my cultural values. (5-point scale: strongly disagree-strongly agree)	The allocation of fish grounds is clear and fair. (5-point scale: strongly disagree-strongly agree)  I trust the QIN government to make the right decisions regarding salmon management. (5-point scale: strongly disagree-strongly agree)

Interviews were transcribed and coded with the qualitative data analysis software ATLAS.ti in two phases. To test the external validity of existing HWB frameworks, we used the Biedenweg et al. (2014) six domains (Psychological, Social, Economic, Cultural, Physical, and Governance) as a starting point for precoding general values ascribed to salmon. We selected this framework because it seemed to encompass the values we had heard during the interviews. Two members of the research team determined intercoder reliability by independently precoding the same interview into the six domains and then discussing the similarities and differences to generate an agreed-upon codebook (Saldaña 2012). The coders found that the Biedenweg et al. (2014) framework sufficiently encompassed the variety of values expressed by the respondents.

This deductive phase of coding was followed by a second, inductive phase of coding to develop attributes within the domains. Readers one and two independently developed the attribute codes, with theoretical saturation occurring by the 12th interview (Saldaña 2012). Disagreement between the two readers was again discussed and final codes were established at the attribute level. The inductive phase of coding is particularly important as it allows researchers to develop an understanding of people's relationship to the topic through the respondents' own language, associations, and worldview (Denzin 1989).

### ***Metric Recommendations***

As mentioned in the introduction, enabling the consideration of nonmaterial HWB values in NRM requires finding metrics that can use existing resource management tools and processes. Because nonmaterial values are difficult to monetize or count, their representation in NRM usually requires the creation of ordinal data, such as the degree of satisfaction with policies, which have a natural order that allow easy comparison of trends across time or between human populations. While social scientists have used such metrics for decades, the application of these measures may not be obvious to natural resource managers. Throughout our detailed results section, in Table 1 we suggest survey questions that would provide ordinal data on the current status of each attribute of HWB related to salmon habitat restoration in the QIN. Such questions can be asked using a survey that is appropriately distributed to a representative sample of the study population.

## **Results and Metric Recommendations**

### ***Domains and Attributes Summary***

The six domains, Psychological, Social, Economic, Cultural, Physical, and Governance, were chosen to organize and describe the different types of values that respondents associated with salmon. We were logically inclined to use the first five as they are widely accepted by tribal members as well as scientists. Psychological well-being describes a tribal member's mental health in relation to salmon, such as positive or negative emotions associated with an increase or decrease in salmon. Social well-being represents the strength of relationships within family and the broader community, often exemplified through sharing among members of the community. Economic well-being encompasses the contribution of salmon to income and economic status. Cultural well-being refers to the tribe's continued sharing of common beliefs and customs around salmon. Physical well-being is the physical health associated with salmon such as a source of protein or nutrition. Lastly, the

interviewees described significant issues of environmental governance when talking about their ability to connect with salmon. While this can arguably be considered a mediator of the ecosystem service process, we decided that making it a domain would highlight its critical role in tribal perceptions of well-being associated with salmon.

The salmon-based values most mentioned by interviewees were identified in the cultural domain, including ceremonial traditions, traditional values, food preparation and preferred foods. For each attribute, we provide example quotes from the interviews, followed by the gender and age group of the respondent, and potential survey questions for monitoring their status as a result of NRM (Table 1).

### ***Psychological***

The psychological well-being of QIN tribal members is deeply intertwined with the abundance of salmon. This manifests itself in the feelings of nostalgia, pride, satisfaction, and security. Ten respondents described the pride they felt as a result of being connected to the blueback.

This is the prized fish of who we are. We are a fishing people but the blueback and the sockeye is very, very important to our lifestyle. M 20–50

The Quinault are incredibly proud of their nation's natural resources and believe that the blueback is the best sockeye available. To monitor the status of this attribute, we could develop a 5-point Likert-style question for their level of agreement with the statement that they are proud of their tribe's relationship to salmon (Table 1).

Another important psychological aspect of salmon is satisfaction. Those who chose a salmon-dependent profession benefit from the flexibility and freedom of that profession. Four respondents discussed how salmon gives them satisfaction.

Youngsters from 20 to 30, are going into the fisheries because you don't need an education. You don't need too much experience or knowledge. They like the freedom of being able to come and go as they choose. M 50–80

Salmon can also be a risky business. Four respondents discussed a decline in their sense of security due to dwindling numbers of salmon.

Um, when they can go out there, a lot of them was getting loans from the tribe to get their gear. But they, the ones that did, they didn't have responsibility. So it just flopped. F 20–50

There was also a discussion of nostalgia for the past in reference to both salmon and traditional lifestyles that salmon provides.

It's sad. It's sad to see it all go. I am not that old. It's gone. F 50–80

The notion of sadness described by the decline in salmon is related to the concept of solastalgia, or anguish felt by the decline of natural resources (Albrecht et al. 2007). Considering these four prevalent psychological attributes, the decline in salmon could potentially have mental health implications on the QIN community.

### ***Social***

Salmon enhances the social fabric of the community, which plays a critical part in the well-being of the QIN. Two attributes arose from the social domain: communal events and the

idea of giving or sharing. Salmon is featured at a variety of events such as community dinners, funerals, and fundraisers. These events bring people together, often using salmon as the centerpiece.

The [students] use the blueback for their fundraisers. It brings us together. M 20–50

The attribute of giving salmon was mentioned by nine respondents.

We share and give it away and sometimes my husband will use it when he goes to different places and just give it to people ... because they don't get the fish. F 20–50

Families share salmon between themselves and among the community, but it is especially important to give salmon to the elders, a finding that has been confirmed in related studies (e.g., Donatuto, Satterfield, and Gregory 2011). Many elders cannot fish due to bodily restrictions and several cannot afford to purchase salmon. Interviewees discussed how elders depend on the younger generations sharing salmon with them. A decline in salmon means that it is not readily accessible to members of the community, decreasing a person's willingness or ability to share. One respondent mentioned a season where he only had three blueback, two of which he shared with elders.

I told Nelson I would give him some blueback last year but I only had three. M 50–80

The two attributes associated with the social domain of salmon are clearly interrelated; communal events are one avenue for giving salmon to members of the community. If members are not willing to give away their salmon, communal events could not proceed.

### **Economic**

Salmon is a vital component of the QIN's economy, which we describe in three attributes: household consumption, income, and trade. Although tribal members receive both direct and indirect economic benefits from salmon, these attributes describe only the direct economic benefits respondents perceived from salmon. Nine respondents mentioned that salmon is a main source of protein. Not only do members of the tribe enjoy eating salmon, they believe that it is a less expensive source of food. The Quinault reservation is located in rural, coastal Washington and it is difficult for QIN members to get to the grocery store. Salmon provides an easy and inexpensive way for members to feed their family. Additionally, preserved salmon has a long shelf life for consumption throughout the year.

I think families still survive on that [salmon]. You know that's some families that's what you have. Living 45 minutes from Safeway makes it a pretty big deal. The way the economy is the way the gas prices are. M 20–50

The QIN are economically dependent on salmon not only because of its status as a food staple but because it provides a source of income for many members of the tribe. Tribal members work in the hatcheries, as fishing guides, as commercial fishers, and other jobs that are salmon dependent.

Well a lot of them make their living off it. You got fish guides up the river who fish. This is how they survive. F 80+

It is unclear how many members of the community are dependent on salmon as a source of income, but informants suggested that the combination of fishing, working in

hatcheries, and guiding provided a significant source of income. Salmon is not necessarily a year-round source of income, but for some it is a primary source of income and for many it is a supplemental source. According to interviewees, those who did not graduate from high school were the most likely to use salmon as a way to make a living.

Some of them don't know how to read. But that's the ones that go fishing. That's how they make a living. F 50–80

While salmon is associated as a source of income for the community, it is also a trade commodity, as described by four interviewees. Salmon has historically been used for trading between families as well as other tribes (James 2012, Storm and Capoeman 1990). While trade is not as popular today, QIN members still trade among each other and along the coast, commonly for canoes, medicines, whale, and elk meat.

But they use the fish the same way we all do up and down the coast; medicine and culture and celebration and trading for other items that they need. M 50–80

The primary economic theme from all interviews was that salmon is a vital source of the QIN formal and informal economy that can only benefit from an increase in abundance of salmon. Salmon provides a variety of jobs for the QIN with many members of the community depending on salmon either as a source of income or an economical way to feed their families. If salmon populations continue to decline, many tribal members will lose an important source of income and food.

### **Cultural**

While culture can be defined in a variety of ways, we focused this domain on the manifestation of culture through traditional beliefs, ceremonial traditions, food preparation, identity, preferred lifestyle, preferred food, traditional knowledge and practices, and traditional values. Like many other tribal communities (i.e., Gerwing and McDaniels 2006; Castleden, Garvin, and Nation 2009; Donatuto et al. 2011; Ebbin 2011; Colombi 2012), the Quinault view salmon as a critical part of their culture. Three respondents described how salmon is tied to tribal beliefs, including the ability of tribal practices to influence salmon abundance.

If you don't [practice the first salmon ceremony] then your greed is taken over and then you seem you don't catch as much fish. But when you give it to one of the elders in the village, the abundance of fish will come. That's the way we were taught on the river. M 50–80

Ceremonial traditions was the most commonly mentioned attribute of culture with 17 respondents. The first salmon ceremony mentioned in the prior quote is the most important cultural ceremony and consists of sharing the first-caught blueback of the season with family and elders. The bones are then returned to the water to ensure a healthy salmon harvest for the next year (James 2012).

Food preparation is another aspect of cultural practices and was mentioned by 11 respondents. This attribute refers to the way the salmon is prepared and cooked for consumption. For example, smoking salmon was common before contact with white settlers and remains popular today. Although we highlight this attribute in the cultural domain, we emphasize that preparing salmon for a meal is also a social attribute; it's another way members of the tribe come together.

Traditional food preparation can be an indication of the status of traditional knowledge. Over time, some traditional practices die out and as salmon populations decrease there are fewer opportunities for younger members to learn or participate in traditions. Yet salmon contributes significantly to the cultural traditions that elders hope will be carried on by future generations. To capture this broader concept of transmitting traditional knowledge and practices, we have denoted it as its own attribute described by nine respondents.

Because that way they're not learning the traditions, they're not learning from the elders, they're not learning from the fishermen—you know, so that knowledge isn't passed on to them if they're living in Aberdeen or some other city. F 80+

The transmission of traditional knowledge and practices is deeply related to the maintenance of traditional values, which were mentioned by 14 respondents. While discussing salmon restoration, Quinault expressed their appreciation, or reverence for nature. Their respect for nature allows them to acknowledge the variety of factors affecting salmon populations and to appreciate nature's offerings.

Mother Nature does what she wants and time will tell [if we will get a good run of salmon].  
M 20–50

As the economic domain demonstrates, salmon-dependent jobs are mostly seasonal. While this can be a financial burden, it is also a preferred lifestyle and thus a critical cultural element for many. Seven respondents believed that salmon allows for a preferred and more traditional lifestyle that is similar to their ancestors.

It gives me a little more time in the summertime with my family and my kids. M 20–50

The manifestation of these traditional lifestyles, practices, knowledge, and beliefs is a unique identity to the QIN. Seven respondents discussed how blueback is a part of the QIN identity. High school students referred to salmon as the tribe's mascot. Older members discussed how salmon is the "heartbeat of our people" (M 20–50).

### ***Physical***

As previously stated, salmon was a traditional subsistence food and has remained a primary (or at least desired) source of protein. Seven interview respondents described salmon's association with nutrition and physical health, viewing it as a source of protein that contains vitamins and nutrients that will make them live a long, healthy life. Elders specifically prefer to eat salmon when they are sick because they believe its nutritional value aids healing.

Salmon? It's healthy. Salmon is good for you. Like Omega 3 in salmon? Might make you live longer. M 50–80

Others feel that there is a decline in health and a decline in one's tolerance for salmon correlated with the change in diet associated with salmon availability. If members are unable to consume salmon regularly, they believe they may become allergic or intolerant to salmon when they do eat it.

And I think the system, your body system, when you go without too much [salmon], then it's not accepting those kind of oils and stuff when you're eating it. And you get allergic to it. My

daughter used to just love fish, but she said now when she goes to eat it, her stomach gets upset. F 50–80

Thus, salmon is associated with nutritional value and healing, but its role in QIN diet is shifting. According to many respondents, more salmon available for consumption could improve the physical health of community.

### **Governance**

We coded five attributes related to the governance of salmon: access, enforcement, stewardship, transparency, and trust. Fishing ground access is passed down from generation to generation but can also be assigned through the tribal council. The division of fishing grounds among the tribe is a complicated and frequently contentious process. Eight respondents felt that the tribal council did not allocate fishing grounds in a fair and unbiased fashion, resulting in unequal access to salmon. Because some grounds are considered to be better than others, and some perceived nepotism in allocating fishing grounds, certain families may receive the best fishing grounds every year.

They changed a lot of our rules. I don't know. I don't think they're good for the river because like all things groups that are family oriented they will look after their family and they will change the setup. M 50–80

In addition to determining access rights, tribal council is also responsible for enforcing fishing policies. Six respondents felt that the council and the fishing committees did not have enough teeth to enforce fishing policies. Respondents discussed that many tribal members would break fishing laws but there was no one there to punish them.

Well, my dad, he is always complaining about the enforcement officers and how they aren't doing their job. M 50–80

Another important aspect of governance is transparency. Six respondents referred to transparent policymaking processes as influencing their well-being in relationship to salmon. They described a lack of communication between tribal-employed scientists and the community, affecting salmon management and public understanding of what is being done to help the river. Many respondents were unaware of how restoration projects would help the salmon population.

I just think there's gotta be a little more focus on how they go about getting the fisherman in the public know. I don't know how much impact they had on the manmade dams in the upper Quinault. M 50–80

Those who mentioned a problem with communication had worked in the fishing industry at some point, whereas those who were completely unaware of restoration projects never had fishing-related jobs.

Trust is often linked to transparency. Five respondents discussed the lack of opportunities to participate in the decision-making process and that this resulted in mistrust. Specifically, members felt that those who were in charge of managing salmon did not listen to their opinions.

So most of the problem from these gillnets right here. And the problem comes from our committee there, fish and game committee. M 20–50

Despite the perceived flaws in the governance of salmon, the tribe values its stewardship activities, including hatcheries. The QIN members view themselves as environmental stewards and are proud of their overall management. They believe salmon is a part of who they are and are willing to do whatever it takes to ensure its survival.

We are in a pretty unique system here, though the Parks Service, the Forest Service, and the Quinaults. It is all tribal ownership and not as much industrial pollution. M 50–80

### ***Interrelationships***

We do not imply discrete categories of tribal values associated with salmon by presenting them within these six domains and 23 attributes. This compartmentalization and disaggregation has analytical and practical usefulness, but should be understood as being inherently different from how tribal nations actually perceive their holistic relationship to salmon. Tribal members do not talk about their values using these categories; rather, they talk about the pervasive interrelationships between the QIN and salmon. For example, quotes show that a respondent will talk about how a decline in salmon can result in a decline in sharing, ceremonies, and mental health. Because of these connections, many of the attributes could fall under a variety of domains. While we placed identity within the cultural domain, for example, we could also easily categorize it within the psychological domain. We recognize the inherent subjectivity of categorizing attributes into separate domains. The development of specific categories, however, ensures attention to the diversity of aspects of HWB in NRM and functions to communicate these values with those more comfortable and familiar with data reduction, which is often the case with natural resource managers.

### **Conclusion**

This study explored two questions: (1) What are the diverse attributes of tribal well-being associated with salmon?; and (2) How might we measure and organize them to develop indicators to influence NRM? Through interviews with QIN members, we found that salmon is directly tied to QIN subjective definitions of well-being in ways that include yet transcend material benefits. The six domains that form the Human Wellbeing Framework by Biedenweg et al. (2014) created a comprehensive framework that facilitated attribute development, while other frameworks, such as the Donatuto, Satterfield, and Gregory (2011) Cultural Health Index, had some overlaps but did not also address the importance of material benefits. We concluded that to examine well-being related to salmon we needed a holistic view that encompassed economic well-being as well as psychological, cultural, social, and physical health.

One of the barriers for considering nonmaterial values in NRM has been a lack of data that readily translates into existing decision frameworks. To address this, we presented example survey questions that would translate many of the nonmaterial values from the interviews into ordinal metrics. These measures were validated as relevant during a community workshop held at the QIN and attended by 10 tribal members (6 women and 4 men) and 2 male tribal employees. Although we tested the validity of these questions with the participants, we did not conduct a full survey with the QIN as would be necessary to inform NRM. In this and other contexts, natural resource managers can collect ordinal data

from a representative sample of the target population using a survey tool (e.g., Web-based surveys, in-person household surveys, or mail-based paper surveys) and sampling design that is appropriate to the region. The data can then be analyzed to demonstrate the status of well-being related to natural resource issues.

For example, in the QIN, imminent policies include a forest management plan and other salmon habitat restoration activities. The former includes the designation of riparian buffer widths that are hypothesized to enhance salmon streams by preventing erosion. In trade-off, this reduces the extent to which timber can be commercially harvested and may impact other important traditions. Habitat restoration has also focused on the development of engineered logjams within the river, which are hypothesized to modify stream flow and generate favorable conditions for salmon spawn. It is unclear, however, whether this is the most culturally beneficial option. By collecting human well-being metrics related to natural resources before and after projects, QIN Department of Natural Resources can monitor the extent to which these policies are impacting broader economic and cultural values. If resources are not available to conduct surveys, the simple identification of culturally valued metrics can enhance the conversation about the most appropriate NRM strategies that take into consideration diverse attributes of well-being of those who steward and depend on the natural resource.

The attributes of tribal well-being identified in this study may be important to other co-managers. While these data are specific to the Quinault context, they could provide a framework for other coastal tribes such as the Quileute or Makah. Federal and state agencies could also use this information to confirm the cultural relevance of management processes and decisions.

Current trends in NRM look to manage for healthy social-ecological systems. To begin addressing this, projects must measure success beyond ecological returns. In this article we demonstrate how sociocultural values can be determined and suggest how such information can be translated into indicators used for planning and monitoring purposes. The multitude and magnitude of values associated with salmon further the importance of restoring salmon populations and provides additional benchmarks against which to make decisions and measure success. This roadmap can be applied with other tribes or resource-based communities to integrate traditional and local ecological knowledge into NRM.

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