

**FY 22-31 *PROJECT* PROPOSAL**  
**DEVELOPMENT OF MARICULTURE (EXCLUDING FINFISH)**

*Proposals requesting FY22 - 31 funding are due to [shivay.wang@alaska.gov](mailto:shivay.wang@alaska.gov) and [linda.kilbourne@alaska.gov](mailto:linda.kilbourne@alaska.gov) by March 29, 2021. Please note that the information in your proposal and budget form will be used for funding review. Please refer to the Invitation for the specific proposal requirements for each Focus Area. The information requested in this form is in addition to the information requested in each Focus Area and by the Invitation. We may make inquiries regarding the project and proposer(s), including consulting with agencies or other parties. Project proposals may be submitted in response to only one current Invitation (FY 22-31 or FY 22-26). A project that is submitted under both Invitations may be disqualified from consideration. Please indicate below if your proposal contains confidential information.*

Does this proposal contain confidential information?  Yes  No

**Project Number and Title**

22220301 Social, cultural and economic assessment of kelp mariculture opportunities for coastal villages within the EVOS spill zone

**Primary Investigator(s) and Affiliation(s)**

Aaron Poe, Alaska Conservation Foundation (PI)  
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**Date Proposal Submitted**

March 29<sup>th</sup> 2021 (revised August 20, 2021)

**Project Abstract (maximum 300 words)**

*The abstract should provide a brief and concise overview of the overall goals and hypotheses of the project and provide sufficient information for a summary review as this is the text that will be used in the public work plan and may be relied upon by the EVOSTC Public Advisory Committee and other parties.*

This is a 5-year project to assess how Indigenous kelp mariculture operations within the spill zone would be socially beneficial, economically viable and compatible with local cultural values of coastal communities. In the 30 years since the Exxon Valdez Oil Spill (EVOS), substantial research has been conducted to understand the status of injured species and habitats, yet less work has been directed to evaluate potential strategies that address continued social, cultural and economic impacts (i.e., *injured services*) to coastal communities in the spill zone. Alaska generally, and the spill zone specifically, now stand at the forefront of an emerging kelp mariculture industry that has demonstrated restorative effects such as improving water quality for ecosystems in other locations. Kelp mariculture has also shown promise to create temporary habitat at key times to buffer important species like herring and salmon from some of the rapid changes now being observed in nearshore habitats (e.g., increased acidity and warmer water temperatures). These broad ecosystem stressors are also challenging the stability of the commercial fishing industry and subsistence harvest of local communities. There is growing recognition of the thoughtful inclusion of kelp mariculture as a critical component to ensure the socioeconomic sustainability of communities in the spill zone. Understanding and establishing the potential benefits of kelp farms in the spill zone relies on baseline data collection including local, Indigenous, traditional ecological knowledge, and

a focused analysis of consumer willingness to pay for kelp products from remote coastal communities. Best practices for the kelp mariculture industry will be investigated through the lens of historical ecological and subsistence food knowledge and practices, local Indigenous stakeholders, newly established and future kelp mariculture practitioners, scientists, and fishermen.

**EVOSTC Funding Requested (round to the nearest hundred, must include 9% GA)**

FY22	FY23	FY24	FY25	FY26	FY22-26 Total
\$829,772	\$668,224	\$727,174	\$775,129	\$667,528	\$3,667,827
<b>FY22-31 Total</b>					\$3,667,827

**Non-EVOSTC Funds to be used, (round to the nearest hundred) please include source and amount per source:**

FY22	FY23	FY24	FY25	FY26	FY22-26 Total
\$125,000					\$125,000
<b>FY22-31 Total</b>					\$125,000

**1. EXECUTIVE SUMMARY (maximum ~1500 words, not including figures and tables)**

*Please provide a summary of the project including key hypotheses and overall goals. Describe the background and history of the problem. Include a scientific literature review that covers the most significant previous work history related to the project. Include which injured resources and services will be studied and describe how these affected resources, services and ecosystems will benefit from this project. Projects are limited to species historically found in the Spill Area or shellfish species currently cultured in Alaska that can meet the State Alaska's licensing and permitting requirements – does this project meet this requirement?*

In the 30 years since the Exxon Valdez Oil Spill (EVOS), substantial research has been conducted to understand the status of injured species and habitats, yet less work has been done to assess potential strategies to address social, cultural and economic impacts (i.e., *injured services*) to coastal communities in the spill zone (Poe and Gimblett 2017). Alaska generally, and the spill zone specifically, now stand at the forefront of an emerging kelp mariculture industry, an industry that has in some cases demonstrated restorative effects like improving water quality for ecosystems in other parts of the world (Jiang, X. et al. 2020), reducing erosion to coastal environments (Durante et al. 2017) and temporarily reducing ocean acidity at local scales (Xiao et al. 2021). Kelp beds, and potentially kelp mariculture sites, also may offer important benefits to critical species like herring and salmon, for example, by providing habitat at key stages of their life cycles (Thornton et al 2010; Thornton and Moss 2021) and possibly buffering some of the rapid changes now being observed in nearshore habitats (e.g., increased acidity and warmer water temperatures).

These broad ecosystem stressors are also challenging the stability of the commercial fishing industry and subsistence harvest by local Indigenous and coastal communities (Pershing et al. 2018). At the same time many recognize the thoughtful inclusion of kelp mariculture as a critical component to the socioeconomic sustainability of communities in the spill zone (Rebours et al 2014). Understanding and establishing the potential benefits of kelp farms in southcentral Alaska relies on baseline data collection including local, traditional, and Indigenous knowledge gathering, and a study of consumer willingness to pay for mariculture

products produced in remote coastal communities. Best practices for the kelp mariculture industry need to be investigated through the lens of local subsistence food knowledge and practices, local Indigenous stakeholders, newly established and future kelp mariculture practitioners, scientists and fishermen.

The most comprehensive research on the seaweeds of Prince William Sound and other areas of the EVOS was conducted just after the EVOS by government agencies, Exxon researchers and the University of Alaska Fairbanks. These studies were not designed to look at areas used for traditional subsistence, so the effects of the oil spill and cleanup are not specific to those areas. Lindstrom et al. (1999) have published a listing and locations of the major algal species found in the Prince William Sound area post-EVOS.

The initial effects of the oil spill and cleanup on the intertidal seaweeds have shown that *Fucus* and a few other species suffered some degree of damage (Highsmith et al 1993, 1994, 1996, Stekoll et al. 1993,1996, van Tamelen et al. 1996, 1997, Stekoll & Deysher 2000) although other studies found conflicting results (Gilfillan et al 1995, 1999). A less intensive effort was made to assess the effect of the spill on the subtidal seaweeds, especially the kelps (Dean et al.1996, Jewett et al. 1995). This research was conducted only in Prince William Sound at a few sites and little effect on subtidal algae was found. A synthesis of the effects of the oil spill and cleanup can be found in Petersen (2001). However, new developments in marine or terrestrial areas may have impacts on existing habitats and cultural uses. A lack of understanding of historical, local and Indigenous cultural values and uses of areas in which development activities are proposed can result in cultural loss and conflict and an exacerbation of the EVOS impacts. Therefore, these values need to be included and carefully considered in any discussion of potential development.

Our research team centers Indigenous perspectives. The idea for this proposed work emerged from a co-production of knowledge approach (e.g., Berkes 2009, Zanotti et al 2020) that was initiated by the Native Conservancy who convened this research partnership throughout 2020. Since that time, the Native Conservancy and the Chugach Regional Resources Commission (CRRC) have provided initial insights about the need for this work in the spill zone. These two organizations also identified three of the project's lead researchers, including Dr. Elizabeth Hoover who specializes in Indigenous food systems and Dr. Thomas Thornton who has decades of collaboration with Indigenous communities on coastal ecological issues in Alaska. They also asked Dr. Michael Stekoll to join this proposal as a senior advisor on kelp ecology.

Collectively, we are proposing that the EVOS Trustees fund a five-year project to help understand the cultural and ecosystem values associated with key kelps in PWS and the Gulf of Alaska and how kelp mariculture operations within the spill zone can be socially and ecologically beneficial, economically viable and compatible with local cultural values of Indigenous communities in the region. We see this research focus as essential to ensure that human services injured by the spill, namely *Subsistence* and *Commercial Fishing*, can benefit from new efforts associated with kelp mariculture in the region. Further, an economic analysis of markets that includes an assessment of US consumer valuation for mariculture activities that promote sustainability will also inform the EVOS Trustees about *Passive Use* in regard to overall perceptions about recovery of the region. The economic analysis will measure both consumer perceptions of passive existence value as well as consumer willingness to pay a premium for products that promote sustainability.

Addressing these three, interconnected human services requires a holistic approach that applies cultural, social and economic methodologies integrated across a series of three, interconnected research themes. For each we offer a guiding hypothesis (H1, H2 and H3) and an outline of key research elements for as follows.

**H1: Evaluation of historical ecology, distribution and practices of traditional Indigenous mariculture and subsistence harvest activities is necessary for effective site selection of potential future mariculture sites.**

- Conduct cultural GIS mapping of local knowledge, uses, and values of kelp identified by Indigenous elders and other key informants from 10 interested Indigenous communities following a 2021/2022 Indigenous Listening Tour.
- Research and document Indigenous place names and how they connect to where mariculture resources were used by communities historically.
- Use information collected to work with communities to assess historic kelp habitats and subsistence uses to inform selection sites and seaweed species criteria for future kelp farms.
- Create a story map of historic cultural seaweed harvest sites by various communities and compare that to contemporary distribution information to help inform how kelp forests have changed over time in order to inform appropriate mariculture development.
- This work is led by Mr. Lankard and Native Conservancy staff, as well as Mrs. Hetrick and CRRC staff. Key design, statistical and analytical oversight as well as implementation will also come from Dr. Thornton, Dr. Stekoll and Dr. Hoover.

**H2: New kelp mariculture activity that is led by Indigenous communities in the spill zone will have additional benefits relative to subsistence harvest and commercial fishing activities at the local scale.**

- Identify up to 10 communities with near-term prospective kelp mariculture operations and refine survey/interview questions based on a contemporary listening tour aimed at engaging 21-30 tribes in 2021/2022 that is being conducted using matching funds.
- Confirm interest by, and maintain relationships with, Indigenous leadership from up to 10 partner communities who will participate in a five-year study to evaluate implications of new kelp mariculture operations.
- Conduct incentivized household surveys and semi-structured interviews to establish a baseline of use, cultural practices and values around seaweed, shellfish and other relevant subsistence harvests prior to the establishment of farms.
- Conduct targeted focus groups to understand broader community interests and concerns about kelp mariculture and how it relates to the injured services of subsistence and commercial fishing prior to the establishment of farms.
- Conduct post-farm household surveys and focus group assessments of how subsistence resource use and cultural practices have changed, as well as how perceptions about kelp mariculture relative to commercial fishing have changed 3-5 years after farms have come in.
- This work is led by Mr. Lankard and Native Conservancy staff, as well as Mrs. Hetrick and CRRC staff. Key design, statistical and analytical oversight as well as implementation also comes from Dr. Hoover and Dr. Thornton.

**H3: Kelp mariculture led by Indigenous communities presents a viable economic activity that can help attenuate continued impacts on commercial fishing in the spill zone.**

- Conduct a Discrete Choice Experiment (DCE) to estimate consumer willingness to pay for kelp products produced at Indigenous-owned, regenerative kelp farms that aim to benefit continued habitat restoration in the spill zone.
- Conduct a willingness-to-pay analysis for environmental monitoring data based on structured interviews of fisheries and other ecosystem managers and scientists in Alaska who are interested in partnering with farms in remote communities.
- Analyze the economic impact of kelp mariculture and identify economically viable strategies for kelp in the context of spill zone communities.
- This work is led by Dr. Berry and Mr. Poe with key insights on small scale, community-led processing models and market channels from Mr. Smith, other GreenWave staff and their partner farmers.

**2. RELEVANCE TO THE INVITATION (maximum 300 words)**

*Discuss how the project addresses the projects of interest listed in the Invitation and the overall goals and objectives of the Focus Area. Describe the results you expect to achieve during the project, the benefits of success as they relate to the topic under which the proposal was submitted, and the potential recipients of these benefits.*

Our research focuses on understanding how kelp mariculture development activities within the EVOS spill zone are likely to be received by communities based on social, cultural and economic considerations. Given the increased interest in mariculture enterprise in the EVOS spill zone (e.g., new permits proposed), it is important to understand how this new development can best complement recovery objectives established by the EVOS Trustees relative to injured human services. We see this research focus as essential to ensure that human services injured by the spill, namely Subsistence and Commercial Fishing, can benefit from new efforts associated with kelp mariculture in the region. An additional component focused on understanding U.S. market valuation for commercial products from the EVOS spill zone will offer insights relative to Passive Use as well.

Our proposed work speaks directly to the Trustee Council’s interest in “funding research to support the development of mariculture in the Spill Area” particularly in regard to understanding questions about the feasibility of kelp farming relative to ecosystem enhancement as discussed in the Mariculture Focus Area for the 2021 RFP. It also includes a significant mapping effort to inform “suitable areas for mariculture within the Spill boundary” as well as community level impacts of mariculture siting as defined in this Focus Area. Our work will benefit managers and community decision makers who are working to learn about how kelp mariculture operations within the spill zone can be socially and ecologically beneficial, economically viable and compatible with local cultural values of Indigenous communities in the region.

**3. PROJECT HISTORY (maximum 400 words)**

*Is this a new or continuing project? If continuing, please describe the history of the project and what has been accomplished to date (i.e., numbers of publications, presentations, podcasts etc.). Please include detailed references to products (i.e., publications, reports, and websites) in the literature cited section.*

In 2019, the Native Conservancy began exploring the concept of small-scale, Indigenous-led farms as an approach to ecosystem restoration, food security and a new source of income to communities that continue to

struggle following the 1989 oil spill. Through several private grants and partnerships with organizations like GreenWave (a leading nonprofit organization in the design of small-scale kelp mariculture farms around the United State) and the Chugach Regional Resources Commission, they launched several pilot farming projects in Prince William Sound in 2020. That same year Native Conservancy and GreenWave approached the Alaska Conservation Foundation for assistance in developing a funding strategy and partnership structure (based on their efforts with [www.SustainableSoutheast.net](http://www.SustainableSoutheast.net) and [www.NorthernLatitudes.org](http://www.NorthernLatitudes.org)) to support a potential network of Indigenous-owned farms.

Those collaborations in 2020, conversations with tribal and industry leaders, and engagements with scientists from agencies, universities, Indigenous organizations, and nonprofits leading kelp mariculture, resulted in the Native Alaska Kelp Initiative which aims to establish 100 regenerative kelp farms along Alaska’s coasts over ten years. All partners participating in this new initiative value conservation, sustainability, and Indigenous self-determination. Crosscutting all these values is a focus on holistic social and ecological research that is designed and implemented through a co-production model with Indigenous communities. For example, McOliver et al. (2015) found that “American Indian and Alaska Native peoples and communities (AIAN) are faced with ongoing environmental health challenges that demand collaborative and sustained research, innovative methods, and culturally appropriate interventions.” In this regard, we are pursuing several collaborative opportunities (including this one) with numerous marine ecology researchers focused on kelp mariculture in Alaska.

In early Fall of 2021, the Native Conservancy and GreenWave are launching a six month ‘Indigenous Listening Tour’ to engage 21 coastal Indigenous communities in Alaska. This tour seeks to document community interests around kelp mariculture and to identify how these activities relate to the traditional, historical and contemporary values held by these communities. The positive response received by the Native Conservancy in early outreach about this effort, as well as our growing collaborations with scientists and industry partners revealed the need for a robust research effort to understand social, cultural, and economic implications of kelp mariculture development. The strong community ties of project partners like the Native Conservancy and Chugach Regional Resources Commission highlighted the unique opportunity for this new, collaborative proposal in the spill zone.

## 4. PROJECT DESIGN

### A. Objectives and Hypotheses

*List the objectives of the proposed project and concisely state why the project is important. Also include an outline of specific restoration objectives independent of mariculture objectives. If your proposed project builds on recent work, provide justification that the data are valuable and will remain valuable and if any changes are proposed. If the proposed project is for new work, provide justification of how the project will provide data useful to addressing management objects, Focus Area goals, and further the Council’s mission of recovering injured natural resources and their services.*

*If applicable (research projects supporting the development of mariculture), clearly state the hypotheses, and describe how these hypotheses contribute to supporting the development of mariculture in the Spill Area.*

Our research focuses on understanding how kelp mariculture development activities within the EVOS spill zone are likely to be received by communities based on social, cultural and economic considerations. The proposed effort aligns with Administrative Order (AO) 280 signed by Governor Walker in 2016 relative to ensure mariculture development is compatible with “traditions and cultures of rural communities,” as well as understanding economic implications for viability and food security via “access to local foods for Alaskans.” Further, it ties to research recommendations from the 2018 Alaska Mariculture Development Plan (MTF 2018)

relative to social and cultural aspects of site selection, market research for kelp species and understanding production opportunities appropriate for the region.

Both the AO and MTF's plan make specific recommendations about the need to engage Alaska Native communities and institutions in mariculture development considerations. In its final report to the Governor the MTF stressed that increased participation and leadership by Alaska Natives will be critical for the development of mariculture in the state (MTF 2021). And the MTF Mariculture Development Plan listed goals which would "promote success [of Alaska mariculture] through Alaska Native participation" (MTF 2018). The MTF organized a workshop in February 2021 where representatives of tribes and Alaska Native Corporations from the spill zone and southeast Alaska raised concerns about how mariculture might affect subsistence harvest and implications for food sovereignty as well as how to ensure that development opportunities don't exclude small, predominantly Indigenous coastal communities in Alaska. Understanding these types of dynamics from the perspectives of individuals from these Indigenous communities is at the heart of the efforts proposed in H1 and H2 of this proposal. To our knowledge, no other current initiative addresses the MTF's concerns about the need for this engagement so directly or so fully within the spill zone or beyond.

Further, the research proposed in H3 will produce key results identified as critical by the MTF for understanding the "economic viability of mariculture operations" (MTF 2018). Prior efforts by Northern Economics (2015) to address this question focused primarily on fin and shellfish and offered limited insights from other countries on the viability of seaweed markets in Alaska. Our proposed work offers a unique look into the viability of seaweed as market products, particularly relative to the potential for premium or niche favorability based on consumer perspectives for wild grown Alaskan products as well as products produced by primarily Indigenous communities. The results of the proposed work under H3 will be interpreted and reported on through the broader context of kelp mariculture operational considerations for the spill zone (processing, shipping, ownership structures, etc.) based on the expertise developed by GreenWave and their network of partners nationally.

Given the increased interest in mariculture enterprise in the EVOS spill zone (e.g., new permits proposed), it is important to understand how this new development can best complement recovery objectives established by the EVOS Trustees relative to injured human services. We see this research focus as essential to ensure that human services injured by the spill, namely Subsistence and Commercial Fishing, can benefit from new efforts associated with kelp mariculture in the region. An additional component focused on understanding U.S. market valuation for commercial products from the EVOS spill zone will offer insights relative to Passive Use as well.

Effectively assessing these mariculture benefits requires an understanding of how Indigenous communities within the region have historically pursued seaweed harvesting along with key parameters around how the placement of farms relates to subsistence and other traditional uses (Fall and Utermohle 1999, Fall, et al 2001, Keating et al. 2021). Assessing benefits also requires an evaluation of how new kelp mariculture installations affect key institutions of community life for EVOS spill-zone communities, such as subsistence harvest and commercial fishing. There is an expectation that kelp farming will serve to supplement income of commercial fishing communities (MTF 2018; Gershenson 2020 ) but neither this consideration nor the implications for subsistence harvest have been specifically evaluated in Alaska. Finally, understanding benefits to communities requires a specific analysis for kelp mariculture activities that takes into context consumer valuation for products from the EVOS spill zone produced by small, often majority Indigenous communities. To fully understand economic benefit, this analysis needs to explore the full portfolio of values presented by these farms, including

perceptions about their capacity for restorative ecosystem services and as distributed platforms to assist managers and researchers in ecosystem monitoring efforts.

We are proposing the EVOS Trustees fund a 5-year project to help understand the cultural and ecosystem values and services associated with key kelps in PWS and the Gulf of Alaska. This will allow managers and community decision makers to learn how kelp mariculture operations within the spill zone can be socially and ecologically beneficial, economically viable and compatible with local cultural values of Indigenous communities in the region. The results of H1 & H2 will specifically offer quantitative and qualitative information, co-produced with spill area communities, about suitability of locations and types of mariculture development. These insights will help managers and community decision makers understand the best ways that these future activities might be able to complement the subsistence and commercial fishing human services harmed by the spill. Finally, though a current permitting mechanism doesn't exist, the resulting data products would also be key assets to guide potential future restorative operations that may be proposed for habitat restoration or enhancement in the spill zone.

This effort has five specific objectives that are organized around three guiding hypotheses introduced earlier and referred to throughout this proposal as H1, H2, and H3. These objectives and hypotheses and their relationship to one another are described below.

#### **Project Objectives:**

Objective A: Understand how kelp mariculture operations within the spill zone can be socially beneficial, and compatible with traditional and contemporary cultural values and uses of Indigenous communities in the region. (H1 & H2)

Objective B: Understand how human services injured by the spill, namely Subsistence and Commercial Fishing, might benefit from new efforts associated with kelp mariculture and production in the region. (H1, H2, H3)

Objective C: Understand perceptions about recovery of the region, its resources and communities (i.e., Passive Use service) relative to restorative mariculture activities. (H2 & H3)

Objective D: Understand the U.S. market for sustainably produced kelp mariculture products and the viability of existing production models in the spill zone based on those used in other small coastal communities. (H3)

Objective E: Understand if environmental monitoring opportunities offered by local farmers in remote, coastal communities represent a valuable enough commodity to managers and scientists that they might help increase the viability of farms in the spill zone. (H3)

#### **Guiding Hypotheses:**

H1: Evaluation of historical ecology, distribution and practices of traditional Indigenous mariculture and subsistence harvest activities is necessary for effective site selection of potential future mariculture sites.



H2: New kelp mariculture activity that is led by Indigenous communities in the spill zone will have additional benefits relative to subsistence harvest and commercial fishing activities at the local scale.

H3: Kelp mariculture led by Indigenous communities presents a viable economic activity that can help attenuate continued impacts on commercial fishing in the spill zone.

## B. Study Design, Procedural and Scientific Methods

*For each objective listed in A. above, describe the study design and identify the specific methods that will be used to meet the objective. Project proposals that seek to continue to contribute new data to the data sets collected in previous years using the same protocols and project design must provide justification that the past methods applied are still appropriate. If changes are needed based on current information a justification for the changes must be provided.*

*In describing the methods for lab work, field work, collection and analysis, identify measurements to be made and the anticipated precision and accuracy of each measurement and describe the sampling equipment in a manner that permits an assessment of the anticipated raw-data quality.*

*If applicable, discuss alternative methods considered, and explain why the proposed methods were chosen. In addition, projects that will involve the lethal collection of birds or mammals must comply with the EVOSTC's policy on collections, available on our [website](#).*

### **H1: Evaluation of historical ecology, distribution and practices of traditional Indigenous mariculture and subsistence harvest activities is necessary for effective site selection of potential future mariculture sites.**

Indigenous place names are associated with outstanding marine features and ecosystem values, including historic cultural uses such as seaweed gathering, and critical habitats such as kelp beds (Thornton 2012). Place-name densities in marine environments, especially bays and sounds, often correlate with high biodiversity and habitats that support cultural keystone species (CKS, Garibaldi and Turner 2004), including Pacific herring (*Clupea pallasii*) and the kelp and other marine flora that support them (Thornton and Kitka 2015).

This proposed research would begin with a focus on PWS place names, with comparative reference to other areas of the Gulf of Alaska, and specifically how Indigenous place name distributions correlate with biodiversity, cultural keystone species, and community subsistence patterns. We propose two methods: 1) historical ecological mapping; and 2) contemporary use and ecosystem services mapping. First, an historical ecological assessment of PWS at the landscape (or marinescape) scale will be carried out. Each marinescape is assumed to have co-evolved from natural and human processes, and methodologically it is important to look at the interaction of these processes over the long term, both prior to and after EVOS. Formal surveys of seaweeds in the region have been conducted since at least 1915 (Stekoll 2019) and Indigenous knowledge of seaweeds extend back to time immemorial.

We propose to bring together these knowledge sources as layers in a GIS mapping to inform contemporary analysis. Critical historical kelp habitats and uses will be mapped by Dr. Bell from relevant sources in the literature and using satellite-derived products provided from an ongoing NASA project, as well as oral sources and expertise in the focal Indigenous communities. Satellite maps of canopy-forming kelp species (ribbon kelp and bull kelp) are derived using methods presented in Bell et al. (2020) and use a linear mixture method to estimate the fractional cover of kelp canopy within 30 meter resolution Landsat imagery from 1984 – present. This information will then be mapped by Dr. Bell for preliminary analysis and to track changes over time in kelp abundance, quality, distribution, and habitat characteristics. Drone footage will be used to collect contemporary aerial data about a particular place name that cannot be seen from ground level. This multi-dimensional data is also necessary to better facilitate successful state and federal historic site registration forms. Additionally,

drone footage is used to make short videos about each named place that ties these linguistic signs to traditional and contemporary stories, and Indigenous and local ecological knowledge about species in that area (including kelp).

Led by Native Conservancy, CRRC, and kelp industry pioneer GreenWave, this work will begin with an Indigenous Listening Tour (launched in early fall of 2021 and running through ~ March of 2022 using matching funds) which aims to engage with 21-30 Alaska Native tribes in and around the EVOS spill zone to document historic and contemporary Native traditions and values associated with kelp harvesting and utilization. This includes identifying which kelp forests have been affected by the EVOS to assess the state of these kelp beds today and the extent to which communities are still able to utilize them. The Indigenous Listening Tour will engage communities in deep conversation about issues of food security and food sovereignty, their perceptions of the impact of the EVOS on these issues, and how Indigenous-led mariculture might reduce the impact. In a broader sense, the tour also seeks to present information about the logistics of developing a kelp mariculture operation to help recruit Native communities to establish kelp farms in their local tribal waters which connects to efforts in H2. In the context of this project, the tour will be critical for recruiting interest from communities that will be participating with subsequent participatory efforts in this proposal including cultural GIS mapping and household surveys.

There has yet to be research and documentation of the historical Eyak, Tlingit, and Sugpiaq seaweed harvesting boundaries/geographies in a GIS. Native Conservancy has experience coordinating and facilitating cultural mapping workshops to revitalize and preserve Eyak and Tlingit knowledge focused on subsistence harvesting sites and practices. They are in the process of launching Seaweed Cultural Mapping in Fall of 2021 using matching funds and this pilot project will conclude before the proposed work is launched and thus will further refine our methods as we work with subsequent communities herein. Through a process of focus group interviews, as well as participatory mapping, Native Conservancy will locate the boundaries of historically harvested and culturally significant gathering areas and identify the cultural significance of three specific kelp species: sugar kelp (*Saccharina latissima*), ribbon kelp (*Alaria marginata*), and bull kelp (*Nereocystis luetkeana*) in the context of other traditional seaweed species. The broad goal of the focus groups is to gain understanding of seaweed and its traditional use as a subsistence food specific to Alaska Native cultures.

Native Conservancy will work with CRRC to select ten villages in the spill zone and organize interest from study participants who will be compensated for their participation and Tribal Councils will be consulted for each community on how the community would like to oversee the efforts and approve final results. The protocol for community mapping would be developed in collaboration with communities following the ethical Principle for Conducting Research in the Arctic (<https://www.nsf.gov/geo/opp/arctic/conduct.jsp>). Dr. Jen Rose, an Eyak Native with substantial experience working with Indigenous communities, will lead the implementation of the cultural GIS component of the proposed work. She and Native Conservancy have developed informed consent procedures to protect sensitive information contributed by community members. Further, working with Dr. Thornton and Dr. Bell, they will implement spatial analytical methods to synthesize and generalize results of the cultural GIS mapping such that specific sensitive sites are not revealed publicly via the final products of this work. [The interim information will only be retained by the Native Conservancy \(according to their policies on management of Indigenous Knowledge as described in their consent documentation\) through the course of this project until final synthesized products are accepted by EVOSTC. Additional details regarding the protection of sensitive information are shared in Appendix A.](#)

Through a series of repeat visits to ten communities, hundreds of participants will use hard copy maps of the coastline and will be invited to draw shapes to represent areas where they and/or their ancestors have harvested or used kelps, seaweeds and mussels/clams. This approach of multiple visits to focal communities, in order to share back results from prior visits for reflection and discussion by community members from prior years is important in order to develop consensus-based summaries of local perspectives. Repeat visits also maximize our chances to engage a diverse array of community members and are important for building relationships that promote community trust in the process and the project results. Through the interviews and participatory mapping research and place names, Native Conservancy will document boundaries of culturally significant seaweed gathering sites for Native Peoples. We will hire Eyak, Tlingit and other Indigenous professionals to conduct the interviews with Indigenous Elders to support intergenerational learnings. This process will include: place names; participatory GIS mapping; geolocation of heritage features; capturing footage with drones; submission of state and federal historic site registration forms; and creation of a community-controlled, interactive online atlas. Given the uniqueness of this effort and the richness of information anticipated Native Conservancy will contract the development of a short film to document this portion of the project as well as a children's book to share Indigenous perspectives and cultural practices associated with seaweeds with a wider audience.

This mapping and analysis, in turn, will inform second-stage interviews in our partner communities and additional mapping of contemporary mariculture development issues in communities. Second-stage interviews will cover contemporary uses, values, and aspirations relating to critical marinescapes where important kelp and seaweeds have existed. Particular attention will be paid to areas that have been affected negatively by anthropogenic activities or other events and whether they recovered and why. Sites where the three kelp species of high interest to mariculture sugar kelp, ribbon kelp, and bull kelp exist or may developed through mariculture will be assessed. This methodology provides important information to evaluate where mariculture sites for kelp farming or restoration could be placed to complement cultural values, minimize impacts to traditional Indigenous uses of marinescapes, and optimize restoration of cultural heritage and ecosystem service values that have been injured by previous impacts.

This mapping effort will also be informed by existing scientific and historical ecological layers identifying abundance and distribution of key types of kelps in the vicinity of each community over time, as well as known commercial, cultural and other uses, and ecosystem service values. Participants' conceptualizations of and comments on the ecology, uses, and other values associated with kelp will also be mapped. Results will be compiled and analyzed to inform criteria for mariculture uses and guide potential future development. Key products from the work include an interactive story map documenting the knowledge of participants integrated with contemporary scientific information about the distributions of kelp and other seaweed species. This story map will be both a communications tool and a scientific product and will be widely distributed to help guide mariculture development in the spill zone. Specifically, we expect that this product and the layers used to create it will be valuable tools for managers and communities when considering suitability of sites for mariculture development.

**H2: New kelp mariculture activity that is led by Indigenous communities in the spill zone will have additional benefits relative to subsistence harvest and commercial fishing activities at the local scale.**

The Native Alaskan Kelp Initiative (NAKI) was launched in 2020 and to date key partners including Native Conservancy and Chugach Regional Resources Commission have received substantial funding from the Denali

Commission, the U.S. Economic Development Administration and the Chorus Foundation. Together CRRC and Native Conservancy are actively working to reduce the barriers to entry to kelp farming for Indigenous peoples in the spill zone and beyond. Taking a comprehensive approach, both organizations have dedicated resources to building infrastructure, conducting research and development, and creating training opportunities related to kelp farming. Accomplishments to date include building seven kelp seed nurseries to serve Prince William Sound near remote villages in the spill area, permitting several more, testing seven ecoregions for kelp farming viability, product research and market development, and organizing a fund to provide long term, low interest, deferred payment loans to new Indigenous kelp farmers. NAKI partners are also training three full time staff to learn how to complete the kelp permit process so that permitting is cost effective and these individuals will be a resource to other interested communities in the spill zone. CRRC now has trained staff at their facility in Seward, the Alutiiq Pride Marine Institute, that are able to raise kelp seed strings for the kelp industry in southcentral Alaska and are actively pursuing methods to scale up kelp production.

Building on these efforts, Native Conservancy is working in partnership with CRRC and GreenWave to host the Indigenous Listening Tour, which is a community organizing tool for Indigenous communities to gain entry into the growing mariculture movement. The Tour will be a series of zoom calls featuring a panel of speakers focusing on the many aspects of food security, food sovereignty and kelp farming. The goal of the sessions is three pronged: to learn about current and historic cultural uses of kelp; to learn about what Native communities perceive as the opportunities and challenges to participation in this new kelp farming industry; and to inform Native communities about the permitting process, the financial challenges and opportunities (such as long-term low-interest loans), as well as expenses for farms, vessels, equipment, marketing, processing and distribution challenges. Participants will be given a survey before and after each session to gauge current uses of kelp, interest in kelp farming, perceived challenges in entering the mariculture business, and the community's food security status. In-person interviews will follow the zoom calls to gain further detail regarding traditional ecological knowledge around kelp sites, harvesting, and uses (per H1). The listening tour aims to engage with 21-30 tribes and the results will help us refine the specific methods and approaches for the rest of the H2 efforts.

Following the listening tour, we will identify up to 10 communities with near-term prospective kelp mariculture operations, and through a 5-year study evaluate the impact of kelp mariculture on food security and food sovereignty status within these communities particularly in regard to subsistence practices. While we know that Alaska Native people have utilized kelp as a resource for millennia, this portion of the project seeks to determine to what extent the introduction of kelp mariculture to villages improves families' sense of food security and food sovereignty, through their ability to produce a product that can either be directly consumed or improve household income through commercialization.

Prior to the expected establishment of farms (ie., year 1 and 2), we will conduct incentivized household surveys and semi-structured interviews in partner communities to establish a baseline of use, cultural practices and values around seaweed, shellfish and other relevant subsistence and commercial harvests. These surveys will also ask participants about their current food security status (i.e. availability of groceries as well as traditional food sources, abundance of food in the home, regularity of access, etc). We aim to collect information from at least 100 participants from Indigenous communities within the spill zone and will work with tribal leadership in each community to ask them to identify the right individuals to participate. In addition to household surveys we will also conduct targeted focus groups (e.g., commercial fishing industry representatives, subsistence harvesters, and community leaders) to understand broader community interests and concerns about kelp

mariculture and specifically how it relates to the EVOS injured services of subsistence and commercial fishing prior to the establishment of farms. In addition to questions that relate specifically subsistence and commercial fishing, we will ask more general, open-ended questions about kelp mariculture to develop a baseline understanding of perspectives (positive, negative, indifferent, etc.) of the sector within focal communities.

At the beginning of year five of the study, we will conduct a follow-up round of household surveys and focus group assessments targeting the same participants who took part in the first round, to gain an assessment of if and how subsistence resource use and cultural practices have changed; how perceptions about kelp mariculture have changed 3-5 years after farms have been established; and whether participants feel as though these kelp farms have improved their food security status and if it is supplementing commercial fisheries income in the communities. In the unlikely event that we are unable to secure the interests of a full 10 communities in the spill region supporting mariculture farms by 2023 our team would work with EVOSTC staff to consider implementing one of two options. We could request a 2-year extension for this piece of the project if it seemed likely that a few additional communities would be available for research in the near term. Alternatively, we could alter the approach of household surveys for communities to match that proposed for focus groups of community leaders. Though the structure of inquiry for this second option would yield less robust results (compared to a robust sample of individuals from all 10 communities with direct experience pre and post farm installation) it would still yield novel and useful results for the spill region.

**H3: Kelp mariculture led by Indigenous communities presents a viable economic activity that can help attenuate continued impacts on commercial fishing in the spill zone.**

Dr. Kevin Berry at the University of Alaska Anchorage will perform an economic analysis focused on the willingness-to-pay of potential consumers for kelp products produced sustainably in Indigenous communities. The goal of this work is to expand upon existing research on the market for mariculture products to better understand the willingness of consumers to pay a premium specifically for products produced by Indigenous people that contribute to ecosystem recovery and sustainable development. Prior work identified cooperatives as a model worth considering in Alaska (Northern Economics 2015). This survey effort would seek to better understand how this structure might change the willingness of consumers to pay for kelp products. Prior work has also not directly addressed the demand side of the market through a detailed study of consumer willingness to pay for kelp mariculture products from Alaska. This was identified as a short-term research need in the State of Alaska's Mariculture Development Plan (MTF 2018).

This work will involve a survey targeting a representative population living predominantly in urban areas on the west coast of the Lower 48. Alaska itself is omitted as the state has a population of 731,000 people and only 396,275 residents in the Anchorage/Mat-Su economic region, with many other locations either not accessible by land or in small, geographically distant communities. We chose the states of California (39.5 million residents), Washington (7.6 million residents), and Oregon (4.2 million residents) because they have significant urban populations, and have large prosperous cities with thriving food scenes. Including the entire west coast also provides market information for what areas in this diverse region are most interested in the product, to aid in later marketing. For example, there is a historic relationship between the city of Seattle, WA and Alaska, as Seattle considers itself a gateway to Alaska. We hypothesize that this specific relationship may lead to a greater market for Alaska made products.

The survey will have two objectives (1) to better understand participant impressions of the health of both communities and ecosystems impacted by the Exxon Valdez oil spill and (2) a Discrete Choice Experiment (DCE) to understand individual willingness to pay for various characteristics of kelp products. In this work Dr. Berry will train and supervise an undergraduate student who will participate in developing the DCE, data collection and cleaning, and preliminary analysis.

The first objective of the survey is to elicit participant perceptions of the status of habitat in the spill zone. It will include questions on ecological, social, and economic impacts. Ecological impacts will include participant beliefs on whether the ecosystem can be considered recovered, and if biomass of fisheries related to the spill zone continues to be negatively impacted by the legacy of the spill. Additional questions will examine other ecosystem impacts, as well as perceptions of whether the ecosystem has returned to its previous, “pristine”, state. This will focus on understanding the passive use and existence value of the ecosystem in addition to potential use values of respondents. Finally, questions will focus on participant understanding of the communities in the region, including knowledge of the sociodemographic characteristics of impacted communities. The survey will also measure participant belief in the ability of kelp to promote ecological and economic recovery in the spill zone.

The second objective of the survey is a DCE to measure consumer willingness to pay for mariculture products produced in the region. Kelp forests have significant ecological, cultural and biodiversity non-use value (Vásquez et al. 2014)). Within the DCE participants are asked to decide whether or not they would make a transaction as characteristics of the product are changed slightly. Potential treatments might include raising or lowering the stated price, highlighting the positive economic benefits from sustainable mariculture for remote, rural, and indigenous communities, or instead promoting the benefits to ecosystem restoration. The goal of the DCE is to better understand both the demand for sustainable mariculture, and product characteristics that are most interesting to consumers. Previous DCE related to kelp have found a willingness of consumers to pay for habitat restoration (Hynes et al. 2021; Yi and Kim 2020). A key part of our study will be a more explicit focus on the impacts to rural and Indigenous communities from mariculture. Additionally, studies of kelp forests as a possible carbon-sink have found little variation in willingness to pay across methods for the same level of mitigation (Fällström and Schelin 2020). We will examine if additional context, including that kelp mariculture would be predominately rural and Indigenous led changes this relationship.

The specific DCE will be designed in consultation with project partners and through discussions with current farmers and distributors of seaweed products. Our main variables of interest in the DCE include the value of information treatments related to both the ecological impacts of seaweed farming and the social impacts on remote, rural, and indigenous communities. Prior to further consultation with project partners, the DCE will include varying the price of the product and characteristics representing both the ecological impact treatment, with potential levels of “inform” or “not inform” and social impact treatment with indicators for whether individuals are informed of the different positive impacts for communities and whether they are “rural”, “remote”, “Alaskan” and/or “indigenous”. We would expand upon existing work by Li et al (2021) by also incorporating different types of seaweed product (3 options – salad, snack or kelp), product name, and varying whether participants are informed that the product is from the EVOS study area. We will use a fractional-factorial design and ensure balance by having a subset of potential attribute levels and combinations occur equally often.

Our proposed sample size is a conservative response to the rule of thumb proposed in Orme (2019) where in order to include both main effects and interactions we follow the formula

$$\frac{nta}{c} \geq 1000$$

Where  $t$  is the number of tasks,  $a$  is the number of alternatives per task, and  $c$  is the largest product of levels of any two attributes. Allowing ourselves room to increase the number of attributes after consultation with project partners, we assume  $t = 6$ ,  $a = 2$ , and  $c = 25$ , to allow for up to two attributes with up to 5 levels. We conservatively leave the experiment design open for these higher attribute levels in anticipation that discussions with project partners might lead to more nuanced information on environmental impact. For example, we might vary whether the impact is via carbon sequestration, habitat restoration for fisheries, erosion control, or other benefits to be identified during the project.

We limit individuals to 6 tasks to avoid overwhelming subjects and focus on a dichotomous choice where consumers are faced with the option between two kelp products and a “choose neither” option. This suggests a minimum sample size of 1562. Our estimate of 3000 is based on a preliminary cost estimate from Qualtrics, which will vary with the complexity of the survey which will be designed during the project. This sample size is significantly larger than comparable studies on seafood demand, such as Tongzhe, Ahsanuzzaman, and Messer (2021) or Li et al. (2020) however these were in person intercept surveys while our study will be delivered online via Qualtrics. In this sense we are trading off between the ability of those studies to encourage incentive compatibility by having individuals purchase the product under come treatments, and a larger sample size that is more geographically dispersed.

The resulting marketing information will provide greater insight into whether mariculture is a viable economic activity that can help attenuate continued impacts on commercial fishing in the spill zone because it will provide estimates for the willingness to pay of individuals for kelp products and provide greater understanding of the marketing opportunities for those products in general. It will also be the first study to focus on any potential price premiums and the willingness to pay of individuals specifically for products produced by Indigenous communities. Additionally, we will be able to estimate interaction terms between whether producers are indigenous, rural, remote, and Alaskan, as well as information treatments on environmental impact.

To understand the potential value of environmental monitoring at remotely placed farms, we will launch an inquiry of ecosystem and fisheries managers as well as scientists to understand key data needs that could be met by farmers with relatively simple training. Examples of this type of community-led science informing agency managers within Alaska includes the Indigenous Sentinels Network (formerly Bering Watch) operated by the Aleut Community of St. Paul Island (Zavdil et al. 2011). Other efforts led by Alaska Native tribes, including the Southeast Alaska Tribal Ocean Research (SEATOR) show that this type of distributed monitoring can be effective when led by communities and that agencies will fund these activities (Harley et al. 2020).

Working through our team’s professional networks (particularly the marine scientists and managers that collaborate with the Northern Latitudes Partnerships hosted by ACF) we will assemble a pool of practitioners interested in potential collaboration with communities on monitoring efforts. We will conduct structured interviews of these individuals to identify key environmental monitoring information of interest and understand the value of these data using a willingness-to-pay framework. We will also build a pool of current and interested Alaska mariculture farmers cultivated by GreenWave and the Native Conservancy through their current training

events and their listening tour planned for 2021. We will conduct structured interviews of these individuals to understand their willingness to collaborate with agency managers and scientists and what types of financial remuneration they might expect to sustain rigorous annual or seasonal monitoring efforts over time.

The resulting information from these inquiries will be compared with the market viability information to understand potential gains that farmers might expect to help supplement their income from salable products. Insights collected from these interviews will also help identify potential opportunities and barriers to collaboration between these two groups of professionals.

The results of this work under H3 will be interpreted and reported on through the broader context of kelp mariculture operational considerations for the region. This includes processing strategies (first-stage stabilization, value-added co-packing, mobile), ownership models (cooperatives, etc.), and existing market channels (food, fertilizer, agricultural inputs, etc.) in Alaska and other regions of the US where kelp mariculture is established. We will analyze viability and potential for adoption in the spill zone and an Indigenous community context, taking into consideration location of farms and potential processing hubs, market demand for Alaska-based sales & exported products, and other key factors. Our ultimate aim is to identify what is economically feasible in Indigenous communities in the spill zone.

#### **A. Data Analysis (If Applicable), Statistical Methods (If Applicable) and Measuring Project Success**

*If applicable, describe the process for analyzing data. Describe the statistical power of the proposed sampling program for detecting a significant change in numbers based on statistical analyses such as power or sensitivity analysis. To the extent that the variation to be expected in the response variable(s) is known or can be approximated, proposals should demonstrate that the sample sizes and sampling times (for dynamic processes) are of sufficient power or robustness to adequately test the hypotheses. For environmental measurements, what is the measurement error associated with the devices and approaches to be used?*

*Analyses and methods proposed must be justified. Project proposals that seek to continue to contribute new data to the data sets collected in previous years using the same protocols and project design must provide justification that the past methods applied are still appropriate. If changes are needed based on current information a justification for the changes must be provided.*

*Describe a plan that will be used to evaluate and measure the success of this project.*

#### **H1: Evaluation of historical ecology, distribution and practices of traditional Indigenous mariculture and subsistence harvest activities is necessary for effective site selection of potential future mariculture sites.**

Research will be approached in two phases. Phase one includes focus group interviews with Indigenous Alaskans in the Southcentral and Southeast regions to document where the kelp gathering locations are or have been as well as the cultural significance of kelp as a food source. All researchers will be Indigenous and if possible, native to the region. Each researcher will report back with information to the larger group and main facilitator. Phase two will use interview-gathered data to geolocate points in the real world and captured in a dataset using GPS. The point- location dataset will be used to create boundaries in a GIS.

Boundary data will be used in the online, interactive map. Further, it is culturally important to Indigenous fishermen to cultivate kelp near historical gathering grounds. Using historically and culturally significant areas will be a factor that Native communities use to determine the best kelp cultivation sites for both food and restoration purposes. Therefore, kelp -gathering boundary data will also serve the multi-layered critical



evaluation (MCE), which combines several variables to produce an output recommendation that answers a complex question (Vergara-Solana et al., 2019). The MCE will include additional variables favorable to the kelp species being studied, such as water temperature, dissolved oxygen, and salinity.

Statistical Analysis within Geospatial Analysis: the MCE will aid decision-making regarding which mariculture endeavors are most beneficial. Native Conservancy will geospatially classify the values of culturally significant sites. Those boundaries will be added to a weighted overlay, where the data will be combined with seaweed mariculture viability variables. Results from the MCE will show which areas are most appropriate to site kelp cultivation based on proximity to culturally significant gathering areas and habitat suitability for kelp under current and future climate conditions .

**H2: New kelp mariculture activity that is led by Indigenous communities in the spill zone will have additional benefits relative to subsistence harvest and commercial fishing activities at the local scale.**

For the pre and post surveys conducted with approximately 100 community members, quantitative data gathered from the surveys will be analyzed in SPSS, and qualitative information will be coded in NVivo qualitative analysis software.

Focus groups and semi-structured interviews will be transcribed in Transcribe software and then analyzed through NVivo qualitative analysis software utilizing codes drawn from the interview question structure, as well as those that arise organically from the content.

**H3: Kelp mariculture led by Indigenous communities presents a viable economic activity that can help attenuate continued impacts on commercial fishing in the spill zone.**

The survey of potential kelp consumers will be administered online via Qualtrics or a similar vendor. Qualtrics survey respondents are recruited via website intercept, member referral, targeted email lists, and other methods. The survey will have a minimum of 3000 participants from California, Washington, and Oregon, with 95% living in urban areas and 5% in rural areas. The survey population will be representative of the socio demographics of the United States. Survey responses will be collected over roughly 3 weeks.

Consumer perceptions will be measured using crosstabs of respondent sociodemographic characteristics and associated perceptions of the status of the Exxon Valdez oil spill area. Overall both sample average responses and subgroup responses will be summarized in a white paper and used in later analysis of the results of the DCE.

The data from the DCE will be analyzed using R statistical software, using a standard random utility modelling (RUM) framework (McFadden 1974). This assumes that individuals choose between consuming the product or not by comparing their indirect utility, which includes a deterministic component based on the characteristics of the product and a stochastic component that represents the unobservable portion of their utility function. We will follow (Hynes et al. 2021) and initially specify the RUM as a Conditional Logit. This model's key assumption is that choices are independent of irrelevant alternatives and homogeneous preferences across respondents. After initial analysis we will consider additional possible specifications detailed in Hynes et al (2021) and Train (2003) that relax these assumptions.

Semi-structured interviews and a potential short online questionnaire will be distributed to the consumers of scientific data from kelp farming operations. Data from the questionnaire will be summarized in a white paper that includes summary statistics of those surveyed, the most common uses of the data product, and stated

willingness to pay for the product as well. The semi-structured interviews will seek to understand both the potential use of the data product, associated willingness to pay for that data, and current expenditures on close substitutes for that data. Notes from these interviews will be summarized and key messages, including the most common uses of the data and alternative products will be published in a white paper that summarizes key findings.

### **Evaluating Overall Project Success**

To measure the success of the proposed effort relative to scientific contributions and partnership development, project leads will annually document and report on any scientific publications, new collaborative projects initiated, as well as new research and restoration funding leveraged resulting from the proposed work. Relative to communication engagement and communication, we will report on any earned media coverage, as well as any presentations at local, state, national and international venues featuring this effort. We will also report annually on the numbers of EVOS spill zone community members directly engaged through the implementation of the proposed work. The research proposed in H2 relative to community perspectives on mariculture will also be helpful for adding new insights about kelp mariculture relative to the outcome of these engagements.

The Alaska Conservation Foundation (ACF) will also solicit bids to contract an outside evaluator, with experience working in Alaska's rural communities, to complete an independent evaluation of the project. We will defer to the specific methodologies recommended by the contractor selected. Based on past experience with large multi-year efforts that engage communities, ACF expects that this evaluation would include structured interviews with the project leads to document their perspectives on the most important project outcomes. We anticipate these results would be compared to insights gathered by interviews and/or focus groups of project participants, including a subset of community members from the spill zone as well as other partners who were engaged by the project during its five-year course. The evaluator will also be tasked with providing recommendations on how to track the use and efficacy of the research products from this effort beyond year 5 of the proposed work.

### **B. Description of Study Area**

*Is the study area within the [Spill Area](#)? Describe the study area, including maps and figures, if applicable, decimally-coded latitude and longitude readings of sampling locations or the bounding coordinates of the sampling region (e.g., 60.8233, -147.1029, 60.4739, -147.7309 for the north, east, south and west bounding coordinates).*

Our proposed work will take place within the Spill Area for the Exxon Valdez oil spill currently recognized by the EVOS Trustees as of January 2021 and will focus primarily in the areas of Prince William Sound, lower Cook Inlet, and the Kodiak Island Archipelago (Figure 1). This area is home to the majority of Indigenous communities impacted by the spill, as well as key commercial fishing hubs like Cordova, Seward, Homer and Kodiak. A portion of the work (H3) also includes a survey to be conducted of U. S. residents from Washington, Oregon and California selected by random, stratified sample relative to markets that are more likely to consume seafood products from Alaska.

We expect that participatory mapping of the geographic area will include: Eyak village (Cordova), Tatitlek village, Chenega village, Quteckak Native Tribe (Seward), Valdez Native Tribe, Yakutat, Kodiak Island (specifics TBD), Tyonek, Nanwalek and Port Graham.

Participatory planning for discussion points with tribes, kelp species and mariculture considerations for the survey and in person meetings will include:

1. Ecosystem health: providing bivalve and herring spawning habitat restoration, supporting the greater ecosystem of Prince William Sound, the Gulf of Alaska, etc.;
2. Land and fisheries rights: beginning with rights for Indigenous Peoples of coastal Alaska, creating a case study and framework for coastal Indigenous Nations across Turtle Island and beyond;
3. Heritage Preservation: seaweed species are a part of Indigenous heritage and are significant to the People as a culture, and
4. Economic diversification and job creation (in the face of failing fisheries): support subsistence and commercial rights for Indigenous Peoples to make a living by growing kelp or other seaweeds.
5. Kelp Species Including Traditional Uses and Future Commercial Uses: Sugar kelp (*Saccharina latissima*), Ribbon kelp (*Alaria marginata*), Bull kelp (*Nereocystis luetkeana*), Black Seaweed (Porphyra), Winged Kelp (*Alaria Marginata*), Sea Lettuce (*Ulva Lactuca*)



Figure 1. Map produced by Alaska Department of Natural Resources, Land Records Information Service, showing the track of the *Exxon Valdez* oil spill--republished in Poe and Gimblett (2017).

CRRC member Tribes include the Tatitlek Village IRA Council, Native Village of Eyak (Cordova), Port Graham Village Council, Nanwalek IRA Council, Chenega Bay IRA Council, Qutekack Native Tribe (Seward), and the Valdez Native Tribe. These people, known as Alutiiq, or Sugpiaq, are a southern coastal people of Alaska. CRRC has seven Board members, one from each of the seven villages listed above.

The planned Tribal beneficiaries of this proposal include:

**Port Graham:** The Port Graham Village Council is a federally recognized Tribe that serves the Alutiiq people of Port Graham, Alaska. The village of Port Graham, also known as Paluwik in Alutiiq, is an Alutiiq community and the Native people of Port Graham call themselves Sugpiaq, meaning “real people.” The Sugpiaq heritage is

strongly based in traditional language, subsistence lifestyle, culture traditions and self-government. Subsistence activities are an important component of the village economy, while commercial employment is primarily with the local school, the Tribal council, the health clinic, and commercial fishing.

**Nanwalek:** The Nanwalek IRA Council, a federally-recognized Tribe, is home to over 300 residents. Almost all the land that could be built upon has been allocated. Nanwalek, formerly known as English Bay, is located at the southwest corner of Alaska's Kenai Peninsula. The name of the village means "place by the lagoon" as it is located by a lagoon that is connected to an extensive lake system. Subsistence activities are a large part of the culture for indigenous people, and Nanwalek is no exception, especially when it comes to salmon, shellfish, and seal harvesting. Many of the current residents are of mixed Russian and Sugpiaq (Alutiiq) heritage. Nanwalek residents speak Sugt'stun, a language closely related to Yup'ik.

**Valdez:** The Valdez Native Tribe (VNT) is in Valdez, Alaska, in Prince William Sound, approximately 300 miles from Anchorage. The VNT, formed in 1974 as a 501c3 non-profit, is the Tribal organization for the local Native community that provides culturally relevant health, social, and educational services to any Alaska Native or American Indian living in the Valdez service area. Currently, there are over 750 individuals from 190 households registered with the VNT.

**Chenega:** Chenega IRA Council, a federally recognized Tribe, is an isolated community accessible only by air or water. The people of the Chenega Tribe have lived in Prince William Sound for some 10,000 years, fishing the waters and harvesting the abundance of their land. They are part of the Alutiiq tribal family. The native language of the Chenega people is a dialect of Alutiiq, called Suqcestun. The word Chenega means "Beneath the Mountain." In 1984, a group of former villagers established a new village on Evans Island, in Prince William Sound. This site was carefully chosen following extensive research as the site best able to meet the needs of the residents' subsistence lifestyle.

**Eyak:** The Native Village of Eyak is a federally recognized Tribe with 515 Tribal members located in Cordova, a small fishing community on the eastern Gulf of Alaska at the boundary between the major ecosystems of Prince William Sound and the Copper River Delta.

**Tatitlek:** The Tatitlek IRA Council is a federally recognized Tribal coastal village of approximately 60 people on the northeast shore of the Tatitlek Narrows on the Alaska mainland in Prince William Sound. In 1989, the oil tanker Exxon Valdez ran aground not far from the Village. Although currents carried some of the oil away from the village, much of the contamination sank. This directly reduced the harvest of subsistence species in subsequent years by 89 percent.

**Qutekcak Native Tribe:** The Qutekcak Native Tribe is an incorporated, non-profit, 501c3 Tribal organization. It is multi-ethnic and serves the Native community of the Seward area through a variety of social, cultural and community, and economic development programs. The 2000 Census lists Seward with over 700 Native residents.

**Yakutat:** On March 24, 1993, the Yakutat Native Association earned its federal recognition – bringing forth the emergence of the Yakutat Tlingit Tribe. Since then, they have served 820 enrolled Tribal members and their traditional territory, which extends to the Yakutat Borough boundaries, encompassing nine thousand four hundred and sixty (9,460) square miles. The village's struggling economy largely consists of fishing, fish processing, and tourism during the months of April to September. The nature of the economy in the area

produces a pattern of seasonal and intermittent employment as many rely upon commercial fishing along with subsistence hunting and fishing for their livelihoods.

**Kodiak island:** The Sun’aq Tribe of Kodiak (STK) is a federally-recognized Alaska Native Tribe located within the City of Kodiak on Kodiak Island. Over two-thirds of the Alaska Native population living in the Kodiak archipelago are members of the Sun’aq Tribe of Kodiak, which is the largest of the 10 federally recognized Tribes in the area and the largest Alaska Native community in the Gulf of Alaska.

**Tyonek:** The 130 people in the Native Village of Tyonek speak an Athabascan dialect called Dena’ina. In 1973 and under the agreements set forth under ANCSA, Tyonek formed Tyonek Native Corporation and became a federally recognized Alaska Native Corporation. Records show that for the past 1000 years, the people of and from Tyonek embrace a culture rich in kelp traditions and harvest that includes areas within the EVOS Spill Zone.

## 5. COORDINATION AND COLLABORATION

### A. With the Alaska SeaLife Center or Prince William Sound Science Center

*A preferred requirement for all proposals is to partner with the ASLC, PWSSC, or both Centers. If not collaborating with either of these Centers, please provide information as to the inquiries and efforts extended to ASLC and PWSSC researchers and/or administrators.*

In the fall of 2020, our team shared the ideas at the center of this proposal with both the ASLC and the PWSSC in the context of a larger proposal that included broader ecosystem inquiries around mariculture relative to ocean acidification and carbon sequestration, habitat provisioning for species like Pacific herring as well as interactions with marine mammals and birds. The ASLC expressed interest in collaborating on education and outreach efforts and shared that their primary role in the mariculture focus area of this RFP would be related to communication efforts. If our work is funded we look forward to collaborating with ASLC in that regard as we see several unique components of this work potentially of interest, particularly relative to appropriately sharing Indigenous perspectives on and history around mariculture. A research consortium that included the PWSSC was interested in physical and biological research ideas because of significant overlap with a number of the consortium’s own objectives. They were less interested in the social science components of our work and ultimately due to these discussions, and a desire to not compete with other ecological objectives, we streamlined our efforts to focus specifically on cultural, social and economic questions. Our team remains interested in collaboration with the PWSSC and the other partners in this consortium and we feel that our research focus could help complement gaps in that team’s efforts relative to implications for communities.

### B. With the EVOSTC LTRM Program

*Provide a list and clearly describe the functional and operational relationships with the other EVOSTC proposed projects in the LTRM Program. This includes any coordination that has taken or will take place and what form the coordination will take (project guidance, shared field sites or researchers, research platforms, sample collection, data management, equipment purchases, etc.).*

We see our proposed work as providing new information for consideration by the LTRM Program relative to potential indicators of recovery that relate to communities within the EVOS spill zone as well as broader perceptions by U.S. residents, at least in the context of seafood consumers. These indicators could offer a useful baseline to assess recovery of injured human services like commercial fishing, subsistence and passive use which have received less focus over time. Further, our evaluation of willingness-to-pay insights collected from

ecosystem managers and scientists active within the spill zone could potentially identify strategies for how scientists might work equitably with mariculture farmers to conduct distributed environmental data collection. Finally, the new perspectives that our research team brings, including three Indigenous co-PIs and leadership by two Indigenous led nonprofits (Native Conservancy & CRRC), and our focus on learning with communities in a co-production approach, will bring a new model for collaborative research to the EVOS science community.

### Data Management Project

*Provide a clear timeline for the submission of data and metadata by individual researchers and when the data will be made available to the public (see Section 7). Data collected by researchers employed by any federal agency must comply with Federal Open Data Policy Requirements.*

The Alaska Conservation Foundation will contract with Axiom Data Science to assist us with data management and sharing per the recommendations of the EVOS Trustees. The PI for this work (Aaron Poe) has had several productive working relationships with Axiom and their close partners with the Alaska Ocean Observing System (AOOS). These collaborations have included efforts to safeguard intellectual property rights and access to data collected and owned by Alaska Native Tribes. Our aim is to make as much of the data collected as publicly available as possible, but we recognize that oftentimes sensitive local, historical and traditional knowledge cannot be appropriately shared publicly and high-level, synthetic summaries that do not reveal specific sites of importance to individuals or house households will have to suffice. Final data sets will be shared via the appropriate AOOS portal no later than the 4<sup>th</sup> quarter of FY 2026 and will also be linked to from various project team members' host organizations as well. Additional insights on interim datasets and access are offered below.

### **H1: Evaluation of historical ecology, distribution and practices of traditional Indigenous mariculture and subsistence harvest activities is necessary for effective site selection of potential future mariculture sites.**

- Historical ecological and cultural mapping layers will be archived in GIS compatible databases with appropriate metadata.
- Information that is sensitive to the Alaska Native communities, such as certain Indigenous site names and harvest locations, will be subject to review with tribal partners from each focal community to determine if it is appropriate for public release. Sensitive sites will be flagged for EVOS data managers beginning FY2024 in order to safeguard intellectual property and avoid compromising sensitive sites. These locations will not be shared as individually identifiable sites.
- After review and protection of any sensitive information, the final synthesized database will be shared with AOOS for distribution at the completion of the project (FY2026)

### **H2: New kelp mariculture activity that is led by Indigenous communities in the spill zone will have additional benefits relative to subsistence harvest and commercial fishing activities at the local scale.**

- Final results from household surveys and focus groups will be summarized and shared back with participants and data devoid of personally identifiable information will be shared via the AOOS portal no later than the 4<sup>th</sup> quarter of FY2026.

### **H3: Kelp mariculture led by Indigenous communities presents a viable economic activity that can help attenuate continued impacts on commercial fishing in the spill zone.**

- Interim data from the Qualtrics survey and semi-structured interviews will be maintained on a secure server maintained by UAA with access limited to Dr. Berry and researchers approved by IRB at the University of Alaska Anchorage
- Data will be summarized and made available via peer reviewed publications and associated white papers that remove any potential identifiers.

Please see Appendix A for the data management plan provided by Axiom Data Science for additional details.

### C. With Other EVOSTC-funded Projects (not within the LTRM Focus Area)

*Indicate how your proposed project relates to, complements, or includes collaborative efforts with the existing projects funded by the EVOSTC that are not part of an EVOSTC-funded program. Anticipated continuing individual projects for FY22 include project numbers 21210128, 21200127, and 21110853. Use the [project search function](#) for project details.*

#### 21200127 - Gulf Watch Ocean Acidification Sampling

Chugach Regional Resources Commission is a collaborator on this proposed project so there is a natural connection for information sharing between these efforts. Insights collected from spill zone communities relative to the status of commercial fishing and subsistence and implications may be useful for informing this research team about public perceptions relative to potential ocean acidification impacts. Similarly, our inquiry into public perspectives about the value of kelp mariculture operations for locally attenuating impacts from ocean acidification may also be useful.

### D. With Other Proposed EVOSTC Mariculture Focus Area Projects

*Indicate how your proposed project relates to, complements, or includes collaborative efforts with proposed EVOSTC mariculture focus area projects.*

This proposal will complement and inform CRRC and Native Conservancy’s joint “Prince William Sound Kelp Mariculture Development for Habitat Restoration and Local Economy” proposal, that seeks to continue ongoing research and development on the practical and operational elements of kelp mariculture farming, including seed production, array design, deployment, monitoring. Additionally, water quality data and sampling will be collected and analyzed at kelp research test sites to inform the restorative possibilities of kelp farming. The research collected and disseminated will be made available to all interested participants cultivated through the listening tour and cultural mapping activities. Meanwhile, the traditional ecological knowledge gathered through this proposed project will be shared by the mariculture team to better inform sustainable and regenerative practices. In addition to this other proposal from CRRC and Native Conservancy, our project team is interested in any equitable and mutually beneficial collaboration opportunities with other teams funded under the 2021 RFP.

### E. With Proposed EVOSTC Education and Outreach Focus Area Projects

*Indicate how your proposed project relates to, complements, or includes collaborative efforts with proposed EVOSTC education and outreach focus area projects.*

A number of the efforts and products proposed here offer unique educational opportunities to help Alaska residents (inside and outside of the spill zone) as well as visitors to the state understand traditional uses of kelp and other seaweeds by coastal Indigenous peoples. Specifically, the resulting interactive story map, film and children’s book planned under H1 will be unique products appropriate for education and outreach. If our proposal is funded we will follow up with the ASLC about their interest in collaborating on sharing these products. We will also work with community and Indigenous institutions that serve communities within the spill

zone to seek appropriate venues from sharing these outreach products as well as presentations about the broader work.

#### F. With Trustee or Management Agencies

*Please discuss if there are any areas which may support EVOSTC trust or other agency work or which have received EVOSTC trust or other agency feedback or direction, including the contact name of the agency staff. Please include specific information as to how the subject area may assist EVOSTC trust or other agency work.*

*If the proposed project requires or includes collaboration with other agencies, organizations, or scientists to accomplish the work, such arrangements should be fully explained, and the names of agency or organization representatives involved in the project should be provided. If your proposal is in conflict with another project or program, note this and explain why.*

The results of this work will be broadly informative to numerous state and federal agencies engaged in the regulation and management of mariculture activities. In developing the original ideas in this proposal we specifically worked with staff from the Alaska Department of Fish and Game (Mike Rehberg and Sue Goodglick from the Marine Mammals Division) as well as the U.S. Fish and Wildlife Service (Robb Kaler from Migratory Birds Management). We also shared earlier versions of these research ideas with Jordan Hollersmith from NOAA Fisheries.

Many of the broad goals of this proposal were also shared by CRRC in meetings with Mr. Doug Vincent-Lang, Acting Commissioner, Alaska Department of Fish and Game about the APMI's kelp culturing efforts and other mariculture initiatives. Dune Lankard of Native Conservancy has held meetings with David E. Schmidt, Regional Forester, Alaska Region USFS/USDA, about the potential for a regenerative mariculture industry in the Spill Zone and about the importance of including Indigenous communities in restoration proposals.

#### G. With Native and Local Communities

*Provide a detailed plan for local and Alaska Native community involvement in the project. This is a mandatory requirement for all proposals.*

Our research team prioritizes Indigenous perspectives, and the idea for this proposed work emerged from a co-production of knowledge approach (e.g., Berkes 2009, Zanotti et al 2020) that was initiated by the Native Conservancy who convened this research partnership throughout 2020. Since that time, the Native Conservancy and CRRC have provided initial insights about the need for this work.

By virtue of our organizations and constituents, Alaska Native community involvement is inherent. CRRC was established by the seven Tribes of the Chugach Region, each of whom holds a seat on the CRRC Board of Directors. The CRRC Board serves at the pleasure of each Tribal Council and are chosen specifically because of their natural resource management inclinations. As part of this project, CRRC will be providing regular updates to the Board of Directors and Tribal members through a variety of outreach efforts (discussed in more detail in the Supplemental package, section 4.c). CRRC will also work closely with Chugachmiut (the social services and cultural education arm of the Tribes in the Chugach Region) and Local Cultural Coordinators in each of the seven communities.

CRRC has already been working closely with three communities (Chenega, Tatitlek and Eyak) in the Spill Area to locate suitable kelp farm locations and have begun to seek funding for these Tribes and/or Tribal members to enter the kelp farming industry. Through this project, the seven communities in the Chugach Region (Port Graham, Nanwalek, Valdez, Tatitlek, Chenega, and Cordova) will have their natural resource entity (CRRC/APMI)



fully committed to development of a burgeoning kelp industry with the utmost capacity for assisting, both financially and technically, and to remove roadblocks so as ensure farm success.

Native Conservancy is led by a 100% Native board of directors and commits to a minimum of 70% Native staff. The organization has deep ties in Eyak and neighboring communities. Native Conservancy provides monthly fresh seafood deliveries to Native elders at no-cost, provides Eyak language revitalization workshops, hosts annual Eyak Culture camps, and leads participatory mapping initiatives to restore Eyak place names and stories to pave the way for land reparations. All Native Conservancy's programs are based on Native community needs and interests, including this program to spearhead a regenerative, restorative kelp farming industry.

These two organizations identified the majority of project collaborators, including an Indigenous scholar (Dr. Elizabeth Hoover) who specializes in Indigenous food systems and another with decades of collaboration with Indigenous communities on coastal ecological issues in Alaska (Thornton). All the regional coordinators for the Indigenous Listening Tour (which aims to engage up to 30 tribal communities) and the interviewers are Indigenous and most are from native communities.

Collectively, the Native Conservancy, Alaska Conservation Foundation and GreenWave have launched the Native Alaskan Kelp Initiative which aims to build a network for farms throughout the state managed by Indigenous institutions (tribes, ANCSA corporations, and Indigenous nonprofits). This initiative was launched following numerous discussions with tribal leaders in the EVOS spill zone organized by the Native Conservancy and CRR. These conversations have highlighted the proposed work with special attention to understanding and documenting traditional stewardship, harvest and cultural practices, seasons, and locations of Indigenous communities relative to seaweed and other marine species.

As these conversations have progressed Native Conservancy has received inquiries from coastal tribes from around the state with many in the Kodiak, lower Cook Inlet and Prince William Sound region. This highlighted the need for the Indigenous Listening Tour focused on the topic of kelp mariculture. This 2021/2022 effort is being funded by the Native Conservancy, GreenWave and Alaska Conservation Foundation, and the results will directly inform our methodological approach (H1 and H2) and confirm the interests of partner communities within the EVOS spill zone in participating in this research. If funded, the work proposed in this project will directly benefit at least 10 tribal communities within the spill zone and will build the research capacities of two key Indigenous led organizations in the region.

## 6. DELIVERABLES

*List and describe expected products that will come from this project. Deliverables include but are not limited to papers, reports, recordings, films, websites, presentations, data, and metadata. Project PI(s) will be responsible for all deliverables unless otherwise noted below.*

**H1: Evaluation of historical ecology, distribution and practices of traditional Indigenous mariculture and subsistence harvest activities is necessary for effective site selection of potential future mariculture sites.**

As the findings are being developed it is understood as their collective intellectual property of contributing communities however the cultural mapping will result in the following key deliverables that will be shared:

- An interactive GIS story map, developed through community-created protocols, will delineate boundaries of key harvesting sites for Eyak, Tlingit, Chugachmiut, Alutiiq/Sugpiaq communities in the spill zone: online map for

a wide audience, showing Native place names, historical and contemporary distributions of kelp species, and detailed accounts of individuals or Nations that have historically harvested in those boundaries and the cultural values and services associated with key kelp and seaweed patches.

- Multi criteria evaluation (MCE) analysis will result in a report including recommendation of appropriate locations for kelp cultivation that incorporates species site suitability and culturally significant harvesting areas.
- Communication products include: a short film documenting the cultural GIS mapping process and a children's book focused on Indigenous practices for stewardship and harvesting of kelp and other seaweeds.
- A report and peer reviewed journal article on the findings concerning the historical ecological changes and cultural significance of seaweeds and kelps in PWS over time, including implications for restoration and mariculture development.

**H2: New kelp mariculture activity that is led by Indigenous communities in the spill zone will have additional benefits relative to subsistence harvest and commercial fishing activities at the local scale.**

- A report on the implications of Indigenous led mariculture development in communities relative to subsistence practices and increased food security as well as the connections between increased mariculture activity and commercial fishing.

**H3: Kelp mariculture led by Indigenous communities presents a viable economic activity that can help attenuate continued impacts on commercial fishing in the spill zone.**

- A peer-reviewed academic publication on consumer willingness to pay for kelp products.
- A report on consumer perceptions of non-use and passive values of kelp forests in EVOS region.
- A report on willingness of researchers and policymakers to pay for scientific information gathered by kelp farmers.

## 7. PROJECT STATUS OF SCHEDULED ACCOMPLISHMENTS

*Milestones are annual steps to meet overall objectives.*

*Tasks are annual steps to meet milestones (for example, sample collection, data analysis, manuscript submittal, etc.)*

*Deliverables are products that will be produced from the project (see section 6 above).*

*For each milestone, task, and deliverable listed, specify by each quarter of each year these will be accomplished. C = completed, X = planned or not completed.*

*For multi-year projects, reviewers will use this information in conjunction with project reports to assess whether the project is meeting its objectives and is suitable for continued funding.*

**H1: Evaluation of historical ecology, distribution and practice of traditional Indigenous mariculture and subsistence harvest activities is necessary for effective site selection of potential future mariculture sites**

Milestone/Task	FY22				FY23				FY24				FY25				FY26			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
<b>Milestone</b>  Identifying which kelp forests have been affected by the EVOS	X	X	X	X	X	X	C													
<b>Task</b>  Archaeological Research at focal communities	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	C		
<b>Milestone</b>  Engage with 21-30 Alaska Native tribes located within the EVOS spill zone- Listening Tour	X	X	C																	

<b>Task</b> <b>Create a Story Map</b>	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	C	
<b>Task</b> <b>Develop children's books</b>	X	X	X	X	X	X	X	X	X	X	X	X	X	C						
<b>Milestone</b> <b>Cultural GIS Mapping</b>		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	C		
<b>Task</b> <b>Research and document Indigenous place names and their associations with mariculture resources and sites used by communities historically.</b>	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	C	
<b>Reporting</b>				C						C									C	
<b>*Annual reports</b>				X	C				X	C						X	C			

<b>FY work plan</b>	X	C			X	C			X	C			X	C			X	C		
<b>Final report</b>							X	C									X	X	C	
<b>Deliverables</b>																				
<b>Peer reviewed paper</b>																	X	X	C	
<b>Data posted online</b>																	X	X	Oct 2026	

**H2: New kelp mariculture activity that is led by Indigenous communities in the spill zone will have additional benefits relative to subsistence harvest and commercial fishing activities at the local scale.**

<b>Milestone/Task</b>	<b>FY22</b>				<b>FY23</b>				<b>FY24</b>				<b>FY25</b>				<b>FY26</b>			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1			

<p>milestone: Confirm interest maintain relationships with indigenous leadership from up to 10 partner communities who will participate in a five-year study</p>	X	X	X	X	C														
<p>Conduct incentivized household surveys</p>	X	X	X	X	X	X	X	X	X	X	C								
<p>Conduct targeted focus groups in partner communities to understand broader community interests</p>						X	X	X	X	X	X	X	X	X	X	X	X	C	
<p>Conduct post-farm household surveys</p>										X	X	X	X	X	X	X	X	C	
<p>Reporting</p>					X	C													
<p>*Annual reports</p>				X	C			X	C			X	C						
<p>FY work plan</p>			X	C			X	C			X	C							
<p>Final report</p>																	X	C	

<b>Deliverables</b>																					
<b>Community Survey Reports</b>														X	C						

**H3: Kelp mariculture led by Indigenous communities presents a viable economic activity that can help attenuate continued impacts on commercial fishing in the spill zone.**

Milestone/Task	FY22				FY23				FY24				FY25				FY26			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
<b>Milestone: Conduct a national willingness-to-pay survey to identify valuation perspectives</b>									X	X	X	C								
<b>Develop several Pilot projects</b>															X	C				







**B. Sources of Additional Funding**

*Fill out the summary table below (should match the table on page 2). Provide a narrative that identifies non-EVOSTC funds or in-kind contributions used as cost-share for the work in this proposal. List the amount of funds, the source of funds, and the purpose for which the funds will be used. Do not include funds that are not directly and specifically related to the work being proposed in this proposal. Please attach documentation from additional project funding sources which confirms and describes matching funds, including date(s) the matching funds are/will be authorized.*

**Non-EVOSTC Funds to be used, please include source and amount per source:**

FY22	FY23	FY24	FY25	FY26	FY22-26 Total
\$125,000					\$125,000

\$75,000 from the Chorus Foundation, July 1, 2020 - August 30, 2021 and an additional \$25,000 from Native Conservancy provides \$100K in match funding for the Indigenous Listening Tour. GreenWave and Native Conservancy will work with coastal tribes, food sovereignty experts, fishermen and Native leaders to offer monthly zoom calls over 6 months on such pertinent topics as Native food sovereignty, Native community-run kelp farming; technical considerations; and seed funding opportunities. The key deliverable is a report summarizing kelp farming interests from Native communities along with their questions and concerns, and appropriate training and support for indigenous communities as well as funding to support the development of a regenerative mariculture industry. Report will also share key tribal stories and traditional uses of kelp for millennia.

The Native Conservancy is also contributing \$25,000 to support the Listening Tour through 2021 and early 2022. Additionally Native Conservancy will invest \$25,000 for the Cultural Mapping component of this project to be issued in Q2 of FY22. This builds on contemporary work to pilot Cultural Mapping project, primarily focusing on placenames and story map development in Eyak (Cordova), Alaska. Learning from this work will directly inform our approach for engaging with other partner communities through the proposed effort.

Two Attachments:

- 1) Commitment letter from GreenWave (2 pages) for funding supporting the Listening Tour
- 2) Commitment letter from Native Conservancy for funding supporting the Listening Tour and Cultural GIS Mapping .

Chorus Foundation c/o  
**Mott Philanthropic**

May 7, 2020

Mr. Brendan Smith  
 Executive Director  
 GreenWave Organization  
 315 Front Street  
 New Haven, CT 06513

RE: \$75,000 GRANT RECOMMENDATION FROM THE CHORUS, INC. DONOR-ADVISED FUND AT FIDELITY CHARITABLE

Dear Mr. Smith:

I am pleased to advise you that I am recommending that a total of \$75,000 be granted to GreenWave Organization (the Grantee) in support of Hiring an Alaska Reef Manager to Increase the Capacity of Alaska's Indigenous Communities to Build a Just and Regenerative Ocean Farming Industry (the Project), from the Chorus, Inc. Donor-Advised Fund at Fidelity Charitable Giving.

Please help keep us informed of your work by following the report procedures outlined below. This will allow us to consider further funding recommendations.

**GRANT NUMBER:** 5514

*Please refer to this number in all communications with Foundation staff.*

**GRANT TERM:**

Start Date: July 1, 2020  
 End Date: August 30, 2021  
 Duration: 13 months

**PAYMENT SCHEDULE DATE:** Within 10 business days of receipt of this counter-signed letter

**GRANT REPORT DUE DATE:** October 1, 2021

The online report will include:

- a. A written narrative, and
- b. A copy of your organization's most recently completed CPA review or Audited Financial Statement.

The grant report form will be posted to your organization's online portal, and instructions will be emailed approximately two months prior to the due date. To complete and submit your report, sign on to your account through the online grant portal [https://www.grantrequest.com/SID\\_1112?SA=AM](https://www.grantrequest.com/SID_1112?SA=AM)

Prudential Tower, 800 Boylston Street, Suite 1560, Boston, Massachusetts 02199 T 617.927.5700 [mottphilanthropic.com](http://mottphilanthropic.com)

CHORUS FOUNDATION-GREENWAVE ORGANIZATION  
 Award #5514  
 May 7, 2020  
 PAGE 2 of 2

**ACKNOWLEDGEMENT, PUBLICITY, AND COMMUNICATIONS**

When acknowledging support, the Foundation will be referred to as “Chorus Foundation” for public purposes in all online and printed materials. Should the Grantee wish to distribute a press release, case study, success story, or any other elaborated material that mentions support from the Foundation or names a particular director of the Foundation, prior written approval must be received from the Foundation. If you have questions about using the Foundation name in other ways, please consult with your program officer, Cuong Hoang, at [cphoang@mottphilanthropic.com](mailto:cphoang@mottphilanthropic.com).

If you have any questions, do not hesitate to contact me or Paula Lentoni at [plentoni@mottphilanthropic.com](mailto:plentoni@mottphilanthropic.com).

Sincerely,

Farhad Ebrahimi  
 Board Chair  
 The Chorus Foundation

cc: Ms. Emily Stengel, Deputy Director

By signing below, I confirm that GreenWave Organization accepts a gift from the Chorus, Inc. Fidelity Charitable Giving Account in fulfillment of the following grant from the Chorus Foundation.

ORGANIZATION NAME:	GreenWave Organization
GRANT #:	5514
PROJECT TITLE:	Hiring an Alaska Reef Manager
GRANT AMOUNT:	\$75,000
GRANT TERM	July 1, 2020–August 30, 2021
GRANT DURATION:	13 months
TYPE OF SUPPORT:	Project Support
PROGRAM OFFICER:	Cuong Hoang <a href="mailto:cphoang@mottphilanthropic.com">cphoang@mottphilanthropic.com</a>

Signature:  Title: Executive Director  
 Name: Bren Smith Date: 5/13/2020  
 (Type or print)

Please email a **complete** signed copy to Paula Lentoni to [plentoni@mottphilanthropic.com](mailto:plentoni@mottphilanthropic.com) or send via fax to 617.927.5710.



NATIVE CONSERVANCY

March 24, 2021

EVOS Trustee Council  
4230 University Drive, Ste 220  
Anchorage, AK 99508-4650

RE: Financial Commitment: Social, cultural and economic assessment of kelp mariculture opportunities for coastal villages within the EVOS spill zone

Dear EVOS Trustee Council Members,

The Native Conservancy (NC) is the very first Native-led, Native-land conservancy in the United States and was formed in 2003, by our Founder and President Dune Lankard, an Eyak Athabaskan Native, fisherman and conservationist from the Copper River Delta and Prince William Sound. The Native Conservancy holds conservation trusts to Native lands and leads comprehensive cultural conservation efforts in the region, that strengthen and enforce inherent Native Rights of sovereignty, subsistence, and spirituality to protect our lands and oceans. Since 2019, Native Conservancy has pioneered kelp mariculture activities to develop the infrastructure and knowledge needed to encourage Native families and communities to enter the industry. We have officially partnered with a group of renowned organizations on an exciting proposal to the Exxon Valdez Oil Spill Trustee Council.

As a Collaborator of the Project, NC is committed to providing the following supplemental funding:

- \$25,000 to support the Indigenous Listening Tour, funds to be issued Q2 of FY22
- \$25,000 to support the Cultural Mapping project, funds to be issued Q2 of FY22

The EVOS Trustee Council has recently expressed a renewed interest and commitment to Alaska Native involvement in both their mission and through input on specific projects, which we wholly embrace and are uniquely positioned to help facilitate. Native Conservancy's involvement with this proposal fulfills this requirement.

What a mutual honor it would be for the EVOS Trustee Council and NC to work together to liaison with the Alaska Native community, garner community input, support and participation in science projects and provide a vector between traditional ecological knowledge and western science to obtain the goals originally set forth by the Trustee Council: restore the spill area for the use of those most impacted by the devastating event.

Sincerely,

Dune Lankard  
Founder & President  
Native Conservancy

## 9. LITERATURE CITED

*Provide literature cited in the proposal.*

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## 10. PROJECT PERSONNEL

*The CV's of all Principal Investigators and other senior personnel involved in the proposal must be provided. Each resume is limited to **two** consecutively numbered pages and must include the following information:*

- *A list of professional and academic credentials, mailing address, and other contact information (including e-mail address)*
- *A list of up to 10 of your most recent publications most closely related to the proposed project and up to five other significant publications. Do not include additional lists of publications, lectures, etc.*
- *A list of all persons (including their organizational affiliations) in alphabetical order with whom you have collaborated on a project or publication within the last four years. If there have been no collaborators, this should be indicated.*



**Aaron James Poe (Proposal PI)**

**Alaska Conservation Foundation/ABSI Partnership**  
**1227 West 9<sup>th</sup> Suite 300**  
**Anchorage, AK 99501**

**Work: 907-433-8202**

**Cell: 907-575-7071**

[Apoe@alaskaconservation.org](mailto:Apoe@alaskaconservation.org)

---

**Education:**

- University of Arizona, Tucson AZ (2008): Master of Science in Natural Resources
- Utah State University, Logan UT (1998): BS Geography (GIS); BS Fisheries and Wildlife Management

**Work History:**

- (2018-present) Alaska Conservation Foundation: Network Program Officer and Coordinator for the Aleutian and Bering Sea Initiative
- (2012-2018) U.S. Fish and Wildlife Service: Science Coordinator, then Coordinator for the Aleutian and Bering Sea Islands Landscape Conservation Cooperative
- (1998-2012) Chugach National Forest: Wildlife Biologist to Prince William Sound Framework Coordinator, and then Partnership Coordinator for the Forest.

**Core Relevant Activities:**

- Acquiring and managing funding from diverse sources (\$3.7 million since 2019) to promote integrated science efforts of federal, state, tribal and private contributors to fill high priority information gaps for managers, tribes scientists and stakeholders in Alaska.
- Building partnerships between Indigenous communities, federal and state managers and academia focused on climate adaptation, resource stewardship and community sustainability.
- Evaluating vulnerabilities of species, habitats and communities to climate change and designing collaborative science and adaptation efforts to address them.
- Strategic science planning focused on landscape level stressors in Alaska (e.g., vessel traffic, pollutants and contaminants, and invasive species) including literature review, expert interviews, information synthesis, and collaborative prioritization process.

**Science Team Leadership:**

- Co-leading a team of 19 scientists and community leaders from across Alaska and western Canada to assess and strengthen community-based environmental monitoring networks.
- Co-leading five projects that engage 23 scientists and managers from the U.S. Fish and Wildlife Service in order to strengthen engagement between federal and state agencies as well as improve collaborative relationships with tribes and federal agencies.
- Leading a team of a dozen scientists and managers from state and federal agencies, tribes and academia synthesizing data on pollutants and contaminants in preparation for a vulnerability assessment for species, habitats and communities in the Aleutians and Bering Sea.
- Co-led a team of 22 scientists, managers and subject matter experts from agencies, tribes and the private sector to develop science translation workshops and tools for coastal managers and communities in the U.S. Arctic.
- Chaired the Aleutian and Bering Sea Islands Pollutants and Contaminants working group composed of 25 scientists and managers from federal and state agencies, tribes, and academia working to identify high priority contaminants issues and information needs
- Led a team of 30 scientists and managers to identify vulnerabilities of resources and ecosystem services from climate change for the Aleutian and Bering Sea region.

- Led a team of a 15 scientists and managers from the U.S. Forest Service and three universities on a suite of six projects in partnership with local communities to evaluate human use in Prince William Sound and overlap with species injured by the EVOS.

#### **Selected Publications:**

- Sullender, B. K., K. Kapsar, **A. Poe** and M. Robards. 2021. Spatial Management Measures Alter Vessel Behavior in the Aleutian Archipelago. *Front. Mar. Sci.* <https://doi.org/10.3389/fmars.2020.579905>
- Holly F. G., E. O. Garton and **A. Poe** "Effects of climate change and environmental variability on the carrying capacity of Alaskan seabird populations," *The Auk* 135(4), (15 August 2018). <https://doi.org/10.1642/AUK-18-37.1>
- Renner, M., E. Nelson, J. Watson, A. Haynie, **A. Poe**, M. Robards and S. C. Hess. 2018. The risk of rodent introductions from shipwrecks to seabirds on Aleutian and Bering Sea islands. *Biological Invasions*, Volume 20; Issue 9:2679–2690
- **Poe, A.** and H. R. Gimblett (eds.). 2017. *Sustainable Wildlands: Integrating Science and Community in Prince William Sound*, University of Arizona Press. 355 p.
- K. Pletnikoff, **A. Poe**, K. Murphy, A. Holman, L. Heffner, D. Holen, H. Stewart, C. Beck. 2017. Promoting Coastal Resilience and Adaptation: a synthesis from four regional workshops in the Alaskan Arctic. Aleutian Pribilof Islands Association, Anchorage Alaska. 80 p. Available at: [www.AdaptAlaska.org](http://www.AdaptAlaska.org)
- Stewart, H, C. Beck, **A. Poe** and K. Pletnikoff. 2017. A Toolbox for Resilience and Adaptation in Coastal Arctic Alaska: Guide for Alaska Communities, Tribes, Agencies and Citizens, Strategies, Actions and Resources. Available: [www.AdaptAlaska.org](http://www.AdaptAlaska.org) 106 p.
- Itami, R. M., Gimblett, H. R. and **A. Poe**. 2016. Level of Sustainable Activity: A Framework for Integrating Stakeholders into the Simulation Modelling and Management of Mixed use Waterways. In S. Gray, M. Paolisso, R. Jordan and S. Gray (eds.): *Environmental Modeling with Stakeholders: Theory, Methods, and Applications*. Springer.
- **Poe, A.** Van Pelt T, and J Littell (eds) 2016. The Aleutian-Bering Climate Vulnerability Assessment. Aleutian and Bering Sea Island Landscape Conservation Cooperative, U.S. Fish and Wildlife Service. Anchorage, Alaska. 151 p.
- Gimblett. H. R., R. Itami & **A. Poe**. 2014. Agent-based Modelling of Social Networks: Natural resource applications of Human/Landscape Interactions across Space and Time. In: R. Stocker & T. Bossomaier (eds). *Networks in Society: Links and Language*. Pan Stanford Publishing Ltd.
- **Poe, A.** and D. Burn. 2013. Addressing Environmental Stressors in the Aleutian Islands and Bering Sea: A Strategic Science Plan. Aleutian and Bering Sea Island Landscape Conservation Cooperative, U.S. Fish and Wildlife Service. Anchorage, Alaska. 120 pp.

#### **Aaron Poe Collaborators**

4	Name:	Organizational Affiliation
C:	Anderson, Marina	Organized Village of Kasaan
C:	Aplin, Marianne	US Fish and Wildlife Service
A:	Beck, Chris	Agnew::Beck Consulting
A:	Blahna, Dale	US Forest Service
C:	Bochenek, Rob	Axiom Data Science
A:	Bond, Nick	University of Washington
A:	Brown, Courtney	US Fish and Wildlife Service
A:	Burn, Douglas	US Fish and Wildlife Service
C:	Butler, Shawn	University of Alaska Anchorage
C:	Christiensen, Bob	Sustainable Southeast Partnership

C:	Coon, Catherine	Bureau of Oean Energy Management
C:	Custard Buddy	Alaska Maritime Prevention and Response Network
C:	Dahlstrom, Michael	Iowa State University
C:	Divine, Lauren	Aleut Community of St. Paul
C:	Dononvan, Shannon	University of Alaska Anchorage
C:	Drew, Gary	USGS Alaska Science Center
A:	Droghini, Amanda	University of Alaska Anchorage
C:	Druckenmiller, Matthew	University of Colorado, Boulder
C:	Drummond, Brie	US Fish and Wildlife Service
C:	Dutton, Karla	Defenders of Wildlife
A:	Eric Nelson	US Fish and Wildlife Service
C:	Ferguson, Aaron	Spruce Root Community Development
C:	Fischbach, Anthony	US Geological Survey
C:	Flamme, Melanie	National Park Service
C:	Furness, Bob	University of Glasgo
C:	GarlichMiller, Joel	US Fish and Wildlife Service
A:	Garton, Oz	University of Idaho
C:	Gieffer, Joeseeph	Alaska Department of Fish and Game
A:	Gimblett, Randy	University of Arizona
C:	Golden, Trevor	Axiom Data Science
C:	Goldman, Max	Reddish Egret Ecology
C:	Goldstein, Michael	US Forest Service
C:	Good, Tom	NOAA
C:	Goodrich, Bethnay	Sitka Conservation Society
C:	Gosuk, Aubery	Tuyuryaq Tribal Conservation District
C:	Gotthardt, Tracey	Alaska Department of Fish and Game
A:	Goyert, Holly	University of Idaho
C:	Hackenmueller, Paul	Spruce Root Community Development
C:	Hagedorn, Birgitte	Sustainable Earth Research LCC
A:	Haynie Alan	NOAA
C:	Hayward, Gregory	U.S. Forest Service
C:	Heffner, Leanna	Alaska Conservation Foundation
A:	Hess, Steve	US Geological Survey
C:	Holen, Davin	Alaska Sea Grant
A:	Hollmen, Tuula	Alaska Sea Life Center
A:	Holman, Amy	NOAA
C:	Howard, Amee	Bureau of Oean Energy Management
C:	Itami, Robert	Geo Dimensions LLC
C:	Jackson, Dawn	Organized Village of Kake
C:	Jacobs, Justin	US Coast Guard
C:	Jamie Trammell	University of Alaska Anchorage
C:	Jessica Cross	NOAA
C:	Jones, Tahzay	National Park Service
A:	Kapsar, Kelly	Michigan State University
C:	Koelsch, Jeannette	National Park Service
A:	Koeppen, William	Axiom Data Science
C:	Kotchuten, Nadine	Aleut International Association
A:	Kuletz, Katherine	US Fish and Wildlife Service
C:	Labunski, Elizabeth	US Fish and Wildlife Service

C:	Leah Kenney	US Fish and Wildlife Service
A:	Littell, Jeremy	USGS Climate Adaptation Science Center
C:	Logerwell, Libby	NOAA
C:	Lopez, Jesse	Axiom Data Science
C:	Mabry, Kristin	NOAA
C:	Mack, Liza	Aleut International Association
C:	Mallot, Anthony	Sealaska
C:	Mari Reeves	US Fish and Wildlife Service
C:	Martin, Kate	US Fish and Wildlife Service
C:	Matheson, Benjamin	US Fish and Wildlife Service
C:	Matz, Angela	US Fish and Wildlife Service
C:	McCammon, Molly	Alaska Ocean Observing System
C:	Melovidov, Connie	Aleutian Pribilof Islands Association
C:	Murphy, Karen	US Fish and Wildlife Service
C:	Mutter, Edda	Yukon River Inter-Tribal Watershed Council
C:	Nickerson, Dennis	Prince of Wales Tribal Conservation District
C:	Paddock, Raymond III	Central Council of Tlingit and Haida
C:	Page, Ed	Marine Exchange of Alaska
C:	Peterson, Alana	Spruce Root Community Development
C:	Peterson, Richard	Central Council of Tlingit and Haida
C:	Piatt, John	US Geological Survey
A:	Pletnikoff, Karen	Aleutian Pribilof Islands Association
C:	Pocwiesz, Amy	US Fish and Wildlife Service
C:	Poe, Chandra	Qawalangin Tribe of Unalaska
C:	Polasek, Lori	Alaska Department of Fish and Game
C:	Powers, Elizabeth	USGS Alaska Science Center
C:	Raymond, Vanessa	Axiom Data Science
A:	Raymond-Yakoubian, Julie	Kawerak Inc.
C:	Rehburg, Michael	Alaska Department of Fish and Game
A:	Reimer, Jesika	University of Alaska Anchorage
C:	Renner, Heather	US Fish and Wildlife Service
A:	Renner, Martin	Tern Consulting
C:	Reynolds, Joel	National Park Service
C:	Rizzolo, Daniel	US Fish and Wildlife Service
A:	Robards, Martin	Wildlife Conservation Society
C:	Robson, Bruce	Community and Ecological Resources LLC
C:	Schuette, Paul	US Fish and Wildlife Service
C:	Siddon, Elizabeth	NOAA
A:	Smith, Melanie	Audubon Alaska
A:	Stewart, Heather	Agnew::Beck Consulting
A:	Sullender, Benjamin	Audubon Alaska
C:	Sullender, Benjamin	Kickstep Approaches
C:	Suryan, Rob	Oregon State University
C:	Sydeman, William	Farrallon Institute
C:	Temte, James	Alaska Pacific University
C:	Thompson, Sarah Ann	Farrallon Institute
C:	Thoms, Andrew	Sitka Conservation Society
C:	Turnipseed, Mary	Gordon Betty Moore Foundation
C:	Van Pelt, Tom	Xboundary Ecologic

C:	Veldstra, Jessica	Aleut International Association
C:	Von Hippel, Frank	University of Northern Arizona
A:	Watson, Jordan	NOAA
C:	Wiese, Edward	Alaska Department of Fish and Game
C:	Wolfe, Ralph	Spruce Root Community Development
C:	Woll, Christine	The Nature Conservancy
C:	Zador, Stephani	NOAA
C:	Zeller, Tamara	US Fish and Wildlife Service

## Biographical Sketch Kevin C. Berry

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### a. Professional Preparation

University of Wyoming, Laramie Wy, Economics, B.S. 2010

University of Wyoming, Laramie Wy, Economics, Ph.D., 2015

Yale University School of Forestry and Environmental Studies, New Haven CT, Environmental Economics, 2015-2016

### b. Appointments

2020-Present, Assistant Professor, Department of Economics, College of Business and Public Policy, University of Alaska-Anchorage

2017-2020, Assistant Professor, Institute of Social and Economic Research and Department of Economics, College of Business and Public Policy, University of Alaska-Anchorage

### c. Research Products

1. Berry, K. E. P. [Fenichel](#), B. Robinson, (2019). The Ecological Insurance Trap, *Journal of Environmental Economics and Management*, 98, 102251.
2. Hamann, M., K. Berry, et al.\*, (2018). Inequality and the Biosphere, *Annual Review of Environment and Resources*, 43, 61-83.
3. Berry, K., C. Allen, R. D. Horan, J.F. [Shogren](#), P. [Daszak](#), D. [Finnoff](#), (2018). The Economic Case for a Global Pandemic Fund. *EcoHealth*, 15(2), 244-258.
4. Horan, R.D., [Finnoff](#), D., Berry, K., Reeling, C. and [Shogren](#), J.F., (2018). Managing Wildlife Faced with Pathogen Risks Involving Multi-Stable Outcomes. *Environmental and Resource Economics*, 1-18.
5. Berry, K., J. Bayham, S. Meyer, E.P. [Fenichel](#), (2018). The allocation of time and risk of Lyme: a case study in ecosystem service income and substitution effects. *Environmental and Resource Economics*, 1-20.
6. Anderson, J.\*, K. Berry, J. Bayham, E.P. [Fenichel](#), (2017). Linking Time-Use Data to Explore Health Outcomes: Choosing to Vaccinate Against Influenza. *EcoHealth* 15(2), 290-301.
7. Berry, K., [Finnoff](#), D. C., Horan, R. D., & McDermott, S. M. (2017). The role of restoration in the prevention of a large-scale native species loss: Case study of the invasive emerald ash borer. *Journal of Forest Economics*, 27, 91-98.
8. [Machalaba](#), C., K. M. Smith, L. [Awada](#), K. Berry, et al., (2017). One Health Economics to confront disease threats, *Transactions of The Royal Society of Tropical Medicine and Hygiene*, Volume 111, Issue 6, 1 June 2017, Pages 235–237
9. Berry, K., & [Finnoff](#), D. (2016). Choosing between adaptation and prevention with an increasing probability of a pandemic. *Journal of Economic Behavior and Organization*, 132, 177-192.
10. [Finnoff](#), D., Horan, R. D., [Shogren](#), J. F., Reeling, C., & Berry, K. (2016). Natural vs anthropogenic risk reduction: Facing invasion risks involving multi-stable outcomes. *Journal of Economic Behavior and Organization*, 132, 113-123.
11. Berry, K\*, [Finnoff](#), D., Horan, R. D., & [Shogren](#), J. F. (2015). Managing the endogenous risk of disease outbreaks with non-constant background risk. *Journal of Economic Dynamics and Control*, 51, 166-179.

**d. Synergistic Activities**

1. Berry is involved in the Beijer Young Scholars (BYS) program at The Beijer Institute of Ecological Economics at the Royal Swedish Academy of Sciences. The BYS is focused on the question of Inequality and the Biosphere, or how different aspects of both wealth inequality and inequality in access to natural resource endowments interact in social-ecological systems. This includes the abilities of communities and individuals at various levels of wealth to adapt to environmental risks, including disease risk.
2. Berry is involved with two NOAA funded projects where he is contributing economic intuition and economic modelling focused on cost minimizing adaptation to climate change, “Thresholds in a changing ocean environment: bioeconomic implications to inform adaptation decisions for Alaska’s salmon fisheries” (Co-PI) and “Building Resilience to Extreme Events and Water Hazard Planning in Rural Communities” (Co-I). He is also a Co-PI on the NSF project “Convergence NNA: ANCHOR - Arctic Network for Coastal Community Hazards, Observations, and Integrated Research.” In every project Berry is focused on the economic tradeoffs individuals face when making adaptation decisions.
3. Berry is the USA PI on a Belmont Forum proposal (US portion sponsored by NSF) focused on coastal community resilience and Alaskan fisheries. The project is focused on developing models of fishery management that incorporate potential ecological and economic tipping points, to better understand how communities can achieve resilience to environmental stressors such as climate change and ocean acidification.
4. Berry is also an advisory board member for the Alaska Center for Climate Assessment and Policy, a NOAA funded RISA center focused on use-inspired science intended to support policymakers in Alaska.

A	Your Name:	Your Organizational Affiliation(s), last 12 mo
	Berry, Kevin	University of Alaska Anchorage
		Yale School of Forestry & Environmental Studies

Table B: List names as Last Name, First Name Middle Initial, and provide organizational affiliations, if known, for the

G:	Your PhD Advisor(s)	
T:	All your PhD Thesis Advisees	
P:	Graduate Advisors	
B	Advisor/Advisee Name:	Organizational Affiliation
G:	Finnoff, David	University of Wyoming
G:	Shogren, Jason	University of Wyoming
G:	Mason, Charles	University of Wyoming
G:	Skiba, Alexandre	University of Wyoming
G:	Liu, Rongsong	University of Wyoming

Table C: List names as Last Name, First Name, Middle Initial, and provide organizational affiliations, if known, for the

A:	Co-authors on any book, article, report, abstract or paper (with collaboration in last 48 months; publication date)
C:	Collaborators on projects, such as funded grants, graduate research or others (in last 48 months).
R:	Additional names for whom a personal, family, or business relationship would otherwise preclude their service as

C	Name:	Organizational Affiliation
A:	Allen, Christopher	EcoHealth
A:	Horan, Richard D.	Michigan State University
A:	Shogren, Jason	University of Wyoming
A:	Daszak, Peter	EcoHealth
A:	Finnoff, David	University of Wyoming
A:	Reeling, Carson	Western Michigan University Kalamazoo
A:	Anderson, Julia	Yale University
A:	Bayham, Jude	Colorado State University
A:	Fenichel, Eli P.	Yale University
A:	Meyer, Spencer	Yale University & Highstead Foundation
A:	McDermott, Shana	Trinity University
A:	James, Alexander	University of Alaska Anchorage
A:	Smith, Brock	Montana State University
A:	Cease, Arianne	Arizona State University
A:	Esler, James	Arizona State University & University of Montana
A:	Delmond, Anthony	Washington State University
A:	Morin Chasse, Remi	University of Prince Edward Island
A:	Strandholm, John	Washington State University
A:	Hosseini, Parvizeh	EcoHealth
A:	Cullen, Darron	University of Leuven
A:	Latchininsky, Alexandre V.	University of Wyoming
A:	Ayali, Amir	Tel-Aviv university
A:	Buhl, Jerome	University of Adelaide
A:	De Keyser, Rien	University of Leicester
A:	Foiquet, Bert	Texas A&M University
A:	Hadrich, Joleen C.	Colorado State University
A:	Matheson, Tom	University of Leicester
A:	Ott, Swidbert R.	University of Leicester
A:	Poot-Pech, Mario A.	Yucatan State Plant Protection Committee



A:	Robinson, Brian E.	McGill University
A:	Smith, Jonathan	University of Leicester
A:	Song, Hojun	Texas A&M University
A:	Sword, Gregory A.	Texas A&M University
A:	Vanden Broeck, Jozef	University of Leuven
A:	Verdonck, Rick	University of Leuven
A:	Verlinden, Heleen	Univeristy of Leuven
A:	Rogers, Stephen M.	Arizona State University & University of Cambridge
A:	Machalabra, Cahterine	EcoHealth
A:	Smith, Kristine	EcoHealth
A:	Awada, Lina	World Organization for Animal Health
A:	Berthe, Franck	World Bank
A:	Bouley, Timothy	World Bank
A:	Bruce, Mieghan	University of Liverpool
A:	Cortinas Abrahantes, Jose	European Food Safety Authority
A:	El Turabi, Anas	Harvard University
A:	Feferholz, Yasha	EcoHealth
A:	Flynn, Louise	DAI
A:	Fournie, Guillaume	Royal Veterniary College, London
A:	Andre, Amanda	EcoHealth
A:	Grace, Delia	International Livestock Research Institution
A:	Jonas, Olga	Harvard University
A:	Kimani, Tabitha	Food and Agriculture Organization
A:	Le Gall, Francois	World Bank
A:	Miranda, Juan Jose	World Bank
A:	Peyre, Marisa	CIRAD
A:	Pinto, Julio	Food and Agriculture Organization
A:	Ross, Noam	EcoHealth
A:	Ruegg, Simon	University of Zurich
A:	Salerno, Robert H.	DAI
A:	Siefman, Richard	
A:	Zambrana-Torrelío, Carlos	EcoHealth
A:	Karesh, William B.	EcoHealth & World Organization for Animal Health
C:	Qui, Jiangxiao	University of Wisconsin-Madison
C:	Chaigneau, Tomas	University of Exeter
C:	Curry, Tracie	University of Alaska Fairbanks
C:	Hamann, Maïke	Stellenbosch University
C:	Heilmayr, Robert	University of Hawaii
C:	Henriksson, Patrik	The Beijer Institute & Stockholm Resilience Centre
C:	Sundberg, Jonas Hentati	Swedish University of Agricultural Sciences
C:	Jina, Amir	University of Chicago
C:	Lindkvist, Emelie	Stockholm Resilience Centre
C:	Lopez-Maldonado, Yolanda	Ludwig Maximilian University of Munich
C:	Nieminen, Emmi	Finnish Environment Institute

C:	Piaggio, Matias	Environment and Development Center for Central America & University of the Republic, Uruguay
C:	Rocha, Juan-Carlos	The Beijer Institute & Stockholm Resilience Centre
C:	Schill, Caroline	The Beijer Institute & Stockholm Resilience Centre
C:	Shepon, Alon	Weizmann Institute of Science
C:	Tilman, Andrew	Princeton University
C:	van den Bijgaart, Inge	University of Gothenburg
C:	Wu, Tong	Arizona State University
C:	Reimer, Matthew	University of California Davis
C:	Reimer, Jesika	University of Alaska Anchorage
	Watson, Brett	University of Alaska Anchorage

Table D: List editorial board, editor-in-chief and co-editors with whom you interact. An editor-in-chief should list the

B: Editorial board: Name(s) of editor-in-chief and journal (in past 24 months).

E: Other Co-Editors of journals or collections with whom you directly interacted (in past 24 months).

	Name:	Organizational Affiliation
B:	Daszak, Peter	Ecohealth Alliance
E:	Chmura, Aleksei	Ecohealth Alliance

1840 Bragaw Street, Suite 150  
Anchorage, Alaska 99507  
(907) 330-9085  
willow@crrcalaska.org

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**WILLOW HETRICK-PRICE, EXECUTIVE DIRECTOR, CHUGACH REGIONAL RESOURCES COMMISSION**

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At .10FTE annually, Mrs. Hetrick-Price will serve as the CRRC representative on the CORaL Network's core team, lead facilitation of scientist and educator collaboration and outreach in the Alaska Native community.

*Dynamic biologist and Executive Director with over eleven years specialized experience providing project management, regulatory compliance, financial management and program development to sea and land-based environmental projects throughout Alaska.*

- Possess unique combination of marine ecology expertise, outstanding community outreach record, strong program development background, and wide network of business and professional contacts throughout Alaska's commercial, government, and non-profit sectors.
- Comprehensive knowledge of non-profit management, marketing, client development, financial management, community relations and customer service. Strong desire for success, embracing organizational goals as personal challenges.
- Extensive experience in grants management and accounting concepts, principles, practices, techniques, and procedures, as well as experience in reviewing and analyzing grant applications and summaries, ensuring effective management and accountability of funds.

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**AREAS OF EXPERTISE**

- |                         |                                  |                         |
|-------------------------|----------------------------------|-------------------------|
| → Scientific Analysis   | → Aerial Wildlife Survey Methods | → Stakeholder Relations |
| → Biological Studies    | → Wildlife Management Programs   | → Complex Presentations |
| → Regulatory Compliance | → Geographic Information Systems | → Training/Supervision  |

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**EDUCATION**

**UNIVERSITY OF ALASKA FAIRBANKS**, Fairbanks, AK  
*Tribal Management*

**UNIVERSITY OF ALASKA SOUTHEAST**, Juneau, AK  
*Master of Public Administration*, GPA: 4.0, 05/2018

**UNIVERSITY OF ALASKA**, Anchorage, AK  
*Graduate Certificate in Environmental Regulations & Permitting*, 05/2018

**UNIVERSITY OF HAWAII AT MANOA**, Honolulu, HI  
*Master of Science in Natural Resources and Environmental Management*, 05/2009  
*Bachelor of Science in Marine Resource Management*, 12/2006

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**RECENT PROFESSIONAL EXPERIENCE**

**CHUGACH REGIONAL RESOURCES COMMISSION**, Anchorage, AK 09/2018 - Present  
*Executive Director*

Responsible for a non-profit Inter-Tribal fish and wildlife commission involved in projects and programs related to the natural resources, subsistence, climate change, environmental management and research, as well as community economy development related to natural resources and the environment. Responsible for subsistence advocacy, development of traditional natural resource management programs in the Chugach Region villages, as well as addressing other natural resources and environmental issues, including food security and food sovereignty, development of natural resource education and training programs and conducting training and special issues workshops in the communities in areas related to CRRC's mission. Work directly with Tribal leaders and their respective Councils to plan and implement community and economic development projects and other areas germane to CRRC's mission. Responsibilities include:

- General oversight of the financial management system of the organization, as well as developing annual budgets and monitoring the budgets for each program.

Willow Hetrick-Price, Executive Director, Chugach Regional Resources Commission

- Perform financial statement preparation, analysis of accounting reports, establishing, or reviewing of internal control systems, and management of financial accounting systems.
- Built solid relationships and developed network throughout Alaska with businesses and external stakeholders, greatly enhancing company ability to maintain positive customer satisfaction and maximize revenue-enhancing opportunities.
- Interpret grant application guidelines, performing comprehensive research on all necessary data, and successfully securing grants due to strict adherence to writing and qualifications requirements.
- Foster and maintain professional relationships with funders and community leaders, serving as agency's representative on community committees and work groups.
- Serve as communications liaison, facilitating more organized flow of information, and allowing for greater cooperative community relations strategy implementation.
- Coordinate with organizational leaders to monitor current organizational goals developments, recommend priorities, and assist in revising positions.

#### SELECTED PUBLICATIONS

##### Peer-Reviewed Publications

Branson, M.A., **Hetrick-Price, W.**, Wisdom, S. Polar Bear (*Ursus maritimus*) behavioral response to vessel presence in the Chukchi and Beaufort Seas. In prep.

**Hetrick, W.**, Cox, L.J, Atkinson, S.K., Malecha, S.R. (2010) Survival of Red King Crab (*Paralithodes camtschaticus*) Juveniles on Natural and Artificial Substrates. *Journal of Life Sciences* 4(3) pages 1-8

##### Conference Abstracts and Proceedings

Branson, M.A., Hetrick J.J., & **Hetrick-Price, W.** (2021). Tribal Monitoring and Recovery of Native Clams in the Chugach Tribe's Subsistence Shellfish Use Areas. Alaska Marine Science Symposium. Anchorage, AK, USA.

Branson, M.A., Hetrick, J.J., Ramsay, J., Atkinson, S., & **Hetrick-Price, W.** (2021) The Chugach Regional Ocean Monitoring program: comprehensive biotoxin, phytoplankton, and water chemistry monitoring throughout southcentral Alaska. Kachemak Bay Science Conference and Kenai Peninsula Fish Habitat Science Symposium. Homer, AK, USA.

Branson, M.A., Hetrick, J.J., Ramsay, J., Atkinson, S., & **Hetrick-Price, W.** (2021) Building capacity for safe and sustainable harvest of traditional shellfish resources in Southcentral Alaska. University of Alaska Fairbanks OneHealth Conference. Fairbanks, AK, USA.

Kovalcsik, C., **Hetrick-Price, W.** & Schwalenberg, P. Preserving Traditional Food Resources in a Changing Environment. Alaska Food Policy Council Festival and Conference. Homer, AK, USA.

#### COLLABORATORS

- Boyd Selanoff, Member of the CRRC Board, Member of the Chenega IRA Council
- Jim Ujioka (project), Vice Chairman of the CRRC Board, Vice President of The Eyak Corporation and President of the Valdez Native Tribe
- Melody Wallace (project), Member of the CRRC Board, Council member of the Qutekcak Native Tribal, Board member of North Pacific Rim Housing Authority
- Nanci Lee Robart (project), Member of the CRRC Board, The Tatitlek Corporation Board, Chief of the Tatitlek IRA Council
- Patrick Norman (project), Chairman of the CRRC Board and Chief of the Port Graham Village Council
- Priscilla Evans, Secretary/Treasurer of the CRRC Board, Second Chief of the Nanwalek IRA Council
- Roberts Henrichs (project), Member of the CRRC Board, ANTHC Board (bylaws and Policy Committee, Executive Committee, Finance and Audit Committee, Leadership Planning Committee, Maintenance and Improvement Resource Allocation Committee), Healthy Alaska Natives Foundation Board of Directors, the Chair of the ANMC Joint Operating Board and Chairman of the Board at Alaska Village Initiatives

**Elizabeth Hoover, PhD**

Associate Professor, Environmental Science Policy and Management  
University of California at Berkeley, 130 Hilgard Way, Berkeley, CA 94720

[Elizabeth.Hoover@berkeley.edu](mailto:Elizabeth.Hoover@berkeley.edu)

**PROFESSIONAL PREPARATION**

Williams College, Williamstown MA	Anthropology/Psychology	B.A.	2001
Brown University, Providence RI	Anthropology/Museum Studies	M.A.	2003
Brown University, Providence RI	Anthropology	Ph.D.	2010

**APPOINTMENTS**

2020-	Associate Professor, Environmental Science Policy Management UC Berkeley
2019-2020	Associate Professor of American Studies, Brown University
2012-2019	Manning Assistant Professor of American Studies, Brown University
2011-2012	Visiting Assistant Professor of Ethnic Studies, Brown University
2010-2011	Visiting Assis Prof of Anthro and <u>Envi</u> Studies, St. Olaf College, Northfield MN
2009-2010	Visiting Assistant Prof of Anthropology, Elizabethtown College, Elizabethtown PA
2005-2006	Visiting Lecturer of Ethnic Studies Program, Brown University, Providence RI
2005	Visiting Lecturer of Anthropology, University of Rhode Island, Kingstown RI

**PUBLICATIONS****10 most recent and relevant:**

- Hoover, Elizabeth.** 2020. "Native Food Systems Impacted by COVID" *Journal of Agriculture and Human Values* 37(3):569-570. DOI: [10.1007/s10460-020-10089-7](https://doi.org/10.1007/s10460-020-10089-7)
- Hoover, Elizabeth.** 2020. "For Tribal Peoples, Food Justice Requires Environmental Justice." In *Lessons in Environmental Justice*. Edited by Michael Mascarenhas. Sage Publishing. P199-215
- Hoover, Elizabeth.** 2020. "Whose Citizenship in 'Citizen Science;' Tribal Identity, Civic Dislocation, and Environmental Health Research." In *Environmental Justice and Citizen Science in a Post Truth Age*. edited by Thom Davies and Alice Mah. Manchester University Press.
- Isaac, Gwyneira; Joseph Gone, Jenny Joe, **Elizabeth Hoover**, Clarita Lefthand Begay, Stewart Hill. 2018. "Native American Perspectives on Health and Traditional Environmental Knowledge" *Environmental Health Perspectives* 126(12). <https://ehp.niehs.nih.gov/doi/10.1289/EHP1944>
- Mihesuah, Devon and **Elizabeth Hoover**, editors. 2019. *Indigenous Food Sovereignty in the United States: Restoring Cultural Knowledge, Protecting Environments, and Regaining Health*. Norman: University of Oklahoma Press.
- Hoover, Elizabeth.** 2018. "Environmental Reproductive Justice: Intersections in an American Indian Community Impacted by Environmental Contamination." *Environmental Sociology*. 4(1): 8-21, DOI: [10.1080/23251042.2017.1381898](https://doi.org/10.1080/23251042.2017.1381898)
- Hoover, Elizabeth.** 2017. *The River is in Us: Fighting Toxics in a Mohawk Community*. Minneapolis: University of Minnesota Press.
- Hoover, Elizabeth.** 2017. "You can't say you're sovereign if you can't feed yourself: Defining and Enacting Food Sovereignty in American Indian Community Gardening." *American Indian Culture and Research Journal* 41(3): 31-70. DOI [10.17953/aicrj.41.3.hoover](https://doi.org/10.17953/aicrj.41.3.hoover)
- Hoover, Elizabeth.** 2016. "We're not going to be guinea pigs;" Citizen Science and Environmental Health in a Native American Community" *Journal of Science Communication* 15(1). <https://doi.org/10.22323/2.15010205>

**Hoover, Elizabeth.** 2013. "Cultural and Health Implications of Fish Advisories in a Native American Community" *Ecological Processes* 2:4. doi:10.1186/2192-1709-2-4

### **5 Other Publications**

**Hoover, Elizabeth** 2019. "'Fires were lit inside them;' The Pyropolitics of Water Protector Camps at Standing Rock." *RIAS - Review of International American Studies; Indigenous Social Movements in the Americas* issue 12(1):11-44. Available at <https://www.journals.us.edu.pl/index.php/RIAS/article/view/7391>  
<https://www.journals.us.edu.pl/index.php/RIAS/ERRATA>

White, Rowen and **Elizabeth Hoover**. 2019. "Our Living Relatives: Maintaining Resilience and Seed Diversity in Native American Communities." IN *The New Farmers Almanac, Vol 4*, edited and published by the Greenhorns, Chelsea Green Publishing Company. P 332-337.

**Hoover, Elizabeth**, Phil Brown, Michael Edelstein and Mia Renault. 2015. "Social Science Collaboration with Environmental Health." *Environmental Health Perspectives*  
DOI:10.1289

**Hoover, Elizabeth**, Katsi Cook, Ron Plain, Kathy Sanchez, Vi Waghiji, Pamela Miller, Renee Dufault, Caitlin Sislín and David O. Carpenter. 2012. "Indigenous Peoples of North America: Environmental Exposures and Reproductive Justice" *Environmental Health Perspectives*. 120:1645-1649.

Senier, Laura; Benjamin Hudson; Sarah Fort; **Elizabeth Hoover**; Rebecca Tilson; Phil Brown. 2008 "The Brown Superfund Basic Research Program: A Multistakeholder Partnership Addresses Real-World Problems in Contaminated Communities" *Environmental Science and Technology*. 42 (13), pp 4655–4662.

### **COLLABORATORS (PAST 4 YEARS):**

Agogino, Alice—UC Berkeley, Mechanical Engineering  
Davies, Thom – University of Nottingham, School of Geography  
Hill, Stewart—University of Manitoba  
Isaac, Gwyneira—Smithsonian National Museum of Natural History  
Gone, Joseph—Harvard, Anthropology  
Joe, Jenny—University of Arizona, American Indian Studies  
Lefthand-Begay, Clarita—University of Washington, Information School  
Mah, Alice-- University of Warwick, Sociology  
Mascarenhas, Michael—University of California Berkeley, ESPM  
Mihesuah, Devon—University of Kansas, Humanities Program  
Scott, Dayna-- York Research Chair in Environmental Law & Justice in the Green Economy  
Sowerwine, Jennifer—UC Berkeley, ESPM  
White, Rowen—Native American Food Sovereignty Alliance



## NATIVE CONSERVANCY

Dune Lankard, Founder and President • dune@nativeconservancy.org • 907.952.5265

### BIO

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Dune Lankard, an Eyak Athabaskan Native of the Eagle Clan, grew up in Cordova, in southcentral Alaska. Born into a fishing family, his life education as a subsistence and commercial fisherman began at age five. After graduating from high school, he earned a living as a fishery and processing consultant and commercially fished for wild salmon, herring, crab, halibut and cod in the Copper River Delta and Prince William Sound until March 24, 1989 - when the Exxon Valdez spewed over 11 million gallons of crude oil into his beloved Prince William Sound. Dune became a passionate community activist and social change activist that day on, and has been fighting to preserve and restore Native and fishing culture and wild salmon habitat ever since. Dune has been offered several higher education scholarships, in law.

### Native and Tribal Affiliations

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- Eyak Name: Jamachakih – Eyak translation: “Little Bird that screams really loud (in the forest) and won't shut up.” Eagle Clan member of the Copper River Delta
- Eyak Traditional Elders Council – Co-Founder and Tribal Member
- Native Village of Eyak – Tribal Member
- The Eyak Corporation (village) and the Chugach Alaska Corporation (regional) – Alaska Native Claims Settlement Act (ANCSA, 1971) shareholder in both Alaska Native Corporation's

### Professional (partial)

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- Native Conservancy Land Trust – Founder and President (2003 – current)
- Eyak Preservation Council – Founder and President (1989 – current)
- FIRE Fund (Fund for Indigenous Rights and the Environment) – Dune helped form and run endowment
- Alaska Representative, Center for Biological Diversity (2017 for one year)

### Experience (partial)

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- Speaker and Commentator on Alaskan, Indigenous, cultural, legal and environmental issues throughout the country and overseas at universities, law schools, grade schools, conferences and various symposiums.
- Articles/quotes/editorials/op eds published– summary list: *The Cordova Times*, *Anchorage Daily News*, *Alaska Dispatch News*, *The Seattle-Post Intelligencer*, *The Los Angeles Times*, and *San Francisco Examiner/Chronicle*, *Wall Street Journal* and numerous publications and magazines
- Highlighted in numerous books: Including "Hope and Heroes: Portraits of Integrity," *London Street Press* and published narrative and photo essay in "Alaska Native Ways" *Graphic Arts Center Publishing*, "Climate Change and Environmental Ethics" *Transaction Publishers*
- Appeared and spoken in videos: *The Thin Green Line*, *Thunderstorm*, *Sierra Club Chronicles-The Day the Ocean Died*, and *The Third Trustee* - and numerous local and national newspapers, radio and TV interviews.

### Notable Achievements

- 1989: Reunited the Eyak Traditional Elders Council (ETEC) after 100 years – the traditional tribal council of the Eyak Nation. ETEC won the Alaska Supreme Court decision that granted “public interest litigant status” to the Eyak people, so they didn't have to pay a \$50M bond and \$500,000 in attorney fees

- 1992 to present – Dune and EPC helped unite Indigenous peoples, ANCSA corporations, scientists, fishermen, logging industry, highest levels of ocean government (Exxon Valdez Oil Spill Trustee Council) and the conservation community around conservation easements in the Exxon spill zone, leading to the preservation of over 700,000 acres of wild salmon habitat along 1,500-miles of Gulf of Alaska coastline
- 1992 and 1995 – Dune filed an “Eyak Cultural” lawsuit in 92’ and a “Shareholder Derivative” lawsuit in 1995 against The Eyak Corporation to stop the clearcutting of his beloved Eyak homelands, these cases led to the preservation of 75,000 acres of the Eyak Rainforest in eastern PWS and the Copper River Delta
- 1998 and 1999: testified, upon request, before the House Committee on Resources opposing the planned 55-mile Bering River/Carbon Mountain road access easement across Copper River Delta
- 1998: Dune led the charge to defeat the Chugach Road Rider (Bering River/Carbon Mountain, road access easement), introduced by the Alaska Representative Don Young and the Chugach Alaska Corporation that would have granted an irrevocable 55-mile, 250-foot-wide, right-of-way road for resource extraction to be built w/o and Environmental Impact Statement (EIS), Restoration Bond or Environmental Assessment (EA)
- 1999: went to Geneva, Switzerland and NYC, USA as a delegate for Alaska Indigenous peoples to the Intergovernmental Forum on Forests at the United Nations
- 2004: helped stop oil drilling on 65,000 acres in the Katalla region, east of the Copper River Delta
- 2016: helped permanently preserve 115,000 acres of wild salmon habitat in the Chugach National Forest and retire 62,000 acres of Chugach Alaska Corporation coal rights in the headwaters of the Bering River region

#### **Elected and Founding Memberships**

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- SEVA Foundation – Advisory Board member for last 17 years – current
- Bioneers Board member – Dune was on their board for 6 years – term ended 2015
- International Funders for Indigenous Peoples (IFIP) Board member – for 5 years – term ended 2014
- Patagonia – Wild Salmon Sourcing Team member

#### **Fellowships and Awards**

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- Time Magazine: Chosen as one of Time Magazine’s Hero for the Planet – 1999
- Ashoka Foundation Fellow
- Hunt Alternative Fund: Prime Movers Fellow
- Future of Fish Fellow

#### **Publications authored by Dune Lankard:**

[Cultural Survival - Healing Our Waters, Healing Ourselves Through A Sustainable Economy](#) – Dec 2020  
[Medium Future Of - Dune Lankard, on the Future of Climate-Changing-Everything](#) – Aug 2019

#### **Collaborators:**

##### **Alaska Conservation Fund (ACF)**

**Michael Barber:** 1227 W. 9th Ave., Suite 300 Anchorage, Alaska 99501 **Direct:** (907) 433-8205  
**Email:** [mbarber@alaskaconservation.org](mailto:mbarber@alaskaconservation.org)

##### **Alutiiq Pride Shellfish Hatchery**

**Jeff Hetrick:** Seward Hatchery Manager **E:** [jih@seward.net](mailto:jih@seward.net) **O:** 907-362-2378

##### **GreenWave**

**Bren Smith:** Executive Director  
 43 E Pearl Street New Haven, CT 06513 **O:** (203) 654-9690 **E:** [bren@greenwave.org](mailto:bren@greenwave.org)



Biographical Sketch  
**Michael Steven Stekoll**  
[msstekoll@alaska.edu](mailto:msstekoll@alaska.edu)

**Professional Preparation:**

Stanford University	Chemistry	B.S., June 1971
University of California at Los Angeles	Biochemistry	Ph.D., June 1976
University of Alaska Fairbanks	Marine Pollution	Post Doc, May 1976-June 1978

**Web pages:**

<https://www.uas.alaska.edu/dir/z-arts-sciences-emeritus-msstekoll.html>  
<https://uaf.edu/cfos/people/faculty/detail/michael-stekoll.php>

**Professional Experience:**

7/20 – Present- Emeritus Professor, University of Alaska Southeast and Joint appointment University of Alaska, Fairbanks, Juneau Center College of Fisheries and Ocean Sciences  
 8/91- 7/20 - Professor of Chemistry and Biochemistry, University of Alaska, Southeast. Joint appointment University of Alaska, Fairbanks, Juneau Center School of Fisheries and Ocean Sciences  
 8/10 - Visiting Research Professor, San Diego State University  
 2/07-12/07, 12/08-1/09 - Visiting Professor, University of Cape Town, Cape Town, South Africa  
 9/97-3/98 - Visiting Research Associate, University of Connecticut, Stamford, Connecticut  
 8/83-7/91 - Associate Professor of Chemistry and Biochemistry, School of Fisheries and Science, University of Alaska Juneau. Joint appointment University of Alaska Fairbanks  
 7/87-10/87 - OFCF Trainee, Hokkaido Regional Fisheries Research Laboratory, Kushiro, Hokkaido, Japan  
 7/86-6/87 - Visiting Associate Research Biologist, University of California at Santa Barbara  
 8/78-7/83 - Assistant Professor, School of Fisheries and Science, University of Alaska Juneau  
 5/79-9/79 - Research Biochemist, NOAA, NMFS Auke Bay Laboratory, Juneau, Alaska  
 4/76-6/78 - Post-doctoral, Institute of Marine Science, University of Alaska, Fairbanks

**Teaching**

Taught university level courses, both undergraduate and graduate, in general chemistry, organic chemistry, biochemistry, marine pollution, and phycology. Research on fish biochemistry, algal physiology/ecology and mariculture, and marine pollution.

**Ph.D. Dissertation:**

'Plant-fungus interactions: an elicitor from *Rhizopus stolonifer* of a phytoalexin in castor beans.' UCLA, 1976.

**Honors and Awards:**

2014: UAS Faculty Excellence Award in Service  
 2013: National Academies Education Fellow in the Life Sciences (2013-14)

2000: UAS (UNAC) Distinguished Faculty Award

### Professional Activities:

2018 - Present: Alaska Governor's Mariculture Task Force  
 2015 - Present: Treasurer and CFO of the International Phycological Society  
 1992-2004: Juneau Wetlands Review Board (Chair 1992-97)  
 2000-2003: Scientific Advisory Panel for the Alaska Cruise Ship Initiative

### Selected Grants Received

Integrated Seaweed Hatchery and Selective Breeding Technologies for Scalable Offshore Seaweed Farming. (\$24,000). Submitted to US Department of Energy – ARPA-E/MARINER (DE-AR0000915) through Woods Hole Oceanographic Institution (\$3,700,000 for 3 years) 6-2018.  
 Development of Scalable Coastal and Offshore Macroalgal Farming (\$586,133). Submitted to US Department of Energy – ARPA-E/MARINER (DE-AR0000911), 4-2018. Renewed with an additional \$2,700,000 for 3 years, 4-2020.  
 Applied Research for a New Seaweed Aquaculture Industry in Alaska. (\$270,148). Submitted to NOAA National Sea Grant NA18OAR4170078, (project no. R/40-09), 9-2016) plus match from Premium Oceanic \$148,429.  
 Applied Research on Seaweed Mariculture for SE Alaska (\$151,760). Submitted to Premium Oceanic. 3-2015.

### Selected Publications

Stekoll, M. S., T. N. Peebles and A. E. T. Raymond. 2021. Mariculture research of *Macrocystis pyrifera* and *Saccharina latissima* in southeast Alaska. J World Aquacult Soc 2021:1-16. <https://doi.org/10.1111/jwas.12765>  
 Kim, J. K., M. Stekoll and C. Yarish. 2019. Opportunities, challenges and future directions of open water seaweed aquaculture in the United States. Phycologia 58: 446-461. (DOI: 10.1080/00318884.2019.1625611)  
 Stekoll, M. S. 2019. Seaweed Resources of Alaska. Botanica Marina. (DOI: <https://doi.org/10.1515/bot-2018-0064>)  
 Conitz, J., R. Fagen, and M. S. Stekoll. 2013. Effects of density and substrate type on recruitment and growth of *Pyropia torta* (Rhodophyta) gametophytes. Botanica Marina 56(5-6):525-533.  
 Okamoto D. K., M. S. Stekoll and G. L. Eckert. 2013. Coexistence despite recruitment inhibition of kelps by subtidal algal crusts. Marine Ecology Progress Series 493: 103-112 (doi:10.3354/meps10505.)  
 Siddon, E. C., C. E. Siddon and M. S. Stekoll. 2008. Community level effects of *Nereocystis luetkeana* in southeastern Alaska. J. Exp. Mar. Biol. Ecol. 361:8-15.  
 Lin, Rulong, S. C. Lindstrom and M. S. Stekoll. 2008. Photosynthesis and respiration of the conchocelis of Alaskan *Porphyra* (Bangiales, Rhodophyta) species in response to environmental variables. J. Phycol. 44:573-583.  
 Lindstrom, S. C., J. M. Conitz, S. Hall and M. S. Stekoll. 2008. Induction of conchospore release: ecotypic variation in northeast Pacific species of *Porphyra*. J. Applied Phycology 20:331-340.  
 Stekoll, M. S., R. Lin and S. C. Lindstrom. 1999. *Porphyra* cultivation in Alaska: conchocelis growth of three indigenous species. Hydrobiologia 398/399:291-297

## CONFLICT OF INTEREST LIST

**Name: Michael S. Stekoll**

**Instructions:**

- Who completes this template: Each project director/principal investigator (PD/PI) or other person that the Request for Applications (RFA) specifies
- How this template is completed:
  - List alphabetically – with last name first -- the full names of the following individuals:
    - All co-authors on publications within the past three years, including pending publications and submissions
    - All collaborators on projects within the past three years, including current and planned collaborations
    - All thesis or postdoctoral *advisees/advisors*
    - All persons in your field with whom you have had a consulting/financial arrangement/other conflict-of-interest in the past three years
- Indicate the person's relationship to you (Co-Author, Collaborator, etc) with an "x".

Additional pages may be used as necessary.

Note: Other individuals working in the applicant's specific area are not in conflict of interest with the applicant unless those individuals fall within one of the listed categories.

Name	Co-Author	Collaborator	Advisees/ Advisors	Other – Specify Nature
Bailey, David		X		
Barbery, Kendall		X		
Bell, Tom		X		
Decker, Julie	X	X		
Dewhurst, Toby		X		
Drach, Andrew		X		
Duncan, Daniel	X		X	
Eckert, Ginny		X		
Fredrikssen, David		X		
Goudey, Cliff		X		
Grebe, Gretchen		X		
Kim, J. K.	X			
Kite-Powell, Hauke		X		
Kraan, Stefan		X		
Li, Yaoguang		X		
Lindell, Scott		X		
Manganelli, Domenic		X		
Mangini, Nicholas		X		
Marsh, Tomi		X		
Marty-rivera, Michael		X		
Meyer, Lexa		X		
Ng, Crystal		X		
Nuzhdin, Sergey		X		
O'Brien, Erik		X		

Pearson, Heidi		X		
Peeples, Tamsen	X	X	X	
Perry, Beau		X		
Pryor, Alf		X		
Raymond, Anne	X	X	X	
Roberson, Loretta		X		
Sande, Trevor		X		
Smith, Bren		X		
Smith, Riley		X		
Stengel, Emily		X		
Stephens, Tiffany		X		
Tallmon, David		X		
Umanzor, Schery		X		
Yarish, Charles		X		

## CURRICULUM VITAE

**Name: Bren Smith**

**Phone: +1 (203) 654-9690**

**E-mail: [bren@greenwave.org](mailto:bren@greenwave.org)**

**Home Page: [www.greenwave.org](http://www.greenwave.org)**

Bren Smith pioneered the development of regenerative ocean farming. A lifelong commercial fisherman, he was named one of *Rolling Stone* magazine's "25 People Shaping the Future" and featured in *TIME* magazine's "Best Inventions of 2017". Bren is the winner of the Buckminster Fuller Prize and has been profiled by *60 Minutes*, *CNN*, *The New Yorker*, *Wall Street Journal*, *National Geographic*, and elsewhere. He is an Ashoka, Castanea, and Echoing Green Climate Fellow and James Beard Award-winning author of *Eat Like a Fish: My Adventures Farming the Ocean to Fight Climate Change*.

### Professional Background

2014 – Present: Founder and Executive Director of GreenWave

2016 – 2017: Chief Missions Officer at Sea Greens Farms

1986 – Present: Commercial fisherman and Ocean Farmer, Owner of Thimble Island Ocean Farm

2000-2013: Co-Owner, Nicola and the Newfoundlander

Environmental and Legislative Consultant

Educational Guide and Educator

### Honors and Distinctions

James Beard Foundation Book Award for Writing for *Eat Like a Fish*, 2020

Castanea Fellow, 2020

Time Magazine's Best Inventions, 2017

Rolling Stone's 25 People Shaping the Future, 2017

Claneil Emerging Leaders, 2017

Draper Richards Kaplan Foundation Entrepreneur, 2017

Buckminster Fuller Prize for Ecological Design, 2017

Ashoka, Fellowship, 2015

Echoing Green, Climate Fellowship, 2014

National Entrepreneur, Future of Fish, 2013

Global Ocean Entrepreneur, SOCAP, 2013

Ocean Hero Award Finalist, Oceana, 2013

Young Climate Leaders Network, New World Foundation/Chorus Foundation, 2012

George J. Lepofsky Memorial Scholarship Award, 2004

Jay and Harriet Waks Scholar of the Year Award, 2004

### Press

CNBC (2020): [Why Demand for Seaweed is About To Boom](#) 15:21

60 Minutes (2018): [Seaweed Farming and its Surprising Benefits](#) 13:07

Time (2017): [The 25 Best Inventions of 2017](#)

Rolling Stone (2017): [25 People Shaping the Future](#)

Grist (2016): [This "Ocean Farmer" Could Make You Hopeful About the Future of the Sea](#)

Huffington Post (2016): [The Farms of the Future](#)

The New Yorker (2015): [A New Leaf](#)

### Video

[Ashoka Unfinished Live](#) 2:36

WWF International: [Can we restore our seas through ocean farming?](#) 5:30

[2016 Disruption Innovation Festival](#) 14:33

### Education

2001 - 2004 Cornell University – Ithaca, NY

Juris Doctorate

1995 Memorial University – St. John’s, Newfoundland

Undergraduate Aquaculture coursework

1991 – 1994 University of Vermont – Burlington, VT

Bachelor of Arts, English and Religious Studies. Minor in Environmental Studies.

English Department Honors and John Dewey Honors

### Bren Smith Collaborators List

4	Name:	Organizational Affiliation
C:	Lindell, Scott	Woods Hole Oceanographic Institute
C:	Bailey, David	Woods Hole Oceanographic Institute
C:	Yarish, Charlie	University of Connecticut
C:	Stekoll, Mike	University of Alaska
C:	Kite-Powell, Hauke	Woods Hole Oceanographic Institute
C:	Roberson, Loretta	Marine Biological Laboratory
C:	Umanzor, Schery	University of Alaska
C:	Eddy, Norah	The Nature Conservancy
C:	Goudey, Cliff	Goudey and Associates
C:	Decker, Julie	Alaska Fisheries Development Foundation
C:	Smith, Riley	Alaska Fisheries Development Foundation
C:	Sylvia, Paula	Port of San Diego
C:	Cueva Uribe, Rafael	Humboldt State University
C:	Hetrick, Jeff	Alutiiq Pride Shellfish Hatchery
C:	Good, Melissa	AK Sea Grant
C:	Pomeroy, Bob	CT Sea Grant
C:	Concepcion, Anoushka	CT Sea Grant
C:	Doall, Mike	Stonybrook University
C:	Kim, Jang	Incheon National University of South Korea
C:	Peterson, Alana	Spruce Root
C:	Perry, Beau	Blue Evolution

Revised 05/01/2020

NSF BIOGRAPHICAL SKETCH

OMB-3145-0058

NAME: Thomas Fox Thornton

POSITION TITLE &amp; INSTITUTION: Professor &amp; Director, Alaska Coastal Rainforest Center

**A. PROFESSIONAL PREPARATION**(see [PAPPG Chapter II.C.2.f.\(i\)\(a\)](#))

INSTITUTION	LOCATION	MAJOR/AREA OF STUDY	DEGREE (if applicable)	YEAR (YYYY)
Swarthmore College	Swarthmore, PA	Sociology & Anthropology	Bachelor of Arts	1986
University of Washington	Seattle, WA	Anthropology	Master of Arts	1990
University of Washington	Seattle, WA	Anthropology	Ph.D.	1995

**B. APPOINTMENTS**(see [PAPPG Chapter II.C.2.f.\(i\)\(b\)](#))

From - To	Position Title, Organization and Location
2021-	Director, Alaska Coastal Rainforest Center (ACRC), University of Alaska Southeast, Juneau, AK.
2018-21	Dean of the School of Arts & Sciences and Vice-Provost for Research and Sponsored Programs, Interim Director of the Alaska Coastal Rainforest Center, University of Alaska Southeast, Juneau, AK.
2008-2020	Director (Environmental Change and Management Programme, 2008-2018), Associate Professor, Senior Research Fellow, Environmental Change Institute, School of Geography and the Environment (Honorary Research Fellow, 2020-). Senior Associate Research Fellow, Christ Church (2009-2020), Oxford, UK.
2008-2010	Royal Anthropological Institute Fellowship in Urgent Anthropology University of Kent (half-time). Canterbury, UK.
2006-2009	Professor /Associate Professor of Anthropology, American Indian Studies, Environmental Studies (affil). Portland State University, Portland, OR (Affiliate Research Professor 2009-).

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## C. PRODUCTS

(see [PAPPG Chapter II.C.2.f.\(i\)\(c\)](#))

### Products Most Closely Related to the Proposed Project

\*Related Products: 2nd place team award (of 13 teams) in the international Geo Hackathon, Canberra, AU. Co-lead (w/ S. Pyare) UAS team. UAS also won the “Societal Value Award” and the “Usability and User Interface Award.”

\*Publications:

2021. (w/ M. Moss). Herring and People of the North Pacific: Sustaining a keystone Species. U Wash. Press.

2020 (Editor w/ Shonil Bhagwat, and contributor). The Routledge Handbook of Indigenous Environmental Knowledge. Routledge.

2019 The Distribution of Subsistence Herring Eggs from Sitka Sound, Alaska. Box of Knowledge Series. Juneau: Sealaska Heritage Institute. 276pp.

2019 (w/ R.K. Puri, S. Bhagwat, and P. Howard). Human adaptation to biodiversity change: An adaptation process approach applied to a case study from southern India. *Ambio*, 48(12): 1431-1446.

2018 (w/ Mamontova, N., 2017. Hunter-Gatherers and Fishing Rights in Alaska and Siberia: Contemporary Governmentality, Subsistence, and Sustainable Enterprises. In *Hunter-gatherers in a Changing World*, pp. 149-173. Springer.

2015 (w/ C. Comberti, et al). Ecosystem Services or Servicing Ecosystems? Valuing cultivation & reciprocal relationships between humans & ecosystems. *Global Environmental Change* 34.

2012 (Editor). *Haa Léelk'w Hás Aaní Saax'ú: Our Grandparents' Names on the Land*. Sealaska Heritage Institute & University of Washington Press. Winner of AK Historical & Library Association awards.

### Other Significant Products, Whether or Not Related to the Proposed Project

2018- Sustainable Development Solutions Network (SDSN-USA). University of Alaska representative to this partnership network. Contributor to the 2020 Zero Carbon Action Plan (ZCAP) to decarbonize US energy. Report: <https://www.unsdsn.org/Zero-Carbon-Action-Plan>. Includes analysis of climate impacts & solution actions.

2016- IUCN (International Union for the Conservation of Nature) Thematic Group on Cultural Practices in Ecosystem Management (CPEM). Member of working group, under IUCN's Commission on Ecosystem Management (CEM) providing "expert knowledge and guidance on: the values and roles of culture and cultural practices to support biodiversity conservation, ecosystem services, and ecosystem management."

## D. SYNERGISTIC ACTIVITIES

(see [PAPPG Chapter II.C.2.f.\(i\)\(d\)](#))

- Co-PI for SUCCESS (Supporting Undergraduate College and Career Efficacy for STEM Students), NSF 5Y project to increase STEM student recruitment, retention, graduation, and career success at our Title III Minority Serving Institution (2020-2025).
- Participant, Adaptation & Evolution--National Socio-Environmental Synthesis Center (SESYNC) project to foster dialog between long-term human evolutionary and cultural anthropological perspectives on adaptation and those emerging in climate science & policy circles seeking “adaptation” solutions to climate change impacts (2020-2021)
- Science Advisor, Alaska Steering Committee, INBRE One Health Grant, U of Alaska.
- Member, Science Review Panel, North Pacific Research Board.
- Member, Pacific Herring Working Group, Ocean Modeling Forum,

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**11. SUGGESTED REVIEWERS (for new project proposals only)**

*Please identify person(s) not associated with individuals or institutions submitting this proposal, but with sufficient expertise and credentials to review the proposal in an unbiased and objective manner. Full contact information is required for a minimum of 5 people. These individuals may be asked to conduct a peer review of your proposal. It is suggested that you contact your proposed reviewers to confirm that they are willing to provide a review. Peer review may also be conducted by others not identified here.*

**Erick Ask**

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**Lee Cervený, Ph.D.**

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## 12. Appendix A. Data Management Plan provided by Axiom Data Science in August, 2021

### DATA MANAGEMENT PLAN

The Exxon Valdez Oil Spill Trustee Council's data policy encourages full and open access to, and confident use of, the data and information used in and produced by programs and projects of the Exxon Valdez Oil Spill Trustee Council (EVOSTC). These data need to be easily understandable, electronically accessible and well organized to allow policy makers, researchers, managers, and the general public to make well-informed decisions. As such, Axiom Data Science, through its partnership with the Alaska Ocean Observing System (AOOS) have considerable experience developing scientific data management infrastructure, and they provide experienced personnel to manage both data and metadata documentation according to federal quality control standards. This project will use the AOOS data management infrastructure (developed and maintained by Axiom Data Science) to manage and share the data generated through this effort, in accordance with the EVOSTC Data Management Procedures. This system uses the standards and best practices defined by the NOAA U.S. IOOS Data Management and Communications committee (IOOS, 2010). Among this infrastructure is an operational stack of open source software components developed by Axiom Data Science, with support from the NOAA Integrated Ocean Observing System (IOOS), EVOSTC, the National Science Foundation and more, which manages large numbers of continuous data feeds and a data catalog framework to integrate and disseminate a variety of data products. Data and data products generated by this project will be posted on the Research Workspace together with standards-compliant metadata for access by the EVOSTC. At the end of the project term, final QA/QC'd data and metadata will be made publicly available through the Gulf of Alaska data portal and made publicly accessible through the AOOS Gulf of Alaska data portal and distributed to DataONE for long-term preservation.

**Data Types, Formats, and Metadata:** This project will generate the following data: i) geospatial database and/or mapped layers containing of local knowledge, uses, and values of kelp; ii) synthesized results from surveys and assessment of mariculture activity and interests; and iii) outputs from economic experiment and analyses of mariculture activities.

Data will be stored in non-proprietary formats to ensure re-use and long-term preservation. Project data may initially exist in proprietary or binary formats as primary-level data, depending on the source provider. Though the data may be in a state which can be easily utilized by the research team, in many cases the primary-level data is not in a form ready to be shared with the broader science community or integrated with other datasets. The final format for project data will be in open standard suitable for long-term archiving, such as:

- Containers: TAR, GZIP, ZIP
- Databases: CSV, XML
- Tabular data: CSV
- Geospatial vector data: SHP, GeoJSON, KML, DBF, NetCDF
- Geospatial raster data: GeoTIFF/TIFF, NetCDF, HDF-EOS
- Moving images: MOV, MPEG, AVI, MXF

- Sounds: WAVE, AIFF, MP3, MXF
- Statistics: ASCII, DTA, POR, SAS, SAV
- Still images: TIFF, JPEG 2000, PDF, PNG, GIF, BMP
- Text: XML, PDF/A, HTML, ASCII, UTF-8
- Web archive: WARC.

Comprehensive metadata using the latest national and international technology and community standards will be written for each data collection generated. The Research Workspace includes an integrated metadata editor, allowing researchers to generate metadata conforming to the FGDC-endorsed ISO 19110 and 19115-2 suite of standards. Axiom will provide technical assistance to project researchers to ensure robust and standards-compliant metadata are generated for final project datasets prior to data publication and archive.

Data Access and Timeframes: Among the Axiom data system infrastructure is the Research Workspace, a web-based scientific collaboration and data management tool used by researchers to secure and centralize project data, generate standards-compliant metadata, and ultimately elect data files and derived data products to be published openly on public data portals and in long-term data archives. Following the EVOSTC data sharing policies, process studies require data and metadata to be made publicly available through the GOA data portal by the end of the project term. As such, information that is sensitive to the Alaska Native communities, such as certain Indigenous site names and harvest locations, will be subject to review with tribal partners to determine if it is appropriate for public release. Sensitive sites will be identified to EVOS data managers beginning FY2024 in order to safeguard intellectual property and avoid compromising sensitive sites. After review and protection of any sensitive information, the geospatial database and/or final mapped products and metadata will be loaded to the Research Workspace at the completion of the project (FY2026). Additionally, final results from household surveys and focus groups will be summarized and shared back with participants and data devoid of personally identifiable information will be shared via the Research Workspace no later than the 4th quarter of FY2026.

Data Storage, Preservation, and Archiving: Interim data from the Qualtrics survey and semi-structured interviews will be maintained on a secure server maintained by UAA with access limited to Dr. Berry and researchers approved by IRB at the University of Alaska Anchorage, Final, approved versions will be uploaded to the Research Workspace, maintained by Axiom. The Axiom data center and services are housed on highly redundant storage and compute resources at a data center in Portland, OR, and are geo-replicated using Amazon Glacier Cloud Archive Services. All databases and code repositories are routinely backed-up, and servers undergo routine maintenance to swiftly address security vulnerabilities. Servers containing source code and databases are located behind an enterprise-level firewall and are physically secure with environmental regulation systems, redundant power, and fire suppression. Axiom's HPC resources are composed of approximately 2500 processing cores staged in a series of interconnected blade arrays as well as 1.8 petabytes of storage. Dedicated disc-space in the amount of 30 TBs will be allocated for long-term storage of all preliminary and finalized data resources produced by this effort.

For long-term preservation, all final data and metadata will be transferred to a national data center. The data developed in this project will be open source and licensed in the public domain. The planned archive for the data collected by this effort is the Research Workspace's DataONE Member Node. The Research Workspace hosts an

integrated system for automating dataset submission to the NSF-sponsored DataONE federation of data repository. The Research Workplace supports and issues Digital Object Identifiers (DOIs), so datasets can be confidentially referenced in the published literature. Upon final permission from the project PI at the end of the project term, final data or data products will be submitted for archive with technical support by Axiom data management staff to ensure appropriate use and compliance with the data center archive requirements.