Project Title: Correlation and Climate Sensitivity of Human Health and Environmental Indicators in the Salish Sea

Project Leader: Dr. Jamie Donatuto, Swinomish Indian Tribal Community, jdonatuto@swinomish.nsn.us, 360-466-1532

Cooperators/Partners:
Dr. Eric Grossman, United States Geological Survey (USGS), egrossman@udgs.gov, 831-234-4674; Dr. Grossman will co-lead the project with Dr. Donatuto. *Dr. Grossman will be in charge of synthesizing and assessing climate change drivers on environmental and community health indicators.*

Sarah Grossman, Swinomish Indian Tribal Community, sgrossman@swinomish.nsn.us, 360-466-7280. *Sarah Grossman will synthesize environmental indicators data from the two indigenous communities and provide general guidance to the project.*

Technical Advisory Group: composed of Tribal, First Nation, federal, provincial and state representatives knowledgeable in Indigenous health, coastal-marine ecosystems, and/or climate change drivers and potential impacts. Although not yet finalized, representatives from the USEPA Region 10 Puget Sound National Estuary Program, Environment Canada's Aboriginal Affairs Unit, the Puget Sound Partnership and the Northwest Indian Fish Commission, BC First Nations and Washington tribes will participate.

Project Summary: The overarching goal of the project is to develop overlapping conceptual models of environmental and community health indicators in reference to climate forecasts. The sensitivity of species and habitats to climate will be cross-walked with recently developed Coast Salish community health indicators (e.g. ceremonial use, knowledge exchange, and physiological well-being) in order to demonstrate how Indigenous Knowledge can be used in conjunction with established landscape-level conservation indicators (e.g. shellfish and water-quality) and employed to identify resource management priorities. While results will be unique to study participants, no Indigenous community in the coastal Pacific Northwest is immune to the impending threats of climate change and land-use policies; the methods developed through this proposal will be applicable for other First Nations (FN) and Tribes across the region.

Project Proposal: Several parallel efforts among US and Canadian Indigenous communities and federal, provincial and state organizations are underway to identify and assess species and habitat sensitivities to climate change at local and landscape scales. The results of these projects will be synthesized and cross-walked with emerging community health indicators being developed for Coast Salish peoples (Donatuto *et al.,* 2011). Influence diagrams relating climate drivers to ecosystem functions and human heath will be formulated in order to provide tools for communities to discuss and evaluate risks to Coast Salish first foods and life ways and develop management strategies. Our focus will be on coastal-marine ecosystems, water quality, and shellfish as they affect community health and resilience under projected climate change.

The Swinomish Indian Tribal Community (Swinomish) will guide this project based on our unique experience and expertise in the fields of environmental indicators, health indicators, and climate change. Swinomish has an established water resources and habitat monitoring program, is leading a project to develop Coast Salish community health indicators (Donatuto *et al.*, 2011; current EPA STAR grant #R834791 awarded to Swinomish) and has recently completed a Climate Change Impact Assessment for its reservation (Swinomish Indian Tribal Community 2009, 2010). Swinomish co-leads the Skagit Climate Science Consortium (www.skagitclimatescience.org) that integrates climate change impacts and resource management across the Skagit River Watershed. Additionally, Swinomish is an active participant in the Coast Salish Gathering, a trans-boundary environmental policy group of Tribal leaders and FN Chiefs (www.coastsalishgathering.com). Through the Gathering and countless other trans-boundary initiatives, Swinomish has developed political affiliations with several Coast Salish FNs, many of whom share Swinomish's commitment to protecting cultural resources. Swinomish and USGS have ongoing collaborative

water quality and climate change research; USGS will provide expertise in climate scenario modeling and indicator sensitivity assessments for the project.

We anticipate that the community health indicators will present similar overarching results for the project's two communities, as well as resonate for other Indigenous communities in the region. The project aims to show how community health indicators and environmental indicators are inter-connected, and how to assess these connections. The climate sensitivity analysis will further demonstrate which environmental and community health indicators are most vulnerable given different future scenarios, as well as which are prioritized for adaptation and/ or mitigation efforts by the communities. Tribes and First Nations across the NPLCC are in a unique position to influence conservation/restoration planning. The outcomes of this proposal will provide as a planning tool to help objectively guide conservation/restoration prioritizations. Project findings will be widely disseminated through distribution of the final report through the project partners and technical advisory group members, posting on the Swinomish website, report summaries in community publications such as the Swinomish Kee-yoks, and through a peer-reviewed journal article.

Objective: The proposed project will address both of the eligible project activities by demonstrating how Indigenous Knowledge[1] can be integrated into landscape-level conservation and sustainable resource management, and employed with a climate sensitivity assessment to identify un-met information needs of Tribes and FNs regarding how natural and cultural resources may be affected by climate change. The integration of Indigenous Knowledge and conventional science/policy has been explored through groups such as the Coast Salish Gathering, the Northwest Indian Fisheries Commission, and the Tribal Journey Water Quality Project. These groups focus on addressing information needs and developing effective partnerships that facilitate the integration of Indigenous perspectives into the current thinking on research and management of ecosystems. This project, as an extension of these existing efforts, will aid in the prioritization of ecosystem restoration efforts by evaluating the influence of climate impacts among a growing number of cumulative effects threatening resources across the NPLCC.

Geographic Extent: The project study areas will center on Swinomish in Washington State and a Coast Salish FN in British Columbia. Although the data derived from cross-walking the environmental and health indicators, and resulting climate sensitivity assessment, will be unique to each community, we anticipate similar overarching findings regarding the connections between environmental health, community health and climate sensitivity. Methods and findings will be applicable to other FN and Tribal groups in the Salish Sea. Moreover, the methods used will be broadly applicable to FNs and Tribes across North America who face natural and cultural resource impacts from climate change.

Methods, Products and Outcomes: In order to achieve the objectives of this proposal, activities have been divided into six tasks. To provide guidance for project tasks a technical advisory group composed of representatives from other Salish Sea tribes and First Nations, and federal, provincial and states agencies will convene for the purpose of reviewing and providing input on the findings, and disseminating the project's goals, results, and reports. The group will communicate primarily via email, with three to four conference calls and one face-to-face meeting over the one-year grant period. Because the advisory group will be providing in-kind match to the project in the form of their time, a travel stipend will be granted to participants for the one meeting. Anticipated call/meeting will occur, at a minimum, after completion of Tasks 1, 4, and 5.

In addition to the technical advisory board group members, in-kind match of time donated to the project will

[1] We prefer to use the term Indigenous Knowledge, rather than TEK. We define Indigenous Knowledge as encompassing the knowledge of and beliefs in the web of life that includes both humans and the environment (Berkes 1999), and is cumulative, yet dynamic, based on moral and spiritual values embedded in local contexts, information and practices that are passed down through multiple generations (Menzies and Bulter 2006). Indigenous Knowledge is broader and deeper than artifacts and information, it is a manifestation of the complex social structure that creates, maintains and guides it (Nadasdy 1999).

be provided by: Dr. Grossman (40 hours in addition to time paid by the project) and Ms. Kalla, Swinomish GIS Analyst and Administrative Supervisor (40 hours).

Task 1: Finalize project partnership with BC FN Timeline: 10/1/2012 to 11/30/2012
Because each Tribe/FN has a unique decision making policy, it is important that proper channels and protocols are followed from project initiation through final reporting of results. Valid, repeatable and defensible research methods, use of the data, and dissemination approaches must be agreed upon by all parties before meaningful collaboration can occur (Menzies 2004). Swinomish has established relationships with several BC FNs; the **product** of Task 1 will be a solid partnership between Swinomish and a First Nation. The **outcome** will be a precedent-setting formal trans-boundary partnership between two individual Indigenous communities to further integration of community health and climate sensitivity research.

Task 2: Compile existing data on environmental indicators for the two project communities. Timeline: 10/1/2012 to 3/31/2013
This proposal will focus on water-quality and shellfish environmental indicators (possibly others as health indicators are developed and/or time allows). Data will be queried from the literature and tribal/FN natural resource departments. **Products** for Task 2 include environmental indicator data synthesized using ArcGIS to create both a library of water quality and shellfish data sources and visual representation of information for use during community interviews (Task 3). The **outcome** will be a synthesis of known current and past environmental conditions in relation to shellfish and water-quality for both communities and will serve as the basis for activities in Task 4 and 5 (see below).

Task 3: Gather and assess community health data. Timeline: 12/1/2012 to 4/30/2013
Cross-walk Coast Salish community health indicators with water quality and shellfish indicators via literature review and interviews: Dr. Donatuto will work with the FN representative to gather and assess community health information as it relates to water quality and shellfish. Potential sources include both community reports (e.g., Annual Reports, Council Goals, historic atlas), and any literature published by government agencies or academia (e.g., Health Canada reports, Environment Canada reports). This information has already been gathered for Swinomish. Indigenous health indictor components will be aligned with the collated data by constructing mental models in order to determine indicator effectiveness in capturing community definitions of health. Mental models are knowledge schemas that are generally defined as the structured explanations people have about the way the world works, for instance about their belief in the relationship between health and contaminated shellfish (Morgan *et al.* 2001). Dr. Donatuto and the FN representative will talk with FN community members to guide and inform the process. The community health indicators are: natural resources security, community connection, ceremonial use, education, self-determination and psychological well-being. The **product** will be broadly constructed mental models of how each community associates health with water quality and shellfish. These products will be used in Task 4. The **outcomes** are: two unique depictions of how community health is connected to water quality and shellfish for two Indigenous communities, which may then be compared for similarities and differences; demonstration of a clear, defensible and repeatable research method to gather community health data that bridges Indigenous Knowledge and conventional science.

Task 4: Cross-walk community health and environmental indicators. Timeline: 1/1/2013 to 6/30/2013
With the results from Tasks 2 and 3 we will develop two hypothetical scenarios, one related to shellfish and one to water-quality. Each community will gather 10-20 community members to participate in a focus group in which the two scenarios will be discussed and ranked in importance in relation to community health indicators. For example, if the project finds that some shellfish beds are more vulnerable to climate impacts, the focus group may ask questions such as, "If the more vulnerable shellfish beds were no longer harvestable due to climate change, are impacts to community connection impacted and if so to what degree?" The information gathered through the focus groups will be used in Task 5. The **product** will be an assessment of how current environmental indicators are connected to community health indicators. An **outcome** of Task 4 will be a demonstration of how to cross-walk environmental and Coast Salish health indicators, providing

information on which health indicators are most impacted by current shellfish and water-quality status for the two communities.

Task 5: Develop climate sensitivity influence diagram. Timeline: 4/1/2013 to 7/31/2013
Using results from Tasks 2 and 4 we will assess species and habitat climate sensitivities across the Salish Sea and NPLCC into (1) influence diagrams (Cullen et. al., 2007) of specific Coast Salish community health indicator sensitivity to climate change, and (2) a prioritized ranking of the vulnerability of identified community health indicators to projected climate change impacts at 2050, 2100 and beyond following DPSIR methodology (Millennium Ecosystem Assessment, 2003). Information will be synthesized from advisory groups, best available climate change model predictions from scientific literature, and research panels. The products will include conceptual models and influence diagrams illustrating principal climate change drivers on the environmental and community health indicators. The outcomes will be tools for assessing the vulnerability of these environmental and Indigenous community health, to prioritize future research directions.

Task 6: Reporting of results. Timeline: midterm March 2013 and final report December 2013
Three reports will be generated as a result of this proposal. The first report on the project's mid-term progress will include milestones and products to-date. Final report drafts will be presented to decision-making bodies of each community. During these presentations findings will be reviewed and approved for release to the public. During this process the sensitivity of community proprietary information will be taken into account. Following approval from the participating communities, a final report will be released describing priority environmental and community health indicators sensitivity to climate change and vulnerability to projected climate impacts. This report will mark the completion of grant deliverables. This report will be made available to the public through the Swinomish website (www.swinomish.org). Within six months of the project end date, a manuscript(s) detailing project methods and findings will be submitted to a peer-reviewed journal.

Table 1: Timeline for accomplishing tasks.

Timeline	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Task 1	X	X										
Task 2	X	X	X	X	X	X						
Task 3			X	X	X	X	X					
Task 4					X	X	X	X	X			
Task 5							X	X	X	X		
Task 6						X	X	X	X	X	X	X

Disclaimer regarding Data Sharing: Any information generated through the focus groups or in relation to the community health indicators will be approved for data sharing by the tribal or FN council, or an appointed decision-making body of the community, before being released.

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