GAINING COMMUNITY PERSPECTIVES:

CLIMATE ADAPTATION PLANNING IN HOONAH, ALASKA

by

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Abstract

To help the community of Hoonah, located on Chichagof Island in Southeast Alaska, be prepared for and resilient against regional climate change impacts, we assisted the Hoonah Indian Association Environmental Department in creating a community-led climate adaptation plan. We reviewed relevant background information and existing climate adaptation plans, assessed which natural resources were deemed highest priority to the community via a survey, used interviews to identify the felt impacts of climate change in Hoonah as well as community members' thoughts on how to adapt to these challenges, planned and led educational games about Hoonah's natural environment for students, and hosted a community event to further discuss felt impacts and ideas for adaptation strategies. Resources including bears, birds, crustaceans, yellow cedar, deer, hemlock, halibut, herring, marine mammals, salmon, seaweeds, shellfish, Sitka spruce, and wild berries were all identified as highly valuable to the community. From the interviews, we found the community is experiencing a loss and/or degradation of resources overall, as well as increases in challenges accessing these resources undermining Indigenous sovereignty. Ideas for adaptation were heavily discussed at the community event, including increased environmental monitoring, restoration, and employing various traditional natural resource management practices. Finally, all of this information was incorporated into the first iteration of Hoonah's Climate Adaptation Plan to provide guidance for future projects and use community voices to lead Hoonah's development with the goal of reducing adverse climate change impacts on the Hoonah Tlingit village's way of life.

Acknowledgements

We gratefully acknowledge the assistance of the following people and organizations, all of whom were essential in the development of this report.

First, we would like to thank Ian Johnson, Julian Narvaez, Brynn Presler-Marshall, and Jeromy Grant at the Hoonah Indian Association Environmental Office for their passion and commitment to making this project as impactful as possible and for their time invested throughout this process.

Next, we would like to thank the community of Hoonah for welcoming us into their town. Thank you to the teachers who brought us into their classrooms and to the students for their openness and excitement to learn about the world around us. Thank you to the parents and friends who always stopped to say hello and see how we were doing.

Finally, thank you to Dr. Kyle Whyte for your dedication to this program, work, and most of all, us. We could not have completed this project without your support, kindness, and wisdom.

Image 1. The UM team viewing the northern lights in Hoonah, AK, 2023.

Preface

This paper was created through the collaborative efforts of Arianna A. Lapke, K. Anjali Pandey, Jillian R. G. Shrader, Megan L. Trapp, and Grace Whipkey; all of whom will be graduates of the University of Michigan School for Environment and Sustainability (UM SEAS) as of April 28, 2023. Our team received invaluable contributions from Dr. Kyle Whyte and the Hoonah Indian Association's Environmental Department (HIA Environmental). Below is a description of each of the parties involved in this project.

Arianna A. Lapke: Arianna earned her bachelor's degree in Environmental Policy in 2018 and her M.S. in the Behavior, Education, and Communication track at UM SEAS. After graduating with her B.A. she worked for the tribal government of the Tlingit people in Alaska, first participating in scientific data collection and community engagement as an AmeriCorps VISTA for the Environmental department and then led youth development programs in and out of the school as the Youth Engagement Coordinator.

K. Anjali Pandey: Anjali has a B.A. in Psychology with a double minor in Spanish Studies and Sustainability from Clemson University and now an M.S. in Environment and Sustainability, specializing in Behavior, Education, and Communication as well as Environmental Justice from UM SEAS. She has experience conducting small research projects which aided in the planning and execution of this project. Anjali also has over four years of leadership experience through her involvement in various sustainability-oriented organizations across her undergraduate and graduate universities.

Jillian R. G. Shrader: Jillian holds a bachelor's degree from the University of Iowa in Environmental Anthropology with a minor in Environmental Planning and certificates in Sustainability and Museum Studies, and now an M.S. in Environment and Sustainability,

specializing in Behavior, Education, and Communications specialization track at SEAS. Jillian has experience in community and youth programming, serving in various educational roles at summer camps, nature centers, and museums. Through these positions, she gained experience in the creation and implementation of educational programming, as well as with community outreach and working with community partners.

Megan L. Trapp: Megan has a bachelor's degree in Program in the Environment from the University of Michigan and now an M.S. in Environment and Sustainability in the Environmental Planning and Policy and Environmental Justice tracks at SEAS. She has extensive practical experience through working on small-scale renewable energy projects, communicating with local organizations and governments to identify needs and project expectations, teaching about sustainability to high-school-aged kids, and conducting informal interviews.

Grace Whipkey: Grace has a bachelor's degree in Decision Science with a minor in Environmental and Sustainability studies from Carnegie Mellon University. She completed both the Environmental Justice and Behavior, Education, and Communication tracks within SEAS. She has experience proposing, running, and analyzing the results of small studies within the field of behavioral and environmental science. She is also currently a research assistant under Dr. Sabina Tomkins working to conduct predictive life cycle assessments on online products.

Dr. Kyle Whyte: Kyle was the faculty advisor for this project. He is a citizen of the Potawatomi Nation and has an incomparable background in supporting Indigenous peoples. He currently holds the title of George Willis Pack Professor at UM SEAS, is the founding faculty director of the Tishman Center for Social Justice and the Environment, a U.S. Science Envoy, President of the Board of Directors of the Michigan Environmental Justice Coalition and the Pesticide Action

Network North America, along with several other accolades (University of Michigan School for Environment and Sustainability, n.d.).

Hoonah Indian Association (HIA) Environmental: HIA Environmental is one department within HIA, the Tlingit tribal government. They are responsible for managing environmental programs in Hoonah including data collection, the monitoring and restoration of natural environments and resources, and performing outreach and communication. The names and roles of the participating parties within this department include: Ian Johnson, HIA Environmental Coordinator and Sustainable Southeast Partnership Community Catalyst; Jeromy Grant, Indian General Assistance Program Manager; Julian Narvaez, Environmental Education Coordinator; and Brynn Presler-Marshall, AmeriCorps VISTA Member. Each contributed their own interdisciplinary expertise to the project as well as an invaluable localized understanding of Hoonah's natural and social environments.

This paper represents our work on this project to date (April 2023), however does not reflect our work in entirety. Our work will continue to develop, and a more complete version will be made available on the HIA Environmental website. For further information please email kapandey@umich.edu.

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Introduction to Hoonah

While climate change is adversely impacting the globe in numerous ways, there are disproportionate effects on particular populations and regions, including Indigenous populations and coastal communities (Environmental Protection Agency, 2022). This is true for the Tlingit village of Hoonah (Xunaa), located on Chichagof Island in Southeast Alaska.

Hoonah, the largest Tlingit village in the world and with a population of approximately 900 people, is nestled between the Tongass National Forest and Neka Bay, connected to Icy Strait.[1] The Tlingit are governed by the HIA, the local tribal government. As the largest intact temperate rainforest in North America, the Tongass is inextricably connected to the Tlingit village and supports its largely subsistence population in virtually every way. Old-growth spruce, hemlock, and cedar forests provide habitat for Sitka black-tailed deer that the community relies on during hunting season, as well as offer shelter to the thriving brown bear population that attracts thousands of tourists every summer. Dozens of berry species grow throughout the forest, which community members look forward to harvesting during their respective seasons. The Tongass also supports plants used medicinally by the Tlingit, including devil's club and new-growth spruce tips from Sitka spruce trees. Similarly, the bountiful waters of Neka Bay and Icy Strait have offered the Tlingit foods and jobs since time immemorial. All five species of Pacific salmon are sought after and largely make up the community's diet and culture, as well as halibut, herring eggs, and shellfish including dungeness and king crabs, butter clams, and cockles. The abundant wild foods found in the forests and waters around Hoonah continue to be integral to the community's culture, and harvesting and gathering them is essential to Hoonah's way of life.

[1] Team member Arianna Lapke lived and worked with HIA for 2.5 years and gained this and the following knowledge through extensive interpersonal relationships and experiences with the community.

The ways in which community members relate to and with the healthy and abundant natural resources and environment around them also reflect their psychological and spiritual connections with the land. Weavers enter the forest with an eye for large strips of yellow cedar bark and long Sitka spruce roots to create baskets, hats, or Chilkat blankets, among others. Similarly, carvers look for the perfect cedar or spruce trees to harvest for totem poles, canoes, or fishing gear such as halibut hooks, for example. Form line art is another traditional practice based on the symbols and shapes found in the natural environment around them. While these are all forms of artistic expression, it is also true that they are innately spiritual and healing practices. Carvers and weavers thank the tree before harvesting from them as a way to show respect to their relatives. It is common law to never harvest more than you need, and if you do, to share with others. Additionally, these practices are used to help people overcome personal struggles, such as experiencing a loss or substance abuse. Traditional practices in Hoonah express the intimate relationships the community has with the lands and waters around them, celebrating and paying respect to those nonhuman relatives.

The same is true for how the Tlingit organize their complex social networks. There are two moieties, or lineages, which are further subdivided into clans, or houses. The two moieties originating from Glacier Bay, the Tlingit peoples' homeland, are Yéil (raven) and Ch'aak' (eagle), and clans within each include T'akdeintaan (sea pigeon), Kaagwaantaan (wolf), Wooshkeetaan (shark), and Chookaneidí (brown bear). A Tlingit person is born into the clan of their mother, assuming the specified origin stories, properties, and stewardship responsibilities of that clan (Worl, n.d.). All clans come together for ceremonies, for example during return trips to Glacier Bay, which they were forced to migrate from in the mid-eighteenth century after being pushed out by advancing glaciers. To the Tlingit, Glacier Bay, like other mountains, waterways,

and rock formations, has its own spirit. It is a place for visiting ancestral spirits as well as nonhuman relatives (Mills & Moss, 2022). An integral part of Hoonah's way of life includes respecting nonhuman relatives and embracing the connections the people have with the land through various traditional practices, values, ceremonies, and social structures.

In addition to supporting the village's harvesting and gathering lifestyle, the expression of their traditional practices, and innate connections with the land, the goods and services offered by the surrounding and healthy lands and seas are also vital to Hoonah's economy. Hoonah was a logging town throughout the mid-late 20th century due to its proximity to high-quality old-growth stands, bringing in jobs for locals for decades (The Nature Conservancy, 2019). Consistently healthy and abundant populations of salmon returning to streams throughout the Tongass for thousands of years helped the trees grow into the high-quality timber they are, since the salmon passed on nutrients from the deep ocean as they decayed along the shorelines.

Moreover, Hoonah has long been a fishing community, as the Tlingit have been expert fishers for thousands of years. The Tlingit were highly skilled navigators, fishing for days against rough tides in the open ocean using hand-carved canoes. Community members in Hoonah fished regularly to secure food and express their cultural identity before commercial fishing was heavily practiced in the area. Then, commercial fishing including purse-seining, trolling, longlining, trawling, gillnetting, and crabbing occurred in Hoonah's waters by local fishermen throughout the 1900s and is still a major part of the town's economy today (Icy Strait Point, n.d.). Thus, healthy, abundant fish populations are again equated as vital to Hoonah's economy and lifestyle.

More recently, Hoonah's economy is largely based on the ecotourism industry in the form of cruise ships docking at the local port, Icy Strait Point (ISP). ISP opened during the early 2000s and has since brought thousands of visitors to Hoonah every summer (Icy Strait Point,

n.d.). Cruise ship tourists excitedly explore the town and admire the natural beauty offered there; bear viewing, whale watching, hiking, going out the road on all-terrain vehicles, or riding a gondola up a nearby mountain are a few of the opportunities tourists have to experience Hoonah's natural environment. While ISP manages most tourist recreational activities in town, locals engage with tourists and make regular revenue from their visits, including selling hand-made jewelry and taking tourists to view wildlife, such as birding or kayaking. Not only that, but the City of Hoonah also gains revenue from ISP to support the town's development and functioning. While the economic benefits of ISP to Hoonah are undeniable, the cumulative impact of such high-volume tourism in town is somewhat contested. Impacts such as local waterway pollution from cruise ship waste, increased marine noise, scaring brown bears from their feeding sites, and in-town congestion from significant increases in pedestrian traffic have all been commented on by locals and underscore some of the negative impacts of increased cruise ship activity in Hoonah. It is undeniable that the cruise ship industry has both real benefits and costs to stakeholders in town, both human and nonhuman. Additionally, it is certain that ISP would not flourish economically without thriving wildlife, as this is what the ecotourism industry sells to their guests in Hoonah.

Overall, Hoonah's community is highly dependent on and interconnected to the natural environment around them. Their psychological, spiritual, physical, and financial well-being are all supported by a healthy and diverse natural environment as well as abundant, high-quality natural resources. Without these, Hoonah's way of life would be irreparably interrupted, and the community's resilience and Indigenous sovereignty (defined here as Indigenous peoples' ability and rights to independently govern their way of life, be that through social structures and organization, political autonomy, natural resource management, cultural identity and practices,

etc., to represent their values and identities as well as ensure their well-being overall) would be undermined. Especially considering the disproportionate effects that Indigenous and coastal communities experience as climate change impacts worsen, it is essential that the nonhuman resources and environments of Hoonah are protected and supported so the community remains resilient against adverse environmental conditions.

Regional Climate Change Impacts

Southeast Alaska is already experiencing changing climatic conditions as a result of human-induced climate change, and they are only predicted to increase in severity and frequency. The primary climate change impacts in this region are increasing air and water temperatures, ocean acidification, sea level change, and changes in precipitation. Moreover, these direct climate change impacts have subsequent adverse effects on Hoonah that threaten their way of life.

Southeast Alaska is a region with diverse and essential ecosystems, including the aforementioned Tongass rainforest as well as nearly 48,000 km of coastline, which are known to be particularly sensitive to various climate change impacts (Johnson et al., 2019). Despite this diversity of landscapes and high terrestrial and marine biodiversity, this region remains highly understudied compared to the Arctic and other coastal areas. Because of this, there is a lack of quantitative data presenting historical climate trends for our areas of study. However, the longevity of many Indigenous communities in this region and their traditions of passing down knowledge through oral histories contributes to an ever-increasing qualitative database (Wyllie de Echeverria & Thornton, 2019).

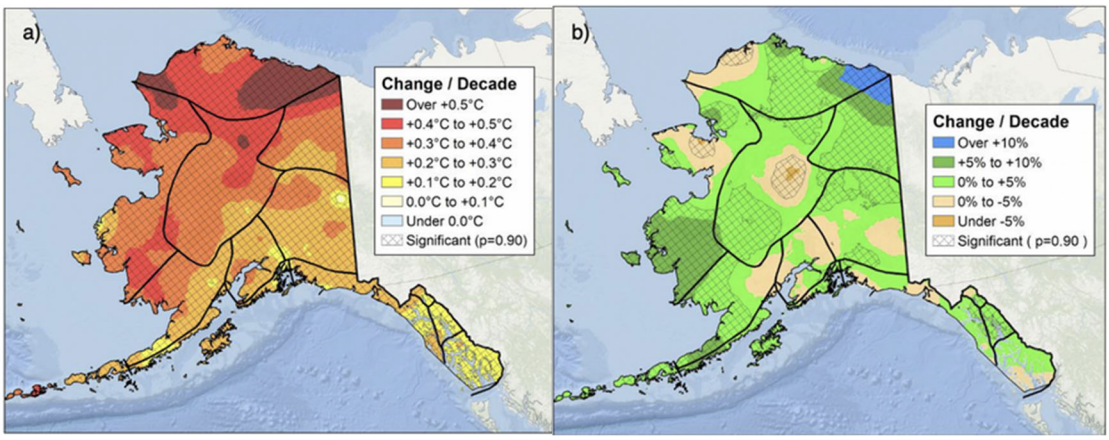

Figure 1. a) Changes in temperature per decade 1957-2021; b) Changes in overall precipitation per decade 1957-2021. From Ballinger et al., 2023

The state of Alaska has experienced greater increases in air temperature than any other region in the contiguous United States, at a level of nearly 3°F compared to 1.8°F since 1925 (Stewart et al., 2022). The greatest amount of warming has occurred in the Northern regions of the state, while Southern Alaska's average temperature has increased around 2°F in the same amount of time. These rising temperatures, while present all year round, are not consistent throughout the seasons. Most significant temperature increases occur in the winter and spring months (Stewart et al., 2022). Average annual temperatures in Southern Alaska are expected to rise by 2°F to 4°F by 2050, and anywhere from 4°F to 8°F by the end of the century (Chapin et al., 2014).

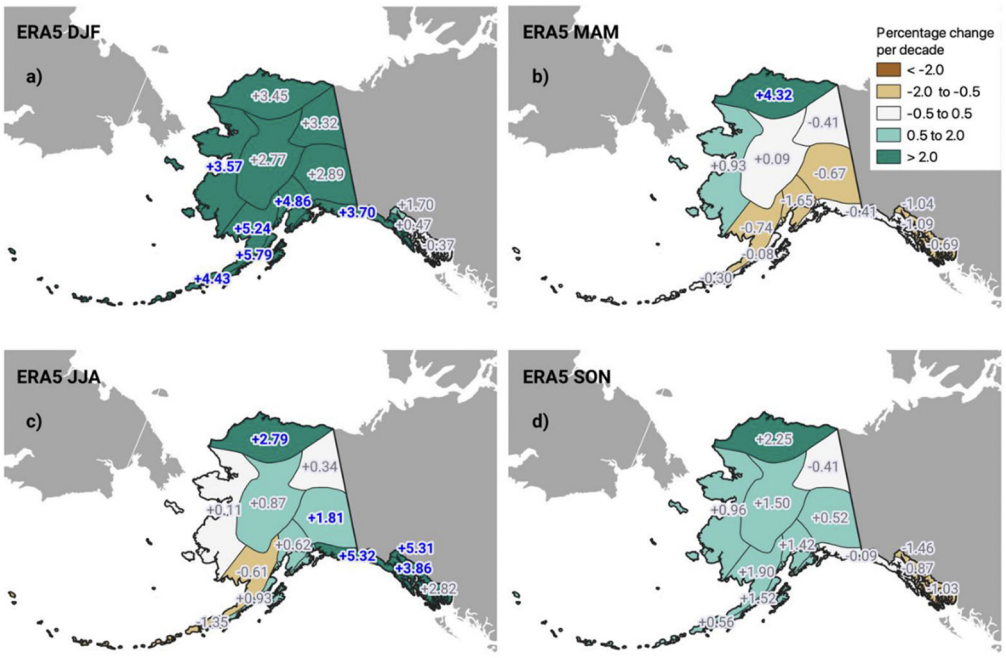

Figure 2. Changes in yearly average precipitation in each season; Summer (a), Fall (b), Winter (c), Spring (d), from 1957-2021 (Ballinger et al., 2023).

These changes in temperature, along with the melting of permafrost and glaciers in the North, contribute to extreme changes in precipitation throughout the region. The annual total precipitation in Southeast Alaska hovers around 200 inches (Ballinger et al., 2023). While precipitation overall has been increasing over the past several decades, the seasonality and type of precipitation have also been changing, affecting the life cycles of many cultural and physical resources, such as cedar and deer. In general, there is evidence of increased precipitation in the summer season and less during winter and spring, correlating with an increase in rainfall and a significant decrease in the amount of snowfall, and therefore snowpack (Ballinger et al., 2023). These changes in precipitation are documented in a limited amount of quantitative research efforts but are prominent in many Indigenous oral histories and interviews. This data reflects the same results: the timing of seasons has shifted and seasons are becoming less defined, and there is a distinct loss of snowfall over the past four or five decades. As temperatures continue to rise in the region, we can expect to see less snowfall and more rain in the coming decades as well.

The melting of the northern glaciers in Alaska has caused varying levels of sea level rise and post-glacial isostatic rebound throughout Southeast Alaska, both of which displace the huge number of human and nonhuman communities located along the coast. In Northern areas of the Alaskan panhandle, sea levels are expected to drop by as much as 6 feet. Hoonah specifically will be facing drops of nearly 3.5 feet, meaning a loss of 30% of the community's estuary coastlines (Johnson et al., 2019). Southern areas of the panhandle will instead be facing increasing sea levels, wherein there will be gains of between 8 and 20 miles of shoreline. These changes will continue to affect coastal communities in many ways, displacing communities, depleting or otherwise changing the abundance and distribution of cultural and physical resources, and more.

Globally, ocean waters have become 30% more acidic due to the absorption of human-induced carbon dioxide (Chapin et al., 2014). Low temperatures and lower levels of salt concentrations resulting from the intake of glacial and permafrost melt make the polar ocean even more vulnerable to acidification. This vulnerability is highly felt by coastal subsistence communities such as Hoonah because the acidification process damages so many marine ecosystems and resources. For example, cultural keystone species such as salmon are dependent on the population of smaller shellfish, such as pteropods. However, these shellfish respond very quickly to acidification and are highly adversely affected by current and future conditions. Evidence shows that a decrease of 10% in shelled pteropod populations may lead to a 20% decrease in adult pink salmon body weight (Chapin et al., 2014). This example is just one of many current and future scenarios that affect coastal communities throughout Southeast Alaska.

Subsequent Effects of Climate Change on Hoonah

The subsequent effects of climate change in Southeast Alaska vary by community. In Hoonah, the cumulative impact of climate change means necessary resources are harder to access, making it more difficult, or, at worst, impossible for community members to express their cultural identity and traditional way of life. Thus, climate change impacts overall undermine Tlingit sovereignty. Moreover, because of Hoonah's physical isolation as a water-locked, remote island village, there are fewer opportunities for the community to access external resources due to the logistical and financial burdens of air or ferry travel. Without regular access to both natural and social resources on the mainland, it is even more important that Hoonah is self-sustaining. As climate change continues to impact the region, Indigenous peoples will have less say in how to utilize, steward, consume, and otherwise relate to the natural resources, environmental processes, and natural environment around them as they are degraded or lost over time. Furthermore, increased human and nonhuman competition will impact the ways in which the Tlingit and community members in Hoonah relate with each other and the natural world. Increased resource scarcity can quickly yield increased competition for such resources, which, given the historical and contemporary relations between settler colonial nation-states and Indigenous peoples, can certainly threaten Indigenous sovereignty, health and safety, territories, and ways of life. It is imperative that the Tlingit people and Hoonah as a community are resilient to all the impacts of climate change to maintain their well-being and Indigenous sovereignty.

Our Project: Hoonah's Climate Adaptation Plan

Climate change impacts such as increasing temperatures, sea level change, and ocean acidification are and will continue to adversely impact the Tlingit village of Hoonah, both biophysically as well as socio-politically, with the potential to severely disrupt their way of life

and threaten the community's well-being. In order to mitigate and prevent some of these impacts, it is essential that the community prepares and plans for climate changes moving forward. HIA Environmental planned to help the community do just that through the development of a Hoonah-specific adaptation plan. They began this work in October of 2022 and enlisted us, the University of Michigan master's project team (henceforth, UM team), to assist them with it. This paper describes our process of gaining community insight to develop the first iteration of a living document: Hoonah's Climate Adaptation Plan (HCAP).

Process

Introduction

A climate adaptation plan is a tool that identifies vulnerabilities within a community and presents strategies to manage climate change impacts and have been employed by many tribal governments across the U.S. for over a decade now ("Adaptation Plan," n.d.; Nursey-Bray et al., 2022). They serve as a critical means of assuring Indigenous futures in a world where many Indigenous peoples, including in the U.S., disproportionately bear the brunt of climate change (Laduzinsky, 2019). The creation of HCAP, specifically, was guided by climate adaptation plans of other Alaska Native communities in Southeast Alaska, primarily the Sitka Climate Change Adaptation Plan.[2] It aims to inform community members about the climate challenges they are facing locally as well as organize interdisciplinary adaptation strategies to help mitigate the adverse impacts of climate change. It can be used to guide community development projects, influence city planning, secure funding, network with stakeholders, and share with other Southeast Alaska communities who may be experiencing similar impacts.

HCAP Goals

Going into the project, HIA Environmental's primary goal was to create a climate adaptation plan that will be appropriate and effective for the city of Hoonah. They also had several intentions for what the adaptation plan as a document would achieve. First, HIA Environmental wanted the plan to serve as an acknowledgment that climate change is happening in Hoonah and that its residents are seeing and experiencing these changes. Additionally, they wanted the plan to identify the current state of resources and how Hoonah residents would like them to be in the future. HCAP's focus is on gathering local solutions and to center community

[2] https://www.ccthita.org/services/community/environmental/documents/T&HClimateChangeAdaptationPlan.pdf

voices surrounding climate-related issues and actions. All these actions are intended to help support the main goal the plan aims to achieve, ensuring the health of the community.

Action Items

After familiarizing ourselves with the climate change impacts in Southeast Alaska, as well as the history and community of Hoonah, we, the UM team, identified our goals and desired end result, then enacted the following series of action items to assist HIA Environmental in the fulfillment of those goals:

1. Design a two-page community survey to be distributed at an upcoming Community Bazaar in Hoonah to identify the resources that are most important to the community and gauge community perceptions regarding climate change, analyze data from the survey and use the findings to inform the resources to be covered in HCAP,
2. Design interviews to identify what environmental changes and their impacts community members are perceiving in Hoonah, as well as analyze data from the interviews to improve our understanding of community concerns and their ideas on how to adapt to changing socio-environmental conditions,
3. Visit Hoonah City Schools to deliver climate-focused lessons to all the local students as a means to learn more about the younger generation's understanding of the world and community around them, and
4. Implement a community event during the UM team's visit to Hoonah to brainstorm climate adaptation strategies that are locally-led and based in traditional Tlingit values as well as establish a space for ongoing conversation surrounding environmental changes in Hoonah, review discussions from the event to inform further plan development.

Each of these project actions will be discussed in further detail in this report.

Data Collection and Analysis

We collected data at two points during this research process. This includes a survey and a set of interviews. During these different stages, we gathered increasing degrees of information to inform our work at the given time.

Survey

Our first major step pursuant of developing HCAP was the creation of a community survey that established a baseline of community perceptions of a changing climate.

Goals

This survey was created with the intention of gauging community perceptions of a changing climate, and the felt impacts on the community and subsistence resources. In particular, the aim was to better understand the social, environmental, and political impacts at play in the community. This survey also aimed to identify interviewees in the community for further conversations around the climate change concerns and impacts in Hoonah.

Methods

In order to gain as much information from the survey as possible, it focused on a wide range of topics. For example, we included demographic questions asking age, gender, and time lived in the community to better understand generational and gendered perceptions of climate change in Hoonah. Research has suggested that gender, in particular, can shape individuals' attitudes and beliefs about climate change, as well as both individual and collective motivations to address it (Pearson et al., 2017). While many of the questions were created from our background knowledge and expertise, we also consulted questions included in other tribal adaptation plans. The Ute Mountain Ute Climate Action Plan (2020) was particularly helpful in

developing questions related to community vulnerability.[3] To make this survey accessible to the community, we created both a Google Form, with an accompanying QR code, and paper version of the survey (see Appendix A). We reviewed the survey for accessibility to ensure the content was as comprehensible as possible for a variety of audiences. This survey was distributed in person by HIA Environmental at the Hoonah Holiday Bazaar in December of 2022.

Results

Our survey resulted in 74 community responses (n = 74), which is about 8% of Hoonah's population. For raw data see Appendix B. All respondents filled out a printed physical version of the survey. Pictured here are two visualizations of our results from the surveys. The figure below represents community responses to the question "Do you believe climate change is worsening?" This question aimed to understand the perception of climate change in Hoonah and whether changes in resource availability, extreme weather, and so on were being attributed as consequences of a changing climate. From our data, about 81.3% of respondents said they believe climate change is worsening. This response in particular informed our approach to discussing climate change with community members while in Hoonah.

[3] http://www.utemountainuteenvironmental.org/sites/umep/assets/PDF/UteMountainUteClimateActionPlan2020%202.pdf

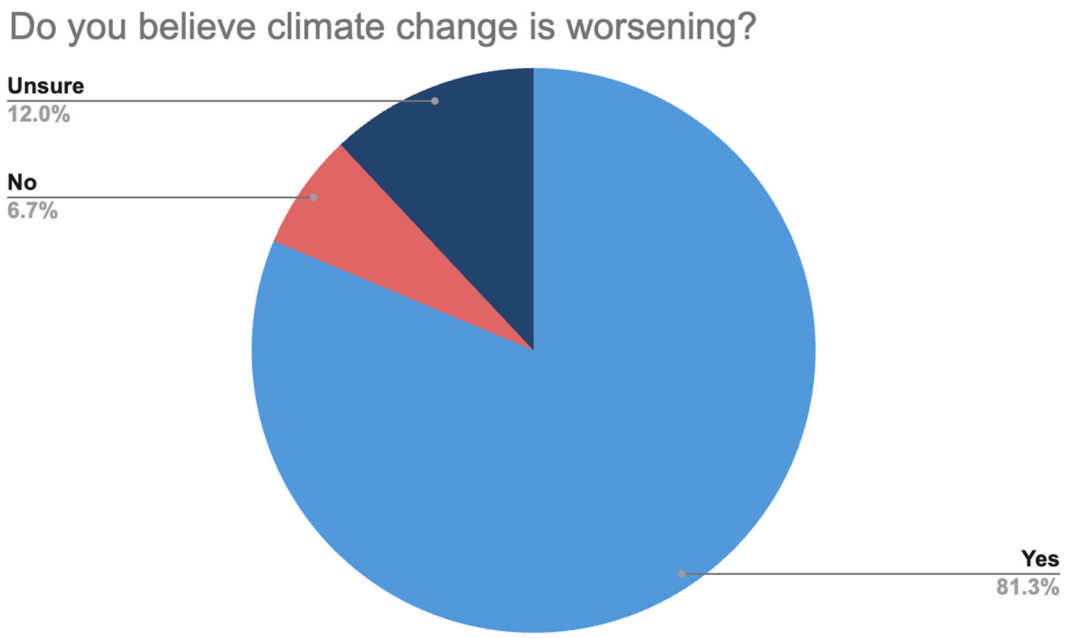

Figure 3. Pie chart of survey responses to the question "Do you believe climate change is worsening?".

Additionally, our survey asked, "As conditions in Hoonah change, which subsistence resources are you most concerned for and think should be protected?" To focus on the concern expressed over food insecurity into the future, this question aimed at identifying which resources were most important to the community. These results helped inform resources addressed within the climate adaptation plan as well. Shown in the word cloud, and listed here, are the main resources of concern in the community: salmon, halibut, berries, cedar, deer, crabs, spruce, clams/cockles, seal, Hudson Bay tea. The majority of these resources are directly food-related, but included too are resources utilized in carving, weaving, and other traditional practices. These results also confirmed that climate concerns for Southeast Alaska in general were being reflected in Hoonah.

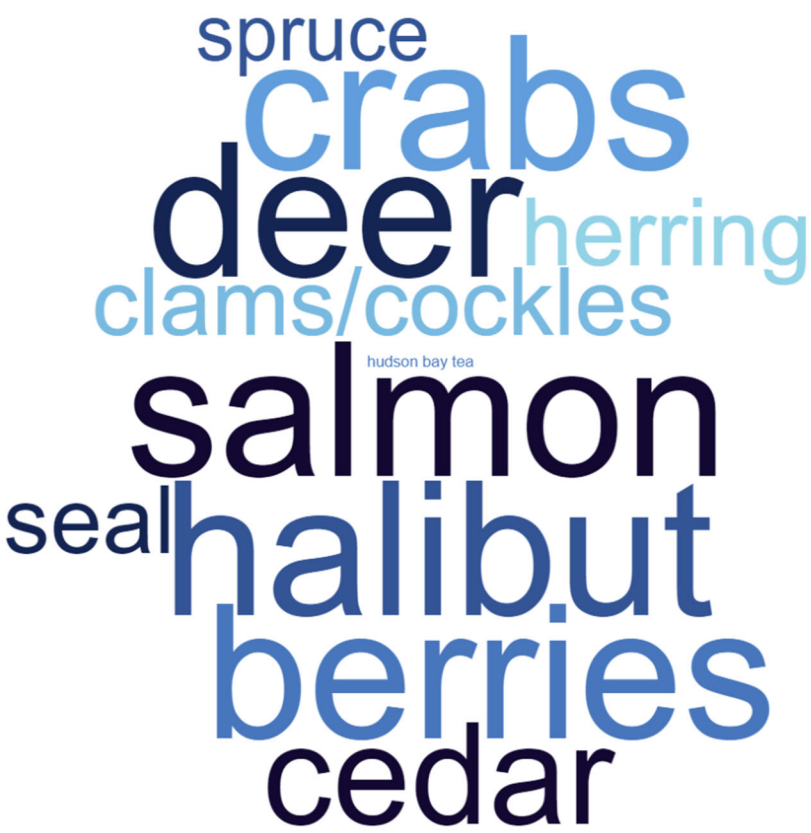

Figure 4. Word cloud representing subsistence resources of concern in Hoonah.

Interviews

The interview stage of our project was the second major step to collect more detailed information about the historical and personal practices by community members related to subsistence resources in the community.

Goals

The primary goal of conducting interviews was to gain a better understanding of what locals in Hoonah were perceiving in terms of environmental changes, as well as gain insights into how their adverse impacts could possibly be mitigated and/or prevented over time. Our primary research question was "What changes regarding the natural environment, and interactions with them, are community members perceiving in Hoonah?" Our additional

questions of interest were “What concerns do community members have about these perceived environmental changes?” and “In what ways can Hoonah’s community better adapt to changing environmental conditions, specifically when they adversely impact traditional ways of life?” The responses to these questions are incorporated into the adaptation strategies section of HCAP.

Methods

First, we drafted the research questions of interest as well as interview questions that could be used to address them. From there, HIA Environmental staff selected and revised the questions to be used during the interviews with community members. The interview questions selected can be found in Appendix C.

HIA Environmental staff then reached out to community members interested and willing to participate in interviews to discuss environmental changes in Hoonah. All participants were asked their preference to remain anonymous, as well as were given free, prior, and informed consent; that is, participants could retract any statements from the interview at any time, refuse to answer any questions, end the interview at any point, and request follow-up information if they wished to do so. They were also asked if they were comfortable and willing to have their interviews audio-recorded, to which no participants denied the request. The project was submitted to the University of Michigan’s Health Sciences and Behavioral Sciences Institutional Review Board and was classified as an oral project, thus deemed “Not Regulated” and did not require further oversight.

Interviews were conducted in-person over the course of several weeks, lasting between ten minutes and one hour. The interviews were semi-structured, independent, and inductive (discovered patterns, themes, and categories that emerged from the data). The raw data (interview recordings) was shared with us by HIA Environmental staff via Google Drive. Each

interview recording was then assigned a unique identifier that eliminated identifiable information from the file name.

We listened to each interview and created memos to begin organizing our initial thoughts. Memos were discussed and deliberated amongst the team to help ensure accuracy of identified patterns and themes. After all interviews had been thoroughly deliberated, relevant information was transcribed and a time-stamp was included. From there, preliminary metadata analysis began. We began coding the interviews based on the research questions they answered. Several iterations of codes were developed and categorized before the finalized codebook was organized. These included events, opinions, values, behaviors, processes, and actions. Soon after, we began identifying emerging themes, patterns, and relationships between codes.

To further analyze and communicate our interview data, we drafted network displays that best represented the patterns and themes observed from the interviews to answer our primary research question. Again, several working iterations of the network display were developed in order to ensure its accuracy and enhance its comprehensibility. The network display graphic was made using the visual collaboration website, Miro, Appendix D.

Results

There were a total of seven interviews conducted and analyzed for the purposes of this project (n = 7), however HIA Environmental staff intend to continue conducting interviews throughout the development of HCAP. Memos, codebooks, and a network display (below) were created to organize and visualize the results of the interviews, addressing the primary research question “What changes regarding the natural environment, and interactions with them, are community members perceiving in Hoonah?” Data gathered pertaining to the secondary

questions of interest (community concerns and ideas for adaptation) can be found in more detail in Appendix E and F.

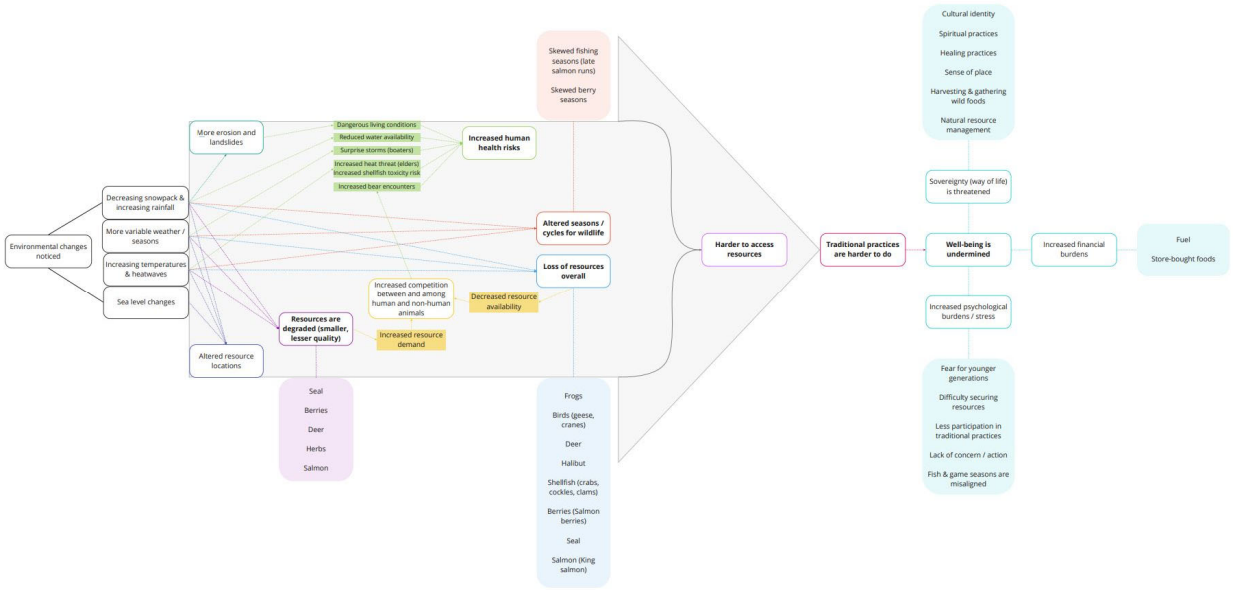

Figure 5. Network display of the perceived environmental changes in Hoonah and their impacts on traditional ways of life based on community member interview findings.

Environmental changes observed by participants are listed on the far left of the network display. Major themes identified from the interviews are in bold, and lines between variables and the environmental changes perceived show a relationship between them (inferred from interviews or explicitly stated in interviews). Examples from the interviews are included, connected by a line to the variable for which they exemplify. Processes through which themes arose are also identified as a caption on lines connecting variables.

Environmental changes and subsequent impacts in Hoonah

Overall, the interview participants listed four environmental changes perceived in Hoonah: decreasing snowpack and increasing rainfall, more variable weather/seasons, increasing temperatures and heatwaves, and sea level changes. “Decreasing snowpack and increasing rainfall” refers to the changes in precipitation that Southeast Alaska is experiencing, which four community members interviewed (57.1%) noted (e.g., “I think the winters have warmed up a

little bit, we seem to get more rain than snow"). Similarly, "more variable weather/seasons" refers to how weather is becoming more unpredictable, changing rapidly without much warning/buffer, or is more off-trend than usual (e.g., "we've been having really cold spells, really colder than usual to me. And then in the springtime it's still kind of cold, so I don't know; to me, it's like our seasons are off just a wee bit, by a month or two"). Of the seven respondents, three (42.9%) mentioned these observations in their interviews. "Increasing temperatures and heatwaves" refers to warmer, drier, summers experienced in Hoonah, of which three people (42.9%) noted (e.g., "it's been a lot hotter every summer and it lasts a little longer"). Lastly, "sea level changes" refers to noticeable changes in shorelines or coastal reefs; more specifically, there was one local (14.3%) that commented on a drop in relative sea level in the interviews (e.g., "on my depth finder, when I'm out on the boat, I've seen some different areas where the change is. There's some reefs out there that hadn't been there… I've been here a lot of years and it's just something different"). While these may not be all of the environmental changes occurring in the region, these are the ones that community members noticed and mentioned during their interview.

There were many subsequent impacts of the environmental changes observed in town. First, an observed impact of environmental changes was a loss of resources overall. All interview participants mentioned this observation in the interviews (100%). Examples they provided included frogs, birds (i.e., geese, cranes), deer, halibut, shellfish (i.e., cockles, clams, crabs), berries (i.e., raspberries, blueberries, salmon berries), seal, and salmon (i.e., unspecified species, King salmon). At times, participants made generalized comments regarding a loss of resources, for example one respondent said "a lot of the things that we depend on will soon disappear, simply because I feel like climate change has affected a lot of things and will continue until

something drastic happens", and another commented "unless there's some real major changes, somewhere, somehow, I'd be surprised if there's anything for future generations to really subsist on." Regardless of the detail provided, all interviewees observed less subsistence and/or non-subsistence resources overall.

Another five out of seven respondents (71.4%) mentioned degradation of natural resources in some way, in that resources have been smaller and/or of poorer quality. This applies to resources including berries, deer, herbs, seal, and salmon. Of the five respondents that mentioned resource degradation, four of them (80%) noted berries as one of the resources for which this code applied, thus berries represented the mode of the "resource degradation" code from these interview participants. Respondents noted that berries were often dried up and smaller because of too much heat, killed prematurely due to surprise freezes, as well as waterlogged due to excessive rainfall.

Additionally, changes in wildlife seasons/cycles were observed by two out of the seven interview participants (28.6%). Both times the fishing seasons were explicitly mentioned, for example one person stated, "the ones that are more outdoorsy in our community have noticed, I've listened to them, our fishing seasons aren't quite right." Another interviewee provided more detail by saying "the sockeye are arriving late." Berries were also noted once as having changes in their seasonality. Similarly, altered resource locations, their physical distribution across the landscape, was noted during the interviews as a subsequent impact of the environmental changes occurring. Participants noted having to go further to access the resources they need, or resources that were not found in their usual locations ("'cause we're having to go farther away to get [food and nonfood resources]"). Given that wildlife seasons such as salmon runs and berry growth as well as resource distribution are at least partially dependent on abiotic environmental factors, it

makes sense that locals would have noticed these impacts as a consequence of abiotic environmental changes.

Increases in human health risks were also noticed by five participants (71.4%), whether it was explicitly mentioned or observed as a result of other processes occurring. One of the risks observed by two participants (28.6%) was an increase in landslides from extreme rain events. One community member stated plainly "the rain is causing a lot more slides around here that never used to happen, regardless of how hard it used to rain." Not only does this pose a potentially dangerous situation to some households and drivers on unstable roads, but landslides can also make it more difficult for community members to access resources by washing out necessary roads/landscapes. Another example of an increased human health risk noted once in the interviews (14.3%) was the risk of red tide, or algal blooms, from increased sun exposure. Paralytic shellfish poisoning (commonly known as PSP) is a result of increases in algal blooms, causing shellfish to be toxic and inhibiting their consumption by humans. Increases in sun exposure, or extreme heat, is known to be more threatening to elders, therefore that was included as an inferred risk as well (Center for Disease Control, 2021). Similarly, one person (14.3%) mentioned there being increased risk on the water from more intense weather/storms. Another manifestation of increased human health risks as a result of environmental changes was a decrease in snowpack, or in other words, a decrease in the City's drinking water. Five out of the seven participants (71.4%) mentioned observing less snow than normal; one person stated "the snows we used to get for winter we no longer get." Lastly, there was an increase in human health risk via increased bear encounters due to increased competition for resources (e.g., "when the berries dry up, the bears wander around town more frequently"). Five participants (71.4%) commented on an increase in bear activity in or around town, deterring them from their everyday

activities including gathering subsistence resources like berries. An increase of out-of-town hunters in Hoonah during the hunting season was also noted as a form of increasing competition, decreasing the community's resource availability even further ("more people come here. I don't know, they seem to like harvesting our wildlife"). These are only some of the possible human health risks exacerbated by climate change impacts.

Overall, the cumulative effect of these subsequent impacts (altered resource locations, more erosion and landslides, degradation of resources, resource depletion, increased competition, increased human health risks, and altered wildlife seasons/cycles) is that it is harder for community members to access resources they need. One interview participant summarized it well when they said, "This makes life so difficult. We won't be able to live the way we used to." Another community member echoed that sentiment with "right now, the way I think it is, with everything the way it seems to be going, I'd be surprised if there was any subsistence [seven generations from now], because I think everything's being so heavily regulated in so many ways. And then I've also noticed it seems like the deer and salmon populations, and just in my lifetime… I remember there used to be a lot of salmon, I mean lots of salmon, compared to what we have now going through [the rivers]." When resources are not only decreasing in abundance and quality, and competition and harvesting regulation for them increases with scarcity, it is no surprise they are harder to access. There are also added factors, such as resources not arriving when or where they usually do. There are also greater risks to go get them, that make it even harder. Locals in Hoonah are clearly feeling the consequences of changing environmental conditions.

Unsurprisingly, increasing difficulty accessing resources makes it harder to participate in traditional practices, which undermines sovereignty overall. Harvesting, gathering, hunting,

fishing, carving, weaving, paying respect to and developing relationships with the land and seas, as well as stewardship responsibilities depend on abundant natural resources. Without natural resources, the Hoonah Tlingit way of life is severely interrupted. This adds psychological burdens and stress on community members by fearing for younger generations, struggling to secure resources they need, not being able to participate in traditional practices as frequently, and an overall lack of concern by municipalities, state, or federal agencies, among others. One participant highlighted these issues with "it concerns me when there's maybe a handful of people who are concerned, and others 'no big deal' because maybe they might not be here, I don't understand that." Another person stated, "if we keep going the direction we're going there's going to be no subsistence resources because we're killing the ocean, we're killing the land, and there's going to be no place for subsistence resources to live." There is also added financial stress; when people can not secure wild foods, they have to spend more money on store-bought foods. This is articulated well by one community member's comment, "Now that it's getting less and less, I pray that this year it's not going to be like that… [hunting and fishing] are important for us to survive, because right now, I went to the store and I came back with a medium sized bag, and it was $47." Indigenous sovereignty are therefore increasingly threatened by climate change impacts, as with less opportunities to engage in preferred ways of life (i.e., healing and spiritual practices, stewardship responsibilities, cultural identities, wild foods harvesting, etc.) and little decision making power over the causes of these impacts, their ability to independently govern their way of life and well-being is taken away from them. It is essential that climate change impacts are ameliorated or prevented entirely to restore and maintain the Hoonah Tlingit ways of life and relationships with the lands and seas around them.

Community Engagement

Community engagement was an essential part of our project, especially once our team arrived in Hoonah in person. Along with generally spending time in the community, we visited the local public school and hosted a public community event to familiarize ourselves with the community and better understand their perspectives.

School Activities

During our trip to Hoonah, we visited students grades kindergarten through eighth at Hoonah City Schools to deliver climate change-focused lessons and activities. It was important for us to visit the youngest members of the community for various reasons. With three out of the five total members of our team being educators or otherwise interested in having a career based in education, this presented an opportunity for us to use our skills and knowledge to supplement students' science education. Additionally, a goal of our project was to reach as many community members as possible to talk about changes in climate in Hoonah, and this included children and teenagers.

To accomplish this goal, three members of our team, Arianna Lapke, Anjali Pandey, and Jillian Shrader, worked with the HIA Environmental Education Coordinator, Julian Narvaez, to create age-appropriate and localized lesson plans. Before creating lessons and activities, our team first determined which students we would try to reach, what we wanted to achieve, and how we would do so. The school is broken into five classes with a total of around 100 students (pre-kindergarten through third grade with 15-20 students each, fourth and fifth grade with 15-20 students combined, seventh through ninth grade with 7-8 students each, and tenth through twelfth grade with 15 students combined). With this information, our next step was to get permission from each of the teachers to come to their classroom for a class period, or 55 minutes.

Narvaez served as liaison for this process, contacting teachers and organizing dates and times for our visits.

We split our in-class engagement into four groups: Littles, Upper Elementary, Middle School, and High School. However, due to the high school students traveling out of town for a basketball tournament, we were only able to visit the younger three age groups.

Then we were able to start creating our lesson plans, which are provided in full in Appendix G – I. Our main questions during this process were:

1. Why is adaptation and adaptation planning important?
2. What does climate change and adaptation look like locally in Hoonah?
3. How can we make these lessons hands-on?

We were aiming to create hands-on, educational activities that would teach students about what climate change looks like in their community, and what they were able to do about it.

Image 2 and 3. Students in Hoonah during the touch tank activity.

Our main activity for our Littles group (PreK-2nd grade) was touch tanks replicating two local ecosystems, the coast and the forest. The HIA Environmental and UM teams spent time outdoors collecting specimens for these touch tanks, including tree branches, moss, dirt, worms, and bear bread for the forest tank, and water, crabs, sea stars, seaweed, and more for the coastal tank. We brought this activity to the classroom, split the class into two groups, and spent thirty

minutes giving the students the chance to explore the bins freely. Our guiding questions for this activity included: What do you recognize in the bin? How do animals (including humans) use or live in this environment? How do we depend on these resources? How can we protect it?

Image 4. "How is nature connected?" game being played by students and UM team members

With the Upper Elementary groups (3rd-5th, two classrooms), we played a game entitled "How is nature connected?" This game explores the food web by assigning each student an organism card (e.g., salmon), with information about what that organism needs to survive and what resources it can provide to other organisms. Each student was given a wristband with three long strings attached to it, and their job was to connect their three strings to the three resources that they needed to survive. In the end, the whole class was a huge, jumbled mess of string demonstrating how interconnected all the organisms in our local ecosystem are. This activity was followed by a group discussion based on the questions: What kinds of services/values did your organism provide? How are humans connected to the lands and waters around us?

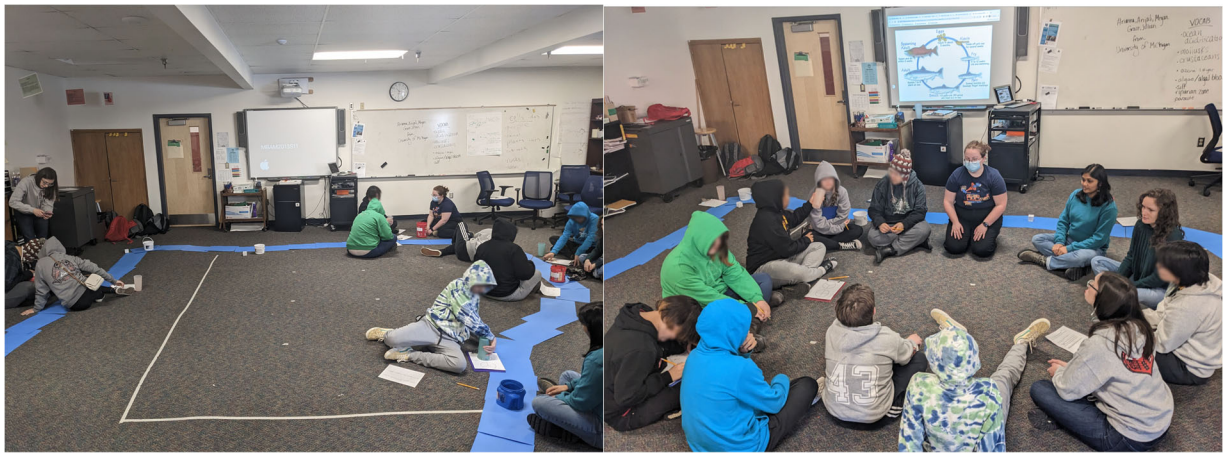

Image 5 and 6. Students and UM team during the life cycle of a salmon.

With the Middle Schoolers (6th-8th grade), we wanted to dive deeper into an essential local resource: salmon. We knew these students would have personal ties to salmon in some way, having eaten it before, being the child of a fisherman, etc., so we modified Trout Unlimited's "Salmon Survival Game," which focuses on the impacts of climate change that salmon may experience at different stages of their life cycle (Gandour-Rood, n.d). In the classroom, we created a stream on the floor made out of blue construction paper, then stationed nine containers at period intervals throughout the stream. These containers each represented a stage in the salmon life cycle (e.g., egg, alevin, fry). We then placed a homemade cube at each station, with each side of the cube containing a climate change impact that the salmon may experience at that specific life stage. The students were tasked with becoming a redd (nest) of eggs trying to make their way from birth all the way back to their spawning waters at the end of their life cycle. The fate of each student was decided by rolling the cube at each station and following the instructions given to them (i.e., ½ of your eggs are washed away during heavy rains). Each station would eliminate up to half of the eggs (represented in the classroom by beads) that each student had, leaving them at the end of the game with only one or two salmon left.

This game was accompanied by a worksheet that prompted students to describe or draw what happened to their salmon redd at each stage of the life cycle. We then followed the game with a group discussion with question prompts such as: What were some ways that you lost your salmon? Why is [warming water/human development/etc.] bad for salmon populations? What can we do to help salmon populations thrive? With this activity, we aimed to not only teach the students about the life cycle of salmon and how vulnerable they are to outside forces, but we also aimed to prompt the students to think about what they could do in their lives and community to help protect salmon, as well as other vulnerable organisms.

Community Event

The community event represents the culmination of the UM team's community engagement work while visiting Hoonah.

Purpose and Design

The main goal of this event was to gain community perspectives on the adaptation plan and, especially, what additional adaptation strategies were needed. This was important to us because our overarching goal for this project was to create an adaptation plan made with the community, for the community.

To widely advertise this event, we created a flier in Canva and posted it on the Hoonah Bulletin Facebook page and also posted printed copies at various locations across town including coffee shops, grocery stores, and public buildings (Appendix J). During the beginning of the event, as people were settling in we also provided a presentation with some guidance and further information about the event (Appendix K).

To gather our desired information, the UM team, in collaboration with HIA Environmental, created two climate-related activities. After each activity, we facilitated discussions during which at least one team member took notes. We also had several printed-out versions of the draft HCAP that we made available to attendees to read and take as they pleased.

The first activity on the itinerary was a game of Jeopardy (Appendix I). We designed the game to review how resources in Hoonah are being affected by climate change, with a particular focus on resources mentioned in the plan. We did this to get attendees comfortable with thinking and speaking about how climate change will affect their lives. After the activity, the discussion centered around information attendees did not know or were surprised about.

We designed the second activity to draw out adaptation strategies the community wanted to add to the plan. To do this, we created a series of five posters, each of which focused on a

different climate challenge in Hoonah. These included: ocean acidification, increased water temperature, increased air temperature, change in precipitation, and sea-level change. We chose these five challenges because they are all impacts Hoonah residents have experienced. They are also broad enough to leave space for creative adaptation strategies.

We included the name and definition of the challenge on the top of each poster and were sure to avoid prompting attendees to give a certain type of response through these definitions. Underneath these items, each poster had the same two questions. The first question was: “How do you feel this impacts you or Hoonah?” Through this question, we intended to have attendees think about specific aspects of their livelihood that will change because of the challenge. The second question was: “How do you want to adapt or respond to these impacts?” The purpose of this question was to have attendees identify the strategies they wanted to be implemented in response to the impacts mentioned under the first question. We gave each participant a stack of sticky notes to respond to these questions and directed them to place the notes under their respective poster questions. We also gave them a set of small stickers to put on the sticky notes they agreed with or wanted to emphasize. A completed event poster is shown below.

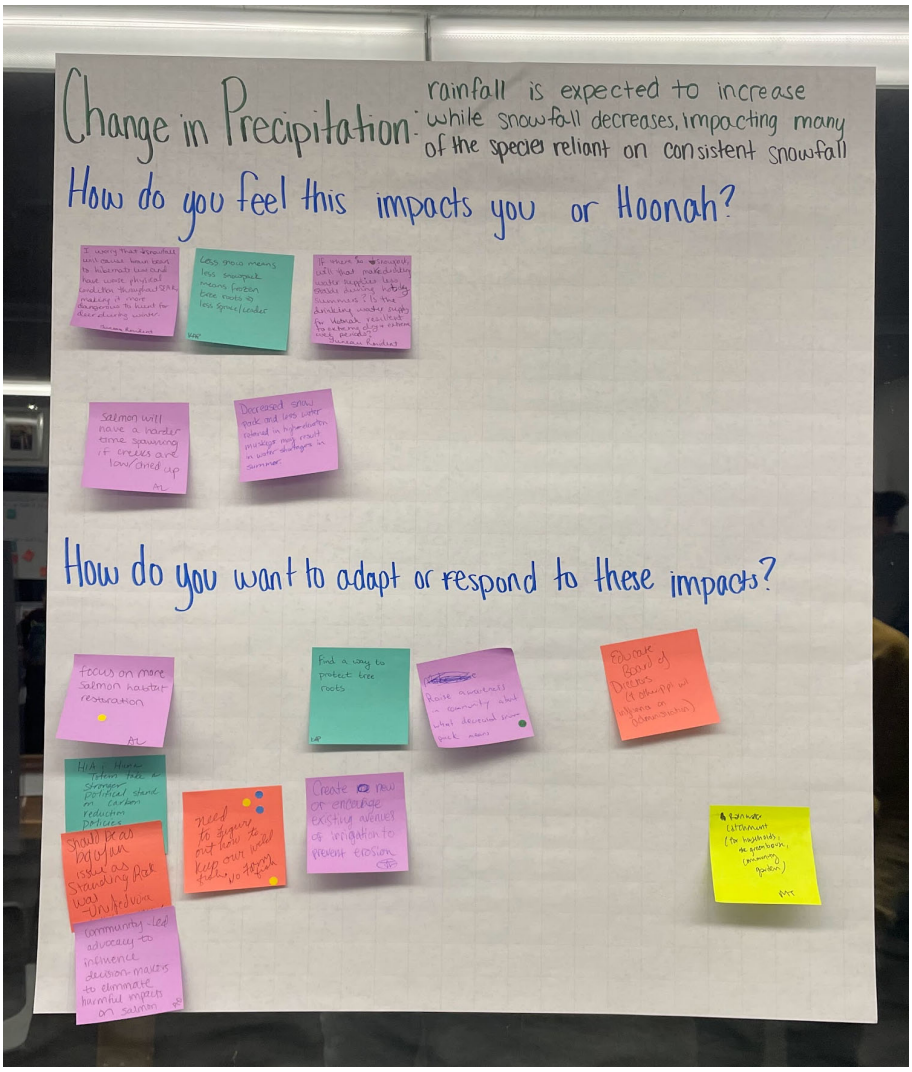

Image 7. Change in precipitation poster from adaptation activity at community event.

Analysis

After the event, the UM team took the data collected and used it to guide the further development of the adaptation plan. To do this, we first did an analysis of the in-person responses. We began by grouping the impacts mentioned by topic while tracking how many people brought up that impact. For example, we grouped mentions of degraded salmon habitat under “salmon habitat in poor condition” and marked that four people touched on that topic. We then went through each proposed strategy and paired it with any impact topic that it may help address. Next, we built out the proposed strategies so that they could be feasibly implemented

and made sense for the community of Hoonah before then incorporating them into the plan. For impact topics without many strategies to address them, we did further research to fill in the gaps. In the end, 25 adaptation strategies were pulled from the community event and incorporated into the plan.

Lessons and Next Steps

The UM and HIA Environmental teams are proud of the event we put on. We drew a diverse crowd and explored a range of topics that were important to attendees. We also learned several lessons that can be used to improve future community events.

The main lesson we took away was to be conscious of time. Our event was three hours long and, while we provided food, it was clear that attendees were tired by the end of it. In the future, we recommend structuring events to be shorter, about two hours long maximum, and include breaks. In the past, HIA Environmental put on a similar event, but in a two-day format. The first day was the Disaster Resiliency Expo which reviewed the relevant material. The second day was a workshop that was used to brainstorm solutions. This two-day model worked well for them and avoids some of the time issues we had with our community event, although it does require more commitment from event attendees.

Additionally, we wish we had better explained what each activity was intended to achieve. Although we explained how to participate in each activity, many attendees were curious about *why* they were doing them. For future events, we recommend incorporating brief descriptions of the goal of each activity beforehand and a more substantial explanation afterward, more akin to how a typical human research study is done.

Community events will remain an important aspect of HIA Environmental's ongoing development of the plan. They will be a useful strategy to gauge HCAP's efficacy as it is

implemented and reevaluated. Community involvement is a fundamental aspect of the adaptation plan and will continue to be essential to its success.

Hoonah's Climate Adaptation Plan

Developing HCAP required a great understanding of the goals that we wanted to achieve and the strategies that other communities have explored and employed. As more plans are developed across the globe, the interconnected adaptation methods will strengthen as will global resilience.

The Making of HCAP

Before we began working with HIA Environmental, they were already researching how they might want to approach the development of HCAP. The HIA Environmental team decided that it would be best to model closely after the Sitka Climate Change Adaptation Plan. With this in mind, the UM team read over the Sitka Climate Change Adaptation Plan and as well as the Status of Tribes and Climate Change (STACC) Report (2021) to gain a better understanding of the components that make up a climate adaptation plan and pull in key aspects to benefit HCAP.[4]

From the survey implemented earlier, we were able to pull out 10 key resources to focus on for this first draft of HCAP. Those resources are salmon, halibut, deer, berries, shellfish, cedar, spruce, herring, deer, and seal. While these 10 resources were the primary focus of this first iteration of the climate adaptation plan, HIA Environmental also decided to include some other resources such as seaweed and crustaceans which are also important to Hoonah's way of life.

[4] The STACC Report (2021) represents the most recent attempt at a summary of Indigenous peoples' climate change issues across the United States and efforts of Indigenous peoples' to mitigate and adapt to climate change. The report is a collaborative product of over ninety authors, developed through the Institute of Tribal Environmental Professionals. It is the first publication of its kind, and one of many to come in the future. In its efforts to centralize and describe the situation of many Indigenous peoples in a climate change context, it simultaneously seeks to honor and amplify the voices of Indigenous peoples across the United States, increase understanding of Tribal lifeways, cultures, and values, and provide recommendations to organizations, governments, and individuals for supporting Indigenous Tribes in their adaptation and mitigation efforts. This report provided our team with an abundance of resources for continuing our research, and showed us a comprehensive and holistic approach to discussing and thinking about Indigenous Tribes in a climate change context.

We took those resources, as well as a few environmental changes including change in air and water temperature, ocean acidification, changes in precipitation, and sea level change, to develop the outline for the plan. For each resource, we followed a simple two-part format (See Appendix M). The first part included science about how climate change impacts that resource and what changes people can expect to see. Most of this part of the plan was completed by the HIA Environmental team, with support from the UM team. Within each science part of the plan, included are the Tlingit names for the resources, information about the role they play as part of the local culture, and how that resource is expected to react to changes as a result of climate change. For example, salmon is a very large part of life in Hoonah. We can expect changing water temperatures to impact the timing of salmon runs and even the number of salmon eggs that survive.

The second aspect of the two-part format is adaptation strategies. This was the primary focus for development by the UM team. Given our areas of study, we have taken classes and implemented smaller projects revolving around adaptation prior to this, and therefore had an understanding of how to develop this part. For the first stage of developing the adaptation strategies, the HIA Environmental team added in ideas based on their local knowledge as well as their familiarity with adaptation efforts in other communities. Next, the UM team added strategies based on simple research as well as our own suggestions based on our prior knowledge developed both in classes and through experience.

Further, we incorporated adaptation strategies suggested and inspired by the community, primarily at our community event. From our aforementioned poster activity, and the following community discussion, we pulled out many ideas to include in the climate adaptation plan. Those

ideas can be seen highlighted in green in the appendix. We also included adaptation strategies gleaned from the interviews.

Next Steps for HCAP

Moving forward into the next phase of the plan, we advise HIA Environmental to continue strengthening the adaptation strategies section as their next actionable step. This can include continuing to research adaptation efforts in other communities through regional and trans-regional conversations and internet research. In addition, we encourage HIA Environmental to hold annual climate adaptation planning meetings to allow space for community members to share their thoughts around current and future actions, as well as provide suggestions for how the tribal government can support the sovereignty of the people.

Suggested actions can be supported and modeled after actions planned and executed in other communities. Within the climate adaptation plan, links to such documents can be included to add transparency and ease of understanding.

In tandem with developing strong adaptation strategies, HIA Environmental should also explore the different funding and community building possibilities. Many of the adaptation strategies include the development of various programs which will need both financial and social support, and we know realistically it takes many people working together to make change happen. This first iteration of HCAP will be utilized by HIA Environmental to bolster grant efforts.

Partnership with other HIA departments, as well as other local organizations, would be greatly beneficial in supporting adaptation efforts. For example, the Cultural Department can support research and implementation of traditional Tlingit practices.

Further, as different adaptation strategies are implemented, HIA Environmental should create evaluation metrics to monitor progress and determine which strategies should continue.

HCAP will remain a living document that is updated every five years or sooner. It should reflect the desires of the community and be supported by many forms of research, including traditional, informal, and formal research. As HCAP continues to grow, we also believe it may be beneficial to hire additional staff or implement youth engagement programs to support efforts without overburdening current HIA Environmental staff who manage a variety of projects throughout the seasons.

HCAP will provide guidance and accountability as Hoonah pursues various efforts to promote Indigenous sovereignty.

Adaptation Strategies

The list of strategies presented below represents a collaborative effort between the UM and HIA Environmental teams, as well as the community members who attended our community event in Hoonah. Short-term goals are those that could be accomplished within one year of implementation, mid-term within two to five years, and long-term goals are those that are expected to take longer than five years. By request of the client, this list includes strategies of varying feasibility - some are efforts already underway in the community, some require extra funding or research before becoming attainable, and some may never be implemented due to various constraints.

Bears

Short-term Goals

1.1: Identify local and regional partners to help address and mitigate climate change impacts on brown bear habitat

1.2: Develop food waste reduction strategies and programs in Hoonah

1.3: Identify and apply for funding sources that support minimizing negative human-wildlife encounters

1.4: Hold annual ceremonies to acknowledge and celebrate brown bears as a relative and community member to restore and revitalize community members' connections with nonhuman relatives, increasing capacities to empathize with brown bears

Mid-term Goals

2.1: Establish suitable bear habitat conservation areas that maintain connectivity under future climate change scenarios

2.2: Develop and implement environmental education plans / programs that help prevent and explain negative human-bear interactions, thus preventing retaliatory action

2.3: Perform environmental restoration practices that increase the availability and quality of brown bear habitats and food resources

2.4: Perform assessments around local bear behavior and annual availability of brown bear food resources to identify prime bear feeding habitat locations and times

2.5 Establish programs and capacities necessary to participate in advocacy efforts around climate change, just transitions, and maintaining Indigenous rights

2.6 Identify and participate in political avenues (e.g. Fisheries Commissions) to address depleting wildlife habitat(s) and food sources

2.7 Develop an evaluation procedure to assess which approaches are more / less effective at maintaining, and expanding, the habitats and food sources of local brown bear populations, thus reducing the threat of brown bears in town

2.8 Investigate effectiveness of bear-proof trash bins, and if deemed appropriate, fund their distribution throughout Hoonah

Long-term Goals

3.1: Develop waste-management plans with relevant stakeholders for varying in-town bear activity scenarios

3.2: Allow unnecessary and/or unused roads to be reclaimed to support bears' out-of-town foraging opportunities

3.3: Adjust bear viewing schedules to prevent tourists / wildlife viewers from detering bear foraging in prime locations and times

3.4 Have continuous representation and participation in advocacy efforts around climate change and Indigenous rights

3.5 Evaluate interdisciplinary efforts to understand which have been effective at supporting / expanding brown bear habitat and food sources to eliminate the threat of brown bears encroaching

Birds

Short-term Goals

1.1: Educate the community about negative impacts on various bird species from increasing water temperatures and other adverse climate change impacts

1.2: Investigate ways to motivate youth to be involved in natural resource management, especially habitat restoration projects

1.3: Assess prime Gull egg harvesting locations throughout Glacier Bay, identifying the ecological characteristics associated with healthy egg nests

1.4: Identify regional partners / stakeholders to help address and mitigate adverse climate change impacts on Gull populations and egg nesting sites

1.5: Identify and apply for funding sources that support traditional Indigenous ways of life and self-determination to fund projects that ameliorate adverse impacts on Gull nesting sites in Glacier Bay and local bird populations

Mid-term Goals

2.1: Explore options that encourage traveling to regions near Yakutat, Juneau, and Petersburg to harvest Gull eggs to maintain traditional harvesting practices

2.2: Perform environmental monitoring in Gull egg harvesting locations throughout Glacier Bay to survey changes in Gull egg nesting habitats

2.2: Establish environmental restoration techniques to improve the quality and/or abundance of Gull egg nesting habitat and ecological conditions in Glacier Bay

2.3: Collaborate with the National Parks Service to establish new protocols / procedures that enable tribal co-management of natural resources within the park

2.4: Evaluate the region for future Gull egg nesting locations after considering prospected climate change impacts

2.5 Establish programs and capacities necessary to participate in advocacy efforts around climate change, just transitions, and maintaining Indigenous rights

Long-term Goals

3.1: Have continuous representation and participation in advocacy efforts around climate change and Indigenous rights

3.2: Participate in natural resource management decisions / processes in Glacier Bay, eliminating threats to Gull habitats and nesting sites

3.3: Maintain Gull egg harvesting practices in Glacier Bay as well as other locations, if necessary, to secure sufficient quantities of Gull eggs

Crustaceans

Short-term Goals

1.1: Continue water quality monitoring program to look for harmful phytoplankton with SEATOR partners

1.2: Develop European green crab monitoring program in collaboration with other tribal, state, federal and international partners

1.3: Support changes to commercial fishing regulations to protect subsistence harvest of crabs in Port Fredrick

1.4: Educate the community about the negative impacts of increasing water temperatures on crabs and other crustaceans

Mid-term Goals

2.1: Establish protocols to monitor crab habitat (e.g. eelgrass beds)

2.2: Assess the need for monitoring biotoxins in crab meat

2.3: Establish environmental restoration practices to improve crab habitats around Port Frederick

2.4: Develop crustacean biomass monitoring program to look for changes in larval, juvenile and adult life stages of relevant crab species.

2.5: Establish programs and capacities necessary to participate in advocacy efforts around climate change, just transitions, and maintaining Indigenous rights

2.6: Investigate relationship between crab and other crustaceans and electromagnetic fields

2.6.1: If relevant, develop adaptation strategies using this relationship in order to reduce crustacean bycatch

Long-term Goals

3.1: Support regional efforts to understand the effects of climate change on relevant crab species

3.2: Research shellfish resiliency - physiological costs of resilience, non-traditional shellfish harvesting and aquaculture strategies, options to mitigate paralytic shellfish poisoning, and more

3.3: Develop and support policy protections for small-scale and local resident fisherman and subsistence fishermen to maintain access to diminishing resources, while limiting large-scale shellfish and fishing harvests

3.4: Participate in natural resource management decisions / processes to eliminate adverse impacts on crabs and other crustaceans in Southeast Alaska

Cultural Resources

Short-term Goals

1.1: Develop strategies for Spruce/evergreen winter preparation including maintaining soil moisture levels pre-freeze, insulating roots with added mulch, avoiding deicing salt buildup near tree roots, utilizing windscreens, and protecting bark from sunscald and frost cracks using tree wraps. (1, 2)

1.2.1: Track seasonal changes to best predict when the ground is expected to freeze in a given year

1.2.2: Acquire materials to be used for winter preparation measures

1.2: Update community procedures for cases of forest fires

1.2.1: Evaluate current forest fire procedures

1.2.2: Understand the patterns of forest fire that are most likely to occur

1.3: Form partnerships with researchers and other communities in the region to further monitor forest fire risk levels and develop a network of knowledge regarding current forest fire risk levels

1.4: Educate community members about options for fire prevention and mitigation

1.5: Monitor and report blackheaded budworms and other species to the Forest Service's crowdsourcing app, iNaturalist.

1.6: Use mountain goat wool sparingly and explore alternative fibers.

Mid-term Goals

2.1: Implement Spruce winter preparation measures to increase the longevity of the trees as snow pack diminishes

2.2: Implement emergency preparedness workshops to keep community members informed of best practices in the event of a forest fire

2.3: Investigate alternative residential and community heating options

2.4: Explore how to use expected changes in vegetation for traditional practices (e.g. an increase in mushrooms in arts, medicines, foods, etc.)

2.5: Create subsistence access program targeted at elders

2.6: Generate a map of all culturally important resources located throughout and near Hoonah

Long-term Goals

3.1: Plant Spruce in areas away from roads and other heavily salted areas

3.2: Update infrastructure to be more resilient to forest fires

3.3: Invest in mental health infrastructure to prepare for any community and cultural losses that may be felt by the changing climate

Deer

Short-term Goals

1.1: Continue to advocate for the protection of old-growth stands and restrict logging to young-growth stands

1.2: Continue tree thinning treatments in previously logged areas to encourage healthy regrowth, particularly in riparian environments

1.3: Continue and increase youth and community engagement in State and Federal decision making processes about subsistence hunting regulations

1.4: Continue the development of youth-focused harvesting and processing activities to increase community knowledge on subsistence deer use

1.5: Continue research into community harvest and hunter efforts around deer to increase understanding of deer populations and their threats

1.6: Creation of community-managed designated areas for berry production that are protected from deer foraging

Mid-term Goals

2.1: Support bear conservation efforts that can reduce the threat of bear predation on deer

2.2: Create, or support the creation of, an educational deliverable teaching non-locals traditional and sustainable deer hunting practices

2.3: Continue efforts to implement a Traditional Homelands Conservation Rule that would increase federal government consultation with local Indigenous tribes

2.4: Utilize aerial imagery and LIDAR to establish a baseline for tree canopy coverage and identify areas of concern

2.5: Encourage and motivate Hoonah youth to participate in natural resource management, especially habitat restoration projects

2.6: Implement heavily enforced hunting regulations against non-local deer hunters.

Long-term Goals

3.1: Continue monitoring deer populations in and around Hoonah for chronic wasting disease

3.2: Start the collection of long-term data on canopy gaps in forest stands near Hoonah to monitor snowpack, light penetration, and other factors significant to understory growth

3.3: Continue support of the Roadless Rule and other conservation measures in the Tongass National Forest

3.4: Creation of artificial canopy gaps to improve high-quality winter forage (i.e., Vaccinium spp. and evergreen plants) in young-growth stands

Halibut

Short-term Goals

1.1: Monitor Halibut populations and sizes

1.2: Investigate options for adapting fishing techniques, such as fishing in deeper water

1.3: Educate the community about negative impacts on halibut stemming from increasing water temperatures

Mid-term Goals

2.1: Increase participation in government management of Halibut

2.2: Reduce impacts of commercial fishing

Long-term Goals:

3.1: Consider aquaculture as a means of assuring long-term access to Halibut and other marine resources

3.2: Policy protection for small-scale and local resident fishermen and subsistence fishermen to maintain access to diminishing resources while limiting large-scale fishing harvests

Herring

Short-term Goals

1.1: Add Pacific Herring to Alaska's Forage Fish Management Plan

1.2: Encourage the growth of marine plants and seaweeds to improve herring habitats

1.3: Continue work on restoring the Icy Straits Advisory Committee to advance local voices on herring management

Mid-term Goals

2.1: Recruit local herring experts to be a part of the field research teams studying herring

2.2: Consider feasibility of herring egg transplantations to enhance spawning stocks

2.3: Work with the city and State to prohibit disturbances of key spawning areas.

2.4: Institute sanctions on irresponsible herring harvesters

Long-term Goals

3.1: Manage herring populations with a cultural-historical perspective - look at numbers from across the past 3 or more generations, rather than the past 40 years.

3.1.1: Use Local and Traditional Tlingit knowledge to inform research and future decisions about herring.

Human Health

Short-term Goals

1.1: Continue working with members of the Kuti program to develop a landslide monitoring program for Hoonah.

1.2: Assess the need to monitor for ticks, deer wasting disease and other zoonotic risks to human health.

1.3: Continue work on both indoor and outdoor air quality monitoring and expand current opportunities for home improvements that can improve air quality.

1.4: Continue to work with the City of Hoonah, Forest Service and Central Council to update emergency preparedness plan and educate community members about resources and procedures.

1.5: Continue to work with the SEATOR network to monitor for and educate community members about Paralytic Shellfish Poisoning.

Mid-term Goals

2.1: Work with Central Council to develop a tribal subsistence program

2.3: Monitor changes in size and quantity of traditional foods harvested

2.4: Maintain ecological diversity through habitat protection and maintenance

2.5: Create a locally-informed landslide emergency plan

Long-term Goals

3.1: Develop citizen science in Hoonah for community monitoring and assessment of biotic and abiotic changes

3.2: Invest in efforts to create climate-durable housing - weatherizing, increasing efficiency, education initiatives, etc.

3.4: Create a locally-informed and comprehensive disaster relief plan

Invasive Species

Short-term Goals

1.1: Continue and expand monitoring programs for both extant and novel invasive species

1.2: Continue management at common recreational sites to limit the spread of invasive species.

1.3: Expand youth opportunities for invasive species management and community educational programs to help residents avoid accidentally introducing invasive species into the area.

1.4: Install boot brush stations at key locations throughout Hoonah and the broader Chichagof Island to prevent the spread of invasive species by foot traffic

1.5: Educate the community on the relationship between invasive species and increasing water temperatures and ocean acidification

Mid-term Goals:

2.1: Introduce and support climate-resilient native species

2.2: Conduct rapid response when new species are detected

2.3: Identify and protect particularly vulnerable native species

2.4: Invest in and develop kelp cultivation projects to improve marine habitats and biodiversity

Long-term Goals

3.1: Collaborate with tribal, state and federal partners to develop invasive species monitoring programs and minimize their spread and impact.

Marine Mammals

Short-term Goals

1.1: Perform outreach and education on the significance of balanced ecosystems, specifically regarding sea otters' role in the ecosystem

1.2: Perform outreach and education on human impacts on marine mammals, including ghost fishing, boating near marine mammals, etc. to reduce adverse impacts on marine mammals

1.3: Identify local and regional partners to help address and mitigate climate change impacts on marine mammals' habitats and food sources

1.4 Identify and apply for funding sources that support the preservation of marine ecosystems and wildlife

Mid-term Goals

2.1: Implement tribal-led assessments to collect data on local and/or regional marine ecosystems (i.e. test OA, dissolved oxygen, kelp bed coverage, etc.) to better understand the condition of local marine mammal habitats / ecosystems

2.2: Perform tribal environmental restoration / monitoring to improve or secure the habitats and/or food sources of marine mammals

2.3: Identify and participate in efforts to better co-manage human-marine wildlife interactions, specifically regarding boater and marine mammals interactions, bycatch policies, ghost fishing, etc. from a tribal perspective

2.4: Develop and implement environmental education plans / programs that increase awareness of marine mammal habitats and ecosystems, food sources, the impacts of climate change, and how to mitigate and/or prevent these impacts

2.5: Establish programs / capacities necessary to participate in advocacy efforts around climate change, just transitions, and maintaining Indigenous rights

2.6: Develop evaluation procedures to understand which approaches are more / less effective at conserving and increasing marine mammal habitats and foods as well as decreasing harmful impacts on marine mammals

2.7: Scout for new potential marine mammal hunting / harvesting grounds after accounting for impacts of climate change

Long-term Goals

3.2: Have continuous representation and participation in efforts around climate change and Indigenous rights regarding marine mammals and human-marine wildlife relationships

3.3: Evaluate interdisciplinary efforts to understand which have been effective at supporting / increasing the quality of marine mammal habitats and food sources

3.4: Develop a community-wide understanding of the negative impacts of humans on marine mammals and ecosystems and a shared responsibility to minimize adverse impacts of human activities on marine mammals

3.5: Coordinate with Icy Strait Point to minimize negative effects of whale watching tours on marine mammals and their habitats and food sources

Other Forest Vegetation

Short-term Goals

1.1: Monitor species changes as conditions continue to change

1.2: Generate a usage guide that explains the various utilizations of forest plants

1.3: Continue to improve the community's gardening capacity through the public garden, greenhouse construction, and educational opportunities to take advantage of the longer growing season.

Mid-term Goals

2.1: Research how each species will be impacted by changing environmental conditions and other comparable species that can be utilized in the event that traditional species grow scarce.

2.2: Monitor commercial impacts on local harvesting sites

Long-term Goals

1.1: Leverage the Tongass as a carbon sink in conservation efforts with regional and national partners.

Salmon

Short-term Goals

1.1: Continue salmon stream restoration projects through the Hoonah Native Forest Partnership

1.2: Encourage Hoonah youth to get involved in natural resource management projects

1.3: Continue documentation efforts of important spawning streams for protections through the Alaska Anadromous Waters Catalog through the Hoonah Native Forest Partnership and in collaboration with State partners.

1.4: Educate the community about negative impacts from increasing water temperatures

1.5: Use local knowledge to educate community members on how to adapt fishing strategies with changing salmon habitats; promote fishing in deeper waters

Mid-term Goals

2.1: Invest time and funds in research on shellfish resiliency and strategies to promote kelp growth

2.2: Research Haida Salmon Restoration Corporation, and their efforts to mitigate climate change effects through an ocean micro-nourishment replenishment program

Long-term Goals:

3.1: Work to reduce environmental stressors to salmon by limiting development, poor logging practices, pollution and erosion.

3.2: Monitor the effects of climate change on salmon, their habitats and local fishers.

3.3: Policy protection for small-scale and local resident fishermen and subsistence fishermen to maintain access to diminishing resources while limiting large-scale fishing harvests

3.4: Promote policies that limit charger fishing to maintain salmon for commercial and subsistence use

3.5: Investigate adaptation strategies stemming from the relationship between sockeye salmon, life stages, and electromagnetic fields

3.5.1: Consider attaching magnets to large fishing boats to reduce salmon bycatch

Seaweeds and Intertidal Vegetation

Mid-term Goals

2.1: Protect intertidal areas where beach greens are commonly harvested from future developments and seek to limit marine pollution that would harm the heath or growth of wild plants.

Long-term Goals

1.1: Research possibilities for local or commercial scale seaweed farming of relevant species of seaweeds.

Shellfish

Short-term Goals

1.1: Continue water samples to monitor for A*lexandrium* blooms near key shellfish harvesting locations near town.

1.2: Continue monthly sampling of shellfish to test for biotoxins in collaboration with SEATOR partners.

1.3: Continue biomass survey in coordination with the SEATOR partners to monitor size and quantity of shellfish

Mid-term Goals

2.1: Educate community members about the risks of paralytic shellfish poisoning and maintain up to date reports on the level of biotoxins detected through the SEATOR network

2.2: Organize events and classes for community members to learn about sustainable shellfish harvesting and safe storage practices.

Long-term Goals

3.1: Consider possibilities for the construction of clam gardens or shell hash development near town.

3.1.1: Target research in areas of rock/sediment

3.2: Research options for enhancing and protecting eelgrass beds

3.3: Work to create plans for shellfish stock restoration and propagation.

3.4: Something about preventing competition from external users?

3.5: Research possibilities for enhancing abalone stocks near Hoonah

Wild Berries

Short-term Goals

1.1: Continue youth-led programs for blueberry patch enhancement near town.

1.2: Research possibilities for transplantation or enhancement of other berry types to more accessible areas.

1.3: Organize community harvesting events for youth, families and elders.

1.4: Communicate the locations of particularly abundant and accessible berry patches to community members, especially to individuals without car access or with mobility problems.

Mid-term Goals

2.1: Develop citizen science efforts to monitor berry timing, availability and condition

2.2: Create designated areas for berry production and encourage community management of these areas

2.2.1: Include the development of trails in these areas to increase accessibility

2.3: Monitor water usage and availability

Long-term Goals

3.1: Investigate effective watering systems to promote berry growth throughout Hoonah

Conclusion

Using a variety of methods, we combined our studies with the socio-environmental context of Hoonah to gain community insight and help create a climate adaptation plan. This plan can be used to assist the development of future projects, secure funding, and guide local governmental decision-making to represent the values and priorities of Hoonah locals. Through HCAP, we hope the community is more prepared for and resilient to adverse climate change impacts to ensure their well-being and ways of life.

Though climate adaptation planning will continue at HIA Environmental well into the future, the UM team will be wrapping up our work with HIA Environmental by mid-summer of 2023. The work we have done and the connections we have made through this project have made lasting impressions on us as students, researchers, and workers in climate change adaptation and mitigation planning.

We once again want to thank Dr. Kyle Whyte, Ian Johnson, Jeromy Grant, Julian Narvaez, and Brynn Presler-Marshall for all their work and support on this project and for welcoming our involvement in the development of the plan. We also want to thank the people of Hoonah for welcoming us into their community and helping us experience all that is Southeast Alaska.

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Appendix A: Survey

Hoonah Community Survey

The Hoonah Indian Association is beginning a climate adaptation plan for Hoonah in collaboration with a team of students from University of Michigan. This plan focuses on food, traditional resources, and way of life. This survey is aimed at helping us guide what resources Hoonah residents have seen change the most, what they are most concerned about, and to help us think about ways to adapt for the future.

Please email um-hia-masters@umich.edu or ian.johnson@hiatribe.org, if you have any questions or concerns. You may also call HIA at 907-945-3545.

Demographics

1. How long have you lived in Hoonah?	2. Are you registered with HIA?	3. How old are you?	4. What gender do you best identify with? (Circle one) Male Female Non-binary other or prefer not to say

4. Do you acknowledge climate change as a real and present force?	Yes	No	Unsure
5. Do you believe that climate change is worsening?	Yes	No	Unsure
6. Do you believe climate change is caused by human activities?	Yes	No	Unsure
5. Do you feel you have adequate access to climate science education?	Yes	No	Unsure

Perceptions on Community Vulnerability

6. On a scale from 1-5 (1 being not at all and 5 being very much), how much do you worry about the availability or condition of subsistence resources or traditional practices for your family?

	1	2	3	4	5	
Not at all	○	○	○	○	○	Very Much

7. What do you feel is the biggest environmental threat to your community's overall health and well-being? (Circle up to 5)

Decreased snow/rainfall (increased annual drought)	Heavy rain events/extreme weather (flash floods and erosion)
Changes to shoreline habitats (cockles and clams)	Natural hazards (landslides, earthquakes, tsunamis, etc.)
Decreasing salmon and halibut habitat	Sea level rise
Bear encroachment	Warming air and water temperatures
Decreasing deer habitat	Change in water quality or ability

Impacts of Climate and Environmental Change

8. As environmental conditions in Hoonah change, which subsistence resources are you most concerned for and think should be protected? (Circle up to 5)

Salmon	Deer	Halibut	Berries
Cedar (cedar bark)	Spruce (tips & roots)	Seal	Herring
Devil's Club	Hudson Bay Tea	Clams / Cockles	Crabs

Other: _____

9. For each of the options below, select the type of impact (negative, none, positive) you have seen based on environmental changes in your own life or of those around you.

	Negative Impact	No Impact	Positive Impact
Financial Well-Being			
Mental Health			
Physical Health			
Community Relationships			
Harvesting Practices			
Carving & Weaving			
Spiritual Practices			
Access to resources			

Optional – explain any of your answers here: _____

_____

_____

Community / Tribal Adaptation Actions

10. What efforts would you like to see in the future to help ensure Hoonah's way of life thrives as environmental conditions change? _____

_____

_____

Optional: If you are open to having a longer conversation with us about climate and environmental changes, please provide your name and a good contact and we will be in touch!

Name: _____

Phone: _____ Email:_____

Thank you for completing this survey. We appreciate your time! For your records, feel free to take a quick photo of this survey with your phone before submitting.

Appendix B: Raw Survey Data

Timestamp	How long have you lived i	Are you enrolled in HIA?	How old are you?	What gender do you best	Do you acknowledge clim	Do you believe climate ch	Do you believe that climat	Do you feel you have ade
12/10/2022 18:0	67	yes	67	Female	Yes	Yes	Yes	Yes
12/10/2022 19:0	2.5	no	31	Female	Yes	Yes	Yes	Unsure
1/6/2023 15:47:2	15	no	15	Female	Yes	Yes	Yes	No
12/10/2022 18:2	14	no	40	Female	Yes	Yes	Yes	No
12/10/2022 18:2	4	no	54	Male	Yes	No	Unsure	Unsure
12/10/2022 18:4	17	yes	17	Male	Yes	Yes	Unsure	Yes
12/10/2022 18:5	1	no	33	Female	Yes	Yes	Yes	Unsure
12/10/2022 18:5	30	n/a	70	Female	Yes	Yes	Yes	Yes
12/10/2022 18:5	29	yes	29	Female	Yes	Yes	Unsure	No
12/10/2022 19:0	3	no	21	Female	Yes	Yes	Yes	Yes
12/10/2022 19:1	11	I don't know [note: she cla	14	Female	Yes	Yes	Unsure	Yes
12/10/2022 19:1	12	no	12	Female	Yes	Yes	Yes	No
12/12/2022 12:2	23	yes	63	Female	Yes	Yes	Yes	No
12/12/2022 14:5	36	no, Sitka Tribe	36	Female	Yes	Yes	Yes	Unsure
12/30/2022 12:0	76	yes	76	Male	Yes	Yes	Yes	No
12/30/2022 12:1	70	yes	70	Male	Yes	Yes	No	No
1/6/2023 15:45:4	12	no, cherokee	18	Female	Yes	Unsure	Yes	Yes
1/6/2023 15:50:2	17	yes	17		Yes	Yes	Yes	Yes
12/10/2022 18:0	23	no	66	Male	No	Yes	Yes	Yes
12/10/2022 18:1	7	yes	26	Female	Yes	Yes	Yes	Yes
12/10/2022 18:1	22	yes	22	Male	Yes	Yes	Yes	Unsure
12/10/2022 18:2	26	yes	40	Male	Yes	Yes	Yes	Unsure
12/10/2022 18:3	52	yes	52	Male	Yes	Unsure	No	Unsure
12/10/2022 18:4	20+	yes	26	Male	Yes	Yes	Yes	No
12/10/2022 18:5	3	no	24	Female	Yes	Yes	Yes	No
12/10/2022 19:0	25	n/a	75	Male	Yes	Yes	Yes	No
12/10/2022 19:0	1	no	33	Female	Yes	Yes	Yes	Yes
12/10/2022 19:1	49	no	70	Female	Yes	Yes	Yes	Yes
12/10/2022 19:1	26	yes	30	Male	Yes	Yes	Unsure	Unsure
12/10/2022 19:1	25	yes	25	Female	Unsure	Unsure	Unsure	Unsure
12/10/2022 19:1	45	no (non-native)	70	Male	Yes	Yes	Yes	Yes
12/12/2022 12:2	25	no	63	Female	Yes	Yes	Yes	Unsure
12/12/2022 12:3	30	unsure -wrote Sealaska o	34	Male	Yes	Yes	Unsure	Yes

On a scale from 1-5 (1 be	What do you feel is the bi	Which subsistence resour	For each of the options be	For each of the options be	For each of the options be	For each of the options be	For each of the options be
2	Bear encroachment		No Impact	No Impact	No Impact	No Impact	No Impact
2	Decreased snow/rainfall (	Salmon, Halibut, Herring, Crabs					
2	Decreased snow/rainfall (	Salmon, Deer, Halibut, Be	Negative Impact	Negative Impact	Negative Impact	Negative Impact	Negative Impact
3	Heavy rain events/extrem	Salmon, Halibut, Seal, Clams / Cockles, Crabs					
3		Salmon, Halibut, Crabs	Negative Impact	No Impact	No Impact	No Impact	Negative Impact
3	Decreased snow/rainfall (	Salmon, Deer, Halibut, Be	No Impact	Negative Impact	No Impact	Positive Impact	Positive Impact
3	Sea level rise						
3	Decreased snow/rainfall (	Clams / Cockles, Crabs					
3	Heavy rain events/extrem	Salmon, Halibut, Herring,	Negative Impact	No Impact	Negative Impact	No Impact	Negative Impact
3	Decreased snow/rainfall (	Salmon, Deer, Halibut, Be	No Impact	Negative Impact	No Impact	No Impact	No Impact
3	Decreasing deer habitat	Salmon, Deer	No Impact	Positive Impact	Positive Impact	Positive Impact	Positive Impact
3	Bear encroachment	Salmon, Deer, Cedar (cedar bark), Herring, Crabs		Negative Impact	Positive Impact	Negative Impact	Positive Impact
3	Decreasing deer habitat, (	Salmon, Deer, Halibut, Be	Negative Impact	No Impact	No Impact	No Impact	Negative Impact
3	Decreasing salmon and h	Salmon, Deer, Berries, Cl	No Impact	Negative Impact	Negative Impact	Negative Impact	Negative Impact
3	Decreasing salmon and h	Salmon, Deer, Herring, Cl	No Impact	No Impact	No Impact	Positive Impact	Positive Impact
3	Bear encroachment, Decr	Salmon, Halibut, firewood, mostly uses spruce for heat in the summer when drying fish, uses hemlock year-round to heat his house					
3	Decreased snow/rainfall (	Salmon, Deer, Halibut, He	No Impact	No Impact	Positive Impact	Positive Impact	Positive Impact
3	Decreased snow/rainfall (	Salmon, Halibut, Berries,	Negative Impact	No Impact	Negative Impact	No Impact	Negative Impact
4	Heavy rain events/extrem	Salmon, Deer, Halibut, Cl	Negative Impact	Negative Impact	Negative Impact	Negative Impact	Negative Impact
4	Decreased snow/rainfall (increased annual drought), Bear encroachment, Decreasing deer habitat, Sea level rise, Warming air and water temperatures, Change in water quality or abilit						
4	Decreased snow/rainfall (	Salmon, Deer, Halibut, He	Negative Impact	Negative Impact	No Impact	Negative Impact	Negative Impact
4	Decreased snow/rainfall (	Salmon, Berries, Clams /	No Impact	No Impact	No Impact	No Impact	Negative Impact
4	Decreasing deer habitat	Salmon, Deer					
4	Decreased snow/rainfall (	Salmon, Deer, Halibut, Be	No Impact	Negative Impact	Negative Impact	Negative Impact	Negative Impact
4	Heavy rain events/extrem	Salmon, Deer					
4	Decreased snow/rainfall (	Salmon, Halibut, Berries	Positive Impact	Negative Impact	Positive Impact	Positive Impact	Positive Impact
4	Heavy rain events/extrem	Salmon, Halibut, Cedar (c	No Impact	Negative Impact	Negative Impact	Negative Impact	Negative Impact
4	Heavy rain events/extrem	Salmon, Halibut, Cedar (c	No Impact	No Impact	No Impact	No Impact	Negative Impact
4	Decreased snow/rainfall (	Salmon, Deer, Berries, Ce	No Impact	Negative Impact	Negative Impact	No Impact	Negative Impact
4	Decreased snow/rainfall (	Salmon, Deer, Halibut, Be	No Impact	Negative Impact	No Impact	No Impact	No Impact
4	Decreasing salmon and h	Salmon, Deer, Halibut, He	No Impact	No Impact	No Impact	No Impact	Negative Impact
4	Decreased snow/rainfall (	Salmon, Deer, Halibut, Be	No Impact	No Impact	No Impact	No Impact	No Impact
4	Decreased snow/rainfall (	Salmon, Deer, Berries, Cl	No Impact	No Impact	No Impact	Negative Impact	Negative Impact

For each of the options be	For each of the options be	For each of the options be	If you would like to explair	What efforts would you like to see in the future to help ensure Hoonah's way of life thrives as envir
No Impact	No Impact	No Impact		
Positive Impact	Positive Impact		I'm ambiguous about seve	Information given to the community, opportunities to come together and discuss these topics as a
Negative Impact	Negative Impact	Negative Impact		prevent from over usage
No Impact	No Impact	Negative Impact	Fuel	
Positive Impact	Positive Impact	Positive Impact		Involving these kids in cultural and harvesting practices
				Community requires more knowledge.
No Impact	No Impact	Negative Impact		
Negative Impact	Negative Impact	No Impact		hands on community education and conservation efforts
Positive Impact	Positive Impact	Positive Impact		to not shoot as much deer as we do now
Negative Impact, Positive	Negative Impact	Negative Impact		maybe clean up more
No Impact	No Impact	Negative Impact		
No Impact	Negative Impact	Negative Impact		
Negative Impact	Negative Impact, Positive Impact			
			concerned about subsiste	youth engagement, teaching kids how to hunt and prepare things. more HIA participation in Fish a
No Impact	No Impact	Positive Impact		Just have people acknolwedge these changes
No Impact	No Impact	Negative Impact		more mangement on most things in the woods
Positive Impact	Positive Impact	Positive Impact	wrote "intentional" next to	We need the Northern SE Borough
y		Negative Impact		Decrease in ship tourism safer tourism ship
Negative Impact	No Impact	Negative Impact		
No Impact	No Impact	Negative Impact		
				unsure
Negative Impact	Negative Impact			Deer surveys, salmon surveys, halibut data
No Impact	No Impact	Positive Impact		common sense solutions to community problems
Negative Impact	Negative Impact	Negative Impact		climate adaptation plans, energy change, food sovereignty, plans for if supply lines have issues
No Impact	No Impact	Negative Impact		allow non-natives to harvest sea otter
No Impact	No Impact	Negative Impact		Reduce competition so outsiders impact isn't felt by locals
No Impact	No Impact	No Impact		community coming together to keep harvesting going
No Impact	No Impact	Negative Impact		community and state conservation efforts and regulations to limit harvest of precious resources to [note: individual wrote "exacerbated by human activities" under question 6]
No Impact	No Impact			accommodations or more bins for cardboard, glass, plastics recycling
Negative Impact	Negative Impact	Negative Impact		keep creeks good for the salmon

Timestamp	How long have you lived i	Are you enrolled in HIA?	How old are you?	What gender do you best	Do you acknowledge clim	Do you believe climate ch	Do you believe that climat	Do you feel you have ade
12/12/2022 12:3	8	unsure, wrote sealaska or	50	Male	Unsure	Unsure	Unsure	Yes
12/12/2022 12:3	15	no, douglas indian assoc.	70	Male	Yes	Yes	Yes	No
12/27/2022 13:4	40	yes	61	Male	Yes	Yes	Yes	Yes
1/6/2023 15:43:5	17	yes	17	Female	Yes	Yes	Yes	Unsure
1/6/2023 15:48:5	17	yes	17	Female	Yes	Unsure	Yes	Yes
12/27/2022 13:4	never; lives in Juneau	yes	21	Female	Yes	Yes	Yes	No
12/27/2022 13:4	never; lives in Juneau	yes	24	Female	Yes	Yes	Yes	Unsure
12/10/2022 17:5	40	yes	40	Female	n/a	Yes	Yes	Unsure
12/10/2022 18:0	3	No	16	Female	Yes	Yes	Yes	Yes
12/10/2022 18:1	61	yes	61	Male	Yes	Yes	Unsure	Unsure
12/10/2022 18:2	43	yes	76	Female	Yes	Yes	Yes	Yes
12/10/2022 18:2	61	yes	61	Male	Yes	Yes	No	Yes
12/10/2022 18:3	72	yes	72	Female	Yes	Yes	Yes	No
12/10/2022 18:3	40	yes	40	Male	Unsure	Unsure	Unsure	No
12/10/2022 18:3	67	yes	67	Female	Yes	Yes	Yes	No
12/10/2022 18:4	1	no	15	Non-binary	Yes	Yes	Yes	Yes
12/10/2022 18:4	30	no	60	Female	Yes	Yes	Yes	Yes
12/10/2022 18:4	45	yes	47	Female	Yes	Yes		Unsure
12/10/2022 18:5	41	yes	41	Female	Yes	Yes	Yes	Unsure
12/10/2022 18:5	25	n/a	25	Male	Yes	No	Yes	Yes
12/10/2022 19:0	67	yes	67	Male	Yes	Yes	Yes	No
12/10/2022 19:0	66	yes	66	Female	Yes	Yes	No	No
12/10/2022 19:1	72	yes	72	Male			Yes	No
12/10/2022 19:1	8	yes	18	Female	Yes	Yes	Yes	Yes
12/12/2022 12:2	45	yes	45	Female	Yes	Yes	Yes	Yes
12/12/2022 12:3	46	yes	46	Male	Yes	No	No	Unsure
12/12/2022 12:3	44	yes	44	Female	Yes	Yes	Yes	Unsure
12/12/2022 12:3	19	no	47	Female	No	No	No	Yes
12/12/2022 14:5	17	yes	17	Male	Yes	Yes	Yes	Yes
12/27/2022 13:3	30	yes	61	Female	Yes	Yes	Yes	Yes
12/27/2022 13:3	30	yes	33	Male	Yes	Yes	Yes	Yes
12/27/2022 13:4	67	yes	67	Male	Yes	Yes	Yes	Yes

On a scale from 1-5 (1 be	What do you feel is the bi	Which subsistence resour	For each of the options be	For each of the options be	For each of the options be	For each of the options be	For each of the options be
4	Decreasing salmon and h	Salmon, Deer, Halibut, Ce	Positive Impact	No Impact	No Impact	Positive Impact	No Impact
4	Heavy rain events/extrem	Salmon, Deer, Halibut					
4	Heavy rain events/extrem	Salmon, Deer, Halibut, Clams / Cockles, Crabs					
4	Heavy rain events/extrem	Salmon, Deer, Halibut, Cl	No Impact	Negative Impact	No Impact		Negative Impact
4	Decreased snow/rainfall (	Salmon, Deer, Herring, Cl	Positive Impact	Positive Impact	Positive Impact	Negative Impact	Positive Impact
4	Decreased snow/rainfall (	Salmon, Deer, Berries, Ce	Negative Impact	Negative Impact	Negative Impact	Negative Impact	No Impact
4	Decreased snow/rainfall (	Salmon, Halibut, Berries,	Negative Impact	No Impact	No Impact	No Impact	Negative Impact
5	Heavy rain events/extrem	Salmon	Negative Impact	No Impact	No Impact	Negative Impact	Negative Impact
5	Decreasing salmon and h	Salmon, Deer, Berries, Sp	Negative Impact	Negative Impact	Negative Impact	Negative Impact	Negative Impact
5	Bear encroachment	Salmon, Deer, Clams / Co	Positive Impact		Positive Impact		Positive Impact
5	Heavy rain events/extrem	Salmon, Halibut, Berries,	Negative Impact	Positive Impact	Positive Impact	No Impact	Negative Impact
5	Warming air and water temperatures						
5	Heavy rain events/extrem	Salmon, Deer, Halibut, Seal, spruce root areas		Negative Impact	Negative Impact	Negative Impact	Negative Impact
5		Salmon, Deer, Halibut, Berries, Herring, Hudson Bay Tea, Clams / Cockles					
5	Heavy rain events/extrem	Salmon, Deer, Halibut, Be	Positive Impact	Positive Impact	Positive Impact	Positive Impact	Positive Impact
5	Decreased snow/rainfall (	Salmon, Deer, Cedar (cedar bark), Spruce (spruce t		Negative Impact	No Impact	Negative Impact	
5	Decreased snow/rainfall (increased annual drought), Heavy rain events/extreme weather (flash floods and erosion), Bear encroachment, Decreasing salmon and halibut habitat, Decrea						
5	Decreased snow/rainfall (	Salmon, Deer, Berries	No Impact	No Impact	No Impact	No Impact	Negative Impact
5	Heavy rain events/extrem	Salmon, Deer, Berries, Cl	No Impact	No Impact	Positive Impact	Positive Impact	Positive Impact
5	Decreasing salmon and h	Salmon, Deer, Halibut, Crabs					
5	Bear encroachment, Decreasing salmon and halibut habitat, Decreasing deer habitat, Sea level rise, Changes to shoreline habitats (cockles and clams), Natural hazards (landslides, ea						
5	Decreased snow/rainfall (	Salmon, Deer					Negative Impact
5	Decreased snow/rainfall (increased annual drought), Changes to shoreline habitats (cockles and clams), Warming air and water temperatures, Natural hazards (landslides, earthquakes						
5	Decreased snow/rainfall (	Salmon, Deer, Halibut, Be	Negative Impact	Negative Impact	Negative Impact	Negative Impact	Negative Impact
5	Heavy rain events/extrem	Salmon, Deer, Halibut, Be	No Impact	No Impact	No Impact	No Impact	No Impact
5	Bear encroachment, Warr	Salmon, Deer, Halibut, He	No Impact	No Impact	No Impact	Negative Impact	Negative Impact
5	Heavy rain events/extrem	Salmon, Deer, Halibut, Be	No Impact	Negative Impact	Negative Impact		Negative Impact
5	Decreasing salmon and h	Salmon, Halibut, Clams /	No Impact	No Impact	No Impact	No Impact	No Impact
5	Decreasing salmon and h	Salmon, Deer, Berries, Cl	Negative Impact, Positive	Negative Impact, Positive	No Impact	No Impact	Positive Impact
5		Salmon, Deer, Herring, Crabs					
5	Heavy rain events/extrem	Salmon, Halibut, Berries, Herring					
5	Decreased snow/rainfall (	Salmon, Deer, Berries, Herring, Crabs					

For each of the options be	For each of the options be	For each of the options be	If you would like to explair	What efforts would you like to see in the future to help ensure Hoonah's way of life thrives as envir
Positive Impact	Positive Impact	No Impact		regulate visitors
			very concerned about sewage from cruise ships, particularly out in the strait. Has noticed changes in jellyfish blooms. Used t	
No Impact	No Impact	Negative Impact		I feel that we could clean up a little bit. possibly look at newer ideas on ways to take care of our wa
Positive Impact	Positive Impact	Positive Impact		
No Impact	No Impact	No Impact		I think protecting the fish more would help counteract the environment effects on them+help
No Impact	No Impact	Negative Impact		cleaner living/less waste/single use plastic
No Impact	Negative Impact	Negative Impact	more times available for a	dvocating impacts on climate changes
Negative Impact	Negative Impact	Negative Impact		ways to ensure that our community is least likely to be affected by climate change.
			I'm on disability, an huntin	To many bears and seeing out of towners take too many deer out of our area and crabs sea autors
No Impact	Positive Impact	Positive Impact		more community engagement
Negative Impact	Negative Impact	Negative Impact	have to go on a boat to ha	more awareness. projects with community involvement
				unsure
Positive Impact	Positive Impact	Positive Impact		more practices to help our our elders
				maybe clean up crew for nature. a group to teach our generation what we can do to help
ısing deer habitat, Changes to shoreline habitats (cockles and clams), Warming air and water temperature				figure out ways to get ISP to contribute to carbon offset structure @Renewable Juneau
Negative Impact	No Impact	No Impact	harvesting is getting shorter every year	
No Impact	No Impact	Positive Impact		
				no doe season
ırthquakes, tsunamis, etc.)				
				keep out town out
;, tsunamis, etc.)				
Negative Impact	Negative Impact	Negative Impact		
No Impact	No Impact	No Impact		Access to river, trails, cabins. Another cabin at freshwater. won't go out the road when there are he
No Impact	No Impact	No Impact	[Note: wrote "unable to pr Otters are decimating clar	Make sea otter legal for everyone, to an extent to tourists. Limit outside hunters to 2 bucks.
No Impact	No Impact	No Impact		regulation of development on or near salmon habitat (all water ways are salmon habitat)
No Impact	No Impact	No Impact	added that she was only v	decreased tours out the road, local area management. plan for seafood like sitka has.
No Impact	Negative Impact	Negative Impact		
			used to be massive berrie	rules to prevent taking small halibut. Recyling. supports the deer proposal.
			weather's gotten hotter, fish have declined, especially the size of King salmon and the number of wild salmon vs hatchery sa	
			All the crab disappeared--something happened to the tanner crabs. Bears didn't come in as much when I was younger.	

Timestamp	How long have you lived i	Are you enrolled in HIA?	How old are you?	What gender do you best	Do you acknowledge clim	Do you believe climate ch	Do you believe that climat	Do you feel you have ade
12/27/2022 13:4	62	yes	62	Female	Yes	Yes	Yes	Yes
12/27/2022 13:5	7	yes	71	Male	Yes	No	No	Yes
12/27/2022 14:0	83	yes	83	Female	Unsure	Yes	Unsure	No
12/27/2022 14:1	61	yes	61	Female	Yes	Yes	Yes	Yes
12/27/2022 14:1	44	no	44	Female	No	Unsure	No	Yes
12/27/2022 14:1	>65 yrs	yes	>65	Female	Unsure	Unsure	Unsure	Unsure
12/27/2022 14:1	40	no	40	Female	Yes	Yes	Yes	Yes
1/6/2023 15:37:4	60	yes	74	Female	Yes	Yes	Yes	No
1/6/2023 15:41:4	50	yes	68	Male	Yes	Yes	Yes	No
12/10/2022 18:1	65	yes	65	Male	Yes	Yes	No	Yes
12/30/2022 12:1	3	no, tulalip	65	Male	Yes	Unsure	No	Yes

On a scale from 1-5 (1 be	What do you feel is the bi	Which subsistence resour	For each of the options be	For each of the options be	For each of the options be	For each of the options be	For each of the options be
5	Heavy rain events/extrem	Salmon, Deer, Halibut, Berries, Clams / Cockles			Positive Impact	Positive Impact	Positive Impact
5	Decreasing salmon and h	Salmon, Crabs	Positive Impact	Positive Impact	Positive Impact	Positive Impact	Positive Impact
5	Warming air and water ter	Salmon, Berries, Herring					
5	Decreasing salmon and h	Salmon, Deer, Halibut, Be	Negative Impact	Negative Impact	Negative Impact	Negative Impact	Negative Impact
5	Decreasing salmon and h	Salmon, Halibut, Crabs					
5	Bear encroachment, Char	Salmon, Deer, Berries, Se	No Impact	No Impact	No Impact	No Impact	No Impact
5	Heavy rain events/extrem	Salmon	Positive Impact	No Impact	No Impact	No Impact	Negative Impact
5	Decreased snow/rainfall (	Salmon, Deer, Halibut, Be	Positive Impact	Negative Impact	Negative Impact	Negative Impact	Negative Impact
5	Decreased snow/rainfall (	Salmon, Deer, Halibut, Be	Positive Impact	Negative Impact	Negative Impact	Negative Impact	Negative Impact
n/a		Salmon, Deer, Halibut, Be	Negative Impact	Negative Impact	Negative Impact	Negative Impact	Negative Impact
n/a							

For each of the options be	For each of the options be	For each of the options be	If you would like to explair	What efforts would you like to see in the future to help ensure Hoonah's way of life thrives as envir
			It would be nice to get eve	Get the younger generation more involved the generation events. [note: additional comments were given on a separate sheet of paper. None of them are strictly spe 1. I sure would like to see the ANB hall to be all done. 2. I would love to have to see a place where we could go to see movies. 3. Get a shuttle year-round for when the senior's bus is not running. 4. I would like to see all the tribal houses to rebuilt so our elders can gather for meetings. 5. Have more jobs for income for everone.
	Positive Impact	Positive Impact	I never done carving weav	
				more communication about climate change.
No Impact	No Impact	Negative Impact	Fishing regulations are us	Limitation on non-local Huna people
		Negative Impact	I'm concerned about susta	More than the environment being called the problem, I think it's how we manage resources and nc
No Impact	No Impact	No Impact		
No Impact	No Impact	No Impact		Get rid of tourism!
Negative Impact	Negative Impact	Negative Impact		More protection for subsistence
Negative Impact	Negative Impact	Negative Impact		more info on changes environmentally, more protections for subsistence
No Impact	No Impact	No Impact		More fisheries and winter tidal studies, better management practice for deer and bear
				get rid of the waste oil tank at the harbor. Restrict people living on boats, prevent boats from becor

Appendix C: Interview Questionnaire

Introduce yourself for the recording

Before we get going, can you confirm that you are OK to be recorded for this interview?

1. What does climate change adaptation mean to you?

Provide a definition of climate adaptation: “Climate change adaptation is the process of adjusting to current or expected effects of climate change. For humans, adaptation aims to moderate or avoid harm, and exploit opportunities; for natural systems, humans may intervene to help adjustment. Adaptation actions can be either incremental or transformative” - Wikipedia

2. What do you think the condition and availability of subsistence resources will be like seven generations from now? Why do you think this?

3. How confident are you in your community’s ability to adapt to changing conditions? What concerns do you have about adaptation?

4. What environmental conditions have you seen change around Hoonah? What changes have your heard from elders?
    a. Rainfall? Snowpack? Temperatures? Extreme weather? Length of seasons? What timescales have you seen those changes on?

5. Have you seen changes in subsistence resources?
    a. Availability? Location? Timing? Quality?

6. Are there traditional practices that rely heavily on certain environmental conditions or resources? Ex: blueberries at pay-off parties

7. What did you learn about weather from your elders?

8. What practices did your elders use to sustain subsistence resources? What can we learn from the Tlingit Culture and Traditional Knowledge to help us be resilient in a changing world?

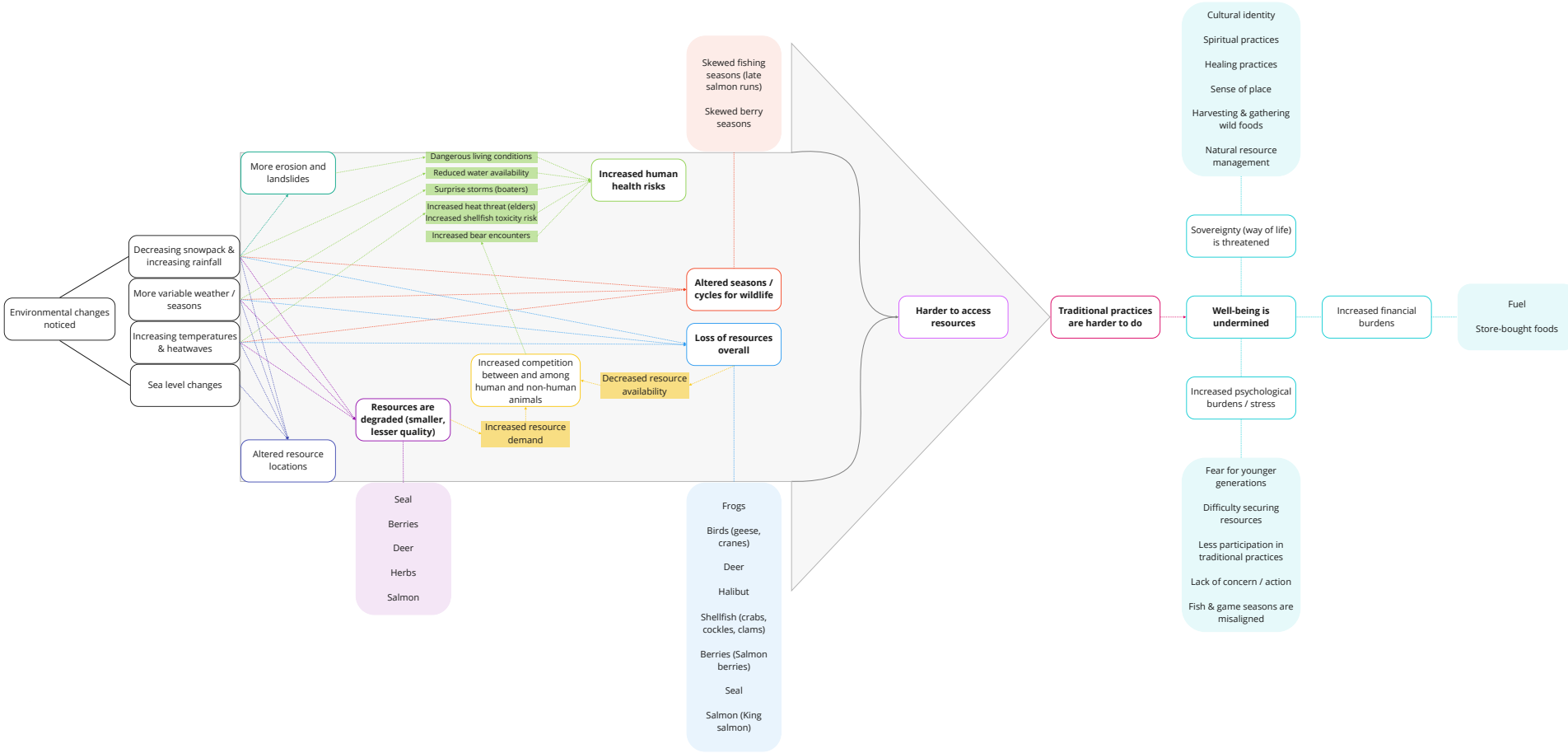
9. Are there any specific actions you would like HIA to take to help preserve resources or make positive changes for the future?

10. Are there other people we should interview?

Can we sign you up for the Hoonah Stewardship Council? If yes, what is your email?

Can we sign you up for updates from our website? If yes, what is your email?

Appendix D: Interview Network Display


Environmental changes noticed
Decreasing snowpack & increasing rainfall
More variable weather / seasons
Increasing temperatures & heatwaves
Sea level changes
More erosion and landslides
Altered resource locations
Dangerous living conditions
Reduced water availability
Surprise storms (boaters)
Increased heat threat (elders)
Increased shellfish toxicity risk
Increased bear encounters
Increased human health risks
Altered seasons / cycles for wildlife
Loss of resources overall
Increased competition between and among human and non-human animals
Decreased resource availability
Increased resource demand
Resources are degraded (smaller, lesser quality)
Seal
Berries
Deer
Herbs
Salmon
Skewed fishing seasons (late salmon runs)
Skewed berry seasons
Frogs
Birds (geese, cranes)
Deer
Halibut
Shellfish (crabs, cockles, clams)
Berries (Salmon berries)
Seal
Salmon (King salmon)
Harder to access resources
Traditional practices are harder to do
Cultural identity
Spiritual practices
Healing practices
Sense of place
Harvesting & gathering wild foods
Natural resource management
Sovereignty (way of life) is threatened
Well-being is undermined
Increased financial burdens
Fuel
Store-bought foods
Increased psychological burdens / stress
Fear for younger generations
Difficulty securing resources
Less participation in traditional practices
Lack of concern / action
Fish & game seasons are misaligned

Appendix E: Interview Coding

Research Focus	Code	Qualitative Data	Interview Number	Resource ?		
Climate change in Hoonah	Loss of resources overall	“A lot of the things that we depend on will soon disappear, simply because I feel like climate change has affected a lot of things and will continue until something drastic happens.”	1			
Climate change in Hoonah	Loss of resources overall	“It just seems like we’re gradually losing all the things that we live on subsistently.”	1			
Climate change in Hoonah	Loss of resources overall	“The things that climate change has done is [it has] made a lot more things impossible for us.”	1			
Climate change in Hoonah	Loss of resources overall	“Halibut- there isn’t as much. Water’s too warm or something, I don’t know.”	1	Halibut		
Climate change in Hoonah	Loss of resources overall	"We used to have an abundance of fish, and it's really scarce now, especially king salmon. We used to have a lot of that. We took it for granted."	2	King salmon, fish		
Climate change in Hoonah	Loss of resources overall	"Well I noticed when we go to our pay-out parties it's getting less and less because it's really hard to go out and pick. I used to go out without [my friend], now we have to worry about bears."	2	Berries		
Climate change in Hoonah	Loss of resources overall	"And it seems like you have to go further out to get berries nowadays, we used to go to our backyard and have berries, now we destroy that by putting homes into them. I'm not saying that's not right, I'm just saying it's harder to get our berries."	2	Berries		
Climate change in Hoonah	Loss of resources overall	“We have to watch out when we have seasons to go out there. [The seasons are] different when the climate starts to change; we have to look at, ‘is this a good time to go out there and process the gumboots, cockles, and clams, or do we have to wait after the red tide as well’. [Climate change] affects all that area.”	3	Shellfish		
Climate change in Hoonah	Loss of resources overall	"[Climate change] is affecting our fishing industry."	4	Fish		
Climate change in Hoonah	Loss of resources overall	"We didn't have hardly any water, we had to really be careful how much water we were using. And fish weren't going up the creek. And every four years, we can expect a big fish run. This year there was hardly anything."	4	Fish		
Climate change in Hoonah	Loss of resources overall	"We haven't had very much blueberries because weather was bad, it go really hot."	4	Blueberries		
Climate change in Hoonah	Loss of resources overall	"Last year, it was very few salmonberries that came this way."	4	Salmonberries		
Climate change in Hoonah	Loss of resources overall	Even when it comes to fishing, or even going out to [fishing location] to get sockeye, it's not like before."	4	Fish, sockeye salmon		
Climate change in Hoonah	Loss of resources overall	"Raspberries - we didn't get a whole lot like we normally do, because we had so much sun and not enough rain."	4	Raspberries		
Climate change in Hoonah	Loss of resources overall	“If we keep going the direction we’re going there’s going to be no subsistence resources because we’re killing the ocean, we’re killing the land, and there’s going to be no place for subsistence resources to live.”	5			
Climate change in Hoonah	Loss of resources overall	“Our generation is the last one that’s going to experience abundance if things keep going in the same direction, that’s the way I feel.”	5			
Climate change in Hoonah	Loss of resources overall	“It seems to me that the abundance of the geese and cranes has lessened.”	5	Geese, cranes		
Climate change in Hoonah	Loss of resources overall	“There have been years where I notice that there was a great abundance of salmonberries, and I don’t think there were any last year.”	5	Salmonberries		
Climate change in Hoonah	Loss of resources overall	“It seems to me like there are more times when there’s no berries than there are times where there are berries. And I think that has to do with a number of factors, I think it has to do with the logging, global warming, and increased rain on forests that have been denuded.”	5	Berries		
Climate change in Hoonah	Loss of resources overall	“[I think the biggest impacts of global warming on Hoonah will be] lack of food. When the water warms up too much things aren’t going to be able to grow.”	5			

Climate change in Hoonah	Loss of resources overall	“The Yukon River has no king salmon. Every year we used to go to the Alaska Federation of Natives, and people would be selling ‘Yukon [king salmon] strips’... we used to look forward to it, but we haven’t been able to buy any for at least 15 years. They just don’t have any, there’s just no king salmon to catch.”	5	King salmon		
Climate change in Hoonah	Loss of resources overall	“We generally get enough [subsistence resources], we just don’t have as much as we used to.”	5			
Climate change in Hoonah	Loss of resources overall	“Not to mention, you notice there’s no red king crab season this year, there’s no snowcrab season this year, and it’s because of global warming and overfishing.”	5	King crab, snowcrab		
Climate change in Hoonah	Loss of resources overall	“In my lifetime we’ve seen frogs in Craig and Klawock, there used to be thousands and thousands of little frogs, now there’s none. Which to me is a dangerous thing, and this happened 30-40 years ago. The danger signs were already appearing then.”	5	Frogs		
Climate change in Hoonah	Loss of resources overall	“I noticed there are not as many [seal], but I’ve noticed too that there are killer whale, and we didn’t used to have the killer whale that much around here.”	6	Seal		
Climate change in Hoonah	Loss of resources overall	“Cause we’re having to go farther away to get [food and nonfood resources].”	6			
Climate change in Hoonah	Loss of resources overall	“Right now, the way I think it is - with everything the way it seems to be going - I’d be surprised if there was any subsistence, because I think everything’s being so heavily regulated in so many ways. And then I’ve also noticed it seems like the deer and salmon populations, and just in my lifetime… I remember there used to be a lot of salmon, I mean lots of salmon, compared to what we have now going through [the river].”	7	Deer, salmon		
Climate change in Hoonah	Loss of resources overall	“Unless there’s some real major changes, somewhere, somehow, I’d be surprised if there’s anything for future generations to really subsist on.”	7			
Climate change in Hoonah	Loss of resources overall	“I do have concerns; I’ve noticed quite a drop in the salmon population.”	7	Salmon		
Climate change in Hoonah	Loss of resources overall	“I used to ride around out the logging roads quite a bit back in the 1990’s, and it seemed like I’d see deer every few minutes, every five minutes, we’re driving along, we’d see a deer grazing away… now, seems like we hardly see deer out the road now. Not sure how things will go.”	7	Deer		
Climate change in Hoonah	Resources are degraded (smaller, lower quality)	“Our berries that we normally pick at certain times of the year, some have dried up because of the heat and some got water logged because of the rain. [It] never used to be that way.”	1	Berries		
Climate change in Hoonah	Resources are degraded (smaller, lower quality)	“We harvest deer and sometimes they aren’t as big as they normally are, they’re getting smaller.”	1	Deer		
Climate change in Hoonah	Resources are degraded (smaller, lower quality)	“Even the herbs are smaller now, mainly because of the heat.”	1	Herbs		
Climate change in Hoonah	Resources are degraded (smaller, lower quality)	“The herbs we normally pick and gather are smaller, so we gotta pick twice as much.”	1	Herbs		
Climate change in Hoonah	Resources are degraded (smaller, lower quality)	“When you go out to pick a lot of berries, really taste the berries in different areas, you can feel and taste the difference of each berry. They can be bitter or they can be sweet, depending on wherever you go. That is a big change there - one would have to actually go out to actually see it and then feel it, and then taste it for themself to know what I’m talking about.”	3	Berries		
Climate change in Hoonah	Resources are degraded (smaller, lower quality)	“[The deer meat] gets to a point where the taste is different… depending on where they’re at, you can taste the difference in the stew. They can be wild but somehow it doesn’t taste right… it’s getting to a point where it makes me wonder ‘where are these deer, what are they eating that makes them taste more stronger’... I don’t know what’s going on with them but I think it has to do with climate change, it’s a rough thing.”	3	Deer		

Climate change in Hoonah	Resources are degraded (smaller, lower quality)	“There’s a stronger taste in seal now. I don’t know what’s going on with them, but the meat is more raunchy.”	3	Seal		
Climate change in Hoonah	Resources are degraded (smaller, lower quality)	"[Friend] went picking and [the berries] were [smaller], and they were dried out."	4	Berries		
Climate change in Hoonah	Resources are degraded (smaller, lower quality)	“Berries have been really strange - I don’t know if it’s been too warm, or it’s been to cold, the winter stayed longer than it should, or… I remember one year the berries came, it was like spring was here and then we had a freeze. [The freeze] killed a lot of the berries. I don’t know, I don’t know what’s causing the weather to be so different.”	6	Berries		
Climate change in Hoonah	Resources are degraded (smaller, lower quality)	“I have heard the same thing, that people are saying some of the salmon they’ve had don’t seem as good as it was before. One guy was joking calling it ‘frankenfish’, I guess it was supposed to be wild salmon that were possibly mixed with farm-raised fish.”	7	Salmon		
Climate change in Hoonah	More competition between / among human and nonhuman animals	"When the berries dry up, the bears wander around town more frequently."	1			
Climate change in Hoonah	More competition between / among human and nonhuman animals	"When it doesn't rain enough, fish can't go up the stream so the bears are in town."	1			
Climate change in Hoonah	More competition between / among human and nonhuman animals	“More people come here. I don’t know, they seem to like harvesting our wildlife.”	2			
Climate change in Hoonah	More competition between / among human and nonhuman animals	“In my days we never had to worry about bears, number one, because we’re digging into their homes and then they’re suffering because of our growth, but that’s life.”	2			
Climate change in Hoonah	More competition between / among human and nonhuman animals	“Well I noticed when we go to our pay-out parties it’s getting less and less because it’s really hard to go out and pick. I used to go out without [my friend], now we have to worry about bears.”	2			
Climate change in Hoonah	More competition between / among human and nonhuman animals	“Otters they overtake our shellfish, and there’s a lot of otters that will ruin our beaches.”	2	Sea otters, shellfish		
Climate change in Hoonah	More competition between / among human and nonhuman animals	“The sea otters and land otters out there - we have so many out there. I was wondering why there aren’t so many tags for them, because the way I see it, they’re digging into the places of our gumboots, cockles and clams, the dungeness crabs, and anything else they can get. If we don’t watch the process of it, the food that’s out there that we harvest each year is gonna be less and less. And when that happens, it’s just gonna be a harder way of life to live.”	3	Otters, shellfish		
Climate change in Hoonah	More competition between / among human and nonhuman animals	“Where they come in, out of towners, get to crabs as we ourselves harvest that stuff. But they take multitudes and multitudes out, of where we in turn have to struggle to find out where they’re at.”	3	Crabs		
Climate change in Hoonah	More competition between / among human and nonhuman animals	“We get six tags [for deer], four in one area and some two in another area. Inbetween Sealaska and Huna Totem [Corporation] it may be private land, but still, even the out-of-towners get in that area… We go out there and hunt and look around, but we have to go further than they do.”	3	Deer		
Climate change in Hoonah	More competition between / among human and nonhuman animals	“We have so many bears out there, I even went to the City Hall and tried to explain it, that in our community, the bears walk through it… We got kids that walk around out here. I got my nieces and nephews out here. I worry about them.”	3			
Climate change in Hoonah	More competition between / among human and nonhuman animals	“[Bear threats] have hindered us from getting our berries, teas - stuff that we harvest - asparagus. I used to go hunting and not have any fear until I got charged [by a bear], and then I still would go out but it was more [watching for bears] than paying attention to what I should be doing. So that to me has hindered us as people because now we have to get more people together to pick [to deter bears].”	6	Berries, beach asparagus, herbs		
Climate change in Hoonah	More competition between / among human and nonhuman animals	“The bears [concern me]. The environment has changed, now the bears are here instead of out where they should be.”	6			

Climate change in Hoonah	More competition between / among human and nonhuman animals	“Now we have the deer that have come in. I don’t know why the deer have all moved in [to town].”	6	Deer		
Climate change in Hoonah	More competition between / among human and nonhuman animals	“I remember when I was little, the bears used to come in. [That] was between, I’m guessing about 40 years ago, bears would kind of come through town, it wasn’t so bad. You didn’t see much deer then.”	6			
Climate change in Hoonah	More competition between / among human and nonhuman animals	“That was in the late 1980’s, early 1990’s, when [the bears] started coming in more. I don’t know what drove them in, if it’s the garbage.”	6			
Climate change in Hoonah	More competition between / among human and nonhuman animals	“The bears are getting more aggressive. We need to do something - cause that’s affecting us, getting our berries. We need to do something to thin out the bear population.”	6	Berries		
Climate change in Hoonah	More competition between / among human and nonhuman animals	“To me, [the bear population] is overpopulated. They’re claiming their island back is what’s happening. That’s honestly what it seems to be; [the bears are] moving back in. We kind of moved [the bears] out when we moved into Hoonah.”	6			
Climate change in Hoonah	More competition between / among human and nonhuman animals	“Maybe that’s why [the bears] are coming into town. They’re running out of places to be out there.”	6			
Climate change in Hoonah	Increasing temperatures and heat waves	“We can see for ourselves that the winter months here are all but mild compared to what it used to be.”	1			
Climate change in Hoonah	Increasing temperatures and heat waves	“There was a time where we couldn’t go out our front doors because of the snow, but since it started warming up, our winters have become less and less cold.”	1	Snow		
Climate change in Hoonah	Increasing temperatures and heat waves	“Our cold snap that lasts probably about a week, sometimes it drops below zero but most the time it stays above zero.”	1			
Climate change in Hoonah	Increasing temperatures and heat waves	“We never used to get any temperatures over 75, now 75 has come and gone many times.”	1			
Climate change in Hoonah	Increasing temperatures and heat waves	“It’s been a lot hotter every summer and it lasts a little longer.”	1			
Climate change in Hoonah	Increasing temperatures and heat waves	“The snows we used to get for winter we no longer get.”	1	Snow		
Climate change in Hoonah	Increasing temperatures and heat waves	"We needed rain, we had too much sunshine."	4			
Climate change in Hoonah	Increasing temperatures and heat waves	"Raspberries - we didn't get a whole lot like we normally do, because we had so much sun and not enough rain."	4	Raspberries		
Climate change in Hoonah	Increasing temperatures and heat waves	“There’s way less snow; when I first moved here [in the 1980’s], we would have 3-4 feet of snow in October. When I first came to Hoonah the snow was up to my hips… I’ve seen that, that’s a pretty major change.”	5	Snow		
Climate change in Hoonah	Increasing temperatures and heat waves	“I think rain has replaced some of the snow.”	5	Snow, rain		
Climate change in Hoonah	Increasing temperatures and heat waves	“I think that there has been some more rain, I think statistically this was one of the wettest years on record in Juneau.”	5	Rain		
Climate change in Hoonah	Increasing temperatures and heat waves	“Because it gets so warm up there [in Kotzebue] now - it’s been hitting 80 degrees [Farenheit] out there, which has never happened ever before - so it warms up the creeks so much it cooks the fish, and it cooks the [fish] eggs.”	5	Fish		
Climate change in Hoonah	Increasing temperatures and heat waves	“I have seemed to notice that it does seem a little warmer than years before, I dont’ know if that’s really climate change or … that’s one trend I’ve noticed.”	7			
Climate change in Hoonah	Increasing temperatures and heat waves	“It seems like it has warmed up some. My father used to talk about how there used to be icebergs out in Icy Strait, he said you had to watch for those, of course we know Glacier Bay has receded… I don’t know if it’s a cyclic thing or if it’s from global warming but that’s one thing my dad talked about, having to watch for icebergs when he was commercial fishing as a young man, and now you don’t see icebergs out there anymore.”	7			
Climate change in Hoonah	Increasing temperatures and heat waves	“Seems like winters used to be colder, not sure if that’s just from old age or … but I think the winters have warmed up a little bit, we seem to get more rain than snow.”	7	Snow, rain		

Climate change in Hoonah	More erosion and landslides from extreme rain events	“The rain is causing a lot more slides around here that never used to happen, regardless of how hard it used to rain.”	1	Rain		
Climate change in Hoonah	More erosion and landslides from extreme rain events	“The mudslides [are a change]. You look across, out the window out here, and you’ll see two mudslides right over there. And it made the water really muddy-looking. I know when I was growing up I can’t say that we never had the water being brown when it rained like that, but it seems like we’re having more rain…it’s like, that’s a lot more rain.”	4	Rain		
Climate change in Hoonah	Sea level changes	“On my depth finder, when I’m out on the boat, I’ve seen some different areas where the change is. There’s some reefs out there that hadn’t been there. I have to watch out where I go… I don’t know where those reefs come from. I’ve been here a lot of years and it’s just something different.”	3			
Climate change in Hoonah	Increased human health risks	“The rain is causing a lot more slides around here that never used to happen, regardless of how hard it used to rain.”	1	Rain		
Climate change in Hoonah	Increased human health risks	“When the berries dry up, the bears wander around town more frequently.“	1			
Climate change in Hoonah	Increased human health risks	“When it doesn’t rain enough, fish can’t go up the stream so the bears are in town.”	1			
Climate change in Hoonah	Increased human health risks	“Well I noticed when we go to our pay-out parties it’s getting less and less because it’s really hard to go out and pick. I used to go out without [my friend], now we have to worry about bears.”	2			
Climate change in Hoonah	Increased human health risks	“In my days we never had to worry about bears, number one, because we’re digging into their homes and then they’re suffering because of our growth, but that’s life.”	2			
Climate change in Hoonah	Increased human health risks	“We have to watch out when we have seasons to go out there. [The seasons are] different when the climate starts to change; we have to look at, ‘is this a good time to go out there and process the gumboots, cockles, and clams, or do we have to wait after the red tide as well’. [Climate change] affects all that area.”	3	Shellfish		
Climate change in Hoonah	Increased human health risks	“I made the mistake one time of going out in rough weather with my dad, I got reprimanded and turned the boat around and came back in and played it safe, not only for myself but for my dad as well. I understood the mistake I made.”	3			
Climate change in Hoonah	Increased human health risks	“We have so many bears out there, I even went to the City Hall and tried to explain it, that in our community, the bears walk through it… We got kids that walk around out here. I got my nieces and nephews out here. I worry about them.”	3			
Climate change in Hoonah	Increased human health risks	“The mudslides [are a change]. You look across, out the window out here, and you’ll see two mudslides right over there. And it made the water really muddy-looking. I know when I was growing up I can’t say that we never had the water being brown when it rained like that, but it seems like we’re having more rain…it’s like, that’s a lot more rain.”	4	Rain		
Climate change in Hoonah	Increased human health risks	“You look out outside right now, we have problems with the bears.”	4			
Climate change in Hoonah	Increased human health risks	“[Bear threats] have hindered us from getting our berries, teas - stuff that we harvest - asparagus. I used to go hunting and not have any fear until I got charged [by a bear], and then I still would go out but it was more [watching for bears] than paying attention to what I should be doing. So that to me has hindered us as people because now we have to get more people together to pick [to deter bears].”	6			
Climate change in Hoonah	More variable weather / seasons	"The weather is different, the weather patterns are different."	5			

Climate change in Hoonah	More variable weather / seasons	“Like our winters have been strange. We used to have tons of snow, so when you get snow it’s usually warmer. We’ve been having really cold spells, really colder than usual to me. And then in the springtime it’s still kind of cold, so I don’t know; to me, it’s like our seasons are off just a wee bit, by a month or two.”	6			
Climate change in Hoonah	More variable weather / seasons	“Berries have been really strange - I don’t know if it’s been too warm, or it’s been to cold, the winter stayed longer than it should, or… I remember one year the berries came, it was like spring was here and then we had a freeze. [The freeze] killed a lot of the berries. I don’t know, I don’t know what’s causing the weather to be so different.”	6	Berries		
Climate change in Hoonah	Altered seasons / cycles for wildlife	“The ones that are more outdoorsy in our community have noticed, I’ve listened to them, our fishing seasons aren’t quite right.”	2	Fish		
Climate change in Hoonah	Altered seasons / cycles for wildlife	“The sockeye are arriving late. I don’t think [F&G] have changed the times [of fishing seasons], it’s just the sockeye have… I don’t know if it’s because of global warming, I don’t know if it’s that or if something has happened that caused their route back to us to change. They have a path that they take. They alway say ‘our fish go out to the ocean, then they come back’ - where do they go? How far away do they go?”	6	Fish		
Climate change in Hoonah	Altered seasons / cycles for wildlife	“Berries have been really strange - I don’t know if it’s been too warm, or it’s been to cold, the winter stayed longer than it should, or… I remember one year the berries came, it was like spring was here and then we had a freeze. [The freeze] killed a lot of the berries. I don’t know, I don’t know what’s causing the weather to be so different.”	6	Berries		
Climate change in Hoonah	Changes in precipitation	“We can see for ourselves that the winter months here are all but mild compared to what it used to be.”	1			
Climate change in Hoonah	Changes in precipitation	“There was a time where we couldn’t go out our front doors because of the snow, but since it started warming up, our winters have become less and less cold.”	1	Snow		
Climate change in Hoonah	Changes in precipitation	“The snows we used to get for winter we no longer get.”	1	Snow		
Climate change in Hoonah	Changes in precipitation	"In my days, we had lots of snow, we had fun playing in the snow. I see colder weather but hardly any snow, which doesn't make any sense."	2	Snow		
Climate change in Hoonah	Changes in precipitation	“It seems to me like there are more times when there’s no berries than there are times where there are berries. And I think that has to do with a number of factors, I think it has to do with the logging, global warming, and increased rain on forests that have been denuded.”	5	Berries, rain		
Climate change in Hoonah	Changes in precipitation	“There’s way less snow; when I first moved here [in the 1980’s], we would have 3-4 feet of snow in October. When I first came to Hoonah the snow was up to my hips… I’ve seen that, that’s a pretty major change.”	5	Snow		
Climate change in Hoonah	Changes in precipitation	“I think rain has replaced some of the snow.”	5	Rain, snow		
Climate change in Hoonah	Changes in precipitation	“I think that there has been some more rain, I think statistically this was one of the wettest years on record in Juneau.”	5	Rain		
Climate change in Hoonah	Changes in precipitation	“Seems like winters used to be colder, not sure if that’s just from old age or … but I think the winters have warmed up a little bit, we seem to get more rain than snow.”	7	Rain, snow		
Community Concerns	Resilience against CC	“Being adapt to just about everything that’s coming on [concerns me]. Heat waves, getting more rain, more heat.”	1			
Community Concerns	Resilience against CC	"Animals will be different [seven generations from now], maybe we'll lose some - extinct, if we don't manage it properly."	2	Animals		
Community Concerns	Resilience against CC	"Climate change, I'll tell you I am concerned about it because it seems to be affecting all over."	4			
Community Concerns	Less participation in traditional practices	"Elders now, they just don't pratice any [sustainable resource practices]"	1			

Community Concerns	Traditions / traditional practices are becoming harder to do	“It just seems like we’re gradually losing all the things that we live on subsistently.”	1			
Community Concerns	Traditions / traditional practices are becoming harder to do	“The herbs we normally pick and gather are smaller, so we gotta pick twice as much.”	1	Herbs		
Community Concerns	Traditions / traditional practices are becoming harder to do	“The things that climate change has done is [it has] made a lot more things impossible for us.”	1			
Community Concerns	Traditions / traditional practices are becoming harder to do	“This makes life so difficult. We won’t be able to live the way we used to.”	6			
Community Concerns	Wasted resources	“Someone kills something and only takes part of the [deer] meat, and leaves the rest. Or, killing the adult female and leaving the babies by themselves. That concerns me.”	2	Deer		
Community Concerns	Wasted resources	“My neighbor, they go out a lot on the boat, for whatever reason, taking pictures or hunting. But they saw a deer walking the beach and they saw it was suffering so they went up close to it and there were bow and arrows on it, and it was infected. So all they could do was put it down. Those are the things that really concern me.”	2	Deer		
Community Concerns	Wasted resources	“[Trophy hunters] do bear traps, just to get them to kill them. I don’t agree with gaming just for the hides.”	2			
Community Concerns	Lack of concern / action	“It concerns me when there’s maybe a handful of people who are concerned, and others ‘no big deal’ because maybe they might not be here, I don’t understand that.”	2			
Community Concerns	Lack of concern / action	“Thanks to HIA and people from outside that are listening to us [about changing conditions], but there are still some who are not really taking us seriously.”	2			
Community Concerns	Lack of concern / action	“Our kids are losing what our values are”	2			
Community Concerns	Lack of concern / action	“It’s hunters that are irresponsible trying to find the deer that they shot [but don’t collect them]. Those are the kinds of things that really concern me.”	2	Deer		
Community Concerns	Lack of concern / action	"Some major things need to start to happen."	5			
Community Concerns	More competition between / among human and nonhuman animals	“When the berries dry up, the bears wander around town more frequently.”	1	Berries		
Community Concerns	More competition between / among human and nonhuman animals	“When it doesn’t rain enough, fish can’t go up the stream so the bears are in town.”	1	Fish		
Community Concerns	More competition between / among human and nonhuman animals	“More people come here. I don’t know, they seem to like harvesting our wildlife.”	2			
Community Concerns	More competition between / among human and nonhuman animals	“Otters they overtake our shellfish, and there’s a lot of otters that will ruin our beaches.”	2	Sea otters, shellfish		
Community Concerns	More competition between / among human and nonhuman animals	“In my days we never had to worry about bears, number one, because we’re digging into their homes and then they’re suffering because of our growth, but that’s life.”	2			
Community Concerns	More competition between / among human and nonhuman animals	“Well I noticed when we go to our pay-out parties it’s getting less and less because it’s really hard to go out and pick. I used to go out without [my friend], now we have to worry about bears.”	2	Berries		
Community Concerns	More competition between / among human and nonhuman animals	“The sea otters and land otters out there - we have so many out there. I was wondering why there aren’t so many tags for them, bc the way I see it, they’re digging into the places of our gumboots, cockles and clams, the dungeness crabs, and anything else they can get. If we don’t watch the process of it, the food that’s out there that we harvest each year is gonna be less and less. And when that happens, it’s just gonna be a harder way of life to live.”	3	Otters, shellfish		
Community Concerns	More competition between / among human and nonhuman animals	“Where they come in, out of towners, get to crabs as we ourselves harvest that stuff. But they take multitudes and multitudes out, of where we in turn have to struggle to find out where they’re at.”	3	Crabs		
Community Concerns	More competition between / among human and nonhuman animals	“We get six tags [for deer], four in one area and some two in another area. Inbetween Sealaska and Huna Totem [Corporation] it may be private land, but still, even the out-of-towners get in that area… We go out there and hunt and look around, but we have to go further than they do.”	3	Deer		

Community Concerns	More competition between / among human and nonhuman animals	“We have so many bears out there, I even went to the City Hall and tried to explain it, that in our community, the bears walk through it… We got kids that walk around out here. I got my nieces and nephews out here. I worry about them.”	3			
Community Concerns	More competition between / among human and nonhuman animals	“The bears [concern me]. The environment has changed, now the bears are here instead of out where they should be.”	6			
Community Concerns	More competition between / among human and nonhuman animals	“Now we have the deer that have come in. I don’t know why the deer have all moved in [to town].”	6	Deer		
Community Concerns	More competition between / among human and nonhuman animals	“I remember when I was little, the bears used to come in. [That] was between, I’m guessing about 40 years ago, bears would kind of come through town, it wasn’t so bad. You didn’t see much deer then.”	6			
Community Concerns	More competition between / among human and nonhuman animals	“That was in the late 1980’s, early 1990’s, when [the bears] started coming in more. I don’t know what drove them in, if it’s the garbage.”	6			
Community Concerns	More competition between / among human and nonhuman animals	“Cause [bear interactions are] getting extremely dangerous.”	6			
Community Concerns	More competition between / among human and nonhuman animals	“The bears are getting more aggressive. We need to do something - cause that’s affecting us, getting our berries. We need to do something to thin out the bear population.”	6	Berries		
Community Concerns	More competition between / among human and nonhuman animals	“To me, [the bear population] is overpopulated. They’re claiming their island back is what’s happening. That’s honestly what it seems to be; [the bears are] moving back in. We kind of moved [the bears] out when we moved into Hoonah.”	6			
Community Concerns	More competition between / among human and nonhuman animals	“Maybe that’s why [the bears] are coming into town. They’re running out of places to be out there.”	6			
Community Concerns	More competition between / among human and nonhuman animals	“[Bear threats] have hindered us from getting our berries, teas - stuff that we harvest - asparagus. I used to go hunting and not have any fear until I got charged [by a bear], and then I still would go out but it was more [watching for bears] than paying attention to what I should be doing. So that to me has hindered us as people because now we have to get more people together to pick [to deter bears].”	6	Beach asparagus, berries, herbs		
Community Concerns	Human impacts on the environment	“People have bonfires out [at Long Island], for a picnic. But they burn pallets. What’s out there left after that is a lot of nails out there. Nails are metal, metal affects the food process. It can’t be stopped because it’s already there.”	3			
Community Concerns	Human impacts on the environment	“But still, when the tide goes out, that gas and oil just sits there [at Graveyard Island]. That’s our food that’s in that area.”	3			
Community Concerns	Human impacts on the environment	“Our beach asparagus, they’re being run over by four wheelers and cars.”	3	Beach asparagus		
Community Concerns	Human impacts on the environment	“The other issue is there’s no big movement to end trawling.”	5	Fish		
Community Concerns	Human impacts on the environment	“We may be in a downward descending spiral, and we may not be able to stop some things no matter what we do.”	5			
Community Concerns	Human impacts on the environment	“The other problem we have is hatcheries, because when they put in a hatchery they put up a weir and they kill the natural stock [of salmon] for the stream… in my opinion, hatcheries can be detrimental, except to the commercial fishermen who make a lot of money fishing dog [salmon] at [a popular dog salmon fishing location].”	5	Salmon		
Community Concerns	Human impacts on the environment	“I think [salmon hatcheries] has and will be making changes to the patterns of fish coming back to different streams.”	5	Salmon		
Community Concerns	Human impacts on the environment	“Got a lot of people living down [at the docks]. Sewage, garbage, boats being cleaned over at the haul out, boats are getting scraped, cleaned, painted, all that. All that chips of what was on the bottom.”	6			
Community Concerns	Human impacts on the environment	“Cruise ships - the sewage from them, oil, fuel.”	6			

Community Concerns	Human impacts on the environment	“There’s so many of us that have boats, we pollute the water ourselves.”	6			
Community Concerns	Human impacts on the environment	“The smokestacks, air pollution, I think is becoming an issue.”	6			
Community Concerns	Human impacts on the environment	“We never used to have this many cruise ships, now we’re getting 2-3 a day, when the season is going. We never had to worry about that.”	6			
Community Concerns	Human impacts on the environment	“We have a lot of abandoned boats and vehicles that are leaking contaminants.”	6			
Community Concerns	Human impacts on the environment	“The first dumpsite is down above where the… skatepark is, up on the hill across the street, up there was the first dump site. They buried that. I don’t know if they dug it out and filled it in, or if they just covered it and called it good.”	6			
Community Concerns	Human impacts on the environment	“There was something that was seeping from the [old dump] site, up that way, and came down and [my uncles] were saying they didn’t think our berries were safe to eat because that [old waste] just comes down.”	6	Berries		
Community Concerns	Decision makers not listening to community voices / little community representation in decision making	“Who has the voice around here? Who actually can have a voice and speak for somebody to hear? Who can be in those seats to have an understanding of where we’re coming from? Will they have an ear to hear, or will they have a closed door, just to say ‘wait’ - how many years do we have to wait?”	3			
Community Concerns	Decision makers not listening to community voices / little community representation in decision making	“It’s like, how do you make [politicians] do something?”	4			
Community Concerns	Increasing difficulty to secure necessary resources	“The herbs we normally pick and gather are smaller, so we gotta pick twice as much.”	1	Herbs		
Community Concerns	Increasing difficulty to secure necessary resources	“Now that it’s getting less and less, I pray that this year it’s not going to be like that…[hunting and fishing] are important for us to survive, because right now, I went to the store and I came back with a medium sized bag, and it was $47.”	4			
Community Concerns	Increasing difficulty to secure necessary resources	“Food is getting expensive to buy at the store. Buying things in Juneau and having them shipped over is getting to be expensive.”	6			
Community Concerns	Increasing difficulty to secure necessary resources	“And then [ADF&G] limit you on how many you can take, they keep dropping the amount you can take. And the price of fuel is crazy.”	6	Fish		
Community Concerns	Poor natural resource management	“Especially when they cut out the wood, and then they try clearing away- especially by Game Creek- because when it rains, it gets muddy. The fish can’t see. And the salmon fry too, it was raining so hard that it’s making me wonder how much salmon is going to come back in a couple years.”	4	Fish		
Community Concerns	Loss of resources overall	“We used to have an abundance of fish, and it’s really scarce now, especially king salmon. We used to have a lot of that. We took it for granted.”	1	Fish		
Community Concerns	Loss of resources overall	“Well I noticed when we go to our pay-out parties it’s getting less and less because it’s really hard to go out and pick. I used to go out without [my friend], now we have to worry about bears.”	1	Berries		
Community Concerns	Loss of resources overall	“And it seems like you have to go further out to get berries nowadays, we used to go to our backyard and have berries, now we destroy that by putting homes into them. I’m not saying that’s not right, I’m just saying it’s harder to get to our berries.”	1	Berries		
Community Concerns	Loss of resources overall	"Seven generations from now they're gonna have a tougher time than we do [accessing resources], guaranteed."	3			
Community Concerns	Loss of resources overall	“If we keep going the direction we’re going there’s going to be no subsistence resources because we’re killing the ocean, we’re killing the land, and there’s going to be no place for subsistence resources to live.”	5			

Community Concerns	Loss of resources overall	“Our generation is the last one that’s going to experience abundance if things keep going in the same direction, that’s the way I feel.”	5			
Community Concerns	Loss of resources overall	“In my lifetime we’ve seen frogs in Craig and Klawock, there used to be thousands and thousands of little frogs, now there’s none. Which to me is a dangerous thing, and this happened 30-40 years ago. The danger signs were already appearing then.”	5	Frogs		
Community Concerns	Loss of resources overall	“Right now, the way I think it is - with everything the way it seems to be going - I’d be surprised if there was any subsistence, because I think everything’s being so heavily regulated in so many ways. And then I’ve also noticed it seems like the deer and salmon populations, and just in my lifetime… I remember there used to be a lot of salmon, I mean lots of salmon, compared to what we have now going through [the river].”	7	Deer, salmon		
Community Concerns	Loss of resources overall	“Unless there’s some real major changes, somewhere, somehow, I’d be surprised if there’s anything for future generations to really subsist on.”	7			
Community Concerns	Loss of resources overall	“I do have concerns; I’ve noticed quite a drop in the salmon population.”	7	Salmon		
Community Concerns	Loss of resources overall	“I used to ride around out the logging roads quite a bit back in the 1990’s, and it seemed like I’d see deer every few minutes, every five minutes, we’re driving along, we’d see a deer grazing away… now, seems like we hardly see deer out the road now. Not sure how things will go.”	7	Deer		
Community Concerns	Limited by social systems	“The problem is to do anything we have to burn gas. We’re going to use our boats, we’re going to use our cars to go hunting or something. We’re kind of stuck between nothing but bad choices.”	5			
Community Concerns	Culture has been transformed by settler colonial systems	“It seems like our culture has been put into paper- everything requires paper. Whereas before, we didn’t need paper, we didn’t need permission to cut trees down or anything … we didn’t need permission or paperwork to hunt deer or get fish. Now we’re required to have licenses to get fish, we’re required to get paperwork to get trees, unless [the USFS] provides it for us.”	1			
Community Concerns	Culture has been transformed by settler colonial systems	“A lot of the things the elders used to do without paperwork.”	1			
Community Concerns	Culture has been transformed by settler colonial systems	“There’s a lot of elders out there that HIA can be helping but they’re not, all because ‘you get too much on retirement’, ‘you make too much money on unemployment’.”	1			
Community Concerns	Culture has been transformed by settler colonial systems	“Everybody became more into the ‘individual family unit’ type of a thing, whereas when I was young it was more like, your family was more included in stuff, I mean your extended family. So it’s not the same anymore.”	5			
Community Concerns	Culture has been transformed by settler colonial systems	“[Fish and wildlife officers] used to go hunting with the local guys. It was really interesting, because [the fish and wildlife officer] went along with the local management, the unwritten / unspoken management system that we used to have- don’t waste things, don’t kill too much, bring everything back or don’t leave stuff in the woods.”	5			
Community Concerns	Culture has been transformed by settler colonial systems	“We had ways of predicting the weather or knowing what was coming, but I don’t know them… we weren’t encouraged to remember these things because… everything was going to be learned in school.”	5			

Community Concerns	People have unlearned connections with Earth	“We had ways of predicting the weather or knowing what was coming, but I don’t know them… we weren’t encouraged to remember these things because… everything was going to be learned in school. And now you see people on Facebook ‘we should teach this in school, we should teach that in school’... in my opinion, maybe you should teach something to your children at home. Like balancing the checkbook… how to cut up a deer, we shouldn’t have to teach that at the school, we should be able to learn that at home.”	5			
Community Concerns	People have unlearned connections with Earth	“We need to relearn [how everything is connected] and stop destroying the communication network of the Earth. I believe it - the Earth is alive and the Earth is getting mad.”	5			
Community Concerns	People have unlearned connections with Earth	“These cermonies need to be rediscovered and they need to start happening again. The streams here, the people here, the clans that used to own them should be out there welcoming the salmon back.”	5	Salmon		
Community Concerns	People have unlearned connections with Earth	“The bears are important. Killing the bears because somebody is afraid of bears is not the solution; the solution is to educate people to respect bears, treat bears as if they are part of our environment.	5			
Community Concerns	People have unlearned connections with Earth	“In my clan, we have a story about the woman that married a bear, and the woman that married a frog. I can’t say that a woman actually went to live with a bear, but these are stories in indication of how close we used to be to the animals.”	5			
Community Concerns	Stringent ADF&G regulations	“When I want to go get sockeye [salmon], there’s this window that they give us. They won’t sway from that window, even though if the sockeye hasn’t come - [I don’t know how] many times we’ve gone out there and there’s no sockeye. And we plead with them… cause we’re trying to get it for a Ku’eex [celebration], and it’s like ‘nope’. So it’s almost next to impossible to get our foods because we’re being told ‘you can’t go at this time’ or ‘the window was here and you missed it’. But it’s not that we missed it, it’s just that the fish hadn’t shown up.”	6	Sockeye salmon		
Community Concerns	Stringent ADF&G regulations	“And then [ADF&G] limit you on how many you can take, they keep dropping the amount you can take. And the price of fuel is crazy.”	6	Fish		
Adaptation	Secure traditional foods for elders (HIA)	“I think HIA should help more elders.”	1			
Adaptation	Secure traditional foods for elders (HIA)	“I think if they [HIA] offered more- there’s a lot of people in this town that can’t go fishing, but they want fish. There’s a lot of people in this town that want seal or deer and can’t hunt or don’t have any way of doing it.”	1	Fish, seal, deer		
Adaptation	Secure traditional foods for elders (HIA)	“So I think HIA should go above and beyond to try and get all the foods that the Natives use.”	1			
Adaptation	Develop trust between the community and HIA	“HIA came by one year and says ‘we’re gonna replace your windows, we’re gonna replace your door’. So they measured the windows, they measured the door. Four years in a row we filled out the application to get new windows and new doors, and every year they come by and measured the window, and measured the door. And it never happened. Every year they said the same thing, ‘we ran out of funds’.”	1			
Adaptation	Develop trust between the community and HIA	“There’s a lot of elders out there that filled out the same paperwork I did, but HIA won’t help them. They’ll come in and measure but they won’t do nothing about it. ‘Youre on the list’, well where the heck’s the list?”	1			
Adaptation	Develop trust between the community and HIA	“It’s all how much money can they [HIA] save and not how much money they can help others with.”	1			

Adaptation	Do what you need to do to secure the resources you need	“I’ve learned to adapt. I’ve learned to overcome a lot of situations. I spent an hour and a half filling out paperwork for food stamps, trying to get on food stamps. Food stamps says ‘we can give you $13 a month’. $13 a month. I told them to keep it. If they were to tell me, before I filled out all that paperwork an hour and a half later, I wouldn’t have filled it out.”	1			
Adaptation	Do what you need to do to secure the resources you need	“When someone objects to cutting our logs, or destroying our land because of the economy, my comeback to them is ‘okay then, find a solution to put food on our families’ table’. That’s my comeback to them.”	2			
Adaptation	Accept / embrace	"It's like talking into the wind and expecting you to hear it. But that's okay. Adapt."	1			
Adaptation	Accept / embrace	"There's nothing we can do but let change in our community."	2			
Adaptation	Accept / embrace	"Well, you have to adapt to it, whether we like it or not."	6			
Adaptation	Don't waste or overharvest resources	"We never overdid when we took what we needed. We never took more than we needed."	1			
Adaptation	Don't waste or overharvest resources	“We never overdid it. We never carried buckets of [berries]. I’ve seen a few people who overpick, and then it goes to waste. They overkill and that goes to waste.”	2	Berries		
Adaptation	Don't waste or overharvest resources	“Never never take more than you can handle. And if you take more than you can handle, pass it on to some elders that can’t go fishing or that can’t go hunting. That’s how we took care of each other.”	4			
Adaptation	Don't waste or overharvest resources	"Don't leave your water running needlessly."	5			
Adaptation	Don't waste or overharvest resources	"Sort of like when you harvest seagull eggs - there are supposed to be a certain amount of eggs in there before you take any, and if there’s only one in [the nest] you leave it alone.”	6	Gull eggs		
Adaptation	Don't waste or overharvest resources	“If you take something, you’re supposed to use it. Don’t take more than you need. If you do, try to share with those that might not have gotten some.”	7			
Adaptation	Don't waste or overharvest resources	“If you have more than you could use, share.”	7			
Adaptation	Environmental restoration	“I really appreciate [the Tribal Environmental Coordinator] for that, making sure our rivers are clear so that we can have more fish come in.”	2	Fish		
Adaptation	Environmental restoration	“I really appreciated seeing how they cleaned up the rivers and fixed it.”	4	Fish		
Adaptation	Environmental restoration	“I think we need to enhance the wild stock [of salmon], not make [salmon] farms.”	5	Salmon		
Adaptation	Environmental restoration	“Right now in Washington and Oregon they’re starting to remove some dams so that the salmon can travel. I think those are the things that need to start happening, because when they take the dams out the salmon can come back, and they will again populate the streams.”	5	Salmon		
Adaptation	Environmental monitoring	“As long as we’re monitoring [marine debris].”	2			
Adaptation	Environmental monitoring	“On our population of the deer, we just have to keep an eye on that.”	3	Deer		
Adaptation	Environmental monitoring	“I kinda feel we have to work on the bear issue too, there’s one too many now.”	3			
Adaptation	Environmental monitoring	“My grandpa told me ‘when you look at the weather, when the winds are blowing as strong as they do and it goes up the bay, it’s safer to be on the other side than it is to be going out in that rough weather’.”	3			
Adaptation	Environmental monitoring	“And by the testing that I’m assuming [HIA Environmental] does, if [environmental testing] can show us that if what [the cruise ships are] doing is okay we can keep monitoring, and if [environmental conditions] changes we need to figure out what area’s not doing what they’re supposed to be doing.”	6			

Adaptation	Environmental monitoring	“It would be nice if we could get the City, or the State, or whoever we need to talk to, or - do we have a program? I don’t know what all our programs do with the environment here, do you guys check into bears?”	6			
Adaptation	Individual behavior change	“But the ones that I go out fishing with are realizing- when we go take a bag for trash, they realize how much trash we have in there. I think that makes an impact. I guess lead by example would help us.”	2			
Adaptation	Individual behavior change	“But I think that we have the ability to deal with it, it’s as simple as everybody has to start to become aware of ‘what are you doing’ when you take a piece of paper towel and you use it, ‘what are you doing’ when you use way more toilet paper than you should be using, ‘what are you doing’, so we all need to pay attention to these small things because if these small things get multiplied by 100,000 or 200,000 they become significant.”	5			
Adaptation	Individual behavior change	“Don’t leave your water running needlessly, don’t dump a cup of oil in the ditch cause it’s easier.”	5			
Adaptation	Individual behavior change	“I like paper towels, but I try not to use them as much as possible. When I clean my glasses I have lens cleaners, but I use them three times, I don’t use them just once. I think little things like that multiplied by large numbers is what we need to do. And if you can walk downtown, walk downtown, don’t drive.”	5			
Adaptation	Individual behavior change	“I think the main thing is to become aware and pay attention to the details, because the details are what’s killing us. If you can do something without burning that extra gallon of gas, don’t [burn the extra gallon of gas].”	5			
Adaptation	Individual behavior change	“Our grandchildren and our great grandchildren are going to inherent the problems that we did nothing about, or the problems we created. We have to take responsibility individually and collectively to [address] these things. It’s going to take all of us.”	5			
Adaptation	Awareness of environmental damages	“But the ones that I go out fishing with are realizing- when we go take a bag for trash, they realize how much trash we have in there. I think that makes an impact.”	2			
Adaptation	Build a healthy community	“I would like to see a healthy community and I would like to see our kids be proud of our community.”	2			
Adaptation	Collaborate locally and regionally	“Thanks to HIA and people from outside that are listening to us [about changing conditions], but there are still some who are not really taking us seriously.”	2			
Adaptation	Collaborate locally and regionally	“But I welcome the people who are willing to improve our community.”	2			
Adaptation	Collaborate locally and regionally	“We can get through them, but we’re gonna have to work together in order to make it work. If we don’t work together, it’s gonna be a tough struggle.”	3			
Adaptation	Collaborate locally and regionally	“I’m pretty confident that we ourselves can adapt, but we can’t do this as individual communities, we need to be united and we all need to do it together. Otherwise nothing will be solved. By everybody, I mean all the people in Alaska, not just the Native people, all the people. Everybody has to be involved to a certain extent.”	5			
Adaptation	Collaborate locally and regionally	“When I was young… the guys used to take turns on sein boats- different sein boats would go out at different times- and they’d take like four or five families, and they’d get all the deer they needed for the entire winter, in one trip. And then they’d wait a while for things to calm down and then another group would go out. So I think that could save some negative impacts of people going out individually.”	5	Deer		
Adaptation	Collaborate locally and regionally	“Our grandchildren and our great grandchildren are going to inherent the problems that we did nothing about, or the problems we created. We have to take responsibility individually and collectively to [address] these things. It’s going to take all of us.”	5			

Adaptation	Better enforcement of wildlife protections and hunting regulations	“We make all these rules and regulations for wildlife, but there’s not enough enforcement. There’s only maybe one or two out there, and there is abuse out there.”	2			
Adaptation	Better enforcement of wildlife protections and hunting regulations	“[I’m] just suggesting more of an input on watching out for [out-of-town hunters].”	3			
Adaptation	Better enforcement of wildlife protections and hunting regulations	“[HIA could] make [the four wheelers] stop smashing all the beach asparagus… there’s a place [over] there where a lot of wild strawberries are. They’re getting run over.”	3	Beach asparagus, strawberries		
Adaptation	Better enforcement of wildlife protections and hunting regulations	“[HIA] could help by not having too many boats take too much crabs out of the area where we can process them ourselves in smaller boats.”	3	Crabs		
Adaptation	Mindful natural resource management	“Some of my family gather them together, the branches of the [blue]berries, and replanted them in the garden in order to sustain what was out there, is now in here, but yet leave enough out there so that others can get them.”	3	Blueberries		
Adaptation	Mindful natural resource management	“I think we need to get back into managing the forest, for instance. I don’t think you can rebuild a forest by creating a tree plantation. Dealing with what we’ve done with all the logging is going to be very difficult and I think it’s going to take hundreds and hundreds of years to repair. Because we’ve destroyed the communication network under the forests.”	5	Forests		
Adaptation	Mindful natural resource management	“I think that we need to just totally stop trawling. It needs to be stopped because- there’s supposed to be mid-water trawlers but they have now defined ‘mid-water trawling’ as the net is in the mid-water, but the doors are dragging on the bottom, killing the bottom.”	5	Fish		
Adaptation	Mindful natural resource management	“Not to mention, you notice there’s no red king crab season this year, there’s no snowcrab season this year, and it’s because of global warming and overfishing.”	5	King crab, snowcrab		
Adaptation	Mindful natural resource management	“I think that the management system of the State of Alaska is not right because they do what’s called ‘single-species management’, we have a salmon management plan, we have a deer management plan, we have a bear management plan; it needs to be an ecosystem management plan. Not any individual harvestable resource.”	5			
Adaptation	Increased hunting for select species	“I was suggesting that they have more tags for [sea otters], especially with the - getting to the point where I spoke about the dungeness crabs.”	3	Sea otters		
Adaptation	Increased hunting for select species	“I kind of feel there’s one too many bears and [we] need more than just one tag for every four years, cause that’s a lot of bears.”	3			
Adaptation	Increased hunting for select species	“I think we need to request that [ADF&G] allow one week, maybe every odd year, one week where people can come in and hunt [bear] with a vehicle and help thin out [the bear] population.”	6			
Adaptation	Empathize with each other	“We have folks that are out here in our community that care enough for one another to help one another. That’s what you call [Tlingit word], ‘pulling together’. I see it, I’ve appreciated it.”	3			
Adaptation	Include more community voices in decision making	“I keep going to the City and explaining things but they always say ‘this is on a different level’, ‘this is on a different meeting’, and they’re waiting on it to try and figure all this out. I said, ‘how many years actually have I come to these meetings?’, one right after the other, and I finally stopped going for a while because it doesn’t make sense for me to speak if they’re not gonna follow [up] on it, and they’re gonna say ‘you gotta wait until next meeting’. That’s just closing it off altogether - a closed door.”	3			
Adaptation	Include more community voices in decision making	“Too many people came in and put up too many fish in Klawock, so they actually had to shut [the town’s fishing creek] down. But keeping closer local control of what’s going on, they have more fish each year.”	5	Fish		

Adaptation	Pass knowledge along (education)	“I find that when you’re out there, it’s good to teach others of what you’re looking for. If you’ve run out of store-bought foods, what can you eat while you’re still out there if your boats dry. You can eat what’s out there, the gumboots by the rocks or the cockles and clams. I eat them raw, and I wait for the tide, and then look around and sometimes when the berries are out you can eat the berries. It’s survival.”	3	Shellfish, berries		
Adaptation	Pass knowledge along (education)	“People need to be educated.”	5			
Adaptation	Pass knowledge along (education)	“We had ways of predicting the weather or knowing what was coming, but I don’t know them… we weren’t encouraged to remember these things because… everything was going to be learned in school. And now you see people on Facebook ‘we should teach this in school, we should teach that in school’… in my opinion, maybe you should teach something to your children at home. Like balancing the checkbook… how to cut up a deer, we shouldn’t have to teach that at the school, we should be able to learn that at home.”	5			
Adaptation	Pass knowledge along (education)	“People need to take responsibility for some education on their own behalf, and not try to dump it off on the school or somebody else. I think we need to be more involved in educating our children.”	5			
Adaptation	Pass knowledge along (education)	“We need to relearn [how everything is connected] and stop destroying the communication network of the Earth. I believe it - the Earth is alive and the Earth is getting mad.”	5			
Adaptation	Pass knowledge along (education)	“[HIA should] educate the people in Hoonah as best you can, to what traditional means and methods we used to have, and try to find people that remember some of them and rebuild them.”	5			
Adaptation	Decrease negative human impacts on the environment	“The thing that I wanted to see done was [stop] the factories who spout… making all that smoke, making it toxic.”	4			
Adaptation	Preventative and immediate action	“For how many years now, it’s been dragging on, and to me, we can take better care of Earth.”	4			
Adaptation	Preventative and immediate action	“All this [natural resource depletion / degradation] should have been taken care of 20, 30 years ago, so that we wouldn’t be at this point.”	4			
Adaptation	Preventative and immediate action	“Do something. We gotta do something; doing nothing is not the answer. Even if we’re doing something and it may not be all that we need to do, it’s at least something, that’s the beginning. Then we can adjust down the line.”	5			
Adaptation	Take responsibility / become aware	“Every community in Southeast Alaska has a 23,040 acre clear cut around it because of our Village Corporations. We ourselves have destroyed the environment around our own communities. That needs to be known and people have to understand that we have some responsibility here, we can’t just say ‘the Corporation did it’ because we allowed it to happen.”	5			
Adaptation	Take responsibility / become aware	“I think it’s unfortunate that people are proud of the fact that ‘we can load a ship [of felled timber] in three days’, I think that we need to have more awareness about what we’re doing.”	5			
Adaptation	Take responsibility / become aware	“I think the main thing is to become aware and pay attention to the details, because the details are what’s killing us. If you can do something without burning that extra gallon of gas, don’t [burn the extra gallon of gas].”	5			
Adaptation	Take responsibility / become aware	“People need to take responsibility for some education on their own behalf, and not try to dump it off on the school or somebody else. I think we need to be more involved in educating our children.”	5			

Adaptation	Take responsibility / become aware	“When our people moved into a place, we didn’t feel like we had the right to dominate it. We had a responsibility to take care of it, and that’s how it was described. They would say, ‘[my clan] takes care of this place’. They didn’t say ‘[my clan] owns this place’, the [clan] takes care of this place.”	5			
Adaptation	Take responsibility / become aware	“Our grandchildren and our great grandchildren are going to inherent the problems that we did nothing about, or the problems we created. We have to take responsibility individually and collectively to [address] these things. It’s going to take all of us.”	5			
Adaptation	Take responsibility / become aware	“Do something. We gotta do something; doing nothing is not the answer. Even if we’re doing something and it may not be all that we need to do, it’s at least something, that’s the beginning. Then we can adjust down the line.”	5			
Adaptation	Reconnect with the environmental through ceremonies	“We had ceremonies to welcome back the salmon, and we would sing songs and welcome them back. When I grew up and we went fishing, we always ate the first sockeye [salmon] we caught. The first sockeye that came aboard the boat, the cook pulled that sockeye aside, the fish was cleaned and hung for a day, and we ate that fish. That’s what we did. And I think that these ceremonies have spiritual signficance, and that spiritual significance and spiritual acts actually can have an impact on physical environments.”	5	Salmon		
Adaptation	Reconnect with the environmental through ceremonies	“These cermonies need to be rediscovered and they need to start happening again. The streams here, the people here, the clans that used to own them should be out there welcoming the salmon back.”	5	Salmon		
Adaptation	Respect wildlfie	"People here - even the local people - get all wound up because a bear walked by their house. The bear were here first.”	5			
Adaptation	Respect wildlfie	“We have a bear, she walks by our house every spring and she eats grass. She’s doesn’t bother anybody. If you go bother her, she will bother you. But what they do is come out and shoot them, which is not a solution. The bear were here first.”	5			
Adaptation	Respect wildlfie	“The bears are important. Killing the bears because somebody is afraid of bears is not the solution; the solution is to educate people to respect bears, treat bears as if they are part of our environment.”	5			
Adaptation	Respect wildlfie	“In my clan, we have a story about the woman that married a bear, and the woman that married a frog. I can’t say that a woman actually went to live with a bear, but these are stories in indication of how close we used to be to the animals.”	5			
Adaptation	Respect wildlfie	“[My wife] is a weaver. When she gets roots from a spruce tree, she thanks the tree. The same thing for my friends that are cedar weavers, they thank the cedar tree before they take the cedar. And it makes a difference, because trees are alive. Obviously, they’re alive.”	5	Spruce, cedar		
Adaptation	Respect wildlfie	“Everything depends on everything else for existence. Everything.”	5			
Adaptation	Respect wildlfie	“When our people moved into a place, we didn’t feel like we had the right to dominate it. We had a responsibility to take care of it, and that’s how it was described. They would say, ‘[my clan] takes care of this place’. They didn’t say ‘[my clan] owns this place’, the [clan] takes care of this place.”	5			
Adaptation	Learning	“To me, [climate change adaptation] is like us learning to live with our surroundings as everything changes. Having to adapt to something.”	6			
Adaptation	Learning	“Having to learn to adapt to [a change].”	6			

Adaptation	Reporting - outreach and education	“If we get reports, if [HIA Environmental] thinks of something that needs to be brought to [the Tribal board’s] attention- I’m always open for anyone to tell me if there’s something that needs to be addressed. Don’t hold it to yourself. Tell me if there’s something we need to address. Let me know, and we can ask questions on it and address [it], if there’s something that we need to.”	6			
Adaptation	Strategic development	“To me, we need to strategically put some [cell towers] in places so our people have a way to call for help [while hunting/gathering without cell service].”	6			
Adaptation	Strategic development	“I think if we strategically plot where we could put another [cell] tower that would benefit the island more.”	6			

Appendix F: Interview Themes

Compiling and organizing themes from interviews

Research questions:

1. What changes regarding the natural environment, and interactions with them, are community members perceiving in Hoonah?
2. What concerns do they have about these perceived environmental changes?
3. In what ways can Hoonah's community better adapt to changing environmental conditions, specifically when they adversely impact traditional ways of life?

Interview 1: HIA_01

- CC in Hoonah
    - Loss of resources overall
        - [1:17] "A lot of the things that we depend on will soon disappear, simply because I feel like climate change has affected a lot of things and will continue until something drastic happens."
        - [5:16] "It just seems like we're gradually losing all the things that we live on subsistently."
        - [10:47] "The things that climate change has done is [it has] made a lot more things impossible for us."
        - [5:06] "Halibut- there isn't as much. Water's too warm or something, I don't know."
    - Resources are degraded (smaller, less quality)
        - [3:53] "Our berries that we normally pick at certain times of the year, some have dried up because of the heat and some got water logged because of the rain. [It] never used to be that way."
        - [4:57] "We harvest deer and sometimes they aren't as big as they normally are, they're getting smaller."
        - [7:46] "Even the herbs are smaller now, mainly because of the heat."
        - [8:35] "The herbs we normally pick and gather are smaller, so we gotta pick twice as much."
    - More competition between/among human and nonhuman animals
        - [4:21] "When the berries dry up, the bears wander around town more frequently."
        - [4:27] "When it doesn't rain enough, fish can't go up the stream so the bears are in town."
    - Increasing temperatures and heat waves
        - [2:22] "We can see for ourselves that the winter months here are all but mild compared to what it used to be."
        - [2:36] "There was a time where we couldn't go out our front doors because of the snow, but since it started warming up, our winters have become less and less cold."
        - [2:56] "Our cold snap that lasts probably about a week, sometimes it drops below zero but most the time it stays above zero."
        - [7:55] "We never used to get any temperatures over 75, now 75 has come and gone many times."

        - [8:06] “It’s been a lot hotter every summer and it lasts a little longer.”
        - [8:27] “The snows we used to get for winter we no longer get.”
    - Changes in precipitation
        - [2:22] “We can see for ourselves that the winter months here are all but mild compared to what it used to be.”
        - [2:36] “There was a time where we couldn’t go out our front doors because of the snow, but since it started warming up, our winters have become less and less cold.”
        - [8:27] “The snows we used to get for winter we no longer get.”
    - Increased human health risks
        - [2:03] “The rain is causing a lot more slides around here that never used to happen, regardless of how hard it used to rain.”
        - [4:21] “When the berries dry up, the bears wander around town more frequently.”
        - [4:27] “When it doesn’t rain enough, fish can’t go up the stream so the bears are in town.”
    - More erosion and landslides from extreme rain events
        - [2:03] “The rain is causing a lot more slides around here that never used to happen, regardless of how hard it used to rain.”

- Community concerns
    - Resilience against CC
        - [1:48] “Being adapt to just about everything that’s coming on [concerns me]. Heat waves, getting more rain, more heat.”
    - Less participation in traditional practices
        - [9:08] “Elders now, they just don’t practice any [sustainable resource practices].”
    - Traditions / traditional practices are becoming harder to do
        - [5:16] “It just seems like we’re gradually losing all the things that we live on subsistently.”
        - [8:35] “The herbs we normally pick and gather are smaller, so we gotta pick twice as much.”
        - [10:47] “The things that climate change has done is [it has] made a lot more things impossible for us.”
    - Increasing difficulty to secure necessary resources
        - [8:35] “The herbs we normally pick and gather are smaller, so we gotta pick twice as much.”
    - More competition between/among human and nonhuman animals
        - [4:21] “When the berries dry up, the bears wander around town more frequently.”
        - [4:27] “When it doesn’t rain enough, fish can’t go up the stream so the bears are in town.”
    - Culture has been transformed by settler colonial systems
        - [9:14] “It seems like our culture has been put into paper- everything requires paper. Whereas before, we didn’t need paper, we didn’t need permission to cut trees down or anything … we didn’t need permission or paperwork to hunt deer or get fish. Now we’re required to have licenses to

get fish, we're required to get paperwork to get trees, unless [the USFS] provides it for us."
        - [10:23] "A lot of the things the elders used to do without paperwork."
        - [13:23] "There's a lot of elders out there that HIA can be helping but they're not, all because 'you get too much on retirement', 'you make too much money on unemployment'."

- Adaptation
    - Secure traditional foods for elders (HIA)
        - [11:20] "I think HIA should help more elders."
        - [13:03] "I think if they [HIA] offered more- there's a lot of people in this town that can't go fishing, but they want fish. There's a lot of people in this town that want seal or deer and can't hunt or don't have any way of doing it."
        - [14:41] "So I think HIA should go above and beyond to try and get all the foods that the Natives use."
    - Develop trust between the community and HIA
        - [18:08] "HIA came by one year and says 'we're gonna replace your windows, we're gonna replace your door'. So they measured the windows, they measured the door. Four years in a row we filled out the application to get new windows and new doors, and every year they come by and measured the window, and measured the door. And it never happened. Every year they said the same thing, 'we ran out of funds'."
        - [19:43] "There's a lot of elders out there that filled out the same paperwork I did, but HIA won't help them. They'll come in and measure but they won't do nothing about it. 'Youre on the list', well where the heck's the list?"
        - [13:39] "It's all how much money can they [HIA] save and not how much money they can help others with."
    - Do what you need to do to secure the resources you need
        - [16:07] "I've learned to adapt. I've learned to overcome a lot of situations. I spent an hour and a half filling out paperwork for food stamps, trying to get on food stamps. Food stamps says 'we can give you $13 a month'. $13 a month. I told them to keep it. If they were to tell me, before I filled out all that paperwork an hour and a half later, I wouldn't have filled it out."
    - Accept / embrace
        - [20:09] "It's like talking into the wind and expecting you to hear it. But that's okay. Adapt."
    - Don't waste or overharvest resources
        - [10:36] "We never overdid when we took what we needed. We never took more than we needed."

Interview 2: HIA_02

- CC in Hoonah
    - More variable weather or seasons
        - [1:51] “In my days, we had lots of snow, we had fun playing in the snow. I see colder weather but hardly any snow, which doesn’t make sense.”
    - Changes in precipitation
        - [1:51] “In my days, we had lots of snow, we had fun playing in the snow. I see colder weather but hardly any snow, which doesn’t make sense.”
    - Loss of resources overall
        - [7:25] “We used to have an abundance of fish, and it’s really scarce now, especially king salmon. We used to have a lot of that. We took it for granted.”
        - [8:38] “Well I noticed when we go to our pay-out parties it’s getting less and less because it’s really hard to go out and pick. I used to go out without [my friend], now we have to worry about bears.”
        - [8:58] “And it seems like you have to go further out to get berries nowadays, we used to go to our backyard and have berries, now we destroy that by putting homes into them. I’m not saying that’s not right, I’m just saying it’s harder to get to our berries.”
    - Altered seasons or cycles for wildlife
        - [7:05] “The ones that are more outdoorsy in our community have noticed, I’ve listened to them, our fishing seasons aren’t quite right.”
    - Increased human health risks
        - [8:38] “Well I noticed when we go to our pay-out parties it’s getting less and less because it’s really hard to go out and pick. I used to go out without [my friend], now we have to worry about bears.”
        - [6:18] “In my days we never had to worry about bears, number one, because we’re digging into their homes and then they’re suffering because of our growth, but that’s life.”
    - More competition between/among human and nonhuman animals
        - [3:50] “More people come here. I don’t know, they seem to like harvesting our wildlife.”
        - [6:18] “In my days we never had to worry about bears, number one, because we’re digging into their homes and then they’re suffering because of our growth, but that’s life.”
        - [8:38] “Well I noticed when we go to our pay-out parties it’s getting less and less because it’s really hard to go out and pick. I used to go out without [my friend], now we have to worry about bears.”
        - [12:45] “Otters they overtake our shellfish, and there’s a lot of otters that will ruin our beaches.”

- Community concerns
    - Wasted resources
        - [10:46] “Someone kills something and only takes part of the [deer] meat, and leaves the rest. Or, killing the adult female and leaving the babies by themselves. That concerns me.”

        - [11:47] “My neighbor, they go out a lot on the boat, for whatever reason, taking pictures or hunting. But they saw a deer walking the beach and they saw it was suffering so they went up close to it and there were bow and arrows on it, and it was infected. So all they could do was put it down. Those are the things that really concern me.”
        - [12:26] “[Trophy hunters] do bear traps, just to get them to kill them. I don’t agree with gaming just for the hides.”
    - Lack of concern / action
        - [1:30] “It concerns me when there’s maybe a handful of people who are concerned, and others ‘no big deal’ because maybe they might not be here, I don’t understand that.”
        - [2:23] “Thanks to HIA and people from outside that are listening to us [about changing conditions], but there are still some who are not really taking us seriously.”
        - [5:53] “Our kids are losing what our values are”
        - [13:46] “It’s hunters that are irresponsible trying to find the deer that they shot [but don’t collect them]. Those are the kinds of things that really concern me.”
    - Resilience against CC
        - [1:19] “Animals will be different [seven generations from now], maybe we’ll lose some- extinct, if we don’t manage it properly.”
    - More competition between/among human and nonhuman animals
        - [3:50] “More people come here. I don’t know, they seem to like harvesting our wildlife.”
        - [12:45] “Otters they overtake our shellfish, and there’s a lot of otters that will ruin our beaches.”
        - [6:18] “In my days we never had to worry about bears, number one, because we’re digging into their homes and then they’re suffering because of our growth, but that’s life.”
        - [8:38] “Well I noticed when we go to our pay-out parties it’s getting less and less because it’s really hard to go out and pick. I used to go out without [my friend], now we have to worry about bears.”

- Adaptation
    - Environmental restoration
        - [7:43] “I really appreciate [the Tribal Environmental Coordinator] for that, making sure our rivers are clear so that we can have more fish come in.”
    - Environmental monitoring
        - [14:28] “As long as we’re monitoring [marine debris].”
    - Individual behavior change
        - [3:12] “But the ones that I go out fishing with are realizing- when we go take a bag for trash, they realize how much trash we have in there. I think that makes an impact. I guess lead by example would help us.”
    - Don’t waste or overharvest resources
        - [10:28] “We never overdid it. We never carried buckets of [berries]. I’ve seen a few people who overpick, and then it goes to waste. They overkill and that goes to waste.”

    - Awareness of environmental damages
        - [3:12] “But the ones that I go out fishing with are realizing- when we go take a bag for trash, they realize how much trash we have in there. I think that makes an impact.”
    - Build a healthy community
        - [5:03] “I would like to see a healthy community and I would like to see our kids be proud of our community.”
    - Collaborate locally and regionally
        - [2:23] “Thanks to HIA and people from outside that are listening to us [about changing conditions], but there are still some who are not really taking us seriously.”
        - [4:28] “But I welcome the people who are willing to improve our community.”
    - Accept / embrace
        - [4:23] “There’s nothing we can do but let change in our community”
    - Do what you need to do to secure the resources you need
        - [4:37] “When someone objects to cutting our logs, or destroying our land because of the economy, my comeback to them is ‘okay then, find a solution to put food on our families’ table’. That’s my comeback to them.”
    - Better enforcement of wildlife protections and hunting regulations
        - [13:16] “We make all these rules and regulations for wildlife, but there’s not enough enforcement. There’s only maybe one or two out there, and there is abuse out there.”

Interview 3: HIA_03

- CC in Hoonah
    - Resources are degraded (smaller, less quality)
        - [14:58] “When you go out to pick a lot of berries, really taste the berries in different areas, you can feel and taste the difference of each berry. They can be bitter or they can be sweet, depending on wherever you go. That is a big change there - one would have to actually go out to actually see it and then feel it, and then taste it for themself to know what I’m talking about.”
        - [16:02] “[The deer meat] gets to a point where the taste is different… depending on where they’re at, you can taste the difference in the stew. They can be wild but somehow it doesn’t taste right… it’s getting to a point where it makes me wonder ‘where are these deer, what are they eating that makes them taste more stronger’... I don’t know what’s going on with them but I think it has to do with climate change, it’s a rough thing.”
        - [26:22] “There’s a stronger taste in seal now. I don’t know what’s going on with them, but the meat is more raunchy.”
    - More competition between/among human and nonhuman animals

        - [0:51] “The sea otters and land otters out there - we have so many out there. I was wondering why there aren’t so many tags for them, because the way I see it, they’re digging into the places of our gumboots, cockles and clams, the dungeness crabs, and anything else they can get. If we don’t watch the process of it, the food that’s out there that we harvest each year is gonna be less and less. And when that happens, it’s just gonna be a harder way of life to live.”
        - [2:06] “Where they come in, out of towners, get to crabs as we ourselves harvest that stuff. But they take multitudes and multitudes out, of where we in turn have to struggle to find out where they’re at.”
        - [3:51] “We get six tags [for deer], four in one area and some two in another area. Inbetween Sealaska and Huna Totem [Corporation] it may be private land, but still, even the out-of-towners get in that area… We go out there and hunt and look around, but we have to go further than they do.”
        - [5:04] “We have so many bears out there, I even went to the City Hall and tried to explain it, that in our community, the bears walk through it… We got kids that walk around out here. I got my nieces and nephews out here. I worry about them.”
    - Sea level changes
        - [22:43] “On my depth finder, when I’m out on the boat, I’ve seen some different areas where the change is. There’s some reefs out there that hadn’t been there. I have to watch out where I go… I don’t know where those reefs come from. I’ve been here a lot of years and it’s just something different.”
    - Increased human health risks
        - [8:52] “We have to watch out when we have seasons to go out there. [The seasons are] different when the climate starts to change; we have to look at, ‘is this a good time to go out there and process the gumboots, cockles, and clams, or do we have to wait after the red tide as well’. [Climate change] affects all that area.”
        - [20:24] “I made the mistake one time of going out in rough weather with my dad, I got reprimanded and turned the boat around and came back in and played it safe, not only for myself but for my dad as well. I understood the mistake I made.”
        - [5:04] “We have so many bears out there, I even went to the City Hall and tried to explain it, that in our community, the bears walk through it… We got kids that walk around out here. I got my nieces and nephews out here. I worry about them.”
    - Loss of resources overall
        - [8:52] “We have to watch out when we have seasons to go out there. [The seasons are] different when the climate starts to change; we have to look at, ‘is this a good time to go out there and process the gumboots, cockles, and clams, or do we have to wait after the red tide as well’. [Climate change] affects all that area.”

- Community concerns

    - Human impacts on the environment
        - [8:01] “People have bonfires out [at Long Island], for a picnic. But they burn pallets. What’s out there left after that is a lot of nails out there. Nails are metal, metal affects the food process. It can’t be stopped because it’s already there.”
        - [3:04] “But still, when the tide goes out, that gas and oil just sits there [at Graveyard Island]. That’s our food that’s in that area.”
        - [7:39] “Our beach asparagus, they’re being run over by four wheelers and cars.”
    - More competition between/among human and nonhuman animals
        - [0:51] “The sea otters and land otters out there - we have so many out there. I was wondering why there aren’t so many tags for them, bc the way I see it, they’re digging into the places of our gumboots, cockles and clams, the dungeness crabs, and anything else they can get. If we don’t watch the process of it, the food that’s out there that we harvest each year is gonna be less and less. And when that happens, it’s just gonna be a harder way of life to live.”
        - [2:06] “Where they come in, out of towners, get to crabs as we ourselves harvest that stuff. But they take multitudes and multitudes out, of where we in turn have to struggle to find out where they’re at.”
        - [3:51] “We get six tags [for deer], four in one area and some two in another area. Inbetween Sealaska and Huna Totem [Corporation] it may be private land, but still, even the out-of-towners get in that area… We go out there and hunt and look around, but we have to go further than they do.”
        - [5:04] “We have so many bears out there, I even went to the City Hall and tried to explain it, that in our community, the bears walk through it… We got kids that walk around out here. I got my nieces and nephews out here. I worry about them.”
    - Loss of resources overall
        - [9:25] “Seven generations from now they’re gonna have a tougher time than we do [accessing resources], guaranteed.”
    - Decision makers not listening to community voices / little community representation in decision making
        - [12:34] “Who has the voice around here? Who actually can have a voice and speak for somebody to hear? Who can be in those seats to have an understanding of where we’re coming from? Will they have an ear to hear, or will they have a closed door, just to say ‘wait’ - how many years do we have to wait?”

- Adaptation
    - Mindful natural resource management
        - [23:47] “Some of my family gather them together, the branches of the [blue]berries, and replanted them in the garden in order to sustain what was out there, is now in here, but yet leave enough out there so that others can get them.”
    - Increased hunting for select species

        - [1:53] “I was suggesting that they have more tags for [sea otters], especially with the - getting to the point where I spoke about the dungeness crabs.”
        - [6:04] “I kind of feel there’s one too many bears and [we] need more than just one tag for every four years, cause that’s a lot of bears.”
    - Better enforcement of wildlife protections and hunting regulations
        - [4:38] “[I’m] just suggesting more of an input on watching out for [out-of-town hunters].”
        - [25:26] “[HIA could] make [the four wheelers] stop smashing all the beach asparagus… there’s a place [over] there where a lot of wild strawberries are. They’re getting run over.”
        - [25:56] “[HIA] could help by not having too many boats take too much crabs out of the area where we can process them ourselves in smaller boats.”
    - Collaborate locally and regionally
        - [10:02] “We can get through them, but we’re gonna have to work together in order to make it work. If we don’t work together, it’s gonna be a tough struggle.”
    - Empathize with each other
        - [10:14] “We have folks that are out here in our community that care enough for one another to help one another. That’s what you call [Tlingit word], ‘pulling together’. I see it, I’ve appreciated it.”
    - Include more community voices in decision making
        - [11:59] “I keep going to the City and explaining things but they always say ‘this is on a different level’, ‘this is on a different meeting’, and they’re waiting on it to try and figure all this out. I said, ‘how many years actually have I come to these meetings?’, one right after the other, and I finally stopped going for a while because it doesn’t make sense for me to speak if they’re not gonna follow [up] on it, and they’re gonna say ‘you gotta wait until next meeting’. That’s just closing it off altogether - a closed door.”
    - Pass knowledge along (education)
        - [21:12] “I find that when you’re out there, it’s good to teach others of what you’re looking for. If you’ve run out of store-bought foods, what can you eat while you’re still out there if your boats dry. You can eat what’s out there, the gumboots by the rocks or the cockles and clams. I eat them raw, and I wait for the tide, and then look around and sometimes when the berries are out you can eat the berries. It’s survival.”
    - Environmental monitoring
        - [26:40] “On our population of the deer, we just have to keep an eye on that.”
        - [26:59] “I kinda feel we have to work on the bear issue too, there’s one too many now.”
        - [20:07] “My grandpa told me ‘when you look at the weather, when the winds are blowing as strong as they do and it goes up the bay, it’s safer to be on the other side than it is to be going out in that rough weather’.”

Interview 4: HIA_04

- CC in Hoonah
    - Increased competition between/among human and nonhuman animals
        - [5:58] “You look out outside right now, we have problems with the bears.”
    - Loss of resources overall
        - [3:06] “[Climate change] is affecting our fishing industry.”
        - [3:35] “We didn’t have hardly any water, we had to really be careful how much water we were using. And fish weren’t going up the creek. And every four years, we can expect a big fish run. This year there was hardly anything.”
        - [6:03] “We haven’t had very much blueberries because weather was bad, it got really hot.”
        - [6:32] “Last year, it was very few salmonberries that came this way.”
        - [7:23] “Even when it comes to fishing, or even going out to [fishing location] to get sockeye, it’s not like before.”
        - [18:46] “Raspberries - we didn’t get a whole lot like we normally do, because we had so much sun and not enough rain.”
    - More erosion and landslides from extreme rain events
        - [11:36] “The mudslides [are a change]. You look across, out the window out here, and you’ll see two mudslides right over there. And it made the water really muddy-looking. I know when I was growing up I can’t say that we never had the water being brown when it rained like that, but it seems like we’re having more rain…it’s like, that’s a lot more rain.”
    - Resources are degraded (smaller, less quality)
        - [18:55] “[Friend] went picking and [the berries] were [smaller], and they were dried out.”
    - Increased human health risks
        - [11:36] “The mudslides [are a change]. You look across, out the window out here, and you’ll see two mudslides right over there. And it made the water really muddy-looking. I know when I was growing up I can’t say that we never had the water being brown when it rained like that, but it seems like we’re having more rain…it’s like, that’s a lot more rain.”
        - [5:58] “You look out outside right now, we have problems with the bears.”
    - Increasing temperatures and heat waves
        - [19:04] “We needed rain, we had too much sunshine.”
        - [18:46] “Raspberries - we didn’t get a whole lot like we normally do, because we had so much sun and not enough rain.”

- Community concerns
    - Resilience against CC
        - [0:53] “Climate change, I’ll tell you I am concerned about it because it seems to be affecting all over.”

    - Decision makers not listening to community voices / little community representation in decision making
        - [4:00] “It’s like, how do you make [politicians] do something?”
    - Increasing difficulty to secure necessary resources
        - [8:08] “Now that it’s getting less and less, I pray that this year it’s not going to be like that…[hunting and fishing] are important for us to survive, because right now, I went to the store and I came back with a medium sized bag, and it was $47.”
    - Poor natural resource management
        - [9:39] “Especially when they cut out the wood, and then they try clearing away- especially by Game Creek- because when it rains, it gets muddy. The fish can’t see. And the salmon fry too, it was raining so hard that it’s making me wonder how much salmon is going to come back in a couple years.”

- Adaptation
    - Decrease negative human impacts on the environment
        - [1:03] “The thing that I wanted to see done was [stop] the factories who spout… making all that smoke, making it toxic.”
    - Preventative and immediate action
        - [2:50] “For how many years now, it’s been dragging on, and to me, we can take better care of Earth.”
        - [6:48] “All this [natural resource depletion / degradation] should have been taken care of 20, 30 years ago, so that we wouldn’t be at this point.”
    - Don’t waste or overharvest resources
        - [7:47] “Never never take more than you can handle. And if you take more than you can handle, pass it on to some elders that can’t go fishing or that can’t go hunting. That’s how we took care of each other.”
    - Environmental restoration
        - [41:14] “I really appreciated seeing how they cleaned up the rivers and fixed it.”

Interview 5: HIA_05

- CC in Hoonah
    - Loss of resources overall
        - [1:23] “If we keep going the direction we’re going there’s going to be no subsistence resources because we’re killing the ocean, we’re killing the land, and there’s going to be no place for subsistence resources to live.”
        - [1:43] “Our generation is the last one that’s going to experience abundance if things keep going in the same direction, that’s the way I feel.”
        - [6:43] “It seems to me that the abundance of the geese and cranes has lessened.”
        - [11:17] “There have been years where I notice that there was a great abundance of salmonberries, and I don’t think there were any last year.”

        - [11:26] “It seems to me like there are more times when there’s no berries than there are times where there are berries. And I think that has to do with a number of factors, I think it has to do with the logging, global warming, and increased rain on forests that have been denuded.”
        - [12:39] “[I think the biggest impacts of global warming on Hoonah will be] lack of food. When the water warms up too much things aren’t going to be able to grow.”
        - [13:35] “The Yukon River has no king salmon. Every year we used to go to the Alaska Federation of Natives, and people would be selling ‘Yukon [king salmon] strips’... we used to look forward to it, but we haven’t been able to buy any for at least 15 years. They just don’t have any, there’s just no king salmon to catch.”
        - [18:46] “We generally get enough [subsistence resources], we just don’t have as much as we used to.”
        - [35:33] “Not to mention, you notice there’s no red king crab season this year, there’s no snowcrab season this year, and it’s because of global warming and overfishing.”
        - [30:01] “In my lifetime we’ve seen frogs in Craig and Klawock, there used to be thousands and thousands of little frogs, now there’s none. Which to me is a dangerous thing, and this happened 30-40 years ago. The danger signs were already appearing then.”
    - Increasing temperatures and heat waves
        - [4:52] “There’s way less snow; when I first moved here [in the 1980’s], we would have 3-4 feet of snow in October. When I first came to Hoonah the snow was up to my hips… I’ve seen that, that’s a pretty major change.”
        - [7:15] “I think rain has replaced some of the snow.”
        - [7:44] “I think that there has been some more rain, I think statistically this was one of the wettest years on record in Juneau.”
        - [12:57] “Because it gets so warm up there [in Kotzebue] now - it’s been hitting 80 degrees [Farenheit] out there, which has never happened ever before - so it warms up the creeks so much it cooks the fish, and it cooks the [fish] eggs.”
    - Changes in precipitation
        - [11:26] “It seems to me like there are more times when there’s no berries than there are times where there are berries. And I think that has to do with a number of factors, I think it has to do with the logging, global warming, and increased rain on forests that have been denuded.”
        - [4:52] “There’s way less snow; when I first moved here [in the 1980’s], we would have 3-4 feet of snow in October. When I first came to Hoonah the snow was up to my hips… I’ve seen that, that’s a pretty major change.”
        - [7:15] “I think rain has replaced some of the snow.”
        - [7:44] “I think that there has been some more rain, I think statistically this was one of the wettest years on record in Juneau.”
    - More variable weather / seasons
        - [5:12] “The weather is different, the weather patterns are different.”
    - Changes in wildlife presence

        - [5:16] “We have birds that we haven’t had before, we have magpies starting to move up here. We have animals from warmer climates moving up here. So those are the things that I’ve seen since I arrived here.”

- Community concerns
    - Loss of resources overall
        - [1:23] “If we keep going the direction we’re going there’s going to be no subsistence resources because we’re killing the ocean, we’re killing the land, and there’s going to be no place for subsistence resources to live.”
        - [1:43] “Our generation is the last one that’s going to experience abundance if things keep going in the same direction, that’s the way I feel.”
        - [30:01] “In my lifetime we’ve seen frogs in Craig and Klawock, there used to be thousands and thousands of little frogs, now there’s none. Which to me is a dangerous thing, and this happened 30-40 years ago. The danger signs were already appearing then.”
    - Human impacts on the environment
        - [14:07] “The other issue is there’s no big movement to end trawling.”
        - [14:43] “We may be in a downward descending spiral, and we may not be able to stop some things no matter what we do.”
        - [19:40] “The other problem we have is hatcheries, because when they put in a hatchery they put up a weir and they kill the natural stock [of salmon] for the stream… in my opinion, hatcheries can be detrimental, except to the commercial fishermen who make a lot of money fishing dog [salmon] at [a popular dog salmon fishing location].”
        - [20:18] “I think [salmon hatcheries] has and will be making changes to the patterns of fish coming back to different streams.”
    - Limited by social systems
        - [15:43] “The problem is to do anything we have to burn gas. We’re going to use our boats, we’re going to use our cars to go hunting or something. We’re kind of stuck between nothing but bad choices.”
    - Culture has been transformed by settler colonial systems
        - [16:53] “Everybody became more into the ‘individual family unit’ type of a thing, whereas when I was young it was more like, your family was more included in stuff, I mean your extended family. So it’s not the same anymore.”
        - [17:54] “[Fish and wildlife officers] used to go hunting with the local guys. It was really interesting, because [the fish and wildlife officer] went along with the local management, the unwritten / unspoken management system that we used to have- don’t waste things, don’t kill too much, bring everything back or don’t leave stuff in the woods.”
        - [25:00] “We had ways of predicting the weather or knowing what was coming, but I don’t know them… we weren’t encouraged to remember these things because… everything was going to be learned in school.”
    - Lack of concern / action
        - [16:01] “Some major things need to start to happen.”
    - People have unlearned connections with the Earth

        - [25:00] “We had ways of predicting the weather or knowing what was coming, but I don’t know them… we weren’t encouraged to remember these things because… everything was going to be learned in school. And now you see people on Facebook ‘we should teach this in school, we should teach that in school’... in my opinion, maybe you should teach something to your children at home. Like balancing the checkbook… how to cut up a deer, we shouldn’t have to teach that at the school, we should be able to learn that at home.”
        - [33:42] “We need to relearn [how everything is connected] and stop destroying the communication network of the Earth. I believe it - the Earth is alive and the Earth is getting mad.”
        - [27:27] “These cermonies need to be rediscovered and they need to start happening again. The streams here, the people here, the clans that used to own them should be out there welcoming the salmon back.”
        - [28:36] “The bears are important. Killing the bears because somebody is afraid of bears is not the solution; the solution is to educate people to respect bears, treat bears as if they are part of our environment.
        - [28:57] “In my clan, we have a story about the woman that married a bear, and the woman that married a frog. I can’t say that a woman actually went to live with a bear, but these are stories in indication of how close we used to be to the animals.”
- Adaptation
    - Collaborate locally and regionally
        - [2:51] “I’m pretty confident that we ourselves can adapt, but we can’t do this as individual communities, we need to be united and we all need to do it together. Otherwise nothing will be solved. By everybody, I mean all the people in Alaska, not just the Native people, all the people. Everybody has to be involved to a certain extent.”
        - [16:03] “When I was young… the guys used to take turns on sein boats- different sein boats would go out at different times- and they’d take like four or five families, and they’d get all the deer they needed for the entire winter, in one trip. And then they’d wait a while for things to calm down and then another group would go out. So I think that could save some negative impacts of people going out individually.”
        - [34:06] “Our grandchildren and our great grandchildren are going to inherent the problems that we did nothing about, or the problems we created. We have to take responsibility individually and collectively to [address] these things. It’s going to take all of us.”
    - Preventative and immediate action
        - [38:15] “Do something. We gotta do something; doing nothing is not the answer. Even if we’re doing something and it may not be all that we need to do, it’s at least something, that’s the beginning. Then we can adjust down the line.”
    - Individual behavior change
        - [3:23] “But I think that we have the ability to deal with it, it’s as simple as everybody has to start to become aware of ‘what are you doing’ when you take a piece of paper towel and you use it, ‘what are you doing’ when you

use way more toilet paper than you should be using, ‘what are you doing’, so we all need to pay attention to these small things because if these small things get multiplied by 100,000 or 200,000 they become significant.”
        - [3:57] “Don’t leave your water running needlessly, don’t dump a cup of oil in the ditch cause it’s easier.”
        - [4:10] “I like paper towels, but I try not to use them as much as possible. When I clean my glasses I have lens cleaners, but I use them three times, I don’t use them just once. I think little things like that multiplied by large numbers is what we need to do. And if you can walk downtown, walk downtown, don’t drive.”
        - [15:28] “I think the main thing is to become aware and pay attention to the details, because the details are what’s killing us. If you can do something without burning that extra gallon of gas, don’t [burn the extra gallon of gas].”
        - [34:06] “Our grandchildren and our great grandchildren are going to inherent the problems that we did nothing about, or the problems we created. We have to take responsibility individually and collectively to [address] these things. It’s going to take all of us.”
    - Don’t waste or overharvest resources
        - [3:57] “Don’t leave your water running needlessly.”
    - Pass knowledge along (education)
        - [4:06] “People need to be educated.”
        - [25:00] “We had ways of predicting the weather or knowing what was coming, but I don’t know them… we weren’t encouraged to remember these things because… everything was going to be learned in school. And now you see people on Facebook ‘we should teach this in school, we should teach that in school’... in my opinion, maybe you should teach something to your children at home. Like balancing the checkbook… how to cut up a deer, we shouldn’t have to teach that at the school, we should be able to learn that at home.”
        - [25:52] “People need to take responsibility for some education on their own behalf, and not try to dump it off on the school or somebody else. I think we need to be more involved in educating our children.”
        - [33:42] “We need to relearn [how everything is connected] and stop destroying the communication network of the Earth. I believe it - the Earth is alive and the Earth is getting mad.”
        - [37:49] “[HIA should] educate the people in Hoonah as best you can, to what traditional means and methods we used to have, and try to find people that remember some of them and rebuild them.”
    - Take responsibility / become aware
        - [11:48] “Every community in Southeast Alaska has a 23,040 acre clear cut around it because of our Village Corporations. We ourselves have destroyed the environment around our own communities. That needs to be known and people have to understand that we have some responsibility here, we can’t just say ‘the Corporation did it’ because we allowed it to happen.”

        - [12:18] “I think it’s unfortunate that people are proud of the fact that ‘we can load a ship [of felled timber] in three days’, I think that we need to have more awareness about what we’re doing.”
        - [15:28] “I think the main thing is to become aware and pay attention to the details, because the details are what’s killing us. If you can do something without burning that extra gallon of gas, don’t [burn the extra gallon of gas].”
        - [25:52] “People need to take responsibility for some education on their own behalf, and not try to dump it off on the school or somebody else. I think we need to be more involved in educating our children.”
        - [30:29] “When our people moved into a place, we didn’t feel like we had the right to dominate it. We had a responsibility to take care of it, and that’s how it was described. They would say, ‘[my clan] takes care of this place’. They didn’t say ‘[my clan] owns this place’, the [clan] takes care of this place.”
        - [34:06] “Our grandchildren and our great grandchildren are going to inherent the problems that we did nothing about, or the problems we created. We have to take responsibility individually and collectively to [address] these things. It’s going to take all of us.”
        - [38:15] “Do something. We gotta do something; doing nothing is not the answer. Even if we’re doing something and it may not be all that we need to do, it’s at least something, that’s the beginning. Then we can adjust down the line.”
    - Include more community voices in decision making
        - [19:23] “Too many people came in and put up too many fish in Klawock, so they actually had to shut [the town’s fishing creek] down. But keeping closer local control of what’s going on, they have more fish each year.”
    - Environmental restoration
        - [21:33] “I think we need to enhance the wild stock [of salmon], not make [salmon] farms.”
        - [34:39] “Right now in Washington and Oregon they’re starting to remove some dams so that the salmon can travel. I think those are the things that need to start happening, because when they take the dams out the salmon can come back, and they will again populate the streams.”
    - Reconnect with the environment through ceremonies
        - [26:38] “We had ceremonies to welcome back the salmon, and we would sing songs and welcome them back. When I grew up and we went fishing, we always ate the first sockeye [salmon] we caught. The first sockeye that came aboard the boat, the cook pulled that sockeye aside, the fish was cleaned and hung for a day, and we ate that fish. That’s what we did. And I think that these ceremonies have spiritual signficance, and that spiritual significance and spiritual acts actually can have an impact on physical environments.”
        - [27:27] “These cermonies need to be rediscovered and they need to start happening again. The streams here, the people here, the clans that used to own them should be out there welcoming the salmon back.”
    - Respect wildlife

        - [27:51] “People here - even the local people - get all wound up because a bear walked by their house. The bear were here first.”
        - [28:00] “We have a bear, she walks by our house every spring and she eats grass. She’s doesn’t bother anybody. If you go bother her, she will bother you. But what they do is come out and shoot them, which is not a solution. The bear were here first.”
        - [28:36] “The bears are important. Killing the bears because somebody is afraid of bears is not the solution; the solution is to educate people to respect bears, treat bears as if they are part of our environment.”
        - [28:57] “In my clan, we have a story about the woman that married a bear, and the woman that married a frog. I can’t say that a woman actually went to live with a bear, but these are stories in indication of how close we used to be to the animals.”
        - [29:22] “[My wife] is a weaver. When she gets roots from a spruce tree, she thanks the tree. The same thing for my friends that are cedar weavers, they thank the cedar tree before they take the cedar. And it makes a difference, because trees are alive. Obviously, they’re alive.”
        - [29:54] “Everything depends on everything else for existence. Everything.”
        - [30:29] “When our people moved into a place, we didn’t feel like we had the right to dominate it. We had a responsibility to take care of it, and that’s how it was described. They would say, ‘[my clan] takes care of this place’. They didn’t say ‘[my clan] owns this place’, the [clan] takes care of this place.”
    - Mindful natural resource management
        - [32:46] “I think we need to get back into managing the forest, for instance. I don’t think you can rebuild a forest by creating a tree plantation. Dealing with what we’ve done with all the logging is going to be very difficult and I think it’s going to take hundreds and hundreds of years to repair. Because we’ve destroyed the communication network under the forests.”
        - [35:13] “I think that we need to just totally stop trawling. It needs to be stopped because- there’s supposed to be mid-water trawlers but they have now defined ‘mid-water trawling’ as the net is in the mid-water, but the doors are dragging on the bottom, killing the bottom.”
        - [35:33] “Not to mention, you notice there’s no red king crab season this year, there’s no snowcrab season this year, and it’s because of global warming and overfishing.”
        - [37:05] “I think that the management system of the State of Alaska is not right because they do what’s called ‘single-species management’, we have a salmon management plan, we have a deer management plan, we have a bear management plan; it needs to be an ecosystem management plan. Not any individual harvestable resource.”

Interview 6: HIA_06

- CC in Hoonah

- Altered seasons / cycles for wildlife
  - [16:00] “The sockeye are arriving late. I don’t think [F&G] have changed the times [of fishing seasons], it’s just the sockeye have… I don’t know if it’s because of global warming, I don’t know if it’s that or if something has happened that caused their route back to us to change. They have a path that they take. They alway say ‘our fish go out to the ocean, then they come back’ - where do they go? How far away do they go?”
  - [20:07] “Berries have been really strange - I don’t know if it’s been too warm, or it’s been to cold, the winter stayed longer than it should, or… I remember one year the berries came, it was like spring was here and then we had a freeze. [The freeze] killed a lot of the berries. I don’t know, I don’t know what’s causing the weather to be so different.”
- Resources are degraded (smaller, less quality)
  - [20:07] “Berries have been really strange - I don’t know if it’s been too warm, or it’s been to cold, the winter stayed longer than it should, or… I remember one year the berries came, it was like spring was here and then we had a freeze. [The freeze] killed a lot of the berries. I don’t know, I don’t know what’s causing the weather to be so different.”
- Loss of resources overall
  - [20:51] “I noticed there are not as many [seal], but I’ve noticed too that there are killer whale, and we didn’t used to have the killer whale that much around here.”
  - [31:26] “Cause we’re having to go farther away to get [food and nonfood resources].”
- Changes in wildlife presence
  - [20:51] “I noticed there are not as many [seal], but I’ve noticed too that there are killer whale, and we didn’t used to have the killer whale that much around here.”
- More variable weather / seasons
  - [27:07] “Like our winters have been strange. We used to have tons of snow, so when you get snow it’s usually warmer. We’ve been having really cold spells, really colder than usual to me. And then in the springtime it’s still kind of cold, so I don’t know; to me, it’s like our seasons are off just a wee bit, by a month or two.”
  - [20:07] “Berries have been really strange - I don’t know if it’s been too warm, or it’s been to cold, the winter stayed longer than it should, or… I remember one year the berries came, it was like spring was here and then we had a freeze. [The freeze] killed a lot of the berries. I don’t know, I don’t know what’s causing the weather to be so different.”
- Increased human health risks
  - [41:46] “[Bear threats] have hindered us from getting our berries, teas - stuff that we harvest - asparagus. I used to go hunting and not have any fear until I got charged [by a bear], and then I still would go out but it was more [watching for bears] than paying attention to what I should be doing. So that to me has hindered us as people because now we have to get more people together to pick [to deter bears].”
- More competition between / among human and nonhuman animals

        - [41:46] “[Bear threats] have hindered us from getting our berries, teas - stuff that we harvest - asparagus. I used to go hunting and not have any fear until I got charged [by a bear], and then I still would go out but it was more [watching for bears] than paying attention to what I should be doing. So that to me has hindered us as people because now we have to get more people together to pick [to deter bears].”
        - [9:52] “The bears [concern me]. The environment has changed, now the bears are here instead of out where they should be.”
        - [10:02] “Now we have the deer that have come in. I don’t know why the deer have all moved in [to town].”
        - [10:19] “I remember when I was little, the bears used to come in. [That] was between, I’m guessing about 40 years ago, bears would kind of come through town, it wasn’t so bad. You didn’t see much deer then.”
        - [12:10] “That was in the late 1980’s, early 1990’s, when [the bears] started coming in more. I don’t know what drove them in, if it’s the garbage.”
        - [35:19] “The bears are getting more aggressive. We need to do something - cause that’s affecting us, getting our berries. We need to do something to thin out the bear population.”
        - [36:26] “To me, [the bear population] is overpopulated. They’re claiming their island back is what’s happening. That’s honestly what it seems to be; [the bears are] moving back in. We kind of moved [the bears] out when we moved into Hoonah.”
        - [43:25] “Maybe that’s why [the bears] are coming into town. They’re running out of places to be out there.”

- Community concerns
    - Stringent ADF&G regulations
        - [1:43] “When I want to go get sockeye [salmon], there’s this window that they give us. They won’t sway from that window, even though if the sockeye hasn’t come - [I don’t know how] many times we’ve gone out there and there’s no sockeye. And we plead with them… cause we’re trying to get it for a Ku’eex [celebration], and it’s like ‘nope’. So it’s almost next to impossible to get our foods because we’re being told ‘you can’t go at this time’ or ‘the window was here and you missed it’. But it’s not that we missed it, it’s just that the fish hadn’t shown up.”
        - [18:05] “And then [ADF&G] limit you on how many you can take, they keep dropping the amount you can take. And the price of fuel is crazy.”
    - Increasing difficulty to secure necessary resources
        - [2:58] “Food is getting expensive to buy at the store. Buying things in Juneau and having them shipped over is getting to be expensive.”
        - [18:05] “And then [ADF&G] limit you on how many you can take, they keep dropping the amount you can take. And the price of fuel is crazy.”
    - Traditions / traditional practices are becoming harder to do
        - [2:44] “This makes life so difficult. We won’t be able to live the way we used to.”
    - Human impacts on the environment

        - [8:31] “Got a lot of people living down [at the docks]. Sewage, garbage, boats being cleaned over at the haul out, boats are getting scraped, cleaned, painted, all that. All that chips of what was on the bottom.”
        - [8:58] “Cruise ships - the sewage from them, oil, fuel.”
        - [9:05] “There’s so many of us that have boats, we pollute the water ourselves.”
        - [9:12] “The smokestacks, air pollution, I think is becoming an issue.”
        - [9:18] “We never used to have this many cruise ships, now we’re getting 2-3 a day, when the season is going. We never had to worry about that.”
        - [9:29] “We have a lot of abandoned boats and vehicles that are leaking contaminants.”
        - [12:35] “The first dumpsite is down above where the… skatepark is, up on the hill across the street, up there was the first dump site. They buried that. I don’t know if they dug it out and filled it in, or if they just covered it and called it good.”
        - [13:29] “There was something that was seeping from the [old dump] site, up that way, and came down and [my uncles] were saying they didn’t think our berries were safe to eat because that [old waste] just comes down.”
    - More competition between/among human and nonhuman animals
        - [9:52] “The bears [concern me]. The environment has changed, now the bears are here instead of out where they should be.”
        - [10:02] “Now we have the deer that have come in. I don’t know why the deer have all moved in [to town].”
        - [10:19] “I remember when I was little, the bears used to come in. [That] was between, I’m guessing about 40 years ago, bears would kind of come through town, it wasn’t so bad. You didn’t see much deer then.”
        - [12:10] “That was in the late 1980’s, early 1990’s, when [the bears] started coming in more. I don’t know what drove them in, if it’s the garbage.”
        - [34:00] “Cause [bear interactions are] getting extremely dangerous.”
        - [35:19] “The bears are getting more aggressive. We need to do something - cause that’s affecting us, getting our berries. We need to do something to thin out the bear population.”
        - [36:26] “To me, [the bear population] is overpopulated. They’re claiming their island back is what’s happening. That’s honestly what it seems to be; [the bears are] moving back in. We kind of moved [the bears] out when we moved into Hoonah.”
        - [43:25] “Maybe that’s why [the bears] are coming into town. They’re running out of places to be out there.”
        - [41:46] “[Bear threats] have hindered us from getting our berries, teas - stuff that we harvest - asparagus. I used to go hunting and not have any fear until I got charged [by a bear], and then I still would go out but it was more [watching for bears] than paying attention to what I should be doing. So that to me has hindered us as people because now we have to get more people together to pick [to deter bears].”
- Adaptation

    - Learning
        - [0:30] “To me, [climate change adaptation] is like us learning to live with our surroundings as everything changes. Having to adapt to something.”
        - [1:05] “Having to learn to adapt to [a change].”
    - Accept / embrace
        - [2:37] “Well, you have to adapt to it, whether we like it or not.”
    - Don’t waste or overharvest resources
        - [28:33] “Sort of like when you harvest seagull eggs - there are supposed to be a certain amount of eggs in there before you take any, and if there’s only one in [the nest] you leave it alone.”
    - Environmental monitoring
        - [30:56] “And by the testing that I’m assuming [HIA Environmental] does, if [environmental testing] can show us that if what [the cruise ships are] doing is okay we can keep monitoring, and if [environmental conditions] changes we need to figure out what area’s not doing what they’re supposed to be doing.”
        - [43:51] “It would be nice if we could get the City, or the State, or whoever we need to talk to, or - do we have a program? I don’t know what all our programs do with the environment here, do you guys check into bears?”
    - Increased hunting for select species
        - [35:49] “I think we need to request that [ADF&G] allow one week, maybe every odd year, one week where people can come in and hunt [bear] with a vehicle and help thin out [the bear] population.”
    - Reporting - outreach and communication
        - [45:53] “If we get reports, if [HIA Environmental] thinks of something that needs to be brought to [the Tribal board’s] attention- I’m always open for anyone to tell me if there’s something that needs to be addressed. Don’t hold it to yourself. Tell me if there’s something we need to address. Let me know, and we can ask questions on it and address [it], if there’s something that we need to.”
    - Strategic development
        - [47:38] “To me, we need to strategically put some [cell towers] in places so our people have a way to call for help [while hunting/gathering without cell service].”
        - [48:21] “I think if we strategically plot where we could put another [cell] tower that would benefit the island more.”

Interview 7: HIA_07

- CC in Hoonah
    - Increasing temperatures and heatwaves

        - [0:39] “I have seemed to notice that it does seem a little warmer than years before, I dont’ know if that’s really climate change or … that’s one trend I’ve noticed.”
        - [4:21] “It seems like it has warmed up some. My father used to talk about how there used to be icebergs out in Icy Strait, he said you had to watch for those, of course we know Glacier Bay has receded… I don’t know if it’s a cyclic thing or if it’s from global warming but that’s one thing my dad talked about, having to watch for icebergs when he was commercial fishing as a young man, and now you don’t see icebergs out there anymore.”
        - [5:09] “Seems like winters used to be colder, not sure if that’s just from old age or … but I think the winters have warmed up a little bit, we seem to get more rain than snow.”
    - Changes in precipitation
        - [5:09] “Seems like winters used to be colder, not sure if that’s just from old age or … but I think the winters have warmed up a little bit, we seem to get more rain than snow.”
    - Loss of resources overall
        - [1:36] “Right now, the way I think it is - with everything the way it seems to be going - I’d be surprised if there was any subsistence, because I think everything’s being so heavily regulated in so many ways. And then I’ve also noticed it seems like the deer and salmon populations, and just in my lifetime… I remember there used to be a lot of salmon, I mean lots of salmon, compared to what we have now going through [the river].”
        - [2:24] “Unless there’s some real major changes, somewhere, somehow, I’d be surprised if there’s anything for future generations to really subsist on.”
        - [2:52] “I do have concerns; I’ve noticed quite a drop in the salmon population.”
        - [3:08] “I used to ride around out the logging roads quite a bit back in the 1990’s, and it seemed like I’d see deer every few minutes, every five minutes, we’re driving along, we’d see a deer grazing away… now, seems like we hardly see deer out the road now. Not sure how things will go.”
    - Resources are degraded (smaller, less quality)
        - [6:46] “I have heard the same thing, that people are saying some of the salmon they’ve had don’t seem as good as it was before. One guy was joking calling it ‘frankenfish’, I guess it was supposed to be wild salmon that were possibly mixed with farm-raised fish.”

- Community Concerns
    - Loss of resources overall
        - [1:36] “Right now, the way I think it is - with everything the way it seems to be going - I’d be surprised if there was any subsistence, because I think everything’s being so heavily regulated in so many ways. And then I’ve also noticed it seems like the deer and salmon populations, and just in my lifetime… I remember there used to be a lot of salmon, I mean lots of salmon, compared to what we have now going through [the river].”

        - [2:24] “Unless there’s some real major changes, somewhere, somehow, I’d be surprised if there’s anything for future generations to really subsist on.”
        - [2:52] “I do have concerns; I’ve noticed quite a drop in the salmon population.”
        - [3:08] “I used to ride around out the logging roads quite a bit back in the 1990’s, and it seemed like I’d see deer every few minutes, every five minutes, we’re driving along, we’d see a deer grazing away… now, seems like we hardly see deer out the road now. Not sure how things will go.”

- Adaptation
    - Don’t waste or overharvest resources
        - [10:06] “If you take something, you’re supposed to use it. Don’t take more than you need. If you do, try to share with those that might not have gotten some.”
        - [10:36] “If you have more than you could use, share.”

Appendix G: Touch Tank Activity

Touch Tanks

Big Idea

There are many different types of animals, each with their own needs and ways to survive

Objectives/Learning Goals

- What are an ecosystem and a habitat, and what are their essential elements?
- Learn about ecosystems and habitats that exist in our own community
- Explore the role that humans and animals play in each other's lives

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Introduction (5 min)

1. Why are we here/Who are we?
    a. Have any of you ever met Ian, Julian, Jeromy, etc? We're working with them on a project and we asked if we could do a fun activity with you all today
    b. We came all the way from Michigan to hang out with you guys and we're super excited to learn and play with you.
2. Explanation of the activity

Touch Tank Stations (30 mins, 10 min rotations)

1. Coastal
2. Forest
3. Underground

Touch Tank set up and guide

1. On the first rotation, be prepared to explain the essential elements of a habitat (food, water, shelter, space)
2. Have students identify what habitat they are looking at
    a. If needed, can prompt them with hints or other questions (i.e., What things do you see in the tank that could help you figure it out? Is it more like an ocean or a forest? etc)
3. Help students identify essential elements of your habitat (represented by the touch tank you're running)
    a. Food, water, shelter, space
    b. What kind of animals are living in this place?
4. Ask questions that lead students to identify where in their own lives they have seen or interacted with this type of habitat?
    a. Have you ever seen anything like this before in real life?
    b. What types of things did you see there? How was it the same or different from the touch tank?
    c. What did you do while you were there? Did you spend time and do things in that environment?

Debrief (10 mins)

1. What did we notice/learn when we were exploring the different habitats?
2. How do animals use these habitats? Where and what do they eat, drink, live in, etc?
3. What can we do to protect these types of places and the animals that live in them
4. How do we see these animals and habitats pop into our own lives?

Appendix H: How is Nature Connected Game (modified)

How is nature connected? A game

Rules:

- Everyone is given a card and therefore assigned that organism. They must "connect" (find, and attach a string of yarn to) with all the other organisms they need for survival. The species that are available in the game are in bold on each card.
- If an organism needs a different organism for multiple functions, they must have a NEW string (another connection) for every way in which they need that creature. For example, **copepods** may need the **phytoplankton** for food AND oxygen, therefore the **copepod** must have TWO strings attached to the **phytoplankton** to represent both ways they depend on it.
- You only need to make a connection with the organisms that give you something you need. For example, **humans** provide detritus to **worms**, **copepopds**, and **crabs**. They do not need to connect with those organisms. Only if those organisms (the **worm**, **copepod**, and **crab** students) came to the **human** to secure something each needs would there be a connection (yarn string).
- You win if you get what you need to survive before the time runs out. Everyone can and should be a winner in this game.

Game conclusions:

- Although the game was made with as much ecological accuracy as possible (without completely overwhelming everyone), it is very much simplified and obviously not completely accurate. The carbon dioxide that salmon exhale doesn't just go straight to a kelp bed. Oxygen made in the ocean from phytoplankton is transferred to the atmosphere, where it also supports terrestrial respirators, and vice versa. Therefore the point of the game is not to teach completely accurate ecological relationships between and among organisms.
- The main point is to show that everything is connected, and to discuss how we (as humans) derive value from all aspects of the natural environment.

You are a <u>human</u>! You do regular human things. Look for the things you need to survive and see what you offer others.

Needs:

1. Oxygen – to breathe, silly! The **forest** or **phytoplankton** will give you this (find at least one)
2. Food – you like to eat, don't you? Look for one of the following: **crabs**, **salmon**, **deer**, **berries**, or **herring** (find at least one)
3. **Clean water** – can't go more than three days without it!

You provide:

1. Detritus – organic material that decays, like poop!
2. Carbon dioxide – this is your exhale!
3. Nutrients – either too much, or just enough, for plants

You are <u>water</u>! You enjoy keepin' it fresh but sometimes you get a bit salty. That's okay, we'll accept you either way <3. Find the things you need to be clean, and see what you offer others.

Needs:

1. **Crabs**, **worms,** or **copepods** – they remove waste and keep you nice and fresh! (find at least one)
2. **Kelp beds** or **phytoplankton** – they remove excess nutrients in the ocean that you don't need (find at least one)
3. **Forest** – the trees' roots keep soil from clogging you up.

You provide:

1. Habitat – if you live in rivers or the ocean!
2. Drinking water – for both human and nonhuman animals!
3. Life to all plants!

You are a majestic bald eagle! You're super cool, especially cause you're a dinosaur descendant. If you don't wanna die like your ancestors, you better find the things you need to survive! See what you can provide to others, while you're at it.

Needs:

1. **Forest** – this is where you live!
2. **Clean water** – for drinking
3. Food – **crabs**, **salmon**, or **herring** are your favorites! (find at least one)

You provide:

1. Detritus – or organic waste (poop)
2. Carbon dioxide – every time you exhale
3. Nutrients – to plants every time fish falls from your nest

You are a salmon! You live a hard life (stop being so tasty and maybe that wouldn't be a problem!). Increase your chances of survival by finding the things you need, and take a look at what you provide others.

Needs:

1. Oxygen – you can thank **phytoplankton**!
2. **Clean water** – so you can swim!
3. Food – once you're in the ocean, you love to eat **herring**!

You provide:

1. A tasty snack for all kinds of animals, including humans!
2. Detritus – a lucky crab or copepods would love to clean you up!
3. Lots of nutrients – a forest can grow big and strong with your help!
4. Carbon dioxide when you exhale

You are a bear! Lucky for you, you're at the top of the food chain! Find everything you need to survive and see how others make use of you.

Needs:

1. Oxygen – the **forest** can help with that!
2. Food – in the form of **salmon**, **berries**, or **deer**! (find at least one)
3. **Clean water** – for drinking (and playing)

You provide:

1. Detritus – or organic waste (poop)
2. Carbon dioxide – every time you exhale
3. Nutrients – you give plants nutrients by bringing them salmon!

You are a berry bush! What a delightful treat you are. Gather what you need to flourish, and see what you provide to others.

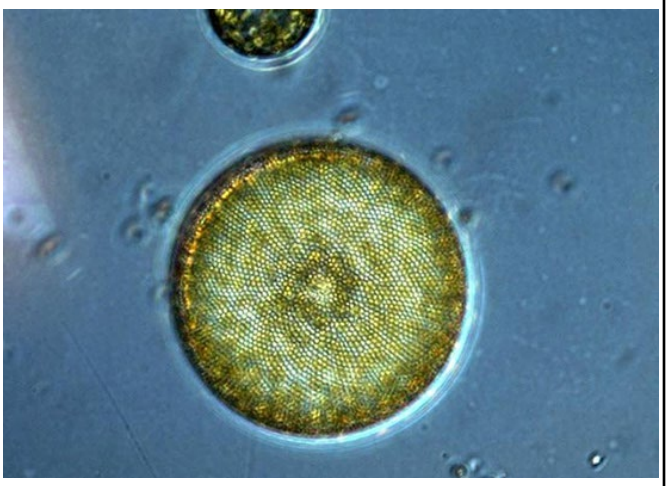
Needs:

1. **Clean water** – so you can make food!
2. Carbon dioxide – brought to you by **humans**, **bald eagles**, **bears**, or **deer** (find at least one)
3. Nutrients – **humans**, **worms**, **bears**, or **bald eagles** can help you here (find at least one)

You provide:

1. Food – for humans, bears, or deer
2. Oxygen – to many land critters
3. Detritus – organic waste like dead leaves for worms

You are phytoplankton! You're a microscopic, photosynthesizing dude who plays a big role in the ocean (virtually all oceanic food webs start with you!). Take a look at what you need to survive and what you offer others.



Needs:

1. **Clean water** – this is where you live!
2. Carbon dioxide – from **humans**, **salmon**, **whales**, **herring**, or **crabs** (find at least one)
3. Nutrients – **humans** give you lots of these!

You provide:

1. Oxygen for all creatures!
2. Clean water, by removing excess nutrients!
3. Food for copepods and herring, which feed everything else in the ocean!

You are a humpback whale! Good for you, you highly intelligent, emotional creature! Find what you need in order to survive, and take a look at what you offer others.

Needs:

1. **Clean water** – who wants to swim in dirty water?
2. Oxygen – **phytoplankton** and the **forest** help out with that! (find at least one)
3. Food – you love to eat **herring** or **copepods** (find at least one)

You provide:

1. Detritus, or organic waste like poop, to copepods and crabs (yummy)
2. Carbon dioxide to plants in the ocean

You are a forest! You are crucial to the survival of most living organisms (they can thank you later). Make sure you get what you need to survive and observe what you offer others.

Needs:

1. Nutrients – in the form of **salmon**! But you also need **bears** or **bald eagles** to bring it to you (find at least one)
2. **Clean water** – you can't grow without this!
3. Carbon dioxide – from **humans**, **bears**, **bald eagles**, **deer, or worms** (find at least one)

You provide:

1. Habitat for all kinds of critters!
2. You're one of the biggest sources of oxygen out there!
3. Detritus, organic waste like leaves and sticks, for worms
4. Clean water by keeping soil from polluting it

You are a crab! You play an important role in the ocean, so don't be crabby about it! Take a look below to see how you affect others, and get what you need to survive while you're at it.

Needs:

1. Oxygen – from your friends, **phytoplankton**!
2. **Clean water** – so you can actually survive!
3. Food – in your case, organic waste (detritus) from **salmon**, **herring**, **copepods**, **whales**, or **humans** (find at least one)

You provide:

1. Carbon dioxide – for plants in the ocean
2. Food for humans and bald eagles, on a bad day
3. Clean water by removing waste!
4. Nutrients by eating decaying organic waste

You are a kelp bed! As the largest form of brown algae, you play a pretty significant role! To make sure you stick around, get all the things you need for survival and see how you help others.

Needs:

1. **Clean water** – can't grow in gross water!
2. Carbon dioxide – you could get this from **humans**, **crabs**, **herring**, **salmon**, or **whales** (find at least one)
3. Nutrients – **crabs** and **copepods** break down organic waste for you to use! (find at least one)

You provide:

1. Oxygen for all creatures
2. Clean water, by removing excess nutrients!

You are a deer! You're especially peaceful and super chill. Make sure you get everything you need to keep kickin' it and see what you can offer others in the process.

Needs:

1. Oxygen – that comes from the **forest**!
2. Food – in the form of **berry bushes** or shrubs in the **forest**! (Find at least one)
3. **Clean water** – for when you're thirsty

You provide:

1. Carbon dioxide for plants!
2. Detritus, or organic waste (poop), for guys who like to eat that stuff
3. Food – for bears and humans, if you're unlucky!

You are herring! You may be small in size, but you sure are large in numbers! If you wanna keep it that way you better get all the things you need to survive. Don't forget to observe how you help others, too!

Needs:

1. Food – **phytoplankton** or **copepods** will keep you full! (Find at least one)
2. **Clean water** – what kind of fish would you be if you didn't live in water?
3. Oxygen – **phytoplankton** should do the trick!

You provide:

1. A tasty treat to salmon, whales, bald eagles, and humans
2. Carbon dioxide for kelp beds or phytoplankton
3. Detritus, or organic waste, when you poop or die (copepods and crabs will thank you!)

You are a copepod! That just means you're a tiny crustacean who does tiny crustacean things. Read below to see what you need to thrive and how you affect others.

Needs:

1. Oxygen – you like to breathe, don't you?! **Phytoplankton** or the **forest** will give you the oxygen you need (find at least one)
2. **Clean water** – this is your habitat, after all!
3. Food – you like waste from **herring**, **whales**, **salmon**, **humans**, or even **phytoplankton** (find at least one)

You provide:

1. You're a major food source for herring, crabs, and whales!
2. You clean the water by removing waste!
3. Carbon dioxide for all aquatic plants
4. Nutrients by eating decaying organic waste

You are a worm! You like to wiggle around through the soil, making lots of changes along the way. Keep up the good work by getting everything you need to survive, and see what you do for others.

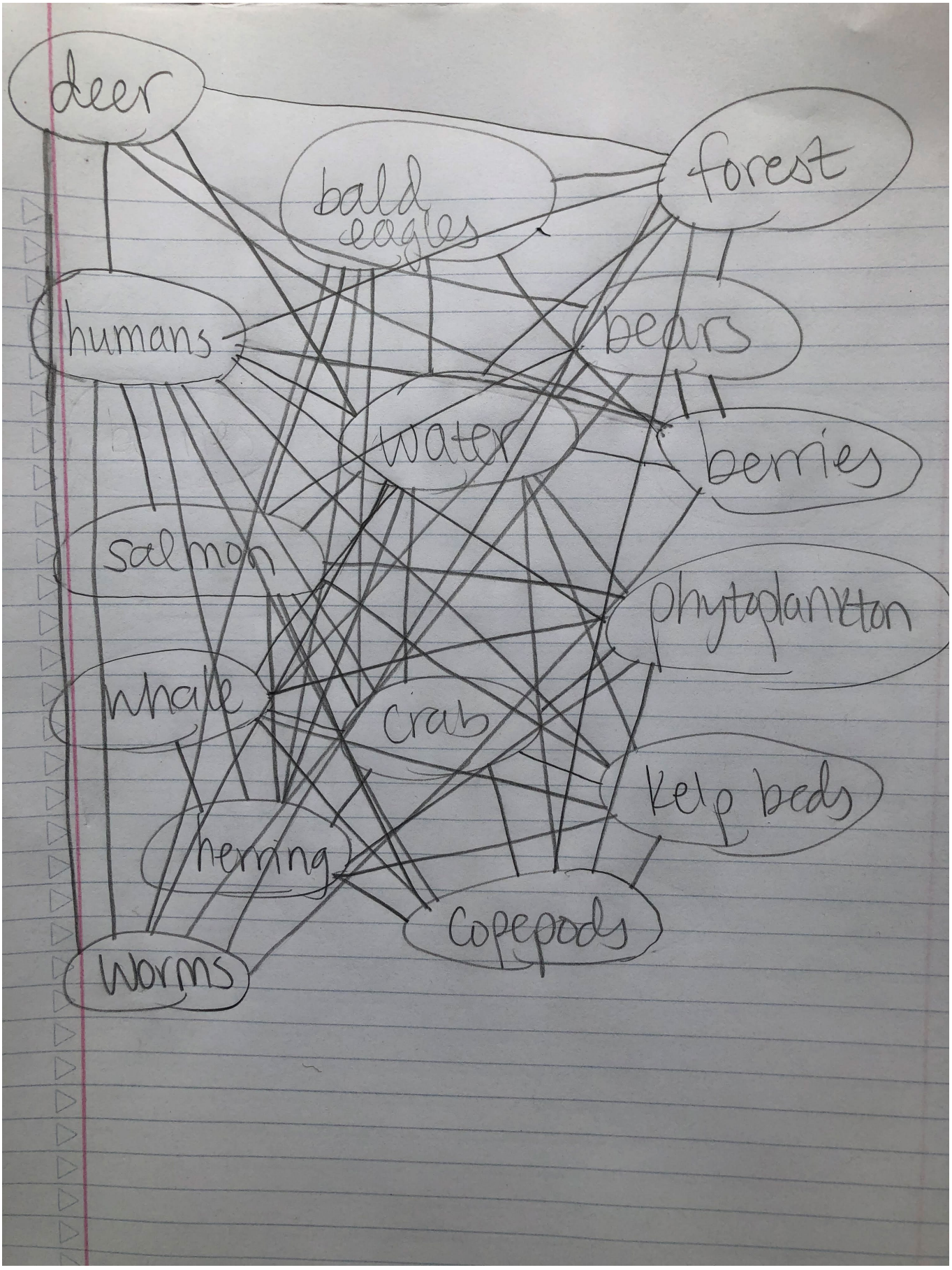
Needs:

1. Food – since you eat organic waste or detritus, look for **humans**, **berry bushes**, **deer**, **bears**, **bald eagles**, or the **forest** (find at least one)
2. Oxygen – that comes from the **forest** or **berry bushes**! (find at least one)
3. **Clean water** – for drinking!

You provide:

1. Clean water by removing waste!
2. Carbon dioxide when you exhale
3. Nutrients for plants by breaking down detritus!

Possible connections



Appendix I: Salmon Survival Game

Stage 1- Salmon egg

	No snowfall during winter! Rivers are unusually warm in summer. Your eggs can't handle the heat. **Lose ½ your eggs!**	
Your parents didn't hide you well enough! A hungry trout sniffs out your eggs and happily eats them. **Lose 2/3 of your eggs!**	A hiker strayed off trail. They stomp through the river, mixing up the gravel & squashing your eggs in the process. Thanks for nothing, human! **Lose 1/3 of your eggs!**	A local farmer used too many pesticides! Excess nutrients from them enters the river, causing an algae bloom. Bacteria uses up the remaining oxygen to digest it. Your eggs choke. **Lose 2/3 of your eggs!**
	Now that's a lot of rain (it's like this is Alaska or something)! The river's flow rate is too strong, & your eggs get swept away. **Lose ½ your eggs!**	
	Who built that road by your river? Stormwater runoff filled with oil, grease, gas, metals, & other icky stuff from the road pollutes the river. Rude. **Lose 2/3 your eggs!**	

Stage 2- Salmon egg w/ eye

	Really trout? You're gonna eat my eggs? Fine, be that way. **Lose ½ your eggs!**	
"Hey, we were using that!" Loggers cut trees that shaded the river and kept the water cool. Now the water's temperature is too hot, & your eggs perish as a result. **Lose 2/3 of your eggs!**	No need to pout, it's just a drought! Except now the river is dried up & your eggs turn all crispy. ☹ **Lose ½ your eggs!**	There's breakage in the sewer system! Fecal matter leaches into the river & kills your eggs. You could say that's pretty… yucky. **Lose ½ your eggs!**
	A huge storm rolls through and stirs everything in the river up! Unfortunately, your redd gets buried by silt. (RIP) **Lose 1/3 of your eggs!**	
	Humans replaced a wetland with a parking lot! Rain can't infiltrate the soil, & all that water washes into your river. Your eggs get washed away. **Lose 2/3 of your eggs!**	

Stage 3- Alevin

	Large insects including Dragonfly larvae and Water scorpions have a feast, and your alevin are the main dish! **Lose ½ your alevin!**	
Dam breaks! Alevin struggle against the stronger current to stay in the redd. They quickly use the energy from their yolk sac & die. **Lose 1/3 of your alevin!**	Someone logs the trees along the river to increase their property value. This makes the water temperature way too hot! **Lose ½ your alevin!**	An herbivore eats the plants that give your alevin dissolved oxygen! Levels drop & your alevin can't breathe anymore. Not cool, herbivore. **Lose ½ your alevin!**
	Humans do some construction upriver, loosening a bunch of silt. That comes barreling down the river and buries your alevin. **Lose 2/3 of your alevin!**	
	Unusually heavy rainfall occurs! The water flow increases from the extra rain, pushing all the gravel downstream. Your alevin just lost their habitat! **Lose ½ your alevin!**	

Stage 4- Fry

	A human thinks that simplifying the river by removing boulders, logs, & debris will help diversity- they're wrong! Now your fry have no pools to feed or hide in. **Lose 2/3 of your fry!**	
Your fry were a little too slow! They stayed in freshwater for too long & got a parasite. **Lose 1/3 of your fry!**	"Uhh, grandpa?? It's me, your grandso—" An older salmon eats your fry. Talk about family problems… **Lose ½ your fry!**	Humans logged the forest along the riparian zone. They took away the habitat of the insects that your fry eat! Well, would have eaten. Now your fry starve. **Lose ½ your fry!**
	There's a hole in the ozone layer in the atmosphere from greenhouse gases! Strong UV rays now beam down & fry your fry. **Lose ½ your fry!**	
	100% chance of precipitation! All the extra water sweeps your fry away before they're ready. They can't handle the saltwater yet (but they're only a little salty about it). **Lose ½ your fry!**	

Stage 5- Smolt

	Farmed salmon break free! They're infested with sea lice & they spread to your smolt. Genetically unprepared, your smolt give in to the lice. **Lose 2/3 of your smolt!**	
A disease wipes out all the plants in your estuary! Carbon dioxide increases and your smolt suffocate. **Lose 1/3 of your smolt!**	Your smolt can't escape a family of sea otters! They quickly become lunch. **Lose ½ your smolt!**	Excess CO_2 from the atmosphere contributes to ocean acidification. The acidic water dissolves crustaceans & mollusk shells, which is what your smolt eat! Well, ate. **Lose 2/3 of your smolt!**
	The estuary where your smolt are living gets replaced by residential buildings. Your smolt sure can't afford that. **Lose ½ your smolt!**	
	Pine beetles kill a tree that was offering your smolt shade. The water temperature increases & your smolt overheat. **Lose ½ your smolt!**	

Stage 6- Adult (ocean)

	A pod of orcas surrounds your salmon! You can probably guess how that ends (they don't call them "killer whales" for nothing). **Lose 2/3 of your salmon!**	
"Wait, I can't eat bottle caps?" Your salmon filled their bellies with plastic instead of food! **Lose 1/3 of your salmon!**	It's been an unusually warm summer. Ocean temperatures increase & your salmon aren't about it. It's almost like the climate is changing… **Lose 2/3 of your salmon!**	Your salmon are looking for herring to eat and can't find them! It might be because they're all caught in the humans' nets. Rough stuff, man. **Lose ½ your salmon!**
	Excess nutrients from a nearby farm cause an algal bloom, & bacteria drain the water of oxygen while digesting the algae. Your salmon can't catch their breath! **Lose ½ your salmon!**	
	Human sewage from the cruise ships leaked into the ocean! Parasites were released & infect your salmon ☹ **Lose 1/3 of your salmon!**	

Stage 7- Adult (ocean ➔ river)

	Don't you love having salmon for dinner? Well, it comes at a price! People ate your salmon! **Lose 2/3 of your salmon!**	
An invasive species was introduced! They eat the same things your salmon does (amphipods, herring, & krill), & leave none for the salmon. **Lose 1/3 of your salmon!**	There's a boom in carp populations! These benthic fish stir up bottom sediments. This leads to lower levels of oxygen & your salmon choke. **Lose ½ your salmon!**	A glacier melts, decreasing cold water flow into rivers during summer. Water temperatures rise & your salmon overheat. **Lose 2/3 of your salmon!**
	Humans combined two rivers & caused a more forceful flow! Now the current is too strong for your salmon to run up it. Sad day ☹ **Lose 1/3 of your salmon!**	
	Heavy rain events caused a landslide on the mountain, and heavy sediments are dumped into your natal stream. You get lost on the way home! **Lose ½ your salmon!**	

Stage 8- Adult (river)

	Your salmon are swimming to their natal streams when- surprise! There's now a dam there instead. Your fish can't make it back home! **Lose ¾ of your salmon!**	
Cattle had access to the river your salmon run in! Their feces saturate the river, & your salmon succumb to the bacteria. **Lose ½ your salmon!**	A farmer diverts water from the river for their irrigation system. The water level dwindles, & your salmon are left shriveling in the sun. **Lose ½ your salmon!**	Your salmon are about to reach their natal stream when they get scooped by the piercing claws of a bald eagle! Better luck next time. **Lose 2/3 of your salmon!**
	Your salmon aren't healthy enough! They didn't eat enough in the ocean & now it's too late. Their energy levels plummet past the point of no return. **Lose 2/3 of your salmon!**	
	Higher temperatures cause the salmon to burn their energy faster, & accelerated flows from melted snow ensures your salmon can't make it upstream. **Lose ½ your salmon!**	

Stage 9- Spawning adult

	"This doesn't smell right…" Your salmon memorized the smell of the plants in their natal streams, but the plants got eaten! They don't realize they're home and never spawn. **Lose ½ your salmon!**	
Humans developed along the riparian zone, removing shade, adding pollution, & eliminating spawning grounds. Yay humans... **Lose ¾ of your salmon!**	Stormwater runoff full of oxygen-consuming bacteria enters the river. Your salmon don't love it so much, but it does take their breath away! **Lose 2/3 of your salmon!**	Climate change is taking a toll on your salmon. The waters are too warm, causing them to have heart attacks. Yes, salmon can have heart attacks. **Lose 2/3 of your salmon!**
	"Woohoo, we made it! And they said we wouldn't survi—" Your salmon were too busy celebrating to notice the bears. **Lose ½ your salmon!**	
	Your salmon were exposed to warm waters for too long, accelerating the growth of disease. The parasites devour your salmon 😞 **Lose ½ your salmon!**	

Stage 1

You are a salmon egg, just laid in a redd (nest) of gravel.

- Require water temperatures between 42°-58°F
- Waterflow rates >6 gal/min are too forceful
- Need highly oxygenated (>11 mg/L) water

Did you know dissolved oxygen (DO_2) solubility decreases as temperatures increase? That means warm water holds less oxygen than cold water!

Stage 2

You developed into an eyed egg. Your eye can be seen through your eggshell.

- Require water temperatures between 42°-58°F
- Waterflow rates >6 gal/min are too forceful
- Need highly oxygenated (>11 mg/L) water

Did you know a single female salmon can lay 500-1,000 eggs per redd? 1/1,000 eggs will live to be a spawning adult.

Stage 3

You hatched into an alevin with a big yolk sac (food).

- Require water temperatures between 42°-58°F
- Need highly oxygenated (>11 mg/L) water
- Silt can bury them, but need gravel to hide in

Did you know cold water causes alevin to grow & use their yolk sac more slowly than warm water? Warm water makes them grow faster, but their overall body growth is reduced!

Stage 4

Now you're a fry who eats small insects & plankton.

- Require water temperatures between 42°-61°F
- Need highly oxygenated (>11 mg/L) water
- Use heterogenous (diverse) habitat for hiding & feeding

Did you know fry imprint/memorize the smell of their natal streams via soil type, plant & animals, & other chemicals?

Stage 5

As a smolt, your body changes so you can live in saltwater.

- Prefer water temperatures between 45°-61°F
- Live in estuaries where salt & freshwater meet
- Eat small fish, crustaceans, mollusks, & insects

Did you know high concentrations of CO_2 (12+ mg/L) cause developmental issues, like thinner than normal skin?

Stage 6

You spend years in the Pacific Ocean, growing to become a huge adult salmon.

- Require water temperatures between 42°-65°F
- Need oxygenated (>7 mg/L) water
- Eat fish, amphipods (shrimp), & gastropods (snails)

Did you know salmon can endure over 3,000 miles of ocean migration? That's an average of 18 miles per day!

Stage 7

As a fully-grown adult salmon, you start heading back from the ocean to the river you came from.

- Require water temperatures. between 42°-61°F
- Need oxygenated (>7 mg/L) water
- Rely on body fat for energy

Did you know adult salmon don't eat after reentering freshwater? Their stomachs dissolve to make room for eggs!

Stage 8

You follow your sense of smell farther upriver, looking for the stream where you hatched.

- Require water temperatures between 42°-61°F
- Need oxygenated (>7 mg/L) water
- Rely on body fat for energy

Did you know when salmon are swimming upstream, they can jump two yards into the air?

Stage 9

Finally, you reach your natal stream. You're so close! If you can get all the way home, you will spawn.

- Require water temperatures between 42°-58°F
- Need oxygenated (>7 mg/L) water
- Rely on body fat for energy

Did you know a salmon can detect one drop of water from its natal stream mixed in 250 gallons of sea water?

Name: _____ Date: _____

Salmon Survival Game

Draw or write about what happened to your salmon at each stage in the game.

Stage 1 – Egg (river)	**Stage 2 – Eyed Egg (river)**	**Stage 3 – Alevin (river)**	**Stage 4 – Fry (river)**	**Stage 5 – Smolt (estuary)**
Stage 6 – Adult Salmon (ocean)	**Stage 7 – Adult Salmon (ocean → river)**	**Stage 8 – Adult Salmon (river)**	**Stage 9 – Spawning Salmon (river)**	**What is your favorite stage? Why?**

Appendix J: Community Event Outreach Flier

OUR FUTURE IS CLIMATE CHANGE

Join us in discussing Hoonah's future climate and brainstorming adaptation solutions

Friday March. 3, 2023 | 5pm
Hoonah Council Chambers

Pizza & Prizes Provided!

Open to all community members!

+ M SEAS

Appendix K: Community Event Presentation

Our Future is Climate Change

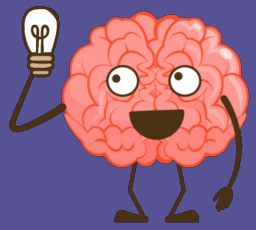
Hoonah Indian Association, Environmental Office
University of Michigan, School for Environment and Sustainability

Welcome in!

Please be sure to
1. Sign in,
2. Grab some pizza, and
3. Find a seat!

On today's agenda...

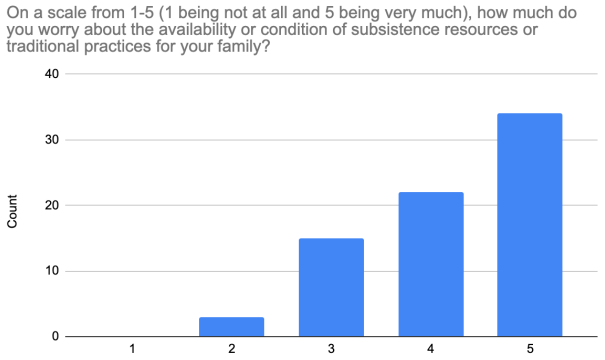
1. Introductions
2. Jeopardy and discussion
3. Brainstorming climate action projects and discussion
4. Closing remarks



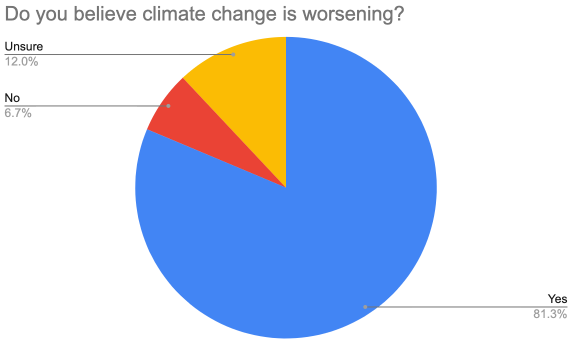
Think about this...

What changes in resources have you noticed recently?

Winter Bazaar Survey Results



Winter Bazaar Survey Results



Key Interview Quotes

"the sockeye are arriving late"

"the berries have been really strange"

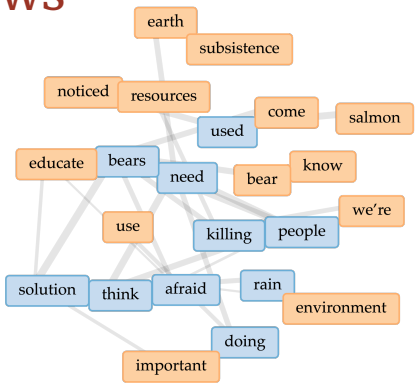
"we're having to go further away to get food"

Reoccurring themes in the Interviews

Key Interview Quotes

"When our people moved into a place, we didn't feel like we had the right to dominate it. We had a responsibility to take care of it, and that's how it was described. They would say, '[my clan] takes care of this place'. They didn't say '[my clan] owns this place', the [clan] takes care of this place."

Connecting themes in the Interviews



Key Interview Quotes

"a lot of the things that we depend on will soon disappear"

"If you have more than you could use, share."

"ceremonies need to be rediscovered and . . .[people] should be out there welcoming the salmon back."


How do you want to adapt or respond to climate change impacts?
1. How do you feel this challenge impacts you or Hoonah?
1a. How do these challenges impact your way of life?
1b. Which climate change challenges are most impactful?
1c. What is affected by what is changing?
2. How do you want to adapt or respond to these impacts?
2a. What types of approaches can/should we take to combat these challenges? (i.e., advocacy, policy, education, restoration, etc.)
2b. How would we respond to these challenges about 300 years ago?
2c. What should youth learn about now to help them prepare for a different climate in the future?
SEAS

Appendix L: Hoonah Jeopardy

Jeopardy!

Our Future is Climate Change

Hosted by
UM Group & HIA Environmental

Categories

Hoonah gonna call?	What do you sea?	Changes in Hoonah - InterYOU	Effects on Hoonah	Current HIA Environmental Projects
$ 100	$ 100	$ 100	$ 100	$ 100
$ 200	$ 200	$ 200	$ 200	$ 200
$ 300	$ 300	$ 300	$ 300	$ 300
$ 400	$ 400	$ 400	$ 400	$ 400
$ 500	$ 500	$ 500	$ 500	$ 500

Categories

Click arrow for Final Jeopardy

Hoonah gonna call?
$ 100

You should contact this person about water quality and shellfish safety.

Categories

Hoonah gonna call?
$ 100

Who is Jeromy Grant?

907 945-3545
jgrant@hiatribe.org

Categories

Hoonah gonna call?
$ 200

These people are good contacts for unknown/invasive animal sightings or miscellaneous weird sightings.

?

Categories

Hoonah gonna call?
$ 200

Who is Ian Johnson or Jeromy Grant?

907 945-3545
ian.johnson@hiatribe.org,
jgrant@hiatribe.org

Categories

Hoonah gonna call?
$ 300

These people are contacts for historical information around traditional Tlingit culture & practices.

?

Categories

Hoonah gonna call?
$ 300

Who is Huna Heritage - Amelia Wilson, HIA Cultural Dept - Darlene See, or Julie Jackson?

Categories

Hoonah gonna call?
$ 400

To report wildfire smoke, contact this office.

?

Categories

Hoonah gonna call?
$ 400

What is the Forest Service, Dispatch, or radio to coast guard?

Categories

Hoonah gonna call?
$ 500

This organization is who you want to contact with questions or concerns about landslides.

?

Categories

Hoonah gonna call?
$ 500

What is Sealaska, Huna Totem Corporation, or the Forest Service?

Categories

What do you sea?
$ 100

These marine mammals help protect kelp from sea urchins and eat a lot of shellfish.

?

Categories

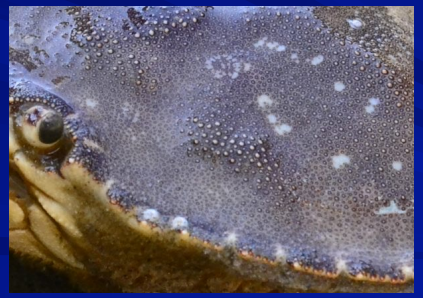
What do you sea?
$ 100

What are sea otters?

Categories

What do you sea?
$ 200

These creatures struggle to grow their shells as the ocean becomes more acidic.



?

Categories

What do you sea?
$ 200

What are crabs and/or shellfish?

Categories

What do you sea?
$ 300

These important fish are sensitive to changes in snowpack since snow melt provides their spawning streams with the water they need.

?

Categories

What do you sea?
$ 300

What is salmon?

Categories

What do you sea?
$ 400

This type of fish may be more resilient to warming temperatures because of their wide habitat range.

?

Categories

What do you sea?
$ 400

What is halibut?

Note: the young of this species are more vulnerable to warming temperatures, but those that survive to adulthood do well in changing conditions

Categories

What do you sea?
$ 500

This shallow-water marine plant is likely to change locations from post-glacial rebound (the rise of land masses that happens as glaciers melt) in Hoonah.

Categories

What do you sea?
$ 500

What is eelgrass/seagrass?

Categories

Changes in Hoonah - InterYOU
$ 100

The activity of this large animal is affected by changing seasonal lengths and has been seen more often around Hoonah, raising safety concerns.

Categories

Changes in Hoonah - InterYOU
$ 100

What are bears?

Categories

Changes in Hoonah - InterYOU
$ 200

Variable sunlight, temperature, and precipitation has been altering the size, location, and amount of these fruits.

?

Categories

Changes in Hoonah - InterYOU
$ 200

What are berries? (all types)

Categories

Changes in Hoonah - InterYOU
$ 300

This type of precipitation is expected to decrease by 11-13.4% within 25 years.

?

Categories

Changes in Hoonah - InterYOU
$ 300

What is snow?

Categories

Changes in Hoonah - InterYOU
$ 400

As the climate becomes warmer, the habitat becomes more hospitable for these berry and foliage-consuming mammals.

?

Categories

Changes in Hoonah - InterYOU
$ 400

What are deer?

Categories

Changes in Hoonah - InterYOU
$ 500

This type of forest management can increase the diversity of plants in the forest.

?

Categories

Changes in Hoonah - InterYOU
$ 500

What is pre-commercial thinning?

Categories

Effects on Hoonah
$ 100

This type of tree, often used for carving and weaving, is at risk of freezing in warmer temperatures because it isn't as insulated by snowpack.

?

Categories

Effects on Hoonah
$ 100

What is cedar?

Categories

Effects on Hoonah
$ 200

This resource is consumed daily and changes in snowfall and snowpack can impact the volume available.

?

Categories

Effects on Hoonah
$ 200

What is drinking water?

Categories

Effects on Hoonah
$ 300

This resource, often harvested in Glacier Bay, is at risk due to climate change-induced bait fish population changes, resulting in fewer and smaller nests.

?

Categories

Effects on Hoonah
$ 300

What are gull eggs?

Categories

Effects on Hoonah
$ 400

Air quality changes as a result of increased wildfires will increase the prevalence of this category of illness.

?

Categories

Effects on Hoonah
$ 400

What are respiratory illness?

Categories

Effects on Hoonah
$ 500

This natural disaster, intensified by road building and clear-cutting steep slopes, can push dirt into rivers and roads making it difficult to fish or get up the road.

?

Categories

Effects on Hoonah
$ 500

What are landslides?

Categories

Current HIA Environmental Projects
$ 100

This is a space for community members to grow their own produce over the summer and receive Tlingit potatoes in the fall.

?

Categories

Current HIA Environmental Projects
$ 100

What is the community garden?

Categories

Current HIA Environmental Projects
$ 200

Every few years, these guidelines and goals are discussed and adjusted to plan for Hoonah's future.

?

Categories

Current HIA Environmental Projects
$ 200

What is the strategic plan?

Categories

Current HIA Environmental Projects
$ 300

This youth development program aims to provide experiential education and training to help Hoonah's youth get on the path to higher education / employment in natural resource management.

?

Categories

Current HIA Environmental Projects
$ 300

What is Alaska Youth Stewards (AYS)?

Categories

Current HIA Environmental Projects
$ 400

This project moves wood into creeks that were historically logged to slow down water and improve salmon habitat.

Categories

Current HIA Environmental Projects
$ 400

What is stream restoration?

Categories

Current HIA Environmental Projects
$ 500

Every two weeks, HIA collects samples of this resource to test for toxins.

Categories

Current HIA Environmental Projects
$ 500

What are shellfish?

Categories

Final Jeopardy

Make your wager

Click for Final Jeopardy

Categories

Final Jeopardy

Tonight, HIA is working with the UM team and you all to create this.

?

Categories

Final Jeopardy Response

What is the Hoonah Climate Adaptation Plan?

Categories

Appendix M: Hoonah's Climate Adaptation Plan (HCAP)

Climate Change and Hoonah

Far northern latitudes are warming much faster than equatorial regions, and Hoonah is no exception. Models indicate that temperatures will rise, rainfall will become more variable and ocean chemistry conditions will become more hazardous for marine animals in the near future. Given the importance of traditional foods in Hoonah, threats to local and traditional resources are at the forefront of people's minds when considering the future of the town.

HOONAH RESIDENTS RELY ON SUBSISTENCE FOODS…

In the 2020 Hoonah Foods Assessment, Hoonah residents reported harvesting 86 different types of subsistence foods, including all five species of salmon, halibut, deer, moose, and a variety of wild berries, seaweeds, plants and mushrooms. 60 percent of residents said at least a quarter of their food was from subsistence, with a sizable minority sourcing well over half of their food directly from the land and ocean. Subsistence users harvested nearly 32,000 pounds of plants, an overwhelming majority of which was wild berries and seaweed. With the costs of food and electricity ever on the rise, it's more important than ever to protect access to traditional subsistence resources. Traditional foods are also significantly healthier than many store bought foods, rich in vitamins and minerals that may otherwise be difficult to get.

…WHICH ARE THREATENED BY CLIMATE CHANGE.

Salmon, crabs and shellfish are all particularly vulnerable to climate change, while other species such as deer may thrive in future conditions. Tribal member Sonya Johnson recalled "I remember going out with my grandpa and there were tons of fish, and now we're lucky to get enough to feed us for the winter," and that scarcity is likely to get worse in future years. While Alaska currently has a lower food insecurity rate than the lower 48, rural areas are likely much more affected and given the importance of traditional foods, that rate may increase in the future.

BECAUSE OF THIS THREAT, MANY RESIDENTS ARE CONCERNED ABOUT CLIMATE CHANGE.

A community survey in December 2022 found that just over 80 percent of community members said that climate change has been getting worse. Nearly half of the survey group said they were extremely concerned about the quality and availability of subsistence resources for their family and no one said they were not at all concerned. Many of the most visible impacts of climate change are already apparent in Hoonah; several people recalled having enough snow that they could jump off their roofs and land in deep snowbanks, now the streets are mostly clear. Other residents immediately brought up concerns about the timing and strength of salmon runs–with hotter drier summers the fish are having a harder time making it up the rivers and are doing so in smaller numbers.

THANKFULLY THE HISTORY OF HOONAH IS ONE OF ADAPTATION AND RESILIENCE, LEAVING RESIDENTS WITH MANY OPPORTUNITIES TO PROTECT THEMSELVES AND THEIR RESOURCES.

The Tlingit people have been adapting to climate change for thousands of years and are experts in finding new ways to thrive even in adverse and changing conditions. While climate change poses a novel and unprecedented threat to Southeast and local ways of living, Hoonah was founded as a response to climate change and the growth of glaciers in Glacier Bay and still holds those strategies for succeeding even in difficult times.

LAID OUT BELOW IS A ROADMAP FOR MOVING FORWARD AND REMEMBERING WHERE WE'VE BEEN, DESIGNED TO ADVANCE WITH THE TIMES AND ADAPT TO LOCAL NEEDS AND NEW SCIENTIFIC DISCOVERIES.

Climate science is constantly evolving, requiring any adaptation strategies to be flexible based on new information. While the broad strokes are widely agreed upon, exactly how the world will change will depend in large part on what actions are taken at national and international scales to curb carbon emissions. While the world is warming and our environments changing, Hoonah has a long history of adapting to changes and thriving even in times of adversity. This document is designed to help guide us while remaining flexible, to help us narrow our focus while still considering the larger picture and to be guided by both the models of climate futures as well as a historical understanding of how we got to where we are.

Temperature

Hoonah has a temperate coastal climate, defined by a short cool winter and a long but relatively mild winter. Over the next century, temperatures are expected to get several degrees warmer which will have direct impacts on key species and lead to secondary impacts by changing the hydrological cycle. Community members have already remarked that the winters aren't as bitterly cold as they once were, and that the sun seems hotter in the summer (including one resident who pointed out it's easier for her to get a tan now).

THE AVERAGE TEMPERATURE IS PREDICTED TO INCREASE BY 3 TO 10 DEGREES FAHRENHEIT BY THE END OF THE CENTURY.

The figure below shows the predicted temperature increases under a medium emissions scenario by the end of the century. The gray bars show the historical average, while the yellow, orange and red bars show the predictions for the decades starting in 2010, 2040 and 2090, respectively. Temperatures are predicted to rise in every month and every decade, with the winter months no longer experiencing much time below freezing by the end of the century. This will lead to less snow in the winter and much warmer rivers in the spring and summer.

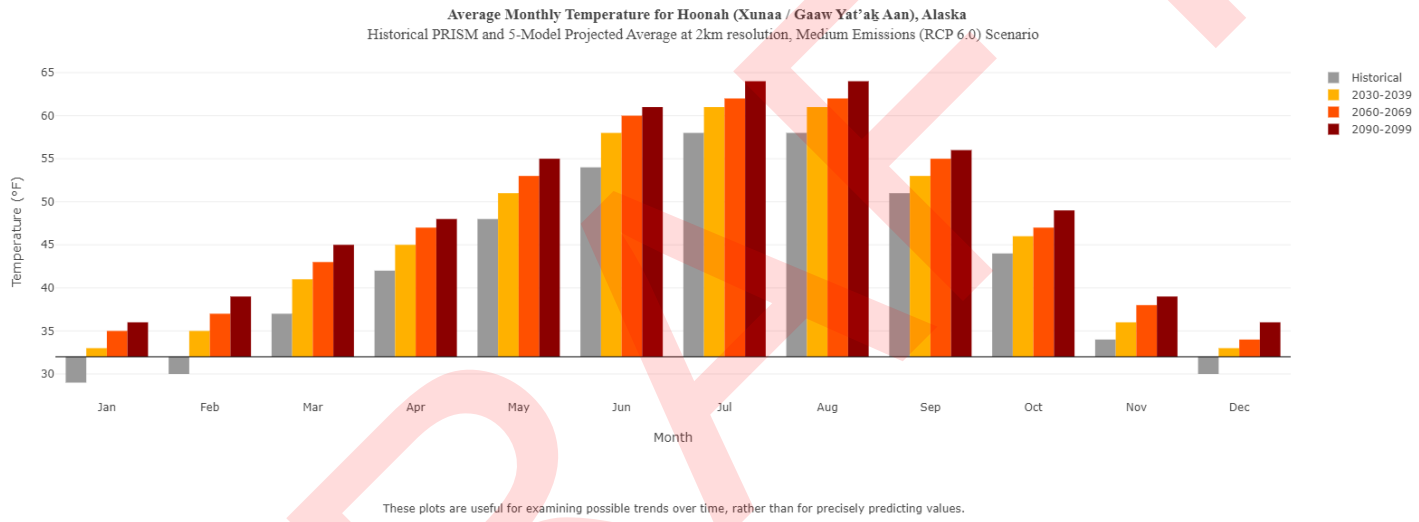


Figure 1 Average monthly temperature forecasts for Hoonah, AK under a medium emissions pathway until the end of the century. Figure from the Scenarios Planning for Alaska+Arctic Planning, University of Alaska Fairbanks.

THE AIR TEMPERATURE INCREASE WILL DECREASE SNOWPACK AND INCREASE GLACIAL MELT AND STREAM TEMPERATURES.

Several community members remarked on the warmer winters that Hoonah has now compared to the way it was when they were younger (60+ years ago). Springtime on Chichagof means the melting of snowpack, which feeds and cools salmon streams across the island. With warmer temperatures bringing less snow, rivers will warm which negatively impacts salmon and other fish. Glaciers are also melting at an unprecedented rate, and when that process ends streams on the mainland will switch from glacially fed to rain dominated, which results in much warmer salmon habitat.

WARMER AIR TEMPERATURES ARE WARMING UP THE OCEAN, DRASTICALLY CHANGING THE CONDITIONS FOR FISH.

Many crab and fish species are directly threatened by warmer waters, and community members have already begun seeing changes in the availability, size, number and location of many of their favorite subsistence foods. One crabber reported that he has to set his pots deeper in order to find the same colder water that Dungeness prefer, while a local fisherman said he had a harder time getting halibut since they also head to deeper waters when it's warmer out.

Precipitation

Surrounded by the world's largest temperate rainforest, Hoonah's climate is defined by abundant rainfall. Early fall tends to be the wettest part of the year, with October receiving nearly 10 inches of rain, while late spring and early summer is the driest. While drought is uncommon due to this high rainfall, Southeast Alaska experienced its first ever extreme drought from 2016-19, which threatened salmon populations, increased insect abundance, and limited power supplies from the hydro plant. Hoonah has already experienced an increase in rain relative to the 1990s. Many tribal elders have shared stories of decreased snowpack within their lifetimes, recalling when the snow would routinely reach to the roofs of their houses and it used to stay on the mountains well into the summer.

THE AVERAGE RAINFALL IS EXPECTED TO INCREASE BY 3-18 PERCENT BY THE END OF THE CENTURY.

As overall precipitation is predicted to increase across Southeast Alaska, the risk of drought is expected to decline. While there are uncertainties in the model, a drought of magnitude experienced in 2018-2020 is about half as likely to occur by 2050. The figure below shows how rain is likely to change under a medium emissions pathway. Slight decreases are predicted throughout the summer for the next few decades, followed by an increase at the end of the century. In Juneau, the average annual rainfall has already increased by 20 inches over the last hundred years.

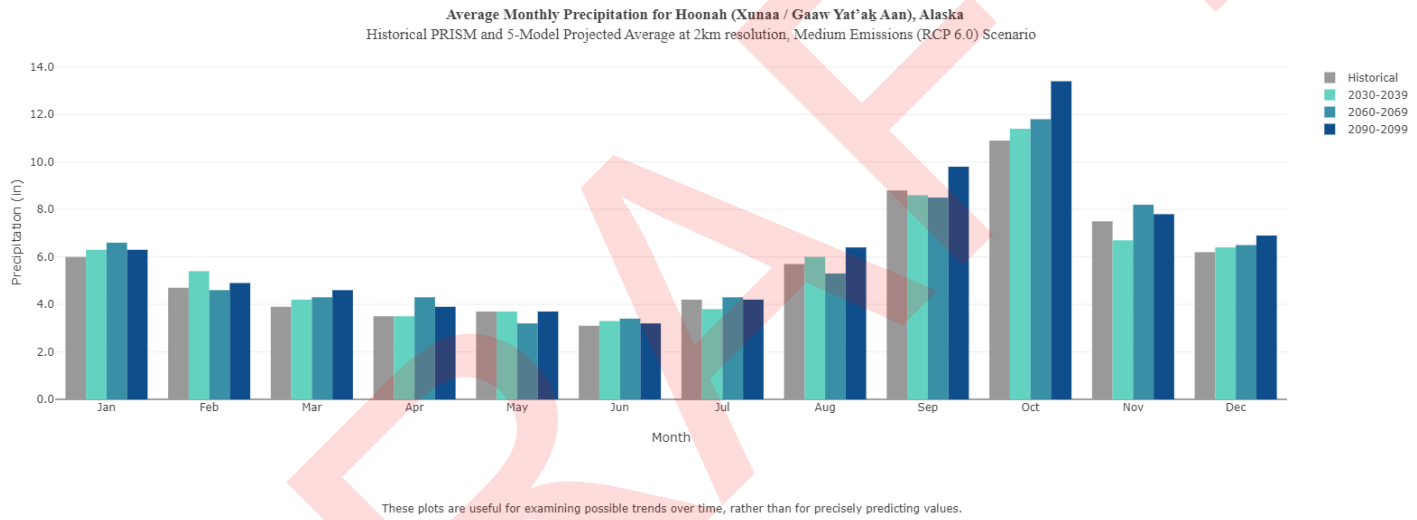


Figure 2 Precipitation forecast for Hoonah under a medium emissions pathway through the end of the century. Figure from the Scenarios Planning for Alaska+Arctic Planning, University of Alaska Fairbanks.

BUT THE TOTAL SNOWFALL MAY DECREASE BY UP TO 60 PERCENT.

Up to 80 percent of the area that now gets snow may not do so by the end of the century. Decreased snowpack will have a variety of effects on the ecosystem, including increased salmon mortalities due to higher water temperatures and lower rivers, a decline in yellow cedar due to a lack of insulation on the roots systems and risks to the municipal water supply and energy production.

PRECIPITATION PATTERNS ARE GOING TO SHIFT, WITH INCREASED PERIODS OF BOTH DROUGHT AND HEAVY RAINFALL.

Severe weather events, such as atmospheric rivers, are expected to increase by two- or three-fold by the end of the century because warmer air can hold more water. While too little rain causes the water in rivers to get too warm for salmon, too much can push the eggs out of the gravel before they have a chance to hatch. Heavy rains also increase the risk of landslides, which can both directly harm residents and reduce road access for subsistence activities. While overall rainfall is going to increase, it will become more variable and leave periods of drought.

Ocean Acidification

Ocean acidification, or OA, is caused by CO_2 from the atmosphere combining with sea water, which both changes the pH of the water and robs many marine animals of the essential chemicals they need to survive. A little over a third of human-emitted CO2 winds up in the ocean, where it has detrimental effects on all the plants, animals and people who rely on those ecosystems. Despite only having 15 percent of the global species, the world's oceans contain 78 percent of the world's animal biomass and 40 percent of the global population (including 100 percent of Hoonah) lives within 60 miles of the coast. HIA currently works in conjunction with the SEATOR network to monitor OA in Hoonah, while federal level monitoring is conducted by NOAA.

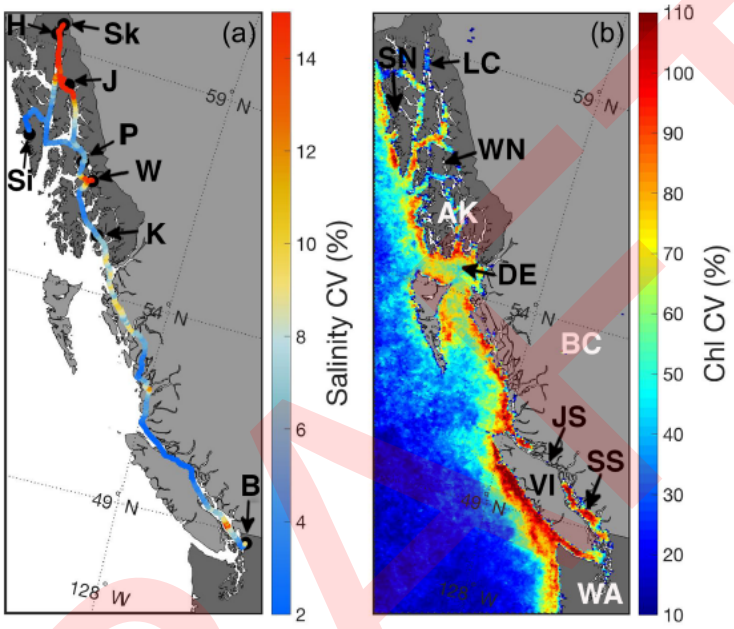


Figure 3 Near-surface measurements of salinity and chlorophyll along the BC and Southeast Alaskan coast. The M/V Columbia takes water quality measurements every three minutes during the sailing from Bellingham to Skagway to monitor environmental changes. Figure from Evans et al. (2022)

OCEAN ACIDIFICATION POSES A LARGE THREAT TO THE FOOD WEB.

While creatures lower on the food chain face the largest direct threat from ocean acidification, negative impacts to them will end up affecting the entire marine food web. Shellfish and crabs face an immediate threat from OA because in acidic conditions they lose the ability to grow their shells, while salmon can have their skeletons damaged and become disoriented. In turn, other animals that eat those species (including humans) then face risks to their food supply and may struggle to find enough to eat. Since shellfish, crabs and salmon are among the most important traditional foods in Hoonah, community members are likely to lose access to important nutritional and cultural resources.

ACIDIFICATION IS EXPECTED TO INCREASE 150 % BY THE END OF THE CENTURY.

The ocean is already about 30 percent more acidic now than it was before the industrial revolution and it's expected to get much worse, especially in Alaska. Alaskan waters naturally hold more carbon dioxide than waters at lower latitudes, and are already more acidic than water from temperate latitudes. Increased freshwater input, from heavy rains and glacial meltwater, decrease the ocean's ability to resist acidification, meaning as precipitation patterns in Southeast change and the glaciers melt, the ocean will become increasingly vulnerable to CO2 absorption.

Sea Level Change and Erosion

While many island communities are worried about sea level rise, post-glacial (isostatic) rebound will outpace the rising waters at least through the end of the century, depending on how quickly the ocean rises. While Hoonah and the rest of the northern panhandle will gain land in the coming years, the reshaping of the shorelines will still affect where tribal members can harvest shellfish and intertidal vegetation and impact salmon runs in important streams. Erosion, while primarily a focus in the western part of the state, is likely to increase over the next decade as severe weather events become more frequent.

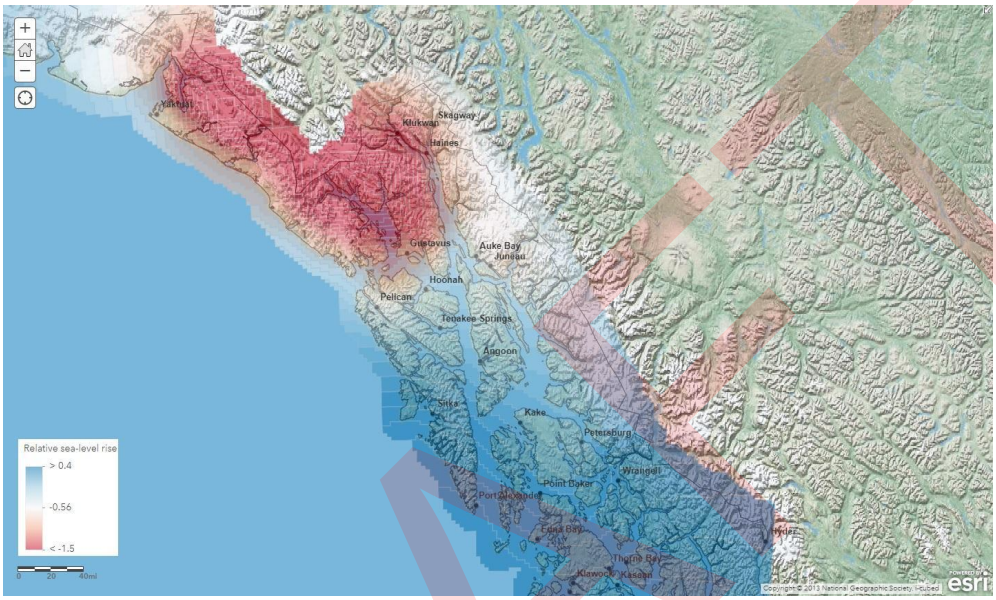


Figure 3 As sea level rise and post-glacial rebound battle it out, the southern half of the panhandle is likely to look land while the northern half (including Hoonah) is likely to keep gaining land under all emissions models. Figure from the Pacific Northwest Research Station/ Johnson and Kruger.

POST-GLACIAL REBOUND IS EXPECTED TO DROP THE SEA LEVEL BETWEEN 4 AND 43 INCHES BY THE END OF THE CENTURY DEPENDING ON HOW FAST HUMANS CURB GREENHOUSE GAS EMISSIONS.

While sea level rise will therefore be less of an issue than for many other islands, sea level and rebound will still dramatically reshape Southeast Alaska's coastlines. Clam and eelgrass beds, currently staples of the shallow intertidal region, are likely to face significant shifts over the next 80 years due to this change. Regions that are currently intertidal are likely to become meadows and no longer support seagrass, shellfish, normal fish, or crabs, while newly exposed regions are likely to fill that gap. Since eelgrass stabilizes sediments, areas that lose their grasses are more likely to face difficulties with erosion and loss of sediments. While the areas that support eelgrasses and shellfish are likely to change, the overall area is predicted to stay the same.

SEA LEVEL CHANGES ARE LIKELY TO BE WORSENED BY INCREASING EROSION, DRIVEN BY SEVERE WEATHER EVENTS.

The US Army Corps of Engineers has been monitoring erosion near the Mendenhall River in Juneau and is attributed to heavy rainfall events and melting of the Mendenhall Glacier. Given that heavy rainfalls and extreme weather are likely to increase in the future, it is likely that shoreline erosion will become more of an issue in Hoonah in the next few decades. Erosion can block salmon streams, damage intertidal vegetation and shellfish beds, and increase the amount of sediment in the water which negatively impacts fish.

Bears

Chichagof Island is home to an abundance of bears (***xóots***), which are a vital part of the ecosystem but can pose a threat to humans. Several tribal members said they didn't recall seeing as many bears in town when they were younger, and those with children voiced concerns about allowing their children to play unsupervised outside because of the risk of encountering a bear. One elder said the rules about garbage had changed from when she was younger, as residents now place bins outside the day of garbage collection as opposed to the night before, but that it clearly wasn't enough based on how often bears got into trash. While bear populations face threats due to various environmental threats, behavioral changes in the bear population poses a direct threat to residents both in the town and while out the road harvesting. An increase in negative bear-human encounters thus endangers local brown bear populations even more, as local efforts to terminate threatening bear encounters can result in more bear shootings in or near town.

Primary Risks

THREATS TO BERRIES AND SALMON ARE THREATS TO BEARS, AND IT DOESN'T LOOK GREAT FOR SALMON.

As an apex predator, the largest risk to bears is upsets in their food availability. Changes in the timing of seasons heavily affects when bears transition from eating berries to fish, and if berries are available until later in the year, bears are likely to spend less time munching on salmon. While this might leave more fish for subsistence fishers to get, it will reduce the number of fish brought into the forest by bears, which provide some 80 percent of the nitrogen to the trees in the Tongass.

CHANGING SEASONS WILL UPSET BREEDING, FEEDING AND HIBERNATION CYCLES.

Bears know when to leave their dens based on weather conditions, and as temperatures get warmer and more variable, it is likely that bears will become confused about when they are supposed to engage in certain behaviors. The beginning and end of hibernation cycles are triggered by the weather, and if Southeast has shorter, milder winters, it's highly likely that the length of time that bears hibernate will decrease. Archeological evidence suggests that a combination of human activity and climate change led to declines in the number and size of bears across Europe at the beginning of the Holocene era (approximately 12,000 years ago).

REDUCED FOOD COULD ENCOURAGE BEARS TO SPEND MORE TIME IN TOWN.

Coastal brown bears get over 40 percent of their food every year from salmon runs, so if salmon runs decrease, the bears are likely to have a problem. If they start going hungry, bears will be more likely to come to town to forage for garbage, which can lead to dangerous interactions with humans and pets. Bears are also becoming increasingly habituated to humans because of increased tourism and a growing population, which means if they do encounter humans, they're less likely to leave the situation.

Adaptation Strategies

SHORT-TERM GOALS:

1.1: Identify local and regional partners to help address and mitigate climate change impacts on brown bear habitat

1.2: Develop food waste reduction strategies and programs in Hoonah

1.3: Identify and apply for funding sources that support minimizing negative human-wildlife encounters

1.4: Hold annual ceremonies to acknowledge and celebrate brown bears as a relative and community member to restore and revitalize community members' connections with nonhuman relatives, increasing capacities to empathize with brown bears

MID-TERM GOALS:

2.1: Establish suitable bear habitat conservation areas that maintain connectivity under future climate change scenarios

2.2: Develop and implement environmental education plans / programs that help prevent and explain negative human-bear interactions, thus preventing retaliatory action

2.3: Perform environmental restoration practices that increase the availability and quality of brown bear habitats and food resources

2.4: Perform assessments around local bear behavior and annual availability of brown bear food resources to identify prime bear feeding habitat locations and times

2.5 Establish programs and capacities necessary to participate in advocacy efforts around climate change, just transitions, and maintaining Indigenous rights

2.6 Identify and participate in political avenues (e.g. Fisheries Commissions) to address depleting wildlife habitat(s) and food sources

2.7 Develop an evaluation procedure to assess which approaches are more / less effective at maintaining, and expanding, the habitats and food sources of local brown bear populations, thus reducing the threat of brown bears in town

2.8 Investigate effectiveness of bear-proof trash bins, and if deemed appropriate, fund their distribution throughout Hoonah

LONG-TERM GOALS:

3.1: Develop waste-management plans with relevant stakeholders for varying in-town bear activity scenarios

3.2: Allow unnecessary and/or unused roads to be reclaimed to support bears' out-of-town foraging opportunities

3.3: Adjust bear viewing schedules to prevent tourists / wildlife viewers from detering bear foraging in prime locations and times

3.4 Have continuous representation and participation in advocacy efforts around climate change and Indigenous rights

3.5 Evaluate interdisciplinary efforts to understand which have been effective at supporting / expanding brown bear habitat and food sources to eliminate the threat of brown bears encroaching

Birds

Southeast Alaska is home to a wide variety of birds, ranging from tiny songbirds to gulls and geese. Glaucous-winged gulls (***kéidladi***) are the most commonly targeted type of bird for their eggs (***k'wát***). They lay small clutches of two to three eggs in dense colonies on rocky outcrops, which are usually only harvested once one or two eggs have been laid to ensure they're fresh. Tribal elders spoke at length in interviews about the cultural significance of harvesting gull eggs and the importance of taking trips to Glacier Bay to harvest eggs. One elder recalled a memory of harvesting in the park prior to the ban and subsequent relegalization of the process: "I think it was connection to your seasons. To …progress in your life. To continuity. To sharing in the community. To everyone coming together and, you know, doing this one thing..." Other tribal members noted that finding gull eggs in the Park had been more challenging in recent years. Residents also hunt ducks and geese, diversifying their diets.

Primary Risks

SINCE GULLS HAVE A VERY DIVERSE DIET AND ARE HIGHLY MOBILE CREATURES, THEY ARE RELATIVELY WELL SUITED TO ADAPT TO CLIMATE CHANGE.

Gulls are notorious omnivores, enjoying fish, shellfish, crabs, smaller birds, some plants, and even garbage dumps and dead animals. Since gulls depend on other animals that will be negatively impacted by climate change, they may face food scarcity, but given their foraging abilities and broad preferences for eating, they have more options than animals that rely on fewer food sources. Warmer temperatures also increase the amount of food birds need to eat, which will require them to spend more effort hunting and possibly put them at odds with fish populations. Gulls are also fairly well suited to adapt to habitat loss, since they have more opportunities for considering new vistas than clams and cockles do. While the area near Hoonah is expected to lose gull habitat, regions near Yakutat, Juneau, and Petersburg are all expected to gain gull habitat by the end of the century.

WARMER AIR TEMPERATURES WILL CHANGE THE TIMING OF WHEN THE EGGS HATCH, WHICH MAY NOT ALIGN WITH WHEN FOOD SOURCES ARE AVAILABLE.

Birds across North America have already been observed to lay their eggs earlier because of rising temperatures. About a third of birds near Chicago lay their eggs 25 days earlier than they did a hundred years ago. The changing in the timing of the laying process may cause a mismatch between when the young are born and when there is abundant food. While gulls have a variety of options for sources of prey, birds that rely more heavily on just a few species may have a hard time feeding their young. The timing issue may also be one of the main reasons that almost a third of birds in North America—about 3 billion—have died over the past fifty years.

POLLUTION MAY REDUCE FOOD AVAILABILITY OR DAMAGE THE QUALITY OF FOOD BIRDS HAVE ACCESS TO.

Birds without enough food lay fewer eggs and have smaller young that are less likely to survive the fledgling stage. Community members interviewed about gull egg harvesting practices reported that the quality and taste of the eggs was dependent on what the gulls had been eating. If their food sources become more polluted or they are required to switch to other food sources, the taste and/or nutrition of their eggs may be affected. While gulls have very diverse diets, songbirds and ducks are somewhat more limited (the first relying almost exclusively on insects, the second eating shellfish, crabs, and insects).

HABITAT DEGRADATION IS THE LARGEST THREAT TO DUCKS AND MANY TYPES OF SONGBIRDS.

Ducks rely heavily on shallow wetlands and estuaries for building their nests and foraging for food. Isostatic (glacial) rebound is going to drastically shift shorelines and habitats across Southeast Alaska, resulting in a loss of duck habitat in the near-Hoonah area by the end of the century. Ducks are also vulnerable to run-off and development near urban areas, namely the expansion of Hoonah's airport in the Garteena Estuary. Songbirds face threats from logging and forest die-offs triggered by drought and insects, though many are adaptable and can nest and forage in clear-cuts as well. Since many of the species of birds in Southeast Alaska are migratory though, conservation efforts focusing on Hoonah are only half of the story and many of the largest threats affect their winter ranges, namely drought and forest fire in the Rockies and American Southwest.

Adaptation strategies

SHORT-TERM GOALS:

1.1: Educate the community about negative impacts on various bird species from increasing water temperatures and other adverse climate change impacts

1.2: Investigate ways to motivate youth to be involved in natural resource management, especially habitat restoration projects

1.3: Assess prime Gull egg harvesting locations throughout Glacier Bay, identifying the ecological characteristics associated with healthy egg nests

1.4: Identify regional partners / stakeholders to help address and mitigate adverse climate change impacts on Gull populations and egg nesting sites

1.5: Identify and apply for funding sources that support traditional Indigenous ways of life and self-determination to fund projects that amlieroate adverse impacts on Gull nesting sites in Glacier Bay and local bird populations

MID-TERM GOALS:

2.1: Explore options that encourage traveling to regions near Yakutat, Juneau, and Petersburg to harvest Gull eggs to maintain traditional harvesting practices

2.2: Perform environmental monitoring in Gull egg harvesting locations throughout Glacier Bay to survey changes in Gull egg nesting habitats

2.2: Establish environmental restoration techniques to improve the quality and/or abundance of Gull egg nesting habitat and ecological conditions in Glacier Bay

2.3: Collaborate with the National Parks Service to establish new protocols / procedures that enable tribal co-management of natural resources within the park

2.4: Evaluate the region for future Gull egg nesting locations after considering prospected climate change impacts

2.5 Establish programs and capacities necessary to participate in advocacy efforts around climate change, just transitions, and maintaining Indigenous rights

LONG-TERM GOALS:

3.1: Have continuous representation and participation in advocacy efforts around climate change and Indigenous rights

3.2: Participate in natural resource management decisions / processes in Glacier Bay, eliminating threats to Gull habitats and nesting sites

3.3: Maintain Gull egg harvesting practices in Glacier Bay as well as other locations, if necessary, to secure sufficient quantities of Gull eggs

Crustaceans

Dungeness (***s'áaw***), King, and Tanner (***x'éix***) crabs are all commonly caught subsistence species for tribal members and are an important traditional and nutritional resource for community members. While less commonly harvested, community members also catch shrimp (***s'éex'át***). Crabs in Hoonah are already dealing with the effects of climate change. One community member reported that he used to pull his pots out with so many crabs in them they could barely fit through the holes, now he struggles to catch more than a dozen at a time. The same man said he noticed them migrating to other places and that the traditional spots where he used to crab weren't as plentiful now as they were. Other tribal citizens were concerned about competition with commercial crabbers and overfishing.

Primary Risks

Increasing ocean temperatures will disrupt molting and growth, resulting in smaller and fewer crabs.

Waters in Alaska have already warmed approximately 2 °C, which is believed to be the major driver behind issues such as the collapse of the snow crab fishery. In normal conditions, small cold traps remain at the bottom of the ocean where crabs can take refuge on hot days, but as waters warm and mixing patterns change, those spots are harder to find. Dungeness need waters between 38 and 65 °F, and in warmer waters they burn more energy, meaning they'll need to eat more to survive, which is a problem if in the future there is likely to be fewer of the shellfish crab eat.

WARMER WATERS REDUCE THE AMOUNT OF OXYGEN IN THE WATER, SUFFOCATING CRABS.

Cold water can hold more dissolved oxygen than warm water, so when the water gets warmer, the oxygen levels drop. Low oxygen events most commonly occur in the spring and summer, when there aren't many larvae in the water, and can

kill off adult crabs. Crabs are particularly vulnerable to low oxygen events because they're stuck on the seafloor and can't just swim to another area where it's easier to breathe.

WARMER WATERS WILL ALSO WORSEN HARMFUL ALGAL BLOOMS, KILLING CRABS OR MAKING THEM TOXIC.

Since crabs eat shellfish, the toxins caused by certain types of harmful algal blooms can be concentrated in the guts of crabs and lead to illness and death if consumed. Algal blooms can also lead to extremely low oxygen conditions and mass die offs. Tanner crabs are also vulnerable to bitter crab syndrome, which makes the meat toxic and commercially non-viable.

OCEAN ACIDIFICATION IS LIKELY TO DAMAGE CRABS' ABILITIES TO GROW SHELLS AND INTERRUPT THEIR BREEDING.

Crab shells are built out of chitin calcium carbonate, which is harder to find as the ocean gets more acidic. Without the building blocks crabs need, larvae have been observed with pitted and folded shells. Crabs use their shells to swim, control their buoyancy and protect themselves from predators, all of which are crucial for their survival. The whiskers that crabs use to navigate underwater and search for prey can also dissolve off their faces, leaving them practically blind while they forage, and at low enough pH can kill larvae before they hatch. Acidic waters also slow the release of crab larvae, leading to a mismatch between the time when the crabs hatch and when the phytoplankton for them to eat is favailable. Lower pH can also disrupt their movement within the water.

INVASIVE SPECIES, SUCH AS EUROPEAN GREEN CRABS, CAN DAMAGE CRUCIAL CRAB HABITAT AND OUTCOMPETE NATIVE CRABS FOR FOOD.

Green crabs can eat up to 40 juvenile clams and mussels per day, outcompeting native Dungeness for food. They also shred eelgrass beds while foraging, which provide critical nursery habitat for young crabs. While green crabs have not yet been detected in Hoonah waters, they were discovered as far north as Metlakatla in the summer of 2022 and are predicted to reach Hoonah in the coming years.

Adaptation strategies

SHORT-TERM GOALS:

1.1: Continue water quality monitoring program to look for harmful phytoplankton with SEATOR partners

1.2: Develop European green crab monitoring program in collaboration with other tribal, state, federal and international partners

1.3: Support changes to commercial fishing regulations to protect subsistence harvest of crabs in Port Fredrick

1.4: Educate the community about the negative impacts of increasing water temperatures on crabs and other crustaceans

MID-TERM GOALS:

2.1: Establish protocols to monitor crab habitat (e.g. eelgrass beds)

2.2: Assess the need for monitoring biotoxins in crab meat

2.3: Establish environmental restoration practices to improve crab habitats around Port Frederick

2.4: Develop crustacean biomass monitoring program to look for changes in larval, juvenile and adult life stages of relevant crab species.

2.5: Establish programs and capacities necessary to participate in advocacy efforts around climate change, just transitions, and maintaining Indigenous rights

2.6: Investigate relationship between crab and other crustaceans and electromagnetic fields

2.6.1: If relevant, develop adaptation strategies using this relationship in order to reduce crustacean bycatch

LONG-TERM GOALS:

3.1: Support regional efforts to understand the effects of climate change on relevant crab species

3.2: Research shellfish resiliency - physiological costs of resilience, non-traditional shellfish harvesting and aquaculture strategies, options to mitigate paralytic shellfish poisoning, and more

3.3: Develop and support policy protections for small-scale and local resident fisherman and subsistence fishermen to maintain access to diminishing resources, while limiting large-scale shellfish and fishing harvests

3.4: Participate in natural resource management decisions / processes to eliminate adverse impacts on crabs and other crustaceans in Southeast Alaska

Cultural Resources

Yellow Cedar ***(Xáay),*** spruce (***shéiyi***), and mountain goats ***(jánwu)*** are three species commonly used for artistic and cultural purposes including weaving and carving. While Chichagof Island lacks mountain goats, tribal members can travel to the mainland in search of the wool they've left behind on bushes and rocks to use when making Chilkat robes. Many other species are used in traditional art but are considered elsewhere in this document (such as animals used for their skins and furs).

Primary Risks

DECREASED SNOWPACK WILL REDUCE INSULATION ON CEDAR ROOTS, LEADING TO TREE MORTALITY.

While it may sound counterintuitive, the warmer winters will increase how often cedar roots freeze. Snowpack normally acts as a blanket on top of the roots and protects them from below-freezing air temperatures, but if snowpack is reduced, the roots can freeze and kill the tree. Large losses have already been documented on western Chichagof and are expected to expand in coming years, which will make it harder for community members to access the cedar they need for traditional art.

WARMER SUMMERS WILL LEAD TO SEVERAL FOREST-BASED THREATS, INCLUDING INSECTS AND THE RISK OF FIRE.

The past several summers, the Tongass has been heavily hit by infestations of blackheaded budworms, which has led to massive swaths of brown forests across Southeast. While some level of budworms is a natural part of the ecosystem, if the environmental conditions allow them to breed out of control, it could lead to increased tree deaths. While the total amount of rain in Southeast is expected to increase, increased variability in rainfall will lead to dry spells which heighten the risk of forest fires. While fires in Southeast are currently quite rare, dry spells will force residents to be more careful about their fire practices to avoid catastrophe. Scientists focusing on the interior and south central have also found that their models to predict forest fires aren't working as well as they used to because of the variability in environmental conditions.

MOUNTAIN GOATS WILL FACE AN INCREASINGLY LIMITED RANGE DUE TO WARMING TEMPERATURES.

As an alpine species, mountain goats are adapted for cold weather and are threatened by rising temperatures. The warmer weather is expected to lead to heat stress, reduced foraging abilities and significantly less viable habitat. The summer range is expected to decline between 17 and 86 percent depending on the emissions model over the next 70 years. Increased rain on snow events throughout the winter and at higher elevations will form a thicker crust on the snow which prevents the goats from finding food underneath. Goat herds also produce fewer offspring than moose and deer and are thus slower to recover from population losses. Smaller herds are particularly vulnerable, including the three distinct subpopulations within Glacier Bay National Park. Under high-emissions simulations, all three groups are expected to be practically extinct by 2085. Because mountain goat herds tend to stay on separate ranges, there is low genetic variability which means they'll have a harder time adapting to changing conditions than more inter-mixed species will. It is highly likely that by the end of the century mountain goat wool will be much rarer and tribal members will need to use alternative materials for weaving.

Adaptation Strategies

SHORT-TERM GOALS:

1.1: Develop strategies for Spruce/evergreen winter preparation including maintaining soil moisture levels pre-freeze, insulating roots with added mulch, avoiding deicing salt buildup near tree roots, utilizing windscreens, and protecting bark from sunscald and frost cracks using tree wraps. (1, 2)

1.2.1: Track seasonal changes to best predict when the ground is expected to freeze in a given year

1.2.2: Acquire materials to be used for winter preparation measures

1.2: Update community procedures for cases of forest fires

1.2.1: Evaluate current forest fire procedures

1.2.2: Understand the patterns of forest fire that are most likely to occur

1.3: Form partnerships with researchers and other communities in the region to further monitor forest fire risk levels and develop a network of knowledge regarding current forest fire risk levels

1.4: Educate community members about options for fire prevention and mitigation

1.5: Monitor and report blackheaded budworms and other species to the Forest Service's crowdsourcing app, iNaturalist.

1.6: Use mountain goat wool sparingly and explore alternative fibers.

MID-TERM GOALS:

2.1: Implement Spruce winter preparation measures to increase the longevity of the trees as snow pack diminishes

2.2: Implement emergency preparedness workshops to keep community members informed of best practices in the event of a forest fire

2.3: Investigate alternative residential and community heating options

2.4: Explore how to use expected changes in vegetation for traditional practices (e.g. an increase in mushrooms in arts, medicines, foods, etc.)

2.5: Create subsistence access program targeted at elders

2.6: Generate a map of all culturally important resources located throughout and near Hoonah

LONG-TERM GOALS:

3.1: Plant Spruce in areas away from roads and other heavily salted areas

3.2: Update infrastructure to be more resilient to forest fires

3.3: Invest in mental health infrastructure to prepare for any community and cultural losses that may be felt by the changing climate

Deer

Deer (***q̲uwakaan***) are a key source of meat for tribal members, with 94 percent of households reporting using deer during the 2017 food survey. Deer are posed to do relatively well because of climate change, with vegetation being more abundant due to the warmer weather. Nearly all community members surveyed were concerned about competition with Juneau hunters and the quality of the deer they can find, with one person saying "I don't come into your backyard and harvest food from your place." Several members reported deer being smaller in recent years and that a lack of snowfall was changing where they were found. Many community members had also seen the evidence of illegal hunting practices—small deer left in ditches, people with more deer than the legal limit in the back of their trucks, etc. The community showed great support for increased enforcement and local control of deer populations to better understand the effects of climate change and human pressures on deer and be able to respond to threats.

Primary Risks

DEER WILL LIKELY HAVE ACCESS TO MORE FOOD THROUGHOUT THE YEAR AND BENEFIT FROM REDUCED SNOWFALL.

A thick layer of snow on the ground reduces both the quality and quantity of food available—not only are there fewer plants poking through, but those that do are taller, woodier plants instead of the herbs and brambles deer prefer. Excess snow on the ground also increases the amount of energy deer burn while walking, as once the snow is above their knees, they have to change their way of walking. At the same time, rain-on-snow events are likely to increase in the near term, which can produce a frozen crust on top of the snow that deer have a hard time breaking through in order to search for food. Snowfall is expected to decline regionally, with 85 percent of the northern rainforest no longer receiving snow by the end of the century. The snowline is expected to raise 2,950 feet, significantly decreasing the wintering grounds and foraging opportunities for deer.

THE BIGGEST THREAT TO DEER IS HABITAT DEGRADATION FROM LOGGING.

Deer rely on old-growth stands with a productive understory, where the canopy layer prevents the plants below from being completely buried by snow. While young-growth stands can provide abundant food for deer in the summer, without a canopy layer, that food is generally unavailable and can lead to mass starvation during the winter. Scientists have found that the majority of the deer population loss on Prince of Wales is driven by young growth stands providing unsuitable deer habitat.

INCREASING COMPETITION FROM URBAN HUNTERS CAN ALSO THREATEN COMMUNITY HUNTING ACCESS.

While the region around Hoonah has some of the highest densities of deer in Southeast, hunters from out of town still place pressure on local users, especially near town. Community members were very concerned about the impact of urban users on the local deer population. While some were concerned about the number of users coming to Chichagof to hunt deer, the overwhelming majority were more concerned about non-local users using unsustainable hunting practices, targeting does and young deer that local users do not traditionally shoot. Increased pressure can force local hunters to travel further, using more gas and time, to get the same number of deer and place additional stress on users who rely on deer to feed their families.

SPREAD OF DISEASES, SUCH AS CHRONIC WASTING DISEASE (CWD) MAY THREATEN DEER IN THE FUTURE.

Chronic wasting disease is a neurological disease similar to mad cow disease that is caused by a misfolded protein in the brain and is 100 percent lethal once symptoms develop. The disease is transmitted when brain or spinal tissue cross-contaminates meat and is accidentally eaten. There are currently no records of CWD within the state of Alaska, but it has been recorded in 29 US states and 3 Canadian provinces. While the state does maintain a testing program, it focuses on animals hit by vehicles near Anchorage and testing hasn't been conducted in Southeast since 2007.

Adaptation Strategies

SHORT-TERM GOALS:

1.1: Continue to advocate for the protection of old-growth stands and restrict logging to young-growth stands

1.2: Continue tree thinning treatments in previously logged areas to encourage healthy regrowth, particularly in riparian environments

1.3: Continue and increase youth and community engagement in State and Federal decision making processes about subsistence hunting regulations

1.4: Continue the development of youth-focused harvesting and processing activities to increase community knowledge on subsistence deer use

1.5: Continue research into community harvest and hunter efforts around deer to increase understanding of deer populations and their threats

1.6: Creation of community-managed designated areas for berry production that are protected from deer foraging

MID-TERM GOALS:

2.1: Support bear conservation efforts that can reduce the threat of bear predation on deer

2.2: Create, or support the creation of, an educational deliverable teaching non-locals traditional and sustainable deer hunting practices

2.3: Continue efforts to implement a Traditional Homelands Conservation Rule that would increase federal government consultation with local Indigenous tribes

2.4: Utilize aerial imagery and LIDAR to establish a baseline for tree canopy coverage and identify areas of concern

2.5: Encourage and motivate Hoonah youth to participate in natural resource management, especially habitat restoration projects

2.6: Implement heavily enforced hunting regulations against non-local deer hunters.

LONG-TERM GOALS:

3.1: Continue monitoring deer populations in and around Hoonah for chronic wasting disease

3.2: Start the collection of long-term data on canopy gaps in forest stands near Hoonah to monitor snowpack, light penetration, and other factors significant to understory growth

3.3: Continue support of the Roadless Rule and other conservation measures in the Tongass National Forest

3.4: Creation of artificial canopy gaps to improve high-quality winter forage (i.e., Vaccinium spp. and evergreen plants) in young-growth stands

Halibut

Halibut (***chaatl***) are an important food source for tribal members that can be harvested year-round. They are one of the most caught species by weight, surpassing even salmon. The size of halibut that could be caught was traditionally determined by the shape of the halibut hook—if the fish were too small, they couldn't get the hook in their mouth, and if they were too large it would slip back out again. This allowed for strict control of which fish were getting caught, leaving the small ones to keep growing and the largest ones to keep breeding. Tribal members were particularly concerned about non-local users harvesting the wrong members of the population, with one HIA member stating, "leave those babies and those giants alone," when talking about people on the docks with chicken sized halibut. With more sport and charter fishers coming from Juneau and other urban areas, the pressure on halibut is likely to increase in the future.

Primary Risks

THE AVERAGE SIZE OF HALIBUT IS LIKELY TO DECREASE BUT IT MAY OR MAY NOT ALL BE CLIMATE RELATED.

The length and size-at-age of halibut rose sharply from the 1920s through to the 1980s, but has been rapidly declining since then. While the exact drivers of that decline are still somewhat unknown, it is linked to environmental causes. Researchers also found that in years when fewer halibut were caught, the average size was larger. The average weight of a 20-year-old halibut has declined over 60 pounds from 1988 to 2013, dropping from 120 lbs. to 45 lbs. Field studies also show that while halibut can be found in waters of 3.8-11 C, they are most commonly found in temperatures of 5-7 C. There was also no relationship between the Pacific Decadal Oscillation, a year's long pattern of climate variability that alters sea surface temperatures, and halibut size. This means that warming waters might not be the culprit for halibut getting smaller, and it may be a result of fishing practices or competition with other species. Regardless of the cause though, halibut are expected to continue getting smaller in the coming decades, meaning tribal members will have to catch more halibut and spend more fuel and time doing so to get the same amount of meat.

WARMER WATERS WILL CHANGE THE TIMING OF HALIBUT EGG DEVELOPMENT AND HATCHING AND INCREASE THE RISK OF DEAD ZONES.

The timing of when halibut lay eggs and how long it takes for them to develop depends heavily on the water temperatures. Warmer waters can cause the eggs to be laid earlier and develop faster than eggs that are laid in cooler water. The larvae that hatch from eggs in warm water are also smaller than those that develop in cooler water. Smaller larvae are more vulnerable to changing ocean conditions and predation. Changing the timing of when eggs are laid, and hatch may mismatch the new larvae with the timing of the plankton they eat when they hatch and cause mortalities. Finally, warmer waters contain less dissolved oxygen and so as oceans warm, there is a higher risk of anoxic dead zones forming where animals cannot get enough oxygen. However, given that halibut are a highly mobile species, they are likely to be more resilient than seafloor creatures such as crabs or sedentary ones such as clams and cockles. Nonetheless, warming waters will likely cause additional halibut mortalities that could reduce the availability of an important resource.

OCEAN ACIDIFICATION WILL NEGATIVELY IMPACT THE FOOD HALIBUT RELY ON, REDUCING POPULATION SIZE AND HEALTH.

Young halibut that live exclusively on the ocean floor rely heavily on crustaceans for prey. Crabs face multiple stressors, including ocean acidification damaging their shells and warming waters reducing the area where they can live, and declines in crab populations will result in halibut going hungry. Adult halibut seek out a wider variety of food sources,

and although the clams, fish and crabs they rely on are likely to be negatively impacted, the broader range of species adult halibut eat will help make them more resistant to change.

GIVEN THE WIDE RANGE OF HALIBUT HABITAT, THEY ARE LIKELY TO BE MORE RESILIENT THAN OTHER SPECIES OF FISH.

Pacific halibut range from California, through the Bering Sea and across to Japan, meaning they're already adapted to a wide variety of temperatures. While juveniles face heightened risks from climate change, individuals that survive to adulthood seem relatively well suited to do well even in changing environmental conditions. Thus, despite the threats to halibut listed above, it is likely that community members will be able to catch sufficient halibut in the future, though it may take more effort.

Adaptation Strategies

SHORT-TERM GOALS:

1.1: Monitor Halibut populations and sizes

1.2: Investigate options for adapting fishing techniques, such as fishing in deeper water

1.3: Educate the community about negative impacts on halibut stemming from increasing water temperatures

MID-TERM GOALS:

2.1: Increase participation in government management of Halibut

2.2: Reduce impacts of commercial fishing

LONG-TERM GOALS:

3.1: Consider aquaculture as a means of assuring long-term access to Halibut and other marine resources

3.2: Policy protection for small-scale and local resident fishermen and subsistence fishermen to maintain access to diminishing resources while limiting large-scale fishing harvests

Herring

Pacific Herring **(yaaw)** are a popular baitfish in the region and also used for consumption. Herring eggs (***gáax'w***) are particularly prized as they are one of the first fresh foods of spring and mark the end of a long, dark winter. The importance of herring and their eggs to the Tlingit people make them a cultural keystone species, and the eggs are commonly savored and preserved for cultural events later in the year. Herring are also an important bait fish, widely used by local subsistence users for catching halibut and crab, and are a vital food source for many marine mammals and ground fish. One tribal member spoke at length about the value of herring in the ecosystem and how further losses in their population would lead to trophic cascade, wiping out species higher on the food chain.

Primary Risks

RISING WATER TEMPERATURES AND OCEAN ACIDIFICATION THREATEN HERRING EGGS.

Data collected over two decades showed that rising water temperature led to earlier spawning and faster growth of young herring. In addition, a separate study found that herring roe exposed to higher water temperatures tended to be shorter, with larger yolks. Those exposed to ocean acidification were longer with smaller yolks. While these two exposures seem to cancel each other out to the naked eye, it was apparent at the molecular level that eggs exposed to warmer temperatures and acidification were compromised. They were stressed and their protein expressions were not functioning normally. This change may go unnoticed by those managing herring stocks, who regularly do so by keeping track of average weight and ages in the population, but don't take into account RNA:DNA ratios.

THEIR PRIMARY FOOD SOURCES (PHYTO-AND ZOOPLANKTON) ARE HEAVILY INFLUENCED BY CLIMATE CHANGE.

While warmer oceans could increase the production of phytoplankton and provide forage fish with more nutritional resources, warmer waters also hold less oxygen and require more energy to be spent on growth and reproduction. Ocean acidification also has negative impacts on zooplankton and small pteropods that are important foods for herring. It is currently unknown how the relationship between increased energy needs and increased food availability will change in the future.

REGIONAL HERRING STOCKS HAVE BEEN HEAVILY DEPLETED BY OVERFISHING.

The current herring population represents only a small fraction of their historical abundance, mostly due to overfishing. The smaller population of fish are more susceptible to being negatively impacted by a changing climate. Several tribal members reported that when they were younger the herring were much more abundant near town, and that they were concerned by drops in the population. Herring eggs are currently harvested in Sitka and brought to Hoonah for local consumption, leaving local stocks to recover with less interference. One resident linked the building of the new creosote-covered harbor to the drop in herring populations, implying that human development may continue to have negative effects on fish.

IMPACTS TO HERRING IMPACT THE ENTIRE ECOSYSTEM.

Herring is an important part of the marine ecosystem and a commercially important fish species. Herring are a vital food source for sea lions, whales, marine birds and larger fish. They are also used as crab and fish bait by local subsistence users.

Adaptation Strategies

SHORT-TERM GOALS:

1.1: Add Pacific Herring to Alaska's Forage Fish Management Plan

1.2: Encourage the growth of marine plants and seaweeds to improve herring habitats

1.3: Continue work on restoring the Icy Straits Advisory Committee to advance local voices on herring management

MID-TERM GOALS:

2.1: Recruit local herring experts to be a part of the field research teams studying herring

2.2: Consider feasibility of herring egg transplantations to enhance spawning stocks

2.3: Work with the city and State to prohibit disturbances of key spawning areas.

2.4: Institute sanctions on irresponsible herring harvesters

LONG-TERM GOALS:

3.1: Manage herring populations with a cultural-historical perspective - look at numbers from across the past 3 or more generations, rather than the past 40 years.

3.1.1: Use Local and Traditional Tlingit knowledge to inform research and future decisions about herring

Human Health

Human health is intrinsically tied to the health of the land, especially in a place like Hoonah where so many of the foods are locally harvested from the sea and forest. Threats to the resources outlined in this document will have profound impact on the health of the people who depend on them, and will be made worse by an increased risk of natural disasters and novel diseases. Local harvesters are concerned about climate change and the effects it will have on local resources; nearly half of survey participants said they were concerned or extremely concerned about the availability or quality of traditional foods in the future. Darlene See, of the HIA cultural department, pointed out that the people of Hoonah have a long history of adapting to climate change, and "we've always adapted, but how do you adapt to this?" Tribal members are also worried about the effects that losing traditional resources will have on community dynamics, since sharing food strengthens interpersonal relationships and specific traditional foods are highly sought after for many cultural events.

Primary Risks

WARMER WEATHER WILL EXPAND THE RISK OF PARASITES AND DISEASES.

Patterns of infectious diseases are sensitive to disturbances in the ecological structure of the environment. As weather becomes warmer, and animal populations begin to vary and deviate from typical habitat, some parasite populations will grow and transmission of human-animal diseases will emerge. Over half of tick-borne illnesses in the past hundred years in Alaska are from the past ten years due to range expansion because of warmer weather. Warmer waters also significantly increase the growth of the harmful algal blooms that cause paralytic shellfish poisoning, as addressed elsewhere in this document, which can make shellfish and crabs lethally toxic to harvesters.

AIR QUALITY CHANGES WILL INCREASE THE INCIDENCE OF LOWER RESPIRATORY ILLNESSES.

The 2017 air quality monitoring project found that many homes in Hoonah have poor air quality because of wood smoke and poor ventilation from how people heat their homes. Older homes, which are often owned by elders, were particularly likely to have increased harmful micro-particulates. Climate change is likely to make the problem worse, due to the risk of increased forest fires and changing wind patterns that can affect the way smoke travels.

AN INCREASE IN RAINFALL AND SEVERE WEATHER WILL DRIVE AN INCREASE IN LANDSLIDES.

Southeast Alaska is no stranger to landslides, but they are becoming more dangerous and more frequent as weather conditions change. Atmospheric rivers, which deliver about a fifth of the yearly rainfall in Hoonah are responsible for 80 percent of the extreme precipitation, which is what triggers the majority of landslides. The frequency, duration and strength of atmospheric rivers are all predicted to increase in Southeast Alaska over the next century, making lethal landslides more likely. Not only do landslides pose a direct threat to human life, it also poses a large infrastructural risk out the road. Several community members reported feeling unsafe traveling out the road to hunt when there had been large rains recently due to the risk of getting stranded if roads were damaged by large slides such as the one near Spasski River in 2021. Sheryl Contreras pointed out "I've noticed that in the last 3-4 years with all the rain we've had there have been more mudslides/ That's a huge impact for hunters–access out the road. And for berries," and while she doesn't personally hunt, she depends on her sons bringing her deer.

THREATS TO SUBSISTENCE FOOD WILL HARM BOTH PHYSICAL AND MENTAL HEALTH.

Traditional foods are a vital element to many tribal members' diets for both the nutritional and cultural value they add. Store-bought meats and produce can be highly variable and are extremely expensive or simply unattainable. Regular consumption of traditional foods is also linked to better mental health and a reduction in substance abuse issues. A study of citizens of the Syilx First Nation in Canada found that individuals that regularly consumed salmon had better physical health (lower rates of heart disease, diabetes, obesity etc.) as well as reported having better personal connections to their community and traditional lands.

Adaptation Strategies

SHORT-TERM GOALS:

1.1: Continue working with members of the Kuti program to develop a landslide monitoring program for Hoonah.

1.2: Assess the need to monitor for ticks, deer wasting disease and other zoonotic risks to human health.

1.3: Continue work on both indoor and outdoor air quality monitoring and expand current opportunities for home improvements that can improve air quality.

1.4: Continue to work with the City of Hoonah, Forest Service and Central Council to update emergency preparedness plan and educate community members about resources and procedures.

1.5: Continue to work with the SEATOR network to monitor for and educate community members about Paralytic Shellfish Poisoning.

MID-TERM GOALS:

2.1: Work with Central Council to develop a tribal subsistence program

2.3: Monitor changes in size and quantity of traditional foods harvested

2.4: Maintain ecological diversity through habitat protection and maintenance

2.5: Create a locally-informed landslide emergency plan

LONG-TERM GOALS:

3.1: Develop citizen science in Hoonah for community monitoring and assessment of biotic and abiotic changes

3.2:

3.3: Invest in efforts to create climate-durable housing - weatherizing, increasing efficiency, education initiatives, etc.

3.4: Create a locally-informed and comprehensive disaster relief plan

Invasive Species

Invasive species are any plant or animal that has been introduced to a new region outside of their natural range and have negative impacts on the native ecosystems. They have the potential to foul boat hulls and fishing equipment, destroy crab and salmon nurseries and kill large swaths of the forest, leading to decreased habitat and increased risk of fire and landslides across Chichagof Island. Invasive species are one of the leading causes of biodiversity loss, which can lead to impacts at all levels of the food chain and threaten food supplies for humans and animals alike.

Primary Risks

THE RANGE OF SEVERAL INVASIVE SPECIES WILL LIKELY INCREASE DUE TO GLOBAL WARMING.

The overall number of invasive species is likely to increase by 36 percent by 2050, with invertebrates making the largest increase. While not all of that growth can be attributed to climate change (other major stressors include trade, tourism, and transportation), climate change will make species more vulnerable and worsen the damage new invasive species can cause.

INCREASED HUMAN TRAFFIC THROUGHOUT THE REGION WILL PROVIDE NEW OPPORTUNITIES FOR INVASIVES TO TRAVEL.

42 invasive species were detected on road surveys in 2007, primarily near town, heavily used recreation sites (Whitestone Harbor, Wukulook, Suntaheen), and near previously logged forest plots that had been reseeded with non-native plants. The survey also found that only 13 of the invasive species documented on Chichagof were also present on Kruzof and Baranof Islands, meaning there is a large potential to increase the number of invasive species present near Hoonah. Invasive species also have the possibility to spread new viruses; sweet rocket (*Hesperis matronalis*) has been documented near Juneau, Ketchikan and Wrangell and can host novel viruses that can infect local plants.

MARINE AND RIPARIAN (STREAM) AREAS ARE LIKELY TO FEEL THE BRUNT OF THE ISSUE.

European Green Crabs pose a large threat to eelgrass beds in the intertidal and shallow subtidal regions, which currently serve as critical habitat for salmon fry, shellfish and juvenile Dungeness crab. EGCs are well established on the coasts of California, Oregon, Washington and British Columbia, and were recently documented as far north as Metlakatla. Stream environments and their related salmon runs also face threats from a variety of invasive species. There are currently over 250 marine invasive species that have settled along the west coast of the lower 48, and while only 15 of them have made it to Alaska, the potential for future invasions is large. Marine species also have an easier time moving from one location to the next, due to their ability to hitch a ride on ships and broadcast spawn in water and allow their larvae to drift from island to island.

INVASIVE LAND ANIMALS ARE THRIVING AND WITH RELATIVELY FEW NATURAL PREDATORS, ARE EXPECTED TO CONTINUE DOING DAMAGE.

While the majority of invasive species documented thus far on Chichagof are plants, there are also several invasive mammals (red squirrels, American martens and feral house cats) established. Without many natural predators, those species are likely to continue breeding and have an ever-increasing effect on local wildlife.

RISING TEMPERATURES HAVE ALSO EXPANDED THE RANGE OF A VARIETY OF INSECTS AND MAKE THEIR ATTACKS LAST LONGER.

Defoliating insects, such as the black-headed budworm, are a natural part of the Tongass, but can intensify climate risks such as droughts and landslides. If trees have already lost many of their needles due to budworms, it doesn't take as heavy of a drought to inflict damage, and if trees are killed by hot weather or bugs, the lack of roots can increase the risk of landslides due to heavy rain.

Adaptation Strategies

SHORT-TERM GOALS:

1.1: Continue and expand monitoring programs for both extant and novel invasive species

1.2: Continue management at common recreational sites to limit the spread of invasive species.

1.3: Expand youth opportunities for invasive species management and community educational programs to help residents avoid accidentally introducing invasive species into the area.

1.4: Install boot brush stations at key locations throughout Hoonah and the broader Chichagof Island to prevent the spread of invasive species by foot traffic

1.5: Educate the community on the relationship between invasive species and increasing water temperatures and ocean acidification

MID-TERM GOALS:

2.1: Introduce and support climate-resilient native species

2.2: Conduct rapid response when new species are detected

2.3: Identify and protect particularly vulnerable native species

2.4: Invest in and develop kelp cultivation projects to improve marine habitats and biodiversity

LONG-TERM GOALS:

3.1: Collaborate with tribal, state and federal partners to develop invasive species monitoring programs and minimize their spread and impact.

Marine Mammals

Marine mammals are some of the most iconic species in Southeast Alaska, including sea otters (***yáxwch'***), sea lions (***taan***), seals (***tsaa***) and humpback whales (***yáay***). Smaller marine mammals provide fur, whiskers, meat and oil for traditional practices, while whales contribute heavily to the tourism industry and ecosystems of the region. Seal oil is highly sought after for ***k̲oo.éex'*** and other social events, while seal skins, sea otter fur and sea lion whiskers are all used in traditional art. Tribal members have already reported changes in the number and behavior of several marine mammals, including the rapid increase in sea otters following their re-introduction post-fur trade and that sea lions have been migrating further into Port Frederick in search of fish.

Primary Risks

CHANGES IN FOOD SUPPLY DUE TO INCREASING ENVIRONMENTAL THREATS IS THE LARGEST ISSUE MOST MARINE MAMMALS WILL FACE DUE TO CLIMATE CHANGE.

Since marine mammals are at the top of the food chain, if their food sources, primarily fish, crabs and shellfish, are negatively impacted by global warming and ocean acidification, they face losing their prey. Harbor seals have been getting smaller as food becomes less abundant—the average seal has gotten 6 kg slimmer per year, which reduces the survival rate of individuals. The decline in body condition was most noticeable for pups. In the Aleutians, harbor seal counts dropped by 86 percent between 1980 and 2000, most likely due to a marine heat wave. As waters continue to warm and their prey becomes less abundant, harbor seals will have a hard time hunting enough to sustain themselves. Whales were also decimated by marine heatwaves such as The Blob; the year before the heatwave National Park Service employees counted 163 humpbacks in Glacier Bay, and the year after they only found 45. Abundant food has allowed the population to begin recovering but is still lower than it was before.

MARINE MAMMALS ARE ALSO VULNERABLE TO POLLUTION AND ENTANGLEMENT FROM FISHING VESSELS.

Gillnets, trawls, seins and weirs can all tangle up marine mammals and cause them to drown. Ghost fishing gear, gear that has been abandoned but is still functional, is a leading cause of death for marine mammals. They're also vulnerable to vessel strikes; of the 108 reported strikes in Alaskan waters between 1978 and 2011, 25 resulted in the death of the whale. With increased fishing and tourism throughout the state and limited enforcement of the regulations on distancing and vessel speed, the number of fatal strikes is likely to increase. They are also vulnerable to side effects from tourism and shipping routes, as their feeding and resting behaviors are often disturbed by marine noise.

SINCE MARINE MAMMALS ARE HIGH UP ON THE FOOD CHAIN, IMPACTS TO THEM CAN ALSO NEGATIVELY IMPACT THEIR ENVIRONMENTS.

Sea otters are critical in protecting kelp, which is not only a food source for people and many other animals but also directly helps reduce the effects of ocean acidification. When there aren't enough sea otters in a region, sea urchins can breed without interference. That can lead to urchin barrens, where the urchins eat the holdfast of large kelps (the bit they use to hold on to the ocean floor) and transform massive kelp forests into wastelands. Kelp forests in California, where sea otters are barely present, have shrunk by more than 90 percent according to historical records. Threats to whale populations could also reduce the occurrence of whale fall, when deceased whales sink to the ocean floor and provide rare and much needed nutrients to the benthic ecosystem.

Adaptation Strategies

SHORT-TERM GOALS:

1.1: Perform outreach and education on the significance of balanced ecosystems, specifically regarding sea otters' role in the ecosystem

1.2 Perform outreach and education on human impacts on marine mammals, including ghost fishing, boating near marine mammals, etc. to reduce adverse impacts on marine mammals

1.3 Identify local and regional partners to help address and mitigate climate change impacts on marine mammals' habitats and food sources

1.4 Identify and apply for funding sources that support the preservation of marine ecosystems and wildlife

MID-TERM GOALS:

2.1: Implement tribal-led assessments to collect data on local and/or regional marine ecosystems (i.e. test OA, dissolved oxygen, kelp bed coverage, etc.) to better understand the condition of local marine mammal habitats / ecosystems

2.2 Perform tribal environmental restoration / monitoring to improve or secure the habitats and/or food sources of marine mammals

2.3 Identify and participate in efforts to better co-manage human-marine wildlife interactions, specifically regarding boater and marine mammals interactions, bycatch policies, ghost fishing, etc. from a tribal perspective

2.4 Develop and implement environmental education plans / programs that increase awareness of marine mammal habitats and ecosystems, food sources, the impacts of climate change, and how to mitigate and/or prevent these impacts

2.5 Establish programs / capacities necessary to participate in advocacy efforts around climate change, just transitions, and maintaining Indigenous rights

2.6 Develop evaluation procedures to understand which approaches are more / less effective at conserving and increasing marine mammal habitats and foods as well as decreasing harmful impacts on marine mammals

2.7 Scout for new potential marine mammal hunting / harvesting grounds after accounting for impacts of climate change

LONG-TERM GOALS:

3.2 Have continuous representation and participation in efforts around climate change and Indigenous rights regarding marine mammals and human-marine wildlife relationships

3.3 Evaluate interdisciplinary efforts to understand which have been effective at supporting / increasing the quality of marine mammal habitats and food sources

3.4 Develop a community-wide understanding of the negative impacts of humans on marine mammals and ecosystems and a shared responsibility to minimize adverse impacts of human activities on marine mammals

3.5 Coordinate with Icy Strait Point to minimize negative effects of whale watching tours on marine mammals and their habitats and food sources

Other Forest Vegetation

Tribal members harvest an abundance of forest plants for medicinal, nutritional and cultural purposes. Important species include, but are not limited to, devil's club (***s'axt'***), fiddlehead ferns (***k'wálx***), fireweed (***lóol***), Hudson Bay tea (***s'ikshaldéen***), wild celery (***yaana.eit***), and many types of mushrooms. Hemlock (***yán***) is also used for harvesting herring eggs, carving and weaving. In 2016, Hoonah residents harvested nearly 32,000 pounds of wild plants, and 40 percent of households reported that they used less vegetation than they had in previous years. Harvesting plants is an important social opportunity for many tribal members and allows multiple generations to come together in search of a common goal. Many community members were concerned about the impacts of tourism or commercial harvest on forest plants, especially devil's club. They were also worried about continued access to common harvesting sites and how access might change based on tourism growth.

Primary Risks

THE PLANTS OF THE TONGASS HAVE THOUSANDS OF YEARS OF EXPERIENCE ADAPTING TO CLIMATE CHANGE, WHICH IS A GOOD INDICATOR FOR THEIR CONTINUED WELL-BEING.

The understory of the Tongass is a very dynamic place, constantly being shaped by natural environmental changes as well as human alteration. Erosion, logging and construction are some of the largest threats to the Tongass in the near future. Many of the common plants in the forest though are highly adaptable to a wide range of conditions based on the ranges they currently inhabit and are predicted to be relatively resilient to future threats.

INSECTS, SUCH AS THE BLACKHEADED BUDWORM, ARE LIKELY TO BECOME A LARGER PROBLEM IN THE TONGASS.

While the worms are a natural part of the local ecosystem, populations are larger in warmer conditions. The insects feed on the new foliage in hemlock trees, and if enough of them are working together, they can kill off the tree. Combined with increased lightning strikes, human stupidity and periods of drought, they can help exacerbate forest fires, which have not traditionally been a part of the Southeast ecology. As a silver lining, when budworms bring down trees, it can help bring new light down to the understory, increasing the growth of berries and other forest vegetation.

INCREASED PRECIPITATION AND HIGHER TEMPERATURES WILL ENCOURAGE PLANT GROWTH.

Plants thrive in warm, humid environments and the Tongass of the future is predicted to be warmer and wetter than the Tongass of today. These changes will affect wild plants in the forest as well as those grown in gardens–the growing season is expected to be almost two months longer by the end of the century than it was in the 1990s and start significantly earlier in the year. While the overall amount of rain is expected to increase, it is also expected to become more variable and increased periods of drought will stress plants. The carbon density of soil in the Tongass is 36 times greater than the world average, meaning there are abundant opportunities for growth in the forest and for leveraging the carbon sink capacity for local protection efforts.

AN INCREASE IN LANDSLIDES AND DECREASE IN AVALANCHES WILL CHANGE THE GEOPHYSICAL FORCES AFFECTING THE FOREST AND AN INCREASE IN DEER MAY AFFECT GROWTH.

An increase in storms and landslides will increase the risk towards harvesters though, who may face dangers when going out the road to forage for wild vegetation. Deer populations are also predicted to increase due to global warming and the increased plant growth, but depending on the rate of increase, they may overgraze vulnerable young plants that are left exposed due to reduced snowpack.

Adaptation Strategies

SHORT-TERM GOALS:

1.1: Monitor species changes as conditions continue to change

1.2: Generate a usage guide that explains the various utilizations of forest plants

1.3: Continue to improve the community's gardening capacity through the public garden, greenhouse construction, and educational opportunities to take advantage of the longer growing season.

MID-TERM GOALS:

2.1: Research how each species will be impacted by changing environmental conditions and other comparable species that can be utilized in the event that traditional species grow scarce.

2.2: Monitor commercial impacts on local harvesting sites

LONG-TERM GOALS:

1.1: Leverage the Tongass as a carbon sink in conservation efforts with regional and national partners.

Salmon

Salmon (***x̲áat***) are one of the most important traditional food sources for Hoonah residents and was among the first concerns listed by nearly all survey participants. According to ADFG reporting, 66 percent of households attempt or are successful in harvesting salmon. There is also a wide sharing economy around salmon, with 80 percent of households giving fish away and 60 percent receiving. Salmon are the second largest resource used by weight (second only to halibut). Local knowledge about changes in salmon run timing, strength, and health is abundant - when the rivers are down from dry spells there are fewer fish and the timing of those times greatly influences how many salmon make it up stream. Local users have also started noticing changes in the size and health of the fish they're managing to catch, with several reporting that the salmon have been getting smaller recently and one fisher noting that the quality of the meat was significantly worse and the fish looked ill. Local users are also worried about salmon crossbreeding with hatchery fish, which also negatively impacts the health of the offspring and continued access to fish. When talking about how scarcity is becoming more common, tribal member Sonya Johnson said "back then [in her childhood] I got sick of fish cause it was all we ate. Now it's just crazy how we have to ration ourself out [sic.]."

Primary Risks

INCREASING WATER TEMPERATURES STRESS SALMON AND INCREASE DEATH RATES.

Salmon are highly vulnerable to changes in water temperatures at all stages of their lives. Rising temperatures affect the timing of when salmon enter streams to breed and causes them to expend more energy moving upstream. High enough temperatures can also simply kill the fish before they make it to their destinations. Warm water also holds less oxygen than cold water, so if streams get too hot in the summer, the fish can suffer mass die-offs due to low oxygen levels. This is made even worse by high temperatures prompting algal blooms which lower the oxygen levels even more. Finally, salmon require more food in warmer waters since it speeds up their metabolism, and thus will need to eat more as the ocean temperatures rise. Given that many food sources of both juvenile and adult salmon are threatened by climate change, it is highly likely that salmon will struggle in all life stages to find enough food in the future.

CHANGES TO OCEAN CHEMISTRY DIRECTLY HARM SALMON AND THEIR FOOD SOURCES.

Ocean acidification poses multiple threats to salmon. Shelled pteropods make up half diets of juvenile pink salmon, and struggle to form their shells in more acidic waters. As a result of declining food sources, some populations of pinks in Alaska have been declining. Ocean acidification also directly threatens the development of juvenile salmon – coho that were exposed to elevated levels of CO2 no longer avoided predators because the lower pH damaged the way their brains could process smells. Those same salmon were able to recover when placed back in normal sea water though, meaning that if there are local areas with particularly favorable conditions, they may be able to serve as refugia even in more hazardous general conditions. A similar study also found that ocean acidification decreases the growth rates and general health of pink salmon but that if pH changes are relatively smooth the fish can adapt to their changing conditions.

CHANGES IN RAIN AND SNOW PATTERNS CAN TRAP FISH IN STREAMS AND KILL THEIR EGGS.

While total annual rainfall is likely to increase in Southeast Alaska, it is predicted to become more variable, meaning that there will likely be very dry periods wherein there is insufficient water in the rivers for the salmon to thrive. Low flows increase water temperatures, since shallow waters warm faster, and decrease the amount of oxygen available for the fish to breathe. At the same time, high-flow events are likely to become more severe; atmospheric rivers are expected to increase two-or three- fold by the end of the century and such events are one of the main threats to salmon eggs. When

rain is restricted to fewer, more extreme storms, the fast moving water scours the bottom of streams and pushes eggs out of the sediment where they've been laid which increases the risk of predation and being swept into the ocean, both of which kill the eggs.

Adaptation Strategies

SHORT-TERM GOALS:

1.1: Continue salmon stream restoration projects through the Hoonah Native Forest Partnership

1.2: Encourage Hoonah youth to get involved in natural resource management projects

1.3: Continue documentation efforts of important spawning streams for protections through the Alaska Anadromous Waters Catalog through the Hoonah Native Forest Partnership and in collaboration with State partners.

1.4: Educate the community about negative impacts from increasing water temperatures

1.5: Use local knowledge to educate community members on how to adapt fishing strategies with changing salmon habitats; promote fishing in deeper waters

MID-TERM GOALS:

2.1: Invest time and funds in research on shellfish resiliency and strategies to promote kelp growth

2.2: Research Haida Salmon Restoration Corporation, and their efforts to mitigate climate change effects through an ocean micro-nourishment replenishment program

LONG-TERM GOALS:

3.1: Work to reduce environmental stressors to salmon by limiting development, poor logging practices, pollution and erosion.

3.2: Monitor the effects of climate change on salmon, their habitats and local fishers.

3.3: Policy protection for small-scale and local resident fishermen and subsistence fishermen to maintain access to diminishing resources while limiting large-scale fishing harvests

3.4: Promote policies that limit charger fishing to maintain salmon for commercial and subsistence use

3.5: Investigate adaptation strategies stemming from the relationship between sockeye salmon, life stages, and electromagnetic fields

3.5.1: Consider attaching magnets to large fishing boats to reduce salmon bycatch

Seaweeds (Laak'ásk) and Intertidal Vegetation

Black seaweed (***Laak'ásk***) is one of the most commonly harvested types of seaweed by Hoonah residents and is highly sought and widely used at a variety of cultural events. Other commonly harvested seaweeds and intertidal plants include bull kelp (***geesh***), ribbon seaweed (***k'áach'***), bladderwrack (***tayeidí***), sea lettuce, goose tongue (***suktéitl'***) and beach asparagus (***sukkáadzi***). Not only are seaweeds an important nutritional source, rich in vitamins and minerals, but kelps are also an important carbon sequestration method that can help ocean acidification and global warming. Kelp forests and intertidal plants also serve as vital nurseries for juvenile crab and salmon. Community members have reported that seaweeds dry out more now than they used to because of higher temperatures while they are exposed, and are concerned about harvesting from areas with high human development or traffic (particularly near the cruise ship docks from Icy Strait Point). Local harvesters have also reported that location and season impacts the taste, color and texture of seaweed, and thus if environmental conditions or harvest locations change in the future, it is likely that many of the characteristics of seaweed may change as well.

Primary Risks

SEAWEEDS ARE MOST THREATENED BY CHANGING ECOSYSTEM DYNAMICS, PARTICULARLY FROM CHANGING LEVELS OF PREDATION.

Sea stars and sea otters are some of the most important animals that help protect kelp forests. Both are voracious predators, which hunt the sea urchins and other animals that eat the kelp. When those species suffer population losses, they can't keep the urchins at bay, which leads to urchin barrens, or massive swaths of the ocean floor that were once teaming with life but have now been entirely consumed by urchins. While it's still not entirely clear what's causing sea star wasting disease, it's led to massive die off's along the west coast and may be linked to climate change. Combined with a loss of sea otters in the Lower 48, it's resulted in massive losses to kelp forests (primarily bull kelp). While the number of sea otters in Southeast has been on the rise following their reintroduction, otters are still threatened by climate change and may suffer losses in the future, which would also be a loss for the kelp forests.

CHANGING WATER CHEMISTRY CAN NEGATIVELY IMPACT THE GROWTH OF SEAWEEDS, BUT INTERTIDAL PLANTS ARE EXPECTED TO ADAPT WELL.

Seaweeds are sensitive to rising ocean temperatures and their growth is stunted when the water gets too warm. Ocean acidification may have mixed results on seaweed and it's still unclearly how exactly they'll respond. While decreasing pH slows grazing by many animals, it also weakens the tissues of seaweeds and it's still unclear how those forces are likely to balance. Many intertidal plants though are accustomed to variable water conditions and are likely to adapt well to future changes. Sea asparagus is particularly adaptable and already thrives in a wide range of environmental conditions, from southeast Alaska to Israel, and has a high tolerance for drought and heat.

SEAWEEDS AND INTERTIDAL PLANTS ARE ALSO THREATENED BY MARINE POLLUTION AND HUMAN DEVELOPMENT.

Seaweeds are also sensitive to changes in their growing environments—if areas have been disturbed by construction or large events of run-off, they often have a hard time coming back. Algal blooms, driven by warmer waters, can restrict the growth of seaweeds, and toxic runoff from spills on land can make the problem even worse. Thankfully, seaweeds naturally act like water filters, and if they're given enough time to recover between events, they can improve water quality and help clean up the local conditions.

THE HARVEST LOCATIONS OF INTERTIDAL PLANTS ARE LIKELY TO CHANGE DUE TO SEA LEVEL DROP.

Just as the locations of clam and cockle beds are likely to change due to the drop in sea level because of post-glacial rebound, harvesting locations for intertidal plants such as beach asparagus and goose tongue may change. It is unknown whether those locations will be more or less accessible to local users, but harvesters will likely need to find new places to source those plants as the shoreline evolves. This problem will be worsened by erosion from increased severe weather events.

Adaptation Strategies

SHORT-TERM GOALS:

MID-TERM GOALS:

2.1: Protect intertidal areas where beach greens are commonly harvested from future developments and seek to limit marine pollution that would harm the heath or growth of wild plants.

LONG-TERM GOALS:

1.1: Research possibilities for local or commercial scale seaweed farming of relevant species of seaweeds.

Shellfish

Butter clams (***gáal'***), cockles (***yalooleit***) and blue mussels (***yaak***) are some of the most commonly harvested shellfish in the Hoonah area and all are extremely vulnerable to the effects of climate change. Community members have shared a great deal of concern about the continued safety of shellfish in a warming climate. One tribal member said her elders used to harvest year-round, but by the time she was a child she was told to harvest only in months with an R. Now, she relies on testing from a lab in Sitka to know when to harvest since it can be dangerous any time of year. Another tribal member said she'd been noticing scarcity the past few years and had had a hard time finding enough cockles for her family. A third said that she had noticed some of her favorite clamming beds were no longer as productive as they had been and that she was having to search for new places to find shellfish due to the way the shoreline had been reshaped.

Primary Risks

OCEAN ACIDIFICATION CAN DISSOLVE THEIR SHELLS, KILLING THEM OR SLOWING GROWTH.

Larval shellfish are particularly vulnerable because of the mineral they use to build their shells. In adult shellfish, several species were found to have 40 percent thinner shells and 17 percent slower growth when placed in more acidic water that represents what ocean conditions could look like in the next hundred years. With thinner shells, the shellfish are more vulnerable to being eaten by other animals, and the smaller size means harvesters need to exert more effort to get the same amount of meat. Since some species are more resilient in acidic conditions, the composition of shellfish beds may change, with scallops being more resistant than many other kinds of bivalves.

WARMER WATERS AND HIGHER AIR TEMPERATURES CAN COOK SHELLFISH IN THEIR SHELLS.

Following heatwaves in Washington, there were massive die-offs of shellfish along the western coast of the US and BC.

Since shellfish tend to mostly stay in one spot, they have fewer opportunities to seek out cool spots to hide from the heat, which can result in them cooking in their shells. This is particularly problematic in inner coastal areas, like Port Fredrick. Cockles, which live in much shallower sediment, were also more at risk, as compared to species like butter clams that dig deeper where the sand remains cooler.

HARMFUL ALGAL BLOOMS ARE EXPECTED TO GET WORSE, WHICH CAN MAKE SHELLFISH TOXIC TO HUMANS AND OTHER ANIMALS THAT RELY ON THEM FOR FOOD.

The plankton *Alexandrium* can produce a variety of paralytic shellfish toxins, including the highly toxic saxitoxin which causes Paralytic Shellfish Poisoning. The plankton thrive in warm water conditions with higher levels of CO2 and in lower salinity, all of which are likely to occur as a result of climate change. While the traditional adage about only harvesting in months with an R in them has kept people safe for thousands of years, as conditions change and blooms become larger and more frequent, the number of months in which it is unsafe to harvest is likely to expand. Saxitoxins can also last inside of some species of shellfish for several years after a large bloom, further impacting shellfish safety.

OCEAN ACIDIFICATION CAN ALSO DAMAGE MUSSEL'S ABILITY TO HOLD ON TO ROCKS AND IMPACT THEIR BREEDING.

Shellfish such as oysters and blue mussels that need to grip onto their surroundings may lose their ability to do so, because the proteins required to build that part of their body can be weakened in acidic conditions. Breeding success may also decline, as some studies on oysters found decreases in acidic environments while others found no effect, which would overall reduce the population of shellfish available.

WHERE SHELLFISH CAN BE FOUND WILL CHANGE DUE TO SEA LEVEL CHANGES.

Post-glacial rebound is predicted to outpace sea level rise at least through the end of the century and will reshape shoreline habitats where shellfish are found. The flat sandy and muddy regions that are the richest shellfish beds are most vulnerable to sea level changes. While the overall amount of habitat is not predicted to change, community members will need to find new clam beds, which may be further from town.

GIVEN THE LOW ENVIRONMENTAL IMPACT OF CULTIVATING SHELLFISH, NEW ECONOMIC POSSIBILITIES MAY BENEFIT THE REGION.

Unlike land animals like pigs and cows, shellfish don't release large amounts of CO2 or methane into the atmosphere, making them a much eco-friendlier source of meat. They can also help clean the water and sequester carbon, and as more people turn towards green solutions in the fight against climate change, the popularity of shellfish is likely to rise. This could result in more jobs and economic opportunities for people interested in starting aquaculture projects in Southeast Alaska.

Adaptation strategies

SHORT-TERM GOALS

1.1: Continue water samples to monitor for A*lexandrium* blooms near key shellfish harvesting locations near town.

1.2: Continue monthly sampling of shellfish to test for biotoxins in collaboration with SEATOR partners.

1.3: Continue biomass survey in coordination with the SEATOR partners to monitor size and quantity of shellfish

MID-TERM GOALS

2.1: Educate community members about the risks of paralytic shellfish poisoning and maintain up to date reports on the level of biotoxins detected through the SEATOR network

2.2: Organize events and classes for community members to learn about sustainable shellfish harvesting and safe storage practices.

LONG-TERM GOALS

3.1: Consider possibilities for the construction of clam gardens or shell hash development near town.

3.1.1: Target research in areas of rock/sediment

3.2: Research options for enhancing and protecting eelgrass beds

3.3: Work to create plans for shellfish stock restoration and propagation.

3.4: Something about preventing competition from external users?

3.5: Research possibilities for enhancing abalone stocks near Hoonah

Wild Berries- Tléikw

Wild berries are a key source of fresh fruit for all rural Alaskans and berry picking is one of the highlights of summer for many families. Berry picking not only helps tribal members avoid dependence on store-bought produce, but also allows for recreational opportunities and intergenerational communication. Commonly harvested species include blueberries (***kanat'á),*** salmonberries (w***as'x'aan tléigu***) and huckleberries (***tleikatánk***). Despite harvesting nearly 32,000 pounds of berries in 2017, 25 percent of families in Hoonah reported not getting enough vegetation. Tribal members reported being the most concerned about the availability of berry bushes near town, the quantity of berries on each bush, and risks from insects. There were also concerns about urban development harming berry patches and increased variability in the timing and availability of berries

Primary Risks

THE LENGTH OF THE BERRY GROWING SEASON IS EXPECTED TO INCREASE AS TEMPERATURES WARM, BUT THE TIMING OF THAT SEASON IS LIKELY TO CHANGE.

When berry bushes produce fruit is highly dependent on temperature and increases and variability in weather is likely to shift berry production times. In Kodiak, when the berry season and salmon season shifted and began to overlap, bears preferred eating berries to catching salmon. That meant increased harvest competition for humans, and fewer fish making their way to provide nutrients to the forest. Farther north, harvesters in the YK Delta have reported up to 75 percent decreases in the abundance of certain types of berries. This makes findings in Maine, where blueberries grown in artificially warmed plots had smaller fruit and leaves. The timing of seasons may also increase risk of plant death; several community members reported that the seasons seemed to transition faster now than they previously had, which can prevent plants from taking the time they need to store energy before winter.

PESTS ARE LIKELY TO PREY ON BERRIES MORE IN WARMER WEATHER.

Warmer temperatures are likely to expand the range, lifetime and reproductive rates of many species. Insects that previously died off in winter due to lower temperatures may be able to survive in the future.

INCREASED PRECIPITATION MAY HAVE VARIABLE EFFECTS ON BERRIES.

Increased rainfall will likely encourage plant growth but decreased snow fall may lead to more competition from deer if the branches are exposed throughout the winter. A study on low-bush cranberries, lingonberries and crowberries found a much higher loss rate of fruit in areas with less snow. Increased rainfall can also increase the risk of berries developing certain diseases. When their roots become waterlogged, it gives bacteria the opportunity to travel more easily and infect new plants.

LOCATIONS OF BERRY GROWTH ARE LIKELY TO CHANGE AND BECOME MORE VARIABLE.

A state-wide survey found that blueberries and cloudberries were the most impacted by that variability. Community members have reported that many of their favorite berry spots close to town have been reduced or eliminated due to increased urban development. Fuel cost, age, and vehicle availability can all make it more difficult to go out the road to harvest berries, which may be required in future years.

INVASIVE SPECIES MAY PROVIDE COMPETITION FOR BERRY BUSHES.

A study from UAF found that when pollinating insects were given the choice between invasive sweet clover and native berry bushes, they preferred the clover. As invasive species are expected to expand in range and diversity with climate change and increased travel throughout the region, invasive species may pose a threat to berry bush reproduction.

THE QUALITY OF BERRIES MAY CHANGE.

Scientists in Maine found that blueberries grown in warmer conditions accumulated more sugar and often got bigger than blueberries grown in cooler weather. Micronutrient decreases have been observed in several types of cultivated crops and may impact berries in the future.

Adaptation Strategies

SHORT-TERM GOALS:

1.1: Continue youth-led programs for blueberry patch enhancement near town.

1.2: Research possibilities for transplantation or enhancement of other berry types to more accessible areas.

1.3: Organize community harvesting events for youth, families and elders.

1.4: Communicate the locations of particularly abundant and accessible berry patches to community members, especially to individuals without car access or with mobility problems.

MID-TERM GOALS:

2.1: Develop citizen science efforts to monitor berry timing, availability and condition

2.2: Create designated areas for berry production and encourage community management of these areas

2.2.1: Include the development of trails in these areas to increase accessibility

2.3: Monitor water usage and availability

LONG-TERM GOALS:

3.1: Investigate effective watering systems to promote berry growth throughout Hoonah