2023 Kenai Peninsula Fish Habitat Science Symposium

~Building Connections to Protect Fish Habitat~

April 20-21

Kenai Visitor Center

ABSTRACT BOOKLET

Thank you to our sponsors for helping to make this year's symposium possible.

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2023 Kenai Peninsula Fish Habitat Science Symposium

Dear Symposium Participants:

Welcome to the sixth biennial Kenai Peninsula Fish Habitat Science Symposium! This year's theme is "Building Connections to Protect Fish Habitat." We chose this as our theme because we recognize that partnerships between our diverse organizations is the key to protecting and conserving fish habitat.

This year's symposium is co-hosted by the Kenai Peninsula Cooperative Invasive Species Management Area. This two day event also marks the first in-person symposium since 2019. Dr. Peter Westley will deliver the keynote address on the morning of April 20; titled "Some modest advice for managers and practitioners: key lessons from salmon conservation science." The second half of day two will be devoted to invasive species presentations. Please join us on the evening of April 20 for food and drinks at Kenai River Brewing Company.

The Kenai Peninsula Fish Habitat Partnership (KPFHP) was established in 2009 to address the decline of fish populations on the Kenai Peninsula. Our mission is to work collaboratively with organizations, agencies, and individuals to protect, restore, and enhance fish habitat. Over the years, our partnership has grown to include a wide range of stakeholders, including state and federal agencies, local governments, tribal organizations, non-profit groups, and private landowners.

We hope that by the end of the symposium, we will have developed new partnerships, ideas, and strategies to improve the health of the fish habitat in the Kenai Peninsula.

Thank you,

The KPFHP Steering Committee:
Erika Ammann, National Oceanic and Atmospheric Administration (NOAA)
Kyle Graham, US Fish & Wildlife Service
Jess Johnson, Alaska Department of Fish & Game
Coowe Walker, Kachemak Bay National Estuarine Research Reserve
Samantha Lopez, Kenai Peninsula Borough
Adam Cross, US Forest Service
Sarah Apsens, Department of Environmental Conservation
Tony Munter, Alaska Department of Fish & Game
Benjamin Meyer, Kenai Watershed Forum
Katherine Schake, Homer Soil & Water Conservation Area
Peter Micciche (advisor), Kenai Peninsula Borough
Mike Daingneault (advisor), US Fish & Wildlife Service
Melissa Smith, KPFHP Coordinator

Thursday April 20, 2023

8:30 Registration and Check-In

9:00 **Welcome Remarks**
Dave Atcheson, Trout Unlimited
Peter Micciche, Mayor, Kenai Peninsula Borough

9:15 Keynote Address

SOME MODEST ADVICE FOR MANAGERS AND PRACTITIONERS: KEY LESSONS FROM SALMON CONSERVATION SCIENCE

Dr. Peter Westley, University of Alaska, Fairbanks

We are in an era of both accelerating change to salmon-producing ecosystems and rapidly mounting data about salmon, their habitats, and connections to society. Attempts to keep up with the monthly onslaught of journal articles and 24-hr news stories can feel like a fool's errand. The Salmon Science Network (Salmon-Net) was inspired by the need to provide context and interpretation of emerging salmon science and to catalyze the use of new science by researchers, managers, and practitioners. In this talk I briefly highlight the work by Salmon-Net and then turn to the key lessons of salmon conservation science that have emerged during the past few decades. These lessons are some that every salmon manager and practitioner needs to know.

Dr. Peter Westley is an associate professor of Fisheries with the University of Alaska Fairbanks College of Fisheries and Ocean Sciences where he holds the Lowell A. Wakefield Chair in Fisheries and Ocean Sciences. His research seeks to understand how fishes respond and adapt to environmental change, including invasive predators, climate change, and hatcheries, with a particular focus on Alaskan salmon. He received his BS and MS from the School of Aquatic and Fishery Sciences at the University of Washington and a PhD in Biology from Memorial University of Newfoundland, Canada. He completed postdoctoral work at University of Washington on the ecology of homing and straying salmon in the Columbia River; work that has inspired research here in Alaska. He works closely with a diverse array of collaborators and partner organizations to co-develop research and communicate their findings with the goal of sustaining the relationships between salmon, people, and wild places. Originally from Anchorage, Alaska, he lives in Fairbanks and has enjoyed a 2022-2023 sabbatical based out of Homer.

10:15 Networking Break

10:45 **Session 1: Proactive Conservation**
Session Leader*: Nicole Schmitt, Alaska Wildlife Alliance*

SCIENCE-BASED TOOLS FOR INCLUDING GROUNDWATER IN DECISION-MAKING

Coowe Walker, Kachemak Bay National Estuarine Research Reserve

In most salmon landscapes around the world, people have disrupted the landscapes and rivers that salmon depend on, and are now spending millions of dollars to try and repair ecosystems and get salmon back. Our salmon landscapes are still intact and we have the remarkable opportunity to not mess them up. The Reserve has been conducting science on how landscapes support salmon in our region, and developing tools to help people use the science to make decisions that will help salmon populations be resilient so that we can avoid what's happened to salmon in other places. We started by surveying small headwater streams and were surprised to find abundant numbers of juvenile salmonids- coho, chinook, steelhead and Dolly Varden. We wondered why and started doing studies. We found that it is the landscape connections surrounding the streams that are driving stream productivity, and groundwater is the link that connects everything.

Groundwater is important for moderating stream temperatures as it maintains a constant temp of 39 degrees. In the summer, when air temperatures rise, streams can reach temperatures of 55-60 degrees F (around 14 °C). Groundwater seeping into streams keeps temperatures cool and comfortable for salmon. In the winter, when surface water sources are frozen, groundwater is the only source of water for streams. Groundwater also carries the nutrients that make our streams productive. Alders are able to fix nitrogen and make it available in the ground, where it is carried by groundwater to streams. Nitrogen is one of the primary nutrients needed for stream productivity- it feeds the alga and aquatic bugs that juvenile salmon depend on for food. Peatlands help recharge groundwater and act as an insulating blanket, keeping groundwater cooler in the summer and warmer in the winter. Peatlands are also a source of dissolved organic carbon, which is important for stream productivity.

Land in the watersheds of the southern Kenai Lowlands are mostly private or unprotected, and have a lot of existing parcelization. Headwater streams where juvenile salmon rear are throughout the watersheds. We know that development activities are going to continue as human populations grow. We have developed science-based tools to help people understand how landscapes are connected to salmon streams, and use knowledge of mapped groundwater flowpaths to inform how we do activities such as gravel extraction, and the conditional landuse permit process. Having information on the hydrology of the site provides additional context for decision making, and allows a more 3D picture to be presented. This can help with considerations including where development is located, spatial extent, access points and potential interruptions to groundwater and impacts to water quality and fish habitat. This way we can help keep our salmon populations as resilient as possible.

DATA DRIVEN APPROACH: USING GIS FOR ENVIRONMENTAL DECISION MAKING

Jeff Knopf, Saint Mary's University of Minnesota

Natural resources provide invaluable contributions to both the aesthetics and the economy of the Kenai Peninsula. The watersheds in the Kenai Peninsula are vital not only to sustaining ecological processes on the landscape and supporting local biodiversity, but to local, regional and world economic development and cultural significance as well.

Saint Mary's University of Minnesota - Geospatial Services (SMUMN GSS) has a long history of partnering with Alaska's stakeholders on projects that develop data which can be used to drive decision making on a broad range of environmental concerns. The data creation projects have additionally incorporated research on different data creation methodologies.

Datasets created by SMUMN GSS can be used to establish a representation of the environment to better understand the potential impacts of present-day anthropogenic activities. Data driven decisions help stakeholders identify and establish priorities for resource management as well as provide for the continued evaluation of the Kenai Peninsula's natural resources.

The Kenai Peninsula is a premier fishing destination and outdoor enthusiast's dream. It is imperative to protect and enhance the native fisheries and aquatic resources of the Peninsula as studies have identified pollution as a threat to these aquatic resources; specifically, heavy metal pollution that flows off of impervious surfaces. Impervious surface mapping is crucial for future priorities regarding environmental planning and water quality improvement. Increasing amounts of impervious surfaces comes at a cost, the reduction of natural areas. The population on the Kenai Peninsula has grown 6.1% over the last 10 years according to the Census Bureau (U.S. Census Bureau 2020). As the population and anthropogenic activities increase so does the need for evaluation and protection of the Kenai Peninsula's natural beauty and economic opportunities.

Surface hydrology is fundamental to knowing where water flows. Surface flow is the primary mechanism for transporting pollutants to and through habitats. Changes in the natural landscape and the extent of human development have altered the region's hydrography. The hydrography data for the Kenai Peninsula was outdated and an inaccurate representation of surface hydrography which limited its application for planning and management applications related to fish habitat conservation and restoration. Now that the hydrography is updated more accurate and robust analysis can be accomplished.

KENAI MOUNTAINS TO SEA: USING THERMAL INFRARED IMAGERY TO IMPLEMENT LONG-TERM SALMON CONSERVATION

Benjamin Meyer, Kenai Watershed Forum

Multiple Authors: Sue Mauger (Cook Inletkeeper), Marie McCarty and Lauren Rusin (Kachemak Heritage Land Trust), Benjamin Meyer (Kenai Watershed Forum)

Cold water refugia, or areas within a stream that are persistently colder than surrounding areas, are critical features of wild salmon habitat throughout their range. Stream reaches with cold seeps and springs often result in much cooler water, which are increasingly important for wild salmon to keep cool as water temperatures in many streams have warmed. Some human activities can diminish or extinguish cold water refugia, such as groundwater withdrawal and construction of impervious surfaces. To conserve cold water refugia these sites must first be mapped and identified, and land owners and managers must understand best practices for their conservation.

Since 2020, three community-based organizations - Cook Inletkeeper, Kachemak Heritage Land trust, and Kenai Watershed Forum - have worked together to identify where cold water refugia are found in the Kenai Peninsula lowlands, a region where productive wild salmon habitat intersects with a growing development footprint. We used cutting-edge methods to locate cold water refugia with thermal infrared imagery, a technology similar to night vision goggles that shows heat contrast. Our resulting "treasure map" of cold water refugia locations is a valuable tool for prioritizing conservation and outreach efforts.

In this project we focused our research on tributaries of the Kenai and Kasilof rivers; specifically, in the lower sections of streams outside of the federally-protected Kenai National Wildlife refuge as outlined in the Mountains to Sea planning document. Our goals for this project were to:

- Identify land parcels that contain one or more cold water refugia features, and communicate information about these features and possible conservation strategies to land owners; and
- Use a variety of techniques to communicate our results to over sixty landowners, agencies, and organizations.

Conservation actions that may result from these efforts include parcel acquisition and conservation easements, voluntary compliance, stewardship and restoration projects, and voluntary land agreements or exchanges.

BUILDING A PEATLAND CARBON PROJECT IN THE SOUTHERN KENAI LOWLANDS

Coowe Walker, Kachemak Bay National Estuarine Research Reserve

In many parts of the world, people are paying big money to restore damaged peatlands. We have an opportunity to conserve our peatlands and put them into carbon markets where they will earn money. Looking down the road to when the human population are much denser and salmon are at more risk from habitat degradation, peatland carbon markets are an opportunity to conserve the peatlands we have, protect salmon, groundwater and enter the global carbon market. This is a presentation to share the science and process so far.

Peat is partially decayed plant material that accumulates in standing water. Moisture and lack of oxygen prevent decomposition. This peat is full of carbon. Peatlands have deep layers of organic carbon, with the more decayed material being closest to the bottom. Peatlands are important to many species of plants and animals that we care about, including baby salmon. In studies where we artificially mimic peatlands by dosing small streams, we saw baby salmon in the streams growing faster and newcomers actually moving into the stream, seeking the enhanced habitat.

As we continue to affect peatlands and groundwater, the big question is whether we can use the science that's available to us to minimize the effect of our activities on salmon. Peatland carbon projects offer an opportunity to do so and provide additional income. The governor of our state recently announced that carbon projects are going to be the focus of new legislation he is proposing. This is a great opportunity for our region to be leaders in carbon project development through a peatland carbon project. Citizen science from Homer Drawdown have taken depth measurements and vegetative community assessments that have enhanced the science. Furthermore, these efforts have resulted in ground truthing, and stakeholder engagement valuing peatlands. In addition, the Reserve works school students around the Borough in collaborative education around groundwater and peatlands, and we partner with Kachemak Heritage Land Trust to connect with fishermen to show the connection between baby salmon and peatlands. As people populations get denser and denser, groundwater and peatlands will be more impacted, and protecting these resources will be increasingly critical. Peatland carbon offers a potentially powerful tool for protecting salmon, which are an income source for many in our region, and with the peatlands that support the baby salmon provide an additional income source.

A VISION FOR A RESILIENT KACHEMAK BAY WATERSHED

Hal Shepherd, Kachemak Bay Watershed Collaborative

Largely due to climate change, watersheds throughout Alaska are beginning to experience the same kinds of degradations that have been on-going Outside for many years. The Kachemak Bay Fox River Watershed, for example, is already showing signs of dramatic impacts on plants and animals including warming fresh and marine water temperatures, increasingly common drought conditions, and spruce beetle outbreaks, that are occurring at a rate no one thought possible even a decade ago.

In response to this threat, the Chugach Regional Resource Commission (CRRC) has established the Kachemak Bay Watershed Collaborative which focuses on sustainable management of the Kachemak Bay Watershed. CRRC is an Alaska Native Tribal consortium who’s Dena'ina, Alutiiq, and Sugpiaq village communities of south-central Alaska have relied on a subsistence economy since time immemorial.

To date the Collaborative has engaged with multiple stakeholders to develop a list of potential projects and funding sources to address climate impacts in the Watershed that fall into several categories including: Wetlands & groundwater, Invasive Species recharge, Wild and hatchery fish and Planning.

The presentation will provide background information about the Collaborative and discuss next steps including:
1. An online vote to see what the top issues are.
2. Holding meetings on issues with collaborative members who are most interested in those issues.
3. Create a feasibility index based on top issues;
4. Establishing legislative sub-committee that crafts smart approaches to solving problems here at different levels of the government, and identifies people as the city, borough or state level who could carry this legislation forward;
5. Pulling together dates of upcoming advisory committee meetings, marine science symposium, state Fish and Game board, and other events that happen every spring etc., and send out to the group week in advance;
6. Create an on-line hub potential stakeholders can obtain background information and how they can join the collaborate.
7. Complete the outline for a Watershed Restoration Plan.

12:00 Lunch Break

1:00 **Panel Discussion: Translating Science to Policy**

In the past it's been a complicated and confusing task to take good science and turn it into policy. We have invited scientists and policy makers to be part of a panel in hopes that the audience and panel will interact in order to build understanding of the processes and barriers to getting science into policy. Joining the panel will be:

Kenai Peninsula Borough Mayor, Peter Micciche
Kenai Peninsula Borough Planning Director, Robert Ruffner
Kenai Peninsula Borough Assembly Member, Lane Chesley
City of Homer Public Works Director, Jan Keisser
Cook Inletkeeper Executive Director, Sue Mauger
Homer Soil & Water District Kenai Peninsula Cooperative Invasive Species Management Area Coordinator, Katherine Schake
Kachemak Bay National Estuarine Research Reserve Manager, Coowe Walker
Master of Ceremonies, Lynn Whitmore

2:30 Break

2:45 **Session 2: Proposed Development Projects**
Session Leader: *Mitch Michaud, Kenai Watershed Forum*

SOLDOTNA RIVERFRONT REDEVELOPMENT PROJECT – RIVER HEALTH, PUBLIC ACCESS & URBAN DEVELOPMENT
John Czarnezki, City of Soldotna
Jason Graf, First Forty Feet

Soldotna is creating a redevelopment masterplan for a portion of its downtown that lies along the Kenai River. The City seeks to create a one-of-a-kind riverfront experience that attracts locals and visitors with shopping, dining, riverfront activity and lodging in a walkable environment. This session will explore the City's planning project and solicit input on ways to maintain and improve river and riparian health while providing opportunities for economic growth and riverfront engagement.

IMPROVING CONNECTIVITY FOR HUMANS AND FISH: FISH HABITAT IMPROVEMENTS INCLUDED IN THE STERLING HIGHWAY MP 157-169 REHABILITATION
Heidi Robuck and Ariel Hippe, DOWL

Sterling Highway Milepost (MP) 157 to MP 169 is a heavily traveled corridor between the communities of Anchor Point and Homer. The primary objectives of this project are to restore the structural integrity, extend the service life, and improve the safety of the roadway. In addition to these primary objectives the project will reduce congestion, stabilize riverbanks, and improve fish passage by replacing bridges and culverts. This project is an example of how roadway rehabilitation projects can improve the connectivity of both highway corridors and fish habitat.

The North Fork Anchor River is currently constricted to four culverts where it passes under the Sterling Highway. These culverts will be replaced with a three-span concrete girder bridge, reestablishing the river channel under the highway. Five additional culverts at Two Moose Creek, Beaver Creek, Ruby Creek, and Diamond Creek will be replaced with new structures meeting fish passage design standards. The project includes riverbank-erosion protection along the South Fork Anchor River that incorporates fish habitat design elements.

3:30 **Session 3: Community Outreach**
Session Leader: *Mitch Michaud, Kenai Watershed Forum*

FISH NEED LAND TOO
Carson Chambers, Kachemak Heritage Land Trust

Since 2018, Kachemak Heritage Land Trust (KHLT) and Kachemak Bay National Estuarine Research Reserve (KBNERR) have been hosting "Fish Need Land Too" field trips on the Kenai

Peninsula. KHLT and KBNERR identify stakeholders who have included fisherman, local government leaders, policy makers, scientists, citizens, and children's school groups to take on these ""boots on the ground"" trips. The field trip participants are brought to small creeks and streams where baby salmon live in locations relevant to the attendees. These streams are often in surprising locations, like in a culvert running under a well-traveled road or in a wetland area miles inland from the ocean.

Through electrofishing, KBNERR scientists are able to temporarily stun juvenile salmon to observe them in photariums. As the field trip participants pass around the baby salmon, KNBERR scientists discuss the lifecycle of salmon and the role that the local ecosystem plays in supporting stream function, water quality and temperature, and ultimately the success of salmon populations. If the surrounding ecosystem is disturbed, it can negatively impact the health of salmon which directly impacts the wellbeing of local human residents and visitors.

KHLT staff describes ways in which landowners, neighbors, residents, decision makers, and visitors can prevent this disruption and negative impacts to salmon. KHLT is a 501c3 nonprofit organization that works with willing landowners to permanently protect priority lands, especially those critical to salmon. Through conservation easements, land acquisition, and supporting third party conservation projects, KHLT ensures that priority lands are preserved forever. This means that salmon have a greater chance of survival and success as their vital breeding and rearing grounds are protected in perpetuity.

The Fish Need Land Too field trips have been an impactful and moving way to bring awareness to the public about salmon lifecycles, local ecosystems, and the role of conservation in protecting salmon and people. This is an ever-evolving program that KHLT and KBNERR hope to expand and make available to more people for years to come. It's an important piece of the puzzle in translating scientific data into meaningful action.

STREAM WATCH: THE IMPACT VOLUNTEERS CAN HAVE ON HABITAT

Brandon Drzazgowski, Kenai Watershed Forum

The presentation will focus mostly on the Stream Watch Volunteer Program. A brief overview and history of the program will be provided at the beginning of the presentation for those that have not been exposed to Stream Watch before. Following this, the presentation will cover the work that Stream Watch has performed over the latest seasons, new partnerships that have been formed, and new events that have been made. Finally, the presentation will take a closer look at where Stream Watch has the possibility to expand. This will cover new projects that the program would like to preform, ways that current events and actions are lacking/how to fix those problems, and how the program plans to expand its presence in the community and on social media. This will include a brief look at the Junior Stream Watch program. The Junior Stream Watch program will officially begin during the summer 2023 season, and will

incorporate a younger age group in Stream Watch tasks as well as some more traditional citizen science activities.

4:00 **Tidbits**
Session Leader: *Jillian Jablonski, Tyonek Tribal Conservation District*

Tidbit
PROPOSAL FOR A NEW COMMUNITY-FOCUSED AND SYSTEMATIC APPROACH TO MAPPING SALMON HABITAT IN THE KENAI PENINSULA BOROUGH
Benjamin Meyer, Kenai Watershed Forum

Headwater salmon streams often do not appear on the maps that land managers use to understand salmon habitat in Alaska. These everyday "backyard" anadromous (salmon-bearing) streams that are part of the landscape in much of Alaska may be individually small, but together they are the nursery and spawning grounds for millions of fish that support subsistence, commercial, sport, and personal-use fisheries, as well serving as keystone species for ecosystems throughout region. When anadromous waters remain undocumented, many existing state, federal, and local regulations to manage and conserve them do not apply. Rivers and lakes in Alaska are presumed to not be anadromous habitat unless a qualified professional documents the presence of juvenile or adult salmon. However in some cases, even the stream channels themselves do not appear on our best available maps. As a result, Alaska has a regulatory gap that can inadvertently permit alteration of salmon habitat prior to even being aware that it exists. The lack of information has implications for construction planning, applying riparian buffer ordinances, prioritizing fish passage improvement work, and other land management concerns. A number of state, federal, tribal, and nonprofit entities are engaged in the work of documenting anadromous habitat in the Kenai Peninsula Borough region. In a new proposed project, Kenai Watershed Forum will work with researchers using advanced mapping tools and recent geospatial data to identify ideal field survey sites, and coordinate the efforts of other regional partners throughout the borough engaged in the work of documenting anadromous habitat, with a focus on areas of watersheds currently at the margin of developing areas. The work aims to add new areas of salmon watersheds to the Alaska Department of Fish & Game's Anadromous Waters Catalog and engage the public in the hands-on process of discovering where undocumented salmon habitat is found.

Tidbit
NOAA FUNDING OPPORTUNITIES
Jeremy Thacher, NOAA

Tidbit
MEETING DEMAND: INCREASING SUPPLY OF CERTIFIED WEED-FREE GRAVEL ON THE KENAI PENINSULA

Jen Chauvet, Homer Soil & Water Conservation District

Alaska's Certified Weed-Free Gravel Certification Program allows gravel producers to certify their materials as weed free while assuring land and project managers that the gravel products they purchase will not be a vector for introducing the most harmful invasive plants. As demand for weed-free products for public construction projects grows on the Kenai Peninsula, so does the capacity for certification.

4:20 **Session 4: Historic and Social-Ecological Perspectives**
Session Leader: *Jillian Jablonski, Tyonek Tribal Conservation District*

HINDSIGHT: HISTORICAL VIEWS OF THE KENAI RIVER AND ITS MODIFICATION
Shana Loshbaugh, Independent Scholar

This presentation differs from others by focusing on imagery and history rather than current research on area fish habitat. Based on my 2013 environmental-history dissertation, "The History of Land Use on Alaska's Kenai River and its Implications for Sustaining Salmon," I will share drawings, maps, and aerial photos showing human activities and plans related to fisheries and changing landscapes along the river. These images provide useful background and context for considering present and future fish habitat conditions on the Kenai Peninsula in general and the lower Kenai River in particular. I plan to allow extra time for questions from those curious about the area's fishy history, and to have rare maps and publications on hand for people to examine.

THE SOCIAL-ECOLOGICAL SYSTEM OF THE KENAI RIVER FISHERY (ALASKA, USA)
Chase Lamborn, Utah State University

We present a collaboratively developed social-ecological model of the Kenai River Fishery. We developed the model through iterative interviews with stakeholders throughout the Kenai Peninsula using a novel participatory Fuzzy Cognitive Mapping process grounded in Ostrom's social-ecological systems framework. Individual social-ecological models, developed one-on-one with stakeholders, were combined into a single aggregated model representing the system's structure and function. We validated this aggregated model through subsequent interviews with stakeholders and focused literature reviews. The result is a model that can: 1) illustrate the breadth and interconnectedness of the Kenai River Fishery's social-ecological system; 2) be used to facilitate discussions around management of the fishery; and 3) be used to explore the components and interactions that move the system toward or away from sustainability. Using the model, we identify how the nature of salmon (migratory) and their habitat (large and unpredictable) leads to uncertainty about effective management strategies. This uncertainty, in addition to a large and diverse set of resource users, creates conflicting management goals that ultimately limit the governance system in making decisions that might increase the sustainability of the fishery.

4:50 Final Announcements/Adjourn, Dave Atcheson (Trout Unlimited)

5:30 Evening Social, Kenai River Brewing (308 Homestead Ln, Soldotna, AK 99669)

Friday April 21, 2023

8:30 Registration and Check-In

9:00 **Welcome Remarks**
Katherine Schake, Homer Soil & Water Conservation District
Benjamin Meyer, Kenai Watershed Forum

9:15 **INVESTIGATING FACTORS ASSOCIATED WITH HEAT STRESS RESPONSES OF TWO ADJACENT POPULATIONS OF SUBARCTIC CHINOOK SALMON IN ALASKA: THE ROLE OF SITE-SPECIFIC TEMPERATURE, BODY SIZE, AND HATCHERY VS. WILD ORIGINS ON HSP70 EXPRESSION**

Madeline Lee, University of Alaska, Fairbanks

Temperatures are rapidly increasing in Alaska, making heat stress research a priority information need for culturally and economically vital Pacific salmon (genus *Oncorhynchus*). Heat shock protein 70 (HSP70) is a tool for research and monitoring of heat stress, but open questions remain about HSP70 expression in relationship to factors beyond water temperature. Here, we examined HSP70 expression from non-lethal muscle biopsies to describe and quantify the thermal stress response in two neighboring Chinook salmon (*Oncorhynchus tshawytscha*) populations and individuals that differed in recent water temperature experiences, rearing (wild or hatchery), and holding for broodstock. Water temperature experiences did exceed the 18°C threshold established by the U.S. Environmental Protection Agency for stress in migrating Pacific salmon. Our results confirmed that as river temperatures increased, so did HSP70 expression, having the strongest association with the maximum temperature over the two days prior to sampling. In addition, HSP70 expression was related to population, rearing (wild vs. hatchery), and holding associated with hatchery egg take protocols when controlled for recent water temperature. HSP70 expression was higher for Chinook salmon sampled in Crooked Creek compared to Ninilchik River, wild-reared compared to hatchery-reared, and those held for broodstock gamete collections compared to those sampled en route without holding. We detected no evidence that body size, day of year, or year affected HSP70. Results suggest hatchery egg take protocols can increase physiological stress.

9:30 **Session 5: Water Quality, Conservation, and Oil Spill Response**
Session Leader: *Benjamin Meyer, Kenai Watershed Forum*

CONSERVING HYDROLOGIC CONDITIONS FOR FISH HABITAT
Leah Ellis, Alaska Department of Fish & Game

Water of sufficient quantity and quality is needed to maintain fish production and ecological functions and values in rivers and lakes. Alaska Department of Fish and Game's Instream Flow Program seeks to protect fish and wildlife habitat through the process of acquiring reservations of water. ADF&G has recently been working in the Quartz Creek, Stariski Creek, and Anchor River watersheds to support instream flow reservations. An overview of the existing and anticipated reservations, as well as the hydrologic data collection efforts to support these reservations will be presented.

WASTEWATER DISPOSAL AND ITS EFFECT ON AQUATIC HABITATS
David Wilfong, Department of Environmental Conservation

Proper wastewater disposal is essential for the protection of aquatic habitats. Improper treatment can lead to algal blooms, low dissolved oxygen and mass fish kills. The State of Alaska regulates most wastewater disposal systems in the state. We will discuss current and proposed regulations, minimum treatment requirements, types of treatment, separation distance requirements, as well as other protections in place to protect public health and the environment.

SELDOVIA OIL SPILL RESPONSE TEAM - COMMUNITY VOLUNTEER DRIVEN OIL SPILL RESPONSE
Stephen Payton, Seldovia Oil Spill Response Team

Created in 1990 after the Exxon Valdez Oil Spill, Seldovia Oil Spill Response Team (SOS) is a community-based response team dedicated to protecting the environment through oil spill education, prevention, preparedness, and response. The vision of the SOS Team is to establish effective and efficient network of community based response teams that exist along the Alaska Coast to protect the sensitive resources of the coastline and to aid each other the State, USCG, and other local regional and industry oil spill cooperatives in times of need.
We will give a brief history of SOS, some of the projects the organization has worked on, and the value this organization of local volunteers brings.

DEC WATER QUALITY MONITORING ON THE KENAI RIVER, 2021 TO 2022
Sarah Apsens, Department of Environmental Conservation

In 2021 and 2022 the Alaska Department of Environmental Conservation set out to evaluate the status of dissolved metals, notably copper and zinc, in the Kenai River. Water quality samples were collected during ice-free months (i.e., between the months of April and November) at 16 sample sites spanning from river mile five near the outlet to Cook Inlet, to river mile 82.1 at the

outlet of Kenai Lake. Sampling events occurred eight times in 2021 and seven times in 2022. Water samples were analyzed for total metals (copper and zinc), dissolved metals (copper, zinc, and a suite of additional metals), hardness (as CaCO3), total dissolved solids, and dissolved organic carbon. Measurements for water temperature, pH, dissolved oxygen, salinity, and turbidity were also collected at each site during each monitoring event. This presentation will discuss the monitoring results of the 2021 sample season and lessons learned. The timeline for releasing the 2022 season will also be discussed.

10:30 Poster Session/Break

Poster

USING REMOTE SENSING AND MACHINE LEARNING TO LOCATE GROUNDWATER DISCHARGE TO SALMON-BEARING STREAMS

Kai Rains, University of South Florida

Many aquatic ecosystems depend on groundwater discharge, including many wetlands, lakes, streams, and estuaries. Groundwater discharge to streams is particularly important, being the sole source of baseflow by definition and commonly also being a substantive subcomponent of stormflow. Such is the case in non-glacial, salmon-bearing streams in south-central Alaska, where groundwater discharge has been shown to support streamflow, modulate temperature, and provide nutrient subsidies. Source-water protection requires stakeholders to know where this groundwater discharge occurs, but field mapping is impractical because the region is rugged and largely roadless. We hypothesized topographic features alone could be used to locate groundwater discharge, but only where diagnostic topographic signatures could first be identified through the use of limited field observations and geologic data. We built a geodatabase from geologic and topographic data, with the geologic data only covering ~40% of the study area and topographic data derived from airborne-based LiDAR covering the entire study area. We identified two types of groundwater discharge: shallow hillslope groundwater discharge, commonly manifested as diffuse seeps, and aquifer-outcrop groundwater discharge, commonly manifested as springs. We developed multistep manual procedures that allowed us to accurately predict the locations of both types of groundwater discharge in 93% of cases, though only where geologic data were available. However, field verification suggested that both types of groundwater discharge could be identified by specific combinations of topographic variables alone. We then applied maximum entropy modeling, a machine learning technique, to predict the prevalence of both types of groundwater discharge using six topographic variables: profile curvature range, with a permutation importance of 43.2%, followed by distance to flowlines, elevation, topographic roughness index, flow-weighted slope, and planform curvature, with permutation importance of 20.8%, 18.5%, 15.2%, 1.8%, and 0.5%, respectively. The AUC values for the model were 0.95 for training data and 0.91 for testing data, indicating outstanding model performance.

Poster

NO GROUNDWATER, NO FISH: THE CRUCIAL ROLE OF GROUNDWATER IN SUPPORTING STREAMFLOW IN NON-GLACIAL, SALMON-BEARING STREAMS IN SOUTH-CENTRAL ALASKA

Tyelyn Bringino, University of South Florida

Groundwater discharge plays a crucial role in the proper functioning of streams, including modulation of streamflow, temperature, and nutrient concentrations. In the Kenai Peninsula Lowlands, Alaska, limited groundwater resources are found in thin aquifers, formed in buried Pleistocene outwash channels. These aquifers provide most of the domestic, commercial, and industrial water supply, but also outcrop on hillslopes, forming seeps and springs that discharge to streams and support overwintering salmonids. Therefore, these limited groundwater resources are delicately balanced between both human and salmonid users and risk depletion due to both rapid population growth and a multidecadal regional drying trend. If streamflow in this region is primarily comprised of groundwater, a reduction in regional groundwater availability may be reflected in an accompanying reduction in streamflow. A total of 410 samples were collected, over a time-period of five years, of precipitation, direct runoff, groundwater, and streamflow, including reoccurring sampling of streamflow in the Anchor River throughout an entire year. We analyzed these samples for major cation and anion concentrations and found that calcium and magnesium were the most informative when describing the hydrochemical variability in the dataset. Calcium and magnesium concentrations were then used in mass-balance mixing models to determine the relative contribution of groundwater to instantaneous and annual streamflow. We found that groundwater contributes disproportionately to streamflow, providing over half of streamflow even during spring snowmelt and all of the streamflow in both late summer and winter. Results show that groundwater resources both provide most of the domestic, commercial, and industrial water supply and play an important role in supporting salmon-bearing streams in the Kenai Peninsula Lowlands. Our results have heightened stakeholder awareness of the tight linkages between the limited groundwater resources balanced between human and salmonid users and potential threats to the system posed by land use-land cover and climate change, and are central to current decision-making by building capacity to support both peer and institutional discussions.

Poster

GROUNDWATER RISK AND RESILIENCE IN SOCIAL-HYDROLOGICAL SYSTEMS

Edgar Guerron Orejuela, University of South Florida

Groundwater is an essential, yet limited resource. It is used for many consumptive uses, especially in rural settings where centralized water resources are limited. However, it is also used by groundwater-dependent ecosystems, including wetlands, streams, and estuaries. In the Kenai Peninsula Lowlands, Alaska, groundwater discharge from seeps and springs to riparian wetlands and streams play fundamental roles in supporting streamflow, e.g., through modulating stream temperatures and delivering nitrogen and carbon subsidies to streams. These processes are critical for the maintenance of stream habitats utilized by overwintering

juvenile salmonids. As regional population grows, consumptive use of groundwater is expected to increase, stressing this limited shared resource. Lacking a shared understanding and tools to facilitate communication and enhance resource management, continued groundwater depletion could lead towards economic, ecological, and cultural collapse. Therefore, the stability and resilience of communities, like the Kenai Peninsula Lowlands, depend on well-informed, science-based, collaborative decision-making. In this study, we partnered with local and regional stakeholders to learn together about groundwater in the area. Using Analytical Hierarchy Process and GIS, we identified areas where groundwater is most vulnerable to anthropogenic impacts, especially consumptive uses. Results include visualizations identifying areas with higher degrees of groundwater vulnerability to anthropogenic impacts. These products are driving a community-wide conversation about the limited but shared groundwater resources. These products are further being used to inform local decision-making and to showcase the use of groundwater vulnerability modeling and collaborative decision-making to other communities facing competition for groundwater so they, too, may consider this approach.

Poster

PREY SPECIES FOR ENDANGERED COOK INLET BELUGA WHALES

William Bechtol, Bechtol Research

Cook Inlet beluga whales (CIBW) are a distinct population segment and an apex predator important for subsistence, culture, and the Cook Inlet ecosystem. During 1993-1998, the CIBW population declined by nearly 50%. Under the Marine Mammal Protection Act, CIBW were listed as depleted in 2000, then listed as endangered under the Endangered Species Act in 2008. During 2008-2018, the CIBW population continued to decline at an average of 2.3% per year, raising concerns over what is inhibiting CIBW recovery. A reduction in the abundance, quality, availability, or seasonality of prey was a threat identified in the CIBW Recovery Plan. But an understanding of CIBW prey remains uncertain because diet composition has largely been derived from a relatively small number of whales. This analysis updates information on presumed CIBW prey, focusing on anadromous eulachon and salmon which co-occur with CIBW in ice-free months.

Spring is a critical time period as CIBW emerge from winter with low energy reserves and must accumulate sufficient energetic reserves to survive the next winter. Adult females are also often lactating or pregnant. Eulachon, a fish with a high fat content, aggregate in spring migrations in Upper Cook Inlet, but little quantitative data have been collected on eulachon spawning returns. Agency surveys in adjacent waters, and personal use fisheries, suggest eulachon populations were generally high in the mid-2000s to early 2010s, but are at relatively low levels in recent years.

Salmon are presumed to be the major prey during June to October when CIBW build the bulk of their energy reserves. All five species of Pacific salmon occur in Cook Inlet, although salmon availability differs spatially and temporally, and CIBW prey selectively is poorly understood. In

the northern inlet where CIBW congregate, commercial salmon harvests are driven by sockeye in the summer and coho in the fall. Commercial salmon harvests, averaged by decade, have declined over the past 40 years.

Understanding linkages between CIBW and their prey is critical to adapting management strategies that promote CIBW recovery while maintaining fisheries and ecosystem function. A lack of data on eulachon abundance and CIBW prey selectivity inhibits that understanding. Several potential research options are discussed with the recognition that the listing of "endangered" limits directly interacting with CIBW.

11:15 **Session 6: Watershed and Habitat Protection and Enhancement**
Session Leader: *Kyle Graham, US Fish & Wildlife Service*

ENHANCING CLAM HABITAT/PRODUCTIVITY USING TRADITIONAL METHODS
Stephen Payton, Seldovia Village Tribe

Clam gardens are ancient intertidal features constructed by coastal indigenous peoples. These gardens were constructed to maintain or enhance the production of shellfish. Residents of Seldovia and the greater Cook Inlet Area have seen declines in shellfish populations and they are now to the point many fisheries have been closed and subsistence harvest amounts have been drastically reduced.
With funding from the BIA, the Seldovia Village Tribes Environmental Program is working to utilize this ancient practice to rejuvenate an area in Jakolof Bay that has been used for shellfish harvest for generations.

KENAI PENINSULA STREAMBANK REHABILITATION & HABITAT PROTECTION COST-SHARE
Jessica Johnson, Alaska Department of Fish & Game

The Kenai Peninsula Streambank Rehabilitation and Habitat Protection Cost-Share (Kenai Cost-Share) is a proactive financial incentive and educational program that provides funding and technical project design assistance for public land managers and private landowners. The Cost-Share has a long history on the Kenai Peninsula and was actually developed on the Kenai Peninsula in the mid to late 1990's. Since the development of the Kenai Cost-Share ADF&G has partnered with USFWS on nearly 800 projects on the Kenai Peninsula.

MINING HELPS RESURRECT A CREEK ON THE CHUGACH NATIONAL FOREST
Adam Cross, US Forest Service
Austin Williams, Trout Unlimited

Other contributors include Angela Coleman and Brian Bair (US Forest Service), and Patrick Shannon (National Forest Foundation).
The National Forest Foundation (NFF), U.S. Forest Service (USFS) Chugach National Forest and Trout Unlimited (TU) in partnership with Kinross Gold Corporation and Hope Mining Company

(HMC) have collaborated to implement stream habitat restoration on approximately 2.2 miles of Resurrection Creek. This project is located on the northern end of the Kenai Peninsula, on the Seward Ranger District and in the historic mining community of Hope, Alaska. Placer mining practices of a century ago resulted in the loss of soil and significantly altered the natural complexity of stream channels and wetlands on Resurrection Creek. The disturbance and loss of the floodplain have adversely altered the aquatic habitat and riparian vegetation composition. Without mechanical intervention, biologic production within the project area will remain limited, conceivably for centuries. A similar restoration project, just upstream, demonstrated the Forest Service's ability to restore natural channel processes and improve spawning and rearing habitat to the benefit of fish populations. Today this unique partnership is working to restore habitat and ecosystem functions, in one of the Chugach National Forests priority watersheds for future generations to enjoy.

12:00 Lunch Break

1:00 Poetry Reading, Steve Schoonmaker

1:15 **Session 7: Invasive Species One**
Session Leader: *Syverine Bentz, Kachemak Bay National Estuarine Research Reserve*

WHICH PATH DO I CHOOSE? PERSPECTIVES ON INVASIVE SPECIES MANAGEMENT
Ben Wishnek, US Fish & Wildlife Service

Authors: Ben Wishnek, Katherine Schake, Dawn Magness
The landscapes of Alaska support diverse biota and largely unaltered abiotic processes that are ecologically, culturally and economically significant at global scales. Introduction of invasive species to these landscapes coupled with increasing rates of environmental change has the potential to negatively impact their socioecological values. Luckily, the impact of invasive species issues in Alaska is largely less than in the lower 48. In contrast, climate change is creating opportunities for more species to colonize Alaska creating questions about whether Alaska will support a more diverse community assemblage in the future and what species should be considered invasive. With increasing rates of change and invasive species introductions, land managers are going to have to make decisions about how to manage invasions in the short and long term. Two complementary approaches, Early Detection and Rapid Response (EDRR) and Resist-Accept-Direct (RAD) can be used to help make these decisions. EDRR emphasizes acting quickly to eradicate infestations in their incipient stages when eradication is more logistically and financially feasible. RAD invites an innovative approach that allows one to decide whether to stop the change from happening, accept that the change is happening because it is logistically infeasible to stop, or deciding to intervene in a manner that steers the system being managed in a more favorable direction. These two

approaches to invasive species management will be discussed and provide context to the decision space that land managers make their decisions in, which is often not black-and-white.

EARLY DETECTION & RAPID RESPONSE IN ACTION: MANAGING INVASIVE SPECIES THROUGH PARTNERSHIP AND PUBLIC ENGAGEMENT

Katherine Schake, Homer Soil & Water Conservation District

The Kenai Peninsula Cooperative Invasive Species Management Area (KP-CISMA: kenaiinvasives.org) is a volunteer partnership dedicated to preventing the introduction and managing the spread of non-native, invasive species. Governmental agencies, nonprofit organizations, and tribal entities have collaborated since 2003 to eradicate invasive species on public and private lands and waters across the 6 million-acre peninsula. We have successfully managed and eradicated high priority invasive plants (aquatic and terrestrial) for over 15 years, assisted in eradicating northern pike from salmon spawning watersheds, and maintain Integrated Pest Management Plans (IPMs) to guide future rapid response. Partners implement Early Detection & Rapid Response (EDRR) by collaborating on permitting, surveying & monitoring, pesticide application, sharing funds and resources, and continually improving data management. Furthermore, public outreach and education coupled with community monitoring programs are critical for preventing new introductions of species such as the European green crab. Together, the KP-CISMA works hard to protect fish and wildlife habitat from current and future invasive species at Alaska's doorstep.

MANAGEMENT OF AQUATIC AND RIPARIAN INVASIVE PLANT SPECIES ON THE CHUGACH NATIONAL FOREST

Peter Frank, US Forest Service

Maintaining the integrity of aquatic and riparian ecosystems necessary to sustain populations of native vegetation, fish, and wildlife is one of the core goals of the Chugach National Forest. Forest biologists with help from our regional partners have identified three invasive plant species, Elodea (Elodea spp.), Reed Canarygrass (*Phalaris arundinacea*) & European Bird Cherry (*Prunus padus*), which are currently present on the forest and if left unmanaged may have negative impacts on the ecological integrity of the forest's aquatic and riparian habitats. In this presentation, we'll identify the current status of these three invasive species on the forest and discuss the management strategies we employ to limit their spread and reduce or maintain their abundance on the forest at levels which do not impede normal ecosystem function.

THE EUROPEAN GREEN CRAB THREAT TO ALASKA FISHERIES AND HABITAT

Jasmine Maurer, Kachemak Bay National Estuarine Research Reserve

Invasive species represent one of the most significant threats to the ecological, economic, and cultural integrity of habitats in Alaska. Invasive European green crabs were found in southeast Alaska in July of 2022, following several years of rapid northerly expansion and population growth in the Northeast Pacific. The European green crab (*Carcinus maenas*, EGC) is a globally

damaging invasive species that poses a threat to native shellfish, crabs, eelgrass beds and estuary habitat critical for juvenile salmon and other culturally and commercially important species. The establishment of EGC populations in Alaska's coastal ecosystems will have economic, ecological, cultural, and social impacts. To protect important resources and habitats from this marine invasive species will require proactively enhancing coordination, increasing detection efforts, and the allocation of resources for rapid response and removal efforts.

2:15 **Tidbits/Break**

Session Leader: *Syverine Bentz, Kachemak Bay National Estuarine Research Reserve*
Christina Kriedeman, Kenai Fjords National Park
Matt Bowser, Kenai National Wildlife Refuge
Kim Schuster, Kachemak Bay National Estuarine Research Reserve
Katey Shedden, Kenai Watershed Forum
Maura Schumacher, Kenai Watershed Forum

2:45 **Session 8: Invasive Species Two**

Session Leader: *Jen Chauvet, Homer Soil and Water Conservation District*

COOK INLET AS AN INVASION PATHWAY FOR INVASIVE NORTHERN PIKE

Rob Massengill, Alaska Department of Fish & Game

For decades, the range of invasive northern pike in southcentral Alaska has expanded through anthropogenic and natural dispersal mechanisms, often resulting in deleterious effects to native fish assemblages. Occasional reports of live northern pike being caught in northern Cook Inlet commercial fisheries, along with their southward distribution creep into Cook Inlet tributaries, suggests Cook Inlet is an invasion pathway. More evidence that Cook Inlet can serve as an invasion pathway includes results of a recent northern pike salinity tolerance trial and discoveries by UAF of marine strontium isotope signatures in northern pike otolith bones collected from Kenai Peninsula and Anchorage freshwaters. Potential areas for future research to address this invasion pathway will be discussed.

SALMON HABITAT AND AQUATIC INVASIVE SPECIES IN WEST COOK INLET

Jillian Jablonski, Tyonek Tribal Conservation District

The aquatic invasive species northern pike (*Esox lucius*) and *Elodea canadensis* threaten salmon habitat on the Kenai Peninsula lands of West Cook Inlet. Both pike and Elodea have demonstrated negative impacts on salmon; pike preferentially prey on juvenile salmonids, and Elodea can reduce and degrade spawning habitat through various mechanisms. Since 2015, Tyonek Tribal Conservation District has collaborated with partners to survey at-risk waters for pike and Elodea and our programs have since expanded to actively address these challenges through pike suppression in four West Cook Inlet drainages and District-wide pike and Elodea survey and monitoring. This presentation will highlight our past, current and future directions

for pike survey and suppression, salmon population monitoring in pike-infested waters, and Elodea surveys in the Tyonek area watershed and West Cook Inlet Kenai Peninsula lands.

IMPACTS OF INTRODUCED ALASKA BLACKFISH

Lucas Byker, US Fish & Wildlife Service

Alaska Blackfish (*Dallia pectoralis*) have become an introduced species of concern where they have been introduced in Southcentral Alaska. Previous studies focused on introduced blackfish diet suggest significant dietary overlap exists between blackfish and native fish species. This dietary overlap, coupled with the blackfish' unique physiological adaptations, have raised concerns that introduced populations of blackfish may have a negative impact on native fish assemblages. This study sought to quantify the effects of an introduced population of blackfish in the lower Kenai River by comparing indexes of abundance of various native fish species in blackfish-impacted streams and unimpacted streams. Additionally, the growth of juvenile Coho salmon (*Oncorhynchus kisutch*) was compared between the two stream types. This study concluded, based on field data and literature review, that Alaska Blackfish are a likely a benign invader to most, but not all, Kenai Peninsula native fish species.

3:45 Final Announcements/Adjourn, Katherine Schake