Copper River Delta Science Symposium

60.5424° N, 145.7525° W

AGENDA AND ABSTRACTS

March 27–29, 2018 | Cordova, Alaska

Conference Location

The symposium will be held at the new Cordova Center, co-located with Cordova's library, city offices and museum.

Introduction

Alaska's Copper River delta is the largest contiguous wetland on the Pacific Coast of North America and an important region for both fish and wildlife. The delta provides vital salmon habitat, serves as a key shorebird stopover and breeding site, and is the primary nesting area for Dusky Canada Geese.

To better integrate current knowledge and plan future research efforts, Copper River Delta Science Symposium presentations focus on the delta as a system, covering topics from hydrology and geomorphology to avian nesting ecology and trophic relationships. This conference provides an opportunity for interdisciplinary examination of the delta and to identify future research needs to better manage and conserve this ecologically significant area in the face of climate change and other environmental transformations.

Thirteen delta research conferences have been held since the early 1970s. The US Forest Service's Cordova Ranger District and Pacific Northwest Research Station, Ecotrust and Alaska Sea Grant supported the most recent conference in 2011. Since that year many research projects have come to fruition, new initiatives have been put in place and many issues have come to the fore including climate change impacts.

Steering Committee

Torie Baker (co-chair) *Alaska Sea Grant Marine Advisory Program, University of Alaska Fairbanks*
Erin Cooper (co-chair) *Cordova Ranger District, USFS*
Stormy Haught Alaska *Department of Fish and Game*
Rob Campbell *Prince William Sound Science Center*
John Whissel *Native Village of Eyack*
Chantel Adelfio *Copper River Watershed Project*
Melissa Gabrielson *Cordova Ranger District, USFS*

Sponsors

Alaska Sea Grant College Program, University of Alaska Fairbanks
Cordova District, US Forest Service
Native Village of Eyak
Pacific Northwest Research Station, US Forest Service
Prince William Sound Oil Spill Recovery Institute
Prince William Sound Science Center
Copper River Watershed Project

Keynote Speaker

The keynote speaker is Dr. Gordon Reeves, USFS, Corvallis, Oregon. Gordie Reeves first set foot on the Copper River delta as a fisheries biologist in 1987. His expertise is in freshwater ecology of anadromous salmon and trout, conservation biology of those fish, the impacts of climate change on aquatic ecosystems and associated biota, and aquatic aspects of landscape ecology.

Monday, March 26, 2018

18:00 **Ice breaker at Reluctant Fisherman Inn**

Tuesday, March 27

8:00 **Breakfast at Cordova Center**

8:45 **Cordova Center**

Opening remarks

Erin Cooper, Chugach National Forest, USFS, CRDSS co-chair

Welcome

Mayor Clay Koplin, City of Cordova

9:00 **Keynote**

Dr. Gordie Reeves, NW Forest & Range Experiment Station, USFS, Corvallis, OR

10:00 **Break**

SESSION 1

Rob Campbell, Prince William Sound Science Center, moderator

10:15

Salmon Blitz: Engaging Citizen Scientists in Documenting Salmon Habitat in the Copper River Watershed

Kate Morse, Copper River Watershed Project, Cordova, AK

10:40

Inriver Abundance, Size, and Migratory Timing of Copper River Chinook Salmon and an Overview of New Technology Available for Monitoring Chinook Salmon Abundance and Distribution within the Copper River Watershed

Matt J. Piche, Native Village of Eyak, Cordova, AK

11:05

Copper River Delta: A Critical Stopover for Red Knots in Spring

Mary Anne Bishop, Prince William Sound Science Center, Cordova, AK

11:30

Baseline Water Quantity and Quality Sampling of Three Small Streams Near Cordova, AK

Jimmy Paley, Native Village of Eyak, Cordova, AK

11:55 **Lunch**

SESSION 2

Torie Baker, University of Alaska Fairbanks, Alaska Sea Grant, moderator

13:15
Aquatic Plant Community Response to *Elodea canadensis* on the Copper River Delta
Elizabeth Camarata, Oregon State University, Corvallis OR

13:40
Understanding Stand for Salmon: Improving Protections for Fish Habitat
Emily Anderson, Wild Salmon Center, Anchorage, AK

14:05
Warming Winter Climate Reduces Landscape-Scale Variability in Pacific Salmon Incubation Duration on the Copper River Delta
Luca A. Adelfio, Chugach National Forest, USFS, Cordova, AK

14:30 **Break**

SESSION 3

John Whissel, Native Village of Eyak, moderator

14:55
Monitoring Amphibians and Amphibian Pathogens Using Environmental DNA (eDNA)
Carmen Harjoe, Oregon State University, Corvallis, OR

15:20
International Connections and the Copper River Delta
Erin Cooper, Chugach National Forest, USFS, Cordova, AK

15:45
Distribution and treatment of *Elodea canadensis* on the Copper River Delta
Kate Mohatt, Chugach National Forest, USFS, Girdwood, AK

18:00 **Reception at Cordova Center**

Wednesday, March 28

8:00 **Breakfast**

8:50
Day 2 Remarks/Housekeeping
Torie Baker, University of Alaska Fairbanks, Alaska Sea Grant, CRDSS co-chair

---

SESSION 4
Chantel Adelfio, Copper River Watershed Project, moderator

9:00
Ranking Culverts for Maximum Benefit from Restoration Dollars
Kate Morse, Copper River Watershed Project, Cordova, AK

9:25
Ice Sheets to Oceans: Linkages between Changing Watersheds and the Northern Gulf of Alaska
Rob Campbell, Prince William Sound Science Center, Cordova, AK

9:50
Variation in Body Size and Energy Content of Sockeye Salmon Returning to the Copper River, Alaska: Preliminary Data and Future Studies
Kristen B. Gorman, UAF College of Fisheries and Ocean Sciences/ Prince William Sound Science Center, Cordova, AK

10:15 **Break**

SESSION 5
Melissa Gabrielson, USFS Chugach, moderator

10:40
Toward More Integrated Salmon Knowledge Systems
Ian Dutton, Nautilus Impact Investing, Anchorage, AK

11:05
An Evaluation of Collaborative Salmon Fishery Management in Prince William Sound, Alaska
Tommy Sheridan, Oregon State University, Corvallis, OR

11:30
Examining Indirect Indicators of Moose Productivity on the Copper River Delta
Charlotte Westing, Alaska Department of Fish and Game, Cordova, AK

11:55
Copper River Delta Moose Herd Genetics
John C. Whissel, Native Village of Eyak, Cordova, AK

12:20 **Lunch**

SESSION 6
John Whissel, Native Village of Eyak, moderator

13:30
Factors Influencing Waterbird Distribution and Abundance on the Copper River Delta, Alaska
Jillian Jablonski, University of Alaska Anchorage, Anchorage, AK

13:55
Hydrologic Regime Changes in a High-Latitude Glacierized Watershed under Future Climate Conditions
Melissa M. Valentin, 2100 Solutions, Denver, CO

14:20
Salmon Resource Waves on the Copper River Delta: Who Is Surfing Them?
Jonny Armstrong, Oregon State University, Corvallis, OR

14:45
Influence of Water Temperature on Synchrony Spawning, Hatching, and Emergence of Coho Salmon on the Copper River Delta
Emily Y. Campbell, Oregon State University, Corvallis, OR

15:10 **Break**

SESSION 7
Erin Cooper, USFS Chugach, moderator

15:35
Habitat Utilization and Seasonal Movements of Radio-Tagged Coastal Cutthroat Trout (*Oncorhynchus clarkii clarkii)* in the Copper River Delta, Alaska and Application toward Conservation Management in Degraded Systems
David Saiget, BIOFISH Environmental Consultants, Cordova, AK

16:00
Growing Stewardship: Youth Involvement in Dusky Canada Goose Artificial Nest Island Program on the Copper River Delta
Nick Docken, Chugach National Forest, USFS, Cordova, AK

16:25
Rare Fungi of the Copper River Delta
Kate Mohatt, Chugach National Forest, USFS, Girdwood, AK

18:00 **Conference/Public Poster Session at Cordova Center**

Thursday, March 29

8:00 **Breakfast**

8:50
Day 3 Remarks/Housekeeping
Erin Cooper, USFS Chugach

9:00
Cross-discipline panel
Gordie Reeves, Erin Cooper, USFS Chugach, moderators

10:30
Closing remarks
Erin Cooper, USFS Chugach

Warming Winter Climate Reduces Landscape-Scale Variability in Pacific Salmon Incubation Duration on the Copper River Delta

Luca A. Adelfio
Chugach National Forest, USDA Forest Service, Cordova, AK, USA, ladelfio@fs.fed.us

Steven M. Wondzell
Pacific Northwest Research Station, USDA Forest Service, Corvallis, OR, USA, swondzell@fs.fed.us

Nathan J. Mantua
Southwest Fisheries Science Center, NOAA, Santa Cruz, CA, USA, nate.mantua@noaa.gov

Gordon H. Reeves
Pacific Northwest Research Station, USDA Forest Service, Corvallis, OR, USA, Greeves@fs.fed.us

---

Incubation duration for fall-spawning Pacific salmon (*Oncorhynchus* spp.) is largely controlled by winter water temperature and may be impacted by climate change. We measured incubation period (October to May) and water temperature at 12 coho salmon (*O. kisutch*) spawning sites that fell into four water source categories: groundwater, groundwater-mixed, precipitation, and precipitation with an upstream lake. We quantified the accumulation of thermal units and modeled incubation duration, contrasting years with historically common snow-dominant conditions and years with anomalously warm rain-transitional conditions, a proxy for an anticipated future climate scenario.

Our results showed that water source controlled the sensitivity of water temperature to changes in air temperature. At groundwater sites, seasonal and interannual temperature variations were strongly attenuated, leading to uniform incubation conditions within and among years. In contrast, incubation duration was reduced by four months during rain-transitional winters at precipitation-fed streams. The impacts of rain-transitional winters were particularly pronounced at sites with shallow lakes upstream, where a 1.6ºC increase in incubation period mean air temperature prevented ice formation and limited the accumulation of snow. Consequently, lakes were exposed to short-wave radiation with the onset of long subarctic spring days and increased solar heating contributed to an 8ºC increase in mean May water temperature. Across all study sites, the coefficient of variation in incubation duration was significantly greater during snow-dominant winters than during rain-transitional winters, indicating landscape-scale variability in salmon life history event timing may be reduced by a warming winter climate.

Understanding Stand for Salmon: Improving Protections for Fish Habitat

Emily Anderson
Wild Salmon Center, Anchorage, AK, USA, eanderson@wildsalmoncenter.org

Alaskans across the state have a vested interest in sustaining the fisheries that support Alaska's regional economies, communities and cultures. Healthy fish habitat, supported by the state's vast network of waterways, is a major factor that contributes to the sustainability of our fisheries. While the state keeps a list of important anadromous waters, the law that aims to protect fish habitat and guide project permitting is nearly 60 years old and very vague. Where modern natural resource laws infuse science based principles into the legal framework, our current law lacks clear standards to guide responsible development or ensure the protection of Alaska's fisheries.
In the spring of 2016, a diverse group of Alaskans proposed a solution: update Alaska's fish habitat protection and permitting law. Now recognized as "Stand for Salmon," a growing number of interested stakeholders are supporting the effort to ensure that communities, economies, and cultures that rely on fisheries are not inadvertently compromised as our state continues to grow.

The Stand for Salmon effort is currently pursuing two tracks: legislative (through HB 199) and a ballot initiative (proposed for the 2018 election). This presentation will provide an overview of the key proposed changes that will strengthen our fish habitat protection and permitting law. The changes include creating science-based habitat protection standards, expanding Alaska Department of Fish and Game's ability to protect vital fish habitat, providing an opportunity for public input, and creating more certainty in the process through clear permitting rules. Finally, the presentation will provide an overview of where the effort stands.

Salmon Resource Waves on the Copper River Delta: Who Is Surfing Them?

Jonny Armstrong
Oregon State University, Corvallis, OR, USA, jonathan.armstrong@oregonstate.edu

Will Deacy
Oregon State University, Corvallis, OR, USA, william.deacy@oregonstate.edu

Gordie Reeves
US Forest Service, Corvallis, OR, USA, gordon.reeves@oregonstate.edu

Luca Adelfio
US Forest Service, Cordova, AK, USA, ladelfio@fs.fed.us

Daniel Schindler
University of Washington, Seattle, WA, USA, deschind@uw.edu

Beyond subsistence and commercial fisheries, salmon runs provide a critical source of food to over 50 species of fish and wildlife. While salmon may be incredibly abundant, they are ephemerally available at spawning sites, offering consumers a fleeting feast. Recent work is emphasizing how salmon population diversity can alleviate the pulsed nature of salmon foraging opportunities. Across heterogeneous watersheds, salmon populations spawn at different times, generating a resource wave that propagates across space, lasting for several months, whereas single populations only spawn for a matter of weeks. This prolonged foraging potential is particularly important for highly mobile, salmon-reliant consumers such as bears. Our group is characterizing salmon resource waves on the Copper River Delta, using trail cameras to document how the presence of bears and salmon shifts across the landscape over the course of the year. Existing work on this topic has been confined primarily to brown bear and single species of salmon. The Delta provides an exciting opportunity to explore how multiple wide-ranging consumers respond to phenological variation across pink, sockeye, and coho salmon. Here we present a range of preliminary results from the project and discuss future research directions and conservation implications.

Copper River Delta: A Critical Stopover for Red Knots in Spring

Mary Anne Bishop
Prince William Sound Science Center, Cordova, AK, USA, mbishop@pwssc.org

Joseph Buchanan
Washington Department of Fish and Wildlife, Olympia, WA USA

Brian McCaffery
Yukon Delta National Wildlife Refuge, Bethel, AK, USA

Jim Johnson
US Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK, USA

With an estimated population of 22,000 individuals, the Red Knot (*Calidris canutus roselaari*) is one of the smallest and least studied shorebird populations in North America. Historically, limited ground-based counts at the Copper River (CRD) and Yukon-Kuskokwim River deltas (YKD) suggested these areas are major stopovers in spring. We used radio telemetry during spring 2014 at CRD and spring 2015 at CRD and YKD to document Red Knot occurrence and space use. In 2014, 12 of 20 Red Knots radio-tagged in Grays Harbor, Washington, on 13 May were detected during 7 d of aerial surveys on CRD. In spring 2015, 50 knots were radio-tagged at Grays Harbor on 1 May (n = 3) and 6 May (n = 47). Ninety-four percent and 70% of the tagged knots were later detected on the CRD and YKD, respectively, signifying a high level of connectivity between Grays Harbor and the two Alaska sites during spring migration. We identified areas previously not known to be important for Red Knots, including Controller Bay on the Copper River Delta. Short length of stay suggests that both CRD and YKD function primarily as stopover areas.

Ice Sheets to Oceans: Linkages between Changing Watersheds and the Northern Gulf of Alaska

Rob Campbell
Prince William Sound Science Center, Cordova, AK, USA, rcampbell@pwssc.org

Andrew Schroth
University of Vermont, Burlington, VT, USA, Andrew.Schroth@uvm.edu

Santiago Gassó
NASA GESTAR, Greenbelt, MD, USA, Santiago.Gasso@nasa.gov

Jeff Welker
University of Alaska Anchorage, Anchorage, AK, USA, afjmw1@uaa.alaska.edu

Pat Tomco
University of Alaska Anchorage, Anchorage, AK, USA, pltomco@uaa.alaska.edu

Rommel Zulueta
NEON, Boulder, CO, USA, rzulueta@battelleecology.org

The Copper River is the largest point source of freshwater to the northern Gulf of Alaska, and the coastal ocean is connected hydrologically, biogeochemically, and biologically with the upriver systems of the watershed; the Copper River salmon fishery is also a major driver of the local economy. The Copper River watershed (and much of southcentral Alaska) is heavily glaciated, and is experiencing very high loss rates of ice mass, among the highest in the world. Those losses have resulted in biogeochemical changes in the upper watershed that are cascading throughout the watershed into the coastal ocean. The recession of glaciers is also likely leading to changes in geochemical (iron) fluxes to the coastal and deep water ocean. Using archived data and the results of recent intensive surveys throughout the watershed and in the coastal ocean, we will describe how the north Gulf of Alaska coast region has changed, and make predictions on how the continued loss of ice mass will manifest in the future.

International Connections and the Copper River Delta

Erin Cooper
US Forest Service, Chugach National Forest, Cordova, AK, USA

The Copper River International Migratory Bird Initiative (CRIMBI) has played an active role in connecting the Copper River Delta to partners throughout the Pacific flyway. These partnerships have led to a variety of scientific and educational projects that have bolstered conservation efforts for migratory waterbirds throughout their range. I will give an update on past, current, and future CRIMBI projects and how they relate to waterbird conservation efforts at home and throughout the Americas.

Growing Stewardship: Youth Involvement in Dusky Canada Goose Artificial Nest Island Program on the Copper River Delta

Nick Docken
US Forest Service, Chugach National Forest, Cordova, AK, USA, ndocken@fs.fed.us

Copper River Stewardship Program participants TBD
Cordova School District, Cordova, AK, USA

Kate Morse
Copper River Watershed Project, Cordova, AK, USA, kate@copperriver.org

Lauren Bien
Prince William Sound Science Center, Cordova, AK, USA, lbien@pwssc.org

Robin Mayo
Wrangell Institute for Science and Environment, Kenny Lake, AK, USA, robin@wise-edu.org

---

Dusky Canada Geese (*Branta canadensis occidentalis*) breed primarily on the Copper River Delta (CRD) in southcentral Alaska. In 1964, an earthquake accelerated habitat changes on the CRD. With ongoing vegetation succession and associated predation, impaired production was anticipated to limit the population of dusky Canada Geese over time (Pacific Flyway Council 2008).

As a land management agency, the US Forest Service (USFS) is responsible for assessing habitat-related changes on the CRD that may influence the breeding population of Dusky Canada Geese. In 1984, the Chugach National Forest and Ducks Unlimited initiated an artificial nest island program to address concerns about the decline in the Dusky Canada Goose population. The purpose of the nest island program is to provide alternative, safe nesting sites for Dusky Canada Geese. The average nest success on nest islands installed on the Copper River Delta is approximately 67% (1984-2017), which is nearly double that found on natural sites (35%, 1984-2004).

Since 2014, the USFS has partnered with the Copper River Stewardship Program (CRSP) to involve youth in monitoring and maintaining dusky nest islands. This field-based, hands-on learning adventure has students immersed in the watershed they are learning about. Students develop strong connections with their local environment and explore potential careers in natural resources.

CRSP participants will work with USFS biologists and CRSP program partners to present an overview of the dusky nest island program, the additional knowledge and skills gained from their hands-on learning experiences, and suggestions for ways to engage youth in scientific research.

Variation in Body Size and Energy Content of Sockeye Salmon Returning to the Copper River, Alaska: Preliminary Data and Future Studies

Kristen B. Gorman
Prince William Sound Science Center, Cordova, AK, USA, kgorman@pwssc.org
Peter S. Rand
Prince William Sound Science Center, Cordova, AK, USA, prand@pwssc.org

Sockeye salmon (*Oncorhynchus nerka*) are an economic cornerstone of the commercial and subsistence salmon fisheries in southcentral Alaska. There has been a long-term decline in size at age of adult Copper River sockeye, with recent years (2015-2017) showing dramatic reductions in body size of returning adults. In other river systems, body size and energy density of sockeye have been negatively related to sea surface temperature during the last year of ocean residency, and recent studies have confirmed growth impacts to sockeye, and other Pacific salmon species, due to density-dependent factors at sea. We are interested in how changes in body size and energy content—measures of fish quality that are shaped during ocean residency—might influence the energetics of migration and spawning performance in the Copper River, a large, glacially dominated watershed. We hypothesize that body size, energy density, and total energy content of returning sockeye to the lower river are positively related (H1), that sockeye with the longest migrations to the upper reaches of the river use more energy than those migrating to lower spawning grounds (H2), and that sockeye with longer migrations invest less in gonad maturation than those with shorter migrations (H3). In a 2016 pilot study, we determined upriver sockeye used about 50% of their total energy to reach the spawning grounds, and up-river energy levels were low compared to other studies. We discuss our results and ideas for future research on the energetics of spawning migration by sockeye and other salmon of the Copper River watershed.

Monitoring Amphibians and Amphibian Pathogens Using Environmental DNA (eDNA)

Carmen Harjoe
Oregon State University, Corvallis, OR, USA, harjoec@oregonstate.edu

Amphibians are at the forefront of biodiversity loss, with declines estimated to be more severe than any other vertebrate taxa. Disease has been identified as an important driver of declines. Specifically, two virulent pathogens, the amphibian chytrid fungus *Batrachochytrium dendrobatidis*, and a strain of *Ranavirus*, have been associated with amphibian declines and extinctions worldwide.

The western toad (*Anaxyrus boreas*) and the wood frog (*Rana sylvatica*) are the only two species whose ranges extend into the Chugach National Forest due the forest's northern latitude. The western toad, a once abundant species in most of its range, is now considered near threatened by the International Union for Conservation of Nature (IUCN). Furthermore, anecdotal evidence suggests that western toad population declines may be happening on forest lands. However, due to a lack of inventory and long-term monitoring, little is known about the distribution or status of amphibian populations across the forest.

In this study, we compared traditional visual encounter surveys and pathogen detection techniques to molecular modes of detection for amphibians and their pathogens in Prince William Sound. Specifically, we employed the use of water sample filtration, followed by digital droplet polymerase chain reaction (ddPCR), to quantify concentrations of target DNA. Detection of amphibians and their pathogens was greatest when both traditional and molecular methods were used together. However, preliminary results suggest that the use of visual encounter surveys was 10% more effective than eDNA surveys in detecting toads, equally as effective in detecting chytrid fungus, but 5% less effective in detecting wood frogs.

Factors Influencing Waterbird Distribution and Abundance on the Copper River Delta, Alaska

Jillian Jablonski

Department of Geography and Environmental Studies, University of Alaska Anchorage, Anchorage, AK, USA, jcjablonski@alaska.edu

Audrey Taylor

Department of Geography and Environmental Studies, University of Alaska Anchorage, Anchorage, AK, USA, artaylor@alaska.edu

---

The Copper River Delta is a highly productive coastal wetland and an important breeding ground for waterbirds. We are investigating a suite of biological, chemical, and physical factors to understand what is driving waterbird distribution and breeding chronology on the Delta, and how the aquatic invasive plant *Elodea canadensis* and differences in pond temperatures may be affecting the food web supporting the waterbird community.

In 2016 and 2017, we surveyed 17 total ponds on the western Copper River Delta for waterbird abundance. Six of the 17 ponds are currently infested with *Elodea canadensis*. Over two seasons, a total of 1,035 individual adult birds were recorded, along with 87 broods and 72 nests. Densities (mean count per visit per hectare pond) ranged from 0.08 to 7.25. Twenty-six species were observed: 17 waterfowl, 6 shorebird, and 3 gull/tern species from six foraging guilds: dabbling ducks, diving ducks, piscivores, herbivores, shorebirds, and carnivores. Our presentation reports the results of statistical analyses utilizing multivariate analysis of variance (MANOVA) techniques to investigate differences in densities of waterbird foraging guilds across study ponds. We additionally examined differences in species diversity across ponds using the Shannon Weiner Diversity Index. Significant relationships identified via multivariate techniques were then analyzed using univariate and regression techniques to further explore associations between waterbirds and key habitat variables.

Aquatic Plant Community Response to *Elodea canadensis* on the Copper River Delta

Elizabeth Camarata
Oregon State University, Corvallis, OR, USA, elizabethcamarata@gmail.com
Kate Mohatt
US Forest Service, Chugach National Forest, Girdwood AK, USA

Elodea is the first observed non-native aquatic plant in Alaska. Since its establishment on the Copper River Delta, the US Forest Service has conducted surveys to collect information in collaboration with a statewide effort. The ecological role of *Elodea canadensis* and response of native plant communities to infestation are currently being assessed. This is achieved by using a variety of sampling approaches employing nested plot design within ponds and lakes to capture changes in abundance and species composition at multiple scales. Ponds that have been treated to eradicate *Elodea* were compared to nearby infested and non-infested ponds with similar characteristics, and pre-treatment data was also collected to compare to post-treatment native macrophyte recovery. Plant community observations from the Bering Lake prior to *Elodea* introduction in 1992 were also compared to recent observations post-introduction using a similar sampling scheme.

Rare Fungi of the Copper River Delta

Kate Mohatt
US Forest Service, Girdwood, AK, USA, kmohatt@fs.fed.us

Mushroom producing fungi are generally poorly understood in North America, and Alaska in particular. Events such as the Girdwood Fungus Fair and Cordova Fungus Festival have brought in a number of highly skilled mycologists who have discovered several interesting and rare species that appear to be unique to the Cordova area. The Cordova milky cap, *Lactarius cordovaensis*, for example was described in 1964 but was photographed for the first time in 2015. DNA sequences of this species compared to known *Lactarius* species confirm its rarity. It is likely that the rare habitats found in the Copper River Delta harbor additional rare and yet undescribed mushroom forming species.

Distribution and Treatment of *Elodea canadensis* on the Copper River Delta

Kate Mohatt
USFS, Chugach National Forest, Girdwood, AK, USA, kmohatt@fs.fed.us
Elizabeth Camarata
Oregon State University, Corvallis, OR, USA, elizabethcamarata@gmail.com
Erin Cooper
USFS, Chugach National Forest, Cordova, AK, USA, ecooper@fs.fed.us

---

Elodea is Alaska's first and only known aquatic invasive plant. *Elodea* was first found in Eyak Lake in 1982, and it has since spread across the Copper River Delta to numerous ponds, sloughs, and Lakes including McKinley, Martin, and Bering. Vegetative fragments are easily spread by boats and floatplanes.

The impact of this species on aquatic communities on the Delta is unknown, but it has impacted native plant communities and fish habitat where it has become established elsewhere. A small scale treatment of this species is currently underway in three small ponds and a short section of slough downstream of Eyak Lake totaling approximately 25 acres. An additional treatment pond near McKinley Lake approximately 13 acres in size may be added in 2019. The purpose of these treatments is to determine the effects of treatment of this non-native species on aquatic communities on the Copper River Delta, and to determine if wide scale treatments are warranted and would be effective. Treatments of this species include the use of time released pellets containing the active ingredient Fluridone. Target concentrations of this herbicide have been difficult to achieve owing to the complex hydrology of the Delta, making the possibility of effective widespread treatment uncertain.

Ranking Culverts for Maximum Benefit from Restoration Dollars

Kate Morse
Copper River Watershed Project, Cordova, AK, USA, kate@copperriver.org
Kirsti Jurica
Copper River Watershed Project, Cordova, AK, USA, juricaka@gmail.com

Improperly designed or installed culverts can block fish passage and degrade water quality in fish streams. A 2002 survey by the Alaska Departments of Fish and Game and Transportation surveyed all culverts on state roads in the Copper River watershed and determined 64% of them were inadequate for passing juvenile fish at all flows. With the potential for a single failed culvert to block miles of upstream spawning and rearing habitat and limit productivity of that fish stream, the Copper River Watershed Project (CRWP) and partners saw a need for evaluating which culverts should be replaced first to achieve the maximum benefit for fish habitat in relation to the anticipated cost of replacing a given culvert.

Since 2008, CRWP has coordinated the development of a culvert-ranking protocol that factors in ecological and culvert conditions, assigning point values for each category. By identifying poorly functioning culverts on high quality fish habitat, we are able to identify priority restoration projects that maximize the benefit for fish and use limited resources efficiently. These scores, additional data, and photographs are made readily available in an online fish passage mapper for the Copper River watershed, https://copperriver.org/wp-content/uploads/CRWP_CulMapper/.

CRWP convenes a fish passage working group twice each year to review high priority sites and coordinate on specific restoration projects. We will provide an overview of restoration successes as a result of this prioritization, as well as discuss future goals and challenges to maintaining fish passage in the dynamic Copper River watershed.

Salmon Blitz: Engaging Citizen Scientists in Documenting Salmon Habitat in the Copper River Watershed

Kate Morse
Copper River Watershed Project, Cordova, AK, USA, kate@copperriver.org
Kirsti Jurica
Copper River Watershed Project, Cordova, AK, USA, juricaka@gmail.com
Richard Brenner
Alaska Department of Fish and Game, Juneau, AK, USA, Richard.brenner@alaska.gov

---

An understanding of Pacific salmon habitat use at all life stages is necessary to protect and sustain Alaska's wild salmon populations. Alaska Department of Fish and Game's (ADF&G) Anadromous Waters Catalog (AWC) is used to document all known rearing and spawning habitat of anadromous fish. However, due to the vast number of streams in Alaska and limited resources, not all salmon streams are currently listed or have detailed information about their use by life stage.

The Copper River Watershed Project worked with ADF&G and other partners throughout the watershed to develop and implement Salmon Blitz, a citizen science program designed to engage community volunteers in collecting stream and fish biology data needed to nominate additional habitats or provide more spatial and temporal detail to the AWC. This project provides data used for salmon management and hands-on learning opportunities for participants. By connecting people with their surroundings and deepening their understanding of the resources on which they depend, we instill a greater sense of engagement and responsibility for the long-term health of the region's salmon.

Over the course of four field seasons, over 450 volunteers completed 98 surveys at 80 sites, resulting in 36 nominations. Nominations included 44.7 new stream kilometers and 221 acres of new lakes and wetlands. New species or life stage designation was added to 51.8 kilometers of cataloged streams. With 100% of nominations accepted by ADF&G, Salmon Blitz demonstrates the effectiveness of citizen science for collecting quality data to inform salmon management efforts in Alaska.

Baseline Water Quantity and Quality Sampling of Three Small Streams Near Cordova, Alaska

Jimmy Paley
Department of the Environment and Natural Resources, Native Village of Eyak, Cordova, AK, james.paley@eyak-nsn.gov

John Whissel
Department of the Environment and Natural Resources, Native Village of Eyak, Cordova, AK, john.whissel@eyak-nsn.gov

---

Baseline water quantity and quality sampling of three small streams that cross Whitshed Road in Cordova, Alaska, began in 2015. Due to the development of the Hartney Bay subdivision in 2011, concerns were that the new development could impact natural processes of the relatively small watersheds on the north slopes of the Heney Range. Heney, Nicholet, and Hartney Creeks have been identified as high priority for sampling efforts.

These small streams flowing down the slopes of the mountains through the marshlands, and emptying back into Orca Inlet support modest runs of pink (*Oncorhynchus gorbuscha*), chum (*O. keta*), and coho (*O. kisutch*) salmon and a number of resident species such as cutthroat trout (*O. clarkii*) and Dolly Varden (*Salvelinus malma*). Many local residents use this area for the harvest of fish and wildlife. Native Village of Eyak upholds their tribal resolution to protect the wild resources on which they have relied historically for traditional and cultural practices and subsistence.

This Bureau of Indian Affairs–funded project has been initiated to gather aquatic data to be used as information leading to an instream flow reservation through the State of Alaska. As the subdivision grows, this project will ensure that adequate water quantity and quality will be maintained in the small streams to support the existing flora and fauna. A water gauging site has been installed in Heney and Hartney Creeks, discharge measurements have been periodically conducted according to USGS protocols, and water quality sampling is currently being initiated.

Inriver Abundance, Size, and Migratory Timing of Copper River Chinook Salmon and an Overview of New Technology Available for Monitoring Chinook Salmon Abundance and Distribution within the Copper River Watershed

Matt J. Piche
Native Village of Eyak Department of the Environment and Natural Resources, Cordova, AK, USA, matt.piche@eyak-nsn.gov

Inriver abundance estimates provide a management tool for tracking inter-annual fluctuations in salmon populations. The Native Village of Eyak has collected 15 years of inriver abundance estimates for returning adult Copper River Chinook salmon. This monitoring program has provided valuable management data used in the post-season derivation of systemwide escapement and total returning run size. Deployment of research fish wheels and mark-recapture techniques have effectively established a long-term baseline data set to build upon. This presentation will discuss trends in annual abundance, length measurements and migratory timing, while introducing new monitoring technology being investigated for use in determining the inriver abundance and distribution of Copper River Chinook salmon.

Influence of Water Temperature on Synchrony Spawning, Hatching, and Emergence of Coho Salmon on the Copper River Delta

Emily Y. Campbell
Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR, embug50@gmail.com

Gordon H. Reeves (presenter)
US Forest Service, Pacific Northwest Research Station, Corvallis, OR, greeves@fs.fed.us

Jason B. Dunham
US Geological Survey, Forest and Rangeland Ecosystem Science Center, Corvallis, OR, jdunham@fs.fed.us

Steven M. Wondzell
US Forest Service, Pacific Northwest Research Station, Corvallis, OR, swondzell@fs.fed.us

Water temperature exerts a strong influence on the development rate of eggs, and time of and size at emergence, of Pacific salmon fry. We determined the time of spawning, hatch, and emergence, and size of fry at emergence of coho salmon in streams with different thermal regimes on the Copper River Delta, Alaska. Study streams included shallow flow paths (primarily surface water), deep flow paths (groundwater), and a combination of these two. Spawning was significantly earlier (mid September–mid October) in the shallow flow path streams compared to streams with groundwater (late November–mid December). Preliminary results indicate that the shallow flow path streams were warmer at the time of spawning but cooler during much of embryo development than the deep flow path streams, whose water temperatures were relatively consistent throughout the year. However, hatching and emergence were synchronous in the study streams even though accumulated thermal units (ATUs) differed. The preliminary results also show that the size of fry at emergence were statistically different among the streams, primarily as result of fish in one shallow flow path stream being smaller than those in the other streams. These patterns are consistent with other studies that examined the influence of water temperature on development of Pacific salmon eggs and suggest that development is temperature specific and populations are adapted to local conditions. The timing of emergence coincides with a period of high productivity of aquatic macroinvertebrates, primarily chironomids, in off-channel habitats used by recently emerged fry, and likely strongly influenced the pattern of synchronization among streams. Changes in water temperature resulting from climate change are likely to be more pronounced in the shallow flow path stream than in the groundwater stream, and thus, there may be more selective pressure on populations in those streams to adapt to the changing environment.

Habitat Utilization and Seasonal Movements of Radio-tagged Coastal Cutthroat Trout (*Oncorhynchus clarkii clarkii*) in the Copper River Delta, Alaska and Application Toward Conservation Management in Degraded Systems

David Saiget
BIOFISH Environmental Consultants, Cordova, AK, USA,
dsaiget@hotmail.com (US Forest Service, retired)

Seasonal migrations of coastal cutthroat trout (*Oncorhynchus clarkii clarkii*) were followed to assess habitat utilization throughout the year. Identification of reproductive, trophic, and refuge habitats is key for conservation management. Protection of seasonal habitats is critical to population persistence.

Radio telemetry was used to track movements of 27 adult coastal cutthroat trout on the Copper River Delta. Tracking of individual fish (272-489 mm fork length) ranged from 6 to 343 days. Freshwater habitats were utilized in all seasons. Residence in overwintering refuge habitats lasted up to six months.

Kelts either remained in their spawning stream for the summer, out-migrated to adjacent freshwater drainages, or out-migrated to estuarine habitats. In late summer and fall, fish were tracked to lakes and ponds where they overwintered and remained until April.

Despite the close proximity to saltwater, movement data indicates the presence of a potamodromous form with migrations occurring entirely within freshwater in addition to an anadromous form, and that both behavioral types may occupy the same habitat during different seasons or may be present in the same habitat at the same time.

Results observed within the pristine un-degraded habitats of the Delta have application toward conservation management in altered degraded systems elsewhere. The preservation of connectivity is critical for fish undertaking seasonal migrations and for completing their life history.

Mainstem rivers are important for not only feeding but as migratory corridors as well. Road culverts that present barriers to migration may affect multiple seasonal life history phases for multiple behavioral types across multiple watersheds.

An Evaluation of Collaborative Salmon Fishery Management in Prince William Sound, Alaska

Tommy Sheridan
Oregon State University, Department of Fisheries and Wildlife, Corvallis, OR, USA, tommysheridan@ymail.com

Collaborative decision-making is often promoted as a means to achieve socially acceptable and enduring solutions to natural resource management issues, and one that holds promise for resolving "wicked" problems. However, success rates for implementation of collaborative recommendations are unknown. The presenter's graduate program explored challenges to collaborative salmon fishery management in Prince William Sound (PWS), Alaska, based on experience made possible through internship service on the Prince William Sound Aquaculture Corporation (PWSAC) Board of Directors, and the Alaska Hatchery Research Project (AHRP) Science Panel. Three constraints to collaborative salmon fishery management in PWS were identified: (1) PWS citizens' mistrust of public managers; (2) recent and ongoing reductions to the State of Alaska's budget; and (3) a lack of individual and organizational capacity among the area's prospective collaborators. The presentation then identifies several broad lessons to consider when collaborating, including: (1) the importance of selecting participants who possess relevant knowledge and who are willing to compromise; (2) an awareness and acceptance of the significant resources and time that collaborations require; (3) the availability of organizational capacity to support these endeavors; and (4) the availability of individuals with the credibility and skills required to effectively lead collaborations. The presentation concludes with some recommendations for the area's fishery participants to consider when attempting collaborations in the future, including resorting to a quasi-traditional top-down management approach should their attempts at collaboration fail.

Hydrologic Regime Changes in a High-latitude Glacierized Watershed under Future Climate Conditions

Melissa M. Valentin
2100 Solutions, Denver, CO, USA, valentin.melissa@gmail.com
Terri S. Hogue
Colorado School of Mines, Golden, CO, USA, thogue@mines.edu
Lauren E. Hay
US Geological Survey, Lakewood, CO, USA, lhay@usgs.gov

A calibrated conceptual glacio-hydrological monthly water balance model (MWBMglacier) was used to evaluate future changes in water partitioning in a high-latitude glacierized watershed in southcentral Alaska under future climate conditions. The MWBMglacier was previously calibrated and evaluated against streamflow measurements, literature values of glacier mass balance change, and satellite-based observations of snow covered area, evapotranspiration, and total water storage. Output from five global climate models representing two future climate scenarios (RCP 4.5 and RCP 8.5) was used with the previously calibrated parameters to drive the MWBMglacier at 2 km spatial resolution. Relative to the historical period 1949-2009, precipitation will increase and air temperature in the mountains will be above freezing for an additional two months per year by mid-century which significantly impacts snow/rain partitioning and the generation of meltwater from snow and glaciers. Analysis of the period 1949-2099 reveals that numerous hydrologic regime shifts already occurred or are projected to occur in the study area including glacier accumulation area, snow covered area, and forest vulnerability. By the end of the century, Copper River discharge is projected to increase by 48%, driven by 21% more precipitation and 53% more glacial meltwater (RCP 8.5) relative to the historical period (1949-2009).

Toward More Integrated Salmon Knowledge Systems

Ian Dutton
Nautilus Impact Investing, Anchorage, AK, USA, ian@nautilusii.com

Madeline Jovanovich
College of Fisheries and Ocean Sciences, University of Alaska Fairbanks, Fairbanks, AK, USA, mjovanovich@alaska.edu

Jorge Cornejo-Donoso
NCEAS, University of California, Santa Barbara, Santa Barbara, CA, USA, cornejo@nceas.ucsb.edu

Sarah Warnock
Nautilus Impact Investing, Anchorage, AK, USA, sarah@nautilusii.com

---

The state of Alaska's Salmon and People (SASAP) is multi-institution initiative that seeks to provide an up-to-date interdisciplinary perspective on Alaska's salmon systems and the people who rely on them.

Alaska salmon management has a firm science foundation, but it can be difficult for stakeholders of Alaska's salmon system to readily access up-to-date, accurate and integrated information. Existing information is often fragmented and lacks a significant body of indigenous knowledge. In addition, knowledge gaps can leave salmon stakeholders inadequately informed about the status of salmon populations and habitats as well as options to address the increasing pressures on salmon systems. Information asymmetries can undermine the stakeholders' ability to equitably and knowledgeably participate in the management processes.

The SASAP project connects knowledge across disciplines and agencies, between cultures and users, and across regions to create new institutional capacity that allows the generation of interdisciplinary salmon knowledge and establish a foundation for integrated knowledge that can be built on over time. This presentation describes the SASAP process and intended outcomes, and seeks audience input on how best to share SASAP information with salmon stakeholders in the Copper River Delta and surrounding salmon systems.

Further details of working group membership and interim progress are available at https://alaskasalmonandpeople.org/.

Examining Indirect Indicators of Moose Productivity on the Copper River Delta

Charlotte Westing
Alaska Department of Fish and Game, Cordova, AK, USA, charlotte.westing@alaska.gov

Moose are an iconic animal of the Copper River Delta (CRD). However, until about 70 years ago, the convergence of glaciers prevented the expansion of moose into what was then tidally influenced saltwater marsh. From 1949 to 1958, 24 bottle-reared moose calves were released on the western CRD. The 1964 Good Friday Earthquake uplifted the area 1.8-3.4 meters and changed the habitat to supertidal wetland that is increasingly dominated by willow and alder. Meanwhile, glaciers on the Copper River significantly receded and moose have been observed moving down the Copper River. Genetic data confirmed that the population contains more genetic diversity than the populations from which it was founded, further supporting that moose on the CRD are most likely not isolated.

Since the initial introduction, the population has grown and spread eastward. Recent surveys estimate 600 moose residing on the west CRD. Numerous metrics including population densities, twinning surveys, browse utilization rates, rump fat depths, and calf recruitment surveys suggest that the population of moose on the west CRD is highly productive. This productivity is also reflected in population trajectory despite aggressive harvest rates overall and on cows.

I will summarize the techniques we have used to monitor moose populations and the results that have come from these efforts. I will also compare these results with other seemingly less productive populations.

Copper River Delta Moose Herd Genetics

John C. Whissel
Department of the Environment and Natural Resources, Native Village of Eyak, Cordova, AK, USA
Clinton W. Epps
Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR, USA
Rachel S. Crowhurst
Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR, USA
Dana M. Sanchez
Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR, USA

We estimated the genetic diversity of the Copper River Delta (CRD) moose population (Game Management Unit or GMU 6), using 14 microsatellite loci using tissue samples from hunter-harvested animals, compared genetic diversity of this population to other nearby populations (GMUs 5 and 13), and tested whether any recent gene flow has occurred between moose in GMU 6 and GMUs 5 and 13. We found no evidence of strong inbreeding in any GMU; GMU 6 showed no signal of inbreeding at all. GMU 13 had higher genetic diversity than GMU 6 and GMU 5, but genetic diversity of GMUs 5 and 6 did not differ. Thus, despite the potential for a genetic bottleneck created by the relatively small number of founding individuals in the introduction of the CRD moose population, genetic diversity in GMU 6 did not appear to be lower that of some native moose populations.

Genetic assignment tests indicated that at least one individual sampled in GMU 5 likely originated in GMU 6, and indicated the potential for gene flow to have occurred recently between GMU 6 and GMU 13, but the strength of that conclusion varied across analyses.

Nonetheless, these findings suggest that gene flow between the CRD moose population and nearby GMUs has occasionally occurred, whether by natural movements or through additional introductions by humans, suggesting that potential dispersal routes should be investigated. Tests for genetic bottlenecks were inconsistent across methods but GMU 6 showed the least evidence for a bottleneck of the three GMUs considered.

Terrestrial Invasive Plants of the Copper River Watershed

Chantel Adelfio
Copper River Watershed Project, Cordova, AK, USA, chantel@copperriver.org

The Copper River Watershed Project (CRWP) works with a wide range of partners to survey and treat invasive plants across property boundaries of the Copper River Watershed. Terrestrial invasive plants in this area are heavily spread by vehicles, ATVs, and movement of soil and gravel. The city of Cordova and the Copper River Delta (CRD) have fewer incidents of introduced terrestrial plant species, compared to areas along the Alaska road system. Currently, there is one terrestrial invasive plant found on the CRD, a sparse population of *Phalaris arundinacea* (reed canary grass).

The CRWP is currently working with partners to monitor and control likely pathways of introduction to the CRD. Our control efforts are focused in Cordova, Whittier, Valdez, and riparian zones of the upper Copper River. High priority species in the area are able to establish populations in riparian zones and alter sedimentation rates in rivers (e.g., reed canary grass and white sweet clover), spread rapidly and shade native plants (e.g., bird vetch), and alter soil conditions (e.g., orange hawkweed). The CRWP uses a combination of mechanical and chemical control methods to treat terrestrial invasive plants in and surrounding the CRD.

Delta Restoration Team: A Collaborative Stewardship Camp

Lauren Bien
Prince William Sound Science Center, Cordova, AK, USA, lbien@pwssc.org

In summers of 2016 and 2017 local and non-local youth participated in the Prince William Sound Science Center's Delta Restoration Team, nicknamed DRT camp. These camps, for middle and high schoolers, focused on restoration projects, leadership development, and ecosystem stewardship. In close partnership with the US Forest Service Cordova Ranger District, DRT campers restored nest islands for Dusky Canada Geese, improved overwintering habitat for juvenile salmonids, revegetated and stabilized eroding stream banks, and much more.

The goal of the camps was to involve youth in service learning, inspire youth through leadership-building activities, and guide them to understand and appreciate their role in one of Alaska's most notable ecosystems, the Copper River Delta. While campers were not setting fish traps to monitor abundance or rebuilding damaged bridges on recreational trails, they worked together on team and leadership building exercises and discussed what it means to be a good steward. The ideas discussed and techniques practiced throughout camp experiences, are ideals the campers will return home with and hopefully carry for the rest of their lives. The Copper River Delta is an idyllic outdoor learning environment and an inspiring setting for aspiring young stewards. The conservation, educational, and recreational activities in DRT Camp will help create our next generation of ecosystem stewards and future public land users and leaders. One camper wrote in his journal, "I love this experience and I can definitely see myself doing these activities as a job."

Will Tree Removal Benefit Duskys on the Copper River Delta, Alaska?

Nicholas R. Docken
US Forest Service, Cordova Ranger District, Cordova, AK, USA, ndocken@fs.fed.us
Brandt Meixell
US Geological Survey, Alaska Science Center, Anchorage, AK, USA, bmeixell@usgs.gov
Melissa L. Gabrielson
US Forest Service, Cordova Ranger District, Cordova, AK, USA, melissalgabrielson@fs.fed.us

---

The Dusky Canada Goose (*Branta canadensis occidentalis*) population breeds primarily on the Copper River Delta in southcentral Alaska. Habitat changes created by uplift from the 1964 earthquake have caused drastic population declines. Most of these population declines have been due to increased predation pressure. Prior studies have indicated that Bald Eagles (*Haliaeetus leucocephalus*) are the main predator of nesting duskys. The USFS is proposing to remove mature cottonwood (*Populus trichocarpa*) and Sitka spruce (*Picea sitchensis*) trees in high density dusky nesting habitat along the Alaganik River. This will be completed within a localized area to determine if eagles will disperse, increasing dusky nest success.

A treatment and control study design will be established. Comparable habitat, eagle abundance, and dusky nesting density will be used to evaluate the effectiveness of the study. Tree removal will take place during the fall of 2018. Eagle occupancy surveys will be conducted pre and post treatment (spring/summer of 2018 and 2019). Dusky nests will be found and monitored with time-lapse cameras to document predator interactions and determine nest survival (spring 2018 and 2019). Results from this study will help managers and the Dusky Canada Goose Sub Committee of the Pacific flyway make future management decisions.

Red Knot (*Calidris canutus roselaari*) Surveys on the Copper River Delta during Spring Migration

Melissa Gabrielson
Chugach National Forest, Cordova Ranger District, Cordova, AK, USA, melissalgabrielson@fs.fed.us

Erin Cooper
Chugach National Forest, Cordova Ranger District, Cordova, AK, USA

Little is known about the current status of the Red Knot (*Calidris canutus roselaar*i). The Copper River Delta in southcentral Alaska is one of the Western Hemisphere's most important shorebird stopover sites. Recently, thousands of Red Knots were observed on one of the more western barrier islands on the Copper River Delta (i.e., Little Egg Island). This led to questions about the Copper River Delta's importance as a stopover site for Red Knots. In 2013, the Copper River International Migratory Bird Initiative (CRIMBI) funded a small survey that documented the timing of the Red Knot migration and use of the Copper River Delta. In an effort to increase the knowledge about Red Knot stopover sites and use on the Copper River Delta, the 2013 surveys were expanded. Two observers were stationed on Little Egg Island in May 2014 and 2015 to document Red Knot numbers, behavior, arrival times, and departures, and to document flagged individuals. The information collected from this effort will be tied in with other surveys that are being conducted to determine the interconnectedness of the Red Knot and its use of stopover sites along its migration pathway.

Improving Habitat for Moose on the Copper River Delta

Melissa Gabrielson
Chugach National Forest, Cordova Ranger District, Cordova, AK, USA, melissalgabrielson@fs.fed.us

Erin Cooper
Chugach National Forest, Cordova Ranger District, Cordova, AK, USA

James Paley
Native Village of Eyak, Cordova, AK, USA

Matt Piche
Native Village of Eyak, Cordova, AK, USA

John C. Whissel
Native Village of Eyak, Cordova, AK, USA, John.Whissel@eyak-nsn.gov

---

The Copper River Delta (CRD) is continuing to undergo successional changes since the 1964 earthquake. The earthquake uplifted the CRD 1-4 meters initiating changes across the landscape. Vegetation changes observed on the west CRD include an increase in woody species such as Sitka alder (*Alnus crispa*), Sitka spruce (*Picea sitchensis*), and cottonwood (*Populus balsamifera*). Willow (*Salix* spp.) is the predominant diet of moose on the west CRD (Stephenson 1995, MacCracken et al. 1997, Smythe 2015). As the alder, spruce, and cottonwood increase, willow species may decrease, reducing favorable moose browse throughout the winter range for moose and hindering moose population performance (MacCracken et al. 1997, Stephenson et al. 2006, Smythe 2015). The moose winter range improvement project was a collaborative effort between the Native Village of Eyak, the Eyak Corporation (TEC), and the US Forest Service (USFS), Cordova Ranger District. The goal of this project was to improve moose winter forage through a vegetation treatment plan that encompassed both Native and federal lands on the west CRD. Managing vegetation communities transitioning from willow to spruce/alder promotes additional willow growth, an aggressive colonizer of open areas, and increases winter forage to support a healthy population of moose on the west CRD. Approximately 817 total acres were treated mechanically by hydroaxe on the west CRD to improve moose winter range habitat on USFS and TEC land.

Integrating Traditional Ecological Knowledge, Archaeological Data, and Cultural Values into Environmental Research and Management of Eyak Lake

David Guilfoyle
Applied Archaeology International, Girdwood, AK, USA, dg@appliedarchaeology.com.au
Jen Smith
University of California, Berkeley, CA, USA, j.smith@berkeley.edu
Genevieve Carey
Applied Archaeology International, Missoula, MT, USA, genevievercarey@gmail.com

---

This poster introduces a community-developed program that aims to demonstrate the critical need to integrate heritage and culture into any environmental research or land management project. We examine the structures and processes that have formed over the last two years for establishing a community-based program of cultural heritage management for Eyak Lake. We note the existing, potential, and multilayered outcomes this program provides for land managers and researchers. This includes a means for understanding cultural protocols, integrating traditional ecological knowledge and archaeological information into current data-sets for more effective management, as well as guiding research studies and on-ground management actions in ways that provide mutually beneficial social and educational outcomes.

The Barrier Islands of the Copper River Delta: Monitoring a Unique System

Cody Davis, Robert Masolini, Christina Rinas, Matt Prinzing, Nick Docken, and Melissa Gabrielson

Chugach National Forest, Cordova Ranger District, Cordova, AK, USA, melissalgabrielson@fs.fed.us

The barrier islands of the Copper River Delta (CRD) region preserve a unique, shifting island system that provides important habitat for sensitive waterfowl species and rare plant communities. Barrier islands are an uncommon landscape feature, occurring across less than 10% of the world's coastlines (Schwartz 1973). Barrier islands along the Pacific Coast are particularly rare. The CRD contains some of the most well-developed barrier islands on the North Pacific coast (Hayes and Kana 1976).

Due to the unique status and importance of the CRD barrier islands, monitoring the extent and impact of human activities is imperative. With the addition of subsistence hunting and egg collecting permits, it is anticipated that all-terrain vehicle use on the islands will increase. Several surveys were conducted during the summer of 2016 to determine the effects of motorized vehicle use on important bird habitat and vegetation communities on the barrier islands. The results of these surveys will help US Forest Service managers make future recommendations for this area.

Zooplankton Abundance and Community Composition at the Mouth of the Copper River

Caitlin McKinstry
Prince William Sound Science Center, Cordova, AK, USA, cmckinstry@pwssc.org
Rob Campbell
Prince William Sound Science Center, Cordova, AK, USA

In the northern Gulf of Alaska, large lipid-rich copepods constitute the majority of zooplankton biomass during the critical grazing period of the spring phytoplankton bloom. Forage fishes, marine mammals, seabirds, and economically important fishes rely on this profusion of energy to grow and reproduce. Little information exists regarding abundance of other zooplankton species or shifts in zooplankton community structure throughout the year near the nutrient rich waters that occur at the mouth of the Copper River. During the spring and summer months of 2010-2013, biological and oceanographic measurements were collected via CTD casts, nutrient samples, extracted chlorophyll *a* samples (as a proxy for phytoplankton), and vertical zooplankton tows (with a 0.6 m bongo net with 202 micrometer mesh) to assess trophic dynamics of this region. Station depth ranged from 4 to 150 m at four transects located along the coastal shelf between Hinchinbrook and Kokenhenik Islands. Zooplankton samples were analyzed for species composition and species abundance (no. per m^3). These data were analyzed using multivariate methods including hierarchical cluster analysis, indicator species analysis, and non-metric multidimensional scaling to illustrate the seasonality of zooplankton communities in the region. Generalized additive models were used to illustrate overall seasonal abundance. The results of these analyses indicate when and where the most energy rich zooplankters (e.g., *Neocalanus* spp.) occur. Variation in abundance and timing of zooplankton aggregations could have cascading energetic consequences for zooplanktivorous predators, specifically forage fishes that constitute the diet of economically important fishes including king salmon (*Oncorhynchus gorbuscha*).

Aquatic Invertebrate Communities on Invasive and Native *Elodea canadensis*

Jennifer Piacente
Department of Biology, Loyola University Chicago, Chicago, IL, USA, jpiacente@luc.edu
Chantel Adelfio
Copper River Watershed Project, Cordova, AK, USA, chantel@copperriver.org
Martin B. Berg
Department of Biology, Loyola University Chicago, Chicago, IL, USA, mberg@luc.edu

Aquatic invasive species can have negative effects on the environment, economy, and human health, and therefore have become a global concern. The aquatic macrophyte, *Elodea canadensis* (Canadian waterweed), is a successful invader around the world and its presence in Alaska coastal wetlands, particularly the Copper River Delta (CRD), has raised considerable concern because of the threat it poses to the suite of ecosystem services provided by CRD wetlands. One of the hypotheses proposed for the success of aquatic invasive plants in naïve systems is the absence of herbivory. The goal of this study was to compare aquatic invertebrate communities associated with *E. canadensis* in areas where the macrophyte is native (Illinois) and invasive (CRD). Aquatic invertebrates were sampled monthly during the growing season in 2016 and 2017 from monotypic beds of *E. canadensis* in four CRD ponds (2016) and in four Illinois ponds (2017). Aquatic invertebrate abundance and species richness were higher in *E. canadensis* beds from native ponds than invaded ponds. Although non-biting midges (Diptera: Chironomidae) were the numerically dominant insects in E. canadensis beds from both native and invaded ponds, Chironomidae abundance was significantly higher in *E. canadensis* beds from native ponds. Densities of taxa commonly associated with vascular hydrophytes also were significantly greater in native ponds. Many of these taxa, such as *Oxyethira* (Trichoptera), *Haliplus* (Coleoptera), and Amphipoda (Crustacea), feed on aquatic macrophytes and their absence in invaded ponds may contribute to the proliferation of *Elodea* on the CRD.

Mussel Sampling Results within the Cordova Harbor

Ivy Patton
Native Village of Eyak, Cordova, AK, USA

The blue mussel, *Mytilus trossulus*, was selected for the Cordova Clean Harbor monitoring plan because it is an important indicator species. Mussels are filter feeders that take up contaminants readily and are an important subsistence food for humans, seabirds, and sea otters. From 2014 to 2016, mussels were collected biannually from the Cordova Harbor in accordance with the NOAA mussel watch program during low tide within the harbor. Samples were sent to NOAA Auke Bay Laboratories in Juneau for analysis.

Mussel tissues were extracted and analyzed for polycyclic aromatic hydrocarbons (PAHs) and alkanes. Total PAH (TPAH) concentrations in mussel tissues within the Cordova Harbor had significantly greater levels than at nearby locations. The composition was mixed, suggesting two different contaminant sources (petrogenic and pyrogenic). The most likely sources are unburned fuel in water (petrogenic), and burned fuel and creosote pilings (pyrogenic).

Incorporating Environmental Change in Planning for Healthy Coastal Ecosystems and Economies

Audrey Taylor
Department of Geography and Environmental Studies, University of Alaska Anchorage, Anchorage, AK, USA

Marty Berg
Department of Biology, Loyola University Chicago, Chicago, IL, USA

Gary Lamberti
Department of Biological Sciences, University of Notre Dame, South Bend, IN, USA

Gordon Reeves
US Forest Service, Pacific Northwest Research Station, Corvallis, OR, USA

Carmella Vizza
Department of Biological Sciences, University of Notre Dame, South Bend, IN, USA

Jillian Jablonski
Department of Geography and Environmental Studies, University of Alaska Anchorage, Anchorage, AK, USA

Sam Wilkinson
Department of Biology, Loyola University Chicago, Chicago, IL, USA

The effects of climate change on coastal environments may impact provision of ecosystem services, especially in Alaska where climate change is predicted to be amplified compared to temperate regions. This project is investigating how two predicted consequences of climate change, increasing water temperatures and *Elodea* invasion, influence components of the coastal pond ecosystem fringing the Copper River Delta (CRD). This information is critical to understanding the dependability of nature-based tourism opportunities in the nearby coastal community of Cordova, Alaska, which relies on ecosystem services provided by the surrounding natural landscape for diversification of its traditional commercial fishery-based economy. To date, we have completed fieldwork for this project and are analyzing water and sediment chemistry, ecosystem metabolism, aquatic invertebrate community structure and secondary production, and waterbird responses to both the temperature gradient and the variability in *Elodea* cover across 16 ponds on the CRD. In our poster, we provide background on the project and information on progress on these analyses, as well as a roadmap for the project over the next year. A companion oral presentation given by Jillian Jablonski will present preliminary results of the waterbird component of the project.