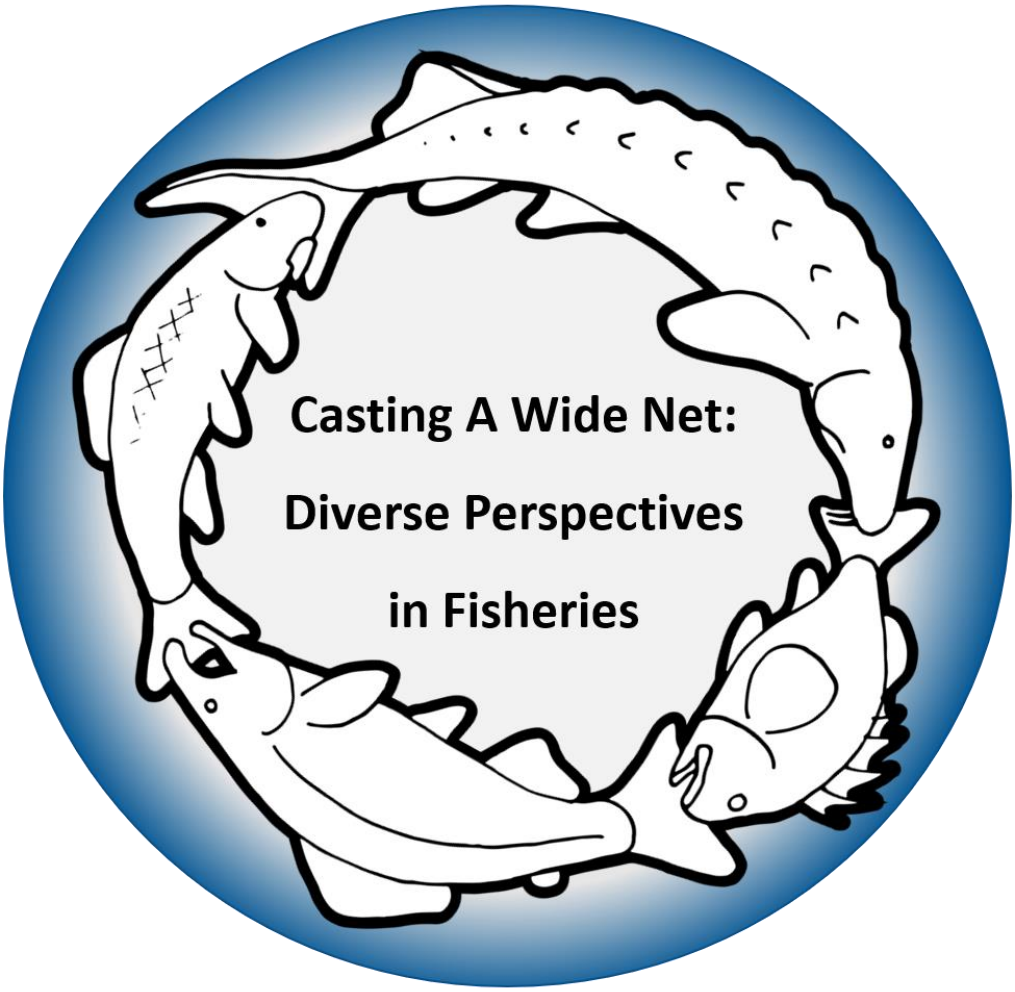

55th Annual
Cal-Neva AFS Meeting
Virtual
March 1-4, 2021

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Schedule in Brief

Time	Event
Ongoing	Spawning Run
Monday March 1, 2021	
8:00 am – 12:00 pm	Continuing Education – Endangered Species Act
1:30 pm – 2:00 pm	Introductory Remarks & Dedication
2:00 pm – 4:00 pm	Plenary Session – "Casting a Wide Net"
4:00 pm – 5:00 pm	Welcome Social
Tuesday March 2, 2021	
8:00 am – 12:00 pm	Continuing Education – Endangered Species Act
1:00 pm – 2:30 pm	Student Symposium I
2:30 pm – 4:00 pm	Technical Session I
4:00 pm – 5:00 pm	Poster Session
Wednesday March 3, 2021	
8:00 am – 12:00 pm	Continuing Education – Practical Statistics in R
12:00 pm – 1:00 pm	Cal-Neva Chapter Business Meeting
1:00 pm – 2:30 pm	Student Symposium II
2:30 pm – 4:00 pm	Technical Session II
4:00 pm – 5:00 pm	Student-Mentor Social
Thursday March 4, 2021	
8:00 am – 12:00 pm	Continuing Education – Practical Statistics in R
1:00 pm – 2:30 pm	Technical Session III
2:30 pm – 4:00 pm	Technical Session IV

President's Message

Welcome to the 55th Annual Meeting of California-Nevada Chapter of the American Fisheries Society

A Virtual Experience

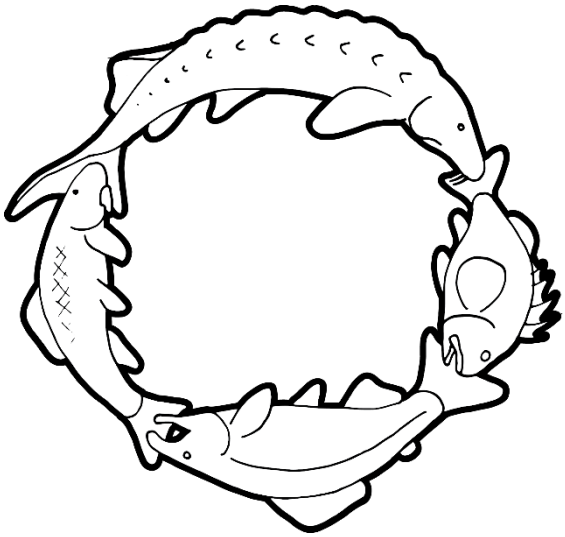
Almost a year ago, I had been leading a great team of Cal-Neva volunteers to plan our 54th Annual Meeting in Folsom. This meeting was shaping up to be a smaller event than we are accustomed to at Cal-Neva as it was coming a short six months after one of the largest gatherings of Fish and Wildlife professionals at the joint AFS-TWS meeting in Reno in October 2019. It was then the pandemic took over and forced the cancellation of our meeting in Folsom. Lots of hard work lost an outlet. Lots of disappointment. But the seriousness of the circumstances required that change.

One of the most important functions of Cal-Neva AFS is to offer our members this annual opportunity to share our work, our contributions to science and fisheries management and to provide the venue to connect with our colleagues, renew our friendships and acquaintances, see each other, and make new connections. A few weeks after the Folsom meeting was cancelled a dozen Cal-Neva members gave their talks and posters in the AFS Virtual Spring Conference (you can still find their presentations on the AFS website). All of us have had to make these virtual adjustments to our everyday lives. Now we are inviting all of Cal-Neva to this virtual gathering to continue our tradition of sharing science, information, and connection. I am grateful for the hard work and efforts of our Program Chair, Matt Young, and our planning team. They have developed the annual meeting using new methods and facing different challenges than our normal in-person meetings. It's a different experience in the virtual platform but there will still be opportunities to see and talk to our AFS colleagues. The Cvent platform will provide our continuing education, plenary, and technical sessions. We will have opportunity for social gatherings and the poster session using the Spatial Chat platform. Come join us there.

This year's meeting also gives us opportunity to honor people who have made significant contributions to Cal-Neva. Two of Cal-Neva's past Presidents passed away this year—Cay Goude and Larry Brown. Both Larry and Cay were great supporters of our chapter, made big impacts on Cal-Neva, and will be dearly missed.

Dave Lentz, Cal-Neva President, a year into the pandemic… It has been said that his barber really misses him.

Dave Lentz
President, California-Nevada Chapter of AFS



Casting a Wide Net: Diverse Perspectives in Fisheries

Conferences such as this provide an important forum for scientists to share their research, educate one another, inspire one another, and discuss the past, present, and future of fisheries. Issues related to fisheries encompass many societal values, including subsistence, recreation, and conservation. It is important that we, as fisheries scientists, managers, and enthusiasts, focus on the wide-ranging relationships between fisheries and society, and how we can better meet the needs of society by maintaining and fostering a diversity of perspectives.

If we do not effectively incorporate diverse perspectives and reach out to diverse communities and stakeholders, then effective and inclusive science-based policy will likely remain an ideal, rather than reality.

Planning Committee

Planning Committee Chair

Matt Young

Fundraising and Donations

Andrew Hampton

Digital Communications

Lisa Thompson

Student Presentation/Poster Judging

Ramona Swenson

Budget and Finance

Matt Young, Jose Setka

Poster Session

Nicole Kwan

Continuing Education/Workshops

Zachary Bess

Student Symposium Coordinator

Kat Dale

Merchandise & Charity Coordination

Christina Parker

Spawning Run

Nicole Kwan

Student-Mentor Social

Ramona Swenson, Kat Dale

Welcome Social Coordinator

Dave Lentz, Lisa Thompson

Student Awards

AFS Student Oral Presentation and Poster Competition

The Student Oral Presentation and Poster judging competition at the 55th Annual Meeting of the AFS California-Nevada Chapter is being organized and presided over by the Northern California District of the American Institute of Fishery Research Biologists (17th straight year!). Oral presentations will be judged during the Student Symposium, to be held the afternoon of Tuesday March 2nd and Wednesday March 3rd. Poster presentations will be judged during the Poster Session, held the afternoon of Tuesday March 2nd.
Student presentations and posters will be in the running for cash prize awards; including $150 for Best Student Presentation, $100 for Best Student Presentation– Runner up, and $50 for third place. The award winners will be announced on the conference website.

Prospective judges for both competitions please contact Tom Keegan (TomK@helixepi.com) prior to the meeting. Judging forms will be provided as a link via email.

Katrina Martens Poster Award

Cramer Fish Sciences is honored to present a $200 award for the Student Poster that best commemorates the qualities and memory of Katrina Martens (09/14/1989 – 12/12/2014).

The CFS Poster Award will be judged and presented separately from the AFS Best Student Poster Award. Special consideration will be given to those who exhibit novel research ideas, innovation, and creative methodology.

Sponsors and Donors

Many thanks to our generous donors and supporters

Sturgeon

Chinook

Plenary Speakers

Erika Zavaleta, Ph.D

Professor, University of California, Santa Cruz (UCSC)

Erika Zavaleta is Professor of Ecology and Evolutionary Biology at the University of California, Santa Cruz (UCSC), where she helped found the Coastal Science and Policy graduate program and runs the Doris Duke Conservation Scholars Program and the Center to Advance Mentored, Inquiry-based Opportunities (CAMINO). Erika joined the faculty in 200 3 and has since partnered on projects with scientists, farmers, hunters, ranchers, Indigenous groups, conservation organizations, state and federal agencies and private foundations. Erika won the 2007 Ecological Society of America (ESA) Sustainability Science Award for work on community responses to climate change in Alaska's boreal forests. She co-edited the book Ecosystems of California, which in 2017 won a California Book Award, and its partner Guide for Policymakers volume, which brought together hundreds of experts across the state in every aspect of ecology and stewardship. Erika serves on boards for the Wildlife Conservation Society and the Society for Conservation Biology and is a Fellow of the California Academy of Sciences. Her favorite pastime is exploring the outdoors with family, friends and her students.

John McManus

President, Golden State Salmon Association

GSSA president John McManus is a long-time salmon fisherman and salmon advocate. He comes from a varied background that includes ten years of commercial salmon fishing in southeast Alaska, 15 years producing news for CNN and more recently, 11 years doing publicity and organizing for the public interest environmental law firm Earthjustice. Work at Earthjustice included organizing and publicity supporting restored salmon fisheries in the Columbia, Klamath and Sacramento rivers.

The Golden State Salmon Association (www.goldenstatesalmon.org) is a coalition of salmon advocates that includes commercial and recreational salmon fisherman, businesses, restaurants, a native tribe, environmentalists, elected officials, families and communities that rely on salmon.

GSSA's mission is to restore California salmon for their economic, recreational, commercial, environmental, cultural and health values.

Alexis Jackson, Ph. D

Fisheries Project Director, California Chapter of The Nature Conservancy

ALEXIS JACKSON serves as a Fisheries Project Director for the Oceans Program of the California Chapter of The Nature Conservancy. At TNC, Alexis leads a team focused on reducing the global bycatch of swordfish fisheries through demonstrating the ability of low bycatch gears to support economically viable fisheries in California and in other major swordfish producing countries along the eastern Pacific Ocean. She also serves as an ocean policy lead, working closely with State agencies, Commissions, and the California Legislature to ensure the adoption of policies that reduce plastic pollution and advance climate-readiness in state fisheries management.

Prior to joining TNC, Alexis worked for NOAA Fisheries and Pew Charitable Trusts where she gained extensive experience in state, Federal, and international fisheries policy and negotiations related to sustainable management of highly migratory species (e.g. sharks, tuna, swordfish). Her past research has primarily focused on application of conservation genetics data to inform fishery management strategies and regulatory processes for commercially important fish and invertebrate species. Alexis holds a B.S. in Ecology and Evolutionary Biology from Yale University and an M.A. and Ph.D. in Ecology and Evolutionary Biology from University of California Santa Cruz.

When she's not at work, Alexis enjoys the performance arts. She takes Modern and contemporary dance classes, supports regional theater, and in the past has performed with Konjo African dance troupe and DIASPORA dance company.

Kenneth Gobalet, Ph. D

Professor Emeritus, California State University, Bakersfield (CSUB)

Kenneth Gobalet completed his undergraduate and graduate degrees in Zoology at the University of California at Davis. His doctoral project was on the morphology of the bone-muscle systems of the parrotfish head. Between his undergraduate and graduate studies (1969-1971), he was an American Peace Corps Volunteer in Central India working to enhance the production of a fish farm. In 2013, he retired from his academic career as a Biology Professor at California State University, Bakersfield where his primary responsibility was teaching and the bulk of his research was the identification and analysis of fish remains recovered from archaeological excavations in California. This scholarship began when he was a graduate student in the 1970s and documents the Native American use of the local fishes as well as their distribution prior to the arrival of Europeans. To complete this work, he amassed a fish skeletal collection numbering in the hundreds of specimens and he has around 50 publications in peer-reviewed journals and uncounted scores of reports buried in gray literature archaeological reports. The collection has recently been donated to the Ichthyology Department of the California Academy of Sciences and he borrows the skeletons to provide comparative materials for his work at home.

Continuing Education

Navigating the Endangered Species Act – Monday March 1 and Tuesday March 2

INSTRUCTOR: Charlotte Ambrose (charlotte.ambrose@noaa.gov)
National Marine Fisheries Service

Description

This course will provide a history and overview of the Federal Endangered Species Act (ESA) with a focus on the major sections of the federal ESA that govern federal listings, recovery planning, habitat conservation plans, safe harbor agreements, interagency consultations, science and enhancement permits, and enforcement. Case studies will be presented on several topics and an ESA handbook will be provided to all participants. Instructors: Charlotte Ambrose has worked for NOAA Fisheries over 20 years and is currently the California Programs Coordinator stationed in Sacramento. She acts as a statewide liaison for NOAA Fisheries on salmon and steelhead programs and initiatives of statewide or regional significance. Charlotte recently served in the capacity of Recovery Coordinator responsible for developing and implementing federal recovery plans for California Central Coast Coho Salmon, Chinook Salmon and steelhead. She has a Bachelor of Science degree from the University of Georgia and experience in both the public and private sectors. Charlotte is most recognized for her leadership working with the California Board of Forestry to improve forest practice regulations for the benefit of salmonids and their habitats. Amanda Cranford has worked for NOAA Fisheries for just over 5 years and is currently a Natural Resource Management Specialist stationed in Sacramento, California. In her current role, Amanda serves as the Central Valley Hatchery Coordinator, assisting with the development of Hatchery and Genetic Management Plans (HGMPs) and the associated permitting for anadromous hatchery programs throughout the Central Valley. Amanda is also the Central Valley point-of-contact for research and enhancement permits and acts as a liaison to NOAA Fisheries Protected Resources Division staff who issue and oversee the majority of the research permits in California. She has a Bachelor of Science degree in Wildlife, Fish, and Conservation Biology from the University of California, Davis and has experience working for both state and federal natural resource agencies, including time as a contractor. Amanda's recent accomplishments include being the recipient of a U.S. Department of Commerce Bronze Medal Award for assisting with the implementation of the Battle Creek Winter-run Chinook Salmon Jumpstart Reintroduction Project. The workshop will host guest speakers on specific topics. Participants with no formal training on the ESA are welcome to attend.

R Introduction – Wednesday March 3 and Thursday March 4

INSTRUCTOR: Kate Crosby (kate@wildlife.ca.gov)
California Department of Fish and Wildlife, Sacramento, CA

This course is designed for participants who wish to gain beginning to intermediate skills in using R for manipulating, visualizing, and analyzing their fisheries data. R is a programming language designed for statistical computing that is open source and free to download. R is a powerful and highly flexible tool for graphical display, data configuration, and statistical analysis. Today, R is one of the most widely used statistical software across various scientific fields.

The goal of this workshop is to allow the attendees to understand the potential uses of R when working with fisheries and environmental data. Attendees will learn how to sort and aggregate data, create a variety of high quality and easily customizable graphical display, and perform common data diagnostic and statistical tests.

Please note that attendees will need to have access to a laptop with the R software program installed. Instructions on how to download the program will be emailed out prior to the class. If feasible, a second screen is recommended so participants can watch the instructor's presentation and work in R simultaneously. Instructors will also be available to help attendees with the download at the beginning of class if needed.

Plenary Schedule

Monday, March 1st

1:30 pm - 1:40 pm	Welcome & Dedication	Matthew Young, President-Elect, Cal-Neva AFS and Dave Lentz, President, Cal-Neva AFS
1:40 pm - 1:50 pm	WD Perspective	Emily Chen, Western Division AFS Representative
1:50 pm - 1:55 pm	Session Overview	Matthew Young, President-Elect, Cal-Neva AFS
2:00 pm - 2:20 pm		Erika Zavaleta (UC Santa Cruz)
2:25 pm - 2:45 pm		Kenneth Gobalet (CSU Bakersfield)
2:50 pm - 3:10 pm		John McManus (Golden State Salmon Association)
3:15 pm - 3:35 pm		Alexis Jackson (CA Chapter of The Nature Conservancy)
3:40 pm - 4:00 pm		Panel Discussion

Oral Presentation Schedule

TUESDAY AFTEROON ✠ MARCH 2, 2021

Session Name	**Student Symposium I**
Moderator(s)	**Kat Dale**
1:00	Transect sampling promotes higher detection rates compared to discrete sampling for environmental DNA applications **Thiago Sanches**
1:20	Applying empirical dynamic modeling to distinguish abiotic and biotic drivers of population fluctuations in sympatric fishes **Ben Wasserman**
1:40	Contrasting histological, otolith, and genetic indicators of growth and condition in an endangered estuarine fish **Rachel Fichman**
	BREAK
Session Name	**Technical Session I – Habitat Restoration and Prioritization**
Moderator(s)	**Mark Gard**
2:30	Using LIDAR data to address fish passage **Mark Gard**
2:50	Implementation of multi-benefit juvenile salmonid habitat restoration on the Lower Yuba River: The Hallwood Side Channel and Floodplain Restoration Project **April Sawyer**
3:10	Newly constructed urban flood basin can be seasonally suitable for steelhead rearing and primary production of food resources through innovative channel engineering, biological monitoring, and regulatory permitting **Hadley Giebeler**
3:30	Butano Creek Channel Reconnection and Resilience Project **Jai Singh**

WEDNESDAY AFTEROON ✠ MARCH 3, 2021

Session Name	Student Symposium II
Moderator(s)	**Kat Dale**
1:00	Hatchery- versus wild maturation schedules and implications for the ocean salmon fishery **Emily Chen**
1:20	Living on the Edge: Thermal Tolerance of Wild Steelhead Trout at Their Southern Range Limit **Terra Dressler**
1:40	Got to catch them all? Balancing maximizing genetic diversity and sample size in a recruitment-limited population of White Sturgeon (*Acipenser transmontanus*) **Amanda Coen**
	BREAK
Session Name	**Technical Session II – Habitat Restoration and Response in the San Francisco Estuary**
Moderator(s)	**Lisa Thompson**
2:30	Assessing food web response to nutrient supplementation in the Sacramento Deep Water Ship Channel **Joseph Merz**
2:50	Tidal Habitat Restoration at Lower Yolo Ranch **Chris Campbell**
3:10	Tidal Wetland Restoration and Adaptive Management for Delta Fishes **Ramona Swenson**
3:30	Juvenile Salmon Diet and Growth in Marsh Habitat of the San Francisco Estuary **Kelly Neal**

THURSDAY AFTEROON ✠ MARCH 4, 2021

Session Name	Technical Session III – Target Species Management
Moderator(s)	**Nicholas Buckmaster**
1:00	A critical review of temperature guidelines used for 303d listing of steelhead streams in California **Andrew Deines**
1:20	Thinking outside the box: potential approaches to manage non-native species in arid landscapes **Nicholas Buckmaster**
1:40	Something old something new: tested and innovative techniques for salmonid habitat restoration **Avery Scherer**
2:00	Reviewing Long Term Monitoring Programs: A Case Study Using the Yolo Bypass Fish Monitoring Program **Amanda Casby**
	BREAK
Session Name	**Technical Session IV – Anadromous Fish in the Central Valley**
Moderator(s)	**Anna Steel**
2:30	Comparing effects of pyrethroid pesticide exposure between larval Green and White Sturgeon **Anna Steel**
2:50	The return of Chinook Salmon to a restored creek in California's Central Valley **Malte Willmes**
3:10	Evaluating Thiamine Injections in Female Broodstock to Combat Thiamine Deficiency Impacts in Hatchery-Reared Endangered Winter-Run Chinook Salmon **Kaitlin Gooding**
3:30	Adaptive Management: Factors driving returns of hatchery Spring-run Chinook Salmon released in the lower Feather River **Jada-Simone White**

Poster Presentations

Number	Abstract Title	Lead Author
1	Evaluating the impact of the North Delta Flow Action on resident and migratory fishes	Nicole Kwan
2*	How Landscape and Local Factors Influence Juvenile Size in Endangered Coho Salmon and Threatened Steelhead Trout	Sam Rosenbaum
3*	Warming waters and smaller fish: Assessing how temperature impacts body size and shape in a population of Amargosa pupfish	Ashley Del Core
4*	Investigation of a known mortality hotspot for out-migrating juvenile salmon in the Sacramento-San Joaquin River Delta	Amanda Agosta
5*	Molecular evaluation of the mating dynamics of snow crab (*Chionoecetes opilio*) in the eastern Bering Sea	Laura Slater
6*	Impact of Largemouth Bass on an isolated Sacramento Perch Population	Ryan Hitchings
7*	Quantifying diversity if size and timing of outmigration in an endangered coho salmon (*Oncorhynchus kisutch*) complex	Rachael Ryan

**Student poster*

Spawning Run

Welcome to our 2020 AFS Cal-Neva virtual spawning run!

Lace-up those running shoes and hit the trails/pavement for a walk, jog, or run. This year we are offering two options: a 1 mile and 5k event. You can complete your run anytime during the week of the conference, from 6:00am March 1st - 9:00pm March 5th. Once you have finished the event, please upload your time to the results page on this website so we can recognize our speediest spawners! You also will have the option to add a photo from your virtual race experience, which we highly encourage so we can all feel a little more connected.

We are not charging for registration since this is a virtual event but invite you to put what you may have spent on registration towards a charitable donation. One worthy cause we suggest is Outdoor Afro (nation-wide coverage): "Outdoor Afro has become the nation's leading, cutting edge network that celebrates and inspires Black connections and leadership in nature." You can donate at: outdoorafro.networkforgood.com.

Oral Presentation Abstracts

#1. Student Symposium I

Moderator: Kat Dale, University of California – Santa Cruz

Transect sampling promotes higher detection rates compared to discrete sampling for environmental DNA applications

Thiago Sanches (UCD), Andrea Schreier (UCD), and Brett Harvey (DWR),
University of California – Davis (UCD); California Department of Water Resources (DWR)

The use of environmental DNA (eDNA) to monitor species in aquatic environments has rapidly increased over the past decade. eDNA has consistently outperformed other methods of detection, yet eDNA relies on an indirect measure to estimate the real distribution of a species. Therefore, understanding the environmental factors that disperse eDNA is of major importance. Here we modelled the use of transect sampling for eDNA studies and also model the impact of river advection on detection radius and the expected probability of detection. Our model suggests that transect sampling: 1) increases the detection probability for both rare and common species, thus reducing the frequency of false negatives, 2) diminishes the standard deviation of the detection probability, which in most cases means higher reproducibility of eDNA studies, 3) better estimates systemwide trends of fish population distinguishing zones of multiple fishes from zones where few fishes are present, and 4) diminishes the effects of eddies and river velocity on the detection probability and detection radius. We propose the use of transect sampling as an alternative method of eDNA sampling with benefits that surpass the disadvantages of not being able to pinpoint exact fish location. Our model also suggests that even short transects (less than 100 m) can yield considerable benefits compared to point sampling.

Applying empirical dynamic modeling to distinguish abiotic and biotic drivers of population fluctuations in sympatric fishes

Ben Wasserman (UCSC), Tanya Rogers (NMFS), Stephan Munch (NMFS), Eric Palkovacs (UCSC)
University of California – Santa Cruz (UCSC) and National Marine Fisheries Service (NMFS)

Fluctuations in the population abundances of interacting species are widespread. Such fluctuations could be a response to abiotic factors, biotic interactions, or a combination of the two. Correctly identifying the drivers are critical for effective population management. However, such effects are not always static in nature. Nonlinear relationships between abiotic factors and biotic interactions make it difficult to parse true effects. We used a type of nonlinear forecasting, empirical dynamic modeling (EDM), to investigate the context-dependent species interaction between an endangered fish (tidewater goby) and a common one (threespine stickleback) in a fluctuating environment: a central California bar-built estuary. We found little evidence for competition, instead both species largely responded independently to abiotic conditions. Stickleback were negatively affected by sandbar breaching. The strongest predictor of tidewater goby abundance was stickleback abundance. This effect wasn't a uniform negative effect of stickleback on goby as would be hypothesized under interspecific competition. The effect of stickleback on gobies was positive, though it was temporally restricted. Tidewater goby abundance in the summer was strongly positively correlated to stickleback abundance in the spring. This represents an offset in the reproductive and recruitment peaks in the two species that may help minimize competition and promote coexistence. We used a novel analytical technique to understand drivers of population abundance in putative competitors, including an endangered species. Such knowledge can be used to choose amongst management alternatives for the endangered species.

Contrasting histological, otolith, and genetic indicators of growth and condition in an endangered estuarine fish

Rachel Fichman (UCD), Wilson Xieu (UCD), Feng Zhao (UCD), Malte Willmes (UCSC), James Hobbs (UCD), Tien-Chieh Hung (UCD), Andrew Schultz (USBR), Swee Teh (UCD), Robert Lusardi (UCD), and Levi Lewis (UCD)
University of California – Davis (UCD) , University of California – Santa Cruz (UCSC), United States Bureau of Reclamation (USBR)

Accurate inferences of fish growth and condition are imperative for the conservation and management of endangered species, like Delta Smelt (Hypomesus transpacificus), an endemic fish to the San Francisco

Estuary. Otoliths are commonly used to estimate fish growth and condition; however, the sensitivity of otolith-based growth reconstructions in relation to other biomarkers of growth and condition remains unknown. Here, we contrast the sensitivity (in timing and magnitude) of otolith, histological, and genetic biomarkers of growth for adult Delta Smelt. Growth was experimentally manipulated over 60 days using variation in food rations. We then contrasted the timing and magnitude of responses of fish in different treatments with respect to their otolith accretion rate, liver glycogen, DNA:RNA, and somatic growth metrics. Condition factor, hepatosomatic index, and otolith accretion rates, each diverged significantly among treatments within a few days of the initiation of the experiment, indicating the highest temporal sensitivity to food limitation, with otolith accretion rates 40% faster in fed versus unfed treatments. Differences in otolith accretion rates were significantly correlated with changes in biomass, but not with fish length, indicating that otolith accretion may serve as a proxy for overall growth, but not length, per se, in older Delta Smelt. These results indicate that otolith accretion rates can provide high-resolution and biologically relevant proxies for reconstructing the growth history of wild adult Delta Smelt.

#2. Technical Session I - Habitat Restoration and Prioritization

Moderators: Mark Gard, CDFW

Using LIDAR data to address fish passage

Mark Gard
California Department of Fish and WIldlife

LIDAR data, along with site-specific dimensions, were used to classify the passage status of 70 Southern California barriers for steelhead. These barriers had previously been assessed with field surveys for Santa Ana sucker. The LIDAR data, along with the data from the Santa Ana sucker surveys, were used as inputs for two-dimensional hydraulic models, using the HEC-RAS software. Jump heights at the barriers were simulated at the low and high passage flows for each stream. The models were able to assess the passage status of all of the barriers. Additional field data would be useful to confirm the passage status of the highest-priority barriers.

Implementation of multi-benefit juvenile salmonid habitat restoration on the Lower Yuba River: The Hallwood Side Channel and Floodplain Restoration Project

April Sawyer (CBEC), Chris Hammersmark (CBEC), Sam Diaz (CBEC), Katie Wrightson (CBEC), Paul Cadrett (USFWS), Jeff Mathews (YWA), Joe Merz (CFS), Kirsten Sellheim (CFS), Philip Colombano (CFS), Aaron Zettler-Mann (SYRCL), and Tyler Goodearly (SYRCL)
CBEC, Inc. EcoEngineering (CBEC), US Fish and Wildlife Service (USFWS), Yuba Water Agency (YWA), Cramer Fish Sciences (CFS), South Yuba River Citizens League (SYRCL)

Anthropogenic actions on the Lower Yuba River dating back to the Gold Rush altered geomorphic and hydraulic conditions and subsequently available habitat for rearing juvenile salmonids. The Hallwood Side Channel and Floodplain Restoration Project was developed to address the United States Fish and Wildlife Service Anadromous Fish Restoration Program's goal to double natural production of anadromous fish in Central Valley rivers. The Project was designed to enhance ecosystem processes to support juvenile rearing fall-run and spring-run Chinook salmon and California Central Valley steelhead. The Project is supported by numerous agencies and stakeholders and takes a novel approach by leveraging relationships with aggregate mining landowners to facilitate economically efficient habitat enhancement. After several years of planning, design, permitting, and pre-project monitoring, 89 acres of habitat was enhanced as Phase 1 implementation was completed in 2020. A network of perennial and seasonal side channels was created and an unnatural constraint separating the main channel from its floodplain was removed. The remaining Phases will proceed over 3 - 5 years and create or enhance up to a total of 157 acres of seasonally inundated floodplain habitat, 1.7 miles of perennial channels, and 6.1 miles of seasonal side channels and alcoves. The project also provides flood benefits by reducing water surface elevations by several feet and reducing pressure on training walls bounding the floodway. A design based on restoring lateral connectivity and removing unnatural constraints coupled with robust monitoring will provide valuable information at a large-scale regarding restoration success and lessons learned.

Newly Constructed Urban Flood Basin can be seasonally Suitable for Steelhead Rearing and Primary Production of Food Resources through Innovative Channel Engineering, Biological Monitoring, and Regulatory Permitting

Hadley Giebeler, Chris Hogle, and Norm Ponferrada, Cardno

Cardno is working closely with a housing developer in Lincoln, California to ensure volitional fish passage within a new urban floodway adjacent to Auburn Ravine. Cardno is ensuring that conditions are suitable and volitional passage is possible for fish should Central Valley steelhead (Oncorhynchus mykiss) become entrained during high flow events. Field monitoring at the site requires continuous collection of temperature, dissolved oxygen, and flow data in the pond and floodway while performing fish rescue and relocation in response to steelhead stranding. Engineers and biologists are working collaboratively on designing a pond outlet step-pool and re-engineering the cut-off slurry wall. When completed, the floodway will provide beneficial seasonal floodplain habitat for Central Valley steelhead including production of food resources. Cardno is working with the developer as well as the California Department of Fish and Wildlife and National Marine Fisheries Service to stay in compliance with existing policy and permits.

Application of Wind Fetch and Wave Models for a Proposed Conservation Bank in Suisun Bay, California

Jai Singh (CBEC), Chris Hammersmark (CBEC), Sam Diaz (CBEC), Jim Robins (SMRCD)
CBEC, Inc. EcoEngineering (CBEC), San Mateo Resource Conservation District (SMRCD)

This multi-objective project addressed critical fish passage, water quality and flood risk challenges affecting Butano Creek, Pescadero Marsh and the surrounding community of Pescadero in unincorporated San Mateo County. Anthropogenic disturbances to the watershed have significantly increased sediment delivery to Butano Creek and Pescadero Marsh. Along large portions of the project reach, sediment accumulation had filled the channel to the top of its banks. The resulting condition was nearly impassable for anadromous fish and other native fish species. These issues were of particular concern for populations of coho salmon and steelhead. Compounding these challenges were the regular development of anoxic conditions in the marsh which caused devastating annual fish fills in Pescadero Lagoon during natural breach events. The loss of Butano Creek's conveyance capacity also caused chronic flooding of Pescadero Creek Road, disconnecting the town from its main access route and emergency services following even moderate rain events. The constructed project excavated accumulated sediment from Butano Creek to reestablish fish passage between the estuary and the watershed and to reduce flooding of Pescadero Creek Road during frequent, low magnitude flood events. This sediment was beneficially reused to selectively aggrade the marsh, filling in relic ditches, borrow pits and other man-made low spots that generate anoxic conditions and allow anoxic water to rapidly drain from the marsh into the lagoon following breach events. These actions restored salmonid access to the watershed's spawning habitat and ameliorated the conditions responsible for creating anoxic water and driving fish kills.

#3. Student Symposium II

Moderator: Kat Dale, University of California – Santa Cruz

Hatchery- versus wild maturation schedules and implications for the ocean salmon fishery

Emily Chen (UCB), Will Satterthwaite (NMFS), Rachel Johnson (NMFS, UCD), Corey Phillis (MWD), Brett Kormos (CDFW), Stephanie Carlson (UCB)

University of California – Berkeley (UCB), National Marine Fisheries Service (NMFS), University of California – Davis (UCD), Metropolitan Water District of Southern California (MWD), California Department of Fish and Wildlife (CDFW)

A key question in Pacific salmon stock management is whether and how hatchery fish are representative of their associated natural-origin counterparts. Data collected from hatchery fish are often used to inform monitoring and managing the combined population. We compared the maturation schedules of hatchery- versus natural-origin endangered Sacramento winter-run Chinook salmon (Oncorhynchus tshawytscha) and explored the management consequences of differences. We performed parallel cohort reconstructions of the two sources using coded-wire tags (CWTs) recovered in hatchery fish and scales recovered and aged in natural-origin fish to inform spawning age structure and maturation. We used CWTs recovered in the fishery to estimate both hatchery- and natural-origin fishing impact. For 2003-2015 cohorts, hatchery fish generally had a lower age-2 maturation and higher age-3 maturation than natural-origin fish, resulting in a more homogenous age-at-maturity but not necessarily earlier maturity in hatchery fish. A lower age-3 maturation rate in natural-origin fish indicate more age-4 winter-run are exposed to the fishery than estimated using only

hatchery fish. We quantified the impact of the fishery on natural winter-run and compared inputs of 1) hatchery- and natural-winter run maturation and 2) winter and fall-run age-4 fishery impact rate. The results of our study provide insight into the extent of which borrowing hatchery data biases monitoring and management tools.

Living on the Edge: Thermal Tolerance of Wild Steelhead Trout at Their Southern Range Limit

Terra Dressler, Vincent Han Lee, Erika Eliason

University of California – Santa Barbara

There is extraordinary habitat diversity across the natural geographical range of Oncorhynchus mykiss, extending along the west coast of North America from southern California to Alaska. Along this gradient, populations encounter different temperature and flow regimes, disturbance regimes, and seasonal variation in habitat conditions. As temperatures rise due to climate change, trout abundance is declining across the range and they are increasingly vulnerable to local extinctions. O. mykiss populations in southern California, the southern range limit for the species, are postulated to have distinctive adaptations to cope with the extreme conditions including fires, drought, and warmer temperatures. In this study, we conducted stream-side oxygen uptake rate and critical thermal maximum (CTMAX) tests to examine thermal tolerance in two southern O. mykiss populations exposed to three ecologically relevant fluctuating temperature regimes. We hypothesized that our southern-most study population has a higher thermal tolerance but is currently inhabiting more physiological stressful temperatures than the other, more northern population. We found that, indeed, the southern-most population had higher, but less plastic, upper thermal limits. We also found that the southern population had higher baseline oxygen demands regardless of temperature but that oxygen consumption rates were less temperature sensitive compared to the more northern population. Additionally, both populations recovered rapidly from exhaustive exercise regardless of temperature, suggesting our test temperatures, while ecologically relevant, were not at the physiological limits for these populations. This study provides novel information about temperature tolerance of an understudied sub-group of a species of management concern.

Got to catch them all? Balancing maximizing genetic diversity and sample size in a recruitment-limited population of White Sturgeon (Acipenser transmontanus)

Amanda Coen (UCD), Ken Lepla (IPC), Phil Bates (IPC), and Andrea Schreier (UCD)

University of California – Davis (UCD), Idaho Power Company (IPC)

Broodstock-based conservation aquaculture can help sustain recruitment-limited populations but may detrimentally impact long term genetic diversity. An alternative propagation method entails the passive collection of embryos and larvae downstream of spawning locations (DCR). This method is currently being employed with wild broodstock propagation for Middle Snake River white sturgeon (Acipenser transmontanus) to address recruitment limitations and disrupted connectivity between isolated river reaches. We examined the impact of propagation method on genetic diversity conservation across five year classes and evaluate how a ten-fold increase in DCR sampling success increased genetic diversity and number of spawners (Ns) represented. Using 13 microsatellites we estimated the total number of alleles and the average number of alleles per individual per locus as measures of genetic diversity in the octoploid white sturgeon. Genetic diversity of the broodstock-based year classes was lower than DCR year classes by all measures. Counter to expectations, the increased sampling success observed in 2019 led to marginal increases in genetic diversity relative to less successful collection years. Various factors beyond sample size can influence the diversity captured within DCR year classes, complicating management decisions about how large of a sample to collect within a season. Higher genetic diversity and Ns in DRC year classes supports continuing with DCR but our results suggest sampling broadly throughout the spawning season is more important than the total number of individuals collected.

#4. Technical Session II – Habitat Restoration and Response in the San Francisco Estuary

Moderator: Lisa Thompson – Regional San

Assessing food web response to nutrient supplementation in the Sacramento Deep Water Ship Chanel

Joe Merz (CFS), Whitney Thorpe (CFS), Avery Sherer (CFS), Bobbie Flores (CFS), Jesse Anderson (CFS), Erwin Van Nieuwenhuyse (USBR)

Cramer Fish Sciences (CFS) and US Bureau of Reclamation (USBR)

Increased food resources are expected to benefit the San Francisco Estuary ecosystem and improve habitat conditions for pelagic fishes, including endangered Delta Smelt (Hypomesus transpacificus). To test this hypothesis, the Bureau of Reclamation (Reclamation) conducted experimental nitrogen (N) supplementation in the upper Sacramento Deep Water Ship Canal (SSC) in early August 2019. Using the Single-Platform Aquatic Species Habitat Sampling System (Platform), a unique sampling boat that funnels fish through a forward deployed fyke-net, past live box cameras and out the stern, we made water quality, primary productivity, and fish observations, that were linked spatiotemporally (latitude, longitude, timestamp). Continuous transects were run upstream and downstream over a ~10-km section of the SSC, including the nutrient supplementation area, weekly beginning one week before the supplementation and continuing for seven weeks thereafter. Chlorophyll α, total fish, and Threadfin Shad (Dorosoma petenense; a representative planktivore) values increased spatially within and downstream of the nutrient supplementation area. However, the response was short-lived (<1 week) and biweekly temporal patterns suggest stronger effects of environmental factors such as tides or wind at this scale of nutrient manipulation. Nevertheless, observed responses support that the Platform is an effective tool to detect food web responses to supplementation efforts and these observations warrant further investigation at a larger scale.

Tidal Habitat Restoration at Lower Yolo Ranch

Chris Campbell (CBEC), Emily McCommas (CBEC), and Carl Jenson (ICF)
CBEC, Inc. EcoEngineering (CBEC), and ICF (ICF)

In conjunction with the California Department of Water Resources, Westlands Water District, Hallmark Group, and ICF, cbec eco engineering designed, permitted, and constructed a 2,149 acre tidal marsh restoration project in the Lower Yolo Bypass near the Cache Slough Complex. The goal of the project was to benefit native fish, including delta smelt Hypomesus transpacificus, and winter- and spring-run salmonids. The Lower Yolo Ranch Restoration Project, which adjoins the Yolo Flyway Farms tidal marsh restoration project (completed in 2018), represents a significant milestone with the completion of a 'turn key' tidal marsh restoration project. This partially fulfills mitigation obligations associated with the ongoing operation of the State and Federal Water Projects, which both deliver irrigation and municipal water to Central and Southern California. The design development and entitlement of the project was overseen by the multi-agency Fish Agency Strategy Team, or FAST, which is tasked with approving mitigation for the ongoing need. The Lower Yolo Restoration Project was designed to take advantage of the large areas of the site that were at ideal elevations for tidal marsh restoration, and that would contribute to the food web of the Cache Slough Complex quickly and without large amounts of earthwork. Construction of the project, under a compressed schedule, began in August 2020 and was completed in October 2020. The California Department of Water Resources, in partnership with the California Department of Fish and Wildlife, will begin collecting monitoring data at the site in 2021.

Tidal Wetland Restoration and Adaptive Management for Delta Fishes

Ramona Swenson, Damien Kunz, and Rachel Brownsey, Environmental Science Associates

Tidal wetland restoration is hypothesized to increase the contribution of wetland-associated invertebrates to the pelagic food web. The Tule Red Project recently restored 425 acres of tidal wetlands in Suisun Marsh to benefit delta smelt, longfin smelt, and juvenile salmonids. The design included a main channel with smaller channels, a pond complex to hold water longer (higher residence time is associated with greater primary productivity), and a gradually sloped habitat berm. Tidal flows were restored October 2019. The adaptive management and monitoring plan provided the framework for physical and biological monitoring to evaluate effectiveness, reduce uncertainty, and trigger management actions. Monitoring in 2020 evaluated the site's first year response to the new flows. The breach and channels are widening and deepening with the tidal forces, which is increasing tidal exchange within the back marsh. The marsh ponds experience a muted tidal cycle. Primary productivity (chlorophyll-a) in the marsh ponds was greater than levels in the marsh channel, and similar to or greater than levels in Grizzly Bay. Dissolved oxygen levels fluctuated diurnally and seasonally, with lowest levels in late summer in a deadend channel, likely due to algal bloom. Vegetation composition and cover reflect the influence of tidal flows and disturbance during construction. Some intertidal zone areas are quickly establishing with native pickleweed. However, Phragmites, a common weed in the region, is invading some areas. Continued coordination with other

monitoring partners will leverage the learning opportunities from this restoration project over the next 4 years of post-breach monitoring.

Juvenile Salmon Diet and Growth in Marsh Habitat of the San Francisco Estuary

Kelly Neal (UCD), Mollie Ogaz (UCD), Brett Harvey (DWR), Anna Sturrock (UE), Jake Sousa (ICF), Michelle Nelson (DWR), Jason Hassrick (ICF), Carson Jeffres (UCD), and Rachel Johnson (NMFS)
University of California – Davis (UCD), California Department of Water Resources (DWR), University of Essex (UE), ICF (ICF), National Marine Fisheries Service (NMFS)

The ability of tidal habitats in California's Central Valley to support juvenile Chinook Salmon rearing has been identified as one of the key uncertainties affecting restoration management decisions. Although pre-smolt juvenile Chinook Salmon have been found within the marsh habitats of the upper San Francisco Estuary, the suitability of this marsh habitat for juvenile rearing is not well understood. One of the key features determining habitat suitability for juvenile salmon is the abundance and availability of energetically valuable prey to support somatic growth. To assess the relationship between habitat-specific prey availability and juvenile salmon growth rates, we are conducting a three-year fish enclosure experiment in marsh habitats across a broad region of the estuary, and here report results from 2019, the first year of the project. Analyses comparing prey availability to juvenile salmon growth rates and diet composition have been conducted. We also examined how juvenile salmon growth rates, prey abundance, and prey taxonomic composition varied over time in relation to abiotic parameters, such as flow and salinity. We found significantly different growth rates between enclosure sites, demonstrating a wide range of rearing potential across marsh habitats of the upper San Francisco Estuary. However, relationships between growth rates, prey abundance, and taxonomic composition were less clear. This information regarding factors associated with beneficial rearing habitat will help improve life-cycle models currently used to inform habitat restoration decisions and other management actions intended to support the recovery of central Valley Chinook Salmon.

#5. Technical Session III – Target Species Management

Moderator: Nicholas Buckmaster, California Department of Fish and Wildlife

A critical review of temperature guidelines used for 303d listing of steelhead streams in California

Andrew Deines and Susan Paulsen
Exponent, Inc.

Warm water temperatures pose a risk to steelhead populations and are a cause for listing streams as impaired under Section 303(d) of the Clean Water Act. The water temperature evaluation guidelines that have been employed in California to evaluate listing decisions for cold water habitats have been derived from studies of salmon and steelhead populations near the species' core range in the Pacific Northwest (PNW). In contrast, steelhead populations in Central and Southern California are at the southern edge of the species' distribution where typical summertime steelhead habitats are naturally warmer than in the PNW. To evaluate the appropriateness of using PNW temperatures as guidelines for California steelhead streams, we reviewed the supporting documents used to develop the PNW temperature guidelines. We found that the PNW guidelines are based primarily on salmon populations other than steelhead and for environmental conditions in the PNW. Few of the studies are specific to steelhead, and none are specific to California. Further, specific portions of the PNW temperature guidelines rely on studies with methodological flaws and data limitations that raise questions about the reliability of these guidelines for drawing conclusions about the thermal tolerance of southern steelhead in particular. Applying PNW-based temperature guidelines to California streams may result in inappropriate listing decisions and resource-intensive response actions, potentially including TMDL development and restoration activities. Attaining inappropriately low management targets may be infeasible and efforts to reach targets could have unintended consequences on other ecosystem functions.

Reviewing Long Term Monitoring Programs: A Case Study Using the Yolo Bypass Fish Monitoring Program

Amanda Casby and Brian Schreier
California Department of Water Resources

Regular reviews, internal or external, are a critical element in keeping monitoring programs adaptable, efficient, and accountable to resource managers, regulatory staff, and stakeholders. Reviews are also essential to maintain the robustness of the data produced and ensure the highest

quality science is being provided to meet management goals and answer management questions. In cooperation with the Interagency Ecological Program, the Department of Water Resources has operated a fish and aquatic ecology monitoring program in the Yolo Bypass since 1998. In the 22-year history of the Yolo Bypass Fish Monitoring Program (YBFMP), the program has not undergone any comprehensive review. Therefore, the YBFMP initiated a two-phase comprehensive review of their program, comprised of a first phase of programmatic review, covering documentation and protocols, and a second phase of scientific review, covering sampling design and methodology (planned for 2021). The programmatic review, which was completed in 2020, involved thorough evaluation of program documentation, making recommendations for changes and additions to program documentation, and creating new program documents. Staff identified 27 program elements for review, covering the range of YBFMP activities, as well as the logistical, operational, and regulatory components of the program. The resulting recommendations, updated documentation, answers to the overarching review questions, and lessons learned for future reviews allowed for improvement of YBFMP's documentation and processes, worked to keep the program responsive to a dynamic regulatory environment, and helped prepare the program for future internal or external reviews.

Something old something new: tested and innovative techniques for salmonid habitat restoration

Avery Scherer, Jamie Sweeney, and Kirsten Sellheim
Cramer Fish Sciences

Restoration in 2019 on the Lower American River (LAR), California involved a proven strategy (gravel augmentation), a novel approach for the reach (side channel construction), and an innovative approach to enhancing complexity (bank contouring). Sailor Bar, located shortly below the limit of anadromy in the LAR, was the location of a successful gravel augmentation project in 2008/2009. In 2019, the site was again targeted for gravel augmentation to counteract degradation of the previous project as well as the construction of a new side channel. Snorkel surveys were conduct monthly in spring 2020 to assess value for rearing juvenile salmonids. Results demonstrated benefits of gravel augmentation in the main channel for Chinook salmon Oncorhynchus tshawytscha and of constructed side channel habitat for O. mykiss. The design of the side channel incorporated novel bank contours which aimed to provide a low-cost and low-effort means of increasing channel complexity. In particular, the features aimed to provide particular hydrodynamic conditions (velocity refugia near areas of higher flow) known to be beneficial to rearing salmonids. Data demonstrated higher occurrence of both salmonid species at bank contours compared to locations near other forms of cover (e.g. vegetation, woody debris) or without cover. The study supports tested means of salmonid habitat restoration (gravel augmentation, off channel habitat construction) provide reliable techniques salmonid habitat enhancement while innovative solutions such as bank contours may continue to improve quality and attainability of restoration benefits.

Thinking outside the box: potential approaches to manage non-native species in arid landscapes

Nicholas Buckmaster
California Department of Fish and Wildlife

Desert fish management presents a unique challenge for resource managers. Aquatic habitats are extremely restricted in desert biomes, creating disparate habitat patches across the landscape. This separation leads to allopatric speciation and the development of unique, endemic fish species that are restricted to relatively small native ranges. Because these fish evolved in isolation and without competition, desert fish are susceptible to invasion by non-native animals. Such invasions pose an existential threat and often result in rapid population declines or complete extirpation of native species. Quick and creative responses are often needed to control non-native species and avoid irreplaceable species loss. Here we present the results of several creative and unorthodox management actions used to control or remove non-native species. These actions ultimately preserved Shoshone Pupfish (Cyprinodon nevadensis shoshone), resulted the restoration of Owens Pupfish (Cyprinodon radiosus) to the landscape at a scale not seen in over a century, and made historic progress in restoring Lahontan cutthroat trout (Oncorhynchus clarkii henshawi).

#6. Technical Session IV – Health and Success of Anadromous Fishes

Moderator: Anna Steel, University of California - Davis

Comparing effects of pyrethroid pesticide exposure between larval Green and White Sturgeon

Anna Steel, Sarah Baird, Dennis Cocherell, Richard Connon, and Nann Fangue
University of California - Davis

Aquatic contaminants are pervasive in the SFBD, and they are recognized as a potential threat to recruitment of California sturgeon. However, knowledge of the vulnerability of sturgeon to aquatic contaminants is limited. Our goal was to investigate sub-lethal effects of a pyrethroid pesticide (bifenthrin) on early life stages of sturgeon. We conducted laboratory exposures of yolk-sac larvae to multiple concentrations of bifenthrin to identify concentration-dependent impacts on growth, motor-coordination, activity levels, and thermal-tolerance. We saw greater sensitivity in White Sturgeon (Acipenser transmontanus) than in Green Sturgeon (A. medirostris), yet both displayed marked loss of motor-control and reduced activity after three days at the highest exposure concentrations. White Sturgeon have been shown to be more sensitive than to many contaminants when compared to other fish species commonly used in toxicity testing. Interestingly, in our study, the bifenthrin concentration at which sturgeon larvae demonstrated an observed effect was higher than concentrations at which effects were observed in fathead minnows or rainbow trout in the literature. This may suggest that sturgeon respond to aquatic contaminants in different ways than other more derived fish species. While sturgeon exposed to low and moderate bifenthrin concentrations (<500ng/L nominal conc.) regained motor control after three weeks in clean water, bioaccumulation can be a concern and should be addressed in future work, along with the potential for synergistic effects with water temperature and contaminant mixtures. This increased knowledge about how sturgeon respond to common contaminants will allow for more targeted management of the species and their habitats.

Evaluating Thiamine Injections in Female Broodstock to Combat Thiamine Deficiency Impacts in Hatchery-Reared Endangered Winter-Run Chinook Salmon

Kaitlin Gooding (USFWS), Taylor Lipscomb (USFWS), Travis Webster (USFWS), Rachel Johnson (NOAA), Heather Bell (UCD), Anne Todgham (UCD), Arnold Ammann, Jacques Rinchard, Carson Jeffres (UCD, Nann Fangue (UCD), and Nate Mantua
US Fish and Wildlife Service (USFWS), National Oceanic and Atmospheric Administration (NOAA), and University of California – Davis (UCD)

Nutritional deficiencies in thiamine has been identified as the likely cause of increased early life stage mortality observed in progeny of multiple runs of Chinook salmon (Oncorhynchus tshawytscha) in Central Valley hatcheries in 2019 and 2020. Thiamine deficiency was diagnosed based on successful treatment of fry with thiamine baths. Overt fry mortality linked to thiamine has not been previously reported in these fish stocks. Observed deficiency is thought to be due to a disruption in marine food webs possibly resulting in widespread and significant impacts to harvestable stocks as well as those of conservation concern in California. Winter Run Chinook Salmon (WRCS) are endangered and are spawned and reared at the Livingston Stone National Fish Hatchery. Here, we test the efficacy of injecting WRCS (N=30) with thiamine [and saline control; N=30] several weeks prior to spawning to limit increased fry mortality caused by thiamine deficiency in the 2020 year class. Egg thiamine concentrations from supplemented females was significantly higher than the control group ($P < 0.001$, 34.2 ± 9.4 and 5.3 ± 9.4 nmol/g, respectively) and significant relationship between juvenile mortality to 120 dpf and egg thiamine concentration was observed. In addition to thiamine status, we determined the utility of thiamine injection to support successful supplementation of the endangered WRCS population. Prior to release, juveniles were fitted with acoustic and coded-wire tags to evaluate outmigration and future return success, respectively. This research contributes to the understanding of thiamine deficiency and its impacts on Central Valley salmon stocks.

Restoration on a Small Stream Provides Home for Chinook Salmon

Malte Willmes (UCSC), Mackenzie Miner (UCD), Rachel Fichman (UCD), Levi Lewis (UCD), Andrew Rypel (UCD), Nann Fangue (UCD), Anna Steel (UCD), James Hobbs (UCD), Eric Chapman (ICF), Rachel Johnson (UCD, NMFS)
University of California – Santa Cruz (UCSC), University of California - Davis (UCD), ICF (ICF), National Marine Fisheries Service (NMFS)

"Tomorrow's most important populations might come from populations that are relatively unimpressive today", Hilborn 2003. The ecological Portfolio Effects literature suggests diverse mosaics of habitats and populations are required for salmon resiliency. Chinook Salmon (Oncorhynchus tshawytscha) are a keystone species and are an integral part of the culture and economy in the Pacific Northwest. Once extirpated from Putah Creek, a small creek in California's Central Valley, recent flow and

restoration efforts resulted in adults spawning annually, since 2013 with 1,500-2,000 estimated in 2016. To better understand the repopulation dynamics and improve management, a monitoring program was setup, starting in 2016 including carcass surveys, juvenile monitoring, and otolith (fish earstone) and genetic studies. Spring sampling of juveniles indicates that Putah Creek supports an adequate forage base for growth and survival, however recent acoustic telemetry studies suggest minimal outmigration success. Otoliths provide an ideal tool to track the extent to which adults represent strays in each generation or were born on and returning to Putah Creek. Our previous research highlighted the origin of the founder populations as being diverse- seven different natal sources, overwhelmingly from Central Valley hatcheries (~88%). These findings showcase that straying fall-run Central Valley Chinook Salmon can rapidly utilize restored habitats, potentially establishing new populations. However, to achieve locally adapted and self-sustaining populations, survival of juvenile outmigrants is a high priority. Reconnecting migratory pathways and restoring many small and diverse streams like Putah Creek thus provides an opportunity to increase life-history diversity, strengthening the recovery and resilience of Chinook Salmon.

Adaptive Management: Factors driving returns of hatchery Spring-run Chinook Salmon released in the lower Feather River

Jada-Simone White (PSMFC) and Jason Kindopp (DWR)
Pacific States Marine Fisheries Commission (PSMFC), California Department of Water Resources (DWR)

For more than a decade, ~50% of the Feather River Fish Hatchery (FRFH) Spring-run Chinook Salmon were released in-river and ~50% were released in the San Francisco Bay. Releasing Spring-run in the bay sometimes increased survival and returns; however, stray rates to other Central Valley (CV) drainages also increased. Beginning in 2015, 100% of the state and federally-listed Spring-run Chinook salmon from the FRFH were released in-river to (1) reach conservation management goals while (2) minimizing impacts to wild populations, including straying. We used Coded Wire Tags (CWT) to evaluate adult returns of FRFH Spring-run smolts released within the Lower Feather River (LFR) during 2015-2017. Of the 13,116 adult Spring-run CWT recovered to date, 91.56% had returned to the CV and 8.44% were caught in the ocean. Of the 12,009 that returned to the CV, most were recovered at the FRFH (94.929%) or in the LFR (4.771%) via carcass or sport fishing surveys. Few were recovered in the Yuba River (0.275%); and, of these, all had been released downstream of the Yuba River confluence (i.e., zero strayed from upstream release groups). Very few strayed to other drainages in the CV (0.025%). In addition, we evaluated returns by release year, and as a function of drought index, release location (Upstream vs. Downstream), release month (March vs. April), average size at release (in grams), and change in flow (maximum-minimum) within the 7 days following release. Due to non-equal release groups, CWT returns were standardized per 100,000 released to allow comparisons among factors..

Poster Presentation Abstracts

Evaluating the impact of the North Delta Flow Action on resident and migratory fishes

Nicole Kwan, Catarina Pien, Rosemary Hartman, Hailey Wright, Jeff Jenkins, Laura Twardlochleb, and Brittany Davis

California Department of Water Resources

The food-limited nature of the San Francisco Estuary (SFE) is hypothesized to be a primary driver of fish declines in the area, particularly so for the endangered Delta Smelt. In the past, beneficial phytoplankton blooms and resulting zooplankton increases have been observed following hydrological changes (i.e. flow pulses) in the North Delta region of the upper SFE. These observations led to the North Delta Flow Action, an ongoing adaptive management strategy which sends an augmented flow pulse through the Yolo Bypass with the goal to restore positive outflow, distribute food through the North Delta, and potentially trigger a phytoplankton bloom. After eight years of managed and non-managed flow actions, the Department of Water Resources began a synthesis effort to better understand the impact of the flow action on a variety of parameters and species, including fish. The fish synthesis included evaluating the impact of managed and non-managed actions on abundance of various fish assemblages, Delta Smelt health, survival, and diet, and adult Chinook salmon straying and health. We accomplished this by compiling and analyzing relevant data from the upper San Francisco Estuary, Yolo Bypass, and Colusa Drain between 2000-2019. The synthesis highlights the challenges of using complex biological data from non-target studies for a new purpose. While no strong effects from the flow action were detected, the effort set a valuable foundation for future analysis and exposed areas where targeted studies could help address key knowledge gaps.

How Landscape and Local Factors Influence Juvenile Size in Endangered Coho Salmon and Threatened Steelhead Trout

Sam Rosenbaum

University of California - Berkeley

This thesis aims to quantify variation in size of juvenile coho salmon (Oncorhynchus kisutch) and steelhead trout (O. mykiss) across the Lagunitas Creek watershed in Marin County. Using underwater footage captured from multiple sites in the Lagunitas watershed at three different time points from June to September of last year, I will be comparing juvenile salmonid size and variation in size across time and multiple spatial scales. At the watershed scale, I will evaluate whether distinct watershed classes defined by their geology, elevation, catchment area, flow, soil texture, and climate give rise to variation in juvenile size. At the local scale, I will be assessing habitat features such as depth, temperature, substrate, density of fish, and presence of large woody debris. I will be using a software called VidSync to determine how the size of these juvenile fish varies across space and time.
I hypothesize that large-scale habitat heterogeneity will be linked to general patterns of juvenile size at the sub-watershed level, and small-scale habitat variables will strongly influence within-pool size variation. I predict that the relationship between size and time will be different for different watershed classes.

Warming waters and smaller fish: Assessing how temperature impacts body size and shape in a population of Amargosa pupfish

Ashley Del Core, Catie S. Cleveland and Sean Lema, California Polytechnic State University

Temperature affects physiology and behavior in fish, but also has potential to alter morphology by impacting development and growth. In 2010, a population of Amargosa pupfish (Cyprinodon nevadensis amargosae) from Tecopa Bore, a groundwater-fed spring in the Death Valley region of California, USA, experienced a mean temperature increase of approximately 9°C following an anthropogenic habitat alteration. That temperature increase was accompanied by a 36% reduction in mean body mass, 7.6% reduction in body length, and the partial or complete inhibition of paired pelvic fin development in 34% of the population. To understand further how living under higher temperatures influences pupfish morphology, we compared body shape variation of C. n. amargosae collected from Tecopa Bore in 2013-2017 to an allopatric population of the same species in the nearby, variable temperature Amargosa River. Pupfish in Tecopa Bore were smaller, continued to show the partial or complete loss of pelvic fins in ~34% of the population, and also exhibited body shape differences with a proportionally larger eye and head size compared to the Amargosa River population. These morphological

characteristics mirror the plastic developmental responses observed when C. n. amargosae were raised under conditions of high temperature in a previous laboratory study, suggesting that the morphological changes observed in the Tecopa Bore population may have emerged in part from phenotypic plasticity. These observations implicate temperature variation as having contributed to morphological divergence between the Tecopa Bore and Amargosa River populations of C. n. amargosae.

Investigation of a known mortality hotspot for out-migrating juvenile salmon in the Sacramento-San Joaquin River Delta

Amanda Agosta (UCD), Colby Hause (CDFW), Gabriel Singer (CDFW), Andrew Rypel (UCD), and Nann Fangue (UCD),
University of California – Davis (UCD), California Department of Fish and Wildlife (CDFW)

Several years of acoustic telemetry data suggests Franks Tract, a 3000-acre flooded island in the South Delta, increases mortality for out-migrating juvenile salmon. To understand juvenile salmon ecology in this area, we studied relative predation risk of juvenile salmon using tethering experiments. Additionally, we conducted an experimental release into Frank's Tract of 100 juvenile spring-run Chinook salmon tagged with acoustic transmitters. We hypothesize that entrainment into Franks Tract increases mortality for salmon via predation by non-native piscivores. Analysis of tethering data is in progress; however provisional telemetry results suggest poor survival overall (2% to ocean entry). However, outmigration survival is notoriously low for fish routing through the interior delta and that some fish survived to ocean entry suggests Frank's Tract is not a complete sink. Understanding spatially-explicit mortality risks may facilitate adaptive management strategies for salmon in the Central Valley.

Molecular evaluation of the mating dynamics of snow crab (Chionoecetes opilio) in the eastern Bering Sea

Laura Slater (UAF), William Gaeuman (ADFG), Wei Cheng (ADFG), Gordon H Kruse (UAF), Chris Habicht (ADFG), Tyler M Jackson (ADFG), Zac Grauvogel (ADFG) and Douglas Pengilly (ADFG)
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Snow crab (Chionoecetes opilio) in the eastern Bering Sea support the largest and most valuable crab fishery in Alaska, which is managed under large-male-only harvest policies. We used a combination of genetic markers to determine the directionality of snow-Tanner (C. opilio x C. bairdi) hybridization and to characterize snow crab mating dynamics in terms of the number and species of male contributors to both sperm reserves and brooded embryos. Evaluation of hybrid maternal lineage revealed reciprocal hybridization, with similar numbers resulting from interspecific mating by females of either parent species. The number of mates represented in the sperm reserves of female snow crab ranged from zero to four, but most females carried stored sperm from a single male. Incidence of interspecies mating was very low. Although females can mate during mating seasons encountered as new shell or old shell crab, results for new and old shell females were similar, suggesting no association with the number of mating seasons in which females participate. Most brooded clutches were sired by a single male, and the sire's genotype was often detected in the sperm reserves. Thus, although females have the ability to store sperm from multiple mates and mating seasons for use 1-3 years later, typical sperm reserves for new shell females indicate that this storage capacity is rarely employed as a buffer against a scarcity of available mates in subsequent mating seasons. This consideration underscores the importance for the population to have large, reproductively active males available for mating and population renewal.

Impact of Largemouth Bass on an isolated Sacramento Perch Population

Ryan Hitchings and John Durand, University of California, Davis

Sacramento Perch are California's only native centrarchid and are currently extirpated from their native range. Two populations were established in two disconnected ponds, Curved and Jameson, on the University of California, Davis campus between 1995 and 2002. In 2011, Patrick Crain and Peter Moyle released a seminal paper on the current status and conservation of the species. In the paper, they made a series of recommendations based on research up to that point, two of which were the rearing of Sacramento Perch in small ponds, and the introduction of Sacramento Perch into all suitable ponds in their native range. Between September 2020 and February 2021, a series of trapping efforts were conducted in Curved and Jameson Ponds. The efforts did not produce any

Sacramento Perch in Curved Pond, but instead revealed a well-established population of Largemouth Bass. The results of this research suggests that under stressful environmental conditions, which are likely to become more frequent, Sacramento Perch are unlikely to be able to coexist with Largemouth Bass.

Quantifying diversity if size and timing of outmigration in an endangered coho salmon (Oncorhynchus kisutch) complex

Rachael Ryan, Stephanie Carlson, and Theodore Grantham
University of California - Berkeley

There is growing appreciation for the importance of life-history diversity in buffering population complexes against environmental variation, yet none have explored the importance of population diversity in small watersheds that support highly vulnerable populations. Our research focuses on endangered Central California Coast coho salmon (Oncorhynchus kisutch) in Lagunitas Creek, at the southern end of their range. In our preliminary analysis, we found that outmigration size and timing differed in their mean and variance between the two primary sub-basins in the watershed. There is no consistent pattern and the direction of these differences depends on the year, indicating that the fish in the two sub-basins are experiencing different environmental conditions. These results highlight the potential for population diversity at small scales in this complex.

Metric Conversion Table

Quantity	To convert from metric unit	To customary unit	Multiply metric unit by	To convert to metric units, multiply customary unit by
Length	millimeters (mm)	inches (in)*	0.03937	25.4
	centimeters (cm) for snow depth	inches (in)	0.3937	2.54
	meters (m)	feet (ft)	3.2808	0.3048
	kilometers (km)	miles (mi)	0.62139	1.6093
Area	square millimeters (mm^2)	square inches (in^2)	0.00155	645.16
	square meters (m^2)	square feet (ft^2)	10.764	0.092903
	hectares (ha)	acres (ac)	2.4710	0.40469
	square kilometers (km^2)	square miles (mi^2)	0.3861	2.590
Volume	liters (L)	gallons (gal)	0.26417	3.7854
	megaliters	million gallons (10*)	0.26417	3.7854
	cubic meters (m^3)	cubic feet (ft^3)	35.315	0.028317
	cubic meters (m^3)	cubic yards (yd^3)	1.308	0.76455
	cubic dekameters (dam^3)	acre-feet (ac-ft)	0.8107	1.2335
Flow	cubic meters per second (m^3/s)	cubic feet per second (ft^3/s)	35.315	0.028317
	liters per minute (L/mn)	gallons per minute (gal/mn)	0.26417	3.7854
	liters per day (L/day)	gallons per day (gal/day)	0.26417	3.7854
	megaliters per day (ML/day)	million gallons per day (mgd)	0.26417	3.7854
	cubic dekameters per day (dam^3/day)	acre-feet per day (ac-ft/day)	0.8107	1.2335
Mass	kilograms (kg)	pounds (lbs)	2.2046	0.45359
	megagrams (Mg)	tons (short, 2,000 lb.)	1.1023	0.90718
Velocity	meters per second (m/s)	feet per second (ft/s)	3.2808	0.3048
Power	kilowatts (kW)	horsepower (hp)	1.3405	0.746
Pressure	kilopascals (kPa)	pounds per square inch (psi)	0.14505	6.8948
	kilopascals (kPa)	feet head of water	0.33456	2.989
Specific Capacity	liters per minute per meter drawdown	gallons per minute per foot drawdown	0.08052	12.419
Concentration	milligrams per liter (mg/L)	parts per million (ppm)	1.0	1.0
Electrical Conductivity	microsiemens per centimeter (µS/cm)	micromhos per centimeter (µmhos/cm)	1.0	1.0
Temperature	degrees Celsius (°C)	degrees Fahrenheit (°F)	(9/5 x °C)+32	(°F - 32) x 5/9

2021 Meeting Program

Your 2021 Planning Committee, and Program Subcommittee, hope you will value our efforts to combine information into this document.

2021 Program Subcommittee

Matthew Young
Nicole Kwan
Dave Lentz

Thank you for another great meeting and we'll see you at the 2022 Cal-Neva AFS Meeting or the annual meetings for the virtual meeting of the Western Division AFS and the National AFS Meeting in Baltimore, MD