The California State University
COUNCIL ON OCEAN AFFAIRS, SCIENCE & TECHNOLOGY (COAST)

Graduate Student Research Award Program
AY 2021-2022 Application Form
Application Deadline: Thursday, January 27, 2022, 5:00 p.m. PST

Please see information on Graduate Student Research Awards on the COAST **website** and read the **Announcement** for full details and instructions.

Save as both a Word document and a PDF file named as follows: *LastName_FirstName_App.docx* and *LastName_FirstName_App.pdf*. Submit both files as attachments, along with your **Advisor Sign-Off Form** and **Department Commitment Form** (if needed) in **ONE** email to graduate@share.calstate.edu. **Please note**: A signature is required from your advisor on the **Advisor Sign-Off Form** in the PDF version of your application that you submit (the word document does NOT need to be submitted with a signature). Your Advisor must submit your LOR to gradletter@share.calstate.edu separately.

Student Applicant Information

First Name:	Katherine	Last Name:	Stonecypher
CSU Campus:	Humboldt State University	Student ID#:	
Email:		Phone:	
Degree Program:		Degree Sought (e.g., MS, PhD):	MS
Matriculation Date (mm/yy):		Anticipated graduation date (mm/yy):	
GPA in Major Courses:		Thesis-based? (Y/N):	Y

Advisor Information

First Name:	Alison	Last Name:	O'Dowd
CSU Campus:	Humboldt State University	Department:	Environmental Science & Management
Email:		Phone:	

Research Project Title:	*Diet, Growth, and Survival of Coho Salmon (Oncorhynchus kisutch) in Off-Channel Floodplain and Estuarine Habitats*
Project Keywords (5-7 keywords related to your project):	Coho Salmon, habitat restoration, estuary, floodplain, macroinvertebrates

Budget Summary (must add up to $3,000)

Award amount directly to awardee:	3000
Award amount to Department (DCF required for department funding):	

The information on this page is for COAST use only and will not be shared with potential reviewers.

Have you previously received a COAST Graduate Student Research Award? (Y/N)	N
If yes, please provide year(s) of award(s):	

CSU Suggested Reviewers (Required): Suggested reviewers must be from the CSU. Use the COAST member database to help identify potential reviewers. Do not suggest any reviewers from your campus or reviewers with a potential conflict of interest.

Name:		
CSU Campus:		
Department:		
Email:		

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Please refer to the **Award Announcement** for detailed instructions on the information required for each of the following sections. All the boxes below will expand as you type.

Project Description (65 points total): 1,500-word maximum; any text over this limit will be redacted

Located along the northern California coast, the Humboldt Bay watershed drains an area of approximately 578 km² and contains the second largest coastal estuary in California and fifth largest coastal estuary along the conterminous Pacific Coast (Schlosser and Eicher 2012; Barnhart et al. 1992). The four major tributaries to Humboldt Bay include Salmon Creek, Elk River, Freshwater Creek, and Jacoby Creek. The Humboldt Bay watershed was heavily modified by anthropogenic activities beginning in the era of European colonization and continuing to the present time (Barnhart et al. 1992).

Commercial timber harvest and associated road building on steep slopes exacerbated naturally high rates of erosion and reduced recruitment of large woody debris to stream channels in the upper reaches of tributary watersheds of Humboldt Bay (Schlosser et al. 2009). The lower elevation portions of Humboldt Bay's tributary watersheds were altered through the construction of tide gates and levees intended to convert wetlands into land usable for agriculture and urban development (Shapiro and Associates 1980). These modifications disrupted sediment transfer processes and decreased the frequency of overbank flood events essential to forming off-channel habitats (Beechie et al. 2010).

Off-channel habitats in floodplains and estuaries provide critical winter rearing habitat for juvenile Coho Salmon (*Oncorhynchus kisutch*) (Flitcroft et al. 2019, Henning et al. 2006), including access to valuable foraging opportunities prior to smoltification (Thorpe 1994, Beck et al. 2001). The availability of off-channel habitat during winter rearing in floodplains and coastal estuaries is associated with overwinter survival in juvenile Coho Salmon; these areas provide refuge for juvenile Coho from high velocity winter flows (Solazzi et al. 2000, Roni et al. 2006). Overwinter survival is considered a limiting life stage for many Coho Salmon populations along the Pacific coast (Gallagher et al. 2012; Nickelson et al. 1992).

Multiple studies have documented increased abundance of Coho Salmon following restoration of off-channel habitat (Ebersole et al. 2006, Johnson et al. 2005). Off-channel habitat restoration may also improve overwinter survival in juvenile Coho Salmon (Ebersole et al. 2006) and promote growth through increasing the abundance of invertebrate prey (Aha et al. 2021, Arbedier et al. 2019, Woo et al. 2017, Bellmore et al. 2013). Few studies have examined the relationship between diet, growth, and overwinter survival in restored off-channel ponds in both floodplains and estuaries. The purpose of this study is to compare prey availability, diet, growth, abundance, and overwinter survival of juvenile Coho Salmon rearing in coastal freshwater and estuarine off-channel restoration projects. Results can be used to quantitatively assess the role of restored off-channel habitats in recovery of threatened Coho Salmon populations.

Methods

I will be sampling three constructed off-channel ponds and adjacent mainstem habitats within the Freshwater Creek watershed for this project: 1) Cochran Creek, 2) Quail Slough, and 3) Howard Heights. Cochran Creek and Quail Slough are tidal estuarine habitats that were constructed by excavating historic slough channels and reintroducing muted tidal influence. Howard Heights is a freshwater floodplain habitat that was constructed by excavating a backwater alcove. These ponds were selected because they provide a useful contrast between floodplain and estuarine off-channel restoration projects. They also align with a Life Cycle Monitoring Station (LCM) for salmonids on Freshwater Creek. The California Department of Fish and Wildlife (CDFW) operates a downstream migrant trap (DSMT) for juvenile Coho Salmon at the LCM which will provide fork length, weight, and detection data that will be used in estimates of growth and overwinter survival.

I will be seining off-channel ponds and adjacent mainstem pool units in December of 2021. Seining will continue twice monthly until May 2022 because these are the months during which the ponds are inundated and fish are present. During monthly seining events, I will be marking Coho Salmon >60 mm in length with Passive Integrated Transponder (PIT) tags. One seining effort is required to mark fish in each

pond or pool unit each month and a second seining effort is required within 72 hours for a mark-recapture estimate of abundance (Grimm et al. 2014).

I will be using a 3-meter and 10-meter seine net to capture fish, which are anesthetized in a prepared solution of 150 mg/L buffered MS-222 (Carter et al. 2011). All fish will be scanned using a handheld PIT tag reader (BioMark HPR Lite) and the weight (g) and fork length (mm) is measured. Tag numbers of previously tagged fish will be recorded as a recapture event. A maximum of 30 unmarked fish will be tagged with a PIT tag. A small incision will be made in the body cavity anterior to the pectoral fin using a sterile scalpel. An 8 mm PIT tag (BioMark, Inc., Boise, Idaho; MiniHPT8, 8.4 mm long, 1.4 mm wide) will be placed in the incision.

I will be using non-lethal gastric lavage to collect samples of gut contents from up to 15 remaining fish. Fish will be held head-down over a mesh sieve while the gut contents are flushed out by a stream of water from a sterile pipette inserted through the mouth (Strange and Kennedy 1981). Diet samples will be preserved in 90% ethanol solution. Following PIT-tagging and/or lavage, all fish will be transferred to a live well for recovery prior to their immediate release back to the location from which they were captured.

A mobile PIT tag antenna was installed at the outlet of the Cochran Creek off-channel pond in December 2021; the location of this antenna will be alternated between the outlet of the Quail Slough off-channel pond and the outlet of the Cochran Creek off-channel pond once per month. This antenna will provide detection data on PIT-tagged fish entering and exiting the constructed ponds. Permanent PIT-tag antenna arrays previously installed at Howard Heights and the Freshwater Creek LCM will also provide detection data.

I am conducting seasonal invertebrate sampling in off-channel pond and mainstem habitats four times during the sampling period (December, February, April, and May). The goal of this sampling is to capture seasonal variation in invertebrate communities to determine if taxa present in lavage samples are representative of taxa present at the sites. Five invertebrate sampling locations will be randomly selected at each pond and adjacent mainstem pool unit and a 500-micron mesh D-net will be swept across any rocks, sediments, and vegetative-woody cover within a $3m^2$ area for approximately 30 seconds to capture macroinvertebrates. I will also tow a plankton net through 5 horizontal transects within off-channel ponds to capture zooplankton on the water surface. Contents of the D-net and plankton net will be drained of excess water and suspended in 90% ethanol solution in Whirl-Pak bags.

In the laboratory, macroinvertebrates and zooplankton from D-net, plankton net, and fish lavage samples will be separated from detritus, placed in petri dishes, and examined under a dissecting microscope. Specimens will be identified to family (using identification guides in Merritt et al. 2019, Thorp & Covich 2009, and Carlton 2007) and measured to the nearest millimeter. Invertebrate biomass will be determined using published length-mass equations (Benke et al. 1999; Sabo et al. 2002; Wardhaugh 2013). Relative gut fullness (mg/g) will be determined for each lavaged fish by dividing total invertebrate biomass from lavage samples by the mass of each fish.

Two HOBO Water Temp Pro v2 data loggers will be deployed in each off-channel pond and adjacent mainstem pool unit to collect continuous water temperature data for the duration of the sampling period (December 2021-May 2022). One data logger will be installed at the bottom of the water column and the other will be suspended in the water column to account for stratification. Water quality data will be collected during each seining and invertebrate sampling event at each site. Salinity, conductivity, and dissolved oxygen will be measured using a YSI handheld multi-parameter meter. Chlorophyll-*a* and turbidity will be measured using a Turner designs field fluorometer.

Data Analysis Plan

Nonmetric multidimensional scaling (NMDS) will be used to compare invertebrate prey communities within and among sampling types, sites, and months. NMDS will also be used to assess differences in diet composition among sites and over time. Daily growth rates of PIT-tagged fish will be calculated as the difference in fork length at first capture and fork length at subsequent recapture events divided by the

number of days between captures. Mark-recapture estimates of abundance in off-channel pond and mainstem habitats will be made using the Lincoln-Peterson method (Lincoln 1930, Rebenack et al. 2015).

Data retrieved from PIT tag antenna arrays will be used with data collected by CDFW at the Freshwater Creek LCM to estimate overwinter survival rates of fish tagged in off-channel pond and mainstem habitats using Cormack-Jolly-Seber analysis (Cormack 1964, Rebenack et al. 2015). Seasonal trends in diet and growth will be assessed using a bioenergetic model to quantify energetic intake with temperature and dissolved oxygen as covariates (Rosenfeld and Taylor 2009). A generalized linear model will be used to assess differences in abundance, growth rates, and overwinter survival among sample sites with prey biomass, gut fullness, temperature, and dissolved oxygen as predictors.

References (0 points): no limit

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Timeline (10 points total): 250-word maximum; any text over this limit will be redacted

Dec 2021-May 2022: Complete field sampling activities and begin processing invertebrate samples
May 2022-August 2022: Laboratory processing of invertebrate samples
August 2022-December 2022: Data analysis and write thesis
January 2023-April 2023: Manuscript preparation for submission to Transactions of the American Fisheries Society journal and write Master's thesis
April 2023: Oral presentation of results at annual Salmonid Restoration Federation Conference
May 2023: Thesis defense and graduation

Need for Research (7 points total): 250-word maximum; any text over this limit will be redacted

Anthropogenic degradation of floodplain and estuarine habitats has been extensive along the Pacific coast, contributing to a loss of habitat complexity including coastal off-channel ponds and decline of salmonid populations (Katz et al. 2013). Coho Salmon in the Humboldt Bay watershed are part of the Southern Oregon-Northern California Coast (SONCC) Evolutionarily Significant Unit (ESU). SONCC Coho Salmon were listed as threatened under the federal Endangered Species Act (ESA) in 1997 (62 FR 24588), a status that was reaffirmed in 2005 (70 FR 37159).

A deficiency in the quantity and quality of off-channel habitats has been identified as a limiting factor for Coho Salmon populations in Humboldt Bay tributaries (NMFS 2014). Recent efforts to restore rearing habitat for Coho Salmon have resulted in the construction of off-channel ponds in Humboldt Bay tributaries. Despite the active restoration of off-channel ponds, there has been limited monitoring and research as to the effectiveness of constructed off-channel ponds to provide productive habitat for threatened Coho Salmon. Results of this study will be used to assess the role of constructed off-channel ponds in growth, abundance, and overwinter survival of threatened SONCC Coho Salmon along the coast of Northern California.

Relevance to state of California (3 points total): 100-word maximum; any text over this limit will be redacted

Many of California's salmonid populations are currently declining, endangered, or at immediate risk of extinction; current population trajectories indicate that within the next century, an estimated 78% of California's native salmonid taxa face extinction (Katz et al. 2013). Despite the vulnerable status of many of California's salmon stocks, data on the role of coastal restoration efforts in salmonid recovery is lacking (Roni et al. 2019). Results of this study will be of interest to state and federal agencies, tribes, non-profits, and all others involved in salmonid habitat restoration across the state of California.

Budget and Justification (15 points total)

Example Budget (feel free to erase the content and use this format, adding additional rows as necessary, or create your own):

Item/Description	**Unit Price**	**Quantity**	**Amount to Awardee (via Financial Aid)**	**Amount to Department**
Living Expenses (1.5 months)			$3000.00	
		Subtotals:	*$3000.00*	
		Grand Total	**$3,000.00**	

Justification (250-word maximum; any text over this limit will be redacted):

Living Expenses (1.5 months) – I am requesting the full award amount of $3000.00 to help defray living expenses incurred during the completion of my thesis work. This amount will cover approximately 1.5 months of living expenses, including rent, electricity, water, insurance, phone, gas, and childcare. Since I do not have alternate funding sources for my research, I am using gear and supplies that belong to the university and working as a scientific aide with the California Department of Fish and Wildlife to help cover my living expenses. Allocating COAST funding entirely to living expenses will free up approximately 255 hours that I can devote to processing invertebrate samples, completing data analysis, and writing my thesis that I would have otherwise been required to devote to working.

Application Deadline: Thursday, January 27, 2022, 5:00 p.m. PST
Save as both a Word document and a PDF file named as follows:
***LastName_FirstName_App.docx* and *LastName_FirstName_App.pdf*.**
Submit both files as email attachments in ONE email (with other required forms) to graduate@share.calstate.edu.

Within 24 hours of application submission, you will receive a confirmation email from COAST. Please save this confirmation email for future reference. If you do not receive a confirmation email, please contact Kimberly Jassowski (kjassowski@csumb.edu) to ensure your application was received.

CSU The California State University
COUNCIL ON OCEAN AFFAIRS, SCIENCE & TECHNOLOGY (COAST)

Graduate Student Research Award Program
AY 2021-2022 Advisor Sign-Off Form

To encourage you to engage with your CSU Advisor as you develop your application, **we are now requiring this Form for all applications submitted to the COAST Graduate Research Award Program**. By signing this form, your advisor indicates that they have reviewed your application, provided guidance and input, and approved it for submission. All information except signatures must be typed. Electronic signatures are acceptable. **Please note:** A signature is required from your advisor on this **Advisor Sign-Off Form** in the **PDF version** of your application that you submit (the word document does NOT need to be submitted with a signature)

Please note: this form is NOT a substitute for a letter of recommendation (LOR). Your Advisor must submit your LOR to gradletter@share.calstate.edu separately.

Applicant Name:

Katherine Stonecypher

CSU Advisor Information:

Name:	Alison O'Dowd	Phone:	707-826-3438
Department:	Env Science & Management	Email:	Ap73@humboldt.edu

I have reviewed my student's application and provided guidance and input. My signature below indicates my approval of the application.

CSU Advisor Signature:  Date: 1/26/2022