Rehabilitation of Clear Lake, CA

Six-monthly Report to the California Department of Fish and Wildlife
Project No. P1720013

For the period: 6/22/2018 – 12/21/2018

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UCDAVIS Tahoe Environmental Research Center

UCDAVIS CENTER FOR REGIONAL CHANGE

1.0 Introduction

As specified in AB 707, UC Davis has been requested to conduct research toward the rehabilitation of Clear Lake, California. Clear Lake is subject to eutrophication as a consequence of the result of high concentrations of nutrients. These nutrients stimulate the growth of high levels of algae and cyanobacteria and consequently present severe challenges to Lake County, the communities the lake serves, water purveyors, tribal entities, and other lake users and stakeholders. These challenges include algal blooms (including cyanobacterial blooms that have potential toxicity and human health consequences), mercury contamination, water taste and odor issues, and the perception issues that these conditions perpetuate. In addition, there are substantive challenges related to invasive species, reduced habitat and spawning areas for native fish, impacts on native vegetation and high water treatment costs.

These water quality and ecological conditions have produced a range of social and economic consequences, stemming in part from a combination of the real and perceived conditions in the lake. The communities of the lake region also face problems of high unemployment and poverty associated with the downturn in the local economy over several decades as well as social issues related to education, public health, and crime.

This project is managed by the **UC Davis Tahoe Environmental Research Center (TERC)**, but the scientific/research effort is the combination of the efforts of TERC and of the **UC Davis Center for Regional Change (CRC)**. Both Centers are coordinating their project activities, including the county, community, and tribal entity engagement, to provide a cohesive and sustainable approach to working with Clear Lake region partners.

TERC Objectives are to understand those processes in the Clear Lake watershed and in the lake itself that are preventing the rehabilitation of the lake water quality and ecosystem health. The data acquisition that will be needed will form the basis of a long-term monitoring strategy to measure status and trends in the future. A set of numerical models will be developed to inform local and State decision-making.

CRC Objectives are to inform social and economic decision-making activities. This will be achieved by conducting applied research toward improving the social and economic outcomes for the communities surrounding Clear Lake in Lake County. The CRC will focus on developing a baseline socio-economic analysis and community and Tribal engagement around strategies to improve the community vitality of the Clear Lake region.

This six-monthly progress report is divided into separate summaries of TERC activities for the period and CRC activities for the period.

2.0 TERC Activities

2.1 Personnel

We have completed the formation of the project team as follows:
Dr. Geoff Schladow (PI) – project direction, field data, numerical modeling
Dr. Alex Forrest (co-PI) – field data, autonomous instrumentation
Dr. Steven Sadro (co-PI) – biogeochemistry, water quality
Graduate Students – Micah Swann, Andrew Stang, Samantha Sharp
Watershed modeling – Dr. Goloka Sahoo
Field staff – Raph Townsend, Brandon Berry, Nick Framstead
Laboratory staff – Tina Hammel, Anne Liston, Steven Sesma, Dr. Lidia Tanaka
Database analyst – Dr. Shohei Watanabe
External Advisor – Dr. Alicia Cortés

The research staff have initiated weekly meetings in order to all stay apprised of progress and challenges.

2.2 Purchase of Equipment

Six water quality stations (or moorings) have been purchased for deployment in Clear Lake. Each station consists of up to 10 RBR temperature loggers and up to 2 RBR dissolved oxygen sensors. Temperature is an excellent indicator of the vertical stratification of the lake. Stratification is important as it controls the dissolved oxygen distribution, and dissolved oxygen is known to control nutrient chemistry, methyl mercury formation, fish kills and a range of other water quality conditions.

The moorings will be deployed in the approximate locations shown in Fig. 1. The final locations are still being discussed.

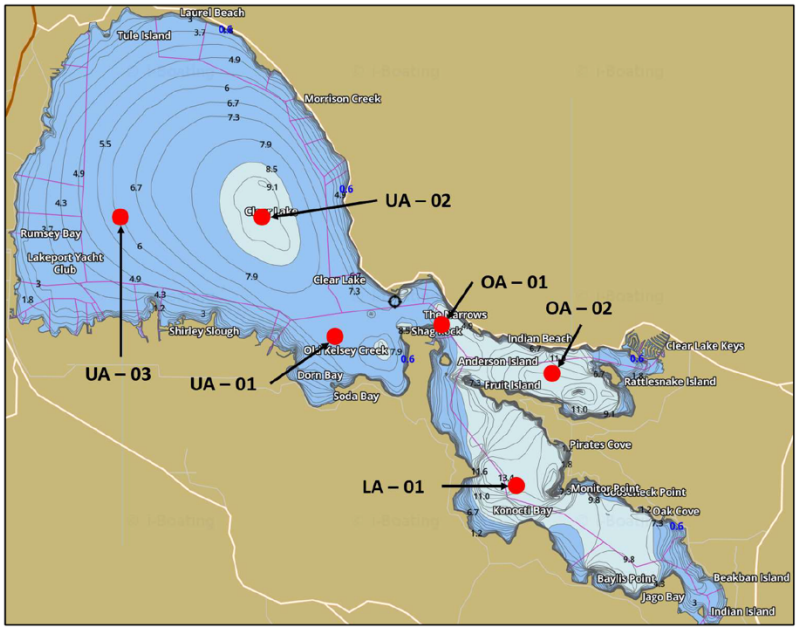

Fig. 1. Mooring Locations

The moorings will in general have the arrangement shown in Fig. 2. The arrangement of the temperature loggers will vary from site to site depending on water depth. Three moorings will have two dissolved oxygen sensors, and the other three will have one dissolved oxygen sensor.

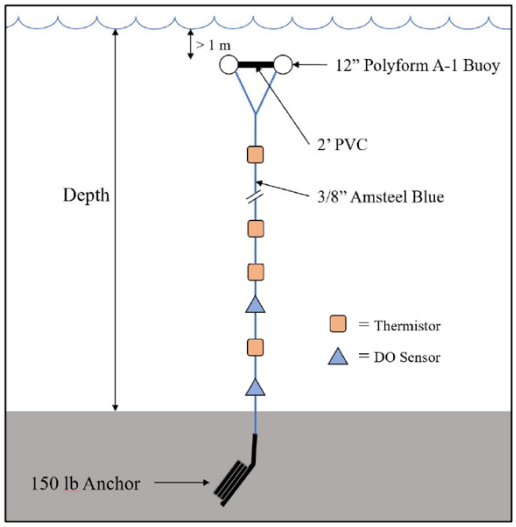

Fig. 2. General mooring design

This equipment is currently being assembled into the stations, and laboratory calibrations are being undertaken to ensure the highest accuracy.

A Nortek Sentinel 1000 ADCP has also been purchased and will be installed adjacent to the different water quality stations for periods of time between 1-3 months. The ADCP is installed on the bottom of the lake by a diver, and measures 3-D profiles of lake currents continuously. These data will help us better understand the movement of water within each lake basin and between them. This instrument can simultaneously acquire echosondes of the water column, allowing us to identify the positions and the numbers of fish (both bass and hitch). We believe that there is an important relationship between the hitch and the dissolved oxygen distribution (which we are measuring at each station). We plan to collaborate with the USGS on this aspect of the project.

In early October, the TERC research vessel was brought to Clear Lake to commence lake surveying and initial water quality measurements. However, a major mechanical failure on this recently overhauled vessel required that it be returned for repairs. It is anticipated that the R/V Frantz will return to Clear Lake in January, 2019.

Three stream turbidity stations were ordered in September. These each comprise a Campbell Scientific data logger (with a modem for real-time data acquisition), a solar panel, and an FTS turbidity and water temperature probe. These stations are being co-located with the DWR flow gaging stations on Middle Creek, Scott's Creek and Kelsey Creek. By collecting these data continuously (every 5 minutes) it will be possible to develop regressions

between these continuous data and the less frequent (every 2-4 week) nutrient data that are collected in a collaboration between DWR, Lake County and TERC.

The Middle Creek station was installed on December 20, 2018, and the Kelsey Creek and Scott's Creek stations were installed on December 21, 2018. The data are being uploaded to UC Davis where they will be collated, QA'd, and then made available to all stakeholders. Figure 3 shows the installation of the Middle Creek turbidity station and an example of the data recorded at each timestep.

[Timestamp] 12/20/18, 10:55:54 PM	
Record Number	8
BattV	12.7236 Volts
PTemp_C	12.0935 Deg C
Turb_Mean	2.19 NTU
Turb_Var	0.0823 NTU
Turb_Median	2.13 NTU
Turb_BES	2.15 NTU
Turb_Min	1.76 NTU
Turb_Max	3.14 NTU
Turb_Temp	11.9 deg C

Fig. 3. Raph Townsend working with DWR staff to install a real-time turbidity station at Middle Creek (left). An example of a data record (right).

2.3 Meetings/Coordination

Since the start of this project TERC has participated in or initiated a number of meetings aimed at coordinating with local stakeholders, agencies and other working groups engaged within Clear Lake. These meetings include:

Site Visit with County (Aug. 27, 2018)

TERC members present: G. Schladow, S. Sadro, M. Swann

A field site visit was conducted in coordination with Angela De Palma-Dow of Lake County Water Resources Department and Harry Lyons. Scotts Creek, Middle Creek, and Kelsey

Creek were visited to assess access determine feasibility of installing turbidity sensors at existing stream monitoring sites. After the site visit, met with David Cowen, Water Resources Director for Lake County to discuss ways in which TERC sampling might augment existing county monitoring programs.

Fire Response Meetings (Oct. 2, 2018)
TERC members present: G. Schladow, S. Sadro

Participated in a meeting of stakeholders who plan to or have interest in conducting post-fire sampling within the Clear Lake watershed. Participants included county representatives, state and federal agency personnel, UCD scientists, non-profit participants, and Native American tribal representatives. Contributed to discussions regarding sampling methods, types of samples to be collected, and logistics of coordinating sampling among participating stakeholders. A second meeting was held several weeks later (S. Sadro participated)

Blue Ribbon Meeting (Oct. 10, 2018)
TERC members present: G. Schladow, A. Forrest, S. Sadro

At this initial meeting, held at Clear Lake, overview of the project was provided by Schladow and questions were taken from the Committee. Feedback from this process was then included in the ongoing development of the work plan.

USGS Meeting (Oct. 17, 2018)
TERC members present: G. Schladow, A. Forrest, S. Sadro, M. Swann, A. Stang, S. Sharp, S. Watanabe

This meeting held on-campus in Davis was set up by the TERC team to better understand ongoing USGS interests in the region. Representatives from both the West Sacramento and Sacramento State units participated. Topics discussed included stream gauging and monitoring, water quality sampling, fish sampling and monitoring of aquatic vegetation around the region. Points of possible collaboration were identified and are currently being developed. It is planned to continue these meetings.

Stakeholder Meeting (Oct. 24, 2018)
TERC members present: G. Schladow, A. Forrest

This three-part meeting (Tribes, local authorities and general public) was held in conjunction with the CRC to identify concerns from the three stakeholder groups. A short presentation was given by researchers from each Center during each 2-hour session followed by an extended Q&A period in breakout groups. This exercise was essential for identifying possible synergies within the work plan that is currently in development with the biggest directed outcome being management of the contacts within the County.

Blue Ribbon Meeting (Dec. 20, 2018)

TERC members present: G. Schladow

In the morning a field trip visited a burn site along Middle Creek, the Middle Creek stream gauging station, Rodman Slough, and the Middle Creek Restoration site. During the afternoon meeting, Schladow substituted for Dr. Paul Dodd, the UC Davis Blue Ribbon Committee representative. Schladow undertook to provide the Blue Ribbon committee with a complete lake and stream measurement and analysis plan in January.

TERC has also been reaching out to a number of stakeholders who have collected water quality or environmental data at Clear Lake. These include provate citizens, retired government employees, retired UC Davis employees. Once we better understand the types of data that are available we will seek to obtain the data that are relevant to our objectives, and compile a comprehensive data repository. The data that TERC collects as part of this project will also become part of this repository and be publicly available.

2.4 Contracting

An amendment to the contract was concluded with DFW. The amendment simply extended (at no change in cost) the length of the contract to the full three-year period that was originally intended.

3.0 CRC Activities

3.1 Meetings & Communication

Blue Ribbon Committee Meeting

The first Blue Ribbon Committee meeting took place on October 10, 2018 at the Running Creek Casino. The meeting provided an overview of the Blue Ribbon Committee's purpose, members, and facilitation process, as well as detailed presentations on the two key components of the Clear Lake rehabilitation study that will inform the decision-making of the Blue Ribbon Committee.

Dave Ceppos, Managing Senior Mediator, and Sam Magill, Senior Facilitator, from the Sacramento State University College of Continuing Education Consensus and Collaboration Program (CCP) provided a presentation on CCP's role as the facilitator of the Committee process and proposed immediate next steps for stakeholder engagement. Geoff Schladow, Director of the UC Davis Tahoe Environmental Research Center (TERC) presented TERC's scope of work for the water quality and ecosystem restoration of Clear Lake. Jonathan London, Faculty Director of the UC Davis Center for Regional Change (CRC), presented the CRC's scope of work for the socio-economic assessment and community revitalization of the Clear Lake region. After the presentation, Committee members and public participants had an opportunity to engage in questions and comments regarding the proposed work. The next meeting will take place on December 20, 2018 at the Habematol Tribal Chambers, which will be preceded by the Middle Creek field visit to learn more about the variety of land uses that impact the lake.

Stakeholder Meeting

The UC Davis Center for Regional Change (CRC) and the UC Davis Tahoe Environmental Research Center (TERC) are committed to cultivating strong stakeholder engagement across tribal, county, and community entities. This work will inform the priorities and strategic planning of the Blue Ribbon Committee. To begin this process, the CRC and TERC held three in-person stakeholder meetings on October 24th to discuss partnerships, priorities, and ongoing efforts related to AB 707. The CRC and TERC briefly presented their scopes of work and introduced the faculty members responsible for leading the environmental assessment and socioeconomic assessment.

These three meetings provided space to meet separately with tribal representatives, county officials and public agency representatives, and residents and organizations (respectively). Each stakeholder group had an opportunity to share their respective knowledge and experience regarding a wide range of topic areas, including economic development, education, youth engagement, social services, cultural preservation, and the environment, among others*.

Following these stakeholder meetings, UC Davis faculty members will build upon these initial relationships and utilize the stakeholder input to inform their research efforts. Continued coordination and communication remain a priority between the CRC, TERC, and CCP as the project moves forward.

UCD Website

The CRC and TERC have created a UCD website to inform the public on the Rehabilitation of Clear Lake project: https://clearlake.sf.ucdavis.edu/. We will keep this website current by posting meeting agendas and notes, news articles, and data and publications related to this project as well as previous research conducted in the area.

3.2 Project Investigator Updates

M. Anne Visser: Community Engagement

The goal of my work on this project is to develop a proposal for a prototype of a mapping tool similar to the Regional Opportunity Index (interact.regionalchange.ucdavis.edu/roi/) that can be used to measure opportunity on Tribal Lands in Lake County specifically, but also a prototype that can be used to measure opportunity across tribal lands in the US broadly. I envision this as a tool in which leaders/tribal members can seek to construct indexes of opportunity based upon their perceptions of issues facing them, selecting from various data sets that we have.

We have been in initial contact with tribal leaders and are setting up meetings and hopefully focus groups over the next six months.

Noli Brazil: Socioeconomics

The goal of the assessment is to summarize the demographic and socioeconomic conditions of the Clear Lake community, how these conditions have changed over time, and how these conditions compare to the broader region. The first step in this process is to scan 1) what

assessments of the area have already been done, 2) what assessments are concurrently in progress (or are planned to be done in the near future), and 3) available data sources. Using feedback from the stakeholders meetings on October 24th, I have reached out to several researchers and agencies in the region to determine what kind of analysis has already been conducted or is in process. I also have an undergraduate working for me who is currently scanning for additional assessment reports of Lake County and surrounding communities.
In the next several months, I plan to conclude steps (1)-(3) above, establish a theoretical and methodological framework for assessing the area, and start collecting necessary data. Rough preliminary results may be available by the next status update in June.

Keith Taylor: Economic Development
Community Economic Development Specialist Keith Taylor has engaged in exploratory fieldwork. As part of those endeavors, Dr. Taylor has started the strategic planning process. Strategic planning also involves the early phases of an asset-based community development assessment. This work will capture the narratives of individuals in Lake County, for the purposes of a strategic plan meaningful and useful to countywide stakeholders.

Project Evaluation
Vikram Koundinya: Possible publications

1. A paper focused on the program development and evaluation methods (modeled on this paper: Enhancing interdisciplinary climate change work though comprehensive evaluation)
2. A paper presenting the evaluation results (modeled on this paper: Core competencies for successful watershed management practitioners)
3. A Journal of Extension methods paper brief from Keith Taylor's *Strategic Doing* method and evaluation of the method (modeled on this paper: UserTesting.com: A tool for usability testing of online resources)

*The October 24, 2018 Stakeholder meeting included 42 participants with representation from the following entities:
Tribal Representatives
Scotts Valley Band of Pomo Indians
Elem Indian Colony
Habematolel Pomo of Upper Lake
Robinson Rancheria
Big Valley Band of Pomo Indians
Middletown Rancheria of Pomo Indians of California

Public Agency Representatives
CA State Parks
Yolo County Flood Control & Water Conservation District (YCFCWCD)
County of Lake Board of Supervisors
County of Lake Administrative Office
National Resources Conservation Service

City of Lakeport
Lakeport City Council
California Fish and Game Commission
County of Lake - Special Districts Administration
Lake County Department of Water Resources
Middle Creek Restoration Coalition

Community Stakeholders
Residents
Clear Lake Environmental Research Center
Clear Lake Youth Center
Redbud Audubon Society
Peggie King and Associates
Lake County Land Trust
Lakeport Economic Development Advisory Committee
Lakeport Unified Sschool District
Lake County Economic Development Corp
Ruzicka Associates, Civil Engineers, Surveyors
Lake County Public Health
Lake County Farm Bureau
Sierra Club Lake Group
Lake County News