2021 Mad River Temperature Monitoring Study Summary Report

Adult Summer Steelhead Observed in Mad River During 2017 Snorkel Survey photo by Jacob Pounds

A project of Blue Lake Rancheria and Mad River Alliance with assistance and cooperation from the North Coast Regional Water Quality Control Board

Introduction

In the summer of 2021, the Blue Lake Rancheria (BLR), in partnership with Mad River Alliance (MRA), and with cooperation from the North Coast Water Quality Control Board (NCRWQCB), undertook a collaborative temperature monitoring project in order to better understand the water temperature dynamics in mainstem of the Mad River Watershed.

During the warmest part of the summer (July-October) 7 HOBO thermographs were deployed between the Matthews Dam at river mile 84 and the Mad River Estuary. Four of these HOBOs were deployed in the Mainstem Mad River to understand temperature dynamics of the free-flowing mainstem between Matthews Dam and the estuary. Three of these thermographs were used at air temperature references throughout the basin where different climate regimes are recognized: lower basin/coastal, middle basin/transitional, and upper basin/inland.

Watershed Overview

The Mad River watershed is located in northern California, and flows roughly 100 miles northwest from its source in the southern Klamath Mountains in southwestern Trinity County, through the Franciscan mélange of the Coast Range mountains in Humboldt County, meeting the Pacific Ocean a few miles north of Humboldt Bay. The watershed drains 497 square miles of steep, forested mountains and rolling oak-grassland hills, and is fairly narrow, averaging six miles wide through the middle-upper canyon.

The Mad River serves as the source of drinking water for 88,000 Humboldt County residents served by the Humboldt Bay Municipal Water District (HBMWD). During the low flow season, typically June through October, Mad River flows are augmented by water releases from R.W. Matthews Dam, which impounds Ruth Lake. HBMWD manages water released from Ruth Lake at R.W. Mathews Dam. These releases likely affect water temperatures downstream of the dam, but the extent and magnitude is unknown.

Mad River Status as Impaired for Sediment, Turbidity, and Temperature

In 1992, the Environmental Protection Agency (EPA) added the Mad River to Clean Water Act Section 303(d) List of Impaired Waters due to elevated sedimentation/siltation and turbidity. The North Coast Regional Water Quality Control Board (NCRWQCB) identified water temperature as an additional impairment to the watershed in 2006 (Stillwater Sciences, 2010), but a temperature TMDL is not yet scheduled (Fitzgerald, Rebecca. California State Regional Water Quality Control Board, pers. comm. 2015). Blue Lake Rancheria and all associated partners hope to fill some of the knowledge gaps regarding temperature conditions in the Mad, with this study.

Previous Temperature Monitoring

- Lewis et al. compiled a report for the Forest Science Project (FSP) in 2000, entitled: Regional Assessment of Stream Temperatures across Northern California and Their Relationship to Various Landscape-Level and Site-Specific Attributes.
- Green Diamond Resource Company (and formerly Simpson Timber Company) collected summer time water temperature data in several tributaries including: Boulder Creek between 1994 and 2007, Maple Creek between 1994 and 1999, at a number of stations in the Cañon Creek sub-basin between 1994 and 2007, and at a single station in Lindsay Creek from 1994 through 2007 (personal communication Matt House 2015)
- Dennis Halligan collected temperatures in Hall and Quarry Creek from 1995 till 1998 for the Fisheries Monitoring Program for Gravel Extraction operations on the Mad River.
- Six Rivers National Forest collected summer time continuous data from Pilot Creek from 1996-2002
- MRA with BLR and various partners (Green Diamond, Humboldt Bay Municipal Water District, HT Harvey and Associates, NCRWQCB) collected tributary and mainstem data for up to 30 sites between 2014-2019).

Methods & Materials

The study consists of two integral parts: 1) guiding documents and 2) physical equipment to collect and process collected data. The guiding document used to guide the process is the, '*Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Station Operation, Record Computation, and Data Reporting.'* From United States Geological Survey. The physical equipment consists of HOBO continuous temperature loggers, PVC tubes and galvanized pipe end caps used to create secure housings for HOBOs, and braided wire cable to secure HOBOs to their respective sampling sites; a field record book and reference photographs to give proper guidance to the deployment and retrieval sites of HOBOs and collect metadata about the deployment/retrieval sites.

Site selection was completed using land ownership and access considerations, local knowledge and satellite mapping software (GoogleEarth). Using known available access points and known holding habitats for salmonid species, a priority list of accessible sites was created. Public access is extremely limited in the stretch of Mad River between the towns of Mad River and Blue Lake, so some desired monitoring sites in the mainstem as well as tributaries were inaccessible. With available public access points, moderate coverage of the mainstem Mad River, between R.W. Matthews Dam and the estuary of Mad River was achieved. The majority of sites were located in the lower portions of the watershed. (See maps below for actual deployment sites).

Figure 1: Mad River watershed with deployment locations:

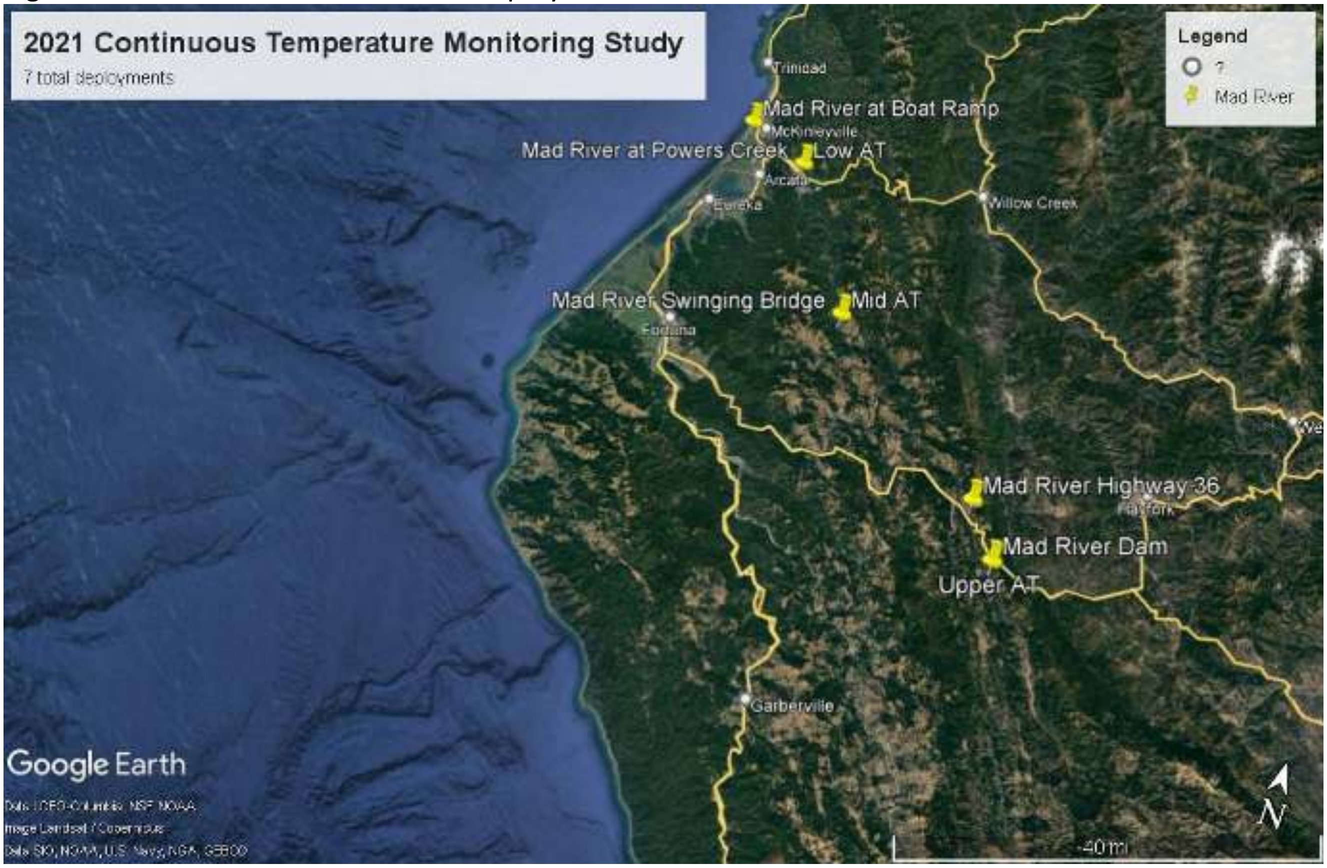


Figure 2: Lower Mad River deployment sites (coastal)

Figure 3: Middle Mad River deployment sites (transitional)

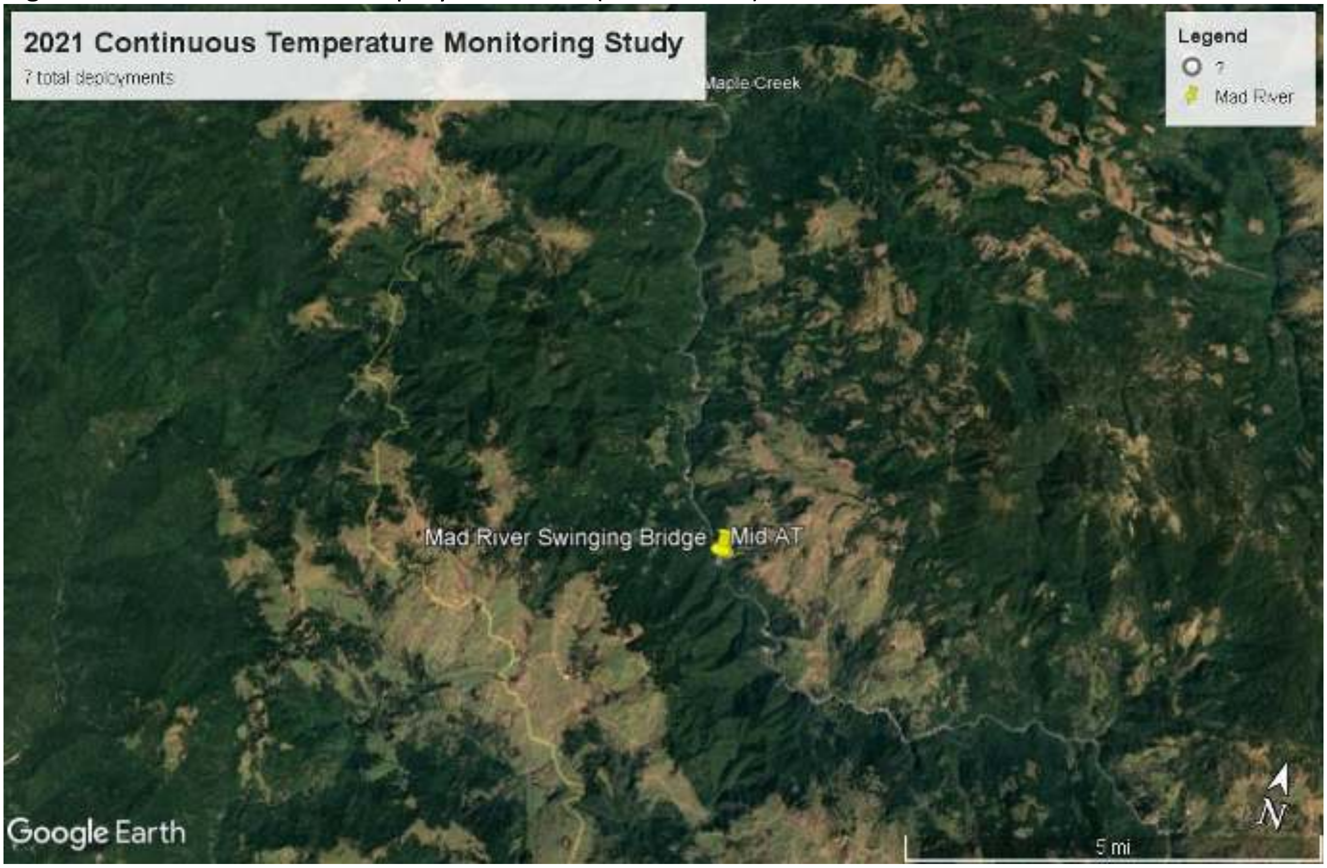


Figure 4: Upper Mad River deployment sites (inland):

Implementation
HOBO deployments occurred over the course of late June to mid-July. This includes all sites from R.W Matthews Dam near the town of Mad River, CA to the mouth near McKinleyville, CA. Site deployments were delayed from usual timing because of the lack of availability of HOBO calibrating equipment, due to the 2021 chip shortage. Also, interest has shifted in collecting only mainstem temperatures at fewer locations due to personnel availability. Because of this, the data set is truncated for 2021.

To assist in the retrieval process, detailed field notes and photographs were taken, and GPS coordinates were collected. During the deployment and retrieval periods, metadata about site conditions were also gathered. These metadata fields include:

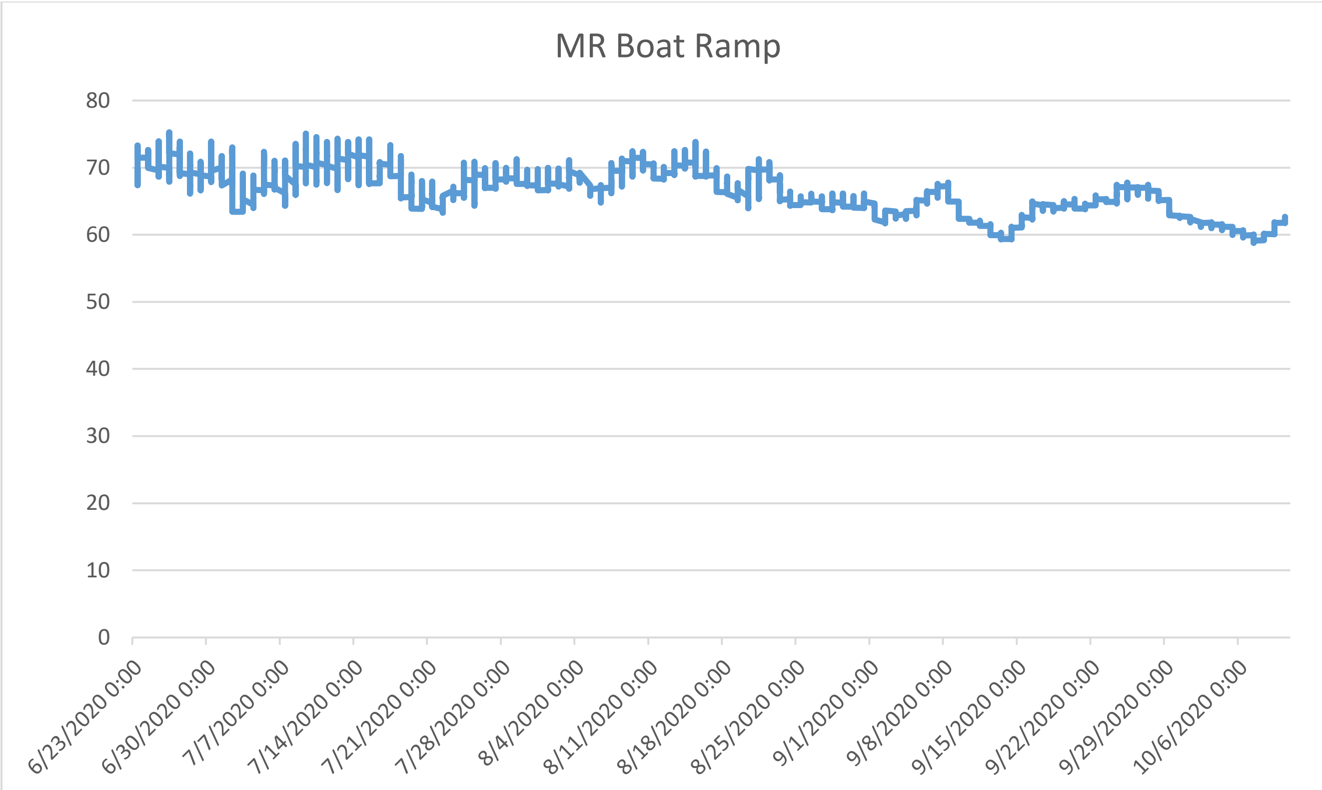
- People deploying/retrieving HOBOs
- Physical description of site conditions
- Presence/absence of birds/wildlife/fish species/algae

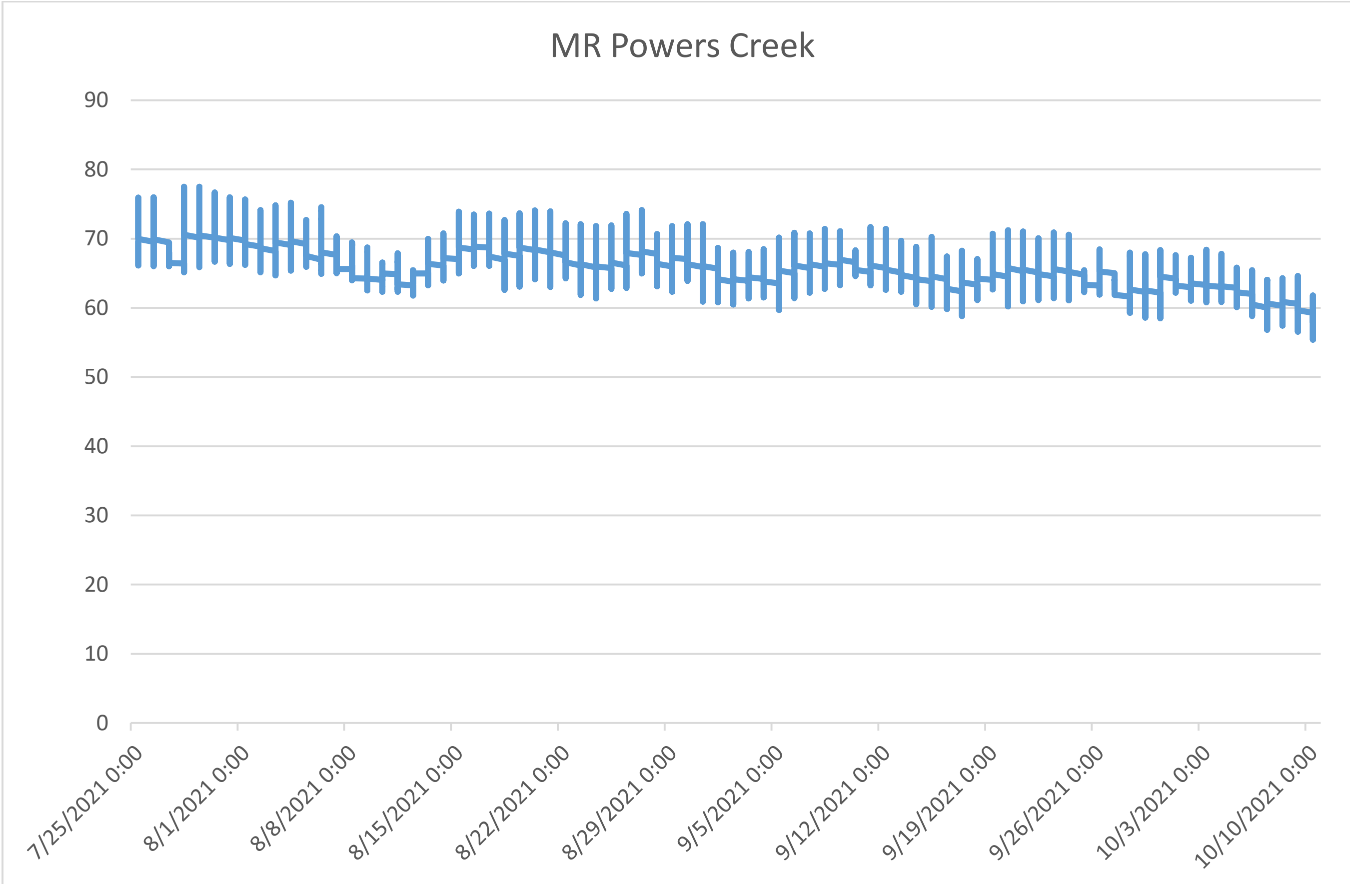
All 7 HOBOs were successfully retrieved from October 2018. One instrument's battery had died (Mid AT site) and data was unrecoverable.

Data
HOBO temperature loggers were set to collect temperature measurements every 30 minutes. These instruments were calibrated to manufacturer's specifications prior to deployment. Although there are many different types and manufacturers of continuous temperature recording technology, NCRWQCB offered 7 HOBOs that had previously been used free of charge.
Data were downloaded off of each individual HOBO and processed with the proprietary HOBOware software by Onset. For each site, a visual (graph) report summary was created, and MRA provided both raw and trimmed data summaries in .csv format in Microsoft Excel spreadsheets. Plots of the raw data, grouped by geographic location and mainstem/tributary are presented in the MRA Data Summary Appendix.

Data Analysis
Data analysis was completed by Jacob Pounds of BLR.
Clear patterns apply to the mainstem temperatures, along a geographic gradient, from the estuary to the dam. Tidal influences were also evident in the lowermost mainstem site (See Figure 2, water temperature plots). For these reasons, we broke the study reach down into three zones: coastal (estuary – Powers Creek), transitional (Swinging Bridge) and inland (below dam).

Graphical Data Summaries, in order from Downstream to Upstream:




MR Powers Creek
90
80
70
60
50
40
30
20
10
0
7/25/2021 0:00
8/1/2021 0:00
8/8/2021 0:00
8/15/2021 0:00
8/22/2021 0:00
8/29/2021 0:00
9/5/2021 0:00
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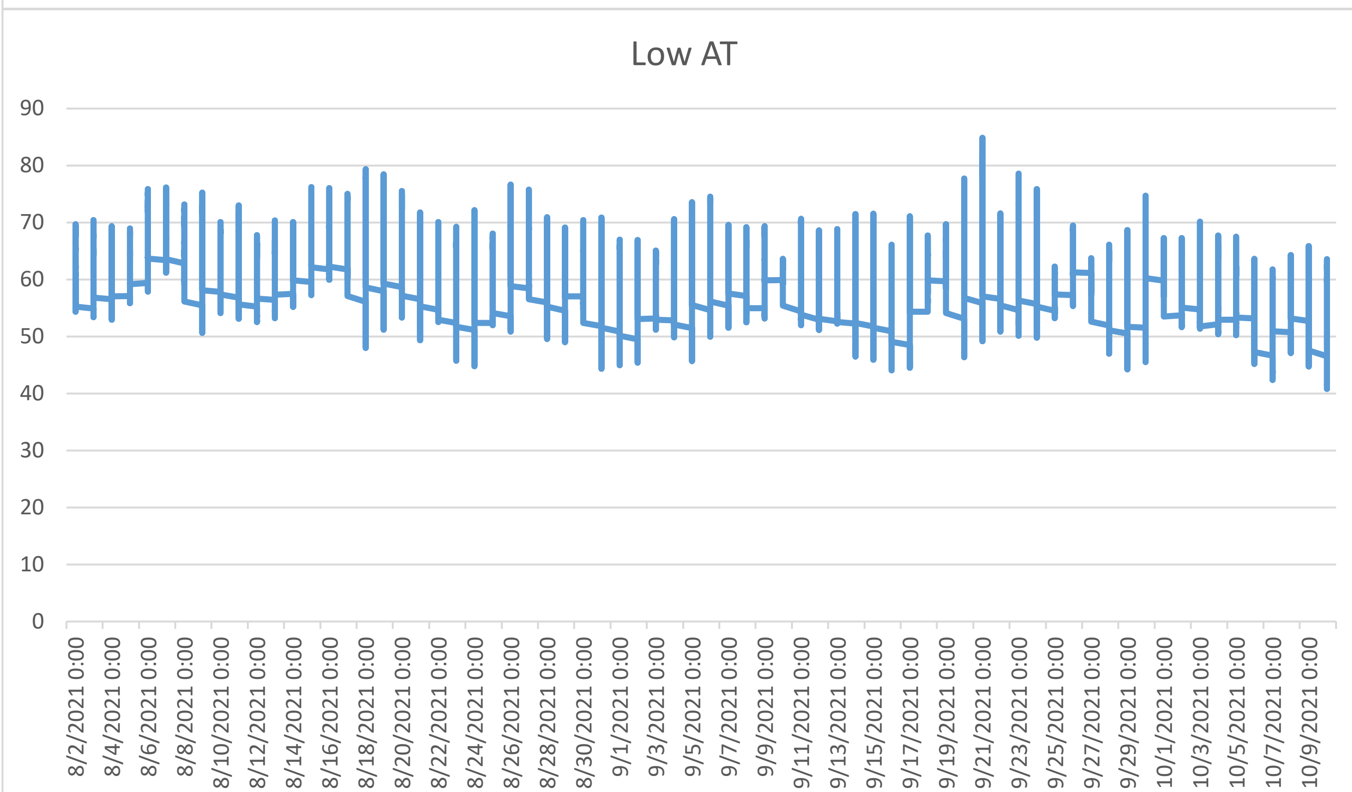
10/10/2021 0:00


Low AT
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0
8/2/2021 0:00
8/4/2021 0:00
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8/8/2021 0:00
8/10/2021 0:00
8/12/2021 0:00
8/14/2021 0:00
8/16/2021 0:00
8/18/2021 0:00
8/20/2021 0:00
8/22/2021 0:00
8/24/2021 0:00
8/26/2021 0:00
8/28/2021 0:00
8/30/2021 0:00
9/1/2021 0:00
9/3/2021 0:00
9/5/2021 0:00
9/7/2021 0:00
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9/11/2021 0:00
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9/17/2021 0:00
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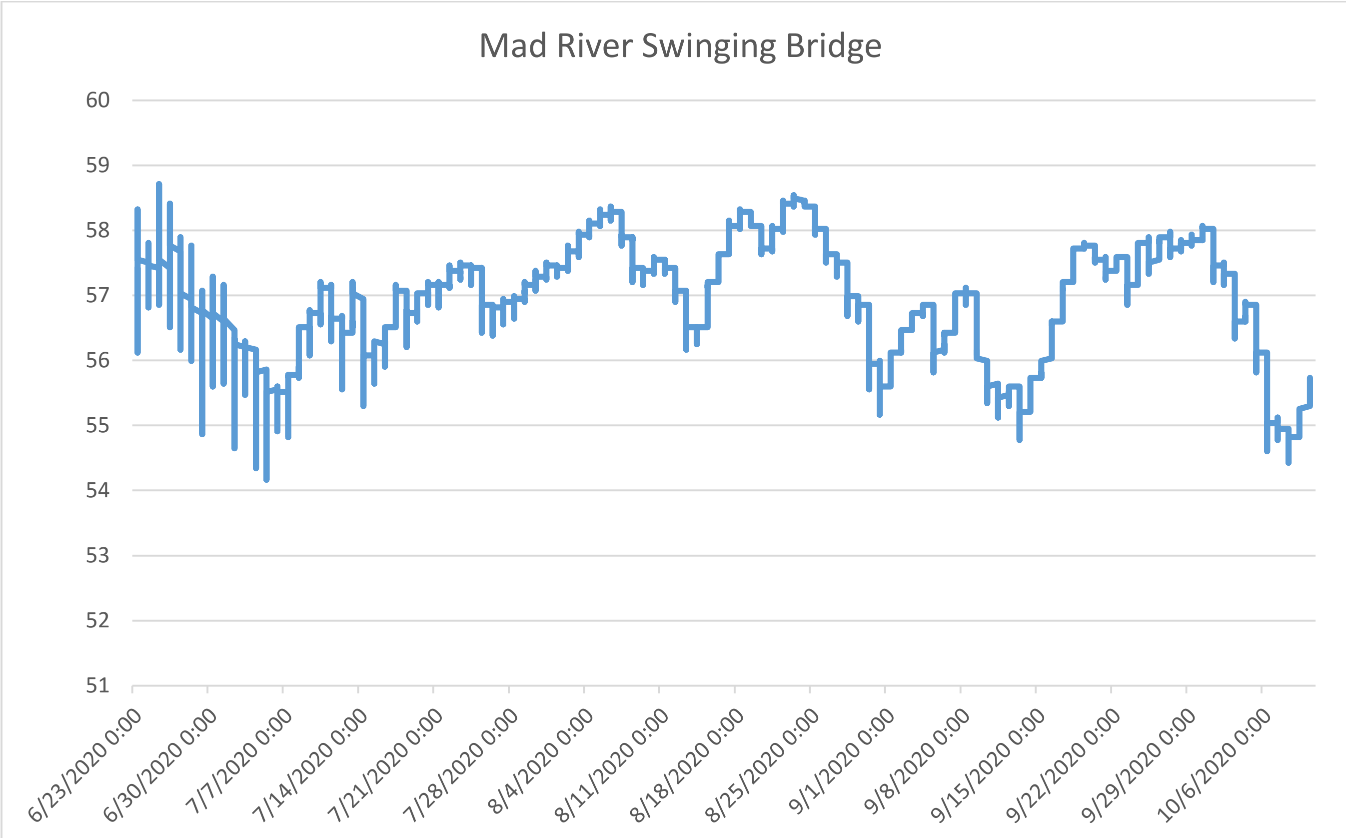
Mad River Swinging Bridge
60
59
58
57
56
55
54
53
52
51
6/23/2020 0:00
6/30/2020 0:00
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7/14/2020 0:00
7/21/2020 0:00
7/28/2020 0:00
8/4/2020 0:00
8/11/2020 0:00
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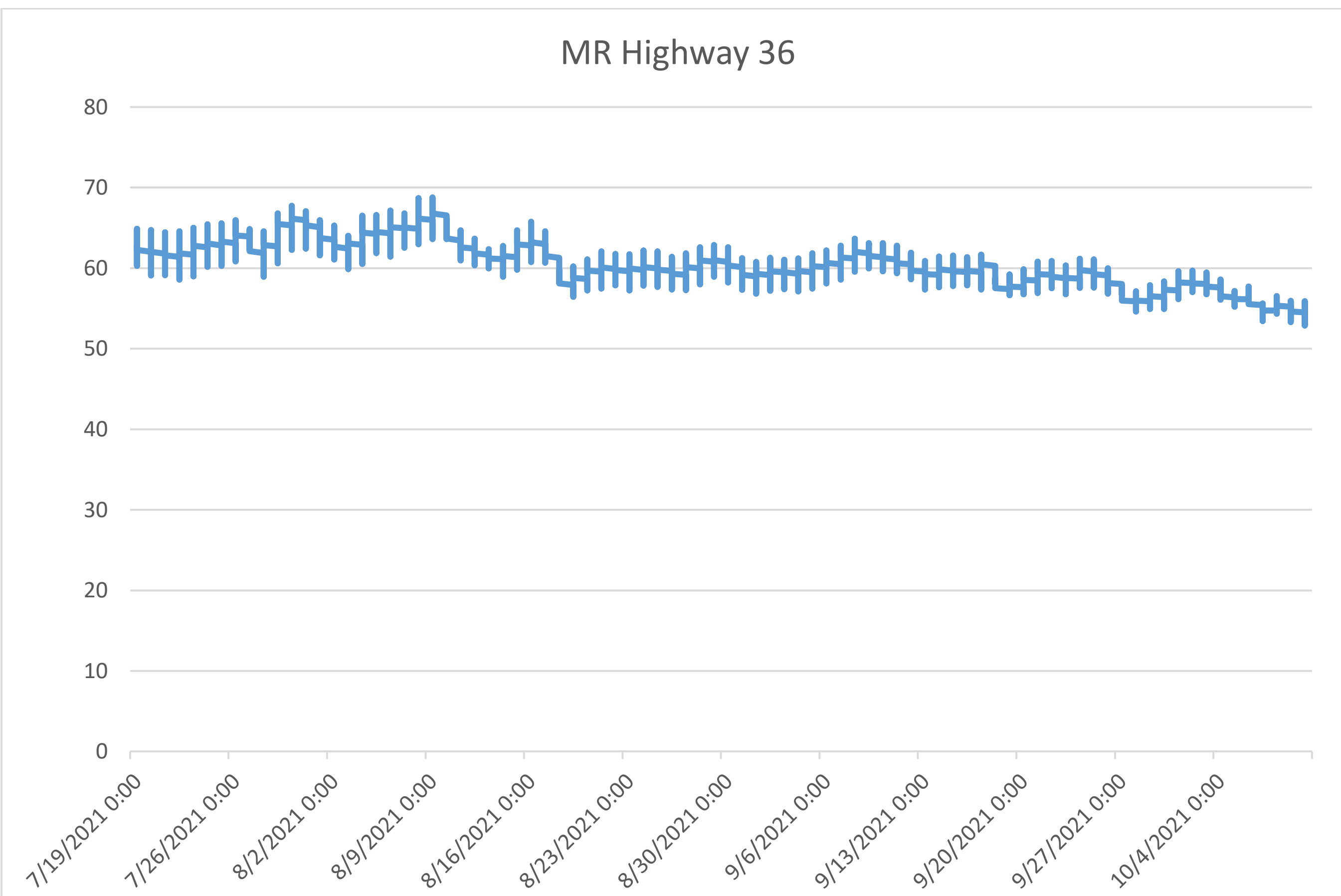
MR Highway 36
80
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8/2/2021 0:00
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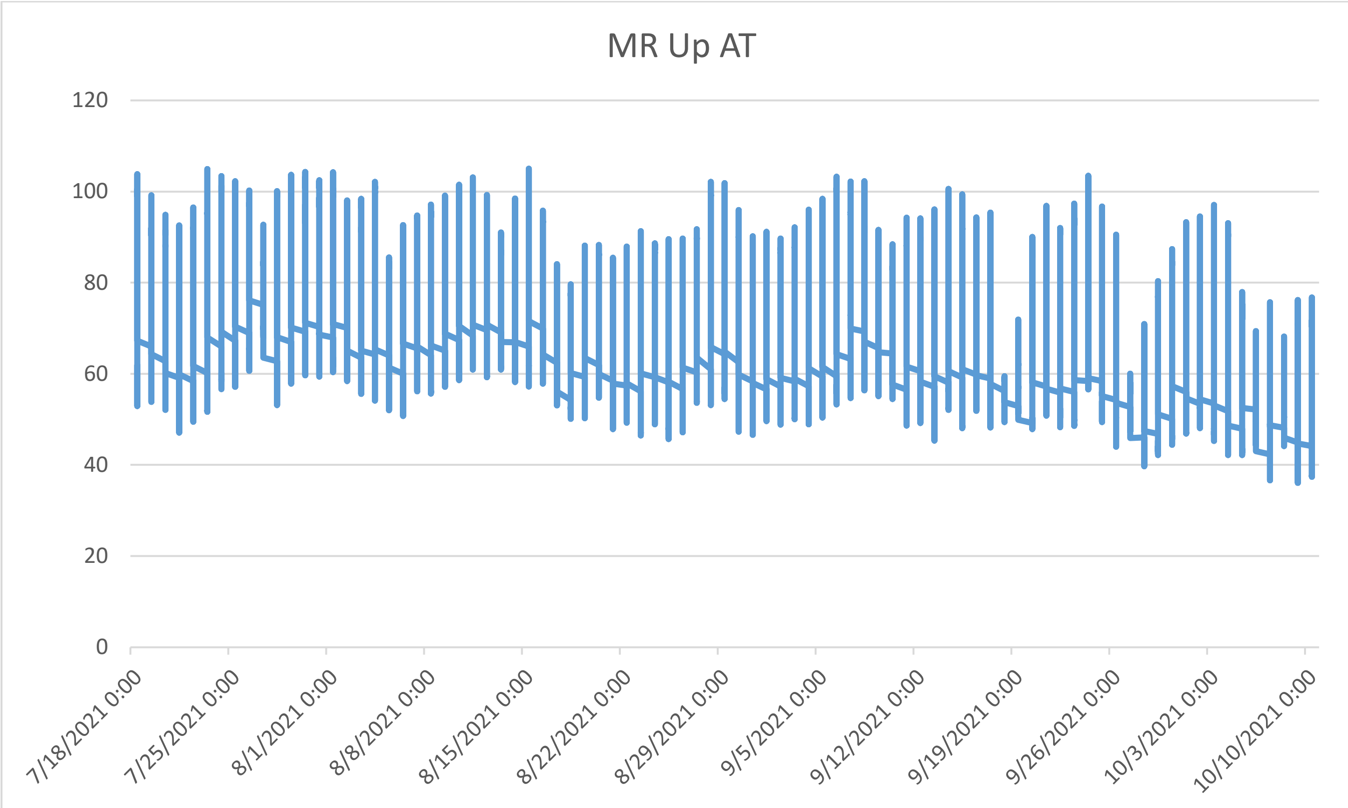
MR Up AT
120
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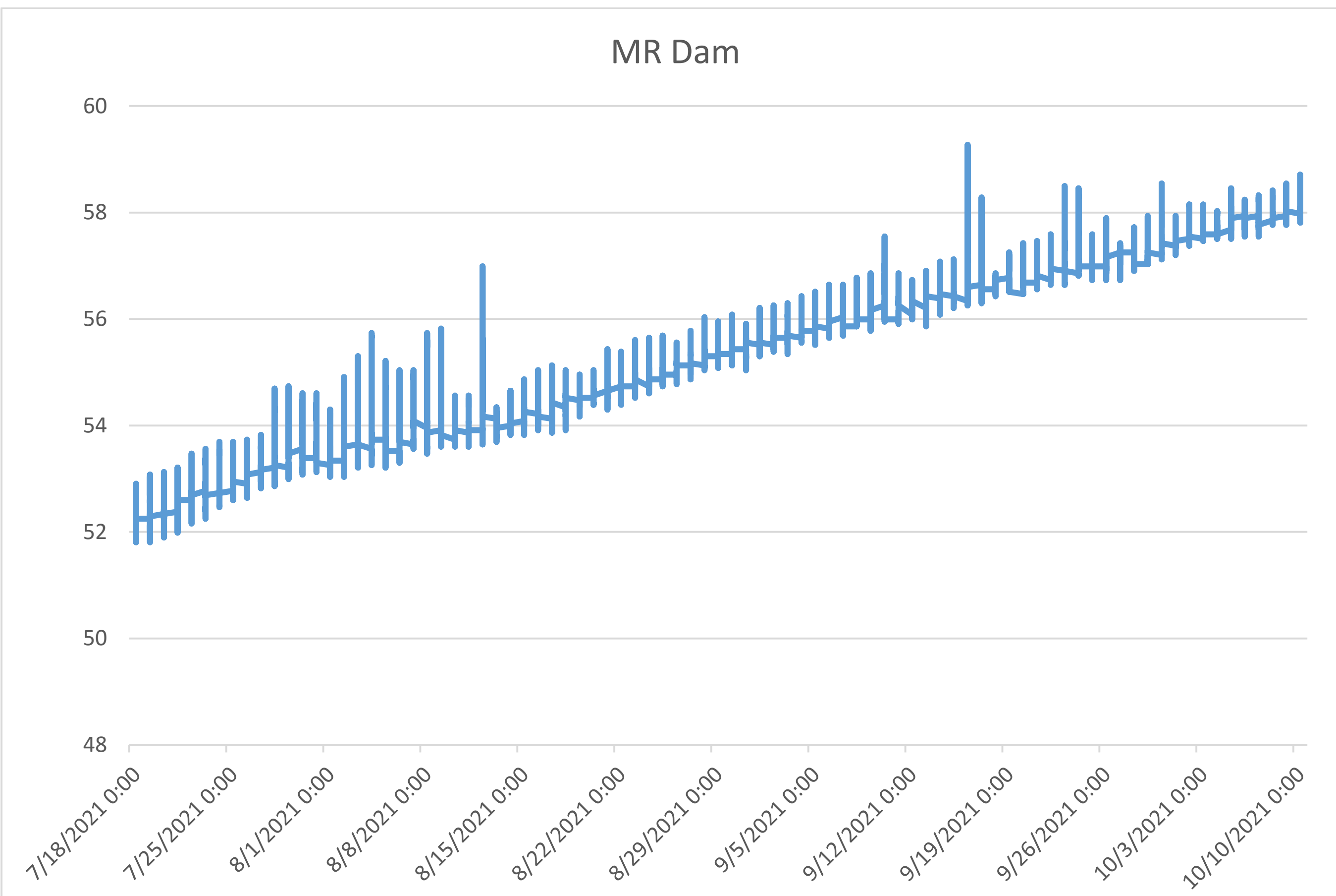
MR Dam
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52
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48
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7/25/2021 0:00
8/1/2021 0:00
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9/12/2021 0:00
9/19/2021 0:00
9/26/2021 0:00
10/3/2021 0:00
10/10/2021 0:00

Acknowledgements
This study was dependent on volunteers and partnerships. Every aspect of this project, from the creation of the study, building of HOBO housings, deployment and retrieval of the loggers, calibration and data handling, and reporting have been done because of dedicated volunteers and partner staff time.

Sources

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Appendix A

Native fish species found in the Mad River and Estuary as of June 2015

Name		Status	Area Found
Coho salmon	*Oncorhynchus kisutch*	Threatened Fed.ESA	Mainstem & tributaries
Coastal cutthroat	*O. clarki clarki*		Mainstem & tributaries
Chinook salmon	*O. tshawytscha*	Threatened Fed.ESA	Mainstem & tributaries
Chum salmon	*O. keta*		Occasional stray
Pink salmon	*O. gorbuscha*		Occasional stray
Sockeye salmon	*O. nerka*		Occasional stray
Steelhead	*O. mykiss*	Threatened Fed.ESA	Mainstem & tributaries
Eulachon	*Thaleichthys pacificus*	Threatened Fed ESA	Estuary & Main & Tribs.
Tidewater gobi	*Eucyclogobius newberryi)*	Endangered Fed.ESA	Estuary
Longfin smelt	*Spirinchus thaleichthy*	Threatened CA. ESA	Estuary
Pacific lamprey	*Entosphenus tridentata*		Mainstem & tributaries
Buffalo sculpin	*Enophrys bison*		Estuary & Main & Tribs.
Coast range sculpin	*Cottus aleuticus*		Estuary & Main & Tribs.
Prickly sculpin	*Cottus asper*		Estuary & Main & Tribs.
Staghorn sculpin	*Leptocottus armatus*		Estuary & Main & Tribs.
Humboldt sucker	*C. occidentalis humboldtianus*		Mainstem & tributaries
Sacramento sucker	*Catostomas occidentalis*		Mainstem & tributaries
Three-spine stickleback	*Gasterosteous aculeatus*		Mainstem & tributaries
Starry flounder	*Platichthys stellatus*		Estuary
Night smelt	*Spirinchus starski*		Estuary
Cabezon	*Scorpaenichthys marmoratus*		Estuary
Penpoint gunnel	*Apodichthys flavidus*		Estuary
Saddelback gunnel	*Pholidae ornate*		Estuary
Pacific herring	*Culpea pallasii*		Estuary
Black rockfish	*Sebastes melanops*		Estuary
Copper rockfish	*S. caurinus*		Estuary
Bay pipefish	*Syngnathus loptorhyncus*),		Estuary
Speckled sanddab	*Citharichthys stigmaeus*		Estuary
Shiner surfperch	*Cymatogaster aggregata*		Estuary