Public Presentation:

CSUMB/USDA Interns Julianne Rhodes & Evan DeLay on Their Field Work Experience with the District in Lagoon & River Surface Water Quality Monitoring, with a Summary of Their Final Reports.

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Staff Contact: Kevan Urquhart

USDA Interns from CSUMB's Professional Science Masters Program

Julianne Rhodes

- Topic: Lagoon Water Quality
- B.A. Geology, SDSU; PSM candidate in 2014

Thomas Evan Delay

- Topic: River Surface Water Quality Temperature Trends
- B.A. in Environmental Science, CSUMB, PSM graduate in 2013

Each contributed 300 paid and 100 volunteer hours worth ~$6,680 in equivalent Water Resources Assistant time.

Kenneth Norberg also served as an undergraduate Intern for 360 paid hours on the Fish Rescue Crew in 2012-2013 worth $5,520 in equivalent Fisheries Aide time.

Carmel River Lagoon Water Quality Monitoring

The Carmel River Lagoon provides key rearing habitat for the federally endangered juvenile steelhead prior to its migration into marine waters. Juvenile steelhead living in coastal lagoons have been found to have faster growth rates and larger size at ocean entry when compared to juveniles that reared further upstream within the freshwater reaches. Several recent studies have also found the return rate of lagoon-reared steelhead to be 95.5%.

Monthly Lagoon Monitoring Locations

N2: Adjacent to parking lot

R2: Main lagoon

S2: South arm at pipe

O1: Odello S. extension

O4: Odello N. extension

Water Quality Parameters Measured

Temperature, salinity, and DO water quality parameters for the lagoon were measured in situ. Measurements were taken monthly from a kayak. The data, which span from January 2007 to April 2013, were collected by various staff and interns working at the MPWMD.

Temp > 19 C, DO < 5 mg/L, Salinity > 10 ppt
Temp <= 19 C, DO >= 5 mg/L, Salinity <= 10 ppt
Temp <= 15 C, DO >= 7 mg/L, Salinity <= 3 ppt

Summary of Findings for 2007-2013

Water quality was poor the majority of the time at all sites during the six-year period we evaluated.

Site	Water Quality	Overall %	Temperature %	DO %	Salinity %
N2		17	53	59	62
		39	29	20.5	23
		44	18	20.5	14
R2		21	43.5	66	70
		39	36	24.5	17
		40	20.5	9.5	13
S2		13	47	59.5	47
		24	25.5	15.5	14
		63	27.5	25	39
O1		12.5	37.5	73.5	61.5
		35	30.5	13.5	19.5
		52.5	32	13	19
O4		11.5	37	64	64.5
		36.5	32	21.5	21.5
		52	31	14.5	14

Conclusion:

Provided there is sufficient freshwater inflow, coastal lagoons will remain well-mixed with respect to fresh and saline waters and the concentration of DO will be high enough to support juvenile steelhead growth.

While efforts have been made by Cal Am and others to find alternative sources of water, flows into the lagoon remain restricted or nonexistent during most of the year. The problem of inadequate flow into the lagoon together with untimely, artificial breaching are the biggest challenges to providing good water quality habitat to young steelhead.

Introduction

My internship as a Water Resources Assistant with MPWMD provided me with experience in collecting water quality data (temperature, dissolved oxygen, turbidity, pH, conductivity and CO^2).

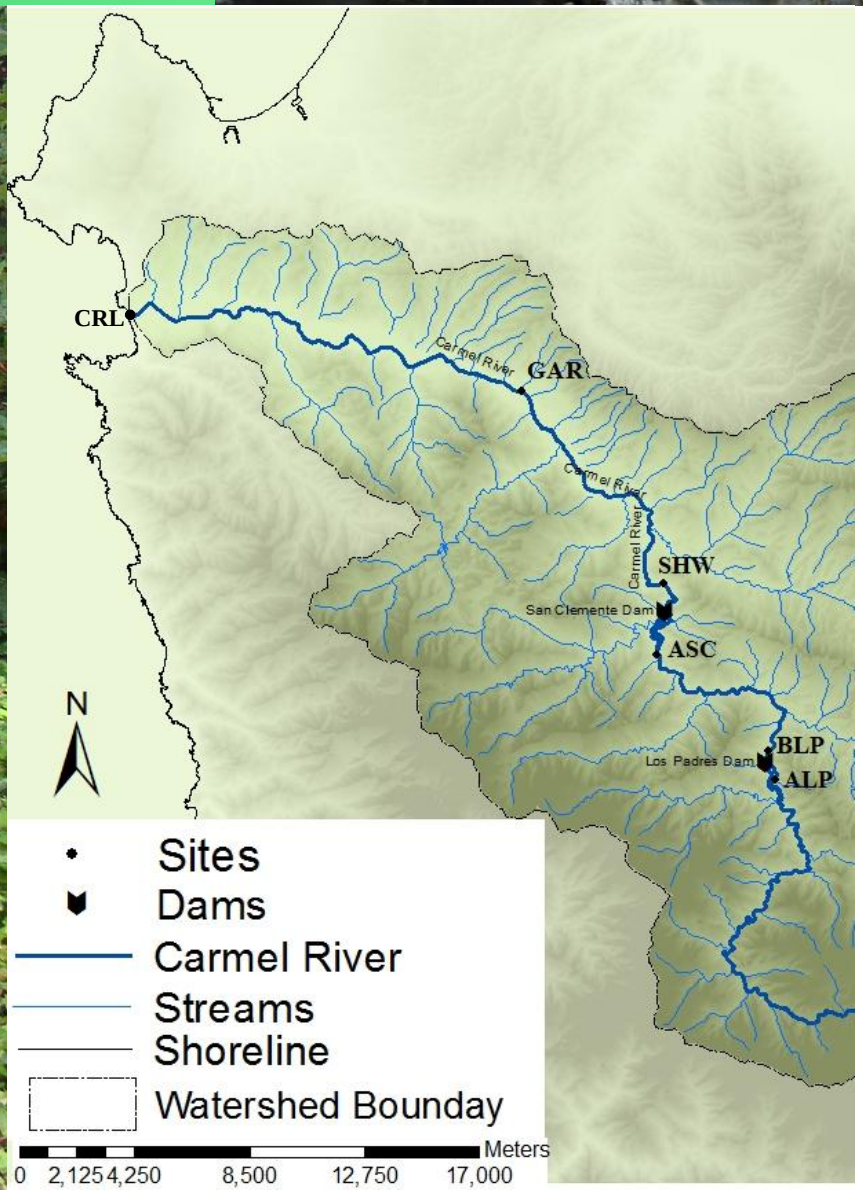
My internship also taught me the current time-series analyses that are used by the USGS and the EPA in monitoring seasonally affected environmental variables.

I collected water quality data from June 2012 to December 2012 and conducted the trends analysis of surface water temperatures from January 2013 to May 2013.

What is the Problem?

- The release of hypolimnial-water from dams can significantly decrease do downstream water temperatures and dissolved oxygen concentrations and can directly affect the health of steelhead and their primary sources of food.
- Seasonal variation can be a confounding factor in environmental time series and can result in non-parametric characteristics such as non-normal distributions, outliers, missing data, serial independence and values below detection limits.
- Trend analyses help identify water quality degradation and assist in avoiding the 303(d) listing under the Clean Water Act and is an essential part of short-term and long-term policy making.
- The Seasonal Kendall tests is a valuable trends test that is considered to be highly robust and a relatively powerful non-parametric because it can be used to analyze water quality when variability exists in relation to seasonal variation.

Map of Sampling Sites



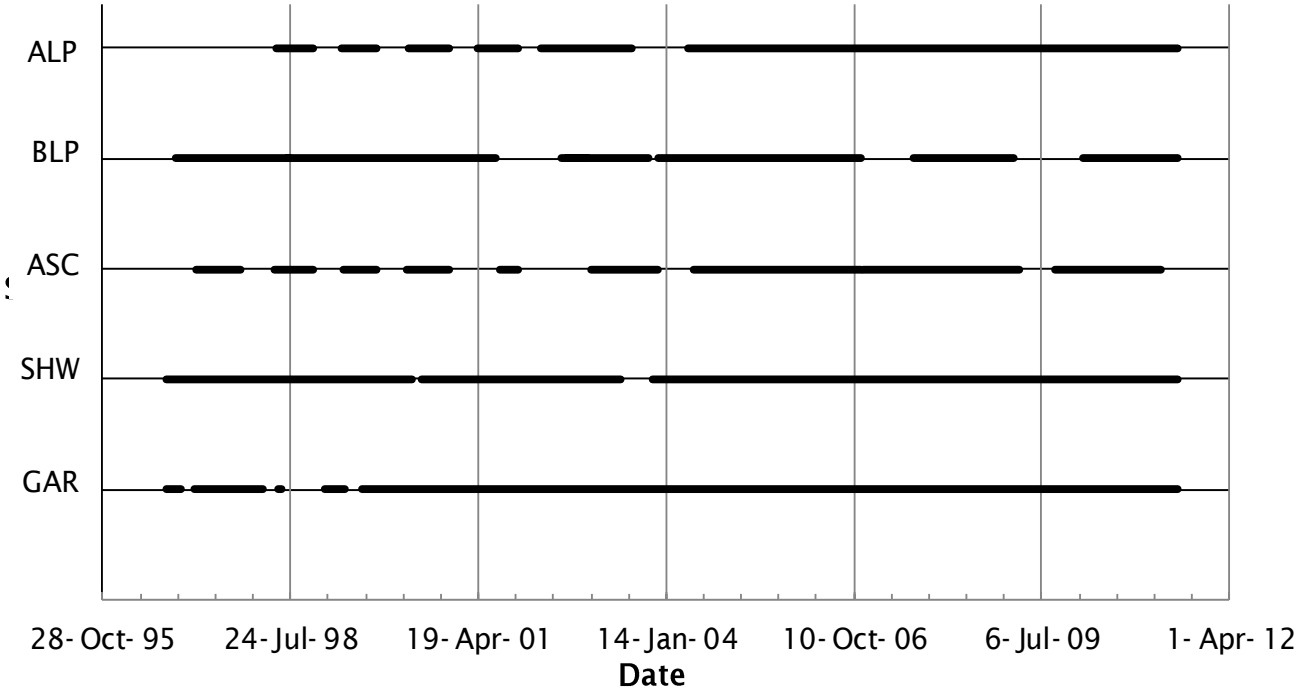
The five study sites included: Above the Los Padres Dam (ALP), Below the Los Padres Dam (BLP), Above the San Clemente Dam (ASC), Sleepy Hollow Weir (SHW) and at Garland Ranch Regional Park (GAR).

Note: I also collected water quality data from the Carmel River Lagoon (CRL).

Purpose and Scope

The purpose of this study was to analyze trends in surface water temperatures with respect to seasonal variation within the Carmel River Basin.

The scope of this project was to focus on surface water temperature at five sites during a 16-year period from 1996 to 2011 without making any comparisons across seasonal boundaries.



Results
What does this mean?

Site	Kendall's *S* statistic	Var(*S*)	Denominator (D)	Kendall's τ (*S*/D)	p-value (Tau)	Sen slope	p-value (slope)
ALP	- 154	2236.667	697.492	- 0.221	0.001	- 0.110	0.001
BLP	- 54	3017.333	890.000	- 0.0607	0.33	NA	NA
ASC	- 264	1808.667	604.497	- 0.437	5.38×10^{-10}	- 0.268	6.25×10^{-10}
SHW	- 407	4331.667	1151.000	- 0.354	6.25×10^{-10}	- 0.210	6.88×10^{-10}
GAR	- 538	3901.333	1068.498	- 0.504	2.22×10^{-16}	- 0.345	8.15×10^{-18}
REGIONAL	NA	NA	NA	NA	NA	- 0.209	3.31×10^{-4}

- For the Seasonal Kendall Test, all of the sites (except for BLP) exhibited statistically significant downward trends in surface water temperatures.

- For the Regional Kendall Test, all of the sites collectively exhibited a statistically significant downward trend in surface water temperatures.

- These results suggests that surface water temperatures are getting colder with each passing year.

- Due to the limitations of the Seasonal and Regional Kendall Test, conclusions cannot be made as to the cause of these downward trends.

Future Recommendations

•Diel and seasonal temperatures fluctuations should be studied.

•Surface water temperature, air temperature, dissolved oxygen and discharged should be analyzed collectively to be able to draw more definitive conclusions as to the cause of downward trending surface water temperatures.

• The desired parameters should be thoroughly sampled during the parts of the year that are expected to exceed water quality standards.

•To account for missing data, future analyses should simulate data so that all the assumptions of the Seasonal Mann-Kendall test can be met.