



**LOS ANGELES COUNTY
SANITATION DISTRICTS**

Converting Waste Into Resources

Santa Clara River Temperature Study

TAC Meeting

March 17, 2026



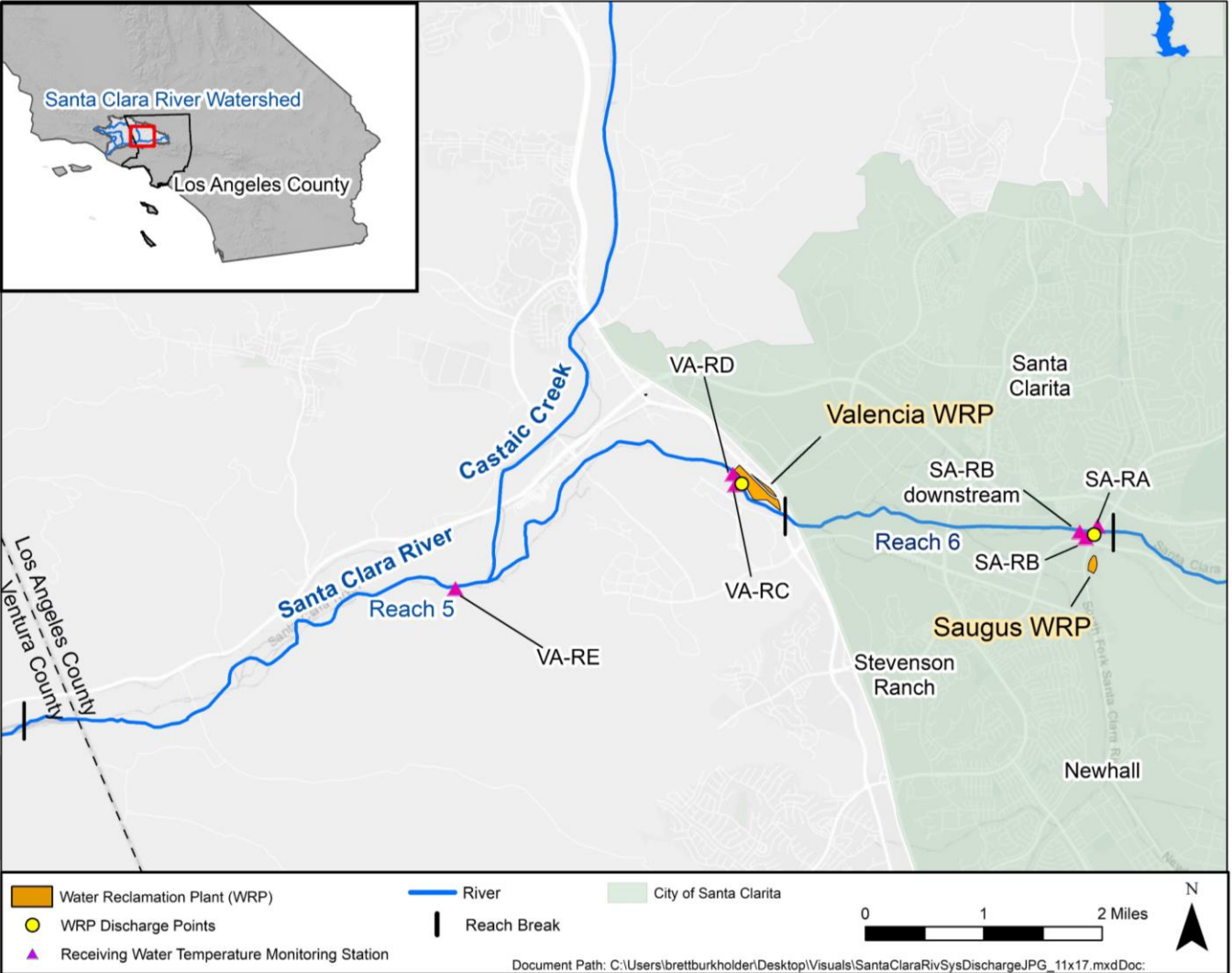
OUR SERVICE AREA

Today's Agenda

- Introductions
- Project Background
- Laboratory Fish Thermal Physiology Studies
- Benthic Macroinvertebrate Results
- Additional Temperature Modeling Results
- Management Options
- Next Steps



Santa Clarita Valley Sanitation District Water Reclamation Plants



September 2023



January 2024



September 2024



Santa Clara River Temperature Study

- Initiated in response to new temperature limits in WRP discharge permits (80°F and cannot alter river >5°F)
- Aimed at addressing the following question: **Are the plant discharges impacting the warm freshwater habitat (WARM) beneficial use of the Santa Clara River?**
 - How do waterbody temperatures affect local aquatic life?
 - How do plant discharges affect river temperatures?

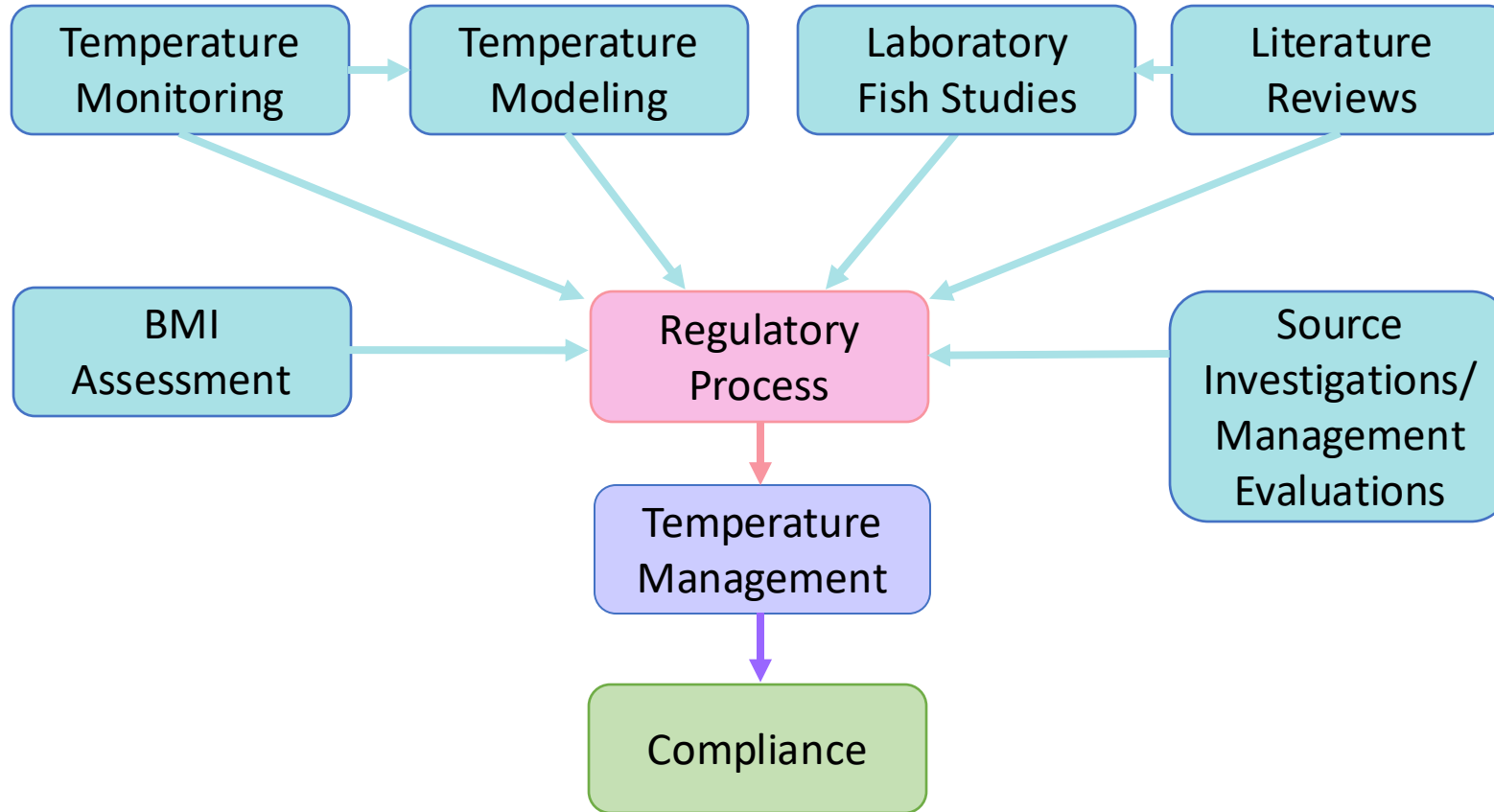
Focus: Unarmored threespine stickleback



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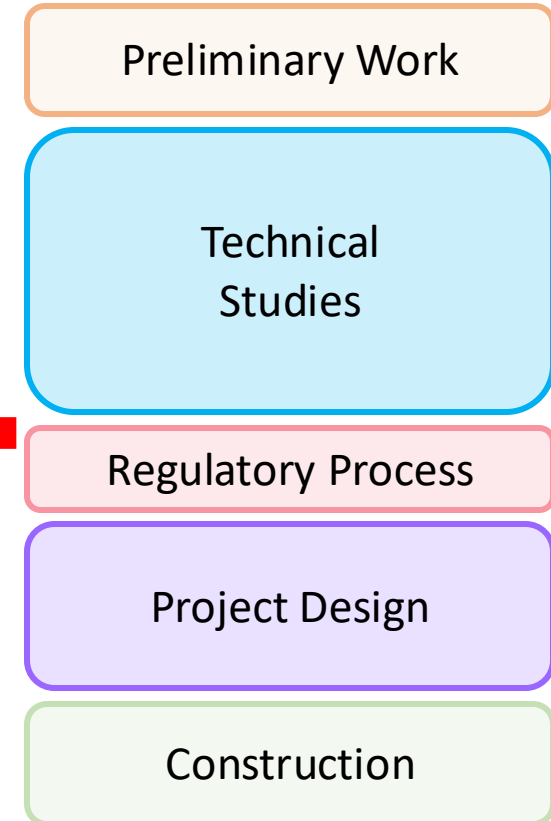


Santa Clara River Temperature Study



Santa Clara River Temperature Study

NPDES Permit Compliance Milestones	
Submit and Begin Implementation of Pollution Prevention Plan (PPP) for Source Control	8/1/2022
Convene TAC and SAG	10/1/2022
Release the Request for Proposal to Retain Consultant to Evaluate Temperature Impacts in the Watershed and Management Options	2/28/2023
Finalize the Technical Workplan	2/28/2024
Prepare a Technical Workplan Progress Report	2/28/2025
Complete Implementation of Technical Workplan	2/28/2026
Notify LA Water Board of selected preferred project and identify regulatory approval process and present results of technical workplan at next scheduled board meeting	4/1/2026
Complete Preliminary Design	4/1/2027
Complete Environmental Review	10/1/2027
Design Preferred Project	7/1/2028
Issue Notice to Proceed for Project Work	7/1/2029
Complete Preferred Project	7/1/2030



Goals for Today

- Discuss results of Phase 2 Fish Studies and BMI Surveys
- Discuss temperature modeling results for shading scenarios
- Discuss findings of studies and implications
- Provide management options analysis
- Discuss questions and comments on the final report
- Discuss next steps and timeline



Thermal Physiology Study

Phase Two Project Updates



UCDAVIS

**DEPARTMENT OF WILDLIFE, FISH
AND CONSERVATION BIOLOGY**

Conducted By:

C. J. Cooper, K. W. Zillig, N. A. Fangué

Summary of Phase One Findings

Collected data on adult fish:

- **Critical Thermal Maximum** (CT_{MAX} ; "Acute" thermal tolerance)
- **Upper Incipient Lethal Temperature** (UILT; "Chronic" thermal tolerance)
- **Resistance time** (average time to succumb to thermal exposure)
- **Temperature Preference** (behaviorally selected temperature)
- **Aerobic Scope** (metabolic capacity)

Summary of Phase One Findings

CT_{MAX} ranged between 89.9 - 92.7°F

UILT showed impacted survival at chronic temperatures >81.7°F

Resistance times show ability to withstand ~86°F for 12-24 hrs

Temperature Preference: behavioral-selection of cooler temperatures when available (mean: 64.4°F, range: 51.3°F - 75.4°F)

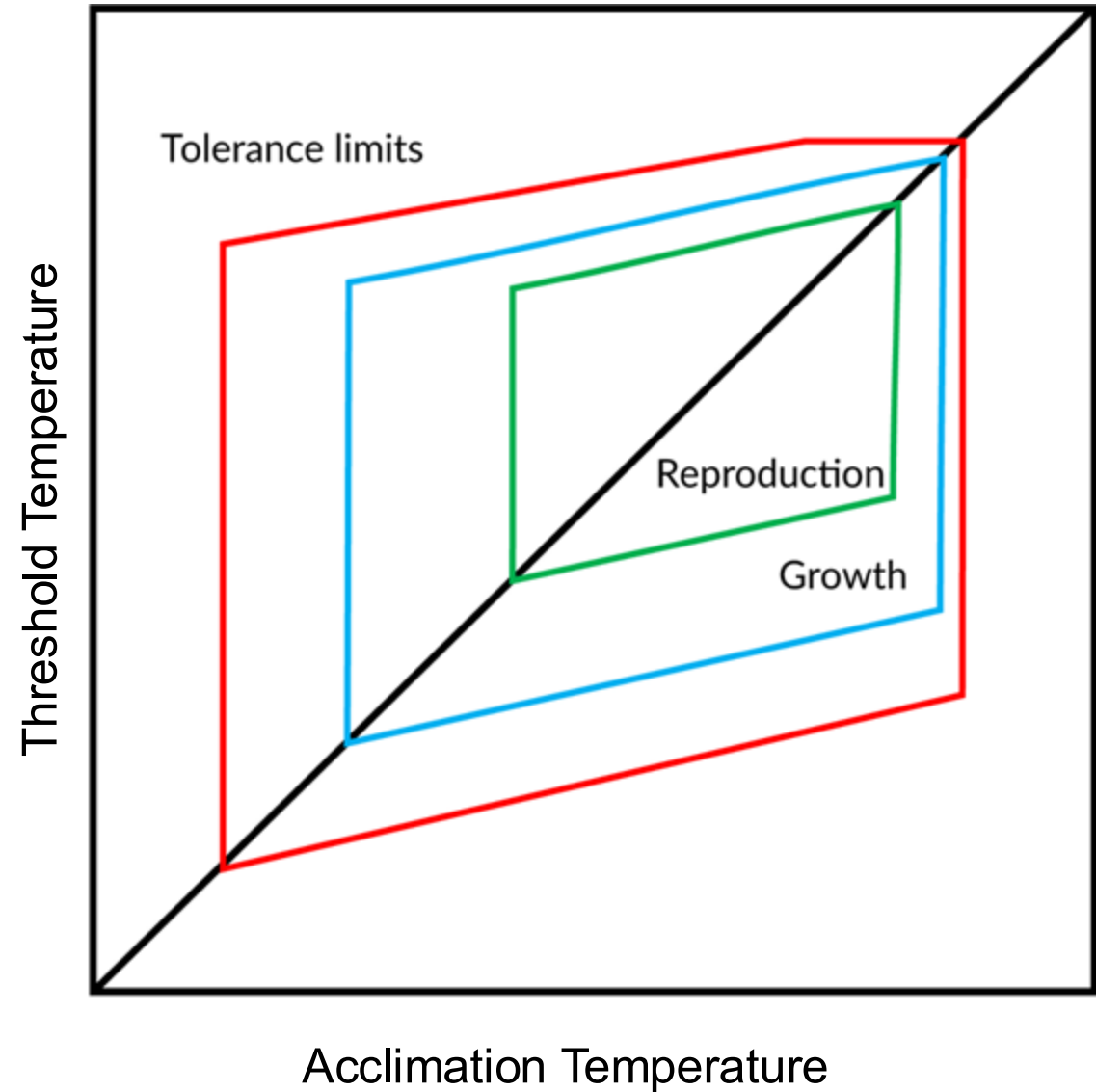
Aerobic Scope reveals metabolic capacity is maximized at temperatures above 70°F but precipitously declines as temperatures approach lethal limits.

Phase Two Goals

Measurements like CT_{MAX} and UILT characterize outer limits for survival

Different biological processes will have different, often narrower operational ranges

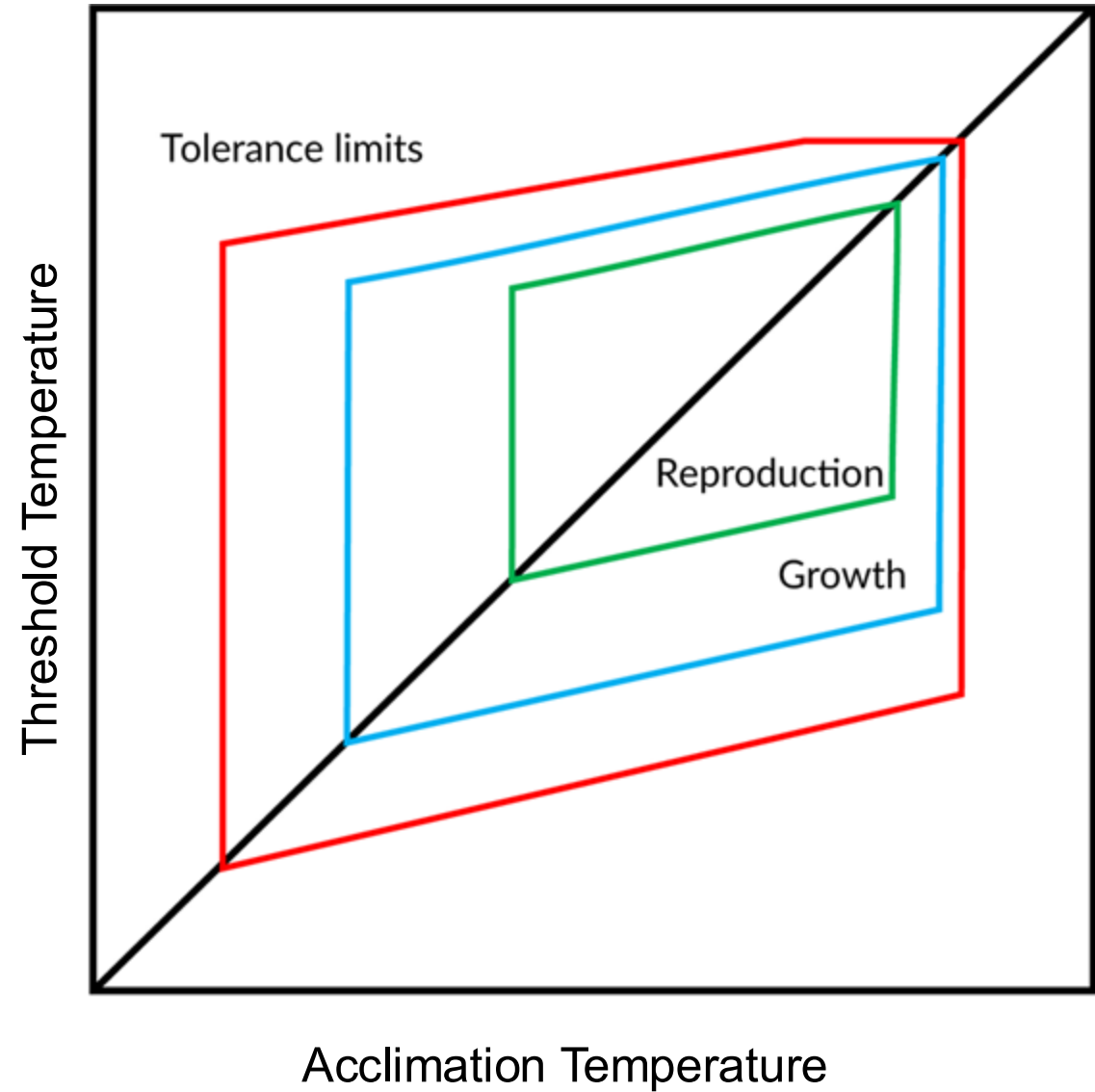
- Measuring different ranges yields more comprehensive understanding of fish's needs
- No “one optimal” temperature



Phase Two Goals

“Phase 1” study focused on classic, fundamental thermal physiology

- E.g., “Routine maintenance costs” and directly lethal limits of tolerance

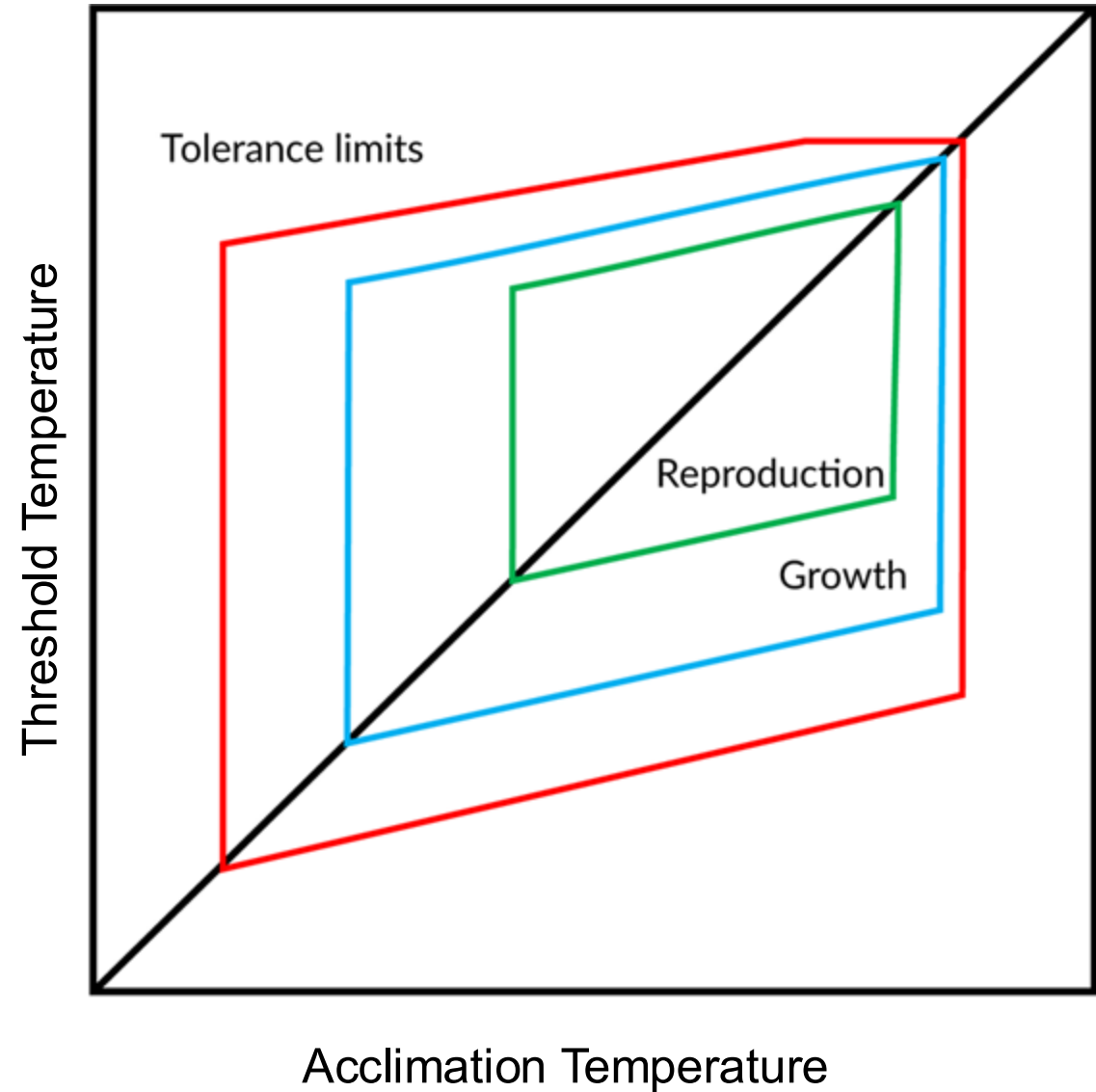


Phase Two Goals

Phase Two adds additional ecological, temperature-dependent traits (e.g., reproduction)

Questions:

- 1) How will temperature affect other life stages? Or spawning and recruitment?
- 2) What is the role of refugia/recovery periods in natural, dynamic temperatures?



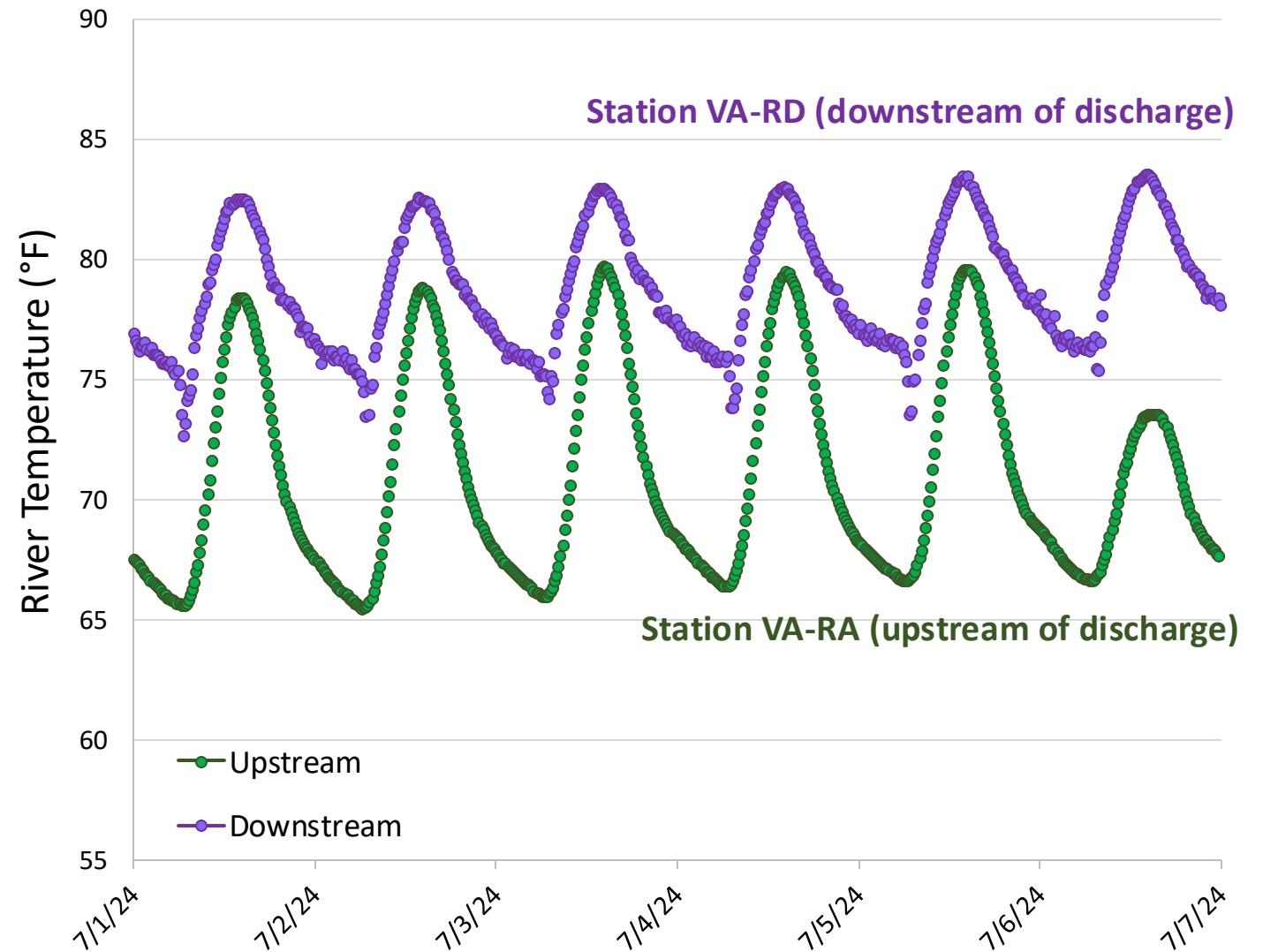
Summary of Phase 2 Experiments

- Collect adult and juvenile fish for experiments and spawning
- Characterize effects of thermal cycle on adult thermal tolerance
- Characterize acute thermal limits of juveniles
- Determine temperature effects on incubation of embryos, survival, and development

Cycling Temperature Experiments

Thermal Cycling

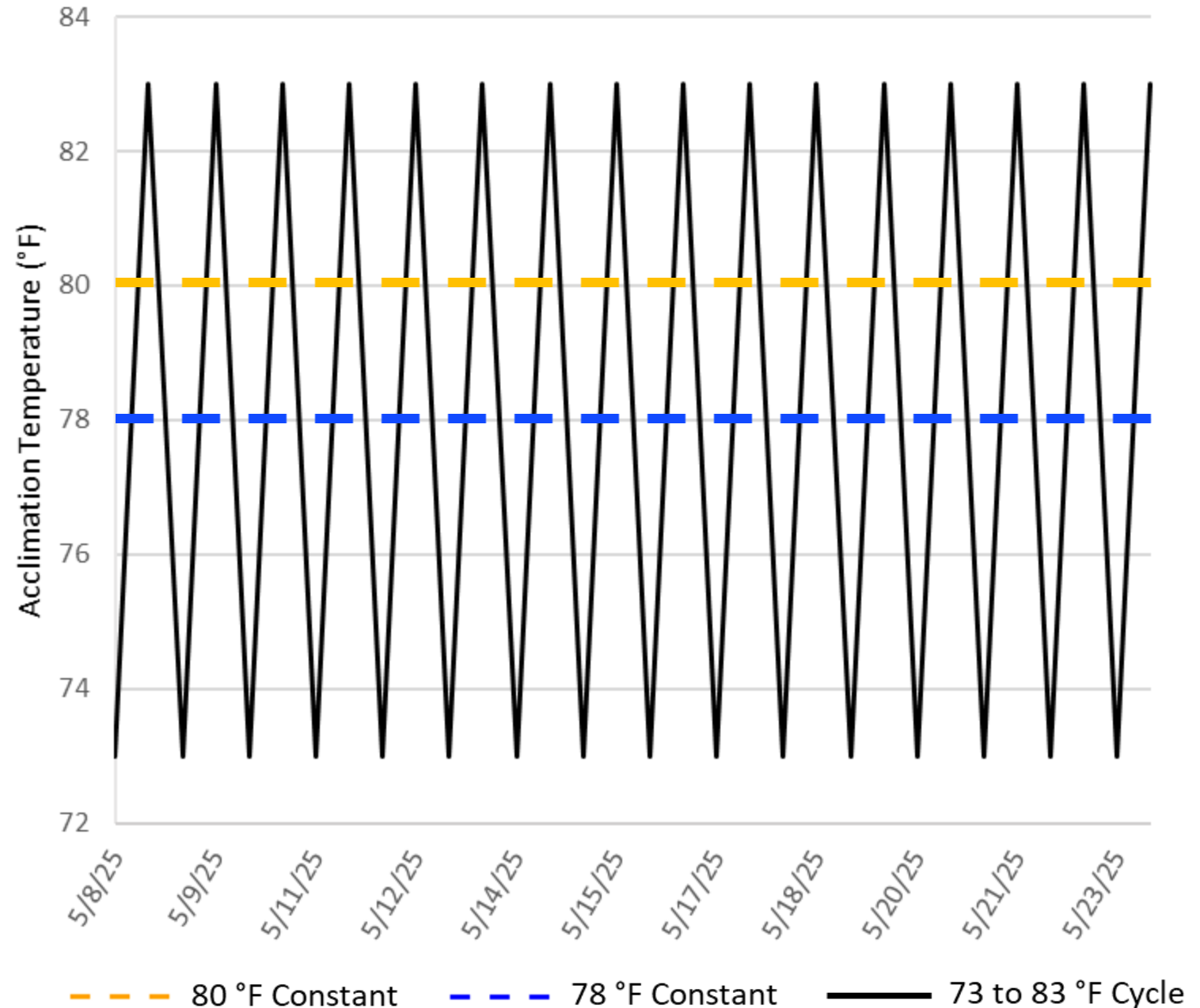
- Fish typically experience dynamic temperature changes in wild settings
- Measured temperatures downstream of Valencia WRP can cycle between 73 - 83°F in summer



Thermal Cycling

May – June 2025

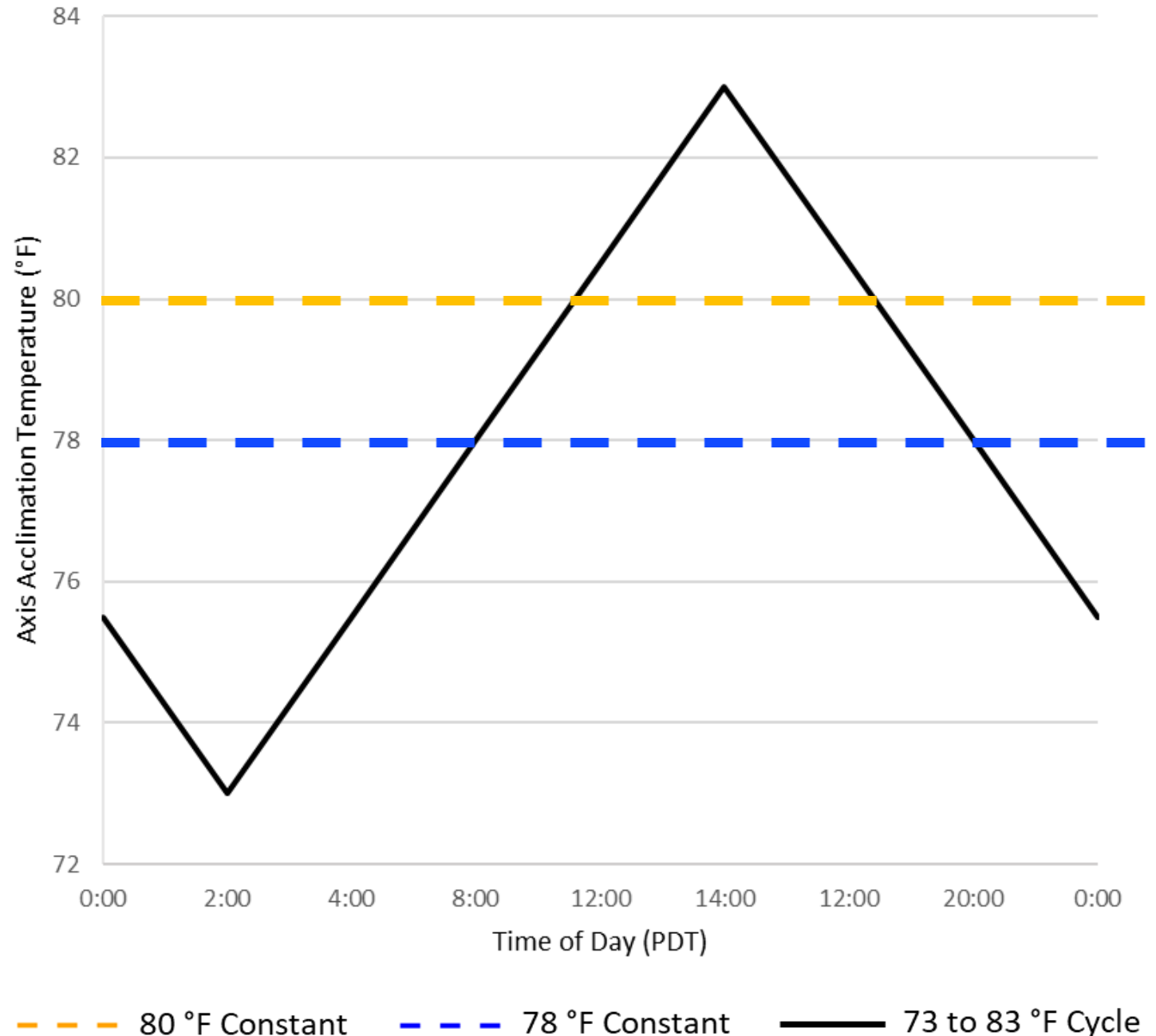
- Replicated natural diel thermal cycle in lab
- Acclimated adult fish to cycling (73 – 83 °F) and constant (78, 80°F) control temperatures for two weeks



Thermal Cycling

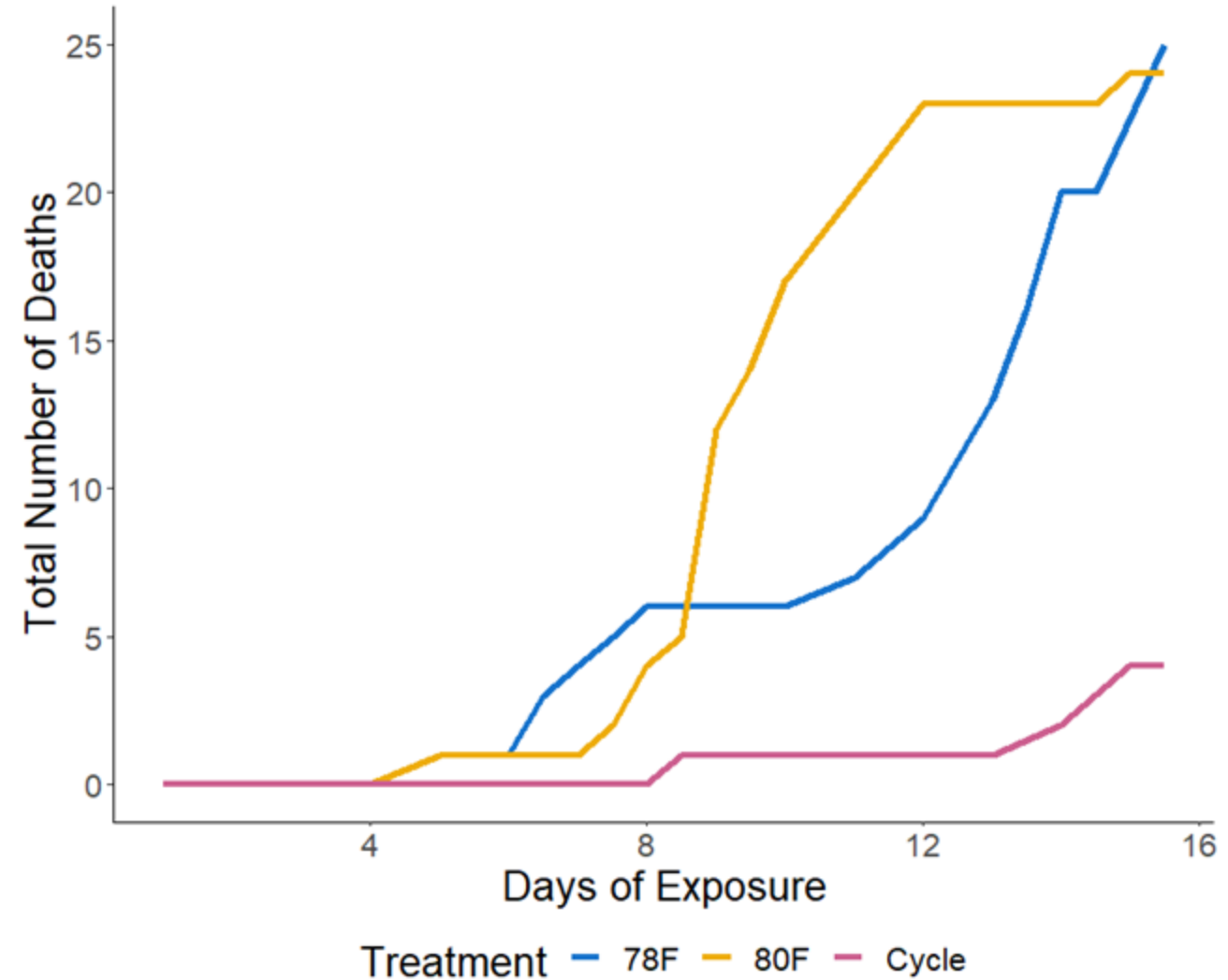
May – June 2025

- Monitored survival
- Characterized changes in CT_{MAX}
 - Daily effects (measured at 2:00 "AM" and 14:00 "PM")
 - Comparison between acclimation groups



Thermal Cycling: Exposure Survival

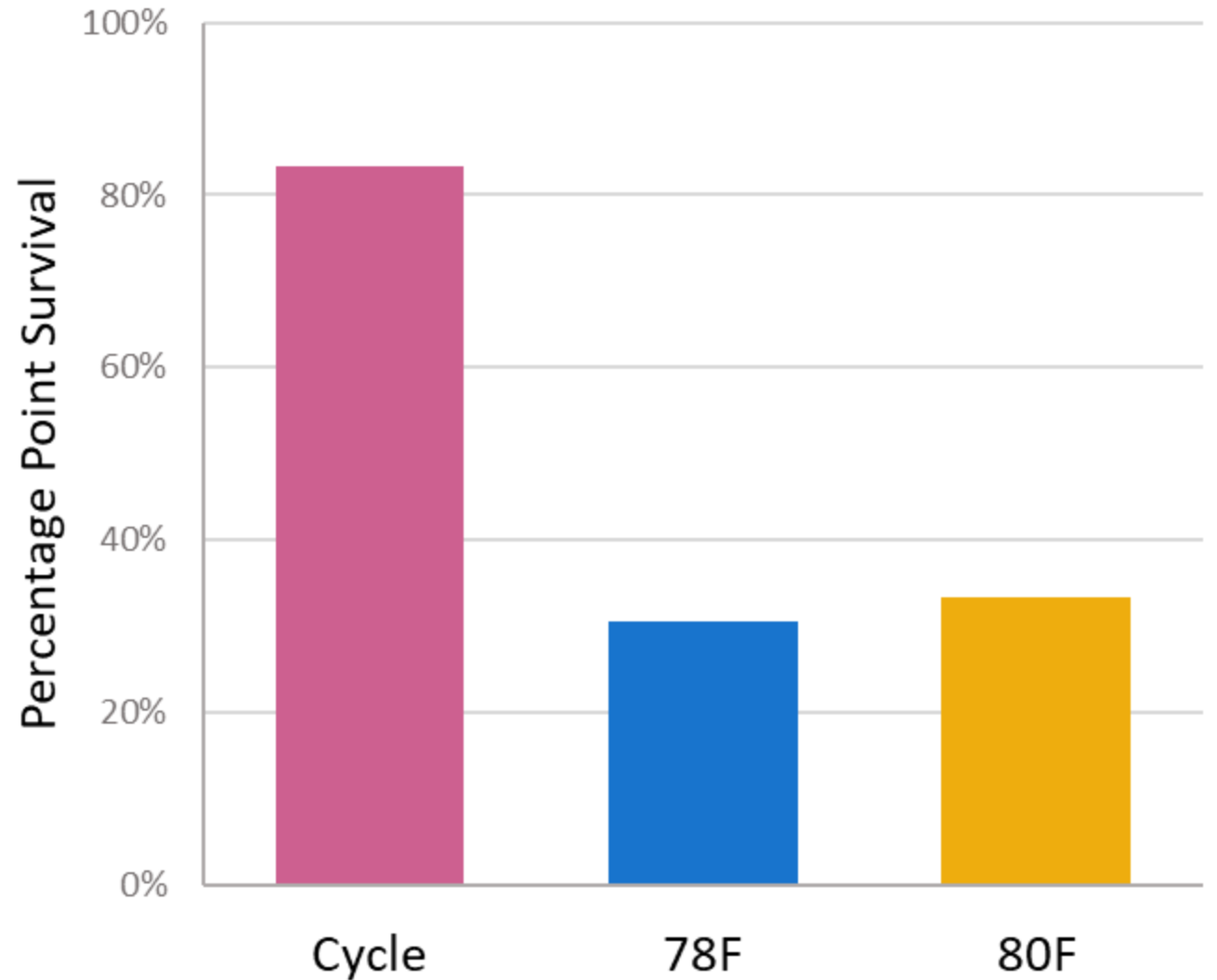
- Constant temperatures had earlier onset of mortality compared to cycling temperatures



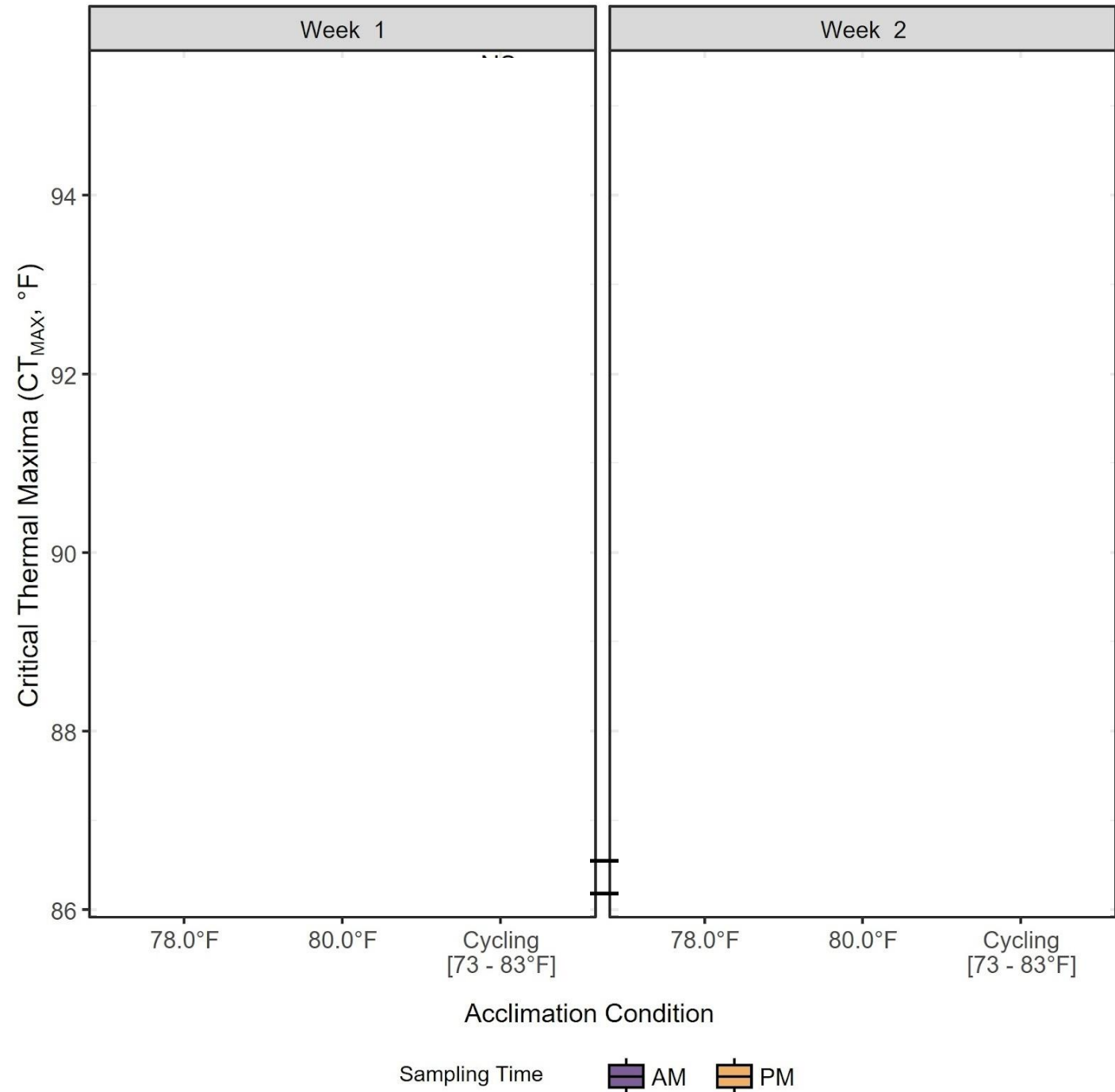
Thermal Cycling: Exposure Survival

- Constant temperatures had reduced survival compared to cycling temperatures

Treatment	Starting Number of Fish	Percentage Point Survival at End of 2 Weeks
78°F	36	31%
80°F	36	33%
73 - 83°F Cycle	36	83%

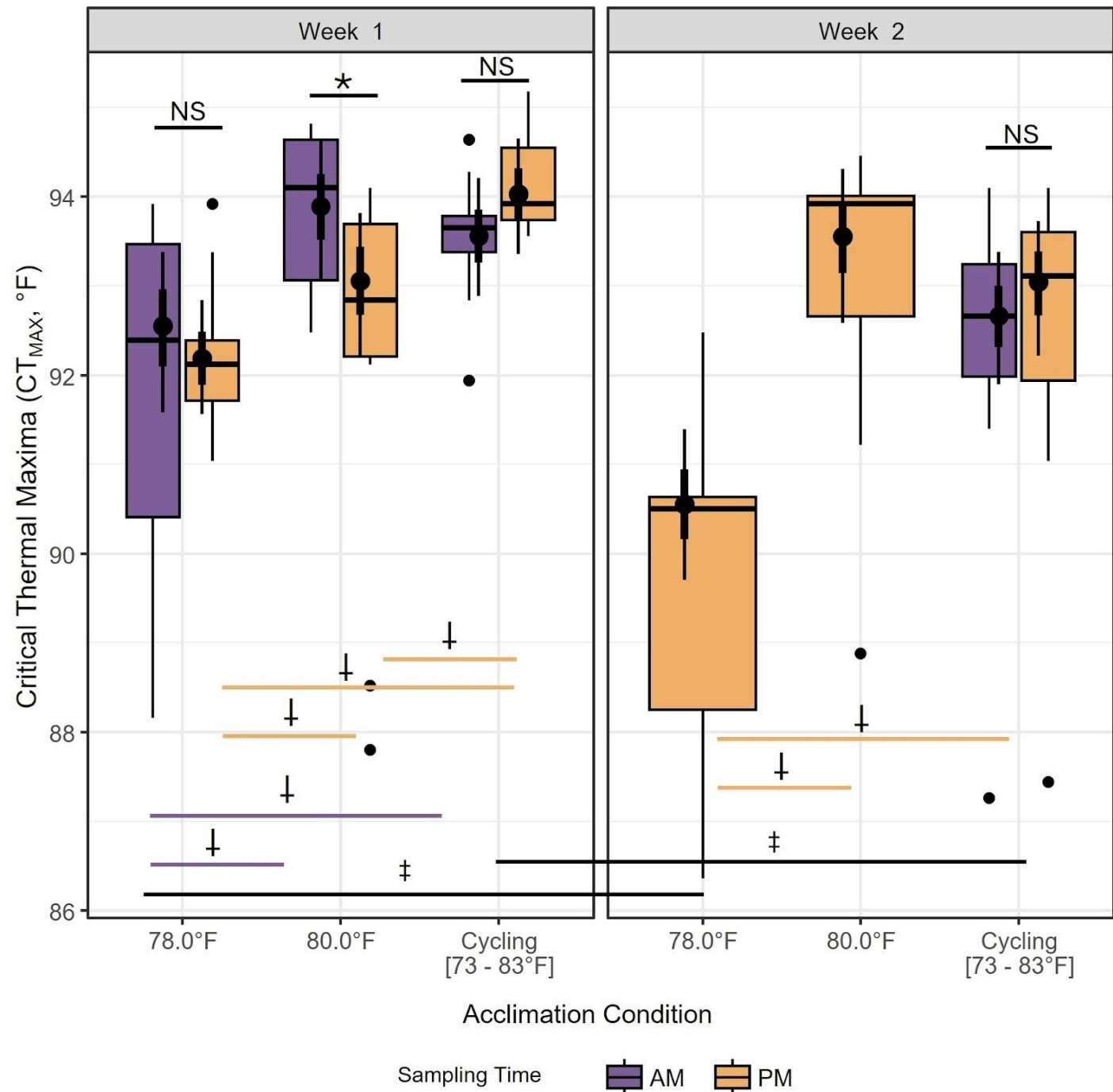


Thermal Cycling: Acute Tolerance



Thermal Cycling: Acute Tolerance

- Cycling did not elicit higher CT_{MAX} compared to constant acclimation
- Fish in the 78.0°F group showed wide variation in week 2
 - Tested at onset of mortality; Likely tested at their chronic limit



Thermal Cycling: Take-Aways

- Fish held at upper range of thermal limits gain no additional acute tolerance from temperatures $>73^{\circ}\text{F}$
- Phase One indicated adults could not survive prolonged exposure to $>77^{\circ}\text{F}$
 - Access to colder temperatures (e.g. via cycling) may provide tolerance benefits
 - Further research is needed to better understand the extent fish are able to utilize refugia for recovery

Male Spawning and Parental Care

Male Spawning and Parental Care

Original Goal:

- Expose adult males in natural-simulation tanks to 60 - 77 °F
- Measure changes in adult male behavioral traits (e.g., nest building)



Male Spawning and Parental Care

- Unable to collect number of gravid females needed
 - Potential density-driven effect on female development
 - Presence of seemingly intersex fish with both female and male gonads
- Prioritized available females toward embryo tolerance work

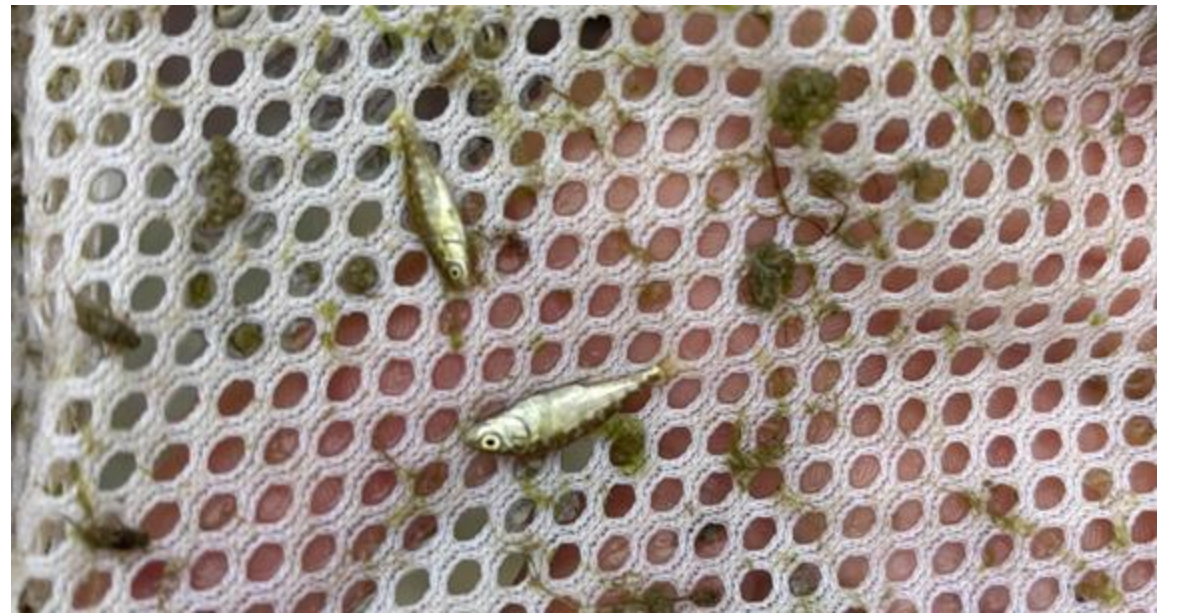


Juvenile Thermal Tolerance

Juvenile Tolerance

Year One Review

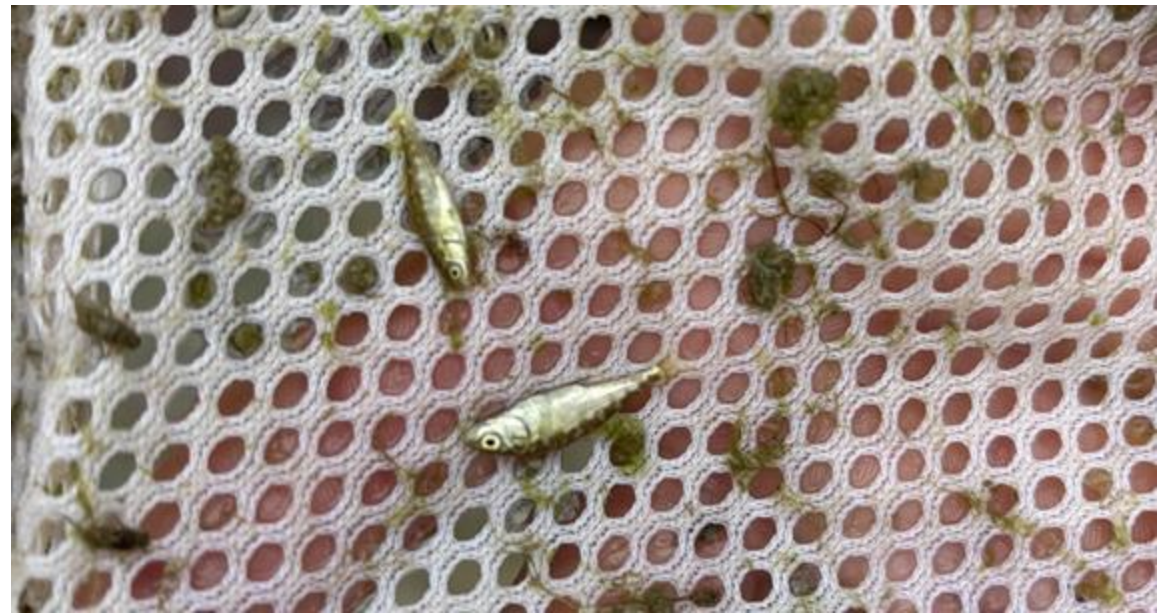
- Collected CT_{MAX} data for adults acclimated to 4 temperatures
 - 60.0, 65.5, 72.9, and 77.0°F
- *Remaining question: Are early life stages more thermally sensitive than adult counterparts?*



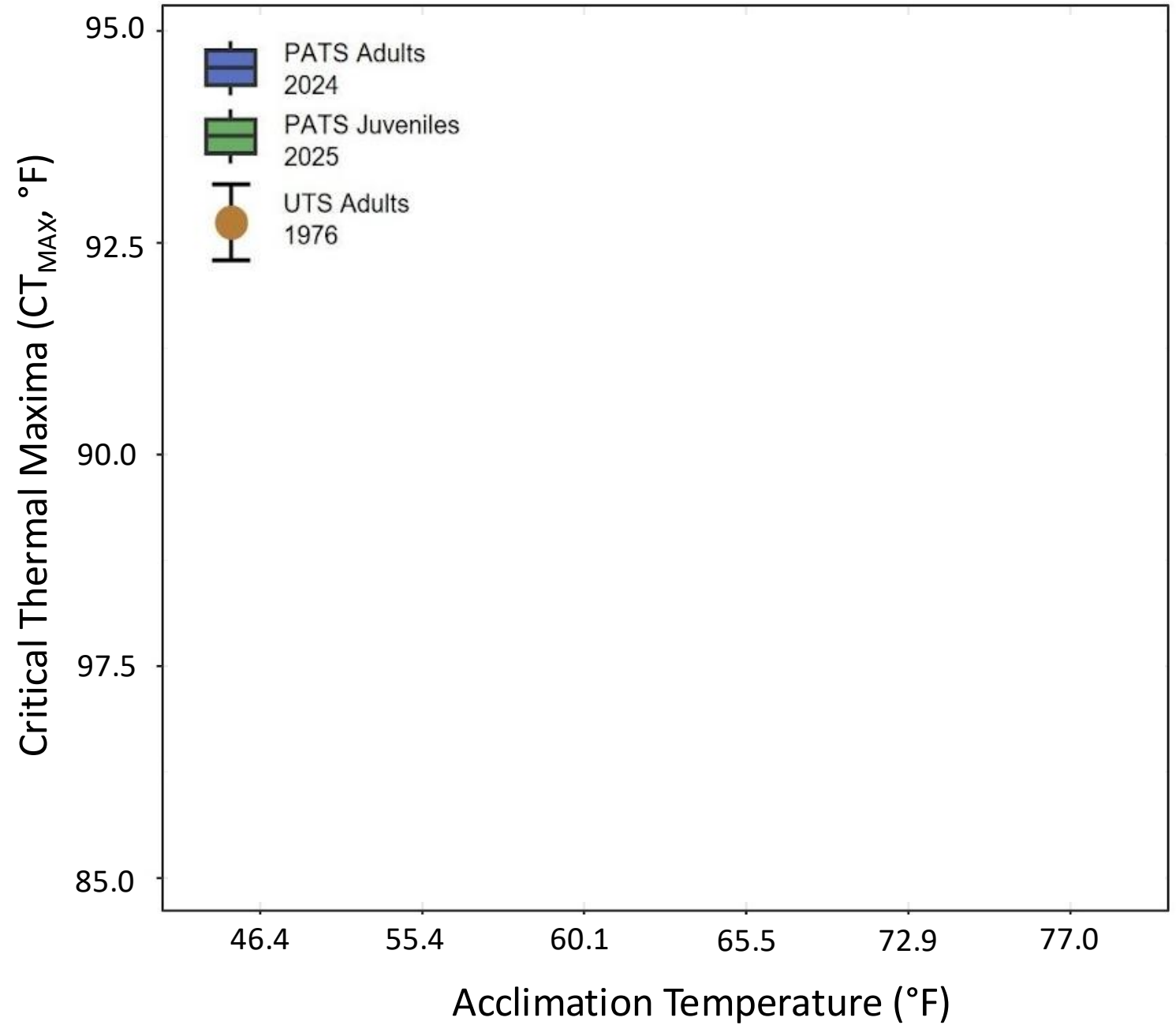
Juvenile Tolerance

July - August 2025

- Collected juveniles from lower SCR
- Acclimate groups of juveniles to 4 temperatures
 - 60.0, 65.5, 72.9, and 77.0°F
- Measured differences in CT_{MAX} between acclimation temperatures and compared to adult fish

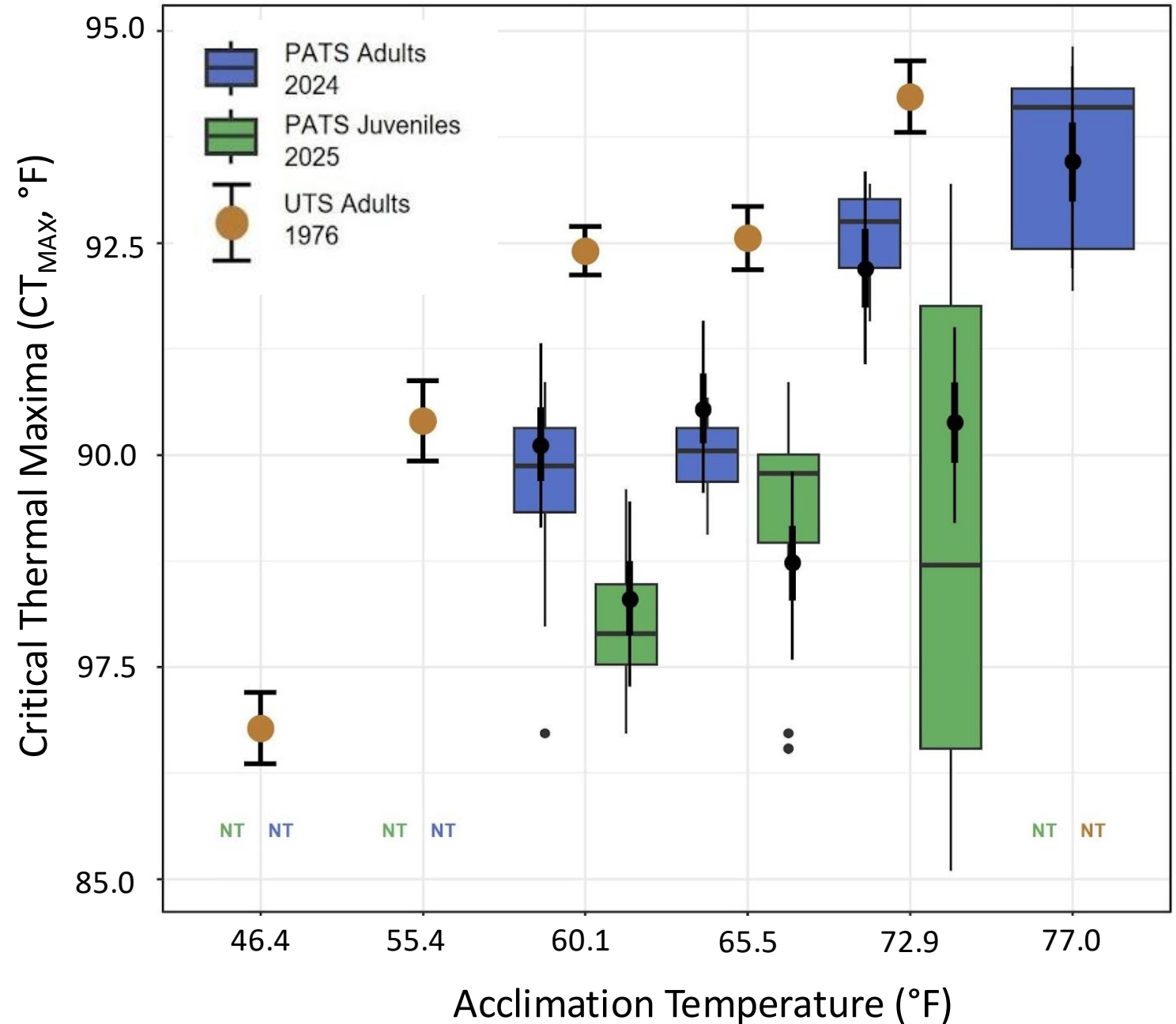


Juvenile Tolerance



Juvenile Tolerance

- Juveniles were unable to be acclimated to 77°F
 - High mortality for 72.9°F group on day before and of trial
- Adult CT_{MAX} was $\sim 2^\circ\text{F}$ higher than juveniles across all temperatures



Juvenile Tolerance: Take-Aways

- Adults are more thermally tolerant than juveniles
 - CT_{MAX} was $\sim 2^{\circ}F$ higher for adult fish
 - Adults were able to successfully acclimate to higher temperatures ($>72.9^{\circ}F$)

Embryo Incubation and Tolerance

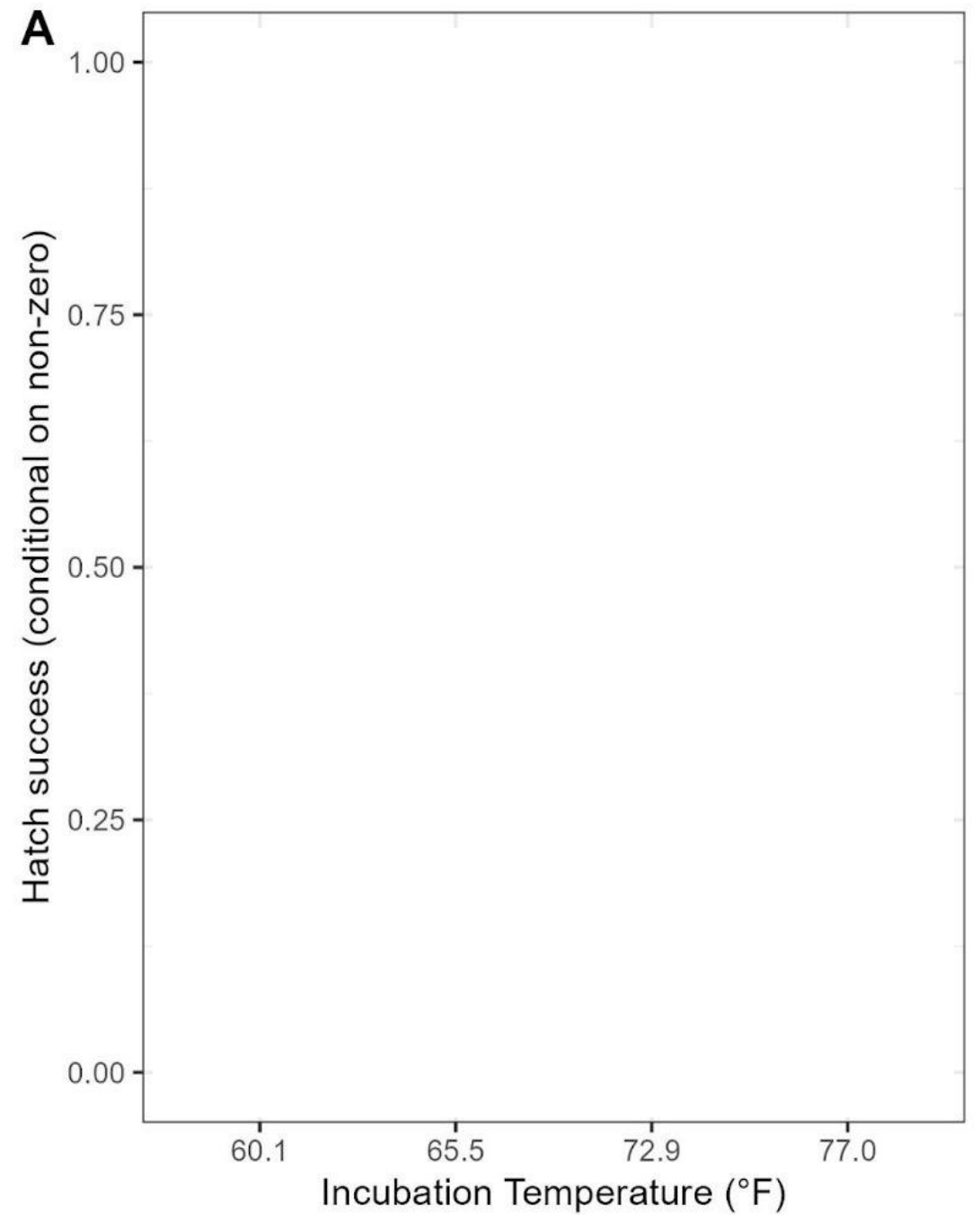
Embryo Incubation

August - October 2025

- Artificially spawned embryos
 - 3 parental crosses
 - 1 male and 1 female per cross
- Incubated embryos at 4 temperatures
 - 60.0, 65.5, 72.9, and 77.0°F
- Measured hatch success, time to hatch and length at hatch

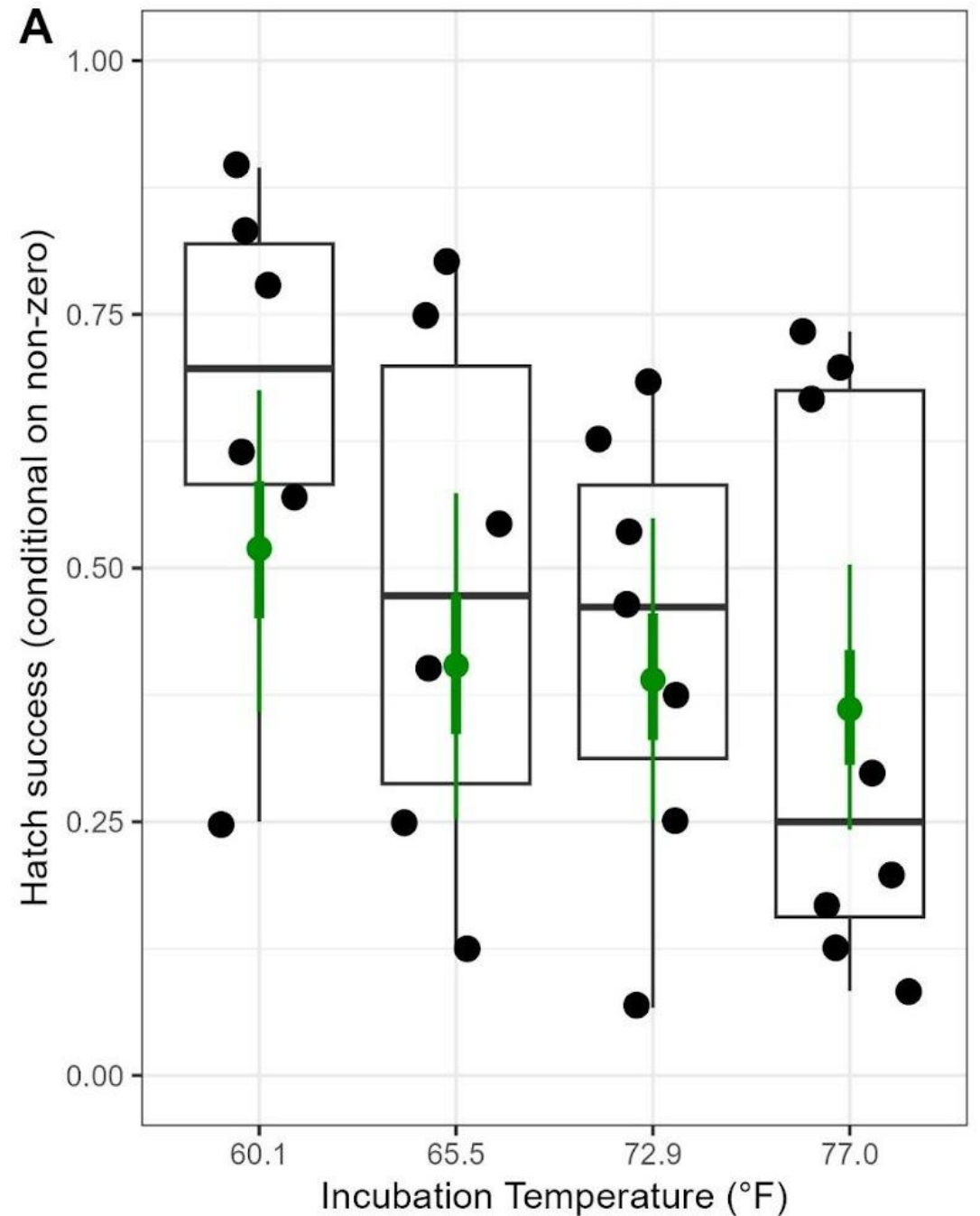


Embryo Incubation: Hatch Success



Embryo Incubation: Hatch Success

- Embryos successfully hatched at all temperatures from 60.1 - 77.0°F
- No significant difference in rate of successful hatching between temperatures



Embryo Incubation: Days to Hatch and Length

- Embryos hatched faster at higher temperatures
 - Hatch time plateaued ~6 days for fish reared at >72.9°F
- Fish reared at >72.9°F also showed shorter length at hatch

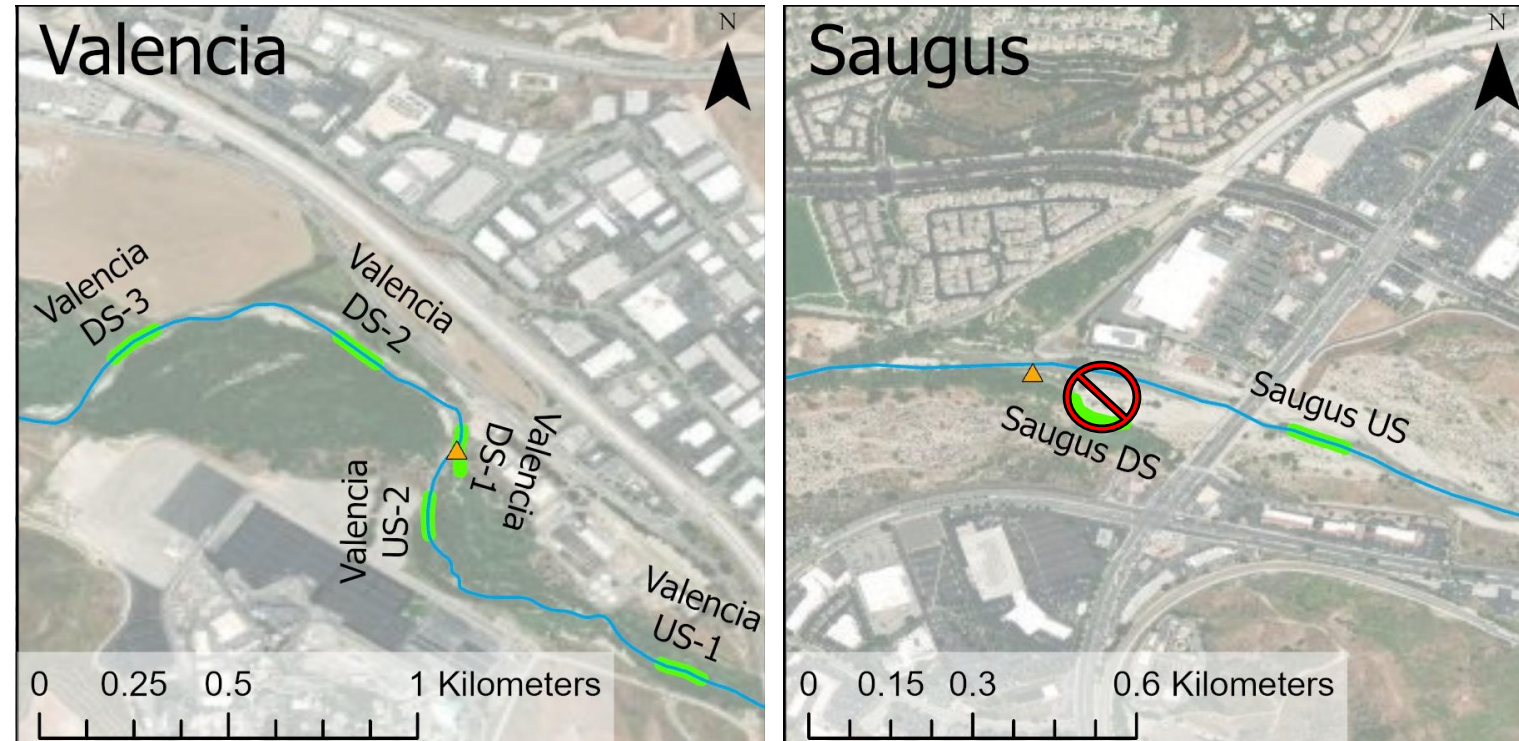
Acclimation Temperature	Days to Hatch Mean \pm Std. Dev.	Length at Hatch (cm) Mean \pm Std. Dev.
60.1°F	11.0 \pm 0.1 ^a	0.53 \pm 0.04 ^a
65.5°F	7.8 \pm 0.4 ^b	0.49 \pm 0.03 ^b
72.9°F	6.0 \pm 0.2 ^c	0.47 \pm 0.03 ^c
77.0°F	5.8 \pm 0.4 ^c	0.47 \pm 0.03 ^c

Embryo Incubation: Take-Aways

- Embryos were thermally robust and hatched at temperatures up to 77.0°F
 - Number of possible parental crosses was low
 - Additional research could increase confidence of results
- Fish incubated at lower temperatures took longer to hatch and were larger
 - Larger sizes may increase swimming and foraging efficiency
 - Longer incubation risks stochastic events (e.g., nest predation) and hatchlings may hatch with fewer endogenous energy stores

Benthic Macroinvertebrate Sampling

- Historical NPDES Sites
 - Saugus RA (“US”)
 - Saugus RB (“DS”)
 - Valencia RC (“US-2”)
 - Valencia RD (“DS-1”)
- 2025 Sampling Sites
 - Saugus - “US” only
 - Halted due to stickleback presence
 - Valencia - 5 Sites
 - Valencia DS-1 site contains transects within the outfall channel
- Taxa identified to SAFIT Level II



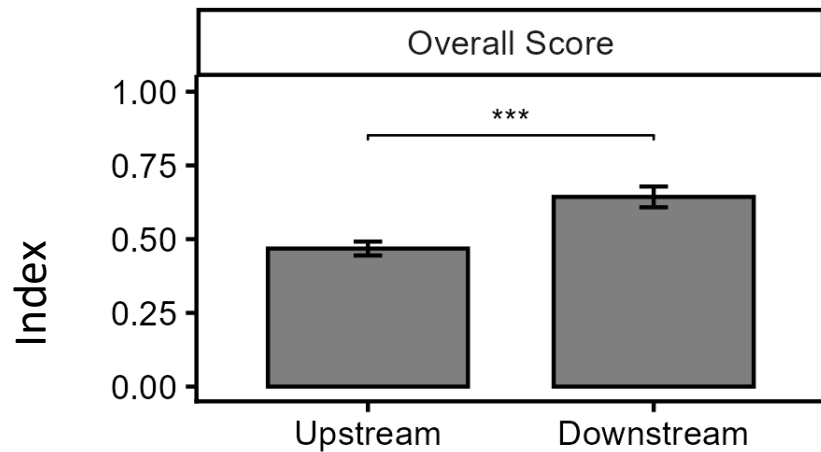
Legend

- ▲ WRP Outlet Confluence
- BMI Sampling Reach
- Santa Clara River

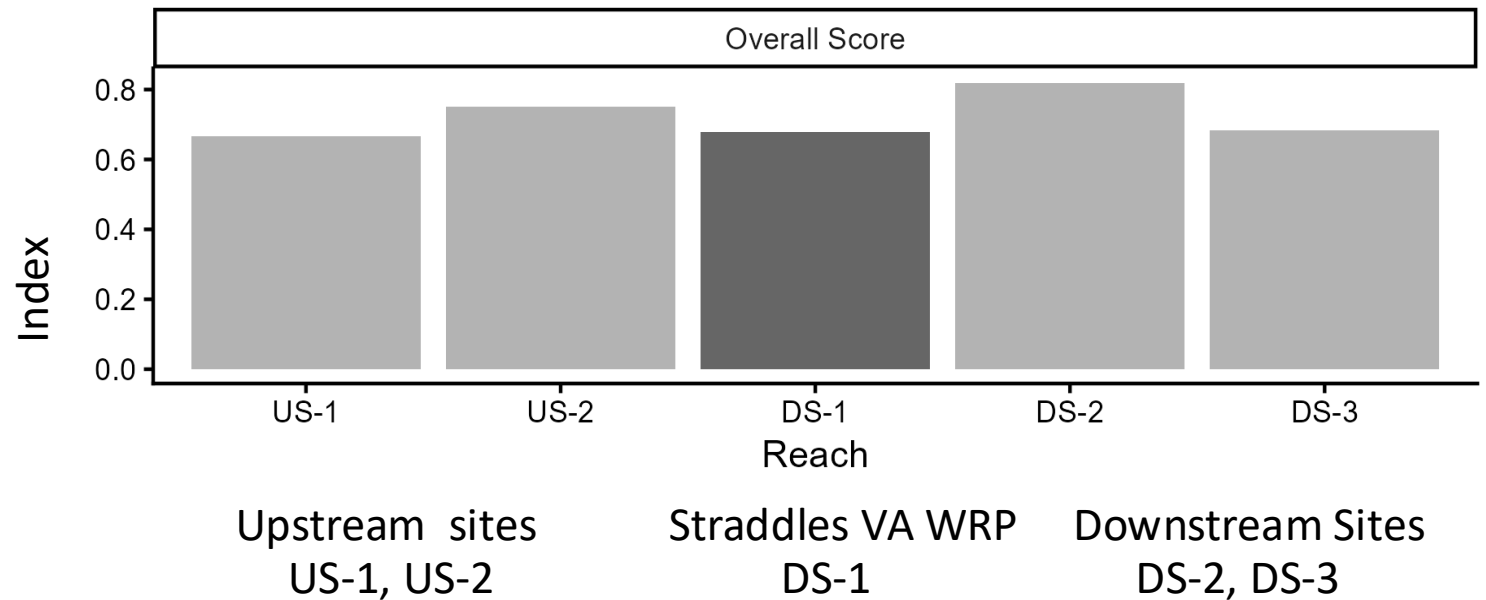


BMI CSCI Scores

Valencia NPDES Sites
(2004-2011, 2013-2015, 2025)



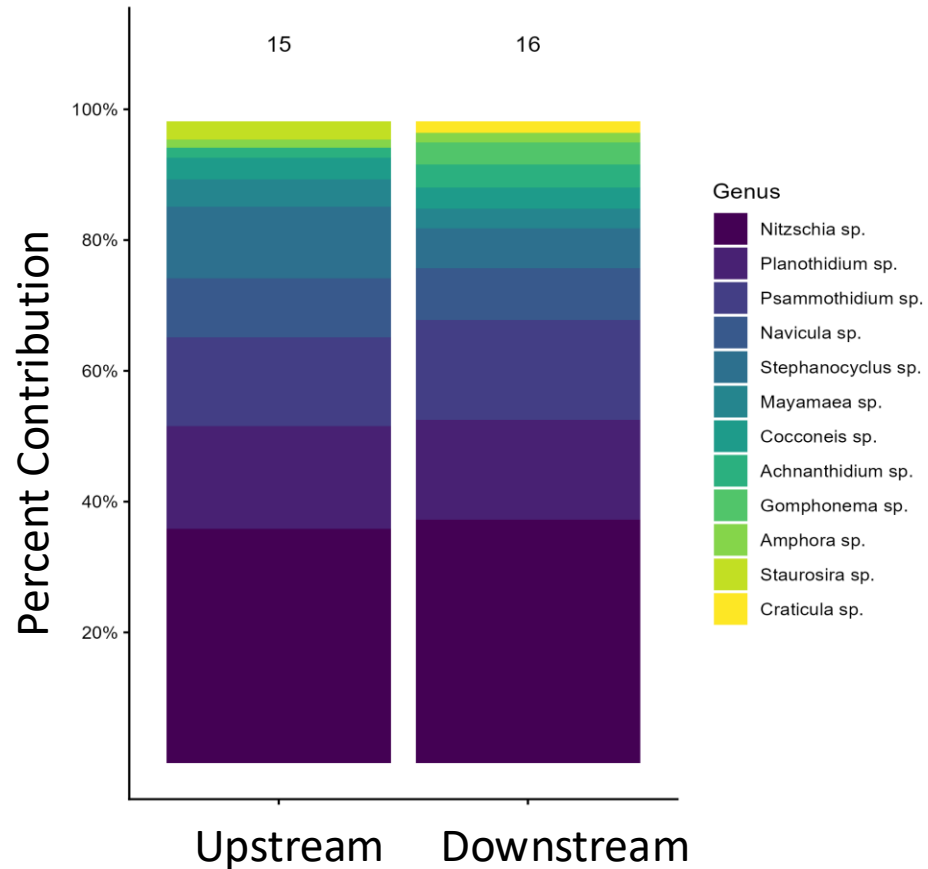
2025 Valencia Sites



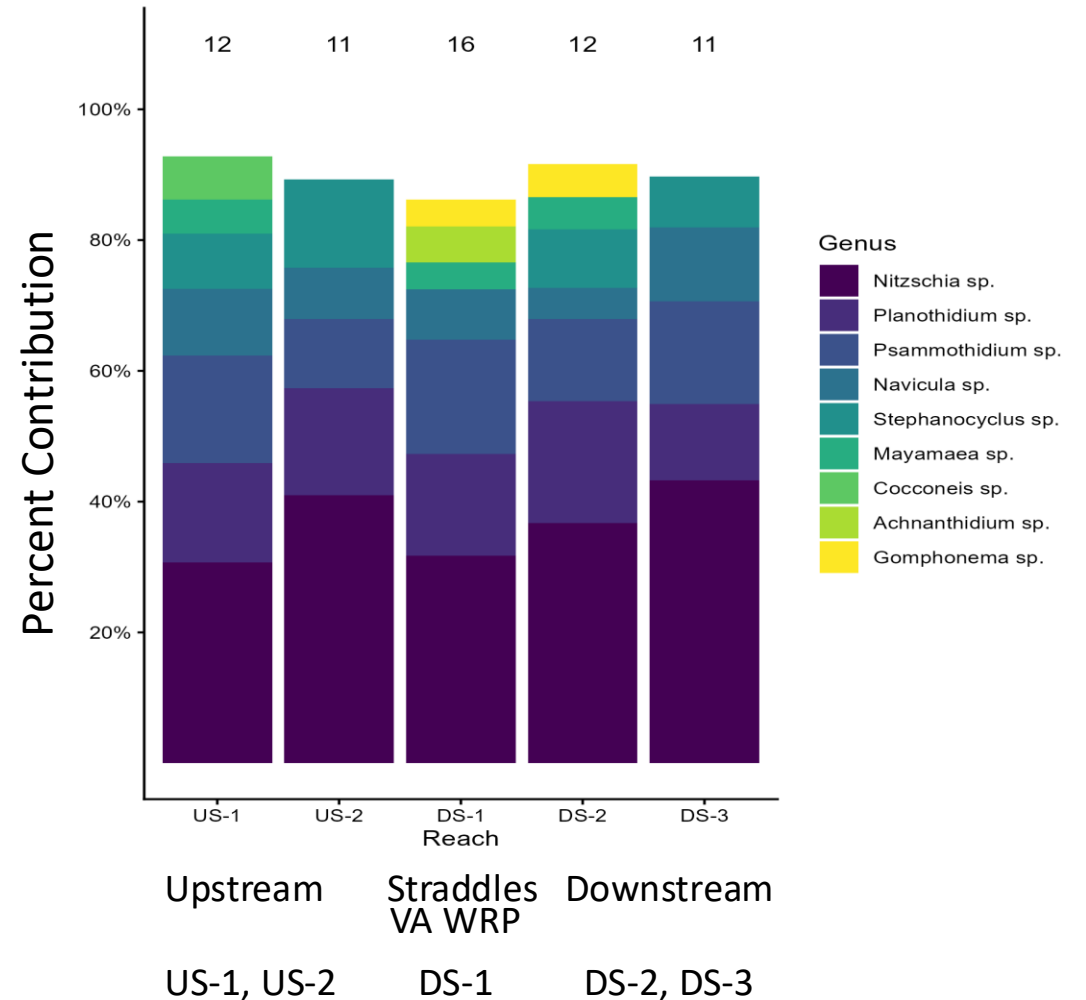
- Average CSCI slightly **greater downstream** of VA WRP
- **No discernable effect** of VA WRP on index components

2025 Diatom Algal Taxonomic Richness

Upstream vs. Downstream Sites



Individual Sites



Benthic Macroinvertebrate and Algal Sampling

Conclusions

- Historic and current CSCI scores indicate “likely altered” biological condition relative to reference conditions
- Stream is highly dynamic (scouring flows, sandy channel)
- Food resources do not appear limited based on observations
- No discernable effect across historic data
- Mean CSCI score was slightly higher downstream of Valencia (not ecologically meaningful)

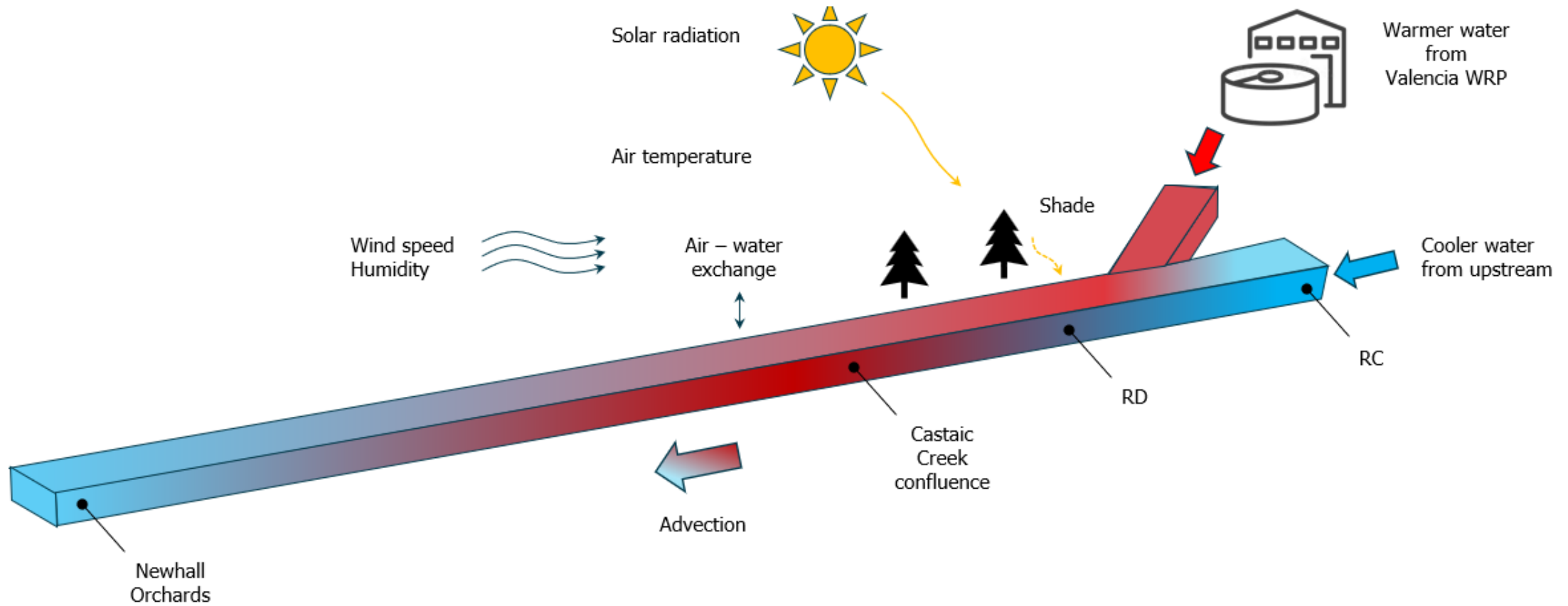


Temperature Modeling

Temperature modeling goals

- Model potential river management actions for their effect on river temperature under a range of conditions (e.g., years with higher or lower mixing flows from upstream)
- Help District screen potential management actions for more detailed consideration

Temperature Model (CE QUAL W2)

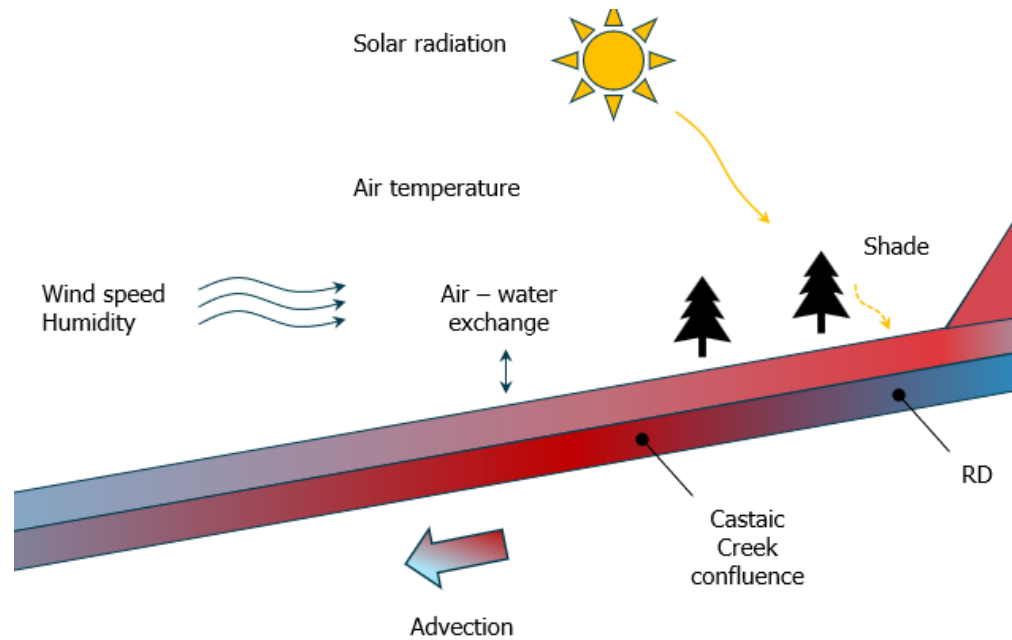


Temperature modeling recap

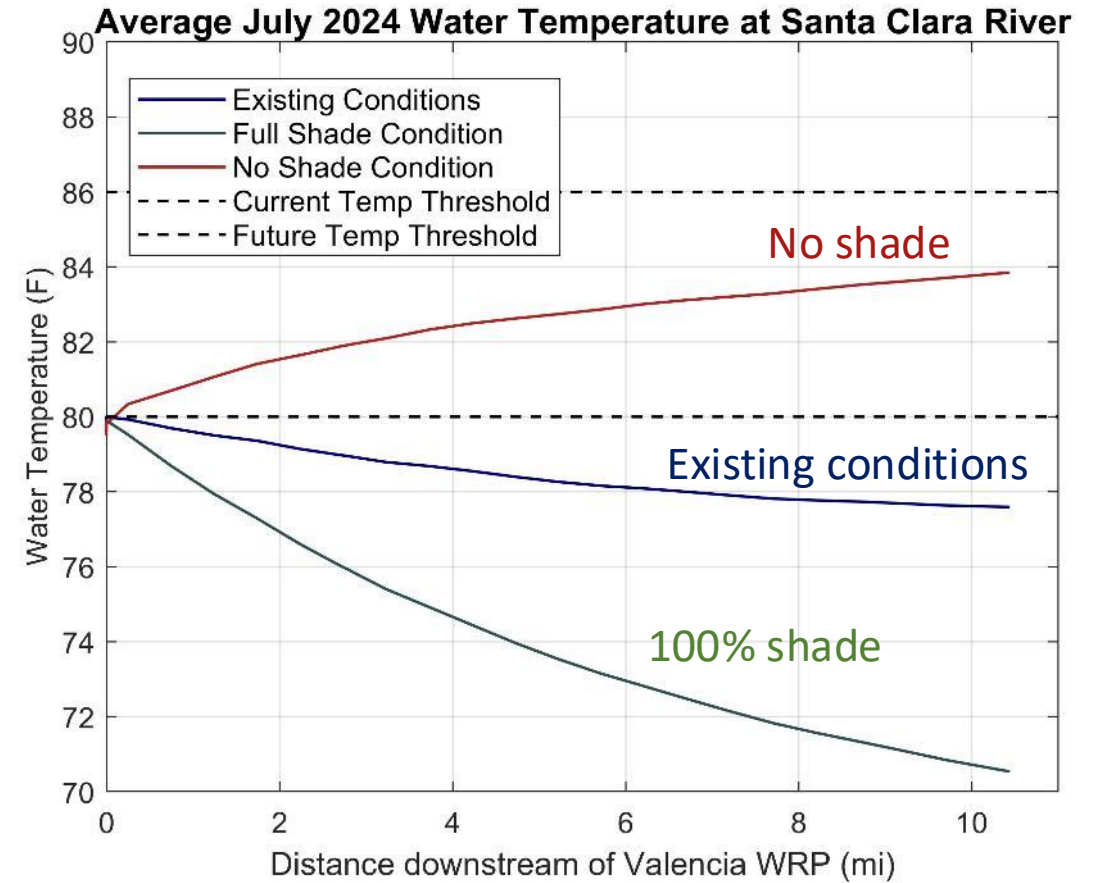
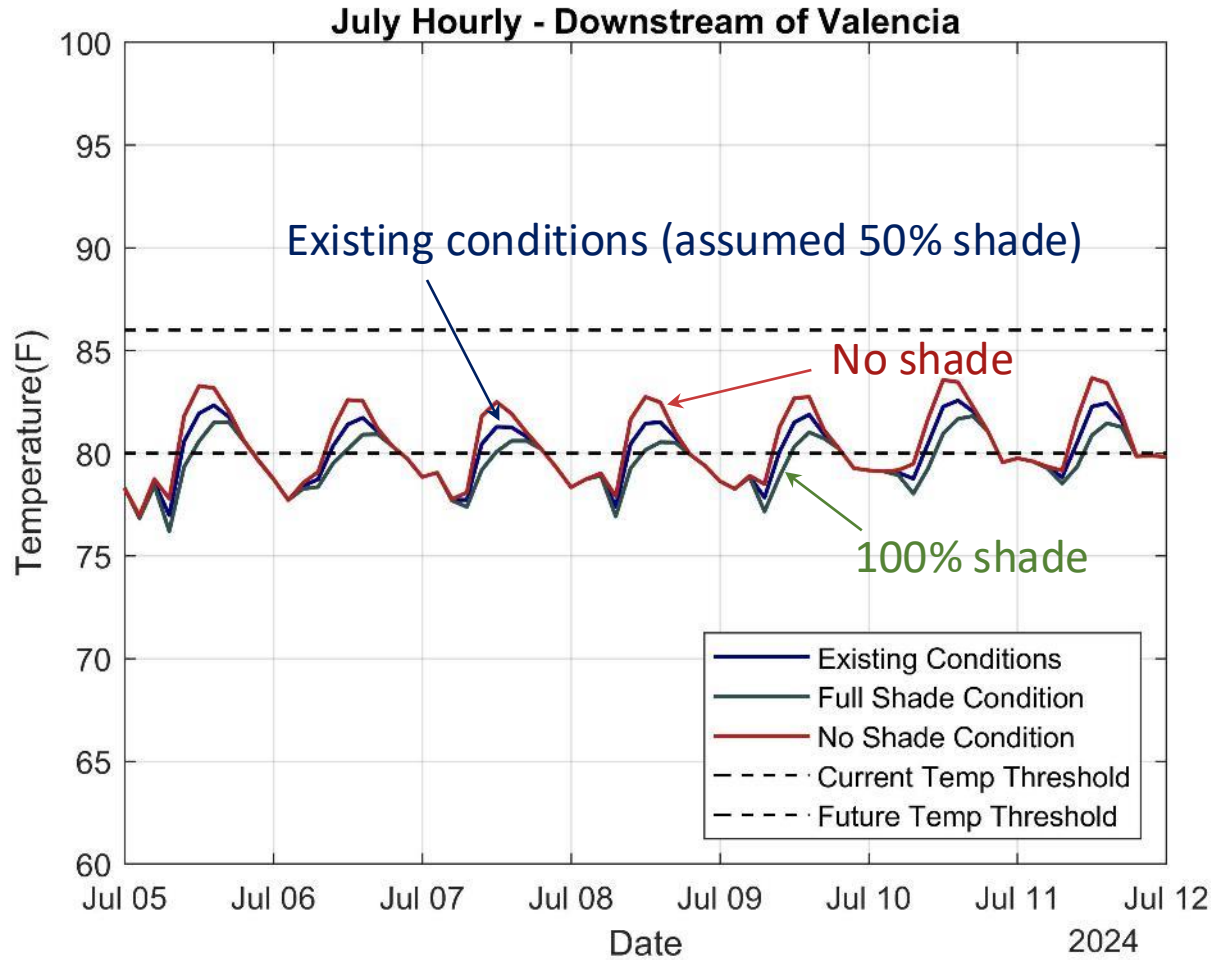
- Simulated summer and fall from a year with higher and lower than average upstream flow contributions
- Tested management scenarios:
 - Existing conditions
 - 50% reduction in effluent
 - 100% reduction in effluent
 - Cap effluent temperature at 80°F
- All management actions still resulted in some days when river temperatures exceeded 80°F (including complete elimination of effluent)

Additional temperature modeling scenario

- Sensitivity of river temperatures to riparian shade

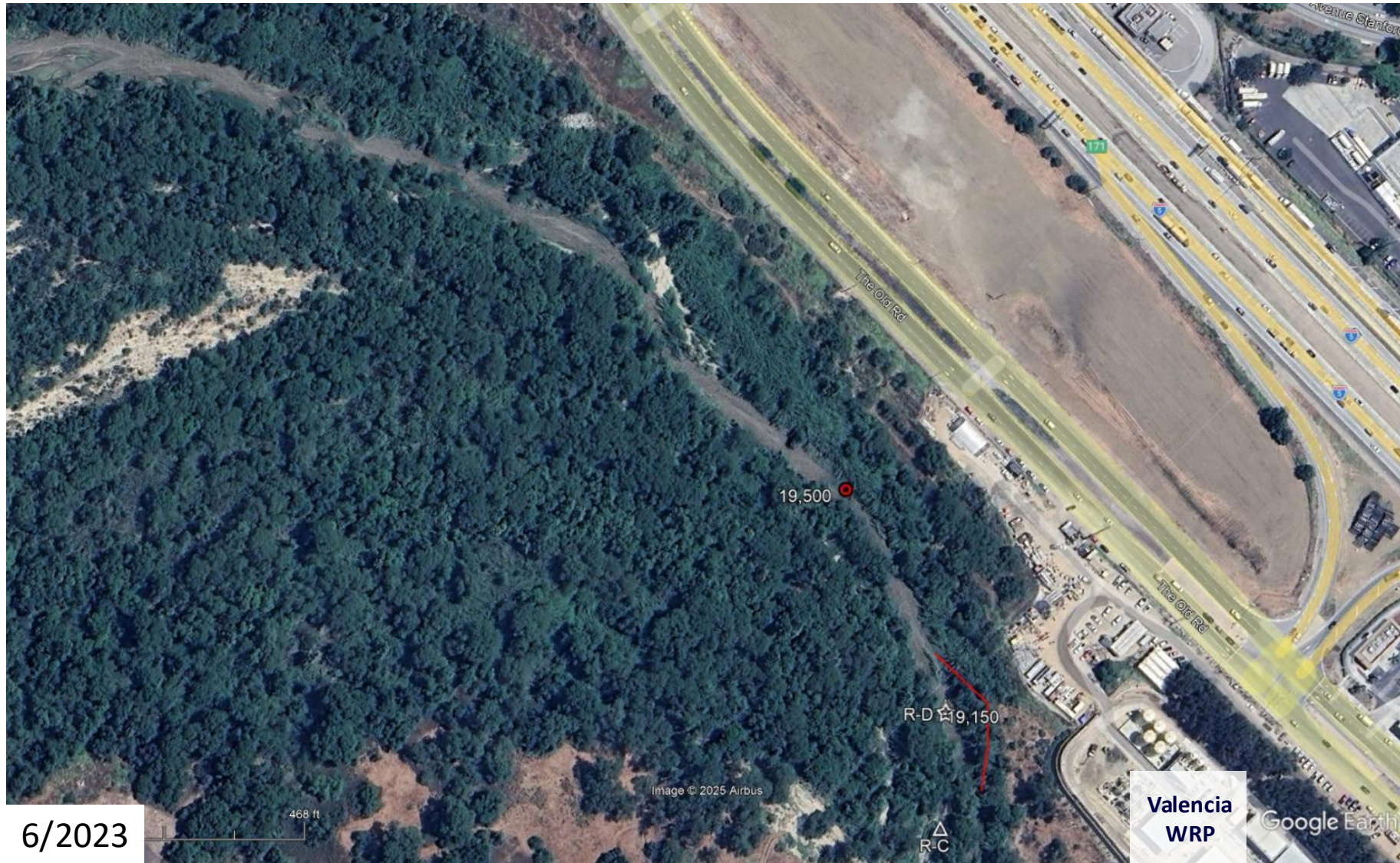


Effects of shade (Water year 2024)



Results: While shade can reduce river temperature by 2-4 degrees F by Castaic Creek, there is no way to guarantee continuous cover given the natural dynamism of the river (e.g., erosion of riparian corridor)

Variation in riparian cover following 5-year flood



Variation in riparian cover following 5-year flood



Variation in riparian cover following 5-year flood



Variation in riparian cover following 5-year flood



Variation in riparian cover following 5-year flood



Castaic
Creek
confluence

5/2022

1203 ft

Google Earth



Valencia
WRP

Variation in riparian cover following 5-year flood



Variation in riparian cover following 5-year flood



Castaic
Creek
confluence

2/2024

Valencia
WRP



Variation in riparian cover following 5-year flood



Castaic
Creek
confluence

8/2024

Valencia
WRP

Study Summary – What We Found

- Strong seasonal & diurnal temperature variability
- Downstream summer peaks ~80–83°F, usually short-duration
- Upstream rarely reaches 80°F; ~9°F cooler on average
- WRP temperature influence attenuates downstream
- Fish community dominated by non-natives; UTS is the only fish native to the watershed
- No effluent-related degradation in BMI or algae



Study Summary – What It Means for UTS

- Risk driven by temperature + duration + life stage
- Juveniles most sensitive; embryos most tolerant
- Short excursions $\geq 80^{\circ}\text{F}$ tolerated with nightly cooling
- Sustained warm periods pose risk, especially to juveniles
- Hydraulic conditions can limit UTS habitat downstream
- WRP controls could reduce but don't eliminate exceedances
- Only removing Valencia WRP discharge meets both criteria near outfall
- $80^{\circ}\text{F} / \Delta 5^{\circ}\text{F}$ alone insufficient to define acceptable conditions



Temperature Management Analysis

- Nature-Based Solutions Considered
 - Cooling in sub-surface or with groundwater (e.g. blending with deep GW, GW heat exchange, subsurface infiltration)
 - Reducing discharge/increasing recycling
 - Shading
 - In-plant changes (shading)
- Issues
 - Do not provide the needed temperature reduction
 - Feasibility issues (e.g. space, permitting, etc.)



Mechanical Chiller Cost Estimates (Preliminary)

	<u>Saugus and Valencia WRPs</u>
Total Capital Cost (\$)	\$213 M*
Annual O&M Costs (\$)	\$3.2 M / yr
Annual Energy Needs (MWh)	16.4 MWh / yr
Annual Emissions - GHG Equivalents	8.6 M lb CO ₂ / yr
Annual Emissions - Gas passenger cars equivalents	910

*Includes estimated costs for 66kV substation for VA WRP to accommodate larger energy demands



Cooling Tower* Cost Estimates (Preliminary)

	<u>Saugus and Valencia WRPs</u>
Total Capital Cost (\$)	\$51 M
Annual O&M Costs (\$)	\$117 k / yr
Annual Energy Needs (MWh)	In progress**
Annual Emissions - GHG Equivalents	In progress**
Annual Emissions - Gas passenger cars equivalents	In progress**

*Unable to meet $\Delta 5^{\circ}\text{F}$ criteria; ongoing work to determine if 80°F can be met under extreme climate conditions (e.g., heatwaves).

**Energy usage will increase; ongoing work to estimate



Feedback and Next Steps

- Any additional questions or concerns over the work presented?
 - Do the studies adequately address the study questions?
 - Are the findings supported by the analyses? To what level of confidence?
 - How can these findings influence the approach to assessing temperature effects?
- Finalize technical report to address comments from today's meeting.
 - Please provide comments on the Final Technical Report by **April 1**.

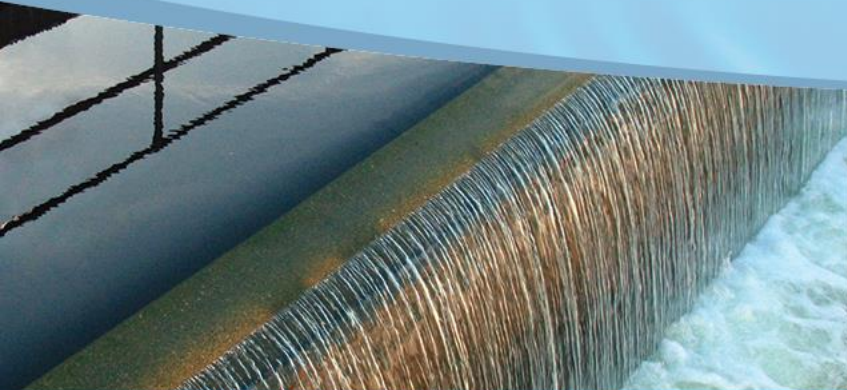




**LOS ANGELES COUNTY
SANITATION DISTRICTS**
Converting Waste Into Resources

OUR MISSION

To protect public health and the environment through innovative and cost-effective wastewater and solid waste management and, in doing so, convert waste into resources such as recycled water, energy, and recycled materials.



WATER RECYCLING



GREEN ENERGY



MATERIALS RECYCLING