

# Stream Habitat Conservation and Restoration

Vision, 26 September 2008

**Goal:** Develop and apply a general approach for stream habitat characterization, management, and restoration, in particular with respect to temperature regimes required by species of conservation concern.

**Background:** Temperature is a fundamental determinant of habitat suitability for aquatic organisms. Water temperature is determined by a complex interplay of prevailing meteorology, local riparian canopy structure and solar exposure, streambed morphology, and surface and subsurface flow patterns. We have developed a methodology for spatial-temporal analysis of stream temperature regimes. Our approach synthesizes long-term records of stream flow and water temperature, meteorology, stream morphology, observed temperature regimes, riparian canopy structure and solar exposure, prediction of temperature regimes, and characterization of species requirements. This approach can be applied to a broad spectrum of streams for habitat assessment, stream conservation, and restoration to accommodate diverse habitat needs, and to examination of potential impacts of climate change.

## Elements of Stream Habitat Stewardship:

- **Long-Term Records:** characterize patterns of stream flow and water temperature from gauging stations, and meteorology from nearby weather stations;
- **Stream Morphology:** analyze channel characteristics (profile, gradient, substrate, etc.) from field characterization and GIS analysis;
- **Riparian Vegetation:** measure canopy structure and solar exposure using hemispherical (fisheye) photography and canopy LIDAR remote sensing;
- **Sensor Network:** measure temperature regimes using iButton Thermochrons;

- **Habitat Requirements:** determine temperature and other habitat needs of key organisms;
- **Habitat Model:** develop habitat suitability model, based on calculation of time series of water temperature in response to heat fluxes using biophysical principles;
- **Education and Outreach:** develop general and site-specific resources (curriculum, web, brochures, presentations, signage, etc.) for education and interpretation of stream processes;
- **Planning and Review:** plan site-specific adaptive management of stream habitat, with periodic review of success and reassessment of goals; facilitate communication/collaboration among stakeholders (scientists, public, resource managers, and decision makers).

## Benefits

- Conservation of critical stream habitat
- Sound scientific basis for proactive, cost-effective stream habitat restoration and management
- Standardized methodology for comparison across different streams and different watersheds

## Contacts

**Karen Ritchie Shihadeh**, Senior Wildlife

*Biologist, Ventana Wildlife Society,*

*karensihadeh@ventanaws.org*

**Stuart B. Weiss**, PhD, CEO and Chief

*Scientist, Creekside Center for Earth*

*Observation, stu@creeksidescience.com*

**Paul M. Rich**, PhD, Senior Scientist,

*Creekside Center for Earth Observation,*

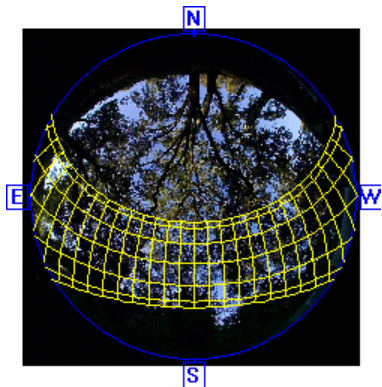
*paul@creeksidescience.com*

*<http://www.ventanaws.org>*

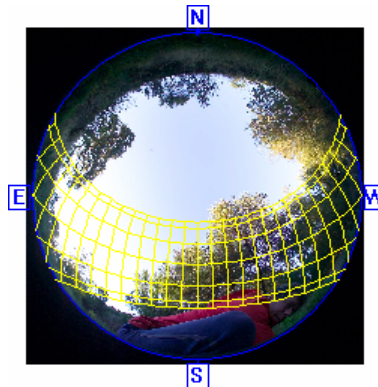
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## Our Approach

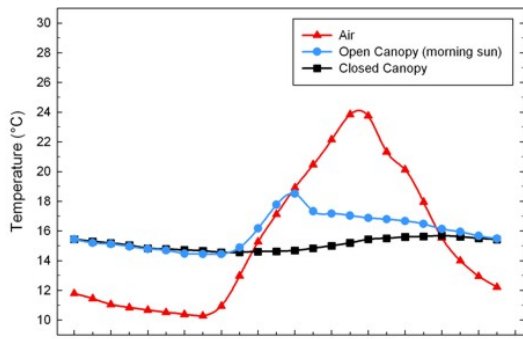


Upward looking hemispherical (fisheye) photograph from a closed canopy reach of San Francisquito Creek (San Francisco Peninsula, California).



Hemispherical photograph from a more open reach of the creek. Overlay of the sunpath enables calculation of solar exposure. This location receives much higher insolation than the location on the left.

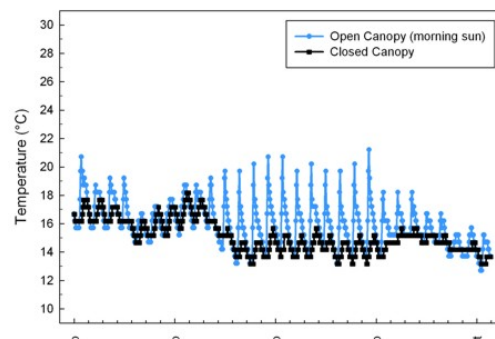
**Stream Habitat Characterization:** We employ hemispherical photography, stream morphology, and meteorological sensors, together with biophysical models of energy balance and temperature to engineer best



Mean hourly temperature for air and closed versus open canopy reaches of San Francisquito Creek.

**Initial Findings for San Francisquito Creek:** Water temperature co-varies with air temperature, diurnally with a lag, and over longer periods; stream reaches with high solar exposure display higher temperature variability (up to 5° C differential from baseline), whereas shaded reaches display modest temperature variability (0.5 - 1.0° C differential); and subsurface flow through gravel beds can decrease temperature by 2 - 3° C. Steelhead (*Oncorhynchus mykiss*) requires relatively cool microsites, whereas California red-legged frog (*Rana aurora draytonii*) and

management strategies. This comprehensive approach enables us to identify, maintain, and restore riparian canopy structure that provides suitable microsites, with respect to solar exposure and temperature.



Daily temperature for closed versus open canopy reaches of San Francisquito Creek.

western pond turtle (*Clemmys marmorata*) require warmer microsites.

**Comprehensive Solutions:** Our approach merges basic science, advanced technology, and adaptive management to restore and conserve stream habitat.

### Key Literature:

Weiss, S.B., P.M. Rich, and A.E. Launer. 2008. San Francisquito Creek Habitat Monitoring Project Final Report. Creekside Center for Earth Observation Report.

available online: <http://www.creeksidescience.com>