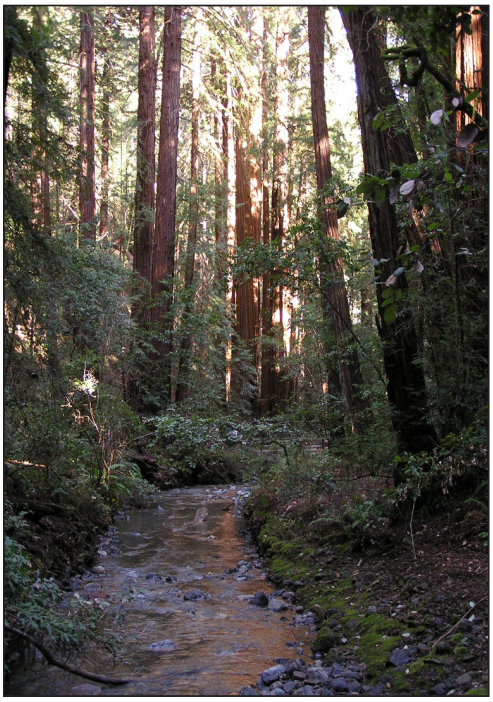
National Park Service
U.S. Department of the Interior
Inventory and Monitoring Program
Research Project Summary November 2008

Water Quality Monitoring in the San Francisco Bay Area Network



Redwood Creek supports a variety of aquatic life including coho salmon.

Importance: *The San Francisco Bay Area Network (SFAN) of the National Park Service (NPS) features many ecologically significant and unique aquatic resources. Water quality is an important indicator of overall ecosystem health.*

Many stream systems flowing through the parks have been altered by development as well as historic and current agricultural activities. NPS measures water quality to document and understand stream conditions and to facilitate better resource management, including efforts to improve water resources.

Freshwater systems within SFAN support a variety of federally protected species such as the California freshwater shrimp (*Syncharis pacifica*), coho salmon (*Oncorhynchus kisutch*), steelhead trout (*Oncorhynchus mykiss*), and the California red-legged frog (*Rana aurora draytonii*). Freshwater quality also directly impacts marine water quality, riparian habitat, and wetlands. It indirectly impacts all plant and animal life as well as human consumption, recreation, and enjoyment.

NPS has a legal obligation to ensure streams meet minimum water quality standards for beneficial uses set by the relevant Regional Water Quality Control Boards (RWQCB) as part of the Clean Water Act. These uses include contact and non-contact recreation, fish spawning and migration, cold freshwater habitat, freshwater replenishment, and wildlife habitat. Long-term water quality monitoring can also provide an important tool for detecting, assessing, and mitigating large-scale impacts such as climate change.

Monitoring Program: *NPS monitors water quality in five SFAN units to determine range, variability, trends, and conformation with federal and state criteria.*

In the past, targeted water quality monitoring has taken place in the parks, but 2007 marked the beginning of the standardized long-term SFAN monitoring program for priority freshwater streams. The objectives of the program are to determine existing ranges, variability, and long term trends in water quality through analysis of selected parameters, as well as to determine the extent to which selected sites meet federal and state water quality criteria.



SFAN staff samples water for temperature, dissolved oxygen, pH, specific conductance, discharge, coliform bacteria, and nutrients.

Staff measure core water quality parameters including water temperature, dissolved oxygen, pH, specific conductance, and discharge; the pathogen parameter coliform bacteria (total coliform and *E. coli*); and the nutrient parameters nitrate, ammonia, and total Kjeldahl nitrogen (TKN). Fecal coliform is also measured in Olema Creek to determine the load to Tomales Bay as part of the Tomales Bay

Table 1. The SFAN water quality monitoring schedule will repeat in the same pattern past 2012.

Creek	# Stations	Park Unit**	Water Year		
			07, 08	09, 10	11, 12
Olema	8	PORE	X	X	X
Pine Gulch	3	PORE	X		X
Franklin	1	JOMU	X		X
Chalone	8	PINN	X		X
Rodeo	2	GOGA	X		X
Tennessee Valley	3	GOGA	X		X
Nyhan	1	GOGA	X		X
Oakwood	1	GOGA	X		X
Redwood	11	GOGA/MUWO		X	
West Union	5	GOGA		X	
Lagunitas	2	GOGA/PORE		X	

Pathogen Total Maximum Daily Load (TMDL) Program established by the San Francisco RWQCB.

The monitoring program consists of eleven watersheds broken into two groups that are sampled in alternate two-year periods (Table 1). Olema Creek is being monitored continuously for the TMDL program. In water year 2007 (October 1, 2006, to September 30, 2007), staff made a total of 255 sampling visits to 25 sites throughout eight watersheds.

Status and Trends: *Water quality results in 2007 commonly met the criteria established by the relevant RWQCBs.*

The first year of the monitoring program provides a glimpse into the water quality issues within the network and ranges of values, but does not yet provide enough data to analyze trends or to provide a definitive answer to the monitoring objectives.

The majority of samples throughout all parks met the established regional water quality standards (Figure 1). To support aquatic life, pH should be between 6.5 and 8.5 and dissolved oxygen should be greater than 5.0 mg/L in warm water habitats (Pinnacles) or 7.0 mg/L in cold water habitats (all other SFAN parks). The pH and dissolved oxygen levels falling outside of established criteria were commonly a result of dry season intermittent or no-flow conditions. *E. coli* bacteria is an indicator of pathogenic organisms which can present a risk to human health. The objectives for *E. coli* are based on the health risk associated with recreational contact, such as swimming. Unionized ammonia is a nutrient that can be toxic to aquatic life when present at concentrations greater than 0.025 mg/L.

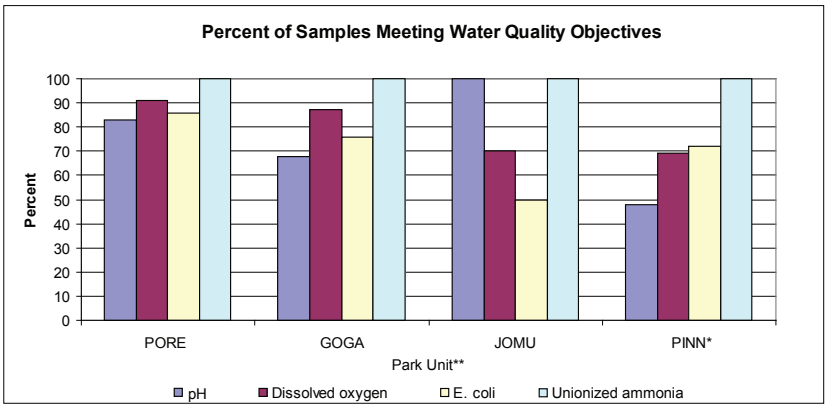


Figure 1. The majority of samples across all park units met the standards. Water quality parameters most often exceeded established criteria in Pinnacles National Monument. *Pinnacles pH criteria: 7.0 to 8.5. **See bottom of page.

Monitoring disclosed two potential problem areas. High bacteria levels on Nyhan Creek (Golden Gate) indicate a possible upstream source; and high specific conductance, high nutrient levels, and indications of bacteria loading on two of the tributaries to Chalone Creek (Pinnacles) point to likely pollutant inputs. After three to five years of data collection, a synthesis report will provide thorough analysis of patterns, trends, and correlations among resources being monitored; provide data interpretation and context; and recommend changes to management practices.

Additional Resources:

Carson, R.G. and J.S. Skancke. 2008. Freshwater Quality Monitoring Program: 2007Annual Report for San Francisco Bay Area Network I&M Program. Natural Resource Technical Report NPS/PWR/SFAN/NRTR—2008. National Park Service, Fort Collins, CO.

View SFAN water quality data through July 2008 in the EPA STORET database: http://www.epa.gov/storet/dw_home.html.

Summary written by Alison Williams. For more information contact Jennie Skancke, Water Quality Specialist, San Francisco Bay Area Network Inventory and Monitoring Program, 415-464-5122. Also see: http://science.nature.nps.gov/im/units/sfan/index.cfm.

**Acronyms: GOGA - Golden Gate, JOMU - John Muir , MUWO - Muir Woods, PINN - Pinnacles, PORE - Point Reyes.