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Sonoran Desert Network—Stream and Washes Monitoring Protocol



Stream Monitoring at Tumacácori NHP

Santa Cruz River Researcher's Day
Tucson Community Service Center
March 27 2009

Presented by
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Overview—why, what, where, when and how

- **Stream Protocol**
- Importance of riparian areas
- Streams Protocol Parks
- What we monitor
- How we monitor
- Some example results



Worker at TUZI--NPS photo

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- Why are riparian areas important?
 - Compose of less than 2% of land area in Southwest
 - Highest density and abundance of plants and animals
 - Critical habitat: supply food, cover and water
 - Habitat connectors and migration routes
 - Control pollution, mitigate erosion and floods
 - Increase groundwater recharge



NPS photo



Sonoran Desert Network Parks



Produced by SODN
December 2004

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- How we monitor...
 - Sample design
 - Sampling gear
 - Data management
 - Reporting
 - Communication
 - Websites



Beaver Creek from the Castle by Paul Ollig

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- Stream Monitoring Protocol Vital Signs
 - Stream Channel Morphology
 - Surface Water Quantity
 - Core Water Quality Parameters
 - Primary Nutrients
 - Pollutant Metals
 - Biological Condition
 - Benthic Macroinvertebrates
 - Fish and Crayfish
 - Riparian Vegetation
 - Exotic Plants Species—Status and Trends



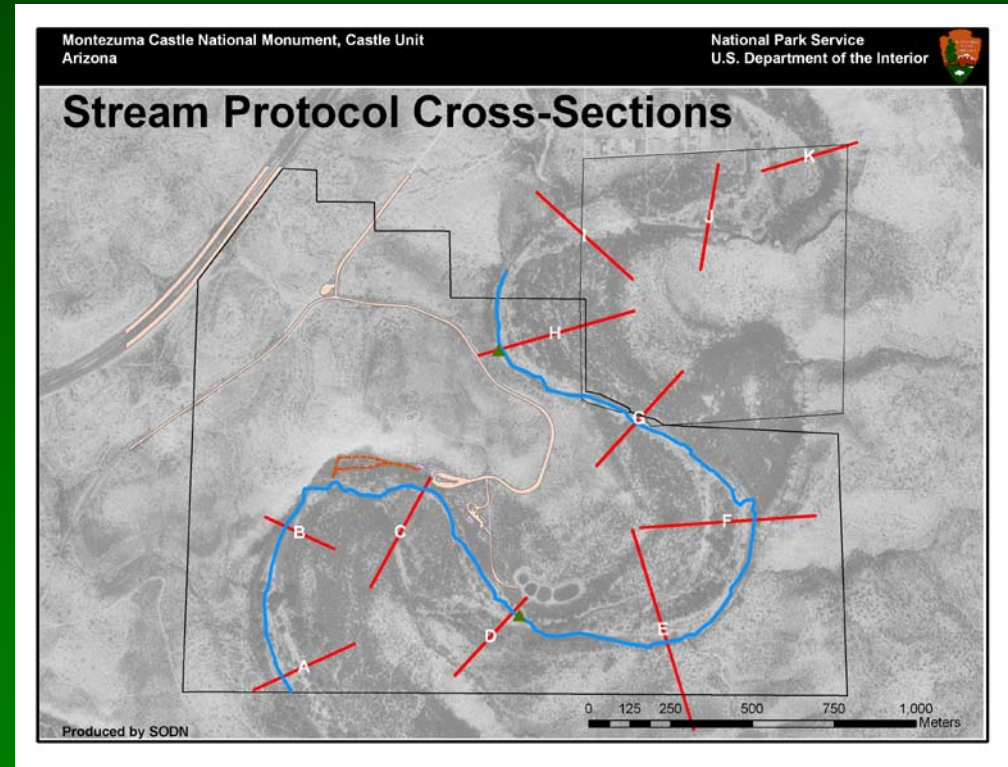
Worker prepares periphyton sample--NPS photo

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- Stream Protocol Notes
 - Comprehensive census of stream length in Park
 - Sampling events at a variety of time intervals
 - Co-location of sampling effort (i.e., vital signs) allows data collection efficiency and data interpretation and integration
 - Integrates EPA EMAP, AZ DEQ and other agencies methods



Sampling reaches at MOCA

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- *Streams Monitoring Protocol Notes continued*
 - 11 evenly distributed cross-sections
 - At each cross-section:
 - Channel morphology
 - Benthic macroinvertebrates & habitat
 - Riparian vegetation
 - Exotic plants-status and trends



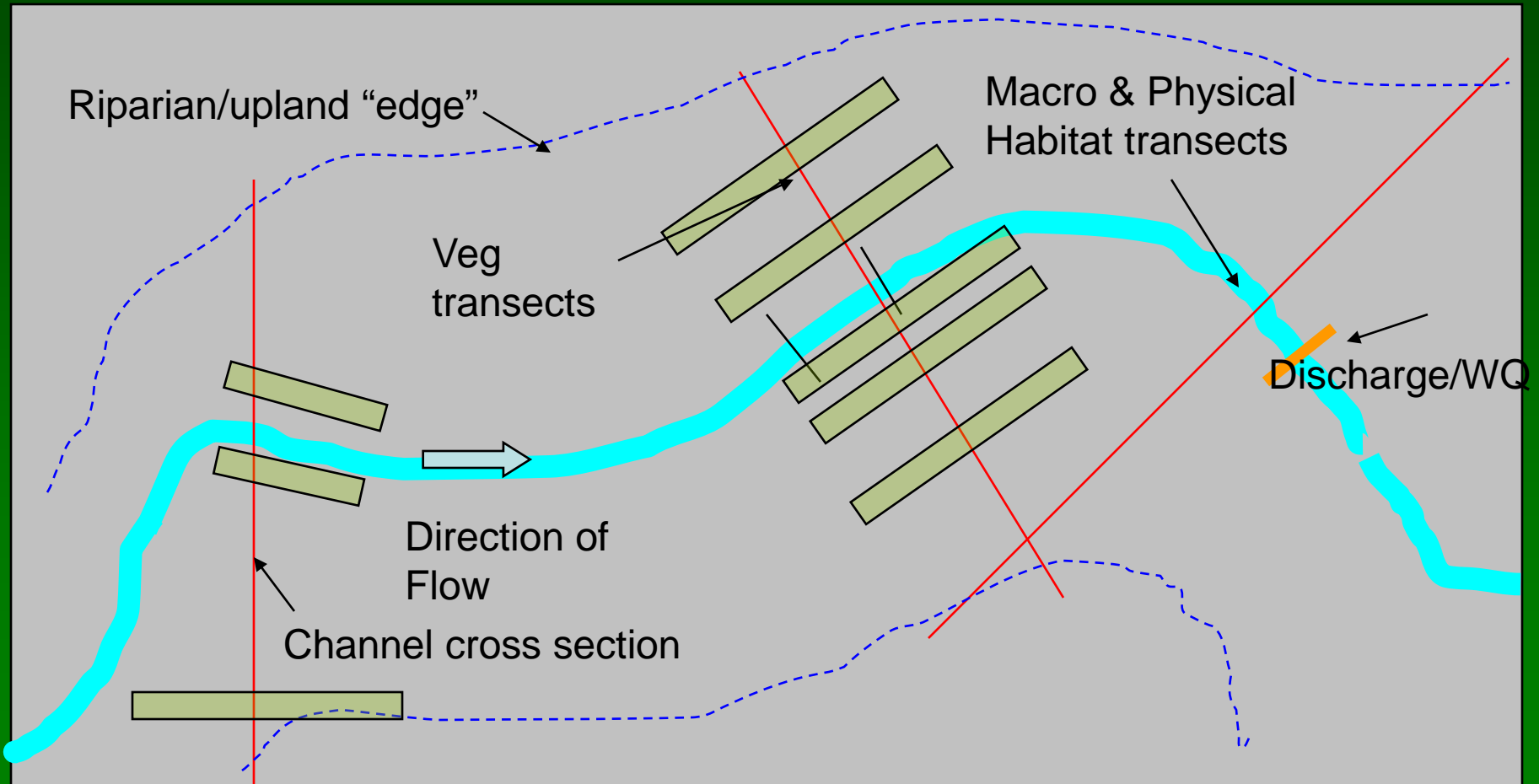
Another happy worker--NPS photo

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- *Streams Monitoring Protocol Notes continued*



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Sonoran Desert Network—Washes and Streams



Stream Monitoring Protocol Vital Signs

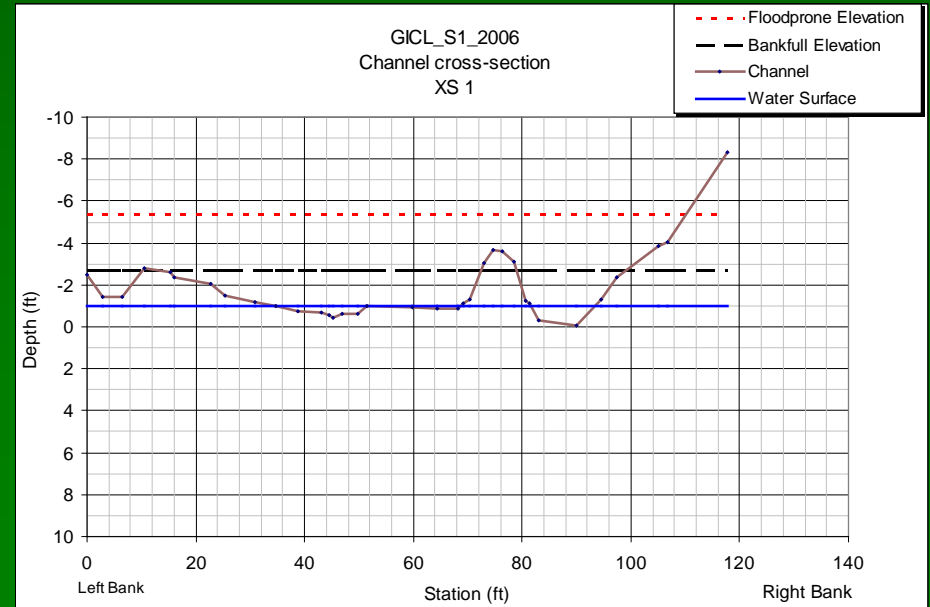
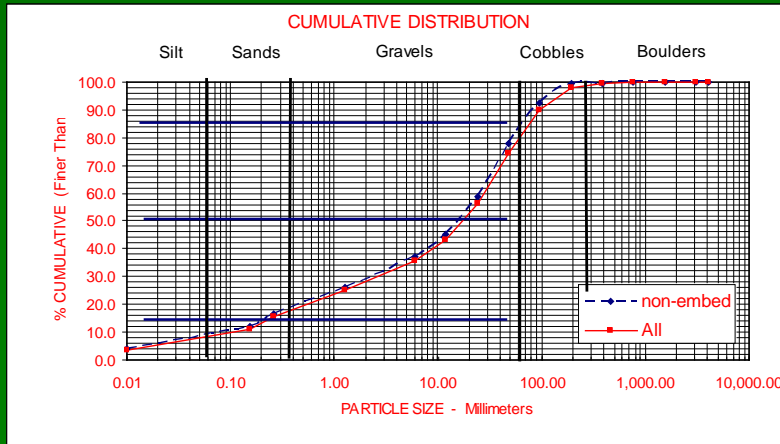
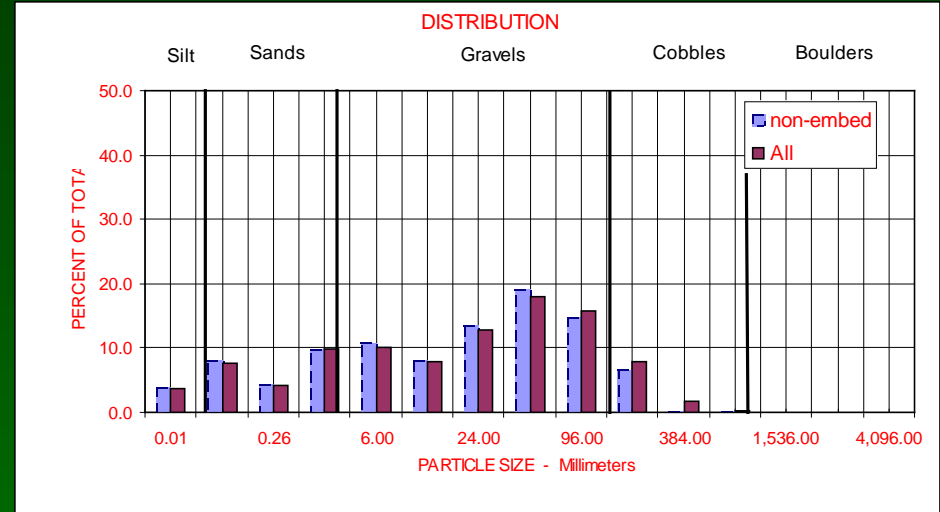
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Stream Channel Morphology

- Sampled once every five years
- The monitoring objectives are:
 - Determine the status and long-term trends in:
 - cross-sectional area
 - sinuosity
 - slope
 - sediment composition
 - width/depth ratio



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Surface Water Quantity

- Sampled four times annually
- Continuous measurement
 - USGS Tubac gauge
- Monitoring objective:
 - obtain discharge estimates that assist with interpretation of water quality data
 - determine seasonal and long-term trends in stream flow
- Work with regional hydrologist and other agencies (e.g., USGS)
- Place Park in regional context



Our intrepid leader—NPS Photo

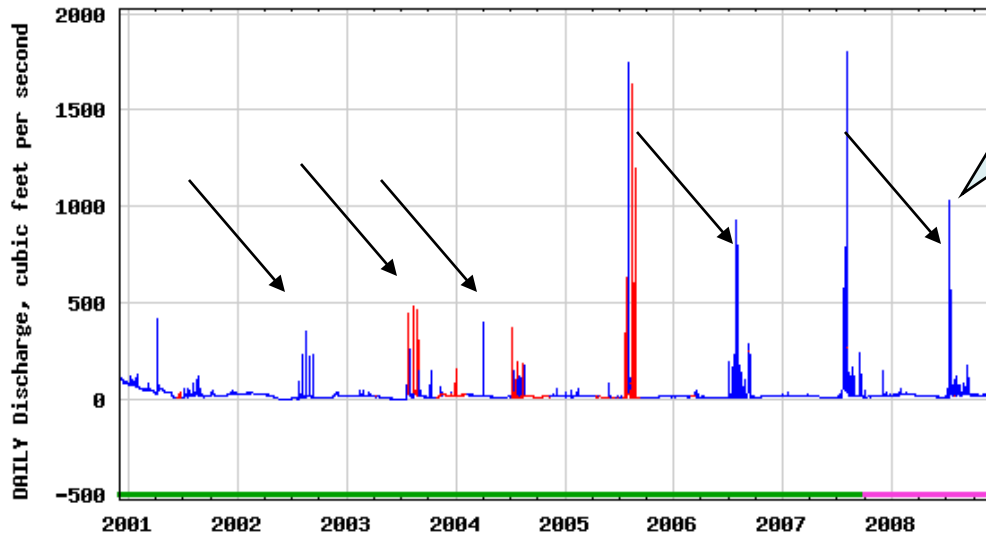
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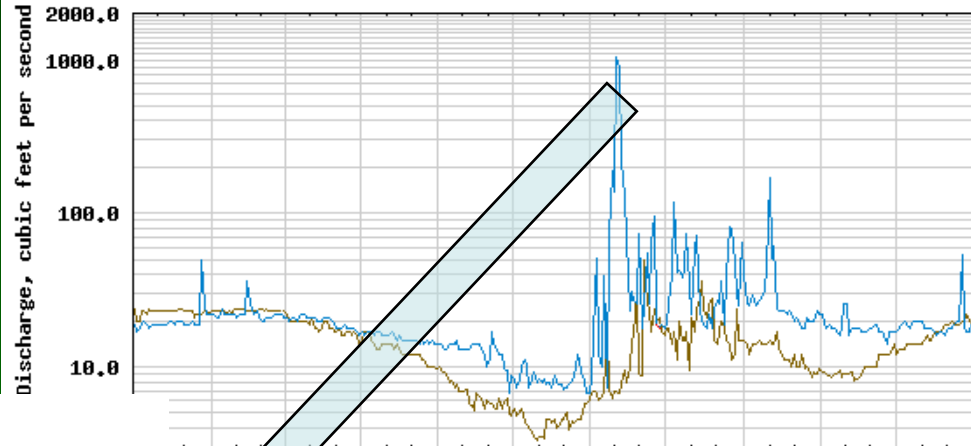
- Bankfull events at TUMA...
- ~500 to 1000 cfs

USGS 09481740 SANTA CRUZ RIVER AT TUBAC, AZ.



— Daily mean discharge
— Estimated daily mean discharge
— Period of approved data
— Period of provisional data

USGS 09481740 SANTA CRUZ RIVER AT TUBAC, AZ.



Feb 01 2008 Mar 01 2008 Apr 01 2008 May 01 2008 Jun 01 2008 Jul 01 2008 Aug 01 2008 Sep 01 2008 Oct 01 2008 Nov 01 2008 Dec 01 2008

--- Provisional Data Subject to Revision ---

— Daily mean discharge (11 years)
— Estimated daily mean discharge



Core Water Quality Parameters and Alkalinity

- Sampled four times annually
- Parameters include:
 - water temperature
 - specific conductance
 - turbidity
 - pH
 - dissolved oxygen
 - discharge
- TUMA, typically high turbidity, low DO



Multiparameter WQ probe--NPS Photo

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Primary Nutrients

- Sampled four times annually
- Monitoring Objective
 - Determine seasonal and long-term trends
 - Total phosphorus
 - Total nitrogen
 - Ammonia
 - Nitrate
 - Nitrite
- Ammonia concentrations have exceeded acute toxic levels



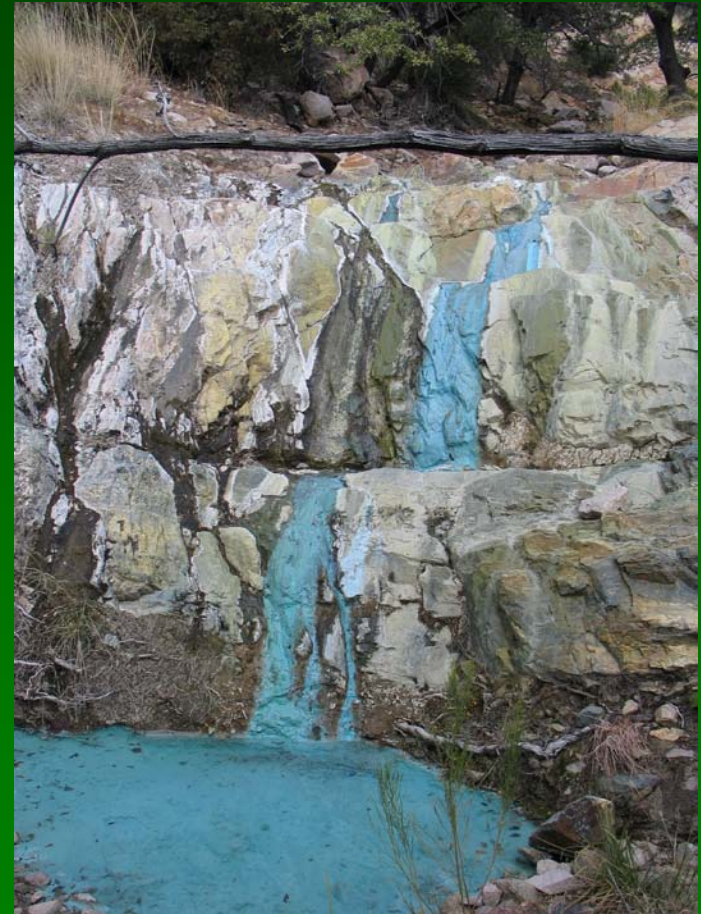
TUMA Sediment—NPS Photo



Pollutant Metals

- Sampled annually
- Monitoring objective
 - Determine long-term trends concentrations

Antimony (An)	Nickel (Ni)
Arsenic (As)	Selenium (Se)
Beryllium (Be)	Silver (Ag)
Cadmium (Cd)	Thallium (Tl)
Chromium (Cr)	Zinc (Zn)
Copper (Cu)	
Lead (Pb)	
Mercury (Hg)	



Coronado NM —NPS Photo

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Biological Condition

- Sampled four times annually
- Parameters
 - *E. coli*
 - Full body contact exceedances at 4 of five Park units
 - BOD
- Monitoring objective
 - Obtain measurements needed to determine seasonal and long-term trends in *E. coli* concentrations

Tumacácori NHP — Spring 2007
Quarterly Water Monitoring Report






Overview
Several threats to water quality occur at Tumacácori NHP, with substantial implications for human health, riparian vegetation, wildlife populations, and overall ecosystem processes. Discharge of treated effluent from municipal and septic wastewater treatment systems, pastoral and agricultural activities, and improper disposal of human waste from illegal border activities and recreation results in nutrient loading and *E. coli* contamination of the Santa Cruz River. Toxic metal pollution is a common result of the long and extensive history of mining in the region, as well as more recent shifts towards high-technology industries and urbanization. Contaminants become concentrated as water levels drop due to evapotranspiration or extraction for human uses, whereas major flow events can dilute or transport contaminants.



Monitoring
The Sonoran Desert Network monitors five vital signs to assess the status of surface water quality and quantity (Table 1): core water quality parameters, nutrient dynamics, microorganisms, surface water flow, and pollutant metals. Water temperature, pH, specific conductance, and dissolved oxygen control biological species and abundance. In addition, specific conductance and water temperature can be indicators of global climate change. *E. coli* is a species of fecal coliform bacteria specific to the fecal material of warm-blooded animals. Effluent water, such as the Santa Cruz River is at high risk for *E. coli* contamination.

Vital Sign	Selected Indicators and Standards	Measured Value
Core parameters	Dissolved oxygen: ≥ 3.0 mg/L	4.5 mg/L
	pH: ≥ 6.5 to ≤ 9.0	7.04
	Specific conductance: no standard	87.8 μ S/cm
Microorganisms	Temperature: no standard	25.7°C
	<i>E. coli</i> : 235 CFU/100mL (for wading)	1600 CFU/100mL
Nutrient dynamics	Nitrite: ≤ 140 mg/L (for swimming)	3.15 mg/L
	Total phosphorus: no standard	6.60 mg/L
Pollutant metals	Arsenic: ≤ 50 μ g/L (total for wading)	not measured
	Mercury: ≤ 42 μ g/L (total for wading)	not measured
	Selenium: ≤ 20 μ g/L (total for wildlife)	not measured
Surface water flow	Discharge: 20th to 80th percentile	12.7 cfs

Table 1. Results of quarterly water quality and quantity monitoring at Tumacácori NHP. Data collected on April 9, 2007.



For further information: <http://www.nature.nps.gov/units/toddy/> or 520-546-1607.



Benthic Macroinvertebrates and Periphyton

- Sampled annually
 - Integrate ecosystem processes at several levels
 - Monitoring objective:
 - Interpret stability, resiliency, and change in the riparian ecosystem
 - Determine seasonal and long-term trends in
 - trophic community composition
 - multi-metric indicators (e.g., IBI)
 - periphyton production



Workers sampling macroinverts—NPS Photo

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- TUMA Spring 2007
 - Low diversity (8 taxa vs. 40 to 60 taxa)
 - Mayflies, Stoneflies and Caddisflies absent
 - Top three abundant groups
 - Black flies
 - Midges
 - Worms



Chironomid larvae



Fish and Crayfish

- Rare or invasive
- Integrate ecosystem processes at several levels
- Predictive modeling
- Monitoring objective:
 - Determine long-term trends in native fish abundance or presence.
 - Detect new introductions of crayfish and selected non-native fish



Quitoboquito pupfish—NPS Photo



Crayfish—NPS Photo



Riparian Vegetation and Exotic Plant Species

- Sampled once every five years
- Zones based on elevation and distance from river
- Point-intercept, frequency plots and belt transects



Workers carefully examining vegetation—NPS Photo

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