Developing Cooperative Monitoring Projects

Goals and Objectives

Goal (Outcome) – what do you want to happen?

I want the community swimming safely in Deer Creek

Objectives – Specific and measurable

- **Reduce bacterial counts in Deer Creek**
- **Reduce # of algal blooms in Deer Creek**
- **Reduce nitrate concentrations from wastewater treatment plant by 35%**

Revise as needed!

Monitoring Plan

Develop Monitoring Objectives

- Problem description
- Watershed description
- Summary of existing data
- Summary of ongoing monitoring efforts

Examples

- Identify changes in water quality
- Identify water quality problems
- Gather information on pollution prevention
- Determine baseline water quality

Design A Monitoring Plan

- Where will monitoring occur?
- What parameters or conditions will be measured?
- How will the parameters be measured?
- When will the monitoring occur?
- How will the samples be collected?

What steps can be taken to assure confidence in the monitoring plan???

Parameters Monitored

Lakes

- Secchi trans.
- Water Temp.
- Phosphorus
- Dissolved Oxygen
- Chlorophyll
- pH

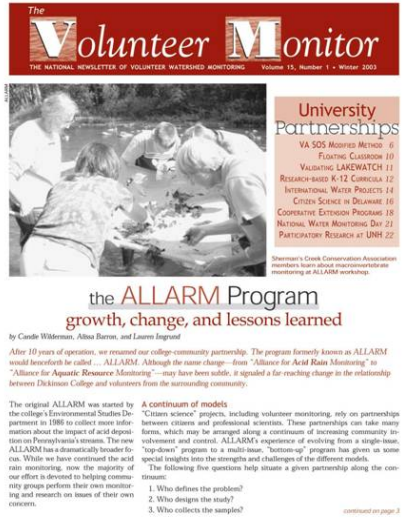
Rivers/Streams

- Water Temp.
- pH
- Macroinvertebrates
- Dissolved Oxygen
- Nitrogen
- Flow/water level

Useful Sources to Locate Methods

- SWAMP Website http://www.waterboards.ca.gov/water_issues/programs/swamp/
- EPA Guidance Manuals
- *The Volunteer Monitor* newsletter
- LaMotte/Hach kits and catalogs
- Secchi Dip-In website http://dipin.kent.edu/
- Standard Methods for the Examination of Water and Wastewater
- Conferences/workshops
- Listservs
- NEMI http://www.nemi.gov/

SWAMP
Surface Water Ambient Monitoring Program


The Volunteer Monitor
THE NATIONAL NEWSLETTER OF VOLUNTEER WATERSHED MONITORING Volume 15, Number 1 • Winter 2003

University Partnerships

the ALLARM Program
growth, change, and lessons learned

Water Quality Monitoring Constituents

- pH
- Temperature
- Conductivity
- Nutrients
- Turbidity
- Dissolved Oxygen
- Bacteria

pH

Measure of how acidic or basic (alkaline) water is (term pH comes from the French: "puissance d'Hydrogène" which means strength of the hydrogen). It is defined as the negative log of the hydrogen ion concentration.

The pH scale is logarithmic and goes from 0 to 14. For each whole number increase (i.e. 1 to 2) the hydrogen ion concentration decreases ten fold and the water becomes less acidic.

As pH decreases, water becomes more acidic. As water becomes more basic, pH increases.

Many chemical reactions inside aquatic organisms (cellular metabolism) that are necessary for survival and growth require a narrow pH range.

At the extreme ends of the pH scale, (2 or 13) physical damage to gills, exoskeleton, fins, occurs.

Changes in pH may alter concentrations of other substances in water to a more toxic form. Ex: a decrease in pH (below 6) may increase the amount of mercury soluble in water. An increase in pH (above 8.5) enhances the conversion of nontoxic ammonia (ammonium ion) to a toxic form of ammonia (un-ionized ammonia).

Temperature

Measure of average energy (kinetic) of water molecules.

Measured on a linear scale of degrees Celsius or degrees Fahrenheit.

One of the most important water quality parameters, because it affects water chemistry and the functions of aquatic organisms. It influences the:

- Amount of oxygen that can be dissolved in water,

- Rate of photosynthesis by algae and other aquatic plants,

- Metabolic rates of organisms,

- Sensitivity of organisms to toxic wastes, parasites and diseases, and

- Timing of reproduction, migration, and aestivation of aquatic organisms.

Electrical Conductivity/Salinity

Salts that dissolve in water break into + & - charged ions

Conductivity is the ability of water to conduct an electrical current; dissolved ions are the conductors

- The major positively charged ions are sodium, (Na^{+}) calcium (Ca^{+2}), potassium (K^{+}) and magnesium (Mg^{+2})

- The major negatively charged ions are chloride (Cl^{-}), sulfate (SO_4^{-2}), carbonate (CO_3^{-2}), and bicarbonate (HCO_3^{-})

- Nitrates (NO_3^{-2}) and phosphates (PO_4^{-3}) are minor contributors to conductivity, although they are very important biologically

Salinity is a measure of the amount of salts in the water. Because dissolved ions increase salinity as well as conductivity, the two measures are related.

Salts in sea water are primarily sodium chloride (NaCl). However, other saline waters (Ex: Mono Lake) owe their high salinity to a combination of dissolved ions including sodium, chloride, carbonate and sulfate.

Electrical Conductivity/Salinity

Salts and other substances affect the quality of water used for irrigation or drinking. They also have a critical influence on aquatic biota, and every kind of organism has a typical salinity range that it can tolerate.

The ionic composition of the water can be critical. For example, cladocerans (water fleas) are far more sensitive to potassium chloride than sodium chloride at the same concentration.

Conductivity will vary with water source: ground water, water drained from agricultural fields, municipal waste water, rainfall. Therefore, conductivity can indicate groundwater seepage or a sewage leak.

Nutrients

Nitrogen is a nutrient that occurs naturally in streams and is essential for plants and animals in an aquatic ecosystem.

- Problems occur when large amounts of nitrogen introduced into stream ecosystem, causing excessive algal growth depleting available oxygen in stream that fish and other aquatic organisms depend upon

Phosphate is a required macro-nutrient for green plants. It is often a limited resource, especially in fresh water systems.

- When naturally occurring levels become elevated, algal blooms can occur which may lead to oxygen depletion and to fish kills

Turbidity

A measure of the amount of suspended particles in the water. Algae, suspended sediment, and organic matter particles can cloud the water making it more turbid.

Suspended particles diffuse sunlight and absorb heat. This can increase temperature and reduce light available for algal photosynthesis.

If turbidity is caused by suspended sediment, it can be an indicator of erosion, either natural or man-made.

Suspended sediments can clog the gills of fish. Once the sediment settles, it can foul gravel beds and smother fish eggs and benthic insects. The sediment can also carry pathogens, pollutants and nutrients.

Dissolved Oxygen

The amount of oxygen dissolved in water.

- Most aquatic organisms need oxygen to survive and grow

- Some species require high DO such as trout and stoneflies

- Others do not require high DO, like catfish, worms and dragonflies

If there is not enough oxygen in the water the following may happen:

- Death of adults and juveniles

- Reduction in growth

- Failure of eggs/larvae to survive

- Change of species present in a given waterbody

Bacteria

Indicator bacteria such as coliform bacteria, fecal coliform bacteria, *E. coli and enteroccus* are all considered indicators of water contaminated with fecal matter.

Contaminated water may contain other pathogens (micro-organisms that cause illness) that are more difficult to test for. Therefore, these indicator bacteria are useful in giving us a measure of contamination levels.

Selecting Constituents and Biological Health Indicators

Case-specific: What is your question?

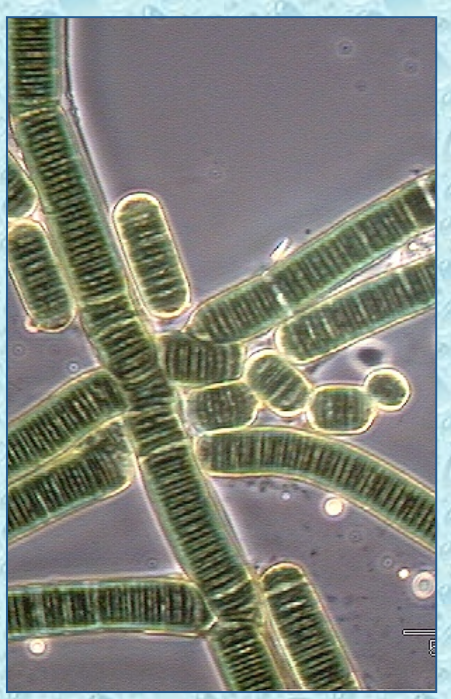
Examples:

- Safe to Swim Study
- Magenta Pond at Empire Mine
- Gravel Augmentation Projects
- Vegetation Restoration Projects

From Pasternack 2009, Gravel Injection Assessment

Bioassessment

An evaluation of the biological condition of a water body using biological surveys and other direct measurements of resident biota in surface waters



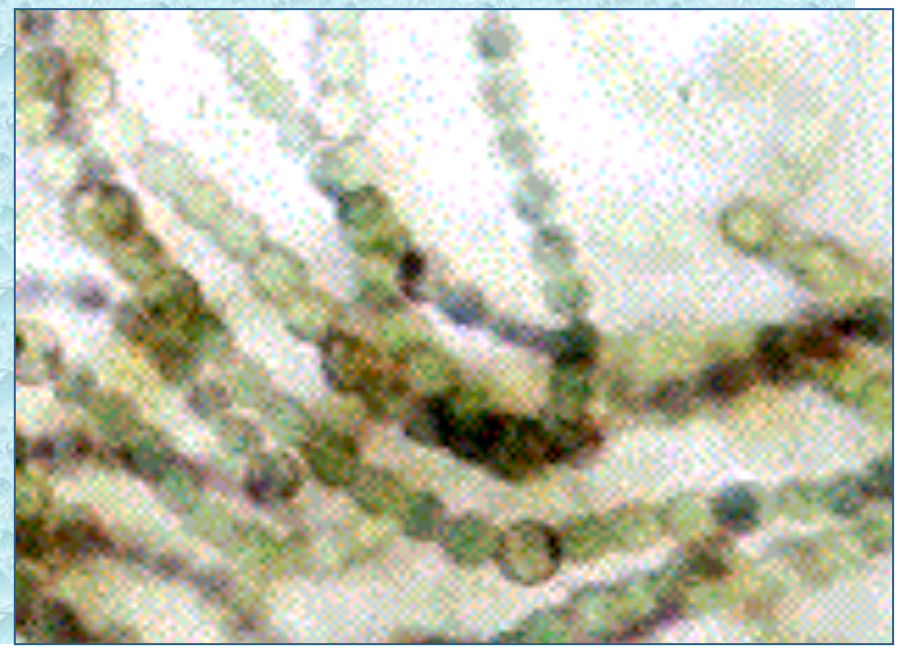
Why Bioassessment?

- Direct measure of integrity of aquatic life uses

- Integrates water quality over time

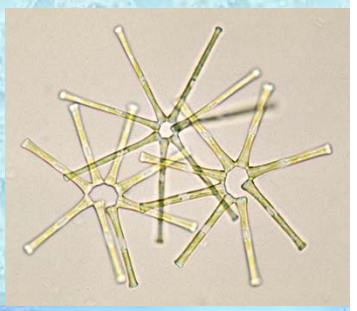
- SWRCB Strategic Plan calls for "bioassessment monitoring program"

- Clean Water Act Section 101(a). . . "restore and maintain the chemical, physical and biological integrity of the nation's water"



Bioassessment typically looks at "assemblages":

- periphyton (i.e., algae)
- benthic macroinvertebrates
- fish
- amphibians
- reptiles
- birds
- vegetation





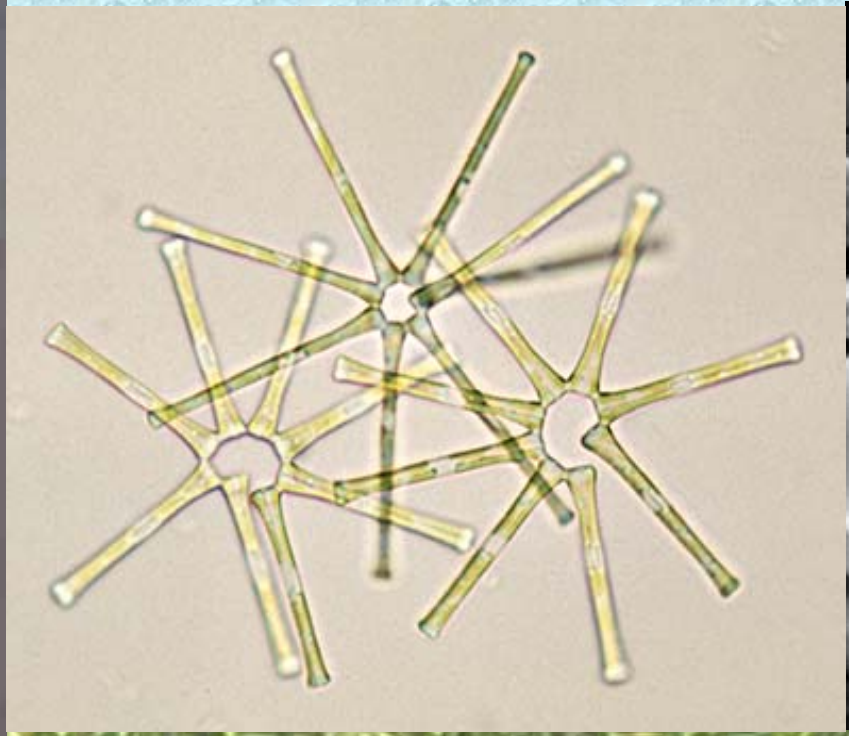


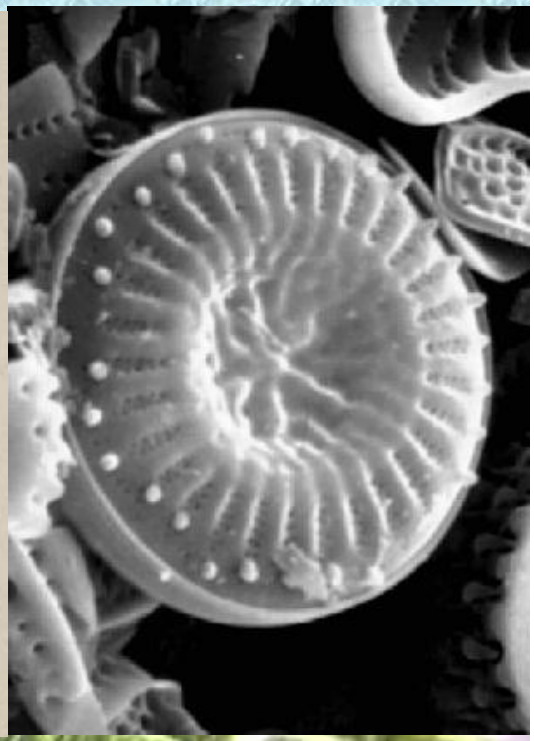
Current applications

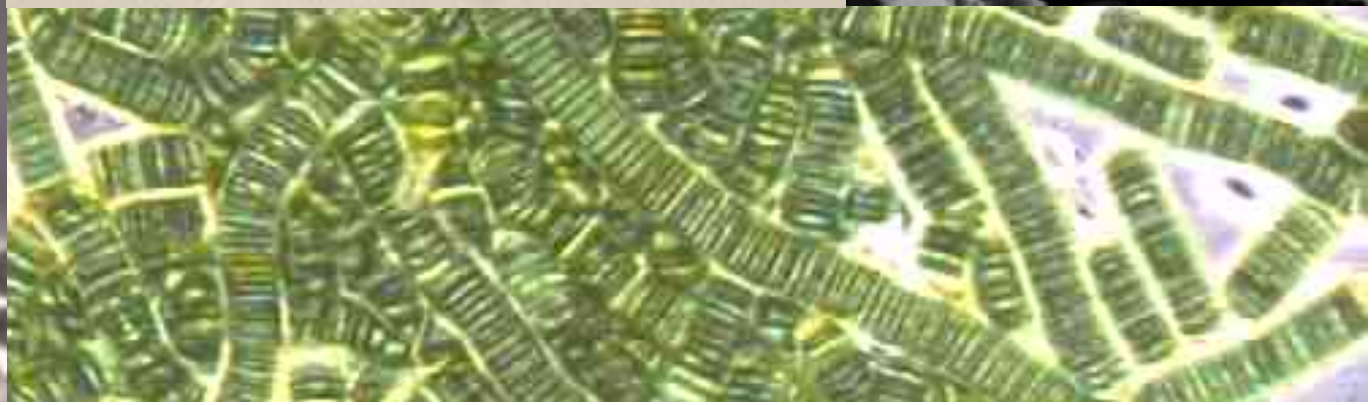
- Baseline & trend monitoring
- Evaluate effectiveness of:
  - BMP implementation
  - restoration projects
  - permit requirements
  - remediation efforts
- Establish biological targets for TMDLs
- Establish reference conditions

Benthic Macroinvertebrates

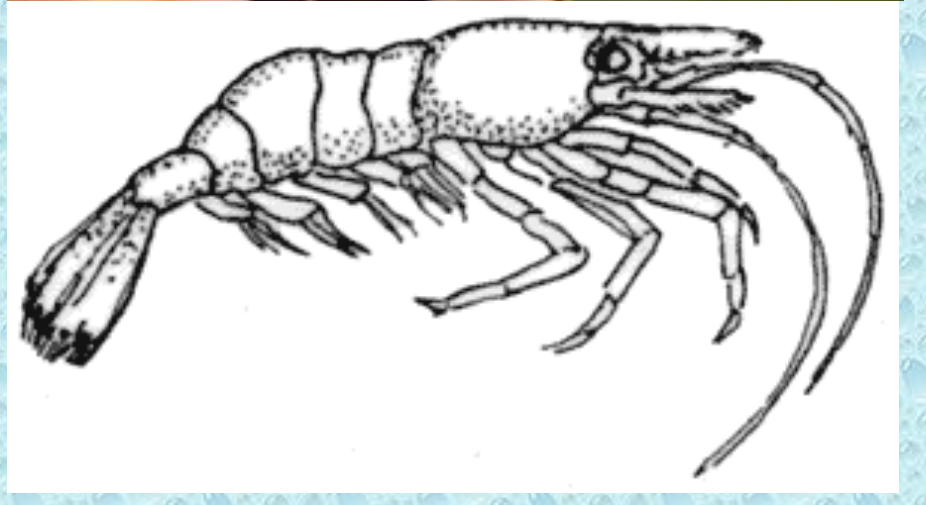
Periphyton







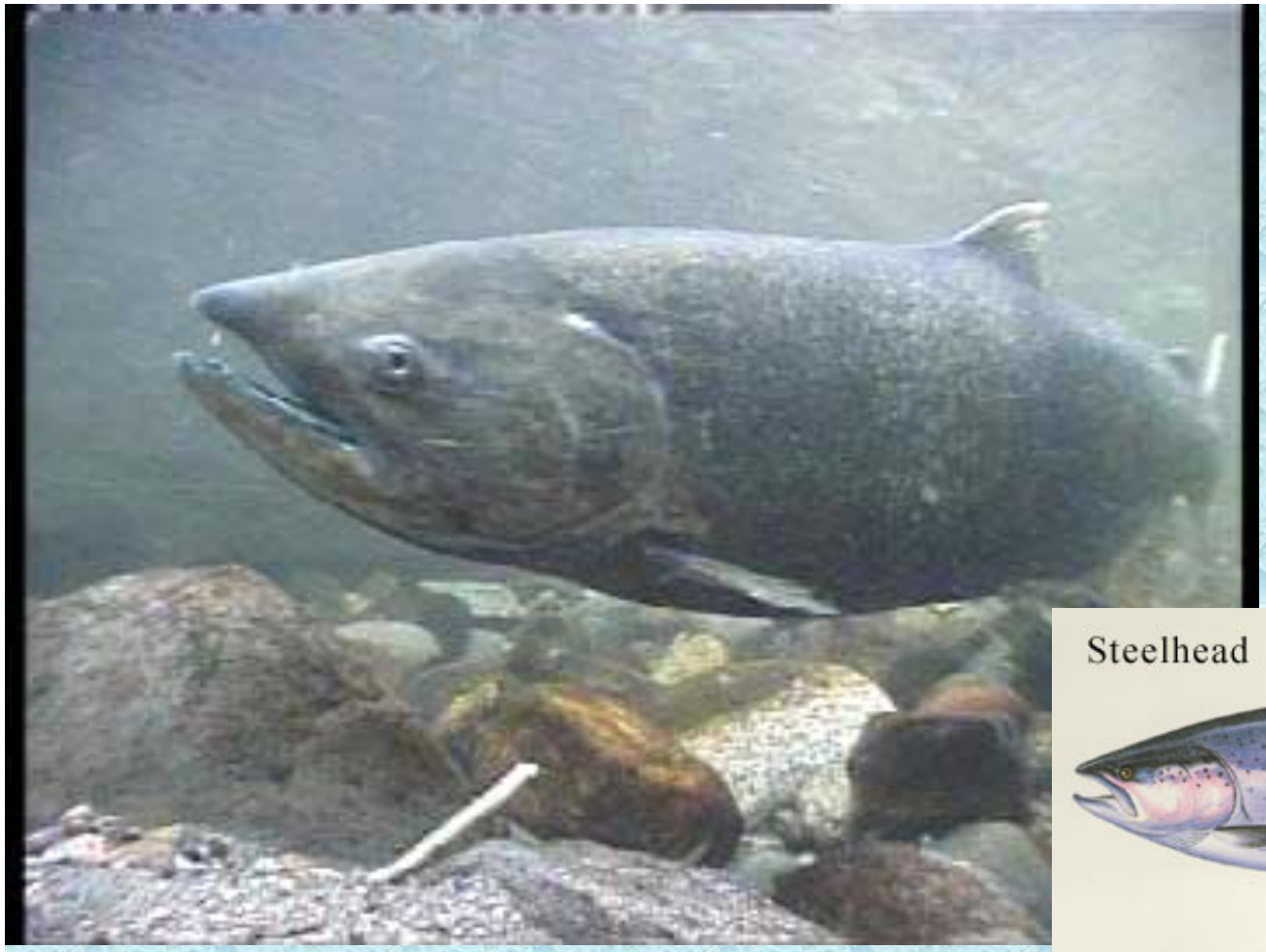
Other Invertebrates



California freshwater shrimp

Tadpole shrimp

Fish



Chinook salmon

Amphibians

Western Toad

Salamanders

Pacific chorus frog

African clawed frog

CA red legged frog

Newts

Reptiles

Giant garter snake

Western pond turtle

Birds

Vegetation


Wate
Eichhornia
Photo by
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Hydrilla
Hydrilla verticillata
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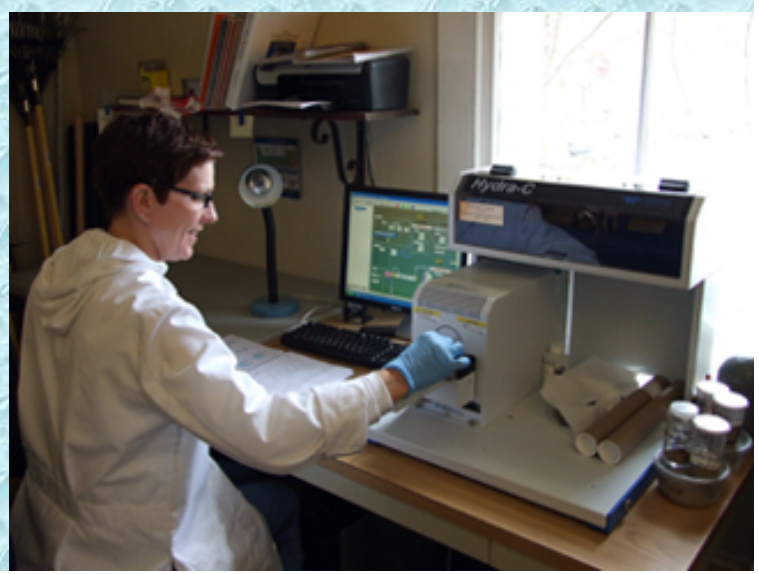
Logistical Support

Not everything you need is data!

- Geographic coordination (where are people doing what?)
- Laboratory support (proper preservation, analysis, etc.)
- Historical records
- Recreation information
- Program support



Qualitative Data

- Watershed groups may be more qualified to do this
- Already have much background info
- Can interact with community and get to site more easily

Example:

Region 8 – Santa Ana

Team of agency staff & community group walk Santa Ana river and record how people are using it


Other Project Ideas??