A National Program for Monitoring Stream Condition in the Western United States

Office of Research and Development

National Exposure Research Laboratory

Environmental Sciences Division

Landscape Ecology Branch

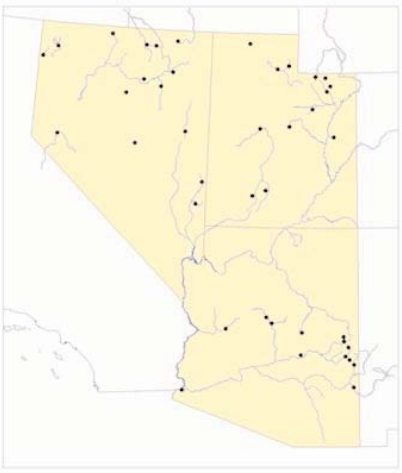
The U.S. Environmental Protection Agency Environmental Monitoring and Assessment Program (EMAP) is a research program to develop the tools necessary to monitor and assess the status and trends of national ecological resources. EMAP's goal is to develop the scientific understanding for translating environmental monitoring data into assessments of ecological condition and forecasts of the future risks to the sustainability of our natural resources.

To accomplish its goal the EMAP program has initiated a large regional study across the western United States. The primary goal of the EMAP Western Pilot Study is to generate state and regional scale assessments of the condition of ecological resources in the western United States, and to identify stressors associated with the degradation of these resources. Beginning in 1999, EMAP embarked on a five-year effort to survey streams in the western United States to demonstrate the application of core monitoring and assessment tools across a large geographical area. This is accomplished by randomly selecting sites and by obtaining a representative sample of biotic assemblages along with physical and chemical measures. These data are then used to estimate the biological integrity of the sites. Since the stream sites are randomly selected, the data collected can be used to make regional and statewide estimates of stream condition. States included in the survey are Arizona, California, Colorado, Idaho, Montana, Nevada, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming.

The EMAP Western Pilot Study is divided into three resource components, i.e. surface waters (lakes, streams, rivers, and wetlands), coastal systems (including estuaries), and landscapes. A probability-based sampling approach is used to monitor the ecological condition of coastal and surface waters. The landscapes component uses remotely sensed imagery and involves synoptic sampling. All three components will produce regional-scale assessments of ecological condition.

The purpose of the Surface Waters component is to describe the current ecological condition of flowing waters of the West and build a database for the long-term monitoring. Methodologies will be developed to advance the science of understanding the ecological function of western ecosystems and the relation of human influence. EMAP Surface Waters will also work with the states and others to build a strong program of ecological monitoring that will lead to better management and protection of the waters of the West.

The current EMAP sampling design for the Western Pilot Study includes approximately 1300 sites which will be sampled across the 12 states over a period of four years (325 sites/year). The sample sites for calendar year 2000 for the states of Arizona, Nevada, and Utah are displayed at the right.



A key goal of the EMAP Western Pilot is to develop local experience with a broad range of ecological indicators (e.g., fish, macroinvertebrate and periphyton assemblages; water chemistry; riparian and in-stream physical habitat). These make up the list of "core" indicators likely to be utilized both in the region-wide surveys and in smaller focus areas.

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Water Quality

Physiochemical water quality characteristics affect the ability of species to persist in a given lotic habitat. Water quality data are collected to determine the pH, trophic condition (nutrient enrichment), and chemical stressors. Physical parameters include light penetration (e.g., turbidity, suspended solids), temperature and ionic strength (e.g., conductivity). Chemical parameters include the concentrations of dissolved gases, major cations, anions, and nutrients (i.e., nitrogen, phosphorus).

Physical Habitat Structure

Stream physical habitat structure includes all those structural attributes that influence or sustain organisms within the stream. Habitat assessments generally provide a critical understanding of a stream's ecology. Some common physical habitat attributes are stream size, channel gradient, channel substrate size and type, habitat complexity and cover, and riparian vegetation cover and structure. The understanding of the physical habitat of an area allows for better assessments of the stream ecosystem and human caused effects.

Aquatic Macroinvertebrate Assemblage

Aquatic macroinvertebrates play important functional roles in lotic ecosystems and are good indicators of stream quality. Aquatic macroinvertebrates represent a fundamental link in the food web between organic matter resources (e.g., leaf litter, periphyton, detritus) and fishes. Within specific biogeographical regions, aquatic macroinvertebrate assemblages respond in predictable ways to changes in stream environmental variables. Because many aquatic macroinvertebrates have limited migration patterns or a sessile mode of life, they are particularly well suited for assessing site-specific effects.

Fish and Aquatic Vertebrate Assemblage

The fish and other aquatic vertebrates can indicate stream and riparian quality. Extensive life history information is available for many species, and because many are high order consumers, they often reflect the responses of the entire trophic structure to environmental stress. Also, fish provide a more publicly understandable indicator of environmental degradation. Fish generally have long life histories and integrate pollution effects over longer time periods and large spatial scales. The objectives of the vertebrate assemblage portion are to 1) collect all except the most rare species in the assemblage and 2) collect data for estimates of relative abundance of species in the assemblage.

Periphyton

Periphyton are algae, fungi, bacteria, protozoa, and associated organic matter associated with channel substrates. Periphyton are useful indicators of environmental condition because they respond rapidly and are sensitive to a number of anthropogenic disturbances, including habitat degradation, contamination by nutrients, metals, herbicides, hydrocarbons, and acidification.

Summary

It is anticipated that information such as that extensively gathered from the EMAP program will assist environmental managers and decision-makers in understanding stream ecological function in relation to human influence. Additionally, it is expected that EMAP monitoring data can be used to develop biological measures or indicators for ecological health and if measured over time, could be incorporated into large-scale trend assessments to determine the changing conditions of our nation's environment.

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http://www.epa.gov/emap/wpilot/

http://www.epa.gov/nerlesd1/land-sci/water/streams.htm