Developing a Biological and Physical Habitat Assessment Program for the Department of Pesticide Regulation (DPR)

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INTRODUCTION

Direct measurements of ambient biological communities including plants, invertebrates, fish, and microbial life have been used for the past 150 years as indicators of sanitation, potable water supplies and the health of water for fisheries and recreation. In addition to these water quality implications, biological assessments (bioassessments) can be used as a watershed management tool for surveillance and compliance of land-use best management practices. Combined with measurements of watershed characteristics, land-use practices, in-stream habitat, and water chemistry, bioassessment can be a cost-effective tool for long-term trend monitoring of watershed condition (Davis and Simon 1996).

Biological assessments of water resources integrate the effects of water quality over time, are sensitive to multiple aspects of water and habitat quality, and provide the public with more familiar expressions of ecological health than the results of chemical and toxicity tests (Gibson 1996). Furthermore, biological assessments when integrated with physical and chemical assessments better define the effects of point-source discharges of contaminates and provide a more appropriate means for evaluating discharges of non-chemical substances (e.g. nutrients, sedimentation and habitat destruction).

Water resource monitoring using aquatic macroinvertebrates is by far the most popular method used throughout the world. Aquatic macroinvertebrates are ubiquitous, relatively stationary and their large species diversity provides a spectrum of responses to environmental stresses (Rosenberg and Resh 1993). Individual species of aquatic macroinvertebrates (BMIs) reside in the aquatic environment for a period of months to several years and are sensitive, in varying degrees, to temperature, dissolved oxygen, sedimentation, scouring, nutrient enrichment and chemical and organic pollution (Resh and Jackson 1993). Finally, aquatic invertebrates represent a significant food source for aquatic and terrestrial animals and provide a wealth of evolutionary, ecological and biogeographical information (Erman 1996).

Between April 2002 and June 2004, the California Department of Fish and Game (DFG) Aquatic Bioassessment Laboratory and the Chico State Research Foundation provided assistance in developing a bioassessment program for the California Department of Pesticide Regulation (DPR). This final report will summarize the accomplishments of the joint effort between DFG and DPR and discuss some recommendation for the future of DPR's use of bioassessment in their pesticide monitoring and assessment program.

CONTRACT ACCOMPLISHMENTS

Assistance with the Development of Bioassessment Procedures for DPR

During the contract period, DFG assisted DPR personnel in developing standard operating procedures (SOP) and various collection and equipment protocols for sampling low gradient streams in the Central Valley. The final set of protocols which were developed included:

California Stream Bioassessment Procedure (CSBP) for Low Gradient Streams

Modified U.S. EPA EMAP Multi-Habitat Procedures

- Reference Site Selection Procedures for San Joaquin Streams
- Biological Field Sampling
- Physical Characterization Worksheet
- Physical Habitat Worksheet
- Water Quality Worksheet

Standard Operationg Proceedures

- Field Procedures for Flow Probe
- Field Procedures for Clinometer
- Field Procedures for Densiometer

Initiate a Pilot Bioassessment Sampling Program in the San Joaquin Valley

During the fall of 2002 and spring of 2003, eight sites within the Central Valley were sampled by DPR personnel using the California Stream Bioassessment Procedure for Low Gradient Streams. The sampling was audited by DFG and the benthic macroinvertebrate samples were processed by the DFG Aquatic Bioassessment Laboratory in Chico.

During the winter of 2003, the Central Valley Bioassessment Workgroup was established. Through the workgroup, DPR collaborated with the Central Valley Regional Water Quality Control Board (CVRWQCB),the Department of Fish and Game (DFG), State Water Resources Control Board (SWRCB), U.S. Environmental Protection Agency (U.S.EPA) and Dr. Lenwood W. Hall of the University of Maryland, Wye Research and Education Center. The working group decided that the Modified U.S. EPA EMAP Multi-Habitat Procedures should be used in Central Valley low gradient streams. As a result, the following sampling event for the same eight Central Valley sites was sampled using this procedure.

Begin Identification and Sampling of Reference Sites in the San Joaquin Valley

During the contract period, DPR initiated “STUDY #209: PROTOCOL FOR THE DEVELOPMENT AND MONITORING OF BIOASSESSMENT REFERENCE SITES IN THE

SAN JOAQUIN VALLEY" under the direction of DPR personnel and with input from DFG and CVRWQCB.
A protocol was developed to provide a quantitative method for selecting reference sites in the San Joaquin Valley watershed area, though the method for selecting the sites may be used for any similar low-gradient (< 2% slope), anthropogenic impacted region. The objective of this project was to locate 30 reference sites in this region. Reference sites are a necessary component in bioassessment studies, in order to compare and interpret past and future biological monitoring data. These reference sites will be used by DPR, CVRWQCB, and other agencies that may have a need for the information.

Though completion of this study was scheduled for the end of December, 2004, locating suitable sites in the region within that time frame has been difficult. The process of finding and evaluating potential sites has been taking considerable more time than expected. Current and historical anthropogenic land uses as well as limit assessibility has made locating 30 reference sites challenging.

RECOMMENDATION

1. Continue Participation in the Central Valley Reference Condition Program

> Developing reference conditions for the Central Valley has proven to be a difficult task; however, it is the framework by which bioassessment data can be most effectively used in an ambient water quality monitoring program. Reference condition development requires identifying and sampling sections of streams that represent the desired state of stream health for a region of interest. Sites may range from a pristine, undisturbed section of a stream to "best available". Since historical anthropogenic land uses and/or water diversions may limit our ability to find minimally disturbed sites, reference sites in the San Joaquin Valley will most likely be those with the least amount of disturbances, or those "best available".
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> The California Department of Fish and Game recommends that DPR continue to participate in identifying and sampling the "best available" stream sections in the San Joaquin Valley. DPR should continue to collaborate with the Central Valley Bioassessment Workgroup in this effort to insure that the data can be used by all water resource agencies. Additionally, participation with the workgroup can guarantee that all efforts are standardized and can provide considerable cost saving for all agencies involved.

2. Monitoring the Effectiveness for BMPs in Improving Biological Condition of CV Streams and Rivers

> Agriculture practices can have a detrimental effect on aquatic biota and stream structure. Implementing Best Management Practices (BMPs) can be used to lessen some of these impacts, thus improving stream health. There are several types of BMPs such as increased buffer area on stream corridors, reduced irrigation runoff, sediment retention

structures, modified pesticide applications and many more. Bioassessment can be used as a monitoring tool that will integrate the effectiveness of all these BMPs.

The California Department of Fish and Game recommends that DPR use bioassessment as a monitoring tool for measuring the effectiveness of BMPs. The most effective use of bioassessment would be as part of a long-term trend monitoring program. Bioassessment data in the form of biological metrics and physical habitat measurements can be charted directly to show changes in values related to stream condition improvements. Once reference conditions are established selected bioassessment metrics can be used to determine compliance to accepted biotic conditions.

3. Measuring Biological Response of Pesticide Use in the Central Valley Streams and Rivers

Pesticide use and its effects on stream biota are typically assessed using field chemistry and laboratory toxicity testing. This form of environmental monitoring is more common in California than other states and can be relatively expensive. Furthermore, relating chemical concentration to effects in laboratory aquatic organisms is not a direct measure of the effect of pesticides on stream biota.

The California Department of Fish and Game recommends that bioassessment be used as a cost effective tool to measure the direct effect of pesticide use on stream biota. By routinely including bioassessment with all field chemistry monitoring programs, relationships with types and amounts of pesticides and their effects of stream biota can be determined. With an adequate database, these effects can be related to community structure and individual species with significant confidence.

The U.S. EPA has an ongoing program to determine tolerance values for various aquatic macroinvertebrates related to environmental stressors including pesticides. DFG recommends that DPR contribute to this effort by providing data from any future pesticide chemical/biological monitoring.

4. Stressor Identification

The stressor identification process is prompted by bioassessment data indicating that a biological impairment has occurred. This process is standardized (U.S. EPA 2000) and used increasingly by states to determine which stressors are causing impairment. Most commonly the stressor identification process is used in performing TMDLs for streams effected by multiple stressors. This procedure would be imperative in investigating impairment in agricultural streams where several stressors including pesticides can be influencing biotic condition.

The California Department of Fish and Game recommends that DPR use biological assessment as an endpoint to indicate if there is a problem with biological integrity at a given site, and then follow up with diagnostic procedures recommended by the U.S. EPA Stressor Identification Guidelines (U.S. EPA 2000).

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