July 28, 1995

To: Interagency Ecological Program

From: Science Advisory Group

Subject: Long Term Monitoring

Introduction

The Science Advisory Group is unanimous in its support for the long term monitoring components of the IEP. Monitoring activities, beginning in the 1960's have produced an invaluable set of observations to document changes in water quality, habitats, and populations of valued species. Although many complex problems remain unresolved, the Bay-Delta ecosystem is one of the best understood and most comprehensively studied estuarine ecosystems in the U.S. as a result of IEP. IEP data are the basis for the public's growing concern for the health of the Bay-Delta and its living resources; it has been critical in detecting the arrival of exotic species and in understanding their ecosystem-level effects; and it is the basis for environmental standards to protect this unique ecosystem. The IEP has made clear efforts in recent years to adapt to changing priorities of concern, to explore mechanisms of increased efficiency, and in organizing its diverse data set into formats that are easily accessible by others. We can offer the following general guidelines and recommendations as priorities to IEP managers as they strive to design the most useful and cost effective monitoring program of the future.

1. IEP should expand the resources allocated to data analysis, synthesis, and dissemination

IEP has focused most of its efforts in the past on monitoring necessary to detect trends in target

species, particularly as they are affected by freshwater flow. This has resulted in one of the world's most valuable data sets on estuarine biology, in terms of the length and continuity of the collection. In addition, IEP has made considerable progress in recent years in analyzing data, making data widely available, and involving the broader research community.

Although IEP monitoring data has been reduced and described, inferential analysis could be expanded. This should be done at the project level, as well as by a higher-level synthesis team.

- At the project level, resources should be specifically allocated for analysis, synthesis, display of data, and publication of results. IEP should encourage agencies to give individual workers time to extract information from their data and establish incentives for workers to publish their work in peer-reviewed journals
- At the higher level, IEP should support a team whose role would be to examine and synthesize monitoring data, formulate critical questions and establish whether in-house expertise exists to fully answer such questions.
- IEP should establish a fund to support substantive collaborations between IEP scientists and outside experts for purposes such as inferential analysis that includes use of specialized techniques not available in-house. This would be available through competitive proposals from any IEP agency scientist.

2. The IEP program should, as one of its highest priorities, maintain sufficient comparability in its measurement methods that trend analyses can take advantage of the entire historical record. Efficiency and other considerations may dictate changes in methods or sampling schemes, but the newer and older data must be comparable in a way that maintains the utility of the entire time series. This comparability could take the form of, for example, a simple reliable transform between the two series that is established by a period of overlapping

measurement.

3. IEP should consider expansion of its present geographic boundaries. Contemporary estuarine science is based around two key concepts: (1) that trends of change are best understood from measurement programs designed around an ecosystem perspective, and (2) that processes and populations within estuaries are strongly influenced by inputs of materials from the watershed. We believe that the IEP monitoring program of the future should be designed around an integrated watershed approach that recognizes the strong linkages that exist between all geographic domains of the Bay-Delta ecosystem. In particular, we recommend:

a. The Bay-Delta watershed extends far beyond the geographic range that IEP can practically monitor by itself. However many opportunities exist to use data developed by other programs monitoring biological and water quality in the Sacramento and San Joaquin catchments (including NAWQA, the Sierra Nevada Ecosystem Project, the California Rivers Assessment, and freshwater monitoring programs in IEP's parent agencies). Available data include flow, temperature, nutrients, and a number of toxics, as well as some biological population parameters. Spatial boundaries for IEP monitoring might be shifted to reflect locations from which the highest quality data are available from other programs. It is likely that some standardization in protocols and data structure would increase the potential of upstream programs to contribute to IEP's monitoring mission. A key role of these data is to estimate fluxes across designated boundary points into regional Bay-Delta analyses and models.

b. The critical programs of water quality, benthos and zooplankton measurement should be expanded throughout the entire San Francisco Bay-Delta system, to include coverage in San Pablo Bay, the Central Bay and South Bay. The scientific community has established clear and strong linkages between Delta outflows and changing physical structure, turbidity, water chemistry, and biological populations and processes in regions well beyond the current seaward

limits of the IEP water quality monitoring. San Pablo Bay, Central Bay, and South San Francisco Bay are connected domains, each of which responds to fluctuations in Delta outflow. Assessments of the status and trends of ecosystem change in the Bay-Delta will remain incomplete until the IEP expands the geographic boundaries of its program. The SAG recognizes that the expansion of geographic coverage will require compromises and redesign of the current allocation of sampling locations. At minimum, we recommend that IEP management consider adding water quality, benthos, and zooplankton monitoring to the existing Bay-Delta fisheries element.

4.. IEP should begin to consider changes necessary to move toward a more community-based monitoring approach. Historically particular sampling methods or gear (i.e. townets) were used to capture individual target species. The first goal of data analysis was to derive an index of abundance for the target species. The occurrence and abundance of other species in the samples received less (e.g.fish) or no (e.g. zooplankton) attention. SAG recommends that the information content of multi-species samples be further and routinely exploited. One benefit in analyzing patterns in non-target species is the detection of unexpected trends - the decrease in delta smelt in summer townet samples is an example. A second benefit of a complete data work-up is the detection of simultaneous trends in co-occurring species (e.g. as shown for starry flounder and California halibut). Considering species or habitats not included in the current monitoring efforts or interpretations could provide important ecological insights. Efforts might be profitably expanded to include species such as gammarid amphipods (because of their broad distribution, use in toxicological studies and broad role as prey), crayfish (due to their importance as decomposers which are largely unstudied in this estuary) and staghorn sculpin (because of their high predation rate on diverse species). If sampling can be expanded to new habitats, shoals, shallows and marshes should be given high priority.

Actual abundance and biomass estimates are examples of measures important for better understanding interactions among species and trophic levels, as well as nutrient cycling and carbon or energy flow (the community or ecosystem view). SAG recognizes the difficulty in measuring actual abundance and biomass but feels such measures are important enough that IEP should consider what would be involved in moving beyond indices to measures that facilitate analyses at the community and ecosystem levels.

5. "Ecological health" of the Bay/Delta should be a consideration in the use of IEP data, but IEP should be aware that substantial effort has been expended by other programs in developing such indices. If IEP employs indices they should make use of what others recommend and make maximum use of existing data in developing the indices. (For example, USEPA EMAP program recommends some simple indices such as oxygen, chlorophyll, marine debris, benthic diversity, abundance of pollution sensitive and pollution tolerant benthos, fish diversity, external fish pathologies, fish flesh monitoring of contaminants, contaminant concentrations in sediments and toxicity of sediments. Nearly all these are presently determined by IEP or other monitoring programs.) Because of its ambiguity, the concept of ecological health could lead to endless unproductive debate. Instead, it might be more beneficial for IEP to give priority to periodically (every 5 years) publishing an analysis of status and trends of estuarine resources, based upon their long term monitoring data.

6. Communication, coordination and collaboration will be keys to the future success and viability of IEP long term monitoring. The program will never have the resources to monitor all that could be monitored. In order to expand its horizons, it must make optimal use of what others are doing and have done. In addition to opportunities mentioned above, examples where communication, coordination and collaboration could be employed in the future include:

1. Wetlands are an underrepresented habitat in IEP monitoring. In order to expand interpretations to include wetlands processes, IEP should coordinate and communicate with existing wetlands monitoring programs such as (...)

2. IEP could efficiently improve the sophistication of its data management system by communication and collaboration with programs with experience in handling such data sets (for example CERES is a program in the California Resources Agency confronted with similar data management challenges). .

3. The new reduced schedule of water quality monitoring in the Bay by IEP should be coordinated with the routine water quality determinations made by USGS, so schedules complement one another.

4. To expand into the area of toxics monitoring IEP should discuss with SFEI and the Regional Monitoring Program, a program of routine fish flesh monitoring.

5. IEP should look to other estuaries for additional ideas about monitoring and understanding the estuary. Ties with programs like that in Chesapeake Bay should be maintained and IEP data should be presented at, for example, the Estuarine Research Federation, where many estuarine programs are represented.

Members of the Science Advisory Group agree that our primary near-term responsibility is to assist the IEP management in the implementation of these recommended changes.