

GOALS FOR RESTORING A HEALTHY ESTUARY

Report on Results of a Workshop of Estuarine Scientists

October 2, 1995
Tiburon, California

Introduction

On October 2, 1995, fourteen CalFed agencies and stakeholders convened a workshop of scientists with particular expertise in estuarine fishery biology and hydrology and wetlands ecology *to specify achievable goals for the restoration of a "healthy" Bay-Delta estuary*. Lists of the sponsoring organizations and expert participants are attached to this report. We undertook this task because existing specifications of goals for the estuary (e.g., those set forth in the Comprehensive Conservation and Management Plan) are too broad to define appropriate restoration actions for the CalFed process. The discussion was confined mainly to technical aspects of ecosystem evaluation and goal-setting, although known societal preferences were taken into consideration in recommending restoration goals.

This report summarizes the consensus of the group. The Appendix contains the white papers by Wim Kimmerer and Josh Collins prepared to stimulate thinking by the participants.

The geographic scope of the discussion was the tidal reaches of the estuary and its associated marshes, including areas that could be returned to tidal action, with an understanding that cause-effect relationships crossing these boundaries would be included in the scope. Much of the emphasis in the workshop was on goals for open-water habitats, partly because of the expertise represented, but also because extensive efforts are underway to develop goals for baylands. The work ongoing on baylands at the San Francisco Estuary Institute may be of particular value to the CalFed process.

Meaning of ecosystem health

Participants agreed that while concepts like "ecosystem health" and "ecosystem integrity" are appealing, they are of limited use in setting ecosystem restoration goals because they cannot be precisely defined in terms of measurable ecosystem functions, processes, or other properties. The participants favored defining ecosystem restoration goals in terms of a system's capacity to provide the full range of ecosystem "services" important to society. Creating and sustaining these services, of course, requires certain ecosystem structures and functions. The extent to which an ecosystem's services to

society meet societal expectations is a measure of the health of that system.

Ecosystem services include all of the uses that society expects to obtain from the ecosystem. These can be inferred from current use of the ecosystem, and from legal and regulatory statements of purpose such as the Clean Water Act or Endangered Species Act. Obvious desired services include water supply of a quality suitable for drinking or irrigation; provision of edible (i.e., non-toxic) fish and shellfish; maintenance of endangered species; safe passage for anadromous fish; water sports; navigation; absorption of wastes; birdwatching and aesthetic enjoyment.

Goals for restoring the estuarine ecosystem to "health" can either address these services directly, or the processes or functions of the ecosystem necessary to support these services. Ecosystem processes or functions that support more than one service may appropriately be considered goals in themselves.

Partial list of goals for the estuarine ecosystem

The following are goals that the group believed were related to ecosystem services for which society had expressed a priority. The goals listed here include only those relating directly to estuarine biota. The group briefly discussed, but did not resolve, whether to include goals related to other services such as clean water for human consumption or agriculture, disposal of sewage, or arable land.

Goals unanimously endorsed:

Restore populations of indigenous species to levels not likely to result in extinction. The group recognized that extinction is a natural process, but that the current rate of extinction is far higher than before human settlement. Therefore, the possibility of extinction is allowed, but at a rate more like that which would have occurred over evolutionary time. Because evolutionary time is very slow compared to the time horizon pertinent to the CalFed planning process, the practical goal is to prevent any appreciable risk of extinction of, at least, all vertebrate species.

Maintain populations of fish and waterfowl that can be eaten safely. There are several sources of contamination resulting in warnings to restrict consumption of fish; most of these are relatively old sources of material with long residence times, such as DDT and mercury.

Provide anglers with a reasonable chance of catching sport fish. Population levels of these species need to be increased.

Increase naturally-produced populations of anadromous fish. This goal is explicit in the

Central Valley Project Improvement Act.

Maintain sediment contamination at least below levels seen in 1950. The public responds unfavorably to reports of sediments contaminated by industrial or other activity, whether or not the levels of contamination interfere with the provision of other ecosystem services. The year 1950 was selected as a baseline before which the level of industrial activity in the bay watershed was low, although the influence of hydraulic mining in the last century cannot be discounted.

Prevent conditions that result in water column anoxia, including harmful and nuisance algal blooms. Advanced treatment of sewage discharge has eliminated the high organic loading that once resulted in anoxic conditions and foul odors over nearly the entire estuary. This progress should not be reversed. A further problem is the continuing occurrence of nuisance blooms in the Delta and along the open coast.

Restrict additional introductions of exotic species. The rate of successful introduction of exotic species is higher in the Bay/Delta estuary than in most other estuaries. This has led to the replacement of many species of indigenous fish, benthos, and plankton with introduced species and alteration of trophic structure.

Enhance aesthetic values. Although aesthetic values are highly subjective, the high level of use of areas such as marshes for non-consumptive recreation (hiking, bird-watching) is a clear indication of public preference for attractive marsh and other habitats.

Sustain natural evolution of baylands. Most of the bay's wetlands have been either converted permanently to other use (e.g. urban development) or diked and drained for use as farms or managed wetlands for hunting. Only a very small fraction of the bay's wetlands remain under the influence of the tides, and therefore subjected to natural development. Marshes have a broad range of functions, some related to other goals above, and should be protected and expanded to support those functions.

Goals that are more equivocal with respect to desired ecosystem services:

Establish a viable commercial fishery in San Francisco Bay that provides fish or shellfish for consumption This was suggested as a way of ensuring that the ecosystem could support a large population of fish or shellfish that were safe to eat. Based on post-workshop consultations, this is apparently a controversial issue due to the historic conflicts between sport and commercial fishing interests in San Francisco Bay associated with the pressure that commercial harvesting has sometimes placed on fisheries. Whether this concern is amenable to a regulatory solution was not discussed.

Decrease turbidity of the water and increase seagrass habitat. Extensive seagrass habitat has been mostly lost from the bay. The cause of this loss is probably high turbidity of the water. Reducing turbidity might solve that problem, providing better habitat for some fish; however, reducing turbidity could also increase phytoplankton primary productivity, increasing the use of the large amount of available nutrients in the water, and resulting in an increased incidence of nuisance blooms.

Goals posited but not addressed:

Provide a greater "sense of place" for Californians with respect to the Bay-Delta. People who live in the Chesapeake Bay region probably feel stronger ties to their estuary as an ecosystem than people in the San Francisco Bay region do to theirs. This goal seems to incorporate a number of others, and may be redundant.

Maintain sustaining to increasing populations of ecologically important species.

"Ecologically important species" refers to forage species for higher trophic levels. It was not decided whether this should be a goal in itself or an objective for support of other services.

Proposed actions for progress toward the goals

The group was not convened to recommend specific actions to achieve the goals listed above. Much of that discussion has taken place, and some continues to take place, in other forums (e.g. the CALFED Bay/Delta process, bayland goal-setting process, species recovery teams). The group instead recommended focused programs to establish specific objectives related to the processes and functions requisite to the goals and related to robust measures of progress toward the goals. The development of goals and initiation of actions to achieve them need to be better integrated between open-water habitats and marshes, for which a greater effort for setting objectives has taken place.

Many of the recommended programs include the use of focused workshops to address these difficult problems. Some guidelines on structure and process to make these "downstream" workshops most productive were enumerated. These workshops should be preceded by meetings of core groups that would establish and conduct the preliminary analyses necessary to ensure the effectiveness of the workshops. The workshops would then be convened to examine the evidence developed, recommend actions to be taken, and assess the need for further analysis. The experts should come together first in a plenary session to agree on the scope, objectives and process, and then break into concurrent work groups concentrating specific expertise on specific problems. "Vertically integrated" white papers, that treat a narrow theme in considerable depth, should be prepared as background and to sharpen the issues for each specialty work group session. The results should be communicated back to the

plenary for synthesis into a final product that "horizontally integrates" across the disciplines and specialty groups. Workshops should span two or more days.

The following section briefly discusses limiting factors, which are the key to increasing abundance of populations. The next sections describe briefly some of the topic areas that might be suitable candidates for focused workshops.

Limiting factors

Limiting factors are poorly known for resident species of the bay/delta. The factors limiting indigenous populations of fish and invertebrates may include:

- Habitat availability
- Freshwater flow
- Entrainment
- Food supply
- Toxic substances
- Fishing

Determining the relative importance of these factors is crucial to deciding what actions would provide protection and enhancement of these populations. Some of these are discussed below. However, it is important to keep in mind that all biological populations must have some (generally unknown) compensatory mechanisms to constrain abundance toward environmental carrying capacity. Actions that increase carrying capacity may be more effective at achieving goals for populations than actions that reduce non-compensatory mortality.

Habitat for open-water species

The CALFED Bay/Delta Program has proposed that providing habitat is the most efficacious means of protecting species occupying that habitat. This conclusion is based partly on the relationships between X_2 and abundance or survival of many estuarine-dependent species. However, these relationships could also arise through other causes related to flow, such as entrainment. Therefore, before the CALFED process goes too far in developing planning alternatives for habitat restoration, the scientific basis for relating habitat to species abundance needs to be further examined. Also, it is notable that the interactions between open-water habitat and tidal wetlands have been poorly studied in this estuary.

We recommend that one or more workshops be held on the benefits of new open-water and marginal habitat. These workshops should examine evidence, prepared in advance, for the relationship between habitat and abundance of estuarine species. Proposed

habitat restoration actions (e.g. flooding a portion of Prospect Island) should be set up as case studies with appropriate recommendations for monitoring and research into the success of these actions in enhancing population size.

Entrainment

The role of entrainment in the delta, including its effects on indigenous species and ecosystem functions, is perhaps the most significant unknown. Entrainment at the major pumping plants is believed to be a cause of declines in at least some species resident in the estuary; entrainment onto Delta islands is poorly known but believed to be important. If these effects are unacceptable, mitigation will require construction of facilities which may be quite expensive and may alter the system in unpredictable ways. Therefore a top priority for managing the bay/delta ecosystem is to assess the importance of entrainment relative to other factors. This assessment would require multiple approaches with an emphasis on modeling and on scientific and statistical rigor.

Exotic species

Participants strongly recommended that regulations to prevent the introduction of additional exotic species be reviewed, strengthened if necessary, and vigorously enforced. The evidence for the frequency of exotic introductions and their effects is being assembled, and CALFED and other agencies should disseminate this information. Research should be conducted into the vulnerability of the ecosystem to invasion, but this should not delay management actions.

Contaminant effects

There are many potential problems with contaminant effects in the Bay/Delta, but no known population-level effects. A group should be formed to investigate to what extent contaminants may interfere with ecosystem functions (this group might be the Contaminant Project Work Team being established by the Interagency Ecological Program, although the San Francisco Estuarine Institute has been holding workshops on toxic indicators). A small workshop should be convened to summarize what we know and don't know and to recommend priority research topics and monitoring programs to provide diagnostic indicators of contaminants. To provide a unifying framework, efforts should include the construction of mass balances and the incorporation of contaminant effects into numerical models.

APPENDICES

Sponsors

Bay Institute

CALFED

California Urban Water Agencies

Center for Sustainable Resource Development (UC Berkeley)

Central Valley Project Water Association

Environmental Defense Fund

Environmental Protection Agency

Metropolitan Water District of Southern California

Natural Heritage Institute

Natural Resources Defense Council

Pacific Coast Federation of Fishermen's Associations

San Francisco Estuary Institute

Save San Francisco Bay Association

State Water Contractors

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