Draft Ecosystem Restoration Goals for the Strategic Plan
July 15, 1998

I. General CALFED Goals.

"The mission of the CALFED Bay-Delta Program is to develop a long-term comprehensive plan that will restore ecosystem health and improve water management for beneficial uses of the Bay-Delta system. The Program addresses problems in four resource areas: ecosystem quality, water quality, levee system integrity, and water supply reliability. Programs to address problems in the four resource areas will be designed and integrated to fulfill the CALFED mission"

"The goal for ecosystem quality is to improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species. The CALFED Ecosystem Restoration Program Plan (ERPP) addresses this goal."

> CALFED Bay-Delta Program Ecosystem Restoration Program Plan Vol. 1 (Technical Appendix to Programmatic EIS/EIR). March 1998. P. 1.

II. CALFED Ecosystem Restoration Program Goals.

The Strategic Plan of CALFED is to be a guide for achieving a reasonable level of "ecosystem quality" for the Sacramento-San Joaquin estuary and its watershed in a way that still allows sufficient water to be available to drive the diverse California economy. The key term ecosystem quality is not well defined and is presumably the same as the similar terms "ecosystem health" and "ecosystem integrity"(e.g., Woodley et al. 1993). All these terms imply the desirability of ecosystems that not only will maintain themselves through natural processes with minimal human interference (i.e., at low cost) but will be aesthetically attractive and produce goods and services in abundance for humans.

While many specific actions and goals to achieve a high level of ecosystem quality for the parts of the estuary and watershed within the purview of CALFED are given in the ERPP, the broader, overall goals are less clear. The Core Team has therefore modified the four general CALFED goals for ecosystem restoration, as follows:

1.Achieve, first, recovery and then large, self-sustaining populations of at-risk native species dependent on the Delta and Suisun Bay, support similar re-establishment of at-risk native species in San Francisco Bay and the watershed above the estuary, and minimize the need for future endangered species listings by reversing downward population trends of non-listed native species.

2. Rehabilitate the capacity of the Bay-Delta estuary and its watershed to support, with minimal ongoing human intervention, natural aquatic and associated terrestrial biotic communities, in

ways that favor native members of those communities.

3. Maintain and enhance populations of selected species for sustainable commercial and recreational harvest, consistent with goals 1 and 2.

4. Protect or restore functional habitat types throughout the watershed for public values such as recreation, scientific research, and aesthetics.

5. Prevent establishment of additional non-native species and reduce the negative biological and economic impacts of established non-native species.

6. Improve and maintain water and sediment quality to eliminate, to the extent possible, toxic impacts on organisms in the system, including humans.

GOAL #1 ENDANGERED SPECIES

Achieve, first, recovery and then large, self-sustaining populations of at-risk native species dependent on the Delta and Suisun Bay, support similar re-establishment in abundance of at-risk native species in San Francisco Bay and the watershed above the estuary, and minimize the need for future endangered species listings by reversing downward population trends of non-listed native species.

This goal is listed first because the conflict between protecting endangered species and providing reliable supplies of water for urban and agricultural uses was a major factor leading to the formation of the CALFED Bay-Delta Program. "At-risk species" are those native species that are either formally listed as threatened or endangered under state and federal laws or that have been proposed for listing. It places highest priority on restoring populations of at-risk species that most strongly affect the operation of the State Water Project and Central Valley Project diversions in the south Delta such as delta smelt, all runs of chinook salmon, steelhead rainbow trout, and Sacramento splittail. The goal gives highest priority to the legal recovery of species formally listed under federal and state endangered species acts because of the high degree of legal protection given the species, especially under federal law. The Strategic Plan, however, also supports actions that will lead to the restoration of large, self-sustaining populations of these endangered species and encourages/supports restoration of populations of species whose listing has less direct impacts on water diversions from the estuary, such as salt marsh harvest mouse (marshes along San Francisco Bay) and yellow-billed cuckoo (riparian areas along the Sacramento River). Because many other native species, especially aquatic species, are also in long-term decline, the Strategic Plan overall seeks to create conditions in the estuary and watershed that increase the distribution and abundance of native species or at least stabilize populations so that trends towards endangerment and extinction are halted.

Although the overall goal of the Strategic Plan is ecosystem rehabilitation, it is highly appropriate that native species be a major focus of the rehabilitation efforts for the following reasons. (1) The state and federal ESAs largely mandate species recovery as the way to achieve ecosystem recovery. (2) The habitats that make up the ecosystem contain mixtures of native and

non-native species, and often the non-native species are part of the reason for declines of the native species (see goal #5). (3) Species can be good indicators of ecosystem recovery and their distribution and abundance is comparatively easy to measure.

GOAL #2 ECOSYSTEM PROCESSES AND BIOTIC COMMUNITIES

Rehabilitate the capacity of the Bay-Delta estuary and its watershed to support , with minimal ongoing human intervention, natural aquatic and associated terrestrial biotic communities, in ways that favor native members of those communities.

Biotic communities are dynamic assemblages of species that typically occur together, in part because of common physiological tolerances, and interact with one another. This goal recognizes that an ecosystem restoration plan must include restoration and maintenance of ecosystem processes, such as seasonal fluctuations in flow and salinity, cycling of nutrients, predator-prey dynamics, and food web structure. While these processes will exist no matter what organisms make up the biotic communities, they may not function within the constraints identified with 'healthy' ecosystem functioning. Particular assemblages of organisms within defined set of conditions (the biotic communities) therefore become indicators of the ecosystem functioning in ways regarded as desirable. For example, if the system is managed to sustain high flow events in March and April, conditions may favor a suite of native fishes (e.g., splittail, hitch, chinook salmon) that respond positively to the increase in shallow water habitat by flooding. Two key aspects of this goal are (1) to have self-sustaining biotic communities, that will persist without continual high levels of human manipulation of ecosystem processes and species abundances and (2) to have communities in which the dominant species, as much as possible, are native species.

This goal stresses rehabilitation rather than restoration because so many of the physical and chemical processes in the watershed have been fundamentally altered by human activity. Thus dams, diversions, levees, and changing patterns of land use have altered the way water, sediments, nutrients, and energy cycle through the system. These changes, largely irreversible within human time scales, set constraints on the nature of the biotic communities that can be maintained. They will allow rehabilitation of ecosystem functioning in ways we find desirable, but not restoration of the communities to some pristine state.

GOAL #3 HARVESTABLE SPECIES

Maintain and enhance populations of selected species for sustainable commercial and recreational harvest, consistent with goals 1 and 2.

This goal recognizes that maintaining some species in numbers large enough to sustain harvest by humans is important, even if the species are non-native. For native species such as chinook salmon, steelhead, and splittail this means maintaining populations at levels considerably higher than those required to keep them from going extinct. For non-native species such as striped bass, signal crayfish, and channel catfish, this means managing populations at harvestable levels

but only as long as such management does not interfere with the restoration of large populations of endangered native fishes or disrupt the structure and function of established biotic communities. Note that this goal neither precludes nor encourages hatchery programs to enhance populations of sport and commercial fishes. However, hatchery programs that enhance populations of top predators in the Bay-Delta estuary and watershed are likely to have negative effects on other species. The goal states "selected" species because some species that may be harvested (e.g. *Corbicula* clams, mitten crabs) are also nuisance species for which it is highly desirable to reduce populations. The species selected for harvest management must be chosen in ways that recognize that species regarded as harvestable varies considerably among ethnic groups and can change with time. Thus most native cyprinids (e.g., splittail, blackfish, hitch) are held in high regard by people of Chinese heritage, even though they are disdained by fishers of European heritage.

GOAL #4 HABITATS

Protect or restore functional habitat types throughout the watershed for public values such as recreation, scientific research, and aesthetics.

Habitats are usually defined through some combination of physical features and conspicuous or dominant organisms, usually plants (e.g., salt marsh, riparian forest). Because of this they are often highly visible natural features and have important roles in the function of the ecosystems of which they are part (e.g., salt marshes can fix large amounts of carbon which can cycle through the entire system). The ERP Plan (Vol. 1, 1998) identifies major habitat types within the estuary and watershed, while Moyle and Ellis (1991) identify, at a finer scale, freshwater habitat types. By definition, different habitats support different species or combinations of species and play different roles (usually poorly understood) in the dynamics of the Bay-Delta Ecosystem. It therefore becomes important to protect and restore large expanses of the major habitat types identified in the ERPP and at least representative "samples" of other habitat types as identified by Moyle and Ellis (1991) and others. There are many direct benefits that arise from protecting a wide array of habitats, including the recovery of endangered species and the production of economically important wild species (e.g., fish, ducks). Equally important are the aesthetic values of natural landscapes containing mosaics of habitats. Less appreciated, but also important, are the ecosystem services provided by natural habitats, such as creation of clean water, removal of toxic materials from air, and delivery of nutrients to systems producing fish and other economically important aquatic organisms (Daily 1997).

GOAL #5 INTRODUCED SPECIES

Prevent establishment of additional non-native species and reduce the negative biological and economic impacts of established non-native species.

This goal is arguably part of the first four goals because protection and enhancement of species, communities, and habitats in estuary and its watershed implicitly includes reducing the impact of invasive non-native species. However, the introduction of new species into the system is still

occurring so frequently and the potential for ecological damage by further invasions is so high, that the necessity for **halting** (not just reducing) further introductions needs to be emphasized. Hobbs and Mooney (1998) document how invasions by non-native species are a major ecological force for change in California. Cohen and Carlton (1998) have labeled the Bay-Estuary as the most invaded estuarine ecosystem in the world and document the accelerating rate at which new species continue to become established, mostly as the result of their deliberate release through the dumping of ballast water of ships. Other sources include illicit introductions by anglers (e.g., northern pike) and aquarists (e.g., *Hydrilla*). This is a problem that needs to be dealt with quickly and directly because new invading species can negate the effects of millions of dollars spent on habitat or ecosystem restoration. Likewise, already established exotic species such as water hyacinth and the Asiatic clam (*Potamocorbula*) continue to have major negative impacts on more desirable species in the system and methods of control have to be devised. It is important that the control methods not be as harmful as the invading species they are designed to control.

GOAL #6 TOXICS

Improve and maintain water and sediment quality to eliminate, to the extent possible, toxic impacts on organisms in the system, including humans.

Like solving the problems with introduced species, solving the problems of toxic materials in the ecosystem could be considered part of the first four goals. Once again, this problem is so pervasive and poorly understood that it deserves recognition as a distinct goal. Major potential problems associated with toxics include the following: (1) Persistent toxics, such as heavy metals, accumulate through food chains, creating health problems not only for carnivorous fish but for the animals that eat them, such as birds and humans. (2) New, highly toxic biocides are aperiodically flushed into the ecosystem through agricultural and urban drains, creating water that is temporarily toxic to small invertebrates and fish; such toxic events may go un-noticed because of the brevity of each event and the small size of the organisms immediately affected. (3) Pesticide use in the Central Valley is increasing, with increased potential for negative effects on aquatic ecosystems. (4) There is considerable potential for ecological disasters caused by large sudden influxes of toxic materials, such as might be caused by flood-released toxic mine wastes (e.g., Iron Mountain Mine) or by spills of a pesticide carrier (e.g., the Cantera spill on the upper Sacramento River). (5) Toxic materials accumulate in sediments where they can affect benthic organisms directly (and the food webs they support) or sit as 'time bombs' waiting to go off when the sediment is disturbed. (6) Substances once thought to be harmless can turn to have harmful effects in subtle ways, e.g., as carcinogens or hormone disruptors. The impact of toxic substances is also an area in which there is high public awareness and considerable concern over the risks of consuming harvested organisms or of drinking water from the system.

III. What Are the Goals Designed to Achieve?

The goal statements provide the basis for a vision of a desired future condition of the Bay-Delta

estuary and associated ecosystems. Basically, they lead to a definition of what is meant by "ecosystem quality" as applied to the CALFED region.

First, the goals reflect a desire for ecosystems which are not continually being disrupted by unpredictable events, such as the invasion of exotic species capable of altering ecosystem processes, massive levee failures, or new endangered species. The ecosystems should be dynamic but function within known limits, be resilient in the face of severe natural conditions, and be capable of changing in a predictable fashion in response to global climate change.

Second, the goals reflect the desire for ecosystems that incorporate humans as integral parts of them, as managers, participants, and beneficiaries. This means the ecosystems under the purview of CALFED are not 'natural' ecosystems in which humans are primarily observers but are systems that (1) continue to be altered by human activity, but in a directed fashion, (2) allow people to both live and make a living in them, and (3) produce products that benefit the larger society, such as water, power, and food.

Third, the goals reflect a desire for ecosystems which maintain substantial self-sustaining populations of the remaining native species and some high-value exotic species (e.g., striped bass, crayfish), with large numbers of species with high cultural, symbolic, or economic value (e.g., salmon, raptors, tules).

Fourth, the goals reflect a desire for a landscape that is aesthetically pleasing and that contains large-scale reminders of the original 'primeval' ecosystem, such as salt marshes, tidal sloughs and expanses of clean, open water.

Fifth, the goals recognize that the ecosystems that will result from CALFED actions will be unlike any ecosystems that have previously existed. They will be made up of mixtures of native and exotic species that will interact in an environment in which many of the basic processes have been permanently altered by human activity and will continue to be regulated by humans. At the same time, the templates for the new ecosystems are the tattered remnants of the original systems and the natural processes that made these systems work.

References

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