SALTON SEA ECOSYSTEM INITIATIVE:

SALTON SEA WORKSHOP

October 22-23, 1996

Madison, Wisconsin

Agencies Participating in the Salton Sea Ecosystem Health Workshop

U.S. Geological Survey:
- Biological Resources Division
  - -National Wildlife Health Center
  - -Northwest Biological Science Center
  - -California Science Center
  - -Midwest Science Center
- Water Resources Division
  - -San Diego, California
  - -Madison, Wisconsin

U.S. Fish and Wildlife Service
- -Salton Sea National Wildlife Refuge
- -Division of Environmental Contaminants

U.S. Bureau of Reclamation

California Department of Fish and Game

Coachella Valley Water District

Imperial Irrigation District

EXECUTIVE SUMMARY

Recent avian and fish epizootics at the Salton Sea in southeastern California have focused local and national attention on the potential for an environmental disaster. Over the last four years the Salton Sea has experienced at least three massive die-offs involving over 175,000 waterbirds. During 1992, at least 150,000 eared grebes died on the Sea. The latest epizootic, during August-November 1996, was caused by avian botulism. This outbreak killed over 14,000 birds, including over 1,400 endangered California brown pelicans, and decimated 10-12% of the west coast American white pelican population. The outbreak was also linked to a concurrent massive die-off of possibly millions of fish.

The Salton Sea, located in the southeastern desert of California, is the terminal basin for agricultural irrigation drainage from the intensively farmed Imperial and Coachella Valleys, as well as the recipient of industrial and municipal sewage waste from neighboring Mexico. The Salton Sea ecosystem is home to five endangered species, numerous sensitive species and literally millions of migrating and wintering waterbirds. The Salton Sea National Wildlife Refuge, located at the southern end of the Sea, has one of the most diverse bird populations of any refuge, providing popular birding and hunting opportunities. This ecosystem also supports a billion dollar agricultural industry and provides recreational opportunities for sport fishing. At one time, boating, swimming, and a host of other economically important activities occurred at the Salton Sea, but these activities have diminished in recent years due to decreasing water quality. Public health warnings have been posted by the California State Office of Health and Hazardous Assessment describing the health risks of eating fish from the Salton Sea. In addition, the Imperial County Health Department published and posted warnings to avoid physical contact with waters from the New River which enters the United States at Calexico and discharges to the Salton Sea.

Historically, repeated flooding of the Salton Trough from the Colorado River and subsequent evaporation left large salt flats in the Salton Basin. The current Salton Sea was

formed in 1905 when a temporary diversion structure on the Colorado River failed and the entire discharge flowed into the Salton Trough until the break was closed in 1907. Dissolution of salts and evaporation have caused salinity to increase rapidly to levels above that of sea water. The Salton Sea is now severely threatened by the continued increasing levels of salinity and decreasing water quality. Fresh water is currently supplied to the Salton Sea by the New, Alamo, and Whitewater Rivers which are comprised largely of irrigation drainwater. Sewage and industrial waste are also carried in the New River from Mexico.

Following the 1996 avian and fish epizootics, scientists along with land and water managers from local, state, and federal agencies, including agricultural interests, gathered at the National Wildlife Health Center in Madison, Wisconsin, to develop an ecosystem approach for mitigating the current crisis and carrying out the long-term studies required to manage this biologically and politically complex ecosystem.

Introduction

Recent die-offs of large numbers of fish and wildlife at the Salton Sea, California's largest inland water body, have elicited a high level of national concern. The media, elected officials, state and federal resource agencies, local governments, and citizens have all expressed alarm over the deaths in 1996 of more than 14,000 birds representing 66 species (including over 1,400 endangered brown pelicans). The 1996 bird die-off, caused by avian botulism, were accompanied by the deaths of hundreds of thousands to millions of fish. Recent research implicating fish disease in the avian botulism outbreak suggests that the Sea's problems are both systematic and pervasive.

Prior to the 1996 botulism outbreak, substantial concern about the health of the Salton Sea ecosystem already existed as a result of previous wildlife epizootics, including the deaths of over 150,000 eared grebes (Podiceps nigricollis) in 1992. There was also substantial concern over the effects on the Salton Sea of agricultural contaminants (selenium and pesticides), increasing salinity, and sewage and industrial wastes entering the Salton Sea from Mexico. Developmental abnormalities, infections, and additional die-offs of fish and wildlife on a lesser scale have occurred with some regularity. Broad consensus has now emerged on the need for nationally coordinated action to address Salton Sea problems. Considering the complexity and scope of the issues, this need can only be faced collaboratively, with multiple agencies and organizations working together at an ecosystem level.

This issue paper is the first step in collaboration. In addition to mobilizing field crews, wildlife biologists, and scientists in response to the recent fish and wildlife die-offs, natural resource agencies involved with the Salton Sea also participated in a workshop convened October 22-23, 1996, at the USGS National Wildlife Health Center in Madison, Wisconsin. Because some 50 to 60 pelicans and other birds were succumbing daily to botulism at the Salton Sea (down from peak numbers in the hundreds per day), the meeting took on a sense of urgency. Because of the severity of fish and wildlife losses and related environmental concerns, the participants--including state agencies, Department of

Interior bureaus, and regional irrigation districts--each offered their full support for the undertaking of a joint collaborative effort.

The Salton Sea Ecosystem

The Salton Sea is a saline desert lake in California's Salton, or Cahuilla, Basin in the Colorado Desert near Mexico. The Sea has no outlet, and receives irrigation return flow from agriculture in the surrounding Imperial and Coachella Valleys. Most water entering the Salton Sea comes from Colorado River via the All-American Canal, a diversion at the Imperial Dam. An extensive network of canals irrigates about 450,000 acres of agricultural lands in the Imperial Valley and a smaller amount in the Coachella Valley. Irrigation return flow, along with sewage from Mexicali, Mexico, enters the New and Alamo Rivers, which flow into the Salton Sea from the south. The Whitewater River is the main drainage from the Coachella Valley to the north.

The current Salton Sea was formed in 1905 when a temporary diversion structure on the Colorado River failed and the entire discharge flowed into the Salton Trough until the break was closed in 1907. Historically, the Colorado River flooded the Salton Trough many times, and the resulting lakes evaporated, leaving large salt flats. The shoreline of the original lake bed (Lake Cahuilla) is still visible in the surrounding mountains. Dissolution of existing salts and a high evaporation rate (5.6 ft/yr) caused the salinity of the newly formed Salton Sea to increase rapidly. Salinity levels continued to rise to about 44 parts per thousand, more than 25% above that of sea water, resulting in the unique ecosystem present today.

The current elevation of the Salton Sea is 226 feet below sea level. Summer air temperatures in the Imperial Valley can reach 120 F, with temperatures over 100 F more than 110 days per year. Annual precipitation is only 2-3 inches. These conditions produce one of the hottest, driest places in the United States. The Salton Sea is shallow (maximum depth 50-55 ft) and approximately 360 square miles.

The aquatic ecosystem in the Salton Sea has low diversity but high productivity resulting from high nutrient loading from irrigation drainwater. This eutrophic condition stimulates high primary productivity of phytoplankton and benthic algae, thus sustaining high secondary productivity of zooplankton and benthic worms, which create an extremely important detrital (decompositional) energy pathway. This high productivity creates favorable conditions for fish which tolerate high temperatures, high salinity, and periodic low concentration of dissolved oxygen. Currently, the most abundant fish is tilapia (Tilapia spp.), an African species introduced in the 1960s.

Although the magnitude of the tilapia population is unknown, it is sufficiently large to attract thousands of pelicans, cormorants, and other fish-eating birds; while other habitat features (the mere presence of water in the desert) contribute to an incredibly high overall bird diversity of some 380 species. Other more specific aspects of the Sea's natural resources are the main focus of this paper, and are discussed below.

Salton Sea Values

The Salton Sea is an extremely valuable resource to both the region and the nation. As in any ecosystem, its values may compete with each other (if human management favors one, another may decline). In general, natural and human economic values of the Salton Sea ecosystem mutually reinforce one another. Each benefit from a healthy ecosystem as well as suffer from its problems. Values pertaining to agriculture, recreation, public health, economic development, and finally, natural resource values are summarized below.

Agriculture in the Imperial and Coachella Valleys is closely tied to water issues affecting the Salton Sea. Agriculture in the Imperial Valley alone produces about one billion dollars worth of output annually, primarily in winter crops. The Salton Sea is legally designated as a repository for irrigation return flow. Management of the Sea directly affects agriculture due to water level needs for irrigation drainage. Also, management of the Sea is affected by regulatory burdens associated with reduction of contaminants.

However, maintaining high natural resource values in the Salton Sea is generally compatible with agriculture.

Recreation has traditionally been a major activity associated with the Sea, including a productive sport fishery and seasonal waterfowl hunting which drew urban residents from throughout Southern California. Environmental deterioration, increasing salinity (4 million tons of salt enter the sea annually), and a decline of introduced sport fish have eroded recreational values in recent decades. Even so, as recently as 1987, 154,600 user households directly spent $76 million in recreation in the region, and the Salton Sea NWR supports an estimated 40,000 visitors each year. Undoubtedly, recreational values would increase with improved conditions in the ecosystem.

Public health values are closely tied to environmental conditions. Concern about human pathogens exists, including recent studies revealing that bacterial infections in fish could affect humans under some conditions. Contaminants in fish tissue, notably selenium, also pose human consumption risks. Two consumption advisories for Salton Sea fish are currently in effect. Very little is known, overall, about microbial pathogens which could be present in the Salton Sea and its tributaries, especially the New River.

Economic development is linked to conditions in the Salton Sea which affect aesthetics, the quality of life, and community values. Land development accelerated 30 years ago in anticipation of a major land boom, then "busted" along with the recreational potential. Lack of sport fish, offensive odors, fluctuating water levels, health advisories, and increasing salinity each reduced the human value of the ecosystem and have hindered economic development.

Finally, the natural values of the Salton Sea, particularly the habitat value for migratory birds, including waterfowl, shorebirds, and colonial waterbirds, are exceptional, but declining or at risk of complete loss. Insofar as these natural resources are linked to the other values described above, the region and the nation generally suffers.

The natural resources of the Salton Sea are the focus of this issue paper. This emphasis is complimentary to the mission of the Salton Sea Authority, a joint powers authority comprised if the Imperial Irrigation District, the Coachella Valley Water District, and the Counties of Imperial and Riverside, created in 1993. The Authority "directs and coordinates actions relating to improvement of water quality, stabilization of water elevation, enhancement of recreational and economic development potential...recognizing the importance of the Salton Sea to the dynamic agricultural economy..." All the participants in this initiative have agreed that natural resource values and the other human values associated with the Salton Sea are generally complimentary.

The Focus: Natural Resource Values

The natural resources of the Salton Sea are irreplaceable. The Sea provides vast aquatic and wetland habitats in a region where water is rare. The ecosystem is composed of a one-of-a-kind association of exotic and endemic species which tolerate the extreme conditions of temperature and salinity. These resources are discussed below.

Migratory Birds. The Salton Sea is perennially among the top three birder destinations in the United States, particularly at the Salton Sea National Wildlife Refuge and its leased lands. This ecosystem harbors one of the highest avian diversities in the nation - about 380 species. The area provides an extremely important wintering and migratory stop-over for Pacific Flyway waterfowl and shorebirds. Wintering waterfowl number to 125,000. More than 70 species of fish-eating birds have been recorded at the Salton Sea. These include white and California brown pelicans (Pelecanus erythrorhynchos and P. occidentalis), cormorants (Phalacrocorax spp.), wading birds; and up to 1 million eared grebes use the Sea annually. The Salton Sea provides abundant fish prey for these species in the high numbers of tilapia. Increasing breeding by fish-eating birds in recent years has been one response to the increased food supply. However, the attraction of fish-eating birds to the Salton Sea became a liability in 1996 when, in just a few weeks during the 1996 incident, more than ten percent of the total

U.S. western population of white pelicans were killed. Production of the fatal botulism toxin has tentatively been tied to bacterial infections in the tilapia. Clearly, these events, as well as other recent fish and wildlife epizootics signal an ecosystem under environmental stress.

Sport/Forage Fish. Fish are important as a prey base for birds, as indicators of water quality, and as species in their own right. Only one native fish species, the endangered desert pupfish, inhabits this ecosystem. All others are exotics, having been introduced for sport (at least three marine species introduced in the 1950s), for control of vegetation in the irrigation drains (fresh water tilapia since 1975, and grass carp in 1981), or merely by accident (another tilapia and at least one other tropical species, escapees from a fish farm in 1964). Increasing salinity has reduced populations of even salt-tolerant marine species such as the introduced orange-mouth corvina (which in previous years served sport angling). The recent discovery that fish are implicated in avian botulism, along with the fact that fish kills are a routine occurrence, make fish and fish disease a high priority for additional study. Little research on fish populations (and none on disease or microbial ecology) has been conducted in the last 30 years, since tilapia came to dominate the ecosystem's food web.

Endangered Species. Five endangered species inhabit this ecosystem: Yuma clapper rail (Rallus longirostris yumaensis), southern bald eagle (Haliaeetus leucocephalus), California brown pelican, peregrine falcon (Falco peregrinus), and desert pupfish (Cyprinodon macularis). Each of these species depends upon specific aspects of Salton Sea habitat, some elements of which are at greater risk than others. For example, over 1,400 California brown pelicans died from botulism in 1996. These birds, which come to the Salton Sea from the Sea of Cortez, cannot be expected to continue sustaining such losses and still remain a viable population.

Water/Wetlands. Water level in the Salton Sea is rising, resulting in loss of fringing wetlands. Manageable lands on the Salton Sea NWR have been reduced by nearly half (from 4700 to 2800 acres), and much of the refuge now consists of open water. Water quality in the remaining habitat is an

issue of high concern. Developmental abnormalities have been found in chicks of colonial waterbirds, and selenium levels in the tissue of some organisms exceed EPA levels of concern. Illegal over spray of pesticides by aerial applicators has been observed, resulting in contamination of fresh aquatic and wetland habitats in agricultural drains.

Stakeholders

A wide variety of stakeholders are affected by issues dealing with the Salton Sea ecosystem and its health and status. Likewise, efforts to address these issues will impact these many stakeholders, both positively and negatively. It is paramount that all stakeholders are considered and are a part of the process to solve these issues. These interests include agriculture, public health, recreation, local economic development, and both consumptive and non-consumptive natural resource uses. Locally, the Salton Sea Authority and its various committees were established to represent the public and agricultural interests influencing the Salton Sea. It is important that developing and carrying out programs proposed under this initiative be coordinated with the Salton Sea Authority, and that this initiative augment their ongoing efforts.

Various federal, state, and local governmental agencies with responsibilities and jurisdiction involving the Salton Sea are also stakeholders, and need to be represented as full partners in this effort, including the US Fish and Wildlife Service, Bureau of Reclamation, US Geological Survey, Army Corps of Engineers, U.S. Environmental Protection Agency, California Department of Fish and Game, Imperial and Coachella Valley Irrigation Districts, Regional Water Quality Control Board, and the local departments of public health. This initiative represents a partnership involving the collective capabilities of these agencies in the physical, chemical, and biological sciences to carry out an integrated program of scientific and socioeconomic investigations leading to an enhanced state of ecosystem health for the Salton Sea and drainages that empty into the Sea.

Because of the water quality concerns regarding the New River, authorities in Mexico are also stakeholders in any

Salton Sea environmental initiative. Involvement and cooperation with Mexican officials via the North American Free Trade Agreement, the International Boundary and Water Commission, and the US Environmental Protection Agency, who has jurisdiction over water quality issues involving international boundaries, are also of major importance to the success of this initiative.

Taking Action: The Partnership

The 1996 botulism incident, along with other major fish and wildlife die-offs, shrinking habitat, increasing salinity and environmental contaminants, have precipitously reduced the natural resource values of the Salton Sea ecosystem. These decreasing values in turn have negatively affected the other values associated with the Sea--public health, recreation, and the general economy. The losses are national in scope, including the loss of a significant fraction of the continental populations of both white and California brown pelicans. The prognosis for the future, without proactive intervention, is no brighter than the recent past.

Therefore, a partnership of agencies and other organizations, including all bureaus of the Department of Interior with responsibilities related to the Salton Sea, have agreed on the need for action to address Salton Sea issues at the ecosystem level. The agencies and organizations supporting this effort, so far, include:

U.S. Fish and Wildlife Service
Coachella Valley Water District
U.S. Geological Survey
    Water Resources Division
    Biological Resources Division
California Department of Fish and Game
Imperial Irrigation District
U.S. Bureau of Reclamation

This issue paper provides the initial framework for this effort. The ultimate goal is to determine appropriate natural resource management actions to enhance the ecosystem--indeed to save it. To succeed will require both an initial and ongoing description of the ecosystem

(monitoring) and scientific research concerning causes and effects (hypothesis testing). As the management actions are identified, they are to be implemented in an adaptive management framework. That is, the appropriate data are collected on the ecosystem outcome of actions taken, and the actions are changed when they don't work.

The goals to address the critical problems faced by the Salton Sea ecosystem, followed by actions proposed by the partnership to achieve effective stewardship of the Salton Sea, are listed below.

RECOMMENDATIONS FOR MITIGATING THE CURRENT CRISIS

Goal: Immediately control and prevent further botulism mortality in fish-eating birds at the Salton Sea.

Management Actions To the extent feasible, implement the following:

1. Continue intensive bird carcass surveillance and pick-up indefinitely to prevent spread of botulism from carcasses.

2. Explore and evaluate options and effects of reducing tilapia populations in the Salton Sea. Options include hiring commercial fisherman to harvest fish and bury carcasses and/or allow commercial fisherman to harvest fish for fish meal. However, because the hazards are unknown, i.e., fish may contain human and animal pathogens, additional investigation is required to guide decisions on tilapia harvest and use.

3. Continue to monitor and methodically collect data and observations related to ongoing epizootic fish and wildlife mortality.

Research Activities should focus on understanding the factors driving the current pelican/tilapia die-offs and methods for interrupting this mortality.

1. Initiate field studies to further elaborate the cause(s) of the current fish mortality, how fish are acquiring

botulism toxin, and the conditions that result in the botulism toxin being transferred to birds.

2. Test hypotheses already generated from field data through controlled experiments.

3. Develop a strategy for data collection and observations to rigorously chronicle the current event. This information is important for current evaluations and for guiding future efforts.

RECOMMENDATIONS FOR RESOLVING LONG-TERM MANAGEMENT NEEDS

Goal: Develop an understanding of the Salton Sea Ecosystem.

1. Evaluate data, including geographic information systems, currently available, and identify information needed to better understand the current biological, physical, and political realities of the ecosystem.

2. Develop a conceptual model of ecosystem function to identify critical physical and biological information needs.

3. Develop a strategy for methodical inventory and monitoring of the physical, chemical, and biological attributes of the Salton Sea ecosystem. Monitoring should include the Salton Sea, its major inflows including the New, Alamo, and Whitewater Rivers, and agriculture drainage systems. Data collection and interpretation must be linked to hydrologic models currently under development for the Salton Sea.

Goal: Develop methodology for managing the Salton Sea ecosystem for maximum sustainability of economic and biological resources.

1. Design biological, earth, and socioeconomic studies to provide the data needed to answer questions about the relations between human actions, water quality, sediment chemistry, pesticide applications, microbial ecology, land use characteristics, and fish and wildlife mortality.

2. Develop strategies to mitigate problems.

3. Implement and test management strategies.

4. Develop an interagency coalition as a forum for interactive dialogue, information exchange, and resolution of biological problems within the Salton Sea ecosystem.

Goal: Develop a long-term fiscal and personnel support base for addressing ecosystem health of the Salton Sea.

1. Pursue Congressional support through agency initiatives

2. Pursue agency support through allocation of discretionary funds.

3. Pursue collaborative initiatives between partners.