

March 19, 2007

MEMORANDUM

To: Technical Review Committee

From: Andy Cohen, Director of the Biological Invasions Program at SFEI

**Re: Request for Funding to Assist with Removing Exotic Oysters from San Francisco Bay, and Identifying the Source of the Introduction**

### Background

A population of the large exotic oyster *Crassostrea gigas* (*C. gigas*) was discovered last summer in southern San Francisco Bay. An effort initiated at that time identified the oysters and collected them along the Bay's southeastern shore from south of the Dumbarton Bridge to just south of the San Leandro Marina, with a few outlying oysters at other sites. Initial examination found nearly all of them to be in good condition, ripe and ready to spawn.

Although *C. gigas* has been grown commercially in central California since 1928, with many millions of oysters reared through maturity and apparently releasing spawn into the environment, there are records over that period of only a few dozen oysters settling as a result. However, we have now collected over 260 *C. gigas* (estimated to be a fraction of the population in the Bay), indicating a rate of settlement that is orders of magnitude greater than observed in the region over the previous 78 years, and in a bay where the oyster has not been grown commercially in recent years. This suggests that something is different in this case: either the oysters are a genetically distinct strain from previously cultured *C. gigas*, or environmental conditions have changed in a way that makes it easier for them to settle.

In San Francisco Bay, *C. gigas* tends to grow faster than the native oyster and up to four times its size. Evidence suggests it would out-compete the native oyster for food or space, overgrow them, or impair their growth with metabolites or feces. It could similarly affect other epibenthic species, and by consuming and reducing phytoplankton populations, alter food webs and impact both benthic and pelagic species. Noting that an exotic clam had reduced primary productivity in northern San Francisco Bay, USGS scientists have expressed concern that if the exotic oyster changed "the balance between light and grazing that seems to control the phytoplankton growth rate in the South Bay, it could mean a reduction in pelagic species" (personal correspondence from Dr. Janet Thompson).

### Possible Means of Introduction

There are a number of different ways in which *C. gigas* might have arrived in San Francisco Bay: as larvae drifting in from other bays where it is grown, or larvae drifting south from a recent, illegal planting of oysters on the Marin shore; in the ballast tanks or on the hull of a vessel; as an illegal planting in the South Bay; or as larvae spawned from oysters placed in the Bay for bioaccumulation studies. The last alternative potentially involves the RMP. At least three programs used *C. gigas* for bioaccumulation monitoring in the Bay between 1991 and 2002: the Regional Board's Bay Protection and Toxic Clean-up Program in 1991-92; the Central Contra Costa Sanitary District, as part of the Local Effects Monitoring Program, in the North Bay in 1991-94; and the RMP at 9 sites in the Bay in 1993-2002. The RMP placed a total of approximately 14,000 mature *C. gigas* (71-149 mm in height) in the Bay, hung in mesh bags in groups of 150, for 90-100 day periods in the wet (Oct-May) and dry (June -Sept.) seasons. The dry season coincides with *C. gigas*' reported spawning period in California, and some of the RMP studies discuss changes in the oysters' condition that suggest that they spawned during deployment. About 2,500 of the oysters were deployed in the South Bay at the Coyote Creek or Dumbarton Bridge stations.

Although the RMP's placement of *C. gigas* in the South Bay in the late 1990s to 2002 makes it a leading candidate, it is not yet known which source is in fact responsible for introducing the oysters to San Francisco Bay. Some of the studies in progress, including genetic analyses and the determination of the age of the oysters, may reduce this uncertainty. Archived (frozen) samples of the oysters used in the RMP studies are apparently available, and so it may be possible through genetic analysis to determine definitively if the RMP oysters were or were not the source of the *C. gigas* population currently found in South San Francisco Bay.

### **Project and Funding Request**

When *C. gigas* was discovered in the Bay in the summer of 2006, SFEI's Biological Invasions Program spearheaded an effort to survey and remove the oysters from the Bay, organizing volunteers and boats and crews provided by USFWS/Don Edwards National Wildlife Refuge and USGS. SFEI also initiated and coordinated related research including research to determine the probable source of the introduction. The latter includes work with Dr. David Goodwin (at Denison University in Ohio) to analyze the age of the oysters through oxygen isotope analysis in order to determine how long the population has been in the South Bay, and with Dr. Patrick Gaffney (Director of the Marine Biology and Biochemistry Program at the University of Delaware) to compare the genetics of the South Bay oysters with possible source populations. To support further work on these efforts, SFEI expects to receive \$25,000 shortly from the California State Coastal Conservancy (SCC), and has submitted a proposal to the National Fish and Wildlife Foundation (NFWF) for \$46,000. USFWS, USGS, California Department of Water Resources (DWR), East Bay Regional Park District (EBRPD) and Hayward Area Parks and Recreation District (HAPRD) have promised further in-kind assistance with the survey and removal effort, and USFWS, CDFG and CalTrans have provided permits and letters of authorization.

The amount of work and funding that will be needed to complete the survey and removal will depend, among other things, on how large and widespread the population turns out to be and

on the scale and number of follow-up surveys that need to be conducted to ensure that the population has been eradicated. The scale of genetic research to determine the source of the introduction will depend on the number of potential source populations that are sampled, the amount of genetic variation between potential source populations, and the number of genetic sites that need to be sampled in order to analyze that variation. To help guide the right level of effort to surveys, removal and research, SFEI will convene an Advisory Panel that includes representatives of the funding organizations, collaborating agencies, and the relevant land managers and regulatory agencies. The informal panel that SFEI convened to review the summer 2006 work and provide direction for the current effort included USFWS, NOAA, USACE, CDFG, SCC, DWR, BCDC, the San Francisco Estuary Project, EBRPD, HAPRD and NFWF, and we expect that many of these would continue to participate.

The funding from SCC and NFWF will not be sufficient to complete all of the work including the initial survey, removing the oysters, conducting the follow-up surveys, and completing the genetic analyses needed to determine the method of introduction. We are therefore requesting \$30,000 from the RMP contingency fund to assist with this effort, and inviting the RMP to participate on the Advisory Panel to help guide this project.