Programmatic Environmental Impact Statement for Evaluating Oyster Restoration Alternatives for the Chesapeake Bay, Including the Use of Native and Non-Native Oysters

Progress Report

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OYSTER EIS PROGRESS REPORT
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BACKGROUND

The Eastern oyster (*Crassostrea virginica*) was once a keystone species of the Chesapeake Bay, having served historically as a primary contributor to the Bay's filtration system and a provider of rich habitat for many other species. Oysters also once supported a commercial fishery that, for many years, was an important component of the economy and culture of the region. A precipitous decline in oyster populations began with the advent of mechanized harvesting in the early 1900s, worsened during the 1960s due to disease, and has continued through the present. This continuing decline has increased the urgency for action to effectively restore the Bay's oyster population so that it can resume its important ecological functions and revive the economic and social benefits of a viable commercial oyster fishery.

Both Maryland and Virginia have conducted a variety of small-scale programs intended to restore oyster populations for many years; however, the success of these efforts has been limited and localized. Little progress has been made to date toward significantly increasing the Bay's total oyster population. Because two oyster diseases, MSX and Dermo, have played a major role in causing the most recent decline of the oyster population and in inhibiting recovery efforts, the concept of introducing a non-native oyster that is resistant to both diseases has stimulated interest among some stakeholders in both states. The Suminoe oyster (*Crassostrea ariakensis*), a native of China, was identified as a species with potential for prospering in the Bay because its environmental requirements are similar to those of the Eastern oyster. Aquaculture experiments conducted in Virginia with non-reproducing Suminoe oysters confirmed that the species grows well in the Bay, is resistant to the two diseases, and results in a marketable seafood product. These findings encouraged some stakeholders' interest in introducing reproductively viable Suminoe oysters into the Bay to establish a thriving population and increase oyster abundance throughout the Bay to historical levels.

The concept of introducing a non-native species to assume the ecological and socioeconomic role of a depleted native species is controversial. The devastating consequences of unintentional introductions of non-native species, such the zebra mussel, have been widely publicized. Also, questions have arisen about whether the levels of effort and funding invested in past and current efforts to restore the native oyster have been sufficient to achieve the desired result. The introduction of reproductively viable Suminoe oysters into the Bay would be irreversible, which contributes to the concern expressed by some stakeholders about taking such an action. Given the potential risks and benefits of introducing the Suminoe oyster, the responsible state and federal agencies agreed that a rigorous formal evaluation of the proposed introduction and alternative strategies for restoring oysters is essential. To that end, Maryland and Virginia initiated preparation of a programmatic environmental impact statement (EIS) to evaluate oyster management alternatives for the Chesapeake Bay. ***The EIS will evaluate the potential outcomes of a range of alternatives for restoring the native Eastern oyster as well as outcomes of the proposed introduction of the Suminoe oyster.*** The specific goal of the EIS is to identify a preferred alternative or combination of alternatives for establishing an oyster population in the Chesapeake Bay that reaches levels of abundance capable of supporting harvests comparable to the harvests recorded during the period 1920 to 1970. The objective is to restore the ecological role of oysters in the Bay as well as the socioeconomic benefits of a commercial oyster fishery.

In 2003, Congress authorized the U.S. Army Corps of Engineers (USACE) to be the lead federal agency coordinating the preparation of this programmatic EIS pursuant to Section 102 of the National Environmental Policy Act (NEPA). NEPA requires Federal agencies to integrate environmental values into their decision-making processes by considering the environmental effects of their proposed actions and reasonable alternatives to those actions. Federal agencies prepare detailed statements known as EISs to meet these requirements. A Notice of Intent to prepare a programmatic EIS for restoring oysters in Chesapeake Bay was published in the Federal Register in 2004. The Virginia Marine Resources Commission (VMRC) on behalf of the Commonwealth of Virginia and the Maryland Department of Natural Resources (DNR) on behalf of the State of Maryland are the lead state agencies. Cooperating federal agencies assisting in the effort include the U.S. Environmental Protection Agency (USEPA), National Oceanic and Atmospheric Administration (NOAA), and U.S. Fish and Wildlife Service (USFWS). The Potomac River Fisheries Commission and the Atlantic States Marine Fisheries Commission are providing additional review and assistance. The EIS Executive Committee supervising the overall effort is composed of Maryland Department of Natural Resources Secretary, John Griffin; Virginia Secretary of Natural Resources, L. Preston Bryant, Jr.; and United States Army Corps of Engineers Norfolk District Commander, Colonel Dionysios Anninos.

The issues that must be addressed in this programmatic EIS are complex, and some of the actions being evaluated would be irreversible if implemented; consequently, preparing the EIS has required the participation of a large number of individuals, the integration of findings and contributions from many sources, complete documentation of all data and information to be incorporated, and detailed and rigorous quality control and peer review. The agencies prepared a detailed peer review plan to comply with the "Final Information Quality Bulletin for Peer Review" issued by the Office of Management and Budget (OMB) on December 16, 2004, and to ensure that the quality of scientific information that supports findings and conclusions of the EIS meets the standards of the scientific and technical community**.**

The peer review plan delineates a series of working groups with specific responsibilities for reviewing the quality of research, modeling, and assessments performed for the EIS. The Independent Oyster Advisory Panel (OAP) has primary responsibility for reviewing the modeling projects (described below) that will provide predictions about the outcomes of actions being evaluated in the EIS. The OAP also will assess the overall scientific adequacy of the Draft EIS (DEIS). The panel includes seven members representing a broad range of non-partisan, scientific expertise and philosophies about marine resources. The OAP is charged broadly to review the adequacy of all data and assessments (and associated uncertainties) used to identify the ecological, economic, and cultural risks and benefits for each EIS alternative; provide advice on the degree of risk involved for each alternative based on available data and assessments; and recommend additional research to reduce the level of risk and uncertainty.

A separate Peer Review Group has been assigned responsibility for reviewing the findings of research projects initiated specifically to support this EIS (described below). The group includes six members nominated by state and Federal resource management agencies for their individual expertise. Additional peer review panels have been assembled whose members have expertise specific to cultural and economic assessments. The Ecological Risk Assessment Advisory Group (ERAAG) is providing technical guidance and peer review on the framework and results of the ecological risk assessment (ERA) that will provide the basis for comparing and contrasting alternatives. The ERAAG consists of five members representing the participating Federal agencies. In addition to these review groups, the Atlantic States Marine Fisheries Commission, Shellfish Transport Committee, is provided the opportunity to review all components of the EIS (i.e., research findings, modeling, assessments of alternatives). The final approved peer review plan, which identifies the members of the working groups, is posted at Maryland DNR's Oyster EIS In Focus Page http://www.dnr.state.md.us/dnrnews/infocus/oysters.asp

A press release issued in January 2007 on behalf of the EIS Executive Committee anticipated that a Draft EIS (DEIS) would be issued in May or June of 2007. Significant progress has been made on all of the critical elements of the EIS since January; however, efforts to develop data and make modifications essential for completing the population model for the Eastern oyster have caused unavoidable delays. In addition, the need to comply with quality assurance requirements that involve scheduling many individuals and allowing adequate time for thorough review and revision of material based on reviewers' comments has further influenced the timeline. These and other factors have precluded meeting the May/June target date. ***Although timely issuance of a DEIS is of critical importance to all parties, the completeness and scientific validity of the document are of even greater importance.***

The DEIS will not be issued at this time, but the lead agencies believe that it is in the public interest to provide an overview of the process of developing the EIS and the progress that has been made to date. This progress report describes the various components of the EIS development process, accomplishments to date on each of the components, and remaining factors that will influence the timeline for completing the DEIS. This summary does not report the findings of individual EIS components specific to the proposed action and alternatives. Presenting preliminary assessments of alternatives would be premature and inconsistent with the rigorous peer review requirements to which the lead agencies are committed.

What is a "Programmatic EIS"?

A programmatic EIS is used to evaluate actions that encompass a large geographic scale and/or that constitute complex programs for which subsequent NEPA analyses will be conducted in tiers, as specific plans for implementing selected alternatives are established. The programmatic Oyster EIS will provide the information needed to assist the lead agencies to select the most appropriate broad courses of action for restoring the ecological and economic functions of oysters throughout the Chesapeake Bay and help to ensure that federal and state agencies and private organizations work coherently and consistently toward a common restoration goal. Although the lead agencies have defined preliminary, hypothetical implementation plans for some alternatives to contribute to modeling analyses, final implementation plans will be prepared only after the lead agencies have reached a decision about the preferred course of action for restoring oyster populations in Chesapeake Bay. Further NEPA analyses (i.e., supplemental EISs) considering specific areas of potential effect for particular management actions may be required in the future as those final implementation plans are defined more clearly. The hypothetical implementation plans used in modeling efforts for evaluating the proposed action and alternatives will be described and documented in the EIS and/or in supporting appendices.

A programmatic EIS is especially pertinent for a decision regarding the proposed introduction of the Suminoe oyster because alternatives that involve the Suminoe oyster could affect coastal estuaries outside the Chesapeake Bay, further increasing the geographic scale of interest. Given the similarities in habitat preference and environmental tolerances between the Suminoe oyster and the native Eastern oyster, the total area that could be affected by the presence of reproductively viable Suminoe oysters within Chesapeake Bay includes most of the area that currently supports the Eastern oyster. That area encompasses the entire Atlantic and Gulf coasts. In the event of successful reproduction of the Suminoe oyster in Chesapeake Bay, a large pool of Suminoe oysters would be available for unauthorized introductions to other estuaries. Modes of dispersal of the Suminoe oyster to other estuaries may include transport of larvae from the Bay in natural currents as well as deliberate or accidental dispersal of larvae or adult oysters by humans. In an effort to obtain input from a coastal perspective, the cooperating agencies work closely with the Atlantic States Marine Fisheries Commission.

The Proposed Action and Restoration Alternatives Being Evaluated

A clear delineation of the proposed action and all alternative actions is necessary for a valid comparison of all these possible actions in an EIS. In order to make the effort of performing a complex environmental impact assessment manageable, the number of alternatives to be evaluated must be finite, and once defined, the alternatives must not be altered during the development of the EIS. All cooperating agencies carefully reviewed and agreed upon the definitions and wording of the proposed action and alternatives for this EIS, which incorporate public input received during the scoping period at the beginning of the project. The proposed action and alternatives are defined as follows:

Proposed Action – The State of Maryland and Commonwealth of Virginia propose to introduce the oyster species *Crassostrea ariakensis* into the tidal waters of Maryland and Virginia for the purpose of establishing a naturalized, reproducing, and self-sustaining population of this oyster species. Diploid *C. ariakensis* would be propagated from the existing third-generation (or later) of the Oregon stock of this species in accordance with the International Council for the Exploration of the Seas' (ICES) 2003 Code of Practices on the Introductions and Transfers of Marine Organisms (i.e., to minimize the risk of introducing new diseases). The states further propose to continue efforts to restore the native oyster (*C virginica*) throughout the Chesapeake Bay using best available restoration strategies and stock assessment techniques.

Alternative 1 - No Action: Continue Maryland's present Oyster Restoration and Repletion programs and Virginia's Oyster Restoration Program under current program and resource management policies and available funding using the best available restoration strategies and stock assessment techniques.

Alternative 2 - Expand Native Oyster Restoration Programs: Expand, improve, and accelerate Maryland's Oyster Restoration and Repletion programs and Virginia's Oyster Restoration Program in collaboration with Federal and private partners. This work would include, but would not be limited to, an assessment of cultch limitations and long-term solutions for this problem and the development, production, and deployment of large quantities of disease-resistant strain(s) of *C. virginica* for broodstock enhancement.

Alternative 3 - Harvest Moratorium: Implement a temporary harvest moratorium on native oysters and an oyster-industry compensation (buy-out) program in Maryland and Virginia, or a program that would offer displaced oystermen on-water work in a restoration program.

Alternative 4 - Aquaculture: Establish and/or expand state-assisted, managed or regulated aquaculture operations in Maryland and Virginia using the native oyster species.

Alternative 5 - Aquaculture: Establish state-assisted, managed or regulated aquaculture operations in Maryland and Virginia using suitable triploid, non-native oyster species.

Alternative 6 - Introduce and Propagate an Alternative Oyster Species (other than *C. ariakensis*) or an Alternative Strain of *C. ariakensis*: Introduce and propagate in the state-sponsored, managed, or regulated oyster restoration programs in Maryland and Virginia, a disease resistant oyster species other than *C. ariakensis*, or an alternative strain of *C. ariakensis* from waters outside the U.S. in accordance with the ICES 2003 Code of Practices on the Introductions and Transfers of Marine Organisms.

Alternative 7 – Establish a naturalized, reproducing and self-sustaining population of *C. ariakensis* in the tidal waters of Maryland and Virginia through introductions beginning when the EIS is completed but discontinue efforts to restore *C. virginica*.

Alternative 8 - Combination of Alternatives – This alternative will be developed after analysis of all of the other alternatives is completed. It is likely to consist of elements of other alternatives that appear to have greatest potential and that would be consistent with each other.

Primary Elements of the Oyster EIS and Their Relationships

Preparing a comprehensive EIS requires acquiring and integrating a wide range of information into a meaningful assessment. The Oyster EIS has required the development of several predictive tools to provide a sound scientific basis for comparing the consequences of the proposed action and the alternatives. Some of the most critical tools that are fully developed or nearing completion, their development processes, and progress to date are listed below:

Ecological Risk Assessment (ERA) - Dr. Charles Menzie, Exponent, Principal Investigator. An ERA evaluates the consequences of a proposed action throughout an ecosystem and is most commonly used in addressing potential outcomes of releasing some contaminant into the environment, such as the consequence for the local flora and fauna. The use of an ERA as a tool for comparing the ecological risks (and benefits) posed by a series of alternative oyster restoration actions being evaluated is a relatively unique application of ecological risk assessment.

The Relative Risk Model (RRM) has been selected as the most applicable approach to conducting the ERA. This choice was made in conjunction with the Ecological Risk Assessment Advisory Group (ERAAG), which is composed of risk assessment experts from USACE, USEPA, NOAA and USFWS. The RRM approach depends on defining the interactions that can occur for each alternative and for each of the ecological receptors (i.e. submerged aquatic vegetation, blue crab, striped bass). This aspect of the work is still being refined, but the following general types of interactions have been identified: habitat-related interactions (availability of space and competition), food-related interactions, water quality effects, and diseases. These interactions can have either a positive or negative effect on a receptor. The magnitude of the effects of individual interactions will depend on the receptor's degree of dependency on the factor (e.g., habitat availability or specific type of food) and the magnitude of change. A high level of dependency and a large magnitude of change would have a proportionally greater positive or negative effect than would a low level of dependency and low magnitude of change. A spectrum of positive and/or negative effects occurs within this range. There might also be a combination of positive and negative interactions for a receptor (e.g., habitat availability increases but food supply diminishes). Different approaches for combining such interactions are being explored. Further development of the RRM is underway; once completed, the RRM will be implemented using the outputs of the Oyster Demographic Model and the Chesapeake Bay Environmental Model Package, which are described below. The ERA will be reviewed by the ERAAG and selected outside experts. ERA results will provide the basis for the Environmental Consequences section of the EIS.

Oyster Demographic Model – Dr. Jon Volstad, Versar, and Dr. Mary Christman, U. of Florida, Principal Investigators. Estimates of the size and distribution of the oyster population expected to result from the proposed action and alternatives at the end of the specified evaluation period (10 years) are required input for the ERA and for assessing the consequences of the alternatives for all the other factors addressed in an EIS. The Oyster Demographic Model, a computer simulation that predicts the growth of the oyster population over time in response to a range of variables that influence the rates of reproduction, mortality and growth of oysters, is the tool being developed to project outcomes of the proposed action and alternatives.

A group of large data sets was required to develop the demographic model because oysters exhibit great spatial and temporal variation in vital population rates in the dynamic environment of Chesapeake Bay. The model is being developed and validated for the Eastern oyster first because a significant body of data is available for the native species, and fewer data are available for estimating vital population rates for the Suminoe oyster in Chesapeake Bay. Many researchers from agencies and academia contributed the data required to develop the model. Maryland DNR, VMRC, and the Virginia Institute of Marine Science (VIMS) provided estimates of the habitat available for oysters in the Bay, salinity at each bar under varying amounts of annual precipitation, and the starting population of Eastern oysters. An annual survey conducted by the Maryland DNR was used to estimate reproductive rates, disease intensity, natural mortality rates, and growth rates. Output from the Larval Transport Model (described below) consisting of predictions of dispersal of oyster larvae among bars after each annual spawning period served as input for annual steps in model execution. Growth was modeled using additional data and analyses contributed by researchers at the University of Maryland Center for Environmental Science and VIMS, as well as from published scientific literature. The model also incorporates environmental data obtained from the U.S. Geological Survey (e.g., frequency of high and low precipitation years). Results of recent and ongoing studies of Suminoe oysters conducted by several researchers are being used to derive vital population rates to be used later for modeling the growth of Suminoe oyster populations in Chesapeake Bay.

The outcome of an oyster-management scenario cannot be predicted reliably from a single model simulation because oysters are affected by many random events and unmodeled variables. For example, annual precipitation strongly affects reproductive success and disease intensity but cannot be predicted for a future time series. Vital population rates also exhibit some variability, even when environmental conditions are similar. To account for these uncertainties, the demographic model estimates the likely trend in oyster abundance for a scenario and calculates the uncertainty of the estimate by conducting 1,000 simulations for each scenario. For each simulation, environmental conditions and vital rates are selected randomly from the distribution of values based on the variability in the empirical data. The predicted trend is reported as the median result of the 1,000 runs, and the uncertainty is estimated based on the difference between the smallest and largest abundance results in 90% of the model runs. This procedure allows for a valid comparison of the likely effects of different EIS alternatives, despite the fact that the model is unlikely to reproduce a single future series of events.

The model has been modified extensively since development began. Some changes were required due to the lack of certain kinds of data. Others were based on comparing the model output with the limited data available for validating the model. Oyster researchers and managers have been consulted through all phases of model development to identify potential deficiencies or inaccuracies in the model and to ascertain the most scientifically sound measures for correcting those problems. As of early June, the demographic model for the native oyster has been implemented and tested in the Java™ programming language. The model is computationally intense, taking about 23 hours to conduct 1,000 runs on an Intel Pentium™ IV, 3.0 GHz personal computer. Model documentation and preliminary runs for EIS alternatives involving Eastern oysters have been completed and will be submitted to the Independent Oyster Advisory Panel for peer review in late June. The Panel will also review the proposed changes in model parameters that will be made for application to the Suminoe oysters. The Suminoe oyster model parameters are being developed based primarily on results of the research studies that are described further below.

Larval Transport Model - Dr. Elizabeth North, U. of Maryland, Principal Investigator. One input required for the Oyster Demographic Model is a prediction about how oyster larvae produced in one location in the Bay may be dispersed and transported to other locations. The Larval Transport Model incorporates a wide variety of information about the behavior of larvae of the two oyster species and the physical factors that influence the dispersal of oyster larvae, including the location of oyster bars; patterns of water circulation in response to tides, river flow, and wind; current velocities; and turbulent mixing. To examine how differences in larval behavior might influence the distribution of oysters on existing bars, the Larval Transport Model uses a particle-tracking model that incorporates predictions from two three-dimensional models of hydrodynamics within Chesapeake Bay and uses a behavior submodel to simulate the behavior of larvae of the two species of oysters. In an effort to ensure that model results are rigorous and defensible, the investigators conducted sensitivity studies and compared hydrodynamic predictions to observations from Chesapeake Bay. They performed a validation analysis to quantify the ability of a hydrodynamic model to predict hydrographic properties in Chesapeake Bay by comparing model predictions with measurements of salinity at Chesapeake Bay Program monitoring stations. The investigators performed additional validation and sensitivity studies to determine if the Larval Transport Model's predictions could reproduce the temporal and spatial patterns of Eastern oyster spat fall. The Larval Transport Model produces predictions regarding the sources and settling areas for larvae of both species; those predictions are used as input to the Oyster Demographic Model. The final report documenting the development and application of the Larval Transport Model was completed in July 2006 and has undergone extensive peer review.

Chesapeake Bay Environmental Model Package (CBEMP) - Dr. Carl Cerco, USACE ERDC, Principal Investigator. The CBEMP is a comprehensive mathematical model of physical and eutrophication processes in the Bay and its tidal tributaries that is used to predict changes in water quality and some other ecosystem components. The Environmental Protection Agency's Chesapeake Bay Program has used the model successfully as a management tool for several years. Three models are at the heart of the CBEMP: (1) modeled flows and loads of nutrients and sediment from the watersheds serve as input to (2) a model that computes three-dimensional intra-tidal transport; computed loads and transport are input to (3) a eutrophication model that computes algal biomass, nutrient cycling, dissolved oxygen, and numerous other constituents and processes. The eutrophication model predicts populations of some living resources, including benthos, zooplankton, and submerged aquatic vegetation (SAV). For the EIS and ERA, the CBEMP will be used to project changes in dissolved oxygen, algal biomass, light penetration, and SAV abundance in response to differences in oyster abundance predicted to result from the proposed action and the alternatives. Some model runs have been made for various categories of oyster abundance. Further evaluations of the effects of alternatives on water quality are pending, based on predictions of oyster population to be generated by the Oyster Demographic Model.

Oyster Demand Model - Dr. Douglas Lipton, U. of Maryland, Principal Investigator. An EIS requires consideration of the economic consequences of the proposed action and the alternatives. An Oyster Demand Model was developed to predict how changes in oyster abundance would affect price of oysters and to estimate the profitability of oyster fisheries that might occur under the proposed action and each of the alternatives. An original model developed in 2006 was updated recently using two additional years of data for national oyster landings. Model projections incorporating these most recent data indicate that the price-per-bushel for oysters is inversely related to the magnitude of harvest; moreover, the magnitude of the relationship is affected most by harvest in Chesapeake Bay. This relationship will be applied to predictions of levels of harvest expected in response to the proposed action and alternatives generated by the Oyster Demographic Model to assess the economic value and viability of fisheries that may occur under the various management alternatives. Additional economic analyses were conducted to assess the economic viability of various oyster aquaculture operations to evaluate aquaculture alternatives being considered in the EIS. Economic analyses yet to be completed include estimating the costs of each of the alternatives, which is required as information for the EIS. In addition, the findings of the economic analysis must be integrated with those of the social/cultural analyses. Such integration is essential for sound assessment of socioeconomic consequences of the proposed action and alternatives.

Social/Cultural Analysis - Drs. Michael Paolisso and Nicole Dery, Principal Investigators. An EIS requires considering the consequences of the proposed action and the alternatives on stakeholders in society. Surveys, analyses, and modeling have been conducted to assess how much shared cultural knowledge and sense of value exists within and across groups of oyster stakeholders concerning the benefits of oysters in general. The investigators also are attempting to determine if stakeholders' views of the benefits of restoring oysters are consistent with their views concerning the benefits of oysters as a resource. This work has also examined stakeholders' views on the acceptability of a non-native species for use in restoration efforts.

In January and February 2007, the investigators surveyed the following groups of stakeholders in Maryland and Virginia: watermen, oyster growers, oyster processors and shippers, scientists, environmentalists, recreational fishers, and restaurant owners. Overall, approximately 2300 oyster stakeholders were sampled. A draft analysis of the cultural model of "oysters as a resource" compared with stakeholders' cultural models of "oyster restoration" has been completed based on all data acquired since project inception and is under review by a peer review panel. Also since January, the investigators have collected data at the stakeholder level concerning the perceived effects of the proposed action and alternatives. A descriptive analysis of these data has been completed and is being peer reviewed.

Research Projects in Support of the EIS - NOAA, Maryland DNR, and others have funded more than 50 research projects to provide data about the Suminoe oyster, its expected behavior in Chesapeake Bay, and its interactions with the native oyster. Such information is required for a number of components of the EIS. The following table lists the general topics addressed in these research projects, the number of projects completed to date, and the sources of funding. Completed projects have been peer reviewed, as described earlier. For continuing projects, data and information available to date are being used in modeling and assessments for the EIS with the approval of the investigators and the acknowledgement that the information is preliminary and has associated uncertainty. It is projected that 89% of the funded research projects will be complete by December 31, 2007, and all projects will be complete by May 31, 2008. The OAP will review research projects that are incomplete at the Draft EIS stage and advise the lead agencies of the risks and level of uncertainty if a decision is made before those projects are completed. Additional information about the studies, as well as the wide range of meetings and other activities relating to the Oyster EIS is posted at Maryland DNR's Oyster EIS In Focus Page at http://www.dnr.state.md.us/dnrnews/infocus/oysters.asp

Topic	**No. of Studies**	**No. Complete**
Understanding *C. ariakensis* Within its Native Range: Taxonomy, Pathogens, and Ecology	5	3
Potential for Population Growth and Sustainability in Chesapeake Bay: Interaction Between *C. ariakensis* and Native Oyster Species, Potential for *C. ariakensis* to Become a Fouling Nuisance, and Ecosystems Services and Functions	26	11
Oyster Disease: Susceptibility of *C. ariakensis* to Known Disease-causing Parasites and Pathogens	8	2
Human Consumption Risk	6	1
Aquaculture and Harvest Management Evaluations	8	1

Completion of the EIS

Major milestones remaining to complete the Oyster DEIS include

- the Oyster Advisory Panel's (OAP) review of the demographic model; model runs of alternatives 1, 2, and 3; and the model documentation report, which includes the proposed approach for modeling alternatives involving the Suminoe oyster

- revisions or modifications of the demographic model in response to the OAP's review

- completion of model runs to project oyster population size (both Eastern and Suminoe oysters) at the end of the evaluation period under all alternatives

- completion of the ecological risk assessment, water quality assessment, and socioeconomic evaluations that require output from the demographic model

- completion of peer reviews of all individual EIS components

- preparation of the Environmental Consequences section of the EIS (introductory sections of the EIS have been completed)

- review of the preliminary DEIS by the lead and cooperating agencies

- revision of the DEIS based on the agencies' input

- review of the DEIS by the OAP, including an assessment of the adequacy of information on the Suminoe oyster employed in all DEIS analyses

- final revision and issuance of the DEIS for public review

- public comment period for written response and several public meetings to obtain feedback from stakeholders on the DEIS

The complexity of the process required to develop the oyster EIS, the number of individuals involved in the process, and the interdependence of the many contributing elements of the process have made scheduling and accurate prediction of milestone dates extremely difficult. Two critical remaining factors have the greatest potential to influence the timeline for preparing the DEIS. The first is the outcome of the OAP's review of the demographic model. The OAP will require at least two weeks to complete its review of the model documentation report, following which the OAP will meet with the model development team. The review meeting has been scheduled for mid-July and will be followed by a meeting of the Executive Committee at which the OAP review will be discussed. The extent of modifications of the model needed to satisfy the OAP's requirements is unknown at this time. The second critical factor is the OAP's peer-review of all components of the EIS, including the preliminary DEIS. The magnitude of revision required to respond to that review will determine the time required to issue a DEIS.