UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
Office of Environmental Measurement and Evaluation
11 Technology Drive, North Chelmsford, MA 01863-2431

MEMORANDUM

Date: July 28, 2003 **QA Tracking #:** RFA - 03385

Subject: QAPP approval
Oyster Reef Mapping and Soft Shell Clam Population Assessments in the Great Bay Estuary, New Hampshire.
Prepared by UNH (June 2003)

From: Alan Peterson, QA Chemist

To: Jean Brochi, EPA Project Officer

The Quality Assurance Unit has reviewed UNH's Oyster Reef Mapping and Soft Shell Clam Population Assessment QAPP (dated June 30, 2003). Based on the information provided, the QAPP meets EPA QA/R-5 requirements and is approved for site work.

Should you have any questions, please feel free to contact me at 617-918-8322.

Oyster (*Crassostrea virginica*) reef mapping and soft-shell clam (*Mya arenaria*) population assessments in the Great Bay Estuary, New Hampshire - 2003

DRAFT 2

June 30, 2003

Prepared by

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Alan Peterson - for Arthur Clark

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Appendix A: Field Data Sheets

A3 - Distribution List

Table 1. QAPP Distribution List

QAPP Recipient Name	Project Role	Organization	Telephone number and Email address
Ray Grizzle	Project Manager	University of New Hampshire	603-862-2175 ray.grizzle@unh.edu
Steven Bernstein	Associate Director, Office of Sponsored Research	University of New Hampshire	603-862-2420 steven.bernstein@unh.edu
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Bruce Smith	NHF&G Biologist	NHF&G Region 3 Durham NH	603-868-1095

Based on EPA-NE Worksheet #3

A4 - Project/Task Organization

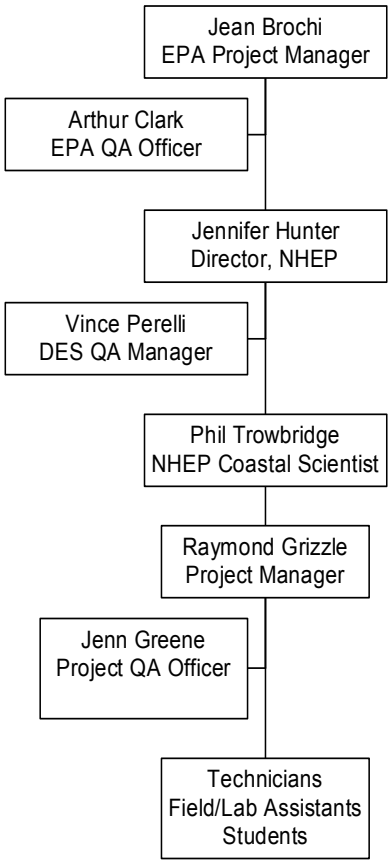
The project manager for this study is Dr. Ray Grizzle of the University of New Hampshire. Dr. Grizzle is responsible for maintaining and distributing the approved QA Project Plan, sampling designs, fieldwork, data gathering and analysis, quality assurance, and filing interim and final reports with New Hampshire Estuaries Project (NHEP).

Dr. Grizzle is assisted with field and laboratory work by technicians employed in his laboratory and undergraduate students from the University of New Hampshire. Jennifer Greene will serve as the Project QA Officer and will supervise field work by technicians and students.

The principal data users will be personnel at the NHEP and the New Hampshire Fish & Game Department.

The New Hampshire Estuaries Project is funding the study.

Figure 1: Organizational Summary



A5 - Problem Definition/Background

The purpose of the NH Estuaries Project (NHEP) is to implement a Management Plan to protect, restore, and manage the state's estuarine systems. To this end, the NHEP must coordinate monitoring the estuarine system to determine impacts of management actions on environmental quality. UNH Jackson Estuarine Laboratory will assist in the monitoring program by accomplishing the following objectives that have been specified in the contract between NHEP and UNH concerned with molluscan shellfish populations:

- Mapping the dimensions of two (2) oyster reefs in the Piscataqua and Squamscott rivers
- Assessing soft-shell clam populations at six (6) sites in the Great Bay Estuary

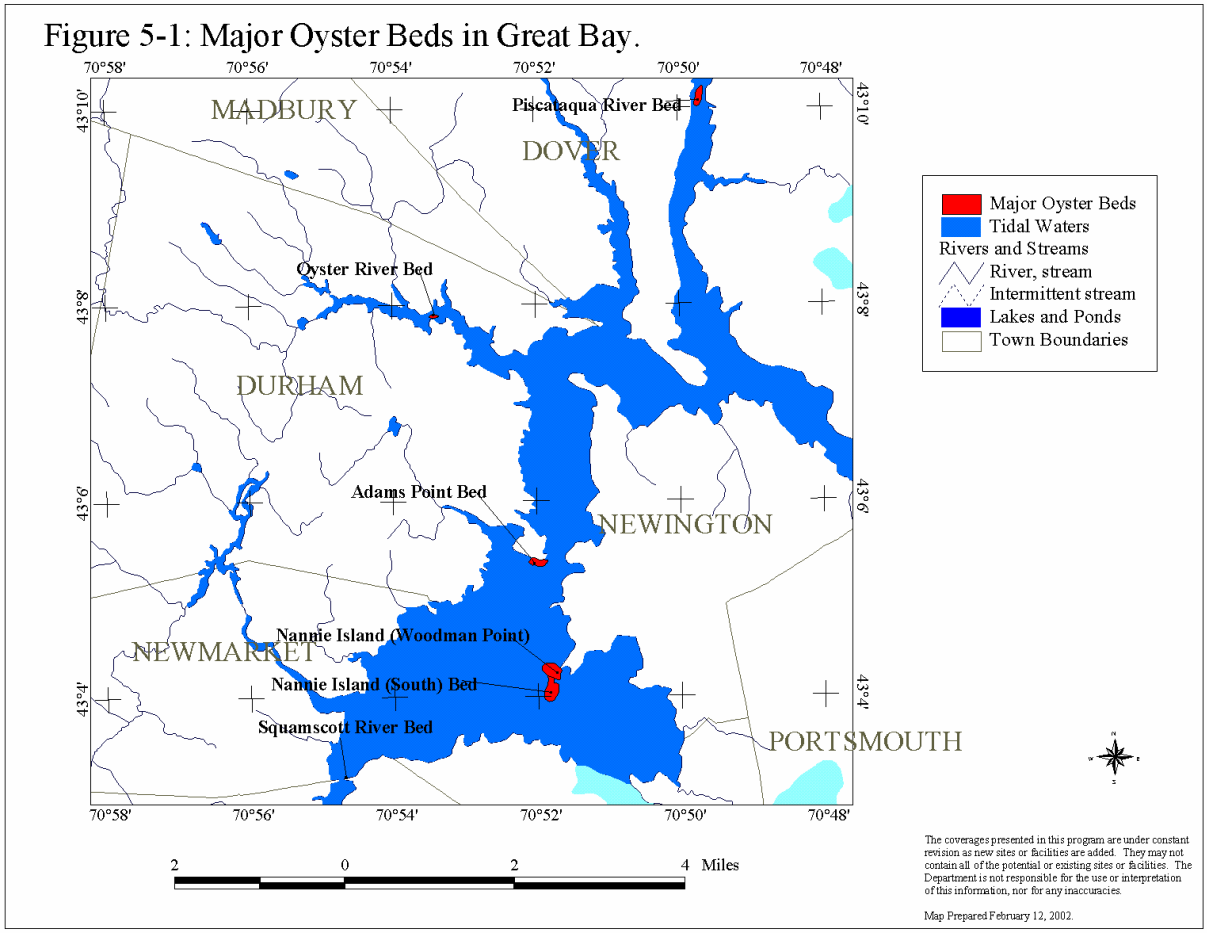
<u>Oysters</u>

The current contract requires mapping the boundaries in order to determine the size of two oyster (*Crassostrea virginica*) reefs: Squamscott River and Piscataqua River reefs (Fig. 2). Maps of these two reefs will be added to existing maps of Nannie Island, Woodman Point, Adams Point, and Oyster River reefs so that NHEP will have information on areal coverage of the six oyster reefs regularly monitored by NH Fish and Game Department (Trowbridge 2002; Smith 2002). The contract states that "Videography methods will be used." and "The final work product will be a GIS (ESRI ArcView or compatible) file with polygons representing boundaries of the two oyster beds, all necessary documentation/metadata for

the GIS file, and a report describing the final results of the project and any deviations from the protocol established in the QA Project Plan."

Figure 2 shows the six major oyster reefs in Great Bay, Oyster River, and Piscataqua River based on previous mapping projects. Reefs at Nannie Island (Woodman Point and South), Adams Point, and Oyster River were recently mapped using methods similar to those proposed for the present study (Smith 2002). The present project will map the remaining two reefs in the Piscataqua River and at the mouth of the Squamscott River. Smith (2002) determined that videography was an appropriate and cost-effective means to monitor the boundaries of oyster beds in Great Bay.

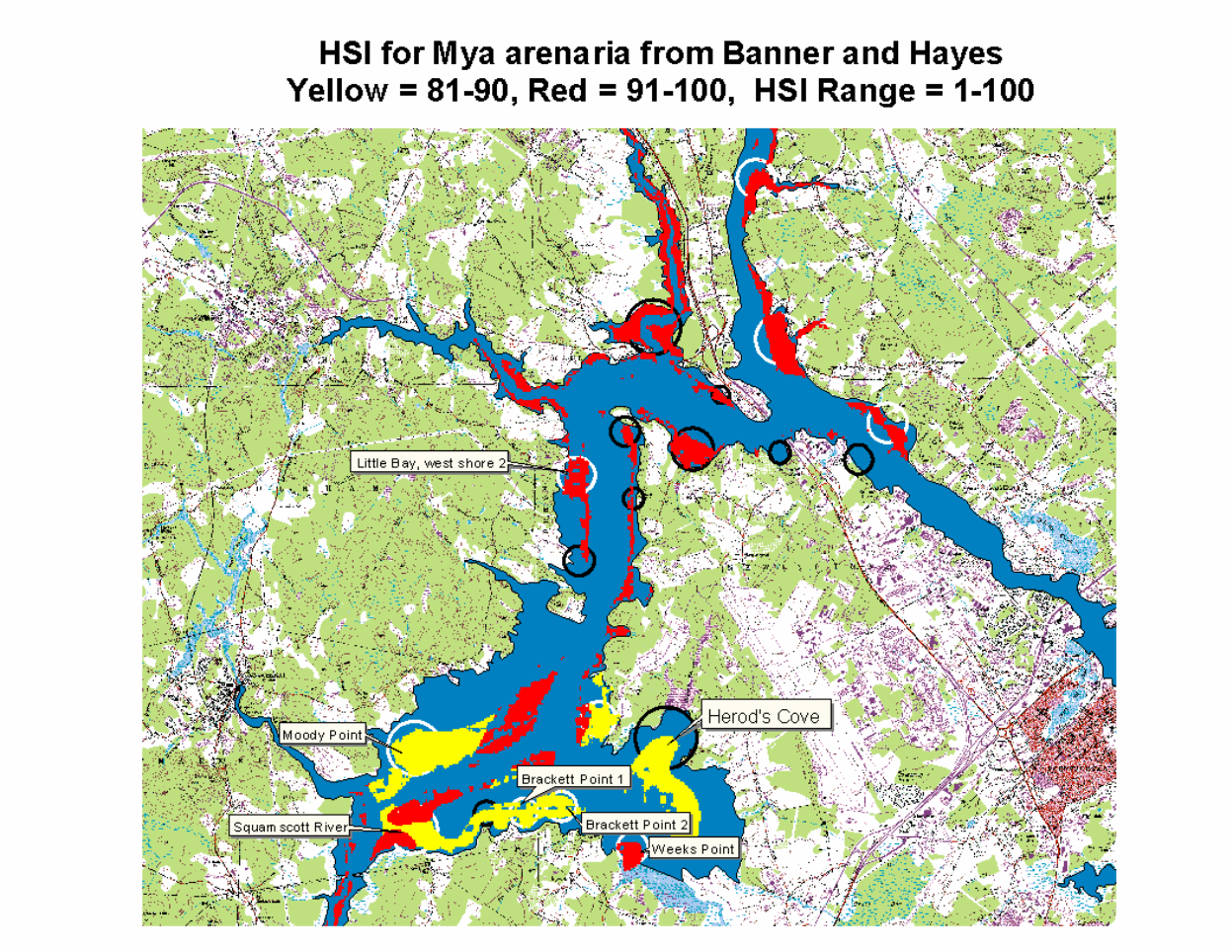
Figure 2: Major oyster beds in Great Bay (from Trowbridge, 2002)



Clams

Studies during 1996 to 2002 yielded quantitative information on distribution and abundances of soft-shell clam (*Mya arenaria*) populations in some areas of the Great Bay and Piscataqua River estuaries (Jones 2000; Smith 2002; Trowbridge 2002). These studies were based on a map showing high quality clam habitat areas produced using the Banner and Hayes (1996) model. A total of sixteen (16) areas were identified and ten (10) have been sampled to date. The present contract requires assessment of the remaining six (6) areas: Weeks Point, Brackett's Point, Squamscott River mouth, Moody Point, Herods Cove, and Upper Little Bay (western shore). The study locations for this project, plus the predicted clam habitat suitability index (HSI) from Banner and Hayes (1996), are shown in Figure 3.

Figure 3: Clam habitats and study areas for this project



A6 - Project/Task Description

The following work tasks will be completed in order to meet the above objectives.

1. PREPARE QUALITY ASSURANCE PROJECT PLAN

Before initiating field sampling, the project director will prepare a Quality Assurance Project Plan. This plan must be approved by Quality Assurance staff from NHDES and USEPA.

2. CONDUCT OYSTER REEF MAPPING

Each of the two study reefs will be mapped by digital video imaging using multiple continuous transects combined with stationary imagery for production of stills at selected points.

3. PRODUCE OYSTER REEF MAPS

Two ArcView-compatible GIS-based maps of the Squamscott River and Piscataqua River oyster reefs will be produced that show the boundaries of each reef. Two photomontages also will be constructed from multiple geo-referenced stills imaged on each reef.

4. CONDUCT SOFT-SHELL CLAM POPULATION ASSESSMENT

At each of the six specified sampling sites (potential soft-shell clam habitat), the approximate boundary of clam habitat will be determined, and multiple quadrats will be raked in each area to provide data on clam abundances. Distributions of major sediment types in each area also will be determined.

5. PRODUCE CLAM DISTRIBUTION MAPS

Two ArcView-compatible GIS-based maps will be produced that show the boundaries of potential clam habitat, sediment distribution, and clam abundances.

6. SUBMIT FINAL REPORT

A final report that describes the methods used, results, and comparison of the results to previous studies shall be submitted by 31 December 2003. The final report shall also contain the following deliverables:

For oysters: (1) Two ArcView-compatible GIS-based maps of the Squamscott River and Piscataqua River oyster reefs, (2) two photomontages constructed from the 50+ stills imaged on each reef, (3) documentation/metadata for the GIS file, and (4) copies of all video imagery.

For clams: (1) an ArcView-compatible GIS file showing the boundaries of each study site, major sediment type distributions at each site, and the locations of all quadrat samples, (2) documentation/metadata for the GIS file, and (3) Excel file of raw data for clam counts and measurements.

Major milestones for this project are summarized in the following table.

Table 2. Project Schedule Timeline

Activity	Dates (MM/DD/YYYY)		Product	Due Date
	Anticipated Date(s) of Initiation	Anticipated Date(s) of Completion		
Prepare QA Project Plan	06/01/2003	07/15/2003	QAPP document	07/15/03
Conduct oyster reef mapping	07/15/2003	08/14/2003	Data for study	
Produce oyster reef maps	08/15/2003	10/15/2003	ArcView GIS maps	
Conduct clam population assessment	08/15/2003	09/15/2003	Data for study	
Produce clam distribution maps	09/16/2003	10/15/2003	ArcView GIS maps	
Submit interim report to NHEP			Interim report	09/30/2003
Submit final report to NHEP			Final report	12/31/2003

A7 - Quality Objectives and Criteria

This study is primarily a field study. The oyster reef mapping involves inspection of video imagery in the laboratory to verify the presence of shell bottom, but no laboratory analyses are involved for either the oyster or clam studies. Therefore, some of the standard data quality objectives metrics are not applicable.

Precision: Not applicable

Accuracy: Accuracy for the clam abundance component of this study will be estimated by the error terms associated with the mean abundance for spat, juveniles, and adults for each study area. Confidence limits of +/- 10% for each abundance estimate will be considered excellent, while +/- 25% will be acceptable.

Representativeness: Stratified random sampling and grid sampling will be employed for the clam and oyster assessments, respectively. Therefore, the resultant data will be representative of the each bed that was assessed.

Comparability: The method used for oyster reef mapping are the same as were used to map the other 4 oyster reefs in the Great Bay Estuary (Smith, 2002). Clam population assessments will be conducted using conventional techniques that are compatible with previous studies.

Sensitivity: Not applicable

Completeness: The project will be considered complete if six clam flats and two oyster reefs are assessed using the sampling methods described in Sections B1 and B2.

A8 - Special Training/Certification

Field and laboratory assistants will be trained by the Project Manager prior to their conducting work on this project. The Project Manager will keep a record of the names of each person who was trained, along with the date of the training.

A9 - Documents and Records

The Project Manager will be responsible for maintaining the approved QA Project Plan and for distributing the latest version of the plan to all parties on the distribution list in section A3. A copy of the approved plan in hardcopy and electronic formats will be on file with the NHEP Coastal Scientist.

The Project Manager will be responsible for retaining the original hardcopy datasheets from this project for a period of 5 years. Electronic files of the database created for this project will be kept by the Project Manager and the NHEP Coastal Scientist for a period of 10 years.

One interim report and one final report will be produced for the NHEP. These reports will be available to the public in hardcopy from the NHEP, and its abstract (in text form only) will be included in the NHEP tracking database. See section C2 for the reporting schedule and details.

GROUP B: DATA GENERATION AND ACQUISITION

B1- Sampling Process Design

Oysters

The objective of the present study for oysters is to determine the boundaries of two study reefs. In the present study area, oyster reef sizes have been determined using a variety of techniques. In 1997, a combination of tonging and diver observations, coupled with differential GPS marked buoys, was used to map the boundaries of seven major oyster reefs (Langan 1997). In 2001, four of the same reefs were mapped using different combinations of acoustic sounders, videography, and quadrat sampling (Smith 2002; Grizzle et al. 2003). For the present study, underwater videography will be used to determine the

boundaries of the study reefs. Each reef will be imaged along multiple transect lines (i.e. boat navigation tracks) with periodic stationary imagery for extraction of stills. Maps of the study locations are provided in Section A5. The number of tracks per reef will be discussed in Section B2. All imagery will be geo-referenced using DGPS.

Clams

The objective of the present study for clams is to determine the distribution and abundance of clams at six study sites. Maps of the study locations are provided in Section A5. The overall sampling process design for clam work in the present study is based on previous work in the general study area and recommendations by Smith (2002). Each of the study sites will be visually inspected for distribution of major sediment types (e.g. sand, mud, cobble) and the presence of clam siphon holes. A sediment distribution map will be produced in the field by walking the boundaries of each "sediment zone" (sampling stratum) with continuous logging of DGPS data. The location of individual samples (quadrats) within each stratum will be randomized, yielding a stratified random sampling design. A minimum of five (5) replicate quadrat samples will be taken in each sampling stratum and a minimum of twenty (20) quadrats per site.

B2 - Sampling Methods

Oysters

Continuous video imagery will be acquired along a minimum of three (3) parallel transects spanning the longest axis of each reef and six transects perpendicular to them. Each transect will extend a minimum of 20 meters in both directions beyond the actual boundary of the reef. This will yield a crisscrossing pattern providing complete video coverage of the reef and allowing accurate determination of reef boundaries. At a minimum of 50 points on the reef proper and at a minimum of 10 additional points off the reef but within the overall matrix of transects, the camera will be dropped to the bottom and a 5-second stationary recording made. Concurrently and synchronized with respect to time with the imaging, DGPS output will be logged at 0.5 second intervals to provide geo-referencing of all the imagery.

Clams

After the boundaries of major sediment types have been mapped at each of the six specified sampling sites and the appropriate sampling strata have been determined, a minimum of five (5) quadrats will be randomly placed using a grid system consisting of a marked line stretched along two perpendicular boundaries of each stratum. Pairs of random numbers corresponding to a fixed position within the grid will be chosen to determine the location of each quadrat, which will be excavated by rake. All excavated sediment will be washed through a 5 mm mesh sieve, ensuring that all clams greater than 5 mm in shell length will be removed from the sediment, measured (shell length to nearest mm with calipers), counted, and returned to the general area. A core of the top 10 cm of sediment will be collected from each quadrat and archived at UNH/JEL to expand the library of sediment data on the Great Bay. Quadrat locations will be geo-referenced using DGPS.

B3 - Sample Handling and Custody

The only samples that will be returned to the laboratory are sediment samples from the clam population assessment. These samples will be stored in the 4^{o}C room at UNH/JEL. These samples will not be analyzed for this study. The samples will be archived for potential future studies of sediment texture and organic content.

B4 - Analytical Methods

N/A

B5 - Quality Control

For oyster assessments, "reef" and "non-reef" video imagery and the coordinates assigned to that imagery will be ground-truthed at a minimum of 20 sites on each reef by returning to each mapped location and sampling the bottom using tongs for a 2-minute period. All live oysters will be measured (shell length to nearest mm using calipers) and counted, and all empty valves will be counted. Particular attention will be paid to imagery near the boundaries of each reef in order to verify the transition from reef to non-reef.

Accuracy of the clam abundance estimates for each growing area will be calculated using the standard deviation between quadrats, the sample size, and the t-distribution to estimate the 95 percentile confidence limits of the mean. The difference between the upper confidence limit and the mean value is the size of the error bar. The length of the error bar will be divided by the mean value to determine the percent +/- in the estimate. As discussed in section A7, an error of +/- 10% or less will be considered excellent, while an error of +/- 25% will be the target maximum error.

B6 - Instrument/Equipment Testing, Inspection, and Maintenance

N/A

B7 - Instrument/Equipment Calibration and Frequency

N/A

B8 - Inspection/Acceptance of Supplies and Consumables

N/A

B9 - Non-direct Measurements

N/A

B10 - Data Management

Field data will be recorded on standard field data sheets (see Appendix A) and transferred to Excel data files. Data entry will be checked using two methods. First, the entire data set will be printed and checked against the entries in each field data sheet. Second, box-plots and other graphical tools (such as residual plots) will be constructed to determine if there are outliers in the data set. All outliers will be examined further to determine whether they represent data entry or other kinds of errors. All data will be stored electronically in spreadsheets or SYSTAT datafiles. Management of hardcopy data and documents is described in Section A9.

GROUP C: ASSESSMENT AND OVERSIGHT

C1 - Assessments and Response Actions

The Project Manager will participate in and evaluate the sample collection methodology as the study proceeds. If problems occur, appropriate adjustments will be made. All such changes will be recorded and reported to the NHEP Project Manager immediately.

C2 - Reports to Management

Reports will be submitted to the NHEP according to the following schedule:

1. Interim report on the project status plus including problems encountered, data summaries, and anticipated completion schedule - September 30, 2003 (two copies)

2. Final Report on the results of the project, including all deliverables described in Section A6 - December 31, 2003 (five copies and one unbound original)

GROUP D: DATA VALIDATION AND USABILITY

D1 - Data Review, Verification, and Validation

The Project QA Officer will review all field data sheets and final computer data files for completeness and accuracy based on the criteria described in Sections A7 and B10. The Project QA Officer will also verify that the methods used for the study followed the procedures outlined in this QA Project Plan. If questionable entries or data are encountered during the review process, the Project QA Officer will contact the appropriate personnel to determine their validity. The Project QA Officer will be responsible for a memorandum to the Program Manager summarizing any deviations from the procedures in the QA Project Plan and the results of the QA/QC tests.

D2 - Verification and Validation Methods

The Project Manager reviews the memorandum from the QA Officer to see if there have been deviations from the QA Project Plan. Any decisions made regarding the usability of the data will be left to the Program Manager, however the Project Manager may consult with project personnel, the NHEP Project Manager, or with personnel from EPA-NE, if necessary.

D3 - Reconciliation with User Requirements

Any problems with the data analysis and interpretation will be reconciled by the Project Manager after consultation with New Hampshire Estuaries Program staff.

REFERENCES

Banner, A. and G. Hayes. 1996. Important Habitats of Coastal New Hampshire. US Fish and Wildlife Service, Gulf of Maine Project.

Grizzle, R.E., L.G. Ward, J.R. Adams, S.J. Dijkstra, and B. Smith. 2003. Research note: mapping and characterizing subtidal oyster reefs using acoustic techniques, underwater videography, and quadrat counts. Proceedings of Symposium on the Effects of Fishing Activities on Benthic Habitats: Linking Geology, Biology, Socioeconomics, and Management. American Fisheries Society. (in press)

Jones, S.J. (ed.) 2000. A technical characterization of estuarine and coastal New Hampshire. New Hampshire Estuaries Project. Concord, NH.

Langan, R. 1997. Assessment of shellfish populations in the Great Bay Estuary. Final Report. Office of State Planning, New Hampshire Estuaries Project. 34 pp.

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