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VIRGINIA SALTWATER RECREATIONAL FISHING DEVELOPMENT FUND
SUMMARY PROJECT APPLICATION*

NAME AND ADDRESS OF APPLICANT:	**PROJECT LEADER (name, phone, e-mail):**
Virginia Institute of Marine Science P.O. Box 1346 Gloucester Point, VA 23062	Dr. Robert J. Latour, 804.684.7312 (latour@vims.edu) Christopher F. Bonzek, 804.684.7219 (cfb@vims.edu)
PRIORITY AREA OF CONCERN: Research	**PROJECT LOCATION:** Virginia Institute of Marine Science

DESCRIPTIVE TITLE OF PROJECT: Data collection and analysis in support of single and multispecies stock assessments in Chesapeake Bay: the Chesapeake Bay multispecies monitoring and assessment program (ChesMMAP)

PROJECT SUMMARY: The Chesapeake Multispecies Monitoring and Assessment Program (ChesMMAP) is fisheries-independent monitoring survey that is prosecuted in direct support of single and multispecies modeling efforts. This program currently provides data on abundance, age- and size-structure, growth (length-at-age and weight-at-length relationships, sex ratio, maturity, and diet composition for several recreationally, commercially, and ecologically important fish species in Chesapeake Bay. We are requesting funding to support field and laboratory activities associated with the ChesMMAP program in 2008. In addition, we are also requesting funds to support the development of life history profiles for 10 – 12 species inhabiting Chesapeake Bay, several of which are managed by the Atlantic Marine Fisheries Commission (ASMFC) and VMRC. These profiles will serve as easily interpretable summaries of the salient biological and ecological characteristics of each species, and will be disseminated to fisheries managers and recreational anglers within the Commonwealth of Virginia. Lastly, since controversy has surrounded the status and management of both summer flounder and weakfish stocks along the Atlantic coast in recent years, we request funding to conduct a series of analyses (i.e., yield-per-recruit (YPR) and egg-per-recruit (EPR)) designed to yield insight about alternative management strategies.

EXPECTED BENEFITS:

For the Commonwealth: Virginia is one of 15 member states of the ASMFC, which serves a deliberative body coordinating the conservation and management of shared nearshore fisheries resources. The best approach for member states to assure equitable distribution of fishery resources is to have reliable knowledge of the population dynamics of fishes within their state's boundaries. The ChesMMAP survey provides unique understanding of abundance, age- and size-structure, growth (length-at-age and weight-at-length relationships), maturity, sex ratio, and diet composition for 10 – 12 recreationally, commercially, and ecologically important species which would otherwise be unavailable. Annually, recreational and commercial fisheries contribute approximately $500 million to Virginia's economy; loss of programs that provide the requisite data for fisheries management in Virginia would jeopardize the future sustainability of fisheries resources and the economic benefits therein.

For recreational anglers in Virginia: The species life history documents are intended to provide anglers in Virginia with succinct and easily interpretable descriptions of the biological and ecological characteristics of highly important sportfishes. These documents will also provide valuable information to fisheries managers and stock assessment biologists in their quest to develop appropriate management regulations for recreationally and commercially important fishes in Chesapeake Bay and along the Atlantic coast. Lastly, the YPR and EPR analyses for summer flounder and weakfish have the potential to yield information about alternative management strategies, which if adopted, will benefit recreational anglers in Virginia by ensuring sustainable fisheries for these species.

COSTS:

VMRC Funding:	$ 494,928
Recipient Funding:	$ 63,059
Total Costs:	**$ 557,987**

Detailed budget must be included with proposal.

Updated 6/1/05

A proposal submitted to the

Virginia Marine Resources Commission

by

School of Marine Science
Virginia Institute of Marine Science
The College of William and Mary
Gloucester Point, Virginia 23062-1346

Data collection and analysis in support of single and multispecies stock assessments in Chesapeake Bay: the Chesapeake Bay multispecies monitoring and assessment program (ChesMMAP)

Principal Investigators:

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Dr. Robert J. Latour
Co-Principal Investigator

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Mr. Christopher F. Bonzek
Co-Principal Investigator

_____
Dr. John E. Olney
Chair, Department of Fisheries Science

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Jane A. Lopez
Director, Sponsored Programs

_____
Dr. Roger L. Mann
Director for Research and Advisory Services

December 15, 2007

A. Need:

Historically, fisheries management has been based on the results of single-species stock assessment models that focus on the interplay between exploitation level and sustainability. There currently exists a suite of standard and accepted analytical frameworks (e.g., virtual population analysis (VPA), biomass dynamic production modeling, delay difference models, etc.) for assessing the stocks, projecting future stock size, evaluating recovery schedules and rebuilding strategies for overfished stocks, setting allowable catches, and estimating exploitation rates. A variety of methods also exist to integrate the biological system and the fisheries resource system, thereby enabling the evaluation of alternative management strategies on stock status and fishery performance. These well-established approaches have specific data requirements involving biological (life history), fisheries-dependent, and fisheries-independent data (Table 1). From these, there are two classes of stock assessment or modeling approaches used in fisheries: partial assessment based solely on understanding the biology of a species, and full analytical assessment including both biological and fisheries data.

Table 1. Summary of biological, fisheries-dependent and fisheries-independent data requirements for single-species analytical stock assessment models.

Data Category	Assessment Type	Data Description
Biological / Life History	Partial	Growth (length / weight)
		Maturity schedule
		Fecundity
		Partial recruitment schedules
		Longevity
		Life history strategies (reproductive and behavioral)
Fishery-Dependent Data	Analytical	Catch, landings, and effort
		Biological characterization of the harvest (size, sex, age)
		Gear selectivity
		Discards/bycatch
Fishery-Independent Data	Analytical	Biological characterization of the population (size, sex, age)
		Mortality rates
		Estimates of annual juvenile recruitment

Although single-species assessment models are valuable and informative, a primary shortcoming is that they generally fail to consider the ecology of the species under management (e.g., habitat requirements, response to environmental change), ecological interactions (e.g., predation, competition), and technical interactions (e.g., discards, bycatch) (NMFS 1999, Link 2002a,b). However, inclusion of ecological processes into fisheries management plans is now strongly recommended (NMFS 1999, NRC 1999) and in some cases even mandated (NOAA 1996). Multispecies assessment models have been developed to move towards an ecosystem-based approach to fisheries management (Hollowed et al. 2000, Whipple et al. 2000, Link 2002a,b).

Although such models are still designed to yield information about sustainability, they are structured to do so by explicitly incorporating the effects of ecological processes among interacting populations.

Over the past several years, the number and type of multispecies models designed to provide insight about fisheries questions has grown significantly (Hollowed et al. 2000, Whipple et al. 2000). This growth has been fueled by the need to better inform fisheries policy makers and managers, however, recent concerns about effects of fishing on the structure of ecosystems have also prompted research activities on multispecies modeling and the predator-prey relationships that are implied. From a theoretical perspective, basing fisheries stock assessments on multispecies rather than single-species models certainly appears to be more appropriate, since multispecies approaches allow a greater number of the processes that govern population abundance to be modeled explicitly. However, this increase in realism leads to an increased number of model parameters, which in turn, creates the need for additional types of data.

In the Chesapeake Bay region, there has been a growing interest in ecosystem-based fisheries management, as evidenced by the recent development of fisheries steering groups (e.g., ASMFC multispecies committee), the convening of technical workshops (Miller et al. 1996; Houde et al. 1998), and the goals for ecosystem-based fisheries management set by the Chesapeake Bay 2000 (C2K) Agreement. In many respects, it can be argued that the ecosystem-based fisheries mandates inherent to the C2K Agreement constitute the driving force behind this growing awareness. The exact language of the C2K agreement, as it pertains to multispecies fisheries management, reads as follows:

1. By 2004, assess the effects of different population levels of filter feeders such as menhaden, oysters and clams on Bay water quality and habitat.

2. By 2005, develop ecosystem-based multispecies management plans for targeted species.

3. By 2007, revise and implement existing fisheries management plans to incorporate ecological, social and economic considerations, multispecies fisheries management and ecosystem approaches.

If either single-species or ecosystem-based management plans are to be developed, they must be based on sound stock assessments. In the Cheseapeake Bay region, however, the data needed to perform single and multispecies assessments is either partially available or nonexistent. The present proposal outlines a suite of field, laboratory, and data analysis activities designed to fulfill these data gaps and ultimately contribute toward the ongoing regional efforts to achieve sustainable fisheries management in Chesapeake Bay.

B. Previous Studies:

In the Chesapeake Bay region, several fisheries monitoring programs have been ongoing for decades. Some examples include the Maryland and Virginia striped bass young-of-year beach seine surveys, the Virginia Institute of Marine Science (VIMS) Juvenile Fish and Blue Crab Trawl Survey, the Maryland summer blue crab trawl survey, the bi-state blue crab dredge survey, and the adult striped bass tagging and monitoring studies. Without exception, however, each of these

surveys is either designed to capture juvenile fishes for purpose of estimating relative year-class strength, or describing population parameters for only a single species.

On a bay-specific spatial scale, formal stock assessments are routinely performed for only two species, namely, blue crab (*Callinectes sapidus*) and striped bass (*Morone saxitilis*). Despite a wealth of data, the assessment results for these species have historically been controversial, and in some instances, perceived to be nonsensical. Moreover, there are a number of exploited species in the bay for which no historic fishing mortality information is available (e.g., Atlantic croaker (*Micropogonias undulates*), summer flounder (*Paralichthys dentatus*), spot (*Leiostomus xanthurus*), weakfish (*Cynoscion regalis*)). Bay-specific assessments for these species have not been performed (in part) because of a lack of fisheries-independent data. That is, the previously mentioned monitoring programs do not provide information on relative abundance for the adult/harvested components of these stocks in the bay.

Despite the aforementioned interest in ecosystem-based management by the bay community and the goals set by the C2K Agreement, the data collected by the previously mentioned monitoring programs can only partially support multispecies modeling efforts. A key requirement for multispecies modeling is data on trophic interactions, yet none of these programs collect those data.

The Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP) trawl survey is designed to support bay-specific stock assessment activities at both a single and multispecies scale. While no single gear or monitoring program can collect all of the data necessary for both types of assessments, ChesMMAP was designed to fulfill the aforementioned data gaps by maximizing the biological and ecological data collected for several recreationally and commercially important species in the bay.

C. Present Studies:

Among the research agencies in the bay region, only VIMS has a research program focused on multispecies issues involving the adult/harvested components of the exploited fish species that utilize the Chesapeake Bay. The multispecies research program at VIMS is comprised of three main branches: field data collection (ChesMMAP and the VIMS Seagrass Trammel Net Survey), laboratory processing (The Chesapeake Trophic Interactions Laboratory Services - CTILS), and data analysis and multispecies modeling (The Fisheries Ecosystem Modeling and Assessment Program - FEMAP).

ChesMMAP is a relatively new monitoring program (initiated in 2002) that is prosecuted in direct support of single and multispecies modeling efforts. In general, ChesMMAP is a large-mesh bottom trawl survey designed to sample adult fish in Chesapeake Bay. This field program currently provides data on relative abundance, length, weight, sex ratio, maturity, age, and trophic interactions for several recreationally, commercially, and ecologically important fish species in Chesapeake Bay.

D. Accomplishments to Date:

The ChesMMAP trawl survey has conducted bimonthly research cruises from March to November each year since 2002 to account for the dramatic seasonal migration of fishes into and out of

Chesapeake Bay. During each cruise, approximately 80 sites are sampled in the mainstem of the bay. Sampling stations are chosen according to a stratified random design, where the strata are based on water depth within five 30 latitudinal minute regions, and the number of stations sampled in each stratum of each region is proportional to its area. Once onboard, the catch is sorted and measured by species or size-class if distinct classes within a particular species are evident. A subsample of each species or size-class is further processed for weight determination, stomach contents, aging, and macroscopic determination of sex and maturity stage.

To date, a total of 89 species have been collected. All fishes were identified, counted, and approximately 20% were processed for length, weight, girth, sex, and maturity determination: stomachs and appropriate aging structures were taken for later examination. Samples taken from managed species and those of particular interest were selected as the main priority for processing lab samples (Table 2).

Table 2. The number of specimens collected, measured and processed for age determination and diet composition information from ChesMMAP 2002 – 2007.

Year	Fish collected	Fish measured	Otoliths collected	Otoliths processed	Stomachs collected	Stomachs processed
2002	32,019	23,605	5,487	4,430	4,556	2,712
2003	30,924	20,828	3,913	2,934	3,250	2,236
2004	47,622	31,245	5,169	4,050	4,272	3,156
2005	45,204	36,909	6,065	4,694	5,066	3,195
2006	43,957	31,243	5,412	3,935	4,400	2,692
2007	30,893	22,124	4,274	In process	3,656	2,282

E. Objectives:

Goal

To collect and provide the data necessary to support single and multispecies stock assessment activities and ultimately the development of ecosystem-based fisheries management plans for Chesapeake Bay.

Objectives

1. To conduct ChesMMAP research cruises bimonthly from March to November 2008, sampling approximately 80 sites, distributed within the mainstem of Chesapeake Bay during each cruise.
2. To estimate the population level parameters necessary to conduct single and multispecies stock assessments. Those include (when appropriate), length-, and age-, structure, sex ratio, weight, maturity stage, and diet composition, for a variety of species (e.g., striped bass, weakfish, Atlantic croaker, spot, summer flounder, butterfish (*Peprilus triacanthus*), white perch (*Morone americana* – in the northern Chesapeake Bay), scup (*Stenotomus chrysops*), northern kingfish (*Menticirrhus saxatilis*), bluefish (*Pomatomus saltatrix*), and several elasmobranch species).

3. To serve as a sampling platform for other bay-related studies focused on, for example, fish disease, water quality, habitat mapping, etc.

F. Approach:

Job 1 – Conduct research cruises

In 2008, the ChesMMAP survey will conduct five research cruises (March, May, July, September, and November). During each cruise, approximately 80 stations will be sampled according to a stratified random design. Data collected during 2002-2007 is being used to assess the adequacy and appropriateness of the latitude and depth strata that were used in past sampling.

Each tow will be conducted using a 13.7m (headrope length) trawl net with 152mm stretch mesh in the wings and body and 76mm stretch mesh in the cod-end, for 20 minutes at approximately 3.5 knots, traveling in the same general direction of the current. Sampling locations will be selected randomly prior to each cruise and the order in which sites are sampled will be dependent on weather, tides, and other logistical considerations.

At each sampling site, the catch will be sorted by species and a subsample will be taken for full processing. The data collected from each subsampled specimen will include length, weight, and macroscopic sex and maturity stage determination. Stomachs will be removed and those containing prey items will preserved onboard for subsequent examination. Otoliths or other appropriate aging structures will also be removed from each subsampled specimen for age determination. All specimens not selected for the full processing will be enumerated, and either all or a representative subsample will be measured for length.

Job 2 – Synthesize data for single species analyses, develop species profiles

Single-species assessment models typically require information on (among others) age- and length-structure, sex ratio, growth (i.e., length-at-age, weight-at-length), and maturity stage. Quality control procedures will be implemented at the conclusion of each research cruise to ensure that the data collection was accurate and complete. These data will then be used to generate life history profiles that will serve as easily interpretable summaries of the salient biological and ecological characteristics of each species. A typical species summary would include information on abundance, age- and size-structure, growth (length-at-age, weight-at-length relationships), maturity, sex-ratios, and diet composition (derived from Job 3 below). When appropriate, these summaries will reflect data syntheses across a variety of spatial and temporal scales (e.g., by year, season, or region of the bay).

Job 3 – Quantify trophic interactions for multispecies analyses

In addition to the population-level information described under Task 2, multispecies assessment models require information on predator-prey interactions across broad seasonal and spatial scales. Accordingly, stomachs collected in the field will be processed following standard diet analysis procedures (Hyslop 1980). In general, these procedures involve identifying each prey item to the lowest possible taxonomic level. Several diet indices will be calculated to identify the main prey types for each species: %weight, %number, and %frequency-of-occurrence. These indices will be

coupled with the information generated from Task 2 and age-, length-, and sex-specific diet characterizations will be developed for each species. Efforts will also focus on characterizing spatial and temporal variability in these diets.

Job 4 – Estimate abundance

Time-series of relative abundance information can easily be generated from the basic catch data of a monitoring survey. For each species, a variety of relative abundance trends will be generated according to year, season, and location within the bay. Absolute abundance estimates can be generated for each species by combining relative abundance data with area swept and gear efficiency information. Area swept will be calculated for each tow by multiplying tow distance (provided by GPS equipment) by average net width (provided by net mensuration gear). Development of gear efficiency estimates will be explored by comparing the number of fish that encounter the gear (from the hydroacoustic data) with the fraction captured (from the catch data). To develop species-specific efficiency estimates, the hydroacoustic data will be partitioned according to the target strength distribution for each species. These distributions will be determined through ongoing cage experiments.

Job 5 – Investigate alternative management regulations for summer flounder and weakfish

Over the past several years, controversy has surrounded the status and therefore management of both summer flounder and weakfish stocks along the Atlantic coast. In the case of summer flounder, that Atlantic States Marine Fisheries Commission (ASMFC) declared that the stock was not overfished, but that overfishing is occurring (ASMFC 2006a). Trajectories of population abundance have increased in recent years, however, the overfishing status has necessitated consistent reductions in total allowable catch. Although the current status of the weakfish stock is presently unknown, the apparent lack of older/larger fish in the catches of fisheries-independent surveys has raised concern (ASMFC 2006b).

In theory, total yield and egg production from the population can be maximized through the proper combination of controls on size at first capture and exploitation rate. Yield-per-recruit (YPR) and egg-per-recruit (EPR) analyses are designed to evaluate the effects of various management scenarios (e.g., levels of fishing mortality) on the overall yield and egg production of a stock. Although the data from the ChesMMAP survey provide a wealth of basic life history information, it is important to recognize that these data can be used to support the aforementioned analyses. Therefore, both YPR and EPR analyses will be conducted for summer flounder and weakfish to determine whether the current management regulations (e.g, size limits, catch quotas, etc.) are appropriate to manage these fisheries. In addition, a variety of alternative management scenarios will be investigated.

G. ChesMMAP funding history

The ChesMMAP survey was initiated in 2002 and has been funded from a variety of sources over the years:

Federal ($1,927,000; 2002 - present): The ChesMMAP survey has been funded primarily by a combination of awards from NOAA Chesapeake Bay Office and VMRC Wallop-Breaux, with the proportion of NOAA funds steadily decreasing from 2002 - present. For calendar year 2007, approximately 80% of the survey costs came from Wallop-Breaux and 20% from NOAA. In June of 2007 we learned that NOAA would not provide funds for 2008. We will be seeking continued support for the survey and its related research objectives from Wallop-Breaux in 2008.

Private ($819,000; 2002 – 2005): The Virginia Environmental Endowment (VEE) provided significant funding to VIMS in support of multispecies fisheries research. The combined support of NOAA and VEE facilitated the initiation of the ChesMMAP survey.

State ($0; initiatives submitted 2006 – present): Over the past two years, VIMS has submitted funding initiatives to the Virginia Department of Planning and Budget to support fisheries-independent monitoring. Our request for fiscal year 2008-2009, which covers expenses for ChesMMAP and other surveys, was approximately $600,000.

H. Expected Results:

For the Commonwealth: Virginia is one of 15 member states of the ASMFC, which serves a deliberative body coordinating the conservation and management of shared nearshore fisheries resources. The best approach for member states to assure equitable distribution of fishery resources is to have reliable knowledge of the population dynamics of fishes within their state's boundaries. The ChesMMAP survey provides unique understanding of abundance, age- and size-structure, growth (length-at-age and weight-at-length relationships), maturity, sex ratio, and diet composition for 10 – 12 recreationally, commercially, and ecologically important species which would otherwise be unavailable. Annually, recreational and commercial fisheries contribute approximately $500 million to Virginia's economy; loss of programs that provide the requisite data for fisheries management in Virginia would jeopardize the future sustainability of fisheries resources and the economic benefits therein.

For recreational anglers in Virginia: The species life history documents are intended to provide anglers in Virginia with succinct and easily interpretable descriptions of the biological and ecological characteristics of highly important sportfishes. These documents will also provide valuable information to fisheries managers and stock assessment biologists in their quest to develop appropriate management regulations for recreationally and commercially important fishes in Chesapeake Bay and along the Atlantic coast. Lastly, the YPR and EPR analyses for summer flounder and weakfish have the potential to yield information about alternative management strategies, which if adopted, will benefit recreational anglers in Virginia by ensuring sustainable fisheries for these species.

I. Dissemination of Results:

Synthesized data in the form of species life history profiles (e.g., abundance, age- and length-structure, growth in the form of length-at-age and weight-at-length relationships, maturity, sex-ratios, and diet composition will be made available via the project web page (www.fisheries.vims.edu/chesmmap) and would be disseminated to the relevant management

agencies (VMRC, ASMFC, and MAFMC). If appropriate, these documents could also be made available on the RFAB website. Note that the species life history profiles will reflect data collected from 2002 through 2008. Manuscripts will be prepared for publication in peer-reviewed journals and oral presentations will be given at regional and national scientific meetings, public outreach programs, and local fishing clubs (e.g., the Peninsula Salt Water Sport Fisherman's Association).

J. Budget Justification

Requested funding by this proposal will be used to cover vessel costs (i.e., rental, fuel, and dockage) for five cruises and associated personnel and field supplies expenses. Funds for the ChesMMAP survey (and other VIMS monitoring programs) have been requested from the Virginia Department of Planning and Budget. We also anticipate submitting a proposal for the ChesMMAP survey to Wallop-Breaux in 2008. Please note that the deliverables of this project would be based on over $2,000,000 of already accrued research funds (data from 2002 – present).

K. References

ASMFC 2006a. Atlantic States Marine Fisheries Commission. 2006 Review of the Atlantic States Marine Fisheries Commission fisheries management plan for summer flounder (*Paralichthys dentatus*). ASMFC, Washington D.C.

ASMFC 2006b. Atlantic States Marine Fisheries Commission. 2006 Review of the Atlantic States Marine Fisheries Commission fisheries management plan for weakfish (*Cynoscion regalis*). ASMFC, Washington D.C.

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NOAA (National Oceanic and Atmospheric Administration). 1996. Magnuson-Stevens Fishery Management and Conservation Act amended through 11 October 1996. NOAA Technical Memorandum NMFS-F/SPO-23. U. S. Department of Commerce.

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L. Budget

ChesMMAP - 2008

	RFAB	VIMS	Project
Salaries	Request		Total

Senior Personnel			
C. F. Bonzek	$ 20,000		$ 20,000
R. J. Latour	$ 15,000		$ 15,000
Other Personnel			
J. Gartland, Marine Scientist - 12 months	$ 54,500		$ 54,500
E. Brasseur, Lab Spec 12 months	$ 33,500		$ 33,500
R. Johnson, Lab Spec - 12 months	$ 33,500		$ 33,500
M. Chattin, Lab Spec - 12 months	$ 33,500		$ 33,500
Graduate Student Workship	$ 6,000		$ 6,000
Fringe Benefits (35% Full Time Faculty & Staff 0% Workship)	$ 66,500		$ 66,500
Vessel - Bay Eagle			
Vessel Rental - (40 14-hour days @ $180/hour including usage & personnel costs); costs for mobilization & de-mobilization; smaller vessels as req'd	$ 100,800		$ 100,800
Supplies			
Field gear including nets, rope, food, containers, expendables	$ 30,002		$ 30,002
Fuel, vessels @ market prices	$ 20,000		$ 20,000
Travel			
Field Travel	$ 2,500		$ 2,500
Dockage during vessel/field activities	$ 300		$ 300
Total Direct	$ 416,102		$ 416,102
Facilities & Administrative Costs	$ 78,826	$ 63,059	$ 141,885
Total cost	$ 494,928	$ 63,059	$ 557,987

*Facilities and Administrative Costs:

F&A costs, 25% for funds provided by RFAB. Institutional approved rate is 45%. Unrecovered facilities and administrative costs are contributed as part of VIMS match for this project.