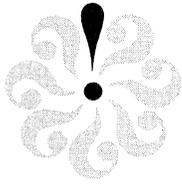


# VIRGINIA RECREATIONAL FISHING DEVELOPMENT FUND SUMMARY PROJECT APPLICATION\*

<p><b>NAME AND ADDRESS OF APPLICANT:</b></p> <p>Dr. Hongsheng Liao, Mr. Eric Robillard, and Drs. Cynthia M. Jones          Old Dominion University          800 W 46<sup>th</sup> St.          Norfolk, VA 23508</p>	<p><b>PROJECT LEADER:</b></p> <p>Dr. Hongsheng Liao, Mr. Eric Robillard, and Drs. Cynthia M. Jones</p>						
<p><b>PRIORITY AREA OF CONCERN:</b></p> <p>Research and Data Collection</p>	<p><b>PROJECT LOCATION:</b></p> <p>Center for Quantitative Fisheries Ecology          Old Dominion University          Norfolk, VA 23508</p>						
<p><b>DESCRIPTIVE TITLE OF PROJECT:</b></p> <p>Sheepshead Population Dynamics in Chesapeake Bay, Virginia</p>							
<p><b>PROJECT SUMMARY:</b></p> <p>Recreational catch of sheepshead in Virginia, estimated by MRFSS, has been increasing in recent years. This increase has made local communities such as CCA concerned on sheepshead population status as the fishery develops. However, little is known about the Chesapeake Bay population beyond minimal catch statistics. Moreover, the population of sheepshead in Chesapeake Bay may be a local stock governed by its unique vital rates. Therefore, specific data on population dynamics of sheepshead stock in Chesapeake Bay must be obtained to provide a scientific base for its management. We are proposing a three-year project to examine age composition, annual growth and mortality rates, and reproductive status of sheepshead in Chesapeake Bay, using this information to establish a baseline for stock assessment of this species in Chesapeake Bay. We present the first year's study here.</p>							
<p><b>EXPECTED BENEFITS:</b></p> <p><i>Fisheries management</i>          Population characters of sheepshead in Chesapeake Bay will be defined and reported to VMRC as basic information for conducting initial stock assessment and for making management policies.</p>							
<p><b>COSTS:</b>                      Year One</p>  <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="padding-right: 20px;"><b>VMRC Funding:</b></td> <td><b>64,545</b></td> </tr> <tr> <td><b>Recipient Funding:</b></td> <td><b>13,826</b></td> </tr> <tr> <td><b>Total Costs:</b></td> <td><b>78,371</b></td> </tr> </table> <p><b>Detailed budget must be included with proposal.</b></p>		<b>VMRC Funding:</b>	<b>64,545</b>	<b>Recipient Funding:</b>	<b>13,826</b>	<b>Total Costs:</b>	<b>78,371</b>
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<b>Recipient Funding:</b>	<b>13,826</b>						
<b>Total Costs:</b>	<b>78,371</b>						

Updated 11/18/02

\*This form alone does not constitute a complete application, see application instructions or contact Chad Boyce at 757-247-8155 or [cboyce@mrc.state.va.us](mailto:cboyce@mrc.state.va.us)



# Old Dominion University Research Foundation

June 1, 2005

Virginia Marine Resources Commission  
RFAB Grant Program  
2600 Washington Ave., Third Floor  
Newport News, VA 23607  
Attn: Chad Boye, Virginia Recreational Fishing Development Fund

Dear Mr. Boye:

Old Dominion University Research Foundation is pleased to submit its proposal entitled "Sheepshead Population Dynamics in Chesapeake Bay, Virginia." This proposal is submitted on behalf of the principal investigator Dr. Cynthia M. Jones, Center for Quantitative Fisheries Ecology, Old Dominion University.

Please note that if an award is made as a result of this proposal, it should be made payable to the Old Dominion University Research Foundation. The Research Foundation is the fiscal and administrative agent for Old Dominion University for sponsored agreements. The Foundation is a not-for-profit corporation, and it is tax exempt under Section 501 (c) (3) of the Internal Revenue Code.

We are pleased to forward this proposal for your review and consideration. Please address any questions of a technical nature to Dr. Jones at (757) 683-4497. Contractual questions should be addressed to Betsy Foushee, Pre-Award Services, at (757) 683-4293 ext 502.

Sincerely,

Audree S. Hughes  
Senior Grant and Contract Administrator

Enclosure: Original and 12 copies

ODU Research Foundation Prop. No. 05-502

Cc: C. Jones  
R. Zimmerman  
J. Rule

## **Sheepshead Population Dynamics in Chesapeake Bay, Virginia**

Proposal for consideration by the Virginia Recreational Fishing Advisory Board

Hongsheng Liao, Eric Robillard, and Cynthia M. Jones  
Center for Quantitative Fisheries Ecology  
Old Dominion University

### **Statement of Problem**

Recreational anglers have expressed interest in carefully developing a fishery for sheepshead (*Archosargu probatocephalus*) in Chesapeake Bay. Recreational catch of sheepshead in Virginia, estimated by Marine Recreational Fisheries Statistics Survey (MRFSS 2005), increased from 1,583 to 4,924 fish from 1999 to 2004 with a peak of 8,513 fish in 2003 (Figure 1). Although sheepshead is not a major fishery in Chesapeake Bay, this increase has raised concern on fish population status of this species as the fishery develops.

The Coastal Conservation Association (CCA) has been the first to express concern about overfishing on sheepshead population in Chesapeake Bay. They believe that information on population dynamics of sheepshead should be collected and provided to fishery management before any negative impact of overfishing occurs on sheepshead in Chesapeake Bay (Personal communication with CCA).

All the previous studies on sheepshead were done for fish from the South Atlantic Bight and Gulf of Mexico. Little is known about the Chesapeake Bay population beyond minimal catch statistics. Moreover, the population of sheepshead in Chesapeake Bay may be a local stock governed by its unique vital rates if it follows the structure found in the Gulf where fish exhibit subpopulation differences (Beckman et al. 1991; Matlock 1992; Render and Wilson 1992). Therefore, specific data on population dynamics of sheepshead stock in Chesapeake Bay must be obtained to provide a scientific base for its management.

### **Background**

Previous studies of sheepshead have been conducted mainly in Florida and states in Gulf of Mexico, providing general information about the species. Beckman et al. (1991) found that annual rings formed once a year and females had faster growth and reached larger maximum size than males in Louisiana waters. Render and Wilson (1992) also reported that sheepshead were 50% mature by age 2, and all males and females were mature over age 3 and 4, respectively in Louisiana. Although it is reported that sheepshead are relatively long-lived species and reach ages in excess of 20 years (Beckman et al. 1991), the oldest sheepshead in Georgia was 14 years based on otolith ageing (Music and Pafford 1984). Tremain (2004) reported that the movement of sheepshead only occurred between their spawning areas and surrounding waters in Florida. To date, there is no evidence that sheepshead migrate along the U. S. Atlantic coast. The best review of

sheepshead biological characteristics and population dynamics was found in stock assessment reports documented by Florida Fish and Wildlife Conservation Commission (Murphy and MacDonald 2000). They confirmed that sheepshead did not migrate along the U. S. Atlantic coast and that their maturity and growth rates could be different among the regions.

Historically, an increasing demand for a fish species resulted in increased of management regulations on the species, concomitant with its decline in abundance. For example, Texas Parks and Wildlife Department imposed more regulations on use of gears, size, bag, and possession limits on sheepshead in response to dramatically increased fishing pressure during 1980s (Matlock 1992). Recently, sheepshead are becoming a more important fishery along the U. S. Atlantic coast, which requires more information on regional or local stocks in order to establish fishery management strategies on a regional scope. Unlike Florida, which has done long-time thorough stock assessments of sheepshead due to its importance there, both Georgia and South Carolina have only begun their initial stages of sheepshead stock assessment (Sedberry 2002; Georgia DNR 2004). Both states have started either monitoring or stock assessment programs for sheepshead.

However, no thorough studies have been conducted and little is known about sheepshead in Chesapeake Bay, although there is a potential that sheepshead may become more popular. Miller et al. (1996) listed sheepshead as a benthivores and nonresident species without any natural reproduction in Chesapeake Bay. However, they lacked information on population dynamics, and further there is evidence to indicate reproduction in the Bay region. Sheepshead in North Carolina is the closest population to the one in Chesapeake Bay but knowledge is also limited there. For example, Schwartz (1990) was only able to use scales to age fish up to eight years and did not provide any information on older fish age composition in North Carolina. The Virginia Game Fish Tagging Program has trained anglers to tag a variety of fish species, including sheepshead. So far, the tagging program has not collected sufficient information to further our knowledge of sheepshead. For example, they had only one recapture each year of tagged sheepshead in 2000, 2001, and 2002, respectively (Lucy and Bain 2002). To effectively manage this species, fisheries managers must first obtain detailed scientific information to identify the Chesapeake Bay sheepshead as a separate stock, to understand population dynamics of the stock, and then to conduct stock assessment for sheepshead fishery management.

Fish population characters such as age composition, growth and mortality rates; and reproduction status are primary information for recognition of putative stocks at the practical fisheries management level (Ihssen et al. 1981; Cadrin et al. 2005). Moreover, such data are necessary in a variety of stock assessment models such as ADAPT, FAST, MUTIFAN, which are used by fisheries scientists to establish effective management strategies. For example, the Atlantic States Marine Fisheries Commission (ASMFC) has been using ADAPT to conduct stock assessment of Atlantic striped bass (*Morone saxatilis*) for many years, providing fisheries managers with population dynamics information of this species. The population of this species has recovered from near depletion during 1980s, and which is considered as one of the most successful examples

of fisheries management (Richards and Rago 1999). Therefore, collecting high quality information on age composition, growth and mortality rates, and reproduction status is the first and critical step to identify a fish stock and further to conduct assessment of the stock, especially a near-virgin stock.

### **Significance**

By definition, a virgin stock is an unexploited standing stock (Gulland 1971), naturally regulated by density-dependent processes and characterized by a high proportion of old fish, slow individual growth rates, and low total mortality rates (Van den Avyle and Hayward 1999). Two signs may indicate that sheepshead in Chesapeake Bay is most likely to be very close to a virgin stock. First, exploitation in Chesapeake Bay is very low compared to other Atlantic regions. For example, the inland recreational catch are 1980 ( $\pm 1,980$  SE) and 3,854 ( $\pm 2,008$  SE) fish in Maryland and Virginia in 2004, respectively, whereas the recreational catch are 70,604 ( $\pm 13,626$  SE), 125,790 ( $\pm 30,441$  SE), 143,422 ( $\pm 31,840$  SE), and 2,986,156 ( $\pm 155,280$  SE) fish in North Carolina, South Carolina, Georgia, and Florida in 2004, respectively (MRFSS 2005). Second, fishermen have been continuously reporting that they catch much larger sheepshead in Chesapeake Bay than other Atlantic regions. So either sheepshead grow larger here than elsewhere, or mortality is so low that fish get much older and larger here.

It is very unusual to find a near-virgin stock in Maryland and Virginia in 2004, and it is also unusual for stakeholders to request study of a fish stock before it is fully exploited--such as sheepshead stock in Chesapeake Bay. Taking this opportunity, we will be able to estimate an approximate natural mortality, and monitor and examine the response of sheepshead stock as fishing pressure increases in Chesapeake Bay. The information from the project will benefit Virginia recreational anglers as follows.

- 1) Theoretically, when a stock is open to exploitation for a certain time, population characteristics start to change. For example, age composition may shift from a majority of older fish to younger fish and individual growth rates may increase. By modeling the sheepshead population in Chesapeake Bay, we may examine and test a variety of theories for its management.
- 2) This study will also contribute biological, ecological, and conservation knowledge on sheepshead in a broad geographical range. It has been reported that sheepshead are widespread from Nova Scotia to Brazil (Robins and Ray 1986). However, we have not found any studies on sheepshead population north of North Carolina. Knowledge of this species in Virginia will provide information to conservation of this species and especially on the potential of connectivity between stocks.
- 3) Parameters for population dynamics of a fish stock could vary among years dramatically. Therefore, one of challenges in fisheries management is to answer questions about how those parameters vary over time and how these temporal variations could impact stock sizes and fishing (Walters and Martell 2004). Moreover, estimating reproduction parameters is based on locating females that are in a fecund state. Because

sheepshead spawning season is unknown in the Chesapeake Bay and also because the fecund state may last a very short period of time (hours), we need a great amount of sampling effort to collect these specimens. Even with the help of recreational and commercial samples, we need more than one spawning season to collect these fish. Therefore, we are proposing a three-year study in order to provide reliable information of temporal variations on age composition, growth and mortality rates, and reproduction status of sheepshead in the bay. Such information will provide fisheries managers with a basic knowledge of the sheepshead population dynamics and help them to decide what kinds of management strategies should be taken in the future.

## **Objectives**

This study would be the first to evaluate sheepshead population dynamics in the Chesapeake Bay and determine whether there is evidence that it is a separate stock, governed by its own vital rates, separate from other Atlantic regions and to establish a baseline for stock assessment of this species in Chesapeake Bay. Our specific objectives are to: 1) examine age composition of the sheepshead population; 2) estimate their annual growth rates; 3) estimate annual mortality rates; and 4) evaluate their reproductive status in Chesapeake Bay. With the information above, we will be able to evaluate sheepshead management in the region to enhance recreational angling experiences.

## **Hypotheses:**

H0<sub>1</sub>: Age composition of sheepshead in the Chesapeake Bay population is the same as for the South Atlantic Bight (SAB).

Ha<sub>1</sub>: Chesapeake Bay population is composed of older fish (Indicating migration or a distinct stock).

H0<sub>2</sub>: Size-at-age is the same for sheepshead in the Chesapeake Bay and SAB

Ha<sub>2</sub>: Chesapeake Bay and SAB sheepshead grow at different rates (Indicates a distinct stock).

H0<sub>3</sub>: Mortality is the same for sheepshead in the Chesapeake Bay and SAB

Ha<sub>3</sub>: Mortality rates differ from the Chesapeake Bay and SAB

H0<sub>4</sub>: Sheepshead reproduction occurs in the Chesapeake Bay and the batch fecundity at size at age is the same from SAB.

Ha<sub>4</sub>: Chesapeake Bay sheepshead has different batch fecundity at size age compared with the SAB (Indicates a distinct stock),

## **Methods**

### *Field work*

Over the past four years, sheepshead has been predominantly caught by recreational anglers in the Chesapeake Bay with over sixty percent of landings made by anglers

(MRFSS 2005). Moreover, fish size varies spatially and between the recreational and commercial fisheries. To obtain a complete range of sizes, it will be necessary to sample sheepshead from both fisheries sectors. We anticipate that anglers will provide some of the samples needed for age and fecundity estimates, but this may have to be augmented by fishery-cooperative or fishery-independent sampling if gonads can't be obtained in "fresh" condition. Commercial sampling will provide a broader range of sizes to determine age composition than can be obtained solely from angling. If "fresh" gonads cannot be obtained from either fishery in sufficient numbers, then we will undertake fishery-independent sampling.

#### Recreational sampling:

With the help of the CCA, we will ask anglers to sample sheepshead, preserve them on ice, and notify us to collect fish from them. We anticipate that this will allow us to collect most of the reproductive organs we will need for fecundity estimates. If insufficient numbers of fish are collected by volunteers, then we will augment samples to reach the target of thirty fish bi-weekly. If the fish show signs of reproduction, we will sample more heavily during that period of time.

#### Commercial sampling

Sheepshead are caught commercially in pound nets. Pound nets are known not to be size selective. This will allow us to collect samples that represent the age and size composition of the population. We will use the help of the Virginia Marine Resources Commission (VMRC), which samples the commercial sector daily. VMRC employees will contact us anytime they intercept sheepshead. We will measure all the sheepshead we encounter, and we will then sub-sample randomly the commercial fish catch by purchasing boxes of fish (50 lbs. Box).

#### Fishery Independent Sampling

If the number of samples is insufficient from the commercial and recreational sector, charter boats will be used to collect sheepshead. Any charter boat captains with experience fishing for sheepshead will be contacted randomly for a full day of fishing on the Bay. This will supplement the number of samples needed for this study.

#### *Lab work*

Once fish are collected they will be brought to the Center for Quantitative Fisheries Ecology (CQFE) at Old Dominion University (ODU) where they will be measured, weighed and the otoliths and gonads will be removed.

#### Otolith processing:

We will use a "bake and thin-section" technique to process sheepshead otoliths for age determination developed by the CQFE. The otolith will be secured to a microscope slide, and sectioned on a Buehler Isomet saw equipped with two Norton diamond wafering blades separated by a 0.4 mm stainless steel spacer, positioned so that the wafering blades straddles the focus. The otolith section will be placed into a ceramic "Coors" spot plate well and baked in a Thermolyne 1400 furnace at 400°C. Baking time will be dependent

on otolith size and gauged by color, with a light caramel color desired. The baked thin-section will be placed on a labeled glass slide and covered with a thin layer of Flo-texx mounting medium.

#### Gonad processing:

Histological sections of ovaries will follow the methods of Wells (1994) who examined the effect of different preservatives on the ability to discriminate amongst several different cellular structures. He found that preservation of ovaries in buffered formalin (5% vol:vol) minimally affected the ability of standard staining techniques, hematoxylin and eosin (H&E) to resolve intra-ovarian structures associated with spawning. Therefore in this study, ovaries will be preserved in formalin and histological sections will be stained with H&E for fecundity estimation. Each ovary will be cut in half and three replicate 1 cm<sup>3</sup> ovarian samples will be taken from each female, making sure that samples are taken from the tunica to the lumen to assure representative parts of gonadal material are sampled.

#### *Data Analysis*

#### Age determination:

Otoliths are read under a microscope using polarized light and an image analysis system. Procedures to establish quality assurance and reliability of age readings are incorporated into our laboratory protocols. We measure precision between age readings done by all readers so that we have consistency. Otoliths are read double-blind (with no knowledge of time or place of capture, or length of fish). A randomly selected subsample is read twice by the same reader and by another reader to test consistency among and between readers (Campana et al. 1995, DeVries and Frie 1996). We use a symmetry test (Bowker 1948) to measure precision and to observe tendencies to over- or underestimate age. Because it is also important to maintain consistency in age readings between years, we insert a sample of hard parts read in prior years among currently collected samples following double-blind procedures to test year-to-year consistency in ageing (Campana et al. 1995). We test for potential differences with repeated-measures ANOVA. Such vigilance keeps our age readings consistent and reliable from year to year.

#### Age composition and growth:

To evaluate growth, observed length-at-age data will be fitted to a von Bertalanffy Growth function (Ricker 1975), by non-linear least square regression (S-PLUS 1999):

$$L_t = L_{inf}(1 - e^{-k(t-t_0)}),$$

- L<sub>t</sub> = length at time t
- L<sub>inf</sub> = asymptotic mean length
- t = time
- t<sub>0</sub> = theoretical age at 0 length
- K = growth coefficient (instantaneous rate).

Likelihood ratio tests (Kimura 1980, Cerrato 1990) will be used to determine if differences exist between von Bertalanffy parameter estimates between sexes and years for mean fork length-at-age data:

$$\chi_k^2 = -N * \ln\left(\frac{RSS_{\Omega}}{RSS_w}\right)$$

Where k is the degrees of freedom (equals the number of constraints placed upon the fit), N is the total number of age groups from both curves combined,  $RSS_{\Omega}$  is the total sum of squared residuals derived from fitting both curves separately and  $RSS_w$  is the total sum of squared residuals derived from fitting the curves with one hypothesized constraints i.e.  $L_{inf}$  are the same,  $t_0$  are the same etc...

To determining the age distribution of the sheepshead population in the bay, we will use the large sample of fish we measured and the ages of the sub-samples and construct an age-length key. We can use the key to convert catch-at-size data into catch-at-age data. The keys specify the probability that fish of a given size belong to one of several age groups.

#### Mortality:

We will use the catch curve analysis to estimate the instantaneous rate of mortality. For this method, we simply plot the logarithms of frequency of occurrence against age. This results in a curve which has a steeply ascending left limb, a dome-shaped upper portion, and a long, descending right limb which is nearly straight. Assuming that fish increase in size by a constant amount from year to year, the slope of the right limb is equal to the negative of instantaneous total mortality (-Z). To estimate natural mortality, we will use two methods based on the longevity of sheepshead in the bay both described by Hewitt and Hoenig (2005). The first is based on a linear regression model (Hoenig 1983). He recommends using the predictive equation:

$$\ln(\hat{M}) = 1.44 - 0.982 * \ln(t_{max})$$

Where  $\hat{M}$  is estimate of natural mortality, and  $t_{max}$  is the maximum age observed.

The second method to estimate natural mortality consists of determining the value of M such that 100(P)% of the animals in the stock survive to the age  $t_{max}$  such that:

$$\hat{M} = \frac{-\ln(P)}{t_{max}}$$

These two methods have been used extensively in work related to stock assessment for blue crab (*Callinectes sapidus*) (Hewitt and Hoenig 2005).

#### Reproduction Status:

It is straightforward to determine whether a fish is a batch or total spawner using histological samples of the gonads. Batch spawners show several developmental stages of oocytes at any given time. In the simplest case all developmental stages (excluding hydrated oocytes) of oocytes are present within one ovary. Similarly, group synchronous spawners would all have at least two distinct stages occurring simultaneously while asynchronous development is characterized by oocytes representing all stages of development and constant oocyte recruitment. The reproductive biology of Sheepshead was studied in the Gulf of Mexico (Render and Wilson 1992). The authors demonstrated that sheepshead in the Gulf of Mexico are batch spawners. We anticipate that Sheepshead in the Chesapeake Bay follow this pattern. If so, we must estimate both batch fecundity throughout the season and estimate the number of batches in a season.

Batch fecundity can be defined as the number of ripened oocytes in the ovary immediately prior to spawning (Bagenal 1978). Two methods will be used to estimate fecundity. For hydrated specimens, the hydrated oocyte method will be used (Hunter et al. 1985). In this method, a sub-sample of the gonad is weighed to the nearest 0.1mg. The number of hydrated oocytes is counted and the projection of batch fecundity is calculated by the product of the hydrated count and the weight of the gonads for both lobes. For specimens that are fully matured but not hydrated, an oocyte size-frequency distribution method will be employed (MacGregor 1957, Hunter et al. 1985). With this method the most advanced modal group of oocytes size classes is determined visually by constructing a size-frequency distribution of the oocytes. The total number of oocytes that constitute the most advanced mode is assumed the spawning batch. This method yields similar results as the hydrated method if highly advanced oocytes are used (Hunter and Goldberg 1980; Laroche and Richardson 1980). Typically, determining the number of batches in a season is difficult. However, by sampling frequently over the course of the spawning season we can estimate the number of batches by examining the proportion of the population with post-ovulatory follicles present (evidence of recent spawning). The inverse of this proportion gives the average time between batches. For example, if 30% of the population has post-ovulatory follicles then the average interval between batches is 3 days. Thus, we can estimate the age-specific, batch fecundity and by summing over the spawning season and we can determine total fecundity for the population using characteristics from the sampled population.

## **Expected Results**

### *Fisheries management*

Population characteristics of sheepshead in Chesapeake Bay will be defined and reported to VMRC as basic information for conducting future stock assessment and for making management policies.

## **Timeline**

### *Year 2005*

#### June to August

1. Search and hire a master's student.
2. Finalize logistics with volunteer fishing groups like Virginia CCA for collecting sheepshead.
3. Contact commercial fishers in Virginia to arrange the purchase of complete size range of harvested sheepshead.
4. Start to collect fish samples and process them.

#### September to December

Train the master student on field and lab techniques, including fish collecting and processing, sample preserving, otolith processing and reading, and histological analysis.

### *Year 2006*

#### January to August

1. Continue bi-weekly sampling to collect commercially harvested fish.
2. Continue to receive samples from recreational anglers.
3. Process ovary samples for batch fecundity estimation and histological preparation.
4. Process Sheepshead otoliths for age and growth analysis.
5. Ovarian samples are sent for histological preparation (first determinations of reproductive strategy).

#### September to December

1. Ageing using otoliths.
2. Preliminary fecundity estimates for sheepshead in the Chesapeake Bay.
3. Create a yield per recruit model to determine biological reference points and report the findings to the VMRC and the Recreational Board.

### *Year 2007*

#### January to August

1. Continue bi-weekly sampling to collect commercially harvested fish.
2. Continue to receive samples from recreational anglers.
3. Process ovary samples for batch fecundity estimation and histological preparation.
4. Process Sheepshead otoliths for age and growth analysis.
5. Ovarian samples are sent for histological preparation (first determinations of reproductive strategy).

#### September to December

1. Ageing using otoliths.
2. Preliminary fecundity estimates for sheepshead in the Chesapeake Bay.

3. Create a yield per recruit model to determine biological reference points and report the findings to the VMRC and the Recreational Board, and to CCA and anglers clubs as requested.

*Year 2008*

January to June

1. Final data analysis
2. Prepare the final project report to the VMRC and the recreational Board.
3. Prepare two manuscripts.

July to August

1. Submit the final project report.
2. Submit one of the manuscripts for peer review.

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## **Laboratory Facilities**

In September 1997, the VMRC established The Age & Growth Laboratory at the CQFE at ODU to provide routine ageing of Virginia's marine finfish catch. The laboratory provides VMRC with the fundamental demographic data necessary for management. It is the mandate of this laboratory to help ensure Virginia's fish stocks remain a viable resource for future generations. To safeguard this resource, the Age & Growth Laboratory has established criteria that not only best suits the individual species, but also is consistent with other ageing facilities to allow for a coast-wide data exchange. Currently the lab is responsible for ageing 14 species of marine finfish. Bony structures presently being used to age fish include otoliths, scales, and opercula. However, we are examining additional hard (bony) structures, including pectoral fin rays, dorsal spines, anal spines, pelvic spines and vertebrae, for use as alternative ageing structures.

**Budget for Year One**

	<b>VMRC</b>	<b>ODU</b>	
<b>PERSONEL:</b>			
Salary of Jones (1 month)	10,448		
Graduate Student	20,000		
Faculty Release Time (Dr. Jones)		10,449	
Fringe Benefits	<u>4,413</u>	<u>3,377</u>	
	<u>\$34,861</u>	<u>\$13,826</u>	
<b>GENERAL EXPENSES:</b>			
Travel/Sample collection	8,320		
Supplies for otoliths processing	955		
	<u>\$9,275</u>		
<b>SUBCONTRACT EXPENSES:</b>			
Reproductive histology	<u>\$7,500</u>		
<b>TOTAL DIRECT COSTS</b>	<b>51,636</b>	<b>13,826</b>	
<b>INDIRECT COSTS</b>	<u><b>12,909</b></u>		
<b>TOTAL SPONSOR COST</b>	<u><b>\$64,545</b></u>	<u><b>\$13,826</b></u>	<b>18% match</b>
<b>TOTAL PROJECT COSTS</b>			<u><b>\$78,371</b></u>

## **Budget justification**

Personnel costs: We have found that for a project such as this one, that a graduate student is more cost-effective than a technician. Because the students use the project as part of their thesis, they are able to provide more commitment to the project's success. The student will collect samples, process them, and conduct data analysis. Dr. Liao and Dr. Jones will oversee the project, coordinate sample collections, and assist data analysis. Dr. Jones will be providing her expertise with population dynamics and statistical issues, is requesting one month direct payment for each year, and also is using a portion of her salary as matching funds. The matching part of her salary will be to train and guide the graduate student to perform this project and help the student to write up results.

We will subcontract the Tidewater Technical to prepare histological sections for reproductive status analysis. We have had a subcontract with this company before on a previous project. The cost is \$15 per slide. We are planning to hire charter boats to collect fish samples for us when sample sizes are insufficient from both recreational and commercial fisheries.

Travel costs consist of sample collections: We estimate traveling 3950 miles per year around Chesapeake Bay to collect samples from recreational and commercial fisheries with a mileage compensation of \$0.41 per mile. The remainder of funds goes to sample collection, processing supplies, and information exchange with local communities and organizations, such as fish clubs.

We present the year one budget here. We anticipate that year two and three will be the same. Based on our experience conducting such studies, we anticipate that we will need three years of collections to obtain fully representative samples of sheepshead and, thus to obtain stable parameter estimates of the population's characteristics. One of the difficulties that we anticipate is in obtaining enough spawning and near-spawning gonads to make estimates of fecundity at age and spawning stock characteristics.

**Figure 1**

Annual total recreational catch of sheepshead (MRFSS: A+B1+B2, all modes and areas combined) in Virginia from 1999 to 2004. Catch is in number of fish. The vertical bar is standard error. The total catch gradually increased from 1999 to 2004 with a peak in 2003.

