VIRGINIA RECREATIONAL FISHING DEVELOPMENT FUND
SUMMARY PROJECT APPLICATION*

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NAME AND ADDRESS OF APPLICANT:	PROJECT LEADER (name, phone, e-mail):
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PRIORITY AREA OF CONCERN:	**PROJECT LOCATION:**
Juvenile Game Fish Mortality	James, York, Pamunkey, Mattaponi, and Rappahannock Rivers

DESCRIPTIVE TITLE OF PROJECT:

Effects of Piscivorous Fishes on Local Juvenile Game Fish Populations

PROJECT SUMMARY:

A better understanding of the predator/prey dynamics of the upper estuaries is needed to help managers predict future game fish stocks. It is possible for a population of piscivorous fishes to have a negative impact upon the recreationally important juveniles utilizing the nursery grounds. The objective of this study is to determine the food habits of the piscivorous fishes within the upper estuary and examine their effects upon local game fish juvenile populations. Multi-mesh gillnets will be deployed throughout the upper estuaries of Virginia's rivers to collect the piscivorous predators. The predators' stomach contents will be analyzed and the degree of predation upon juvenile game fish will be assessed.

EXPECTED BENEFITS:

The effective management of any species requires a thorough understanding of its predator/prey interactions. This study will allow managers and scientists a better estimate of the natural mortality of game fish due to mortality related to piscivory in Virginia's estuaries. Data from this experiment may be incorporated into multi-species stock assessment analysis and enable managers to have a better estimate of local game fish populations. This will ensure populations of local game fish to remain at sufficient levels in order to be fished sustainably.

COSTS:

VMRC Funding:	$45,530
Recipient Funding:	15,349
Total Costs:	**$60,879**

Detailed budget must be included with proposal.

Updated 6/1/05

***This form alone does not constitute a complete application, see application instructions or contact Sonya Davis at 757-247-8155 or sonya.davis@mrc.virginia.gov : Due dates are June 15 (Jul. – Nov. Cycle) and December 15 (Jan. – May Cycle)**

PROPOSAL SUBMITTED TO

VIRGINIA RECREATIONAL FISHING DEVELOPMENT FUND

BY THE VIRGINIA INSTITUTE OF MARINE SCIENCE
OF THE COLLEGE OF WILLIAM AND MARY

EFFECTS OF PISCIVOROUS FISHES ON LOCAL JUVENILE GAME FISH POPULATIONS

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Need

Estuaries are important juvenile rearing habitats for many recreational species. Anadromous fishes, like striped bass and American shad, use the tributaries and upper estuaries to spawn and their juveniles continue to reside there growing large enough to lower the predation in the ocean or Chesapeake Bay. The larvae of shelf spawning species, such as Atlantic croaker and spot, move into Chesapeake Bay and up the rivers where their juvenile stage can grow in a more protected setting. The juvenile stage has been theorized to be one of the most critical stages in a fish's life (Hjort 1914, Cushing 1975). Juveniles must find enough food in order to quickly outgrow their predators. The upper estuaries provide abundant prey for the juveniles with a relatively small number of predators. However, this important rearing habitat is not completely devoid of predators; a small suite of piscivorous predators feed in the same area the juveniles utilize to grow.

The Virginia Institute of Marine Science's juvenile trawl survey and striped bass seine survey routinely catch the juveniles of many important recreational species in the upper estuaries of Virginia (Figures 1 and 2; Montane and Fabrizio 2006). Striped bass, American shad, and other anadromous species are caught during the late spring and summer months in all of the major rivers (Austin et al. 2006). The larvae of shelf spawning species, such as weakfish, croaker, and spot, move up the rivers to spend their juvenile life within the protected estuary (Able and Fahay 1998). The juvenile stage of many of the recreationally caught fishes depends upon the upper rivers to provide them with nourishment and protection. However, a few large predators, such as adult striped bass, largemouth bass, channel catfish, blue catfish, juvenile bluefish, and longnose gar, are associated with these juvenile nursery grounds and have the ability to consume great quantities of these young fishes.

The predator prey dynamics of the upper estuaries is important to understand because of the impacts the predators could have on recreationally important species during a crucial stage in their lives. Populations can fluctuate due to the relative density of their predators. This is especially true during the

juvenile stages of a fish's life. In order to understand these fluctuations in predator and prey abundance, fisheries researchers and managers are developing multi-species management plans for commercially and recreationally important species. A multi-species stock assessment does not just utilize population data of the species in question, but incorporates the population data of its prey and predators. The population data is combined with data on the trophic interactions to produce a model more realistic to real life. In order to obtain these trophic interactions a comprehensive diet analysis must be completed.

Diet analyses must incorporate the spatial and temporal variability of a system. It has been demonstrated that a striped bass diet changes based on the location in which it resides. Striped bass in the ocean often feed upon menhaden, while striped bass in sea grass beds often feed upon blue crabs (Parthree et al. 2006). Trophic interactions can change temporally as well due to the densities of prey items changing throughout the year. It is important to understand how these trophic interactions change by river system and over the course of a year. Presently, fishery managers lack diet data from the large predators of the upper estuarine systems. The upper estuarine food chain has been overlooked and it must be understood for the benefit of multi-species models that will be produced to regulate our fisheries. This project aims to examine the diets of the piscivorous predators in all of the major rivers in Virginia over the course of a year. The work will spatially and temporally cover the juvenile nursery grounds to examine the sources of mortality for the popular sport fishes.

Objective

A better understanding of the predator/prey dynamics of the upper estuaries is needed to help managers predict future game fish stocks. It is possible for a population of piscivorous fishes to have a negative impact upon the recreationally important juveniles utilizing the nursery grounds. It has been theorized that these nursery areas provide protection from these predators, but

formal studies within Virginia's estuaries are lacking. The objective of this study is to determine the food habits of piscivorous fishes within the upper estuary and examine their effects upon local game fish juvenile populations.

Expected Results

The effective management of any species requires a thorough understanding of its predator/prey interactions. This study will allow managers and scientists a better estimate of the natural mortality of game fish due to mortality related to piscivory in Virginia's estuaries. Data from this experiment may be incorporated into multi-species stock assessment analysis and enable managers to have a better estimate of local game fish populations. This will ensure populations of local game fish to remain at sufficient levels in order to be fished sustainably.

Approach

Field procedures

We intend to use multi-mesh gillnets within the James, Pamunkey, Mattaponi, York, and Rappahannock Rivers to obtain representative samples of the piscivorous fish populations in each river. Gillnets utilized in this survey will randomly be deployed in the oligohaline and tidal freshwater reaches in the three main river systems in order to characterize the diet of piscivorous fishes residing on the upper estuarine nursery grounds. This project will focus on the York River system (which includes the Pamunkey and Mattaponi Rivers) by setting gill nets twice a month in a stratified random design. Gillnetting will begin in June 2007 and end in November 2007 when water temperatures cool down and fish movements decline. Gillnetting will resume in March and continue through to the end of May 2008. The York River system will be broken up into nine seven-mile zones from river-mile 21 to river-mile 56 (on both the Pamunkey and the Mattaponi) (Figure 3). Each zone will also be subdivided into seven one-mile sections and during each sampling period one section will be randomly selected to sample from each zone. A sampling period will consist of three consecutive

days in which three zones are sampled per day with a 270 foot multi-mesh monofilament gillnet (9 (30' x 10') panels; 3", 3 ¾", 4 ½", 5 ¼", 6", 6 ½", 7", 8", 9" mesh sizes) that will be fished for six hours.

The James and Rappahannock Rivers will also be sampled seasonally to compare diet between the three major river systems. Both rivers will be sampled during June, August, and October in 2007 and March and May in 2008. The rivers will be divided into three seven-mile zones from river-mile 35 to river-mile 56 (Figure 4 and 5). Each zone will also be subdivided into seven one-mile sections and during each sampling period one section will be randomly selected to sample. Each zone will be sampled with a 270 foot multi-mesh monofilament gillnet for six hours.

The same procedures for recording environmental parameters and handling fish captured within the gillnets will be used in all of the rivers. Air temperature, water temperature, salinity, and dissolved oxygen will be recorded directly before retrieval of the gillnet. All fishes will be enumerated, measured, and have the mesh size of capture recorded. Piscivorous fish will also have their weight recorded, stomachs removed (preserved in 70% ethanol), and eviscerated weight recorded.

Laboratory and Statistical Analyses

Stomach contents will be removed, identified to the lowest discernable taxon, lengths measured (whole prey items only), and weighed by taxon. Mean percent number (M%N), mean percent weight (M%W), percent abundance (%N) and percent weight (%W) will be calculated for the prey items of each piscivorous fish (Cortes 1997; Graham et al. 2006). Mean percent number and mean percent weight are measures used to assess the overall diet composition for each piscivorous species. These two measures utilize each stomach as an individual sampling unit, which makes them less biased than other prey indices and allows for computation of confidence intervals. Percent abundance and percent number are used to estimate the impact a predator has on its prey populations. Stomach fullness will also be analyzed with the Index of Relative

Fullness (IRF) which is the ratio of the weight of the stomach contents and the total evicerated weight of the fish multiplied by 100 (Hyslop 1980).

Multiple Analysis of Variance (MANOVA) will be utilized to test for differences by location, fish size, and month for %N, %W, and the IRF data if the assumption of normality and homogeneity of variance is not violated. Data will be either transformed or non-parametric tests utilized if the assumptions are violated. The data collected from the gillnet surveys will also provide fishery-independent CPUEs and length frequencies per location and month. This will allow description of where piscivorous fishes are located and their relation to exploited species nursery grounds. CPUEs will also be compared between rivers with a one-way ANOVA for the months where sampling occurs in each river.

Literature Cited

Able, K. W., M. P. Fahay. 1998. The First Year in the Life of Estuarine Fishes in the Middle Atlantic Bight. Rutgers University Press, New Brunswick, NJ.

Austin, H. M., A. H. Hewitt, J. K. Ellis, and M. C. Fabrizio. 2006. Estimation of juvenile striped bass relative abundance in the Virginia portion of Chesapeake Bay, January 2005-December 2005. Annual Progress Report to Virginia Marine Resources Commission, 31 p.

Cortes, E. 1997. A critical review of methods of studying fish feeding based on analysis of stomach contents: Application to elasmobranch fishes. Canadian Journal of Fisheries and Aquatic Sciences 54(3):726-738.

Cushing, D. H. 1975. "Marine Ecology and Fisheries". Cambridge University Press, Cambridge.

Graham, B. S., D. Grubbs, K. Holland, and B. Popp. 2006. A rapid ontogenetic shift in the diet of juvenile yellowfin tuna from Hawaii. Marine Biology DOI 10.1007/s00227-006-0360-y

Hjort, J. 1914. Fluctuations in the great fisheries of northern Europe. Rapp. P.-v. Cons. Perm. Int. Explor. Mer 20: 1-228.

Hyslop, E. J. 1980. Stomach contents analysis - A review of methods and their application. Journal of Fish Biology 17(4):411-429.

Montane, M. M. and M. C. Fabrizio. 2006. Estimating relative abundance of recreationally important finfish and crustaceans in the Virginia portion of Chesapeake Bay, Project # RF 05-15, June 2005-May 2006. Annual report to the Virginia Marine Resources Commission Marine Recreational Fishing Advisory Board. Virginia Institute of Marine Science, Gloucester Point, VA. 125 pp.

Parthree, D. J., C. F. Bonzek and R. J. Latour. 2006. Chesapeake Bay Trophic Interactions Laboratory Services, June 2003-June 2006, Project RF 05-12. Final report to Virginia Marine Resources Commission Marine Recreational Fishing Advisory Board. Virginia Institute of Marine Science, Gloucester Point, VA. 22 pp.

Figure 1. Weakfish, spot, and striped bass juvenile distributions as reported by the VIMS juvenile fish and blue crab trawl survey (Montane and Fabrizio 2006).

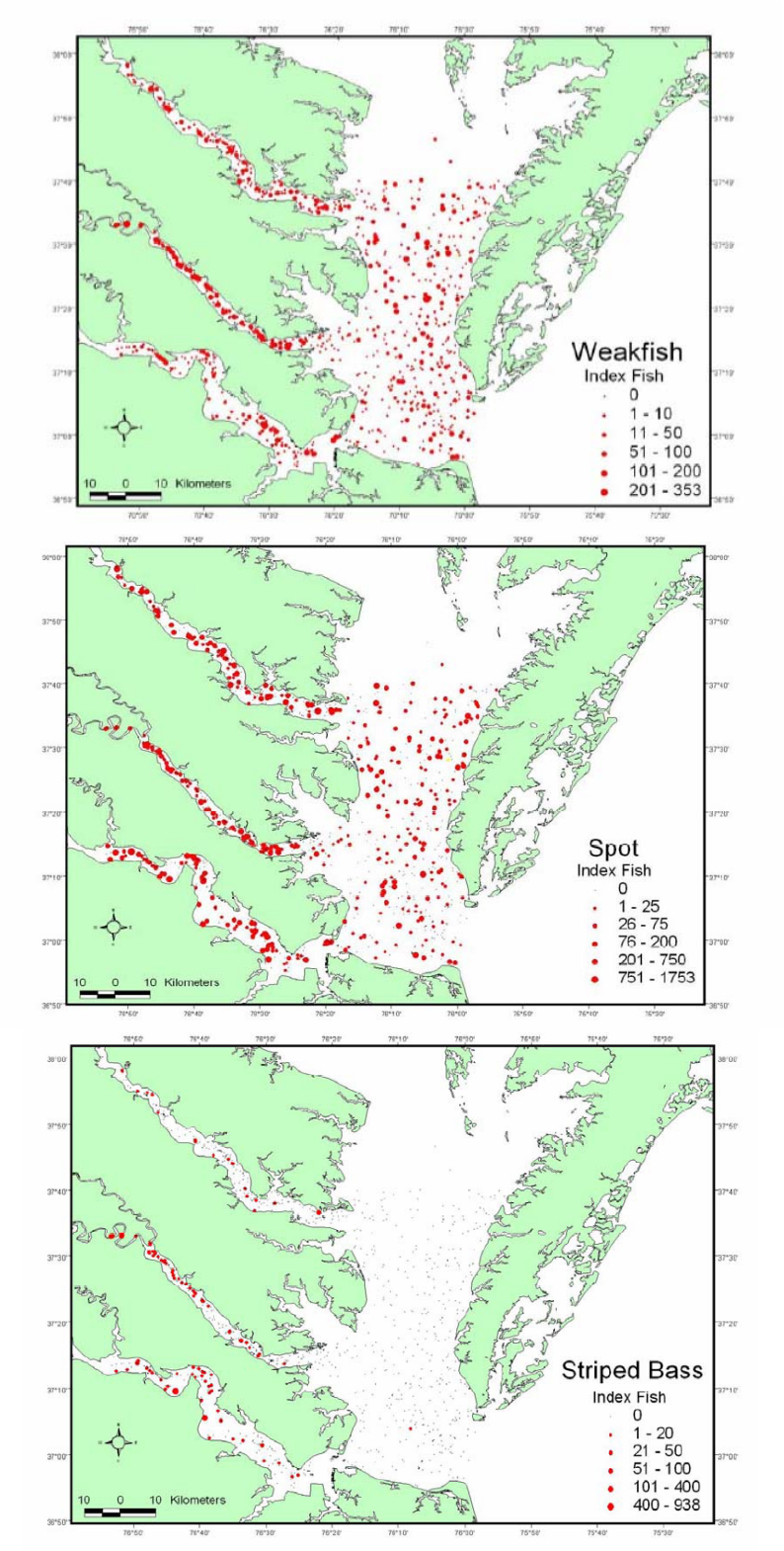

Figure 2. Striped bass juvenile distribution as reported by the VIMS juvenile striped bass seine survey (Austin et al. 2006).

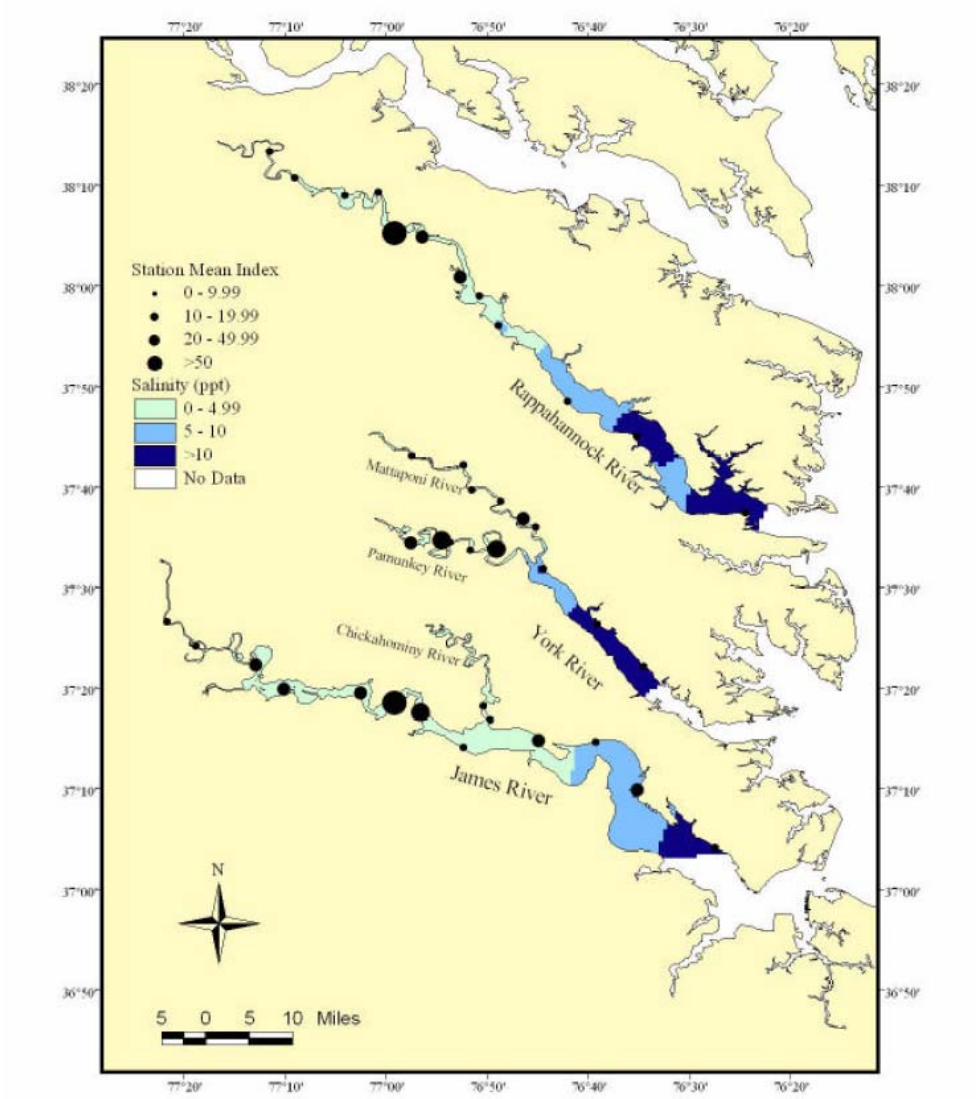

Figure 3. Map of the York River system and the demarcation of the nine zones.

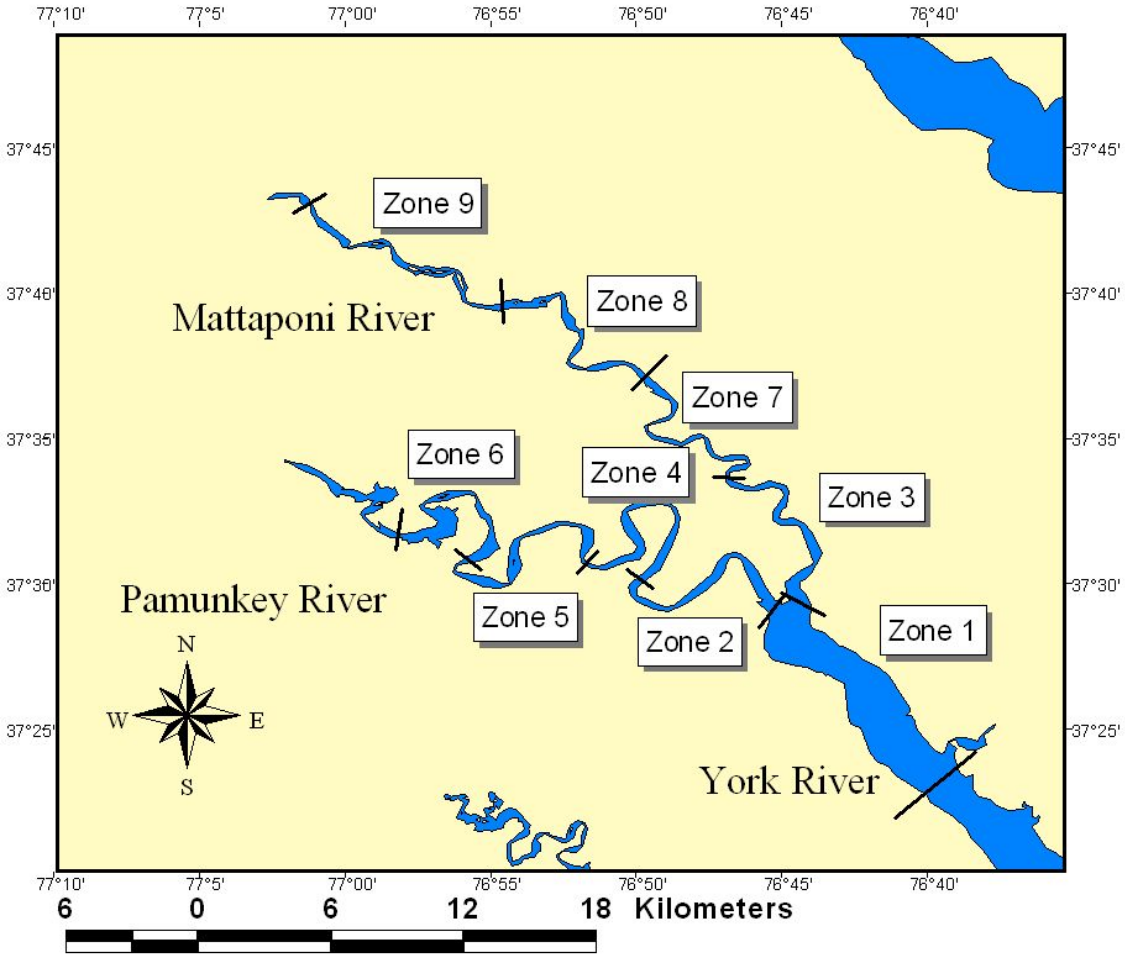

Figure 4. Map of the James River and the demarcation of the three zones

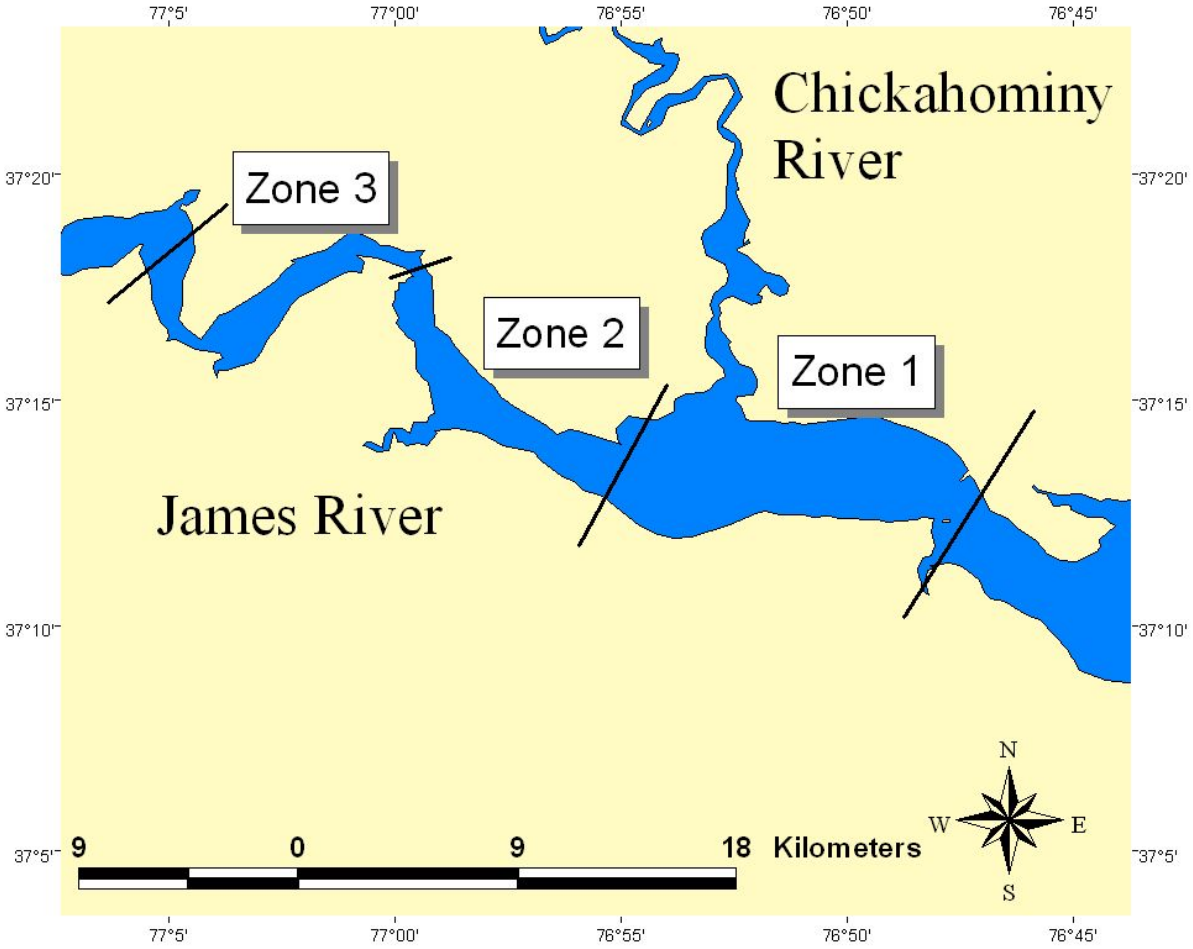

Figure 5. Map of the Rappahannock River and the demarcation of the three zones.

PISCIVOROUS FISHES/RECREATIONAL IMPACT

Personnel	**REQUEST**	**VIMS matching**
PI (Musick; 4%)		6,140
Graduate student stipend	17,100	
Fringe on PI salary (30%)		1,842
sub-total	**17,100**	**7,982**
Supplies		
Field Supplies (gill nets, fuel, knives, floats, anchors)	5,000	
Lab supplies (glassware, plasticware, chemicals)	1,000	
Vessel fuel	1,000	
sub-total	**7,000**	
Travel		
Travel to field sites (VIMS vehicle rental and fuel; truck @$.58/mile)		
sub-total	**4,524**	
Vessel Rental		
Vessel rental (65 @$120/day)		
sub-total	**7,800**	
Facilities & Administrative Costs (25%)	**9,106**	7,367
Total	**45,530**	**15,349**

Facilities and Administrative Costs:
F&A costs limited to 25% for funds provided by VMRC.
Institutional approved rate is 45%. The remaining costs are contributed as part of VIMS match for this project.