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VIRGINIA RECREATIONAL FISHING DEVELOPMENT FUND
SUMMARY PROJECT APPLICATION*

NAME AND ADDRESS OF APPLICANT:	**PROJECT LEADER(name, phone, e-mail)**
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PRIORITY AREA OF CONCERN Tributaries of the Chesapeake Bay	**PROJECT LOCATION** Brackens and Wormley Ponds (York R.), Kamp's Millpond (Rappahannock R.) and Wareham's Pond (James R.)

DESCRIPTIVE TITLE OF PROJECT

Estimating relative abundance of Young-of-Year American Eel, *Anguilla rostrata*, in the Virginia tributaries of Chesapeake Bay.

PROJECT SUMMARY:

The need for fisheries independent data from monitoring surveys is essential to many of the fishery management plans (FMP) for the Atlantic States Marine Fisheries Commission (ASMFC) and other management agencies. Specifically, this project meets the mandates of the ASMFC's FMP for American eel. Monitoring of glass eels (young-of-year) as they enter the estuary will provide estimates of recruitment in Virginia and allow for long-range planning for future harvestable stocks.

EXPECTED BENEFITS:

Recreational and commercial fishermen will benefit from this study as it will provide the Virginia Marine Resources Commission (VMRC) and ASMFC with an index of annual recruitment for juvenile American eels. The American eel is an important bait fishery in Virginia for game fish such as striped bass and cobia. Additionally, the American eel commercial fishery in Virginia from 2000-2005 landed an average of 121,302 lbs. Estimates of year class strength provide an "early warning" of recruitment success or failure, and are vital for proper species management.

COSTS:
VMRC Funding: $36,325
Recipient Funding: $5,812
TOTAL COST: $42,137

Detailed budget 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)**

Estimating relative abundance of Young-of-Year American Eel, *Anguilla rostrata*, in the Virginia tributaries of the Chesapeake Bay.

Proposal Submitted to:

Virginia Marine Resources Commission
Marine Recreational Fishing Advisory Board
2400 Washington Avenue, Newport News, VA 23607

15 January 2007 – 31 December 2007

Submitted by:

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December 1, 2006

Title: Estimating relative abundance of the young-of-year American eel, *Anguilla rostrata*, in the Virginia tributaries of Chesapeake Bay.

Introduction

The Atlantic States Marine Fisheries Commission (ASMFC) adopted an interstate fishery management plan for American eel (*Anguilla rostrata*) in 1999. The plan mandated that all states/jurisdictions would be required to conduct an annual fishery-independent survey for young-of-year (YOY) American eel using specific methods and gears approved by the ASMFC Technical Committee. These surveys would be required of all states/jurisdictions beginning in 2001. The importance of the American eel commercial fishery in Virginia is well known. Additionally, this fishery also produces a large bait component for recreational anglers with little known about the potential impact bait harvest has on the overall fishery, or the eel population in general.

In Virginia, during Spring 2000, exploratory surveys were conducted by the Virginia Institute of Marine Science (VIMS) to establish appropriate sampling gear and methodologies to evaluate American eel recruitment. Since 2001, both the VMRC Marine Recreational Fishing Advisory Board and the Commercial Fishing Advisory Board have supported this project.

History and Relevance

VIMS has a long history of monitoring and assessing the fishery stocks in the lower Chesapeake Bay. In particular, there are several long-term programs specifically targeting juvenile fishes with a primary goal of obtaining annual recruitment estimates (i.e. VIMS Trawl Survey since 1955 and the VIMS Striped Bass Seine Survey, initiated in 1967). Although American eel are often captured by these surveys, most are juveniles (yellow eels, total length or TL > 180 mm), with very few YOY (glass eels) collected. Only a few states/jurisdictions (Maine, Maryland, New Jersey, and Nova Scotia, Canada) have historically collected information on glass eel recruitment. With the new ASMFC mandate, a coastwide estimate of annual recruitment for glass eels was established.

Information for American eel is often limited or lacking possibly due to its unique life history. The American eel is a catadromous species, present along the Atlantic and Gulf coasts of North America and inland in the St. Lawrence Seaway and Great Lakes (Murdy et al., 1997). The species is panmictic and supported throughout its range by a single spawning population (Haro et al., 2000). Spawning takes place during winter to early spring in the Sargasso Sea. The eggs hatch into leaf-shaped ribbon-like larvae called leptocephali, which are transported by the ocean currents (over 9-12 months) in a generally northwesterly direction. Within a year, metamorphosis into the next life stage (glass eel) occurs in the Western Atlantic near the East Coast of North America. Coastal currents and active migration transport the glass eels into rivers and estuaries from February to June in Virginia and Maryland. As growth continues, the eel becomes pigmented (elver stage) and within 12 –14 months acquires a dark color with underlying yellow (yellow eel stage; Facey and Van Den Avyle, 1987). Many eels migrate upriver into freshwater rivers, streams, lakes, and ponds, while others remain in estuaries. Most of the eel's life is spent in these habitats as a yellow eel. Age at maturity varies greatly with

location and latitude, and in Chesapeake Bay may range from 8 to 24 years, with most eels less than ten years old (Owens and Geer, 2003). *A. rostrata* from Chesapeake Bay mature and migrate at an earlier age than eels from northern areas (Hedgepeth, 1983). Upon maturity, eels migrate back to the Sargasso Sea to spawn and die (Haro et al., 2000). Metamorphosis into the silver eel stage occurs during the seaward migration that occurs from late summer through autumn.

It has been suggested that glass eel migration consists of waves of invasion (Boetius and Boetius, 1989 as reported by Ciccotti et al., 1995), and perhaps a fortnightly periodicity related to selective tidal stream transport (Ciccotti et al., 1995). Additionally alterations in freshwater inflow (patterns and magnitudes) to bays and estuaries may alter flow regimes and consequently affect the size, timing and spatial patterns of upstream migration of glass eels and elvers (Facey and Van Den Avyle, 1987).

The American eel is a valuable commercial species along the entire Atlantic Coast from New Brunswick to Florida, with Virginia historically accounting for one-third of annual Atlantic and Gulf Coast landings and Chesapeake Bay one-half of the total (NMFS, 2006). Landings along the U.S. Atlantic Coast have varied from 290 MT in 1962 to a high of 1600 MT in 1975 (NMFS, 2006) and the American eel once accounted for more than 25% of the total fish biomass of East Coast streams (ASMFC, 2005).

In recent years there has been a decline in landings in Virginia with similar patterns seen in the Canadian Maritime Provinces. These declines are also apparent in fishery-independent trawl surveys in Chesapeake Bay (Montane and Fabrizio, 2006). Although primarily a commercial species, an unknown portion of the total harvest in Virginia is part of the bait fishery for coastal gamefish (Jenkins and Burkhead, 1993) such as striped bass and cobia. Information available from NMFS regarding Atlantic Coast eel harvest for bait also indicates a large decline in harvest since the mid-1980's. As these recreational fisheries continue to grow, the amount of eels sold as bait to support the fishery will grow as well.

American eel are not usually considered a sport fish, though they may be caught by recreational fishermen (Collette and Klein-MacPhee, 2002). The NMFS Marine Recreational Fisheries Statistics Survey (MRFSS) shows a similar declining trend in catch of eels for Virginia during the 1990's (Anonymous, 2001).

With coastwide declines in harvest observed throughout the Atlantic States and Maritime Provinces, it is essential that reliable information on recruitment and other life history parameters (e.g. length and age, age at maturity) be obtained to establish a reliable stock assessment plan. Hypotheses for the coastwide decline include shifts in the Gulf Stream which affect recruitment, pollution, overfishing, parasites which affect migration and spawning, and up-river impediments, such as fish barriers (Castonguay et al., 1994).

Many present fisheries management techniques cannot be applied to American eels because basic data on its biology are either missing or studies have shown conflicting results. Different growth rates between water systems, and large variations for length at age have made it difficult to perform stock assessments (Owens and Geer, 2003). Additionally, few studies have addressed the recruitment of glass eels to Atlantic Coast estuaries from the spawning grounds in the Sargasso Sea, and long-term datasets for American eels are lacking (Powles and Warles, 2002).

Need:

Measures of juvenile abundance are widely employed as a key element in the management of many Atlantic states coastal fishery resources. Fluctuations in relative abundance of early juveniles (age 0 or YOY) generated from fisheries-independent survey programs have been found to provide a reliable and early estimator of future year class strength for species such as striped bass (Goodyear, 1985) and crabs (Lipcius and Van Engel, 1990) in Chesapeake Bay. For example, the current Interstate Fisheries Management Plan for the striped bass relies heavily on estimates of juvenile abundance, both as 'action levels' for the intensification and relaxation of restrictions and as a measure of year class strength in mathematical population models (USDOI and USDOC, 1989). In addition to providing FMP input, juvenile indices can be an "early warning" of year class failure. ASMFC mandates that all Atlantic coastal states and jurisdictions conduct an annual American eel YOY survey.

Objectives:

1. To monitor the glass eel migration, or run, into the Virginia Chesapeake Bay tributaries, to determine spatial and temporal components of recruitment.

2. Examine the tidal, lunar, and hydrographic parameters (temperature, pH, etc.) which may influence young-of-year eel recruitment.

3. Collect basic biological information on glass eels (i.e. length, weight, and pigment stage).

Field work is performed from late February to late May likely corresponding to the period of maximum American eel recruitment.

Expected Benefits and Results:

A primary benefit of this project is to insure that recruitment of American eel will be monitored in tidal waters of Virginia. Since the Chesapeake Bay jurisdictions (Virginia, Maryland, and the Potomac River Fisheries Commission) comprise nearly 63% of the commercial landings on the Atlantic East Coast, monitoring annual recruitment in this region constitutes a key element in multi-state efforts to manage this Atlantic coastal fishery resource. This need was further emphasized by the Atlantic Coastal Cooperative Fishery Management Act (PL-103-206), specifying that states identified in ASMFC management must be in compliance, with the American Eel FMP directly requiring monitoring of YOY recruitment.

The information collected from this study will provide better information on the timing and distribution of YOY American eel recruitment into the Chesapeake Bay's tributaries. The effects of tidal and lunar factors on abundance will be examined as well as relationships between abundance and hydrographic parameters. The information collected will be used by resource management agencies on the State, Federal, and possibly International levels, to better

understand recruitment of this catadromous species and provide a valuable tool for assessing the success of present management strategies.

Approach:

Minimum criteria for YOY American eel sampling has been proposed by the ASMFC American Eel Technical Committee, and approved by the American Eel Management Board. Due to the importance of the eel fishery in Virginia, additional sites are sampled to insure proper temporal and spatial coverage, and to provide reliable recruitment estimates.

To provide the necessary spatial coverage at least one site should be sampled per major tributary (the James, York, and Rappahannock Rivers). Site selection will be based on known areas of glass eel migrations, accessibility, and specific criteria which have been documented as sources of glass eel concentration (such as millponds which feed directly into the estuaries). Prior sampling has revealed several sites that met these criteria and produced adequate numbers of glass eels (Montane et al., 2006). Current (and proposed) sites to be sampled include Brackens and Wormley Ponds on the York River, Kamp's Millpond on the Rappahannock River and Wareham's Pond on the James River (Figure 1).

The minimum sampling period based on ASMFC's mandates is four days per week for at least six weeks. Previous years results indicate the run in Virginia to be more protracted, requiring a longer sampling period (Montane et al., 2006). In accordance with the ASMFC mandate, sites will be sampled a minimum of four days per week (usually Monday, Tuesday, Thursday, Friday, and possibly weekends at the York River sites), starting around end of February/early March. Sampling will continue throughout the glass eel run (end of May/early June) or until 0 glass eels are caught. To determine the start of the run, sites will be sampled at least once weekly until some threshold value is reached, indicating the start of the sampling period. When catches fall below this threshold later in the season, sampling effort will be reduced until the run is completed. Over several years, it is hoped that the timing of the run may become more predictable and this window of preliminary sampling might be diminished, though the start of the run is variable between years. Dipnetting may also be performed at the beginning and end of the survey, if necessary, to confirm presence/absence of glass eels.

At each site (sites combined if on the same tributary) a sample of sixty eels will be collected weekly, measured to the nearest 0.1mm TL, weighed to the nearest 0.01g, and pigment stage recorded (see Haro and Krueger, 1988 for staging criteria). The remaining catch will be enumerated and placed above the spillway. At each site temperature, tidal stage, stream flow, time, and condition of the gear will be recorded. The gear utilized will be an Irish eel ramp (B. Jessops design; see Montane et al., 2006 for gear configuration).

Sites chosen in the past have proven to be excellent locations to study YOY eel recruitment and these sites will again be studied to lengthen the time series. Brief results from the past surveys follow. In the York River (Brackens and Wormley Ponds combined) CPUE for both YOY and elvers were variable since 2000, though YOY CPUE exhibited an increasing trend (Figure 2, top) and elver CPUE a decreasing trend through 2006 (Figure 2, bottom). Separately by site, YOY CPUE for Brackens Pond increased from 2005, but exhibited no trend over the time series (Figure 3, top). Wormley Pond 2006 YOY CPUE increased from 2005 and also exhibited no trend over the time series (Figure 3, top). Elver CPUE for 2006 decreased at

Brackens Pond compared to 2005 and exhibited a decreasing trend over the time series (Figure 3, bottom). Elver CPUE for 2006 increased at Wormley Pond compared to 2005, and also showed a decreasing trend (Figure 3, bottom). Kamp's Millpond 2006 YOY CPUE decreased compared to 2005, and YOY CPUE increased at Wareham's Pond in 2006 compared to 2005 (Figure 4, top). Kamp's Millpond exhibited decreasing trends in YOY CPUE over the time series, while Wareham's Pond exhibited no trend (Figure 4, top). Kamp's Millpond 2006 elver CPUE was nearly similar to 2005 (Figure 4, bottom). Wareham's Pond 2006 elver CPUE increased compared to 2005, and both sites also exhibited slight increasing trends (Figure 4, bottom).

Location:

Proposed sites to be sampled include Brackens and Wormley Ponds on the York River, Kamp's Millpond on the Rappahannock River and Wareham's Pond on the James River (see Figure 1).

Deliverables and Final Products:

Quarterly progress reports and a final report will be submitted to VMRC MRFAB according to their reporting requirements. Data will be made available to ASMFC to fulfill their mandate and also presented at local, regional and national/international meetings as well as submitted for publication in scientific journals.

Estimated Cost:

VMRC American Eel Budget 2007:

Estimating relative abundance of young of year American eel, *Anguilla rostrata*, in the Virginia tributaries of Chesapeake Bay.

Personnel	**Time**	**MRFAB**	**VIMS**	**Total**
Montane, PI	10%	6,033		6,033
Brooks, Lab Specialist	14%	5,159		5,159
Halvorson, Lab Specialist	10%	3,373		3,373
Lab Specialist (TBD)	15%	5,135		5,135
Fringe, 30% salaries		5,910		5,910
Supplies[1]				
Field and lab supplies		1,000		1,000
Travel				
Field Sites		2,050		2,050
Regional Meeting (1 person)		400		400
Facilities & Administrative Costs		7,265	5,812	13,077
Totals		**$36,325**	**5,812**	**$42,137**

Facilities and Administrative Costs: F&A costs are assessed at 25% for funds provided by Marine Recreational Fishing Advisory Board.

[1]Supplies include waders, water temperature dataloggers, materials for eel traps, waterproof paper, etc.

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Figure 1. 2007 YOY Eel Sampling Sites.

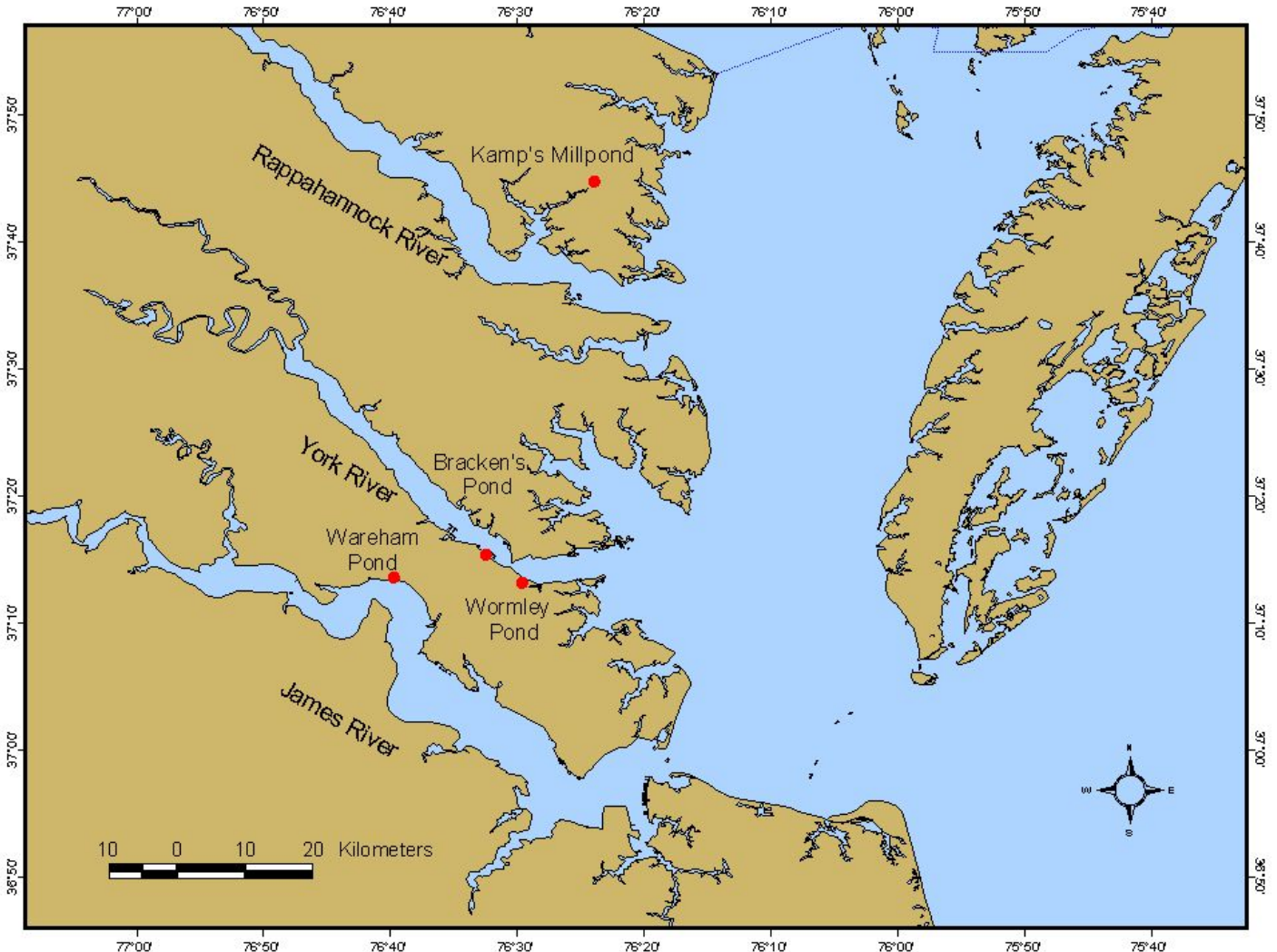

Figure 2. YOY (top) and Elver (bottom) CPUE (Geometric Means) for Brackens and Wormley Ponds combined (2000-2006). Note: dashed lines are trend lines and error bars denote standard error.

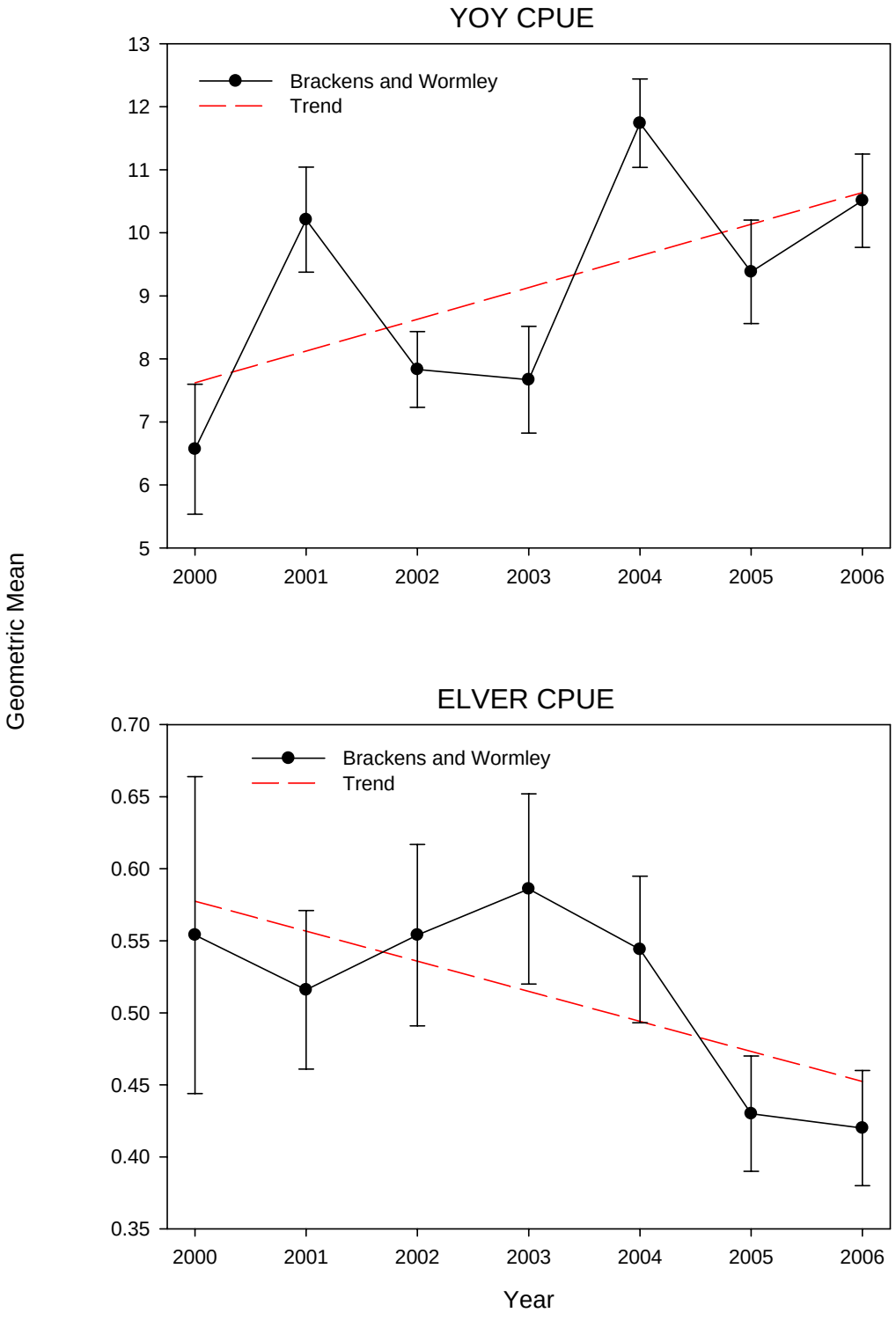

Figure 3. YOY (top) and Elver (bottom) CPUE (Geometric Means) for Brackens and Wormley Ponds (2000-2006).

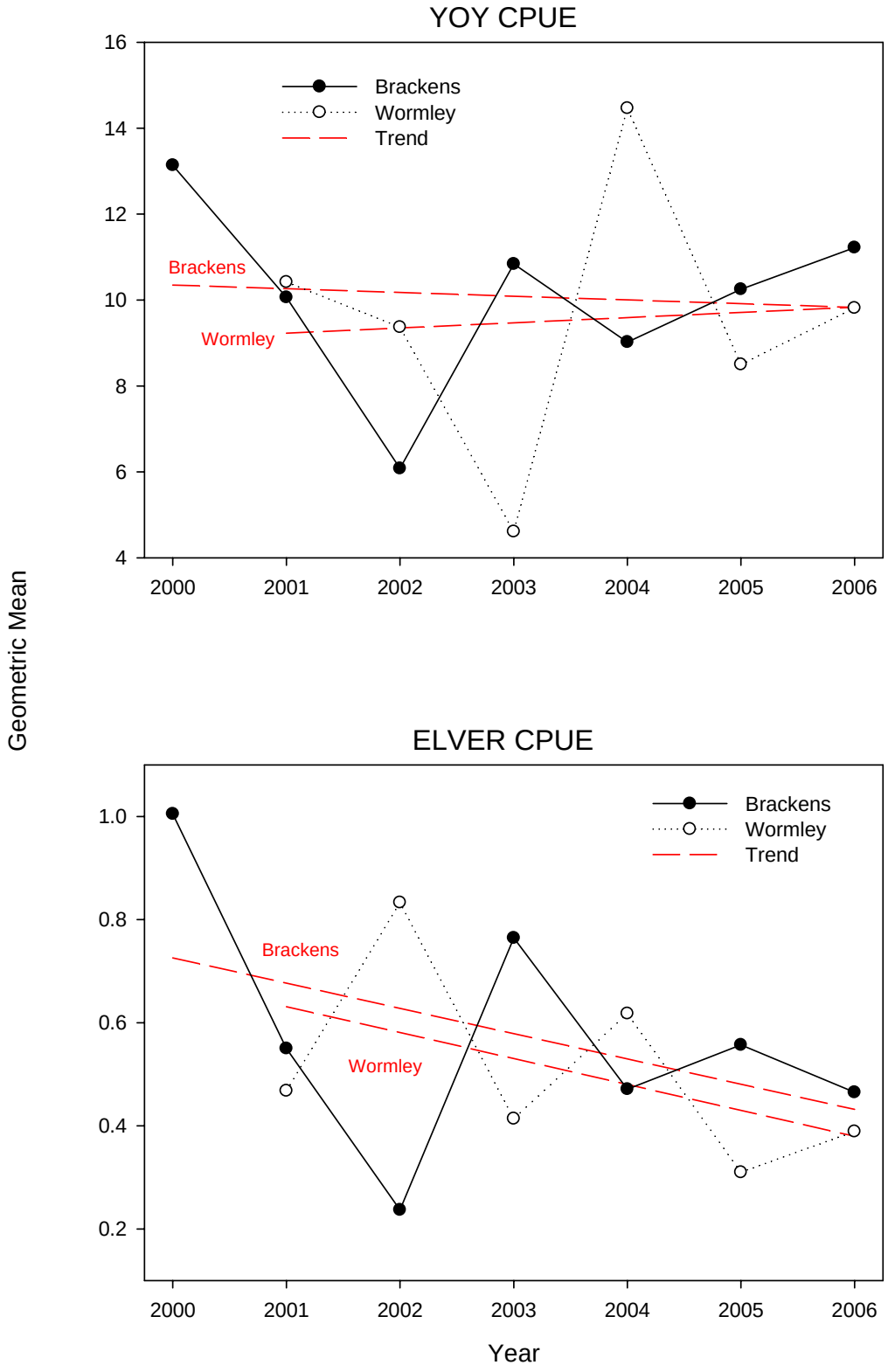

Figure 4. YOY (top) and Elver (bottom) CPUE (Geometric Means) for Kamps (2000-2006) and Warehams Ponds combined (2003-2006).