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VIRGINIA RECREATIONAL FISHING DEVELOPMENT FUND
SUMMARY PROJECT APPLICATION*

NAME AND ADDRESS OF APPLICANT:

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PRIORITY AREA OF CONCERN:

Research & Data Collection

PROJECT LOCATION:

Lower Chesapeake Bay and lagoons along Virginia's Eastern Shore

DESCRIPTIVE TITLE OF PROJECT:

Abundance, distribution and biology of sharks and rays in Chesapeake Bay and Virginia's coastal lagoons: Continuation of a long-term monitoring and research program

PROJECT SUMMARY:

The Virginia Institute of Marine Science has conducted a fishery independent longline survey since 1973 to monitor trends in abundance of coastal shark stocks in Virginia waters. This survey has provided important biological and abundance data to state and federal agencies to aid in stock assessment and management. Funding is requested to 1) continue the long-term longline survey and tagging program monitoring abundance, length frequency, and movements of sharks in Chesapeake Bay 2) continue a detailed study of abundance and habitat use of sharks and rays in lagoons on Virginia's Eastern Shore, 3) to complete a study comparing growth parameters of sandbar sharks in Chesapeake Bay before and after population depletion, and 4) complete analyses of genetic samples necessary to determine effective population size of sandbar sharks in Virginia waters and to if philopatry, the tendency to return to natal origins to give birth, occurs in this population.

EXPECTED BENEFITS:

Landings data indicate that sharks are important to recreational and commercial fisheries and most landings occur in state waters. Data from the VIMS longline survey are relied upon by NMFS and VMRC in developing management actions for coastal sharks. Catch rates of juvenile sandbar sharks in Chesapeake Bay declined dramatically from 1992-2004. The portion of the survey conducted in Chesapeake Bay is crucial to monitoring this population trend and evaluating the effect of management actions on recovery. The nursery ground research has also been identified specifically as an outstanding data gap that must be filled for effective management of shark stocks. In addition, maintaining stable populations of top predators like sharks may be critical to the balance and proper function of the Chesapeake Bay ecosystem.

COSTS:

The VIMS shark research program federally funded through the National Shark Research Consortium. Due to a 25% reduction in the NSRC budget, funding levels are insufficient to allow completion of the longline survey and several research projects. The proposed funding through the VMRC would primarily cover vessel rental fees and field supplies needed to continue portions of the longline survey and shark research program that are concentrated in Chespeake Bay and lagoons along Virginia's Eastern Shore. This proposal is being submitted for consideration by the RFAB and the CFAB.

VMRC Funding:	$89,073
Recipient Funding:	$26,053
Total Costs:	**$115,125**

Detailed budget must be included with proposal. See attached detail for discussion of companion federal support.

Proposal Submission to

Virginia Marine Resources Commission

By

THE VIRGINIA INSTITUTE OF MARINE SCIENCE
COLLEGE OF WILLIAM AND MARY

Abundance, distribution and biology of sharks and rays in Chesapeake Bay and Virginia's coastal lagoons: Continuation of a long-term monitoring and research program

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December 2006

Background/Need for study

Recreational and commercial fisheries for sharks in U.S. waters expanded rapidly during the period between 1975 and 1992. Prior to 1978, annual commercial landings of sharks and rays in the U.S. never exceeded 5,000 MT. By 1992, these landings had grown by an order of magnitude to over 54,000 MT (Vannuccini 1999). U.S. commercial landings of large coastal species of sharks along Atlantic coast and in the Gulf of Mexico grew from an estimated 16,200 sharks in 1982 to 351,000 sharks in 1989 (Cortes et al. 2002), more than a 20-fold increase. Recreational landings in the U.S. Atlantic far exceeded commercial landings until the late 1980's (Figure 1) and annual totals have ranged from maximum of 746,600 sharks in 1983 to a minimum of 90,100 sharks in 1999. Since 1988, recreational landings have ranged from 63% to 147% of commercial landings (Cortes et al. 2002). Total large coastal shark landings for commercial and recreational fisheries in the region over the period from 1988 to 2001 were approximately 2.7 million and 2.8 million sharks respectively.

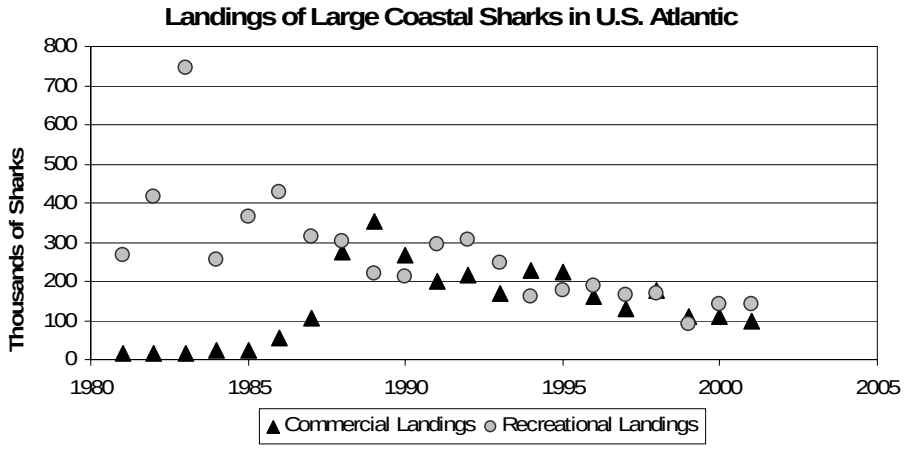

Figure 1: U.S. recreational and commercial landings of large coastal sharks from 1981-2001.

Sharks are highly susceptible to overfishing, in part, because they are slow growing with late maturation and low fecundity (Musick 1999). The large coastal shark stocks of the western North Atlantic were deemed overexploited by 1989 (NMFS 1991) which led to the development of a US Fisheries Management Plan (FMP) for the shark resources of the Atlantic and Gulf coasts, implemented in 1993. In addition, several states including Virginia enacted laws regulating shark fishing in their territorial waters. However, stock assessments for management purposes have been hindered by a lack of appropriate data, especially at the species level (Anderson 1990; Parrack 1990). Hoff and Musick (1990) and the NMFS Fishery Management Plan for East Coast Sharks (NMFS 1991) and (Anon. 1994) identified several important requirements for more detailed assessments, including:

(1) mapping inshore pupping and nursery grounds to define stock-recruitment relationships and reproductive potential for each species;

(2) delineation of age-related and sex-related distributions and migrations of shark species shark to better identify ecological relationships and habitat requirements; and

(3) generation/evaluation of a statistically valid sample of fishery-independent data on catch and effort, representing population abundance, for each species over time.

A Scientific Review Panel of Experts concluded in April 1994 (Anon. 1994) that the stocks of large coastal sharks were depleted to much lower relative levels than realized in the FMP and that stock recovery would take decades rather than two years as stated in the plan. Consequently, the Panel recommended that the total allowable catch (TAC) of sharks remain constant rather than increased in 1995 as recommended in the Management Plan. In a reassessment of the Atlantic shark stocks in 1996 the review panel concluded that a 50% reduction in fishing mortality below that allowed in the 1993 FMP was necessary for stock recovery. In April 1997, NMFS implemented just such a reduction in the commercial quota (from 2,570 MT to 1,285 MT) and recreational creel limit. Federal quotas for large coastal sharks along the US Atlantic and Gulf of Mexico coasts were further reduced to 1,017 MT in 2004.

In 1997, Virginia moved to the forefront in proactive shark management by implementing a minimum size regulation of 58-inch fork length for commercial fisheries (with a 200-pound bycatch exception) and a recreational bag limit of one shark within Virginia's territorial waters (three miles from shore). These regulations were designed to protect juvenile sharks from commercial exploitation while in the summer nursery areas. In 2005, these regulations were amended, in part, to mirror current federal regulations. Specifically, the list of federally prohibited species was extended to recreational and commercial fisheries in state waters and a minimum size limit of 54-inches was placed on large coastal species for recreational fisheries. In addition, the 200-pound bycatch allowance of undersized sharks in state waters was deleted; however, the minimum size requirement for commercial landings was altered to apply only to waters west of the COLREGS line, thereby eliminating the size limit for all coastal waters.

The Virginia Institute of Marine Science has carried out a longline sampling program since 1973 to study the distribution, abundance and biology of coastal sharks from Cape Hatteras, NC to Cape Henlopen, DE with most effort in Virginia waters. This long-term program contributes to the data needs outlined above - biological data, catch/effort by species, and fishery independent assessment. The program was expanded during 1980 and 1981 with Sea Grant support (Colvocorresses and Musick 1980), thus providing a strong historical baseline concerning the sharks inhabiting coastal and estuarine waters prior to the escalation of the recreational and commercial fisheries. The survey was later supported by funding through the Wallop-Breaux program (1990-1994, 1998, and 1999) and the Virginia Marine Resource Commission Salt Water License Fund (1995-1997). In 2002, the National Shark Research Consortium (NSRC) was formed through a federal appropriation. VIMS is one of four members of this consortium and funding to the NSRC has supported the continuation of the VIMS Longline Survey (1973-2006) which tracks population abundance, species composition, size and age distributions and sex ratios of sharks in the coastal ocean. The federal NSRC budget was reduced by 25% between FY2005 and FY2006, resulting in an overall reduction of research effort during 2006. Funding during for the 2007 fiscal year is anticipated at the level of 2006. Current funding through the NSRC is only sufficient to complete the coastal portions of the longline survey and age/growth studies that are NMFS priorities. The proposed funding through the VMRC would represent a 25% state match to federal funds and would allow the continuation of the portions of the VIMS longline survey and shark research program that are most critical in evaluating the health of resources in Virginia waters. Most important is the continuation of the long-term survey and tagging program monitoring of recruitment and relative abundance of juvenile sandbar sharks in Chesapeake Bay and Eastern Shore nurseries. This survey is the only means for gauging the effect of state shark regulations on the resource. This funding would also allow the continuation of a detailed study of the distribution and habitat use of sharks and rays in the lagoons of Virginia's Eastern Shore, continued investigation into movements and philopatry of sandbar sharks in Virginia waters, and the completion of genetic analyses investigating the population structure and kinship of sandbar sharks using Virginia waters as nurseries and evaluating the importance of these regions in the overall dynamics of the north Atlantic population.

Project Goals and Objectives:

The primary objectives of this project are to

1. continue the VIMS fishery-independent longline survey to monitor abundance of sharks using Chesapeake Bay and lagoons along Virginia's Eastern Shore and to provide vital biological data needed for continued management of dominant species,
2. continue juvenile sandbar shark tagging program to examine long-term movements, degree of site fidelity, and occurrence of philopatry while in the Chesapeake Bay nursery and during migrations to and from wintering areas,
3. continue to monitor trends in age, size, and sex composition of juvenile sandbar sharks in the nursery areas and examine the effects of recent management efforts on existing juvenescence trends in Chesapeake By and in Virginia coastal waters,
4. continue tracking studies to determine the distribution and habitat use of sharks and rays in coastal lagoons along Virginia's Eastern Shore,
5. complete the aging study comparing life history parameters of sandbar sharks before and after overexploitation to determine the biological potential for sustainability, and
6. complete genetics projects including investigations of philopatry and effective population size of adult female and juvenile sandbar sharks using Chesapeake Bay and Eastern Shore lagoons.

Approach

The VIMS Longline Survey

The VIMS longline survey is a depth-stratified station-oriented field survey of the Chesapeake Bay, Virginia coastal waters, and tidal lagoons and inlets along Virginia's Eastern Shore. A unit of effort is a 100-hook longline covering approximately 1.25 nautical miles, which is fished for 4 hours. Gear characteristics have been similar throughout the program (1973-2006). The distribution of sampling effort for the longline program from 1973 to 2006 is shown in Figure 2. Eight standard stations plus ancillary localities are fished each month (May or June through September or October). Sampling for each month is completed within five days to reduce between-station variability. Each fish is measured and sexed and biological samples are taken as needed for genetic, age/growth, and reproduction analyses. Healthy specimens not needed for these samples are tagged and released for long-term studies on migration, growth, and habitat use. Greater detail on this program is given in Grubbs and Musick (in press), Grubbs et al. (in press), and Musick et al (1993).

CPUE data from the VIMS survey for large coastal species (Figures 3 and 4) common to the region (sandbar sharks - *C. plumbeus*, dusky sharks - *C. obscurus*, tiger sharks - *Galeocerdo cuvieri*, and sandtiger sharks - *Carcharias taurus*) suggested a rapid decline of about 80% in the stocks between 1980 and 1992 accompanied by juvenescence in the populations of the most common species, sandbar sharks (Figure 4b) and dusky sharks. Catch rates of the only common small coastal species in the survey, the Atlantic sharpnose shark (*Rhizoprionodon terranovae*) were relatively stable over this period (Figure3b). Following the introduction of a federal management plan in 1993, we observed a moderate increase in CPUE of sandbar sharks through 1998 (Figure 4a), though overall biomass remained depressed due to the continued juvenescence of the stock, a primary symptom of overfishing. Dusky sharks composed approximately 20% of the shark catch in the VIMS survey from 1974-1981, but had virtually disappeared from the survey by 1990 (Figure 3a). Dusky shark CPUE remained very low through 1998, but has increased moderately in recent years. VIMS catch rates for tiger shark and sandtiger sharks in Virginia waters have remained very low since 1990 (Figures 3c,d). Both species were absent from the survey in 2004 and 2005, however, three tiger sharks and 12 sandtiger sharks were captured during 2006.

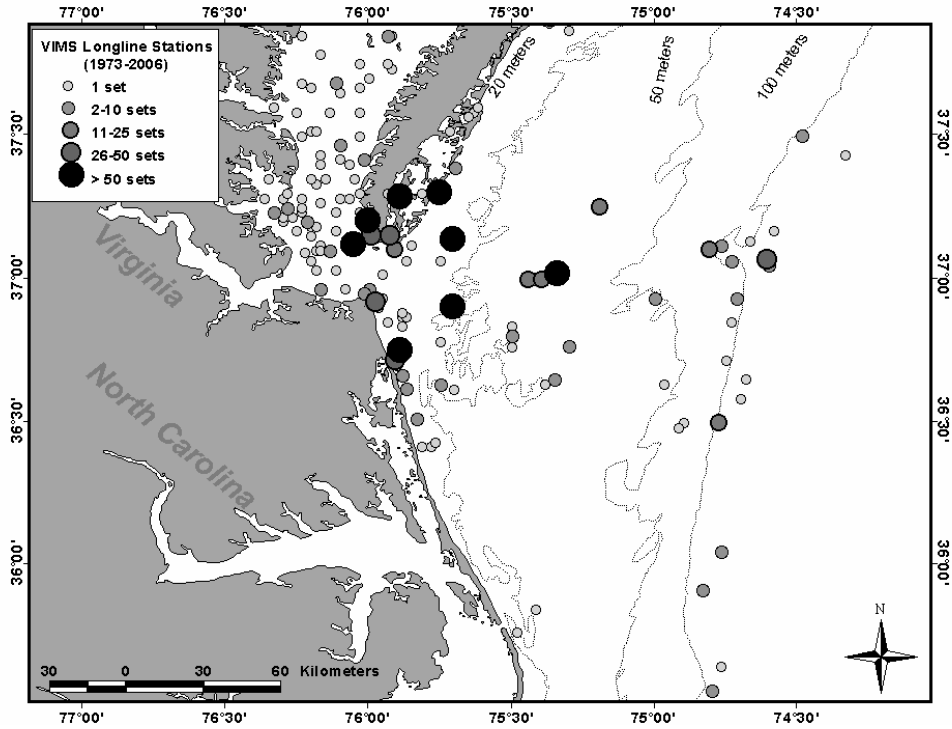

Figure 2: Distribution of longline sets made by the VIMS Shark Ecology Program 1974-2006.

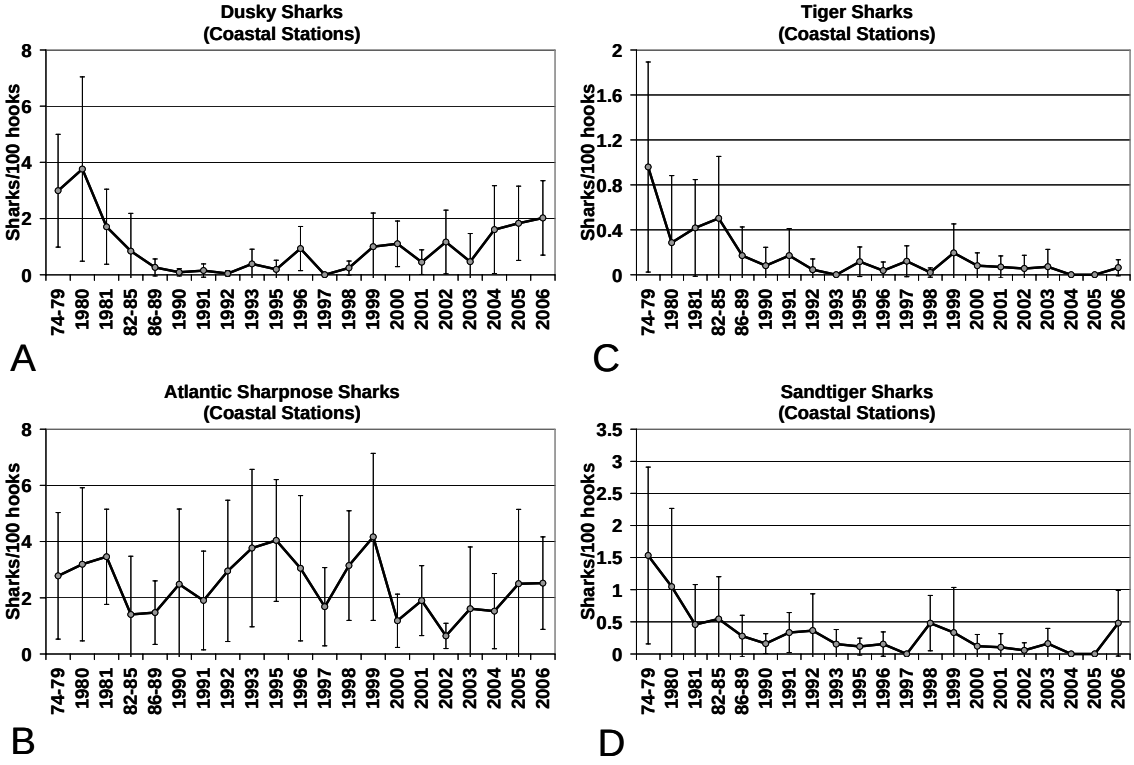

Figure 3: Nominal catch rates (sharks per 100 hooks) of A) dusky sharks, B) Atlantic sharpnose sharks, C) tiger sharks, and D) sandtiger sharks at standard coastal stations sampled by the VIMS longline survey. (Error bars = 95% CI)

Chesapeake Bay Nursery Trends

The VIMS longline survey has included stations in the lower Chesapeake Bay (Figure 2) and in the lagoons along the Eastern Shore of Virginia which compose the principal nursery grounds for sandbar sharks (Grubbs et al. in press). Musick et al (1993) showed that despite the severe decline in abundance of adult female sandbar sharks and presumably in young of the year recruitment, juvenile sharks remained relatively abundant in lower Chesapeake Bay. They suggested that substantial catches in juvenile sandbar sharks might be related to decreased predation. Juvenile survivorship may have increased due to decreased predatory pressure from larger sharks, including that of larger sandbar sharks, as their abundance declined. In fact, the abundance of juvenile sandbar sharks in the nursery in 1990 was very similar to that in 1980 and 1981 and increased dramatically in 1991 and 1992 (Figure4c). A peak in juvenile abundance was observed in 1992, which corresponded to the abundance minimum observed for large coastal sharks on the Virginia continental shelf. Catch rates of juveniles in Chesapeake Bay declined dramatically from 1993 to 1996 as a result of the development of a directed commercial shark fishery targeting juvenile sandbar sharks in the Chesapeake Bay nursery. In response to these data the Virginia Marine Resource Commission imposed a commercial size limit of 58 inches fork length (size of maturity for sandbar sharks) for all sharks except dogfish caught in Virginia waters. Abundance of juveniles in the nursery increased slightly in 1997 and 1998, but again declined significantly in 1999. The lowest CPUE in the history of the survey was observed in Chesapeake Bay in 2004 (Figure 4c). In addition, the mean size of juvenile sandbar sharks caught in Chesapeake Bay decreased from 76 and 81 cm pre-caudal length in 1980 and 1981 respectively to only 54 cm pre-caudal length in 2003 representing a loss of three age classes (Figure 4d). This decline in abundance and mean size may be a function of an increase in commercial landings for sharks in nearshore waters along Virginia's Eastern Shore beginning in 1999 (Figures 5,6). This area is the primary migration route for juvenile sandbar sharks. VIMS catch rates in Chesapeake Bay increased in 2005 and 2006 (Figure 4c). In addition, the juvenescence trend reversed during the last three years suggesting either the presence of very strong years classes in 2003 and 2004 or higher survival of these year classes (Figure4d). The mean size of sandbar sharks in the nursery during 2006 was similar to that of 1990. Continued monitoring of these stations from May to October of 2007 is crucial to evaluate the effect of existing regulations on this nursery population.

Shark Tagging Program

In 1995 we initiated a tagging program for juvenile sandbar sharks to monitor long-term movements, site fidelity, and to provide estimates of population abundance within the Chesapeake Bay and Eastern Shore nurseries. Approximately 5,200 juvenile sandbar sharks have been tagged in Virginia waters. Of these, 52% were tagged in Chesapeake Bay, 33% were tagged in Eastern Shore lagoons and inlets, and 15% were tagged in coastal waters. Information from nearly 100 tag recaptures has been compiled. Approximately 50% of reported tag returns were from recreational fishers, 40% were from commercial fishers, and 10% were from research programs including VIMS. Short-term returns (<100 days at liberty) indicate that juvenile sandbar sharks remain in the lower Chesapeake Bay and Eastern Shore nurseries throughout the summer, though they travel considerable distances within the nurseries. Nearly all recaptures in subsequent summers occurred near the tagging location suggesting high nursery fidelity. All sharks recaptured in winter were south of the tagging location and indicate a winter nursery area in the vicinity of Cape Hatteras, North Carolina (Grubbs et al. in press). The continuation of this tagging program and analysis of recapture information during the summer of 2007 is vital for understanding stock structure as well as properly defining nursery ground limits.

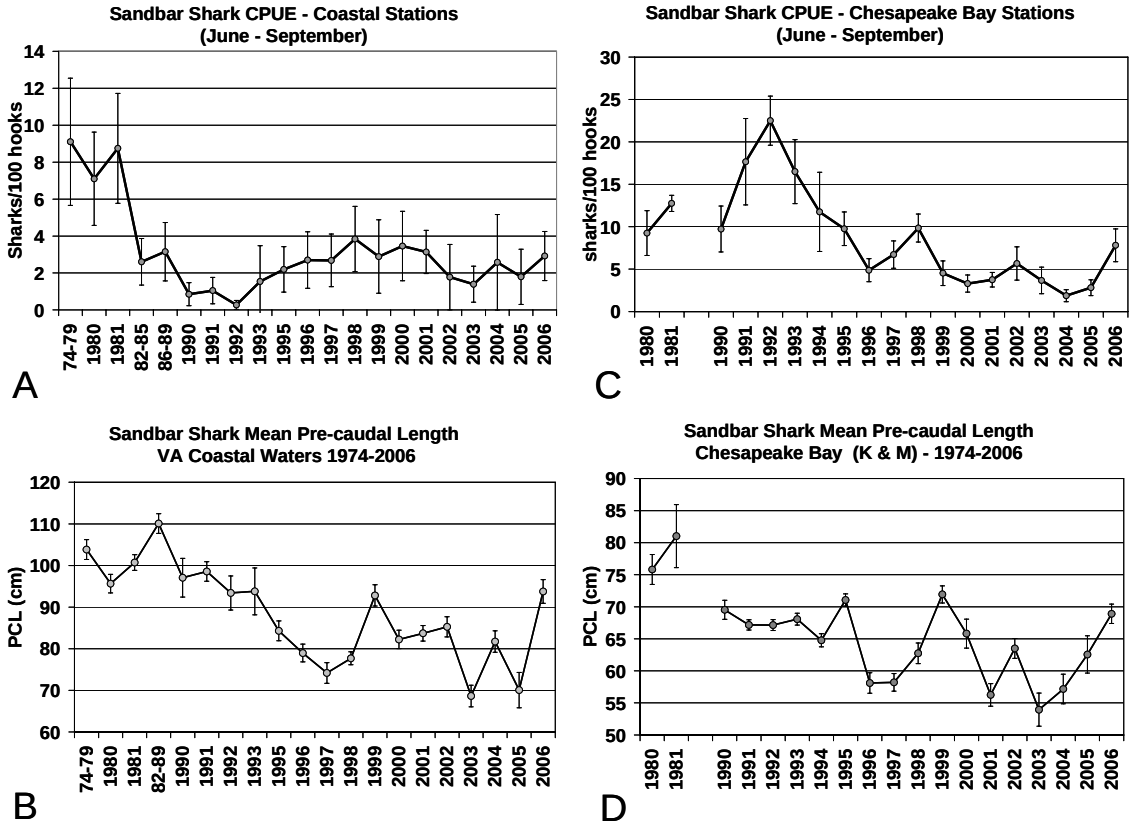

Figure 4: Nominal catch rates and mean lengths of sandbars sharks from VIMS longline survey at A, B) Virginia coastal stations and C, D) Chesapeake Bay stations. (Error Bar = 95% CI)

Shark and Ray Distribution and Habitat Use

The coastal lagoons of Virginia provide a source of protection and food for many migratory elasmobranchs. Previous studies by VIMS have determined that these lagoons are important pupping areas for sandbar sharks and serve as important nursery habitats for this species (Conrath 2005). Little research has been conducted on the rays and other sharks that inhabit the region. These lagoons have distinct environmental gradients including sediment types and concurrent fauna, temperature regimes and tidal influence that may influence the habitat use and movements of elasmobranchs. In 2006, VIMS began a detailed investigation of abundance, movements, and habitat use of sharks and rays in this region. Intensive longline sampling was conducted from May until October using monofilament gear and circle hooks. Gangions were spaced approximately 20 meters apart were baited with menhaden. Stations were selected using a stratified random design dispersing effort in coastal areas, inlets, and tidal creeks and lagoons along Virginia's Eastern Shore. During the summer of 2006, a total of 126 ancillary longline sets were made fishing 9,433 circle hooks (Figure 7). The results suggest a diverse array of elasmobranchs (17 species) use this region during summer months. The catch included 857 sharks from nine species: 537 sandbar sharks (*Carcharhinus plumbeus*), 142 smooth dogfish (*Mustelus canis*), 101 Atlantic sharpnose sharks (*Rhizoprionodon terraenovae*), 36 dusky sharks (*Carcharhinus obscurus*), 27 blacktip sharks (*C.* l*imbatus*), six spinner sharks (*C. brevipinna*), five sandtiger sharks(*Carcharias taurus*), two scalloped hammerhead sharks (*Sphyrna lewini*), and one bull shark (*Carcharhinus leucas*). In addition, 277 skates and rays of eight different species were captured: 142 clearnose skates (*Raja eglanteria*), 54 southern stingray (*Dasyatis americana*), 24 bluntnose stingrays (*Dasyatis sayi*), 21 smooth butterfly ray (*Gymnura micrura*), 19 spiny butterfly rays (*Gymnura altavela*), 12 cownose rays (*Rhinoptera bonasus*), four roughtail stingrays (*Dasyatis centroura*), and one bullnose ray (*Myliobatis*

fremenvilli). All live sharks and rays are tagged with nylon dart tags or Petersen disc tags to monitor larger-scale movements and temporal use of the tidal creeks and lagoons. We propose to continue this important research during the summer of 2007 to further characterize the fauna using the region and to investigate habitat use for essential fish habitat modeling for the most common species.

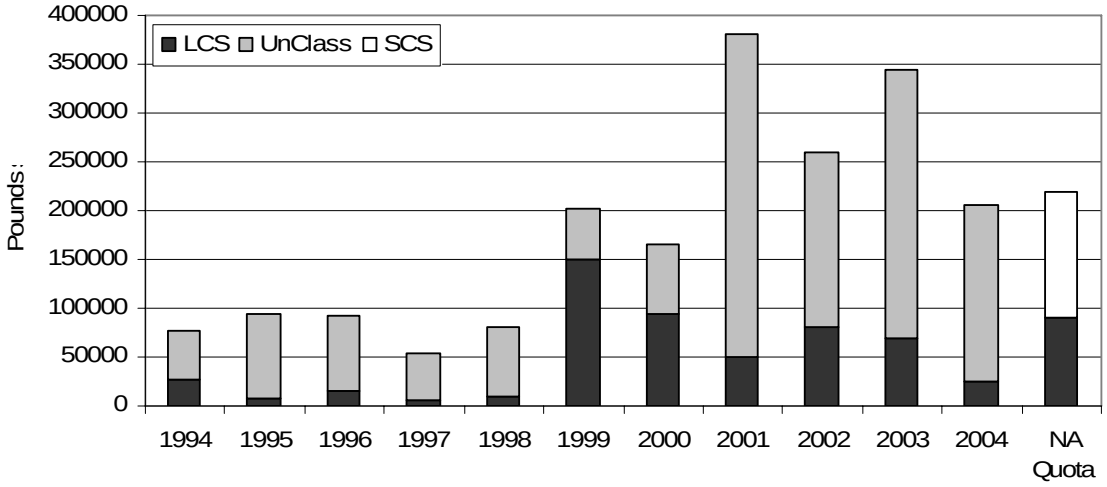

Figure 5: Virginia commercial landings of sharks excluding smooth dogfish and spiny dogfish (1994-2004). The 2005 federal quota for the North Atlentic region is also shown. Source of data: VMRC & NMFS. LCS = Large Coastal Species, UnClass = Unclassified Sharks (non-dogfish), SCS = Small Coastal Species

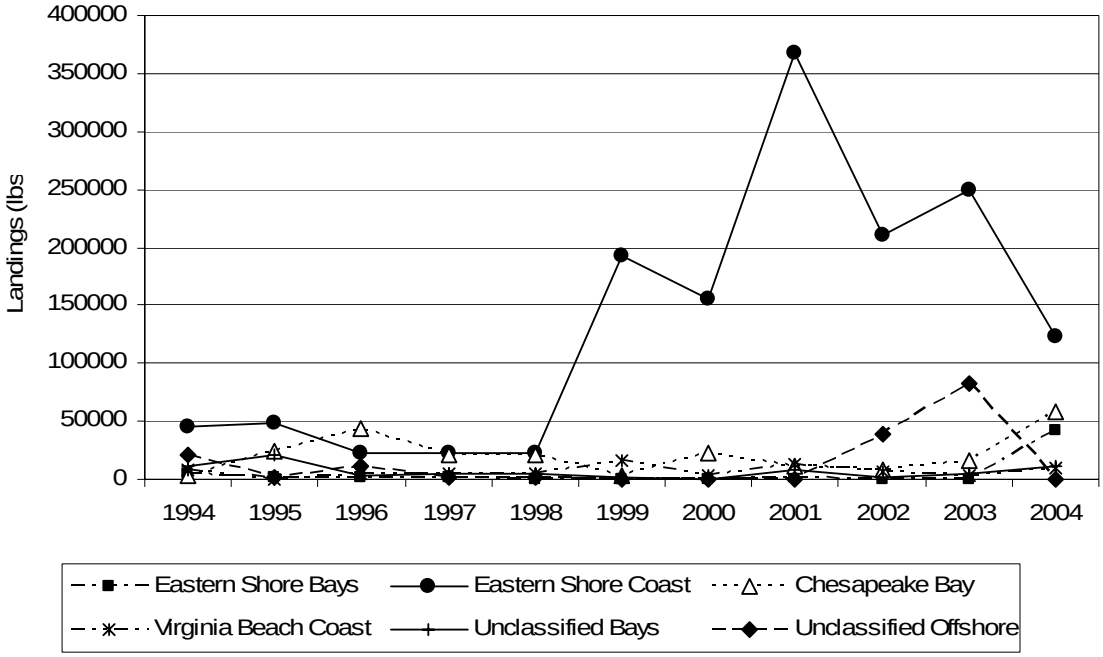

Figure 6: Regional commercial landings of sharks (excluding smooth dogfish and spiny dogfish) in Virginia (1994-2004). Source of data: VMRC

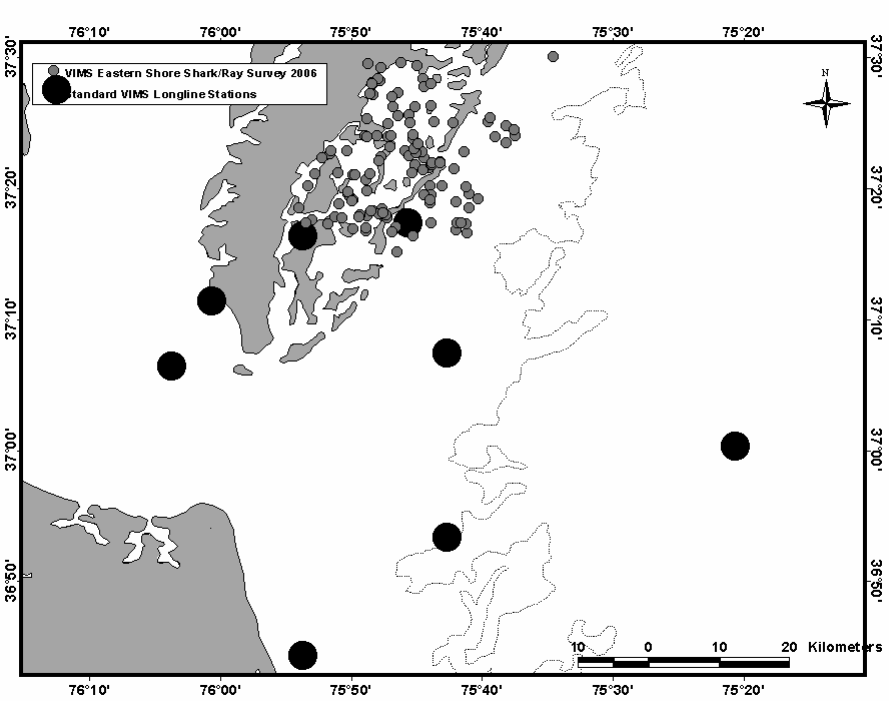

Figure 7: Locations of standard longline stations (large circles) and distribution of ancillary longline sets made in 2006 (small circles) to investigate the distribution and habitat use of sharks and rays on Virginia's Eastern Shore.

Although standard tags have provided a great deal of information on shark movements and migration, they only provide two pieces of geographic information: point of release and point of capture. A subset of the sharks and rays were fitted with ultrasonic transmitters and an array of listening stations (Vemco VR2 receivers) was used to monitor their movements and residency in the tidal lagoons. The passive acoustic receiver array (ranging from 15 to 21 receivers) was deployed in Eastern Shore lagoons during the summers of 2003, 2004, and 2005 to monitor movements, residency, and site fidelity of sandbar sharks using Wachapreague Inlet and associated tidal creeks. During 2003 and 2004, a total of 64 sandbar sharks were implanted with transmitters. During 2004, 37.1% of the sharks transmittered in 2003 returned to the Wachapreague array. Four additional sharks were detected by a similar array maintained by researchers in Delaware Bay and four were known to be harvested by fishers. During 2005, 67.6% 6f those transmittered in 2004 were detected by the Wachapreague array and one of these sharks was detected in Delaware Bay. The results from both years confirm that at least 67% of the sharks transmittered survived to the next summer, suggesting the annual survivorship rates of sandbar sharks estimated by Cortes and Brooks (2005), which were 79-85% for the age classes in the telemetry study, may be realistic.

In 2006, 19 Vemco VR2 receivers were deployed throughout Hogg Island Bay and surrounding inlets on Virginia's Eastern Shore in early June to assess habitat use by sharks and rays. We also deployed two water quality monitors (YSI) within the array to archive temperature, salinity, and dissolved oxygen every fifteen minutes throughout the summer months. The receivers were cleaned and data were downloaded on a weekly to biweekly basis. During 2006, we implanted Vemco acoustic tags with multi-year battery life in five bluntnose stingrays and five southern stingrays. Preliminary data suggest the bluntnose stingrays use the lagoon beginning in June and depart in late July while southern stingrays immigrate to the lagoon in early July but remain until early October. In early June, four-year transmitters were also implanted in three adult female sandbar sharks that were postpartum. Based on catch data, it has been hypothesized that adult sandbars leave nearshore waters soon after pupping. Surprisingly, all

three sharks remained in the lagoon for a minimum of three weeks and one remained until late August. We intend to have the receiver array in place covering all inlets from Smith Island Inlet to Wachapreague Inlet by early May to monitor the arrival of tagged animals. During the summer of 2007, we intend to implant 7 additional transmitters in adult female sandbar sharks and 30 transmitters will be allocated to the large demersal rays. Continued monitoring of this array in subsequent summers is needed to investigate annual fidelity and seasonal use of these lagoons by all species tagged and to examine whether pregnant sandbar sharks show biannual fidelity for spawning sites. Requested funds will allow the purchase of ten additional transmitters and to replace three receivers lost in storms during 2006.

Age, Growth and Demographic Studies.

Knowledge of age, growth and demographic parameters are essential to informed management of any species. Elasmobranch age and growth studies have been ongoing at VIMS since 1973. These data have been essential to modeling efforts by VIMS scientists as well as NMFS scientists at the NMFS Shark Evaluation Workshops which have formed the basis for NMFS stock assessments. In many teleost species it has been shown that as populations are harvested and intraspecific competition declines, fish populations will compensate by increasing growth rates and perhaps maturing earlier. These compensatory responses have been difficult to identify in sharks due to their long generation times. We compared growth rates for sandbar sharks in 1980 and 1992, before and after the major stock decline, and found little growth compensation and no change in age at maturity. Now in 2006 the sandbar shark population is still less than 50% of that in 1980 and compensation has had more time to become apparent. Therefore, we are examining sandbar shark growth rates (based on vertebral analysis) in 2001-2006 for comparison to published historical rates and those derived from archived vertebrae. A portion of the proposed funding would be used to complete this compensatory aging study.

Genetic Studies.

We continue our work using modern genetic techniques to estimate the effective population size of sandbar sharks using the Chesapeake Bay nursery as well as the effective number of females pupping in these nurseries. We are also comparing gene frequencies of animals caught in the Chesapeake Bay nurseries with those found in other nurseries along the East Coast to examine philopatry and estimate gene flow. Periodicity will be assessed within nurseries by using highly polymorphic loci to detect young-of-year kin groups within and between sampling years. In order to accomplish these goals, over 1000 fin clips have been collected from juvenile and adult female sandbar sharks in the Eastern Shore and lower Chesapeake Bay nurseries with an additional 500 samples from Delaware Bay. Two pregnant females caught in lagoons on Virginia's Eastern Shore and their litters were screened at these eight loci. The first litter contained 11 pups and a minimum of four sires was necessary to explain the observed gene array. The second litter contained seven pups and a minimum of two sires was necessary to explain the observed gene array. In addition, a YOY sandbar shark caught in 2003 was identified as the progeny of an adult female caught in the same Eastern Shore Lagoon in 2005 using relatedness software. Eighteen additional mother/litter groups were genotyped to examine the prevalence of multiple paternity in sandbar sharks throughout the western North Atlantic. Of the twenty litters examined, seventeen showed evidence of multiple paternity (Portnoy et al. in press). The number of estimated sires per polyandrous litter varied from 2 to 5. The control region has been sequenced for 102 YOY sharks from Chesapeake Bay and 50 sharks from Delaware. Samples of YOY from Georgia, South Carolina and GOM will be added in the next year enabling us to estimate the effective population size of adult females and define the nature of gene flow between nurseries. In addition, multiple paternity is being investigated in spiny dogfish (*Squalus acanthias*) and smooth dogfish (*Mustelus canis*) using five polymorphic microsatellite loci. Nearly all needed sampling has been completed. A portion of the requested funding would be used for the analysis of these samples.

Expected Results and Benefits

The nursery ground research has been identified specifically in the FMP and by the NMFS workshop panel (Anon. 1994) as an outstanding data gap that must be filled for effective management of the stocks. In addition, the VIMS longline survey has provided the only reliable fishery-independent assessment of relative abundance of East Coast shark stocks and was the longest-running historical data source used in the recent stock assessments for the large coastal shark complex (Cortés et al. 2002), small coastal shark complex (Cortés 2002), and individual stock assessments for dusky sharks (Cortés et al. 2006) and sandbar sharks (Cortés, E. and Babcock 2006) by NMFS. Thus its value has been recognized as an important tool in defining trends in East Coast shark abundance over a 32-year period. Continued collection of fishery-independent data to estimate shark abundance will contribute significantly to evaluating the effectiveness of management measures implemented in the FMP, and could contribute significantly to future revisions in the FMP. Further analysis of size/age frequencies for important species can provide information on the status of the stock relative to management effectiveness.

Sharks are important resources to recreational and commercial fisheries and most landings occur in state waters. Data from the VIMS longline survey are relied upon by VMRC in developing management actions for coastal sharks. Catch rates of juvenile sandbar sharks in Chesapeake Bay declined dramatically from 1992-2004. The portion of the survey conducted in Chesapeake Bay is crucial to monitoring this population trend and evaluating the effect of management actions on recovery. In addition, maintaining stable populations of top predators like sharks may be critical to the balance and proper function of the Chesapeake Bay ecosystem.

The ultimate benefit of this proposed research will be to contribute to more effective management of shark stocks, to further stock recovery, and provide a more stable fishery. Primary beneficiaries of the research will be the VMRC, NMFS, ASMFC, the Management Councils responsible for management of fishery resources of the middle and southeastern Atlantic states, and ultimately the fisheries themselves. We will continue to publish the results of our work in recognized scientific journals. During the past two years, nearly 20 peer-reviewed papers have been published on the biology of sharks and rays by our research group. Project personnel will continue to present scientific papers on our work to international meetings of the American Society of Ichthyologists and Herpetologists and the American Elasmobranch Society. Perhaps most importantly, we will continue to provide our data for use by state, regional, and federal management agencies for use in stock assessments and developing management plans.

Locations:

- Virginia Institute of Marine Science, Gloucester Point, VA.
- VIMS Eastern Shore Field Station, Wachapreague, VA.
- Anheuser-Busch Coastal Research Center, Oyster, VA

This study will be focused in the lower Chesapeake Bay and lagoons along Virginia's Eastern Shore. Implications of this research are far reaching because the Chesapeake Bay nursery appears to be the principal nursery for sandbar sharks in the western North Atlantic. Also relative catch rates for large coastal sharks from Virginia generally reflect population trends for coastal sharks throughout the northwest Atlantic Ocean (Musick et al., 1993).

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VIMS Shark Program Budget
Abundance and distribution of sharks and rays in Chesapeake Bay and Virginia's coastal lagoons

MRFAB REQUEST

	VMRC	VIMS	TOTAL
Personnel			
Principal Investigator - Musick (6%)		9,210	9,210
Principal Investigator - Grubbs (15%)	5,700		5,700
Fringe @30% salary	1,710	2,763	4,473
Supplies, field			
Telemetry (VR2 receivers, R-code transmitters)	13,200		13,200
Longline Supplies (mainline, branchlines, bait, gaffs, tags, totes, etc)	4,200		4,200
Fuel (200 gal/day @ $2.35/gallon)	5,640		5,640
Supplies, lab			
Age, growth, etc (saw blades, slides, stains)	1,320		1,320
Genetics (Sequencing kits, PCR kits, reagents, buffers, gloves, microcentrifuge tubes)	5,640		5,640
Travel (to field sites @$.58/mile, tolls)	2,000		2,000
Dormitory/Lab Fees (Eastern Shore)	1,800		1,800
Tag Rewards (100 x $10)	1,000		1,000
Vessel costs			
R/V Bay Eagle Rental & Crew (12 days @ 16 hours/day and $110/hr)	33,560		33,560
Eastern Shore Vessel Rental (30 days @ $100/day)	3,000		3,000
Total Direct Costs	78,770	11,973	90,743
Facilities & Administrative Costs	10,303	14,080	24,382
TOTAL,VIMS Longline Survey	89,073	26,053	115,125

PROJECT SUPPORT
NATIONAL SHARK CONSORTIUM

FEDERAL YEAR 2006	
Benefits	14,709
Salary - Classified	28,500
Principal Investigator	25,980
Grad Assistant	88,300
Travel	7,275
Supplies & Material	19,200
Grad Scholarships	43,146
Vessels	40,000
Indirect Costs	54,830
	$321,940

FEDERAL YEAR 2005	
Benefits	9,127
Salary - Classified	9,000
Principal Investigator	25,980
Wages-Hourly	5,000
Grad Assistant	82,000
Printing	200
Travel	14,150
Supplies & Material	44,822
Grad Scholarships	40,990
Rent-Equipment	39,500
Vessels	60,000
Equipment	5,000
Indirect Costs	93,838
	$429,607

VIMS has been part of a large national shark research program since 2002. Last year funding was decreased by 25%. This request seeks support to allow completion of the 2006-07 project in Virginia waters. Budget summaries above depict most recent two-year support from the National Marine Fisheries Service.

Status of support for 2007-08 is still uncertain pending finalization of the federal budget.

Budget Explanation

Salaries: Two co-principal investigators and five graduate research assistants will participate in this research. The only personnel support requested is 15% of the Principal Investigator's salary.

Vessel costs:
R/V Bay Eagle; Rental plus crew = $180/hour, 12 days @ 16 hours per day = $33,560
Fuel = 200 gallons/day @ $2.35 per gallon = $5,640
Small Vessels; 30 days @$100/day = $3,000

Field Supplies:
Telemetry = 3 VR2 receivers @$1,000 = $3,000
30 V16 transmitters @ $300 = $9,000
Batteries = $800
Replacement Hardware = $400
Longline Supplies include bait and cruise supplies as well as replacement costs for mainline, floats, anchors, branchline materials, gaffs, tagging applicators, dehookers etc.

Lab Supplies:
Age and Growth = Replacement blades for isomet saw; 4 @ $250 = $1,000
Slides, Crystal Bond, Slide Boxes etc = $200
Stains = $120
Genetics = Sequencing kits, 2 @ $790 = $1,580
PCR kits, 2 @ $530 = $1,060
Labeled Primers = $1,200
Reagents, cleaning, equipment maintenance = $1,000
Misc. supplies and shipping costs = $800