

# Wildlife and Fisheries Technical Paper Abstracts

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## Multi-state Qualitative Chronic Wasting Disease Risk Assessment

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*Abstract:* Random active surveillance for Chronic Wasting Disease (CWD) in free-ranging populations of cervids is challenging due to low prevalence and heterogeneous distribution of the disease. Furthermore, geographic areas are at different levels of risk for exposure to CWD depending on the presence of various risk factors. Based on the assumption that areas of Virginia in proximity to concentrations of farmed or captive deer or elk are at the highest risk for the introduction of CWD into the free-ranging white-tailed deer population (*Odocoileus virginianus*), the Virginia Department of Game and Inland Fisheries (VDGIF) conducted a qualitative risk assessment that resulted in the stratification of the state into three risk categories (high, medium, and low risk) and the application of different surveillance strategies in each region. All captive cervid facilities within Virginia and the neighboring states (Kentucky, Maryland, North Carolina, Tennessee, and West Virginia) were designated a CWD risk category based on species present, movement histories and the state's CWD surveillance program for captive cervid facilities. The highest risk facilities were defined as facilities with known or suspected importations of white-tailed deer, elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), black-tailed deer (*Odocoileus columbianus*), moose (*Alces alces*), as well as any hybrids or subspecies from out of state within the last five years and facilities that moved these species within the state from one of the above facilities within the last five years. In addition, any facility of unknown status or without adequate CWD surveillance was considered at high risk. These facilities with 10-mile buffers were mapped using GIS (ArcView, ESRI, Redlands, California), and the distribution of the high risk facilities was used to stratify the state into the risk categories. Based on a concentration of high risk facilities, we identified a region of northwest Virginia including sections of Shenandoah, Frederick, Clarke, and Loudoun counties at high risk for exposure to CWD. Subsequent to this risk assessment, West Virginia reported its first CWD-positive case adjacent to the previously defined high risk surveillance area. This risk assessment provided valuable information in delineating an area of highest concern where active surveillance was focused, allowing VDGIF to maximize the use of resources. This study also illustrates the importance of adopting a regional approach to assessing CWD exposure risk factors and designing appropriate surveillance strategies.

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# Evaluation of Downing Population Reconstruction: Simulations for Black Bear and White-tailed Deer Populations

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*Abstract:* Population reconstruction is a technique that uses harvest-at-age data and backward addition of cohorts to estimate minimum population size over time. Management agencies use population reconstruction because it uses data that are commonly collected for managed species, particularly for bear and deer populations. However, this technique had not been rigorously evaluated for accuracy or precision. We used computer simulations to evaluate the impact of life history parameters, harvest rate, sampling error, and violated assumptions on Downing population reconstruction estimates. This technique was robust to collapsing age classes if harvest rates for the oldest two age classes in the reconstruction were similar. Harvest and natural mortality rates were the driving factors in the accuracy of population reconstruction estimates. The technique was most accurate when harvest rate was high and natural mortality was low. Use of population reconstruction to detect population trends was confounded by changes in harvest and natural mortality rates. Gradual changes in these rates over time could potentially mask underlying population trends. Large annual variations in harvest rate also could make trend detection difficult. Given these findings, population reconstruction appears to be a promising management tool for species with high, relatively constant harvest mortality, such as many hunted bear and deer populations.

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# Population Abundance and Genetic Structure of Black Bears in Coastal North Carolina and Virginia Using Noninvasive Genetic Techniques

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*Abstract:* We investigated population densities and genetic structure of black bears at three national wildlife refuges (Great Dismal Swamp [GDSNWR], Pocosin Lakes [PLNWR], and Alligator River [ARNWR]). We derived density estimates from DNA samples collected noninvasively at each refuge for two consecutive summers. Hair samples were analyzed for individual identification using 6–7 microsatellite markers. Estimated densities were some of the highest reported in the literature and ranged from 0.56–0.63 bears/km<sup>2</sup> at GDSNWR to 0.65–1.12 bears/km<sup>2</sup> at ARNWR to 1.23–1.66 bears/km<sup>2</sup> at PLNWR. Sex ratios were male-biased at all refuges. We also assessed genetic variability of bear populations at these refuges using 16 microsatellite markers for 40 bears at each refuge. Genetic variability was substantially high at all refuges compared to other bear populations in North America, with observed heterozygosities ranging from 0.6729 at GDSNWR to 0.7219 at ARNWR.  $F_{ST}$  and  $D_S$  values were relatively low (0.0257–0.0895 and 0.0971–0.3640, respectively), suggesting that gene flow across the landscape is adequate to prevent high levels of genetic differentiation among refuge populations. Genetic statistics at GDSNWR compared to ARNWR and PLNWR (lower heterozygosity, higher  $F_{ST}$  and  $D_S$ , etc.) suggest that this population is partially isolated, potentially due to geography (i.e., the Albemarle Sound) and urbanization (i.e., the towns of Suffolk and Chesapeake). U.S. Fish and Wildlife Service should consider maintenance of natural corridors to the south of ARNWR to ensure adequate gene flow among populations.

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# Home Range Dynamics of Black Bears in the Alleghany Mountains of Western Virginia

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**Abstract:** The Cooperative Alleghany Bear Study (CABS) was initiated in 1994 to address concerns over the lack of biological and ecological data for black bear (*Ursus americanus*) populations in the Alleghany Mountains of western Virginia. We examined home range dynamics of bears during 1994–2002 on two study areas (referred to hereafter as the north and south) that were approximately 160 km apart. We analyzed data with three home range programs (Animal Movement Analysis—AMA, Home Range Extension—HRE, and ABODE), and determined the HRE was best suited for our analyses. We used HRE to generate annual home ranges (fixed-kernel) for 90 bears over 160 bear years. We also generated seasonal home ranges using Minimum Convex Polygon (MCP). Annual and seasonal home ranges of male and female adult bears in the southern study area were larger than that of male and female adult bears in the northern study area. Southern females and northern males had annual home ranges similar in size at the 95% and 75% fixed-kernel contours. In both study areas, most bears did not shift the geographic location of their home range when transitioning from spring to summer (north: 63.0%, south: 57.0%) or from summer to fall (north: 67.0%, south: 65.0%), while most bears shifted their seasonal range between spring and fall (north: 67.0%, south: 52.0%). Most female bears in both study areas maintained the same spring and summer home range throughout the duration of the study, while 63% of northern females changed their fall home range and 55% of southern females maintained their fall home range. We found no differences in annual and seasonal home range size among years or among age classes for adult females, but tests for intra-year seasonal difference indicated that fall range ( $\bar{X}=6.0$  km<sup>2</sup>) was larger than spring ( $\bar{X}=2.8$  km<sup>2</sup>) and summer ( $\bar{X}=2.4$  km<sup>2</sup>) in 1997. This may have been associated with a poor mast crop in western Virginia during this year. Reproductive status did not alter annual home range size of adult females; females with and without cubs of the year (COY) had similar annual home ranges in both study areas (north: females w/COY: 16.6 km<sup>2</sup>, females w/o COY: 13.3 km<sup>2</sup>; south: females w/COY: 61.9 km<sup>2</sup>, females w/o COY: 47.5 km<sup>2</sup>), suggesting that cubs do not inhibit the overall movements of their mothers throughout the year. Long-term, multi-region research projects, such as this one, are uncommon but provide unique opportunities to examine how variability affects home range dynamics of black bear populations. One outcome of this project is it allowed us to observe differences in the home range dynamics of two black bear populations within western Virginia which may reflect regional differences in habitat quality and population demographics. The length of this study also allowed us to monitor individual bears over several years and through multiple reproductive cycles, enabling us to make comparisons of home range size and site fidelity with less variability. Variation among bears can obscure the relationship between home range dynamics and influencing factors that function in determining how a bear chooses to move around its environment. Knowledge of a bear's home range provides insight into several behavior and ecological processes. It also, simply, identifies where an animal is occurring, which is critically important for managing a species.

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# Innovative Approaches to Resource Conservation

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*Abstract:* Managing for quality sport fishing is becoming more difficult as natural resources dwindle. This trend also creates additional problems with endangered species. Benefits accrued from land and water conservation programs pay dividends to both. Texas Parks and Wildlife Department has embarked upon an aggressive approach to resolving species and habitat conflicts through cooperative programs with local governments and especially private landowners. To date, 1) a “natural” cienega for two endangered fishes has been recreated, 2) a Conservation Agreement has been enacted to enable private landowners to create wetlands for the Pecos pupfish (*Cyprinodon pecosensis*) and preclude the need to list it as endangered, 3) restoration has begun on an urban stream that emanates from the third largest spring in the state and is home to a federally threatened minnow, 4) a watershed management team, consisting of private landowners and government representatives, has been convened to develop a comprehensive strategy to protect habitat essential for five state and federally listed fishes, 5) we are working with a local river authority and fishing clubs on a Guadalupe bass (*Micropterus treculi*) stocking program designed to reverse the trend of hybridization with introduced smallmouth bass (*M. dolomieu*), and 6) in coordination with city and county governments, we have begun a project to restore habitat in what was one of the largest springs in Texas. Involving individuals and local governments in conservation of species and their habitats increases the likelihood of achieving long-term benefits for natural resources as well as protection of these resources for the public.

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# Striped Bass Brood Stock Management in Texas: Planning for the Future

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*Abstract:* Striped bass (*Morone saxatilis*) were first introduced into inland waters of Texas in 1967. Since that initial introduction, 44 inland waters within the state have been stocked with over 120,000,000 striped bass and the species has become the fourth most popular sport fish among anglers. Although successful striped bass fisheries have been established in numerous Texas reservoirs, there are few self-sustaining populations, and maintenance of the fisheries is dependent upon hatchery stocking programs. The high fecundity of striped bass renders the species vulnerable to genetic drift and inbreeding since hatcheries may meet production quotas with relatively few brood fish. Even when large numbers of brood fish are used, offspring typically are reared and distributed in a manner that may limit the effective population size ( $N_e$ ) of fisheries created and maintained through hatchery stockings. In 2005, a sample of 56 brood fish collected from the Trinity River below Livingston Reservoir, which serves as the primary source of hatchery brood fish, was evaluated at nine microsatellite loci. This sample demonstrated a lower mean heterozygosity (0.428) than those reported elsewhere for striped bass (typically > 0.500) and an estimated  $N_e$  depressed from the sample size to 34.8. These findings prompted a revised stocking plan designed to increase genetic diversity for long-term maintenance of this important population.

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# Planning for Prevention of Invasions of Hitchhiker Contaminates

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*Abstract:* Invasive species, diseases and parasites often move from place to place as undetected hitchhiker contaminants contained within pathways. Natural resource agencies could inadvertently provide pathways for invasions through their work unless protocols are developed to prevent and remove hitchhikers. Strategic planning which identifies and removes contamination risks is necessary to craft effective protocols or best management practices (BMPs). HACCP (Hazard Analysis and Critical Control Point) is a strategic planning tool developed by Pillsbury Foods in the 1960s to ensure product safety in food produced for the space program. Its straightforward planning logic has been modified slightly to serve as a pathway management tool. Sequential steps in HACCP guide planners to ask the right questions to identify hazards and define effective BMPs to prevent, remove or reduce pathway contamination. Strategically examining complexes of linked actions focuses preventions with impact at key pathway junctures. HACCP is the world gold standard in food production to prevent and remove contamination for a reason. This simple planning strategy could prevent impacts to resources, people, and species by preventing invasions. Often, irreparable damage is done to the environment and economy through unintended introductions. Human mediated introductions are not accidental. Unintentional introductions are a result of failure to plan. HACCP plans help managers prioritize resources and base decisions on facts which will prevent introductions. This presentation describes how universally applying a HACCP concept to an intra- or interstate pathway is a good business strategy for natural resource professionals. A national and international support system has been developed at [www.HACCP-NRM.org](http://www.HACCP-NRM.org)

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# Expansion of a Northern Snakehead Population in Virginia Potomac River Tributaries

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*Abstract:* A northern snakehead (*Channa argus*) population was documented within a 23-km reach of the tidal freshwater Potomac River and associated tributaries in 2004 when 20 snakeheads were collected with several gears including hook-and-line and electrofishing. An additional 272 snakeheads were collected in 2005, and 143 more were captured in 2006 (through September) primarily with electrofishing gears including boat, tote barge, and backpack units. The majority of captures in 2005 occurred during an October migration when juveniles and young adults ascended above the fall line. Boat electrofishing mean catch rate in tidal Dogue and Little Hunting creeks increased from 0.2 fish/hr in 2004 to 6.9 fish/hr in 2006 ( $r^2 = 0.99$ ,  $P = 0.07$ ). Reported angler catches during 2006 (32) exceeded the combined total of the two previous years despite declining media attention. Mean total length and weight in 2006 were 446 mm (SD = 141) and 1271 g (SD = 1027), and the length weight relationship was:  $\text{Log}W = -5.16 + 3.05(\text{logTL})$ . Dominant habitat uses were shallow waters (< 1 m) with floating and/or emergent vegetation. Natural reproduction was suspected during 2004 and 2005 based on the collection of age 0 fish both years and identification of nine year-classes in 2005 but confirmed in 2006 when a nest was located. Over 500 northern snakehead fry (mean total length 20 mm) were collected in September from this nest. Trends in female GSI and otolith daily ring counts of age 0 fish suggested protracted and/or repeat spawning beginning in early May and extending to August. Females were fecund carrying an average of 40,786 eggs that ranged in size from 1 to 2 mm. The collection pattern suggested snakeheads originated in Dogue Creek, as 88% of those we collected came from that watershed. The Virginia tributaries to the immediate north and south of Dogue Creek had the next highest number of captures. Fifteen forage species were identified from the gut contents of 253 northern snakeheads, and banded killifish were the dominant food item (22% frequency of occurrence). Bluegill, pumpkinseed, and white perch were also commonly consumed, but only two largemouth bass were found. A one-year radio-telemetry study was initiated in March 2006 to learn more about northern snakehead migratory habits and behavior. Twenty fish were implanted with transmitters, and locations and habitat use were recorded weekly. That study is still underway, but early results indicate a high degree of site fidelity, discrete home ranges, and movement in response to changes in flow regime. All fish for that study were tagged in Dogue Creek, but several fish moved to adjacent drainages where movement patterns were similar to distributions of angler-caught fish. Although the population appears to be expanding based on electrofishing and angler catch rates, overall range expansion (area known to be colonized) has not increased greatly since 2004. Recent increases in angler catch at the northern and southern terminus of the existing distribution, however, suggest range expansion is probably imminent.

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# Zebra Mussel Status in Virginia: A First Attempt to Eradicate the Species

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*Abstract:* In September 2002, the Virginia Department of Game and Inland Fisheries (VDGIF) confirmed that a zebra mussel infestation was present in Millbrook Quarry, western Prince William County, documenting the first known population within the Commonwealth. The 12-acre, 93-foot-deep quarry has been inactive since at least February 1963 and is currently used solely for scuba diving. While Millbrook Quarry has no surface inflow or outflow, given the proximity of Millbrook Quarry to an adjacent river (Broad Run) and its extensive use as a dive location, it is highly unlikely that the zebra mussel population would remain isolated. Broad Run has historically flooded the bank separating it from Millbrook Quarry (1972, Hurricane Agnes), and unintentional transport of veligers by divers from the quarry to other state waters is likely. Given the potential biological and economic impacts if zebra mussels were to escape from Millbrook Quarry, VDGIF worked with federal, state, and local agencies; industry and conservation organizations; and individuals to pursue eradication. The three-and-a-half-year effort involved establishing an interagency workgroup to assess the feasibility of eradicating the population; investigating the hydrologic, geochemical, and biological characteristics of the quarry and infestation; evaluating potential avenues for eradicating the zebra mussels; surveying nearby Broad Run, Lake Manassas, and other popular dive sites and reservoirs to ensure that zebra mussels had not escaped into other waters; issuing a request for proposals to eradicate the infestation; selecting a process and contractor to conduct the eradication; and surveying Broad Run for occurrence of native mussels or other species that might be impacted by potassium seepage from the quarry. A panel of biologists, chemists, geologists, engineers, and human health experts representing seven Virginia agencies evaluated the proposals submitted, and the project contract was awarded to Aquatic Sciences L.P. of Orchard Park, New York, with eradication finally commencing on 27 January 2006. The eradication comprised of elevating potassium concentrations in the quarry through the introduction of potash—a commercial grade fertilizer. The entire quarry was injected with 174,000 gallons of potash solution (12% potassium) over a three-week period, with a target concentration of 100 milligrams per liter of water (ppm); far below the level that would invoke environmental or human health concerns, but more than twice the minimum concentration needed to kill all zebra mussels. Eradication was confirmed via examination of mussels scraped from rocks at numerous sites around the quarry, visual confirmation by VDGIF scuba divers, video documentation of the dead zebra mussels through use of a robotic camera, and achievement of 100% mortality of eighty bioassays of 100 live zebra mussels each placed at various locations and depths throughout the quarry. In dramatic contrast, other aquatic wildlife including turtles, fishes, aquatic insects, and snails continue to thrive in the quarry. To our knowledge, this is the first successful eradication of an open water zebra mussel population from a large, open water body.

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# The Mid-Atlantic Regional Panel on Aquatic Invasive Species: Facilitating Action-oriented Approaches to Aquatic Invasive Species Management

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*Abstract:* In April 2005 a newly formed panel of the Aquatic Nuisance Species Task Force (ANSTF) held its first meeting. The Mid-Atlantic Regional Panel on aquatic invasive species (MARP) is authorized under Section 1203 of the Non-Indigenous Aquatic Nuisance Protection and Control Act of 1990 (NANPCA). The MARP consists of individuals representing Federal and state agencies, regional and academic entities, non-profit environmental groups, and commercial interests from Delaware, District of Columbia, New Jersey, New York, North Carolina, Maryland, Pennsylvania, Virginia, and West Virginia. Challenges and exciting opportunities for management of aquatic invasive species are framing an action-oriented agenda for this newly-formed panel. The MARP's mission is to "assist state and federal agencies, and other stakeholders in developing and implementing strategic, coordinated, action-oriented approaches to prevention and control of aquatic invasive species in the Mid-Atlantic region." As one of six ANSTF regional panels, the MARP looks to connect national, state, and local interest in aquatic invasive species issues. The MARP meets on a semi-annual basis to develop and track progress of annual work plans. Three working groups, policy, education and outreach, and science and management, are tasked with implementing actions in the work plans. A priority of these groups is to improve cooperation, coordination and communication on invasive species issues across the region. These and other priorities will be discussed as well as strategies for strengthening regional efforts to address aquatic invasive species management.

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# Texas Response to Largemouth Bass Virus: Five Years of Monitoring Freshwater Hatcheries and Fisheries

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*Abstract:* Since largemouth bass virus (LMBV) was implicated in 1998 and 1999 as responsible for fish kills in some of Texas' most prestigious bass fisheries (Fork, Sam Rayburn, Conroe and Toledo Bend lakes), the Texas Parks and Wildlife Department (TPWD) has taken an active role to better understand this emerging pathogen. An extensive statewide survey of 49 water bodies conducted in 2000 coupled with continued monitoring of bass fisheries has detected LMBV in 23 water bodies within nine of 13 water basins in the state. The virus has also been detected at TPWD freshwater hatcheries and procedures intended to minimize the incidental spread of this pathogen have been implemented. These measures include routine testing of hatchery-produced fingerlings and available brood stock, limiting stockings from LMBV-positive hatcheries to LMBV-influenced waters, disinfection of fish hauling units, and fish health inspection requirement for fish imported to the state. The TPWD has also participated in annual LMBV workshops sponsored by Bass Angler Sportsman Society to facilitate nationwide research and communication efforts to better understand LMBV.

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# Spatial and Temporal Differences of Atlantic Menhaden Recruitment across Major Drainages of the Chesapeake Bay

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*Abstract:* Atlantic menhaden (*Brevoortia tyrannus*) is well-known for its commercial and ecological importance and has been historically declining in the Chesapeake Bay, Maryland, one of its principal nursery habitats along the eastern coast. Utilizing data from the Striped Bass Seine Survey of the Maryland Department of Natural Resources, we evaluated how the distribution of over 1 million Atlantic menhaden had changed from 1966 to 2004 for 12 river drainages. We observed significant or marginally significant declines in 42% of the drainages, with drainages of the northern Bay showing the majority of those declines. Continued recruitment to several drainages of the Bay may partly explain why the adult spawning population is not putatively declining. We determined if temporal changes in abundance were related to changes in salinity or water quality for five major drainages of the watershed. For one of these drainages, the Patuxent River, differences in productivity across sites largely explained differences in abundance. For the four remaining drainages, differences in recruitment could not be explained by salinity or productivity. During 2005 (July–August), we sampled four rivers of the Chesapeake Bay watershed and two rivers of the Delaware Bay watershed to compare habitat use by recruiting Atlantic menhaden. We collected 69 juvenile Atlantic menhaden, which were most abundant in the Choptank River. Abundance was highest downstream for rivers of the Delaware Bay, suggesting a distributional relationship to salinity. In the four rivers of the Chesapeake Bay, preliminary data indicate a weak relationship of Atlantic menhaden to land use, salinity, or other physical factors and on-going work will elucidate the relationship between phytoplankton size and community structure to the distribution of Atlantic menhaden. While reducing nitrogen loading and enhancing water clarity may improve Atlantic menhaden production, we suggest that the role of offshore processes on large-scale declines has been largely neglected and studies on larval ingressions are necessary for further elucidation of spatial and temporal patterns of juvenile distribution in the Chesapeake Bay.

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# Potential Conflicts between Dredging and Migratory Behavior of American Shad

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*Abstract:* The U.S. Army Corps of Engineers (USACE), Norfolk District, conducts maintenance dredging of federal navigation channels within the James River, Virginia. Maintaining navigability of these shipping channels is important for large vessels visiting terminals in the cities of Newport News and Richmond. However, channel dredging activities are currently restricted from 15 February until 30 June each year due to concerns that dredging during these months may interfere with the upstream pre-reproductive migration of American shad (*Alosa sapidissima*) and other anadromous fish that utilize the James River and its tributaries. Anadromous fish species require access to tidal freshwater and non-tidal rivers and streams for spawning. There have been few scientific investigations examining the potential effects of channel dredging on the migratory behavior of anadromous fishes, as evidenced by a lack of peer-reviewed publications on this subject. Resource agencies, mandated to protect biological resources, frequently choose conservative management options in the absence of biological data. This management practice is often referred to as the precautionary principle. In many cases, protection is afforded by constraining the dredging operations to environmental windows; i.e., dates believed to have minimal conflict with resource use of the waterway. Unfortunately, compliance with environmental windows can complicate dredging contracting schedules with significant economic impacts. Although there appears to be no conclusive, documented evidence that dredging operations impede fish migration, this remains a recurring reason for compliance with environmental windows in many USACE districts.

In spring 2005, the USACE Engineer Research and Development Center (ERDC) and the College of William and Mary, Virginia Institute of Marine Science (VIMS), conducted a study using acoustic telemetry designed to assess the potential impacts of channel dredging on the migratory behavior of American shad in the James River. Eight hydrophone arrays were deployed within the James River to monitor the migration throughout the main-stem as well as entrance into the two major tributaries, the Chickahominy and Appomattox rivers. The movements of tagged shad through the dredging transect and in the vicinity of the dredge were examined to assess differences in migratory behavior among the tagged cohort. Ninety eight American shad and seven hickory shad were tagged and released over seven tagging events. A total of 51 of the total 105 tagged individuals proceeded upstream to at least the Chickahominy River. The channel dredge was on station and excavating sediments from 9–28 March 2005 for approximately 298 hours. The results of this intensive study reveal the difficulties faced when dealing with environmental factors such as weather and availability of fish. Even with strong partnerships and coordination among several natural resource management agencies, it can be a struggle to effectively execute a natural resource project or study with the unpredictable nature of our surrounding environment.

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# Contribution of Stocked American Shad Fry to Juvenile American Shad Outmigration in the Roanoke River, North Carolina

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*Abstract:* Significant declines in American shad (*Alosa sapidissima*) populations have warranted restoration efforts by natural resource agencies along the Atlantic coast. In 1998, the North Carolina Wildlife Resources Commission developed a restoration plan for declining stocks of American shad in the Roanoke River. One strategy in the plan was to supplement wild American shad reproduction with annual stockings of hatchery-reared American shad fry. The fry were marked with a discrete oxytetracycline (OTC) mark specific to the stocking year and stocking location in the upper Roanoke River basin. Total numbers of American shad fry stocked ranged from 481,000 in 1998 to 2.5 million in 2005. To evaluate the contribution of stocked American shad fry to the portion of juvenile American shad that outmigrate, we checked for OTC marks on processed otoliths of American shad juveniles collected at night during weekly fall (September-November) samples in the lower Roanoke River. From 2000 to 2005, using boat-mounted electro-fishing gear, we collected and processed a total of 985 juvenile American shad with total lengths from 48 mm to 107 mm. Numbers of American shad juveniles collected ranged from 4 juvenile American shad in 2000 to 421 juvenile American shad in 2005. Since our first OTC-marked juvenile collected in 2002, the number of OTC-marked juvenile American shad, with total lengths ranging from 48 mm to 95 mm, comprised between 1% and 9% of the total juvenile American shad captured over the last four years. We present the annual contribution of hatchery-reared American shad to wild juvenile American shad abundance as well as a comparison of the relative contributions of two separate stocking locations. Ultimately, successful fry stockings yielding hatchery-reared juveniles may enhance the spawning stock of American shad on the Roanoke River.

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# Cooking Data in the Southeast: Recipes for Catching, Cleaning, and Consuming Information Harvested from the South Atlantic Snapper-Grouper Economic Data Collection

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*Abstract:* The following presentation examines the costs which fishermen holding commercial permits in the south Atlantic snapper-grouper and mackerel fisheries incurred to participate in those fisheries for calendar years 2002 and 2003. The two types of data collected to conduct an economic analysis were the variable costs data for each individual fishing trip and the fixed annual expenses data for operating in the fisheries. This evaluation has been undertaken to gain a better understanding of the economic ramifications, which different changes in management and regulation of the fisheries might have on the individual fisherman as well as the industry as a whole. To achieve this goal, regulation history is described, methodology is explained, and results are presented through correlations between vessel lengths, gear types, fishing locations, and crew size. The purpose of this assessment is to help managers make more informed decisions which consider the small business owner (i.e., permit holder). Any change in the regulation and management of fisheries has an effect on the national, regional, and local economies. This investigation attempts to bring some of these issues to the forefront to aid in the decision-making process.

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# **A Literature Review on Alligator Gar and Implications for a Reintroduction Project at Mingo National Wildlife Refuge in Southeast Missouri**

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*Abstract:* We performed a literature review on alligator gar (*Atractosteus spatula*). It revealed that habitat loss and over-harvest has caused this species to decline throughout the southern United States. The literature contained information about range, status, growth, sex determination, ecological roles in various habitats, and the public's perception of this fish. This information leads us to believe that alligator gar could be successfully reintroduced at Mingo National Wildlife Refuge. A fish community sample will be conducted prior to releasing alligator gar into Mingo NWR. We will employ a multi-gear approach to assess fish species richness and community structure. Sampling will include enough effort to detect changes in fish population size structure for selected species of interest (e.g., crappies, shad, buffalo, and carp) which may be affected by alligator gar predation. Stocking is planned for summer 2007. All alligator gar will be PIT- and floy-tagged to obtain reliable recapture data and to assess the efficacy of each tagging method. Ten alligator gar will be radio-tagged prior to release. We will attempt to sample alligator gar twice a year during one-week periods in spring and fall to obtain age/growth data, tag retention, gear efficiency, movement, and habitat use. Before and during this project we will conduct outreach and education efforts. This will include public meetings, small informational meetings, identification posters for anglers, outreach activities for youth, and a three page brochures, news releases, magazine articles, and a DVD.

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# Knowledge, Attitudes, and Opinions of Community Leaders and Residents in Tazewell County Regarding Endangered Species and Aquatic Conservation

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*Abstract:* Effective conservation and restoration of endangered mussels requires community support. Numerous studies have been made of the aquatic resources in the upper Clinch River, Tazewell County, Virginia, but prior to this effort, no study has assessed what the human community that lives in this biodiversity hotspot knows and thinks about their community's natural resources. We surveyed community leaders and residents of Tazewell County, Virginia, to assess baseline knowledge of the upper Clinch River watershed, endangered mussels, aquatic conservation, and water quality issues. The survey response rate is 40%. We compared total knowledge scores of the community to attitude and opinion data to assess if knowledge and understanding of endangered mussels are correlated with attitudes and opinions of the resource. According to preliminary results, residents are aware mussels occur in the community, but are not as aware of their status or their ecosystem services. We also surveyed and interviewed community leaders responsible for making land use management decisions to determine if their views were consistent with views of their constituents. Survey results will be used to develop specific outreach strategies designed to generate community support for aquatic resource conservation in Tazewell County.

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# Prevalence of Vibrionaceae and Aeromonaceae in Ribbed Mussels in Regard to Feral Horse Activity along Assateague Island National Seashore, Maryland

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*Abstract:* Assateague Island National Seashore supports approximately 150 non-native horses (*Equus caballus*) and it is important to ensure they do not adversely affect native species. The objective of this study is to determine the relationship between feral horse activity and bacteria levels in ribbed mussels (*Geukensia demissa*). Understanding this relationship is important because shellfish host bacterial pathogens, including those within the Vibrionaceae and Aeromonaceae families, can negatively affect the health of aquatic organisms and human health. We test two hypotheses: 1.) whether there is a difference in Vibrionaceae and Aeromonaceae levels in ribbed mussels along the Island and 2.) if there is a difference in Vibrionaceae and Aeromonaceae levels in ribbed mussels in regards to levels of horse activity, using horse distribution data. Bimonthly from May to November 2006, three replicates of 50 g of ribbed mussels were collected at each site. The mussels were homogenized with 450 mL of buffer, diluted 1:10 with 0.1% peptone, and spread onto tryptic soy agar plates. After incubating at 37C overnight, one countable plate from each replicate was used for total bacteria counts and then overlaid with a cellulose acetate membrane containing a substrate, which fluoresces when cleaved by enzymes present in Vibrionaceae and Aeromonaceae. ANOVA and post-hoc Tukey tests were used to determine if there were statistical differences between study locations. Lastly, correlation statistics were used to determine the relationship between feral horse activity and water quality. We were expecting to see variation in bacteria levels along the Island, such as elevated levels of Vibrionaceae and Aeromonaceae in areas of high horse activity due to increased nutrients in the water from their manure.

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# Fish Assemblage Response Following a Hurricane-induced Fish Kill in the Lower Roanoke River, North Carolina

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*Abstract:* On 18 September 2003, Hurricane Isabel inundated northeastern North Carolina with heavy winds, rain, and storm surge that flushed high BOD organic materials and anoxic water from the floodplains adjacent to the lower Roanoke River and its tributaries into the river proper. Dissolved oxygen levels rapidly decreased and remained at or near  $0 \text{ mg L}^{-1}$  for 12 days causing an extensive fish kill throughout 25 km of the lower Roanoke River. Using boat-mounted electrofishing gear, we had surveyed fish assemblages at three fixed sampling sites on the lower Roanoke River during the summers of 2001 and 2002 and at two of the three sites one week prior to the hurricane in 2003. We returned one month after the hurricane to examine the fish assemblages at those two sites following the fish kill. We assessed recovery of the fish assemblages at the three lower Roanoke River sites by sampling during the summers of 2004 and 2005. One month after the hurricane and fish kill, species richness at the two lower Roanoke River sites had decreased by nearly 50%, and relative abundances of all remaining species were drastically reduced. The resulting fish assemblages were dominated by bowfin (*Amia calva*) and eastern silvery minnow (*Hybognathus regius*). Previously abundant sport fish such as largemouth bass (*Micropterus salmoides*) and bluegill (*Lepomis macrochirus*) were absent or represented by only a few individuals. Species richness and relative abundances of most species increased as the lower Roanoke River fish assemblages recovered a few years following Hurricane Isabel. Results from our study indicate that lower Roanoke River fish assemblages can recover from catastrophic disturbances, and that access to and from refugia is critical for successful recolonization of affected areas. We emphasize the need to identify areas of refugia and to elucidate fish movement patterns in response to large-scale disturbances.

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# **An Examination of Feed Quantity and Quality for Oyster Mussel Held at White Sulphur Springs National Fish Hatchery, West Virginia**

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*Abstract:* Recovery of the federally endangered oyster mussel (*Epioblasma capsaeformis*) depends upon present efforts to successfully propagate and rear juveniles, and hold adults in a captive environment. An understanding of food quantity and food quality requirements for *E. capsaeformis* is vital to successful captive care. Neither an optimum food quantity nor specific food quality requirements have been identified for adults of this species. Oyster mussels were collected from Clinch River, Tennessee, and held at White Sulphur Springs National Fish Hatchery, West Virginia, during spring, summer, and fall 2005 and 2006. An optimum feed ration for adults fed green-algae (*Neochloris oleoabundans*) was determined via measurements of filtration rate and absorption efficiency. Diet quality was examined by targeting protein demand of specimens, since protein is essential for all biosynthesis and serves as a secondary energy source. Seasonal protein demand was examined by feeding mussels diets of *N. oleoabundans* differing in protein composition, and consequently C/N ratio. Mussels were fed a diet that was low, intermediate, or high in protein for three weeks in spring, summer, and fall. O/N ratio was used to evaluate nutritional status of mussels before and after trial diets. Regression analyses of C/N and O/N ratios provided an indicator of seasonal protein demand for adults of this species.

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# Efficacy of a Liquid Live Micro-organisms System, to Reduce Sediments and Improve Water Quality and Koi Carp Production in Hatchery Ponds

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*Abstract:* Turbidity and sediments in hatchery ponds can adversely impact water quality and fish production. To reduce turbidity, hatchery managers use chemical coagulants, chopped hay, or cottonseed meal. However, the turbidity-causing substances removed from the water column sink to pond bottoms as sediments which, when the pond is drained, can pollute receiving water bodies. For hatcheries to operate within effluent discharge limits, total suspended solids (TSS), total settleable solids, total ammonia nitrogen, pH and carbonaceous biochemical oxygen demand (CBOD) must be effectively managed. We tested the effects of the probiotic, the Liquid Live Micro-Organisms System (LLMO), on sediment accumulation, selected water quality variables (turbidity, Secchi disk transparency, CBOD, chlorophyll *a*, TSS, and pH), and koi carp production in plastic-lined ponds for 148 days (June–November 2004). The LLMO was applied at 1 L per 63,237 L of pond water at two-week intervals plus a booster of the same rate applied twice weekly for six weeks toward the end of the study. Data were collected as follows: pH, daily; chlorophyll *a* and Secchi disk visibility, once weekly; TSS, CBOD and turbidity, 14-day intervals; and sediment and fish data, after pond draining. The results revealed no significant ( $P > 0.05$ ) differences in sediment accumulation, water quality variables, and koi carp production between ponds treated with the LLMO and untreated control ponds. Our results did not support reports that LLMO can significantly reduce sludge accumulation or chlorophyll *a* levels, or improve water clarity.

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## Texas Freshwater Fisheries Center: A Valuable Production and Outreach Tool

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*Abstract:* Faced with declining license sales in the last quarter of the twentieth century, Texas Parks and Wildlife Department recognized that it needed to take a new approach to traditional fisheries management. Research, fishery surveys, and fish stocking were no longer enough. Education and outreach were also needed to help sustain the high quality of Texas recreational sport fishing in the new millennium by maintaining the existing customer base while building interest in fishing among a population that was increasingly urban, multi-ethnic and exposed to a wide variety of potential recreational activities. Fishing now has to compete for consumers' limited time and money with a plethora of school activities, organized sports leagues, the Internet and a host of other recreational activities. The Texas Freshwater Fisheries Center (TFFC), opened in November 1996, was constructed to facilitate two top-priority needs: sportfish production and outreach. From the very beginning, TFFC was designed to be an educational center and hatchery complex that would both teach visitors about fish and fishing. Unlike typical aquarium facilities, TFFC features natural habitats constructed around the outside of the building rather than on the inside. From an educational perspective, TFFC takes guests on a tour of Texas aquatic ecosystems ranging from wetlands to the bottom of a Texas reservoir. In nine years, the Texas Freshwater Fisheries Center has established itself as a leader in educating the public about fishing and conservation. Through August 2005, 545,735 people visited the center; 208,211 were school-aged children, and over 35% of the total visitation came from the Dallas/Ft. Worth, Houston, and Tyler, Texas, urban areas. My presentation summarized the efforts and impacts of this outreach facility.

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# Socio-economic Characteristics of Anglers Participating in a Common Carp Fishing Tournament in Austin, Texas

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*Abstract:* The common carp (*Cyprinus carpio*) has been described as one of North America's most widely distributed and underutilized fishery resource. This resource has been largely ignored by the majority of anglers in the United States because of the reputation of carp as an undesirable species. In contrast, carp are highly esteemed as a sport fish and food fish in many other countries of the world. In recent years, the negative perception of carp in the United States has been challenged by a small but growing number of anglers who view carp as a sport fish. The Carp Anglers Group has held the annual Austin Team Championship (ATC) carp tournament at Town Lake in Austin, Texas, since 2002. The lake is a world-renowned trophy carp fishery. Anglers competing at the fifth ATC (24–25 March 2006) were surveyed to gauge the status of carp fishing in Texas. A maximum of 45 two-person teams were permitted to compete at the event. The survey was conducted on-site, and a total of 83 of the 90 participating anglers were interviewed giving an effective response rate of 92%. Most of the anglers (70%) were from out-of-state (18 states, Washington, D.C., and Romania) and 42% of respondents were fishing the tournament for the first time. The majority of anglers were male (94%) Caucasian (98%), and the average age was 44. Forty-nine percent of anglers had at least completed a four-year degree and 42% of respondents had average household incomes of more than US\$100,000. Seventy-one percent of anglers said that carp fishing was their most important outdoor recreational activity. Respondents had been fishing for carp for an average of 19 years. The majority of anglers (81%) said that relaxation was the most important aspect of their fishing experience, and most respondents (46%) said that they predominantly fish with their friends. Sixty-nine percent of respondents were not at all interested in fishing as a means of obtaining food. Although the total of all prizes awarded during the tournament were valued at \$7500, only 22% of respondents indicated that winning a prize or trophy was very/extremely important to them. However, 74% considered catching a trophy fish (average weight of 11.9 kg) to be very/extremely important. Fifty-three percent of anglers indicated that they were extremely satisfied with the tournament and an additional 31% reported that they were very satisfied. The total direct expenditure in Texas by the 83 anglers interviewed was \$46,744 of which \$32,478 was accounted for by out-of-state anglers. It is hoped that the results of this study will provide baseline data that can help to address the broader issue of whether carp fishing has the potential to become an important component of freshwater recreational fishing and what implications that might have for angler recruitment and fisheries management in Texas.

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# Development of Largemouth Bass Fishing and Management in Texas

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*Abstract:* The creation of lentic habitats in Texas by reservoir construction provided the impetus for the establishment and management of largemouth bass (*Micropterus salmoides*) fisheries. Concurrently, many underlying societal factors and advancement in fishing technology helped focus the utilization of these fisheries. Just as Texas was experiencing a boom in new reservoir construction and angling opportunities, the population was becoming urbanized with more free time and money and better baits, boats, rods, reels and electronics were being developed. Competitive bass angling became well established, Florida largemouth bass (*M. s. floridanus*) stocking programs expanded, and bass management philosophy changed from being focused on harvest to catch-and-release. Presentation summarized information on how these factors combined to create a renowned recreational fishery which has a huge impact on the Texas economy.

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## ShareLunker Program

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*Abstract:* The ShareLunker program is a multifaceted angler recognition program that encourages anglers to donate largemouth bass (*Micropterus salmoides*)  $\geq 5.9$  kg to the Texas Parks and Wildlife Department (TPWD). These fish and their offspring have been used to enhance trophy bass fishing in Texas. Data from the program have been used to evaluate Florida largemouth bass stocking success and restrictive harvest regulations, and to identify reservoir characteristics which produce trophy fisheries. In addition, the program has emphasized the importance of catch and release fishing. The mission of the program is to involve the public in the conservation and enhancement of trophy bass fishing in Texas. TPWD provides significant incentives for anglers to participate, and cooperation from anglers has been excellent. Since the program's inception in 1986, a total of 418 fish from 54 reservoirs and 13 private lakes have been donated to the program. With the continuing demands on our freshwater resources, careful management of our trophy bass fisheries has become even more important in Texas. Improved methods of transporting, holding, and treating these fish for stress and injuries has resulted in improved survival and spawning. This presentation gives an overview of the history and success of this program, and the methods of holding and propagating ShareLunkers and their offspring.

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