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Epizootic mycobacteriosis in Chesapeake Bay striped bass: What is the fate of infected fish?

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USGS/NOAA Workshop on Mycobacteriosis in Striped Bass, May 7-10, 2006, Annapolis, Maryland

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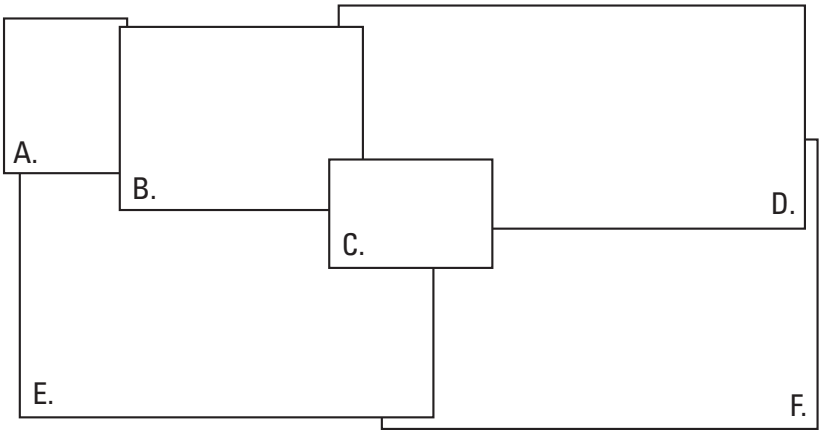

A. U.S. Fish and Wildlife Service biologist weighing Chesapeake Bay striped bass exhibiting skin lesions. Photo by Christine L. Densmore, U.S. Geological Survey

B. Stained tissue section taken from the spleen of a Chesapeake Bay striped bass exhibiting granulomatous lesions associated with a mycobacterial infection. Photo by David Gauthier, Virginia Institute of Marine Science

C. Chesapeake Bay striped bass exhibiting emaciation and skin lesions consistent with mycobacteriosis. Photo by Mark Matsche, Maryland Department of Natural Resources

D. Collection of blood sample from striped bass harvested from the Nanticoke River, Maryland, in November 2002. Photo by Mark Matsche, Maryland Department of Natural Resources

E. U.S. Geological Survey field crew processing striped bass as part of a mycobacteriosis survey conducted in the tidal portions of Chesapeake Bay rivers during 2002 and 2003. Photo by Mark Matsche, Maryland Department of Natural Resources

F. Live well transport and landing of striped bass by U.S. Fish and Wildlife personnel. Photo by Mark Matsche, Maryland Department of Natural Resources

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of resident striped bass. The model output (simulated catches and harvest) in the HCM was expressed as year (1984-2004) and age (ages 1-9) effects. Input parameters in the HCM include growth parameters in length (mm) and weight (kg) by age, percentage maturity by age, natural mortality (M) by year according to our M estimates from tagging and recruitment (age 0) by year-class based on the Maryland juvenile index. We assumed that the simulated recreational catches were composed of ages 1+ stripers, whereas the landings were composed of ages 3+ striped bass using a partial recruitment vector that was consistent with the current 18.0-in. minimum size limit. The HCM output would support the hypothesis of a rise in M if the trends in simulated fall recreational catches and harvest from 1995 to 2004 were similar to the trends in observed fall recreational data. Results from the HCM indicated that the simulated fall catches and landings from 1995 to 2004 under a simulated rise in M were very similar to the trends in the observed fall recreational catches and harvest. These findings suggest that a rise in natural mortality since 1996 has apparently reduced the number of legal-size (18 in.+) stripers in the recreational harvest after 1997. However, the attrition effects of enhanced natural mortality are less likely to be manifested on younger (ages 1-3) stripers, thereby leading to more stable fall catches of ages 1+ stripers in Maryland from 1996 to 2004. These findings are consistent with our stated hypothesis that M on resident striped bass has risen systematically since 1995. The model results did indicate, however, that the HCM could reproduce a similar trend in fall recreational catches and harvest under a constant M if either striped bass somatic growth declined systematically after 1995, or if striped bass migration rates from the Bay to the Coast accelerated after 1995.

Epizootic mycobacteriosis in Chesapeake Bay striped bass: What is the fate of infected fish?

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Striped bass (*Morone saxatilis*) in Chesapeake Bay, USA, are currently experiencing an epizootic of mycobacteriosis. Visceral disease prevalence in resident fish exceeds 50% and prevalence of skin ulcers can exceed 30% in some areas. Two primary hypotheses regarding emergence of this chronic bacterial disease propose that anthropogenic stressors constitute important underlying modulating factors. The first suggests that elevated nutrient inputs to the Bay and the associated eutrophication results in loss of summer thermal refugia for striped bass, forcing the fish into sub-optimal and stressful habitat during the warm summer months. The second hypothesis proposes alterations in trophic structure and starvation as a result of over-harvesting of key prey species such as Atlantic menhaden (*Brevoortia tyrannus*) and reductions in the food forage base. Ongoing striped bass tagging programs in Maryland and Virginia indicate a significant increase in non-fishing (natural) mortality in recent years. The contribution of mycobacteriosis to this increased mortality and which, if any, environmental factors modulate disease expression in Chesapeake Bay remain unclear. The high disease prevalence and concurrent increase in natural mortality of striped bass in recent years are of great concern to environmental scientists, fisheries managers, and anglers. A critical question regarding striped bass mycobacteriosis pertains to potential adverse impacts of the disease at the population level. Does the disease cause mortality in striped bass and will it have a long-term detrimental effect on the Atlantic Coastal migratory stock?

During 2005 we initiated field studies to determine whether mycobacteriosis is a cause of significant mortality in striped bass. The objectives of this study were to determine the rate of progression/regression of dermal disease by holding striped bass under field conditions (caging studies) to determine the relative mortality of fish with and without visible skin lesions, and to develop and apply a statistical model to estimate relative survival in fish with and without visceral disease as predicted by the presence of skin lesions (tagging studies). To accomplish this we made use of an existing annual striped bass tagging program at Virginia Institute of Marine

Science and initiated short-term field caging studies in the Rappahannock River, Virginia.

During fall 2005 we photographed (to document fish health status), tagged, and released a total of 1,811 striped bass belonging to two groups, fish that exhibited skin lesions characteristic of mycobacteriosis and fish without them. The rationale for this approach was that if the disease causes mortality, then tag returns from the group of fish exhibiting disease signs should be lower than returns from the group without signs of the disease. This study is ongoing and another large group of fish with and without external clinical signs will be tagged during 2006. The fraction of tags returned from each group will then be used to estimate relative survival (i.e., impact of the disease). We have established and widely publicized a tag return reward program in collaboration with the Virginia Marine Resources Commission (VMRC) that will motivate commercial and recreational anglers to return whole tagged fish to us on ice. We offer a $20 reward for the return of a whole fish tagged with a special fluorescent green internal anchor tag and $5 for return of the tag only. Additionally, VMRC has issued an exemption in effect from 2005 - 2008 for all striped bass with the green streamer tag. Tagged fish will not count against daily creel limits or tag quotas and fish size and seasonal restrictions will not apply to these fish. Because we photo-document health status of all fish prior to tagging and release, this program should also provide important information on skin lesion progression or regression/healing over the course of the study. As of April 2006, we have had ~120 tag returns (~6.6% tag return rate), many of which were returned to us as whole fish. Most of these returns were short-term recaptures by commercial pound net fishermen working in the mouth of the Rappahannock River.

We have held fish with and without skin lesions in two large net pens deployed in the upper Rappahannock River (near Tappahannock, VA) during fall 2005. This study was conducted in order to observe short-term temporal aspects of disease prevalence, severity, survival rates, and progression/healing. Weather conditions were unusual during this time period, with water temperatures remaining high (>20 ºC) very late into the season, followed by a rapid dropoff of temperatures to <10 ºC. The optimal temperature range for striped bass lies between these two values; therefore, we were not able to keep striped bass in the pen enclosures for the amount of time that we anticipated. We were, however, able to maintain some fish in the pen for up to 10 wk. Histological analysis of these fish is in progress. Changes in skin lesion appearance were subtle or absent in penned fish over the course of the study, suggesting that these changes occur over relatively long periods of time. We plan to repeat this study during fall 2006. As striped bass are stressed at very low salinities such as those observed in the upper reaches where we deployed the net pens in 2005, we plan to move them to the mouth of the Rappahannock River in 2006 to take advantage of the higher salinity regime.

Estimation of relative mortality between diseased/non-diseased animals via tag-recapture studies requires non-lethal diagnostic methods for determination of disease/exposure state. A serologic test of disease status would be ideal, as a small sample of blood could be collected prior to fish tagging and release. However, such a non-lethal diagnostic is not yet available for mycobacteriosis in striped bass. We have therefore focused efforts on better characterization and detection of what we believe to be the very earliest and most subtle skin pathologies associated with mycobacteriosis in the striped bass. Based on extensive histological verification, we consider these lesions to be pathognomonic (specific) for the disease and feel that their prevalence has been significantly underestimated in prior studies. We believe this to be one of the reasons for the large disparity between skin (30%) and visceral (50-70%) disease prevalence. Better tracking of these early skin lesions will provide us with higher concordance between the dermal and visceral disease states and will allow use of skin pathology as an indicator of overall disease state in lieu of a non-lethal serologic test. This work was funded in part by the Virginia Marine Resources Commission and Virginia Sea Grant Program.