

INSIDE THIS ISSUE:

Why Are the Eagles Dying?

Page 1

AVM Quick Info

Page 3

Resources

Page 4

S.C. TASK GROUP ON HARMFUL ALGAE

S.C. Sea Grant Consortium

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Why Are the Eagles Dying?

Scientists from around the country have been studying mysterious bald eagle (*Haliaeetus leucocephalus*) deaths in the Southeast due to avian vacuolar myelinopathy, or AVM. AVM is characterized by lesions in the white matter of the central nervous system that can be diagnosed only by microscopic examination of the brain. Birds exhibiting signs of AVM have difficulty swimming, flying, and walking—appearing uncoordinated and intoxicated. Affected birds also experience decreased reflexes, weakness, and paralysis. AVM typically occurs during the nesting season for bald eagles in the Southeast, which is from November through April. Adult bald eagles wintering in this region and transient juveniles may be affected throughout the active disease phase.

Since 1994 AVM has been implicated in at least 93 bald eagle deaths so far in Arkansas, Georgia, South Carolina, and North Carolina. Over the past three years, researchers have retrieved 29 AVM-positive eagle carcasses in South Carolina alone. However, these numbers could be even higher as the recovery rate of banded eagles is fairly low. AVM also affects countless American coots that come to the Southeast to winter, and has been diagnosed in a small number of mallards, ring-necked ducks, buffleheads, Canada geese, great horned owls, and killdeer. Scientists are in a race against time to discover the cause of AVM, but to date none has been clearly identified.

Tissues of infected birds have been tested for a wide range of disease-causing agents including bacteria, viruses, and parasites, all of which were negative. Researchers have also searched for the presence of several contaminants such as organic metals, pharmaceuticals, and plant toxins, none of which have been detected in AVM-affected birds. The causative agent of AVM is believed to be either a natural or synthetic toxicant. All of the reservoirs where AVM occurs are man-made, relatively low in nutrients, contain submerged aquatic plants, and have American coot populations.

ONE HYPOTHESIS

Susan Wilde, a scientist with the S.C. Department of Natural Resources (SCDNR) and USC, is researching a possible link between AVM and the blue-green algae *Hapalosiphon fontinalis*, a type of algae that produces indole alkaloids. Indole alkaloids are bioactive compounds produced by marine *H. fontinalis* that have been shown by other researchers to kill cells in the laboratory. However, it has yet to be proven that indole alkaloids cause morbidity, mortality, or lesions in any animals or birds.

Research currently being conducted by SCDNR, Clemson University, University of South Carolina's Baruch Institute, University of Georgia's Savannah River Ecology Lab, and other agencies is based on the premise

that there may be a correlation between the aquatic vegetation and the cause of AVM. Could it be that American coots inadvertently consume *H. fontinalis*, which grows on *Hydrilla verticillata*? Hydrilla, an aquatic nuisance species, is a staple in the coots' diet. Bald eagles then prey on the affected coots and contract AVM. Other waterfowl may contract the disease by consuming the algae-laden Hydrilla.

BACKGROUND RESEARCH

Previous studies performed by the U.S. Geological Survey's (USGS) National Wildlife Health Center (NWHC), the U.S. Fish and Wildlife Service (USFWS), and the Southeastern Cooperative Wildlife Disease Study (SCWDS) indicate that eagles and other predatory birds can contract the disease on-site by feeding on other affected birds, such as coots. This theory was tested in 2001, when SCWDS fed AVM-positive coot tissue to non-releasable red-tailed hawks. After the 30-day trial, all 5 hawks tested positive for AVM. The

USFWS and NWHC released disease-free coots and mallards at a lake during an AVM outbreak and found that the birds contracted AVM within 5-10 days after arrival at the reservoir; severely affected birds died within 5-7 days. And in a USFWS-sponsored study conducted by North Carolina State University, researchers concluded that AVM cannot be spread from one bird to another. They also discovered if AVM is caught early enough in birds that have minimal exposure, clinical recovery is possible even though the birds still have a brain lesion. In an attempt to determine if mammals could be susceptible to AVM, SCWDS researchers fed AVM-positive coot tissue to young pigs. During the month-long trial, the pigs exhibited no clinical signs of AVM and no significant lesions. However, additional research is needed to fully evaluate AVM susceptibility in species other than birds.

SAMPLING METHOD

Wilde samples reservoirs where AVM has been documented along

with 14 reservoirs that have not been known to have any incidence of AVM. She has taken samples of Hydrilla, sometimes called aquatic kudzu, from eight reservoirs in South Carolina, including the four AVM-affected reservoirs Lake Murray, Lake J. Strom Thurmond, L Lake, and Par Pond. Wilde has also measured water quality and chemistry, types of aquatic plants present, epiphytic (living on the surface of the plant) algal identification, and types of algae found in the sediment. Wilde found the epiphytic algal communities to be diverse—there were seven potentially toxic blue-green algae growing on the Hydrilla. From a sampling period of July 2002 - September 2002, Wilde discovered that *H. fontinalis* was either present, abundant, or dominant in 105 of 156 sampling sites in South Carolina. Wilde also sampled plant and algal communities at other AVM-affected areas in Arkansas, Georgia, and North Carolina, and found *H. fontinalis* dominant in most of the sites. The reservoirs where AVM has been documented also contain other exotic aquatic plants that *H. fontinalis* colonizes on, including Eurasian watermilfoil and Brazilian elodea, but Hydrilla was present at most of the sites Wilde sampled.

Through mallard feeding studies carried out at Clemson University, researchers began to focus on *H. fontinalis*. In a breakthrough last year, Clemson University scientists fed mallard ducks Hydrilla (with *H. fontinalis* colonies on it) that was collected from Lake J. Strom Thurmond, and some of the ducks contracted AVM. While this study established a cause-effect link with the aquatic vegetation and AVM, the exact agent has yet to be identified. "Our goal is to support or refute *H.*

South
Carolina
Task
Group

Harmful Algae

The S.C. Task Group on Harmful Algae publishes this newsletter three times a year to share knowledge about harmful algae and communicate activities of the task group. Interested constituents include elected and appointed officials, natural resource managers, public health organizations, and the general public. Comments regarding this or future issues are welcomed. Subscriptions are free upon request.

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fontinalis as the cause of AVM,” said Wilde. “Through our research, it may be possible to show that this particular algae growing on the Hydrilla is the agent.” In the near future, Wilde will work with the NOAA/NOS Marine Biotoxins Program to culture *H. fontinalis* in sufficient quantities needed to perform lab experiments.

BALD EAGLE RECOVERY?

The bald eagle, on the list of threatened species since 1995, has been making a comeback. According to Tom Murphy, wildlife biologist with SCDNR, the bald eagle population statewide has been increasing at 8.5% per year, from around 105 occupied nests in 1995 to 171 occupied nests in 2002. However, on Lake J. Strom Thurmond, the location of 27 eagle deaths to date, recent population surveys have revealed that nesting is eliminated. Murphy believes that the adult bald eagles contract the disease during nesting season and are dead before they can even lay eggs. The current long-term bald eagle mortality rate in South Carolina is about 14%, although the incidence of AVM will raise this rate and decrease the current 8.5% increase in nesting. In other words, any new mortality from AVM will reduce the rate of recovery. “In a single year, AVM could set back eagle recovery on affected reservoirs by decades,” said Murphy. There are 54 pairs of eagles nesting near South Carolina reservoirs, and 20 of those pairs are or were located on AVM-affected areas, which comprise nearly a quarter of the state’s reservoirs. It remains to be seen whether AVM will follow the Hydrilla into new reservoirs, creating the possibility for the disease to affect hundreds of thousands of acres of eagle habitat.

Hydrilla is now choking the shorelines of Lake Murray and Lake J. Strom Thurmond, and is already spreading into remaining fresh water reservoirs. Mitigation efforts by SCDNR, South Carolina Electric & Gas, and local municipalities to control the plant’s growth are underway at Lake Murray, through the introduction of Hydrilla-eating grass carp.

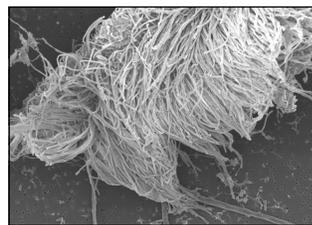
Although the source of the toxicant remains elusive, the multi-institutional research collaboration

is impressive. The correlation between the blue-green algae, *H. fontinalis*, and the incidence of AVM is just one potential cause. Once the causative agent is positively identified, natural resource managers can plan mitigation measures. Clearly, there is much more funding and research needed to save the future of our national symbol, the bald eagle. Look for updates on AVM in future issues of this newsletter.

AVM QUICK INFO

What is AVM?

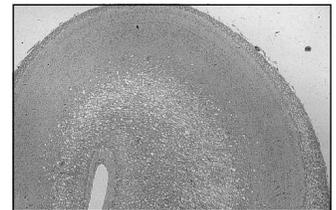
A neurological disease causing lesions in the white matter of the brain. So far, the disease is known to only affect birds.



NOAA, MARINE BIOTOXINS PROGRAM

What may be the cause?

Scientists believe the causative agent of AVM is either a natural or synthetic toxicant. SCDNR’s Susan Wilde is studying the potential link to the blue-green algae *Hapalosiphon fontinalis*.



USGS

Which bird species are affected?

Bald eagle and the American coot, plus smaller numbers of mallard, ring-necked duck, bufflehead, Canada geese, great horned owl, and killdeer.



USFWS

Who’s researching AVM?

SCDNR, University of South Carolina, Clemson University, SC Center for Birds of Prey, Georgia DNR, Savannah River Ecology Lab (University of Georgia), NC State University, Wright State University (OH), state fish and wildlife agencies from AR, GA, NC, and SC, Cyanolab (FL), USGS National Wildlife Health Center, Southeastern Cooperative Wildlife Disease Study, US Fish and Wildlife Service, US Army Corps of Engineers, and NOAA/NOS Marine Biotoxins Program.

Who to call?

SC Department of Natural Resources at 1-800-922-5431. Report birds displaying signs of AVM during the winter on inland reservoirs. Specific location where birds are seen could be helpful.

Information and Resources

Web sites

NOAA's Marine Biotoxins Program:

<http://www.chbr.noaa.gov/CoastalResearch/Whois.htm>

NOAA Coastal Services Center's Harmful Algal Bloom Project: <http://www.csc.noaa.gov/crs/habf>

National Office for Marine Biotoxins and Harmful Algal Blooms at Woods Hole Oceanographic Institution: <http://www.whoi.edu/redtide>

Bigelow Laboratory for Ocean Sciences, Toxic and Harmful Algal Blooms: <http://www.bigelow.org/hab>

Centers for Disease Control and Prevention, Health Studies Branch: <http://www.cdc.gov/nceh/hsb>

Ecology and Oceanography of Harmful Algal Blooms (ECOHAB) Program: <http://www.redtide.whoi.edu/hab/nationplan/ECOHAB/ECOHABhtml.html>

Publications

Harmful Algae News. The Intergovernmental Oceanographic Commission (IOC) newsletter on toxic algae and algal blooms, Tim Wyatt, Editor: <http://www.ioc.unesco.org/hab/news.htm>

Harmful Algae. Sandra Shumway and Theodore Smayda, Editors-in-Chief: <http://www.elsevier.com/locate/hal>

Nature Out of Balance video and educational guide. Covers types of HABs and their effects on water quality and human health. Order from N.C. Sea Grant at <http://www.ncsu.edu/seagrant>

The Pfiesteria Files, documentary video co-produced by MD Sea Grant and MD Public Television. Order from MD Sea Grant at <http://www.mdsg.umd.edu>

International Directory of Experts in Harmful Algae, an IOC publication: <http://ioc.unesco.org/hab/data.htm>

S.C. Task Group on Harmful Algae Web Site Now On-line at www.scseagrant.org/schab.htm

4



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