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CESU Interim Report Summary for
Environmental Factors Influencing Blooms of a Neurotoxic Stigonematalan Cyanobacterium Responsible for Avian Vacuolar Myelinopathy
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Purpose: We have linked avian vacuolar myelinopathy (AVM), a neurologic disease that has severely impacted waterbirds and raptors since it was first diagnosed in 1994, to invasive submerged aquatic vegetation. Our research to date supports the hypothesis that a novel cyanobacterial epiphyte in the Order Stigonematales produces an uncharacterized toxin resulting in a neurological disease--AVM, in waterfowl and their avian predators in the Southeast. This cyanobacterium is especially abundant on invasive exotic submerged aquatic vegetation (SAV), including hydrilla (Hydrilla verticillata), Brazilian elodea (Egeria densa) and Eurasian watermilfoil (Myriophyllum spicatum) but is also present on native species (Wilde et al. 2005). The species can cover up to 95% of the surface area of SAV leaves. Field surveys conducted from 2001-2010 documented the geographic distribution of the Stigonematalan species and confirmed that invasive aquatic plants supported the most dense and frequent coverage of this species. These field surveys and preliminary models provide insights into predicting the prevalence of Stigonematales in reservoirs seasonally and consequently identifying reservoir systems with the greatest likelihood of AVM affected birds.

Location: Lakes in the Southeastern US. Our field surveys conducted from 2001-2010 documented AVM in five states to date: North Carolina, South Carolina, Georgia, Arkansas and Texas. New hydrilla infestations (Lake Horton, Lake Varner, Smith Reservoir, Upper Towaliga Reservoir) in Georgia represent the most recent sites where SCWDS has confirmed the characteristic AVM brain lesions within symptomatic or dead birds. We have discovered Stigonematales in 9 states including North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Arkansas, and Texas.

Proposed Methods: Initial SAV and algal surveys conducted from 2001-2010 included samples from all 18 waterbodies where AVM has been confirmed. We also solicited and received or collected 62 SAV samples from additional waterbodies in the Southeastern United States with similar characteristics including the presence of SAV and waterbirds. SAV samples included all submerged plants present at the reservoir. These were primarily three invasive species (Hydrilla, Brazilian elodea, Eurasian watermilfoil) but also included twelve native species (Najas marina, Brasenia schreberi, Ceratophyllum demersum, Chara sp, Utricularia spp., Nymphaea odorata, Potamogeton spp, Bacopa caroliniana, Vallisneria americana, Nelumbo lutea).

Anticipated Results: The highest Stigonematales densities we documented during field surveys conducted from 2001-2010 were in reservoirs with dense hydrilla in the late fall.
Water temperatures in the field during the highest average percent coverage on hydrilla leaves

were lower than the optimal laboratory temperatures for rapid growth. Even if they are not growing at maximal rates, Stigonematales colonies may be promoted on hydrilla leaves relative to other epiphytic species under the conditions present in late fall in these AVM reservoirs. When Stigonematales is dominant on the leaves, the diversity and abundance of diatoms and other cyanobacteria are reduced. Temperature, dissolved oxygen, previous hydrilla density, and turbidity significantly correlated with the abundance of Stigonematales in this study, but we expect that there are more factors affecting Stigonematales' growth patterns. Turbidity levels had a significantly negative relationship with Stigonematales abundance and turbidity is frequently invoked as a factor inhibiting hydrilla growth (Bowes, et al 1979, Pesacreta 1988). Shannon (2008) found significantly lower turbidity, specific conductivity and pH in AVM positive lakes than in AVM negative lakes.
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