Roane County Environmental Review Board (RCERB)
Draft Information/Work Plan for the Management of Non-Native Invasive Aquatic Plants (Weeds) on Watts Bar Lake

These can be “fleshed” out and added to as time goes on.

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I. Background and Timeline

A. Watts Bar Facts and Information
   a. Lake Length = 72.4 miles between Fort Loudon and Watts Bar Dams
   b. Shorelines = 722 miles, includes Clinch and Emory River arms. Clinch is navigable to Melton Hill Dam. Emory is navigable 12 miles upstream from entry into Clinch
   c. Water Surface Area = 39,000 acres
   d. Minor tributaries = Poplar Creek, Caney Creek, White's Creek
   e. Large islands notable = Thief Neck, Long, Sand

B. Timeline of Recent Invasive Non-Native Plant Activity
   a. June/July 2015: Non-native aquatic plants began growing in many areas of Watts Bar Lake. These plants were identified by Dr. Brett Hartis, Program Manager for Aquatic Plants for TVA as Eurasian Water Milfoil, Spiny Leaf/ Brittle Naiad, and Hydrilla.
   b. September 2015: These non-native aquatic plants (weeds) have become very invasive in various areas.
   c. October 2015: TVA, either through overflight or aerial imagery, documented the growth/spread of aquatic plants via a grey scale map. Dr. Hartis indicates this is mostly submersed aquatic plants; however, site visits during the growing season this year would have to take place to determine what exactly is growing there. The areas in "red" on the grey scale map should not be considered the only areas that potentially held aquatic plants in 2015, simply the areas that were detectable at the time of overflight/image acquisition. This also does not predict exactly where growth will occur 2016, but it is a good starting point. Reference Appendix A 2015 Grey Scale Map of Aquatic Weed Growth.
   d. 2016:
      1. Dr. Hartis made the following statements (summarized)
         - It is legal for lake homeowners to hire a Tennessee licensed/approved aquatic applicator to treat the invasive aquatic plants.
         ii. TVA only treats public access areas (parks, boat ramps, etc.).The only public area that TVA treated in 2016 on Watts Bar Lake was Camp John Knox.
         iii. TVA no longer receives any appropriations to help with management of aquatic plants.
         iv. Nuisance weeds are not an uncommon problem with freshwater lakes throughout the United States.
      b. Many Watts Bar Lake home owners hired an approved/licensed aquatic applicator to treat the aquatic weeds at a cost of $400 per acre.
      c. Aquatic weed growth on Watts Bar Lake "exploded" in the areas that were not treated.
      d. TVA has not had an opportunity to update its grey scale map documenting the growth/spread of aquatic weeds in 2016 via an overflight or aerial imagery. Dr. Hartis said he expected/estimated aquatic weed growth more than doubled in 2016 if not more.
   5. 2017:
      a. Lake home owners should expect to have additional expenses in treating aquatic weeds in 2017 due to the growth of Hydrilla. The cost is estimated to climb to ~$1,000 per acre as Hydrilla is harder to "knock down". Hydrilla is called the "kudzu" of aquatic plants; is not affected by drawdowns or cold weather; and can stay dormant for 8-10 years, then rehydrate and start growing.
      b. February 6, 2017: Roane County Commission holds a special work session with the RCERB to become more educated about the facts and science of aquatic weeds. Over 200 people from the public attend.

c. February 10, 2017: Roane County Commission Chair Ron Berry expresses the idea of a special Roane County Commission committee being formed to work with the RCERB as to a path forward.
d. February 16, 2017: About 70 lake homeowners attend a meeting at the Kingston Community Center to hear Troy Goldsby of Aqua Services discuss the types of weeds, their characteristics, and methods of treatment.

II. Science About Eurasian Milfoil, Spiny Leaf Naiad, and Hydrilla

A. General
   1. These invasive species can NOT be eradicated, can only be managed.
   2. Invasive plants displace native plants, bad in its own right. Typically results in less species diversity, undesirable from an ecological standpoint.
   3. 20-40% of waters with aquatic plant coverage considered optimum balance for enhancing fishing while controlling the other negative effects.
   4. Too many weeds/plants can result in reduced oxygen levels in water, particularly during long periods of cool and cloudy weather. This can result in fish kills. Can alter the entire food chain.
   5. Invasive species, in general, have no local natural enemies, enhancing chances of survival.

B. Eurasian Milfoil
   1. Is a perennial
   2. Commonly found in water from 1 to 15 feet deep but can occur at depths of up to 30 feet (extremely clear water)
   3. Overwinters as root crowns
   4. Reproduces predominantly by vegetative means through fragmentation, which occurs when stems are broken

C. Spiny Leaf Brittle Naiad
   1. Is an annual
   2. Propagates via seeds

D. Hydrilla
   1. Is a perennial and most “robust” of these; considered the “Kudzu” of aquatic plants
   2. Spreads by plant fragments because it does not produce seeds.
   3. Propagates via - fragmentation – turions (similar to tubers)
   4. Has no natural enemies (enhances survival) in these waters
   5. Tubers/turions are in 6-9" of sediment, overwinters, sprouts in Spring
   6. 8-10 year life even if dormant
   7. Started in Florida via the aquarium industry
   8. 90-98% water – not worthy of harvesting
   9. Needs less than 1% of sunlight to thrive
   10. There are 2 types of Hydrilla
   11. Monoecious Hydrilla is the worse – each plant has both male and female flowers. It produces many stolons (runners) and rhizomes, as well as turions in the leaf axils which detach upon maturity and spread. Can grow 1” a day from each stalk/branch.
   12. Dioecious Hydrilla - each plant bears only male or female flowers. Can grow 1” a day from each stalk/branch.

E. Further Information (place holder)

III. Recent Laws/Regulations Regarding Aquatic Plant Treatment (Herbicides)

A. Source Documents

1. **State TWRA Definition of Aquatic Pest Control (APC)** - the control of aquatic plants and algae through the application of pesticides. Applicants for this license must be certified in (C05) Aquatic Pest Control.
2. **Tennessee Application of Pesticides Act" (TAPA)** - Tennessee's law that governs the custom application of pesticides
3. **These regulations are given "authority"** via cited portions of the laws in the Tennessee Code Annotated (TCA), enacted April 2016 and effective June 2016.
4. **TN Department of Agriculture 0080-09-02-.01 SCOPE -** (1) …applies to any person who buys, sells, or uses a restricted use pesticide. (2) Any person who buys, sells, or uses a restricted use pesticide must be licensed by the department …
5. **(5) Aquatic Pest Control (C05) -** (a) Description. This category includes commercial applicators who use or supervise the use of general or restricted use pesticides in aquatic environments.

B. General Description

It is legal for lake homeowners to hire a Tennessee licensed/approved aquatic applicator to treat invasive aquatic plants. According to Kathy Booker, Pesticide Administrator, Tennessee Department of Agriculture: a lake homeowner must be certified and licensed in order to treat their aquatic plants/weeds**.** "In the state of Tennessee, in order to treat your lake area yourself, you must have a 4-year degree with course work related to aquatic plants. If you do not have a 4-year degree/course work in aquatic plants, you must work for a licensed aquatic applicator for a minimum of 2 years before you can take the test and become certified."

C. Regulations Scope

These regulations apply regardless of the amounts you use (no matter how small) or how frequently (even seldom) you use them.

D. Consequences of Noncompliance

Operating as a custom pesticide applicator without getting a charter and license: Operating without a charter is a Class A Misdemeanor under TAPA, punishable by up to a $2,500 fine and 11 months 29 days of incarceration.

IV. Potential Impacts (Positive and Negative)-need more research from others to verify/clarify/add information

A. Navigation/Boating
   1. Less open water/more congested barge/boat traffic
   2. Clogged boat props
   3. Restricting use of marinas
   4. Restricted use of boat ramps/docks, both public and private
   5.

B. Power Production/Utilities
   1. Clogged cooling water intake screens
   2. Clogged drinking water intakes
   3. More maintenance costs
   4.

C. Fishing/Hunting Waterfowl
   1. Enhances fishing habitat
   2. Can decrease fishing habitat if too concentrated and fish are deprived of oxygen
   3. Enhances duck/waterfowl hunting for species that feed on the plants
   4.

D. Swimming/Skiing/Water Sports
   1. Swimmers can become entangled, particularly small children
   2. Non-desire to use public parks, campgrounds, etc.
   3.

E. Waterfowl and Predator Bird Health
   1. Certain species of ducks and coots feed on aquatic plants, good food source
   2. New type of cyanobacteria that resides in hydrilla found: In 2015, several publications discuss the discovery of a new, previously unknown species of growth form found on the leaves of water plants in lakes, specifically hydrilla. It is harder to detect as this new species hides on the undersides of the aquatic leaves. Coots eat the hydrilla, then bald eagles prey on the coots. The eagles developed a neurological disease (causes brain lesions). First found in Arkansas, 80 deaths were from one Georgia impoundment on the Savannah River. There are 20 confirmed sites in 6 states, including North Carolina, South Carolina, Florida and Texas. There is a total of 160 known bald eagle deaths. (Source: University of Georgia Warnell School of Forestry and Natural Resources http://news.uga.edu/releases/article/identify-name-toxic-cyanobacteria-killing-american-bald-eagles-0215/). Other reports indicate thousands of ducks (mallards, ring-necked, buffleheads, Canada geese have also died in 19 lakes in these 6 states. Refer to Appendix B Related Article regarding bird health concerns.

F. Animal Health
   Refer to paragraph E.2 above: Dogs are particularly susceptible to blue-green algae poisoning because the scum can attach to their coats and be swallowed during self-cleaning. (Source: Environmental Health News September 2014).

G. Lake and Non-Lake Property Values/County Tax Revenues
   1. Lost sales by realtors of lake properties infested with aquatic weeds
   2. Potential for lake property to devalue, resulting in non-lake property to increase in value.

3. Property assessments may cause tax rates to decrease for lake properties and increase for non-lake properties.

H. Economic Impacts on Tourism

1. Increased visitation from fishing tournaments
2. Hotel/restaurant revenue increase from increased tourism
3. Campground use increase
4. Sales/gas tax revenue increase

I. Others

V. Methods of Aquatic Weed Control and Management

A. General Guidelines (Balanced Approach)

Review of other lakes with aquatic plan management plans provide lessons learned about the effectiveness of using a "balanced" mix of weed control methods. Most incorporate the spreading of herbicides and the strategic stocking of triploid grass carp. Some use mechanical harvesting, depending on the aquatic plants being controlled.

B. Spreading of Herbicides

1. Herbicides are aquatic plant specific; different herbicides are used for different species.
2. Herbicides attack the biological pathways to block photosynthesis.
3. Herbicides are approved by EPA. Those that are approved have shown no side effects to humans and pets.
4. Herbicides need a few hours of contact with the plants to be effective.
5. Only restriction is to not use lake water treated with herbicides to irrigate landscapes for three days following treatment. Swimming/fishing not affected.
6. Treatments can only be effective during the growing season and require different times of treatment relative to the aquatic plants being treated. Hydrilla may require treatment several times during the growing season.

C. Triploid (Sterile) Grass Carp

1. Must be stocked in lengths of over 8-9" to 13" to be effective and not be eaten by other fish species.
2. Relatively shy, not effective in publicly used/busy areas.
3. Must continue to be stocked periodically to account for different fish ages and life span (life span expectancy is about 10 years).
4. Do not eat Eurasian Milfoil. Does like Hydrilla. However, after Hydrilla is gone or not in the area, will consume certain native species of aquatic plants.
5. Requires about 20 fish per plant acre to control aquatic weeds. North Carolina Wildlife Resource Commission and Virginia Department of Game and Inland Fisheries approved the use of 18.5 Triploid (Sterile) Grass Carp per acre.

D. Mechanical Harvesting

1. Effective in quickly clearing pathways.
2. Resulting vegetation not suitable/cost effective for composting. Aquatic plants are 95% water.
3. Can spread aquatic weeds due to fragmentation of plants, particularly hydrilla.
4. Rocks/stumps can be obstructive.
5. Time consuming and appropriate specialized equipment necessary.

E. Establishment of Multi-Species Stands of Native Aquatic Vegetation

1. Hydrilla may displace native species.

VI. Costs of Aquatic Weed Management

A. Herbicides
   1. $1200/acre if infested with all three invasive species/season

B. Triploid Grass Carp

C. Mechanical Harvesting

D. Establishment of Multi-Species Stands of Native Aquatic Vegetation

VII. Potential Sources of Funding for Aquatic Weed Management

A. Lake Property Owners
   1. Hire licensed aquatic herbicide companies.

B. Utilities (Power Producers, Water Districts)

C. Marinas/Resorts/Parks/Hotels

D. Federal/State Agencies (e.g., TVA, Corp of Engineers, TWRA)

E. Local Government Budgets and Local Taxes

F. Property Taxes

G. Gas Taxes

H. Boat Registrations

I. Hunting & Fishing Licenses

J. Boat Ramp Usage Fees

K. Penalties For Boat Users Spreading Aquatic Weeds

L. Grants and Donations (Federal, State, Private)

M. Others

VIII. Establishment of Stakeholders Group

A. Identify Potential Stakeholders

1. Fisherman and duck hunters; outdoor sports groups
2. Lake users – boaters, campers, water sports
3. Local governments
4. Property owners
5. Homeowners/lake associations
6. TVA/Corp of Engineers/TWRA
7. Marinas/Parks/Resorts
8. Lawmakers
9. Water sports-related businesses and retailers (e.g., boat sales, bait/tackle shops, herbicide applicators)
10. Tourism boards, Chamber of Commerce
11. Realtors

B. Organizational Structure of Stakeholders Group

1. By-Laws and Governance
2. Responsibilities & Duties
3. Fiscal Requirements

C. Operations by the Stakeholders Group

1. Policies and Procedures
2. Work Plans and Timelines
3. Technical Research and Assistance
4. Education and Communication (Outreach)
5. Fiscal Management and Reporting
6. Aquatic Weed Management Results and Reporting

IX. Review of Other Lakes with Aquatic Plant Management Plans

A. Lake Gaston

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Appendix B - Researchers identify, name toxic cyanobacteria killing American bald eagles

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List sources of information; TVA, TWRA, etc.

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APPENDIX A – 2015 Grey Scaly Map of Aquatic Weed Growth

Enclosed

APPENDIX B - BALD EAGLE AND WATERFOWL HEALTH CONCERNS

University of Georgia researchers have formally identified and named toxic cyanobacteria that have been killing American bald eagles across the Southeast.

After years of studying the cyanobacteria coating the leaves of water plants in lakes, researchers in UGA's Warnell School of Forestry and Natural Resources have determined that it is a previously undiscovered species in a new genus. In a paper published recently in the journal Phytotaxa, they named it Aetokthonos hydrillicola and lay out evidence that it is responsible for the eagle deaths.

Read more at: http://phys.org/news/2015-02-toxic-cyanobacteria-american-bald-eagles.html#jCp

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"This new species has a growth form and gene sequence so unusual that it does not fit into any of the existing families," said Susan Wilde, the Warnell professor who has been leading the research. "The naming convention for cyanobacteria is to use Greek for the genus—Aetokthonos translates to 'eagle-killer.' The species name is always Latin, and hydrillicola means 'lives on hydrilla.'"

Beginning in the mid-1990s, American bald eagles started to die off in noticeable numbers from a neurological disease called avian vacuolar myelinopathy. AVM was first found in Arkansas in 1994, but over the past two decades, 160 eagles are known to have died across the Southeast from the disease, including 80 from one Georgia impoundment on the Savannah River, the J. Strom Thurmond Reservoir.

Researchers speculate the death toll is actually much higher because most of the dead birds are never found. And the deaths will continue to rise and spread to new locations, Wilde said, because "the invasive hydrilla and associated cyanobacteria spread to new lakes."

Animals afflicted with AVM develop brain lesions that impair their motor skills, causing difficulty walking, swimming or flying. Once they consume the toxin, eagles suffer a neurological breakdown with unique holes in the brain and spinal cord, then death.

Wilde realized that in virtually every site where bald eagles died, there was an intense invasion of hydrilla, an invasive aquatic plant native to Asia and considered the ultimate aquatic weed in freshwater locations where it is found. She hypothesized that the eagles were eating tainted prey: waterbirds called coots eat the hydrilla, develop AVM, then pass it on to the eagles who prey on them as food. She just had to figure out why that was happening, and a close examination of the hydrilla led her to the culprit-blue-green algae coating the leaves of the very plants the coots were eating, confirmed at every location where birds were dying from AVM.

Over the past few years, Wilde has been collecting samples from every site of an AVM eagle death, taking slimy hydrilla to her Warnell lab for analysis. She found that Lake Thurmond near Augusta has the highest cyanobacterial concentration of the 20 confirmed AVM sites in six states.

Since 2008, she has been testing these samples using DNA sequencing, light microscopy, epiflourescent microscopy, scanning and transmission electron microscopy and other tests to

identify its characteristics. She and her team originally placed the cyanobacteria in the order Stigonematales, but their tests show Aetokthonos hydrillicola is actually in a new genus and is unique even at the family level.

Wilde's co-authors on the study include Jeffrey Johansen of John Carroll University, Dayton Wilde and Peng Jiang of the UGA department of horticulture, former Warnell student Bradley Bartelme now at EnviroScience, and Rebecca Haynie, a former toxicologist in Wilde's lab now at the SePRO Corporation.

Aetokthonos hydrillicola's growth is strange even for cyanobacteria. It forms large colonies that branch out horizontally and vertically on the hydrilla leaves but is not found in the water or sediment. Cyanobacterial blooms that cause wildlife, livestock and even human health concerns are increasing in recent decades and mostly occur in the water column. Another UGA project called CyanoTracker has started to trace these cyanobacterial water blooms using social media. This new species associated with eagle deaths is hiding on the underside of the aquatic plants, so it is more difficult to detect.

In order to test the theory that the cyanobacteria is producing the neurotoxin that causes disease in birds, the researchers studied many lakes with hydrilla infestations. Some had the new cyanobacterial colonies on the leaves, but many did not. By monitoring both types, the researchers demonstrated only the lakes with Aetokthonos hydrillicola have birds suffering and dying from AVM.

Wilde said now that they have strong evidence for what's causing the AVM deaths, she will need to find out what environmental conditions are promoting Aetokthonos hydrillicola.

"It's already in lakes from North Carolina to Texas," Wilde said, "and if it continues to spread, it could greatly undermine the bald eagle's recovery and threaten other birds and aquatic wildlife. We already know that grass carp and turtles can develop the same AVM lesions, but we need to find out how it can affect the rest of the aquatic food web."

A solution to stopping the spread of Aetokthonos hydrillicola might not be easy, but one idea involves releasing grass-eating carp into affected lakes, a tactic that was successful in Lake Murray in South Carolina, where 64,000 carp ate 3,880 acres of the invasive plant over two years. Unfortunately, she said, this non-native, sterile carp consumes other desirable water plants important for fish and wildlife habitat.

Explore further: Aquatic ecologist studies silent killer of bald eagles

More information: "Aetokthonos hydrillicola gen. et sp. nov.: Epiphytic cyanobacteria on invasive aquatic plants implicated in Avian Vacuolar Myelinopathy." *Phytotaxa*, DOI: dx.doi.org/10.11646/phytotaxa.181.5.1

Provided by: University of Georgia

Read more at: https://phys.org/news/2015-02-toxic-cyanobacteria-american-bald-eagles.html#jCp

APPENDIX C - ITEMS FOR SUCCESS AND LESSONS LEARNED

1. Stakeholder group needs to be balanced and representative with strong leadership that has a "home base".
2. Aquatic Weed Management Plan will likely be a combination of techniques that is adjusted in time. Don't get "hung-up" on the technical details, let the TAG do that work / decision.
3. Very likely, there will never be adequate funding to do it right.
4. The funding plan will be eclectic in its make-up.
5. The presence of Hydrilla could be leveraged to engage the State and Federal agencies and to request their financial support as well. An excellent vehicle for Federal funding would be to restore / allocate TVA budget money to address Hydrilla.
6. It is very likely that the bordering property owners and businesses will have perpetual funding obligations within a successful funding plan. This funding obligation may also extend to the County level in some form.
7. The perfect plan and stakeholder group without adequate and perpetual funding will not be successful. - (Lake Guntersville)
8. Having a large benefactor associated with the funding plan is highly desirable. (Lake Gaston / Virginia Beach)
9. All successful plans have very supportive and direct involvement by their State environmental organizations.
10. Local control and direction is mandatory. Usually this lies at the County level with State support and awareness.
11. Education and communication are critical to local "buy-in" and continued support.
12. A highly skilled knowledge base (TAG) is vital to the creation of a treatment and maintaining plan.
13. Local, County, and State legislators will be needed to garner / manage Federal involvement and possible funding.
14. Don't overlook private involvement for support and possible funding.
15. Don't make the stakeholder group too large, but it must have diverse representation for proper buy-in to arrive at the best compromise solution.
16. Grants may be very useful to initiate the treatment plan, but are not structured to be a long term funding option.