J. Strom Thurmond Project AVM Public Meeting

Sign-In Sheet

McCormick

#	NAME	CLUB/ORGANIZATION
Ex:	"John Doe"	"No Name Boating Club"
1	BOBBY STANFILL	CLARK HILL COMMITTEE
2	Brian Epps	" " "
3	Jerry Miller	SLV
4	Lyn Miller	SLV
5	Betty Rapp	SLV
6	ROBERT RAPP	SLV
7	Nelson & Gloria Brooks	Wells Creek Garden Club
8	Charles Haralson	Bass Fishing / Hunting
9	Brian Henderson	Concerned Citizen
10	DAVE NAWYN	Clarks Hill Striper Club.
11	JAKE TRANTHAN	" " " "
12	JUDY LORIER	SLV
13		
14		
15		

#	NAME	CLUB/ORGANIZATION
Ex:	"John Doe"	"No Name Boating Club"
16	George C Selfridge Jr	[illegible]YC
17	J.B + Ann Mathews	Wells Creek resident - lake lot owner
18	Daniel Richey	Clarkshill Community
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J. Strom Thurmond Project AVM Public Meeting
Sign-In Sheet

#	NAME	CLUB/ORGANIZATION
Ex:	"John Doe"	"No Name Boating Club"
1	NANCY BOBBITT	US SENATOR JOHNNY ISAKSON
2	LEE HOREYSECK	LOT OWNER / RESIDENT
3	Bob Sargent	GADNR
4	Debbie Harris	U.S. Fish & Wildlife Service
5	Mike Lenz	Resident
6	Nelson Brooks	Adjacent Property Owner
7	Jennifer Harrell	Resident adjacent property owner
8	Kevin Harrell	Resident adjacent property owner
9	DIANNE WHITE	Resident
10	BRIAN WHITE	Resident
11	Roy [illegible]	LEAH LAKE ASSOCIATION
12		
13		
14		
15		

#	NAME	CLUB/ORGANIZATION
Ex:	"John Doe"	"No Name Boating Club"
16	Ferris Broxton	Walkinshaw Sportsman's Club
17	ROBIN WHISENANT	CLARK HILL COMMITTEE OF THE CSRA
18		
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COMMENTS: SO MUCH HYDRILLA IN CHEROKEE CREEK THAT IT IS NOT PASSABLE ½ WAY TO ASHMORE BARDON BRIDGE BY MID SUMMER. MANY SICK COOTS AS WELL.

VERY GLAD TO HEAR ABOUT USE OF STERILE CARP!

THANKS

NAME DIANNE WHITE
ADDRESS 1491 PLANTATION CIR. LINCOLNTON GA
PHONE 706-359-3010
EMAIL

COMMENTS: Please do all you can to eliminate hydrilla hydrilla kills bald eagles messes up fishing and swimming in many areas. Destroyed and took over many caves used for catching crapie and other pan fish. We fully support this program in eliminating all hydrilla possible.

NAME Jennifer Harrell

ADDRESS 2261 Maxim Rd.
Lincolnton Ga. 30817

PHONE 706(359-5816)

EMAIL

COMMENTS: I WANT LESS HYDRALLA IN THE BUFFALO CREEK AREA IN LITTLE RIVER S.C OUR COVE WAS COMPLETLY COVERED IN HYDRILLA LAST SUMMER WE WERE NOT ABLE TO USE OUR BOAT DOCKS. WE HAD PAID $2000.00 PAST YEAR TO HAVE COVE SPRAYED WHICH ONLY LASTED 1 YEAR.

NAME J. O TRANTHAM

ADDRESS 171 KIRKLAND DR.
McCORMICK S.C
29835

PHONE 864-391-2176

EMAIL J.T. TRANTHAM @ YAHOO. COM.

COMMENTS: We have tried Chemical application by professional applicators and the treatment lasted about one year.
We are in favor of stocking the grass Carp.
The shallow Coves in the Wells Creek area get Completely Covered in late summer and early fall.
It also surrounds the boat ramp.

NAME J.B. + Ann Mathews
ADDRESS 1320 Wells Creek Dr Lincolnton, GA. 30817
PHONE 706-359-1439
EMAIL jbmathews@aol.com

COMMENTS: Please do all you can to kill hydrilla and protect eagles and other Avian species as well as aquatic species adversely impacted by bacteria and the hydrilla. Many coves have been overtaken by hydrilla making them inaccessible for me and my family to catch crappie and other panfish. We would love to see the hydrilla destroyed or at least minimalized so the eagles can restore as well as many coveted fishing areas & coves that we have fished for generations in our family. I and my family fully support and encourage this program. P.S. We also bass fish and have been very successful in Clarks Hill lake for Largemouth bass and others and I cannot believe why some bass fisherman would even entertain the idea of keeping the intrusive hydrilla around. I favor the wildlife and panfishing to return. bass fishing has always been good.

NAME Kevin Harrell

ADDRESS 2261 Maxim Rd.
Lincolnton, GA, 30817

PHONE (706) 359-5816

EMAIL

COMMENTS: OUR LOT IS NEAR LITTLE RIVER, SC AND WHEN WATER LEVEL IS ~ 4-5' BELOW POOL THE COVE COMPLETELY FILLED IN WITH HYDRILLA TO THE POINT WHERE SWIMMING AND BOATING WAS VIRTUALLY IMPOSSIBLE. RAKING WAS TEDIOUS AND RESULTS WERE POOR.

IT IS OBVIOUS THAT THE WILDLIFE AS WELL AS SHORELINE RESIDENTS NEED SOME FORM OF ECONOMIC CONTROL OF HYDRILLA

WE SUPPORT USE OF CARP AND SUGGEST THAT PRIVATE INDIVIDUALS BE ALLOWED TO PARTICIPATE IN THE CARP PROGRAM IF THEY SO DESIRE.

NAME Robert Rapp

ADDRESS 170 VALENTINE DR
McCORMICK SC
(LITTLE RIVER COTTAGE SITE

PHONE 864-391-2833

EMAIL BLCRAPP@AOL.COM

COMMENTS: We are in favor of doing treatment to rid the lake of hydrilla.

We live on the river and use it for recreation. ~~Als~~ Also it is very beautiful. We hate the eagles dying, etc

NAME Judy Lorier

ADDRESS 183 Savannah Dr.
McCormick, SC
29835

PHONE

EMAIL JUDY.LORIER1@GMAIL.COM

United States Department of the Interior
Fish and Wildlife Service
105 West Park Drive, Suite D
Athens, Georgia 30606
706-613-9493 Fax: 706-613-6059

West Georgia Sub Office
P.O. Box 52560
Ft. Benning, Georgia 31995-2560
706-544-6428 Fax: 706-544-6419

Coastal Sub Office
4980 Wildlife Drive
Townsend, Georgia 31331
912-832-8739 Fax: 912-832-8744

May 27, 2016

Savannah District
U.S. Arming Corps of Engineers|
Planning Division
ATTN: Mr. Nathan Dayan
100 West Oglethorpe Avenue
Savannah, GA 31401-3640

Re: Proposed AVMP draft EA and Draft FONSI-managing hydrilla in J. Strom Thurmond Lake, February 2016

Dear Mr. Dayan:

Thank for the opportunity to review the subject document, which was received in our office on April 29, 2016. The Army Corps of Engineers (ACOE) has prepared a draft Environmental assessment (EA) and a Draft Finding of No Significant Impact (FONSI) to evaluate the impacts of managing hydrilla within J. Strom Thurmond Lake (JST) to reduce occurrences of Avian Vacuolar Myelinopathy (AVM) in bald eagles. The Fish and Wildlife Service (Service) submits the following comments and recommendations under the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16. U.S.C. 1531 et seq.), the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d) and the Migratory Bird Protection Act (16 U.S.C. 703-712).

The ACOE has prepared this draft Avian Vacuolar Myelinopathy Plan (AVMP) with the goal of reducing or eliminating adverse impacts of AVM on birds. Extensive research has shown AVM mortality to be the result of a bioaccumulation of a toxin from a cyanobacterium (*Aetokthonos hydrillicola*) (Birrenkott et al. 2004, Fischer et al. 2003, Fischer et al. 2006, Wilde et al. 2005, Wilde et al. 2014). Eighty-one dead eagles were recovered from JST from 1998 through 2015. AVM was confirmed as the cause of death in 29 of these eagles. Aspergillosis was the cause of one mortality. The remaining 51 mortalities could not be determined due to decomposition, although AVM is suspected in the majority of the cases (Wilde 2014).

The ACOE has investigated several treatment alternatives to reduce AVM bald eagle deaths, including no action, mechanical control, herbicide applications, lake drawdown, biological control with insects or pathogens, biological control with grass carp, and integrated management. The ACOE's preferred alternative is integrated management with incremental triploid grass carp stocking and herbicide use.

General Comments on the Draft EA and Draft FONSI

The Service has been working on a team with the ACOE, the Georgia and South Carolina Natural Resources Departments, and University of Georgia researchers for several years to find a way to reduce the bald eagle mortality at JST (US Fish and Wildlife Service 2014). Therefore, we are pleased to see the progress the ACOE has made in developing the Draft EA for the AVMP. The Draft EA is generally complete in its analysis of potential impacts on fish and wildlife resources of the proposed action and reasonable alternatives.

We are supportive of the preferred alternative but believe the herbicide application plan needs more investigation on application timing and impacts to other wildlife (see specific comments below). The grass carp, as discussed in the preferred alternative, should greatly reduce the hydrilla and thus eagle mortality. Adding more monitoring and an adaptive management plan to the AVMP allow more flexibility in response to changing environmental conditions.

Specific Comments on the Draft EA and Draft Service Specific FONSI

Section 2.0 Management Objectives, Objective 2, Page 3

Suggested wording change for goal (2) "survey and monitor both AVM and *non-native submerged aquatic vegetation...*;

Section 4.1 No Action, Page 3

The Service cannot "require" but recommends a "take permit" for expected future bald eagle mortalities.

Section 5.2 Management Plan, Pages 6-7

More investigation and collaboration with researchers is needed to determine the best time of year to apply herbicide. For example, herbicides might not be as effective if applied in the fall when water temperatures are warm and chemicals break down more quickly. Many waterfowl and bald eagles are in the area in the fall that could be impacted by eating plants treated with herbicide. Also, some preliminary studies have shown that herbicide in the fall could cause hydrilla to die back but won't kill the cyanobacteria. It would likely be better to apply the herbicide in the spring on new growth hydrilla when water temperatures are cooler and there are not as many waterfowl or bald eagles in the area. Eliminating the hydrilla at this time of year would remove a medium for the cyanobacteria to grow on in the fall. The ACOE should ensure that the herbicide they use does not contain copper due to the sensitivity of mussels and other invertebrates to this substance. It may be more cost-effective to wait and see how well the carp eliminate the hydrilla before applying herbicide.

Section 5.2 Management Plan, Page 8

We have concerns about funding for this project based on the last statement in this section. "Stocking grass carp and herbicide use are dependent on available funding." The Service strongly supports the ACOE's requests to Congress for funding due to the importance of this project for reducing the health hazard of AVM to birds, particularly bald eagles, and possibly other wildlife.

Section 6.0 Monitoring Vegetation, Page 8

The Service recommends that the hydrilla be surveyed and mapped each year. We recommend that surveys be developed for the cyanobacteria, and that toxicity level of herbicide in the water and in invertebrates be monitored.

It would also be important to monitor carp numbers and movement in conjunction with the hydrilla surveys to determine effectiveness of the treatment.

Section 7.0 Monitoring the effects of AVM, Page 8

More surveys for bald eagles will be needed to measure effectiveness of management actions. Weekly or bi-monthly boat and/or aerial surveys during the fall, winter and spring (i.e. time of highest bald eagle use) are needed for the best information and analysis of management treatments. A regular survey for dying/dead American coots, as well as the ongoing live coot sampling, is also needed.

Section 10.0 Coordination, Page 9

The Service appreciates the ACOE's hosting of the AVM meetings to share data and results. We encourage continuation of this annual reporting to document the work of the ACOE and other agencies and universities trying to reduce bird and wildlife mortality due to AVM at JST.

Service Comments under the Endangered Species Act

Species protected under the ESA are not likely to occur within the lake project area.

Summary Comments

The Service appreciates the progress the ACOE has made in developing a management plan for AVM control in JST. We support the preferred alternative with modifications as detailed above. We believe that more monitoring is needed to get a better picture of this complex problem of bird mortality from consumption of the cyanobacteria growing on the abundant and noxious hydrilla. We recommend that the ACOE continue to collaborate with state and federal agencies and researchers to develop an adaptive management plan for monitoring the changing levels of hydrilla, cyanobacteria, grass carp and bird mortality and provide flexibility to make changes, as needed.

Thank you again for the opportunity to comment. This constitutes the report of the Department of the Interior. Please contact Deborah Harris (Deborah_C_Harris@fws.gov) if you have questions about our comments.

Sincerely

Donald W. [signature]

Donald W. Imm, Ph.D.
Field Supervisor

cc:
Mr. Dan Forster, Georgia Department of Natural Resources, Social Circle, GA
Mr. Robert Sargent, Georgia Department of Natural Resources, Social Circle, GA
Mr. John Biagi, Georgia Department of Natural Resources, Social Circle, GA
Mr. Jon Ambrose, Georgia Department of Natural Resources, Social Circle, GA
Mr. Alvin A. Taylor, South Carolina Department of Natural Resources, Columbia, SC
Mr. Bob Perry, South Carolina Department of Natural Resources, Columbia, SC
Mr. Derryl Shipes, South Carolina Department of Natural Resources, Columbia, SC
Ms. Emily Cope, South Carolina Department of Natural Resources, Columbia, SC
Mr. Tom McCoy, U.S. Fish & Wildlife Service, South Carolina Field Office, Charleston, SC
Ms. Jennifer Koches, U.S. Fish & Wildlife Service, South Carolina Field Office, Charleston, SC
Ms. Ulgonda Kirkpatrick, U.S. Fish and Wildlife Service, Southeast Region, Atlanta, GA
Mr. John Stanton, U.S. Fish and Wildlife Service, Division of Migratory Birds, Atlanta, GA
Mr. John Elofson, U.S. Fish and Wildlife Service, Division of Law Enformcement, Atlanta, GA
Mr. Jeff Brooks, U.S. Army Corps of Engineers, Savannah District, Savannah, GA
Mr. Ken Boyd, U.S. Army Corps of Engineers, Savannah District, Savannah, GA
Dr. Susan Wilde, University of Georgia, Athens, GA
Dr. John Fischer, University of Georgia, Athens, GA

Literature Cited

Birrenkott, AH, Wilde, S.B., Haines, J.J., Fischer, J.R., Murphy, T.M., Hope, C.P., Parnell, P.G., and Bowerman, W.W. 2004. Establishing a food-chain link between aquatic plant material and avian vacuolar mylenopathy in Mallards (*Anas platyrhnchos*). Journal of wildlife Diseases 40(3);485-492.

Fischer, J. R., Lewis-Weis, L. A., Tate, C. M. 2003. Experimental vacuolar myelinopathy in red-tailed hawks. Journal of wildlife diseases 39:400-406.

Fischer, J., Lewis-Weis, L.A., Tate, C.M., Gaydos, J.K., Gerhold, R.W., Poppenga, R.H. 2006. Avian vacuolar myelinopathy outbreaks at a southeastern reservoir. Journal of Wildlife Diseases 42:501-510.

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Wilde, S.B. 2013. Investigating stakeholder perceptions of aquatic Wilde, S. B., Murphy, T. M., Hope, C. P., Habrun, S. K., Kempton, J., Birrenkott, A., Bowerman, W.W., Lewitus, A. J. 2005. Avian vacuolar myelinopathy linked to exotic aquatic plants and a novel cyanobacterial species. Environmental Toxicology. 20:348-353.

Wilde, S.B., Johansen, J.R., Wilde, H.D., Jiang, P., Bartelme, B.A. Haynie, R.S. 2014. *Aetokthonos hydrillicola gen. et sp. nov.*: Epiphytic cyanobacteria on invasive aquatic plants implicated in Avian Vacuolar Myelinopathy. Phytotaxa 181:243-260.

May 18, 2016

Nathan Dayan
Planning Division
U.S. Army Corps of Engineers
100 W. Oglethorpe Avenue
Savannah, Georgia 31401-3604

Dear Mr. Dayan:

This is in response to Release 16-13, dated April 26, 2016 that requested comments on the Corps' proposed use of sterile triploid grass carp and herbicide to control the infestation of hydrilla in Thurmond Lake. On behalf of our Board of Directors and more than 2600 property owners we strongly support this effort.

We wholeheartedly agree that the incidence and spread of Avian vacuolar myelinopathy (AVM) has seriously and adversely impacted the bald eagle population in the lake habitat, and that a reduction in the amount of hydrilla present would be an important step in reducing the number of avian deaths attributable to this disease. The bald eagle population here is an important part of our ecological environment, and of considerable interest and enjoyment to our residents, all of whom reside within a few blocks of the lake.

In addition, the control of hydrilla in Thurmond Lake has enormous corollary benefits to our resident and visiting sportsmen and boaters who use the lake for recreational purposes. The recent uncontrolled growth of hydrilla has created serious access problems for our dock owners, presents a threat to safe boating and navigation of the lake, and has clogged many our shallow inlets and coves, making them virtually inaccessible.

The economic impact of the uncontrolled spread of hydrilla in the lake is also an important consideration. We believe that it reduces the assessed values of lake front and other property that, in turn, reduce county property tax collections; and that it reduces the utility and attractiveness of the lake for recreational purposes, which results in corresponding reductions in sales by commercial enterprises that depend on the lake for a substantial portion of their annual revenues.

We would also recommend that the Corps seek multiple-year funding to fully implement this project to assure its completion and effective evaluation.

In summary, we emphatically support the Corps' proposals for controlling hydrilla and believe they have significant ecological and other benefits that warrant their adoption and expeditious implementation.

Please let us know if we can be of further assistance or support.

Sincerely,

Ray Tarnosky
President

Kirk Smith
General Manager/Chief Operating Officer

SAVANNAH LAKES VILLAGE
5812 US HWY 378 WEST | MCCORMICK, SC 29835
800.332.0013 | SAVANNAHLAKES.COM

April 29, 2016

To: Mr. Nathan Dayan, CESAS-PD@usace.army.mil
From: Ferris Broxton, Secretary Walkinshaw Sportsman's Club
Subject: AVM Plan, April 2016- JST Hydrilla Management

I applaud pursuing a biological solution to the hydrilla infestation by introducing triploid grass carp (TGC) and approvingly note several references to the informative 2013 report by Stich et al- see the AVM Plan for literature citation. Even so, I offer several suggestions and a concern.

1. Reduce hydrilla coverage by 75%. A 50% reduction places hydrilla in the most difficult to control condition of ideal growth because of established lake coverage and new room to grow due to TGC consumption; in other words, the current objective falls on the steepest and most difficult to control portion of an invasion curve. Although negatively affecting waterfowl feeding locations, the more severe reduction could improve gamefish growth rates and sport fishing by reducing hiding places for prey.

2. Reconsider an initial stocking rate of 20 TGC per adjusted acre to develop implied TGC biomass.
a. As discussed in the AVM Plan, established hydrilla require a more aggressive approach than the typical initial stocking rate of 20 TGC per vegetated acre for early hydrilla detection. In addition, the table below indicates little TGC biomass difference between the AVM Plan and my proposal after two years.
b. Because of high hydrilla growth rates, the stocking rate of 7.5 TGC per adjusted acre will more likely compare to TGC farming than hydrilla control for the first year. The AVM Plan Group 1 stocking rate results in only a third of the peak TGC biomass at the end of one year, providing essentially no information for Group 2 targeted stocking. The table applies an empirical formula developed by Stich et al that estimates TGC weights based on age. The formula and the AVM Plan mortality rates provide the total estimated TGC biomass, which is representative of hydrilla consumption. Although later years show a gradual TGC biomass reduction, Stich et al note that studies have demonstrated an inverse relationship between feed assimilation and mass, requiring greater energy for larger TGC weight gain. TGC weight gain in Lake Gaston remained approximately linear after age 4 or the beginning of Year 3, with greater energy needed for growth and indicating higher hydrilla consumption rates per pound of TGC.
c. Initial stocking at the proposed rate reduces the waiting period for observed results and analysis.

	AVM PLAN TGC BIOMASS (LBS)				PROPOSED TGC BIOMASS (LBS)			
YEAR	Total	Group 1	Group 2	Group 3	Total	Group 1	Group 2	Group 3
0	185,891	185,891	-	-	495,699	495,699	-	-
1	440,593	198,937	241,655	-	530,479	530,479	-	-
2	565,762	214,202	258,615	92,945	571,172	571,172	-	-
3	593,332	215,408	278,461	99,464	574,363	574,363	-	-
4	594,682	207,568	280,020	107,094	553,444	553,444	TBD	-
5	571,764	194,252	269,825	107,687	517,922	517,922	TBD	-
6	534,207	177,947	252,497	103,763	474,459	474,459	TBD	-
7	488,803	160,391	231,311	97,101	427,668	427,668	TBD	TBD

3. Develop a perpetual model that incorporates TGC and hydrilla biomass projections. Referencing observed hydrilla biomass to even a spreadsheet model will facilitate analysis and adjustments.

4. I remain concerned that TGC seeking flowing water or responding to spawning urges could migrate up the Broad River or other streams and consume vegetative growth to the detriment of other species.

From: McCord, Larry
To: Chris Page; Austin Smith; Bob Perry; David Wannamaker; Jeannie Eidson; "Jeff Thompson"; Josh Baker; Bill Marshall; Stan Hutto; Tammy Lark-Lognion
Cc: Susan Wilde (swilde@uga.edu); Susan Wilde (swilde@warnell.uga.edu); Kierspe, Tom; Williams, Pamela; Davis, Chip; Moorer, Casey; Morrison, John; CESAS-PD, SAS; Grant, John; Becca Haynie (hayniers@gmail.com)
Subject: [EXTERNAL] RE: Strom Thurmond Reservoir
Date: Tuesday, May 03, 2016 3:41:53 PM
Attachments: image001.gif
Public Notice AVM final.pdf

Ladies and Gentlemen; it pleases me greatly to see that the USACOE has decided, after some 15 years of contributing to the deaths of likely more than 80 American Bald Eagles and untold hundreds of ducks, geese and other waterfowl, to initiate a real aquatic plant management plan to control *Hydrilla verticillata*, a federally listed, non-native, invasive plant that is known to be the primary substrate for the algae containing the AVM toxin. Experienced aquatic plant management professionals, including myself, have strongly recommended control efforts targeting Hydrilla many times over the period with little or no response. Lake Thurmond managers have sited the unsupported, undocumented powers of Hydrilla to increase and improve the Largemouth Bass population in reservoirs, as well as, the high cost of chemical control, as reasons for allowing this federally regulated invasive species to thrive and spread over nearly two decades. Management decisions, such as this, make the task of invasive plant management much more difficult for other reservoir managers by fueling the tanks of special interest groups who seldom need biologically sound information to support their claims. As educated and experienced lake management professionals and “Councils”, we must make our decisions based on science and experience, or we could all see unacceptable, devastating results such as what has, and is still, happening at Lake Thurmond. The Biological/Chemical integrated approach (alternative 3) is certainly the most sound plan. However, to site protection of the Shoals Spider-Lily as the reason for low grass carp stocking numbers supports another unsupported, undocumented premise that grass carp will negatively impact this plant. Hopefully we will not lose significantly more waterfowl and eagles during the time required for this plan to achieve results

Larry McCord
Manager – Environmental Resources
Ext. 5735
(843)761-4101
Cell: (843)870-7576

Description: log

From: Chris Page [mailto:PageC@dnr.sc.gov]
Sent: Tuesday, May 03, 2016 12:23 PM
To: Austin Smith; Bob Perry; Chris Page; David Wannamaker; Jeannie Eidson; 'Jeff Thompson'; Josh Baker; McCord, Larry; Bill Marshall; Stan Hutto; Tammy Lark-Lognion
Subject: [EXTERNAL SENDER] Strom Thurmond Reservoir

Dear Council Members,
Please see the attached document from the USACOE for Lake Thurmond. They have come up with alternative treatment plans for the AVM issue(Hydrilla) in the lake. The SCDNR has recently met on this and it looks as if we are in agreeance with their suggested method of an integrated approach (d. alternative 3). It is geared for the long term by easing into the carp introduction with chemical control. The carp are being utilized in a very limited fashion because of concern for the impacts to the shoals spider-lily a state threatened species. We have asked for a clarification on the acreage figures to be utilized in this approach as their methodology has two different numbers.

I would like for you to email me your opinions, as a vote, as to which method you would like to see utilized. Any concerns could also be included.
I you could get me this email vote by the early part of next week it would be appreciated. When you send me your vote and please copy all so that others may see the varying opinions.

Thanks,
Chris

Chris Page
SCDNR-Aquatic Nuisance Species Program
pagec@dnr.sc.gov

From: "CESAS-PD, SAS" <CESAS-PD.SAS@usace.army.mil>
Date: April 27, 2016 at 10:06:21 AM EDT
To: Undisclosed recipients:;
Subject: Public Notice: USACE Savannah District - Bald Eagles at J. Strom Thurmond Lake (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

Please see Attached: Notice of Availability of a proposed Avian Vacuolar Myelinopathy Plan (AVMP), Draft Environmental Assessment (EA), and Draft Finding of No Significant Impact (FONSI) to evaluate the potential impacts of managing hydrilla within J. Strom Thurmond Lake (JST) to reduce occurrences of Avian Vacuolar Myelinopathy in bald eagles.

Thank you
Nathan Dayan
Environmental Team Leader
USACE - Savannah District

CLASSIFICATION: UNCLASSIFIED

****

From:	Joey Spradley
To:	CESAS-PD, SAS
Subject:	[EXTERNAL] Don"t kill the grass.
Date:	Wednesday, May 04, 2016 9:04:30 AM

I want to speak for myself but also the many fishermen I network and fish with. Killing the grass in Clarks hill will kill the fishery as it has in the past. The lake is just turning back into the great fishery it was when I was growing up bass fishing with my grandfather. I am a tournament bass fisherman who spends thousands of dollars a year in the csra on tackle, gas, and supplies. The economic value of having a great fishery far out ways the value of an eagle but if you want to combat these so called deaths by eating waterfowl that in turn give the Eagles AVM I have better solutions than spraying herbicide that will kill the grass. First of all extend or change the opening and closing dates of our duck season. I spend 3-5 days a week on that lake and as an avid duck hunter I can tell you the majority of ducks don't get here until mid to late February. Also have an open season as they do on santee cooper on cormorants and coots. Don't kill a third party that provides more good than bad, kill the waterfowl. If y'all gurus that run this program think this is the only body of water that has hydrilla that these waterfowl eat your sadly mistaken. These are migratory birds that eat grass all the way to our lake do just what they are suppose to do, migrate. They are here 4 months out the year and fly back north so there problem is short lived but the killing of vegetation that provides shelter and oxygen for the fish we spend our weekends, vacations and hard earned time off trying to catch is the most outlandish crap I have ever heard. This lake is turning into an amazing fishery again and a bird that does nothing for our area is gonna ruin it again as y'all have in the past. The corp of engineers isn't highly spoken of in the eyes of fishermen not that y'all care but don't make it worse. I love this lake it's part of me it's part of who I am. I became a fisherman because of this place and I bass fish for living because of what I learned at this lake. If you don't think the economy in our area is important kill the grass but just know when you do that the effects will be felt through the fishing community not the yuppies making these idiotic decisions. The corp will go on generating power, the people that enjoy the water will continue to ski and joy ride and the fishing community will go spend there money in other places and other lakes within driving distance. I know in my heart this is just a formality to make the public feel like they have a voice and opinion but as soon as the meetings are over and the paperwork is finalized y'all will dump herbicide from one end to the other and slowly kill the fishery we enjoy. If hydrilla is invasive and unnatural what is the herbicide is it derived from the lake or is it a chemical that again doesn't belong? Will the herbicide be ingested by fish which I'm pretty sure is also part of an Eagles diet? Is that herbicide safe for fish, Eagles and the people who eat the fish out of this lake and if so show me and the rest of us your research. Let's work together to find a better solution before aiming a loaded gun at the fish we love to catch.

Joey Spradley

From:	john Humphrey
To:	CESAS-PD, SAS
Subject:	[EXTERNAL] hydrilla management
Date:	Thursday, May 05, 2016 11:18:39 PM

To whom it concerns:

I make a living on this lake and love seeing the bald eagles when i do see them but I do have a few questions about AVM.

1st - Do the grass carp pick up AVM from eating the hydrilla?

2nd - If so can the eagles get it from eating the grass carp.

The reason I am asking and I will follow up with a 3rd question after is, I have seen the eagles eating the dead carp that end up littering the shoreline along Hwy 28 in the Parksville area. The reason the carp litter the shoreline is from the bow fishermen that come out at night and shoot and dispose of the fish they kill.

3rd - Will they stop bow fishing on the lake for this reason. I can not see how someone can tell between a regular carp and a grass carp in a matter of seconds. Most bow fishermen have only seconds to decide when shooting?

Thank you

John Humphrey
108 Depot St
Plum Branch SC 29845
706-401-7256

www.jhdocks.com <http://www.jhdocks.com>

From: Jeffrey Woods
To: CESAS-PD, SAS
Subject: [EXTERNAL] Hydrilla/Bald Eagle
Date: Friday, May 06, 2016 10:30:23 AM

To ACorp of E,

The input you requested from those of us that use the lake is appreciated. I fish the lake year round and for 15 years and my level of excitement rises when hydrilla is present. It is important to us that fish and to the fishery.
The info in the report, though 29 eagle deaths due to the grass, is over 18 years. It would seem that the food source for the eagles
are helped by the grass and therefore benefit the eagles as well. I'm not sure that eliminating grass would profit the eagle population except that the focus is on the 29 deaths caused by grass waterfowl ate.

I have no real knowledge of the situation, but I care about the grass, the fishery and the eagles. I do not want to see the grass
eliminated or grass carp introduced.

thanks,
Jeff Woods

From: Birdwell, Billy E SAS
To: Robert Oenbrink
Subject: RE: [EXTERNAL] Proposed Hydrilla Management Plan, Clarks Hill Lake
Date: Friday, May 06, 2016 10:26:29 AM
Attachments: image001.jpg
image002.jpg
image003.jpg
image004.jpg
image005.jpg
image006.jpg

Dear Mr. Oenbrink:

Thank you for your comment. I have forwarded it to our Planning Division as an official comment on the study.

Sincerely,

BILLY E. BIRDWELL
Senior Public Affairs Specialist
Savannah District, US Army Corps of Engineers
912-652-5014 (office)
912-677-6039 (mobile)

From: Robert Oenbrink [mailto:rsoenbrink@yahoo.com]
Sent: Friday, May 06, 2016 9:47 AM
To: Birdwell, Billy E SAS <Billy.E.Birdwell@usace.army.mil>
Subject: [EXTERNAL] Proposed Hydrilla Management Plan, Clarks Hill Lake

My wife and I both agree that your proposed hydrilla management plan is both comprehensive and well documented. The use of grass carp and herbicide to control the hydrilla is supported.

Robert Oenbrink
92 Chigoe Lane
Appling, GA 30802
(706) 309-9359

From: linda crochet
To: CESAS-PD, SAS
Subject: [EXTERNAL] Hydrilla Control
Date: Saturday, May 07, 2016 4:26:42 PM

I applaud your concern for the eagles. I lived in Conroe, Texas before coming to McCormick 1 1/2 years ago. Lake Conroe also had a hydrilla problem and introduced grass carp into the lake. The carp did a great job. In fact, they ate most every living plant in the lake. Now the lake is a brown lake without proper plant life to support the fish. It was thought that the carp were not able to reproduce. Nature changed things. They reproduced over the years. They are nice, docile fish. I even trained some - or they trained me to feed them dog food every morning at my dock!

Good luck!

Linda Crochet
204 Links Place
McCormick, SC 29835

864-391-9696 - Home
713-851-1669 - Cell
linda48crochet@gmail.com <mailto:linda48crochet@gmail.com>

From:	Birdwell, Billy E SAS
To:	Karen
Cc:	CESAS-PD, SAS
Subject:	RE: Your comments on the hydrilla study
Date:	Monday, May 09, 2016 8:11:06 AM
Attachments:	image001.jpg image002.jpg image003.jpg image004.jpg image005.jpg image006.jpg

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Dear Ms. McCullough:

Thank you for participating in the public comment period for our study. With this note I forward your comment to our Planning Division for inclusion in the official comments for the study.

BILLY E. BIRDWELL

Senior Public Affairs Specialist

Savannah District, US Army Corps of Engineers

912-652-5014 (office)

912-677-6039 (mobile)

<https://www.facebook.com/savannahcorps/> <https://twitter.com/savannahcorps>
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<http://balancingthebasin.armylive.dodlive.mil/> <http://www.sas.usace.army.mil/>

-----Original Message-----
From: Karen [mailto:kmmccullk@gmail.com]
Sent: Saturday, May 07, 2016 5:35 PM
To: Birdwell, Billy E SAS <Billy.E.Birdwell@usace.army.mil>
Subject: [EXTERNAL] Fantastic!

So glad you are going to treat the hydrilla to help eliminate bald eagle deaths!!!

Karen mccullough

137 davis lane

McCormick

From: Kenneth Sweet
To: CESAS-PD, SAS
Subject: [EXTERNAL] Hydrilla Management Plan
Date: Monday, May 09, 2016 7:58:31 AM

My name is Kenneth Sweet and I am a property owner and full time resident on Clarks Hill Lake in southern Lincoln County. I fully support the proposed approach to reduce and eliminate Hydrilla in Clarks Hill Lake. I have lived on the Lake for four years and have observed the increasing spread of Hydrilla in the lake. Without active and aggressive reduction efforts I believe the problem will continue to grow and spread to many more areas of the lake. In addition to the impact on Bald Eagles and other wildlife, Hydrilla affects the use of the lake for fishing and recreation. In areas where Hydrilla is present it can completely restrict navigation or any type of recreation activity. I highly recommend going ahead with the proposed Hydrilla management plan.
Kenneth Sweet

From:	[redacted]
To:	Dayan, Nathan S SAS
Cc:	Wicke, Russell A SAS; swilde@warnell.uga.edu
Subject:	[EXTERNAL] Fwd: TGC
Date:	Wednesday, May 18, 2016 4:43:20 PM
Attachments:	Malone Triploid Grass Carp.pdf Stich et al 2013_Growth and pop size grass carp for hydrilla control_NAJFM.pdf

Nathan, don't know why AOL left "army" out. Ferris

Ferris L. Broxton
[redacted]

-----Original Message-----
From: Ferris L Broxton [redacted]
To: swilde <swilde@warnell.uga.edu>
Cc: Russell.A.Wicke <Russell.A.Wicke@usace.army.mil>; Nathan.S.Dayan <Nathan.S.Dayan@usace.mil>
Sent: Wed, May 18, 2016 4:33 pm
Subject: TGC

To: Susan B. Wilde, UGA, Daniel B. Warnell School of Forestry and Natural Resources

Hi Susan,

Thank you for the informative discussion at the AVM meeting in Appling yesterday evening. I appreciate your passion to eradicate AVM and attack the hydrilla invasion. I copy Russell Wicke on all USACE related correspondence to keep him in the loop and because he often has information or contacts related to my concerns, and I copied Nathan because of the project.

As requested, I again ask this question- What is the failure rate for the TGC supplier for Thurmond? The Owen & Williams website does not offer these statistics. The attached Malone document advertises a failure rate of 1 in 98,000 tested over 24 years, but vendor statistics can be misleading and I think an independent assessment valuable.

Rather than an often discussed 6-7 year life span, the 2013 Lake Gaston study by Stich et al shows TGC up to at least age 16 provide important weed control. My highlighted copy of the document is attached for your information; the highlights are not necessarily relevant to our discussion and are from my previous study. The extended life expectancy could factor into testing failures for anticipated quantities.

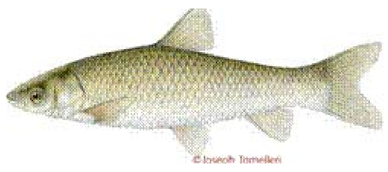
Nathan, during our discussion I referred to Figure 1 on the numbered page 18. Thanks for your project insights!

Best regards,
Ferris

Ferris L. Broxton
[redacted]

[redacted]

Triploid Grass Carp



Availability: Good

Size Range: 8" to 10", 10" minimum, 12" minimum, headsize

Best Time of Year to Handle: Handle best during cool weather, usually between October and April. It is best to stock before aquatic vegetation takes over your pond. Survival is lowest for grass carp stocked May –September.

Follow this link to purchase grass carp from J.M. Malone and Son, Inc.: http://www.shop.jmmaloneandson.com

Grass Carp, also called white amur, are a biological control for aquatic vegetation. Unlike common carp, Grass carp will not spawn in ponds or muddy the water. Native to the Amur river in China, grass carp are strict herbivores using specialized teeth in the back of their throat to graze submerged plants from the top down. Grass carp require flowing water of large rivers to spawn and therefore cannot reproduce in ponds. Grass carp also grow to large sizes, are fun to catch and good to eat.

Grass carp were imported in 1963 by the USFWS for evaluation as an alternative to chemical control methods. Proving to be the most effective aquatic vegetation control, grass carp were made available to the public in 1973 for stocking private ponds. Because grass carp are an exotic species, concerns over their spread prompted many states to outlaw the stocking of diploid (fertile) grass carp in 1977.

This prompted J.M. Malone and Son, Inc. to develop a method for the production of triploid (sterile) grass carp on a commercially viable scale. In 1983, the company successfully produced their first triploid grass carp and pioneered the use of the Coulter Counter and inspection protocol to rapidly identify, isolate and certify 100% triploid grass carp for sale. With the introduction of certified 100% Triploid Grass Carp many states allowed the sale and stocking of triploid (sterile) grass carp for aquatic vegetation control.

Like you and me, regular diploid grass carp have two chromosomes in every cell allowing the fish to produce viable eggs or sperm with 1 chromosome each. Triploid Grass carp have three chromosomes in each cell preventing them from producing viable eggs or sperm, making them functionally sterile. Triploid grass carp are produced by combining the eggs and sperm from diploid grass carp and then shocking the fertilized eggs with temperature, pressure or chemicals early in development. The shock causes the egg to retain a naturally occurring third set of chromosomes that would normally be discarded.

This process is often variable, therefore, to ensure only high ploidy groups of grass carp are stocked for production, J.M. Malone and Son, Inc. tests each group of grass carp fry before they are stocked into nursery ponds and each group of grass carp fingerlings before they are stocked into production ponds. Then, before triploid grass carp can be sold each fish must be individually blood tested to ensure it is triploid. Once each fish has been individually tested using a coulter counter, a USFWS inspector visits the farm and randomly retests 120 fish from each prospective shipment. If all of the 120 randomly selected fish are triploid a certificate is issued verifying that every fish in the prospective shipment is in fact a triploid. If even one diploid is found during the random inspection of the prospective shipment, no certificate is issued and every fish in the shipment must be individually retested. Before a certificate can be issued another 120 randomly selected fish must pass another USFWS inspection. Once an inspection is passed and a certificate is issued triploid grass carp may be shipped from the farm. To see this process follow this link to our slideshow.

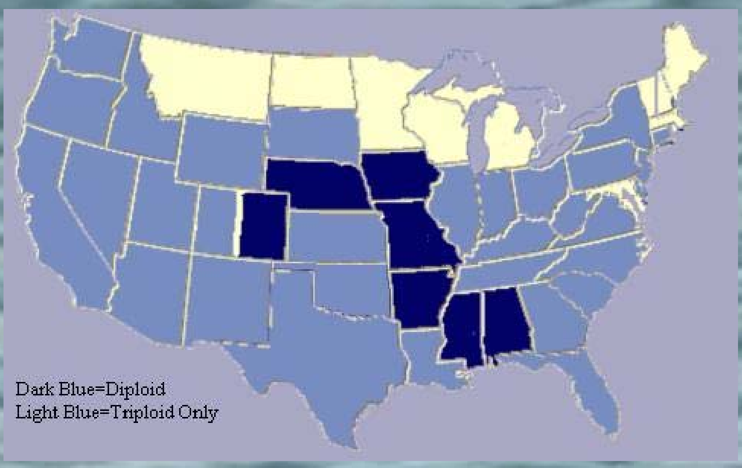
As the World's Largest Producer of Certified 100% Triploid Grass Carp J.M. Malone and Son, Inc. operates a state of the art Triploid Grass Carp Blood Analysis Lab. With a full time staff of seven people our lab is capable of individually testing 1000 grass carp per hour and by volume has the lowest failure rate in the USFWS Triploid Grass Carp Ploidy Verification Program. Our lab's 24 year average reflects one failed inspection for every 98,000 grass carp tested. The industry average in the State of Arkansas alone is one failure for every 42,000 grass carp tested.

Pond owners may be required to purchase permits from their State before stocking Triploid Grass Carp in their pond. Due to the required blood testing and USFWS certification Triploid Grass Carp are more expensive than normal diploid grass carp.

Currently diploid grass carp are only allowed in Alabama, Mississippi, Arkansas, Missouri, Iowa, Nebraska, and east of the continental divide in Colorado.

Triploid Grass Carp certified by the USFWS are required by Oklahoma, Texas, Louisiana, Florida, Georgia, North Carolina, Virginia, West Virginia, Pennsylvania, New Jersey, New York, Connecticut, Kentucky, Illinois, Indiana, Ohio, western Colorado, Kansas, Arizona, New Mexico, Utah, Nevada, California, Oregon, Washington, Idaho, South Dakota and Wyoming. Tennessee and South Carolina only allow Triploid Grass Carp however USWFS certification is not required.

Please check your local laws regarding the purchase of Grass Carp for vegetation control in your pond. Many states require evaluations or permits before grass carp can be purchased. It is a federal offense to transport grass carp across state lines in violation of state law, so please be informed of your local laws.



Grass Carp should be stocked between October and April before vegetation is actively growing. Triploid grass carp purchased at this time of year are robust after completing a full growing season and dormant from cool water temperatures. This allows for improved handling and stocking, ultimately resulting in more effective vegetation control. Once water temperatures begin to rise in the spring the fish will emerge unscathed from their dormant state with a racing metabolism and a need to consume an abundance of aquatic vegetation. Triploid grass carp purchased and stocked during late spring and summer do not handle as well due to their high metabolism. Stocking triploid grass carp during this time period is often unsuccessful due to high water temperatures, low oxygen concentrations and dense aquatic vegetation resulting in poor aquatic vegetation control.

Grass carp prefer aquatic vegetation such as Duckweed, Chara, Naiad, Potamogeton, Eurasian Watermilfoil, Bladderwort, Hydrilla, Elodea, Coontail, Spikerush and Water Stargrass. Grass carp generally do not prefer filamentous algaes, watermeal, watersheild, spatterdock, waterlilly, arrowhead, water hyacinth and cattails. Plant preference is greatly linked to fish size. Smaller grass carp will readily eat filamentous algae and pithophora while larger grass carp do not prefer this species but will eventually eat it once they have eaten other available species. Emergent vegetation such as hyacinth and arrowhead are generally not preferred by grass carp, however once grass carp have reached large sizes they will eat these species.

Complete eradication of aquatic vegetation can be rapidly achieved by stocking 10 to 12 grass carp per surface acre. While eradication is sometimes preferred by some pond owners, it is normally not in the best interest of public water bodies. Aquatic vegetation can be managed rather than eradicated by using smaller periodic stockings of grass carp and monitoring the response of the aquatic vegetation to grazing, weather and water quality. Stocking 1 to 3 grass carp per vegetated surface acre every 3 to 5 years is becoming more popular with public vegetation control projects. The growth of aquatic vegetation is influenced by weather, water quality and water levels. The level of control provided by grass carp is dependent on the size and age structure of the grass carp population and the growth rate of the aquatic vegetation. Modern aquatic vegetation management plans must continuously monitor these dynamic relationships to achieve the desired outcome.

Growth and Population Size of Grass Carp Incrementally Stocked for Hydrilla Control

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ARTICLE

Growth and Population Size of Grass Carp Incrementally Stocked for Hydrilla Control

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Abstract
In weed control plans that use Grass Carp *Ctenopharyngodon idella* for intermediate control of hydrilla *Hydrilla verticillata*, the knowledge of population dynamics improves efficacy of management. Our objective was to characterize growth, mortality, and associated population metrics of long-lived (up to 16 years) triploid Grass Carp that were incrementally stocked into Lake Gaston, Virginia–North Carolina, starting in 1995. Grass Carp (ages 1–16) were collected by bowfishers during 2006–2010. Growth of Grass Carp was described by the von Bertalanffy growth model as $L_t = 1{,}297[1 - e^{-0.1352(t+1.52)}]$, where L_t is TL at age *t*. We used three methods to estimate Grass Carp mortality, and annual abundance and biomass of Grass Carp were estimated from each mortality estimate. Estimated annual mortality ranged from 0.20 to 0.25 depending on the method used. The use of constant mortality rates versus age-specific mortality rates produced divergent models of Grass Carp biomass and represented a different approach for tracking the progress of weed control. Grass Carp biomass (but not abundance) was related to hydrilla coverage in Lake Gaston based on several scenarios that described time lags between Grass Carp stocking in year *i* and decreases in hydrilla coverage (in years $i, i+1, \ldots, i+5$). Regardless of the mortality estimate used to derive Grass Carp biomass, the strongest biomass–hydrilla coverage relationship was observed for a time lag of 4 years. Fish older than age 10 constituted nearly 50% of the total Grass Carp biomass in Lake Gaston during some years, and the relationship between Grass Carp biomass and hydrilla coverage was strongest when fish up to age 16 were included in models. These results indicate that Grass Carp up to at least age 16 are important for weed control, thus highlighting the need for stocking models and bioenergetics models that include contributions of older fish when assessing long-lived Grass Carp populations.

Grass Carp *Ctenopharyngodon idella* have been widely stocked for biological control of aquatic vegetation in the USA since the species' introduction in 1963 (Mitchell and Kelly 2006). The Grass Carp has been proven as an effective control agent for invasive aquatic weeds, including hydrilla *Hydrilla verticillata*, which is a preferred food source for Grass Carp (Allen and Wattendorf 1987; Chilton and Muoneke 1992; Kirk et al. 2000). However, variable success has resulted in Grass Carp stocking rates that range from 2 to 500 fish/vegetated hectare (Kilgen and Smitherman 1971; Allen and Wattendorf

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Received January 23, 2012; accepted October 3, 2012
Published online January 9, 2013

1987; Bonar et al. 1993, 2002; Kirk et al. 2000). Traditional approaches to using Grass Carp for biological control of hydrilla often involve large, isolated stocking events. In many situations, Grass Carp either provide inadequate control of vegetation (Baker et al. 1974; Kirk 1992; Killgore et al. 1998) or completely eradicate vegetation (including nontarget species) from aquatic systems (Stott and Robson 1970; Bettoli et al. 1993; Killgore et al. 1998; Schramm and Brice 2000).

In some cases, weed management goals target some intermediate level of noxious weed infestation that is specific to stakeholder views and generally is based on some predetermined surface coverage of hydrilla (Bonar et al. 2002). This management goal is highly controversial but generally is the result of conflicting stakeholder views (Chilton and Magnelia 2008; Richardson 2008). One approach to the intermediate control of hydrilla is the incremental stocking of Grass Carp in combination with low-level herbicide application (Chilton and Magnelia 2008; Chilton et al. 2008). This approach theoretically allows fisheries managers to make adjustments to Grass Carp stocking rates so that fish density can be maintained at a desired level based on knowledge of the population's growth, mortality, and longevity. However, information regarding population characteristics of Grass Carp is often lacking; therefore, stocking rates are commonly determined on the basis of maintaining a desired number of Grass Carp per total surface area of the lake or per unit of surface weed coverage (e.g., Kirk et al. 2000; Bonar et al. 2002; Chilton and Magnelia 2008; Chilton et al. 2008) rather than based on the biology of Grass Carp in the system of interest. For example, this management approach assumes that for the purpose of making management decisions, the number of Grass Carp in a system is more important than Grass Carp biomass; however, this assumption has not been validated for large reservoirs.

Mortality and growth rates of Grass Carp vary by geography, climate, availability of food, and fish age (Chilton and Muoneke 1992). State and federal agencies have developed software programs that predict, based on a host of factors, the potential effects of a cohort for up to 10 years after stocking (e.g., Stewart and Boyd 1999). Limiting the analyzed effects to 10 years post-stocking is likely due to the contention in the published literature that triploid Grass Carp older than age 10 make up a negligible proportion of population size and biomass in most systems (Kirk and Socha 2003). However, we suspect that this belief results from (1) high stocking rates and subsequently high mortality rates of Grass Carp due to the elimination of aquatic vegetation in the system that received the stocked fish (e.g., Morrow et al. 1997; Kirk et al. 2000; Kirk and Socha 2003); (2) the application of assumed mortality rates in lieu of either indirect or direct estimation of Grass Carp mortality (e.g., Chilton and Magnelia 2008); and (3) the fact that Grass Carp are thought to consume less hydrilla and grow more slowly in proportion to body mass as they increase in body size and age (Gorbach 1961; Osborne and Sassic 1981).

Research has shown that Grass Carp may live up to 21 years in systems where food is plentiful (Gorbach 1961) and that growth (in mass) of Grass Carp can be approximately linear with age (Gasaway 1978; Morrow et al. 1997). Although some life history studies have been conducted on triploid (sterile) Grass Carp (e.g., Morrow et al. 1997; Kirk et al. 2000), little information exists regarding the characteristics of established populations that have not eradicated all of the vegetation in the stocked water body. As integrated pest management (IPM) becomes more common as an approach to aquatic weed control (Chilton and Magnelia 2008; Richardson 2008), knowledge of the population dynamics of long-lived, incrementally stocked Grass Carp populations will become increasingly important because the IPM approach relies more on long-term, low-level Grass Carp stocking than on traditional stocking strategies, which are designed to eradicate vegetation in the short term.

Hydrilla was first identified in Lake Gaston, Virginia–North Carolina, in 1992 (Ryan et al. 1995). Since then, millions of dollars have been spent on hydrilla control in the reservoir. Coverage of hydrilla was initially about 10 ha and later peaked at 1,364 ha in 2003 (Dodd-Williams et al. 2008). Since 1995, incremental Grass Carp stocking has been integrated with annual fluridone applications to control hydrilla in Lake Gaston (Lake Gaston Weed Control Council [LGWCC], unpublished; www.lgwcc.org). The hydrilla leaf-mining flies *Hydrellia pakistanae* and *H. balciunasi* (Diptera: Ephydridae) were introduced into the lake in 2004, but they failed to establish viable populations and are considered to have been ineffective (Grodowitz et al. 2010). Due to the highly controversial nature of aquatic weed control (Kirk and Henderson 2006) and the variety of conflicting views among Lake Gaston stakeholders (see Richardson 2008), the goal of weed control at the lake is not the complete eradication of hydrilla. Instead, the management goal for hydrilla control, as established by the LGWCC, is "to develop and maintain a healthy lake ecosystem based on a diverse plant community dominated by native species" (LGSB 2005:8). To achieve this goal, one stated objective of management is to reduce hydrilla coverage to 120 ha by 2012. The remaining hydrilla coverage of 120 ha is designed to serve as a buffer for expected Grass Carp grazing and to allow for the re-establishment of desirable aquatic vegetation (LGSB 2005). The target density for Grass Carp standing stock in 2011 was 37 fish/vegetated hectare (LGWCC, unpublished; www.lgwcc.org). By 2010, hydrilla coverage in Lake Gaston was reduced to approximately 666 ha (ReMetrix 2011), but this level of coverage was unsatisfactory in relation to management objectives for the lake.

The present study is the result of research that began in 2006 to assess the current status of Grass Carp with regard to the efficacy of weed control in Lake Gaston. One objective was to characterize the growth and mortality of the long-lived Grass Carp population in Lake Gaston in order to estimate the current standing stock of Grass Carp in the lake. The second objective was to use the standing stock estimates to characterize relationships between hydrilla coverage and Grass Carp numbers and biomass in Lake Gaston. Our third objective was to explore the importance of Grass Carp up to age 16 for weed control and to rank the relative contributions of various age-groups to the efficacy of weed control. The information and relationships defined in this study will be useful for assessing the current status of hydrilla control in Lake Gaston and should provide a basis for improved management through a better understanding of the Grass Carp's contribution to this long-term integrated weed management effort.

METHODS

Study site.—Lake Gaston is an impoundment of the Roanoke River and spans five counties in Virginia and North Carolina. The total surface area of the reservoir is 8,423 ha, the total volume is about 5.6×10^{11} L flowing at 1,245 m^3/s, and the retention time is 29 d at the full-pond elevation of 61 m (Richardson 2008; Dominion Power 2010). The reservoir is bordered upstream by Kerr Reservoir and downstream by Roanoke Rapids Lake. Lake Gaston is operated to regulate discharges from Kerr Reservoir, the primary flood control station for the Lower Roanoke River; therefore, lake elevation fluctuates little in Lake Gaston, although flow is variable. The primary purpose of Lake Gaston is hydropower production, but it also supports popular sport fisheries and is a center of residential development in the region and therefore is used for a number of nonconsumptive recreational activities (Richardson 2008). Human population density is highest at the lower end of the reservoir, whereas the upper portion of the reservoir is sparsely populated and includes designated wildlife management areas. The reservoir also acts as a major source of drinking water for the City of Virginia Beach (Cox 2007).

Age and growth.—Specially permitted volunteer bowfishers collected 243 Grass Carp from Lake Gaston during 2006–2010. We measured TL (mm) and mass (g) of individual Grass Carp. Lapillar otoliths were removed from the fish and were prepared and aged by using methods that were documented in the literature but adapted based on technological advances (Morrow and Kirk 1995; Morrow et al. 1997). A consensus was reached between multiple readers in order to assign an age to each Grass Carp based on annular ring formation in otoliths.

The Fraser–Lee method was used to back-calculate lengths at each age (DeVries and Frie 1996). We estimated von Bertalanffy growth parameters (von Bertalanffy 1938) simultaneously from raw age–length data and plotted the von Bertalanffy growth curve in R software (R Development Core Team 2011). To optimize the fit of the von Bertalanffy growth model (VBGM), preliminary values of parameter estimates (obtained by using mean length at age in FAST; Slipke and Maceina 2001) were employed as starting values for the final parameter estimation in R. Parameter estimates for the growth curve were reported in the following form:

$$L_t = L_\infty[1 - e^{-K(t-t_0)}], \quad (1)$$

where L_t is the mean length of fish at age t, L_∞ is the theoretical maximum length of fish in the population, K is the Brody growth coefficient, and t_0 is the arbitrary origin of the equation (i.e., theoretical age at zero length; von Bertalanffy 1938). We estimated 95% confidence intervals (CIs) for growth parameters by using bootstrap methods iterated 20,000 times. We predicted mean length at age, and we constructed 95% CIs for lengths at each age by using the bootstrapped results for VBGM parameter estimates in R.

The length–weight relationship for Grass Carp collected from Lake Gaston was estimated by use of the function $W = a\text{TL}^b$, where a and b are constants, W is fish weight in grams, and TL is total length in millimeters (Ricker 1975). We used this equation to predict the weight of Grass Carp at each age from back-calculated lengths at age (Anderson and Neumann 1996). The predicted weight at each age was used in combination with mortality estimates (as described below) to estimate the biomass of Grass Carp in Lake Gaston.

Mortality.—Morrow et al. (1997) used bowfishing catch data to estimate Grass Carp mortality in the Santee–Cooper Reservoir system, South Carolina, by using catch curves. However, our data did not meet the assumptions of catch-curve analysis; therefore, we used three alternatives based on VBGM parameters. We used multiple methods to estimate mortality because (1) it is the only estimated demographic parameter used in predicting Grass Carp population size in Lake Gaston and (2) there is a high degree of uncertainty associated with using indirect methods of mortality estimation (Hewitt and Hoenig 2005). The first method we used was based solely on life history theory (Jensen 1996), the second method was based on empirical equations derived from meta-analysis of fish life history characteristics (Pauly 1980), and the third method was one that allowed age-specific mortality to be estimated based on fish life history characteristics (Chen and Watanabe 1989). We estimated 95% CIs for each of the three mortality estimates by using bootstrapped 95% confidence limits (CLs) for the VBGM parameters. To assess the importance of using growth parameters from an established population when using indirect estimates of mortality, we also estimated mortality from the VBGM parameters reported by Morrow et al. (1997) for Grass Carp in the Santee–Cooper Reservoir system. Because harvest of Grass Carp is not permitted in Lake Gaston, estimated annual natural mortality (M) represents the total annual mortality rate, and changes in the size of the Grass Carp population depend entirely on mortality (i.e., reproduction is zero due to triploidy).

Jensen (1996) demonstrated that the relationship between M and the growth coefficient K could be expressed as

$$\hat{M} = 1.50K. \quad (2)$$

Mortality rates that we estimated by using the method of Jensen (1996) will be referred to as $\hat{M}_j$.

Pauly (1980) estimated fish mortality based on relationships between L_∞, K, temperature (T), and M for 175 fish stocks as

$$\log_e \hat{M} = 0.654 \cdot \log_e K - 0.28 \cdot \log_e L_\infty + 0.463 \cdot \log_e T. \quad (3)$$

Temperature used for estimating mortality with this method can be based on average annual water temperature or on air temperature. We used average annual water temperature at Lake Gaston as measured in Grass Carp telemetry studies (D. S. Stich, unpublished data) that were conducted during the same years as the present study. Mortality estimates resulting from the Pauly (1980) method will be referred to as $\hat{M}_p$.

Finally, we used a method developed by Chen and Watanabe (1989) to estimate age-specific mortality rates (M_{cw}) of Grass Carp in Lake Gaston based on maximum observed age (t_{max}), K, and t_0 as described mathematically by

$$M_{cw} = \begin{cases} \dfrac{K}{1 - e^{-K(t-t_0)}}, \; t < t_{max} \\ \dfrac{K}{a_0 + a_1(t - t_{max}) + a_2(t - t_{max})^2}, \; t \geq t_{max} \end{cases}, \quad (4)$$

where a_0, a_1, and a_2 are constants pertaining to senescence.

Population size and biomass.—We used the $\hat{M}_j$ and $\hat{M}_p$ values to estimate the number of Grass Carp at each age remaining in Lake Gaston at the start of each year ($N_{t,i}$) based on the number of fish stocked (R_i) at time i:

$$N_{t,i} = N_{t-1,i-1}e^{(-\hat{M})} + R_{t,i}. \quad (5)$$

We also used age-specific estimates of mortality (M_{cw}) to estimate the number of Grass Carp in Lake Gaston at each age from 1995 to 2010 ($N_{t,i}$):

$$N_{t,i} = N_{t-1,i-1}e^{(-M_{cw})} + R_{t,i}. \quad (6)$$

We estimated population size at the start of each year ($\hat{N}_i$) and the biomass of Grass Carp in each age-class at the start of each year ($B_{t,i}$) by using each method of mortality estimation:

$$\hat{N}_i = \sum N_{t,i} \quad (7)$$

and

$$B_{t,i} = N_{t,i} W_t. \quad (8)$$

Finally, we estimated standing biomass ($\hat{B}_i$) of Grass Carp in Lake Gaston at the start of each year:

$$\hat{B}_i = \sum B_{t,i}. \quad (9)$$

We estimated the 95% CI for population size based on the 95% CLs for each mortality estimate; the 95% CI for biomass was estimated by propagating errors around estimated population size and weight at each age (Frishman 1975). For comparison with biomass estimated by using mortality derived from catch-curve analyses in other systems, we used mortality estimates reported by Kirk and Socha (2003; Santee–Cooper Reservoir system) to project biomass of the Lake Gaston Grass Carp population, and we developed 95% CIs for biomass based on weight at age in Lake Gaston.

Hydrilla coverage estimates used in this study were privately contracted by the LGWCC on an annual basis during 1995–2010. Because a time lag was expected to occur between Grass Carp stocking and subsequent effects on hydrilla coverage, we tested the relationship between model-estimated numbers and standing biomass of Grass Carp in year i and hydrilla coverage in years i, $i+1$, $i+2$, $i+3$, $i+4$, and $i+5$ by using simple linear regression (Montgomery et al. 2006). Models of each time lag were ranked by using an information-theoretic approach based on Akaike's information criterion adjusted for small sample sizes (AIC$_c$; Burnham and Anderson 2002) in SYSTAT version 12 (SYSTAT 2007). When each model was fitted individually with the complete data set, all lag scenarios (including a lag of zero) indicated a strong empirical relationship between total Grass Carp biomass and hydrilla coverage ($R^2 > 0.90$). However, use of AIC$_c$ to rank competing models requires that all models be drawn from the same set of observations (Burnham and Anderson 2002). To meet this requirement, only 1998–2005 data could be used for ranking the relative plausibility of different lags because (1) hydrilla data for 1996 and 1997 were not available and (2) the longest lag scenario (5 years) prevented us from including years after 2005.

We used the zero-lag model of the Grass Carp–hydrilla relationship to determine the importance of Grass Carp up to age 16 for controlling hydrilla in Lake Gaston. To accomplish this, we developed four additive models within a hierarchical framework to test the relative contributions of four Grass Carp age-groups (ages 1–4, 5–8, 9–12, and 13–16) to the efficacy of hydrilla control in Lake Gaston (Table 1). The use of these age-groups was intended to avoid overparameterization of models for age-classes in which data were sparse; however, the age-groups also coincide with previously documented changes in Grass Carp growth and mortality. For example, Grass Carp growth has been reported to be most rapid during ages 1–4 and declines to approximately 2.5 cm/year by age 8 (Gorbach 1961). The maximum age of Grass Carp in the southeastern USA was reported as 12 years (Kirk and Socha 2003), and the growth dynamics of Grass Carp older than age 12 are relatively undocumented in the USA. Because the existence of subsequent age-classes is dependent upon the existence of preceding age-classes, we did not construct reduced-parameter models that considered only the effects of the three oldest age-groups. The zero-lag scenario was used to maximize the data available for model subsets and

TABLE 1. Model development and description for additive models used to test the relative contributions of four age-groups of Grass Carp to the efficacy of hydrilla control in Lake Gaston, Virginia–North Carolina.

Model	Description
Hydrilla (B_4[a])	Response of hydrilla to biomass of Grass Carp ages 1–4
Hydrilla ($B_4 + B_8$[b])	Response of hydrilla to biomass of Grass Carp ages 1–8
Hydrilla ($B_4 + B_8 + B_{12}$[c])	Response of hydrilla to biomass of Grass Carp ages 1–12
Hydrilla ($B_4 + B_8 + B_{12} + B_{16}$[d])	Response of hydrilla to biomass of Grass Carp ages 1–16

[a]Biomass of Grass Carp ages 1–4.
[b]Biomass of Grass Carp ages 5–8.
[c]Biomass of Grass Carp ages 9–12.
[d]Biomass of Grass Carp ages 13–16.

because it allowed us to compare the relative weights of models that included the oldest fish present in the system, whereas long (e.g., 4- or 5-year) time lags would not. The information-theoretic approach based on AIC$_c$ (in SYSTAT version 12) was used for model selection, and the relative plausibility of models was ranked based on AIC$_c$ weights.

RESULTS

Growth and Mortality

Grass Carp ranged in age from 1 to 16 years, and all stocked cohorts except 2010 were represented in the sample (Table 2). The TL of Grass Carp ranged from 417 to 1,350 mm, and mass ranged from 0.95 to 34.0 kg. Grass Carp growth in Lake Gaston was highly variable within age-classes. The relationship between TL (mm) and weight (W; g) of Grass Carp was $W = (3.25 \times 10^{-5}) \times \mathrm{TL}^{2.87}$ (Figure 1b), suggesting that Grass Carp became less rotund as TL increased (see Anderson and Neumann 1996). The relationship between weight (W_t; g) and age t was nearly linear: $W_t = 1{,}448 + 1{,}623t$ ($r^2 = 0.99$, $P < 0.001$; Figure 1c). Predicted Grass Carp TL (mm) at each age was described by the VBGM as $L_t = 1{,}297[1 - e^{-0.135(t + 1.52)}]$, where L_t is length at age t (Figure 1a; Table 3).

The estimate of $\hat{M}_j$ (mean = 0.20; 95% CI = 0.18–0.22) was significantly different from the estimate of $\hat{M}_p$ (mean = 0.25; 95% CI = 0.23–0.28) within years (after 1996) based on the lack of overlap between 95% CIs. Age-specific mortality (M_{cw}) declined rapidly between ages 1 and 5 and declined by less than 2% between subsequent ages after age 5 and by less than 1% between ages after age 8 (Table 4). Although this pattern is expected based on the formulation by Chen and Watanabe (1989),

TABLE 2. Stocking years, number of fish stocked (N), and annual catch of Grass Carp by bowfishers in Lake Gaston, 2006–2010.

		Number caught per year					
Cohort	N	2006	2007	2008	2009	2010	Total
1995	20,000	12	25	9	17	22	85
1997	680	2	1	5	2	5	15
1999	5,000	0	2	1	3	12	18
2003	25,392	22	14	4	6	7	53
2006	7,000	1	7	7	16	9	40
2007	7,720	0	0	0	7	14	21
2008	100	0	0	0	0	9	9
2009	6,520	0	0	0	0	2	2
2010	7,347	0	0	0	0	0	0
Total	79,759	37	49	26	51	80	243

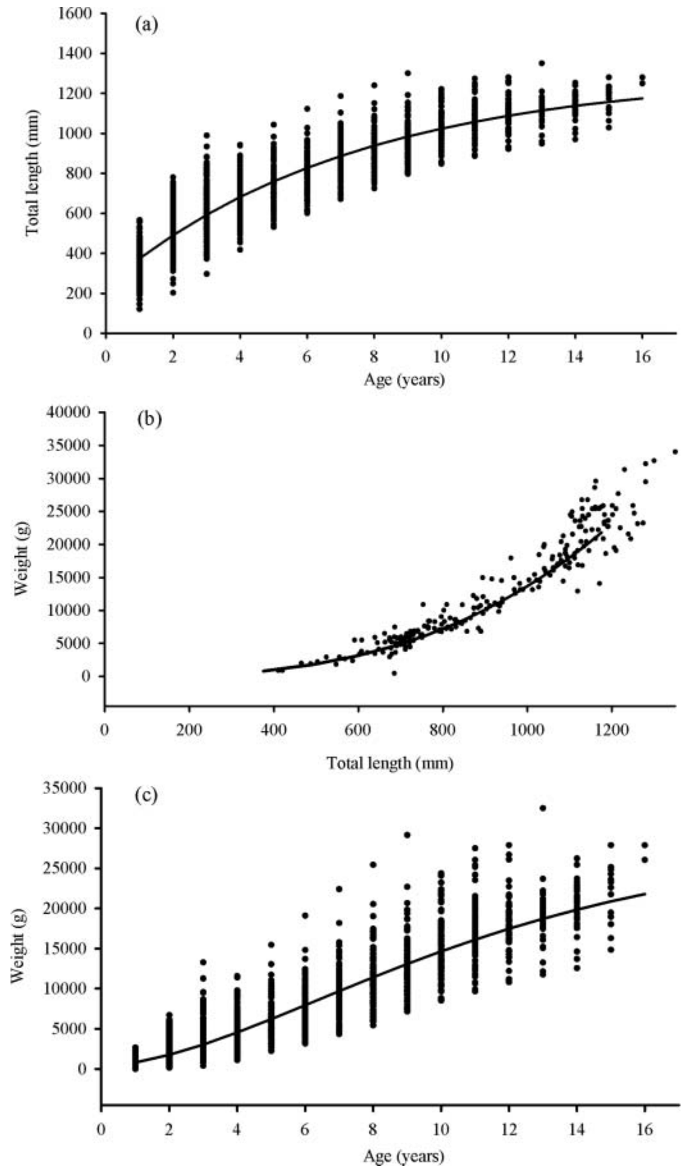

FIGURE 1. Growth characteristics of Grass Carp in Lake Gaston, including **(a)** the von Bertalanffy growth model describing length at age, **(b)** the length–weight relationship, and **(c)** the age–weight relationship.

TABLE 3. Means, SEs, 95% confidence limits (CLs), and test statistics for parameterization of the von Bertalanffy growth function used to describe growth of Grass Carp collected from Lake Gaston (L_∞ = asymptotic length [TL, mm]; K = Brody growth coefficient; t_0 = theoretical age at zero length).

Parameter	Estimate	SE	Lower 95% CL	Upper 95% CL	t	$P > t$
L_∞	1,297	24.160	1,253	1,348	53.66	<0.0001
K	0.135	0.007	0.122	0.149	19.67	<0.0001
t_0	−1.52	0.112	−1.75	−1.31	13.54	<0.0001

the rate of decline in mortality between ages is a function of the specific growth characteristics of Grass Carp in Lake Gaston. When VBGM parameters from the Santee–Cooper Reservoir population (Morrow et al. 1997) were used to estimate mortality via the indirect methods applied in our study, we found that $\hat{M}_j$ was equal to 0.93 and that M_{cw} decreased from 2.76 at age 1 to 0.64 at age 6.

Population Size and Biomass

Estimated population sizes ($\hat{N}_i$) and biomass ($\hat{B}_i$) of Grass Carp varied widely dependent upon the method used to estimate mortality. In all years, population sizes estimated based on $\hat{M}_p$ were intermediate to and significantly different from those estimated based on $\hat{M}_j$ and M_{cw} (Figure 2). Biomass predicted based on $\hat{M}_p$ was significantly different from biomass estimated with $\hat{M}_j$ only for 2010 (Figure 3). Population sizes and biomasses estimated using $\hat{M}_j$ and M_{cw} also differed significantly in all years. Annual population sizes and biomass predicted with M_{cw} were consistently smaller than those predicted by using $\hat{M}_p$ or $\hat{M}_j$. For years of greatest disparity between estimates, population size and biomass derived from $\hat{M}_j$ were more than double those derived from M_{cw}.

TABLE 4. Age-specific mortality rates (M_{cw}; derived by the method of Chen and Watanabe 1989) and associated 95% confidence limits (CLs) for Grass Carp in Lake Gaston.

Age	M_{cw}	Lower 95% CL	Upper 95% CL
1	0.47	0.43	0.51
2	0.36	0.33	0.38
3	0.30	0.28	0.31
4	0.26	0.24	0.27
5	0.23	0.22	0.24
6	0.21	0.20	0.22
7	0.20	0.19	0.21
8	0.19	0.18	0.20
9	0.18	0.17	0.19
10	0.17	0.16	0.18
11	0.17	0.15	0.18
12	0.16	0.15	0.17
13	0.16	0.15	0.17
14	0.15	0.14	0.17
15	0.15	0.14	0.16
16	0.15	0.14	0.16

To assess the precision of indirect methods in comparison with direct estimation of mortality, we estimated annual biomass of Grass Carp in Lake Gaston by using five mortality rates (Kirk and Socha 2003) that were based on catch-curve analyses (Figure 4). Biomass estimated from four of the five mortality rates fell within the 95% CI for biomass estimated with M_{cw} in the present study; biomass derived from the fifth mortality rate fell within the 95% CIs for biomass values that we estimated by using $\hat{M}_j$ and $\hat{M}_p$.

We did not detect a significant relationship between Grass Carp population size in year i and hydrilla coverage in any of the time lag scenarios (i.e., $i, i + 1, \ldots, i + 5$). A significant inverse relationship existed between Grass Carp biomass at time i and hydrilla coverage in all time lag scenarios (including the zero-lag scenario) using each of the three indirect mortality estimates. The best model of hydrilla coverage in Lake Gaston was consistently achieved with a 4-year time lag between Grass Carp biomass and hydrilla coverage, regardless of the mortality estimate used (Table 5).

Grass Carp greater than age 10 accounted for 1–20% of the annual total population size, and they contributed 22% to nearly 50% of the total annual biomass from 2005 to 2010 depending on the mortality estimate used (Figure 5). The oldest age-classes of Grass Carp also appeared to have a significant effect on hydrilla coverage in Lake Gaston relative to other age-classes. The best model of the effects of Grass Carp age on the efficacy of weed control included Grass Carp of all ages up to age 16, regardless of the method used to estimate mortality (Table 6). When $\hat{M}_p$ or $\hat{M}_j$ was used to estimate biomass, the model that included ages 13–16 was over 200 times more plausible than the next-best model, which included only ages 1–8. When M_{cw} was used to estimate biomass, the model including ages 13–16 was 45 times more plausible than the model that included only ages 1–8. Based on AIC$_c$ difference (Δ_i) values, models that did not include the oldest age-group of fish had virtually no support in the data.

DISCUSSION

The collection of Grass Carp in Lake Gaston by bowfishers provided an effective means of sampling for age and growth analyses of the population, as has been previously documented (Morrow et al. 1997). However, because we lacked information on sampling effort and because there was no standardized regime for sampling Grass Carp in the lake, the Grass Carp catch

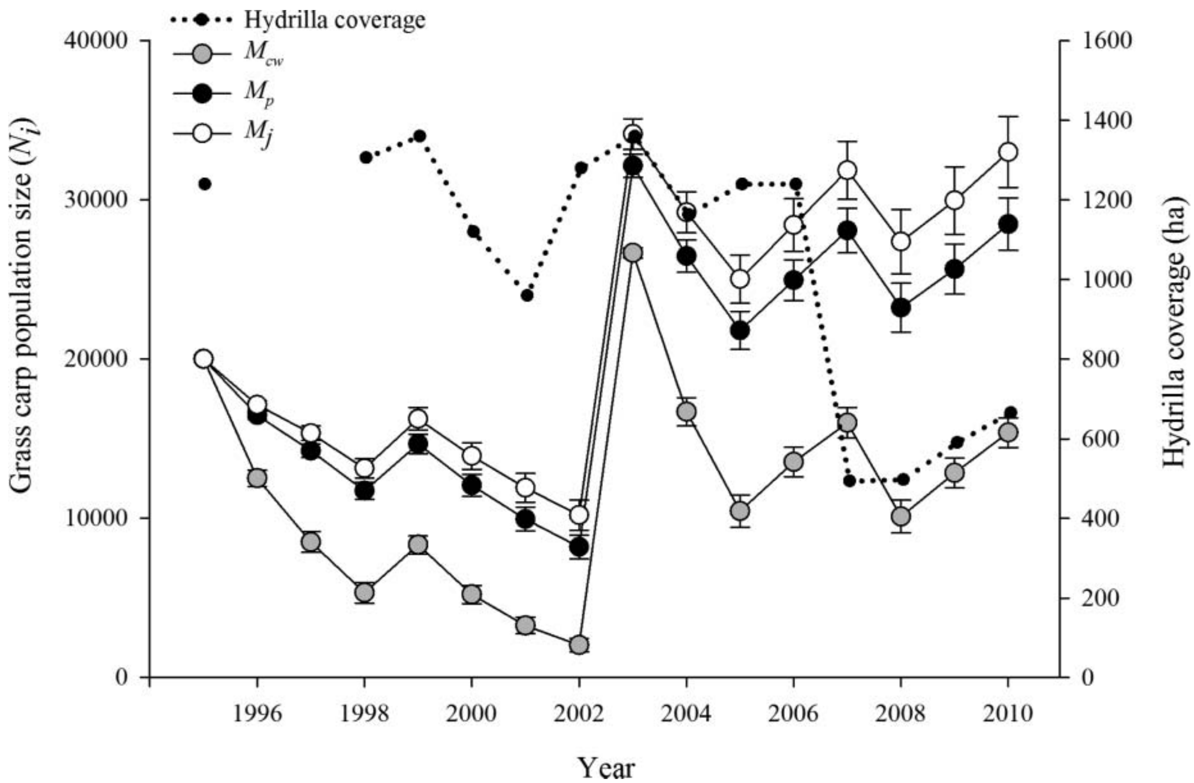

FIGURE 2. Estimated Grass Carp population size ($\hat{N}_i$; $\pm$95% confidence interval) in Lake Gaston during 1995–2010, presented in relation to hydrilla coverage. Population size was predicted based on (1) mean mortality (across all ages) derived by the method of Pauly (1980; $\hat{M}_p$), (2) mean mortality derived by the method of Jensen (1996; $\hat{M}_j$), or (3) age-specific mortality derived by the method of Chen and Watanabe (1989; M_{cw}).

data did not meet some of the underlying assumptions for use of direct mortality estimation methods (such as catch curves), which have been widely applied in fisheries monitoring for the last 50 years (Thorson and Prager 2011). The mortality rates reported by Kirk and Socha (2003) for the years 1998 ($M = 0.33$), 1999 (0.39), 2000 (0.35), and 2002 (0.38) produced biomass estimates for the Lake Gaston Grass Carp population that fell within the 95% CI of biomass predicted by using M_{cw} in our study. The low mortality rate of 0.22 (for 2001) reported by Kirk and Socha (2003) resulted in a predicted biomass that was within the 95% CI of biomass estimated with $\hat{M}_p$ and $\hat{M}_j$ in the present study. These results suggest that (1) the indirect methods we used to estimate mortality have precision comparable to that of direct estimation based on catch curves for other systems and (2) age-specific mortality may present more comparable estimates over the life span of Grass Carp. Although the reliability of the indirect methods we used cannot be measured against that of the estimates derived by Kirk and Socha (2003), the agreement between results of the two studies suggests that the precision achieved in the present study should be satisfactory for use in management.

The expected longevity of the population should be considered when using indirect methods of estimating mortality based on growth of triploid Grass Carp. In this study, we were able to obtain a large number of individuals of various ages for use in estimating VBGM parameters for the Lake Gaston population, resulting in well-informed parameter estimates based on data that were representative of fish approaching the maximum age in their native system (Gorbach 1961). In contrast, when we used VBGM parameters from the Santee–Cooper Reservoir population (Morrow et al. 1997) to estimate mortality with the indirect methods applied in our study, we found that estimated mortality was not within the range of estimates that were derived by using catch-curve analyses in the same system, even within the same years (Morrow et al. 1997; Kirk and Socha 2003). These results suggest that the use of VBGM parameters from populations that are short lived (or are expected to be short lived) is not an appropriate approach to mortality estimation, despite large sample sizes such as those obtained from the Santee–Cooper Reservoir population (Morrow et al. 1997; Kirk et al. 2000; Kirk and Socha 2003). Because our estimates are based on a long-lived population of Grass Carp that were stocked incrementally, they should be useful for projecting Grass Carp population sizes in other southeastern U.S. systems, especially where the goal is the intermediate control of weeds rather than eradication and where Grass Carp are stocked incrementally in sufficient numbers to persist for more than 10 years (the age accommodated by other stocking models; e.g., Stewart and Boyd 1999).

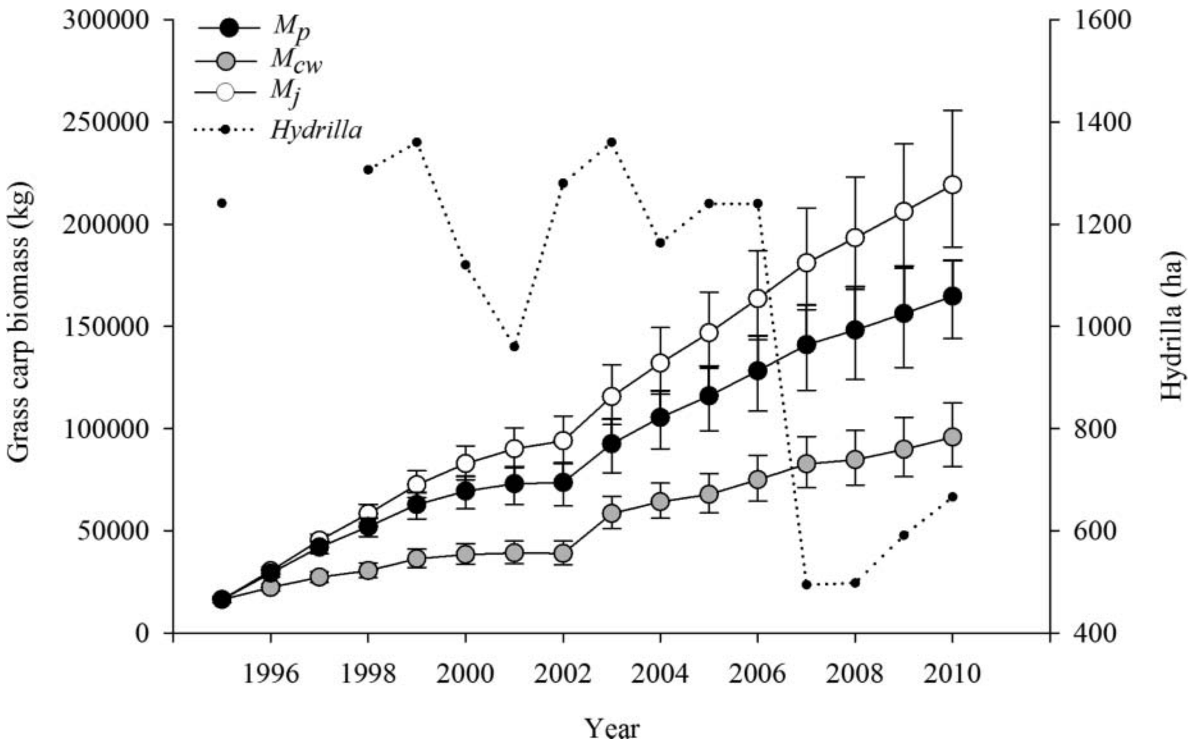

FIGURE 3. Annual hydrilla coverage in Lake Gaston during 1995–2010, presented in comparison with estimates of Grass Carp standing biomass that were derived from mortality estimated by the method of **(a)** Jensen (1996; $\hat{M}_j$), **(b)** Pauly (1980; $\hat{M}_p$), or **(c)** Chen and Watanabe (1989; M_{cw}). Biomass was estimated by using the mean and 95% confidence limits (CLs) for mortality at each age, and the 95% confidence interval around each biomass estimate is based on the upper and lower 95% CLs for weight at each age.

The mortality estimates and resulting biomass estimates in our study represent two somewhat divergent models of Grass Carp population dynamics in Lake Gaston. The constant instantaneous mortality estimates ($\hat{M}_p$ and $\hat{M}_j$) we obtained generally represented lower overall mortality in the Grass Carp population and therefore resulted in biomass estimates that were higher than those derived from age-specific mortality estimates (M_{cw}). As a result of the differences in biomass estimated from these methods, we suggest that constant and age-specific mortality estimates represent two potential approaches to assessing Grass Carp in Lake Gaston, depending on how stocking rates are determined in the future. Application of age-specific mortality estimates to the Lake Gaston Grass Carp population results in a lower estimated number of fish per vegetated hectare and a smaller estimated biomass than does the use of constant mortality rates. Because the biomass estimated from age-specific mortality rates is lower, the absolute difference between current biomass and some target level of biomass would be smaller—and thus the estimated addition of biomass required for stocking would be lower—when age-specific mortality rates are used instead of a constant rate to estimate biomass. When the risk of overshooting the target hydrilla coverage is considered, the use of age-specific mortality in stocking models that are based on biomass therefore represents a more conservative approach to Grass Carp stock assessment than does the use of a constant mortality rate. Relative to the use of a constant mortality rate, the use of age-specific mortality in stock assessment and stocking models is less likely to result in overshooting the target coverage of hydrilla but is more likely to result in failure to achieve adequate control of hydrilla. Our results demonstrate that the approach to

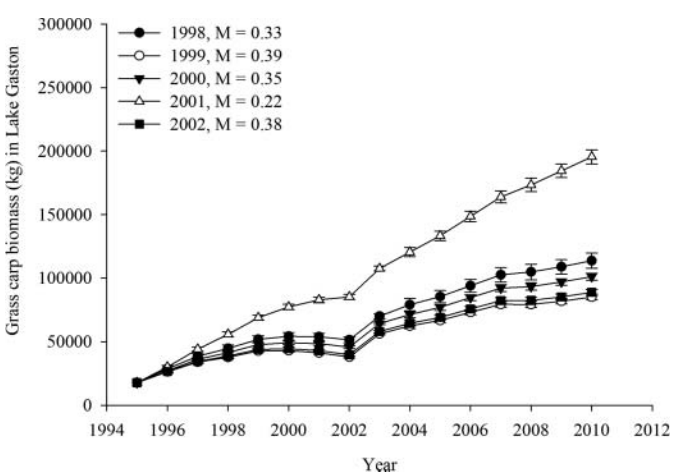

FIGURE 4. Grass Carp biomass in Lake Gaston, as projected by using five mortality estimates (1998–2002) developed for Grass Carp populations in the Santee–Cooper Reservoir system, South Carolina, via catch-curve analysis by Kirk and Socha (2003).

TABLE 5. Model selection statistics for linear regressions characterizing the relationship between Grass Carp biomass in year i and hydrilla coverage in Lake Gaston based on various time lag scenarios (i.e., coverage in years i, $i+1, \ldots, i+5$). Biomass was estimated from (1) constant mortality (across all ages) derived by the method of Pauly (1980; $\hat{M}_p$), (2) constant mortality derived by the method of Jensen (1996; $\hat{M}_j$), or (3) age-specific mortality derived by the method of Chen and Watanabe (1989; M_{cw}). Model selection statistics include the number of parameters estimated (k), Akaike's information criterion corrected for small sample sizes (AIC_c), the difference between the AIC_c value for the given model i and the best model (Δ_i), and Akaike weight (w_i), which describes the relative probability that the given model is the best among the models considered. Models were ranked separately for each mortality estimate.

Mortality estimate	Lag time (years)	k	AIC_c	Δ_i	w_i
M_{cw}	0	2	186.8	19.1	0.00
	1	2	187.8	20.1	0.00
	2	2	185.3	17.6	0.00
	3	2	181.2	13.5	0.00
	4	2	167.7	0.0	1.00
	5	2	180.8	13.1	0.00
M_p	0	2	193.2	13.8	0.00
	1	2	193.2	13.8	0.00
	2	2	191.6	12.2	0.00
	3	2	188.1	8.7	0.01
	4	2	179.4	0.0	0.96
	5	2	186.8	7.4	0.02
M_j	0	2	198.7	19.3	0.00
	1	2	198.7	19.3	0.00
	2	2	197.1	17.7	0.00
	3	2	193.7	14.3	0.02
	4	2	186.0	6.6	0.92
	5	2	191.7	12.3	0.05

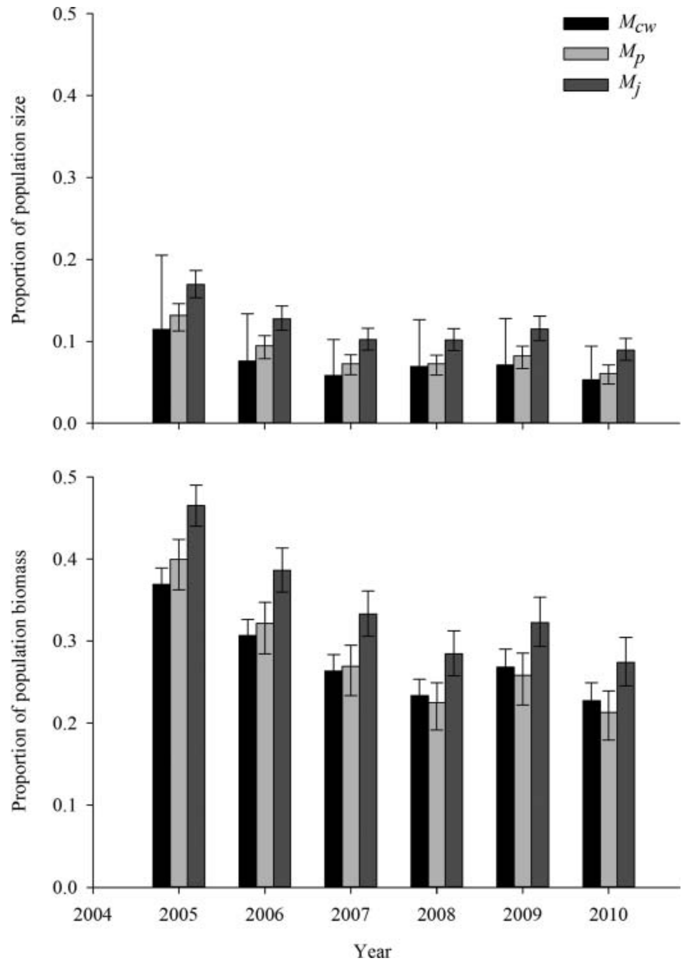

FIGURE 5. Proportion of the Grass Carp population size accounted for by individuals older than age 10 (upper panel) and the proportion of Grass Carp population biomass contributed by individuals older than age 10 (lower panel) in Lake Gaston. Population size and biomass were estimated by using mortality derived from the methods of Pauly (1980; $\hat{M}_p$) and Jensen (1996; $\hat{M}_j$) across all ages or by using age-specific mortality derived from the method of Chen and Watanabe (1989; M_{cw}).

Grass Carp stock assessment (i.e., the mortality estimator used) is dependent upon the specific weed control objectives.

Our results indicate that Grass Carp biomass is a more appropriate index of fish density than Grass Carp abundance. We failed to detect a relationship between Grass Carp abundance and annual hydrilla coverage in Lake Gaston under any of the time lag scenarios. We did, however, observe strong negative relationships between Grass Carp biomass and hydrilla coverage under all of the time lag scenarios. The biomass–hydrilla coverage relationship was strongest when we considered a 4-year lag between Grass Carp stocking and observed effects on hydrilla coverage. Because the 4-year lag scenario was the best model regardless of whether biomass was estimated from age-specific mortality or from a single mortality rate, we suspect that the lag is not a result of age-specific changes in mortality. As all of the lag scenarios provided a good fit to the data, we speculate that the importance of a 4-year lag is not based simply on the Grass Carp population attaining a threshold biomass at which hydrilla reduction is achieved. Bioenergetics studies of Grass Carp have demonstrated that the feed assimilation rate is inversely related to mass, whereas the standard metabolic rate and energy per gram of wet weight are positively related to mass (Wiley and Wike 1986). These factors cause an increase in the energy required per unit of mass gained by Grass Carp as they grow larger; greater energetic requirements necessitate increased hydrilla consumption by the fish in Lake Gaston. Growth of Grass Carp has been observed to decrease after age 4 in native systems (Gorbach 1961). However, growth (in mass) of Grass Carp in Lake Gaston remained approximately linear with age after age 4, thus amplifying the increase in energy needed for growth after that age. Therefore, the 4-year lag between Grass Carp stocking and observable effects on hydrilla coverage likely reflects an increase in hydrilla consumption due to the greater energetic demands of Grass Carp for maintenance of linear growth in mass after they reach age 4.

TABLE 6. Model selection statistics for multiple linear regression models used to determine the relative effects of Grass Carp biomass at different ages on the hydrilla coverage in Lake Gaston. Biomass was estimated from (1) constant mortality (across all ages) derived by the method of Pauly (1980; $\hat{M}_p$), (2) constant mortality derived by the method of Jensen (1996; $\hat{M}_j$), or (3) age-specific mortality derived by the method of Chen and Watanabe (1989; M_{cw}). Models are defined in Table 1; model selection statistics are defined in Table 5. Models were ranked separately for each mortality estimate.

Mortality estimate	Model	k	R^2	AIC_c	Δ_i	w_i
M_{cw}	Hydrilla (B_4)	2	0.00	209.4	18.9	0.000
	Hydrilla ($B_4 + B_8$)	3	0.67	198.1	7.6	0.022
	Hydrilla ($B_4 + B_8 + B_{12}$)	4	0.67	202.9	12.4	0.002
	Hydrilla ($B_4 + B_8 + B_{12} + B_{16}$)	5	0.92	190.5	0.0	0.976
M_p	Hydrilla (B_4)	2	0.01	209.4	19.2	0.000
	Hydrilla ($B_4 + B_8$)	3	0.63	199.7	10.7	0.005
	Hydrilla ($B_4 + B_8 + B_{12}$)	4	0.63	204.7	15.7	0.000
	Hydrilla ($B_4 + B_8 + B_{12} + B_{16}$)	5	0.92	189.9	0.0	0.995
M_j	Hydrilla (B_4)	2	0.01	209.4	19.2	0.000
	Hydrilla ($B_4 + B_8$)	3	0.59	200.9	10.7	0.005
	Hydrilla ($B_4 + B_8 + B_{12}$)	4	0.59	205.9	15.7	0.000
	Hydrilla ($B_4 + B_8 + B_{12} + B_{16}$)	5	0.92	190.2	0.0	0.995

The lag between Grass Carp stocking and observed effects on hydrilla coverage is likely different than the lags present in other systems, such as Lake Austin and Lake Conroe in Texas (Chilton and Magnelia 2008; Chilton et al. 2008) and the Santee–Cooper Reservoir system (Kirk et al. 2000; Kirk and Socha 2003), because stocking densities are much lower in Lake Gaston than in these other systems. For example, Lake Conroe (8,347 ha; Chilton et al. 2008) is similar in size to Lake Gaston (8,423 ha) but received 371,766 diploid and triploid Grass Carp from 1982 to 2007 (Chilton et al. 2008), whereas only 92,959 triploid Grass Carp were stocked in Lake Gaston from 1995 to 2011. The Santee–Cooper Reservoir system (70,000 ha) is considerably larger than Lake Gaston, and it received the single largest Grass Carp stocking (786,500 fish) in history (Kirk et al. 2000).

We recognize that the Grass Carp biomass–hydrilla coverage relationship reported here is singular and correlative in nature and that it cannot be used to infer a cause-and-effect relation (i.e., because this is an observational study). However, given the dependency of Grass Carp on hydrilla as their primary energy source, the strength of the observed relationship ($R^2 > 0.90$), and the expansive time series used, we believe that this relationship is a useful means of monitoring the progress of weed control efforts in Lake Gaston. In fact, the regression relationship based on Grass Carp standing biomass was useful for predicting the Lake Gaston hydrilla coverage within 40 ha of the coverage that was estimated with sonar surveys conducted in 2010 and 2011 (D. S. Stich, unpublished data). The unexplained portion of variation in the biomass–hydrilla coverage relationship is likely due to environmental variation during the 16 years represented. We also recognize the potentially confounding effects of the low-level herbicide application that occurred in conjunction with Grass Carp stocking in Lake Gaston. Because the relationship between Grass Carp biomass and hydrilla coverage is subject to confounding factors like herbicide application, we cannot speculate whether the relationship observed in our study is necessarily transferable to other water bodies.

Although Grass Carp in Lake Gaston appear to have reduced the amount of hydrilla to below peak coverage, the management objective of 120 ha by 2012 was not met. The problem of reaching a target level of hydrilla without overshooting it suggests that there are specific situations in which an aggressive approach to weed control at Lake Gaston may give way to a more conservative model and vice versa. It is difficult to predict the time period (if any) over which the target level of hydrilla coverage will be reached at the current stocking rate for Grass Carp in Lake Gaston; it is possible that the stocking rate will have to be increased in order to reach the target level of coverage.

Stocking models that are more refined than the monitoring tools we present here are available; such models are useful for estimating the numbers of Grass Carp needed to control a given coverage of hydrilla over time (e.g., Stewart and Boyd 1999), but these models apply only to the first 10 years after stocking. Based on the bioenergetics of Grass Carp (Wiley and Wike 1986) and the linear patterns of weight gain observed in Lake Gaston and other systems (e.g., Morrow et al. 1997), it is likely that Grass Carp older than age 10 also make important contributions to weed control. In Lake Gaston, fish exceeding age 10 made substantial contributions to the total biomass—but not the number—of Grass Carp in the system. The first year in which Grass Carp older than age 10 were present in Lake Gaston was 2005. After 2005, Grass Carp that were older than age 10 accounted for more than 22% of total estimated standing biomass in each year, regardless of the mortality estimate used; in some years and under some mortality scenarios, fish older than age 10 accounted for nearly 50% of the total estimated population biomass. In most years, the older fish contributed less than 10% and as little as 1% (depending on the model used) to the total number of Grass Carp in the system. Since weight gain of Grass Carp in Lake Gaston is approximately linear with age, there is reason to believe that fish up to at least age 16 continue to provide some control of aquatic weeds and should therefore be considered in stocking models. Other research has speculated that large Grass Carp (up to 10 kg) may be just as effective for weed control as small fish (Osborne and Riddle 1999). Our regression models of hydrilla coverage response to various age-groups confirm this for fish up to at least age 16; the strongest model of hydrilla coverage was based on Grass Carp biomass estimates that included fish up to 16 years of age. The contribution of Grass Carp to weed control through age 16 in Lake Gaston highlights the need for all ages to be included in stocking models and bioenergetics models, especially as IPM becomes increasingly prevalent and as management of long-lived Grass Carp becomes more commonplace.

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From:	Jesse Williams
To:	CESAS-PD, SAS
Subject:	[EXTERNAL] re: Aquatic Management program
Date:	Thursday, May 19, 2016 11:47:36 AM

Ladies and Gentlemen-
Please consider the ramifications of stocking grass carp in Clarks Hill. We have seen the destruction caused by overstocking of grasscarp in Santee Cooper throughout the 90's and early 2000's, one of the largest blunders by any DNR in the country. It is now recovering from that disaster. It has now come to light that many of the stocked grass carp were not sterile. Please consider how to manage the process other than opening pandora's box with the grass carp.

I would suggest continuing to study the validity of that many bald eagles dying to AVP related to infected coots, and look at that data closely. There are many areas in the country that have handled this issue with much more success than SCDNR did with Santee Cooper.
I am opposed to stocking grass carp in Clarks HIll

Thanks,
Jess Williams
803-491-5732

From: Doug Bolin Agency
To: CESAS-PD, SAS
Subject: [EXTERNAL] Hydrilla Control on Thurmond Lake
Date: Thursday, May 19, 2016 12:08:27 PM

I have deep concerns with the proposed plan to control hydrilla on Lake Thurmond/ Clarks Hill. I duck hunt on this lake. I bring much needed economic relief to the area. If you kill off the hydrilla to save eagles you will make the lake sterile for bass and ducks. It will become a waste land. It amazes me that the government thinks they can control nature? The circle of life is the issue. Lake Murray in Lexington SC was made sterile by this program. Maybe you should relocate your beloved eagles so they want eat the coots that eat the hydrilla. DO NOT KILL OFF THE HYDRILLA!!!!!!!!!!

Doug Bolin

Lexington SC

Blockedhttp://www.bassmaster.com/conservation-news/hydrilla-control-plan-proposed-thurmond-lake

From:	Gary Hannah
To:	CESAS-PD, SAS
Subject:	[EXTERNAL] Lake Thurmond hydrilla
Date:	Thursday, May 19, 2016 11:11:34 AM

Please do not introduce grass carp into the lake. They may eat hydrilla but they also eat other grasses, etc. I witnessed a small community lake in FL totally stripped of anything green including grass along the shoreline. Please consider other options!

Gary Hannah
SLV
Mcormick
391 8454

From:	Josh Keesey
To:	CESAS-PD, SAS
Subject:	[EXTERNAL] Clarks Hill
Date:	Thursday, May 19, 2016 12:21:55 PM

Please leave the grass alone. Don't add and fish or try to manage it with chemicals. Look at what others have done to other lakes. Lakes like Murray, Marion, and Moultrie. Lakes that were well known for there bass fishing and there duck hunting are now just memories of what once was. Look at lake Guntersville in AL. The bass fisherman struggle to find good fish. The dick hunters haven't had a good season in years. I urge you to come up with different ideas for the safety of the Eagles. Why does one species that gives nothing back to its local community get special treatment? Sportsman are why that lake is great. They come for what the lake provides.

Josh Keesey
803-600-6966

Sent from my iPhone

From: [redacted]
To: Dayan, Nathan S SAS
Cc: Wicke, Russell A SAS
Subject: [EXTERNAL] TGC Failure Rate
Date: Tuesday, May 24, 2016 4:11:55 PM

Hi Nathan,

I talked with a representative at Owen & Williams Fish Farm a few minutes ago. She advised that GA requires testing of each TGC fish by the supplier before GA deliveries, removing my concern that a few stray fertile carp may escape detection with batch testing. I do not find this critical testing information in the preliminary study documents. I also learned that their threshold for raising the fry is a 99.5% pass rate based on UGA testing, and that they typically have 1 or 2 failures per 1,000 fish tested before shipment. She agreed that 12" fish would be about a year old.

Best regards,
Ferris

Ferris L. Broxton
[redacted]

From:	Harold Shelley
To:	CESAS-PD, SAS
Subject:	[EXTERNAL] Release no. 16-13
Date:	Wednesday, May 25, 2016 10:46:21 PM
Attachments:	FSRB Letter.docx FSRB Letter.pdf

Attached please find the Friends of the Savannah River Basin comments on the hydrilla management plan to reduce bald eagle deaths at J. Strom Thurmond Lake. We thank you for the opportunity to comment.

Harry and Barb Shelley

Nathan Dayan
Planning Division
U.S. Army Corps of Engineers
100 W. Oglethorpe Avenue
Savannah, Georgia 31401-3604

The Friends of the Savannah River Basin (FSRB) appreciates the opportunity to respond to Release no. 16-13 requesting comments on the ACOE plan to manage hydrilla in J. Strom Thurmond Lake (JST) to reduce bald eagles deaths.

Our members represent a similar cross section of the stakeholders polled in the 2013 public survey developed by UGA. The vast majority of stakeholders preferred less hydrilla or native only plants and were supportive or indifferent in stocking the carp.

The FSRB strongly supports the implementation of the integrated management plan as written. We concur with the Draft Environmental Assessment's findings that the Grass Carp stocking with selected use of herbicides provides the best option to manage the rapid spread of hydrilla in the lake. Hydrilla is present along approximately 53 percent of the shoreline. Although not a large percent (approximately 7%) of the lake's total surface acreage, it has a disproportionate impact on the recreation and total economic impact resulting from lake activities.

Clearly the elimination or drastic reduction in the deaths of Bald Eagles and other waterfowl is key to the environmental wellbeing and public enjoyment of the lake and surrounding land. Lake Thurmond consistently ranks in the top ten most visited Corps projects in the nation and offers recreational opportunities to millions of visitors a year. The well forested shorelines are unusual around such a large body of water and afford a rare visual experience.

The presence of the mats of hydrilla around the shoreline significantly impacts the various water recreation experiences and reputation of the lake. In addition several of the less developed counties are dependent on this "eco-tourism" and developments around the lake for commercial enterprise income. This is especially true of Lincolnton County in GA and McCormick County in SC. As an example the 4,000 acre Savannah Lake Village development in McCormick with its 2600 residents provides a significant portion of the county's tax revenue.

The success of this plan is critically dependent on the execution of multi-year steps involving fish stocking, comprehensive evaluation and spot treatments of herbicide. Because of the minimum 4-year time lag to achieve the desired reduction in hydrilla coverage, it will be impossible to adequately assess the success of the effort in a piecemeal fashion. Hydrilla was first discovered in 1995. Aggressive herbicide treatments have failed to provide any significant control. As citied above it currently covers over 50% of the shoreline impacting many of the desirable developmental and recreational areas. This plan represents the best chance of reducing AVM deaths and maintaining the unique environment of the lake. It is strongly recommended that the ACOE examine alternate cooperative federal and state and potentially private funding sources to execute this plan for at least a six year period.

Sincerely,

Barb and Harry Shelley
Facilitators Friends of the Savannah River Basin

From:	Walls, Beth
To:	Dayan, Nathan S SAS
Cc:	Militscher, Chris
Subject:	[EXTERNAL] EPA Comments on Draft EA: Avian Vacuolar Myelinopathy Reduction for J.S.T. Lake (April 2016)
Date:	Thursday, May 26, 2016 3:04:41 PM
Attachments:	EPA.Comment.sJST-hydrillaMgmtDEA.May.26.2016.docx

Hi Nathan:

Attached are EPA Region 4's comments regarding the above EA.

Sincerely,

Beth Walls
Environmental Scientist
NEPA Program Office
U.S. EPA, Region 4
404-562-8309

EPA Comments on US Army Corps of Engineers Savannah District (ACE) Draft Environmental Assessment (April 2016) for Avian Vacuolar Myelinopathy (AVM) Reduction for J. Strom Thurmond (JST) Lake, Columbia, Lincoln, McDuffie, Elbert, and Wilkes Counties, GA and McCormick and Abbeville Counties, S.C.

Proposed Action

The ACE proposes to reduce AVM occurrences in area bald eagles through an integrated hydrilla (an invasive submerged aquatic vegetation species) management approach (AVM Plan) for the JST Lake. The purpose of this action appears to be to respond to the U.S. Fish and Wildlife Service (FWS) concerns. *As the federal agency most responsible for the continued recovery and well-being of bald eagle populations, the Service strongly supports the ACOE's decision to seek funding to complete a management plan for JSTL and begin eradicating the hydrilla as soon as possible. We recommend that a management plan to eradicate the hydrilla be in place before the 2015/2016 nesting season and that eradication of the hydrilla begin soon after. We believe removal of this SAV is essential for bald eagle populations to begin nesting again around JSTL*." [1] Consequently, the FWS recommended the ACE obtain a "take permit" for expected future bald eagle mortalities to avoid a violation of the Bald and Golden Eagle Protection Act of 1940 and the Migratory Bird Treaty Act of 1918.

The mode of bald eagle death by AVM at JST Lake is hypothesized to be strongly linked to the American coot and hydrilla. Migratory coots typically are present in late fall and winter when they ingest hydrilla growing in the shallow areas of the Lake. Hydrilla alone does not appear to be linked to AVM incidences. The hydrilla provides a substrate for a recently identified cyanobacteria, *Aetokthonos hydrillicola*. Once ingested, a small percent[2] of exposed coots develop AVM and suffer *A. hydrillicola*-induced neurological impairment making them easy prey for bald eagles. Over a 16-year period (1998 – 2014), 81 dead eagles were recovered at JST. AVM was confirmed as the agent of death for 29 eagles. One died of Aspergillosis. Four were confirmed to have died from mercury exposure.[3] Because AVM diagnoses depends upon fresh brains, the decomposition status of the remaining eagles prohibited determining if AVM was the cause of death.

AVM has been documented to have affected a number of bird species. The birds most impacted by AVM appear to be American coots. According to the U.S. Geological Survey (USGS), possibly thousands of American coots have died from AVM since it was first discovered in 1994 at DeGray Lake in Arkansas.[4] Feeding studies have experimentally induced AVM in red-tailed hawks[5] and chickens[6] fed AVM-infected coots, in mallards fed *A. hydrillicola*-infested hydrilla,[7] and laboratory birds fed invasive apple snails that had fed on *A. hydrillicola*-infested hydrilla.[8] Similar AVM lesions and neurological symptoms were induced in turtles[9] and AVM-like lesions were induced in grass carp[10] fed *A. hydrillicola*-infested hydrilla. AVM was found in numerous coots, 6 mallards, 2 ring-necked ducks, and 2 buffleheads at Lake Surf (Woodlake), North Carolina.[11] At JST Lake, AVM was also found in coots, 16 Canada geese, 2 Great horned owls and a killdeer.[12] It has been suggested that JST Lake may have the highest cyanobacterial concentration of the 20 confirmed AVM sites in six states.[13] AVM has been documented at 20 manmade impoundments located in Arkansas, Florida, Georgia, North and South Carolinas, and Texas.

The proposed AVM Plan is to reduce the hydrilla/*A. hydrillicola* abundance by 50 percent, or reduce AVM-related bald-eagle mortalities at the Lake, by incrementally introducing functionally sterile (triploid) grass carp and using herbicides during the approximately 4-year interim between carp introduction and the establishment of sufficient carp populations to effectively reduce hydrilla concentrations. The ACE proposes to use, consistent with the FWS' 1985 Biological Opinion finding triploid grass carp used for aquatic weed control to be environmentally safe to stock for use in closed or open waters. The FWS oversees the certification of triploid grass carp via the National Triploid Grass Carp Inspection and Certification Program. Because hydrilla is very hardy and efficient at propagating itself, the ACE expects grass carp stocking will be a permanent part of the proposed JST Lake AVM Management Plan. However, carp stocking is dependent upon funding availability. There are four management objectives for the proposed management plan: (1) reduce or eliminate AVM at JST Lake; (2) surveil and monitor both AVM and aquatic vegetation to determine treatment effectiveness, without eliminating all aquatic vegetation; (3) collaborate with stakeholders and subject matter experts to ensure decisions are science based; and (4) use public education and outreach in AVM and vegetation management.

Affected Environment

The construction of the JST dam created approximately 68,013 acres of lacustrine habitat bordering Georgia and South Carolina on the Savannah, Broad, and Little Rivers. JST Lake extends 39.4 miles up the Savannah River, 29 miles up the Little River, and 6.5 miles up the Broad River in Georgia, and 17 miles up the Little River in South Carolina. At full pool elevation, JST comprises nearly 71,100 acres of water and 1,200 miles of shoreline. Approximately 1,331 acres of various types of wetlands border the Lake. A total of 54,086 acres of project lands are managed as wildlife management areas, including 7,984 acres leased to SC DNR, 18,362 acres leased to GA DNR, and the remaining 27,740 acres managed by USACE. The Lake and its wetland habitats support many aquatic species of amphibians, reptiles, water and migratory birds, and mammals. The shallow water areas are used for breeding, raising young, foraging, and hibernation. Some migratory bird species, e.g., coots, use the Lake's ecosystem for their wintering habitat.

In 1992, the first bald eagle nest was verified on J. Strom Thurmond Lake.[14] In 1995, hydrilla was first located in the Little River, Georgia arm of JST. The extent of coverage was estimated at 54 acres.[15] During 1995 – 1998, ACE implemented hydrilla herbicide management in JST Lake. In 1998, the first AVM eagle death at JST Lake was reported. By 1999, seven active eagle nests were located on JST Lake with one nest found on the Richard B. Russell dam and lake project.[16] By 1999, hydrilla had increased to approximately 2,000 acres. By October 2000, hydrilla covered 5.5% (3,004 acres) of JST Lake despite aggressive herbicide applications in 1996 and 1997.[17] Since 1998, herbicides have only been applied to public recreation areas and around private boat docks with annual herbicide applications being less than 79 acres.[18] By 2000, about half of the nesting eagle pairs successfully fledged young each year.[19] From 1998 – 2004, a diagnostic and epidemiologic study was conducted annually at JST Lake during the months of October – March.[20] During the winters of 2000-2001 and 2001-2002, 23 eagle carcasses were recovered.[21] AVM was confirmed for 15 and suspected in 13 dead eagles. AVM was confirmed for 15 Canadian geese and suspected in another goose, and confirmed for the deaths of 6 American coots, 2 great-horned owls, and 1 killdeer.[22] During the winters of 2004 – 2006, 17 more AVM bald eagle deaths occurred at JST Lake.[23] By October 2005, hydrilla covered 7.2% (5,120 acres) of JST Lake.[24] During the winter of 2005-2006, 3 bald eagle carcasses were discovered but too decomposed for any AVM determinations.[25] During the winter of 2006-2007, an opportunistic study was conducted of a large-scale AVM epizootic occurrence on JSTL.[26] During this time 12 bald eagle carcasses were recovered. AVM was confirmed as the cause of death for seven with the remaining 5 too decomposed to determine their AVM status. During a 2010 survey, approximately 11,271 acres were estimated to contained hydrilla at a percent area coverage of 44% or a total of 4,959 acres of hydrilla. A 2015 survey indicated hydrilla now occurs on approximately 10,644 acres at a percent area coverage of 22.2% or a total of 2,363 acres. In April 2015, transmitters were attached to three bald eagle nestlings to track and determine if these birds remain onsite and develop AVM in the future or if they move offsite to another location.

Environmental Impacts:

Hydrilla is extremely effective at propagating and spreading. Hydrilla can sprout new plants from root fragments or stem fragments. It is efficient at producing turions (buds) and tubers (roots), which can withstand ice cover, drying, herbicides, ingestion and regurgitation by waterfowl, and can persist in the bottom sediments for many years. Hydrilla is readily spread by waterfowl and boating activities. The EA indicates the likelihood for triploid grass-carp stocking will become a permanent part of the proposed action. Without restocking, every introduced triploid grass-carp population will eventually die out because they are functional sterile. Grass carp have a life span of approximately 10 – 21 years. In the Santee Cooper reservoirs in South Carolina, significant numbers of grass carp have persisted for a least 5 years and perhaps as long as 9 years. One specimen from North Dakota was found to be greater than 33 years old.[27]

Negative impacts to submerged aquatic vegetation (SAV) can be expected if the excessive stocking of grass carp occurs. Removal or reduction in the size of stands of hydrilla would have temporary insignificant adverse impacts to fish using those stands for forage and cover. There could be negative impacts on largemouth bass because they are attracted to vegetated areas. Aquatic herbicides are non-selective, therefore SAVs will be negatively impacted in the treatment areas. Use of herbicide treatments on large areas of aquatic vegetation may result in long term indirect impacts by reducing the amount of dissolved oxygen in the water when dead vegetation decays, possibly leading to isolated fish kills. Herbicide applications may have a negative effect on SAV within the treatment areas. Chemical applications may have long term direct negative effects on fisheries by reducing the number of prey organisms, and possible lethal effects to fisheries. Treatment of hydrilla by herbicides may also have short term, indirect impacts on aquatic invertebrates and fish due to water quality changes.

Recommendations:

The EPA appreciates the significance of the problem facing the ACE in its management of JST Lake and other reservoirs in the south. A potentially pervasive and insidious toxin spread by a hard (and expensive) to control opportunistic, invasive aquatic vegetation that could potentially detrimentally impact numerous waterfowl and raptors, particularly protected species such as the bald eagle. The EPA supports the ACE's efforts to collaborate with stakeholders and subject matter experts to ensure decisions are science based. We defer to the ACE and FWS' expertise in addressing this complex issue. From the documents provided, the EPA was unable to determine whether the ACE had considered the issues raised in the below recommendations. In light of the significance of this issue and limited funding, the EPA suggests the ACE's final environmental assessment incorporate responses to the following recommendations.

Recommendation No. 1: Since hydrilla is an aquatic plant addressed by the ACE's existing Aquatic Plant Management (APM) Plan, the EPA recommends the final EA explain why the existing APM plan is deemed insufficient; hence the necessity to introduce grass carp. The EA indicates the 2010 survey estimated approximately 11,271 acres contained hydrilla, at a percent area coverage of 44% or a total of 4,959 acres of hydrilla. A 2015 survey indicated hydrilla now occurs on approximately 10,644 acres at a percent area coverage of 22.2% or a total of 2,363 acres. It appears the existing APM plan is making progress in hydrilla reductions.

Recommendation No. 2: Since the proposed action anticipates the high likelihood that stocking of triploid grass carp will be a permanent part of the JST AVM Management Plan, the EPA recommends the final EA explain whether the proposed action will eliminate all existing, and/or prevent repopulation of desirable SAV important for fish and wildlife habitat after the carp population has been sufficiently established to reduce or eliminate the hydrilla. How will that impact the Lake's ecosystem and water quality? A 2010 survey of submerged aquatic vegetation at JST Lake identified 32 acres of water primrose, 72 acres of alligator weed, and 600 acres of slender pondweed. *Egeria densa* has also been found in JST Lake in isolated patches since the early 1980s.[28] The EA indicates the aquatic plants that grass carp most prefer are hydrilla, Southern naiad, pondweeds, and chara (musk-grass). According to South Carolina Department of Natural Resources (SC DNR)[29] in South Carolina's waters, grass carp has demonstrated flexibility in its preferred vegetation (i.e., Naja sp., Bladderwort sp., Coontail, Hydrilla, Salvinia, Potomegton sp., Slender spikerush, Elodea, and Duckweed) and willingness to consume less preferred species, such as Water milfoil, Cabomba, Water lilies, Cat-tails, Water shield, Water meal, Pithophora algae, Alligatorweed, Water primrose, Lyngbya algae, Water hycanith, Water lotus, Pennywort, and Parrot's feather. Does the ACE anticipate the end result will be no SAV at JST Lake?

Recommendation No. 3: It would be helpful if the EA discussed whether the introduced grass carp will facilitate undesirable, replacement aquatic vegetation. The EA indicates the establishment of desirable native SAVs has been relatively unsuccessful. *A. hydrillicola* has been found growing on other invasive aquatic plants, including the Eurasian water milfoil, Egeria densa, and some native plants that co-occur with them. Similar to hydrilla, the invasive Eurasian water milfoil has the potential to become a major problem within South Carolina because it is spread by fragmentation.[30] Grass carp may prove to be a poor control option Eurasian water milfoil.[31] It would be helpful to know the risk for the introduction of grass carp leading to the invasion of an aquatic vegetation species hosting *A. hydrillicola* that carp will not eat and the resulting potential indirect impact to the bald eagles.

Recommendation No. 4: It would be helpful if the final EA explained what mitigation strategies the ACE has considered should water quality be detrimentally impacted by the removal of vegetation by grass carp. Results of studies on the impacts of grass carp introduction on water quality are inconsistent. However, in general, turbidity, alkalinity, chlorophyll a, ammonia-nitrogen and phosphorus concentrations can increase after the removal of vegetation by grass carp, while dissolved oxygen levels can decrease.[32] It would be helpful to better understand the benefit to bald eagles in contrast to the cost to the JST Lake's aquatic ecosystem. Are there an available, relevant studies on this issue?

Recommendation No. 5: There have been studies indicating changes in diet, densities and growth of native fishes associated with the introduction of grass carp that can result in changes in resident fish communities. Some waterbodies exhibited changes in diversity and biomass of their fish populations, while others did not. For example, grass carp removed hydrilla from a pond in Florida and, in doing so, destroyed spawning grounds of native centrarchids.[33] Similarly, grass carp stocked in a reservoir caused the elimination of vegetation and changed spawning substrate which resulted in a 50% reduction of centrarchids.[34] In another study, the standing crop of bluegill was significantly lower in ponds where grass carp were introduced. The study ruled out competition for food organisms, predation and water quality parameters and hypothesized that grass carp constantly invaded blue gill spawning areas.[35] It would be helpful if the final EA explained whether it reasonably foreseeable for grass carp introductions to decrease the reproductive success of vegetation-dependent spawners within JST Lake. The EA indicates there could be negative short term indirect impacts on largemouth bass because they are attracted to vegetated areas but once native plant populations recover, they will provide habitat for the largemouth bass. However the EA also states the establishment of desirable native SAVs has been relatively unsuccessful and grass carp stocking is highly likely to be will be a permanent part of the proposed action. The EA also indicates largemouth bass is among the list of popular game fish within JST Lake.

Recommendation No. 6: It is unclear how the proposed action will protect the bald eagle and eliminate FWS "take" permit requirement. Over a 16-year period, 81 dead eagles were recovered at the JST Lake area. AVM was confirmed as the agent of death for 29 eagles. One died of Aspergillosis. Four were confirmed to have died from mercury exposure.[36] The decomposition status of the remaining eagles prohibited determining if AVM was their cause of death. AVM is diagnosed by microscopic observation of spaces in the white matter of very fresh brain tissue from affected birds.[37] It would be helpful to explain why AVM is suspected over mercury or lead poisoning. Were the remaining undiagnosed eagles tested for mercury or lead poisoning? The EA indicates both Georgia and South Carolina have issued fish-consumption advisories for Largemouth bass on JST Lake due to the potential for unsafe mercury levels associated with outside sources. Fish is the bald eagles preferred prey. A recent USGS study determined lead poisoning continues to be an important cause of mortality for bald eagles. It found the proportion of lead-poisoning diagnoses for bald eagles submitted to the National Wildlife Health Center displayed a statistically significant increase in all flyways after the autumn 1991 ban on the use of lead shot for waterfowl hunting.[38] Approximately 55,000 acres of public land around Thurmond Lake are available for hunting including over 28,400 acres of project lands leased to the Georgia and South Carolina Departments of Natural Resources for wildlife management. While the proposed AVM hypothesis has some intriguing elements warranting future research investments, at this time, it is unclear whether sufficient study has been done to support drastic changes to JST Lake's ecosystem. It has been stated, *the available* [AVM] *research does not support specificity in the cause of a given effect. Several anthropogenic and naturally occurring compounds can elicit intramyelinic edema, the characteristic AVM-lesion. Reduction in populations of coots and bald eagles are not specifically caused by AVM; a variety of factors may influence population numbers*.[39] The hypothesized mode of bald eagle death by AVM is AVM-infected coots. Coots are also preyed upon by osprey[40] and great horned owls. The EA also indicates red-tailed hawks are among several of the most common bird species in the immediate vicinity of JST Lake and AVM feeding experiments have induced AVM in red-tailed hawks fed AVM-infected coots.[41] Yet it is the bald eagle that dominates the raptors found dead.

Recommendation No. 7: It is unclear how the proposed action will protect the bald eagle and eliminate FWS "take" permit requirement. Bald eagles, while opportunistic feeders, prefer fish and carrion. During its breeding season, bald eagles occur in virtually any kind of wetland habitat: seacoasts, rivers, large lakes or marshes or other large bodies of open water with an abundance of fish. Fish are susceptible to the harmful effects of cyanotoxins.[42] Fish can bioaccumulate these compounds in their tissues.[43] Grass carp that were fed *A. hydrillicola*-infested hydrilla in field and laboratory trials developed microscopic lesions in the white matter of the brain similar to lesions seen in AVM-affected birds.[44] While an experimental study feeding chickens grass carp with AVM-lesions did not infect chickens with AVM, the researchers found the study inconclusive as to whether grass carp could induce AVM in bald eagles.[45] It would be helpful if the final EA explained whether bald eagles feeding on grass-carp eating *A. hydrillicola*-infested aquatic vegetation year round could significantly increase their risk of contracting AVM by expanding the opportunity to contract AVM beyond the winter season when the existing AVM eagle and coot moralities appear to have concentrated.

Recommendation No. 8: It would be helpful if the final EA could explain the severity of impacts to bald eagles within the JST Lake area associated with AVM. What is the reference baseline eagle population for JST Lake to measure success of the proposed action? What are non-AVM mortality impacts to eagles that can be reasonably expected in the JST Lake eagle population?

Recommendation No. 9: It would be helpful if the final EA could discuss whether any relationship might exist between herbicide use and hydrilla bearing *A. hydrillicola*. Existing AVM studies have noted all AVM sites are associated with manmade impoundments. Herbicides are commonly used in such impoundments. It is unclear whether a link could exist between the location of herbicide use and the occurrence of AVM and *A. hydrillicola*. The Lake Surf, NC, AVM study noted AVM-positive mallards tended to cluster at the boat ramp and the dam.[46] At JST Lake, herbicides have only been applied to public recreation areas and around private docks since 1998.[47] Additionally the proposed action proposes to use spot treatments of herbicide, priority given to areas known to have high concentrations of American coots and past eagle mortalities, and grass-carp stocking. At Lake Surf, liquid copper, copper sulfate, diquat dibromide, glyphosate, & 2, 4-dichlorophenoxyacetic acid were the herbicides used to control hydrilla. The EA indicates the ACE intends to use copper-based compounds, Diquat, Endothall, and Fluridone. One study has suggested that cyanobacteria can develop resistance to copper sulfate treatment, leading to increased use of this treatment, and potential bacterial resistance to copper sulfate.[48] Could past use of herbicides have facilitated the presence of *A. hydrillicola*? Could the continued use of herbicides lead to the profilgation of *A. hydrillicola*? Studies have raised an additional concern, the potential release of toxins when herbicides are used to control hazardous algal blooms. One study found the use of copper-based algicides for the treatment of *Microcystis aeruginosa* bloom caused the release of microcystin toxins into the surrounding water.[49] A similar issue was noted in other studies.[50]

Recommendation No. 10: It would be helpful if the EA could discuss if any relationship might exist between known ubiquitous pollutants that might be present in JST Lake with hydrilla bearing *A. hydrillicola*. For example triclosan, a synthetic antibacterial widely used in personal care products, may be realizing the development of resistant bacteria in streams and rivers.[51] Numerous studies indicate that triclosan degrades into toxic secondary products and metabolites. For example the triclosan metabolite, methyl triclosan has been show to bioaccumulate in algae.[52]

Recommendation No. 11. It would be helpful if the final EA could discuss whether the proposed AVM strategy has worked in other reservoirs to eliminate bald eagle deaths. For example, AVM was first observed and documented in southwestern Arkansas at 3 lakes, particularly DeGray Lake, Lake Ouachita, and Lake Hamilton. From mid-October to February over 1,700 eagles may migrate to and winter in the vicinity of these lakes. It is reported that the COE has used an integrated control technique with diploid grass carp and the Asian hydrilla leaf-mining fly to significantly decrease hydrilla in both lakes, DeGray and Ouachita. However, it has also been noted that in 2005, 3 more dead eagles were recovered at DeGray Lake.[53] For Lake Hamilton, Entergy's Nuisance Aquatic Vegetation Management Plan uses another integrated approach: combining winter lake-level drawdowns and grass carp. Additionally in North Carolina during the winters of the period 1994-98 at Lake Surf, at least 58 eagles died of AVM and an undetermined number of coots were affected.[54] It would be useful to understand if aquatic vegetation management strategies employed in areas also associated with AVM bald eagle mortality was effective in preventing bald eagle deaths.

Recommendation No. 12. It would be helpful if the final EA will discuss the Georgia Department of Natural Resources opposition to stocking grass carp in JSTL as indicated in USACE's Aquatic Management Plan referenced in this EA. At the time of the 2003 update to this Management Plan, the stocking of functionally sterile grass carp was not viewed as a viable management alternative.

EPA staff contact: Beth Walls, Physical Scientist, NEPA Program Office, US EPA Region 4.

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From:	Ambrose, Jon
To:	Dayan, Nathan S SAS
Cc:	Sargent, Bob
Subject:	[EXTERNAL] Comments on AVM Management Plan and Draft EA for J Strom Thurmond Reservoir
Date:	Tuesday, May 31, 2016 2:26:41 PM
Attachments:	2016_05_31 USACE_AVM Plan Response.pdf

Nathan-

Attached are comments submitted on behalf of the Georgia Department of Natural Resources, Wildlife Resources Division regarding the AVM management plan for J Strom Thurmond Reservoir and the associated Draft Environmental Assessment. Printed copies of these documents have been mailed to your attention.

Thank you for the opportunity to provide comments on this important issue.

- Jon Ambrose

Jonathan Ambrose, Ph.D.
Chief, Nongame Conservation

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MARK WILLIAMS
COMMISSIONER

DAN FORSTER
DIRECTOR

May 31, 2016

Savannah District, U.S. Army Corps of Engineers
Planning Division, ATTN: Nathan Dayan (PD)
100 W. Oglethorpe Avenue
Savannah, GA 31401-3604

Dear Mr. Dayan:

We appreciate the opportunity to review and comment on the U.S. Army Corps of Engineers (USACE) J. Strom Thurmond Reservoir (JST) proposed Avian Vacuolar Myelinopathy (AVM) Reduction Plan (Plan) and Draft Environmental Assessment (EA). Comments pertaining to these two documents are attached.

The Plan and draft EA preferred alternative integrate limited herbicide applications with incremental and supplemental triploid grass carp stocking over 5 or 6 years at a rate of 15 fish per hydrilla acre in an attempt to reduce the presence of AVM in the reservoir. The specified goals of the plan are to: "(1) reduce or eliminate AVM at JST; (2) surveillance and monitoring of both AVM and aquatic vegetation for effectiveness, but do not result in eliminating all aquatic vegetation; (3) collaborate with stakeholders and subject matter experts to ensure decisions are science based; and (4) use public education and outreach in AVM and vegetation management."

Our staff has developed comments regarding the Plan and we request that additional management alternatives or combinations of alternatives be analyzed in the plan (see "Treatment Options Not Explored" on page 3). Recommendations include a more detailed consideration of water level manipulations (drawdowns or over-filling) as a tool for either controlling hydrilla or for making it difficult for coots to forage on this species. We also request that the plan evaluate the potential value of controlling coot numbers on the reservoir and investigate alternative methods to discourage eagles from nesting in AVM-infected areas.

We look forward to continued coordination with the USACE as the AVM Plan and Draft EA undergo revisions. Please contact Bob Sargent at 478-994-1438 with questions.

Sincerely,

Dan Forster

Dan Forster

Attachment

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Georgia DNR/WRD Comments on USACE AVM Plan, J. Strom Thurmond (JST) Reservoir
May 31, 2016

Section 1.0:

--The primary goal is to reduce or eliminate AVM. If the average number of eagles that normally winter at this reservoir has already been substantially reduced, as has the number of occupied eagle nesting territories, then the goal of reducing the impacts would be especially difficult to quantify. Instead, perhaps the goal should be a specified percentage reduction in the acreage of SAV on which the cyanobacterium occur. Note that in section 5.1 the stated objective is to reduce hydrilla coverage by 50% lake-wide. These goal statements (i.e., reducing AVM occurrence and reducing hydrilla acreage) should be merged, especially since they appear to be interconnected. However, it should be made clear to the reader that accomplishing the hydrilla reduction goal does not necessarily ensure that the AVM reduction goal will be accomplished.

--The introductory paragraph does not mention impacts of AVM on herpetofauna, but the draft EA does state that it harms turtles. Research has also indicated that vultures are infected when they feed on washed ashore carcasses. This information should be included in the plan.

--"Kill deer" is one word.

--In the second paragraph the plan states that hydrilla "may have" cyanobacteria attached to its parts, as though this is not a certainty or it only occasionally happens. We suggest rewording this phrase to indicate that this cyanobacterium is known to be epiphytically associated with hydrilla. It is also associated with native SAV found in JST. Research by Wilde et al. (2005) indicates that it has been found growing on southern pondweed and southern naiad, although it is uncertain if the cyanobacterium associated with those species is the toxin-producing form. Are data available from the stomach contents analyses of dead coots? Do we know if they are mostly eating hydrilla or a diversity of SAV species? If available, this information should be included.

--Paragraph three summarizes recorded eagle deaths, but says nothing about the documented reduction in eagle nest territories from 7-8 to 2-3 in the past 18 years, nor does it mention any estimate of eagle numbers present at the reservoir in the years prior to the appearance of hydrilla. This is relevant information that should be included, especially the reduction in the number of nesting territories, as it indicates a substantive loss in the recruitment of young eagles to the population during that timeframe. This paragraph should also describe the trend (up or down or consistent) of eagle deaths at the lake since 1998. Wasn't there an initial large (i.e., 17-18) pulse in eagle deaths observed at JST in the early 2000s?

--Paragraph three mentions the presence of AVM at 18 lakes and reservoirs throughout the Southeast, but does not mention that 8-9 of those water bodies are located in GA. What can be said about AVM impacts to birds at other "infected" lakes in GA and elsewhere? Besides Lake Gaston, is the USACE conducting hydrilla control experiments at any other lake or reservoir in the Southeast? Can the USACE provide preliminary results concerning control experiments conducted in conjunction with Dr. Susan Wilde (Univ. of GA)?

--The reported difference in acreage infested by hydrilla between 2010 (4,959 acres) and 2015 (2,363 acres) is treated as simple variability in sampling results. Is it possible that a 50% reduction has actually occurred, or could this result be attributed to differences in sampling effort and technique between the two survey periods? The plan does not provide a comparison of native SAV species acreage between 2010 and 2015. If the toxin-producing cyanobacteria do grow epiphytically on native SAV species, is it possible that reductions in hydrilla will lead to increases in acreage of those species and continued prevalence of the cyanobacterium and AVM? Perhaps something unique about the nutrient load or some other hydro-chemical issue is causing the prevalence of this cyanobacterium at JST. Is the USACE studying this ecosystem with the intent to identify and possibly alter the causative agents responsible for the proliferation of the problematic cyanobacteria and the hydrilla? What lessons learned could be employed to help prevent these problems from recurring in this reservoir, as well as occurring in other Georgia reservoirs and lakes? These considerations should be addressed in the plan as a commitment to future preventative actions.

--Paragraph four mentions that efforts to control hydrilla via herbicides failed in the late 1990s, yet paragraph six states that the USACE APMP has adequately addressed aquatic plant management and in section 4.3 the plan refers to the effective use of herbicides to control aquatic plants nationwide. Herbicides have not been effective in controlling nuisance aquatic plants in large, deep water bodies, and this plan appears to overestimate their expected effectiveness in the integrated management scheme described. It also does not adequately address the potential negative impacts of herbicide use on native emergent, floating, and submerged aquatic plants within the reservoir and perhaps downstream. We recommend including a reference for the statement that toxic cyanobacteria can grow on densely growing native SAV.

--Explain the relevance of "monoecious biotype" in the last sentence of paragraph four, as some readers may not recognize the management implications.

--With regard to the Hartwell and Russell reservoirs, why are we not seeing AVM problems at those water bodies? The plan and EA note that those two are deeper on average than JST, but they certainly feature hundreds, if not thousands, of acres that are shallower than 20 feet (i.e., the ideal depth for the growth of hydrilla). Is this largely a matter of the older JST reservoir being more "silted in," and therefore having more suitable acreage for hydrilla establishment than the other two reservoirs? If this is the case, then wouldn't the inclusion of a cautionary statement regarding the potential future hydrilla infestation of the upstream reservoirs be useful here in defending the current need for aggressive hydrilla control in JST? It would be helpful to reference differences in wintering coot abundance on those reservoirs vs. JST, if those data are available.

--In paragraph eight, the statement "...84.5% of respondents prefer less hydrilla or native plants only, while 74.3% were indifferent or support stocking grass carp" is confusing because it implies that 74.3% could be indifferent to the presence of hydrilla, and that is not accurate. It should say, "...84.5% of respondents prefer less hydrilla or native plants only, while 74.3% support stocking grass carp or were indifferent to stocking proposals." The survey also found that 65.8% supported removal of aquatic vegetation once they learned about its connection to AVM, even if this means reducing fish and wildlife habitat. This should be stated in this paragraph. Note that the results of a recent SCDNR creel survey indicate a very different perception of the hydrilla/AVM issue. This information should be included, as well.

Section 1.1:

--The proposed integrated approach alternative suggested in the Environmental Assessment (EA) combines both biological and chemical control agents to manage hydrilla densities in JST. Biological control through the use of certified sterile grass carp should not have any unforeseen impacts to any freshwater mussels in the reservoir, but may pose a threat to important fish, and other wildlife, habitat. Chemical control discussed on page five of the biological assessment may threaten any freshwater mussel species occurring within the reservoir depending on the control agent used and the locations of use. Aquatic herbicides containing copper may be extremely toxic to freshwater mussels as these organisms have repeatedly shown sensitivity to acute and chronic exposure at various life stages (Naimo et al. 1995; Wang et al. 2007; Wang et al. 2007b.; March et al. 2007).

Section 2.0:

--Objective #1 is to reduce or eliminate AVM at JST. Reduce to what level? How will the reduction be measured? See comments under section 1.0 above.

Section 3.0

-- One Georgia state-protected (i.e., listed as threatened) freshwater mussel species not identified in section 3.2.5 is the Altamaha Arcmussel (*Alasmidonta arcula*). The Center for Biological Diversity (CBD) petitioned to have this species federally listed in 2010. That petition was withdrawn in December 2015, in large part due to an expansion of the known range of this species which now includes JST. Any potential threats to this species, such as the loss or harm of its population in JST, may result in a re-petition for listing by the CBD. The Altamaha Arcmussel was first collected in JST at seven locations in September 2007 (GA DNR, unpublished data). Live animals and recent dead shells were collected in nearly all back water coves searched and generally occurred along the lake shore at depths less than 0.5 meters. The widespread occurrences and abundant shells of this species along the lake shore strongly suggest that it likely occurs throughout a large portion of JST in shallow habitats. Therefore, Altamaha Arcmussel populations within JST, while perhaps one of the most abundant remaining populations, may be particularly vulnerable to impacts caused by chemical vegetative control agents used in shallow portions of the lake.

Chemical control of aquatic vegetation has been suggested as a probable cause of the loss of the Atlantic Pigtoe (*Fusconaia masoni*) from its last known location in Georgia at the Magnolia Springs State Park spring run. This species is now extremely rare throughout its historical range from Virginia south to the Altamaha River and presumed extirpated from Georgia; hence, it is currently undergoing a species status assessment by the US Fish and Wildlife Service to determine if federal protection is warranted. We strongly suggest that chemical treatments be avoided unless absolutely necessary. If chemical treatments should become necessary, we recommend against the use of copper based control agents and further suggest that the USACE research potential toxicity of other agents to freshwater mussels before initiating such approaches.

Section 4.1:

--This section includes the phrase "...failure to treat dense aquatic vegetation...in continued AVM-related mortalities." Is the plan proposing to treat all dense vegetation, even if it is native SAV? We recommend this be clarified unless data indicate that the neurotoxin-producing cyanobacteria is prevalent on dense native SAV, too.

Section 4.3:

--This section states that herbicides can reduce water use conflicts without negative impacts to the natural resources. Note that they can kill non-target, native floating, emergent, and SAV, leading to significant food chain degradation. This statement needs to be rephrased. Page 40, Section 4.3.3, of the draft EA states that herbicides will selectively control hydrilla and promote native plant species, but this plan does not make that assertion. What safeguards will ensure minimum impacts to native SAV important to fish, waterfowl and other wildlife?

Treatment Options And Issues Not Explored:

--Carp stocking combined with short-term drawdowns and herbicide treatment of hydrilla patches exposed by the drawdowns. This option should be evaluated, even if it is deemed "non-preferred."

--Lake filling. There is considerable anecdotal evidence that lake filling during late fall and early winter severely limits the deadly cyanobacteria because hydrilla is no longer "topped-out." More deeply submerged "infected" hydrilla would likely be less accessible to foraging coots. We recommend a new section in the plan that would address the AVM control value (or lack thereof) of lake filling during late fall/early winter as a management option.

--Encouraging the spread of native SAV. WRD biologists have managed sport fish and other wildlife at Clarks Hill Lake since its creation and have noted an on-going increase in the presence of several SAV species in recent years. Some of these SAV such as *Chara*, *Nitella*, naiads and pondweeds are already displacing hydrilla. Consider the development of a management option that accounts for the ecological values of natural and perhaps man-induced spread of native SAV.

--Controlling coot numbers. If these birds are the mechanism via which eagles contract AVM from cyanobacteria, then perhaps an aggressive coot harassment or hunting effort could be implemented.

--We recommend that alternative methods to discourage eagles from nesting in AVM-infected areas be investigated.

--The plan should include a discussion of the possibility that grass carp will escape the reservoir and enter other aquatic systems.

Section 5.1:

--In paragraph one, explain what "minimizing" AVM-related mortality means in terms of a measurable goal. See related comments under section 1.0 above.

--Note that the study results referenced in the second paragraph would be more instructive if the reader knew the time span for each. For instance, how long did it take to achieve a 50% reduction in hydrilla acreage at Lake Gaston following carp stocking at the rate of 15 fish per acre?

--In the fourth paragraph the plan states that hydrilla reduction efforts will be especially focused in areas where the majority of the eagle mortalities occurred. The locations of eagle carcasses found could be indicative of preferred roosting habitats around the lake's perimeter, rather than directly correlated with proximity to the highest concentrations of neurotoxin-producing cyanobacteria. Ideally, hydrilla control efforts should be focused on locations where sampling indicates high densities of the plant, high densities of cyanobacterium growth on plants, and high densities of eagle mortality.

Section 5.2:

--In the second paragraph, the noted substantial difference in acreage of hydrilla observed in 2010 and 2015 raises many questions. See the seventh comment above. Different sampling devices were used between years. It would have been instructive to test both devices in a small body of water that features a known acreage of SAV. The lesser acreage of hydrilla recorded in 2015 could reflect an actual reduction, perhaps due to an increase in acreage of native SAV. What was the trend for the latter from 2010 to 2015? There seems to be a lack of confidence in the survey method. If so, should the USACE be considering other survey methods?

--Would grass carp stocking levels be based on an average of hydrilla infested acreage in 2010 vs. 2015? If the carp are effective in reducing hydrilla, what is the plan if the species then switches to heavily grazing native SAV? Section 4.6 states that carp might eliminate native SAV if stocked at a high density. One benefit of herbicides over grass carp is that herbicides will kill the plant, while grazing grass carp may leave tubers in the substrate that can re-sprout in the future. Will grass carp be a short-term solution?

--At what time of the year would herbicides become an option?

--We recommend that at least preliminary vegetative sampling occur in year 4 or 5, recognizing that results from carp stocking often take 4+ years to appear. Perhaps a subset of sampling plots could be measured. There is a risk that the carp might be substantially reducing native SAV during this six-year wait, or they might not be abundant enough to cause any measureable reduction in hydrilla.

Section 6.0:

--This section lacks sufficient detail. At what time of year will sampling occur? How long are the sampling transects and how far are they from the shore/what depth? What native SAV parameters will be measured, and will these data be compared to data from 2015 and/or 2010? What is the protocol for future vegetative sampling (hydrilla and native SAV)?

Section 7.0:

--Does not mention GADNR's eagle nest surveys (January and March).

Section 8.0:

Explain the status of the other two bald eagles that were outfitted with transmitters in 2015: one lost its harness and the other one recently returned to JST. What are the current results from the UGA experimental grass carp and herbicide study? Will the AVM plan (e.g., proposed carp stocking rates) be adjusted, if necessary, based on information from that study?

Section 9.0:

Public education should include AVM details and agency points of contact in the event that dead birds are found.

Environmental Assessment (EA) Comments:

--Section 1.1 of the draft EA states that CESAS will conduct hydrilla surveys periodically, summer through fall, but that statement is not part of the AVM plan. Why not?

--The EA emphasizes adaptive management, referencing alternative approaches in the event that the preferred alternative does not work. That language should also be included in this plan.

--The EA notes that carp develop AVM lesions but do not seem to be harmed by the virus, nor do chickens that have been fed AVM-infected carp (fish meal). Has anyone determined if raptors, wading birds, and other piscivores will similarly be unaffected by the consumption of AVM-infected (live) carp? Wilde et al. (2005) reported that AVM was experimentally induced in mallards that were fed cyanobacteria-containing hydrilla leaves. This issue needs more thorough evaluation.

--Section 1.4.1 of the draft EA, fourth paragraph: "in-action" should be "no action."

Literature Cited

March, F.A., F.J. Dwyer, Augspurger, T, C.G. Ingersoll, N. Wang, and C.A. Mebane. 2007. An evaluation of freshwater mussel toxicity data in the derivation of water quality guidance and standards for Copper. Environmental Toxicology and Chemistry 26:2066-2074.

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From:	Bob Perry
To:	Bailey, William G SAS; CESAS-PD, SAS
Cc:	Dan Forster; John Biagi; Ambrose, Jon; Alvin Taylor; Derrell Shipes; Emily Cope; Thomas McCoy; Donald Imm; Jennifer Koches; Ulgonda Kirkpatrick; John Stanton; John Elofson; Brooks, Jeffrey J SAS; Boyd, Kenneth H SAS; Susan Wilde; John Fischer; john.sargent@dnr.state.ga.us; Harris, Deborah; Ken Rentiers; Chris Page; Billy Dukes; Ross Self; Lynn Quattro; Dan Rankin; Amy Tegeler; Tom Swayngham; Cory Drennan; Richard Morton; Dean Harrigal; Breck Carmichael; Mark Caldwell
Subject:	[EXTERNAL] P/N AVM Plan, Draft EA and FNSI to Evaluate the Potential Impacts of Managing Hydrilla within JST to Reduce Occurrences of AVM in Bald Eagles
Date:	Tuesday, May 31, 2016 5:28:23 PM
Attachments:	image001.gif AVM Plan Draft EA FONSI.Lake Thurmond.31May16.pdf

Bill, Please see the attached comment letter submitted pursuant to the above referenced public notice. The original is being mailed to your attention through the U. S. Postal Service. Please do not hesitate to contact me if your office will require any additional information regarding this matter. Thanks, Bob

Bob Perry

Director, Office of Environmental Programs

S. C. Department of Natural Resources

Suite 336 Dennis Building

PO Box 167

Columbia, SC 29202

Office: 803.734.3766

Cell: 843.833.3894

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<Blockedhttp://www.dnr.sc.gov/admin/team/sticker.html>

South Carolina Department of

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Alvin A. Taylor
Director
Robert D. Perry
Director, Office of
Environmental Programs

May 31, 2016

William G. Bailey
Chief, Planning Division
U. S. Army Corps of Engineers
Savannah District
100 West Oglethorpe Avenue
Savannah, GA 31401-3604

ATTENTION: Nathan Dayan

REFERENCE: Avian Vacuolar Myelinopathy Plan, Draft Environmental Assessment and Finding of No Significant Impact to evaluate the potential impacts of managing hydrilla within J. Storm Thurmond Lake to reduce occurrences of Avian Vacuolar Myelinopathy in bald eagles

Dear Mr. Bailey,

Personnel of the South Carolina Department of Natural Resources (DNR) have reviewed the above referenced Public Notice and its referenced documents prepared by the United States Army Corps of Engineers Savannah District (CESAS). DNR respectfully submits the following comments.

CESAS has prepared the draft Environmental Assessment (EA) to evaluate the potential impacts of managing hydrilla (*Hydrilla verticillata*) within J. Strom Thurmond Lake (JST) to reduce occurrences of avian vacuolar myelinopathy (AVM) in bald eagles (*Haliaeetus leucocephalus*). The draft EA outlines a number of potential actions with the proposed action being an integrated approach of biological control, with incremental grass carp stocking [certified sterile triploid grass carp (*Ctenopharyngodon idella-triploid*)] and chemical control, to consist of more targeted and limited herbicide use. Together these approaches are proposed to reduce the issue of AVM in avian species using JST.

The occurrence of AVM affecting avian species utilizing JST has been an issue for a number of years. DNR has participated in numerous meetings to discuss these issues with staff of the Georgia Department of Natural Resources and CESAS, and our staff has reviewed considerable literature documenting the problem with AVM caused avian mortality and resultant loss of bald eagle nesting territories on JST. DNR accepts the science for what it states. While there have been questions about accurately assessing the coverage of hydrilla in JST, DNR accepts the estimate of 3,661 acres as reasonable for the purposes of moving forward with a plan to reduce or control hydrilla as described in the draft EA. Effectively addressing the problem of avian mortality caused by AVM without causing additional natural resource and user issues has always been the challenge plaguing the agencies. If a good solution to this issue existed, the agencies collectively would have arrived at an acceptable plan and CESAS would have implemented such well before now.

Significantly, the draft EA presents the conundrum of using an exotic species to control an exotic invasive species that, whether liked or not, provides the enhanced habitat base for fish and wildlife and contributes to the overall success of hunters and fishermen. In turn, ample evidence exists to indicate that moving forward with almost any approach that uses carp as the principle or as a component of hydrilla control introduces the potential for unintended consequences, even if reasonably understood.

DNR submits its support of the proposed action of integrating biological and chemical control. Specifically, as presented in the public notice, DNR supports Alternative 3, the Tentatively Selected Plan also termed the integrated approach with incremental grass carp stocking and herbicide use. DNR completely understands that hydrilla is an invasive exotic supporting the continuation of AVM, and that it must be treated.

That noted, DNR recommends the following if the proposed alternative is to be implemented. DNR does not suggest either state or CESAS has the wherewithal to address all of the following, but in the spirit of honesty and transparency, many of these issues simply must be acknowledged.

1. The final EA should include an acknowledgement that fisheries and wintering waterfowl habitat will be negatively affected if hydrilla is reduced and especially if it is effectively eliminated.
2. There should be an acknowledgement that other aquatic vegetation will be negatively affected, and the future establishment of desirable, native aquatic vegetation is unlikely as long as grass carp remain in the system at the population level necessary to control hydrilla.
3. There should be an acknowledgement that the future success of waterfowl hunters and fishermen also will be diminished. DNR believes the very best Southeastern fisheries have one common denominator: submersed aquatic vegetation.
4. There should be acknowledgement that implementation of the proposed alternative will not ensure reduction of the incidence of AVM in bald eagles or other avian species, and will not ensure re-establishment of lost bald eagle nesting territories. Furthermore, it should be noted that, not including JST, bald eagles are thriving elsewhere in South Carolina.
5. While open, deep-water treatment of submersed aquatic vegetation is not always effective, DNR recommends inclusion of provisions that permit subsequent chemical treatments within a growing season, if necessary to increase efficacy.
6. Any future herbicide treatment should target areas with known high concentrations of American coots (*Fulica americana*) and past bald eagle mortalities and locations (boat ramps) where transportation of hydrilla out of JST is likely to occur.
7. The issues of measurement of success, evaluation of measures and adaptive management need additional consideration. DNR stresses the importance of monitoring, and mitigation, if indicated by monitoring, for any major natural resource impacts. DNR has excellent data on the recreational fishery prior to any management action, with creel surveys conducted during the 2005-2009 and 2014-2015, and surveys scheduled for 2016-2017. DNR recommends creel surveys funded by CESAS be conducted at a mutually agreeable frequency after the implementation of the preferred alternative. Such creel surveys should focus on native gamefish and assess any potential positive population response or incursion by Alabama bass within the overall JST fishery.
8. A robust plan to replace lost fish and wildlife habitat needs to be developed, funded and implemented. For fishery benefits, such a plan should have a focus on structural habitat enhancements in numerous strategic locations since it will be difficult to re-establish native, desired aquatic vegetation within JST after grass carp are introduced. A habitat enhancement plan for wintering waterfowl should be forthcoming; DNR suggests coordination with

professionals from the state of Georgia as well as stakeholder hunters in order to target the development of adjacent, off-reservoir habitats where hydrilla can be controlled while managing for preferred, natives plant species favored by wintering waterfowl.

9. DNR strongly recommends that in order to ensure that future grass carp reproduction will not occur within JST and reproductive grass carp will not be transported downstream, triploid grass carp to be stocked in JST must be certified as sterile by the National Triploid Grass Carp Inspection and Certification Program and DNR Freshwater Fisheries standards, as mandated by State of South Carolina statute.

DNR requests the above recommendations be incorporated into the proposed alternative or any other forthcoming modification of the plan prior to a final decision being made. Should any additional information be needed, please do not hesitate to contact me.

Respectfully,

Bob Perry
Director, Office of Environmental Programs

ec: Dan Forster, Georgia DNR
John W. Bowers, Georgia DNR
John Biagi, Georgia DNR
Don Imm, U.S. Fish and Wildlife Service
Tom McCoy, U.S. Fish and Wildlife Service
Alvin A. Taylor
Ken Rentiers
Chris Page
Emily Cope
Derrell Shipes
Billy Dukes
Ross Self
Breck Carmichael

From:	Chris Page
To:	CESAS-PD, SAS
Cc:	"Austin Smith"; Bob Perry; Chris Page; "David Wannamaker"; "Jeannie Eidson"; "Jeff Thompson"; "Josh Baker"; "Larry McCord"; Bill Marshall; "Stan Hutto"; "Tammy Lark-Lognion"
Subject:	[EXTERNAL] Public Notice: USACE Savannah District - Bald Eagles at J. Strom Thurmond Lake (UNCLASSIFIED)
Date:	Tuesday, May 31, 2016 10:40:45 AM
Attachments:	APMC response to COE Thurmond.docx

Chris Page, APMC Chair

2730 Fish Hatchery Road, West Columbia, SC 29170

ATTN: Mr. Nathan Dayan (PD)

Savannah District, U.S. Army Corps of Engineers,

Planning Division,

Dear Sir:

The Aquatic Plant Management Council is composed of one representative from several state agencies; the Governor's Office, S.C. Public Service Authority, S.C. Department of Parks, Recreation, and Tourism, S.C. Department of Health and Environmental Control, S.C. Department of Natural Resources, and the Clemson University Department of Fertilizer and Pesticide Control. The representative from the Land, Water & Conservation Division of the S.C. Department of Natural Resources serves as Chairman of the Council. The Council provides valuable interagency coordination and serves as the principal advisory body to the South Carolina Department of Natural Resources on all aspects of aquatic plant management and research. Furthermore, the Council establishes management policies, approves all management plans, and advises the Department on research priorities.

The members of the SC Aquatic Plant Management Council (APMC) have thoroughly reviewed the Public Notice proposal by the U.S. Army Corps of Engineers, Savannah District (COE) for J. Strom Thurmond Lake (JST). The Savannah district's proposed actions include an incremental stocking of sterile triploid grass carp plus limited herbicide application to control hydrilla in an effort to eliminate Avian Vacuolar Myelinopathy (AVM) and its devastating effects on Bald Eagles and other wildlife around the JST.

* The APMC concurs with the COE in that of the presented options Alternative 3, the integrated approach, would be best suited. However, a concern is that the plan in itself is too conservative and could take years to produce meaningful results.

* The APMC would like to verify the exact acreage numbers that the COE is utilizing in forming this stocking rate for the final plan as there are 2 differing distinct values of acreage based on the most current survey.

* The APMC stresses a long term management plan which includes an adaptive management component in the current configuration of the plan to make any adjustments necessary to ensure the continued effectiveness of the plan.

Thank you for your consideration,

Chris Page
Chairman, Aquatic Plant Management Council

Email: pagec@dnr.sc.gov

From:	Chris Page
To:	CESAS-PD, SAS
Subject:	[EXTERNAL] Re: Public Notice: USACE Savannah District - Bald Eagles at J. Strom Thurmond Lake (UNCLASSIFIED)
Date:	Tuesday, May 31, 2016 3:07:25 PM

I sure did. I apologize. I was writing it this morning for the noon deadline and didn't proof it well enough.

Get Outlook for iOS

On Tue, May 31, 2016 at 7:33 AM -0700, "Chris Page" <PageC@dnr.sc.gov> wrote:

Chris Page, APMC Chair
2730 Fish Hatchery Road, West Columbia, SC 29170

ATTN: Mr. Nathan Dayan (PD)
Savannah District, U.S. Army Corps of Engineers,
Planning Division,

Dear Sir:

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- The APMC concurs with the COE in that of the presented options Alternative 3, the integrated approach, would be best suited. However, a concern is that the plan in itself is too conservative and could take years to produce meaningful results.
- The APMC would like to verify the exact acreage numbers that the COE is utilizing in forming this stocking rate for the final plan as there are 2 differing distinct values of acreage based on the most current survey.
- The APMC stresses a long term management plan which includes an adaptive management component in the current configuration of the plan to make any

adjustments necessary to ensure the continued effectiveness of the plan.

Thank you for your consideration,
Chris Page
Chairman, Aquatic Plant Management Council
Email: pagec@dnr.sc.gov

From:	Dianne White
To:	CESAS-PD, SAS
Subject:	[EXTERNAL] Sterile carp
Date:	Tuesday, May 31, 2016 8:02:28 PM

I have attended a meeting with Corps personnel and read the proposed plan to use herbicide and sterile carp to control the AVM. I have seen the nerve damaged coots on Cherokee Creek and know that it leads to the Bald Eagle deaths. The Corps does wonderful work at the Lake and I agree with this plan.
Thank you.

Sent from my iPad

From:	stanfillb@nctv.com
To:	CESAS-PD, SAS
Subject:	[EXTERNAL] Thurmond AVM Comment Form
Date:	Tuesday, May 31, 2016 4:46:41 PM
Attachments:	AVM Letter PDF.pdf

Nathan,

I could not fit my comments on the small blue form so I put them in a letter to you. See the attachment. Feel free to call me directly with any questions or comments.

Bobby Stanfill

Date: 5/31/16

Nathan Dayan
J. Strom Thurmond Lake
U.S. Army Corps of Engineers
Savannah District, Planning Division
100 West Oglethorpe Avenue,
Savannah, GA 31401-3640
Fax: 912-652-5787

Dear Mr. Dayan,

We have been closely following the political storm revolving around AVM in our region. We have reviewed the 2016 Environmental Draft Assessment dated April 2016. We do not agree with the actions outlined in the current plan.

It is our understanding, AVM stems from blue green algae that is present in the reservoir. The blue green algae enters the food chain by colonizing on hydrilla. Migratory birds ingest the hydrilla and eagles consume the migratory birds. It is widely known, migratory waterfowl winter in the area because of the available food source (hydrilla). The current plan will eliminate the food source and therefore greatly decrease the numbers of waterfowl wintering in the area. While we understand the current plan could reduce bald eagle exposure, it will also create negative impacts for other species in the system. There are many factors that need to be studied before any action is taken.

Impact to the Fishery

Recruitment

As you know, the fishery at Clarks Hill has greatly benefited from the presence of hydrilla. Hydrilla provides excellent habitat for all native fish species. It is a critical component fish recruitment. Hydrilla provides the young with a place to live and hide reducing predation and exponentially increasing recruitment. The overall result has been tremendous population increases of all desirable species in the reservoir. If hydrilla is eliminated from the system, recruitment will decline at an alarming rate, resulting in fewer fish reaching adult size and age. An overall downturn in our booming fishery will be inevitable.

Hydrilla is the foundation of the fishery. If you remove part or all of the foundation from any structure, what would happen? The structure would fail. Removing hydrilla from this reservoir will have the same effect.

Other Invasive Species

The Alabama Spotted Bass is a non-native invasive species that has been introduced into Thurmond. Its presence has been confirmed by the USACE and the SCDNR. This aggressive species has been illegally introduced into many reservoirs in our region including Keowee, Hartwell, Russell, Lanier, and Allatoona. Every time these fish are stocked into one of our lakes, the results are always the same. The Alabama Spotted Bass (ASB) multiplies quickly and displaces native species at rapid pace.

One of the species greatly impacted by ASB is the Savannah River Red Eye Bass. The ASB breeds with our native Red Eye and creates a hybrid. The SC DNR is keenly aware of this issue and has documented the far reaching hybridization of our native species. Today, there are very, very few pure strain Savannah River Red Eye Bass in existence. The Savannah River Red Eye Bass is in great peril and could very easily be eliminated completely by the hybridization occurring.

Two other species that are directly impacted by the ASB are native largemouth bass and black crappies.

To understand the impact on largemouth bass, we only need to look upstream to Lake Keowee. Creel surveys and electro-shocking results by the SCDNR indicate the ASB has already displaced the majority of the largemouth bass in the reservoir. Approximately 80% of the bass species in the reservoir are now spotted bass. The invaders have also had a tremendous impact on the black crappie population. Recent SCDNR surveys for 2015 show almost ZERO black crappies.

These same impacts are currently occurring on Lake Russell. Native Red Eyes have almost been eliminated, largemouth bass populations are approximately 40% of the bass species now, and black crappie populations are showing a definite decline.

What does all of this have to do with Hydrilla? So far, our examples above are all reservoirs that do not contain aquatic submergent vegetation. It is well documented what happens to these systems when the ASB is introduced. However, there are many reservoirs in this country that have this species and the natives are thriving. For example, TVA lakes Guntersville and Pickwick both contain ASB. Largemouth bass in these reservoirs are not on the decline. In direct contrast, these largemouth fisheries are flourishing. What is the difference? These reservoirs contain submergent vegetation (hydrilla and milfoil). High recruitment and low predation is the key to sustaining these important fisheries. Eliminating hydrilla from Thurmond will create favorable competitive conditions for the ASB. History shows us what will happen to the native species in our area in a reservoir without vegetation. Considering this path and expecting different results is the definition of insanity.

<u>Alternate Methods of Control</u>

The current Environment Draft Assessment appears to be a plan to minimize bald eagle impact. If the overall goal is mitigation, there are some other control methods that should be strongly considered.

In the public AVM meetings held in May 2016, the USACE stated blue green algae grows in the upper three feet of the hydrilla canopy (mat). If this is accurate, algaecide could be used to spray the historically problematic areas that top out with hydrilla. We realize this is a fluid situation that can change from year to year depending on water levels, plant growth, etc. However, we have enough historical data to show us exactly where the most prolific areas are.

The current program suggests herbicides and grass carp will be used to control hydrilla. In order to spray herbicides, overall assessments of coverage will have to be made each year. Instead of spraying these areas with herbicides, these areas should only be sprayed with algaecides. Algaecides would destroy the colonized blue green algae, leaving the hydrilla unharmed. We realize, the cost of herbicide vs algaecide is not equal but isn't it worth something to insure we are not harming the habitat our fishery depends on? Furthermore, this action insures minimal impact to migratory waterfowl. Their food source would contain significantly less blue green algae and the entire food chain would remain intact.

The other portion of the plan includes grass carp as a method of control. We are 100% against the use of non-native species to control or minimize the effects of blue green algae. Grass carp are not selective. We have witnessed this first hand on Lake Murray. The grass carp stocked at Lake Murray eliminated all hydrilla, elodea, and milfoil. Once these plants were gone, they grass carp consumed all native plants including some plants that they were not supposed to eat. These included primrose, gator grass, water willow, etc.

The life cycle of hydrilla at Thurmond is very defined. It emerges in late May / early June and by early January each year, all physical sign of hydrilla is absent. What exactly are these grass carp going to feed on from January to June? We all should remember that grass carp are just like goats. They are going to eat hydrilla until it is gone and then they are going to eat everything else including primrose, gator grass, water willow, maidencane, etc. The emergent plants that we have in the reservoir are not part of the plan and should be protected as well. Although not as important as the submergent vegetation, the emergents do provide habitat for some of our fish species and do aid in recruitment. Their impact is valuable but varying water levels can render them ineffective in some years.

Impact to the Economy

Local Economy

Thurmond is located in a rural area. The small communities and businesses surrounding the reservoir are dependent on recreational traffic. The vast majority of the money generated is from the fishery. This revenue keeps all the small businesses afloat. The single species responsible for the majority of the revenue is the largemouth bass. Anything that can be done to bolster the largemouth bass fishery helps everyone in the region. The current plan will have the opposite effect. Declines in the fishery will be directly proportional to reduction in revenue. This is a very concerning aspect of the equation. If we review history associated with Lake Guntersville, it shows us exactly will happen our local economy if we suffer a fisheries decline.

Summary

Clearly, removing hydrilla from the system will not eliminate blue green algae nor will it eliminate AVM. At best, this will be a mitigating effort with far reaching impacts to countless other native species. The current strategy simply creates more problems than it solves.

In a perfect world, the tax dollars allocated for hydrilla control would be spent on blue green algae research. Developing methods to control blue green algae without any other ecological impacts is the ideal solution. Since this option is not on the table, how do we minimize the impacts created by the current plan? If the USACE moves forward, an ultra conservative approach should be adopted.

An ultra conservative approach requires exacting measures. Algaecides / Herbicides would be extremely controllable whereas grass carp would not. Spraying could result in human error but would not eradicate all vegetation in the reservoir. Stocking too many grass carp could easily result in eradication of hydrilla as well as other vegetation that is not currently targeted. Damage in this scenario would be irreversible.

Sincerely,

Bobby Stanfill

Bobby Stanfill
207 Wentworth Drive,
Greenwood, SC 29649
864-377-6708

From: Brian White
To: CESAS-PD, SAS
Subject: [EXTERNAL] AVM Comments
Date: Tuesday, May 31, 2016 7:40:19 PM

Hi,
I attended the meeting in Columbia County and was impressed by the various presentations.
For the record, I am totally in favor of the introduction of sterilized carp into the lake. Although the primary goal is to reduce the impact of AVM, I should note that the reduction/elimination of hydrilla which is an invasive plant is important to me as a lake property owner. I have spent money on chemical intervention but with little success.
Reduction/elimination of this invasive species is desirable for both reasons. I feel confident that the project can be carried out over several years, without negative impact on the lake or native fish.

Thanks
Brian White

From:	Nelson Brooks
To:	CESAS-PD, SAS
Subject:	[EXTERNAL] Hydrilla/AVM - http://1.usa.gov/1VlDgsw.
Date:	Tuesday, May 31, 2016 6:25:32 PM
Attachments:	Document1.docx

I apologize - the attachment bounced-

Dear Corps of Engineers

My comments on the plan to get rid of hydrilla in Thurmond are as follows:

1. Please see the attached.

2. Please consider using adjacent property owners' permitted boat ramps to deliver the fish, this will save money

3. Your plan to get rid of the hydrilla will prove to be more effective than any thing I have tried:

   http://www.lincolnjournalonline.com/news/2009-10-29/front_page/011.html

4. I do not agree with using herbicides in the water we drink, I don't care about the PPM argument.

Thank you

Nelson Brooks
Executive Vice President
Legislative Affairs
Wells Creek Garden Club

706 359 2010

http://1.usa.gov/1VlDgsw.

Comments must be received by May 31, 2016. The public can send letters to: the Savannah District, U.S. Army Corps of Engineers, Planning

Division, ATTN: Nathan Dayan (PD), 100 W. Oglethorpe Avenue, Savannah, Georgia 31401-3604, by FAX to 912-652-5787, or by emailing the comments to:

CESAS-PD@usace.army.mil.

A RESOLUTION

A RESOLUTION TO STOP THE SPREAD OF AN INVASIVE ALIEN AQUATIC PLANT

Whereas, hydrilla has infested the southernmost reservoir on the Savannah River to the point that it has impacted boating, fishing, swimming and property values,

Whereas, hydrilla is a nonnative aquatic plant that is easily spread by boats, trailer, water fowl and humans to any other body of water in Georgia,

Whereas Georgia has had one drowning death in Clayton County directly attributed to entanglement in hydrilla,

Whereas, hydrilla poses a threat to Georgia's drinking water supply intakes as proven at Lake Varna,

Whereas, hydrilla is the base of the food chain that has caused Georgia to earn the dubious distinction of the bald eagle death capital of the world,

Whereas, all federally approved herbicides used to temporarily control hydrilla are recognized as carcinogenic on their Material Data Safety Sheets.

Whereas, sterile grass carp have been used successfully by the US Army Corps of Engineers in the Walter F. George reservoir on the Georgia/Alabama line after Georgia Department of Natural Resources concerns were resolved;

Whereas, the University of Georgia Warnell School of Forestry conducted a survey of all Thurmond/Clark Hill lake users which resulted in a clear consensus to use sterile grass carp to get rid of the invasive hydrilla.

Be it resolved by this convention that the Georgia Department of Natural Resources; the US Army Corps Engineers; both Georgia Legislative Bodies and the myriad involved agencies, both State and Federal, cooperate to expeditiously remove the hydrilla threat from every body of water in Georgia.

Respectfully submitted

Brian Henderson

Lincoln County

From: Robin Dushane [mailto:RDushane@estoo.net]
Sent: Friday, June 17, 2016 9:41 AM
To: Morgan, Julie A SAS <Julie.A.Morgan@usace.army.mil>
Subject: [EXTERNAL] Strong Thurmond Lake Eagle Management

Julie,

Thank you for the opportunity to comment on the recommended management approach of stocking carp and limited herbicide application at Strong Thurmond Lake.

As this work will not include ground disturbance, the ESTO has no objections to this action.

Sincerely,

Robin Dushane

Tribal Historic Preservation Officer

Eastern Shawnee Tribe

70500 E 128 Rd.

Wyandotte, OK 74370

918 533 4104-cell

rdushane@estoo.net

Organization/Public	Comment	Response
Public – Ms. White	In agreement that there is way too much Hydrilla in the creek, said there are many sick coots in the area, and was glad to hear about the proposed use of sterile carp.	Comment supports the proposed action.
Public – Ms. Harrell	Asked the USACE to do all we can to eliminate hydrilla in the area and fully support the proposal to eliminate the hydrilla from taking over in the future.	Comment supports the proposed action.
Public- Mr. Trantham	Wants less hydrilla the Buffalo creek area in Little River S.C. Their cove was completely covered in hydrilla last summer and they were not able to use their boat docks.	Comment supports the proposed action.
Public – Mr. and Mrs. Matthews	In favor of stocking the grass carp to manage hydrilla levels within the lake.	Comment supports the proposed action.
Public – Mr. Harrell	Would like the USACE to do all we can to kill the hydrilla and protect eagles and other avian species as well as the aquatic species that could be adversely impacted by bacteria and hydrilla and therefore support the plan outlined by the USACE.	Comment supports the proposed action.
Public – Mr. Rapp	Support the use of Carp and suggest that private individuals be allowed to participate in the carp program if they so desire.	One of the goals of the program will be to reduce the amount of hydrilla with limited impacts to native plants. Maintaining vegetation is important for fish and wildlife habitat. Having private individuals stocking fish will impact USACE ability to control the stocking density.
Public – Ms. Lorier	In favor of the doing treatment to rid the lake of hydrilla.	Comment supports the proposed action.

Organization/Public	Comment	Response
U.S. Fish and Wildlife Service	USFWS is supportive of the preferred alternative but believe the herbicide application plan needs more investigation on application timing and impacts to other wildlife (provided specific comments within their letter). The grass carp, as discussed in the preferred alternative, should greatly reduce the hydrilla and thus eagle mortality. Adding more monitoring and an adaptive management plan to the AVMP allow more flexibility in response to changing environmental conditions.	Specific responses to comments below.
	1) Section 2.0 – change wording to "Survey and monitor both AVM and non-native submerged aquatic vegetation."	1) We will be monitoring AVM and all aquatic vegetation, not just non-native submerged aquatic vegetation.
	2) Section 4.1 – the Service cannot require but recommends at take permit	2) Agree to wording change
	3) Section 5.2 – More investigation and collaboration with researchers is needed to determine the best time of year to apply herbicide. Herbicides might not be effective if applied in fall; waterfowl and eagles in fall could be impacted by eating plants treated with herbicide; some preliminary studies suggest herbicide in the fall could cause hydrilla die back but won't kill cyanobacteria. It would likely be better to apply herbicide in spring on new growth hydrilla when water temps are cooler and not as many waterfowl or eagles in the area. Eliminating hydrilla at this time of year would remove a medium for the cyanobacteria to grow on in fall. ACOE should ensure herbicides do not contain copper due to sensitivity of mussels and other invertebrates to this substance. It may be more cost-effective to wait and see how well the carp eliminate hydrilla before applying herbicide.	3) Herbicide will be selectively applied based on highest priority areas for eagle mortality and hydrilla density and in accordance with labeled requirements. We will remain flexible as far as timing of application; however, late-summer through Fall treatment is intended to allow us to better target areas where hydrilla is topped out and would result in less impact to fish habitat in spring and summer.

Organization/Public	Comment	Response
	4) We have concerns about the statement that stocking grass carp and herbicide use are dependent on available funding; the Service strongly supports ACOE requests to Congress for funding due to the importance of this project for reducing the health hazard of AVM to birds, particularly bald eagles, and possibly other wildlife.	4) All of our activities are contingent upon available funding. Recent budget submittals for AVM have been favorable.
	5) Section 6.0 – Recommends hydrilla be surveyed and mapped each year and that surveys be developed for the cyanobacteria and that toxicity level of herbicide in water and invertebrates be monitored; it would also be important to monitor carp numbers and movement in conjunction with the hydrilla surveys to determine the effectiveness of the treatment.	5) Because our vegetation survey is very labor intensive (100 man-days for vegetation survey and 10 additional man-days for hydroacoustics), we will add the use of enclosures located in various areas of the reservoir to evaluate hydrilla at year 5 and 6 to determine the effectiveness of our treatments. We expect a 4-year time lag between grass carp stocking and results. Herbicide toxicity levels have already been determined through EPA testing requirements prior to products being labeled. Treatment effectiveness will be determined by enclosures in years 5 and 6 and a hydrilla survey at year 6 per our protocol in the Plan.
	6) Section 7.0 – Weekly or bi-monthly boat and/or aerial surveys during the fall, winter, and spring (i.e., time of highest eagle use) are needed for the best information for analysis of management treatments. A regular survey for dying/dead coots, as well as ongoing live coot sampling is also needed.	6) We will submit funding requests for additional aerial surveys for eagle/coot mortality. GADNR conducts 2 aerial surveys in January and April. We also make observations during a January lake-wide boat survey for eagles and waterfowl.

Organization/Public	Comment	Response
	7) Section 10.0 – We encourage continuing the AVM meetings to share data and results.	7) AVM meetings will be continued.
	8) Species protected under ESA are not likely to occur within the lake project area.	8) Concur
Savannah Lakes Village	Savannah Lakes Village emphatically support the Corps' proposals for controlling hydrilla and believe they have significant ecological and other benefits that warrant their adoption and expeditious implementation.	Comment supports the proposed action.
Walkinshaw Sportsman's Club – Mr. Broxton	Is overall supportive of pursuing the biological solution to the hydrilla infestation by introducing triploid grass carp.	Comment noted.
	It was suggested that hydrilla coverage should be reduced by 75%, that the USACE should reconsider an initial stocking rate of 20 carp per adjusted acres to help develop implied carp biomass, and develop a perpetual model that incorporates TGC and hydrilla biomass projections.	The 50% reduction rate was chosen in to reduce the amount of hydrilla while maintaining some vegetation for fish and wildlife habitat.
	There was one concern that the carp seeking flowing water or responding to spawning urges could migrate up to Broad River or other streams and consume vegetative growth to the detriment of other species.	Recent studies regarding grass carp site fidelity predict they will remain in areas where there is high density of food. Although carp will move considerable distances especially soon after stocking, they tend to remain with the highest density of vegetation which is primarily on the southern part of the lake.
Public – Mr. McCord	Was pleased to see that the USACE has decided to initiate a real aquatic plant management plan to control Hydrilla verticillata, a federally listed, nonnative, invasive plant that is known to be the primary substrate for the algae containing the AVM toxin.	Comment supports the proposed action.

Organization/Public	Comment	Response
Public – Mr. Spradley	Believes the economic value of having a great fishery far out ways the value of an eagle but if the USACE wants to combat these so called deaths by eating waterfowl that in turn give the Eagles AVM they have better solutions than spraying herbicide that will kill the grass such as extend or change the opening and closing date of the duck season. Rather than kill the grass, it would be better to kill the waterfowl.	The 50% reduction rate was chosen to minimize overall impact to recreational fishing. Removal of coots or harassment of coots was considered but considered not practical due to thousands of coots and hundreds of miles of shoreline involved.
Public – Mr. Humphrey	Makes a living on the lake and loves seeing the bald eagle where they are there but had three questions hoping to be answered:	See responses to specific comments below.
	1st - Do the grass carp pick up AVM from eating the hydrilla?	When fed hydrilla with Aetokthonos hydrillicola, grass carp developed lesions that look similar to those in affected birds, but the fish did not appear impaired and eliminated hydrilla in the experimental tanks and pond.
	2nd - If so can the eagles get it from eating the grass carp (eagles have been seen eating dead carp).	In addition, these AVM-positive grass carp were used in a chicken feeding trial and the chickens did not develop AVM lesions.
	3rd - Will they stop bow fishing on the lake for this reason. I cannot see how someone can tell between a regular carp and a grass carp in a matter of seconds. Most bow fishermen have only seconds to decide when shooting?	Bow fishing will not be limited. There will be signs that will discourage the harvesting of grass carp.
Public - Mr. Woods	Cares about the grass, the fishery, and the eagles. Does not want to see the grass eliminated or grass carp introduced.	Comment noted. Not all of the hydrilla will be eliminated.

Organization/Public	Comment	Response
Public – Mr. and Mrs. Oenbrink	Agreed that the USACE proposed hydrilla management plan is both comprehensive and well documented. The use of grass carp and herbicide to control the hydrilla is supported.	Comment supports the proposed action.
Public – Ms. Crochet	Applaud the concerns for the eagles. Provided an example of where another lake introduced grass carp to control the hydrilla where they ended up eating all plant life in the lake and ended up reproducing over the years.	Stocking density of fish is designed to reduce hydrilla, but vegetation will not be eliminated. Monitoring will be used to regulate any proposed future stocking or herbicide use. Testing requirements and methods have improved in verify that sterile carp are used.
Public – Ms. McCullough	Very glad to see that the USACE is going to treat the hydrilla to help eliminate bald eagle deaths.	Comment supports the proposed action.
Public – Mr. Sweet	Highly recommended going ahead with the proposed hydrilla management plan.	Comment supports the proposed action.
Walkinshaw Sportsman's Club – Mr. Broxton	Provided the USACE and the University of Georgia School of Forestry and Natural Resources with some relevant information that might be deemed helpful.	Thanks for the additional information.
Public – Mr. Williams	Suggested continuing to study the validity of that many bald eagles dying to AVM related to infected coots, and look at that data closely. There are many areas in the country that have handled this issue with much more success than SCDNR did with Santee Cooper. Is also opposed to stocking grass carp in Clarks Hill.	Stocking density of fish is designed to reduce hydrilla, but vegetation will not be eliminated. Monitoring will be used to regulate any proposed future stocking or herbicide use. Testing requirements and methods have improved in verify that sterile carp are used.
Public – Mr. Bolin	Has concerns with the proposed plan to control hydrilla on Lake Thurmond/ Clarks Hill. Concerned that if you kill off the hydrilla to save the eagles, we will make the lake sterile for bass and ducks and it will become a wasteland.	Stocking density of fish will be monitored to prevent over grassing.

Organization/Public	Comment	Response
Public – Mr. Hannah	Does not want to see grass carp introduced into the lake because they not only eat hydrilla but other grasses as well. Witnessed a small community lake in Florida completely stripped of everything green because of the carp. Would like us to consider other options.	The 50% reduction rate was chosen in to reduce the amount of hydrilla and limit impacts to native plants.
Public – Mr. Keesey	Would like us to leave the grass alone and not add any fish or try to manage it will chemicals. Would like us to come up with different ideas for the safety of the eagles.	Comment opposes the proposed action.
Walkinshaw Sportsman's Club – Mr. Broxton	Provided the USACE some additional information gained from a conversation with Owen and Willams Fish Farms with regards to TGC. Georgia requires testing of each TGC fish by the supplier before Georgia deliveries, removing the concerns from the individual that a few stray fertile carp may escape detection with batch testing and believes this information should be included in the study documentation.	Comment supports the proposed action.
Friends of Savannah River Basin	Strongly supports the implementation of the integrated management plan as written and concurs with the Draft Environmental Assessment's findings that the Grass Carp stocking with selected use of herbicides provides the best option to manage the rapid spread of hydrilla in the lake. Believe that this plan represents the best chance of reducing AVM deaths and maintaining the unique environment of the lake.	Comment supports the proposed action.

Organization/Public	Comment	Response
	The Friends of Savannah River Basin strongly recommends that the USACE to examine alternate cooperative federal and state and potentially private funding sources to execute this plan for at least a six year period.	The anticipated FY17 and FY18 funding as budgeted should fund the program if received. USACE is coordinating with the states to assist where possible for surveys (eagle, hydrilla).
U.S. EPA, Region 4	Provided some background information on the affected environment and the AVM disease. Explained that without restocking, every introduced triploid grass-carp population will eventually die out because they are functional sterile and that Negative impacts to submerged aquatic vegetation (SAV) can be expected if the excessive stocking of grass carp occurs. In addition aquatic herbicides are non-selective, therefore SAVs will be negatively impacted in the treatment areas. Removal or reduction in the size of stands of hydrilla would have temporary insignificant adverse impacts to fish using those stands for forage and cover. EPA provided a series of recommendations for the USACE to incorporate in their final EA.	See responses to specific comments below.

Organization/Public	Comment	Response
	1) Explain why the existing APMP is insufficient, based on the 2010 and 2015 survey it appears hydrilla acreages have been reduced.	1) The existing APMP was designed to manage issues associated with other project purposes such as recreation and hydropower; AVM was not evaluated under the APMP. We recognize that hydrilla acreage differences will occur annually largely due to fluctuating water levels, so for management purposes we chose to use the average of hydrilla coverage between 2010 and 2015. Herbicide treatments were not a factor in the differences between 2010 and 2015.
	2) With high likelihood that stocking grass carp will be a part of AVM plan, EPA recommends the final EA explain whether the proposed action will eliminate all existing, and/or prevent repopulation of desirable SAV important for fish and wildlife habitat after the carp population has been sufficient established to reduce or eliminate hydrilla. How will that impact Lake's ecosystem and water quality? Does the ACOE anticipate that the end result will be no SAV at JST lake?	2) The stocking rate is intended to reduce hydrilla coverage by 50%. As stated in the plan, monoecious hydrilla at Lake Gaston was reduced 50% at 15 fish per acre stocking rate. Research indicates that at least 20 fish per acre with annual stockings to offset mortality are needed to eliminate all hydrilla. We do not anticipate significant changes in water quality or a large increase in native SAV following the introduction of grass carp.
	3) What is the risk for the introduction of grass carp leading to the invasion of an aquatic vegetation species hosting A. hydrillicolla that carp will not eat and the resulting potential indirect impact to bald eagles? Grass carp may be a poor control option for Eurasian water milfoil.	3) To date, we are not aware of the presence of Eurasian water milfoil. Though not out of the realm of possibility, based on our current situation, we do not believe that reducing hydrilla would allow this plant to increase.

Organization/Public	Comment	Response
	4) The final EA should explain what mitigation strategies the ACOE has considered should water quality be detrimentally impacted by the removal of vegetation by grass carp. Results of studies on impact of grass carp on water quality are inconsistent; however, turbidity, alkalinity, chlorophyll a, ammonia-nitrogen and phosphorus concentrations can increase after the removal of vegetation by grass carp, while DO levels can decrease. It would be helpful to better understand the benefit to eagles in contrast to cost to the JST lakes aquatic ecosystem; are there relevant studies on the issue?	4) Generally, turbidity and excessive nutrients have not been issues. Summer stratification and the associated hypolimentic dissolved oxygen depletion represents the largest water quality issue. We do not anticipate any significant changes to nutrient or dissolved oxygen levels as a result of the Plan.
	5 Some studies have shown that after grass carp removed hydrilla and other vegetation that centrarchids were negatively affected; another study ruled out competition for food organisms, predation and water quality and hypothesized that grass carp constantly invaded bluegill spawning areas. The EA should explain whether grass carp will result in a decrease in the reproductive success of vegetation-dependent spawners within JST lake. Also, EA suggests short-term negative impacts on largemouth, but once native plant populations recover, they will provide habitat; however EA also states that establishment of desirable native plants has been unsuccessful.	5) We agree that removal of aquatic vegetation will negatively impact a number of species including largemouth bass. Again, that is why we are trying to achieve a balance by reducing 50% of hydrilla coverage and ideally reduce hydrilla within the top 2-3 feet of the water column (where cyanobacteria is most concentrated and available to coots) while maintaining SAV that provides habitat for a number of species (there is some indication that carp will focus their feeding on actively growing hydrilla which would be growing toward surface in summer). We do not anticipate a large establishment of native SAV with implementation of the Plan.

	6) It is unclear how the proposed action will protect bald eagle and eliminate the FWS take permit issue. Why is AVM suspected over mercury or lead poisoning; were the remaining undiagnosed eagles tested for mercury or lead poisoning? There are fish consumption advisories for mercury in JST and fish are a preferred prey. A USGS study found lead poisoning to be an important cause of mortality for bald eagles. Questions the validity of AVM mortality based on Haynie Dissertation 2008 “reductions in populations of coots and bald eagles are not specifically caused by AVM; a variety of factors may influence population numbers.”	6) Southeastern Cooperative Wildlife Disease Study (SCWDS) conducted all necropsies. Based on their records from 1998 to 2014, they necropsied a total of 51 eagles from Thurmond (some birds were decomposed and couldn’t be examined). There were 33 birds confirmed with AVM; From the total of 51 eagles necropsied, 6 birds had elevated mercury levels. AVM vacuoles are distinct in appearance and location from other toxins in that they form quickly in white matter of the brain. With mercury poisoning, the peripheral nerves and spine are affected first and then the brain. AVM eagles are also in good nutritional condition because the toxin results in acute poisoning unlike mercury poisoning which tends to be chronic with emaciated birds. Also, the birds with elevated mercury levels also had elevated Selenium which counteracts mercury toxins. SCWDS did not confirm mercury poisoning as cause of mortality in any of the eagles from Thurmond. There were no lead poisoning issues in any of the eagles examined. The Haynie dissertation does not question the validity of AVM mortality in coots and eagles, but does question

Organization/Public	Comment	Response
		the impacts on overall population numbers “Analysis of the existing AVM research according to the epidemiologic criteria, strongly supports a causal linkage between presence of the Stigonematalan cyanobacterium and incidences of AVM. The analysis also identified a weaker cause-effect linkage between incidence of AVM and decreases in bald eagle productivity on JSTL. A causal linkage was not found between AVM and population level effects in coots on JSTL (pg 100).
	7) Final EA should explain whether eagles feeding on grass-carp eating A. hydrillicola infested aquatic vegetation could significantly increase their risk of contracting AVM by expanding the opportunity to contract AVM beyond the winter season when the existing AVM eagle and coot mortalities appear to have concentrated.	7) We cannot exclude the possibility that grass carp could convey some level of toxin to eagles because studies are lacking in this area. However, based on the one study in this area, grass carp consumed the toxin when fed hydrilla and developed vacuolar myelinopathy, but they did not induce lesion formation when fed to chickens (Haynie, et al 2013). Also, there is laboratory data demonstrating that coots with AVM fed to chickens did cause AVM (Lewis-Weis, et al 2004).

Organization/Public	Comment	Response
	8) Final EA should explain severity of impacts to bald eagles within the JST lake associated with AVM. What is the reference baseline eagle population for JST Lake to measure success of the proposed action? What are non-AVM mortality impacts to eagles that can reasonably be expected to the JST lake eagle population?	8) The objective is to reduce or eliminate AVM mortality in bald eagles. Whether that results in an increase locally in the eagle population around Thurmond or increased nesting is undetermined.
	9) EA should discuss if herbicide use is linked to use of herbicides in an impoundment; could past use of herbicide facilitate the presence of A. hydrillicola? Could herbicide use lead to potential release of toxins when herbicides are used to control algal blooms.	9) There are no studies at this time linking herbicide use and A. hydrillicola. Also, past herbicide use has been very limited around recreation areas only. UGA researchers have suggested that timing of herbicide applications will be important and late fall applications could trigger the algae to release toxins sooner than normal. We will evaluate annually and determine the best timing of herbicide application. Of course, the key to preventing AVM in eagles will be reducing hydrilla availability to coots in areas where they are feeding.
	10) It would be helpful if EA could discuss any relationship between known pollutants in JST lake and A. hydrillicola. For example, the triclosan (antibacterial personal care product) metabolite, methyl triclosan has been shown to bioaccumulate in algae.	10) We are not aware of other pollutants in Thurmond Lake or possible interactions with A. hydrillicola.

Organization/Public	Comment	Response
	11) Have aquatic vegetation management strategies employed in other lakes or reservoirs associated with AVM bald eagle mortality been effective in preventing bald eagle deaths.	11) Susan Wilde, UGA has cited 7 lakes where AVM no longer occurs as result of vegetation management. For example, DeGray lake, where AVM was first identified, stocked grass carp in 2005-2008 and has not experienced further AVM mortality.
	12) The final EA should discuss the GA DNR opposition to stocking grass carp in JST as indicated in the APMP as of the 2003 update of the plan	12) Agree, statement was added.
Georgia Department of Natural Resources, Wildlife Resources Division	Provided several pages worth of comments regarding the Avian Vacuolar Myelinopathy (AVM) Reduction Plan and requested that additional management alternatives or combinations of alternatives be analyzed in the plan.	USACE met with GADNR on 16 September to discuss their comments. USACE provided information regarding evaluation of other alternatives proposed by GADNR, grass carp stocking rates, hydrilla estimates, and native plants. See responses to specific comments below.
	1) In Section 1.0 - Make it clear that the hydrilla reduction goal does not mean AVM reduction goal will be accomplished	1) Agree, wording was changed.
	2) Mention AVM impacts on herpetofauna and vultures	2) AVM lesions have been observed in turtles and is mentioned in the EA. Though the potential pathway exists, we are not aware of research or any information indicating impacts to vultures.

Organization/Public	Comment	Response
	3) Note in the plan that cyanobacteria is epiphytically associated with hydrilla and native SAV also do we know coots are eating hydrilla or also other SAV	3) Although the cyanobacteria is denser and more prevalent on hydrilla (Wilde et al. 2005), it is noted that the cyanobacteria is epiphytically associated with hydrilla and other native SAV. Coots will eat other SAV, but have been observed feeding on hydrilla due to the abundance and location of hydrilla near surface when coots are present.
	4) Eagle mortalities are mentioned but not nesting territories	4) Agree, nesting information has been added. There are currently 3 active nests.
	5) AVM occurs at other lakes, what are impacts at other lakes and is Corps doing hydrilla control at any other lake or reservoir in Southeast	5) Many of the lakes in the southeast where AVM has been confirmed are not Corps reservoirs. Although the Corps does employ hydrilla control at other lakes in the Southeast (i.e., Seminole, Walter F. George, John H. Kerr), hydrilla control for the purposes of AVM is only proposed at Thurmond.

Organization/Public	Comment	Response
	6) Is difference in hydrilla acreage between 2010 and 2015 an actual change in acreage or a result of different sampling technique and effort?	6) The distribution portion of the survey in 2010 and 2015 was similar. The acoustic portion of the survey used to measure "percent area coverage" changed from a BioSonics/Echoview process in 2010 to a Lowrance/BioBase process in 2015. An article by Radomski in the Journal of Aquatic Plant Management 53:151-159 compares the two techniques. The BioBase technique will be continued in future surveys.
	7) Compare native SAV between 2010 and 2015; will hydrilla reduction result in increase in other native SAV and still lead to continued cyanobacterium and AVM; what are other causative agents that contribute to presence of cyanobacteria (i.e., nutrient loads or water chemistry) and is USACE studying.	7) We did not survey native SAV in 2010 for comparison. UGA has studied various parameters and it is undetermined the water chemistry factors that influence cyanobacteria. We do not anticipate a large increase in the acreage of native SAV.
	8) If the APMP adequately addresses aquatic plant management, why statement that herbicides failed in 1990s; also need to address negative impacts of herbicides on native floating, emergent and SAV; also state the cyanobacteria can grow on native SAV.	8) The APMP adequately addresses aquatic plant management for recreation, hydropower, flood control and other authorized purposes, not for AVM. A small proportion of native floating, emergent, and SAV exists at Thurmond and could be impacted by treatments, We will state that cyanobacteria can grow on native SAV (see 3 above).
	9) Explain relevance of monoecious biotype	9) We included a statement explaining the relevance of the monoecious biotype.

Organization/Public	Comment	Response
	10) Why does JST have hydrilla issue and not Russell or Hartwell; with potential for spread should you include cautionary statement to help justify the current need for aggressive control at JST.	10) We do not know why only Thurmond has hydrilla. Thurmond may provide better substrate and on average is slightly shallower in depth than Russell and Hartwell.
	11) Regarding the public survey it should be stated that 65.8% supported removal of aquatic vegetation once they learned about the connection to AVM, even if that means reducing fish and wildlife habitat. This should be added to the paragraph. A SCDNR creel survey indicate a different perception of the issue; this information should be included as well.	11) The information has been incorporated.
	12) In Section 1.1 - Biological control through grass carp should not have any unforeseen impacts to freshwater mussels, but may pose a threat to important fish, other wildlife, and habitat. Chemical control may threaten mussels especially those containing copper. Section 3.0 - Altamaha Arcmussel is Georgia listed as threatened and not in Section 3.2.5. Collected in 7 locations at JST in 2007 and may be particularly vulnerable to chemical control in shallow portions of the lake; recommend against copper-based control agents	12) Any herbicide use will be selectively applied based on highest priority areas for eagle mortality and hydrilla density and in accordance with labeled requirements.

Organization/Public	Comment	Response
	13) In Section 2.0 - Objective to reduce or eliminate AVM – reduce to what level and how will reduction be monitored?	13) There are no guarantees that implementation of the plan will eliminate AVM. The 50% reduction in hydrilla has not been evaluated for eliminating AVM. Our monitoring observations will determine first the effectiveness of vegetation control and second AVM mortality. Based on this information, we will determine the future course of action.
	14) In Section 4.1 - Plan says failure to treat dense aquatic vegetation could result in continued AVM-related mortalities; is the plan proposing to treat native SAV also? Clarify, unless data show cyanobacterium prevalent on dense SAV, too.	14) There is no proposal to treat the few native SAVs present in Thurmond Lake. Hydrilla will be targeted, but we recognize there could be impacts to native SAVs.
	15) Rephrase statement in 4.3 that says regarding herbicides without negative impacts to natural resources; can kill native vegetation also effecting the food chain; 4.3.3 of EA says herbicides will selectively control hydrilla and promote native species but Plan does not state same. What safeguards ensure minimum impacts to native SAV important to fish and wildlife?	15) Statements have been rephrased. We recognize that herbicides can have negative impacts to natural resources. The objective of 50% reduction in hydrilla with spot treatments of herbicides in areas of highest AVM incidence is intended to minimize impacts to native SAV. However, it is acknowledged that native SAV may also be impacted.

Organization/Public	Comment	Response
	16) Treatment options not explored that need to be examined; short term drawdowns along with carp stocking and herbicide treatment; Lake Filling during late fall and early winter; Encourage spread of native SAV; DNR has noticed increase in Chara, Nitella, naiads, and pondweed and are displacing hydrilla; consider option that accounts for ecological values of natural and man-induced spread of native SAV; Controlling coot numbers through harassment and hunting; Alternative methods to discourage eagle nesting in AVM-infected areas; discuss possibility that grass carp will escape the reservoir and enter other systems.	16) Other options have been considered and have been added to the EA: Drawdown impacts other project purposes (i.e., recreation and hydropower) and also would negatively impact native SAV; lake filling is hydrology dependent and the fall is typically our driest time of the year. This would also create a loss of flood storage in winter at Thurmond. Coot harassment is not practical with 600+ miles of shoreline where hydrilla occurs; also would impact ducks and other waterfowl. Eagle harassment to discourage nesting would require a permit and likely be ineffective (too many alternate nest sites around Thurmond). Also, this alternative would not prevent AVM in eagles that are not nesting. Our management option for a 50% reduction in hydrilla is intended to help account for the ecological values of natural and man-induced spread of native SAV. We acknowledged in the EA that grass carp can escape the reservoir and enter other systems.

Organization/Public	Comment	Response
	17) In Section 5.1, explain what minimizing AVM related mortality means in measurable goal	17) Minimizing AVM-related mortality is based on our assumption that reducing hydrilla coverage will reduce or eliminate AVM related mortality which will be determined based on monitoring.
	18) How long did it take at Lake Gaston to achieve 50% reduction?	18) Approximately 4 years.
	19) Hydrilla control should be in areas of highest plant density, highest cyanobacterium density, and highest eagle mortality	19) Agreed, those priorities are stated in the Plan.
	20) In Section 5.2, questions regarding differences in hydrilla between 2010 and 2015; survey method, sampling devices; native SAV trends during same time period. Is USACE considering other survey methods?	20) See number 6 above regarding survey methods. As another survey method, enclosures will be used for survey at years 5 and 6.
	21) Is grass carp stocking based on average between 2010 and 2015; If carp reduce hydrilla what is the plan if they switch to heavily grazing native SAV? One benefit of herbicides is they kill the plant, while carp leave the tubers that can resprout; will grass carp be short-term solution?	21) As stated in the Plan, the grass carp stocking is based on the average of hydrilla coverage between 2010 and 2015. We disagree that herbicides kill the plant and grass carp are a short term solution. Herbicides will likely only be effective for one growing season.
	22) What time of year are herbicides an option?	22) We will plan to target the late-summer early fall timeframe.
	23) Recommend preliminary vegetation sampling in year 4 or 5, perhaps a subsample of plots could be measured. Carp could be reducing native SAV during 6-year wait or not abundant enough to reduce hydrilla.	23) Enclosures will be used for preliminary sampling in year 5 and 6. The large scale hydrilla distribution and abundance sampling will occur during year 6.

Organization/Public	Comment	Response
	24) Section 6.0 – Need more detail regarding sampling, what time of year, transects from shore to what depth; what native SAV parameters measured; and will that be compared to 2010 and 2015; protocol for future sampling.	24) Additional detail has been provided in Section 6.0.
	25) Section 7.0 does not mention GADNR eagle nest surveys in Jan and Mar.	25) GADNR nest surveys have been included in Section 7.0.
	26) Section 8.0 - Explain status of 2 eagles fitted with transmitters in 2015; results from UGA study; will AVM plan (e.g. carp stocking rates) be adjusted based on information from that study?	26) One transmitter lost; one eagle currently at Thurmond. The study is not designed to provide information regarding carp stocking rates but may be beneficial in terms of stocking locations based on movements determined from telemetry data.
	27) Section 9.0 – Public education should include AVM details and agency POCs in event dead birds are found.	27) Agreed; information has been incorporated
	28) EA Comments – Section 1.1 EA says hydrilla surveys conducted periodically summer-fall, but not in Plan – Why not?	28) Plan has been changed for surveys of enclosures in Year 5 and 6 in addition to the distribution and abundance survey in year 6.
	29) EA emphasizes adaptive management referencing alternative approaches if preferred alternative doesn't work; this language should be in plan	29) Adaptive management will occur depending on results of monitoring and survey at Year 6 as stated in the Plan.
	30) Carp develop AVM lesions but seem unaffected as do chickens fed AVM-infected carp. Are raptors, wading birds, and other piscivores unaffected by consumption of AVM-infected live carp?	30) See response to EPA (7).
	31) Section 1.4.1 in action should be no action.	31) Wording in EA correct in-action was the term used by USFWS.

Organization/Public	Comment	Response
South Carolina Department of Natural Resources	SC DNR submitted its support of the proposed action of integrating biological and chemical and more specifically supports the tentatively selected plan as described in the EA. SC DNR understands that hydrilla is an invasive exotic species that is supporting the continuation of AVM and must be treated. SC DNR also provided some comments that they would like to see incorporated into the proposed alterative or any other forthcoming modification of the plan prior to a final decision being made.	See responses to specific comments below.
	1) Final EA should acknowledge the following: fisheries and wintering waterfowl habitat will be negatively affected if hydrilla is reduced or eliminated; other aquatic vegetation will be negatively affected and future establishment of desirable, native vegetation is unlikely as long as grass carp are in the system; the future success of waterfowl hunters and fishermen will be diminished; the best Southeastern fisheries have one common denominator – SAV; implementing the plan will not ensure reduction of the incidence of AVM in eagles or other avian species and will not ensure reestablishment of lost eagle nesting territories; bald eagles are thriving elsewhere in South Carolina.	Additional text placed in various portions of the EA describing the impact if 100% of the hydrilla is removed. The plan is not intended to reestablish eagle nest in the area.
	2) DNR recommends inclusion of provisions that permit subsequent chemical treatments within a growing season if necessary to increase efficacy.	2) Agree and have incorporated; flexibility in herbicide treatments is needed.
	3) Future herbicide treatments should target areas with known high concentrations of coots, past eagle mortalities, and locations (boat ramps) where transportation of hydrilla out of JST is likely to occur.	3) Agreed and stated in the Plan.

Organization/Public	Comment	Response
	4) Measurement of success, evaluation of measures, and adaptive management need additional consideration. DNR stresses importance of monitoring and mitigation, if indicated by monitoring, for major natural resource impacts. DNR has excellent recreational fisheries data through creel surveys 2005-2009 and 2014-2015 and recommends additional creel surveys funded by Corps in future years at a mutually agreeable frequency. Surveys should focus on native gamefish and assess population response or incursion by Alabama bass within the JST fishery.	4) Corps can submit budget request for creel surveys; funding is uncertain. We do agree that creel surveys could provide useful information.
	5) Develop a plan to replace fish and wildlife habitat along with funding and implementation. For fisheries, focus on structural habitat enhancements since it will be difficult to re-establish native aquatic vegetation after grass carp are introduced; develop a habitat enhancement plan for wintering waterfowl through coordination with professionals from GA and stakeholder hunters to target development of adjacent off-reservoir habitats where hydrilla can be controlled while managing for preferred native plant species favored by waterfowl.	5) Fisheries management activities will be increased with expanded cut and cable of existing trees along the shoreline to improve structural habitat. Creating waterfowl habitat is more difficult. The Corps can submit budget request for waterfowl management and enhance existing areas, Russell Creek and Fishing Creek. We can also identify beaver ponds and place levelers to allow direct seeding of Jap millet and improve habitat.
	6) Strongly recommend that grass carp stocked in JST be certified sterile by the National Triploid Grass Carp Inspection and certification Program and DNR Freshwater fisheries standards and mandated by SC state statute.	6) Agree, we will coordinate with suppliers and make the National Triploid Grass Carp Inspection and certification Program and DNR Freshwater fisheries standards mandated by SC state statute a requirement for all grass carp stocked by the Corps of Engineers in Thurmond Lake.

Organization/Public	Comment	Response
Aquatic Plant Management Council (APMC)	The APMC concurs with the USACE that of all of the alternatives discussed in the EA, alternative 3, the integrated approach, would be best suited The APMC stresses a long term management plan which includes an adaptive management component in the current configuration of the plan to make any adjustments necessary to ensure the continued effectiveness of the plan.	See responses to specific comments below.
	There was a concern that the plan in itself is too conservative and could take years to produce meaningful results.	The plan is intentionally conservative in attempt to not significantly impact, fisheries, recreation and wildlife.
	The APMC would like to verify the exact acreage numbers that the USACE is utilizing in forming this stocking rate for the final plan as there are 2 differing distinct values of acreage based on the most current survey.	We recognize that hydrilla acreage differences will occur annually largely due to fluctuating water levels, so for management purposes we chose to use the average of hydrilla coverage between 2010 and 2015.
	The APMC stresses a long term management plan which includes an adaptive management component in the current configuration of the plan to make any adjustments necessary to ensure the continued effectiveness of the plan.	Monitoring and adaptive management is part of the plan.
Public – Ms. White	Agrees with the proposed plan	Comment supports the proposed action

Organization/Public	Comment	Response
Public Mr. Stanfill	Does not agree with actions outlined in the current plan. The current plan will eliminate the food source for migratory birds and therefore greatly decrease the numbers of waterfowl wintering in the area. While the current plan could reduce bald eagle exposure, it will also create negative impacts for other species in the system. Believes that there are many factors that need to be studied before any action is taken.	The 50% reduction rate was chosen in to reduce the amount of hydrilla while minimizing impacts to native plants and other species. Reducing vegetation will have a corresponding reduction in waterfowl habitat and would impact largemouth bass; however, again the objective is to continue to maintain vegetation to minimize negative impacts. Alabama bass occur in significant numbers in Russell and Hartwell and could increase in JST above their present levels. Populations of Alabama bass could increase even higher with removal of vegetation; however, impacts are unknown at this time. If funding allows, we will try and monitor through creel surveys.
Public – Mr. White	Very much in favor of the introduction of sterilized carp into the lake. Reduction/elimination of the hydrilla is desirable not only to protect the eagles but to minimize headaches as a lake property owner. Feels confident that the project can be carried out over several years, without negative impact on the lake or native fish species.	Comment supports the proposed action

Organization/Public	Comment	Response
Wells Creek Garden Club – Mr. Brooks	Would like the USACE to consider using adjacent property owners' permitted boat ramps to deliver fish to save money, believes that the USACE's plan to get rid of the hydrilla will prove more effective that past efforts from others, and does not agree with using herbicides in the water people drink. Provided an attached resolution document that expressed the desire to expeditiously remove the hydrilla threat from every body of water in Georgia.	Only those herbicides labeled as "aquatic use" by the Environmental Protection Agency (EPA) will be used. Product labels with instructions and warnings can be found at http://www.cdms.net/manuf/default.asp.