Appendices

AVIAN VACUOLAR MYELINOPATHY REDUCTION FOR J. STROM THURMOND (JST) LAKE

Appendix A:
Grass Carp Biological Opinion

United States Department of the Interior

FISH AND WILDLIFE SERVICE
WASHINGTON, D.C. 20240

ADDRESS ONLY THE DIRECTOR,
FISH AND WILDLIFE SERVICE

Biological Opinion

Use of Triploid Grass Carp in Public Waters of South Carolina

Robert E. Stevens, Chairman
FWS Grass Carp Committee

Triploid grass carp were produced by J.M. Malone & Sons Enterprises in 1983 for the purpose of producing sterile grass carp. Triploid fish, in theory, are sterile because the odd chromosomes cannot synapse in gametogenesis. Gonads are structually deformed and reproduction cannot occur.

In order to test this concept, Julia Doroshev at the University of California at Davis, California, conducted histological examinations of the gonads of the original triploid grass carp of both sexes at one year of age in 1984 and again at two years of age in the summer of 1985. She reported that both investigations demonstrated that the gonads of females were abnormal and that no functional oocytes were visible. She concluded that female triploid grass carp will be incapable of producing eggs at maturity. The gonads of triploid male grass carp produced only a few sperm cells which lacked flagella. She concluded that the sperm of male triploid grass carp will probably not be functional at the time of spawning.

Several States have long since accepted the triploid grass carp as sterile and have permitted their use in open water systems.

There seems to be no compelling reason to prohibit the use of certified triploid grass carp in open systems because there is every reason to assume that they will not reproduce themselves. Any adverse impact on desirable aquatic plants will be short-lived and reversible.

It is concluded that the stocking of triploid grass carp in either closed or open water situations will result in no adverse impact on the environment.

Robert E. Stevens
12/2/85

Biological Opinion
Evaluation of Sterility of Triploid Grass Carp
FWS Hybrid Grass Carp Committee
Robert E. Stevens, Chairman
Jon G. Stanley, Member

Triploidy, in theory, produces complete sterility of individual animals because the odd chromosomes cannot synapse in gametogenesis. Gonads are structurally deformed and reproduction will not take place.

The gonads of triploid grass carp examined by Julia Doroshov at the University of California at Davis are very abnormal. It is extremely unlikely that reproduction could occur. We believe the triploid grass carp are completely safe for stocking in ponds where large numbers are unlikely to escape to large rivers.

There is one reservation. In amphibians, triploids are partially fertile--they can be artifically reproduced in the laboratory. A few viable gametes are produced because of chance combination of the correct chromosomes. Very few viable eggs are produced. The production of viable spermatozoa is greater but still diminished compared to normal animals. In animals with a high fecundity, such as grass carp, there is a possibility that triploids could form some viable gametes. Reproduction, however, is not likely to occur in nature because of diminished fertility. Nevertheless, I recommend that stocking be restricted to ponds and lakes without direct connections to major rivers, until the reproductive status is more fully explored. Nearly complete protection can thus be afforded against naturalization. Ingrams Pond clearly fits this category.

Certification of sterility of each individual is impossible without breeding trials. Instead, each fish could be tested to determine its ploidy, and only certified triploids need be stocked. Such certified fish are available from reputable dealers in Arkansas. Alternatively, the agency could analyze each fish to determine the ploidy. Instruments needed are a modern Coulter counter that measures sizes of cells, or a cytometer that measures DNA content. Both methods are extremely precise and diploid contaminates can be detected with certainty.

Triploids are as effective as diploid grass carp in control of aquatic vegetation. In tests done in California the triploids fed slightly faster. In Washington, they grew slightly slower. In both preliminary tests, there were not statistically significant differences.

Finally, this review is not an endorsement for biological control of aquatic plants. If, however, one wished to destroy aquatic plants in a body of water, triploid grass carp are the safest and most effective method. Hybrid grass carp and bighead carp are not recommended because they are ineffective in controlling aquatic vegetation.

ENVIRONMENTAL ASSESSMENT

Evaluation of a biological method of vegetation control

2/1/86-1/31/89

I. Purpose and Need

Introduction

Aquatic vegetation has become the most serious problem in many of Delaware's public and private ponds in recent years. Two submergent exotic plant species, Hydrilla verticillata (hydrilla) and Cabomba caroliniana (fanwort), which have proven difficult to control in a limited number of ponds are rapidly spreading to most of the ponds in Sussex County. Although total eradication of these species is not feasible, some control of plant abundance and biomass is required to lessen adverse impacts both on fish populations and water-based recreational activities.

Colle and Shireman (1980) found that if hydrilla density occupied the entire water column, a marked reduction in growth and condition of bluegill and largemouth bass occurred. A comparison of condition factor change with macrophyte abundance indicated that hydrilla coverage in excess of 40% caused a decline in condition which was magnified in larger bass and bluegill. This density level has been common in many of the infested Delaware ponds from August into November. Angling and other water-based recreation have also been negatively affected by plant abundance. Fishing in several ponds with nearly 100% coverage by hydrilla and/or fanwort has been virtually impossible during the summer and early fall. Increasing complaints of anglers, boaters and shoreline residents requires additional emphasis on weed control.

The objectives of the proposal discussed in this assessment are to evaluate the efficacy of a herbivorous fish in controlling aquatic weeds in a Delaware pond and to determine the impact of this fish on existing fish populations.

Background

The problems presented by over-abundant aquatic vegetation in Delaware were recognized in the mid-seventies and resulted in a research project, Aquatic Vegetation Control in Delaware Ponds (D-J Project F-27-R). Both mechanical and chemical methods of control were tested under this project with varying degrees of success, dependent upon the plant species involved (Bonner 1978). A survey and classification of trophic conditions of 30 Delaware ponds was conducted from March 1979 to March 1980 under the EPA Clean Lakes Program (Ritter 1981). Most of the ponds in Delaware were classified as highly eutrophic, indicating that aquatic weeds will be a long-term problem. During the mid to late seventies, fanwort, the primary problem weed in the Sussex county ponds, was controlled by winter water level drawdowns. However, in 1981 hydrilla was positively identified from three Delaware ponds. By the fall of 1983, hydrilla with or without fanwort had been documented in seven public ponds and four private ponds (Table 1). In most cases, the two species of weeds now occur together.

When fanwort is controlled, hydrilla quickly moves into the cleared areas. Hydrilla, which has been documented as a major nuisance in southern waters (Haller 1978), effectively negates the positive effects of the winter drawdown.

Description of Area

Ingrams Pond, the test area, is located one mile west of the Town of Millsboro (Figure 1). It consists of 9.9 ha surface area with a mean depth of 1.3 m and maximum depth of 3.1 m. It is typical of the hydrilla-fanwort infested ponds, being slightly acidic (pH 6.2-7.0) with a muck bottom, low turbidity and high light penetration. The major portion of the drainage basin is forest (62%) with some agricultural lands, primarily broiler operations (Ritter 1981).

The present fish community consists of: largemouth bass (*Micropterus salmoides*), chain pickerel (*Esox niger*), black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), pumpkinseed (*L. gibbosus*), bluespotted sunfish (*Ennaecanthus gloriosus*), golden shiner (*Notemigonus crysoleucas*), brown bullhead (*Ictalurus nebulosus*), mosquitofish (*Gambusia affinis*) and swamp darter (*Etheostoma fusiforme*). A variety of amphibian, reptile, bird and small mammal species also inhabit the area.

Bald eagles occur within a five-mile radius and frequently fly over the ponds in the area to obtain fish for food.

Prior to the presence of hydrilla and fanwort, the typical plant species were: bladderwort (Utricularia spp.), bushy pondweed (Najas gracillima), water lily (Nymphaea odorata) and spatterdock (Nuphar spp.) (Lesser 1966).

Concerns

Public concern has been expressed by increasing complaints and inquiries as to plans for weed control. Public meetings in the fall of 1983 were held in the Towns of Laurel and Millsboro to present information on aquatic weed biology, the effect on fishes and control methods and costs. Both meetings were well attended with legislators, anglers, boaters, municipal officials and shoreline residents represented. The primary concerns were negative influence of the weeds on recreation, possible environmental effects of herbicide application, negative impact of weeds on tourist activities and cost of treatment. Legislative concern was evidenced by a legislative appropriation of $75,000 for the purchase of a mechanical weed harvester to aid in the control of aquatic weeds. A machine was demonstrated in 1983 and evaluated in terms of control effected and numbers of fish harvested incidental to plant biomass.

II. Alternatives

There are four alternatives to consider in the aquatic weed control study:

1) Do nothing to control aquatic weeds. This is impractical due to the public outcry for control and the continual spread of the two target species to additional ponds from those currently infested.

2) Use herbicides to control hydrilla and fanwort. This alone provides only short-term control using currently registered herbicides and is economically infeasible. The current weed control budget and manpower allocation within the Division of Fish and Wildlife cannot provide weed control for the acreage currently infested by these two plant species. Public concern on possible long-term adverse environmental impacts of herbicide use also precludes complete dependence on this alternative.

3) Mechanical vegetation control is a third alternative. Mechanical methods include seasonal water level drawndown or weed harvesting. The water level drawdown from November until March does not control hydrilla and therefore is known to be unacceptable. Harvesting via a mechanical weed harvester is being investigated. However, it is slow and short-term and the use of the harvester is subject to a priority listing for all state-owned ponds,which includes ponds that have problems with other weeds such as filamentous algae. Only limited control in a few ponds is practical using a weed harvester.

4) The fourth alternative is to evaluate a herbivorous fish to control the target weeds. The test fish would be the sterile triploid grass carp (*Ctenopharyngodon idella* which is being subjected to considerable testing in Florida beginning in 1984. This job will be activated only if results of the Florida testing prove favorable. Only sterile fish would be used to prevent any lasting impact on native fish populations if the introduced fish were to escape from the test pond.

III. Affected Environment

If aquatic weeds are not controlled, fish populations would revert from predaceous game fish species to herbivorous or crustacean-eating species. As the plant biomass increases, the amount of silt retained within each pond would increase and accelerate the filling of the pond. The ponds would shortly revert to a freshwater marsh habitat. More habitat would become available to reptiles and amphibians but no change in their species composition would be expected.

If aquatic weeds are controlled, the public will continue to utilize the ponds for angling, boating, canoeing, picknicking and birdwatching.

The bald eagle is the only endangered species occurring within the test area. Eagles frequently visit ponds within the area to obtain fish for food and would be negatively impacted by a pond reverting to a marsh habitat. Limited utilization of a stocked exotic species of 9-12 inches by bald eagles would be probable.

There will be no planned activities that would affect the floodplain.

IV. Environmental Consequences of Alternatives

In the evaluation of the effects this proposal may have on the environment, issues relating to the physical, biological and social categories have been reviewed. Those which would be affected are: wildlife, vegetation, water quality, economy, aesthetics, and land use.

A comparison of alternatives for the aquatic vegetation control program is presented in a matrix format following discussion of the four alternatives (Table 2).

Alternative #1 - No action

If no action is taken, there will be no impact on native fish species by chemical herbicides, mechanical harvesters or exotic species of fishes. Additionally, there would be no immediate economic drain on the pond owner, whether state, municipal or private individual. The negative impacts of this alternative would be many. Fanwort and hydrilla would continue to grow within the affected ponds and continue to spread to other ponds. As the plant biomass within Ingrams Pond increased, game fish species' growth and condition would decline. Silt accumulation would accelerate. The aesthetic qualities of a pond would be greatly reduced with a possible decline in values of land adjacent to the pond. Angling and other water-based recreational activities would decline, resulting in less public use of the area and a negative economic impact on tradesmen (bait and tackle shops, restaurants, gas stations, etc.) within the area. Public demand for control already expressed to government officials and legislators would override this alternative.

Alternative #2 - Chemical control

Any herbicides used for aquatic weed control would be EPA registered and applied by State Certified Pesticide Applicators at recommended rates. The effect of most herbicides on weeds is relatively quick acting, so control would be achieved within a short time period. Proper safety clothing and procedures will minimize risk to individuals involved in mixing and application of the pesticides. Signs would be posted at the treated ponds citing time restrictions on irrigation, angling and other water-based activities.

The high cost of chemical treatment ($200 per acre) and the relatively short-term effect for each application (two months) are major negative impacts of a continuing chemical control program. Limited funding is not sufficient to control the present pond surface acreage impacted, so a priority list of treatment areas would have to be drawn up. The lower priority ponds would have no weed control programs. Although currently registered chemicals for hydrilla and fanwort control (Diquat and Cutrine Plus) have had no documented evidence of adverse impact on human health, there still remains public concern on long-term environmental impacts of periodic herbicide use. In many cases, agricultural interests and adjacent landowners would be adversely impacted by irrigation restrictions of treated waters. Restrictions on angling following pesticide applications would be dependent on the chemical used.

Alternative #3 - Mechanical Control

Neither over-winter water level drawdowns nor mechanical harvesting pose environmental hazards to humans or require restrictions on water use for agricultural interests or shoreline residents. Another positive aspect of a weed harvesting operation is that a harvester was purchased in 1983 and is available for use. Harvested plant material is actually removed from the pond thereby diminishing nutrients by a minute amount within the system.

The major negative impact of a winter water level drawdown is that it will not control hydrilla; only fanwort is controlled by this method. Because the two species generally occur together, control of fanwort is followed by immediate colonization by hydrilla of the control area. Although spring/fall drawdowns are recommended for hydrilla control, this method takes two or more years to be effective. This schedule would also have the greatest negative impact on fishermen by preventing fishing during the peak angling season. There are several negative aspects of the mechanical weed harvester. The harvester can only be used to harvest plant material within the upper water column because of stumps at shallow depths. Both target species are rooted in the sediments at depths of up to eight feet. The effect of harvesting is short-term due to the rapid growth rate of hydrilla. Harvesting is a slow process with a maximum of two acres harvested per day under ideal conditions. To achieve seasonal control, the harvester would have to remain in no more than two ponds over the entire growing season (June-October). Two men are required for operation of the harvester. Some young-of-the-year fishes are retained by the harvester incidental to plant material harvest although in very limited numbers with negligible impact on the total fish population (Martin 1983).

Alternative #4 - Stocking of herbivorous fish species

Four positive aspects of this alternative are apparent. There is the greatest chance of long-term weed control with no concern over the use of pesticides. Secondly, a relatively low investment is required to purchase and stock adequate numbers of fish for a full evaluation of their efficacy in controlling the target weed species. No restrictions on water use by agricultural interests, anglers, shoreline residents, etc. would be required. Stringent evaluation of the effects of sterile grass carp on native fishes in Delaware would be conducted during this study.

Negative aspects of this fish introduction are divided into two categories - physical and biological. The major physical impact would be the relatively slow progress of control. It would take some time before noticeable control could be achieved as a result of plant biomass consumption by herbivorous fishes. However, a major concern is for an exotic to escape to areas outside the stocking site and the chance for an exotic fish to become established in the area if the stocked fish are not sterile. These concerns should be minimized by the construction of a trap or barrier at the outfall of Ingrams Pond and the use of a certified sterile triploid grass carp. The barrier would be constructed prior to stocking to prevent egress of the stocked fish. Additionally, only certified sterile fish would be stocked to prevent any possibility of the species reproducing and becoming established within the state.

V. Consultation/Coordination

1. State Clearinghouse - review to determine that project is in accordance with state goals and objectives.

2. Rue Hestand and Jeff Underwood, Florida Game and Freshwater Fish Commission - update on status and testing program of sterile triploid grass carp.

3. Public meeting - Laurel, Delaware, October 25, 1983 - receive information on needs and concerns of interested citizens on pond weed problems in western Sussex County.

4. Public meeting - Millsboro, Delaware, November 15, 1983 - receive information on needs and concerns of interested citizens on pond weed problems in eastern Sussex County.

Literature Cited

Bonner, F.C. 1978. Aquatic vegetation control in Delaware ponds. Ann. Rep. Fed. Aid Fish. Restor. Proj. F-27-R-2 (D.J.), De. Div. Fish Wildl., Dover, De. 22 pp.

Colle, D. E. and J. V. Shireman. 1980. Coefficients of con- condition for largemouth bass, bluegill and redear sunfish in hydrilla-infested lakes. Trans. Amer. Fish. Soc. 109 (5): 521-531.

Haller, W.T. 1978. Hydrilla - a new and rapidly spreading aquatic weed problem. University of Florida Agri- culture Exp. Stat. Circular S-245. Gainesville, Fla. 13 pp.

Lesser, C.A. 1966. Aquatic vegetation survey. Final report Fed. Aid. Fish. Restor. Proj. F-21-R (D.J.) De. Bd. Game and Fish Commission, Dover, De. 65 pp.

Martin, C.C. 1983. Delaware pond management program. Fed. Aid. Rep. Fish Restor. F-32-R (D.J.) De. Div. Fish Wildl., Dover, De. In preparation.

Ritter, W.F. 1981. Survey and classification of Delaware's public lakes. Univ. De. for Div. Fish Wildl., Newark, De. 469 pp.

Table 1. Incidence of hydrilla and fanwort in Delaware's ponds, 1983.

Ponds	Hydrilla only	Hydrilla and fanwort
Public ponds:		
Horseys		X
Ingrams		X
Records		X
Trap		X
Trussum[1]	X	
Tubmill[1]	X	
Waples	X	
Private ponds:		
Betts		X
Burtons	X	
Concord	X	
Fleetwood[1]	X	

[1] Occurs in limited quantities

Table 2. Comparison of alternatives for control of hydrilla and fanwort in Delaware's ponds.

Criteria	#1 No action	#2 Chemical	#3 Mechanical	#4 Fish stocking
1. Controls both target species	-	+	-	+
2. Offers possibility of long-term effect	-	-	-	+
3. Addresses public concern over weed problems	-	+	+	+
4. Maximizes public use of area	-	+	+	+
5. Minimizes public concern over use of chemical herbicides	+	-	+	+
6. Minimizes restrictions on irrigation and other water uses	+	-	+	+
7. Minimizes adverse effects on water quality	-	-	+	+
8. Minimizes economic losses due to loss of tourism and trade	-	+	+	+
9. Minimizes individual exposire to chemical herbicides	+	-	+	+
10. Economically feasible	+	-	+	+
11. Provides fast acting control of weeds	-	+	-	-
TOTAL	4	5	8	10

Rating System: + High probability criteria would be satisfied

- Low probability criteria would be satisfied

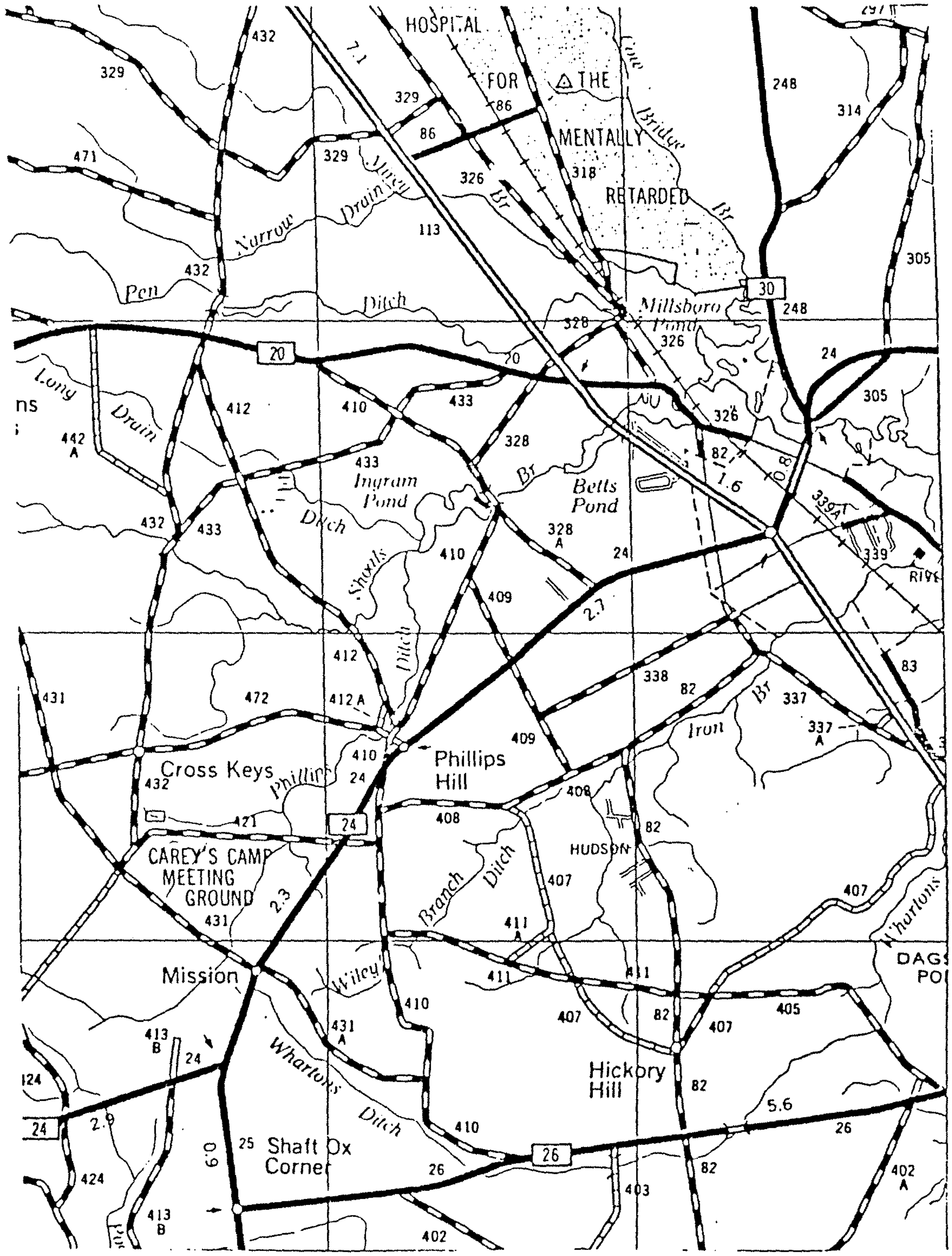

Figure 1. Map of Ingram Pond and vicinity.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
WASHINGTON, D.C. 20240

ADDRESS ONLY THE DIRECTOR, FISH AND WILDLIFE SERVICE

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SEP 19 1985

Mr. Carl R. Sullivan
Executive Director
American Fisheries Society
5410 Grosvenor Lane
Bethesda, Maryland 20814

Dear Sully:

I know you are well aware of the growing interest in this country in the use of grass carp to control vexing aquatic weed problems. We have received numerous appeals from the Federal, State, and private levels for the Fish and Wildlife Service to assume a role in certification of triploid grass carp used for this purpose. I am happy to report that we have made arrangements to carry out this role.

We have assigned the responsibility to our Fish Farming Experimental Station (FFES) at Stuttgart, located about 40 miles from the Malone and Hill Farms, the current principal suppliers of the triploid grass carp.

Our protocol will be as follows:

(1) Malone and Hill will process the blood of each fish for shipment through a Coulter Counter and certify each fish to be triploid.

(2) At the time of shipment, a scientist from the FFES will go to each farm and randomly select from each truckload a number of fish to be determined by the protocol of the receiving State. This sample will again be processed through the Coulter Counter. If all fish in the sample are triploid, the scientist will certify that fact. If one or more diploids are found, the entire load will be rejected.

I hope we have your support in this decision.

Sincerely,

ROBERT A. JANTZEN

Director

cc: Directorate Reading File — DD Chron
R&D Reading File — FR Reading File

FWS/FR/GRuhr:fran:9/6/85:gr#4

Appendix B:
Lake-wide Aquatic Plant Survey, J. Strom Thurmond Lake

Final Report: Lake-wide Aquatic Plant Survey, J. Strom Thurmond Lake

Duration: September 1, 2015 – November 19, 2015

Participants: U.S. Army Corps of Engineers, Savannah District, Georgia Department of Natural Resources, South Carolina Department of Natural Resources, and University of Georgia, Warnell School of Forest Resources

Objective:

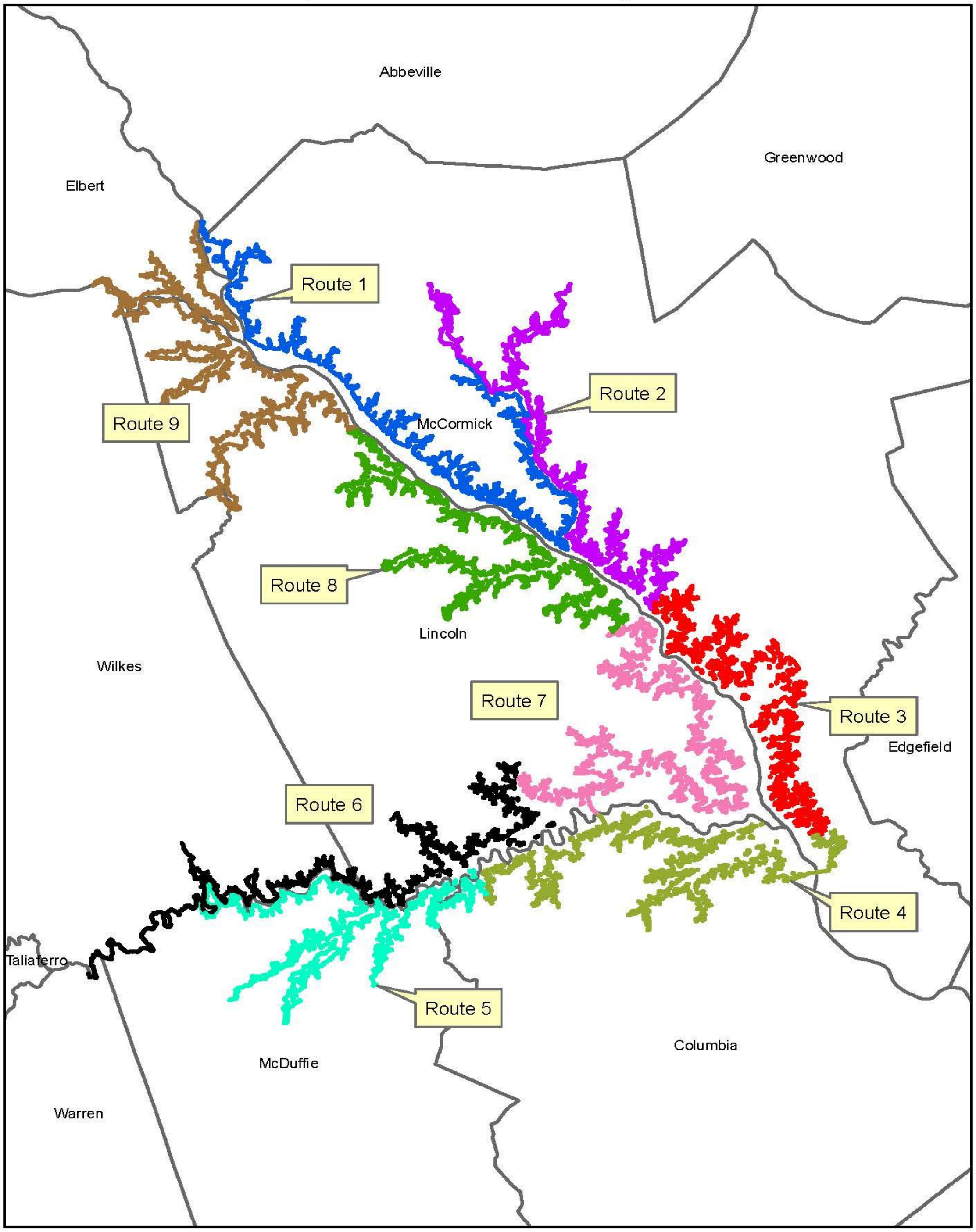
Determine the distribution of aquatic plants in J. Strom Thurmond Lake and the abundance of *Hydrilla verticillata* (hydrilla).

Methods:

The survey was divided into two phases; plant distribution and hydrilla abundance. The lake was divided into nine lake strata (survey routes), each strata contained approximately 275 survey points (Figure 1).

The distribution phase of the study was conducted from September 1 through October 7, 2015. The study participants used the point intercept method to survey the aquatic plant community. This method involved spot observations of presence or absence of any submersed, floating leaf or emergent aquatic plants at the survey point. Sampled points were evenly spaced every ½-mile of reservoir shoreline. The survey teams were provided maps and also used GPS equipment to assist in locating each survey point. A double-tined rake attached to a rope was used to collect submersed plant specimens. At each point the rake was tossed into the water near the shoreline and then drug out to a depth of at least 15-feet. After a collection was made, each plant species was identified and marked as present. Shoreline emergent species were also noted if present.

Figure 1 - 2015 Aquatic Plant Survey Routes



The hydrilla abundance phase of the study was conducted from November 10 through November 19, 2015. The abundance survey points were chosen by randomly selecting 5% of the point intercept survey points from each strata where hydrilla was noted as present. There were 70 total survey points randomly selected. The selected points were surveyed with either a Lowrance High Definition System (HDS) consumer echosounder or Lowrance Elite CHIRP consumer echosounder. Both Lowrance systems had single-beam 200-kHz transducers (208 by 208 half-power beam angle) oriented vertically and mounted on the boat stern approximately 8-inches below the surface. Echosounder settings were those recommended by Navico BioBase for the Lowrance units. Ping rate was 10 pings per second and boat speed varied, but was always less than 5 mph. The GPS and acoustic signals were logged to data storage cards in sl2 format. The acoustic echograms were collected at the selected survey points by backing the boat into the shoreline as shallow as possible (less than 3-feet water depth) and then proceeding perpendicular to the bank until reaching 20-feet of water depth or until again intersecting shallow water, whichever came first.

The 70 collected echograms were uploaded to Navico BioBase, a signal processing software designed specifically for aquatic plant and bathymetry surveys using recreational acoustic equipment. An independent report was generated by Navico BioBase for each of the 70 survey points. An example of a Navico BioBase transect report is attached as Figure 2.

Figure 2 -Sample Navico BioBase Transect Report

BIOBASE

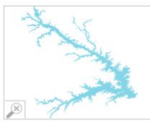
VEGETATION ANALYSIS REPORT

J. Strom Thurmond Reservoir, Columbia County
Georgia

Generated: 11/23/2015 8:41:38 PM (UTC)

Waterbody Size: 27,632.37 ha *(68,281.10 acres)*

report link



Data Collector
James Sykes

Data Collection Date
11/17/2015 5:15:02 PM (UTC)

Average Water Temperature
17.79° C (64.03° F)

Location
Start: 33.64999771, -82.46492004
End: 33.64881897, -82.46582031

Survey Size
Area: 0.91 ha (2.25 acres)
Volume: 23,145.70 cu. m (18.76 acre ft)

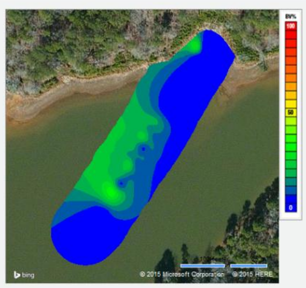
Settings
Track Buffer: 25 m
Grid Cell Size: 5 m
Min. BV Detect: 5%
Min. Veg Depth Detect: 0.73152 m

Quality Control
Reviewer: McCormack, Ian
Comments: Passed

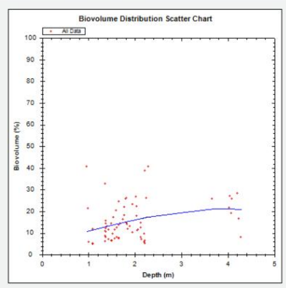
Area of Interest Summary

AOI ?	Type ?	PAC ?	Avg BVp ?	SD BVp ?	Avg BVw ?	SD BVw ?	Depth Range	Avg Depth	Distance	No. Points
1	Point	45.1%	15.5%	±8.7%	7%	±9.7%	1.01-5.14 m	2.27 m	174.14 m	153
	Grid	51.5%	14.1%	±6.1%	7.3%	±8.3%	0.02-5.14 m	2.46 m	-	227

Vegetation Biovolume Heat Map



Biovolume Distribution Scatter Chart



Biovolume Analysis by Quantity

AOI ?	0-5%	5-20%	20-40%	40-60%	60-80%	>80%
1	54.9%	32.68%	11.11%	1.31%	0%	0%

Biovolume Analysis by Depth

AOI ?	Depth	Type ?	Count	PAC ?	Avg BVp ?	SD BVp ?	Avg BVw ?	SD BVw ?
1	0-1m	Point	7	42.9%	22.7%	±14.3%	9.7%	±14.6%
	1-2m		92	44.6%	13.5%	±6.3%	6%	±7.9%
	2-3m		27	63%	16%	±10.9%	10.1%	±11.6%
	3-4m		1	100%	25.8%	±0%	25.8%	±0%
	4-5m		17	41.2%	21.1%	±6.6%	8.7%	±11.2%
	5-6m		9	0%	-	-	0%	±0%
	6-7m		0	-	-	-	-	-
	7-8m		0	-	-	-	-	-
	8-9m		0	-	-	-	-	-
	>9m		0	-	-	-	-	-
	0-1m	Grid	31	51.6%	12.9%	±5.7%	6.6%	±7.6%
	1-2m		93	59.1%	15%	±5.5%	8.9%	±8.5%
	2-3m		30	66.7%	13.6%	±6.9%	9.1%	±8.6%
	3-4m		16	93.8%	16.4%	±6.9%	15.4%	±7.7%
	4-5m		39	28.2%	9%	±2.6%	2.5%	±4.3%
	5-6m		18	0%	-	-	0%	±0%
	6-7m		0	-	-	-	-	-
	7-8m		0	-	-	-	-	-
	8-9m		0	-	-	-	-	-
	>9m		0	-	-	-	-	-

Glossary

AOI
Area of Interest: Defines the individual transects or contiguous data samples as depicted by the color coding of each trip line. Seperate areas of interest can be generated through merging of multiple trips, appending data to a single sonar log or lapses in time (greater than five minutes) within a sonar log.

BVp
Biovolume (Plant): Refers to the percentage of the water column taken up by vegetation when vegetation exists. Areas that do not have any vegetation are not taken into consideration for this calculation.

BVw
Biovolume (All water): Refers to the average percentage of the water column taken up by vegetation regardless of whether vegetation exists. In areas where no vegetation exists, a zero value is entered into the calculation, thus reducing the overall biovolume of the entire area covered by the survey.

PAC
Percent Area Covered: Refers to the overall surface area that has vegetation growing.

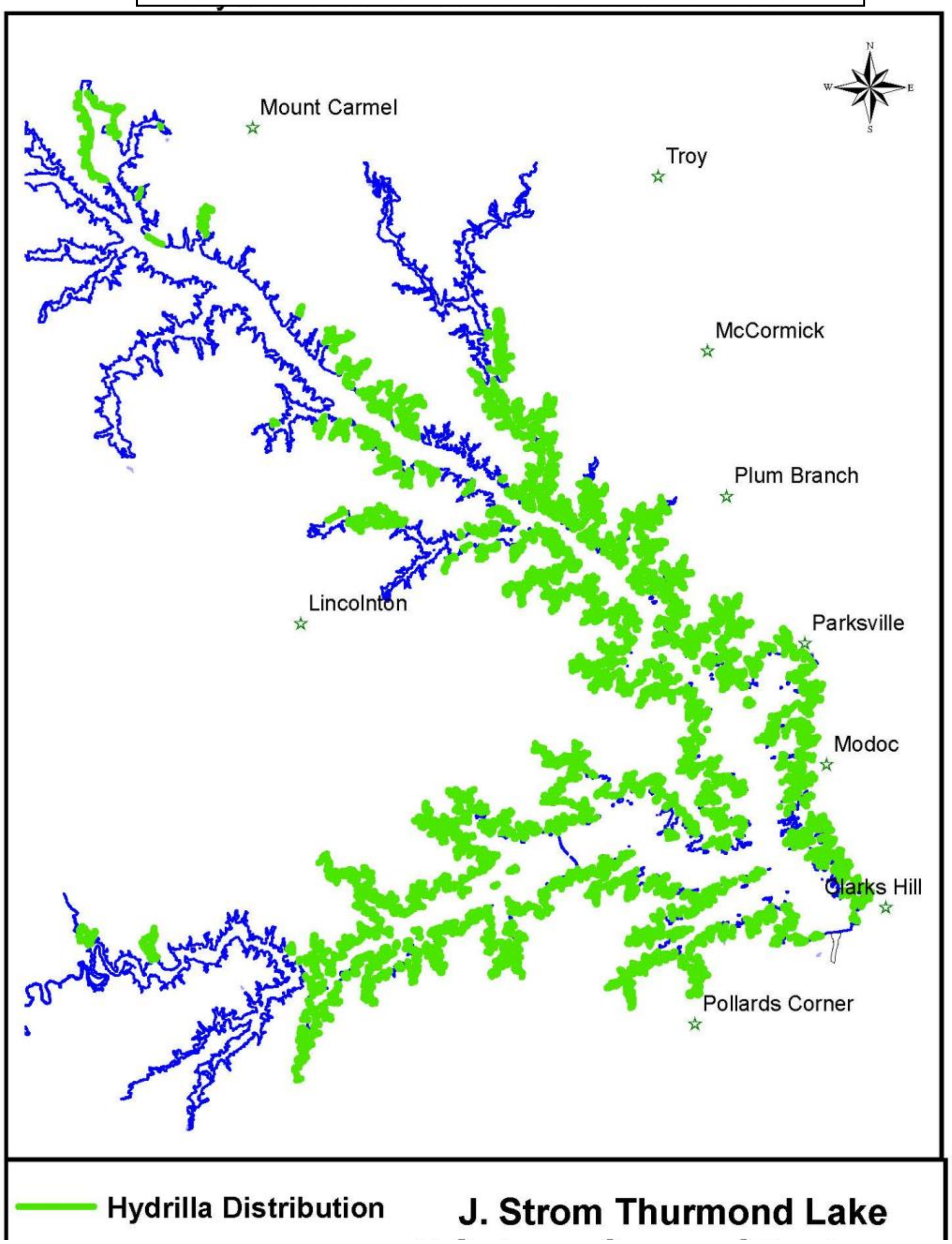
Grid
Geostatistical Interpolated Grid: Interpolated and evenly spaced values representing kriged (smoothed) output of aggregated data points. The gridded data is most accurate summary of individual survey areas.

Point
Individual Coordinate Point: A single point represents a summary of sonar pings and the derived bottom and canopy depths. Individual point data create an irregularly spaced dataset that may have overlaps and/or gaps in the data resulting in a increased potential for error.

Results and Discussion:

There were 2,319 total point intercept survey locations in the distribution portion of the survey. Table 2 summarizes the results. The most predominant plant was hydrilla which was present at 1,312 surveyed locations. Hydrilla was found along an estimated 613.3-miles of shoreline, including 386.8 miles in Georgia and 226.5 miles in South Carolina. A map of the hydrilla distribution is included as Figure 3.

Figure 3 – Hydrilla Distribution October2015



Other commonly found species included; Chara, Maidencane and Najas. There were a total of 25 different species noted including submersed, floating leaf and shoreline emergent species (Table 1).

Table 1 – Aquatic Plant Survey Results

		Percent Occurrence
Total Points Surveyed	2319	
Hydrilla Present	1312	56.6%
Hydrilla Absent	1007	43.4%
Other Vegetation:		
Chara	560	24.15%
Illinois Pondweed	7	0.30%
Najas	364	15.70%
Nitella	161	6.94%
Slender Pondweed	226	9.75%
Variable-leaf Pondweed	16	0.69%
American Pondweed	2	0.09%
Duckweed	14	0.60%
Alligator weed	27	1.16%
Arrowheads	2	0.09%
Cattail	6	0.26%
Creeping Burhead	8	0.34%
Maidencane	442	19.06%
Parrotfeather	1	0.04%
Pennywort	2	0.09%
Road Grass / Spikerush (Eleocharis)	87	3.75%

Table 1. Continued		
Rushes	84	3.62%
Sedges	35	1.51%
Water Primrose	49	2.11%
Water Willow	3	0.13%
Cut Grass	2	0.09%
American Lotus	2	0.09%
Luziola (southern watergrass)	1	0.04%

With the use of GIS and a 1-foot bathymetric contour map layer of JST Lake, a "potential acreage where hydrilla is present" was calculated in all areas where hydrilla was found by estimating the total acreage between elevations 330 msl and 315 msl. The total "potential acreage where hydrilla is present" was determined to be 10,644.3 acres.

To determine the abundance of hydrilla, the results from 67 of the 70 acoustic transects were analyzed to determine a mean "percent area coverage" (PAC) for the reservoir. PAC is defined by the BioBase analytical software as "the overall surface area that has hydrilla growing". Due to changes in the lake elevation during the period between the 2015 growing season and the abundance survey, data from each transect less than 3.3 feet were eliminated from the PAC analysis. Also, transect data at depths greater than 19.7 feet were also eliminated from the analysis. PAC results were applied to the "potential acreage where hydrilla is present" to estimate the lakewide abundance of hydrilla at 2,363 acres.

Appendix C:
April 2015 Fact Sheet - Avian Vacuolar Myelinopathy (AVM)

FACT SHEET
AVIAN VACUOLAR MYELINOPATHY (AVM)
Updated April 2015

1. Background:

a. The first bald eagle death attributed to AVM at J. Strom Thurmond (JST) lake occurred in 1998. The first known bald eagle death from AVM occurred at DeGray Lake, Arkansas in 1994.

b. AVM has been linked to mortality not only in bald eagles, but also in other raptors (hawks and great horned owls) and waterfowl.

c. Research suggests that an epiphytic blue-green algae (cyanobacteria) produces a toxin which causes the neurological disease AVM. Aquatic plants such as milfoil, hydrilla, and elodea provide a substrate for the blue-green algae. Lakes with submerged vegetation that do not have this particular blue-green algae (*Aetokthonos hydrillicola*) do not have AVM.

d. Hydrilla was first observed in JST in 1995.

e. Herbicides were used at JST from 1995-1998 in an attempt to control hydrilla; however, hydrilla coverage increased from several hundred acres to over 2,000 acres by 1999.

f. The typical food chain link for eagle mortality occurs when coots eat hydrilla which has the blue-green algae. Coots develop neurological symptoms and become easy prey for bald eagles. Eagles consume the coots and develop AVM.

g. AVM occurs seasonally when the blue-green algae begins to produce toxins. The peak period is November through February. During this time, water chemistry changes as the lake cools and begins to mix. Hydrilla also begins to senesce; however, the environmental factors that trigger toxin production have not been identified.

2. Current Conditions:

a. There have been 81 dead bald eagles found at JST from 1998 to 2015. There were four mortalities in winter of 2014-2015. These mortality events have been attributed to AVM; however, less than half of the birds (29) could be confirmed with AVM due to the extent of decomposition. One bird from 2013 was confirmed non-AVM resulting from Aspergillosis.

b. AVM meetings to discuss ongoing research have been hosted at J. Strom Thurmond Project in 2004, 2005, 2007, 2009, 2011, 2012, and 2014. Researchers from the University of Georgia (UGA) continue to evaluate AVM, hydrilla, and the possible environmental factors affecting toxin production.

c. As a result of the 2007 AVM meeting, the Corps received letters from GADNR and SCDNR regarding the AVM issue. They provided four recommendations: 1) document hydrilla coverage and expansion using best available techniques; 2) initiate a public involvement and stakeholder process examining hydrilla and resource issues relating to hydrilla; 3) conduct public involvement with input from the US Fish and Wildlife Service and state agencies; and 4) utilize ERDC to prepare a management plan to address AVM using input from the public involvement process.

d. In October 2010, the Corps, with assistance from GADNR and SCDNR, completed a comprehensive survey of hydrilla at JST. The total area with some hydrilla coverage is 11,271 acres. Based on an acoustic survey to determine actual bottom coverage (density), hydrilla covers about 44% of the area where it has been located, so actual bottom coverage (areal coverage) would be approximately 4,959 acres.

f. With input from UGA, USFWS, and state agencies, a survey was developed to evaluate public opinion regarding hydrilla and impacts to the resource at JST. The stakeholder survey was completed in May 2013 and a final report was received in September 2013. The survey was completed through modification of an existing cooperative agreement with ERDC and included questions about sterile grass carp which will be the most controversial treatment method if it is determined that hydrilla eradication is the preferred alternative. Results indicate that 84.5% of respondents prefer less hydrilla or only native plants and 74.3% are either indifferent or in support of stocking grass carp. Survey results are available at http://www.sas.usace.army.mil/Portals/61/docs/lakes/thurmond/UGA%20Perception%20Survey_Final%20Report.pdfA

g. During the May 2014 meeting, the USFWS suggested that continued eagle mortalities at Thurmond could require a “take permit” pursuant to the Bald and Golden Eagle Protection Act. When we raised the issue that “take” typically involves some action or activity that results in the “take”, USFWS responded that “in-action” to prevent eagle mortality could be considered a “take”. In August 2014, we met with GADNR and SCDNR to get their input and position regarding controlling hydrilla in Thurmond. They requested we send a letter, proposing an action to control hydrilla and the agency would provide a position.

h. In December 2014, we sent a letter to both state agencies and USFWS proposing an integrated plan using grass carp and herbicide to control hydrilla. USFWS and SCDNR concurred and offered technical assistance; GADNR wanted a better explanation of the extent of control, impacts to native species, and other details worked out through the EA process.

i. Funding was received in FY15 for an EA/AVM management Plan. Planning Division is in the process of preparing an EA with treatment alternatives. The POC for the EA is Ellie Covington, PD.

3. Future Direction:

a. Coordination with PD, state agencies, USFWS, and UGA researchers is ongoing for development of the EA and AVM plan.

b. We anticipate completion of the EA and plan during FY15. During budget development, we will add a budget package for aquatic plant control related to AVM.

c. Research is ongoing to better determine effects from AVM. In April 2015, transmitters were attached to three bald eagle nestlings. These transmitters will allow UGA researchers to track movements and determine if these birds remain onsite and develop AVM at some point in the future or if they move offsite to another location.

d. UGA has provided a proposal to USFWS for funding that would allow an experimental stocking of grass carp in several coves on lake Thurmond as a telemetry study to evaluate grass carp movement. To date, USFWS has not completed evaluation of the proposal and determined if they would provide funding.

Savannah District POC: Jeff Brooks, District Wildlife Biologist, OP-SR

Appendix D:
JST Species List

Commonly Occurring Terrestrial and Aquatic Plants of JST Project	
Common Name	**Scientific Name**
Overstory	
Southern Sugar Maple	*Acer baratum*
Red Maple	*Acer rubrum*
Silver Maple	*Acer saccharium*
River Birch	*Betula nigra*
Bitternut Hickory	*Carya cordiformis*
Pignut Hickory	*Carya glabra*
Shagbark Hickory	*Carya ovata*
Mockernut Hickory	*Carya tomentosa*
White Ash	*Faxinus americana*
Sweetgum	*Liquidamber styraciflua*
Yellow Poplar	*Liriodendron tulipifera*
Southern Magnolia	*Magnolia grandiflora*
Blackgum	*Nyssa sylvatica*
Shortleaf Pine	*Pinus echinata*
Slash Pine	*Pinus elliottii*
Longleaf Pine	*Pinus pulustris*
Loblolly Pine	*Pinus taeda*
Sycamore	*Plantanus occidentallis*
Eastern Cottonwood	*Populus deltoides*
White Oak	*Quercus alba*
Scarlet Oak	*Quercus coccinea*
Southern Red Oak	*Quercus falcata*
Turkey Oak	*Quercus laevis*
Laural Oak	*Quercus laurifolia*
Blackjack Oak	*Quercus marilandica*
Water Oak	*Quercus nigra*
Pin Oak	*Quercus palustris*
Willow Oak	*Quercus phellos*
Swamp Chestnut Oak	*Quercus prinus*
Northern Red Oak	*Quercus rubra*
Post Oak	*Quercus stellata*
Black Oak	*Quercus velutina*
Winged elm	*Ulmus alata*
American elm	*Ulmus americana*
Midstory	
Boxelder	*Acer negundo*
Beauty-berry	*Callicarpa americana*
American Hornbeam, Musclewood	*Carpinus caroliniana*
Hackberry	*Celtis occidentalis*
Redbud	*Cercis canadensis*
Fringetree	*Chionanthus virginicus*
Dogwood	*Cornus florida*
Hawthorn	*Cratagus sp.*
Persimmon	*Diospyros virginiana*
Honeylocust	*Gleditsia triacanthos*
American Holly	*Ilex opaca*
Black Walnut	*Junglans nigra*
Eastern Red Cedar	*Juniperus virginiana*
Red Mulberry	*Morus rubra*
Waxmyrtle	*Myrica cerifera*

Commonly Occurring Terrestrial and Aquatic Plants of JST Project	
Common Name	**Scientific Name**
Eastern Hop Hornbeam, Ironwood	*Ostrya virginiana*
Sourwood	*Osydendron arboreum*
Black Cherry	*Prunus serotina*
Wild Plum	*Prunus sp.*
Winged Sumac	*Rhus copallia*
Blacklocust	*Robinia pseudoacacia*
Palmetto	*Sabal minor*
Black Willow	*Salix nigra*
Sassafras	*Sassafras albidum*
Southern Catapala	*Catalpa bignonioides*
Sparkleberry	*Vaccinium sp.*
Blueberry	*Vacinium corymbosum*
Ground Covers	
Trumpet Creeper	*Campis radicans*
Yellow jassamine	*Gelseminum sempervirens*
Virginia Creeper	*Parthenocissus quinquefolia*
Ferns	*Polystichum sp.*
Poison Oak	*Rhus quercifolia*
Poison Ivy	*Rhus radicans*
Poison Sumac	*Rhus vernix*
Black Berry	*Rubus sp.*
Greenbrier, Smilax	*Smilax sp.*
Wood grass	*Uniola sessiliflora*
Periwinkle	*Vinca minor*
Muscadine	*Vitis rotundifloia*
Aquatic Plants	
Brazilian elodea, egeria	*Egeria densa*
Waterhyacinth	*Eichhornia crassipes*
Hydrilla	*Hydrilla verticillata*
Water primrose	*Ludwigia hexapetala*
Parrotfeather	*Myriophyllum aquaticum*
Eurasian watermilfoil	*Myriophyllum spicatum*
American lotus, lotus lily	*Nelumbo lutea*
Alligatorweed	*Alternanthera philoxeriodes*
Fanwort	*Cabomba caroliniana*
Coontail, hornwort	*Ceratophyllum demersum*
Chara, musk grass	*Chara sp.*
Elodea	*Elodea canadensis*
Marsh Hibiscus	*Hibiscus moscheutos*
Southern watergrass	*Hydrochloa caroliniensis*
Water pennywort	*Hyrocotyle umbellata*
Waterwillow	*Justicis americana*
Southern naiad	*Najas guadalupensis*
Slender naiad, spiny-leaf naiad	*Najas minor*
Fragrant waterlily	*Nymphaea odorata*
Water paspalum	*Paspalum fluitans*
Pickerelweed	*Pontederia cordata*
Pondweed	*Potemogeton sp.*
Arrowheads	*Sagittaria sp.*
Cattail	*Typha sp.*
Bladderwort	*Utricullaria sp.*

Commonly Occurring Terrestrial and Aquatic Plants of JST Project	
Common Name	**Scientific Name**
Exotics	
Japanese honeysuckle	*Lonicera japonica*
China-berry	*Melia azedarach*
Kudzu	*Pueraria lobata*
Wisteria	*Wisteria frutesus*
Chinese Tallow	*Sapium sebiferum*
Gaint Reed	*Arundo donax*
Chinese Privet	*Ligustrum sinense*
Old World Climbing Fern	*Lygodium microphyllum*
Johnson Grass	*Sorghum halepense*
Autumn Olive or Eleagnus	Eleagnus umbellata
Bamboo	*Phyllosachys sp*
Hydrilla	*Hydrilla verticillata*
Alligator Weed	*Alternanthera philoxeroides*
Parrot Feather	*Myriophyllum aquaticum*

Commonly Occurring Bird Species of JST project		
Common Name	**Scientific Name**	**Season**
Wood Duck	*Aix sponsa*	Summer
Mallard	*Anas platyrhynchos*	Summer
Canada Goose	*Branta canadensis*	Summer
Hooded Merganser	*Lophodytes cucullatus*	Summer
Blue-winged Teal	*Anas discors*	Winter
Green-winged Teal	*Podilymbus podiceps*	Winter
Northern Shovelers	*Anas clypeata*	Winter
Canvasback	*Aythya valisinera*	Winter
Redhead	*Aythya americana*	Winter
Ring-necked Duck	*Aythya collaris*	Winter
Greater Scaup	*Aythya marila*	Winter
Lesser Scaup	*Aythya affinis*	Winter
Long-tailed Duck	*Clangula hyemalis*	Winter
Bufflehead	*Bucephala albeola*	Winter
Common Golden eye	*Bucephala clangula*	Winter
Common Merganser	*Mergus merganser*	Winter
Red Breasted Merganser	*Mergus serrator*	Winter
Ruddy Duck	*Oxyura jamaicensis*	Summer
Pacific Loon	*Gavia Pacifica*	Winter
Common Loon	*Gavia immer*	Winter
Red Throated Loon	*Gavia stellata*	Winter
Pied Billed Grebe	*Podilymbus podiceps*	Summer/Winter
Horned Grebe	*Podiceps auritus*	Winter
Eared Grebe	*Podiceps nigricollis*	Winter
American Coot	*Fulica americana*	Winter
Double-crested Cormorant	*Phalacrocorax auritus*	Summer/Winter
Anhinga	*Anhinga anhinga*	Summer
Belted Kingfisher	*Megaceryle alcyon*	Summer
Great Egret	*Ardea alba*	Summer
Great Blue Heron	*Ardea herodias*	Summer
Green Heron	*Butorides virescens*	Summer
White Ibis	*Eudocimus albus*	Summer
Least Bittern	*Ixobryhus exilis*	Summer

Commonly Occurring Bird Species of JST project		
Common Name	**Scientific Name**	**Season**
Wood Stork	*Mycteria americana*	Late summer
Brown Pelican	*Pelecanus occidentalis*	Winter
White Pelican	*Pelecanus erythrorhynchos*	Winter
Chimney Swift	*Chaetura pelagica*	Summer
Ruby-throated Hummingbird	*Archilochus colubris*	Summer
Chuck-will's-widow	*Caprimulgus carolinensis*	Summer
Whip-poor-will	*Caprimulgus vociferus*	Summer
Common Nighthawk	*Chordeiles minor*	Summer
Killdeer	*Charadrius vociferus*	Summer
Cooper's Hawk	*Accipiter cooperii*	Summer
Sharp-shinned Hawk	*Accipiter striatus*	Summer
Red-tailed Hawk	*Buteo jamaicensis*	Summer
Broad-winged Hawk	*Buteo playtypterus*	Summer
Red-shouldered Hawk	*Buteo lineatus*	Summer
Bald Eagle	*Haliaeetus leucocephalus*	Summer/Winter
Osprey	*Pandion haliaetus*	Summer/Winter
Turkey Vulture	*Cathartes aura*	Summer/Winter
Black Vulture	*Coragyps atratus*	Summer/Winter
Peregrine Falcon	*Falco peregrinus*	Winter
American Kestrel	*Falco sparverius*	Winter
Mourning Dove	*Zenaida macroura*	Summer/Winter
Yellow-billed Cuckoo	*Coccyzus americanus*	Summer
Northern Bobwhite	*Colinus virginianus*	Summer/Winter
Wild Turkey	*Meleagris gallopavo*	Summer/Winter
Cedar Waxwing	*Bombycilla cedrorum*	Winter
Northern Cardinal	*Cardinalis cardinalis*	Summer/Winter
American Crow	*Corvus brachyrhynchos*	Summer/Winter
Fish Crow	*Corvus ossifragus*	Summer/Winter
Blue Jay	*Cyanocitta cristata*	Summer/Winter
Eastern Towhee	*Pipilo erythrophthalmus*	Summer/Winter
American Goldfinch	*Carduelis tristis*	Summer/Winter
House Finch	*Carpodacus mexicanus*	Summer/Winter
Red-winged Blackbird	*Agelaius phoeniceus*	Summer
Orchard Oriole	*Icterus spurius*	Summer
Brown-headed Cowbird	*Molothrus ater*	Summer
Common Grackle	*Quiscalus quiscula*	Summer
Eastern Meadowlark	*Sturnella magna*	Summer
Loggerhead Shrike	*Lanius ludovicianus*	Summer
Northern Mockingbird	*Mimus polyglottos*	Summer/Winter
Brown Thrasher	*Toxostoma rufum*	Summer/Winter
Tufted Titmouse	*Baeolophus bicolor*	Summer/Winter
Carolina Chickadee	*Poecile carolinensis*	Summer/Winter
Pine Warbler	*Dendroica pinus*	Summer/Winter
Yellow-breasted Chat	*Icteria virens*	Summer
Prothonotary Warbler	*Protonotaria citrea*	Summer
American Redstart	*Setophaga ruticilla*	Summer
Hooded Warbler	*Wilsonia citrina*	Summer
Ovenbird	*Seiurus aurocapilla*	Summer
Louisiana Waterthrush	*Seiurus motacilla*	Summer
Black-and-White Warbler	*Mniotila varia*	Summer
Kentucky Warbler	*Oporornis formosus*	Summer
Common Yellowthroat	*Geothlypis trihas*	Summer

Commonly Occurring Bird Species of JST project		
Common Name	**Scientific Name**	**Season**
Hooded Warbler	*Wilsonia citrina*	Summer
Northern Parula	*Parula Americana*	Summer
Pine Warbler	*Dendroica pinus*	Summer
Yellow-throated Warbler	*Dendroica dominica*	Summer
Prairie Warbler	*Dendroica discolor*	Summer
Yellow-Breasted Chat	*Icteria virens*	Summer
Bachman's Sparrow	*Aimophila aestivalis*	Summer/Winter
Chipping Sparrow	*Spizella passerine*	Summer/Winter
Field Sparrow	*Spizella pusilla*	Summer/Winter
Grasshopper Sparrow	*Ammodramus savannarum*	Summer/Winter
Song Sparrow	*Melospiza melodia*	Summer/Winter
White-throated Sparrow	*Zonotrichia albicollis*	Winter
Summer Tananger	*Piranga rubra*	Summer
Northern Cardinal	*Cardinalis cardinalis*	Summer/Winter
Blue Grosbeak	*Passerina caerulea*	Summer/Winter
Indigo Bunting	*Passerina cyanea*	Summer
Red-winged Blackbird	*Agelaius phoeniceus*	Summer/Winter
Eastern Meadowlark	*Sturnella magna*	Summer
House Finch	*Carpodacus mexicnus*	Summer/Winter
American Goldfinch	*Carduelis tristis*	Summer/Winter
Ruby-crowned Kinglet	*Regulus calendula*	Winter
Brown-headed Nuthatch	*Sitta pusilla*	Summer/Winter
European Starling	*Sturnus vulgaris*	Summer/Winter
Blue-gray Gnatcatcher	*Polioptila caerulea*	Summer
Summer Tanager	*Piranga rubra*	Summer
Carolina Wren	*Thryothorus ludovicianus*	Summer/Winter
Wood Thrush	*Hylocichla mustelina*	Summer
Eastern Bluebird	*Sialia sialis*	Summer/Winter
American Robin	*Turdus migratorius*	Summer/Winter
Great Crested Flycatcher	*Myiarchus crinitus*	Summer
Eastern Phoebe	*Sayornis phoebe*	Summer
Eastern Kingbird	*Tyrannus tyrannus*	Summer
Red-eyed Vireo	*Vireo olivaceus*	Summer
White-eyed Vireo	*Vireo Grieus*	Summer
Pileated Woodpecker	*Dryocopus pileatus*	Summer/Winter
Red-bellied Woodpecker	*Melanerpes carolinus*	Summer/Winter
Red-headed Woodpecker	*Melanerpes erythrocephalus*	Summer/Winter
Downy Woodpecker	*Picoides pubescens*	Summer/Winter
Yellow-bellied Sapsucker	*Sphyrapicus varius*	Winter
Great Horned Owl	*Bubo virginianus*	Summer/Winter
Eastern Screech-Owl	*Megascops asio*	Summer/Winter
Barred Owl	*Strix varia*	Summer/Winter
**compiled from "Georgia Breeding Bird Atlas", Georgia Ornithological Society Records, UGA Museum of Natural History Records, and field observations		

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Common Mammals of JST Project	
Common Name	**Scientific Name**
Hispid Cotton Rat	*Sigmodon hispidus*
Golden Mouse	*Ochrotomys nuttalli*
Eastern Harvest Mouse	*Reithrodontomys humulis*
White-footed Mouse	*Peromyscus leucopus*
Cotton Mouse	*Peromyscus gossypinus*

Common Mammals of JST Project	
Common Name	**Scientific Name**
Common Muskrat	*Ondatra zibethicus*
Oldfield Mouse	*Peromyscus polionotus*
Southern Flying Squirrel	*Glaucomys volans*
Eastern Gray Squirrel	*Sciurus carolinensis*
Eastern Fox Squirrel	*Sciurus niger*
Eastern Chipmunk	*Tamias striatus*
Southern Short-tailed Shrew	*Blarina carolinensis*
Least Shrew	*Cryptotis parva*
Eastern Mole	*Scalopus aquaticus*
Eastern Cottontail	*Sylvilagus aquaticus*
Swamp Rabbit	*Sylvilagus floridanus*
Eastern Pipistrille	*Pipistrellus subflavus*
Rafineques Big Eared bat	*Corynorhinus rafinesquii*
Southeastern Myotis	*Myotis austroriparius*
Big Brown Bat	*Eptesicus fuscus*
Little Brown Bat	*Myotis lucifugus*
Silver-haired Bat	*Lasionycteris noctivagans*
Eastern Red Bat	*Lasiurus borealis*
Hoary Bat	*Lasiurus cinereus*
Seminole Bat	*Lasiurus seminolus*
Evening Bat	*Pipistrellus subflavus*
Coyote	*Canis latrans*
Gray Fox	*Urocyon cinereoargenteus*
Red Fox	*Vulpes vulpes*
Bobcat	*Lynx rufus*
Striped Skunk	*Mephitis mephitis*
Spotted Skunk	*Spilogale putorius*
Long-tailed Weasel	*Mustela frenata*
Mink	*Mustela vison*
Northern Raccoon	*Procyon lotor*
Northern River Otter	*Lontra canadensis*
Virginia Opossum	*Didelphis virginiana*
American Beaver	*Castor canadensis*
Nine-banded Armadillo	*Dasypus novemcinctus*
White-tailed Deer	*Odocoileus virginianus*

Common Reptiles of JST project	
Common Name	**Scientific Name**
Snakes	
Eastern Black Racer	*Coluber constrictor*
Corn Snake	*Elaphe guttata*
Rat Snake	*Elaphe obsoleta*
Eastern Hognose Snake	*Heterodon platirhinos*
Southern Hognose	*Heterodon simus*
Mole Snake	*Lampropeltis calligaster*
Eastern King Snake	*Lampropeltis getula*
Scarlet King	*Lampropeltis triangulum elapsoides*
Coachwhip	*Masticophis flagellum*
Plain-bellied Watersnake	*Nerodia erythrogaster*
Northern Watersnake	*Nerodia sipedon*
Brown Watersnake	*Nerodia taxispilota*
Rough Green Snake	*Opeodrys aestivus*

Common Reptiles of JST project	
Common Name	**Scientific Name**
Queen Snake	*Regina septemvittata*
Brown Snake	*Storeria dekayi*
Red-bellied Snake	*Storeria occipitomaculata*
Southeastern Crowned Snake	*Tantila coronata*
Eastern Ribbon Snake	*Thamnophis suaritus*
Common Garter Snake	*Thamnophis sirtalis*
Rough Earth Snake	*Virginia striatula*
Smooth Earth Snake	*Virginia valeriae*
Copperhead	*Agkistrodon contortrix*
Cottonmouth	*Agkistrodon piscivorus*
Timber Rattlesnake	*Crotalus horridus*
Pygmy Rattlesnake	*Sistrurus miliarius*
Lizards	
Eastern Fence Lizard	*Sceloporus undulatus*
Green Anole	*Anolis carolinensis*
Five-lined Skink	*Eumeces fasciatus*
Southeastern Five-lined Skink	*Eumeces inexpectatus*
Six-lined Racerunner	*Cnemidophorus sexlineatus*
Slender Glass Lizard	*Ophisaurus attenuatus*
Eastern Glass Lizard	*Ophisaurus ventralis*
Broadhead Skink	*Eumeces* laticeps
Ground Skink	*Scincella lateralis*
American Alligator	*Alligator mississippiensis*
Turtles	
Common Snapping Turtle	*Chelydra serpentina*
Eastern Box Turtle	*Terrapene carolina*
Pond Slider	*Trachemys scripta*
Painted Turtle	Chrysemys picta
River Cooter	Pseudemys coninna
Eastern Musk Turtle	Kinosternon subrubrum
Common Musk Turtle	Sternotherus odoratus
Spiny Softshell	*Apalone spinifera*
Compiled utilizing “Amphibians and Reptiles of Georgia”and the UGA Museum of Natural History Records website	

Common Amphibians of JST Project	
Common Name	**Scientific Name**
Frogs and Toads	
American Toad	*Bufo americanus*
Fowler's Toad	*Bufo fowleri*
Northern Cricket Frog	*Acris crepitans*
Bird-voiced Treefrog	*Hyla avivoca*
Cope's Gray Treefrog	*Hyla chrysoscelis*
Green Treefrog	*Hyla cinerea*
Barking Treefrog	*Hyla gratiosa*
Squirrel Treefrog	*Hyla squirella*
Spring Peeper	*Pseudacris crucifer*
Upland Chorus Frog	*Pseudacris feriarum*
Southern Chorus Frog	*Pseudacris nigrita*
Eastern Narrowmouth Toad	*Gastrophryne carolinensis*
Eastern Spadefoot Toad	*Scaphiopus holbrookii*
Bullfrog	*Rana catesbeiana*

Common Amphibians of JST Project	
Common Name	**Scientific Name**
Green Frog / Bronze Frog	*Rana clamitans*
Pickerel Frog	*Rana palustris*
Southern Leopard Frog	*Rana sphenocephala*
Salamanders	
Spotted Salamander	*Ambystoma maculatum*
Marbled Salamander	*Ambystoma opacum*
Mole Salamander	*Ambystoma talpoideum*
Two-toed Amphiuma	*Amphiuma means*
Spotted Dusky Salamander	*Desmognathus conanti*
Two-lined Salamander	*Eueycea bislineata complex*
Three-lined Salamander	*Eueycea guttolineatta*
Atlantic Coast Slimy Salamander	*Plethodon chlorobryonis*
Savannah Slimy Salamander	*Plethodon savannah*
Mud Salamander	*Pseudotriton montanus*
Red Salamander	*Pseudotriton ruber*
Compiled utilizing “Amphibians and Reptiles of Georgia”and the UGA Museum of Natural History Records website	

Commonly Occurring Fish Species of JST Project	
Common Name	**Scientific Name**
Game Fish	
Bass	***Serranidae***
Striped bass*	*Morone saxatilis*
White bass	*Morone chrysops*
Hybrid bass*	*Morone saxaltils x Morone chrysops*
White perch	*Morone americana*
Sunfish	***Centrarchidae***
Largemouth bass	*Micropterus salmoides*
Black crappie	*Pomoxis migromaculatus*
White crappie	*Pomoxis annularis*
Bluegill	*Lepomis macrochirus*
Redbreast	*Lepomis auritus*
Green sunfish	*Lepomis cyanellus*
Pumpkinseed	*Lepomis gibbosus*
Flier	*Centrarchus macropterus*
Warmouth	*Chaenobryttus coronaris*
Redear	*Lepomis microlophus*
Perch	***Percidae***
Yellow perch	*Perca flavescens*
Rough Fish	
Catfish	***Lepisosteidae***
Channel catfish	*Ictalurus punctatus*
White catfish	*Ictalurus catus*
Flat bullhead	*Ictalurus platycephalus*
Brown bullhead	*Ictalurus nebulosus*
Flathead catfish	*Pylodictis olivaris*
Other	
Longnose gar	*Lepospsteus osseus*
Chain pickeral (jack)	*Esox niger*
Redhorse sucker	*Maxostoma spp.*
Northern hogsucker	*Hypentelium nigricans*
Spotted sucker	*Minytrema melanops*

Commonly Occurring Fish Species of JST Project	
Common Name	**Scientific Name**
Carp	*Cyprinus carpio*
Forage Species	
Shad and herring	***Clupeidae***
Gizzard shad	*Dorosoma cepedianum*
Threadfin shad	*Dorosoma petenense*
Blueback herring	*Alosa aestivalis*
Minnows	***Cyprinidae***
Spottail shiner	*Notropics hudsonius*
Golden shiner	*Notemigonus chrysoleucas*
Livebearers	***Poeciliidae***
Mosquito fish	*Gambusia affinis*
*Stocked Species	

Appendix E:
Comments and Responses to Comments

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