A thirty year history of grass carp studies

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EE-A

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ERDC
Engineer Research and Development Center

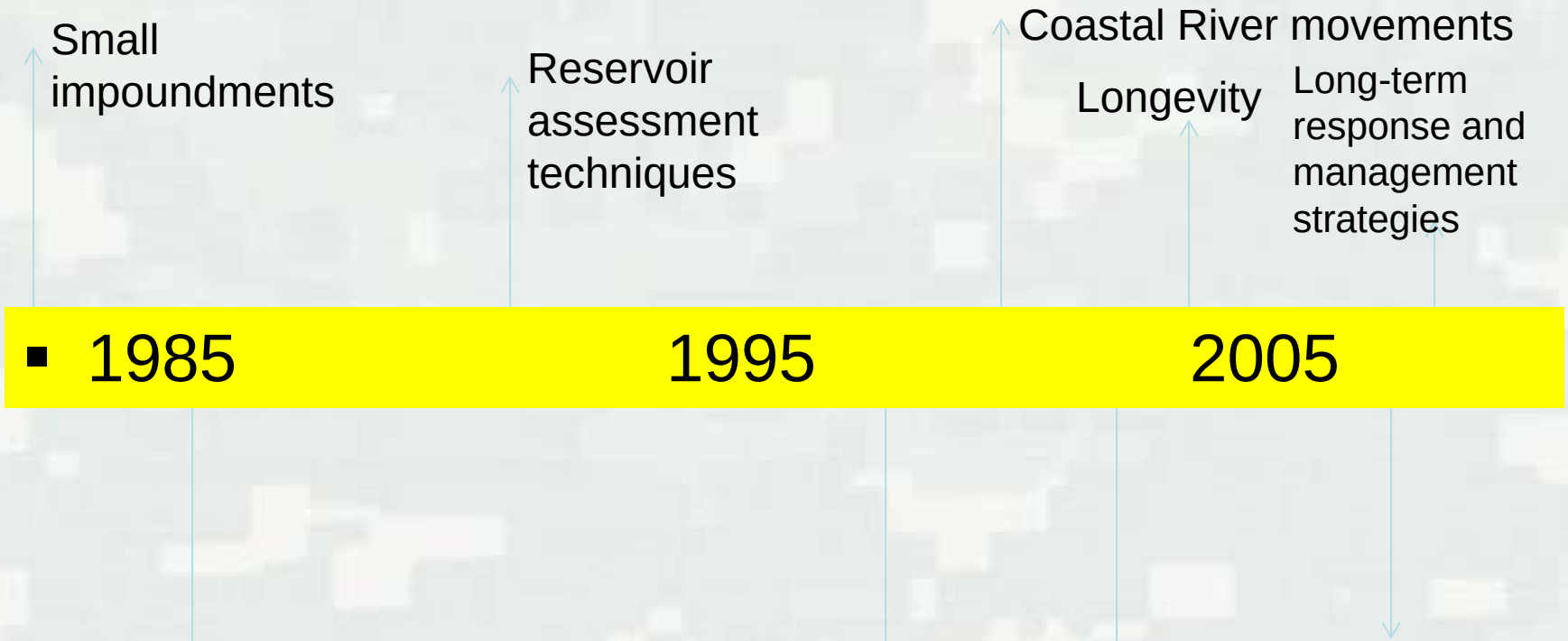
US Army Corps of Engineers®

Research Objectives:

A better understanding of grass carp biology

To make the triploid grass carp an improved management tool for primarily hydrilla in reservoirs

A timeline of grass carp studies



Small impoundment studies

Small impoundment studies were conducted in over 30 small impoundments in South Carolina

Different stocking rates were evaluated as well as grass carp survival

Early survival erratic with major management consequences

Larger minimum size recommended and care in hauling to release site – important for reservoir use

Kirk, J. P. 1992. Efficacy of triploid grass carp in controlling nuisance aquatic vegetation in South Carolina farm ponds. North American Journal of Fisheries Management 12:581-584.

Early reservoir studies

Conducted in Lake Guntersville, Alabama and the Santee Cooper reservoirs, South Carolina

Studies evaluated fish communities

Movements

Grass carp growth

Killgore, K. J., J. P. Kirk, and J. W. Foltz.1998. Response of littoral fishes in upper Lake Marion, South Carolina following hydrilla control by triploid grass carp. Journal of Aquatic Plant Management 36:82-87

Morrow, J. V. and J. P. Kirk. 1995. Age and growth of grass carp in Lake Guntersville, Alabama. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 49:464-473

Development of assessment techniques and population estimates

- Developed collection techniques using bowfishers after conventional sampling methods failed
- Bowfishing now the standard collection method
- Developed age and growth techniques
- Used population modeling to predict densities
- Provided input to decision makers for the last 20 years

Morrow, J. V., J. P. Kirk, and K. J. Killgore. 1997. Age, growth, and population attributes of triploid grass carp stocked into the Santee Cooper reservoirs, South Carolina. North American Journal of Fisheries Management 17:38-43

Kirk, J. P., J.V. Morrow, Jr., K. J.Killgore, S. J. deKozlowski, and J. W. Preacher. 2000. Response of triploid grass carp to declining levels of hydrilla in the Santee Cooper reservoirs, South Carolina. Journal of Aquatic Plant Management 38-14-17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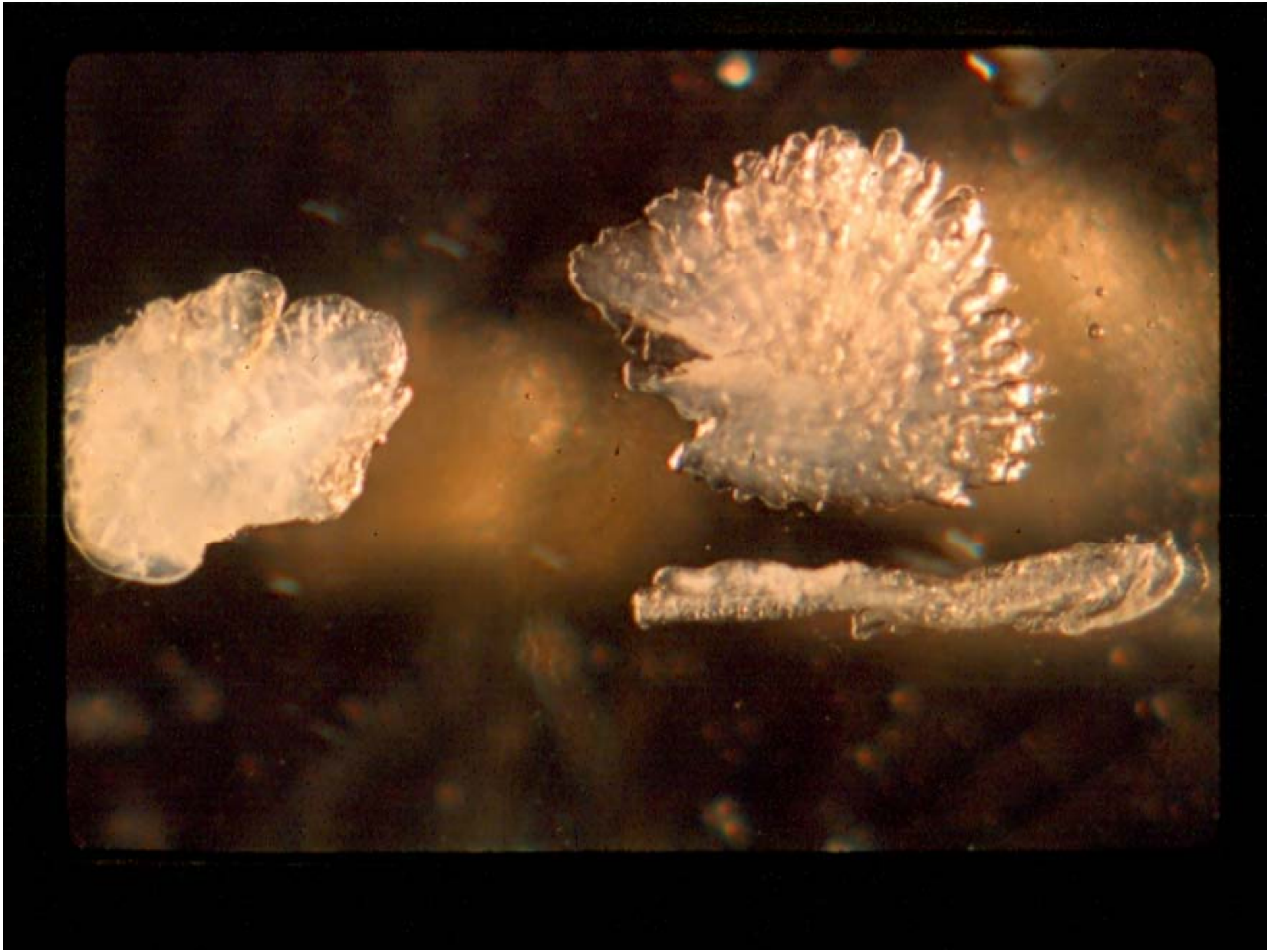
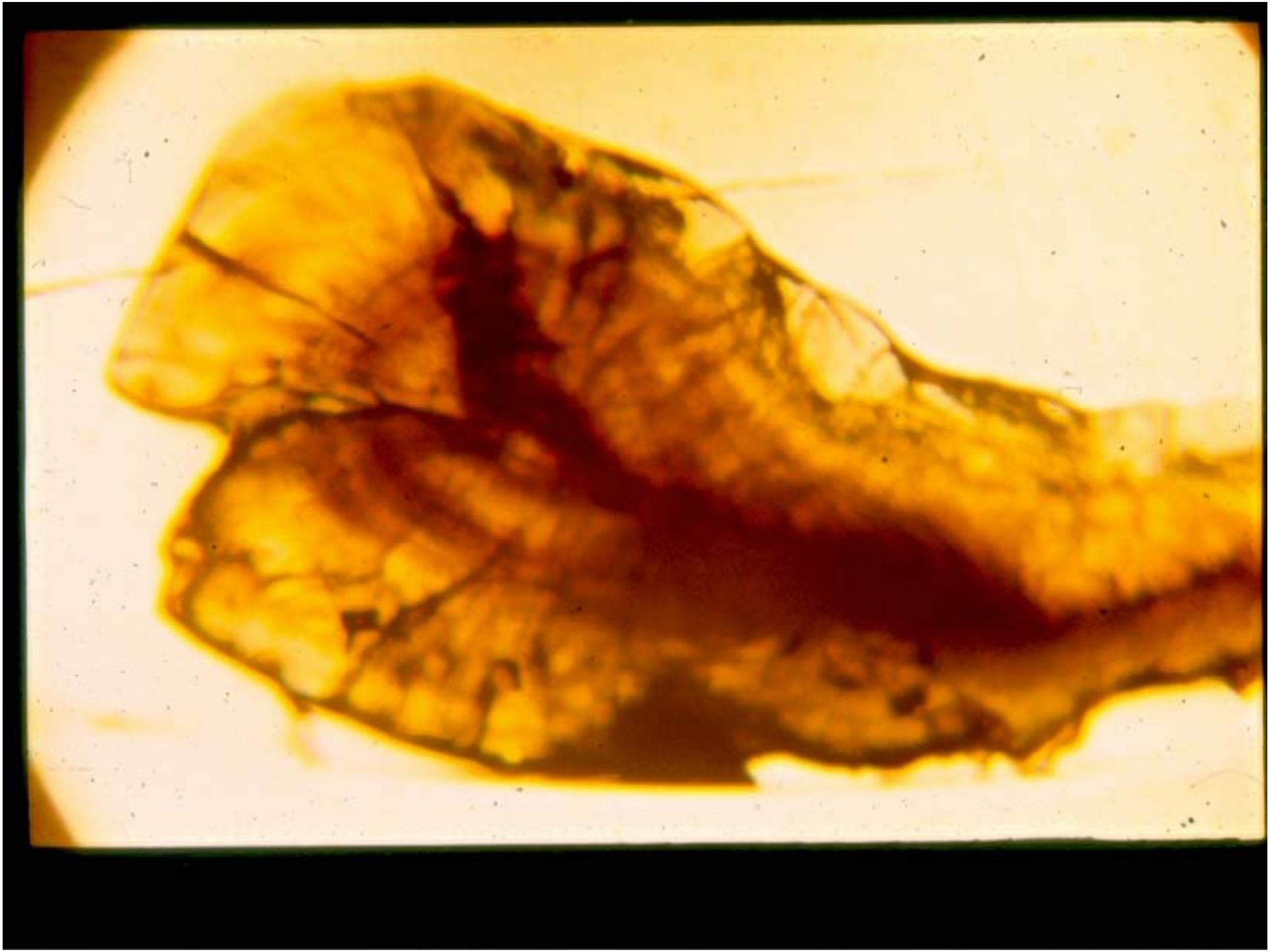




Potential environmental impacts evaluated

- Grass carp movements evaluated via telemetry
- Water quality (dissolved oxygen and temperature studies)
- Movements in coastal rivers – critical question for some government agencies

Chappelear, J. W. Foltz, K. T. Chavis, J. P. Kirk, and K. J. Killgore. 1991. Movements and habitat utilization of triploid grass carp in Lake Marion, South Carolina. Proceedings 25th Annual Meeting, Aquatic Plant Control Research Program. Miscellaneous Paper A-91-3: 157-165. U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, MS

Robinson, M. S., J. W. Foltz, and J. P. Kirk. 1993. Aquatic vegetation and water quality in Lake Marion, South Carolina. Proceedings 27th Annual Meeting, Aquatic Plant Control Research Program. Miscellaneous Paper A-93-2: 264-278. U. S. Army Engineer Waterways Experiment Station, CE, Vicksburg, MS.

Kirk, J. P., K. J. Killgore, J.V. Morrow, Jr., S. D. Lamprecht, and D. W. Cooke. 2001. Movements of triploid grass carp in the Cooper River, South Carolina. Journal of Aquatic Plant Management. 39:59-62

Life span evaluations

- Average life span evaluated based upon reservoir studies
- Used long-term data sets
- Important parameter in population models
- Assists with maintenance stocking strategies
- Life span varies: studies still continue

Kirk, J. P. and R. C. Socha. 2003. Longevity and persistence of triploid grass carp stocked into the Santee Cooper reservoirs of South Carolina. Journal of Aquatic Plant Management 41:90-92

Collection using skilled archers

Fish team age and growth lab

Socio-economic ramifications of vegetation management

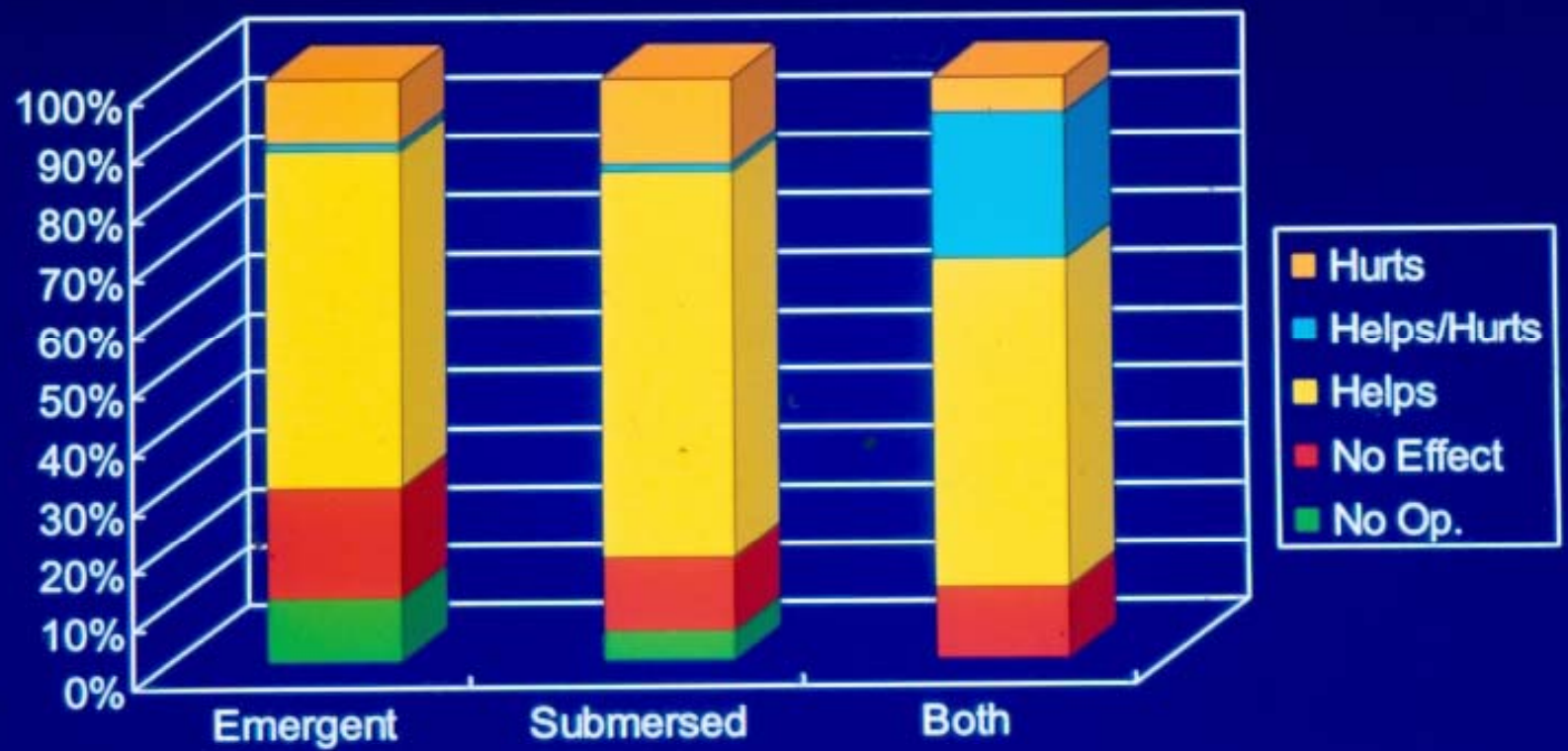
Inter-disciplinary studies conducted with other ERDC scientists and the South Carolina Department of Natural Resources

Used economic models and software and angler creeling (surveys)

Anglers strongly prefer aquatic vegetation –even hydrilla

Henderson, J. E., J. P. Kirk, S. D. Lamprecht, and W. E. Hayes. 2003. Economic impacts of aquatic vegetation to angling in two South Carolina reservoirs. Journal of Aquatic Plant Management 41:53-56

Effect of Plants on Fishing – Lake Murray



Long-term responses of hydrilla and triploid grass carp

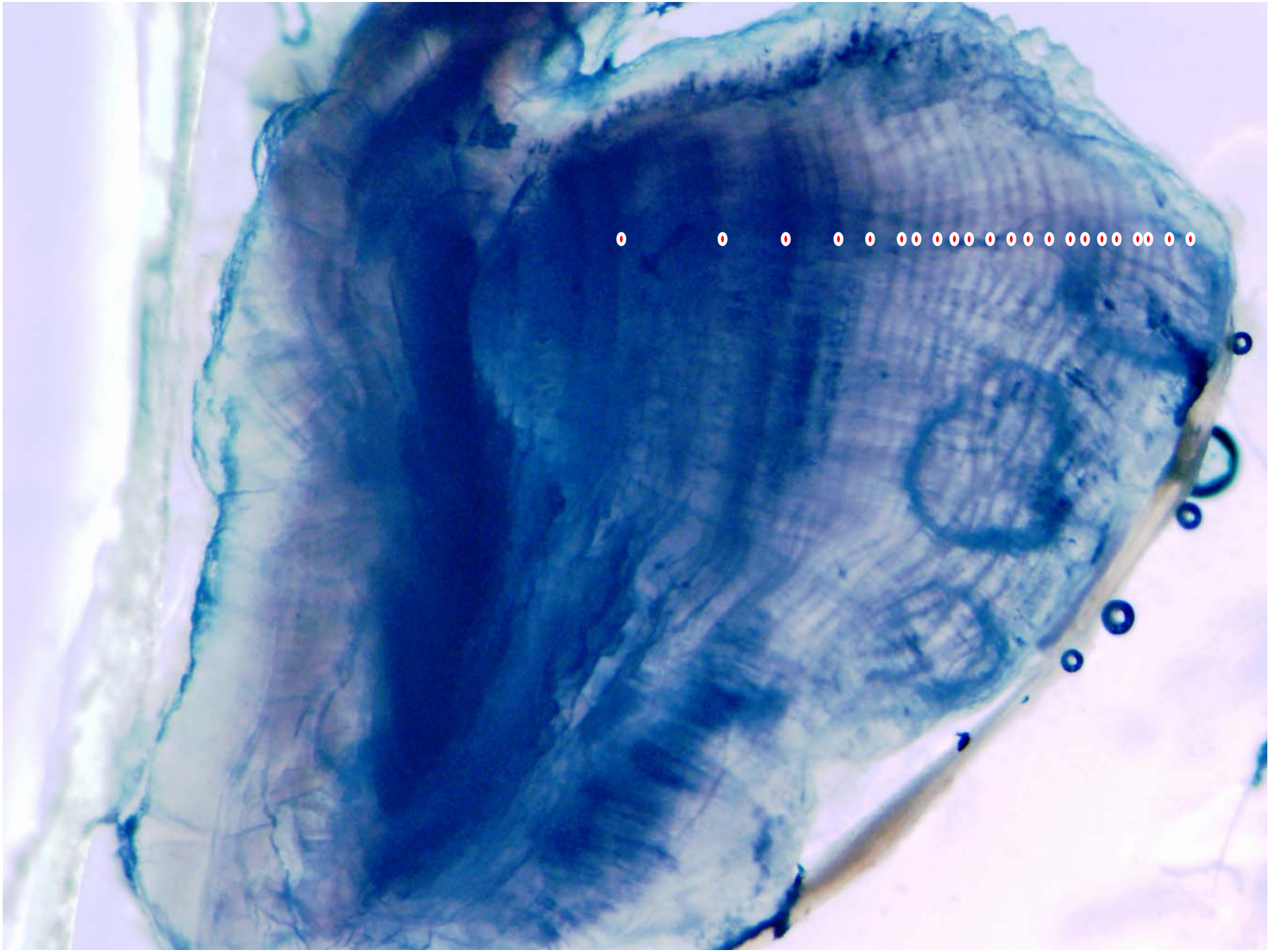
Evaluated grass carp populations during and after hydrilla control

Documented successful management in the Santee Cooper system

Shared the twenty year history of grass carp stocked to control hydrilla, the success of management strategies, and public response to hydrilla control

Kirk, J. P., J.V. Morrow, Jr., K. J.Killgore, S. J. deKozlowski, and J. W. Preacher. 2000. Response of triploid grass carp to declining levels of hydrilla in the Santee Cooper reservoirs, South Carolina. Journal of Aquatic Plant Management 38:14-17

Kirk, J. P. and J. E. Henderson. 2006. Management of hydrilla in the Santee Cooper Reservoirs, South Carolina: experiences from 1984 to 2004. Journal of Aquatic Plant Management 44:98-103



Life span limitation devices and patents

The idea of Dr. Steve Miranda, USGS

A response to problems in Florida

More research needed to develop a toxicant and delivery system

ERDC critical in patent application process

Thomas, R. M., L. E. Miranda, and J. P. Kirk. 2006. Feasibility of an implantable capsule for limiting lifespan of grass carp. Journal of Aquatic Plant Management 44:80-89

US patents granted: 7,156,049; 7,350,479; and 8,156,879B2

US 8,156,897 B2

US008156897B2

(12) **United States Patent**
Evans et al.

(10) **Patent No.: US 8,156,897 B2**
(45) **Date of Patent: Apr. 17, 2012**

(54) **"IMPLANT AND FORGET" MECHANISM TO INTERACT WITH BIOTA, IN PARTICULAR FAUNA THAT MAY OUTGROW AVAILABLE HABITAT AND METHOD OF USE THEREOF**

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(73) Assignee: **The United States of America as represented by the Secretary of the Army**, Washington, DC (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1118 days.

(21) Appl. No.: **12/008,538**

(22) Filed: **Jan. 7, 2008**

(65) **Prior Publication Data**

US 2008/0110407 A1 May 15, 2008

Related U.S. Application Data

(60) Division of application No. 11/179,541, filed on Jul. 13, 2005, now Pat. No. 7,350,479, and a continuation-in-part of application No. 10/943,646, filed on Sep. 10, 2004, now Pat. No. 7,156,049.

(51) **Int. Cl.**
A01K 61/00 (2006.01)

(52) **U.S. Cl.** **119/215**; 119/174; 43/4.5; 43/1

(58) **Field of Classification Search** 119/215, 119/174, 712, 860; 43/1, 4.5

See application file for complete search history.

(56) **References Cited**

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5,939,453	A		8/1999	Heller et al.
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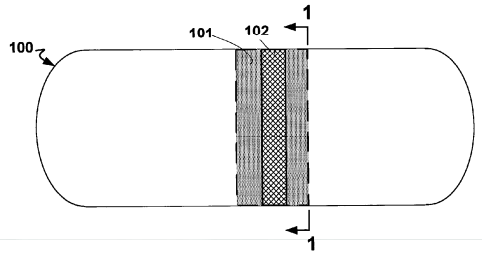
(Continued)

Primary Examiner — Joshua J Michener
(74) *Attorney, Agent, or Firm* — Earl H. Baugher, Jr.

(57) **ABSTRACT**

An "implant and forget" device for interacting with biota after a pre-established time period. Preferably, the biota are fauna and more particularly fish. In select embodiments, the device comprises packaging enclosing an apparatus for timing interaction via opening the packaging. In select embodiments of the present invention, the device is a sealed capsule inserted in fish. Embodiments of the present invention are implanted in triploid grass carp (*Ctenopharyngodon idella*) to facilitate control of aquatic weeds in bodies of water. When the carp have been in the water for a pre-established approximate period of time, toxins in the device are dispensed via long term bioerosion of the sealed opening in the packaging. Otherwise, the carp may destroy all vegetation and harm the aquatic environment for other aquatic life. Several alternative bioerodible seal configurations are provided as embodiments.

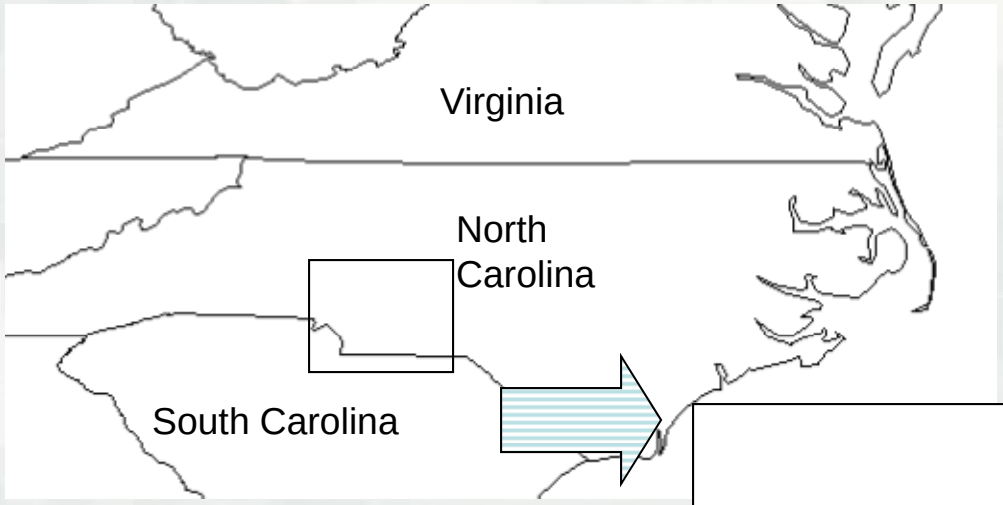
8 Claims, 4 Drawing Sheets

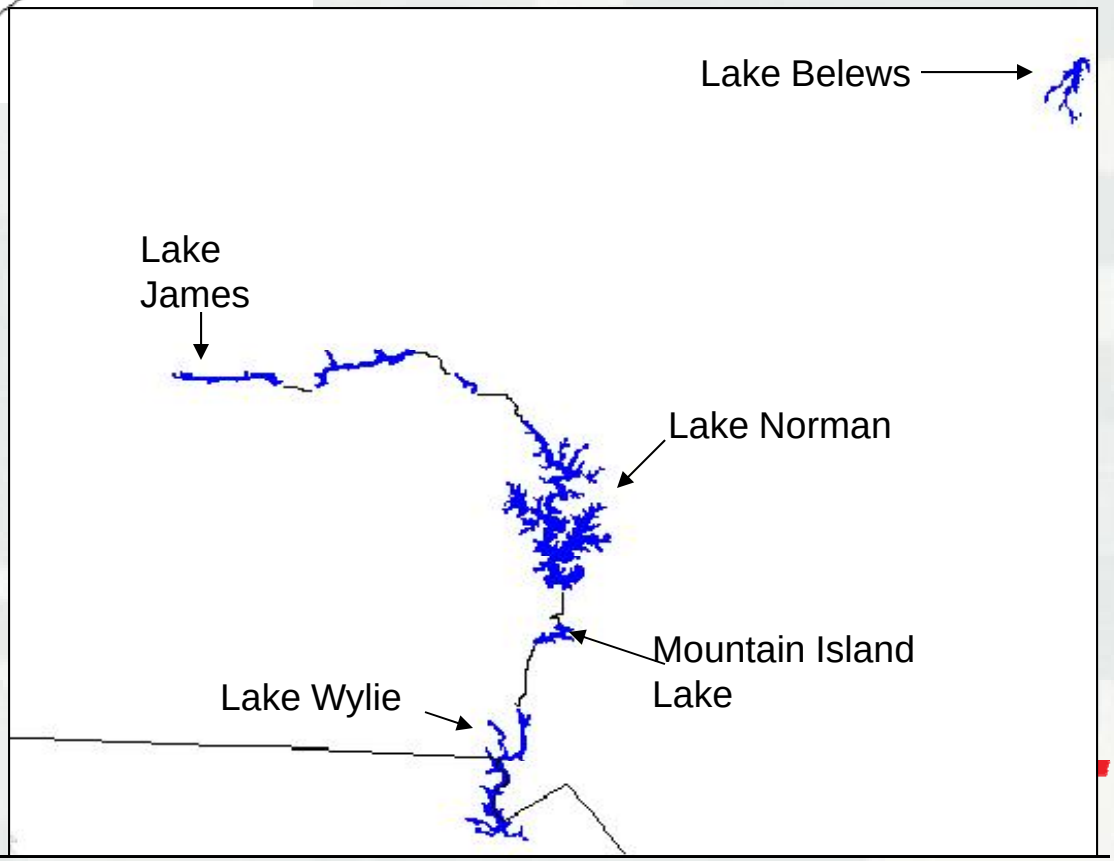


Hydrilla management strategies developed in Duke Energy reservoirs

- Developed a successful hydrilla management strategy in five reservoirs: Belews, James, Mt. Island, Norman, and Wylie
- Integrated registered herbicides, triploid grass carp at 20/vegetated acre, and maintenance stockings
- Success with smaller and smaller infestations – eventually controlled hydrilla at 1% reservoirs coverage

Study sites


Virginia
North Carolina
South Carolina


Lake Belews
Lake James
Lake Norman
Mountain Island Lake
Lake Wylie

Important summary statistics

Reservoir	Surface area	Potential infestation	Infested area	Lag period in control
Norman	32,475	8,000	400	No
Mountain Island	3,281	1,200	1,000	Yes
James	6,812	1,400	1,050	No
Belews	3,663	920	106	No
Wylie	13,443	3,400	90	No

Piedmont reservoirs: take home points

In Piedmont reservoirs – success should be routine

Early detection, mapping, and response are critical

Integrate herbicides and triploid grass carp - use early and decisively

Hydrilla infestations unlikely to be eliminated in the short-term – hence maintenance stocking

Hydrilla management difficult if 1) hydrilla mixed with submersed vegetation or 2) rapidly expanding

Current management recommendations

- Small impoundments managed for “balance”
- Most reservoirs
- Water bodies in Florida
- The Santee Cooper reservoirs

Small impoundments

- Are fertilized for fish production
- Manage without vegetation
- Stock grass carp to prevent aquatic vegetation
- Stocking rates depend on location and length of growing season
- Management strategy in place size the 1960's

Most reservoirs

- Submersed native vegetation usually sparse
- Detect hydrilla early and suppress with registered herbicides
- Stock grass carp at 20/vegetated acre
- Control feasible at 1% coverage
- Maintain grass carp for 10 to 20 years for controlling re-growth of hydrilla

Hydrilla control in Florida

- Grass carp are usually not satisfactory
- Long-term depletions of all vegetation
- Issues with herbicides too – resistance and cost
- Much more research needed and a possible role for life span limitation devices

The Santee Cooper reservoirs

- A hybrid between Florida systems and most reservoirs
- A coastal plain system with a history of nuisance aquatic vegetation
- Herbicides alone failed to control hydrilla from 1982 to 1989
- Hydrilla expanded to 48,000 acres before control by grass carp in 1997
- Initially submersed vegetation eliminated but then expanded to approximately 16,000 acres
- Grass carp densities of 1 per 8 surface acres controlled hydrilla but allowed native species to flourish
- Hydrilla controlled from 1997 to about 2005 but now is rapidly expanding
- Approximately 140,000 triploid grass carp have been stocked since 2007

Current work and future directions

Performing long-term survival studies (10 – 22 years)

Very different regional responses

Exploring opportunities to work in different regions of the country