



Grass Carp for Biocontrol



1

Background


- Common Names: grass carp, white amur, waan ue
- Scientific Name: *Ctenopharyngodon idella* Greek for "comb-like throat teeth"
- Native to large river systems in Asia and the eastern portion of the former U.S.S.R.
- Grass carp can now be found in 93 countries; 47 states (except: Alaska, Montana, and Rhode Island)



2

A Brief History

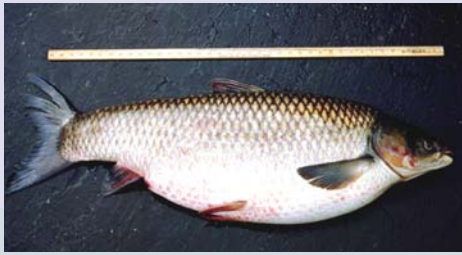
- First imported to the U.S. in 1963 to control aquatic vegetation in aquaculture ponds
- First imported into Florida in 1970 by USDA
- Reproducing population was discovered in 1971 in the Mississippi drainage system
- Sterile carp were first produced in the U.S. in 1979 as inter-specific crosses between female grass carp and male bighead carp *Aristichthys nobilis* (Malone 1982)



3

Commonly Reach 30 lbs or More

- Records:
- weight 99 lbs
 - length 4.9 feet

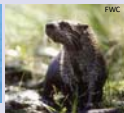


4

Typically Live 10-15 Years, Unless...



American Alligator



River Otter



Osprey



Largemouth Bass

THURSDAY, OCTOBER 22, 1998 • THE LEDGER

51-POUND GRASS CARP



Alex Ratcliff of Winter Haven, 12, managed to land this 51-pound grass carp on a Zebco 33, closed-face reel spooled with 12-pound-test line. Alex, a 6th-grader at Westwood Middle School, was fishing with a bread ball when the huge specimen of this vegetarian species came along. Grass carp are hybrids introduced into Florida waters to battle hydrilla. They are rarely caught on hook and line.



5

Typically Live 10-15 Years, Unless...

ATTENTION

TRIPLOID GRASS CARP
HAVE BEEN STOCKED IN
THESE WATERS TO
CONTROL EXCESSIVE
AQUATIC VEGETATION



IF CAUGHT PLEASE RELEASE
IMMEDIATELY AND UNHARMED

THESE FISH ARE ILLEGAL TO
POSSESS WITHOUT A PERMIT



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6

Largemouth Bass Predation Studies

Largemouth bass have the gap size to consume large prey



Study 1: You need to stock 7.8" or larger grass carp to avoid predation by 12.8" or smaller largemouth bass

Study 2: Bass size vs maximum size carp it could eat:

Bass Size (Inches)	Grass Carp Size (Inches)
12	7
18	11.5
24	16



7

Triploid Production



➤ Fertilized eggs are subjected to hydrostatic pressure resulting in three sets of chromosomes rendering the fish sterile



8

Grass Carp Feeding Preferences Frequently Eaten

- Brazilian Elodea (*Egeria densa*)
- **Duckweed**
- Elodea
- Hydrilla
- Musk Grass (*Chara*)
- Pondweed
- Slender Spikerush
- Southern Naiad
- Widgeon Grass



Duckweed



Hydrilla



9

Grass Carp Feeding Preferences Sometimes Eaten


- > Algae, Filamentous
- > Baby Tears
- > Bacopa
- > Banana Lily
- > Bladderwort
- > Bog Moss
- > Bulrush
- > Cattail
- > Coontail
- > Fanwort
- > Hygrophila
- > Knotgrass
- > Limnophila
- > Maidencane
- > Marine Naiad
- > *Nitella* spp. (Stonewort)
- > Rush Fuirena
- > Soft Rush
- > Southern Water grass
- > Spikerush
- > Water Meal
- > Water Shield



10

Grass Carp Feeding Preferences Rarely Eaten

- > Algae, Planktonic
- > Alligator Weed
- > American Lotus
- > Azolla (Mosquito Fern)
- > Burhead Sedge
- > Common Arrowhead
- > Duck Potato
- > Eelgrass
- > Frog's Bit
- > Para Grass
- > Parrot's Feather
- > Pennywort (Dollarweed)
- > Pickerelweed
- > Red Ludwigia
- > *Salvinia* spp.
- > Sedges
- > Smartweed
- > Spatterdock
- > **Torpedo grass**
- > Water Paspalum
- > **Water Hyacinth**
- > **Water Lettuce**
- > Water Lily
- > Wild Taro



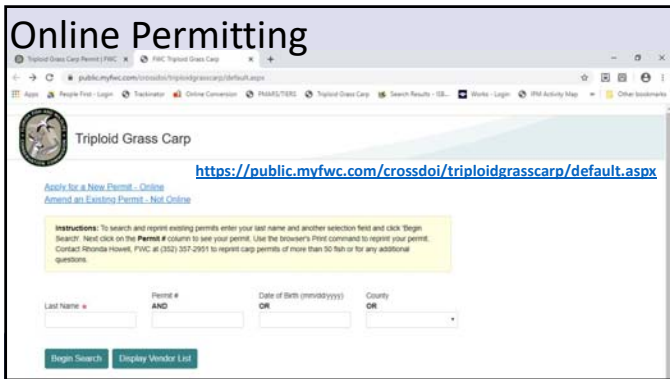
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Permit Status in Southeastern U.S.

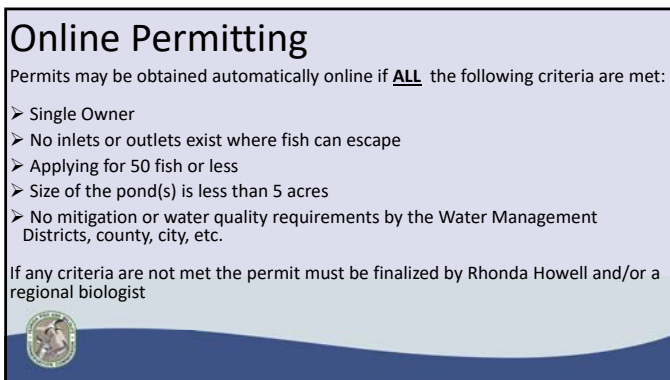
State	Status	Genetic Requirements
Alabama	Legal - no permits required	Diploid or triploid
Arkansas	Legal - no permits required	Diploid or triploid
Florida	Legal - permit required	Triploid only
Georgia	Legal - permit required	Triploid only
Kentucky	Legal - permit required	Triploid only
Louisiana	Legal - permit required	Triploid only
Mississippi	Legal - permit required	Diploid or triploid
North Carolina	Legal - permit required	Triploid only
Oklahoma	Legal - no permits required	Triploid only
Puerto Rico	Legal - dealers permitted	Diploid or triploid
South Carolina	Legal - permit required	Triploid only
Tennessee	Legal - dealers permitted	Triploid only
Texas	Legal - permit required	Triploid only
Virginia	Legal - permit required	Triploid only
Virgin Islands	Legal - not available	Diploid or triploid

Information from the Southern Regional Aquaculture Center July 2002 Publication

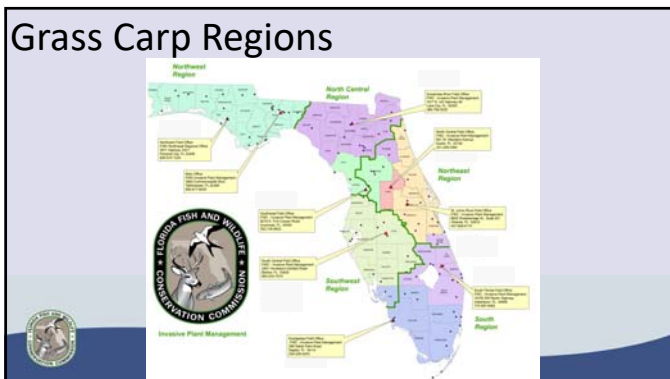
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13



14



15

Permits Issued Statewide

Fiscal Year	Total Permits Issued	New Permits	Amendments
2014/2015	1,056	532	524
2015/2016	986	542	444
2016/2017	998	523	475
2017/2018	915	448	467
2018/2019	950	481	469



16

Fish Barriers

- Sturdy construction
- Gaps must be 1.5" or less
- Bars can be vertical or horizontal
- Overflow should allow for major rain events to alleviate flooding



17

Fish Barriers



18

Barrier Issues – Maintenance/Vandalism



19

Barrier Issues – Water Movement/Flooding



20

Barrier Issues – Poor Construction/Design



21

Barrier Issues – Water Direction/Pressure



22

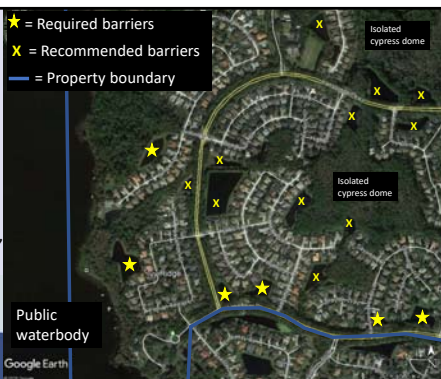
Barrier Issues – Size/Location



23

Barrier Locations

- Required vs Recommended
- What do the ponds connect to?
 - Off site waterbodies
 - Other ponds, ditches, natural areas on site
- Street drains



24

Stocking Rates

Stocking rates are difficult to predict due to:

- Differences in vegetation coverage and densities (e.g., total plant acreage compared to total water body acreage)
- Weather events (e.g., droughts, hurricanes)
- Plant species present

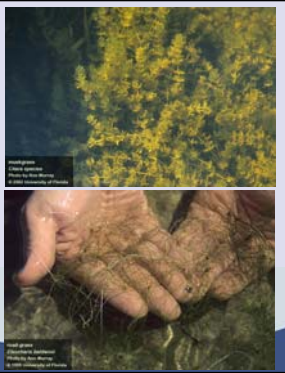


25

Stocking Rates (cont.)

For 100% coverage of small ponds (<5 acres), using only grass carp, the recommended stocking rates are:

- 10 fish/acre for Hydrilla and Elodea
- 15 fish/acre for Chara, Southern Naiad, Pondweed
- 20 fish/acre for Roadgrass, Duckweed, Bladderwort
- 30 fish/acre for Filamentous Algae



26

Feeding Rates

- Depends on age/size of carp, ambient temperature, dissolved oxygen, size, location, & plant species found
- For a herbivore, carp have a short gut which allows them to process and eliminate plant material quickly
- In U.S. feeding begins ~52°F, optimal between 68-86°F, declines above 86°F
- In Florida, cease feeding below ~61°F
- Tend to be less selective at higher temperatures
- Selective grazing may result in expansion of aggressive unpalatable plant species



27

Feeding Rates


Study 1 - Hydrilla (Sanders et al. 1991)

Carp Weight (lbs)	% Eaten/Body Wt/Day (lbs/day)
<6.6	~100 (6.6 lbs)
6.6-13.2 (Avg. 9.9)	75 (7.4 lbs)
>13.2	26-28 (3.6 lbs)

Study 2 - Brazilian Elodea (Osborne and Sassic 1981)

Carp Weight (lbs)	% Eaten/Body Wt/Day (lbs/day)
5.5	76 (4.2 lbs)
14.3	25 (3.6 lbs)
31.1	0.5 (1.6 lbs)

In Central FL grass carp can reach 31 lbs by year three!




28

Salinity Tolerance

- Tolerant of low salinity levels and may move from one river to another through brackish-water estuaries
- 2+ year old carp survived 10.5ppt salinity for ~24 days and 17.5ppt for 5 hours. (Atlantic Ocean 33-37ppt; Gulf of Mexico 28-32ppt; Mississippi River delta 5-10ppt)
- Studies showed that fingerlings reduce feeding at 9 ppt and stop feeding at 12 ppt. Adults fed on smooth cordgrass (*Spartina alterniflora*) in Galveston Bay, TX at 9ppt, but lost weight



Information from the USGS Nonindigenous Aquatic Species website.



29

Movement - Telemetry Studies


- High rate of movement (first 7-10 days lake and 6-12 weeks canals) after stocking emphasizes the importance of installing and maintaining barriers
- Reluctant to move into or spend much time in shallow (<3.3' deep) narrow canals
- Preference for less confined areas (wide deep canals, canal intersections)

30

Movement - Telemetry Studies


- River study showed carp moved average of 9 miles from release point; 98% of carp moved 12.5 miles or less, but hydrilla was present throughout river
- 70% of sightings by hydrilla stands



31

Public Lakes


- Stocking request is sent to or initiated by FWC.
- For small waterbodies or ones without a Working Group, a Waterbody Specific Team is created including:
 - FWC Invasive Plant Management Regional Biologist
 - FWC Waterfowl Biologist
 - FWC Freshwater Fisheries Biologist
 - FWC Aquatic Habitat Restoration and Enhancement Section Biologist
 - Local cooperators (if there is one for the waterbody)
- For large or high profile waterbodies with a Working Group:
 - Above biologists plus the FWC Snail Kite biologist



32

Public Lakes

The Team or Working Group reviews the request and cost effectiveness related to other control options, inspects the waterbody (if necessary), and determines if the stocking of TGC will be a benefit to the waterbody.



33

Just Some Reminders!

- Be very conservative in large water bodies using acres of vegetation instead of surface water acres
- There is **always** the possibility of the lake becoming **totally cleared** of aquatic vegetation (shift from aquatic macrophytes to phytoplankton based ecosystem)
- Use adaptive management (grass carp + herbicide)
- Plan on re-stocking every 3-5 years
- Be patient!!!
- Questions call Rhonda Howell at 352-357-2951



34

Citations

Cassani, J.R., editor. 1996. Managing Aquatic Vegetation with Grass Carp, A Guide for Water Resource Managers. American Fisheries Society, Bethesda, Maryland.

Cassani, J.R. 1988. Potential of Triploid Grass Carp for Managing Aquatic Vegetation in a Municipal Canal System. Final Report to the Florida Dept. of Natural Resources, Bureau of Aquatic Plant Management, 100pp.

Cassani, J.R. and D.M. Maloney. 1991. Grass carp movement in two morphologically diverse reservoirs. *Journal of Aquatic Plant Management* 29:83-88.

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.

Osborne, J.A. and N.M. Sassic. 1981. The size of grass carp as a factor in the control of hydrilla. *Aquatic Botany* 11:129-136.

Sanders, L., J.J. Hoover and K.J. Killgore. 1991. Triploid grass carp as a biological control of aquatic vegetation. Aquatic Plant Control Research Program A-91-2. U.S. Army Engineers Waterways Experiment Station, Vicksburg, Mississippi.



35

Michael Sowinski
Florida Fish & Wildlife Conservation Commission
2001 Homeland-Garfield Road
Bartow FL 33830
michael.sowinski@myfwc.com
Office: 863-578-1123



36
