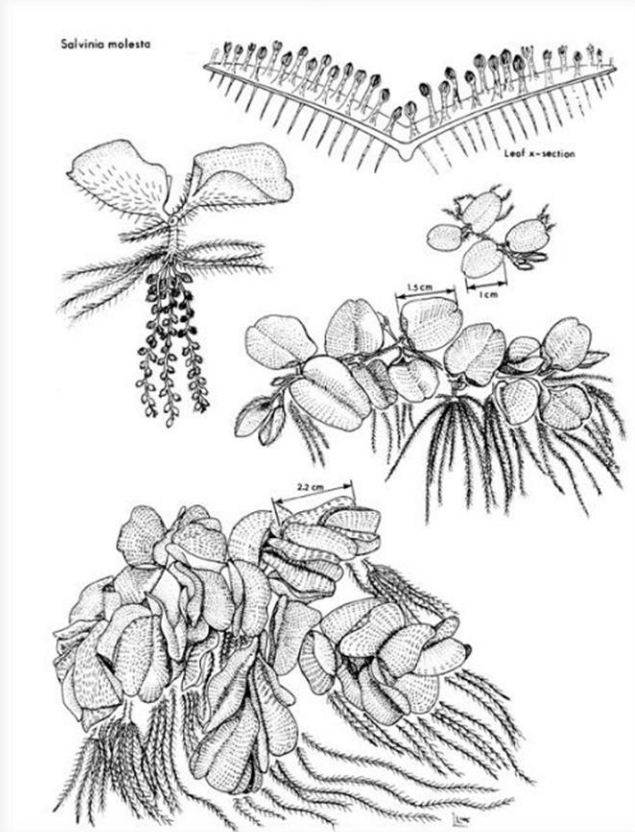


LOUISIANA: AQUATIC PLANT MANAGEMENT

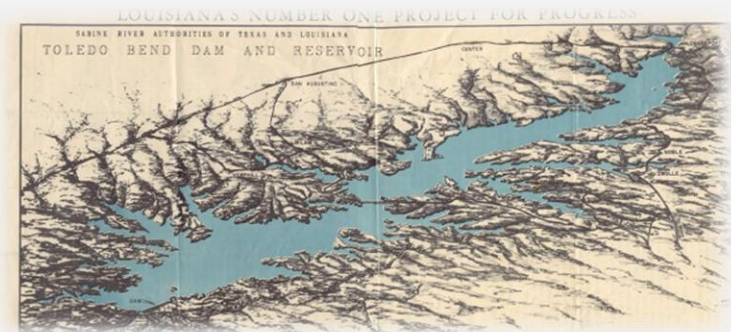


Daniel C. Hill | Arkansas Chapter of the American Fisheries Society | August 9, 2023

GIANT SALVINIA – *Salvinia molesta*



- Native to Southeastern Brazil
- Problem in Australia, Africa, Asia, and US
- Spreads by fragmentation
- Rapid establishment
- Probably entered US in water garden trade



ECOLOGY



**Giant
salvinia**



- **Free-floating aquatic fern, rootless**
- **3 Growth Phases: primary, secondary, tertiary**
- **Leaf surfaces resemble “egg-beater”**
- **Reproduction is strictly vegetative as spores are sterile**
- **Under favorable natural conditions, biomass can double in about one week to 10 days*****
- **Freshwater species, not tolerating brackish or marine environments**

WATER HYACINTH – *Eichhornia crassipes*



- **Native to South America**
- **Problem in most of the frost-free regions of the world**
- **Rapid establishment by producing stolons or "daughter" plants**
- **1884 Cotton Exposition in New Orleans**



ECOLOGY

Water hyacinth



- Fragmentation of stolons and to a lesser extent via seeds
- Under favorable natural conditions, biomass can double in 6 - 14 days
- Freshwater species

CUBAN BULRUSH –

Oxycaryum cubense/Scirpus cubensis



Burhead sedge
Oxycaryum cubense (syn. *Scirpus cubensis*)
Photo by Ann Murray
© 1999 University of Florida

[Center for Aquatic and Invasive Plants | University of Florida, IFAS \(ufl.edu\)](http://Center for Aquatic and Invasive Plants | University of Florida, IFAS (ufl.edu))

- Native to South America & West Indies
- Epiphytic perennial floating herb
- Triangular stem (sedge)
- Likely entered US via ship ballasts
- Forms floating mats...

ECOLOGY

Cuban bulrush



- **Triangular stem up to 92 cm**
- **Slender leaves form at the base of the stem**
- **Reddish runners form mass, together or with the roots/rhizomes of other plants to form floating mats creating “floaton”**
- **Multiple inflorescences: umbellate or monocephalous**
- **Seeds form spring through fall**

ENVIRONMENTAL IMPACT



- **Displaces all other floating vegetation, native and nonnative**
- **Once dense mats are formed, virtually all sunlight is blocked, killing all submersed vegetation**
- **Causes reduced DO levels making large expanses unusable**
- **Serves as vectors for other invasives... Apple Snails**

ECONOMIC IMPACT

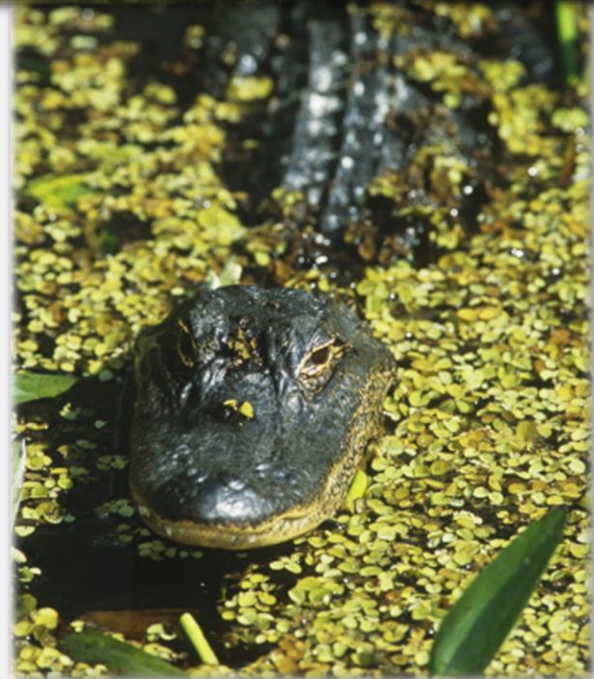


- **Limits boating access (hunting, fishing, shipping and recreational activities)**
- **Decreases property value**
- **Reduces tourism (swamp tours, aesthetic appearance of lakes)**
- **Cost associated with control efforts \$\$\$**

DISPERSAL

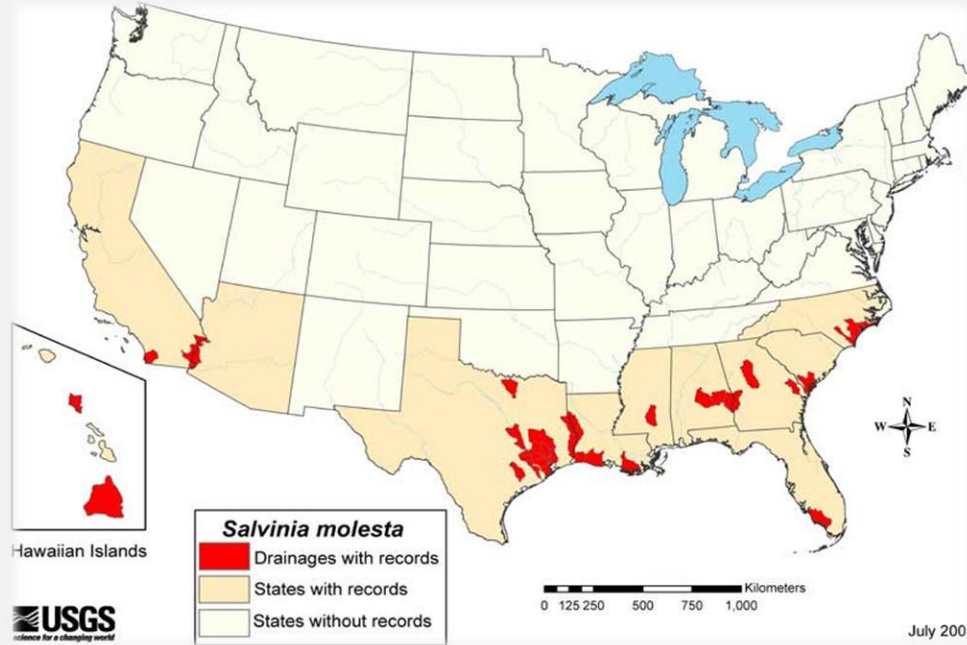


<https://www.dec.ny.gov/animals/48221.html>

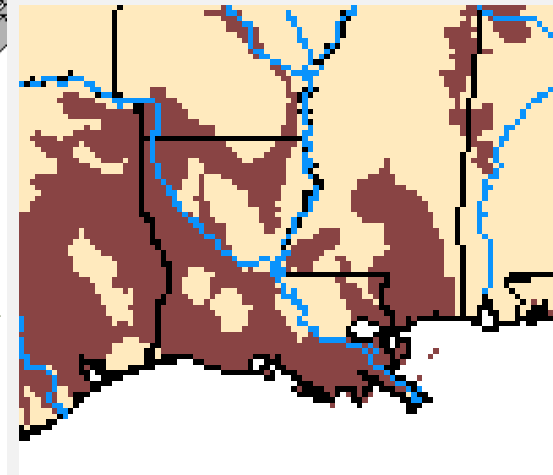


THE SPREAD OF GIANT SALVINIA

2003 →

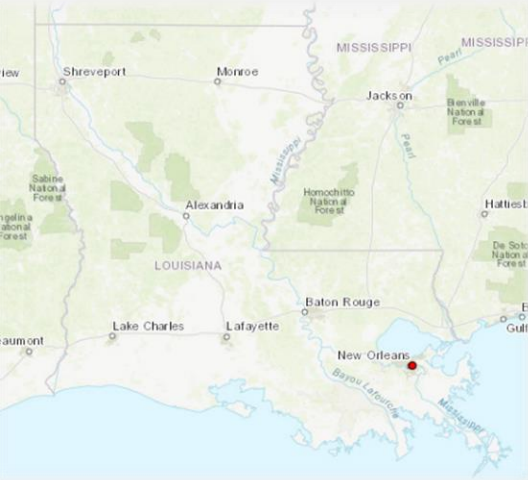


← 2023 →

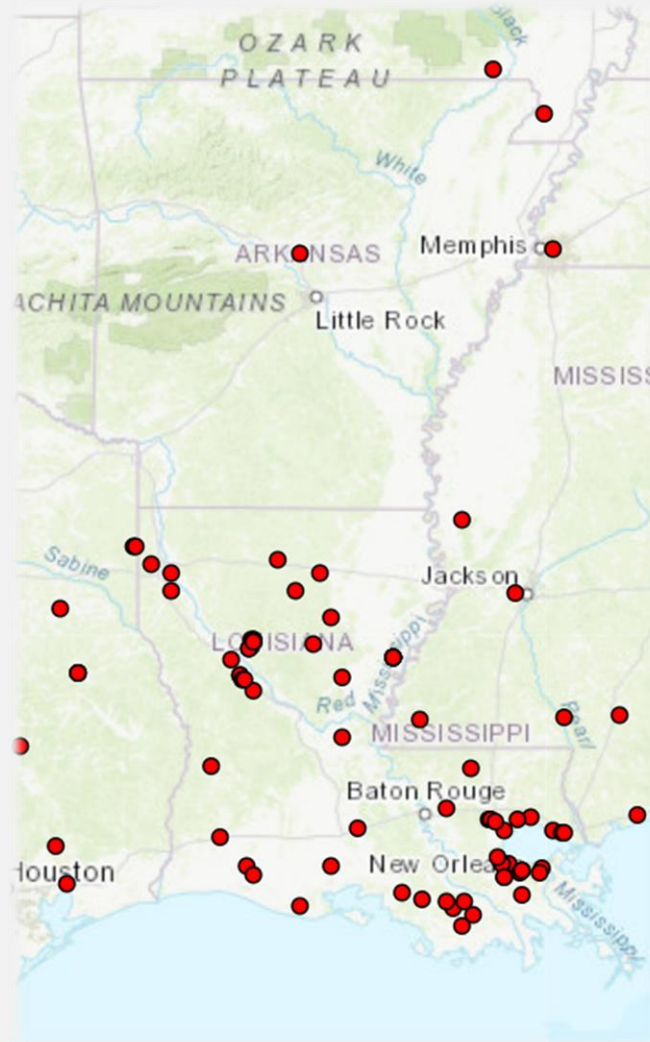


THE SPREAD OF WATER HYACINTH

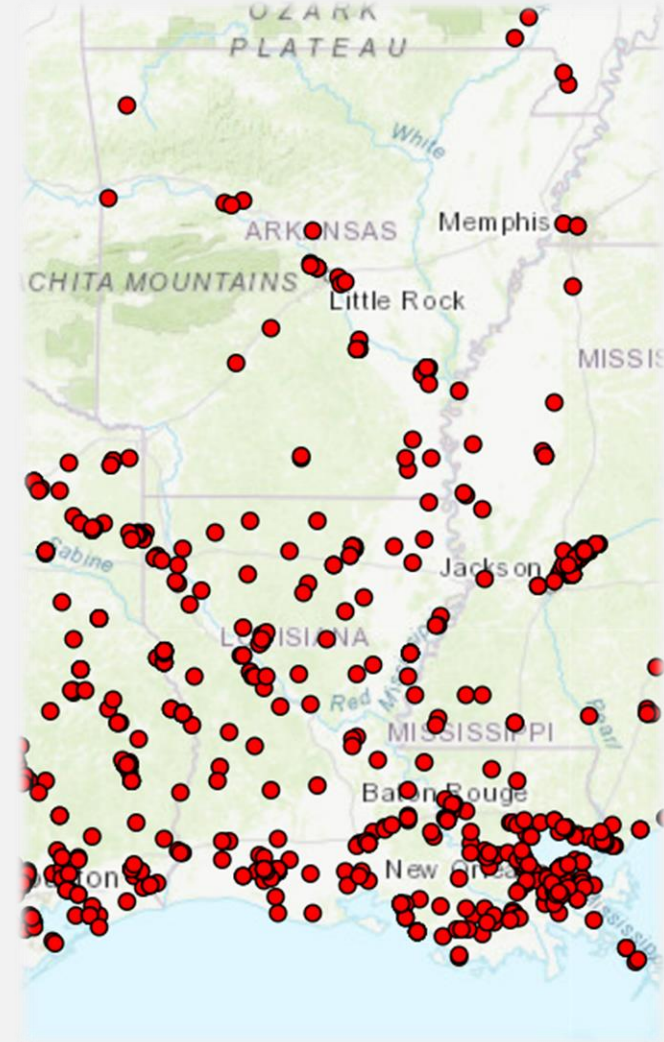
1884



1984

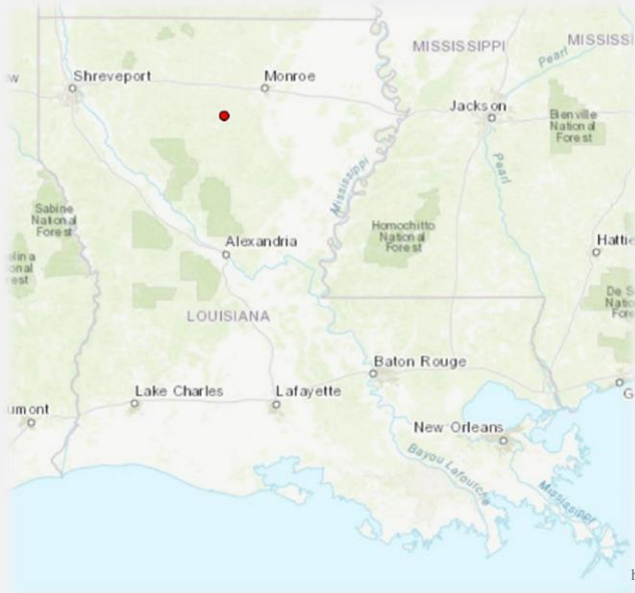


2023



THE SPREAD OF CUBAN BULRUSH

1962

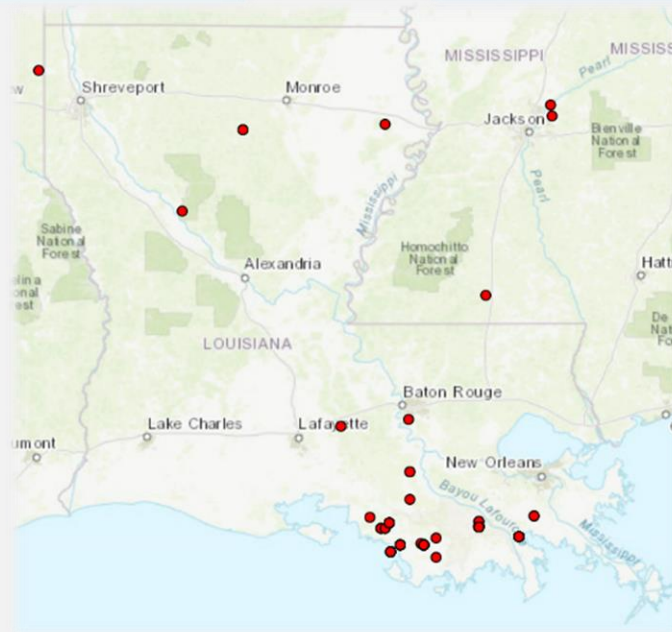


2002

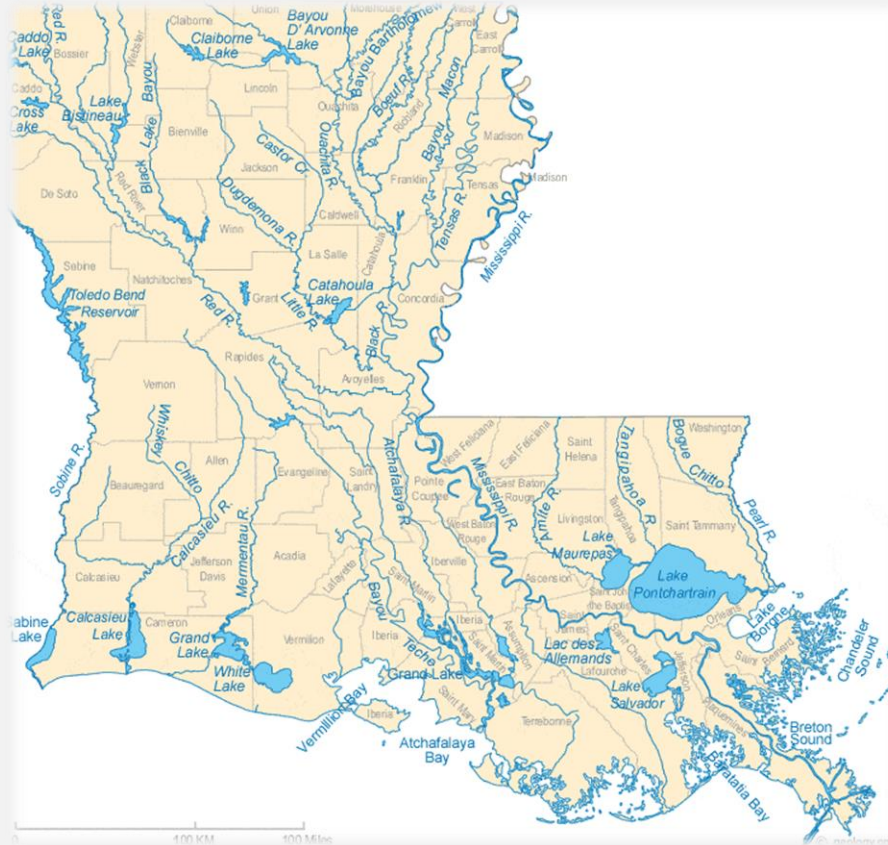


<https://nas.er.usgs.gov>

2023



LA ISSUES



- Large number of freshwater systems – 17% of Louisiana is water
- Swamps/flooded timber - access
- Connected waterbodies – 9,174 miles²
- Large number of boaters – 316K
- Subtropical Climate

ACREAGE OF AQUATIC PLANTS TREATED

Fiscal Year	Total Acres (GS : WH)
2013	98,727 (32,811 : 51,136)
2014	56,506 (19,462 : 25,109)
2015	52,296 (18,098 : 23,138)
2016	53,037 (20,594 : 22,984)
2017	77,369 (47,960 : 21,183)
2018	35,401 (13,516 : 12,594)
2019	38,663 (17,523 : 15,193)
2020	34,512 (15,475 : 13,386)
2021	25,817 (10,643 : 10,169)
2022	34,182 (20,207 : 9,993)

CONTROL METHODS

Integrated Pest Management (IPM)

```
graph TD; IPM[Integrated Pest Management (IPM)] --- Chemical[Chemical]; IPM --- Mechanical["Mechanical (Physical)"]; IPM --- Biological[Biological];
```

Chemical

Mechanical

(Physical)

Biological

CHEMICAL CONTROL



State Spray Crews

- Maintenance/Small Areas

Contract Applications

- Boats
 - Metered/Tank
- Aerial



CHEMICAL CONTROL



Metered

- Larger Areas
- Pulls form waterbody
- Faster
- Less Exact/Chemical Limitations

Tank

- Premixed
- Exact Amounts
- Small Areas
- Refill w/ clean water



CHEMICAL CONTROL

- GPS



HERBICIDES & SURFACTANTS

- **Bispyribac**
- **Carfentrazone**
- **Copper Complexes**
- **Diquat**
- **Endothall**
- **Fluridone**
- **Flumioxazin**
- **Glyphosate**
- **Imazamox**
- **Penoxsulam**
- **Topramezone**
- **Metsulfuron***
- **Endogenous biocides,
Fungicides****
- **Non-ionic**
- **Modified Vegetable Oils**
- **Methylated Seed Oils**
- **Organosilicone**
- **Stickers**
- **Penetrants**
- **Acidifiers**
- **Deposition Aids**

SALVINIA SPP. SOP

Salvinia spp. Alternative 1 Common/Giant Salvinia (April 1 to October 31)	Glyphosate (0.75 gal/acre) Diquat (0.25 gal/acre)	MVO/MSO (or approved equivalent, 0.25 gal/acre)
Salvinia spp. Alternative 2 Common/Giant Salvinia (April 1 to October 31)	Glyphosate (0.75 gal/acre) Flumioxazin (2 oz./acre)*	MVO/MSO (or approved equivalent, 0.25 gal/acre)
Salvinia spp. Alternative 3 Common/Giant Salvinia (April 1 to October 31)	MSM (1 oz./acre) Flumioxazin (1 oz./acre)*	MVO/MSO (or approved equivalent, 0.25 gal/acre)
Salvinia spp. Alternative 4 Common/Giant Salvinia (November 1 to March 31)	Diquat (0.75 gal/acre)	Nonionic surfactant (0.25 gal/acre)
Salvinia spp. Alternative 5 Common/Giant Salvinia (November 1 to March 31)	Flumioxazin (12 oz./acre)*	MVO/MSO (or approved equivalent, 0.25 gal/acre)

** Use of Flumi may require buffering agent – i.e., water with high pH*

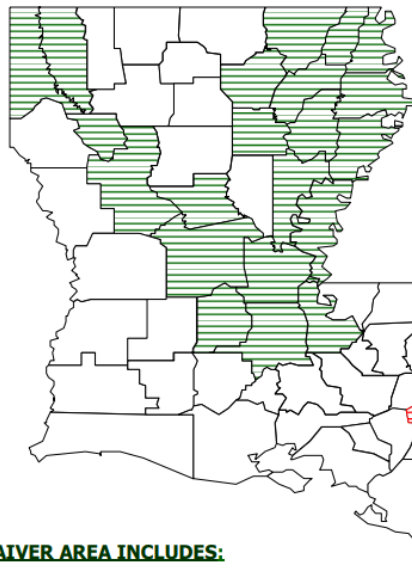
EICHHORNIA CRASSIPES SOP

Water Hyacinth	2, 4-D (0.5 gal/acre)	Nonionic surfactant (1 pint/acre)
Water Hyacinth in waiver areas (March 15 to September 15)	Glyphosate (0.75 gal/acre)	Nonionic surfactant (0.25 gal/acre)

LOUISIANA DEPARTMENT OF AGRICULTURE & FORESTRY
MIKE STRAIN DVM, COMMISSIONER



RESTRICTED HERBICIDE WAIVER APPLICATION AREA



APRIL 1 – SEPTEMBER 15

Commercial aerial & ground applicators must obtain a **waiver** for applications in all marked parishes for any herbicides containing but not limited to **2,4-D, Dicamba** and **Picloram** as defined in LAC section 1103.B.

MARCH 1 – JUNE 15

Commercial aerial & ground applicators shall not make applications of restricted herbicides as defined in LAC section 1103.B in the area between the Mississippi River and U.S. Hwy 61 in the Parishes of **St. James and St. John the Baptist**.

JANUARY 1 – DECEMBER 31

Commercial aerial & ground applicators shall not make applications of restricted herbicides as defined in LAC 1103.B in **Plaquemines** parish.

WAIVER AREA INCLUDES:

Avoyelles, Bossier, Caddo, Caldwell, Catahoula, Concordia, East Carroll, Evangeline (Wards 1, 3, 5), Franklin, Grant, Madison, Morehouse, Natchitoches, Ouachita, Pointe Coupee, Rapides, Red River, Richland, St. Landry, Tensas and West Carroll

MECHANICAL CONTROLS



Containment Boom

- Limits plant movement
- Containment for herbicide application



MECHANICAL CONTROLS

SALINE LAKE



TURKEY CREEK LAKE



MECHANICAL CONTROLS



Drawdown

- Targets shoreline plants
- Affects entire waterbody
- Removes large quantities at low \$\$\$

ISSUES



<https://plants.ifas.ufl.edu>



<https://www.weedooboats.com>



<https://www.amazon.com>

Pro

- Herbicide Concerns
- Nutrient Removal
- Highly Selective/Site Specific/Promote Natives

Con

- Labor Intensive/Disposal
- Expensive
- Suspended sediment/Increase Turbidity

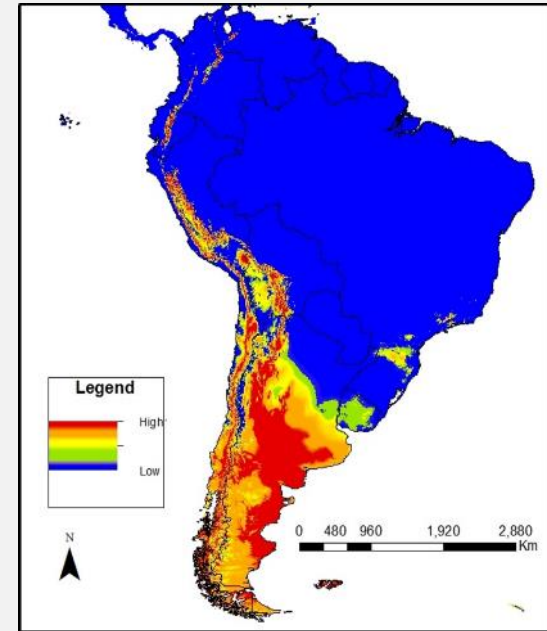
BIOLOGICAL CONTROL



Giant salvinia weevil stocking:

- Rearing/releasing since 2008
- Low winter survival in northern Louisiana...
- 3,733,251 Total stocked

GIANT SALVINIA WEEVIL



Failure to establish in temperate regions

- High winter mortality of adults due to freezing temperatures
- Failure to establish north of 32° N in US

Cold tolerant weevils

- Weevil populations from temperate distribution of native range possibly more cold tolerant than populations from LA?

LSU WEEVIL RESEARCH

Biological control with *Cyrtobagous salviniae* has seen variable success



- **Failure to establish in temperate regions**
 - Failed to establish south of 34° S in AUS (Julien et al. 2009) and north of 32° N in US (Mukherjee et al. 2014)
- **Winter mortality of adults and limited reproduction due to freezing temperatures is a limiting factor**
- **Golden question: Can we find a population of *C. salviniae* adapted to survive freezing winter temperatures?**

BIOLOGICAL CONTROL

Species-specific Control

- Water Hyacinth Weevils (2)
- Water Hyacinth Mite (native)
- Water Hyacinth Moth



www.lsuagcenter.com/

UGA0002075



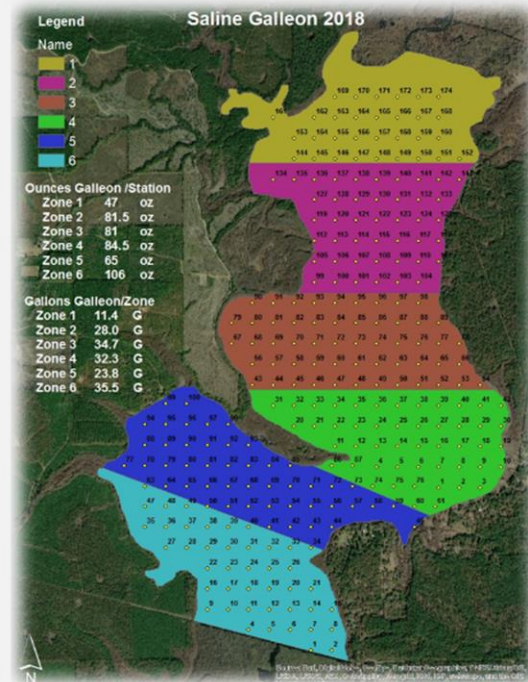
www.lsuagcenter.com/



www.lsuagcenter.com/

ISSUES

- Public Perception
- Access
- Watersheds
- In-water
- Tree Removal
- \$\$\$



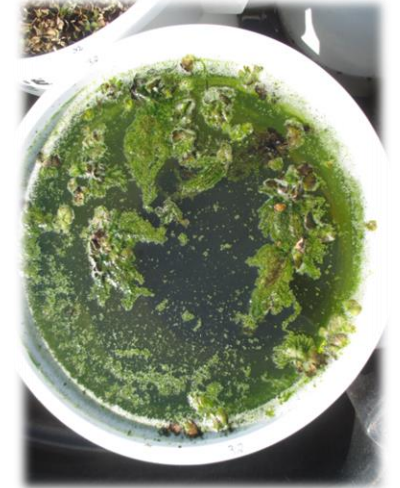
CURRENT & FUTURE RESEARCH

LSU AgCenter

- Herbicide/Surfactant trials
- Giant salvinia weevil production
 - Brazilian ecotype
 - Argentinian ecotype (north LA)

Army Corps of Engineers

- Giant salvinia weevil production
- Weevil population monitoring



CURRENT & FUTURE RESEARCH

University of Louisiana at Lafayette

- Biodiesel
- Methane, hydrogen
- Commercial glues

Mercantile

- Commercial Goods



<https://www.vintiquewise.com>



www.medalistfeed.com/products



<https://zocohome.com/>



<https://amazon.com/>

EDUCATION

PROTECT YOUR BOAT AND LOUISIANA'S WATERS

Slow the spread of non-native aquatic invaders that:

- Choke waterways
- Foul boats and engines
- Clog intake pipes

These plants become nuisances when they multiply in Louisiana's waters. Avoid accidentally spreading them to other lakes and streams by taking the following precautions after boating:

INSPECT boat and trailer carefully for any living matter, **REMOVE** all plants or other living organisms. Discard in the trash, not in the water.

DRAIN all water from boat, including bilge, live well, and cooling system to avoid transporting small seeds or spores.

DRY boat and trailer in the sun for at least two days to kill plants **OR RINSE** off boat and trailer, anchor, anchor chain – all boat parts – with tap water.

Common Salvinia



Hydrilla



Water Hyacinth



Giant Salvinia



PROTECT YOUR WATERS FROM THE GREEN MONSTER

GIANT SALVINIA – exotic plant that can:

- Clog waterways
- Foul boats and engines
- Eliminate recreational activities
- Cover the surface of the water harming fish and wildlife

LOOK OUT FOR THIS INVADER

- Report new infestations to the proper authority

HELP PREVENT THE SPREAD – protect your waters:

- Remove all plants from your boat, trailer, prop, tackle, decoys, live well any place that giant salvinia could potentially hide before launching in another waterbody.

SPREAD THE WORD

- Let others know about the dangers and how they can help.

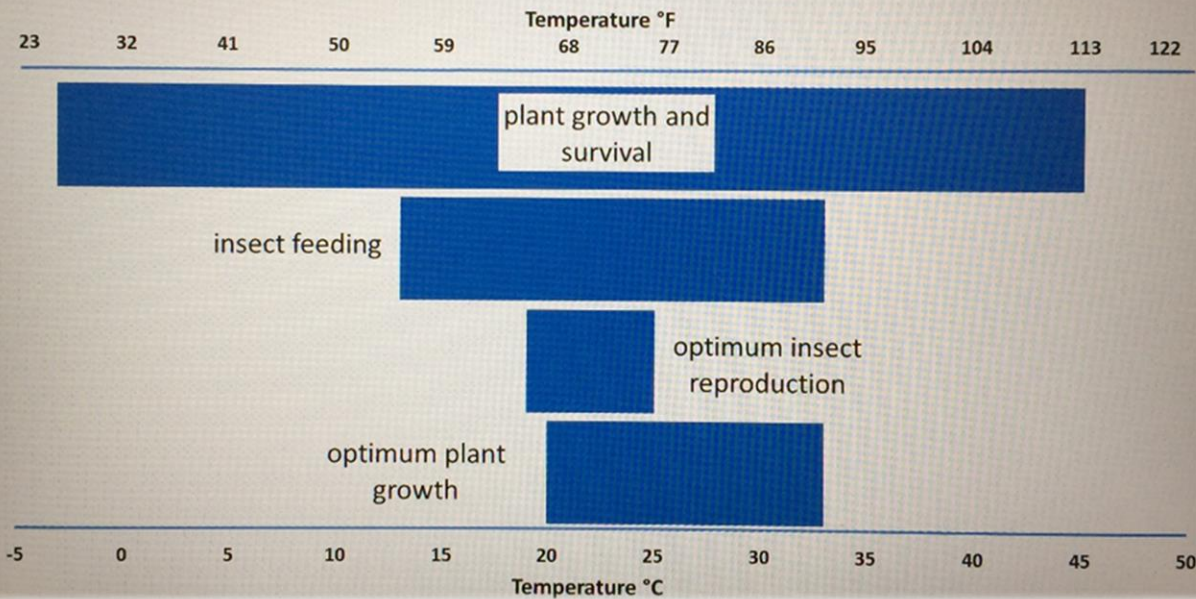


For more information on giant salvinia and other aquatic invasive species please contact
Louisiana Department of Wildlife and Fisheries



IPM THOUGHTS

Temperature Ranges for *S. molesta* and *C. salviniae*



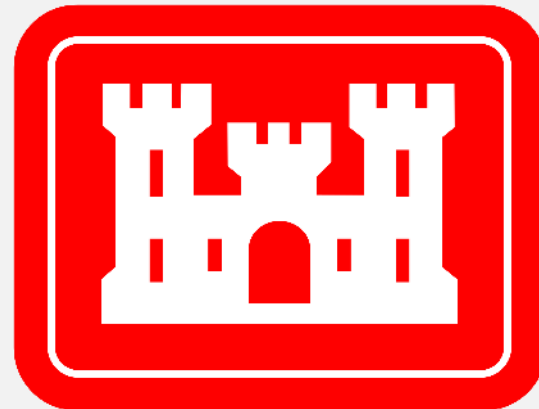
https://digitalcommons.lsu.edu/gradschool_theses/Allie_Cozad

- **Biological**
- **Chemical**
- **Mechanical**

	Month												
	1	2	3	4	5	6	7	8	9	10	11	12	Average
Arkansas													
Average High	49	54	64	72	80	87	92	92	85	74	62	51	71.8
Average Low	27	31	40	48	58	66	70	69	61	49	39	30	49
Louisiana													
Average High	59	62	69	75	82	87	88	89	86	79	70	62	75.7
Average Low	43	46	52	59	68	73	75	74	70	61	53	45	59.9

<https://www.worldclimate.com/climate/us>

ACKNOWLEDGEMENTS



QUESTIONS?

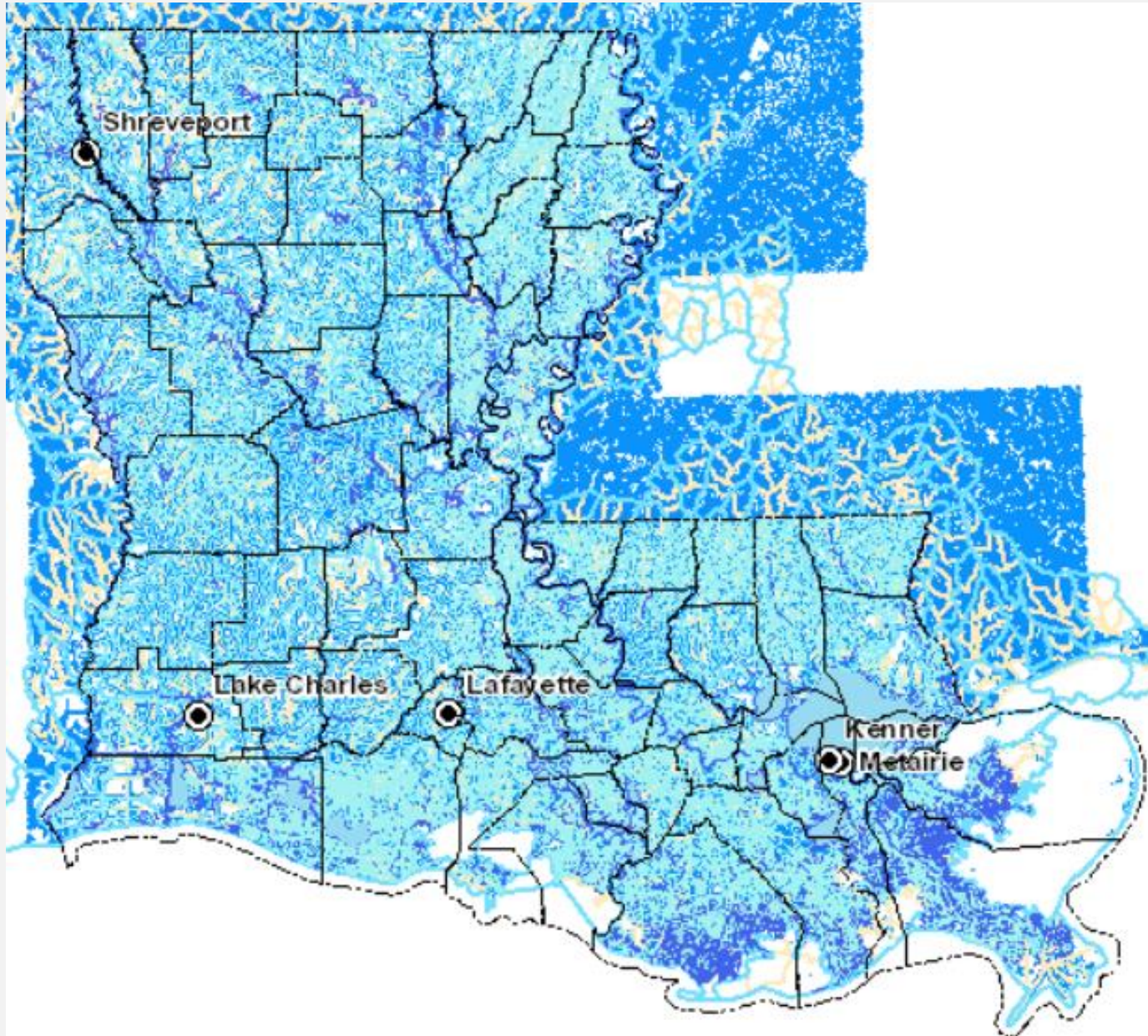
DANIEL C. HILL

SOUTHEAST VEGETATION MANAGEMENT

AQUATIC PLANT CONTROL

DANIELH@SOUTHEASTVM.COM

Issues for Louisiana



WATER HYACINTH WEEVILS

- **Two Species Stocked from South America:**

- *Neochetina bruchi*
- *Neochetina eichhorniae*

- **Suppress growth and reproduction**
- **Adults feed on leaves**
- **Larvae burrow into stem**



<https://edis.ifas.ufl.edu/ag019>



Neochetina eichhorniae
Mottled water hyacinth weevil
Copyright 1997 USDA, ARS

https://entnemdept.ufl.edu/Creatures/BENEFICIAL/BETLES/Neochetina_eichhorniae.html

WATER HYACINTH MITE

- *Orthogalumna terebrantis*
 - Native to U.S.
 - Feed on both water hyacinth and the native pickerelweed
- Can be effective control agent when combined with weevil



Katherine Parys, USDA-ARS, Bugwood.org

5460003



UGA0002082

WATER HYACINTH MOTH

- *Niphograptia albiguttalis*
 - From South America
- First Stocked in Florida in the 1970's
- Now found throughout Gulf Coast
- Larvae feed on buoyant stems and can destroy new buds



<https://www.lsuagcenter.com/topics/environment/invasive%20species/water-hyacinth/biocontrol>

TRIALS AND TRIBULATIONS - BIOLOGICAL

- Weevils-Texas, LSU, COE, LSUS
- Weevil survivability improvements (insulation with tarps, pine needles, mulch, etc.)
- Weevils-Florida, Brazilian, cold chambers, ponds, greenhouses, Argentina, etc.
- Weevils-nitrogen levels, survival studies, mortality during transport, herbicide compatibility, stocking strategies
- Grass carp
- Weevil day
- Crawfish trials
- **Manatees, hippos, moose, *Hydrellia pakistanae***
- Nanotechnology research
- Growth experiments
- Re-growth experiments following mulching, herbicides, etc.
- Organic buildup experiments
- Fisheries research

TRIALS AND TRIBULATIONS - CHEMICAL

- Vinegar
- Herbicide trials-Sanders
- Herbicide trials-Mudge
- Saltwater spray
- **Salt in water**
- Salt granules
- Copper Sulphate
- In-water treatments
- Herbicide test plots on lake with multiple mixtures, new herbicides etc.
- Endocides
- Herbicides-major pushes, steady efforts, contractors
- Aerial herbicides-fall, winter, multiple herbicides, test plots and large area treatments
- Cypress tree herbicide experiments
- Backpacks, wading, airboats, mudboat, ATV, UTV, skiffs, john boats
- Fungicides-Miss St.
- Fungus-LA Tech
- Treating nursery areas
- Essential Oils-LSUS
- Boom and spray
- Cold temperature herbicide trials
- Surfactant tests
- Drones
- **Dropping water balloons of sonar/penoxsulam to treat areas**
- Individual spray training program for homeowners

TRIALS AND TRIBULATIONS – PHYSICAL/MECHANICAL

- Water mower-multiple versions and trials (mulchers/grinders)
- Harvester-Caddo
 - Fences/booms across lake - Caddo
 - **Physical removal with dip nets**
 - Roundups
 - Cut leaf hairs off plant and apply herbicide directly to plant
 - Drawdowns-different timings
 - Drawdowns-pulses/fluctuating to increase efficiency
 - Drawdown enclosure
 - Inmate help
 - Army Reserve help
 - Microwave
 - **Salvinia dogs-physical removal and sniffing to find it on trailers**
 - Tree removal (cutting/pulling)
 - Dredging-further draining the lake
 - Skimmers
- Burn trials
- Weedoo
- Bucket boat
- Suction dredge
- **Oil suction barge**
- Beaver dam removal
- Booms, booms and more booms
- Salvinia traps
- **Firehose spray boats**
- Dry-out experiments
- Sweetwater
- Push boats
- Shoreline harvester
- Round up with booms and boats