



Landscape Habitat Suitability Modeling for Parrotfeather Using USGS Stream Gauge Data from Mississippi

By Louis L. Wasson, Ryan Wersal and John D. Madsen, MSU Geosystems Research Institute

A key resource that is often limiting in aquatic systems is the availability of nutrients for macrophyte growth. The amounts of nutrients of anthropogenic origin are increasingly finding their way into waterbodies with little information of how nutrient enrichment is affecting aquatic plant communities or the invasion process. Some invasive species are able to increase their growth rates in response to increases in nutrient availability and out-compete native species that cannot respond in a similar fashion. Controlled mesocosm studies were conducted in 2006 and 2007 at Mississippi State University to determine parrotfeather yield response to water column nutrient loading. These data were then used to establish critical tissue nutrient concentrations needed to sustain nuisance growth. The yield response of parrotfeather was positively related to increasing nitrogen concentrations, and tissue nutrient content indicated that critical concentrations (1.8% nitrogen

and 0.2% phosphorus) are needed for nuisance growth.

Stream gauge data from Mississippi were downloaded and nitrogen and phosphorus data extracted. Model builder in ArcGIS was utilized to create a habitat suitability model for parrotfeather

using the USGS stream gauge data and critical nutrient concentrations established in mesocosm studies. The model only selected stream gauge data that were at or above the 1.8% nitrogen level, and using the IDW interpolation technique the model extrapolated those values to

Nutrient Suitability Map for Parrotfeather Nitrogen Levels > 1.7ppm

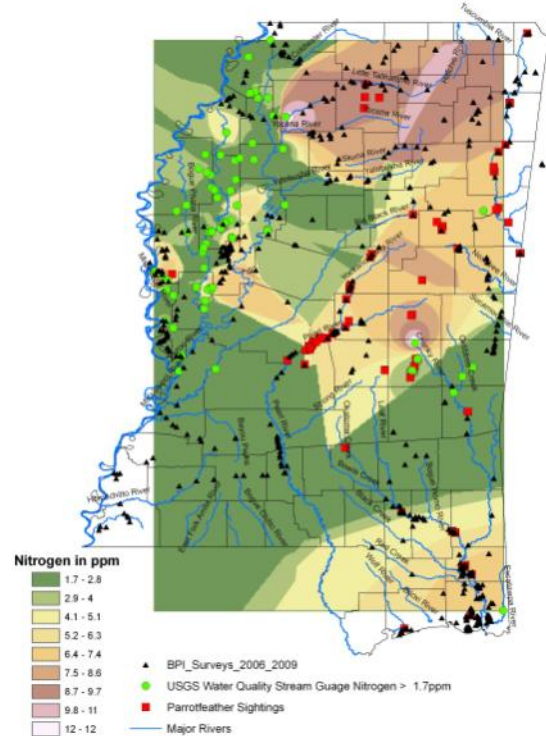


Fig. 1. Interpolated surface water nitrate concentration (ppm) and locations with parrotfeather locations in red.

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Special points of interest:

- Cuban Bulrush and Giant Salvinia Threats
- Progress in Tracking Cactus Moth
- Updates on Cactus Moth Genetics
- Updates on CMDMN and IPAMS
- Surveys for IPAMS, CMDMN and APHIS

Landscape Habitat Suitability Modeling for Parrotfeather Using USGS Stream Gauge Data from Mississippi (cont.)

indicate suitable habitat for nuisance parrotfeather growth (Figure 1). Data from previous statewide surveys were then loaded into ArcMap to spatially ground-truth the model. In general, parrotfeather was located in areas where water column nitrogen was high ($> 4.1 \text{ mg L}^{-1}$) (Figure 1). Currently, we are limited by the number and locations of stream gauges which

will over or under estimate nutrient concentrations in the model for some areas of the state. Additional water column data in areas under-represented within Mississippi would increase the accuracy of the model.

These data provide further evidence that parrotfeather requires high levels of nitro-

gen to achieve nuisance growth. Survival through uptake of water column nutrients may be a mechanism for survival during adverse conditions, a means of long distance dispersal of fragments, or may offer a competitive advantage over species that rely on sediment nutrients.

A New Non-native Aquatic Plant Being Tracked by the Nonindigenous Aquatic Species Database

By Ryan Wersal and John D. Madsen, MSU Geosystems Research Institute

Cuban bulrush or Cuban club-rush *Oxy-caryum cubense* (Poepp. & Kunth) Palla is a non-native rush from the West Indies or South America, and was brought to the United States likely by migratory birds or in ship ballast. Cuban bulrush can be described as an epiphytic plant, as it requires a raft of other aquatic vegetation to attach to (Figure 1). Once Cuban bulrush gets established on other vegetation, it rapidly outgrows and eventually kills the other plants creating a monotypic self sustaining population of Cuban bulrush. Cuban bulrush reproduces sexually through the production of achenes (Figure 2), or more commonly via vegetative means. It was previously described to be a vigorous invasive plant with growth rates similar to giant salvinia and water lettuce.

Fig. 2. Cuban bulrush reproduces through the production of achenes but also through vegetative.



Fig. 1. Cuban bulrush outgrows and kills other plants after attaching to rafts of other aquatic vegetation.

Cuban bulrush has been present in the Southeastern United States for almost 100 years, though until recently, little attention has been given to this species. Recently, Cuban bulrush has begun to displace other non-native aquatic plants, most notably waterhyacinth, in the Tennessee Tombigbee Waterway

in Mississippi and Alabama. In 2009, it was reported for the first time in the Ross Barnett Reservoir near Jackson Mississippi. It is unclear how Cuban bulrush ended up in the Ross Barnett since the reservoir is not connected to the Tennessee Tombigbee Waterway. Given its rapid growth rate, ability to out compete species such as waterhyacinth, and potential means of long distance dispersal; Cuban bulrush will be a species to closely monitor in the future.

Nuisance Issues due to the Presence of Giant Salvinia at Golf Courses

By Wilfredo Robles Vasquez, University of Puerto Rico, Mayaguez

Invasive aquatic plant species has been implicated with the malfunctioning of water bodies worldwide. The aquatic fern, giant salvinia (*Salvinia molesta*) is considered an invasive aquatic plant and listed in the Federal Noxious Weed List. For instance, the introduction and out controlled growth of giant salvinia may limit the water body function. Consequently, issues with oxygen depletion and aesthetics arise. High nutrient loading which is common in eutrophic water bodies is responsible in part for the out controlled growth of giant salvinia.

Currently, a recent introduction of giant salvinia at the Dorado del Mar Golf Club (DMGC) in Puerto Rico is causing nuisance problems. For instance, the aesthetics of the golf club and habitat for birds are affected by giant salvinia presence. Moreover, keeping giant salvinia is representing a drowning risk to people as well as a serious threat of spread to nearby water bodies. All four ponds of the golf club are fully infested with giant salvinia covering a total of 21 surface acres. No other aquatic plant species have been observed at those ponds.



Fig. 1. Infestation of giant salvinia at Dorado del Mar Golf Club, Puerto Rico.

As a common management practice, greens are fertilized twice a month with high nitrogen fertilizer (24-2-10). Low cut mowed bermudagrass (*Cynodon dactylon*) grows at those greens. High nutrient runoff from low cut bermudagrass

drains into the ponds where giant salvinia is growing; keeping giant salvinia thriving in a eutrophic water system. Mechanical removal and contact herbicides have been used at this site to manage giant salvinia with minimal success.



Fig. 2. Partial control of giant salvinia with foliar applications of diquat.

Pricklypear Cactus Surveys in the MidSouth

By Victor Maddox, MSU Geosystems Research Institute

Host and pest surveys were conducted in AL (April), MS (May), LA (June), and TX (June) during the second quarter of 2010. Most notable were the surveys conducted in LA and TX from 3 June through 10 June. During the eight day trip, 407 host reports were collected primarily along the southeastern coast of TX. Some areas along the north shore of Lake Pontchartrain in LA were also surveyed during the return from south Texas, particularly south of Covington,

LA (St. Tammany Parish). However, most areas were heavily developed and negative for host. Only a limited amount of time was spent surveying this area and it is

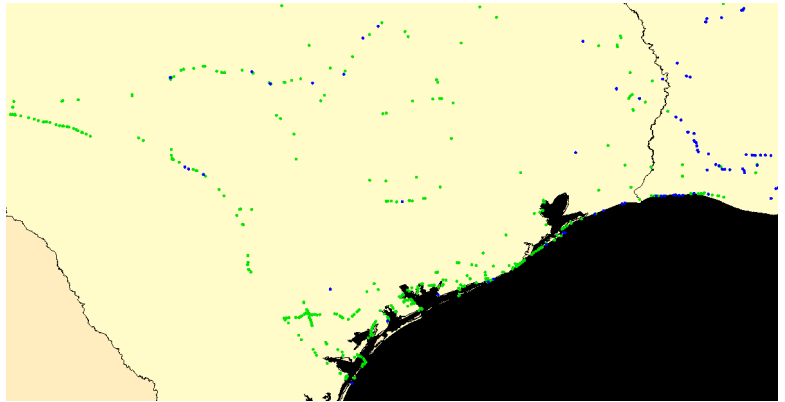


Figure 2. Host map as of 30 June 2010 from the Cactus Moth Detection and Monitoring Network showing georeferenced data form points in southern Texas.



Figure 1. *Opuntia ficus-indica* (L.) Mill. is an example of cultivated *Opuntia* observed during the surveys in southern Texas. Photo by Victor Maddox, MSU-GRI.

possible that host exist in more remote areas near Lake Pontchartrain.

Most were positive reports (247), but negative reports (160) were also collected particularly in strategic areas to prevent duplication and provide host distribution insight. Host species included *Opuntia cochenillifera* (L.) Mill. [Syn. *Nopalea cochenillifera* (L.) Salm-Dyck], *O. ellisiana* Griffiths, *O. engelmannii* Salm-Dyck ex Engelm., *O. ficus-*

indica (L.) Mill., *O. humifusa* (Raf.) Raf. and *O. leucotricha* DC., but *Opuntia engelmannii* (Fig. 1) was the most prevalent along the coastal dunes and had the highest plant count during the surveys. New host counties were added to the Cactus Moth Detection and Monitoring Network (CMDMN) database for Texas during these surveys. Host survey data from the trip is currently being added to the CMDMN database and close to 200 of the over 407 host reports have been added as of 30 June 2010 (Fig. 2). Much of the negative data is still being entered. Additional Surveys in southern Texas are planned for July, 2010. These will most likely provide new distribution information about the host in southern TX.

President of Mississippi State University and Vice-President of Agriculture Visit Cactus Moth Quarantine Facility

By Richard Brown, MSU Department of Entomology and Plant Pathology

Dr. Mark Keenum, President of Mississippi State University, and Dr. Gregory Bohach, Vice President of Agriculture, visited the Insect Rearing Facility in the Clay Lyle Entomology Building on June 8. During the tour of the Cactus Moth Quarantine Unit, Richard Brown provided an overview of the cactus moth, and Gary Ervin and Chris Brooks reported on their collaborative research with Travis Marsico, Lisa Wallace, Mark Welch, and Anastasia Woodard. Posters

on genetic diversity within native ranges of *Melitara prodentalis* and *Cactoblastis cactorum* and on differential defense response of cactus to these two species were displayed.



Figure 1. Dr. Gregory Bohach (left) and Dr. Mark Keenum (right) in insect rearing facility. Photo by Kat Lawrence, MSU Ag Communications.

Integrating environmental modeling and population genetics to better understand the success of *Cactoblastis cactorum* invasion

By Gary N. Ervin, MSU Department of Biological Sciences

Our current work encompasses three major areas of research – environmental modeling based on data from the *Cactoblastis cactorum* native range, genetic studies of *Opuntia* and cactophagous moths, and experimental studies of growth performance of *C. cactorum* and native US cactus moths on native south-eastern US *Opuntia* species.

One manuscript reporting results of our environmental modeling work has been submitted for review, and another is nearing completion. Both papers form the basis for a grant proposal being submitted to NSF in collaboration with USDA-ARS scientists. Details from those papers and grant proposal will be included in the September report and are being presented by Dr. Chris Brooks at the Ecological Society of America conference in Pittsburgh, PA (co-authored by Gary Ervin), and by Brooks and Ervin at the Entomological Society of America conference in San Diego in December.



Figure 2. Freshly ground *C. cactorum* larvae from Argentina, awaiting analysis to determine genetic haplotypes for an ongoing project in collaboration with USDA-ARS scientists in the US and Argentina.

We have completed one series of growth chamber experiments, with the native moth, *Melitara prodenialis* taking almost a full year to complete its life cycle (egg to adult) in the laboratory (Figure 1). A second series of

these experiments has been initiated by Dr. Travis Marsico, at Arkansas State University, with similar results. Assisting with those studies is former Mississippi State undergraduate, Anastasia Woodard.

Anastasia now is beginning graduate studies under the direction of Marsico. Marsico will be presenting results from this work at the Ecological Society of America conference in Pittsburgh, PA (co-authored by Gary Ervin).

The growth chamber experiments also were part of a June 8th tour of the Lyle Entomology insect rearing facility, given to the MSU President and the Vice President for Agriculture, Forestry, and Veterinary Medicine. This aspect of the tour was led by Drs. Richard Brown, Chris Brooks, and Gary Ervin; Brown gives more details in a separate report.

We recently received a shipment of 41 additional collections of cactus-associated moths and larvae from Argentina. These are part of an ongoing collaboration with USDA-ARS scientists and will be used to better understand the biology of *C. cactorum* in its native range and as part of the NSF proposal in development. These collections have undergone DNA sequencing, and are being compared with our previous collections (Fig. 2). Thus far, results from these analyses concur with our previous collections, with the added benefit that we have obtained collections of at least one additional *Cactoblastis* species (*C. doddi*), which feeds on a different suite of cactus species than does *C. cactorum*. We anticipate this additional manuscript being completed over the next six months.

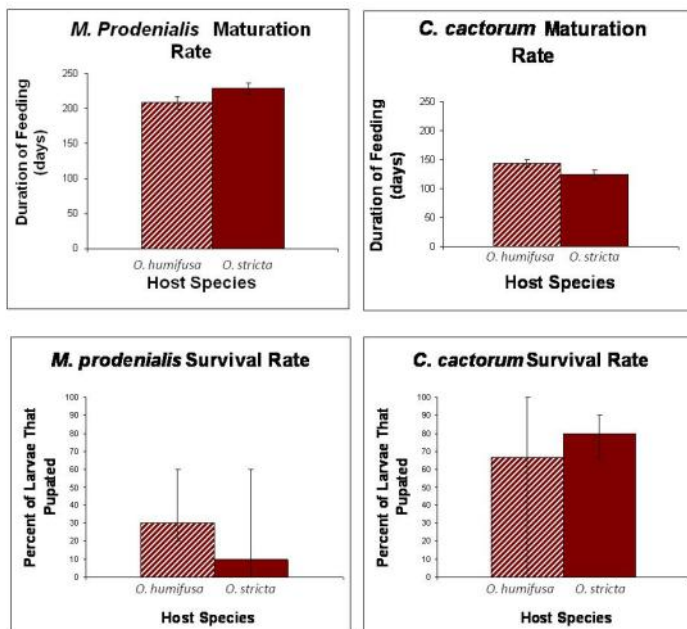


Figure 1. Some of the results from growth chamber experiments; these were presented as an undergraduate research project. The native *Melitara prodenialis* tended to mature much more slowly and have lower rates of survival than did *Cactoblastis cactorum* in our rearing facility experiments.

Invasive Plant Atlas of the MidSouth ... and Puerto Rico

By **John D. Madsen**, MSU Geosystems Research Institute

The Invasive Plant Atlas of the MidSouth is now being used in the Commonwealth of Puerto Rico as a tool for volunteers and natural resource agency personnel to track the occurrence of invasive plants. A new project, guided by Dr. Wilfredo Robles of the University of Puerto Rico-Mayaguez, allows volunteers in Puerto Rico and other Caribbean territories of the U.S. to map invasive plants and receive educational materials and access to training workshops.

Dr. Robles, a May 2009 Ph.D. graduate of Mississippi State University, has been an Assistant Professor of Weed Science at University of Puerto Rico-Mayaguez since August 2009. Dr. Robles' focus is on invasive plants of noncrop and aquatic habitats.



Figure 1. Dr. Wilfredo Robles sampling hydrilla in Gainesville Lake, Mississippi.

Hurricane *Cactoblastis*?

By **Clifton Abbott**, MSU Geosystems Research Institute

Warning! Hurricane *Cactoblastis* is likely to make landfall on the gulf coast early next week. *Cactoblastis* is a minimum Category 3 hurricane punching winds of 115 mph. This storm carries the potential to spread the cactus moth to several states.

Yes, this scenario may sound silly. However, it demonstrates a real possibility. Hurricanes have the potential to pick up debris and deposit it hundreds of miles away. The likelihood of a storm picking up an infected cactus pad or a flying moth is strong given the right conditions.

This year, the hurricane predictions have a large number of major storms hitting the U.S. Given the cactus moth's current locations along the southern Atlantic coastline, throughout all of Florida, and along the gulf coast into Louisiana, the chances of an infestation being in the path of a major storm are high.

Efforts to eradicate infested cactus plants along the gulf coast have been under way since 2005. Yet, cactus moth populations still seem to be spreading west along the coast. In all of the efforts to eradicate the infestations, there are always some that

get missed. Whether it is the lack of manpower to search for cactus locations, or the ability to get to the areas where the infestations are located, many get missed.

Another unknown this year is the effect of the oil spill in the gulf. If a major storm comes and the oil is left on the cactus pads, what effect will it have on the cactus plant? Will it kill off the plant, thus removing potential future moth infestations? Will the plant live but become an undesirable host for the moth? Will the oil kill off current moth infestations? Will the oil spill end up being a positive thing with respect to the fight against the cactus moth? These are all questions that can only be answered by locating the cactus and inspecting infestations.

How can I help? I'm glad you asked. Volunteers are needed to locate cactus locations along the gulf coast. When

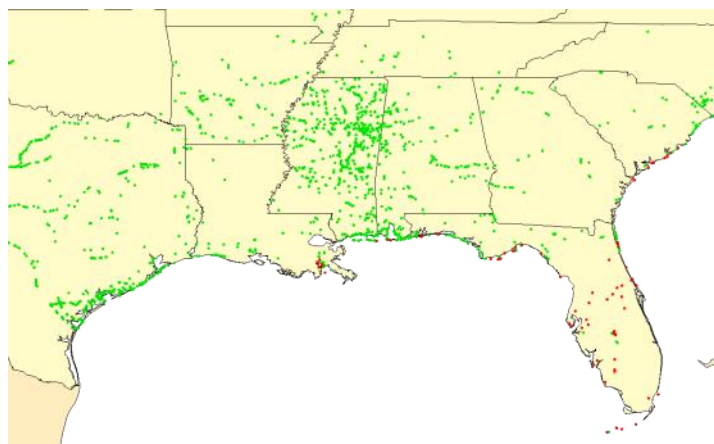


Figure 1. Positive cactus moth locations (red dots) with known pricklypear cactus populations (green dots) along the gulf coast.

these cactus locations are found, they can be inspected for the presence of the moth. The plant location is then stored and mapped so that it can be revisited later. Information is also recorded about the presence of the cactus moth, or the lack thereof. If the cactus is located in the leading edge of the moth's progression, you can volunteer to set up a sentinel site, or a site that you go back and inspect at regular intervals. A few months after a strong storm, you can volunteer to revisit known cactus locations for inspection. Your help is needed. For more information, please visit http://www.gri.msstate.edu/cactus_moth.

GRI Surveys LA and TX for APHIS

By Victor Maddox, MSU Geosystems Research Institute

For the last few years MSU-GRI has been working closely with USDA-APHIS to assist with their efforts to prevent the spread of the cactus moth, particularly to the west. With limited funding for both USDA and USGS, there is a need to collaborate with both agencies to help fill potential gaps and assist with agency needs such as participating in larger pest surveys along the leading edge. As USGS funding was available, MSU-GRI has assisted with survey and eradication efforts to help prevent the spread of cactus moth and provide information about pest and host distribution.

Recently, MSU-GRI received funding from USDA-APHIS to conduct cactus moth and host surveys along the coast in southern Texas. As part of the project protocol, data is submitted daily to strategic USDA personnel during the surveys. In addition, the data is being entered into the Cactus Moth Detection and Monitoring Network (CMDMN) database. The first survey trip bridged gaps in specific pest and host data between Louisiana and Corpus Christi, TX, previously absent in



Figure 1. *Opuntia engelmannii* Salm-Dyck ex Engelm. found in Galveston County, Texas with heavy infestation of *Melitara* Photo by Victor Maddox, MSU-GRI.

the CMDMN database. This data should provide new pest and host information for USDA-APHIS, as well. It should be noted that negative pest and host data are

also recorded during surveys which can also assist with strategic planning during an infestation.

Surveys were initiated in June and will continue while funds remain. The first survey included approximately 2500 miles of roads and highways and yielded 407 pest/host reports. Some plants were heavily infested (Figure 1), but only *Melitara* sp. (Figure 2) was observed during the surveys.



Figure 2. Close-up of native *Melitara* found in *Opuntia engelmannii* Salm-Dyck ex Engelm. in southern Texas Photo by Victor Maddox, MSU-GRI.

Collaborations April to June 2010

Gary Ervin and **Chris Brooks** were invited to present their research in an organized symposium entitled “The Multiple ‘Personalities’ of *Cactoblastis cactorum*: A Multi-Disciplinary Response to the Biological Impacts of the Moth’s Geographical Wanderings” as part of the annual meeting of the Entomological Society of America, 12-15 December 2010 in San Diego, CA.

Maddox, V. Attended the Tennessee Invasive Plant Steering (TIPS) meeting. 14 Jan 2010. Ed Jones Auditorium, Elington Agricultural Center, Nashville, TN.

Maddox, V. Attended the Southern Weeds Sciences meeting (Weed ID committee). 24-27 Jan 2010. The Peabody Little Rock, Little Rock, AR.

Maddox, V. Participated in cactus moth survey with USDA-APHIS on Mississippi Barrier Islands, 1-3 Feb 2010.

Maddox, V. Attended the Mississippi Cooperative Weed Management Area Board Meeting, 10 Feb 2010, MS Farm Bureau Board Room, Jackson, MS.

Maddox, V. Participated in cactus moth survey with USDA-APHIS on Mississippi Barrier Islands, 9-12 Mar 2010.

Maddox, V. Attended the Mississippi Cooperative Weed Management Area Board Meeting, 15 Apr 2010, MS Farm Bureau Board Room, Jackson, MS.

Maddox, V. Attended the Alabama Invasive Plant Conference (ALIPC). 20-22 Apr 2010. Auburn Hotel, Auburn, AL.

Maddox, V. Participated in Cogongrass Teleconference call between Southeastern States to develop a white paper. 12 May 2010. Bureau of Plant Industry Building, Mississippi State, MS.

Maddox, V. Participated in Cooperative Agricultural Pest Survey meeting. 20

May 2010. Bureau of Plant Industry Building, Mississippi State, MS.

Maddox, V. Provided a 5 min MSU cactus moth project update during a USDA teleconference call hosted by USDA-APHIS on 24 May 2010 for the United States and Mexico.

Maddox, V. Attended Mississippi Exotic Pest Plant Council meeting. 2 June 2010. Engineer Research and Development Center, Vicksburg, MS.

Madsen, J.D. North American Invasive Species Network. Organizing Committee Teleconference, April 19, 2010.

Madsen, J.D. North American Invasive Species Network. Organizing Committee Teleconference, May 24, 2010.

Madsen, J.D. North American Invasive Species Network. Organizing Committee Teleconference, June 25, 2010.

Publications April to June 2010

Peer-Reviewed Journals

Wersal, R. M., Madsen, J. D., Woolf, T. E., & Eckberg, N. (2010). Assessment of herbicide efficacy on Eurasian watermilfoil and impacts to the native submersed plant community in Hayden Lake, Idaho, USA. *Journal of Aquatic Plant Management*. 48, 5-11.

Wersal, R. M., & Madsen, J. D. (2010). Combinations of penoxsulam and diquat as foliar applications for control of waterhyacinth and common salvinia: Evidence of herbicide antagonism. *Journal of Aquatic Plant Management*. 48, 21-25.

Wersal, R. M., Madsen, J. D., Massey, J. H., Robles, W., & Cheshier, J. (2010). Comparison of daytime and night-time applications of diquat and carfentrazone-ethyl for control of parrotfeather and Eurasian watermilfoil. *Journal of Aquatic Plant Management*. 48, 56-58.

In Press

Maddox, V. L., J. Byrd, Jr., and B. Serviss. 2010. Identification and control of invasive privets (*Ligustrum* spp.) in the Middle Southern United States. *Invasive Plant Science and Management*, In press.

Wersal, R.M. and J.D. Madsen. 2010. Comparison of subsurface and foliar herbicide applications for control of parrotfeather (*Myriophyllum aquaticum*). *Invasive Plant Science and Management*, In Press.

Submitted

Wersal, R.M. and J.D. Madsen. 2010. The response of the invasive aquatic plant *Myriophyllum aquaticum* to seasonal drawdown events. Submitted to *Aquatic Ecology*.

Wersal, R.M. and J.D. Madsen. Comparative effects of water level variations

on growth characteristics of the invasive amphibious plant *Myriophyllum aquaticum*. Submitted to *Weed Research*.

Robles, W., J.D. Madsen, and R.M. Wersal. 2010. Lakewide aquatic vegetation assessment and herbicide efficacy of waterhyacinth control in Lake Columbus, Mississippi. Submitted to *Journal of Aquatic Plant Management*.

Articles in Trade Journals and Popular Press

Maddox, V. L. 2010. Prioritizing invasive weeds on Mississippi and Louisiana golf courses. Tee to Green. Louisiana-Mississippi Chapter of the GCSAA. Spring 2010, 10.

Maddox, V. L. 2010. Cooperative Weed Management Area (CWMA). Tee to Green. Louisiana-Mississippi Chapter of the GCSAA. Spring 2010, 3.

Publications April to June 2010 (Continued)

In-House

Madsen, J. D., Brown, R. L., Ervin, G. N., Shaw, D. R., Abbott, C. F., Maddox, V. L., Wersal, R. M., McBride, D. W., & Madsen, N. 2010. Research to Support Integrated Management Systems of Aquatic and Terrestrial Invasive Species. GRI#5039. Mississippi State University: Geosystems Research Institute. 41pp.

Technical Report

Madsen, J. D., Wersal, R. M., Getsinger, K. D., & Skogerboe, J. G. 2010. Combinations of Endothall with 2,4-D and Triclopyr for Eurasian Water-milfoil Control. APCR Technical Notes Collection (ERDC/TN APCR-CC-14). Vicksburg, MS: U.S. Army Engineer Research and Development Center.

Presentations

Ervin, G. N. 2010. Anthropogenic dispersal corridors override large-scale natural disturbance in determining distribution of a widespread invasive grass (*Imperata cylindrica*). Weeds Across Borders, National conservation Training Center, Shepherdstown, WV, June 01-04, 2010.

Ervin, G. N. 2010. Getting the jump on invasives: Considerations during habitat management and restoration. SE-EEPC/SERI Joint Conference in Chattanooga, TN, May 11-12, 2010.

Ervin, G. N. 2010. Mississippi's noteworthy exotic plant species: Final draft list for comment. SE-EEPC/SERI Joint Conference in Chattanooga, TN, May 11-12, 2010.

Hughes, S. and G. Ervin. 2010. Construction of a GIS predictor for locating new sites for prairie conservation efforts in the Blackland Prairie region of Mississippi. SE-EEPC/SERI Joint Conference in Chattanooga, TN, May 11-12, 2010.

Jolley, R., D. Neal, B. Baldwin, and G. Ervin. 2010. Optimizing rhizomal propagation of rivercane (*Arundinaria gigan-*

tea). SE-EEPC/SERI Joint Conference in Chattanooga, TN, May 11-12, 2010.

Lucardi, R. L., C. T. Bryson, L. Wallace, and G. N. Ervin. 2010. Assessing genetic diversity in a model invasive species: cogongrass (*Imperata cylindrica*) in the southeastern U.S. SE-EEPC/SERI Joint Conference in Chattanooga, TN, May 11-12, 2010.

Madsen, J.D. and G.N. Ervin. 2010. An update on the Invasive Plant Atlas of the MidSouth. Weeds Across Borders 2010, Shepherdstown, WV. June 1-3, 2010.

Woodard, A. M., T. D. Marsico, and G. N. Ervin. 2010. Evaluating Differential Defense Response In Two Native Cactus Species. Mississippi State University Biology Undergraduate Research Symposium, Mississippi State, MS, April 16, 2010.

Professional Presentations

Maddox, V. L. Southwest Mississippi Invasive Plant Species. Pike County Landowners Meeting, Pike County Fairgrounds, McComb, MS. 11 May 2010.

Maddox, V. L. Southwest Mississippi Invasive Plant Species. Master Gardener Meeting, Pike County Fairgrounds, McComb, MS. 11 May 2010.

Maddox, V.L. Invasive weeds of turf and ornamentals in the MidSouth. BWI Turf and Landscape Seminar, Whispering Woods Hotel and Conference Center, Southaven, MS. 13 April 2010.

Maddox, V. L. Invasive Plant Atlas of the MidSouth Volunteer Training Workshop. 5 April 2010. Lafayette County Extension Office, Oxford, Biloxi, MS.

Awards and Recognitions

Wersal, R. M. (2010). 2010 Centers and Institutes Research Support Staff Award. Mississippi State University. Thesis and Dissertation

Cheshier, J.C. 2010. The Biology, Ecology, and Management of Common Reed

[*Phragmites australis* (Cav.) Trin. Ex. Steudel]. M.S. Thesis, Mississippi State University, August 2010. 69pp.

Wersal, R.M. 2010. The Conceptual Ecology and Management of Parrot-feather [*Myriophyllum aquaticum* (Vell.) Verdc.]. Ph.D. Dissertation, Mississippi State University, August 2010. 199pp.

Fleming, J.P. 2010. Macrophyte Re-establishment and Deductive GIS Modeling to Identify Planting Locations for Fish Habitat Enhancement Projects. M.S. Thesis, Mississippi State University, May 2010. 113pp.

Leveraging Grants and Partnerships

Madsen, J.D. 2010. Invasive aquatic plant control project for the Pend Oreille System, Idaho. Idaho State Department of Agriculture (subcontract of USAERDC ARRA). July 1, 2010 – Sep 30, 2011. \$98,678.

Madsen, J.D. 2010. Selective control of EWM and CLP on Noxon Reservoir: Demonstration and Evaluations, Phase 2. Sanders County, MT (subcontract of USAERDC ARRA). May 1, 2010 to July 30, 2011. \$77,538.

Madsen, J.D. and V.L. Maddox. 2010. Mississippi Cooperative Weed Management Area Coordinator. MS CWMA. February 1 to January 1, 2011. \$35,000.

Madsen, J.D. and V.L. Maddox. 2010. Cactus Moth Response West of Mississippi: Survey, Training, and Verification. USDA APHIS PPQ, March 15, 2010 – March 31, 2011. \$30,000.

Madsen, J.D. 2010. Memorandum of Understanding between MSU/GRI and MDAC/BPI. Mississippi Bureau of Plant Industry, January 1, 2010 – December 31, 2010. \$5,000.

Madsen, J.D. 2010. Ecology, Phenology and Assessment of Flowering Rush (*Butomus umbellatus*) in the Detroit Lakes Area. Pelican River Watershed District, Detroit Lakes, MN. 05/01/10 - 03/31/11. \$30,000.



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