

**Invasive Species Management Plan
for
Grand Bay National Estuarine Research Reserve**

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Invasive Species Management Plan

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Summary

Grand Bay National Estuarine Research Reserve (Grand Bay NERR) is dedicated to the protection of the natural resources within the reserve boundaries and the surrounding watershed. This document identifies invasive species known to occur on Grand Bay NERR and outlines appropriate management activities for the control or eradication of such species. In addition, a goal of Grand Bay NERR is the identification of future threats by invasive species and the implementation of a proactive plan to prevent future biological invasions. Actions that meet these identification and prevention goals are described herein.

Management activities will focus primarily on the prevention, control, and eradication of invasive species. Research and educational opportunities will be pursued as appropriate. Grand Bay NERR will conduct research activities to improve existing knowledge of the life histories of invasive species and to identify suitable management techniques for ecosystems of Grand Bay NERR. Educational activities (e.g., public outreach, demonstration projects) will be used to involve members of the local community and decision-makers in the identification, prevention, and control of invasive species.

Glossary

Allelopathic – emitting chemicals that retard or prevent the seed germination or growth of competitors.

Basal-bark – application of herbicide-oil mixtures directly to the base of woody stems or bark of trees using a sprayer. Generally the lower 12-20 inches of the stem should be wetted around its entire circumference.

Cut stump treatments – application of herbicides (either concentrate or diluted mixes) to freshly cut tree stumps using a sprayer or paint brush.

Exotic – foreign; originating outside the continent of North America.

Foliar spray – application of water-based herbicide to the foliage of target plants using equipment with a spray nozzle (e.g., backpack sprayer).

Invasive – outcompeting other plant species for nutrients, water, or sunlight.

Stem injection – application of herbicides (either concentrate or diluted mixes) into woody stems by creating a downward incision in the stem and spraying chemical into the incision. Incisions can be made with hatchet, ax, machete, etc., should penetrate the cambium, and should be spaced around the entire circumference of the stem.

Introduction

Grand Bay National Estuarine Research Reserve (Grand Bay NERR) encompasses about 7,285 ha (18,000 ac) of relatively pristine estuarine, wetland, and upland habitats in Jackson County, Mississippi. Exotic invasive species are scattered throughout Grand Bay NERR, though, based on current knowledge, severe infestations are limited to the area historically known as the Goat Farm, which is located south of Bayou Heron Road about 1.2 km (0.75 mi) west of Bayou Heron Boat Launch. Cogongrass and Chinese tallow are the primary invasive species on Grand Bay NERR, both in terms of hectares infested and the destructive impacts on native natural resources and ecological processes. However, other invasive species occur on Grand Bay NERR (Table 1).

Without proper management, invasive species will continue to spread and displace native species through competition for nutrients and sunlight. The goal of this management plan is to control or eradicate current invasive species on Grand Bay NERR and to prevent future biological invasions. This goal will be achieved through a combination of stewardship actions, research opportunities, and educational outreach.

Grand Bay NERR advocates the protection of native species, minimization of disturbance by management activities, and the return of habitats to their native conditions. While management actions may be intrusive (e.g., disturbing soil, temporarily displacing native

Table 1. Known invasive organisms on Grand Bay NERR.

Taxonomic Group	Common Name	Scientific Name
Plant	Chinese privet	<i>Ligustrum sinense</i>
	Chinese tallow	<i>Sapium sebiferum</i>
	Common reed	<i>Phragmites australis</i> ¹
	Cogongrass	<i>Imperata cylindrica</i>
	Japanese climbing fern	<i>Lygodium japonicum</i>
	Japanese honeysuckle	<i>Lonicera japonica</i>
Invertebrate	Argentine ant	<i>Linepithema humile</i>
	Red Imported Fire Ant	<i>Solenopsis invicta</i>
Bird	Brown-headed cowbird	<i>Molothrus ater</i>
	European starling	<i>Sturnus vulgaris</i>
Mammal	Feral hog	<i>Sus scrofa</i>
	Nutria	<i>Myocastor coypus</i>

¹ Phragmites may be a native invasive or exotic invasive. (plant and animal species), Grand Bay NERR will use techniques that minimize such

disturbance. In addition, after treatment of invasive species, appropriate corrective actions (e.g., topographic re-contouring, seedling plantings) will be taken to restore native habitats and processes.

Agency Coordination and Cooperation

Grand Bay NERR will coordinate with other natural resource agencies (USFWS, NRCS, DMR, Forestry Commission) in Jackson County, MS and Mobile County, AL to maintain current knowledge of preventive measures, invasion of new nonindigenous species or new invasions of known nonindigenous species in the area, control and management techniques and actions. Staff at Grand Bay NERR will participate in periodic training, conferences, and other activities to meet this goal.

Grand Bay NERR will approach public works agencies (e.g., utility companies, road maintenance) to seek cooperation in the use of best management practices where invasive species are concerned. This should include maintenance of public works with minimal soil disturbance because disturbed sites are vulnerable to invasions. In addition, vehicles should be maintained (i.e., cleaned) prior to and after activities occur on Grand Bay NERR to prevent new invasions on the reserve or areas outside the reserve.

Prevention of Biological Invasions

Grand Bay NERR will identify potential avenues of biological invasion. Potential threats will be addressed as they arise, and appropriate preventive actions will be taken. The community education activities should stress prevention because prevention will be less expensive than control of an established invasive species.

Prevention measures will include:

- Cleaning vehicles (trucks and ATVs) after they have been in an area where invasive species are present, especially during the period of seeding.
- Minimizing activities that result in exposed mineral soil.
- Educating the community and user groups of activities that may increase the likelihood of invasions (both animal and plant).

Inventory and Surveillance of Invasive Species

Effective control and management of invasive species depends on early detection and assessment of the threat to native natural resources. Threat assessment will consist of identification of the invasive species, recording the extent of invasion, likelihood of spread, estimated rate of spread, and the investment (both personnel and financial) required to eradicate or control the invasion. The likelihood of spread should be based on proximity to transportation routes, areas of high foot traffic (e.g., hiking trails), and

disturbed soils or habitats. The likelihood of spread may be affected by the vigor of the species and its life history characteristics (e.g., seed production).

The inventory and surveillance program will consist of a combination of remote sensing and field surveys. Because access to much of Grand Bay NERR is limited and designation of the reserve occurred relatively recently (1999), a thorough inventory has not been conducted. Remote sensing offers a powerful tool for identifying large areas impacted by biological invasions. Grand Bay NERR will use field surveys to complement remotely sensed data. Field surveys will allow detection of new (i.e., small) invasions. In addition, field surveys will allow more detailed assessments and verification of invasions identified by remote imagery. Furthermore, due to the costs associated with acquiring and classifying remotely sensed data, we do not anticipate updating these data annually. Invasions could spread significantly during the period between acquisition of remote sensing data; therefore, Grand Bay NERR will dedicate field time to annual monitoring of known sites and surveys in areas where data are lacking. Surveillance and inventory efforts will focus on right-of-ways, stream banks, roads and trails, and other likely routes of invasion.

During the course of normal outdoor activities, Grand Bay NERR staff should be cognizant of invasive species and should take note of the area and extent of invasions. This information should be relayed to the Stewardship Coordinator, who will make a more detailed risk assessment and plan control activities as necessary. In addition, researchers and contractors conducting activities on Grand Bay NERR should be informed of common invasive species that they might encounter and should report problem areas to reserve staff. After initial detection of invaded areas, data collection will consist of monitoring rate and pattern of spread and effects on natural resources. In addition, staff may conduct research (see *Research* section below) to develop new control methods or to estimate the impact of invasive species on native species.

Control and Management

Control and management activities should be undertaken after development of specific goals and objectives for a particular project. The project planning and design phase should address the following topics:

- Identification of local native species that would be suitable replacements or post-restoration target species for the site based on site topography, elevation, hydrology, etc.
- Identification of a source for local native material (i.e., plants, seeds) to replace invasives. The source may be a commercial nursery, an area of native plants growing adjacent to the restoration site, or some other suitable source.
- Proposed methods (e.g., transplanting “plugs” from a nearby area, sowing harvested seeds, purchasing and planting nursery plants, natural succession, etc.) for re-vegetation of the treated site.
- Assessment of the allelopathic characteristics of the invasive plant (i.e., does the plant produce a chemical that inhibits growth of other species). If the invasive is

allelopathic, how long is the allelotoxin expected to be active in the soil, and how will the site be maintained after removal of the invasive but before establishment of native species.

- Establishment of several small treatment plots utilizing different control techniques or chemical concentrations. This is necessary to compare the effectiveness of treatment options. Results should be monitored to identify a “best” solution.

Control and management of a biological invasion will depend on several factors, including:

- species involved
- location
- extent of the invasion
- presence of non-target species
- season
- potential for spread
- consideration for other management and research activities

Acceptable methods for control and management include:

- Mechanical
 - o Mowing
 - o Discing
 - o Chainsaw
 - o Drum chopping
- Chemical
 - o Basal-bark (basal treatment)
 - o Cut-surface (stem injection, girdling, cut-stump painting or spraying)
 - o Foliar (broadcast spraying, spot spraying)
- Controlled ecological processes
 - o Prescribed fire
 - o Flooding or moist soil management
- Biological

(Appendix 1 provides treatment suggestions for some invasive plants on Grand Bay NERR. Appendix 2 provides additional management considerations for individual invasive plant species.)

When using chemical treatments, Grand Bay NERR staff should be aware of the potential adverse effects of herbicides and pesticides on non-target species. Adverse effects may include prolonged soil activity, which may prevent the establishment of native plant species after invasive species have been removed. Personnel applying chemicals will follow all warning labels on chemical containers, and proper permits will be secured prior to treatment activities. In addition, all management activities will emphasize the restoration of native vegetation and ecosystem processes after invasive species have been controlled or eradicated. Successful chemical treatments should:

- use a herbicide known to provide effective control of the invasive species,
- follow application methods and warning labels provided with the herbicide,

- be applied during an optimal time (i.e., season) to achieve uptake by the plant,
- involve a detailed record of the chemical concentration used and the application method and rate.

Biological methods (i.e., introduction of one species to control another) are of particular concern. In general, these methods will be avoided due to the documented occurrence of unpredicted ecosystem effects following biological control techniques. In cases for which extensive laboratory work has been conducted and the impact upon non-target species within Grand Bay NERR has been examined, biological management techniques may be considered.

An integrated management approach may be used for the control of invasive species. Integrated management involves the combination of 2 or more techniques to achieve improved kill rates. For example, summer mowing followed by fall herbicide application may improve control of particular species.

Invasive birds and mammals should be trapped or taken opportunistically. The method of trapping or take will be determined on a case by case basis and will depend on public visibility of trap sites, potential for affecting non-target animals, etc. Potential methods include firearms, mist nets, and live traps.

Research

When appropriate and feasible, Grand Bay NERR will incorporate research projects into treatment and management actions for invasive species. Research topics may include:

- physical constraints determining invasion and expansion
- life cycle of invasive species
- effects on native plants and animals
- eradication and control techniques
- human and economic impacts
- assessment of the effectiveness of treatments based on monitoring plant and animal abundance, both invasive and native

Research activities will emphasize restoration science. That is, monitoring programs will be established to compare diversity and abundance of species between treated and reference (untreated and historically undisturbed) areas. In addition, when possible a separate, untreated site that exhibits a similar type and stage of infestation prior to treatment will be monitored to assess the success of management activities. Site selection for restoration activities may be based on:

- level of infestation
- probability of re-infestation
- value (economic value or value as habitat for wildlife) of the land area after invasive species are removed
- degree to which the area acts a source for invasion elsewhere (e.g., seed dispersal)
- opportunities for research or education activities

Community Education

The educational component of the invasive species management plan will attempt to increase public awareness of the potential negative impacts of invasive species to biological systems, ecological processes, and the local economy. Educational outreach may consist of formal workshops, printed materials, and presentations to visitors at Grand Bay NERR. Coastal Training Program workshops may be organized to heighten awareness of invasive species issues and to disseminate information from management activities at Grand Bay NERR. At a minimum, educational materials should be provided to the following groups, which might be conducting activities on Grand Bay NERR.

- hunters/fishers
- contractors
- researchers
- utility companies

Future Needs

- Thorough inventory and status assessment of invasive species on Grand Bay NERR, including the following habitats and taxonomic groups.
 - Terrestrial
 - Aquatic
 - Invertebrates
- Outreach to utility companies.

Appendix 1. Suggested treatment options for invasive plant species on Grand Bay NERR.

Species	Season or Condition		Treatment		Comment
		Type	Target	Chemical ²	
<i>Imperata cylindrica</i>	Year round, except during seeding	Mechanical	Entire plant and soil		Frequent tillage using mower, disc, or similar implement
	Year round	Herbicide ¹	Foliage	Roundup Ultra or Roundup Pro at 5 qts/ac or as a 1.5% solution	Repeated applications every year for several years, as necessary
	Mid-late summer	Herbicide	Foliage	Arsenal AC at 12oz/ac with 0.25% v/v nonionic surfactant; 20gal spray /ac	
	Mid-late summer	Herbicide	Foliage	Roundup at 96oz/ac of 3lb ae/gal formulation (with 0.5% v/v nonionic surfactant if none in formulation); 20gal spray /ac	Treatment in consecutive years may be necessary
	Mid-late summer	Herbicide	Foliage	Arsenal + Roundup at 16oz Arsenal AC + 64oz Roundup per ac with 0.25% v/v nonionic surfactant; 20gal spray /ac	
	Mid-July to first frost, areas with hardwoods	Herbicide, broadcast treatment	Foliage	Roundup at 2.5 qts/ac + surfactant at 6oz/ac; 20gal spray solution/ac	
	Mid-July to first frost, areas with hardwoods	Herbicide, spot treatment	Foliage	Roundup at 2.6fl oz/gal or 2% v/v + surfactant at 0.32oz/gal water or 0.25% v/v	
	Mid-July to first frost, areas without hardwoods	Herbicide, broadcast treatment	Foliage	Roundup at 1qt/ac + Arsenal AC at 1.5 pt/ac + surfactant at 6oz/ac; 20gal spray solution/ac	
	Mid-July to first frost, areas without hardwoods	Herbicide, spot treatment	Foliage	Roundup at 2.6fl oz/gal or 2% v/v + Arsenal AC at 0.6 fl oz/gal or 0.5% v/v + surfactant at 0.32oz/gal water or 0.25% v/v	

<i>Ligustrum sinense</i>	May-Sept	Herbicide	Foliage	Roundup + Garlon 4	
		Herbicide		Escort at 4oz/100gal water + 1% v/v nonionic surfactant	
		Herbicide	Basal	Garlon 4 at 20% in oil-based solution with penetrant	
	May-Aug	Herbicide	Foliage	Arsenal AC at 1% v/v solution with 0.5% v/v nonionic surfactant	
	Aug-Dec	Herbicide	Foliage	Glyphosate herbicide at 3%	
		Herbicide	Cut-surface	Arsenal AC at 10%, or a glyphosate herbicide at 20%	Apply herbicide immediately after cutting.
<i>Lygodium japonicum</i>	Apr-Sept	Herbicide	Foliage	Garlon 4 or Roundup + Garlon 4	
	Apr-Sept	Herbicide	Basal	Garlon 4	Girdle prior to treatment
	Jul-Oct	Herbicide	Foliage	Arsenal AC at 1%, or a glyphosate herbicide at 4%, or a combination of these	
<i>Phragmites australis</i>	Year round	Mechanical	Stem		Cut stems monthly and remove cut debris.
	Mar-Nov	Cover	Entire plant		Cover plants with thick, black plastic until plants die.
	Dec-Feb	Burn	Entire plant		Fire must be hot enough to burn the rhizomes.
	15 Aug-15 Sept	Herbicide	Foliage	Roundup or Garlon 4 at 1.5%	Spray, drip, or wick herbicide on the plant when the seed head is fully emerged. Most effective method.
<i>Sapium sebiferum</i>	Feb-Oct	Herbicide	Foliage	Roundup + Garlon 4	
	Feb-Oct	Herbicide	Basal	Garlon 4	Girdle prior to treatment
	Feb-May	Herbicide	Cut-surface Frill	Roundup at 25% - 100% concentration	Cut trunk on each side and spray or paint chemical in wound
	Jul-Oct	Herbicide	Foliage	Arsenal AC at 1%	
	Year round	Mechanical	Stem/trunk		Intensive mowing or chainsaw cutting

¹ All herbicide treatments are spray to wet unless otherwise noted.

² All herbicides are diluted in water and contain a nonionic surfactant unless otherwise noted.

Appendix 2. Management consideration for individual invasive plant species.

Imperata cylindrica – cogongrass

- Usually seeds March-May. Do not mow the grass while it is in bloom; this spreads the wind-borne seeds.
- Cogongrass is highly invasive/aggressive and seeds earlier than native grasses; thus, it is able to colonize disturbed areas before native plants.
- Round-up at 16 oz/ac provides about 88% seed head suppression.
- Treatment regime and timing of treatment: The most effective treatment is a combination of mechanical and chemical techniques. Mow in the spring (June), then apply chemicals in the fall. Chemicals work best if applied in the late summer to fall (July to mid-November). Spring chemical treatment provides about 90 days of effect before the grass recovers. When treating in the summer/fall, the underground rhizome stores are at a minimum because the stores have been spent on growth. Application of herbicide at this time results in effective uptake of the chemical because as the grass approaches its dormant period, it begins to replenish its stores for the following growing season. So the chemical is quickly transferred to the rhizomes along with other resources produced in the grass blade.
- Spray during the fall with full coverage, then do a touch up during spring for areas that show growth.
- During fall, spray a 6-8ft buffer area around the aboveground cogongrass vegetation; this kills the underground rhizomes and prevents development of a doughnut-shaped aboveground growth pattern following the growing season.
- An alternative treatment is to disc an area in the fall to expose the rhizomes. Freezing temperatures over winter will then help to kill the grass.
- A mixture of Roundup and Arsenal is the best treatment at 1.5% Roundup XP or Roundup Pro, 0.5% Arsenal, plus surfactant. For Roundup, use 41% active ingredient, which translates to 4 lbs of product. This mixture is good any time of year. (Arsenal should be used with a 4% non-ionic surfactant. Use red label Arsenal for roadsides; green label Arsenal for private lands.)
- “Spray to wet” using a fan-tipped nozzle; do not soak plants or apply extra herbicide to areas where thick bunches of grass occur.
- Effective treatment requires destruction of the seed head *and* rhizomes. Cutting or burning just top-kills the grass and promotes underground rhizome growth.
- Open fields may require 2-3 treatments to achieve control/eradication; in pine understory, 1 treatment may be sufficient.
- If treatment involves multiple herbicide applications over time, the grass must recover (i.e., show regrowth) between applications.
- DO NOT use Arsenal around hardwoods; it will kill them. When treating areas containing hardwoods, provide an untreated buffer area equal to 2 times the dripline to prevent killing the trees or shrubs. Within the dripline cogongrass can be treated with Round-up or some other herbicide. The dripline is defined as the

distance from the trunk of the tree to the outer edge of the vertical foliage (i.e., the area where precipitation drips through the foliage).

- Allow chemical a minimum of 6 weeks to translocate to the rhizomes before burning or taking other management actions.

Chemical Notes:

- Arsenal and Roundup are non-selective herbicides and may damage or kill nearby native vegetation, including hardwood trees.
- Arsenal remains active in the soil for long periods; thus, a single treatment in an area may be effective for long periods (up to a year).
- Arsenal *does not* affect water quality or aquatic organisms.
- “One-step” is a combination of glyphosate (Roundup) and Imazapyr (Arsenal).

Sapium sebiferum – Chinese tallow

- Cutting – cut trees at ground level. Cutting is most effective when trees have begun to flower because it prevents seed production. Treatments of other types will be needed if the plant resprouts from the roots.
- Cut and frill – use a hatchet to cut through the bark, and into the cambium, around the trunk of the tree at 15cm (6in) above root collar. Resprouts are common with this method. Not recommended for large areas due to the likelihood of additional treatments.
- Hand pulling – effective for young seedlings. Best after a rain because the soil is loose.
- Foliar spray – effective for large thickets of seedling trees when damage to non-target species will be minimal. Air temperature >65°F is recommended.
 - Apply glyphosate as 2% water-based solution with 0.5% non-ionic surfactant and thoroughly wet the leaves. Glyphosate may kill non-target species.
 - Apply triclopyr as 2% water-based solution with 0.5% non-ionic surfactant and thoroughly wet the leaves. Triclopyr affects broadleaf species, but will not harm understory grasses.
- Cut stump – effective for treatment of individual trees, or selective treatment in areas that contain non-target species. Apply glyphosate or triclopyr as 50% water-based solution to the stump, immediately after the stem is cut horizontally near the ground. Cover the outer 20% of the stump.
- Basal bark method – effective year-round. Apply a mixture of 25% triclopyr and 75% horticultural oil to the lower 30-38cm (12-15in) of the stem. Soak thoroughly.
- Burning produces abundant seedlings.
- Seedlings and saplings – spray to wet all leaves with a herbicide diluted in water with a surfactant during July to October. Use Arsenal AC as a 1% solution (4 oz per 3-gallon mix).