



Exotic Plant Management in Acadia National Park, Maine

2015 Annual Summary Report

ACAD NR Report #: 2016-9



ON THE COVER

Exotic Plant Management Team members Joe Kelley (left) and James Burka map a photo point at Merchant's Cove on Isle au Haut, July 2015 (NPS staff Alex Fetgatter and Tony Tocci not shown). This photo point will be used for years to come to measure the effectiveness of management practices. Canada thistle (*Cirsium arvense*) and bull thistle (*Cirsium vulgare*) infest this site currently; individual plants were treated with herbicide by the EPMT in 2015. Photo: NPS

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Executive Summary

The National Park Service's (NPS) Acadia National Park Exotic Plant Management Team (EPMT) continues to protect the long-term ecological functions of park environments by managing the most threatening invasive exotic (non-native) plant species, preventing their establishment and restoring native habitats. The EPMT's mission is to safely, professionally and efficiently manage approximately 25 of the highest-priority invasive exotic plant (IEP) species on NPS-administered lands to protect naturally-functioning habitats and allow visitors to experience landscapes unaffected by IEPs. Management actions are based on sound and current science, applied through an integrated pest management approach, and includes community partnerships, especially outreach and education.

In 2015, we systematically surveyed 498.96 acres of forest, wetland, riparian and other habitats for the presence of IEPs prioritized for management, 48 sites were monitored, and 18 species of IEPs totaling 6.19 infested acres* were managed on NPS and adjacent private lands (Figure 1). The four-person crew spent a total of 1,627 hours managing exotic plants. In this seventh year of management, we completed intensive surveys, initial and follow-up re-treatment of glossy buckthorn in all federally-owned portions of the Cromwell Brook Watershed. EPMT staff participated in community outreach events to educate visitors, neighbors and the local community about exotic plant identification and management. The EPMT continued to restore the cultural landscape at Sieur de Monts with native plantings around the spring pool, Dorr Memorial and west of the Nature Center. The landscape around the Moore Auditorium on Schoodic Peninsula was rehabilitated using native plants with the help of volunteers. The EPMT also built a fence there to hide the auditorium's unsightly ventilation system.

Direct program costs for calendar year 2015 were \$239,986. This program is funded primarily through four grants and other "soft" funding sources, including a donation from the Federal Aviation Administration (FAA) to mitigate wetland impacts from expanding the runway at the Hancock County Airport, NPS recreational fee revenues and a grant from Canon USA procured by Friends of Acadia (FOA). This figure includes personal services for the crew and half of the park's vegetation program manager's salary, as well as supplies, equipment, and limited training and travel. Maintenance and administrative support, offices, storage, vehicles and fuel were funded through other NPS operational funds and are not included in the figure above.

**(Infested acres, in this case, are defined as canopy cover of invasive plant species at 100 %.)*

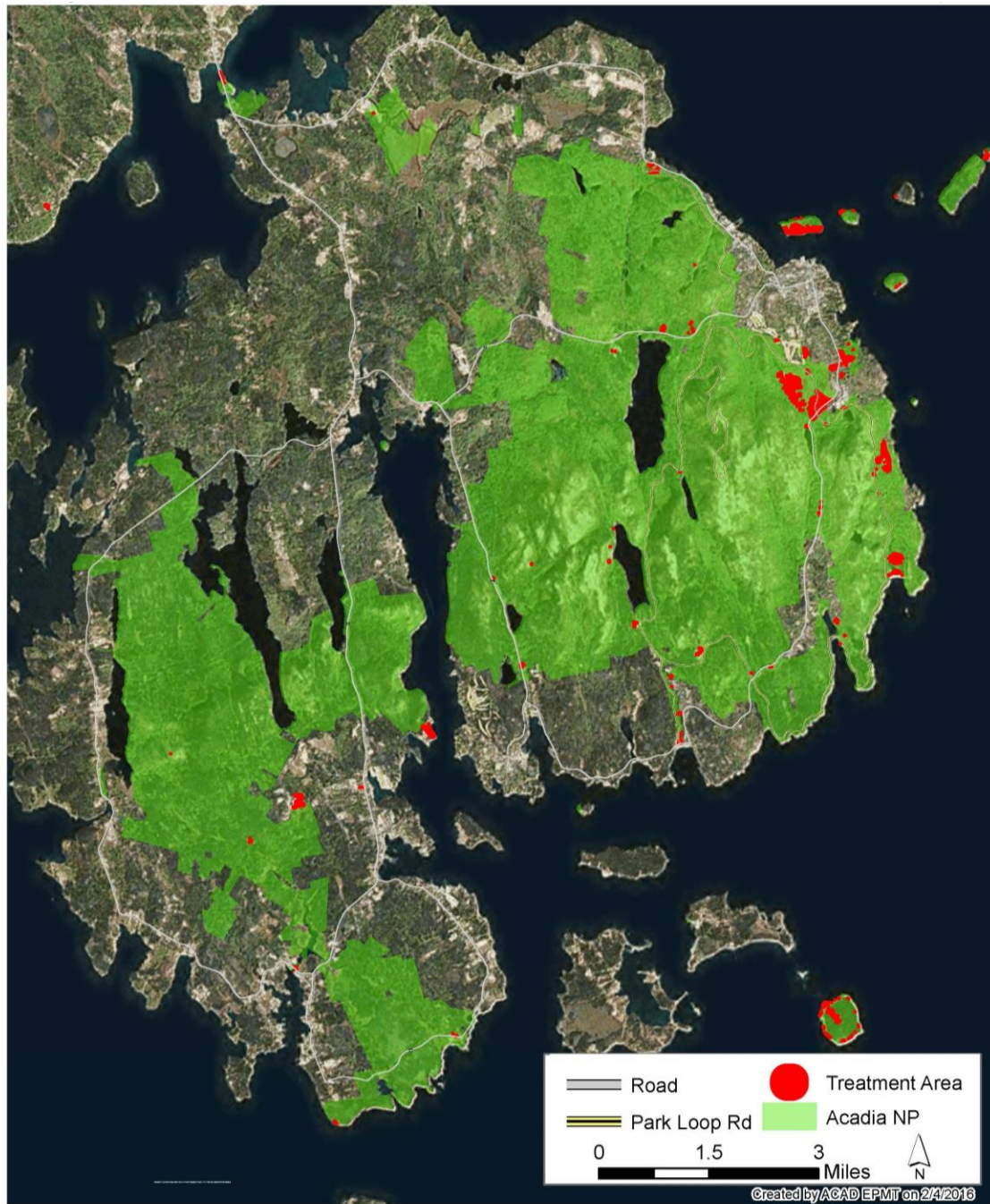


Figure 1. Location of invasive exotic plant populations that were detected, suppressed, re-treated or monitored during 2015. Treatment and survey efforts of 18 invasive exotic species covered over 500 acres May through October. Management areas on Isle au Haut, Schoodic Peninsula and Saint Croix Island International Historic Site are not presented here. Map created by Joseph Kelley, NPS.

Introduction

Invasive Exotic Plants (IEPs) represent a significant threat to the ecosystems of Acadia National Park, in particular those lands managed on Mount Desert Island (MDI), which has a long history of human disturbance and introductions of horticultural plants that later proved to be invasive and ecologically damaging. IEPs can degrade or destroy native habitats by displacing the native species that previously occupied the area. In extreme cases, IEPs out-compete native plants and form dense monocultures. This has far-reaching consequences for other components of the ecosystem, both flora and fauna, that rely on these native plants for habitat and food. IEPs can also obstruct or change views enjoyed by park visitors, damage structures and degrade cultural resources of the park.

The Acadia National Park Exotic Plant Management Program goals are to:

- (1) Preserve healthy habitats using **early detection and rapid response (EDRR)** to prevent IEP populations from becoming established;
- (2) **Manage existing populations** of IEPs to prevent their spread and reduce their populations to thresholds where they no longer adversely impact native ecosystems (Fully suppressed / Maintenance level); and,
- (3) Employ a professional crew that **safely, effectively and efficiently meets the park's exotic plant management needs** using a science-based integrated pest management (IPM) approach.

EDRR addresses either a newly introduced species not previously found in the area such as black swallow wort (*Vincetoxicum nigrum*), or a new population of a species already existing in the area such as glossy buckthorn (*Rhamnus frangula*, previously *Frangula alnus*). Correct identification of the species in question is the first step in the process, particularly with species that are new to the area. Once a species has been positively identified, information is gathered on its biology and proven best management practices. If a “new” invasive plant species can be detected and treated before it has a chance to fully establish itself, the possibility of eradicating it from the site is greatly increased. As time goes by, the amount of disturbance at a site, accumulations of seeds and populations spreading to surrounding areas decrease the likelihood of eradicating the plant from the site. Furthermore, the cost in time and resources needed for treatment goes up dramatically.

Current EDRR efforts are focused on areas of the park where IEPs have been previously detected or are most likely to occur, including former, house or garden sites where they may have been introduced by residents, and previously-disturbed areas such as Wildwood Stables and the carriage road system, where horses, seeds in hay and vehicles can introduce and move weed seeds. At construction sites, ground disturbance may create a habitat for IEP species or vehicles and heavy equipment can carry weed seeds from infested areas. In high visitor-use areas (e.g., trails and parking areas) foot traffic compacts soils and tramples vegetation, creating disturbance that favors pioneer IEPs. EDRR efforts are also focused on high-value habitats; these include

wetlands such as Bear Brook and the Tarn, both of which have been heavily infested with glossy buckhorn.

Managing IEPs is an ongoing process that requires a long-term commitment. Enduring seed banks, undetected individuals and dispersing populations from adjacent private lands mean that while we can reduce populations below levels where environmental harm occurs (damage thresholds), total eradication over a long time may be unlikely. Long-term management goals are determined species by species, and usually focus on either fully suppressing populations or simply maintaining IEPs at such low levels that environmental harm is prevented. Just as a historic building or landscape requires ongoing maintenance following significant rehabilitation, managing IEPs on natural landscapes may require an initial high-intensity effort to significantly reduce populations that have been long established, followed by lower but consistent effort to protect natural habitats and maintain views of Acadia's natural environment unchanged by IEPs.

Goals and Management Objectives

The EPMT's goal regarding established populations of IEPs is to first remove sexually mature plants to prevent further seed production (initial attack) and then to reduce the population of all managed IEP species to < 1% total cover of the management unit (suppression). Once this is achieved, the site is considered at maintenance level, and will be monitored regularly to determine the need for follow-up treatments and to detect any new exotic plant invasions. Ideally, sites will be monitored once a year for three years; if IEPs are absent, then once every five years. Although initial treatment efforts can be time- and labor-intensive, once exotic plant populations are significantly reduced then cyclic maintenance to manage low-level populations requires much less investment (Figure 2).

All management actions (treatments, survey or monitoring) are logged on standard data sheets that record the following information: location, personnel involved, hours worked, weather, amount and type of herbicide used, treatment methods, level of infestation and the phenology of the dominant exotic species present. All treatment areas are mapped using Global Positioning System (GPS) and Geographic Information System (GIS) technology to record the location of the infestation. Photo points are taken during pre- and post-treatment to help monitor changes in populations over time (Figure 3).

With many sites and species scattered throughout ANP, it is necessary to prioritize which species are treated and when. To that end we now manage IEPs in the park by watershed (e.g. Cromwell Brook); to maintain continuity between past years, watersheds are further described using work location names (e.g. Sieur de Monts, Great Meadow). These management units and watersheds have been mapped using GPS and GIS, and will continue to be surveyed for presence/absence of targeted IEPs. Management by species and location are reported here to summarize management actions.

Park resource managers have also developed management plans for 27 of the IEP species of greatest concern, including plans for the 2016 field season (Table 1). Although there are more than 27 IEP species in the park, these species were chosen for active management based on the biology of the species including invasiveness, the threat they pose to park resources (the relative ecological or cultural values at risk from the plant), as well as the feasibility that we can successfully manage them. These plans describe species abundance and location within the park, and provide information about habitat, species identification and best management practices. The latest scientific literature is reviewed and action plans are updated annually to ensure they prescribe management strategies that are based on the latest scientific and exotic plant management techniques using least toxic, IPM approaches.



Figure 2. Cyclic maintenance is carried out in some locations, like this site on Fernald Point, in Southwest Harbor, ME. First-year leaves of garlic mustard (*Alliaria petiolata*) are seen growing underneath this ramp. Pulling these plants before they seed during their second year will reduce the seed bank and, over time, significantly reduce or eliminate this population (NPS photo, taken 05/15/2014).

Table 1. 2015 invasive exotic plant species status and 2016 management goals by species for Acadia National Park.

Species	Initial effort	Long-Term Goal	Current Status	Mgt. effort	Primary Treatment Method	Current Status - Park Only
Amur maple (<i>Acer ginnala</i>)	2006	Full Suppression	Fully Suppressed	Incidental	foliar herbicide	
Asiatic bittersweet (<i>Celastrus orbiculata</i>)	2010	Full Suppression	Nearly Suppressed	Active (High)	foliar and cut stump herbicide	
Autumn olive (<i>Elaeagnus umbellata</i>)	2013	Below Management Threshold	Early Detection	Rapid Response	foliar and cut stump herbicide	
Barberry species (Japanese, common, hybrids) (<i>Berberis</i> spp.)	2006	Near Suppression	Population Reduced	Active (High)	foliar herbicide	
Bittersweet nightshade (<i>Solanum dulcamara</i>)	2012	Below Management Threshold	Selective Control	Incidental	foliar herbicide	
Burning bush, Winged burning bush (<i>Euonymus</i> spp.)	2011	Below Management Threshold	Early Detection	Rapid Response	foliar and cut stump herbicide	
Canada/Bull thistle (<i>Cirsium arvense/vulgare</i>)	2003	Full Suppression	Nearly Suppressed	Active (High)	foliar herbicide	
Coltsfoot (<i>Tussilago farfara</i>)	2002	Below Management Threshold	Early Detection / Rarely Found	Rapid Response	foliar herbicide	
Common mullein (<i>Verbascum thapsis</i>)	2011	Below Management Threshold	Selective Control	Incidental	hand pull	
Common reed (<i>Phragmites australis</i>)	2014	Full Suppression	Population Contained	Active (low)	foliar herbicide	Early Detection
European bittercress (<i>Cardamine impatiens</i>)	2005	Below Management Threshold	Population Contained	Volunteer (High)	hand pull / foliar herbicide	
Exotic bush honeysuckle species (<i>Lonicera</i> spp.)	2003	Full Suppression	Nearly Suppressed	Active (High)	foliar and cut stump herbicide	
Foxglove (<i>Digitalis purpurea</i>)	2003	Below Management Threshold	Fully Suppressed	Active (Low)	foliar herbicide	
Garlic mustard (<i>Alliaria petiolata</i>)	2003	Full Suppression	Population Reduced	Active (Med)	hand pull	
Giant hogweed (<i>Heracleum mantegazzianum</i>)	2003	Below Management Threshold	Early Detection / Rarely Found	Rapid Response	foliar herbicide	At very low levels
Glossy buckthorn (<i>Rhamnus frangula</i>)	2006	Full Suppression	Population Reduced	Active (High)	foliar and cut stump herbicide	Nearly Suppressed
Japanese honeysuckle (<i>Lonicera japonica</i>)	2012	Below Management Threshold	Early Detection	Rapid Response	foliar herbicide	
Japanese knotweed (<i>Fallopia japonica</i>)	2003	Full Suppression	Population Reduced	Active (High)	foliar herbicide and cut stem	
Lupine (<i>Lupinus polyphyllus</i>)	2004	Education / Monitor	Population Monitored	Volunteer (Low)	seed pod removal	
Multiflora rose (<i>Rosa multiflora</i>)	2006	Below Management Threshold	Early Detection	Rapid Response	foliar herbicide	

Table 1 (continued). 2015 invasive exotic plant species status and 2016 management goals by species for Acadia National Park.

Species	Initial effort	Long-Term Goal	Current Status	Mgt. effort	Primary Treatment Method	Current Status - Park Only
Norway maple (<i>Acer platanoides</i>)	2016	Population Contained	Population Increasing	Active (Low)	cut stump herbicide / girdling	Population Contained
Privet (<i>Ligustrum</i> spp.)	2016	Full Suppression	Population Increasing	Active (High)	cut stump herbicide	
Purple loosestrife (<i>Lythrum salicaria</i>)	1988	Full Suppression	Nearly Suppressed	Active (Med)	foliar herbicide	Full Suppression
Shrubby St. Johnswort (<i>Hypericum prolificum</i>)	2008	Full Suppression	Nearly Suppressed	Active (Low)	foliar herbicide	
Spotted knapweed (<i>Centaurea stoebe</i>)	2010	Below Management Threshold	Early Detection	Rapid Response	foliar herbicide	
Yellow iris (<i>Iris pseudacorus</i>)	2003	Below Management Threshold	Early Detection	Rapid Response	hand pull	
Currently Under Review, Management N/A						
Forest woodrush (<i>Luzula luzuloides</i>)	2011	Under Review	Monitoring	Inactive	foliar herbicide	
Reed canary grass (<i>Phalaris arundinacea</i>)	2010	Under Review	Monitoring	Inactive	foliar herbicide	
Golden Chain Tree (<i>Laburnum watereri</i>)	N/A	Under Review	Monitoring	Inactive	Cut stump	

Definitions

Fully Suppressed = Density or cover below Maintenance level threshold (no reproductive plants known); seed bank may still be viable

Nearly Suppressed = Known populations are small and contain few reproductive individuals; seed bank managed regularly

Population Reduced = Population infested acres reduced from previous year

Population Contained = Population infested acres remains constant and established populations prevented from spreading to uninfested areas

Population Increasing = Population infested acres increasing or likely expanding to uninfested areas

Incidental = This plant managed when encountered during mgt. of other species

Early Detection = New and small recurring populations (Maintenance level)

Rapid Response = Active management when population discovered

Volunteer = Treatment primarily carried out by volunteers to improve outreach and education

Active = management time devoted to specific species

Active (High) = crew works on this plant for 100+ person hours/season

Active (Med) = crew works on this plant for 30-100 person hours/season

Active (Low) = crew works on this plant for 1-30 person hours/season

Inactive = Management of species is not targeted due to incomplete management plans

All exotic plant management plans and actions are based on the following principals of IPM:

- 1:** Survey the area to identify resources at risk and determine the location and extent of IEP infestations.
- 2:** Prioritize infestations for management based on the threat they pose, their potential rate of spread, distribution and the feasibility of successful treatment.
- 3:** Review scientific literature and base future management actions on a thorough understanding of the biology of the invasive species, treatment alternatives and potential effects.
- 4:** Consider all available treatment options and select the methods that will most effectively treat the species of concern with the least potential environmental damage.
- 5:** Monitor treated areas to determine treatment success and the need for re-treatment or restoring treated areas with native species.
- 6:** Evaluate treatment results and use them to guide future management actions.

Due to the many hazards associated with exotic plant management, as well as the demanding and technical nature of the work, it is of utmost importance that the park's EPMT be a well-trained, professional crew. To this end crew members and staff all take part in a comprehensive training program, and are licensed by the State of Maine Board of Pesticides Control as Commercial Pesticide Applicators. Program leaders participate in regional professional meetings such as the Maine Invasive Species Network annual meeting to stay abreast of research and improve partnerships and collaborations. Staff also completes required NPS training including personnel management, computer security, hazardous materials communication and supervision. Field crew training for new staff starts with two weeks of classroom and field training beginning early May, and is continued throughout the season with frequent safety and IEP species reports and tailgate safety sessions. The team operates on the following principles, each one building on the next:

Work Safely

Exotic plant management is hazardous work by nature. Herbicide, hand tools, exposure to ticks and tick-borne diseases, physically demanding work, remote job sites and steep terrain are part of the team's daily operations. To enhance safety the team incorporates frequent training sessions and discusses hazards on the job, and how to mitigate them.

Work Effectively

The EPMT has limited time and resources. To best protect resources and meet program goals, crew members must be proficient at using and caring for tools, vehicles and equipment. This includes handling, transporting, maintaining, storing and using herbicides in the most safe and efficient manner possible.

Work Efficiently

Time is always a factor in exotic plant management. The longer an area is infested with IEPs the more seed will be produced, the more disturbed the site will be and the greater the potential for spread to surrounding sites.

Working in a safe, effective and efficient manner allows the EPMT to best utilize its time and resources.

Program Accomplishments

The 2015 field season began May 4th by managing early-blooming herbaceous species such as garlic mustard (*Alliaria petiolata*). Returning employees James Burka and Alex Fetgatter were hired into term GS-05 biological science technician positions. These positions are essentially the same as those Alex and James filled in 2014, only they allow up to 48 weeks of work per year. The previous seasonal GS-05 positions only allowed up to six months of work in a calendar year. The term positions also provide health and retirement benefits. The above perks, as well as the possibility of employment for four years without having to re-compete, helps keep turnover down and better the program's ability to keep good employees.

Exotic plant management field operations ran 26 weeks in 2015, ending October 28th. This is two weeks longer than in 2014, and four weeks longer than in 2012. Alex, James, Joe and Tony continued field work after October 28th in a different capacity, aiding the Maintenance Division's efforts to rehabilitate historic vistas along carriage and motor roads. In addition to assisting with tree felling operations, they provided the important addition of systemic herbicide application to prevent deciduous trees from stump sprouting. James, Joe and Tony also worked with arborists in training through the NPS's Olmstead Center for Landscape Preservation. This collaboration enhanced their chainsaw experience and professional development; at the same time Alex completed a week-long chainsaw course called S-212: Wildland Fire Chain Saws.

In November, Jesse Wheeler was hired as the EPMT's new term lead biological technician and program leader. Jesse comes to us from the NPS Inventory and Monitoring Program. He completed his master's degree in forest ecology at Antioch College of New England, has previous work experience as a member of Acadia's resource management field staff working on exotic plant management and revegetation using native plants, and has a thorough knowledge of park resources having grown up on MDI. During the first two weeks of December Jesse joined the crew in the field to assist with vista rehabilitation, then worked with Tony Tocci to learn about program administration, and completed annual pesticide use reporting.

During the early portion of the 2015 season, the team was able to quickly return to active management of IEPs since all team members returned from the previous year, requiring much less time for training. During this time data manager and acting field crew leader Joe Kelley obtained a Master Commercial Pesticide Applicator license from the State of Maine; acting program leader Tony Tocci attended a week-long NPS supervisory workshop at no cost to the park. Alex Fetgatter and James Burka completed NPS Operational Leadership, a course teaching the importance of situational awareness, safety and speaking up when safety concerns arise.

Invasive Exotic Plant Species of Greatest Concern Managed in 2015

In 2015, 18 species of IEPs were surveyed and treated at 48 sites. A total of 6.19 infested acres (measured as species canopy cover at 100%) were managed on NPS and adjacent private lands with written permission of landowners. A list of the most widespread species requiring significant attention between multiple populations, and the associated infested and surveyed acres, are listed in Table 2. Of these, the five most heavily-managed species (from greatest to least) were glossy buckthorn, Asiatic bittersweet (*Celastrus orbiculatus*), bush honeysuckle (*Lonicera spp.*), Japanese knotweed (*Fallopia japonica*) and barberry (*Berberis spp.*). Several other IEPs are less widespread and often fall below ecological impact thresholds. The infested and surveyed acres of these species are found in Table 3.

Table 2. 2015 infested and surveyed acres of invasive plant species managed to significantly reduce populations in designated treatment areas (Population Reduced or Contained).

Species (total infested, total survey) in acres	Site / Location	Infested Acres	Surveyed Acres
Bush honeysuckle (<i>Lonicera spp.</i>) (0.857, 498.96)	Bar Island	0.639	59.50
	Compass Harbor	0.021	28.00
	Fernald Point	0.001	36.00
	Frazer Point	0.001	2.84
	Jackson Lab	0.014	5.33
	Kent Field	0.009	24.93
	New Mills Meadow	<0.001	1.33
	Native Plant Nursery	0.044	15.50
	Otter Cliffs Rd	0.010	6.50
	Precipice Trailhead	0.001	2.10
	Rt3/Tarn	0.001	11.7
	Stanley Brook	0.003	6.00
	The Furnace (Duck Brook Rd)	0.007	1.40
	The Hop (Off Long Porcupine Is.)	0.106	1.06
Garlic mustard (<i>Alliaria petiolata</i>) (0.117, 498.96)	46 Jordan Pond Rd	0.003	0.40
	Bass Harbor	0.005	0.60
	Compass Harbor	0.073	28.00
	Fernald Point	<0.001	36.00
	Holy Redeemer Cemetery	0.001	0.35
	Jordan Pond Carriage Rd	0.012	10.83
	Jordan Pond Rd (Erosion site)	<0.001	1.01
	Ledgelawn ext.	0.017	9.70
	Otter Cliffs Rd	<0.001	6.50
	Otter Cove	<0.001	0.25
	Seawall	0.004	0.36
	Stanley Brook	<0.001	6.00

Table 2 (continued). 2015 infested and surveyed acres of invasive plant species managed to significantly reduce populations in designated treatment areas (Population Reduced or Contained).

Species (total infested, total survey) in acres	Site / Location	Infested Acres	Surveyed Acres
Barberry (<i>Berberis</i>, spp.) (0.210, 498.96)	Bar Island	0.146	59.50
	Bernard Mountain	0.001	1.40
	Compass Harbor	0.036	28.00
	Fernald Point	0.003	36.00
	Native Plant Nursery	0.013	15.50
	Seal Cove Rd	0.010	4.57
	Sieur de Monts	<0.001	2.53
	Stanley Brook	0.001	3.00
Asiatic bittersweet (<i>Celastrus orbiculatus</i>) (0.910, 498.96)	Bar Island	0.646	59.50
	Brown Mountain Gatehouse	0.010	2.52
	Compass Harbor	0.040	28.00
	Fernald Point	<0.001	36.00
	Frazer Point	<0.001	2.84
	Great Meadow	<0.001	92.05
	Jackson Lab	0.001	5.33
	Jordan Pond Carriage Rd	0.002	10.83
	Jordan Pond House	0.002	0.70
	Native Plant Nursery	0.009	15.5
	Otter Cliffs Rd	0.001	6.50
	Parkman Mountain	<0.001	0.20
	Precipice Trailhead	0.002	2.10
	Rt3/Tarn	0.087	11.7
	Seal Cove Rd	0.078	4.57
	Seawall	0.030	0.36
	Shooting Range	<0.001	0.60
	Stanley Brook	0.002	3.00
	Thompson Island	<0.001	5.44
	Wild Gardens od Acadia	<0.001	0.54
Japanese knotweed (<i>Fallopia japonica</i>) (0.601,498.96)	Compass Harbor	0.597	28.00
	Holy Redeemer Cemetery	<0.001	0.35
	Hulls Cove House	<0.001	1.10
	Jordan Pond Rd (Erosion site)	0.001	1.01
	Parkman Mountain	<0.001	0.20
	Rt3/Tarn	0.001	11.7
	Shooting Range	0.001	00.60
	Sieur de Monts	<0.001	2.53
	St Croix Island (IHS)	<0.001	4.17
Glossy buckthorn (<i>Rhamnus frangula</i>) (3.055, 498.96)	Bar Island	0.001	59.50
	Bear Brook	0.001	0.20
	Beaver Dam Pond	<0.001	1.50
	Brown Mountain Gatehouse	<0.001	2.52
	Compass Harbor	0.001	28.00
	Great Meadow	2.103	92.05
	Jackson Lab	0.623	5.33
	Kent Field	0.317	24.93
	Precipice Trailhead	0.003	2.1
	Rt3/Tarn	0.007	11.70
	The Furnace (Duck Brook Rd)	<0.001	1.4
	Wild Gardens	<0.001	0.54

Table 3. 2015 infested and surveyed acres of invasive plant species managed below ecological impact thresholds (Fully or Nearly Suppressed - Maintenance level). Other non-native plant species not listed here required incidental management by mechanical means; these include burdock (*Arctium minus*), spotted knapweed (*Centaurea stoebe*), mullein (*Verbascum thapsus*), bittersweet nightshade (*Solanum dulcamara*), garden lupine (*Lupinus polyphyllus*) and autumn olive (*Elaeagnus angustifolia*).

Species (total infested, total survey) in acres	Site / Location	Infested Acres	Surveyed Acres
Amur maple (<i>Acer ginnala</i>) (0.001, 498.96)	Great Meadow	0.001	92.05
European bittercress (<i>Cardamine impatiens</i>) (0.001, 498.96)	Bass Harbor	0.001	0.60
Canada thistle (<i>Cirsium arvense</i>) (0.143, 498.96)	Baker Island	0.016	32.9
	Bar Island	0.015	59.50
	Frazer Point	0.003	2.84
	Great Meadow	0.002	92.05
	Hulls Cove House	0.000	1.10
	Isle au Haut	0.076	92.00
	Jordan Pond House	0.003	0.70
	Native Plant Nursery	0.020	15.5
	Parkman Mountain	0.000	0.20
	Pooler Farm	0.000	0.64
	Precipice Trailhead	0.002	2.10
	Sand Beach	0.000	2.88
	Shooting Range	0.000	0.60
	Sieur de Monts	0.001	2.53
	Thompson Island	0.002	5.44
	Tremont School	0.000	3.52
	Visitor Center	0.002	2.63
Bull thistle (<i>Cirsium vulgare</i>) (0.054,498.96)	Baker Island	0.015	32.90
	Bar Island	0.015	59.50
	Fernald Point	<0.001	36.00
	Hulls Cove House	0.001	1.10
	Isle au Haut	0.012	92.00
	Kent Field	<0.001	24.93
	Sand Beach	0.001	2.88
	Thompson Island	<0.001	5.44
	Tremont School	<0.001	3.52
	Visitor Center	0.002	2.63
	Wildwood	0.007	4.4
Foxglove (<i>Digitalis purpurea</i>) (0.004,498.96)	Wildwood	0.004	4.4
Winged euonymous (<i>Euonymus alatus</i>) (0.008,498.96)	Compass Harbor	0.003	28.00
	Jackson Lab	0.005	5.33
Giant hogweed (<i>Heracleum mantegazzianum</i>) (0.050,498.96)	Liquor Locker	0.001	0.35
	Stanley Brook	0.001	6.00
	Walter's Way Trenton	0.048	1.4
Shrubby St. Johnswort (<i>Hypericum prolificum</i>) (0.136,498.96)	Great Meadow	0.136	92.00

Table 3 (continued). 2015 infested and surveyed acres of invasive plant species managed below ecological impact thresholds (Fully or Nearly Suppressed - Maintenance level).

Species (total infested, total survey) in acres	Site / Location	Infested Acres	Surveyed Acres
Purple loosestrife (<i>Lythrum salicaria</i>) (0.032, 498.96)	Beaver Dam Pond	<0.001	1.50
	Kent Field	0.001	24.93
	Marshall Brook	0.028	11.80
	Precipice Trailhead	0.002	2.10
Multiflora rose (<i>Rosa multiflora</i>) (0.002, 498.96)	Bar Island	0.001	59.50
	Jackson Lab	0.001	5.33
Coltsfoot (<i>Tussilago farfara</i>) (0.010, 498.96)	Headquarters	0.002	0.068
	Hunters Brook	0.001	0.76
	Jordan Pond Carriage Rd	0.001	10.83
	Jordan Pond Rd (Erosion)	0.001	1.01
	Otter Cliffs Rd	<0.001	6.50
	Sand Beach	<0.001	2.88
	Wildwood	0.004	4.40

Before:



After:



Figure 3. Pre- and post-treatment photo points of Asiatic bittersweet (*Celastrus orbiculatus*) taken along Stanley Brook. EPMT crew members began treatment here on June 11, 2014. The photo on the left was taken on that date prior to treatment. The photo on the right was taken roughly one year later (June 18, 2015) and shows successful suppression of the bittersweet population. Management consisted of an initial cut-stump treatment to rid the site of reproductive individuals, with subsequent foliar herbicide treatments to manage re-sprouts and seedlings in an effort to reduce the root mass and seed bank. Follow-up, “Maintenance level” visits are planned for future growing seasons to monitor natural revegetation progress and continue suppression efforts (NPS Photo).

Management Activities by Location

Paradise Hill Area

Portions of the Paradise Hill management unit (approximately 130 acres), just east of the village of Bar Harbor, were revisited in 2015. Exotic plant management in this unit is funded by a three-year Recreation Fee project, of which 2015 was the final year. IEPs are now few and far between in this area, which stretches from Eagle Lake Road on its southern border to the Hull's Cove Visitor Center in the north, and from the Paradise Hill Road at the west, the east to the NPS boundary near Cleftstone Road. Japanese and common barberries have been the most prevalent IEPs here; bush honeysuckle, glossy buckthorn, Asiatic bittersweet and multiflora rose have also been treated. After three successful years of management based on IPM principles, only occasional maintenance treatments will be required to keep the area below the action threshold. There is a wetland north of Eagle Lake Road, east of Duck Brook Road and west of Paradise Hill Road where glossy buckthorn and purple loosestrife have been found. This area should be surveyed more extensively and a management plan should be created; prompt management is essential to prevent rapid spread of these IEPs.

Outer Islands

As part of a focus to manage IEPs on islands off MDI, the EPMT visited 10 islands in 2015: the four Porcupine Islands, The Hop, Rum Key, Thompson Island, Baker Island, Bar Island and Isle au Haut. All but Thompson and Bar islands require boats to access. On Baker Island (Figure 4) and Isle au Haut (Figure 5) the team continued managing Canada and bull thistles (*Cirsium spp.*), spending one night on Baker in tents and two nights on Isle au Haut in the Eli Creek Cabin. The entire shoreline of ANP land on Isle au Haut, with the exception of the Eastern Head area, was treated for Canada and bull thistles. Frenchman Bay's Porcupine Islands were also surveyed, while The Hop and Bar Island were actively managed (Figure 6). The Hop was treated for bush honeysuckle in 2015; original IEP management began there in 2003. In all, 219.11 acres were surveyed on islands this season (this does not include all the Porcupine Islands) and 2.53 infested acres were actively managed; 607.25 person hours were committed.



Figure 4. Alex Fetgatter manages bull thistle (*Cirsium vulgare*) on Baker Island, July 2015. This application method is known as a foliar spot treatment; here individual plants are targeted, as opposed to the wide-spread spraying often used in large-scale agriculture. Spot treatment reduces herbicide use, prevents non-target kills, and minimizes disturbance related to management while still providing highly successful treatment. (NPS photo).



Figure 5. EPMT members (from left) Alex Fetgatter and Joe Kelley manage Canada thistle (*Cirsium arvense*) and bull thistle (*Cirsium vulgare*) on the shore of Merchant's Cove on Isle au Haut, July 2015. The thistle infestation here grows among common milkweed (*Asclepias syriaca*). Milkweed is the preferred food of monarch butterflies and the only plant species on which they will successfully lay their eggs; managing thistles protects milkweed, which in turn protects monarch butterfly habitat. As shown in the photo, thistle specimens close to the milkweed plants are removed by hand to prevent non-target herbicide damage; foliar herbicide treatments are used on thistles in outlying areas. NPS photo.



Acadia EPMT Work Areas

Location ID: Frenchman's Bay - Last Treatment Date: 10/27/2015

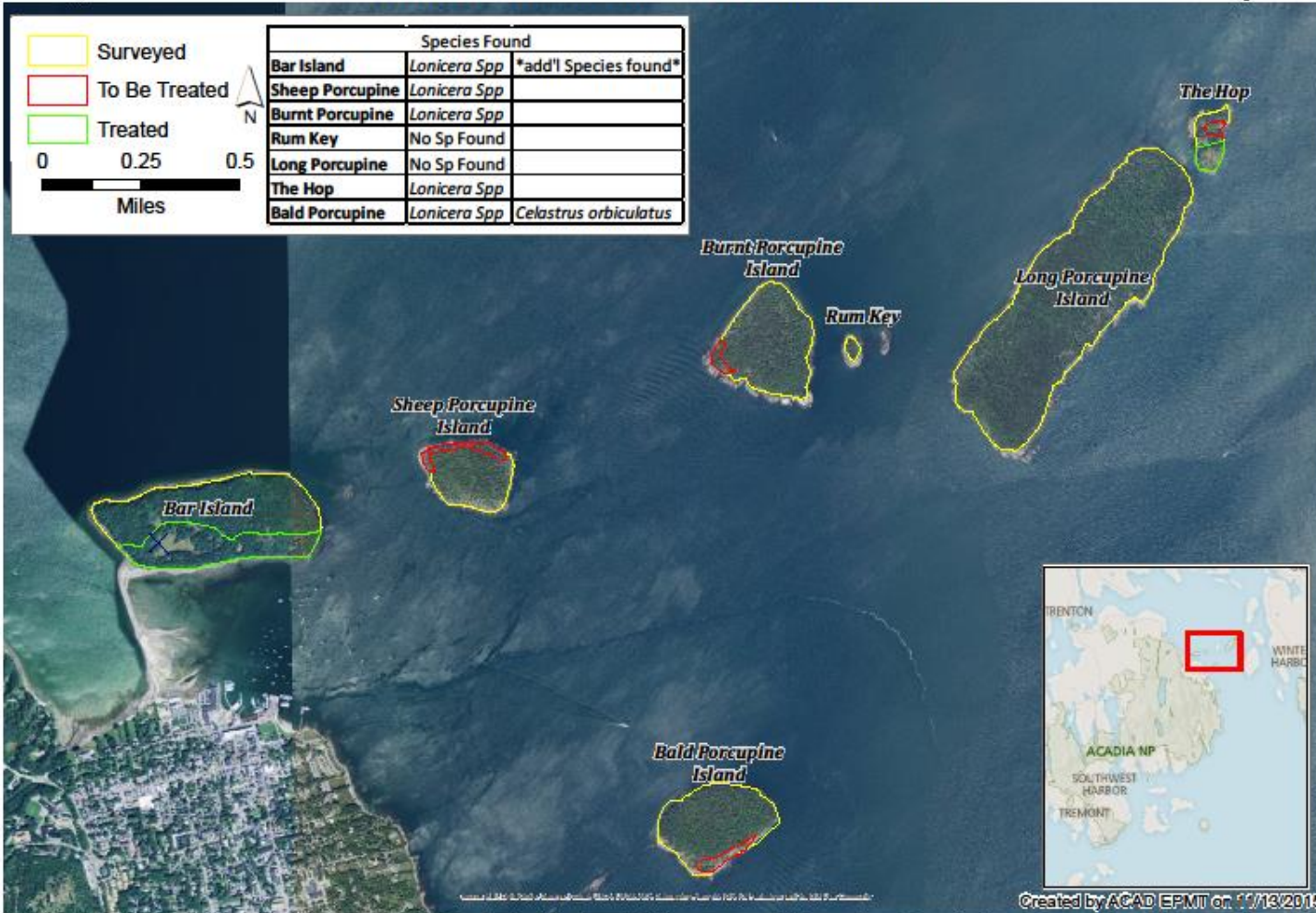


Figure 6. Areas of the Porcupine Islands and Bar Island in Frenchman Bay that were treated and surveyed in 2015. The Porcupine Islands will be more actively managed in 2016.

Bar Island

A goal for the 2015 field season was to manage IEPs on Acadia's islands near MDI, including Bar Island. We wanted to remove all sexually reproductive bush honeysuckles, Asiatic bittersweet and Japanese barberry plants from the island (Figure 7). Bar Island was surveyed for IEPs in March by Joe Kelley and Tony Tocci, and a treatment strategy for the island was developed (Figure 8). Surveys revealed eight IEP species of concern and infested areas were almost tripled our original estimates.

Active management began on April 16th. Bush honeysuckles were the main species of concern, but Asiatic bittersweet and Japanese barberry were also treated. Five management units were created to best target individual species populations and/or visitor use areas (e.g., Unit 1 encompasses the primary access to the island and surrounds the heavily used trail). Work on Bar Island for the 2015 season ended in October. Bar Island is reachable by vehicle within a four-hour window surrounding low tide. Given this time constraint, the EPMT managed to work a total of 447 person hours on the island over the six-month field season, surveyed 10.85 acres and managed 1.46 infested acres. All sexually reproductive bush honeysuckles, Asiatic bittersweet plants and Japanese barberry plants were cut and treated with herbicide. It is always assumed that a very small number of individuals are missed during this first phase of treatment, but for all intents and purposes, all seed-producing IEPs on Bar Island were removed.



Figure 7. Prior to management in 2015, Asiatic bittersweet vines and bush honeysuckle shrubs on Bar Island created visibility and maintenance issues along trails. Photo taken just before leaf out, May 12, 2015. (NPS Photo).

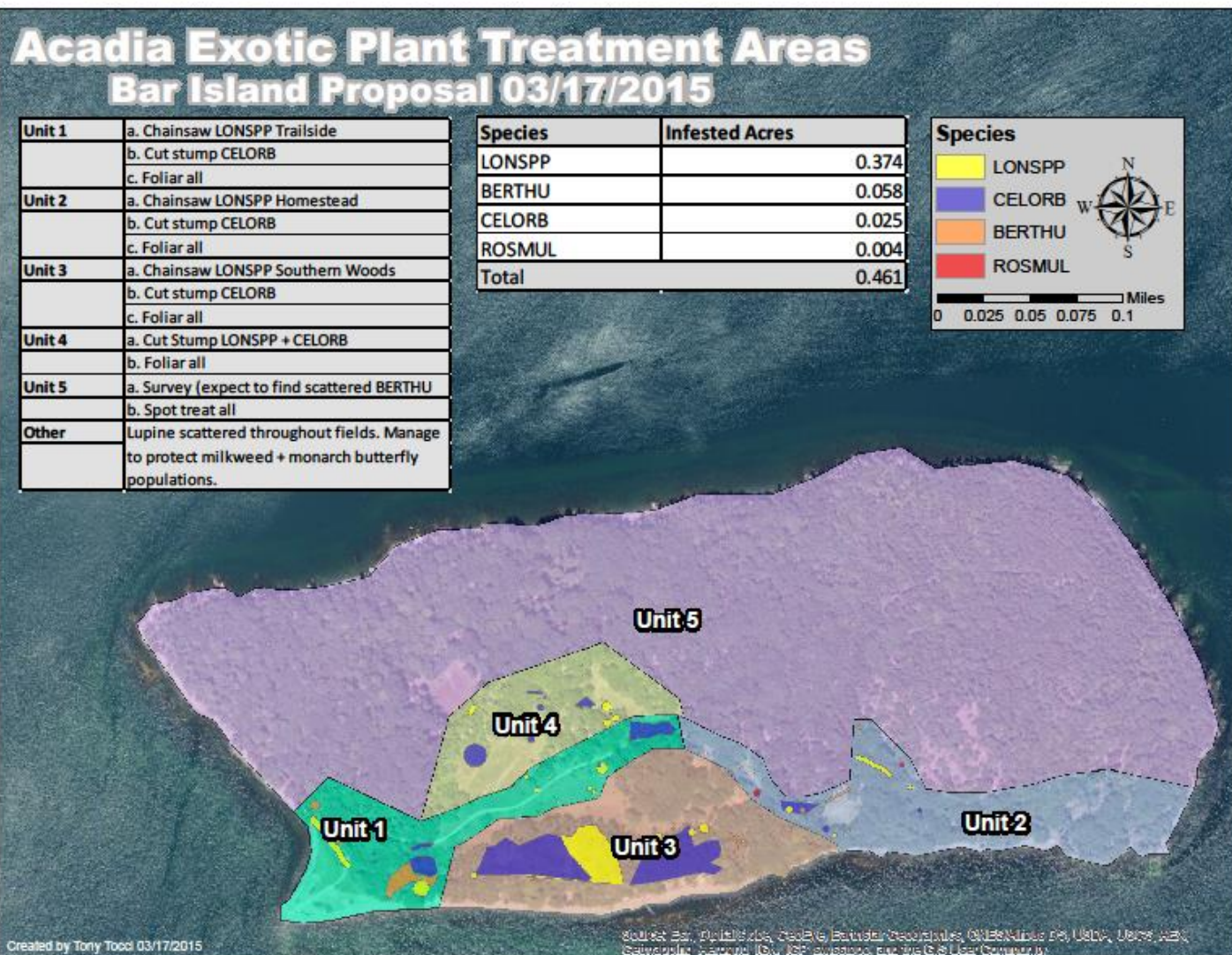


Figure 8. 2015 Invasive exotic plant treatment plan for Bar Island. The five management units were delineated based on individual species populations and/or visitor use areas. Species and infested acreage polygons are initial estimates, with total infested acres more than tripling original estimates by summer's end.

Great Meadow

In June 2015, the EPMT returned to the Great Meadow portion of the Cromwell Brook Watershed (an area loosely defined by Kebo Golf course to the north, the Jackson Laboratory to the east, the Tarn to the south and Dorr Mtn. to the west) to continue managing glossy buckthorn and several other exotic species. Last year (2014), we surveyed 231.52 acres; of these, 2.05 acres were treated for IEPs (1.89 of which were infested with glossy buckthorn). 588 person hours were committed to the area. In 2015, we managed the wetter areas in the center of Great Meadow and spent more time treating cut-stumps of glossy buckthorn, which is more labor-intensive than foliar spraying (Figure 9). In 2015, 92.05 acres of Great Meadow were surveyed, of which 2.38 acres were treated for IEPs--of these, 2.1 acres were infested with glossy buckthorn. We spent 420 person hours in the area this season. On September 29th the crew finished re-treating cut-stumps of glossy buckthorn at an area in the northwestern section of the Great Meadow, called Unit 6 by previous ANP exotic plant management crews. This completed the inventory and initial suppression of IEPs, most importantly glossy buckthorn, in the Great Meadow's entirety. Follow-up maintenance treatments will continue as needed.

An overview of the management units and infested acres from 2014-2015 is depicted in Figure 10. All seedbearing glossy buckthorn plants have been removed from the Great Meadow (again, with the caveat that inevitably a few stray seedbearing plants are missed during this initial phase of treatment). In the two seasons it took to completely cover this area, 1,008 person hours were committed and 323.57 acres were surveyed. 4.43 of these acres were treated for IEPs, 3.99 of which were infested with glossy buckthorn. This was a huge undertaking, and all members of the team performed above expectations and maintained great attitudes. The Great Meadow is not an easy area to work day in and day out. Lack of shade in some areas exacerbates the heat during hotter summer months, and dense groundcover in other areas makes it nearly impossible to see where one is stepping. Many days ended (or, more unfortunately, began) with soaking-wet boots and pants from an unexpected tumble into a deeper, unseen pool within the wetland. In total, portions of 105 days were spent in the area from June – September of 2014 and 2015.



Figure 9. EPMT members Amanda DuPrey and Alex Fetgatter performing “cut-stump” treatment of glossy buckthorn (*Rhamnus frangula*) in the Great Meadow wetland, July 2014. (NPS photo).

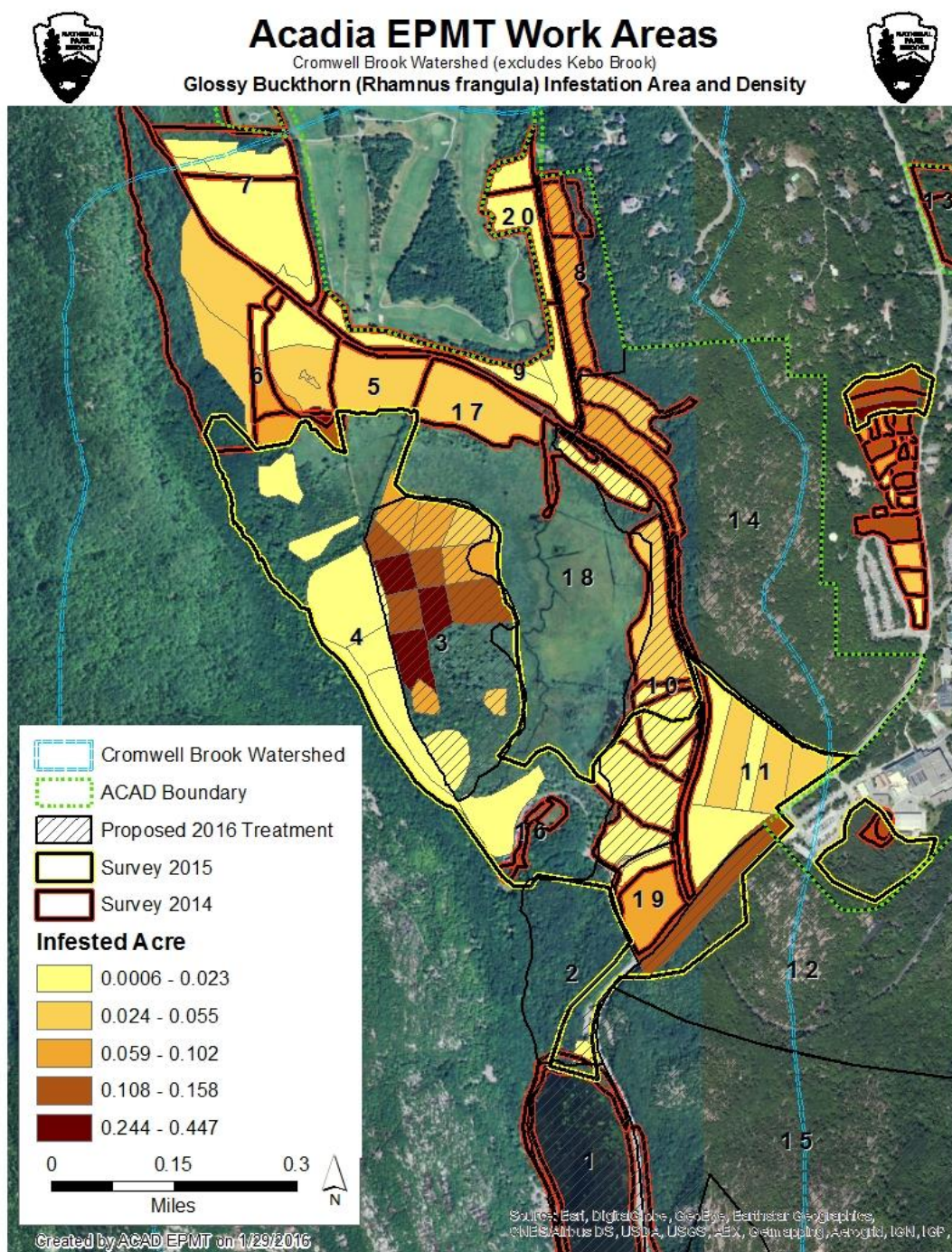


Figure 10. Map of the Great Meadow, within the Cromwell Brook Watershed, and the Jackson Laboratory property, within the Bear Brook watershed on the far right of the map, showing glossy buckthorn (*Rhamnus frangula*) infested acres surveyed and/or treated in the 2014-2015 field seasons.

Collaborative Work on Adjacent Lands

The Jackson Laboratory

The EPMT continued to work on Jackson Laboratory property in 2015, with permission from Greg Forrest and laboratory administrators. The 2015 work area is located just east of the Park's boundary (on the far right of Figure 10) at the southern end of Bar Harbor. The large population of glossy buckthorn (5.33 acres) was surveyed in 2015, and 0.64 acres of mature seed-producing plants were cut and treated. We primarily cut stems with brush cutters, and then applied Garlon 4 Ultra by sprayer to stumps. While some stems were inevitably missed, the main goal of this initial treatment was successful: to remove all seed-producing plants, returning later to foliar spray re-sprouts and individuals not yet bearing seed.

Marshall Brook

A handful of days throughout August were spent managing purple loosestrife (*Lythrum salicaria*) in the Marshall Brook watershed (Figure 11). The majority of time there was spent outside ANP on land owned by the John Goodwin family, which grants permission to remove IEPs from this property. Marshall Brook flows southward through this adjacent property before reaching ANP; it is therefore essential to treat these upstream areas to keep purple loosestrife seeds from entering the park and threatening valuable wetlands, including the Bass Harbor Marsh wetland complex. Purple loosestrife continues to be nearly fully suppressed on ANP lands.



Figure 11. Purple loosestrife (*Lythrum salicaria*) is managed by cutting and disposing of flowering heads, then foliar spraying each plant. This photo of former NPS-employee Frank Archuleta is taken within the Marshall Brook watershed. (NPS photo).

Native Plant Restoration

In 2015, the EPMT conducted some work reminiscent of ANP vegetation programs of old. Two sites in particular were the focus of revegetation: the Sieur de Monts spring pool and surrounding area (including the Dorr Memorial), as well as the Moore Auditorium at the Schoodic Education and Research Center (SERC). At Sieur de Monts the team planted grass seed to rehabilitate the lawn surrounding the spring pool planting beds, planted nearly 200 native plants in these beds, installed species labels for public education purposes and weeded throughout the growing season. This area is being restored to look the way it did in ANP's early days, roughly 100 years ago. This work pays tribute to the "Father of Acadia National Park" George Dorr, and also provides the public with examples of native plant species they can grow in their own gardens. The gardens outside Moore Auditorium at SERC were also rehabilitated in 2015. Here two volunteer native planting days were held, and later the EPMT returned to weed and place a few additional plantings. In May the EPMT built a row of fence to hide the auditorium's unsightly ventilation systems to the right of the entrance doors (Figure 12).



Figure 12. Team members and their newly built fence screening air handlers at the Moore Auditorium, Schoodic Education and Research Center, May 2015. (NPS Photo/Judy Hazen Connery).

Treatment Summary

The following summarizes the exotic plant management work completed by the ANP EPMT in 2015.

Total Infested Acres Treated	6.19*
Total Acres Surveyed	498.96
Total EPMT Hours	1,627
Number of Species Treated	18
Estimated Program Costs (Fiscal Year 2015)	\$239,986

**(Infested acres, in this case, are defined as canopy cover of invasive plant species at 100 %.)*

2015 Work Sites

Baker Island	Seal Cove Mall
Bar Island	Marshall Brook Wetland (w/permission)
Bass Harbor Head Lighthouse	New Mills Meadow
Bear Brook Watershed	Native Plant Nursery
Beaver Dam Pond	Ocean Path
Bernard Mountain	Otter Cliff Road
Brown Mountain Gatehouse	Otter Cove Watershed
Compass Harbor/Old Farm Tract	Parkman Mountain
Fernald Point/Valley Cove	Paradise Hill Management Unit
Frazer Point	Pooler Farm
The Furnace (Duck Brook Rd. / Rte. 233 intersection)	Precipice Trailhead
Great Meadow Wetland	Route 3 / The Tarn
Park Headquarters	Sand Beach
Holy Redeemer Cemetery	Seal Cove Road
The Hop	Seawall
Hulls Cove House	Sieur de Monts
Hulls Cove Visitor Center	Shooting Range
Hunters Brook	St. Croix International Historic Site
Isle au Haut	Stanley Brook Watershed
Jackson Laboratory (w/permission)	The Tarn
Jordan Pond Carriage Road	Thompson Island
Jordan Pond House Grounds	Tremont School
Kent Field	Wild Gardens of Acadia
Great Meadow Drive (formerly Ledge lawn Road Extension)	Wildwood Stables

Herbicides Used in 2015

Garlon 4 Ultra®: active ingredient triclopyr

Garlon 4 Ultra® is a broadleaf-specific herbicide applied by the EPMT during cut-stump applications. It is generally more effective on perennial broadleaf species than glyphosate. Triclopyr's broadleaf-specificity allows its application to broadleaved exotic plants in grassy areas or comingled with evergreens without causing non-target damage to these native species. Garlon 4 Ultra® is an ester formulation that can be mixed with a plant-based oil diluent. An oil-based diluent allows for a larger time period between the stem being cut and an effective application of herbicide. Garlon 4 Ultra® is a growth regulator, and works particularly well in the early part of the growing season when plants are actively growing. Garlon 4 Ultra® was applied during cut-stump treatment at the rate of 18.1 %. The diluent was basal bark oil, and oil-based blue dye was used for color.

Herbicide	Acres Treated	Gallons Used
Garlon 4 Ultra®	137.74*	0.98641*

*These numbers do not include the Garlon 4 Ultra® used in fall 2015 with the historic vista rehabilitation program.

Species treated: Japanese barberry (*Berberis thunbergii*), European barberry (*Berberis vulgaris*), Asiatic bittersweet (*Celastrus orbiculatus*), winged euonymus (*Euonymus alatus*), glossy buckthorn (*Rhamnus frangula*), bush honeysuckle species (*Lonicera spp.*) and multiflora rose (*Rosa multiflora*).

Rodeo®, active ingredient glyphosate

Rodeo® is a broad-spectrum herbicide applied by the EPMT during both foliar and cut stump applications. It is widely used in exotic plant management because of its effectiveness on many different species and its low toxicity to non-plant species. It is also effective on perennial grasses such as reed canary grass. Glyphosate is an amino acid disrupter. While it can be used throughout the growing season, it is particularly effective in the fall when perennial plants are sending resources to their roots. During foliar treatments Rodeo® was applied at the rate of 3 - 5%, and at a cut-stump application rate of 25%.

Herbicide	Acres Treated	Gallons Used
Rodeo®	396.64	6.37043

Species Treated: Japanese barberry (*Berberis thunbergii*), Asiatic bittersweet (*Celastrus orbiculatus*), autumn olive (*Elaeagnus umbellata*), winged euonymus (*Euonymus alatus*), Japanese knotweed (*Fallopia japonica*), glossy buckthorn (*Rhamnus frangula*), giant hogweed (*Heracleum mantegazzianum*), bush honeysuckle species (*Lonicera spp.*), purple loosestrife (*Lythrum salicaria*), multiflora rose (*Rosa multiflora*), poison ivy* (*Toxicodendron radicans*), coltsfoot (*Tussilago farfara*) and common mullein (*Verbascum thapsus*).

*=Native species treated for visitor and employee safety along the Ocean Path.

Milestone[®], active ingredient aminopyralid

Milestone[®] is a broadleaf-specific herbicide used by the EPMT in foliar applications only. The active ingredient in Milestone[®] is aminopyralid, which has an auxin growth regulator mode of action. Milestone[®] is particularly effective on bull thistle (*Cirsium vulgare*) and Canada thistle (*Cirsium arvense*). According to the label, Milestone[®] cannot be applied directly to water, so the ANP EPMT does not apply Milestone[®] within 50 feet of any water source or wetland with standing water. It is used to manage thistles and spotted knapweed because neither Garlon 3A[®] nor Rodeo[®] are very effective against these herbs. Milestone[®] was applied at a rate of 0.25% as a foliar application.

Herbicide	Acres Treated	Gallons Used
Milestone [®]	9.9	0.04898

Species Treated: Canada thistle (*Cirsium arvense*) and bull thistle (*Cirsium vulgare*).

Transline[®], active ingredient clopyralid

Transline[®] is a broadleaf-specific herbicide used by the EPMT in foliar applications only. It is particularly effective on legumes and asters. According to the label, Transline[®] cannot be applied directly to water, so the ANP EPMT does not apply Transline[®] within 50 feet of any water source or wetland with standing water. Transline[®] is a growth regulator like Garlon 3A[®]. It is used in ANP for treating thistles and spotted knapweed because neither Garlon 3A[®] nor Rodeo[®] are very effective against these herbs. Transline[®] was applied at a rate of 0.5% as a foliar application.

Herbicide	Acres Treated	Gallons Used
Transline [®]	11.75	0.03422

Species Treated: Canada thistle (*Cirsium arvense*) and bull thistle (*Cirsium vulgare*).

Program Recommendations and Objectives for 2016

- Keep current size of EPMT at four or five members, including program leader. The amount of time-consuming cut-stump projects are lessening and the team will operate most efficiently at that size.
- Keep term positions of the GS-05/06/07/09 grades by converting to the mandatory Term-Full time or Term-Full Time/Part Time Mix schedule.
- Fill the EPMT Field Crew Leader position that will have data management responsibilities.
- Continue to improve the data management program. Create new and update existing SOPs, and bring all vegetation staff members up to speed to institutionalize data processes so they can remain despite changes in staff.
- Continue collaborative work with Jackson Laboratory and Maine Coast Heritage Trust. Improve cooperative work with private landowners and landscape businesses to address populations outside park boundaries that threaten park resources.
- Consider taking on different projects as focus is moving to a maintenance phase park-wide. Norway maple management should be piloted in limited areas, such as the southern end of Great Meadow Drive. Islands off MDI should be monitored and infestations treated as time permits.
- Continue to seek new methods of effective outreach to inform the local community of the threat posed by IEP's; also inform them of the benefits of planting native plant species. Videos may be good tools for the future. Continue to work with Acadia's Graphics Ranger and FOA to produce outreach materials.
- Continue using FOA volunteers as needed for glossy buckthorn treatment around The Jackson Laboratory. This keeps the relationship between the EPMT and FOA strong, serves as a form of outreach and keeps the program relevant in the community. (This is becoming harder to do as available cut-stump work decreases over time. Continue to do this on Jackson Lab land if not using brush cutters. Otherwise find another way to engage volunteers, such as lupine dead-heading.)
- Continue to seek project and NPS operational funding to support the exotic plant management program.
- Upgrade the fleet of trucks used by the program. Purchase one new Ram 1500 with a crew cab to replace the 1998 Chevy. Try to procure a used truck (regular cab with open bed) to replace the 1995 Dodge truck. Keep the Ford crew cab throughout 2016.
- Continue to expand the work of the EPMT to include restoration projects similar to the Sieur de Monts spring pool to develop diverse skills and abilities of the EPMT staff.
- Continue and expand work conducted on Acadia's islands. Foliar applications for Asiatic bittersweet, Japanese barberry and bush honeysuckle (both seedlings and re-sprouts) as well as cut-stump treatments for privet are needed on Bar Island. Initial attack of bush honeysuckles on The Hop is underway and should be continued. Start initial treatments on other Porcupine Islands.
- Return to sections of the Great Meadow to foliar spray areas still heavily infested with glossy buckthorn seedlings and re-sprouts after initial cut-stump treatments in 2014-15.

National Park Service
U.S. Department of the Interior



Acadia National Park

Resource Stewardship and Science

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