

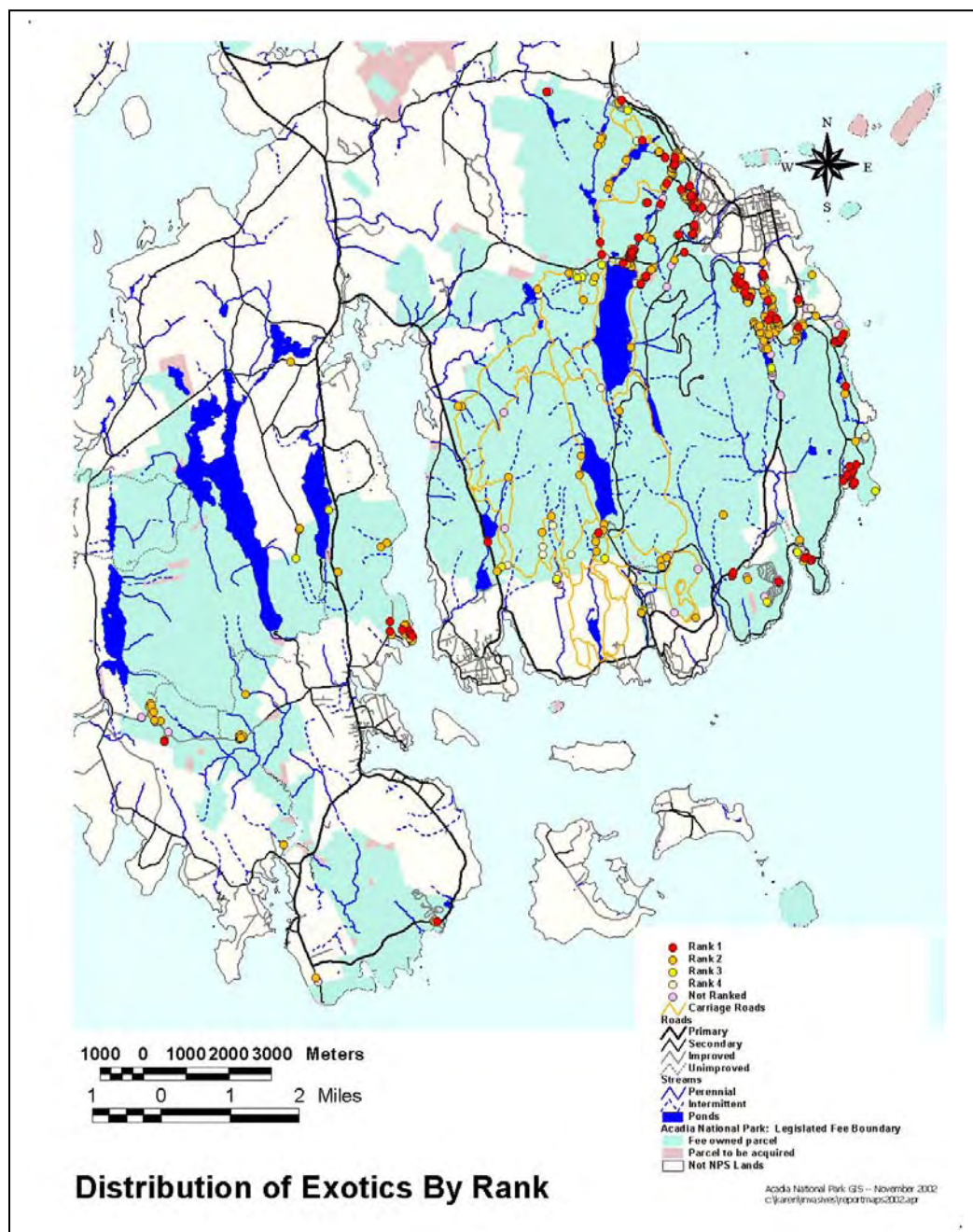
National Park Service
U.S. Department of the Interior

Northeast Region
Boston, Massachusetts



Invasive Plant Species Distribution and Abundance in Acadia National Park

Technical Report NPS/NER/NRTR--2004/003



ON THE COVER

Geographic Information System Map of exotic plant species locations by management priority rank
Developed by: Karen B. Anderson, Geographer, Acadia National Park

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U.S. Department of the Interior
National Park Service
Northeast Region
Boston, Massachusetts

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Executive Summary

The Park Service has a mandate to preserve native species diversity and natural ecosystems. Invasive plant species can decrease native plant diversity and disrupt ecosystems. This report presents the results of an inventory of the distribution and abundance of 24 invasive plant taxa in Acadia National Park.

Acadia National Park is located in east-coastal Maine. Three main units comprise the majority of its holdings: Mount Desert Island, Schoodic Peninsula and Isle au Haut. The current inventory was limited to the Mount Desert Island Unit.

The scope of the invasive plant distribution and abundance inventory was narrowed to sites with known disturbance history and areas proximal to them. *De novo* searches were made in areas likely to harbor invasive plants. These sites included the many old estates and other locations that were inhabited prior to Park ownership, areas disturbed by Park construction projects, carriage roads and sites with proximity to boundaries where invasive species might enter Park property. Additionally, much of the eastern portion of ACAD burned in 1947 as the result of a wildfire, a catastrophic disturbance which created habitat for invasive plant species.

About 600 invasive plant sites were documented by the inventory. Of the 24 taxa inventoried, alder-buckthorn, non-native honeysuckles and Japanese barberry occur at the greatest number of sites. Japanese barberry is also the most widely distributed species and can colonize natural areas, as well as the disturbed sites where it would be expected. The majority of documented invasive species occurrences are on the east side of Acadia National Park, within the extent of the 1947 wildfire. Specifically, invasive species sites are concentrated in the area around Great Meadow and Sieur du Monts Spring, and the number of plants per site is higher there than in other parts of the Park. Only three of the taxa inventoried, were listed in a flora of Mount Desert Island published in 1894; all but one taxon was listed as occurring here when a regional flora was published in 1950. The results of the current inventory suggest the best strategy for invasive plant species management at Acadia National Park is by site rather than by species.

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Acknowledgments

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Objectives

The objectives of the Distribution and Abundance Inventory were to: 1) determine the current distribution of invasive plant species at ACAD, 2) estimate the number of plants at each invasive plant occurrence, and 3) create maps to illustrate the distribution and abundance of invasives at ACAD which will aid in development of management strategies.

Background

Acadia National Park (ACAD) is located on Mount Desert Island (MDI), in eastern Maine. Although the Island has only been connected to the mainland by road for a relatively short time, it has not been isolated from the rest of the world. Europeans arrived there in the 17th century and occupation has been continuous since then. Settlers brought food, medicinal and ornamental plant species from their countries of origin. Many of these were native to Europe or Asia, but not necessarily to North America. Later, ships from the Maine coast routinely traveled around the world to engage in trade. Each return voyage undoubtedly brought the intended cargo as well plant seeds, unintentionally picked up at foreign ports and brought to MDI.

The introduction of plant species accelerated when MDI became a summer haven for wealthy people. Many seasonal residents built large estates with vast gardens that included plant species from all over the world. Some plants flourished and could not be kept within the confines of a formal garden, and they spread to roadsides, fields and even undisturbed natural areas.

Non-native plant species were documented by botanists within ACAD's legislated boundaries long before the park's creation (Rand and Redfield, 1894). Maine's flora comprises over 2100 species, of which some 1600 are native and 500 are non-native (Campbell et al., 1995). Non-native species are those that have arrived in Maine since the advent of European settlement. Plants included in the flora but considered non-native have become naturalized since their arrival in Maine, that is, they reproduce and persist in the environment without human intervention. Of the numerous non-native plant species, only 33 are considered to be invasive in Maine (Cameron, 2000). Though the seeds of non-native invasive species were brought here from Europe and Asia, most often the insect, fungal and bacterial species which controlled them in their home range were left behind, enabling populations of these plants to increase almost without limit, and to spread

into any habitat that would support them. Invasive species can dominate the vegetation in areas where they have become established, outcompeting and eventually displacing native plants. Decline of native plant species alters other components of natural communities: mammals rely on native plants for forage; avian species feed on fruits, seeds and nectar of native plants; many insects depend on a particular plant species for forage and egg-laying; and fungal species are often associated with the roots of specific plants.

The National Park Service (NPS), in general, and ACAD resource staff, in particular, have a clear mandate to protect the natural resources present on Park lands. Goals of a protection strategy are to: 1) preserve native species diversity and 2) maintain the integrity of ecosystems comprising the areas under NPS jurisdiction. The spread of invasive species in ACAD undermines these goals. Awareness of the effects of non-native invasive species has increased over the last decade or so. During this period, resource staff at ACAD began to document the occurrence of invasives within the park. With the exception of work on purple loosestrife (Hazen and Anderson, 1990; Connery and Anderson, 1991; Connery, 1991; Anderson and Connery, 1992; Anderson, Connery and Gregory, 1997a,b; Hiebert et al., 1997; Chase and Gregory, 1998, 1999, 2001; Gregory and Dow, 1998a,b; Chase, Gregory and Halperin, 2002), documentation of invasives was opportunistic, often anecdotal, and derived from projects which did not specifically address them (Greene, 1990, 1997, 2002; McMahan, 1993; Mittelhauser, Hazen Connery and Jacobs, 1996; Lubinski, Hop and Gawler, 2003, reports by ACAD staff from all divisions). When enough evidence accumulated to suggest that invasives had become a serious problem in natural and managed areas at ACAD, biologists began to plan for the removal and control of invasive non-native plants within its boundaries.

Reiner and McLendon (2002) provided ACAD with a list of potentially invasive plants known to occur in the Park. Their work also assessed the relative threat posed by each listed species and suggested possible management strategies. ACAD resource staff then sought to determine the parkwide distribution and abundance of the most problematic species listed by Reiner and McLendon. This report presents the findings of the invasive plant distribution and abundance inventory.

Methods

Inventory Scope and Study Area

Three units comprise the majority of ACAD's holdings: MDI, Schoodic Point and Isle au Haut (Figure 1). The current inventory was limited to MDI for the following reasons: 1) preliminary data were available regarding the presence and locations of invasive species, 2) it has an extensive history of disturbance and intentional introduction of non-native plant species, 3) continuing development immediately adjacent to Park lands creates numerous points of entry for invasive species, and 4) the MDI unit houses the facilities and staff to implement management and control of invasive plant species. It was decided that limiting survey efforts to the unit likely to harbor the highest concentration of invasive plant species would be most immediately beneficial to ACAD.

Some habitats of the MDI unit were excluded from this inventory because previous studies had documented very few occurrences of invasive plant species in them. During the Ecological Reserves project, vegetation sampling for natural community description and assessment was conducted throughout ACAD in diverse habitats (Gawler, 2000; McMahon, 1993). Invasives were absent from almost all plots (ACAD, unpublished data). Field work preparatory to creation of a vegetation map was carried out from 1997-1999 (Lubinski, Hop and Gawler, 2003). Specifically, in 1997-98, vegetation was sampled in 216 plots representative of the natural communities identified for mapping. Data collected were used to characterize 56 natural communities, from sea beaches to freshwater wetlands, upland forests and treeless mountain summits. The presence of invasive plant species was noted, and, of the two hundred-sixteen 0.02 hectare plots, invasives were present in less than 20. During the second phase of the vegetation mapping project, 724 randomly selected points were visited to identify the natural communities present. Surveys included inspection of an area within a 50m radius (0.5 hectare) of the designated point coordinates. Locations of any invasives encountered en route to or at the sample point were recorded using a Global Positioning System (GPS). Again, very few invasive plant occurrences were documented. The current inventory eliminated sites visited in the projects described above unless they harbored occurrences of invasives (Figure 2).

Figure 1. Locator Map for Acadia National Park

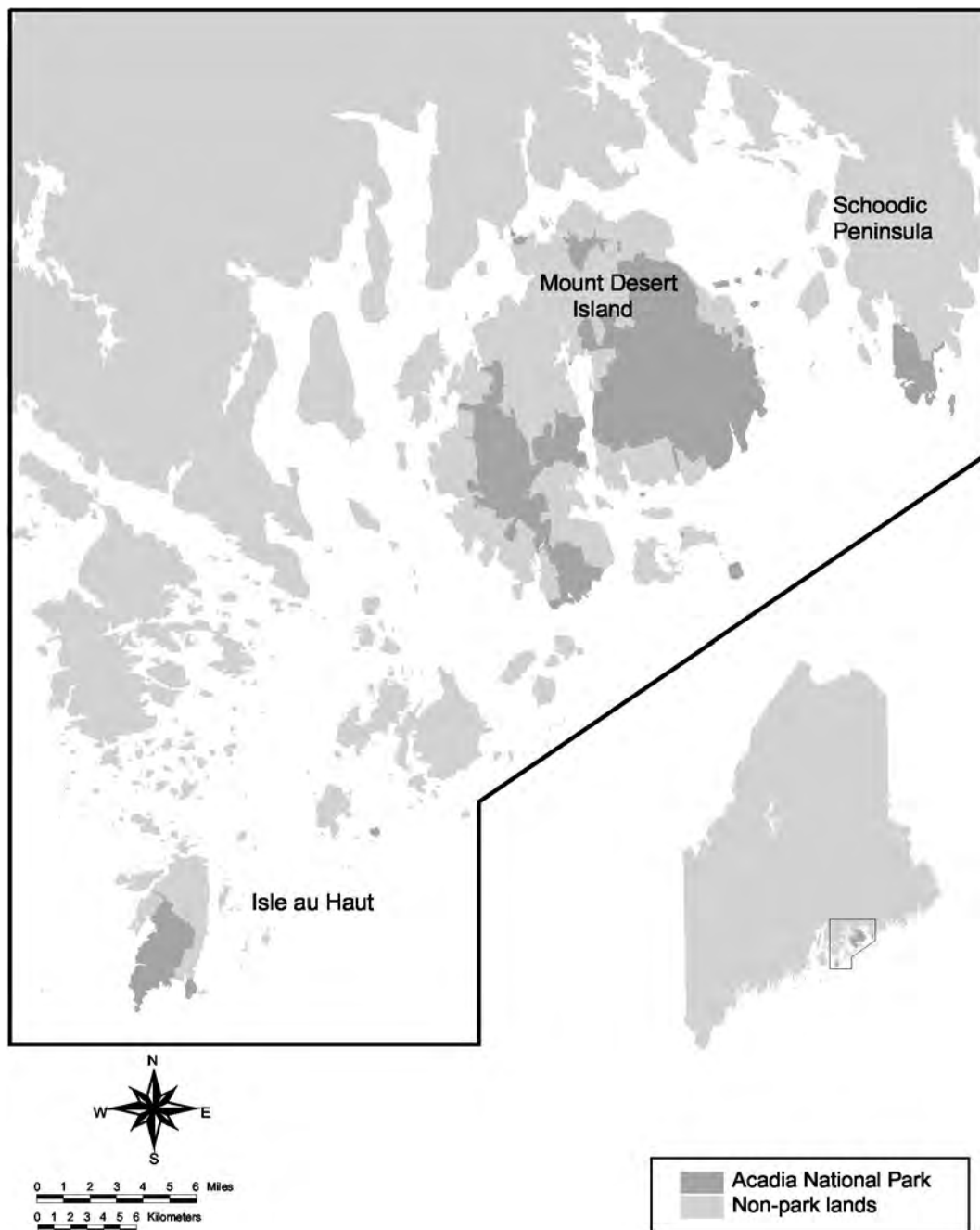
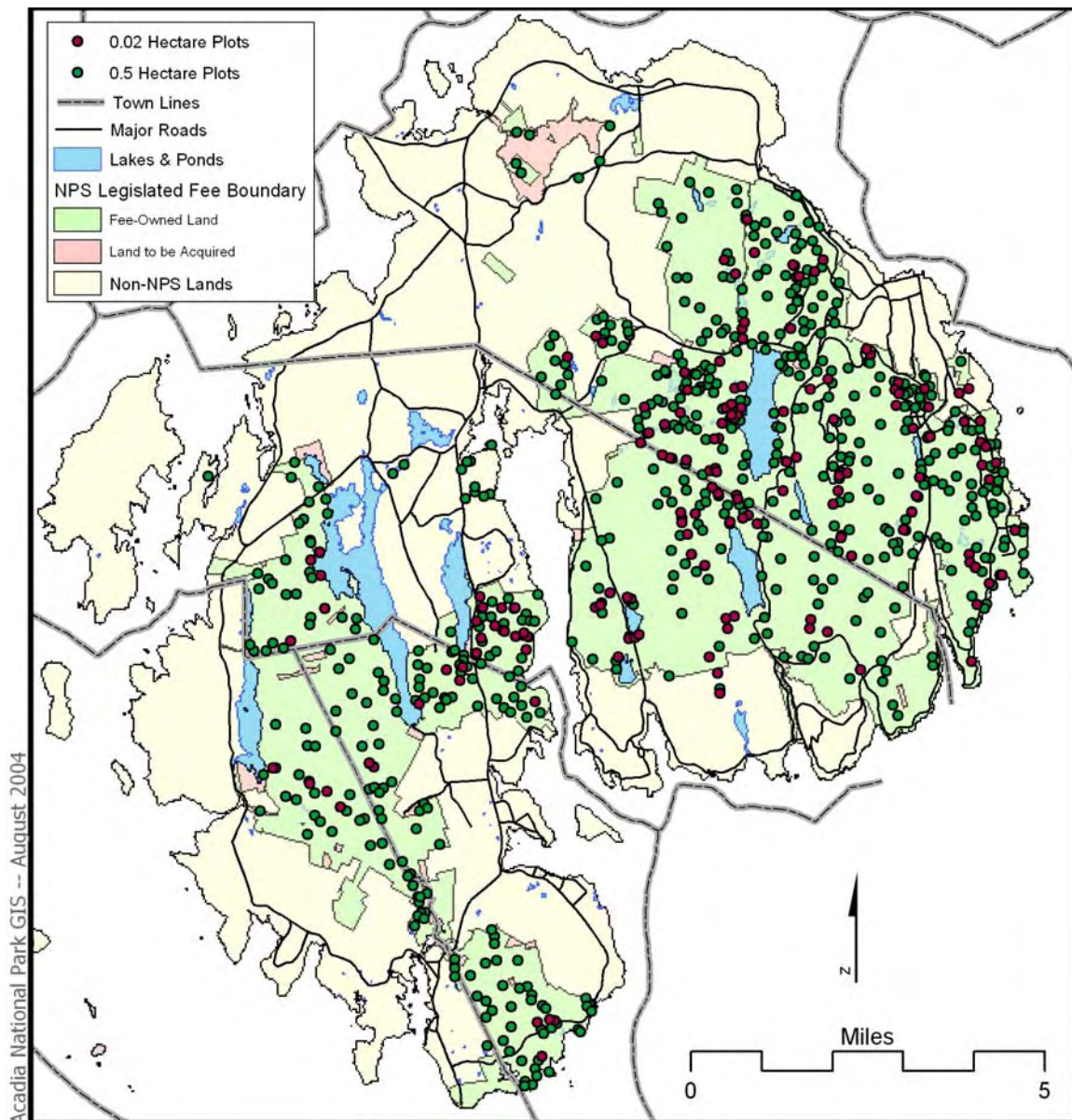


Figure 2. Sites sampled during vegetation mapping project.



Because so few populations of invasive plant taxa were discovered during these ecologically and geographically diverse vegetation studies, many natural communities were largely excluded from the current inventory. In general, invasives were not present in undisturbed areas, and were conspicuously absent from ACAD's mountain summits, slopes and undisturbed, forested lowlands. The scope of the inventory was narrowed to sites with known disturbance history and areas proximal to them. These included old home and farm sites, carriage roads and sites documented by the vegetation studies described above.

ACAD staff provided known locations of target species populations. These previously documented sites were revisited and additional data were collected. *De novo* searches of areas likely to harbor invasive plants were also conducted. These sites included the many old estates and other locations that were inhabited prior to ACAD's ownership, areas disturbed by Park construction projects, carriage roads and sites with proximity to ACAD's boundaries where invasive species might become established on Park property. Additionally, much of the eastern portion of ACAD burned in 1947 as the result of a wildfire, a catastrophic disturbance which created habitat for invasive plant species (Figure 3). Each population was surveyed and its size (number of individuals) was determined. Locations were recorded with a hand-held Garmin III+ GPS unit. When a GPS point was taken, an area within ten meters in all directions around it was searched and plants counted. Plants of that species found more than 10 meters away from any other point were considered as a separate site. General location, disturbance regime, dominant associated plant species by stratum, an estimate of population extent and phenologic stages present were noted for each point using standardized data sheets (Figure 4). Nomenclature follows Haines and Vining (1998). Field work was carried out from 2000-2002.

Species Included in Inventory

Prior to the current study, Reiner and McLendon (2002) developed a model to predict which invasive non-native plant species were likely to be most problematic at ACAD. First, they scored non-native species documented in and near ACAD according to their potential ecological impact, as determined by literature reviews and some direct study of life history characteristics. Species receiving at least 65% of the total points possible (higher score = greater ecological threat) were classified as "species of special concern"

Figure 3. Extent of 1947 fire.

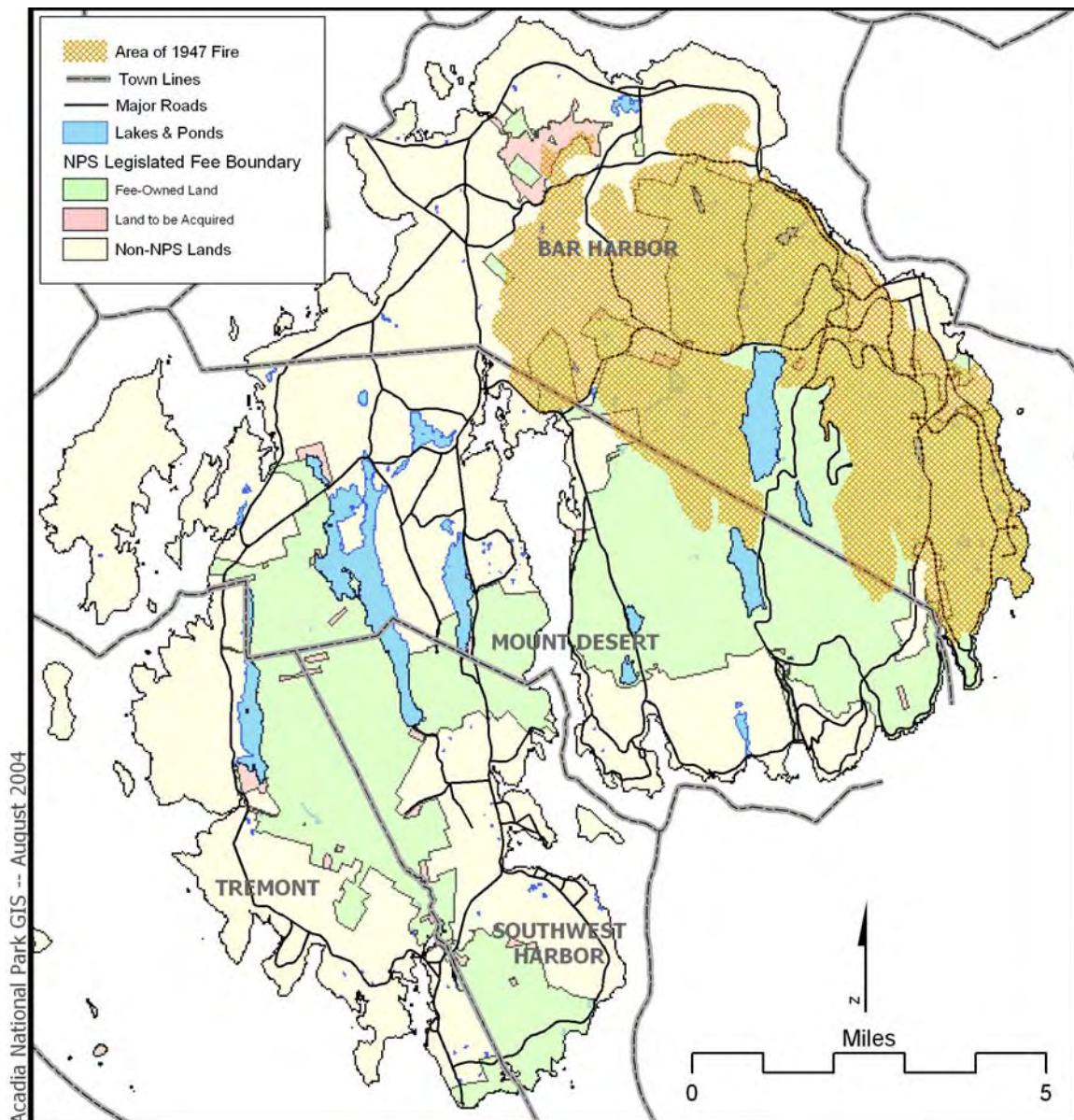


Figure 4. Sample data sheet

INVASIVE PLANT ABUNDANCE AND DISTRIBUTION PROJECT

Species _____

Date _____

Surveyors Sally Rooney and Jill Weber **Photo** _____

Location (UTM) _____ N _____ E

USGS Quad _____ **Air Photo (1997)** _____

Aspect (T) _____ **Landmark/General Area** _____

Site Description (check one) ☐ disturbed road edge

☐ disturbed trail edge

☐ undisturbed area near road; distance from road _____ ft.

☐ undisturbed area near trail; distance from trail _____ ft.

☐ other disturbance; describe _____

☐ other undisturbed site; describe _____

Associated Plant Species:

Stratum	Dominants	Cover (%)
Canopy		
Shrub/Sapling		
Herb		
Bryophyte		

Population Size:

☐ 1-5 individuals ☐ 5-10 individuals ☐ 10-20 individuals

☐ 20-100 individuals ☐ >100 individuals

Area: ☐ <1 acre ☐ >1 acre

Phenologic Stages observed: ☐ vegetative ☐ flowering

☐ fruit ☐ seedlings

and further analyses were conducted; lower scoring species were excluded from further study. The next round in the assessment considered the estimated current and potential distribution, current and potential impact, and ease of control for each species of special concern. Analyses of these factors for all study species yielded priority rankings for each (Table 1). Species predicted by the assessment parameters to be most likely to spread widely and have the greatest ecological impact were given a rank of 1 (highest management priority); those least likely to spread and/or which pose the least threat to natural communities received a rank of 4 (lowest management priority).

Table 1. Species of special concern, as identified by Reiner and McLendon (2002).

Scientific Name	Common Name	Rank
<i>Acer platanoides</i>	Norway Maple	3
<i>Alliaria petiolata</i>	Garlic Mustard	3
<i>Berberis thunbergii</i>	Japanese Barberry	2
<i>Bromus inermis</i>	Smooth Brome Grass	4
<i>Celastrus orbiculata</i>	Oriental Bittersweet	2
<i>Cirsium arvense</i>	Canada Thistle	4
<i>Dactylis glomerata</i>	Orchard Grass	4
<i>Frangula alnus</i>	Alder-Buckthorn	2
<i>Lonicera japonica</i>	Japanese Honeysuckle	1
<i>Lonicera X bella</i>	Belle's Honeysuckle	1
<i>Lonicera morrowii</i>	Morrow's Honeysuckle	1
<i>Lythrum salicaria</i>	Purple Loosestrife	2
<i>Rosa multiflora</i>	Multiflora Rose	2
<i>Solanum dulcamara</i>	Bittersweet Nightshade	3
<i>Sonchus arvensis</i>	Field Sow-Thistle	4
<i>Tussilago farfara</i>	Coltsfoot	3

The 16 species predicted by the model to be most invasive at ACAD (Table 1) were chosen for inclusion in the distribution and abundance inventory. Japanese, Belle's and Morrow's honeysuckles (*Lonicera japonica*, *L. x bella* and *L. morrowi*) were ranked 1, most invasive. Rank 2 species are: Japanese barberry (*Berberis thunbergii*), oriental bittersweet (*Celastrus orbiculata*), alder-buckthorn (*Frangula alnus*), purple loosestrife (*Lythrum salicaria*) and multiflora rose (*Rosa multiflora*). Norway maple (*Acer platanoides*), garlic mustard (*Alliaria petiolata*), bittersweet nightshade (*Solanum dulcamara*) and coltsfoot (*Tussilago farfara*) are rank 3. Rank 4 taxa are: smooth brome grass (*Bromus inermis*), Canada thistle (*Cirsium arvense*), orchard grass (*Dactylus glomerata*) and field sow-thistle (*Sonchus arvensis*).

Preliminary data indicated that some of the species ranked by Reiner and McLendon should not be included in this inventory. Purple loosestrife was effectively eliminated from our study because management and control of this species has been ongoing at ACAD since 1989, and its occurrence within the Park was well known at the start of this work. Smooth brome grass and orchard grass emerged as potentially highly invasive in Reiner and McLendon's analysis. While relatively common in disturbed areas, they had never been documented from an undisturbed site in ACAD nor had extensive field work by the authors and others prior to this study yielded evidence of their invasiveness here. The same is largely true of field sow-thistle.

Fourteen species were added to the survey after field work began. They comprise two types of species: those reported to be invasive in Maine or elsewhere and observed at ACAD after field work began (Cameron, 2000), and non-native species that, while not known invasives, were observed to be actively spreading in natural areas at ACAD. Table 2 lists the additional species and why each was included.

Table 2. Species added to inventory during field phase.

Latin Name	Common Name	Reason Added
<i>Acer ginnala</i>	Amur Maple	Invasive
<i>Berberis vulgaris</i>	Common Barberry	Invasive
<i>Berberis thunbergii</i> x <i>vulgaris</i>	Ottawa Barberry	Invasive
<i>Cardamine impatiens</i>	European Bittercress	Invasive
<i>Euonymus alatus</i>	Winged Euonymus	Invasive
<i>Fallopia japonica</i>	Japanese Knotweed	Invasive
<i>Hypericum prolificum</i>	Shrubby St. Johnswort	Spreading
<i>Ligustrum</i> sp.	Privet	Invasive
<i>Lysimachia nummularia</i>	Moneywort	Invasive
<i>Luzula luzuloides</i>	Forest Woodrush	Spreading
<i>Physocarpus opulifolius</i>	Ninebark	Spreading
<i>Robinia pseudoacacia</i>	Black Locust	Invasive
<i>Vicia cracca</i>	Cow Vetch	Spreading

Species included because they are known to be invasive outside ACAD are: Amur maple (*Acer ginnala*), common barberry (*Berberis vulgaris*), Ottawa barberry (*Berberis thunbergii* X *vulgaris*), European bittercress (*Cardamine impatiens*), winged euonymus (*Euonymus alatus*), Japanese knotweed (*Fallopia japonica*), privet (*Ligustrum* sp.), moneywort (*Lysimachia nummularia*) and black locust (*Robinia pseudoacacia*). Taxa actively spreading at ACAD but not known to be invasive are: shrubby St. Johnswort (*Hypericum prolificum*), ninebark (*Physocarpus opulifolius*), forest woodrush (*Luzula luzuloides*) and cow vetch (*Vicia cracca*).

To summarize, of 16 species ranked most problematic by Reiner and McLendon's model, 11 were included in the inventory (Belle's and Morrow's honeysuckles were combined as "*Lonicera* species" because they are difficult to discern without flowering or fruiting material). Thirteen species not included in the model were added, for a total of 24 species for which distribution and abundance at ACAD were to be determined (Table 3).

Table 3. Final list of taxa included in distribution and abundance inventory.

Scientific Name	Common Name
<i>Acer ginnala</i>	Amur maple
<i>Acer platanoides</i>	Norway maple
<i>Alliaria petiolata</i>	Garlic mustard
<i>Berberis thunbergii</i> x <i>vulgaris</i>	Ottawa barberry
<i>Berberis thunbergii</i>	Japanese barberry
<i>Berberis vulgaris</i>	Common barberry
<i>Cardamine impatiens</i>	European bittercress
<i>Celastrus orbiculata</i>	Oriental bittersweet
<i>Cirsium arvense</i>	Canada thistle
<i>Euonymus alatus</i>	Winged euonymus
<i>Fallopia japonica</i>	Japanese knotweed
<i>Frangula alnus</i>	Alder-buckthorn
<i>Hypericum prolificum</i>	Shrubby St. Johnswort
<i>Ligustrum</i> sp.	Privet
<i>Lonicera japonica</i>	Japanese honeysuckle
<i>Lonicera</i> sp.	Honeysuckle species
<i>Luzula luzuloides</i>	Forest woodrush
<i>Lysimachia nummularia</i>	Moneywort
<i>Physocarpus opulifolius</i>	Ninebark
<i>Robinia pseudoacacia</i>	Black locust
<i>Rosa multiflora</i>	Multiflora rose
<i>Solanum dulcamara</i>	Bittersweet nightshade
<i>Tussilago farfara</i>	Coltsfoot
<i>Vicia cracca</i>	Cow vetch

Results

Below is a summary of the inventory results, by species. In addition to distribution and abundance data for each taxon, some preliminary data on habitat and associated species are included. Original data sheets have been submitted to ACAD but are not included here as an appendix because they comprise 598 pages. Data will also be entered in a database following NPSpecies protocols (B. Gawley, personal communication).

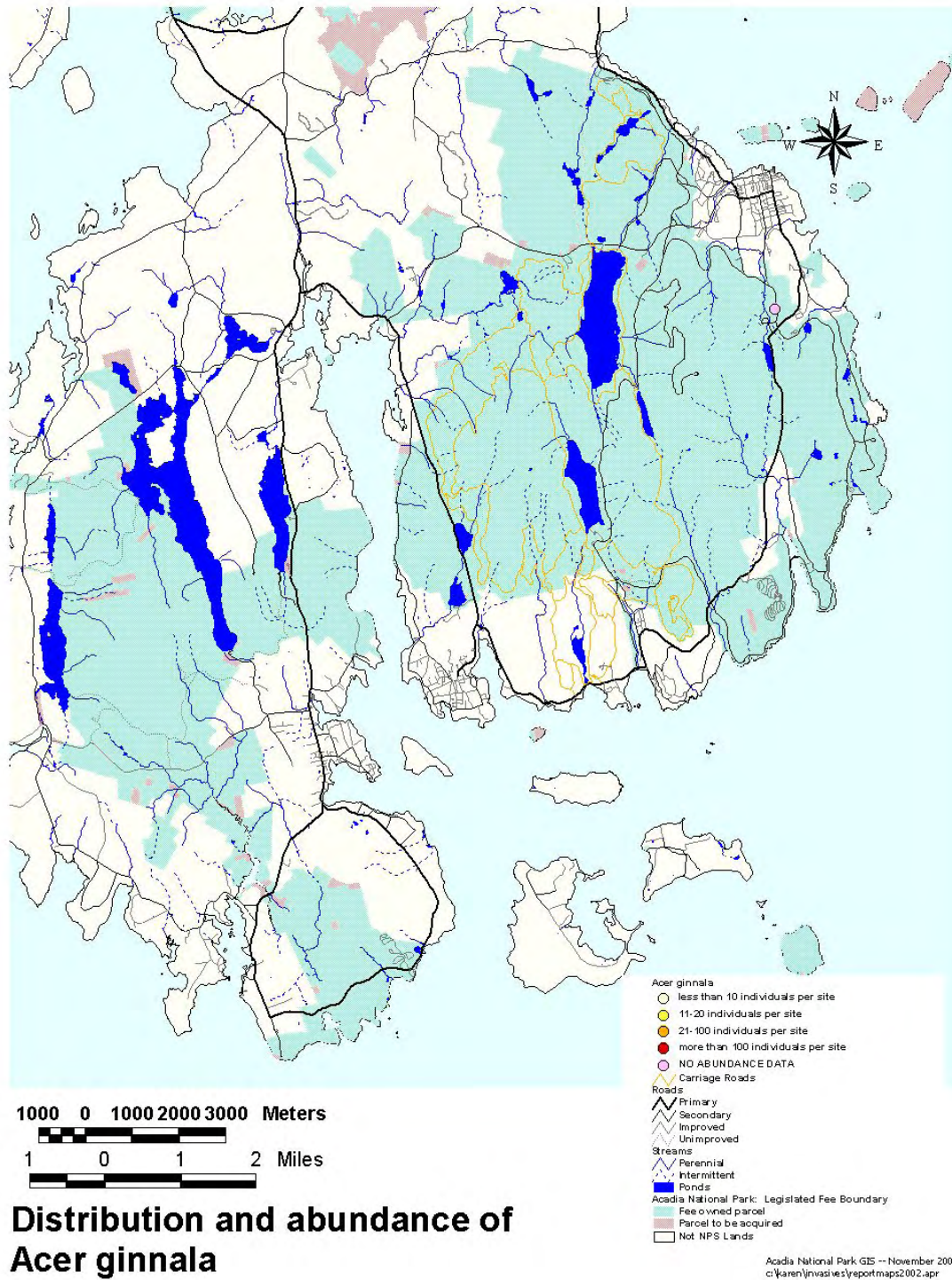
Taxon: **Amur maple (*Acer ginnala*)**

Distribution: Amur maple was documented from one site east of Great Meadow, just off the park loop road (Figure 5).

Abundance: There are about 20 individuals at the site, several of which are mature and producing seed.

Habitat: This occurrence is located in an area which burned during the 1947 fire. Gray birch (*Betula populifolia*) and red maple (*Acer rubrum*) dominate the canopy. Alder-buckthorn, a woody invasive is the dominant shrub and downy goldenrod (*Solidago puberula*) and flat-topped white aster (*Doellingeria umbellata*) dominate the herb layer. Many occurrences of invasives were documented near this site.

Figure 5. Distribution and abundance Amur maple.



Taxon: **Norway maple (*Acer platanoides*)**

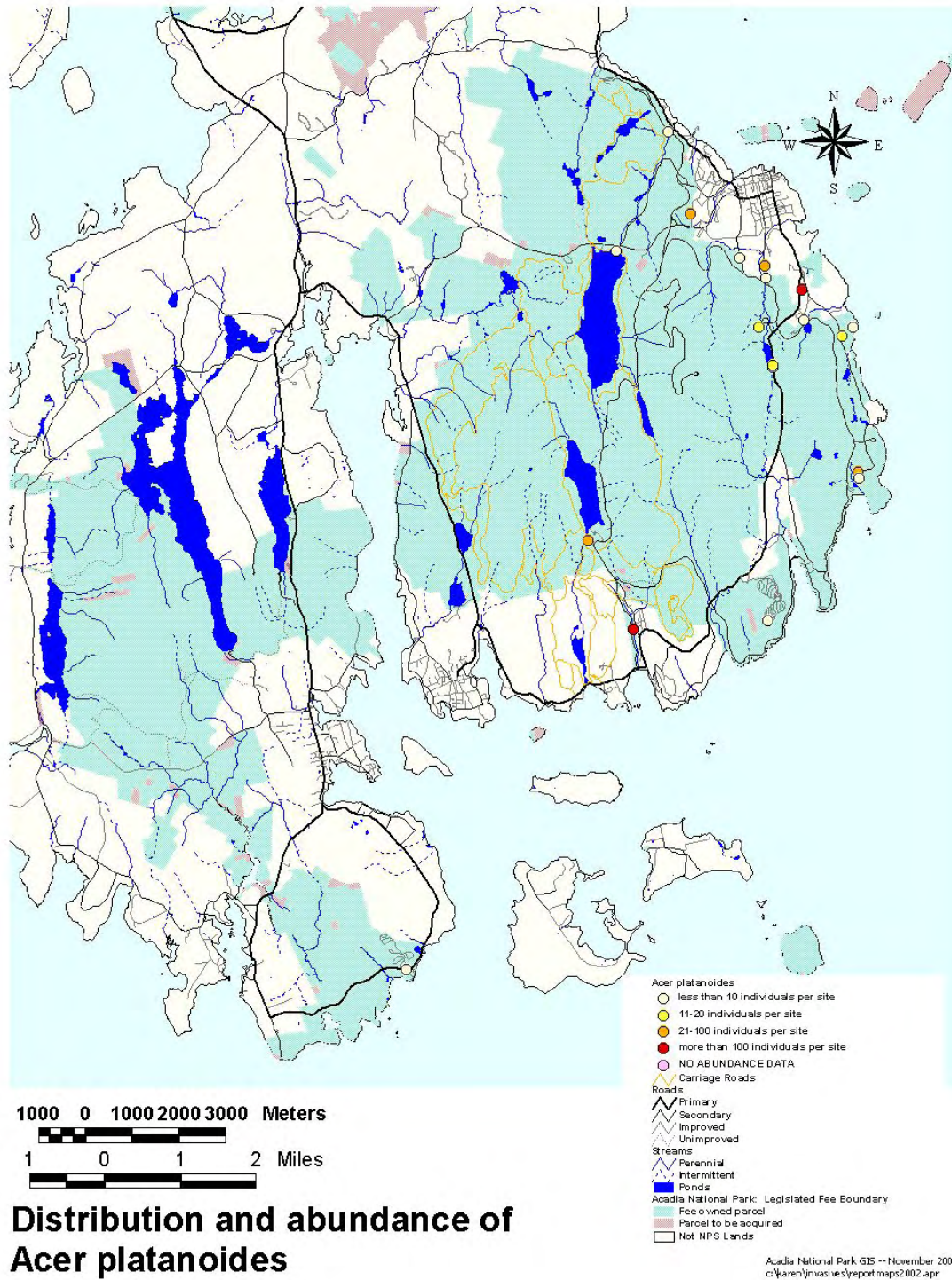
Distribution: Norway maple was documented from 17 sites on the east side of MDI and one site on the west side of the island. Most of the populations are within about two miles of downtown Bar Harbor, but this taxon also occurs on Great Head, at Blackwoods Campground, Jordan Pond, off the Stanley Brook Road and at the Seawall Picnic Area (Figure 6).

Abundance: At nine of the sites, the populations comprised 10 or fewer individuals. Three of the populations had 11-20 individuals, three had 21-100, two had more than 100 and no population estimate was made for one population.

Habitat: Norway maple often occurs as a canopy species, but was present in other layers, even under a closed canopy. Within ACAD, it is most often associated with old estates and the extant populations are likely the progeny of trees used in landscape plantings.

Associated canopy species include white pine (*Pinus strobus*) and green ash (*Fraxinus pennsylvanica*). Where Norway maple occurs in the canopy, it is usually present in all other strata. Herbaceous species often found with Norway maple are: wood bluegrass (*Poa nemoralis*), large-leaved aster (*Aster macrophyllus*) and downy goldenrod.

Figure 6. Distribution and abundance of Norway maple.



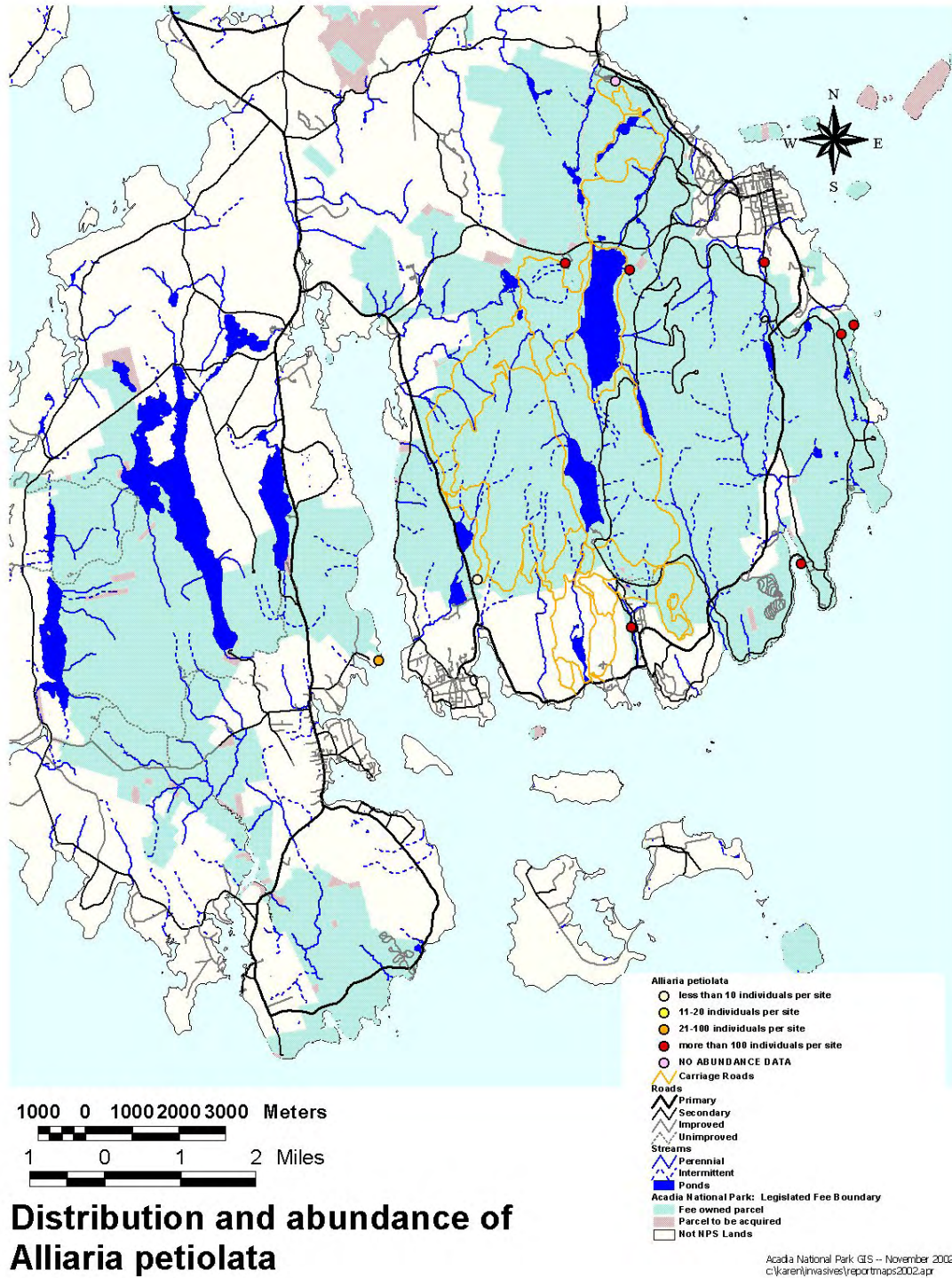
Taxon: **Garlic mustard (*Alliaria petiolata*)**

Distribution: Garlic mustard was documented from 12 sites in ACAD: 11 on the east side of MDI and one west of Somes Sound. Nine of the eastern sites are within the extent of the 1947 fire, the other two are near Stanley Brook and northwest of the Brown Mountain Gatehouse (Figure 7).

Abundance: Nine of the populations comprised more than 100 plants (often >1000 in a square meter). One population comprised 21-100 plants, one had 10 or fewer individuals and no population count was made at one site.

Habitat: Establishment of this annual species appears to be dependent on the availability of bare, mineral soil. While many garlic mustard sites documented by this inventory burned in 1947, several did not. Garlic mustard was found in a variety of habitats: burned areas, a carriage road edge, beaches, an old home site and a stump dump. Plants that colonize disturbed areas, including many invasive species, were present with garlic mustard. Associated taxa are: Japanese knotweed, European bittercress, wood bluegrass, ox-eye daisy (*Leucanthemum vulgare*), tumble mustard (*Sisymbrium altissimum*) and yellow king-devil (*Hieracium caespitosum*).

Figure 7. Distribution and abundance of garlic mustard.



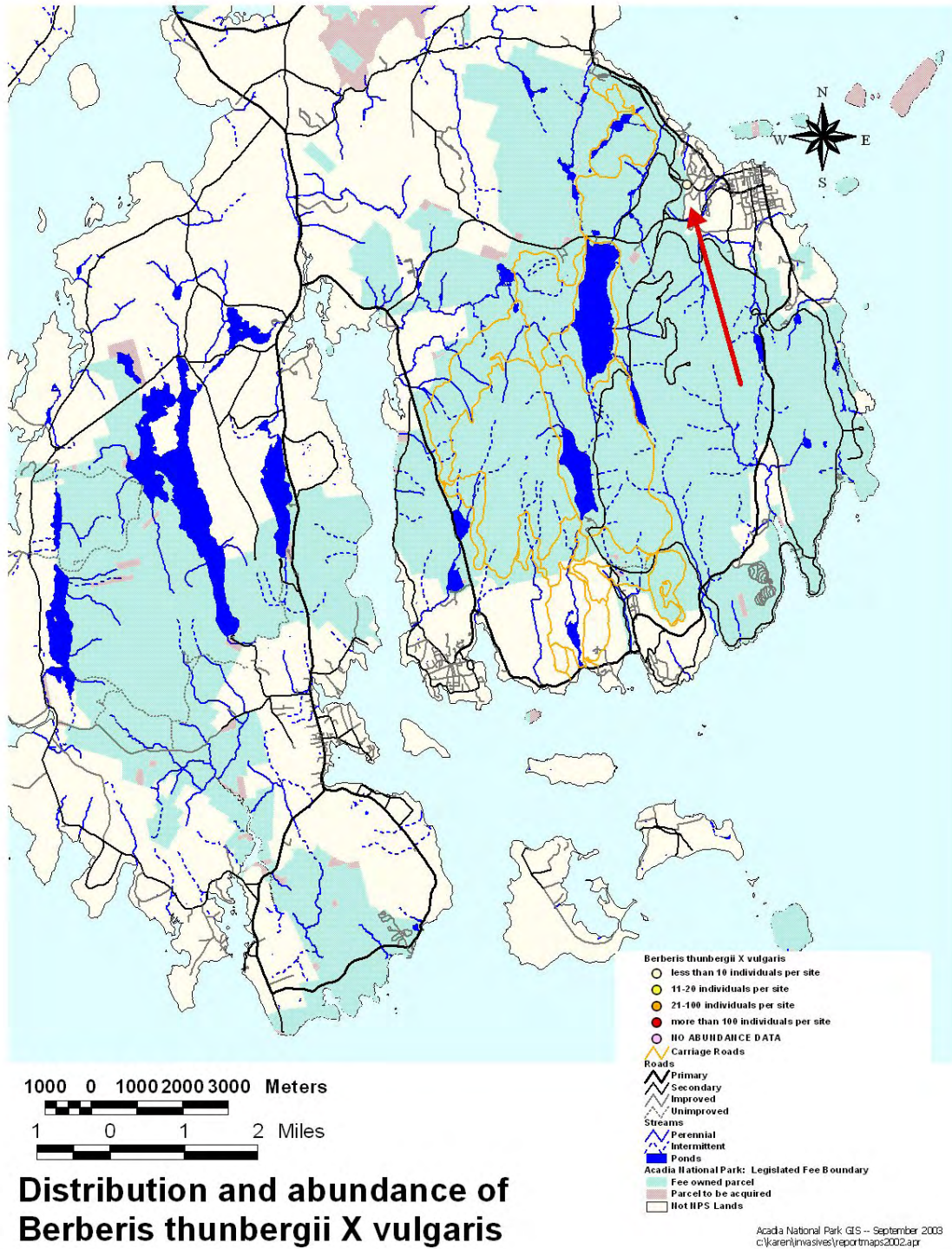
Taxon: **Ottawa barberry (*Berberis ottawensis*)**

Distribution: Ottawa barberry, previously undocumented on MDI was recorded from one site in Bar Harbor near an old driveway (Figure 8).

Abundance: One individual was observed.

Habitat: The organic soil layer at this site was destroyed by the 1947 fire, and scrubby, post-fire vegetation still dominates here. There is a sparse canopy of red oak (*Quercus rubra*) and white birch (*Betula papyrifera*), with huckleberry (*Gaylussacia baccata*), shrubby honeysuckle (*Diervilla lonicera*) and meadowsweet (*Spiraea alba*) in the shrub layer. Large-leaved aster is the most common herbaceous species.

Figure 8. Distribution and abundance of Ottawa barberry.



Taxon: **Japanese barberry (*Berberis thunbergii*)**

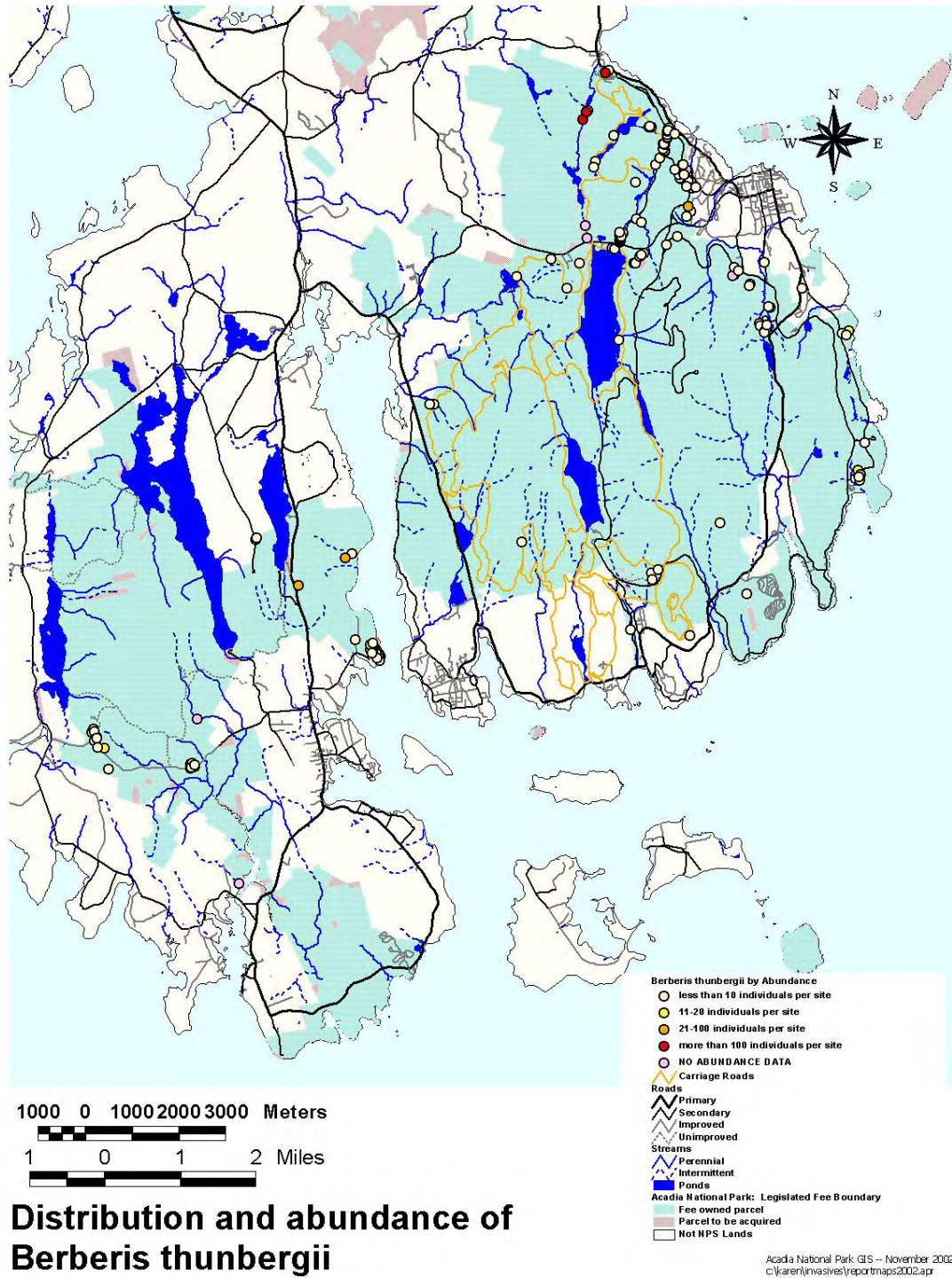
Distribution: Japanese barberry is distributed across MDI (Figure 9). It occurs most frequently on the east side, near old estates and carriage roads, but it was also documented from similar sites west of Somes Sound. Of particular note is its distribution along three water bodies: Duck Brook, Breakneck Brook and Witch Hole Pond. Its distribution pattern at these sites suggests that its seeds may have been water-dispersed.

Abundance: This taxon was recorded at 157 sites, 131 of which had ten or fewer plants present. Nine sites had 11-20 plants, five sites had 21-100 plants and three had more than 100 plants. No population data were taken at seven sites.

Habitat: Japanese barberry occurs in diverse habitats within ACAD. It has colonized dry, sandy and rocky sites, including carriage road edges and talus slopes. Barberry also grows on deeper, richer soils near Jordan Pond and near Park housing at Hardin Farm. In addition to these upland sites, there are extensive barberry populations in wetlands, most notably: the Great Meadow, Duck Brook and Breakneck Brook.

Japanese barberry can grow in full sun, in the absence of a tree canopy, or under a closed forest canopy. On upland sites, it is most often associated with white pine, white birch and red oak in the canopy, meadowsweet in the shrub layer and wood bluegrass, large-leaved aster, hawkweeds (*Hieracium* spp.) and low sweet blueberry (*Vaccinium angustifolium*). Red maple, and green ash dominate the canopy on wetland sites, with meadowsweet, green ash and winterberry (*Ilex verticillata*) in the shrub layer and bluejoint grass (*Calamagrostis canadensis*) and green ash in the herb layer. The wetland sites where Japanese barberry occurs at ACAD comprise sedge peat, sphagnum peat and mineral substrates.

Figure 9. Distribution and abundance of Japanese barberry



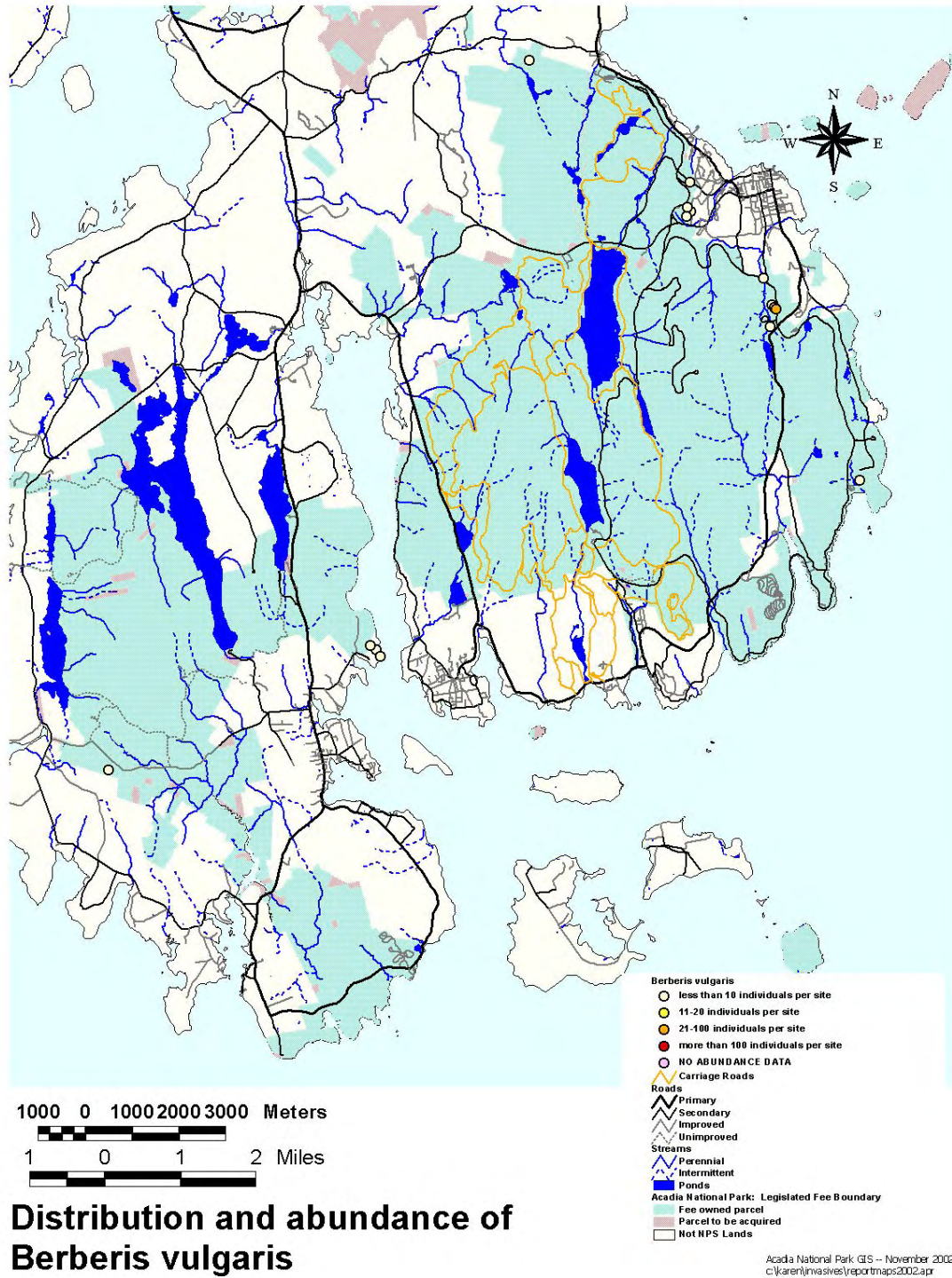
Taxon: **Common barberry (*Berberis vulgaris*)**

Distribution: Common barberry was documented throughout MDI (Figure 10). All populations located by this inventory were near old home or other building sites.

Abundance: Fifteen populations were discovered: 13 with 10 or fewer plants, one with 11-20 plants and one with 21-100 plants.

Habitat: Common barberry was found most often in post-disturbance forests comprising white birch, white pine and quaking aspen (*Populus tremuloides*) in the canopy. There is usually a well-developed shrub layer, often with invasive species present. Associated shrubs include: quaking aspen, alder-buckthorn, honeysuckles, Japanese barberry and low sweet blueberry. Downy goldenrod and blujoint grass are usually present in the herb layer, with large-leaved aster, flat-topped white aster and lupine (*Lupinus polyphyllus*) sometimes present.

Figure 10. Distribution and abundance of common barberry.



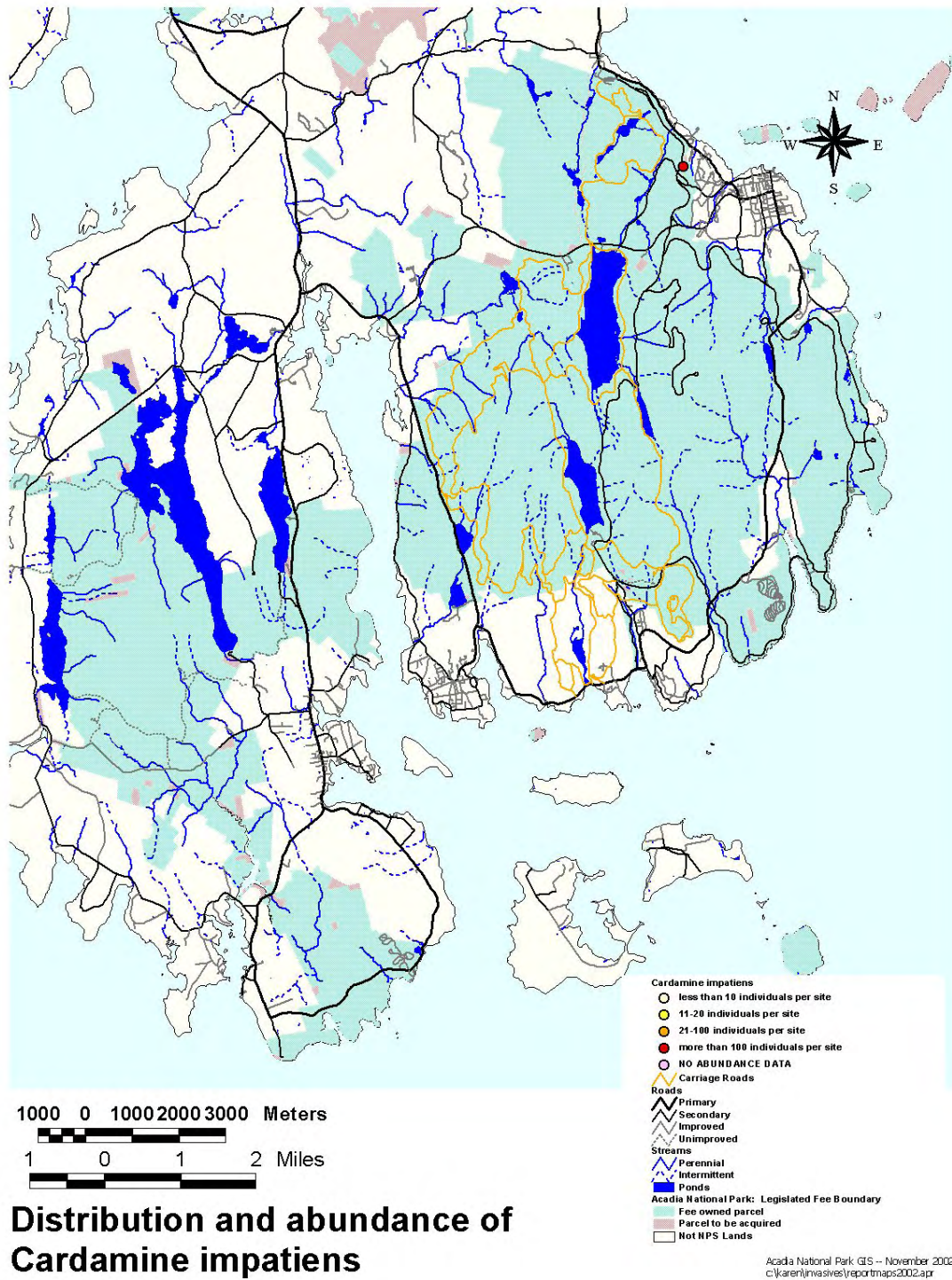
Taxon: **European bittercress (*Cardamine impatiens*)**

Distribution: This taxon has been documented from only three sites on MDI, all of which are in the town of Bar Harbor (Figure 11).

Abundance: Two of the populations comprise thousands of plants. The third is located in the Wild Gardens of Acadia and was documented prior to this inventory. Wild Gardens volunteers initiated control efforts (pulling annual plants), but the population is persisting.

Habitat: All of the ACAD populations of European bittercress occur in highly disturbed areas. As mentioned above, this plant grows in the Wild Gardens of Acadia. The population is located in an area managed to mimic a beach environment. Another population is located downslope of the Park Loop Road. This site appears to have been part of a farm or dwelling and was probably also disturbed when the Park Loop Road was constructed. The population is limited to a seepy area dominated by cinnamon, interrupted and sensitive ferns (*Osmunda cinnamomea*, *O. claytoniana* and *Onoclea sensibilis*, respectively) under a canopy of quaking aspen and white birch. The third site is located downslope of the Bar Harbor Transfer Station, along an old road bed that is highly disturbed and harbors what may be the most diverse collection of invasive species in the Park.

Figure 11. Distribution and abundance of European bittercress.



Taxon: **Oriental bittersweet (*Celastrus orbiculata*)**

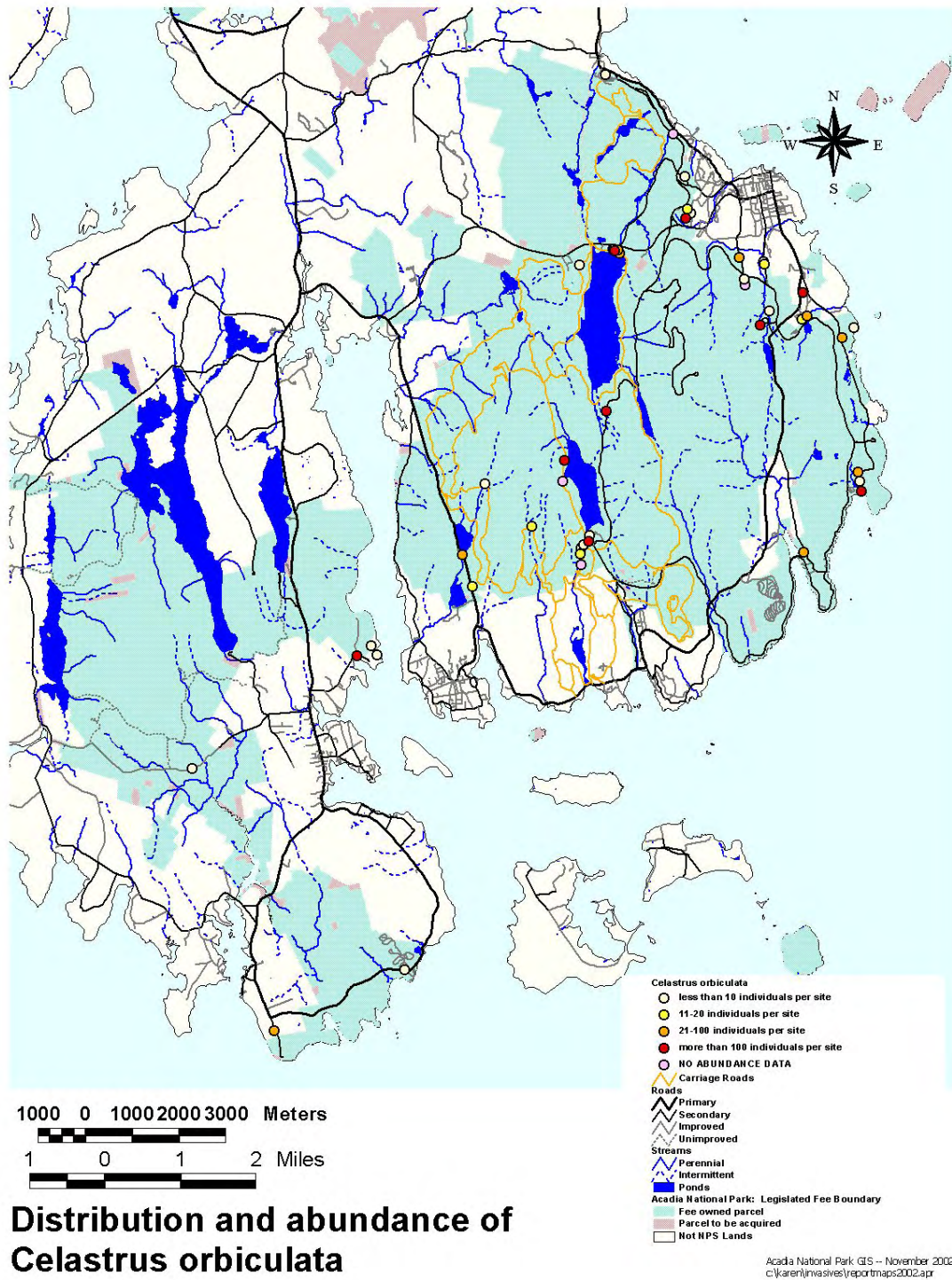
Distribution: Oriental bittersweet occurs across MDI. The majority of populations surveyed are located on the east side of the island (Figure 12).

Abundance: Oriental bittersweet was documented from 42 sites. Sixteen populations have 10 or fewer individuals, six have 11-20, eight have 21-100, 8 have more than 100 and no population data were recorded from four populations.

Habitat: Most populations appear to have persisted from horticultural plantings. Oriental bittersweet populations were found near disturbed areas, including: carriage road bridge abutments, the Jordan Pond House, an old farmstead and the Eagle Lake pump house. This species was also found in several locations along Jordan Stream, which drains from Jordan Pond. Fruits may have floated downstream from the horticultural plantings and become established on the stream banks and gravel bars.

Associated tree species include: red oak, green ash, white birch, yellow birch (*Betula alleghaniensis*) and sugar maple (*Acer saccharum*). Shrub species are: red maple, huckleberry, meadowsweet and red spruce (*Picea rubens*). Dominant species in the herb layer include: large-leaved aster, wood bluegrass, downy goldenrod and bracken fern (*Pteridium aquilinum*).

Figure 12. Distribution and abundance of Oriental bittersweet.



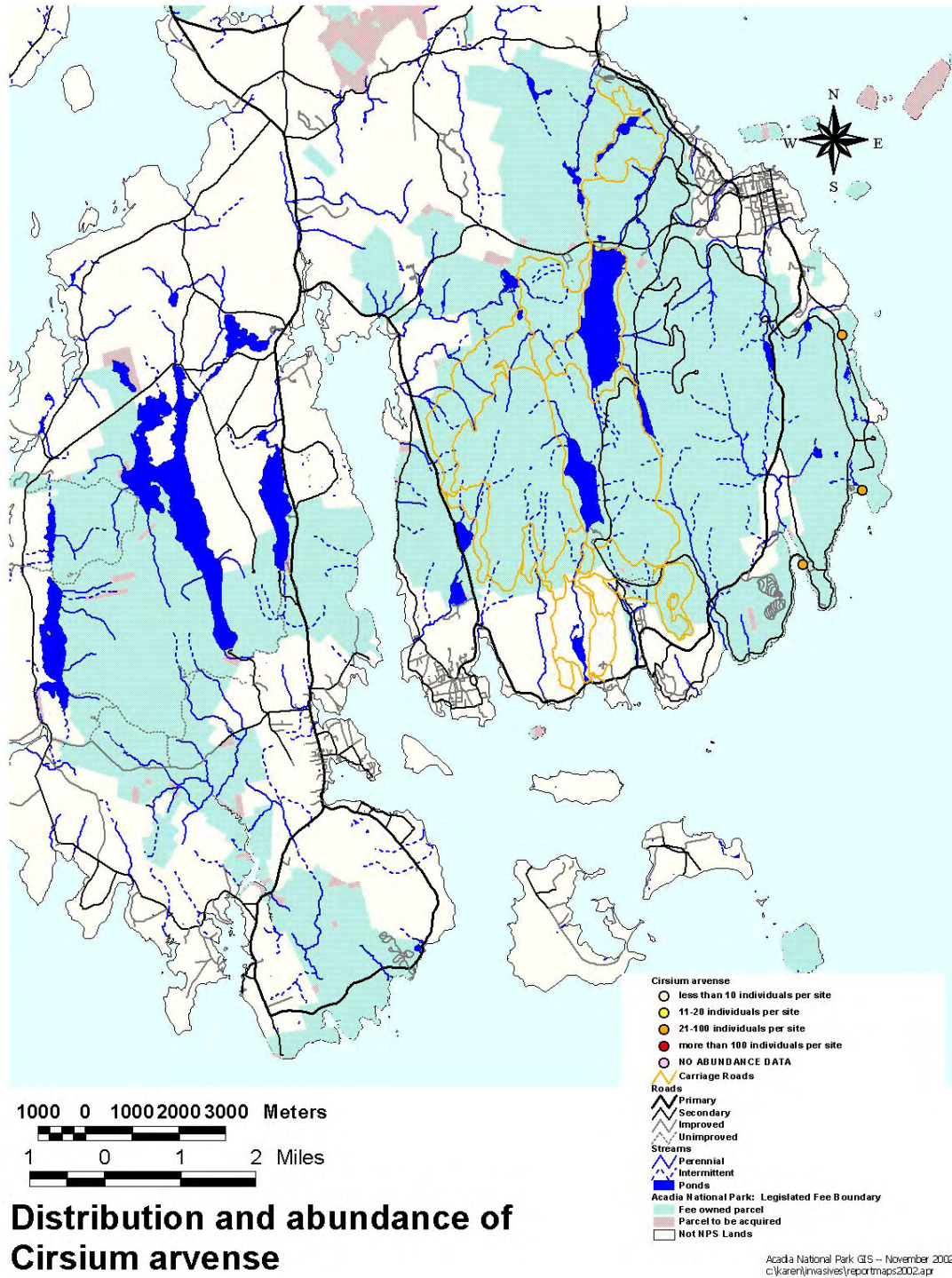
Taxon: **Canada thistle (*Cirsium arvense*)**

Distribution: Canada thistle was documented most often in ACAD's eastern portion and only once west of Somes Sound (Figure 13). Undoubtedly, this taxon is distributed more widely than the current inventory suggests. It probably grows in every open field on the island (inside and outside the Park) and along many beaches.

Abundance: Twelve populations were documented: two with 10 or fewer plants, 3 with 11-20 plants, 5 with 21-100 plants, one with more than 100 plants and one for which no population data were collected.

Habitat: Canada thistle was seen most commonly associated with human disturbance (e.g. old field, carriage road edge), but was also observed to have colonized sites disturbed by beaver activity. In fact, the largest populations were on gravel bars and beaver meadows along Little Harbor Brook. This species often grows in open areas, without a tree canopy. Trees recorded at the thistle populations were red maple and gray birch. The most common shrub species observed were white pine, meadowsweet, Morrow's honeysuckle and English hawthorn (*Crataegus monogyna*).

Figure 13. Distribution and abundance of Canada thistle.



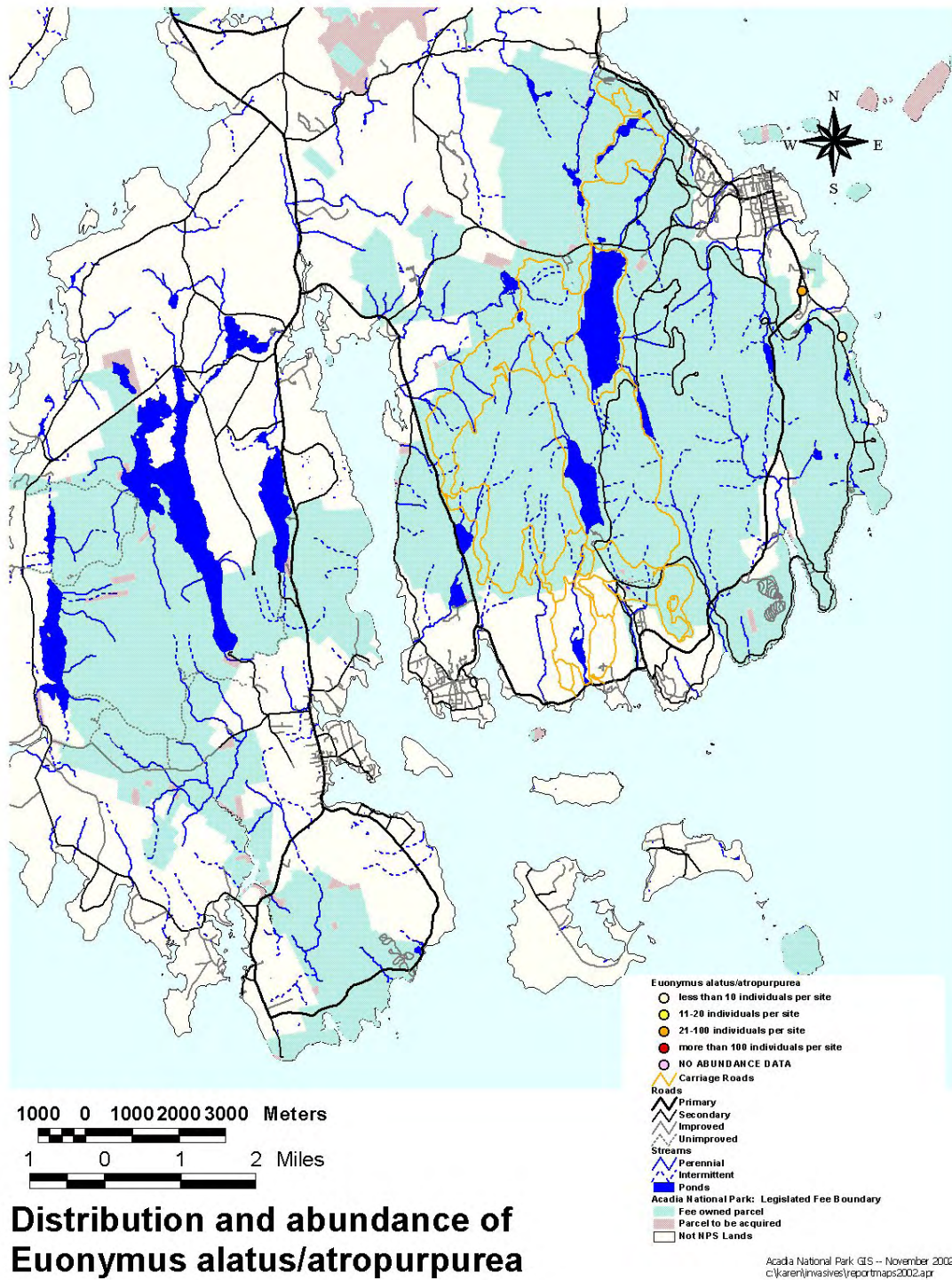
Taxon: **Winged euonymus (*Euonymus alatus*)**

Distribution: Winged euonymus was documented at two sites in the town of Bar Harbor: an old estate and an old nursery (Figure 14).

Abundance: One site supported 10 or fewer plants and the other had 21-100 plants.

Habitat: Both sites where winged euonymus was found had a closed canopy comprising: white birch, Norway maple and quaking aspen. Green ash, Oriental bittersweet, privet and Morrow's honeysuckle occurred in the shrub layer and large-leaved aster, wood bluegrass and flat-topped white aster dominated the herb layer.

Figure 14. Distribution and abundance of winged euonymus.



Taxon: **Japanese knotweed (*Fallopia japonica*)**

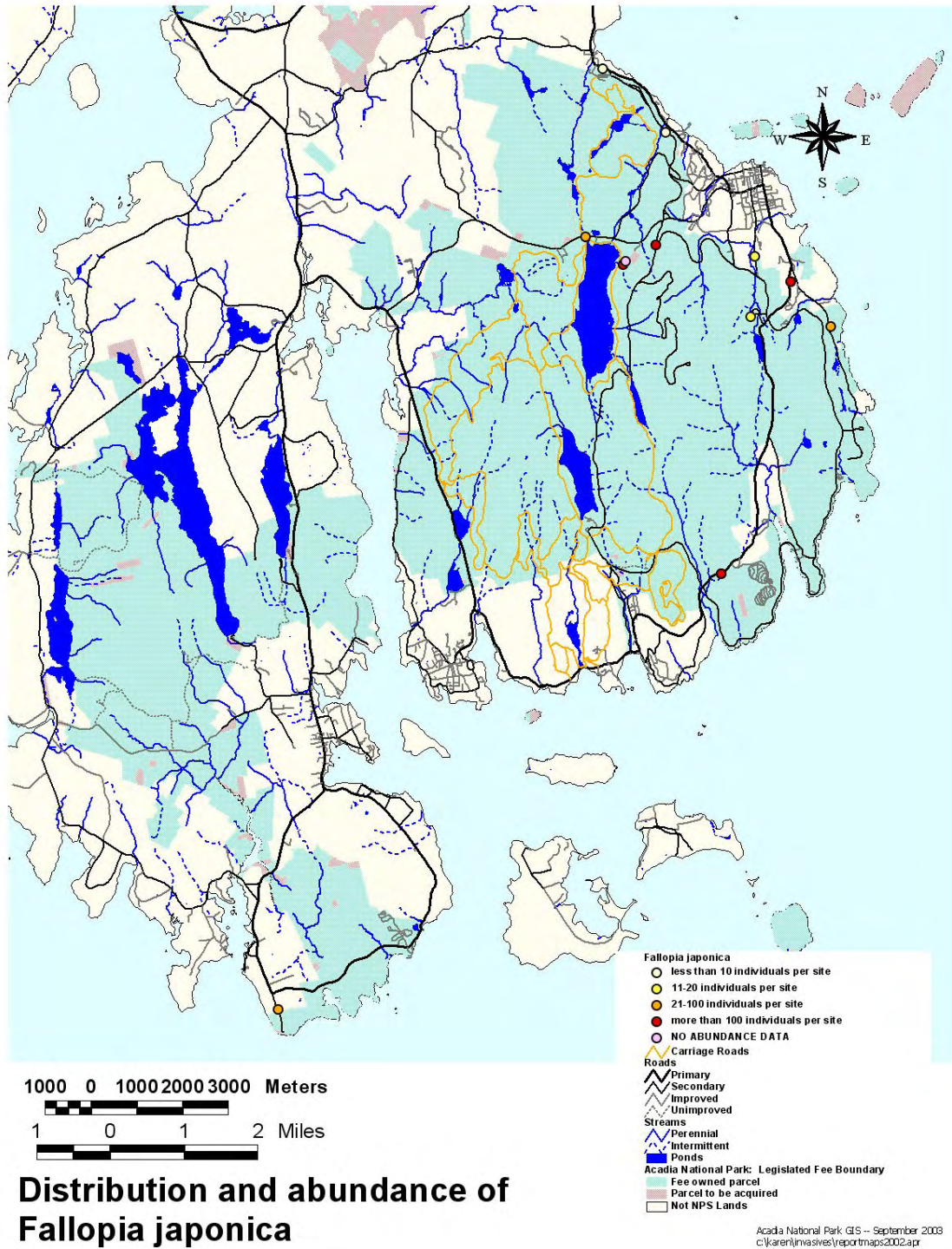
Distribution: All sites documented for Japanese knotweed are located on the east side of MDI, with the exception of one site on the southwest part of the island (Figure 15). Human disturbance is apparent at all occurrences.

Abundance: Ten populations of Japanese knotweed were recorded in ACAD. Two have ten or fewer plants, one has 11-20 plants, three have 21-100 plants and three have more than 100 plants.

Habitat: Habitats for this taxon range from a highly disturbed stump dump to a relatively natural streambank.

When present, the tree canopy comprises red maple, heart-leaved birch (*Betula cordifolia*), white pine, Norway maple and quaking aspen. Honeysuckles and roses (*Rosa* spp.) occur in the shrub layer. Associated herbaceous species include wood bluegrass, large-leaved aster and spreading dogbane (*Apocynum adrosaemifolium*).

Figure 15. Distribution and abundance of Japanese knotweed.



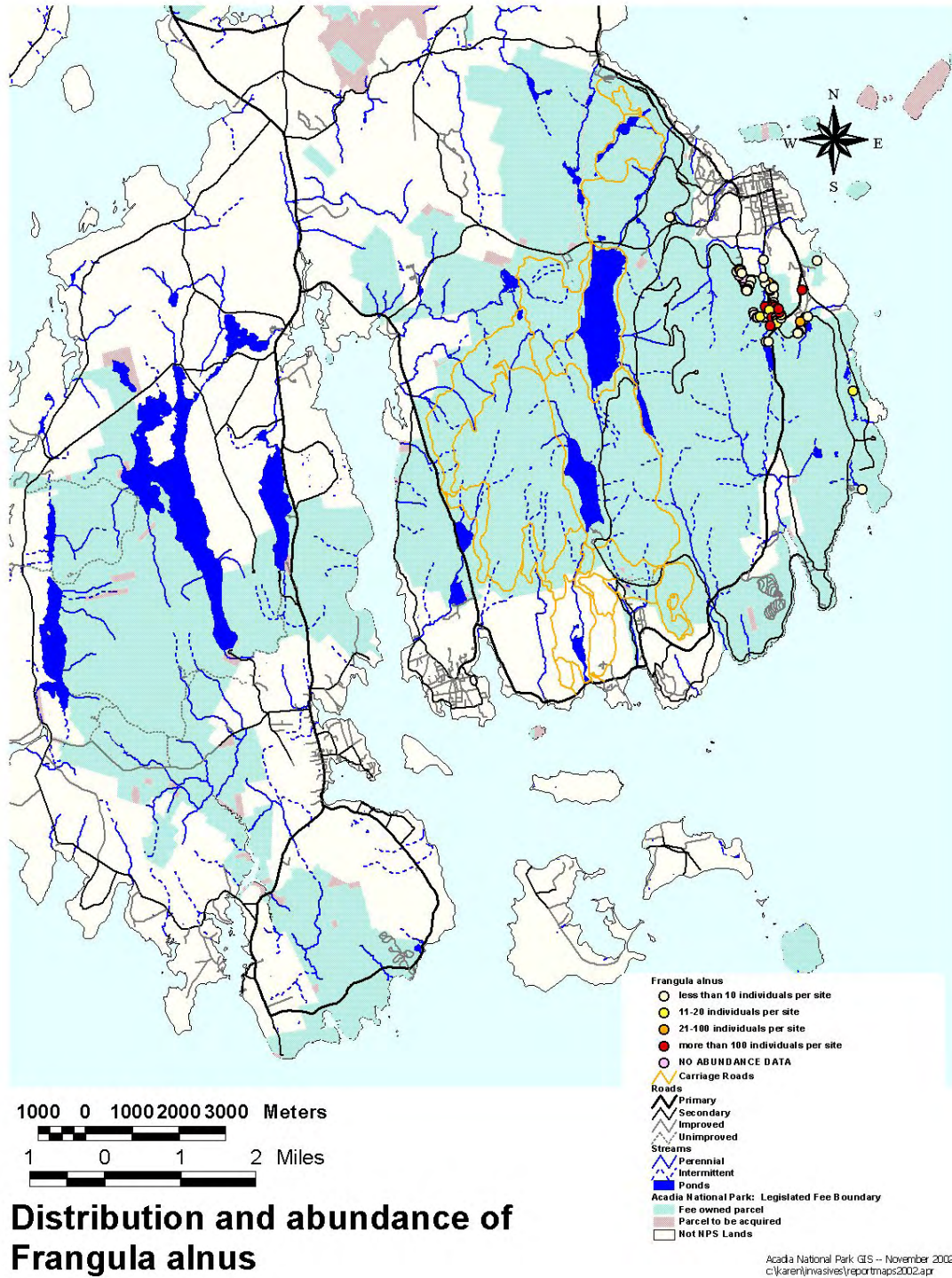
Taxon: **Alder-buckthorn (*Frangula alnus*)**

Distribution: Sites for alder-buckthorn are limited to the town of Bar Harbor, on the east side of MDI (Figure 16).

Abundance: Alder-buckthorn was recorded at 76 locations. There were 10 or fewer plants at 35 of them, 11-20 plants at nine of them, 21-100 plants at 11 of them and 100 or more plants at 13 of them. No abundance data were collected from eight locations.

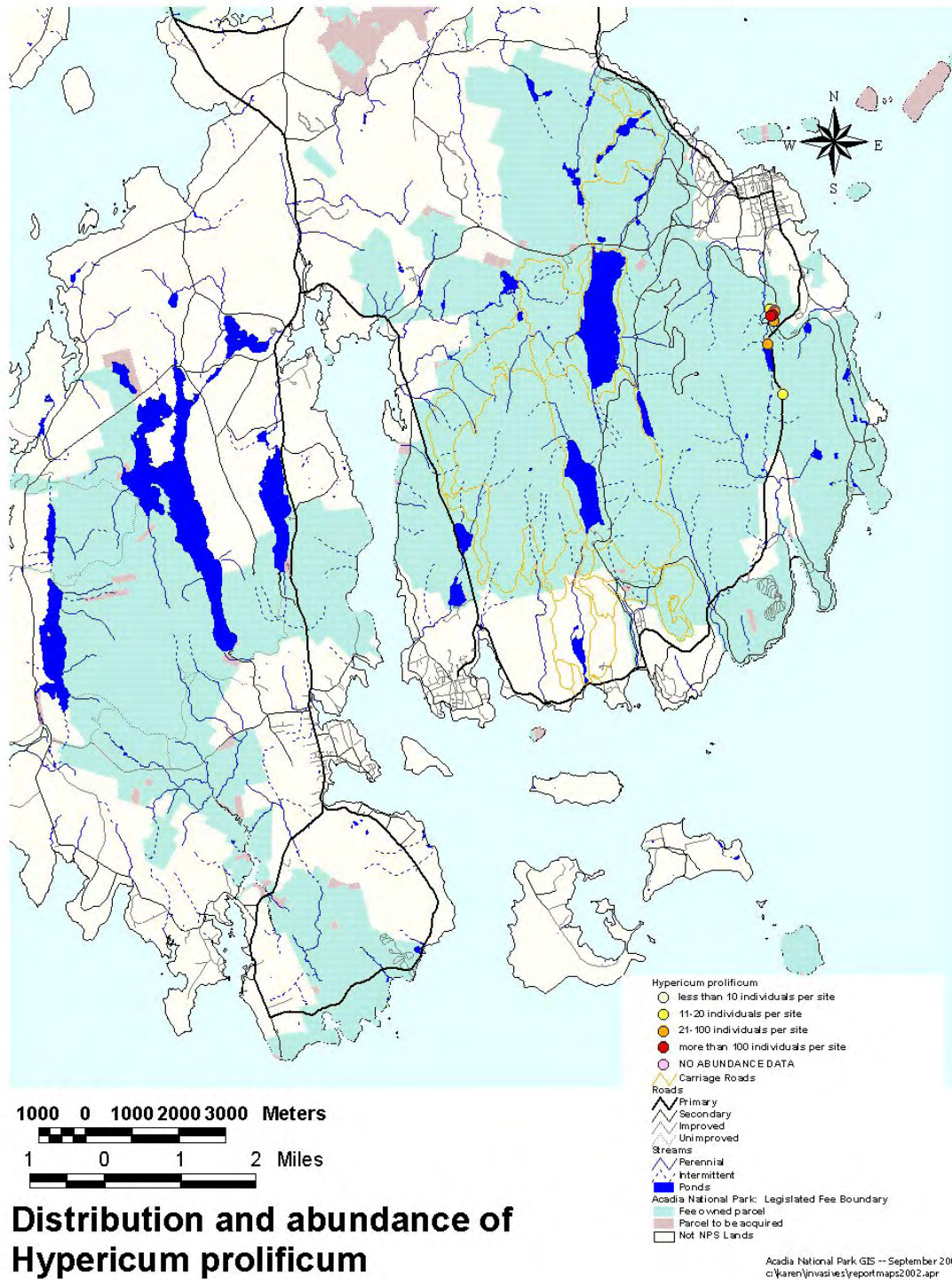
Habitat: All alder-buckthorn sites are within the area burned during the 1947 fire. In some places, the fire was hot enough to have destroyed all vegetation and the organic matter in the soil, allowing bare soil to erode and leaving little soil. Areas with these fire-damaged soils which also support alder-buckthorn are east of Great Meadow and between Schooner Head the Park Loop Roads. Quaking aspen, white birch and red oak are the dominant trees on drier sites. Shadbushes (*Amelanchier* spp.) and quaking aspen are common shrubs and wood bluegrass and flat-topped white aster are common herbs. Alder-buckthorn populations are much larger in the vicinity of Great Meadow, a basin where soils are deeper and wetter. Gray birch, white birch and quaking aspen comprise the often sparse canopy. Red maple, ninebark, green ash and wild-raisin (*Viburnum nudum* v. *cassinoides*) make up the shrub layer, with flat-topped white aster and bluejoint grass the most frequently found herbs.

Figure 16. Distribution and abundance of alder-buckthorn.



- Taxon: **Shrubby St. Johnswort (*Hypericum prolificum*)**
- Distribution: Shrubby St. Johnswort is known only from the area immediately east of Great Meadow and at the north end of the Tarn, in Bar Harbor (Figure 17).
- Abundance: This taxon is unique, in that it had been documented by only one or two herbarium specimens prior to this study. It had never been reported as invasive in Maine, yet the extant population near Great Meadow comprises thousands of individuals. Transects across the population show a population density of slightly over one shrubby St. Johnswort plant per square meter (Weber and Rooney, unpublished data).
- Habitat: Gray birch, white birch and quaking aspen comprise the often sparse canopy. Red maple, common and Japanese barberry, ninebark and wild-raisin (*Viburnum nudum* v. *cassinoides*) make up the shrub layer, with flat-topped white aster and bluejoint grass the most frequently found herbs.

Figure 17. Distribution and abundance of shrubby St. Johnswort.



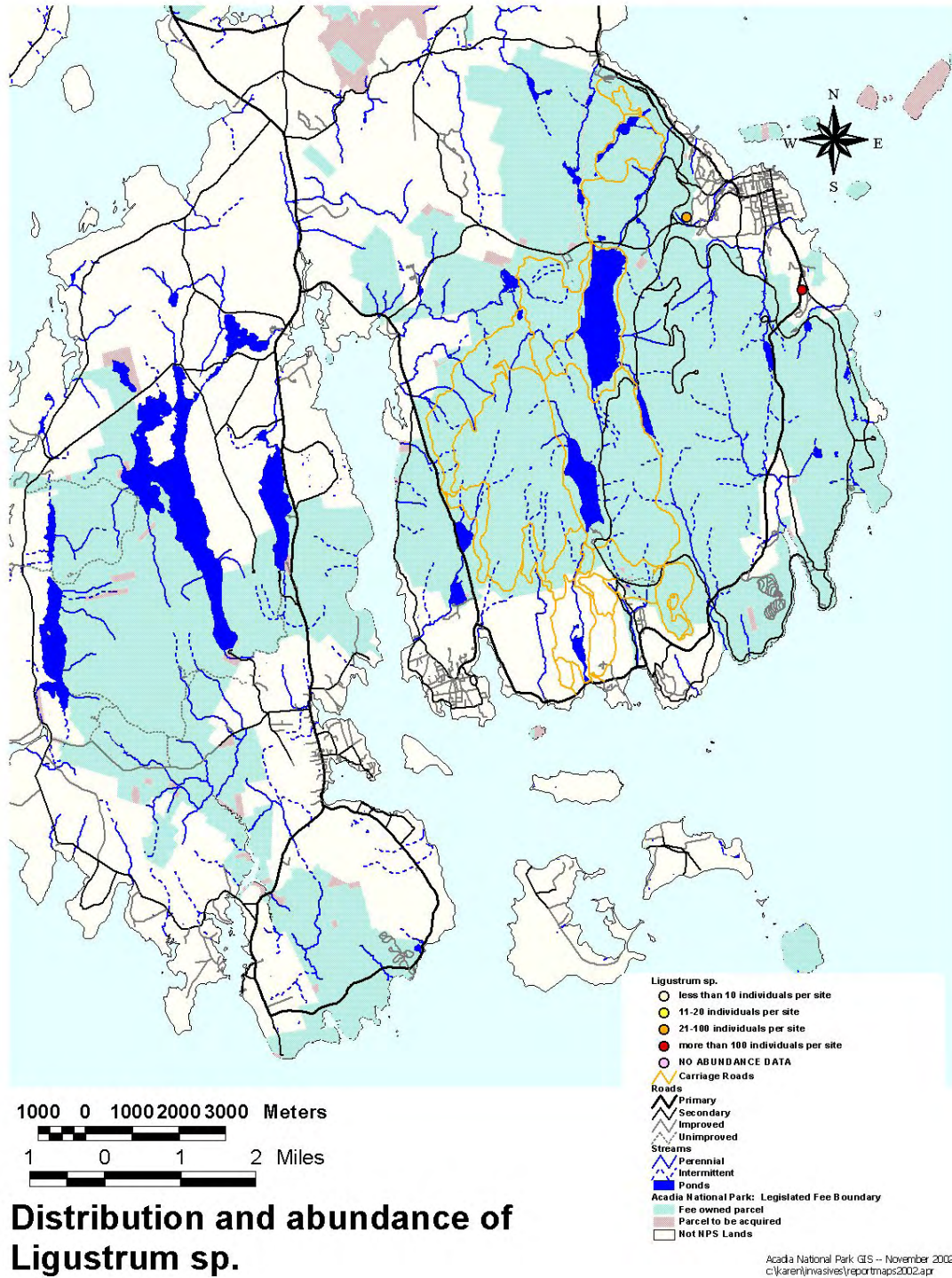
Taxon: **Privet (*Ligustrum* sp.)**

Distribution: Privet is likely more widely distributed than this inventory reflects. Because it was not ranked as an invasive, documentation of its occurrence did not begin at the start of the inventory. Two sites were recorded in Bar Harbor (Figure 18).

Abundance: One occurrence comprises 21-100 plants and there are over 100 plants at the other site.

Habitat: Privet was documented at the location of an old plant nursery and from the grounds of an estate that burned in 1947. Both sites harbor many invasive plant species. The forest canopy at the nursery site is dominated by quaking aspen and red oak. Alder-buckthorn and non-native honeysuckles are the major shrubs there and flat-topped white aster and wood bluegrass are the most common herbaceous species. Red maple, white birch and Oriental bittersweet comprise the canopy at the former estate.

Figure 18. Distribution and abundance of privet.



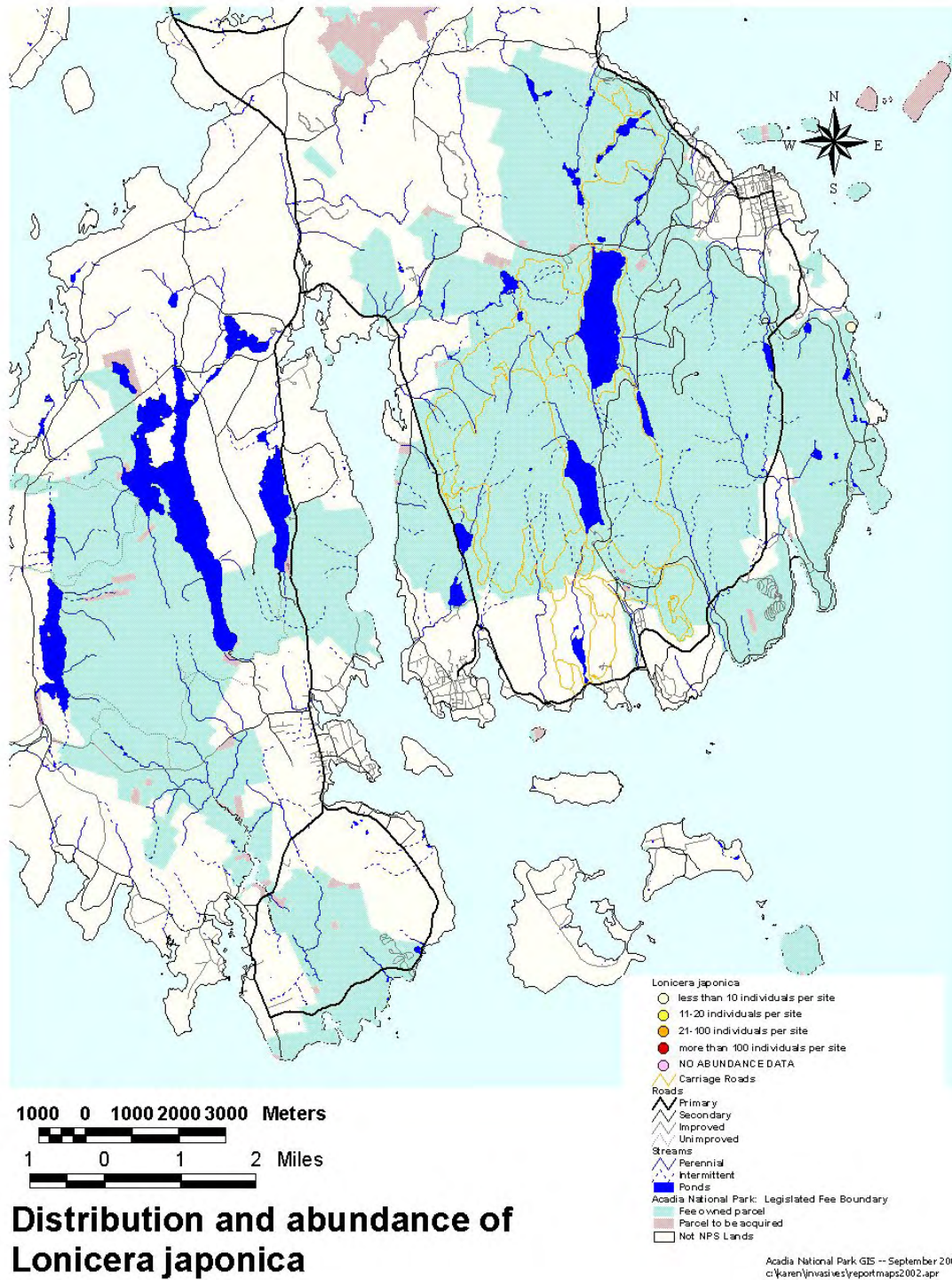
Taxon: **Japanese honeysuckle (*Lonicera japonica*)**

Distribution: Japanese honeysuckle is known from one location where it is growing on the edge of a former estate. (Figure 19).

Abundance: One clone comprises the solitary occurrence of this taxon.

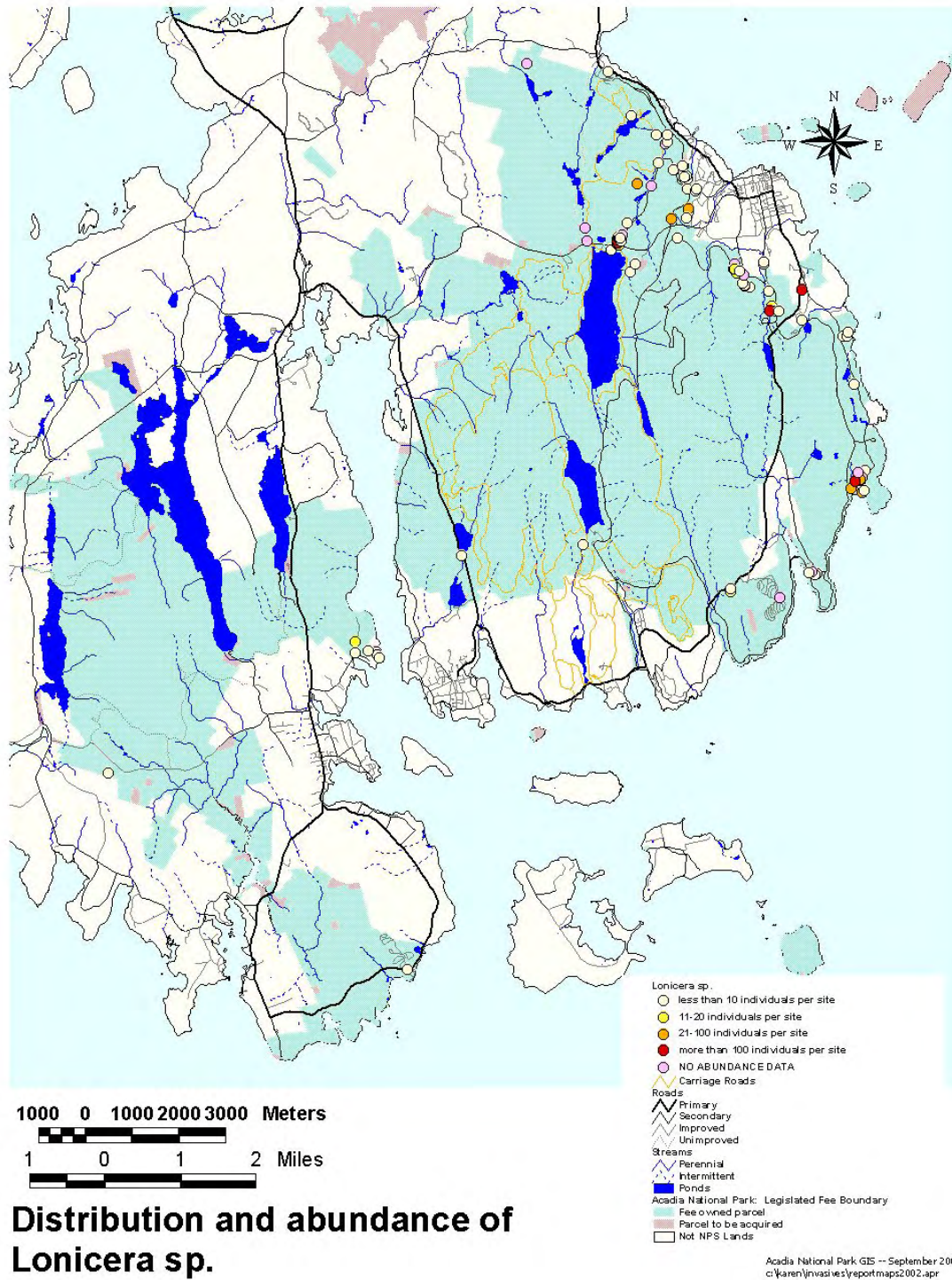
Habitat: ACAD's only plant of Japanese honeysuckle is growing under a partially closed canopy of red maple and green ash. There are many Morrow's honeysuckle and Japanese barberry shrubs nearby. Interrupted ferns, large-leaved aster and yellow king-devil provide almost continuous herbaceous cover.

Figure 19. Distribution and abundance of Japanese honeysuckle.



- Taxon:** **Honeysuckle species (*Lonicera morrowii*, *L. x bella*)**
- Distribution:** Most of the honeysuckle populations documented by this inventory are in Bar Harbor (Figure 20). There are a few occurrences south of Bar Harbor and east of Somes Sound and even fewer west of Somes Sound.
- Abundance:** Of 94 honeysuckle sites documented, there are ten or fewer plants at 56 of them, 11-20 plants at seven of them, 21-100 plants at seven of them and more than 100 plants at 9 of them. No population data were recorded from 13 honeysuckle sites.
- Habitat:** Non-native honeysuckle occurs in a variety of habitats at ACAD: along old roads, on a pondshore, in a streambed and associated with old habitations. These shrubs are found most often in dry, open areas or where there is a sparse canopy of red oak, red maple or big-toothed aspen (*Populus grandidentata*). Regenerating canopy species and huckleberries are usually present in the shrub layer and wood bluegrass, large-leaved aster, sarsaparilla (*Aralia nudicaulis*) and pale sedge (*Carex lucorum*) comprise the herb layer. Honeysuckles also occur as a linear population that extends from the outlet of Eagle Lake and intermittently along Duck Brook, to the ocean. The shrubs grow on gravel bars in the stream bed which emerge after the spring run-off and in the brook's floodplain.

Figure 20. Distribution and abundance of honeysuckle species.



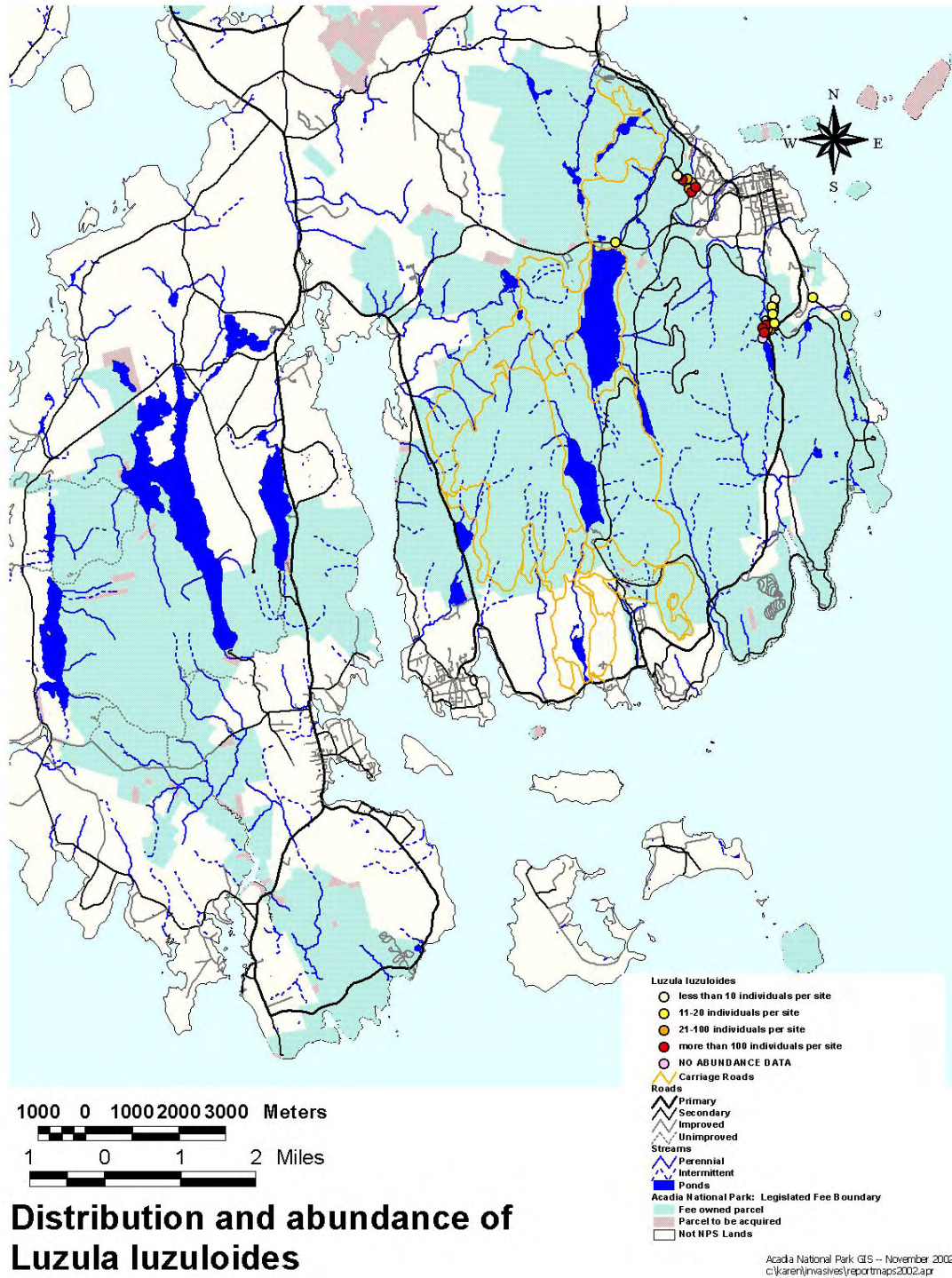
Taxon: **Forest woodrush (*Luzula luzuloides*)**

Distribution: The current distribution of forest woodrush is limited to Bar Harbor (Figure 21). Two main areas of concentration were documented: near Sieur de Monts Spring and near the intersection of West St. Extension and Duck Brook Road.

Abundance: Twenty-four sites were documented for forest woodrush during this inventory. Two sites support 10 or fewer plants, six support 11-20 plants, five support 21-100 plants, 10 support over 100 plants and there is one site at which no plant count was made.

Habitat: Forest woodrush occurs under a closed canopy with red oak, white pine, big-toothed aspen, white birch, red maple, American beech (*Fagus grandifolia*) or hemlock (*Tsuga canadensis*) as components. Regenerating canopy species comprise the shrub stratum and striped maple (*Acer pensylvanicum*) and balsam fir (*Abies balsamea*) are present at some sites. Wood bluegrass, large-leaved aster and bracken fern are herbaceous species often associated with forest woodrush.

Figure 21. Distribution and abundance of forest woodrush.



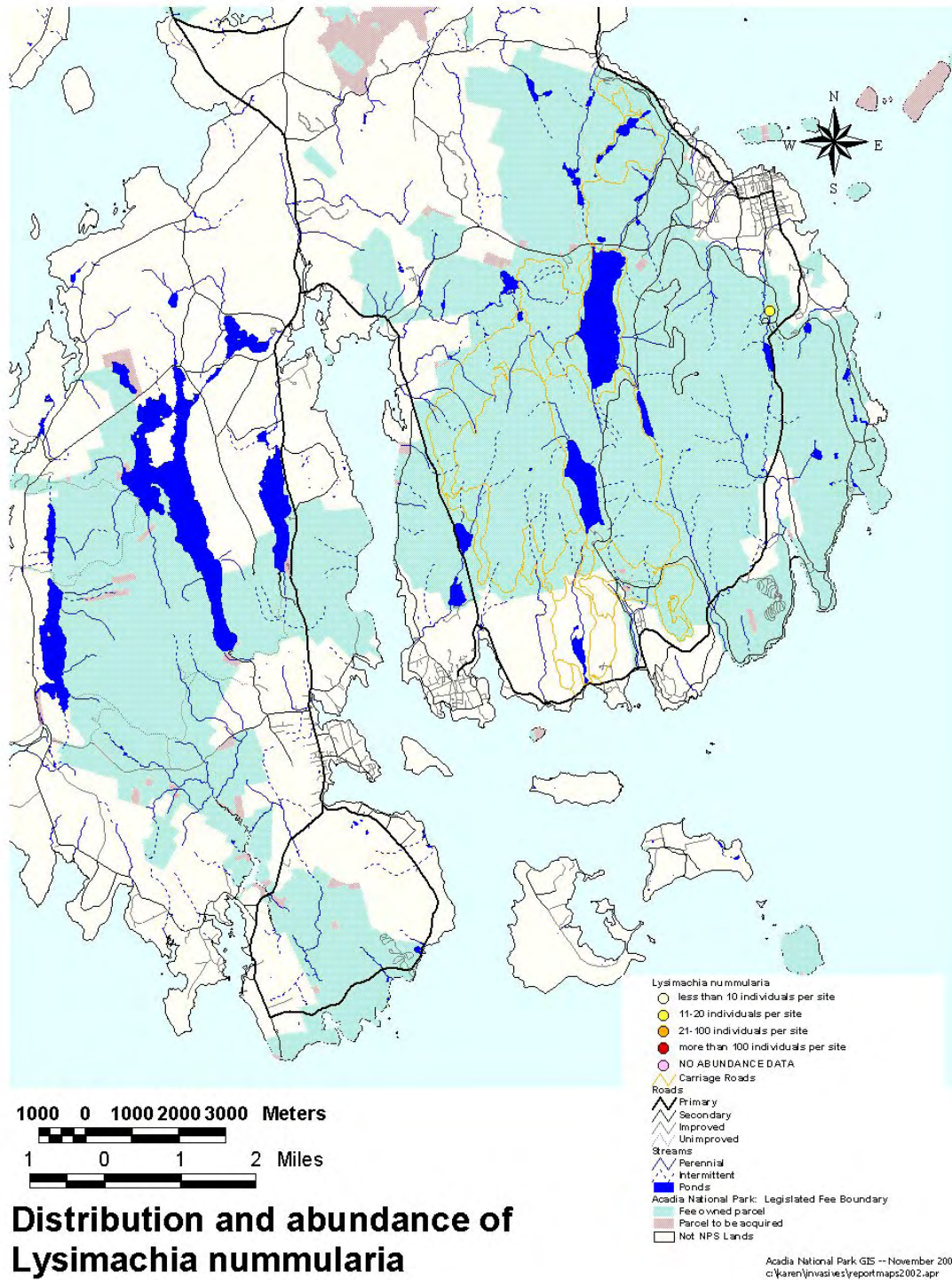
Taxon: **Moneywort (*Lysimachia nummularia*)**

Distribution: Moneywort was documented from one site near Sieur de Monts Spring, in Bar Harbor (Figure 22).

Abundance: Eleven to twenty individuals comprise the population found during this inventory.

Habitat: The moneywort is growing in a disturbed area under a partially closed canopy of white birch and quaking aspen. Non-native honeysuckles, ninebark, quaking aspen and speckled alder (*Alnus incana* ssp. *rugosa*) comprise the shrub layer. Wood bluegrass, flat-topped white aster, bluejoint grass and Morrow's honeysuckle form almost continuous cover in the herb layer.

Figure 22. Distribution and abundance of moneywort.



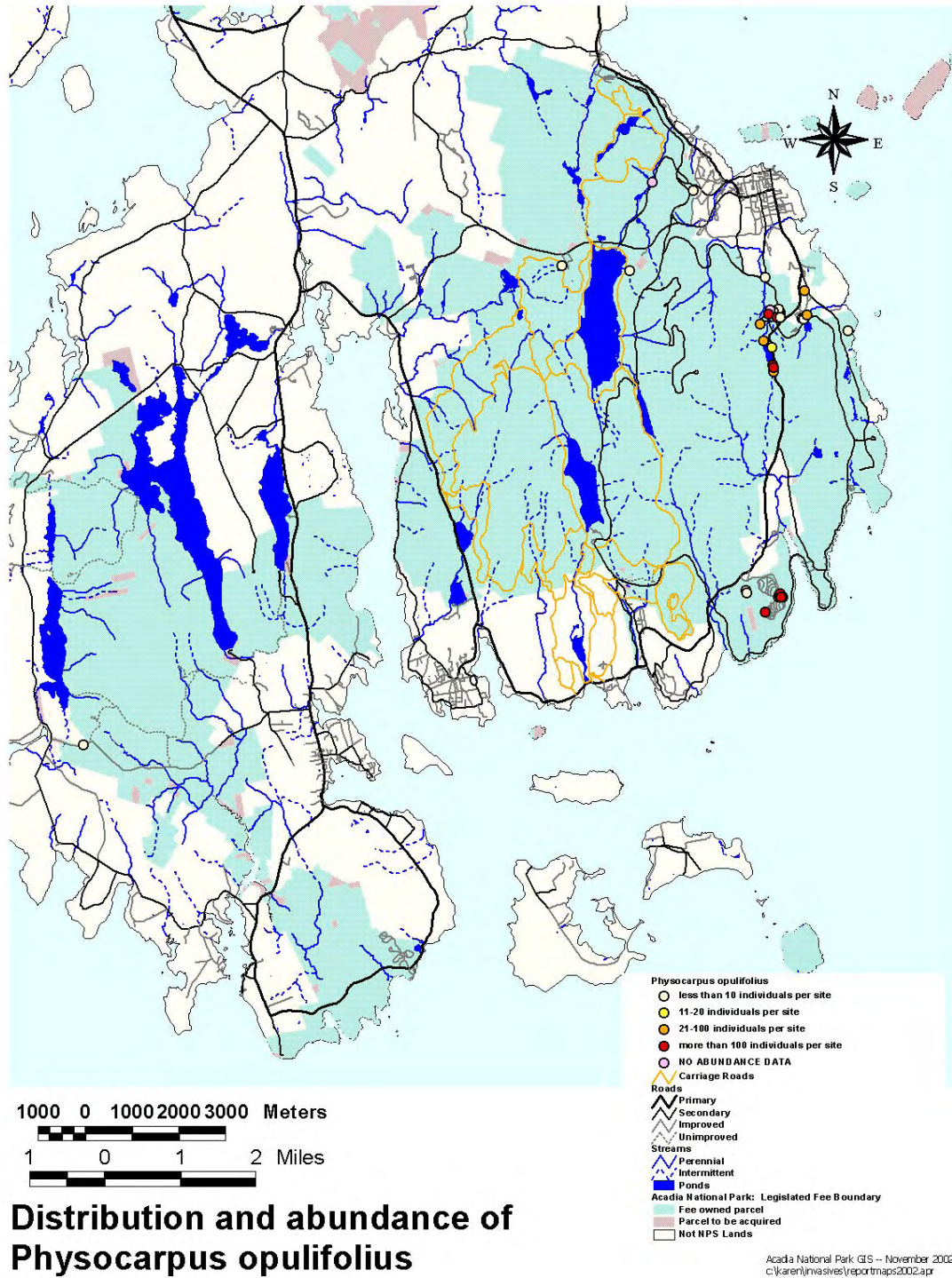
Taxon: **Ninebark (*Physocarpus opulifolius*)**

Distribution: The occurrences of ninebark at ACAD are concentrated in the Great Meadow/Tarn area (Figure 23). This plant is also spreading in and around Blackwoods campground.

Abundance: Thirty-six ninebark sites were documented during this inventory. Fourteen sites have ten or fewer plants, two have 11-20 plants, eight have 21-100 plants and eleven have more than 100 plants.

Habitat: Ninebark is concentrated in area that had been used agriculturally and commercially before burning during the 1947 fire. Many non-native species have colonized the site under a partial canopy of red maple and quaking aspen. Alder-buckthorn is the dominant shrub, but red maple, shadbush and blackberry (*Rubus allegheniensis*) are also present. Alder-buckthorn is an important component of the herb layer, with wood bluegrass, flat-topped white aster and bluejoint grass as co-dominant species.

Figure 23. Distribution and abundance of ninebark.



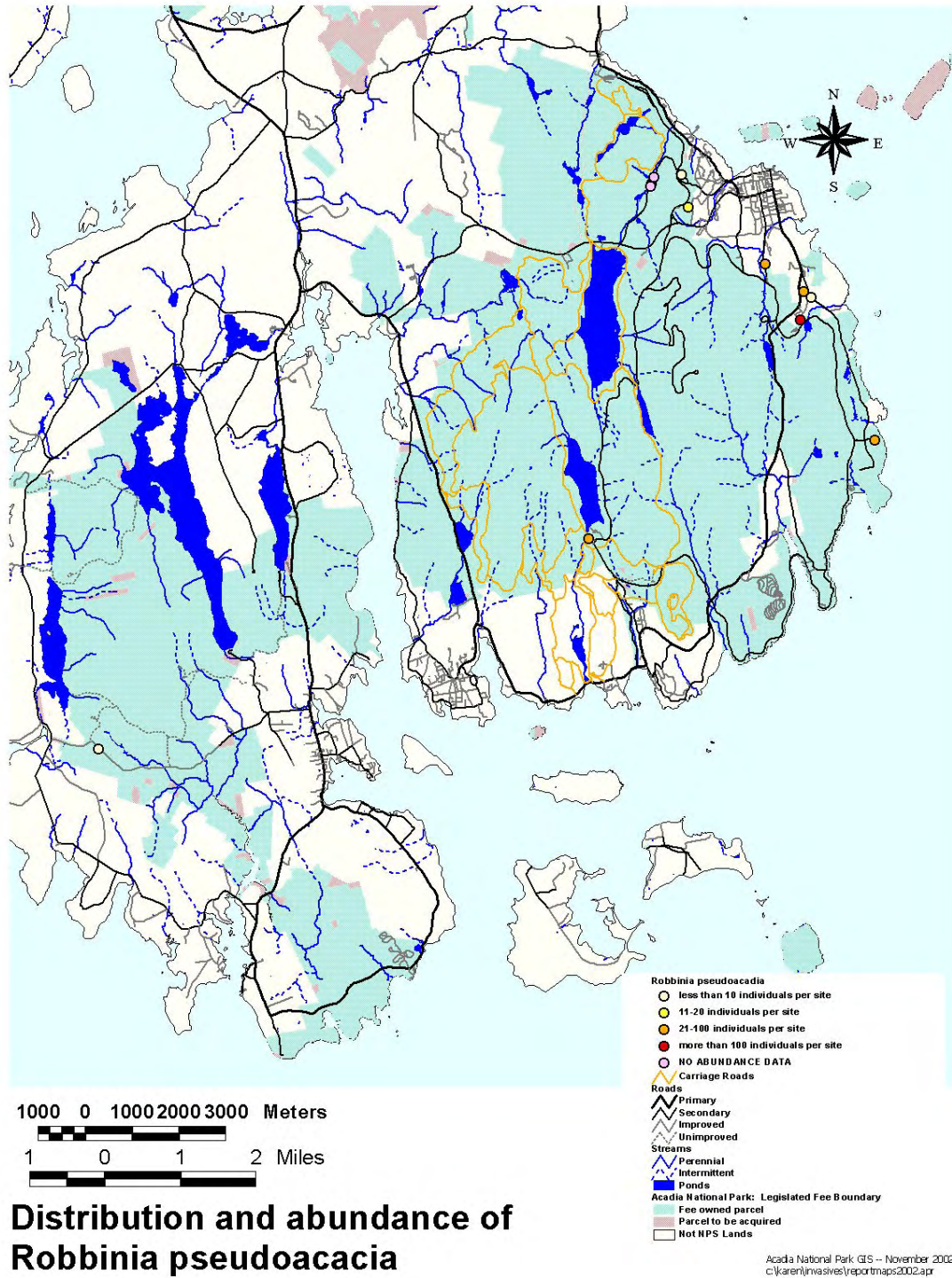
Taxon: **Black locust (*Robinia pseudoacacia*)**

Distribution: Most of the sites documented for black locust are in the Bar Harbor area. This species was also observed at the south end of Bubble Pond, in Mt. Desert, and on the Seal Cove Road, in Tremont (Figure 24).

Abundance: Black locust populations mapped include: three with 10 or fewer plants, one with 11-20 plants, four with 21-100 plants and one with more than 100 plants. No population data were recorded at three sites.

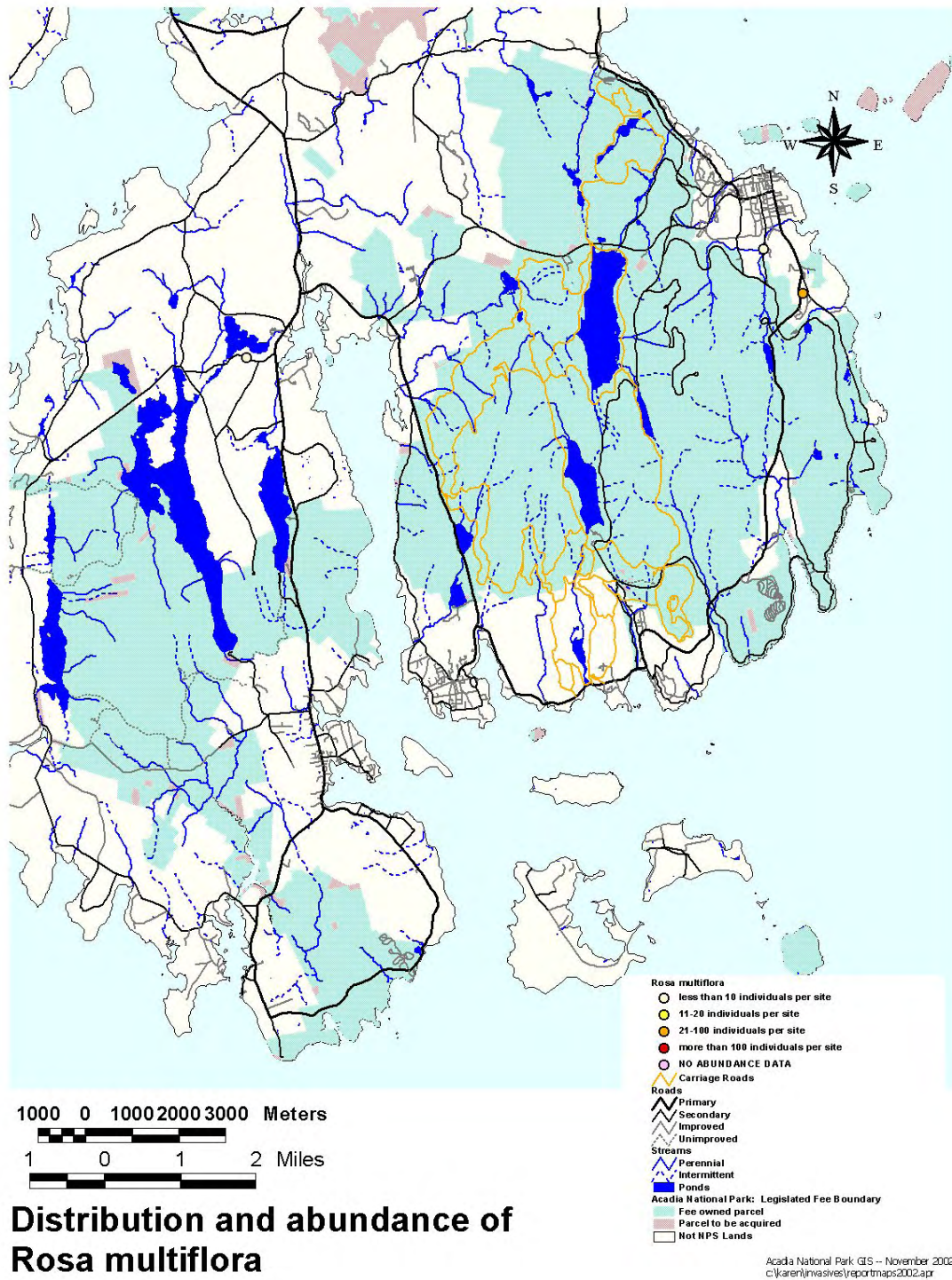
Habitat: Black locust is a tree species that has colonized open, disturbed areas. At ACAD, it occurs most often within the limits of the 1947 fire and often at sites where other types of disturbance have occurred (e.g. farming, road-building). This taxon often forms a monospecific, partially open canopy. Red maple, quaking aspen, Norway maple, green ash and white spruce (*Picea glauca*) were also observed. The canopy species also occur in the shrub layer, with Morrow's honeysuckle, shadbush and meadowsweet. Wood bluegrass, bluejoint grass, flat-topped white aster and bracken fern commonly comprise the herbaceous stratum.

Figure 24. Distribution and abundance of black locust.



- Taxon: **Multiflora rose (*Rosa multiflora*)**
- Distribution: Multiflora rose is more common outside ACAD than it is in the Park. However, two sites were recorded within the Park's boundaries (Figure 25).
- Abundance: Ten or fewer plants make up one population and the other has 21-100 plants.
- Habitat: Multiflora rose can grow on open sites or those where canopy closure is fairly complete. The ACAD populations are growing under a partial canopy of black locust. The shrub stratum is well-developed and includes: speckled alder, red maple, ninebark, privet and Morrow's honeysuckle. Oriental bittersweet, large-leaved aster, green ash, wood bluegrass and flat-topped white aster comprise the herb layer.

Figure 25. Distribution and abundance of multiflora rose.



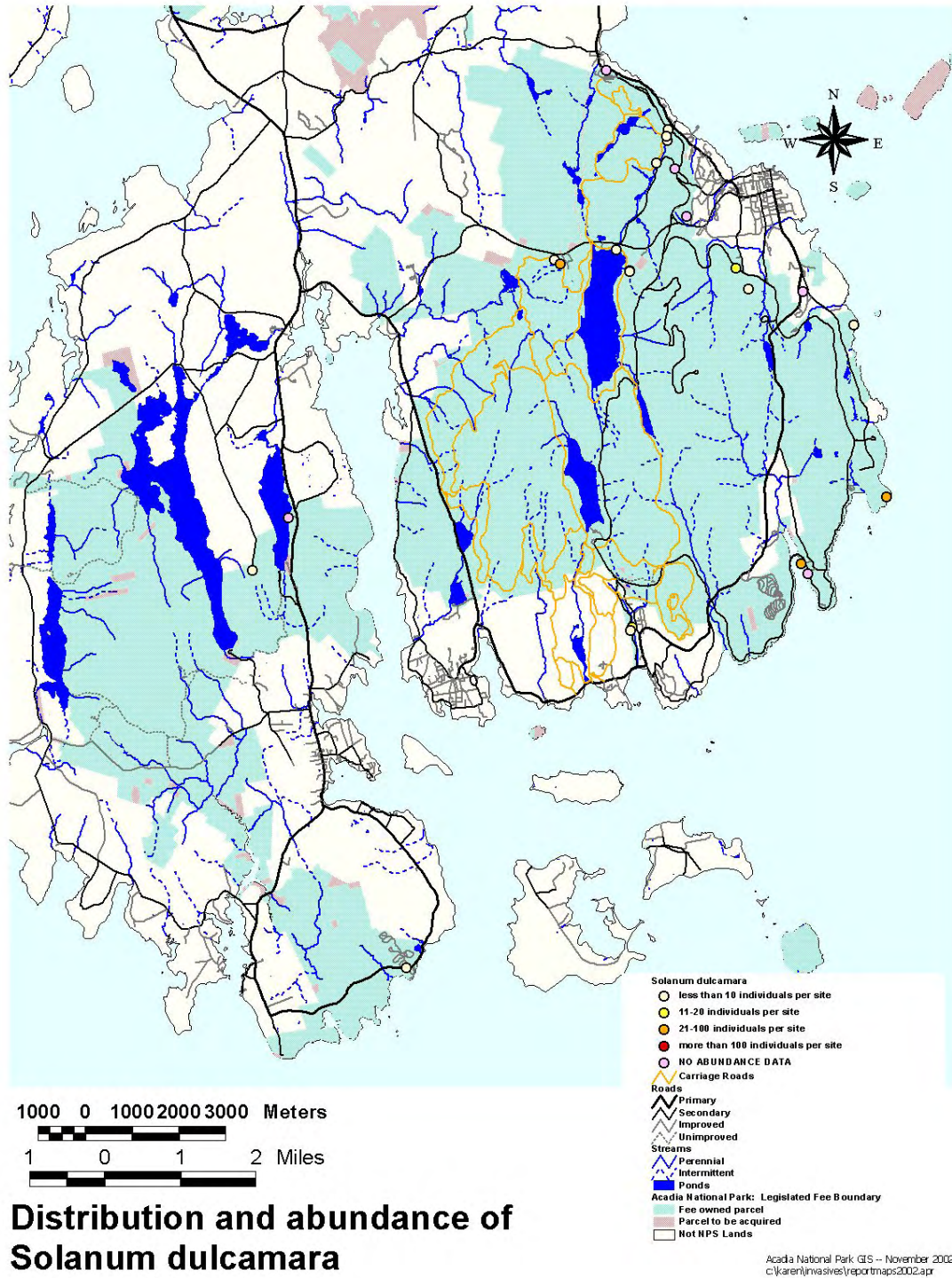
Taxon: **Bittersweet nightshade (*Solanum dulcamara*)**

Distribution: Bittersweet nightshade is distributed over the whole island and is likely much more common than this inventory reflects (Figure 26). Beaches and headlands were largely excluded from this inventory because previous work had shown that few invasives colonize them. They do, however, provide suitable habitat for bittersweet nightshade and, if time had been spent searching them, its distribution would likely have been shown to be much wider.

Abundance: As discussed above, if a large time commitment had been made to search for bittersweet nightshade, the resulting abundance estimate would doubtless have been higher. Twenty-three sites were documented for bittersweet nightshade by this inventory. Thirteen of the sites had ten or fewer plants, two had 11-20 plants and three had 11-21 plants. No plant counts were made at five of the sites.

Habitat: Bittersweet nightshade can grow in full sun, but the sites documented by this inventory usually have at least a partial canopy of green ash, red maple, yellow birch and northern white cedar (*Thuja occidentalis*). Speckled alder and winterberry grow in the shrub layer and wood bluegrass, sensitive fern, fowl mannagrass (*Glyceria striata*) and nodding and sallow sedges (*Carex gynandra*, *C. lurida*) occupy the herbaceous layer.

Figure 26. Distribution and abundance of bittersweet nightshade.



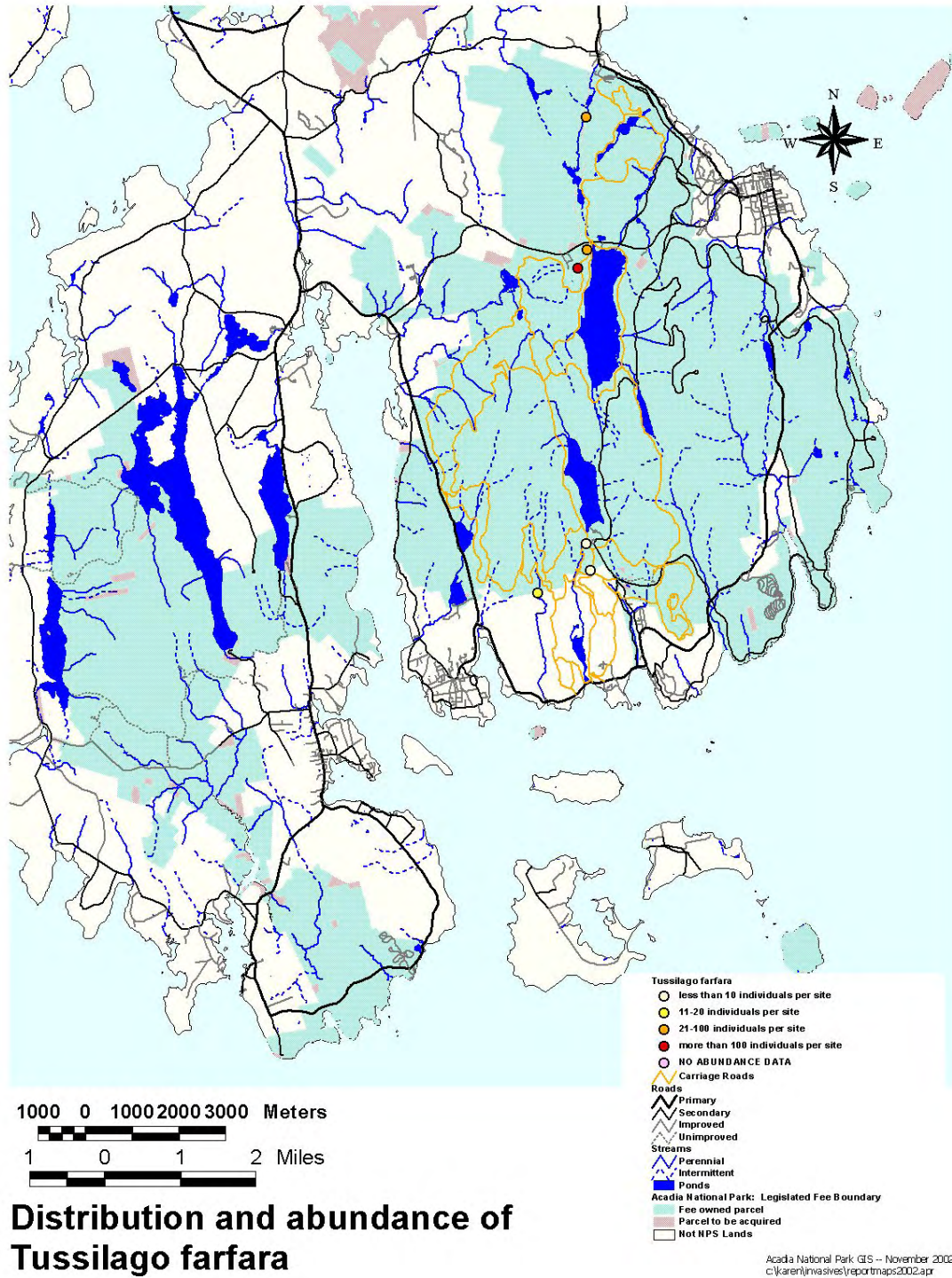
Taxon: **Coltsfoot (*Tussilago farfara*)**

Distribution: Coltsfoot occurs primarily on carriage road edges on the east side of MDI. It was also recorded from two streambeds (Figure 27).

Abundance: Five coltsfoot populations were documented. One population comprises ten or fewer plants, one has 11-20 plants, two have 21-100 plants and one has over 100 plants.

Habitat: At ACAD, coltsfoot grows in disturbed, sandy and gravelly areas, either along carriage roads or on gravel bars in streambeds. There is often a fairly dense canopy comprising red spruce, yellow birch, balsam fir and white pine. Shrub cover is minimal. Blackberry, nodding sedge, goldenrods, calico aster (*Symphyotrichum lateriflorum*), sweet vernal grass (*Anthoxanthum odoratum*) and common woodrush (*Luzula multiflora*) occur in the herb layer.

Figure 27. Distribution and abundance of coltsfoot.



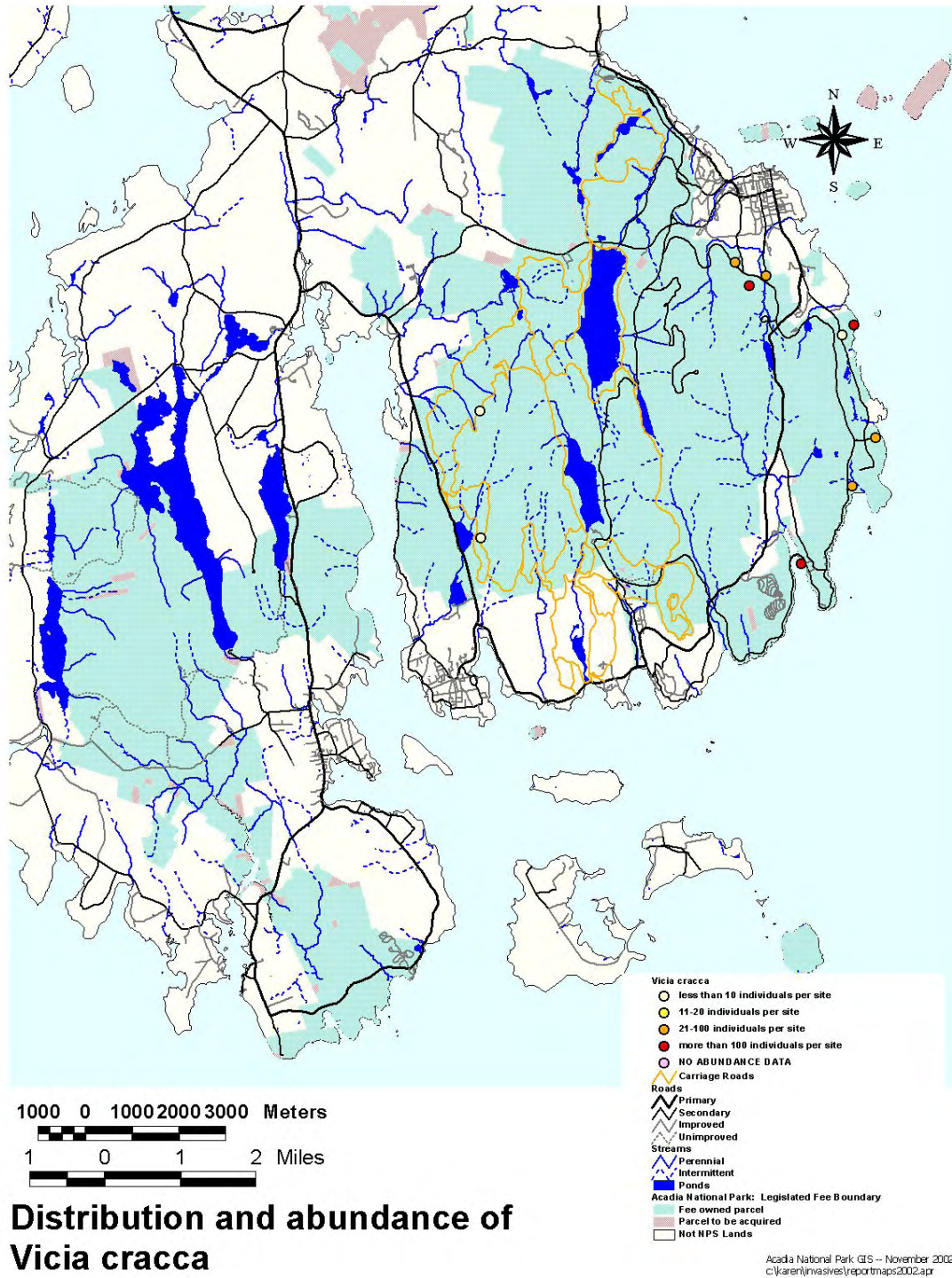
Taxon: **Cow vetch (*Vicia cracca*)**

Distribution: Cow vetch sites were not recorded at the start of this inventory. It was observed to be widely distributed in the park, and in some areas, to be impacting native vegetation. It is likely more widespread than the results suggest. This taxon is known to occur over the eastern half of MDI (Figure 28).

Abundance: Ten cow vetch sites were recorded. Three of them have 10 or fewer plants, four have 11-20 plants and three have more than 100 plants.

Habitat: At ACAD, cow vetch grows most frequently on sites disturbed by agriculture or road-building. Quaking aspen, white birch and green ash form a partial canopy. Quaking aspen, white pine, green ash, Morrow's honeysuckle and staghorn sumac (*Rhus hirta*) are components of the shrub layer and wood bluegrass, large-leaved aster, bracken fern, yellow king-devil and flat-topped white aster occur in the herb layer.

Figure 28. Distribution and abundance of cow vetch.



Summary

Table 4 summarizes the results presented above. The table shows the total number of points and the approximate number of plants documented by the distribution and abundance inventory for each species. The estimate for total number of plants was calculated by taking the midpoint of the abundance range for each site and totaling them to obtain a species total. For example, if the population estimate for a site were 21-100 plants, then 50 plants was used as the midpoint for that site. Table 4 also provides some relative distribution and abundance data over time. Rand and Redfield published a comprehensive flora of MDI in 1894, Wherry published another, less comprehensive report in 1928 and Fernald included distribution and abundance data pertinent to MDI in a 1950 manual. The table shows whether or not each inventoried species was listed in the manuals. Wherry did not address plant families that he considered too difficult for the layperson to discern; these species are indicated by three dashes in the “Wherry” column.

Abundance

There was a wide range in the number of sites documented for the inventoried species. Amur maple, Ottawa barberry, Japanese honeysuckle and moneywort were documented from one site each. European bittercress, winged euonymus, privet, multiflora rose and coltsfoot were observed from two to five sites. Garlic mustard, Norway maple, common barberry, Canada thistle, Japanese knotweed, black locust and cow vetch were documented from 10-20 sites. Oriental bittersweet, shrubby St. Johnswort, forest woodrush, ninebark and bittersweet nightshade were documented from 23-42 sites each. Alder-buckthorn and honeysuckle sp. were recorded from 76 and 94 sites, respectively. Japanese barberry was documented from 157 sites, 60% more sites than honeysuckle, which was second in number of sites.

The abundance results can also be viewed in terms of the number of plants of each invasive species present at ACAD. Total plants per species range from 1 to over 2000 (Table 4). Ottawa barberry, Japanese honeysuckle, Amur maple, moneywort, winged euonymus and multiflora rose are represented by relatively few occurrences, with few plants at each (Table 4). However, European bittercress, represented by only three documented sites, comprises a total population of about 2000 plants. Conversely, bittersweet

Table 4. Summary of distribution and abundance data ^a 1=most invasive, 4=least invasive, U=unranked

Scientific Name	# of Sites	Approx. # Plants	Rank (Reiner, 2002) ^a	Distribution in ACAD	Rand & Redfield (1894)	Wherry (1928)	Fernald (1950)
<i>Acer ginnala</i>	1	20	U	east side	no	no	escaping from ME to CT
<i>Acer platanoides</i>	17	400	3	east side	no	no	thriving in hedgerows & roadside thickets
<i>Alliaria petiolata</i>	12	1000	3	east/west	no	no	near houses Quebec to VA
<i>Berberis thunbergii</i> x <i>vulgaris</i>	1	1	U	east side	no	no	not mentioned
<i>Berberis thunbergii</i>	157	1300	2	parkwide!	no	yes	escapes from Nova Scotia south to NC
<i>Berberis vulgaris</i>	15	130	U	east/west	yes	yes	“abundantly naturalized” Nova Scotia to DE
<i>Cardamine impatiens</i>	3	2000	U	east side	no	no	southern NH to eastern PA
<i>Celastrus orbiculata</i>	42	1300	2	parkwide	no	no	NY to VA and southwest
<i>Cirsium arvense</i>	12	400	4	east side	no	no	ubiquitous
<i>Euonymus alatus</i>	2	50	U	east side	no	no	spreads from cultivation
<i>Fallopia japonica</i>	10	475	U	east side	no	---	“rapidly spreading and becoming obnoxious”
<i>Frangula alnus</i>	76	2100	2	Great Meadow	no	---	“recently and very rapidly spreading”
<i>Hypericum prolificum</i>	40	1000	U	Great Meadow	no	no	locally escaped in MA
<i>Ligustrum</i> sp.	2	150	U	east side	no	---	open woods southern ME to NC
<i>Lonicera japonica</i>	1	1	1	east side	no	no	FL to TX and north to MA
<i>Lonicera</i> sp.	94	1600	1	east/west	no	no	ME to NY and MI
<i>Luzula luzuloides</i>	24	1300	U	east side	no	---	Nova Scotia to Ontario and MI
<i>Lysimachia nummularia</i>	1	20	U	east side	no	no	New England to GA, MO and KS
<i>Physocarpus opulifolius</i>	36	1600	U	east side	no	yes	western NY to MN and CO
<i>Robinia pseudoacacia</i>	12	330	U	east side	yes	yes	native GA to PA; north to Nova Scotia
<i>Rosa multiflora</i>	2	55	2	east side	no	no	southern New England and southwest
<i>Solanum dulcamara</i>	23	250	3	east/west	yes	yes	northeastern US and Canada
<i>Tussilago farfara</i>	5	200	4	east side	no	no	Newfoundland south to PA
<i>Vicia cracca</i>	10	500	U	east side	yes	yes	throughout New England

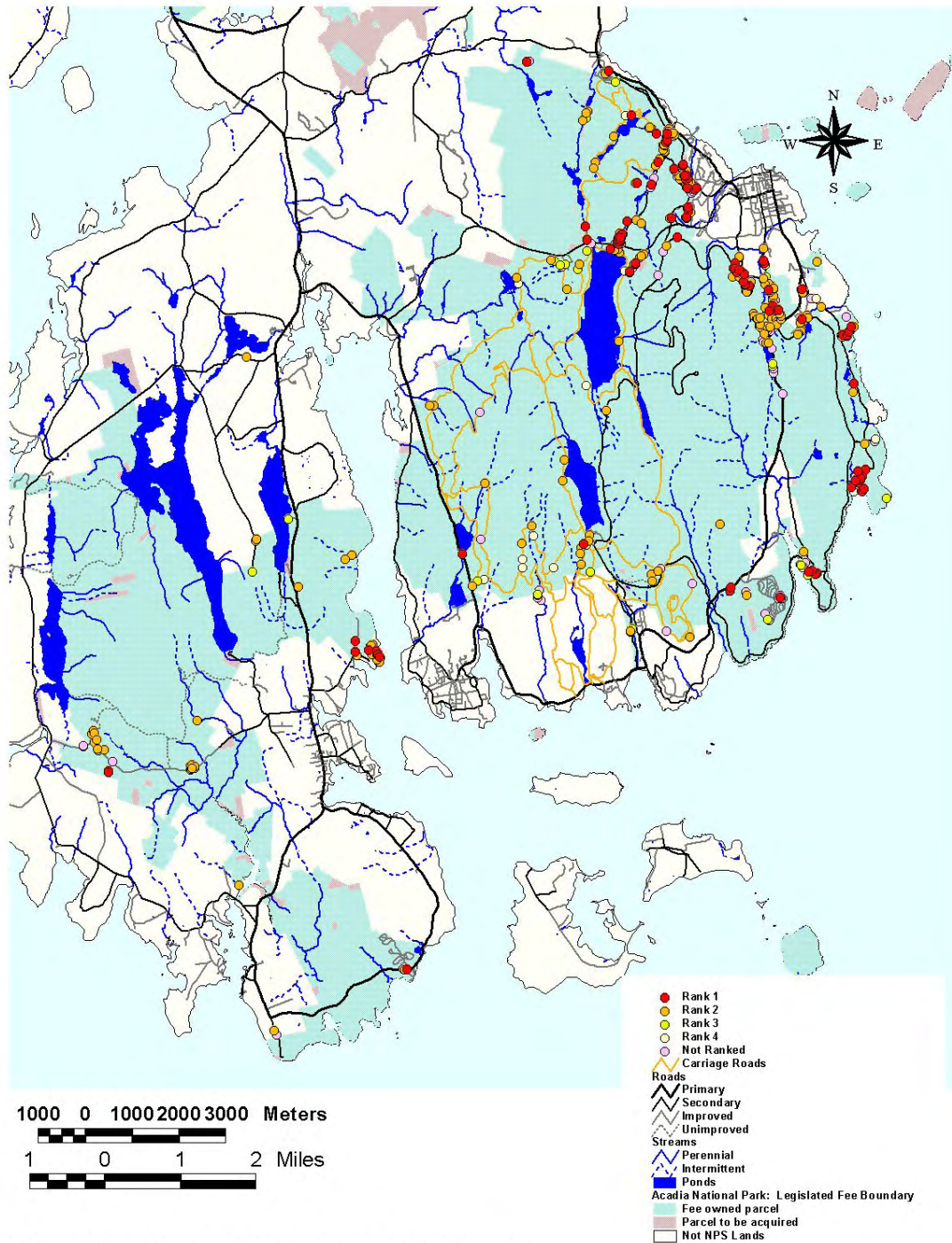
nightshade is known from 23 sites, yet the total number of plants is low, at about 250 (Table 4). Species estimated to have population sizes of at least 1000 plants at ACAD are: garlic mustard, shrubby St. Johnswort, Japanese barberry, Oriental bittersweet, forest woodrush, honeysuckle spp., ninebark, European bittercress and alder-buckthorn.

Distribution

Table 4 summarizes distribution data from the current study and indicates historic distribution, if known (distribution maps by species appear above in Figures 5-28). Of 24 taxa inventoried, only three were listed by Rand and Redfield in their 1894 publication: common barberry, black locust and cow vetch. At that time, common barberry was known from only three sites outside gardens: two in Southwest Harbor and one in Seal Harbor. The current inventory documented this species from Southwest Harbor and Seal Cove, on the west side of MDI, and more frequently around Bar Harbor, on the east side of MDI. Black locust was listed as having escaped to roadsides in Southwest Harbor, Somesville, Town Hill and Seal Harbor. Current black locust localities are concentrated in Bar Harbor. Rand and Redfield listed cow vetch as common in fields islandwide, however, current sites are primarily on the east side. When he published his wildflower book 34 years later, Wherry (1928) reported Japanese barberry as occurring occasionally islandwide. The current inventory documented Japanese barberry from 157 locations across MDI. In 1950, Fernald published a flora which covered the northeastern US and adjacent Canada, including the MDI region. Of all the taxa included in the ACAD inventory, Ottawa barberry is the only one not mentioned by Fernald. He reported several species as escaping regionwide: Amur maple, Norway maple, garlic mustard, common and Japanese barberries, Canada thistle, winged euonymus, Japanese knotweed, alder-buckthorn, honeysuckle sp., forest woodrush, moneywort, black locust, bittersweet nightshade, coltsfoot and cow vetch. Fernald noted that European bittercress, Oriental bittersweet, shrubby St. Johnswort, privet, Japanese honeysuckle, ninebark and multiflora rose had not been recorded as escaping from cultivation in Maine.

Extant invasive plant species locations in ACAD are concentrated on the east side of MDI. Figure 29 shows sites documented by the distribution and abundance inventory, with sites coded by the ranks assigned by Reiner and McLendon (2002). Many of the 598 locations cannot be discerned at this scale because they are as little as 10 meters apart, but the concentration of

Figure 29. Summary map showing all sites documented during distribution and abundance inventory.



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dots makes a few locations stand out as centers of invasive plant distribution. The area with the greatest number of species, the greatest concentration of occurrences and the largest number of plants per occurrence extends from the ACAD boundary, on the southern edge of Bar Harbor to Great Meadow and Sieur de Monts Spring. Another cluster of invasives occurs along Duck Brook, from the outlet of Eagle Lake all the way to its confluence with Frenchman Bay (Figure 29). Smaller concentrations also are apparent in places where large estates were located prior to the 1947 fire: northeast of downtown Bar Harbor and along the eastern shore, south of Bar Harbor.

There are two main areas where invasive plant species are concentrated on the west side of MDI. One is located on fee and easement lands on Fernald Point, in Southwest Harbor (Figure 29). Settlement has been almost continuous since 1613, when Jesuit priests established an encampment there (McLane, 1985) and the presence of invasives likely is the result of long-term human disturbance and non-native plant introduction. Similarly, the other cluster of invasives on the west side of MDI is associated with a string of old farms located in Tremont along the Seal Cove Road.

Conclusions

- Japanese barberry is the most widely distributed taxon studied and the one for which the most sites were documented.
- Japanese barberry colonizes natural areas, as well as the disturbed sites where it would be expected.
- European bittercress, shrubby St. Johnswort, forest woodrush and ninebark were not ranked by Reiner and McLendon, but have populations of at least 1000 plants in ACAD.
- Wood bluegrass (*Poa nemoralis*), not previously considered a problematic invasive plant at ACAD, is a dominant species associated with 16 of the 24 taxa inventoried.
- Multiflora rose, considered very invasive (ranked 2 by Reiner and McLendon) was documented at only two sites in ACAD.
- The results of the current inventory suggest invasives should be managed by site rather than species (i.e. management should be concentrated around places like Great Meadow, where there are many occurrences of invasives).

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