

Assateague Island National Seashore
Exotic Species Management,
1999-2002

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April 2003

ABSTRACT

A program to manage invasive exotic species began in 1999 with the discovery of Asiatic Sand sedge (*Carex kobomugi*) on Assateague Island National Seashore (ASIS). To date, Asiatic sand sedge, Tree-of-Heaven (*Ailanthus altissima*), and Purple Loosestrife (*Lythrum salicaria*), have been targeted for management action on ASIS. Additionally, ASIS personnel are also aware of the presence of other invasive exotics not currently targeted for management, including *Rosa multiflora*, *Lonicera japonica*, *Eragrostis curvula*, and *Clematis terniflora*. The current status of these species will be intermittently assessed for the threat they pose to native plant communities in order to determine if any change in management action is recommendable. Presented in this report is information regarding the specific invasive exotics of concern, their documented population locations, growth habits, threat potential, monitoring programs, treatment recommendations and actions, where applicable.

INTRODUCTION

Assateague's unique barrier island vegetative communities are often affected by tides, strong winds, intense heat, salt spray, storm overwash, and human disturbance. The harsh saline and xeric environments present on ASIS inhibit the establishment of many exotic plant species that grow extensively on the mainland (Lea, pers. comm.). Stunted or dwarfed growing habits, along with flagging from high winds and salt spray, are examples of effects caused by growing in these difficult seaside habitats. While barrier island habitats can limit the negative effects of many invasive exotics that are problematic in mainland environments, some invasive species have prospered under the typically unfavorable growing conditions present on ASIS.

The National Park Service defines an exotic species as one that occurs in a given place as a result of direct or indirect, deliberate, or accidental actions of humans. Furthermore, an invasive species is defined as:

- 1.) Non-native (alien) to the ecosystem under consideration and
- 2.) One whose introduction causes or is likely to cause economic or environmental harm or harm to human health (Executive Order 13112, 1999).

Exotic plant invasions can occur naturally via seed dispersal by wind, water, or wildlife. Additionally, they can be accidentally established in areas where there has been human disturbance. On ASIS, these human disturbed areas include current and old roadways, developed campgrounds, previous private camp leaseholdings, former primary dune areas and spoil piles where sand and sediment were deposited from dredging activities. Once established, some invasive exotics reproduce vegetatively and/or produce extensive underground root systems that can make control measures difficult once they become established. Due to the ease with which some invasive exotics colonize, they can soon become problematic and require management action.

Invasive exotic plants can reduce biodiversity by displacing or out-competing native plants, which in turn may degrade habitat for wildlife, and often disrupting natural ecosystem processes (Heffernan, 1998). Legislation specific to ASIS (Public Law 94-578) directs the Secretary of Interior to plan "measures for the full protection and management of the natural resources and natural ecosystems of the seashore." Certain exotic species have extremely disruptive impacts on native ecosystems (National Park Service, 1991);

therefore, management of such species, where feasible, will further fundamental purposes of the National Seashore.

CURRENT MANAGEMENT APPROACHES

The three steps necessary to make any exotic species management program successful are: assessment, treatment, and monitoring. Assessment includes the initial field reconnaissance and development of strategic plans for management. The National Park Service issues a Handbook for Ranking Exotic Plants for Management and Control (Hiebert and Stubbendieck 1993). This manual states that managers must weigh the cost (equipment, chemicals, manpower) of implementing a program for a particular exotic species against the impact this species has or may have on the park's ecosystem. Therefore, higher priority should be given to controlling and managing species that have high impacts on park resources and are also thought to be relatively easy to control.

In the planning stages, it is important to note that all exotic invasive management should be approached in a species-specific manner. Factors such as population abundance, means of dispersal, competitive ability, and visual impact need to be assessed for each species (Hiebert and Stubbendieck 1993). Treatment involves applying a chosen management program because the requirements of species differ greatly. Aspects of each individual species' biology and ecology must be considered.

After the treatment of an exotic invasive, monitoring is required to assess the success or failure of the control method implemented. The completed monitoring information is then used to reassess management objectives.

Currently, Asiatic sand sedge (*Carex kobomugi*), Tree-of-Heaven (*Ailanthus altissima*) and Purple Loosestrife (*Lythrum salicaria*), are actively targeted for management by ASIS resource management personnel. Table 1 summarizes all treatments for these species at ASIS from 1999-2002 and table 3 documents all herbicide use for the years 1999-2002.

All of the locations for the invasive exotic species mentioned in this report were recorded by real-time global positioning system (GPS). All species listed in this report are vouchered in the ASIS herbarium. Specific descriptions of individual exotic invasive species currently growing on Assateague Island National Seashore are as follows:

ASIATIC SAND SEDGE (*Carex kobomugi*)

Asiatic sand sedge, hereafter referred to as CaKo, is a native perennial sedge of East Asia. This exotic invasive is identified by its triangular stem and yellow-green leaves. These leaves have tiny serrations that can be felt along the leaf margins. It reproduces vegetatively and forms colonies through strong rhizomes capable of sending up new plants if roots are not entirely removed. CaKo fruits and flowers from April through June.

CaKo was introduced into the United States for its sand-stabilizing capabilities. Planted in coastal sands from Massachusetts to Virginia during the 1930s, this clonal species colonizes fore dunes, a niche otherwise occupied by native beach grass (*Ammophila breviligulata*) (Small, 1954). Due to its smaller stature (less than a foot), CaKo doesn't have the strong dune-stabilizing capabilities possessed by the native beach grass.

This can create a weakened dune system, which in turn can disrupt the natural process of dune formation and island protection (Small, 1954). Also, dunes dominated by CaKo are less species-rich than dunes where natives dominate (Small, 1954).

On ASIS, CaKo poses a competitive threat to the federally listed threatened species, seabeach amaranth (*Amaranthus pumilus*) (Lea and King, 2001). In several cases, these two species were found thriving adjacent to each other in low-lying dunes. The threat of Asiatic sand sedge out-competing seabeach amaranth makes it a high priority for eradication on ASIS.

ASIS Ecologist Chris Lea first discovered CaKo on Assateague Island in 1999 at multiple locations. Currently, all known locations are treated and they will continue to be monitored. In 2001, three colonies were also found in Virginia on Tom's Hook, which is part of the Chincoteague National Wildlife Refuge and is managed by the U.S. Fish and Wildlife Service. See Figure 1.

Management

Methods for the removal of CaKo on ASIS are: foliar application of glyphosate herbicide (2% Roundup™) with a pump sprayer and/or hand digging. Typically, herbicide has been used to destroy large colonies (>5 ramets) and hand digging to remove small (<5 ramets) colonies. Safety precautions are always taken in the preparation and application of herbicide. During treatment, any pieces of root not removed has the capacity to resprout, therefore care is given to remove the entire root system when hand digging. Herbicide use from 1999-2002 is presented in Table 3.

All known colonies of CaKo on ASIS in Maryland were monitored and treated between 1999 and 2002 (see Table 1). An experiment was set up in August of 2000 to determine the most effective foliar herbicide application for CaKo and its methodology is described on the following page (McIntyre, et al 2001). From this research we have been able to develop an effective treatment strategy for decreasing and ultimately erradicating CaKo colonies on the island.

Herbicide Treatment Research on Asiatic Sand Sedge

In 2000, three different herbicide treatment regimes were tested for their effectiveness at reducing the number of ramets of CaKo. Three of the larger colonies of this species, which correspond to sites CaKo 16, CaKo 20, and CaKo 27 in Figure 1 and Table 1, were chosen for this experiment. These colonies had formed small dunes and had been previously treated in 1999 without great success (possibly due to the timing of the application).

Each colony was subdivided into three experimental blocks, each having approximately equal numbers of ramets and each block received a different treatment. The three treatments were: (1) summer herbicide treatment (2) fall herbicide treatment (3) summer and fall herbicide treatment. Each colony was assigned a treatment by alternating east, central, or west block locations between sites in order to avoid possible confounding effects of dune position, see figure 2. Ramets were counted in each block before the application of 2% glyphosate, and early in the growing season following treatments. No control blocks were employed. It was assumed that glyphosate was the main cause of shoot mortality and that untreated colonies would either remain stable or grow in shoot number under no treatment.

The results of this experiment are shown in table 2. All three treatments were effective, but treatment during summer was more successful than treatment during fall, and as effective as the summer/fall treatment.

Annual monitoring of known CaKo sites, in conjunction with other field season activities, will continue in order to identify populations before they can spread and become problematic.

TREE-OF-HEAVEN (*Ailanthus altissima*)

Tree-of-heaven (AiAl), hereafter referred to as *Ailanthus*, is native to central China. It can be identified by its large compound leaves (1-4 ft in length) with lanceolate leaflets that may exhibit one to three serrations toward the base. The leaves, when crushed, give off a strong distinct odor. Large flower panicles are produced in late spring and, due to the prolific nature of this species, can result in a great abundance of seed in late summer and early fall.

In 1784, a gardener first brought *Ailanthus* to the United States, where it became a popular tree for landscaping in cities during the 1800's (Hoshovsky, 1988). Because of its popularity, hardiness in poor soils and ability to tolerate urban pollutants, *Ailanthus* quickly became naturalized across the nation.

As a pioneer species, *Ailanthus* is often found in areas with a history of disturbance. As a prolific seed producer, it is believed that one tree can produce as many as 350,000 seeds per year. These seeds are easily dispersed by wind or water due to its papery winged samara form. Once established, *Ailanthus* grows quickly, and not only out-competes native plant species for sunlight and growing space, but also releases toxins into the soil which prevent the establishment of other species (Swearingen and Pannil, 1999). Dr. Steven Hill (1986) first recorded *Ailanthus* on Assateague Island in 1984. Two populations of *Ailanthus* are known to exist, both in disturbance-prone areas; see Figure 1 (AiAl 1 and 2 are considered to be one

population). The southern population, in the area of Valentine's cabin, is close to an administrative road, making it possible for vehicular seed dispersal. The second, smaller population is found on the North End of the island, approximately 50 meters south of the Ocean City inlet.

Management

Since 2000, *Ailanthus* has been managed by both chemical and physical treatments. Larger trees were treated by girdling, or cutting through the cambium layer around the entire circumference of the trunk. Saplings were broken off after which the exposed xylem of the remnant stems were immediately hand sprayed with .7% triclopyr triethylamine (Brush-Be-Gone™). Smaller *Ailanthus*, such as seedlings and smaller root suckers, were hand pulled.

In October 2000, AiAl 3 consisted of 25 saplings and 40 seedlings/root sprouts. It was hoped that the shade cast by the residual canopy cover, consisting of native tree and vine species, would retard regrowth by any stems not killed by herbicide. However, in 2001, there was a total of 314 stems, with 248 seedlings or sucker sprouts, and 66 saplings. The trunks that were girdled appeared to be dead since they had a barren canopy, however, sucker sprouts were present in several places at the base of the girdled tree trunk. Furthermore, the new opening in the forest canopy, due to the girdled trees, allowed for the growth of smaller *Ailanthus* and possibly triggered the seed bank to begin invading the area.

On October 22, 2001, AiAl 3 and the 3 stems found on the North End (AiAl 1 and 2) were treated as in 2000. This year, however, to increase likelihood of success after herbicide application, para-film was stretched over the treated stump and held in place using a rubber band to ensure that rain would not wash the newly applied herbicide off and onto surrounding vegetation. Also, a large portion of an *Ailanthus* stump containing root suckers at AiAl 2, was cut off with a handsaw, and .7% triclopyr triethylamine was reapplied and two smaller trees at AiAl 1 were treated in the same manner.

Monitoring in 2002 revealed that the previous year's treatments had greatly reduced the number of stems in the southern site, while numbers increased from 3 to over 30 stems in the North End population; see Figure 3. It should be noted that due to the close proximity of sites AiAl 1 and 2, they were consolidated in 2002 and became AiAl 2.

Since *Ailanthus* is a prolific seed producer and also creates abundant root sprouts when cut, continued monitoring and treatment will be necessary to thoroughly kill off the root systems of the larger cut trees and deplete the seed bank. Monitoring and treatment of *Ailanthus* (physical and chemical) will continue and if necessary, treatment frequency per growing season will be increased.

PURPLE LOOSESTRIFE (*Lythrum salicaria*)

Purple loosestrife, a native of Eurasia, is most easily identified by its bright magenta flower spike, square woody stem, and opposite or whorled lanceolate leaves. This highly invasive exotic can regenerate from pieces of rootstock and spread vegetatively to form dense homogenous stands. Purple loosestrife is widely distributed due to its heavy seed set, producing as many as 300,000 seeds on a single stalk (Hamilton, 2001).

This species was introduced into the northeastern part of the United States and Canada in the early 1800's for ornamental and medicinal purposes (Swearingen 1997). Because purple loosestrife prefers wetland habitats and disturbed areas subject to drainage, drawdown, ditching, and siltation, ASIS is a likely target for

infestation (Bender and Randall, 2001).

The Chesapeake Bay Program's Invasive Species Workshop listed purple loosestrife as one of the top six most damaging invasives in the Bay area. Monospecific stands of the species crowd out native wetland species such as cattails, grasses, sedges, and rushes which provide better habitat for wildlife. Purple loosestrife seed banks are often large and due to high seed viability, many years of treatment are necessary to deplete the seed supply.

Purple loosestrife was first found on Assateague Island at Oceanside Campground in August 2000 by Christian Diehm, a campground office volunteer. This population consisted of 6 stems and was located in a wet depression under a groundsel tree (*Baccharis halimifolia*) east of the wooden fence along the second of three camper parking lots, see figure 1.

Management

In August of 2000, immediate action was taken to deter further growth of the species. The flowering heads of the plants were cut and sealed in a plastic bag. The stems were then spot treated with glyphosate. No plants were found at this site in the summer of 2001. During 2002 monitoring of this site led to the discovery of 5 stems late in September. These stems had been previously observed as new growth, but were not identified as being purple loosestrife until they had already flowered and produced seed. The 5 (2002) stems were carefully hand dug and bagged in the manner previously described.

Depending on the size and developmental stage of a given population, the method of removal and treatment will be hand-pulling and spot application of glyphosate. This species is capable of reproducing from its stem or root segments, therefore care must be taken when removing the plant from the site. All hand pulled plants will be bagged on site so that fragments are not dropped during transport. As with all exotics, early detection is the most effective means of controlling a severe invasion, therefore in the future monitoring will occur more frequently. Also a notice will be posted in ASIS campgrounds during summer months in an attempt to detect the presence of purple loosestrife plants early, before they set seed.

COMMON REED (*Phragmites australis*)

Phragmites, or Common Reed, is a tall (3 to 13 feet) perennial grass that thrives in sun-rich wetland habitats, especially in disturbed wet areas. Its stems are tough, bamboo-like and produce dense purple-brown plumes in late June. This invasive species spreads primarily by means of its rhizomes or rhizome fragments. The Virginia Department of Conservation and Recreation states that invasive stands of *Phragmites* eliminate diverse wetland communities, and provide little food or shelter for wildlife (1997).

Phragmites is found on every continent except Antarctica and is said to have possibly the widest distribution of any flowering plant (Benton et al, 1998; Tucker, 1990). It is debatable whether or not *Phragmites* is truly an exotic species since there are two sources that date its existence on this continent as early as 900A.D. (Benton et al, 1998; Kane & Gross 1986; Breternitz et al. 1986). According to the Virginia Department of Conservation and Recreation, it is suspected that a non-native, more aggressive strain of this species was introduced in the early 20th century. It is believed that this strain is now manifesting itself into one of the most damaging invasives currently populating the Chesapeake Bay watershed (Chesapeake Bay Program, 2001).

Whether indigenous or not to Assateague Island, there is little doubt that the species is invasive, can alter ecosystem functions, and reduce biological diversity (Hudson 2000). Populations can increase dramatically, forming large monospecific stands which threaten native and rare wetland plant species. *Phragmites* has been listed as one of the top six highest priority invasives in the Bay area by the Maryland Department of Natural Resources.

Although there is no data by which to draw firm conclusions, anecdotal observations suggest that *Phragmites* has been and will continue to increase on Assateague (Hudson 2000). Hudson states, “its abundance and distribution throughout the island ensure that any general reduction and/or eradication efforts that would restore ecosystem function would require considerable effort, with little guarantee of sustained success. Unfortunately, control of this species is expensive, labor-intensive, and necessarily long-term, therefore a feasible management program at ASIS is not currently under consideration. Beyond the feasibility of managing a species such as *Phragmites*, it may also be worth noting that the impact of removal and/or control can create high levels of habitat disturbance, leaving treated areas susceptible to further invasion by exotic species (Hiebert and Stubbendieck 1993; Westman 1990).

ASIS started a monitoring program in 1984 for small stands of *Phragmites* located within the Chincoteague and Sinepuxent Bays. This project was eventually terminated due to the lack of funds and other projects that were deemed of higher priority. Currently, *Phragmites* is only managed at ASIS on a very localized scale, where it is cut back by interpretive staff near trails and park facilities (Lea 2000). No further management of this species is presently being considered.

JAPANESE HONEYSUCKLE (*Lonicera japonica*)

Japanese honeysuckle is a perennial woody vine native to east Asia. At ASIS, Japanese honeysuckle retains its leaves throughout the year. It's opposite, ovate leaves are always on short petioles, which make it distinguishable from native honeysuckles whose uppermost leaves are fused. The exotic invasive honeysuckle produces long white to yellow tubular flowers from late April to August and black seeds from September through November.

Japanese honeysuckle was introduced to the U.S. in the 1800s for horticultural uses. It has since spread and become a pest from the Gulf of Mexico to Massachusetts, as well as Hawaii and California. This vine can girdle and engulf small trees or shrubs and out compete native plants for light or soil resources. Due to its evergreen nature, it may also inhibit germination and growth of annuals, seedlings, and understory plants that depend on available light prior to the leafing out of deciduous trees and shrubs (Nuzzo, 1997).

Japanese honeysuckle prefers full sun and develops dense mats in young forests, although it is shade and drought tolerant and can grow in a wide variety of habitats (Leatherman, 1955; Nuzzo, 1997). It reproduces vegetatively and by seed, although this plant is less likely to set seed in shaded conditions. The vines are capable of rooting where nodes come in contact with soil and rhizomes create strong, extensive root systems.

The Plant Conservation Association recommends the use of a foliar herbicide such as 2.5% glyphosate or 2% triclopyr mixed with water during the spring or late fall when other native species are dormant. Additionally, they recommend the cutting and removal of vines from trees and shrubs to prevent girdling and additional herbicide can be sprayed on cut stems (Bravo, 2003).

In 1986, Hill first listed Japanese honeysuckle as infrequent on ASIS, but apparently established and increasing (Hill 1986). During an brief exotics survey in the ASIS developed area in April 2003 Japanese honeysuckle was found to be abundant and growing in many locations over low-lying vegetation along roadsides and parking areas, see figure 1. The distribution and abundance of this species will be surveyed in 2003 after which ASIS will assess its management needs.

WEeping LOVEGRASS (*Eragrostis curvula*)

Weeping lovegrass, a native clump forming grass of Africa, is a vigorous growing perennial of 2 to 6 feet. It has an extensive root system with numerous slender shoots and long narrow leaves that curve downward to give this grass its characteristic “weeping” appearance (Shoop and McIlvain, date unknown). Flowering occurs in June and July when open panicles from 8 to 10 inches can be seen.

Weeping lovegrass was brought to the United States in 1927 by the Department of Agriculture for use in soil control. It was used in the USDA’s Soil Bank program (1950s) and Crop Reserve Program (1980s and 1990s) and continues to be used throughout the south and as far north as New Jersey for erosion control and in forage production for livestock (Shoop and McIlvain, date unknown).

Virginia Department of Conservation and Recreation lists weeping lovegrass as an invasive alien species that threatens the crowding out of other native grasses as a result of its aggressive nature and characteristic rapid early growth (1999). The roots of weeping lovegrass can reach out at least 3 feet and fill all of the soil surface between plants, making effective use of little rain and preventing other plants from establishing (Shoop and McIlvain, date unknown).

This species was listed as “rare on Assateague,...seen only at North Beach parking lot,” by Hill (1984) during his surveys in the mid 1980s. Today, it is abundant along roadsides throughout the ASIS developed area. Specific locations weeping lovegrass have been noted in the following areas: along Bayberry Drive, at the entrance to Assateague State Park, on the western edge of Bayside campsite #48, on the periphery of the North Beach parking lot, in Ocean Side campground sites #1-41, and along the northern side of the Boat House parking lot. To date, ASIS has not monitored this species nor planned any management action to control its spread to other parts of the island.

Given weeping lovegrass’ drought tolerance, and preference for well drained, sandy soils and considering its apparent expansion on ASIS since the mid 1980’s it is likely that weeping lovegrass will pose a problem for ASIS in the future. Therefore, initially we will monitor its encroachment into new areas, especially areas south of Assateague’s developed zone. This will enable ASIS resource managers to determine weeping lovegrass’ current range and habitat affiliations, and from there assess the need for and feasibility of further management action.

MULTIFLORA ROSE (*Rosa multiflora*)

Multiflora rose is a highly invasive exotic native to Japan, Korea, and eastern China. It is a thorny perennial shrub and can be identified by fringed stipules at the base of each compound leaf. White to pinkish white flowers appear in May and June and rose hips tend to persist year round. Terminal ends of Multiflora rose canes can root when in contact with soil and lead to the formation of dense, impenetrable thickets. Birds eat

and disperse the seeds which can remain viable for up to 20 years (Virginia Department of Conservation and Recreation, 1999).

Multiflora Rose was introduced to the East Coast from Japan in 1886 as a rootstock for ornamental roses (Eckardt and Martin, 2001) and later utilized by the U.S. Soil Conservation Service in the 1930s for erosion control and natural fencing for livestock (Bergmann and Swearingen, 1997). It has the ability to tolerate varying light and moisture levels, as well as poor quality soils, and is now widely distributed across the U.S. Multiflora rose not only has the ability to choke out native plants with its formation of dense thickets, but also has been studied for its affects on soil nutrient depletion (Eckhardt and Martin, 2001).

Currently, no management program exists to monitor and control the presence of multiflora rose. Hill (1984) first documented its presence on Assateague in the mid-1980s. Apparently, only one plant was known to exist at that time, although common throughout the mainland in Maryland. Hill's herbarium voucher documents the population as being, "Rare on Assateague, only one plant seen in State Park near S end along road... a troublesome weed that crowds out the native vegetation". He underscores, "This plant should, if possible, be eliminated before it can spread, as it has the potential to become a serious problem on the island." (Hill, 1984).

As with the other species mentioned in this report, the known locations of multiflora rose were taken with GPS in April 2003, see figure 1. These locations included the following, in the circle at the end of Bayberry Road, within the Bayberry campground area, and at the entrance to the Life of the Marsh Trail (see Figure 1). The degree to which multiflora rose currently threatens Assateague's native habitats is unknown, therefore its distribution and abundance of will be monitored during as general island survey in 2003, after which ASIS will assess any possible need for management action.

YAM-LEAFED CLEMATIS/JAPANESE VIRGIN'S BOWER (*Clematis terniflora*)

This climbing vine is a native of Japan. Depending on the source, this species is considered anywhere from naturalized, occasional or non-invasive to strongly invasive and potentially damaging to natural areas. Planted as an ornamental, it has escaped into the wild where it often covers native shrubs. Large panicles of white flowers form from late August to October, and this profuse bloom typically covers the foliage (MOBOT 2002).

A single population of *Clematis terniflora* was discovered in September 1998 on the northwest side of the Bayside Campground bay access parking lot. This population covered roughly 100 square meters and did not appear to be expanding as of 2000, when it was last monitored. Because this clematis species is able to form dense, tangled thickets over native vegetation, its distribution and abundance will continue to be monitored.

ADDITIONAL INVASIVES

The following is a list of other exotic species that are potentially invasive and known to have been found on ASIS between 1984 and 2002. The Virginia Department of Conservation and Recreation lists most of these species as being only moderately to occasionally invasive (2002). While the abundances and distributions of these species on ASIS are not known at this time, these species are not presently considered for management action. However, in other areas some these species have been known to be highly invasive and ASIS resource managers be on the lookout for signs if their increased abundance on the island.

This list was compiled from information made available by the Virginia Department of Conservation and Recreation, Virginia Native Plant Society, Maryland Department of Natural Resources, and Steven Hill's Annotated Checklist of the Vascular Flora of ASIS (1986).

<i>Albizia julibrissin</i>	Mimosa	
<i>Allium vineale</i>	Wild Onion	
<i>Artemisia vulgaris</i>	Mugwort	
<i>Bidens polylepis</i>	Long-bracted Beggar-ticks	*
<i>Centaurea maculosa</i>	Spotted Knapweed	*
<i>Cirsium Vulgare</i>	Bull Thistle	
<i>Commelina communis</i>	Common Dayflower	
<i>Dactylis glomerata</i>	Orchard Grass	
<i>Ipomoea hederacea</i>	Ivy-leaved Morning Glory	
<i>Lespedeza cuneata</i>	Chinese Lespedeza	*
<i>Lonicera japonica</i>	Japanese Honeysuckle	*
<i>Melilotus alba</i>	White Sweet Clover	*
<i>Melilotus officinalis</i>	Yellow Sweet Clover	*
<i>Morus alba</i>	White Mulberry	
<i>Pinus thunbergii</i>	Black Pine	
<i>Poa compressa</i>	Canada Bluegrass	
<i>Rumex acetosella</i>	Red Sorrel	
<i>Stellaria media</i>	Common Chickweed	

* Listed by the Virginia Department of Conservation and Recreation as being a "Highly Invasive Species", or by the Maryland Department of Resources as a species that "may become a threat to native species and communities".

FUTURE NEEDS

At their current population levels, Asiatic sand sedge, *Ailanthus*, and purple loosestrife will continue to be actively managed by ASIS resource management. Monitoring and spot treatment of Asiatic sand sedge will require one summer herbicide application applied to recurrences of the species, followed by spot checks in late summer/early fall. *Ailanthus* sites will be visited twice during the growing season to dig up and spot treat new seedlings and root sprouts. The purple loosestrife site will be monitored regularly and treated as necessary. Limiting the population levels of these three invasive exotics is ASIS's best defense against serious future infestations.

ASIS has undergone two surveys of vascular flora by E. Higgins (1971) and S. Hill (1984) and continued monitoring of ASIS's vascular plant communities will assist in identifying the presence of new invasive exotic species not yet known to occur. Therefore, during May 2003, a search of the Maryland end of Assateague will be conducted to evaluate all known invasive exotics on the island and, perhaps, alert staff of undiscovered invasive exotics and/or threatened and rare plant species. Small populations of exotics species that are encountered may be treated promptly when it is determined that their immediate removal will outweigh the potential cost of delay.

A management approach similar to that of *Ailanthus* may be most effective in controlling other exotic invasive species. For example, frequent cutting back of individual plants and application of glyphosate to cut stumps late in the growing season is recommended by the PCA Alien Plant Working Group for the control of multiflora rose (Swearingen and Pannill, 1999). A similar treatment of cutting back vines in winter and allowing them to wither then later applying 2% glyphosate to new growth is recommended by the Nature Conservancy to combat *Clematis* species (2001).

The survey mentioned above will allow ASIS personnel to determine the current range of weeping lovegrass so future population expansion can be monitored. Because this population is more widely distributed, management and/or removal of weeping lovegrass would be considerably more costly in terms of personnel, time, and herbicide use. Also, large scale herbicide application may pose a threat to ASIS wildlife. Given these and other issues of concern, (public safety, park appearance after treatment, etc.) prior to any large scale treatment of this species, a management action plan would need to be developed. With this understood, due to its clumping habit, herbicide application would be restricted to small patches rather than needing to be sprayed over an entire region. The foliar application of glyphosate to new spring growth before flower formation is recommended by Virginia's Department of Conservation and Recreation as an effective method of control (1999).

ACKNOWLEDGEMENTS

Monitoring and removal efforts were done by Helen Hamilton, Shanna Ramsey, Rebecca Anderson, Shanda King, Brandie Hosier, Bill Hertl (NPS). Assisting in search efforts were Mike Hill, Karen Burns, Deborah Kreiser, Dave Horner, Chris Overbaugh, Sarah Muffelman, Christian Diehm(NPS), Wayne Tyndall, Tim Larney (MDNR), Irv Ailes, Kendra Willet (FWS), MDNR volunteers, and seasonal FWS personnel in Chincoteague National Wildlife Refuge.

LITERATURE CITED

- Bender, J and Jay Randall, update 2001. Element Stewardship Abstract for *Lythrum salicaria*: Purple loosestrife. The Nature Conservancy, Arlington, VA.
- Benton, Nancy, Gary Bell, and Jil M. Swearingen, 1998. Common Reed fact sheet. The Plant Conservation Alliance Alien Plant Working Group (www.nps.gov/plants/alien).
- Bergmann, Carole, and Jil M. Swearingen, 1997. Multiflora Rose fact sheet. The Plant Conservation Alliance Alien Plant Working Group (www.nps.gov/plants/alien).
- Bravo, Melissa A., 2003. Japanese Honeysuckle fact sheet. The Plant Conservation Alliance Alien Plant Working Group (www.nps.gov/plant/alien).
- Brown, M. L. and R.G. Brown. 1984. Herbaceous plants of Maryland. Port City Press, Baltimore, MD.
- Fernald, M. L. 1950. Gray's manual of botany, 8th ed. Dioscorides Press, Portland, OR.
- Gleason, H. A. and A. Cronquist, 1991. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. The New York Botanical Garden, Bronx, NY. 910 pp.
- Harvill, A. M., T. R. Bradley, C. E. Stevens, T. F. Wieboldt, D. M. E. Ware, D. W. Ogle, G. W. Ramsey, and G. P. Fleming, 1992. Atlas of the Virginia Flora, 3rd ed. Virginia Botanical Associates, Burkeville, VA. 144 pp.
- Hamilton, Helen. 2001. Common Plants of Assateague Island. National Park Service, Berlin, MD.
- Heffernan, K. E. 1998. Managing Invasive Alien Plants in Natural Areas, Parks, and Small Woodlands. National Heritage Technical Report 98-25. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Richmond, VA.
- Hiebert, Ronald D. and James Stubbendieck, 1993. Handbook for Ranking Exotic Plants for Management and Control. National Park Service, Natural Resources Publication Office. Denver, CO.
- Hill, S. R., 1984. A Botanical Survey of the Maryland portion of Assateague Island. Report to the National Park Service. College Park, MD.
- Hill, S.R., 1986. An Annotated Checklist of the Vascular Flora of Assateague Island (Maryland and Virginia). *Castanea* 51:265-305. College Park, MD.

- Higgins, E. A. T., R. D. Rappleye, and R. G. Brown, 1971. The Flora and Ecology of Assateague Island. University of Maryland Agricultural Experiment Station Bulletin A-172. 70pp.
- Hoshavsky, M. 1986. The Nature Conservancy Element Stewardship Abstract: *Ailanthus altissima*. The Nature Conservancy, San Francisco, CA.
- Hudson, F. 2000. Assateague Island National Seashore Exotic Species Management 1999-2000. National Park Service, Assateague Island National Seashore.
- Invasive alien plants of Virginia: Tree-of-heaven (*Ailanthus Altissima*) fact sheet. Virginia Department of Conservation and Recreation and Virginia Native Plant Society, date unknown.
- Invasive Alien Plant Species of Virginia: Weeping Lovegrass (*Eragrostis curvula* (Schrader) Nees) fact sheet. Virginia Department of Conservation and Recreation and Virginia Native Plant Society, 1999.
- Lea, C. 1997. Vegetation classification of Assateague Island National Seashore, Addendum 1 - July 23, 1997. National Park Service, Assateague Island National Seashore.
- Lea, C. and S. King, 2001. Seabeach Amaranth Restoration Progress Report, 2000. Summary Report. National Park Service, Berlin, MD.
- Lea, Chris and Greg McLaughlin, 2002. Asiatic sand sedge fact sheet. The Plant Conservation Alliance Alien Plant Working Group (www.nps.gov/plants/alien).
- Martin, Tunyalee, 2001. *Clematis vitalba*. The Nature Conservancy, Wildland Invasive Species Program (www.tncweeds.ucdavis.edu).
- Maryland Department of Natural Resources, Wildlife and Heritage Service, 2003. Non-Native Plant Species (www.dnr.state.md.us/wildlife/iepintro.html).
- McAvoy, W. and K. Bennett, 2001. The Flora of Delaware - An Annotated Checklist. Delaware Department of Natural Resources and Environmental Control. Dover, DE.
- McIntyre, B., F. Hudson and C. Lea. 2001. Exotic species management 1999-2001. Assateague Island National Seashore - internal report. Division of Resource Management. Berlin Maryland
- Missouri Botanical Garden (MOBOT), 2002. *Clematis terniflora*. Kemper Center for Home Gardening (www.mobot.org/gardeninghelp/plantfinder).
- National Invasive Species Council, 1999. Executive Order 13112, (www.invasivespecies.gov).

National Park Service Report, date unknown. Monitoring Phragmites Stands on Islands in Chincoteague Bay (02.02.100).

National Park Service, 1991. Natural Resource Management Guideline (NPS-77). National Park Service, Washington, DC.

Nuzzo, Victoria, 1997. Nature Conservancy Element Stewardship Abstract for *Lonicera japonica*. The Nature Conservancy, Arlington, VA.

Shoop, M. C. and E. H. McIlvain, date unknown. Growth Pattern of Weeping Lovegrass and How They Relate to Management. U.S. Southern Great Plains Field Station, Woodward, OK.

Small, J.A. 1954. *Carex kobomugi* at Island Beach, New Jersey. Ecology 35: 289-291.

Swearingen, Jil M., 1997. Purple Loosestrife fact sheet. The Plant Conservation Alliance Alien Plant Working Group (www.nps.gov/plants/alien).

Swearingen, Jil M. and Phil Pannil, 1999. Tree-of-Heaven fact sheet. The Plant Conservation Alliance Alien Plant Working Group (www.nps.gov/plants/alien).

Table 1. EXOTIC SPECIES LOCATIONS UNDER TREATMENT FOR THE YEARS 1999-2002

Site numbers	Location	Year of discovery	Treatment 1999	Ramets 2000	Treatment 2000	Ramets 2001	Treatment 2001	Ramets/Stems 2002	Treatment 2002
AiAl 1	Inlet/Bay	2001	n/a	n/a	n/a	2	dug; BBG 10/22	counted with AiAl 2	dug 9/25
AiAl 2	Inlet/Bay	2000	n/a	1	girdled; BBG 8/29	1	dug; BBG 10/22	14 (8/15), 30+ (9/25)	dug 9/25
AiAl 3	Valentines	1984	n/a	65	girdled; BBG 9/5	314	dug; BBG 10/22	11	10 dug;1 BBG 9/26
CaKo 1	Inlet	2000	n/a	13	dug up	0	none	none	n/a
CaKo 2	N Km 4	2000	n/a	no count	dug up	30	2% glyphosate 9/3	none	n/a
CaKo 3	N Km 5	2001	n/a	no count	dug up	0	none	none	n/a
CaKo 4	N Km 5	2001	n/a	n/a	n/a	13	2% glyphosate 9/3	none	n/a
CaKo 5	N Km 5	2001	n/a	n/a	n/a	36	dug 5/4	none	n/a
CaKo 6	N Km 5	2001	n/a	n/a	n/a	20	dug 5/4	none	n/a
CaKo 7	N Km 5	2000	n/a	14	dug up	0	none	none	n/a
CaKo 8	N Km 5	2001	n/a	n/a	n/a	9	dug 5/4	none	n/a
CaKo 9	N Km 5	2001	n/a	n/a	n/a	33	dug 5/4	11	2% glyphosate 9/17
CaKo 10	N Km 5	2000	n/a	n/a	n/a	43	dug 5/4	none	n/a
CaKo 11	S Km 5	2000	n/a	50	dug up	0	none	none	n/a
CaKo 12	Km 6	2001	n/a	37	dug up	0	none	none	n/a
CaKo 13	Km 6	2001	n/a	n/a	n/a	158	untreated	many, 5m	2% glyphosate 9/17
CaKo 14	Km 6	2001	n/a	n/a	n/a	80	untreated	many, 4m	2% glyphosate 9/17
CaKo 15	S Km 17	2000	n/a	374	2% glyphosate 8/29	2	2% glyphosate 8/3	none	n/a
CaKo 16	N Km 18	1999	2% glyphosate	608	Experimental	81	2% glyphosate 8/2	2	dug 7/2
CaKo 17	S Km 20	2000	n/a	no count	none	5	2% glyphosate 9/9	91	dug 7/2; 2% glyphosate 7/3
CaKo 18	S Km 20	2000	n/a	no count	none	1	2% glyphosate 9/9	91	dug 7/2; 2% glyphosate 7/3
CaKo 19	S Km 18	2000	n/a	277	2% glyphosate 8/29	16	2% glyphosate 8/3	12	2% glyphosate 9/17
CaKo 20	S Km 20	1999	2% glyphosate	3608	Experimental	208	2% glyphosate 8/1	91 (7/2), 2 (9/6)	dug 9/6; 2% glyphosate 7/3
CaKo 21	W Km 28	1999	2% glyphosate	no count	n/a	no count	*	site not found 9/17	n/a
CaKo 22	Km 27	1999	2% glyphosate	no count	*	109	dug;2% glyphosate 8/3	none	n/a
CaKo 23	Km 27	1999	2% glyphosate	no count	n/a	no count	*	none	n/a
CaKo 24	Km 27	1999	2% glyphosate	no count	n/a	no count	*	1	dug 9/6
CaKo 25	Km 27	1999	2% glyphosate	no count	n/a	no count	*	none	n/a
CaKo 26	S Km 28	2000	n/a	1	dug up 8/3	1	dug 8/3	none	n/a
CaKo 27	S Km 29	1999	2% glyphosate	1238	Experimental	7	2% glyphosate 8/1	50 (7/6), 1 (9/6)	dug 9/6; 2% glyphosate 7/3
CaKo 28	N Km 34	2000	n/a	4	dug 8/25	0	none	none	n/a
CaKo 29	S Km 34	2001	n/a	n/a	n/a	6	dug 5/2	none	n/a
CaKo 30	Toms Cove	2001	n/a	n/a	n/a	150	untreated	none	n/a
CaKo 31	Toms Cove	2001	n/a	n/a	n/a	250	untreated	none	n/a
CaKo 32	Toms Cove	2001	n/a	n/a	n/a	100	untreated	none	n/a
CaKo 33	Km 5.0	2002	n/a	n/a	n/a	n/a	n/a	23	2% glyphosate 9/17
CaKo 34	Km 4.5	2002	n/a	n/a	n/a	n/a	n/a	4	dug 8/8
LySa 1	Lots 66-82	2000	n/a	6	2% glyphosate 8/29	0	none	5	dug (after flower!) 9/17

Note: In 1999, Ramets were not counted; All treatment were conducted in November.

* conflicting information from herbicide logs

Table 2. Experimental sites for herbicide removal of *Carex kobomugi*.

Experimental Site at CaKo 16, Figure 1				
		Bayside Plot	Middle Plot	Oceanside Plot
	Date	Summer	Fall	Summer & Fall*
	AUGUST			
Pre-application count	08/03/2000	162	276	170
Application	08/07/2000	3		3
Application	10/04/2000		3	3
Post-application count	06/26/2001	16	50	15
	% Survival	9.9%	18.1%	8.8%

Experimental Site at CaKo 20, Figure 1				
		Oceanside Plot	Bayside Plot	Middle Plot
	Date	Summer	Fall	Summer & Fall*
	AUGUST			
Pre-application count	08/03/2000	1933	752	923
Application	08/07/2000	3		3
Application	10/04/2000		3	3
Post-application count	06/26/2001	31	163	14
	% Survival	1.6%	21.7%	1.5%

Experimental Site at CaKo 27, Figure 1				
		Middle Plot	Oceanside Plot	Bayside Plot
	Date	Summer	Fall	Summer & Fall*
	AUGUST			
Pre-application count	08/03/2000	447	522	269
Application	08/07/2000	3		3
Application	10/04/2000		3	3
Post-application count	06/26/2001	0	0	0
	% Survival	0.0%	0.0%	0.0%

- Pre-application and post-application counts include the number of shoots counted before and after each herbicide treatment.
- Check marks (3) indicate when each of the three experimental blocks was treated.
- *Roundup was applied to live ramets only (not to dead ramets) in the Fall treatment of the Summer & Fall treatment group.
- 84 additional plants in the CaKo 16 site (fall treatment) plants were present but dug up for experimental use by Salisbury State and not included in the 923 total.

Table 3. Herbicide use for 2000 – 2002. No record of herbicide use found for 1999.

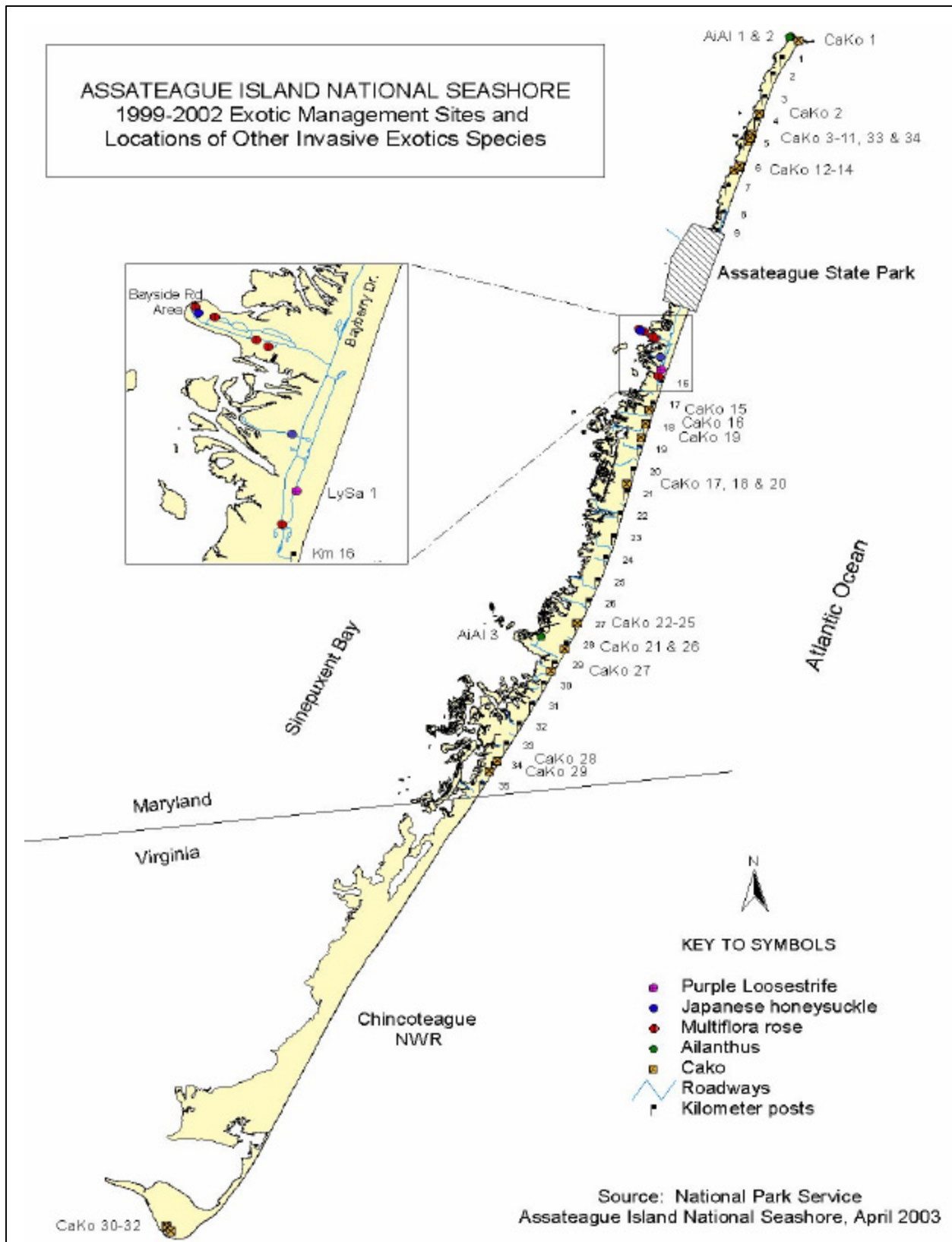
Herbicide Log 2000				
	<u>Date of Use</u>	<u>Purpose</u>	<u>Concentration(%)</u>	<u>Amount Used (oz)</u>
Roundup				
- glyphosate, isoproylamine salt 18.0%	08/07/2000	CaKo	2.00	48.00
- other ingredients 82.0%	08/29/2000	CaKo & LySa	2.00	10.00
	10/04/2000	CaKo	2.00	24.00
			Total oz.	82.00
	<u>Date of Use</u>	<u>Purpose</u>	<u>Concentration(%)</u>	<u>Amount Used (oz)</u>
Brush-B-Gon				
- triclopyr, triethylamine salt 00.70%	09/05/2000	AiAl	100.00	24.00
- other ingredients 99.30%				
			Total oz.	24.00

Herbicide Log 2001				
	<u>Date of Use</u>	<u>Purpose</u>	<u>Concentration(%)</u>	<u>Amount Used (oz)</u>
Roundup				
- glyphosate, isoproylamine salt 18.0%	08/01/2001	CaKo	2.00	1.92
- other ingredients 82.0%	08/02/2001	CaKo	2.00	0.64
	08/03/2001	CaKo	2.00	2.56
	09/03/2001	CaKo	2.00	1.28
	09/04/2001	CaKo	2.00	1.28
			Total oz.	7.68
	<u>Date of Use</u>	<u>Purpose</u>	<u>Concentration(%)</u>	<u>Amount Used (oz)</u>
Brush-B-Gon				
- triclopyr, triethylamine salt 00.70%	10/23/2001	AiAl	100.00	12.00
- other ingredients 99.30%				
			Total oz.	12.00

Table 3 (continued). Herbicide use for 2000 – 2002.

Herbicide Log 2002					
		<u>Date of Use</u>	<u>Purpose</u>	<u>Concentration(%)</u>	<u>Amount Used (oz)</u>
Roundup					
- glyphosate, isopropylamine salt	18.0%				
- other ingredients	82.0%	7/3-4/2	CaKo, weeds	0.02	2.56
		17-Sep	CaKo, weeds	0.02	3.84
Total oz.					6.4
Brush-B-Gon					
		<u>Date of Use</u>	<u>Purpose</u>	<u>Concentration(%)</u>	<u>Amount Used (oz)</u>
- triclopyr, triethylamine salt	00.70%	26-Sep	AiAl	0.7	<0.5
- other ingredients	99.30%				
Total oz.					<0.5

Figure 1



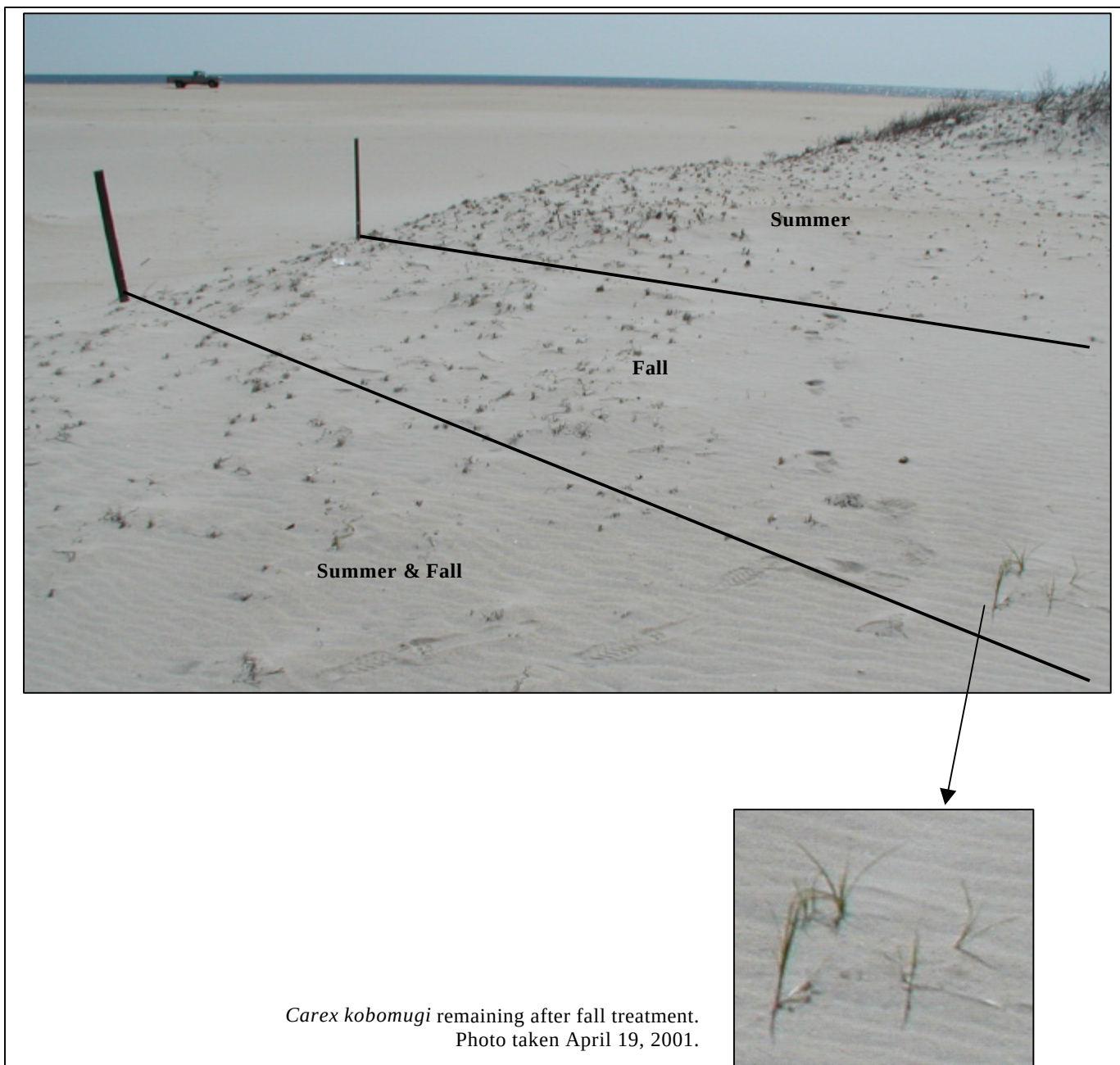


Figure 2. Experimental Site at CaKo 20 (See Figure 1 for location) following application of 2% glyphosate showing seasonal experimental blocks.

Figure 3



Ailanthus altissima

(AiAl 2-2002)

Photograph taken August 15, 2002

Left: A main stem of approximately 3 cm in diameter located just over the sandy bayside bank. In 2002, the North End locations, formerly AiAl 1 and AiAl 2, were treated as a single population due to proximity. Fourteen stems were found at the time of these photographs, over 30 more were discovered and treated September 25 (see Table 1). No stems exceeded 3 cm in diameter.

Right: The location of AiAl 1 and 2 as photographed from the bayside of ASIS.

The population is less than half a kilometer south of the Ocean City inlet.



Most of the stems were found just over the bank in a deep depression.

No evidence of a central stump was found.

The population was restricted to an area of approximately 5m in diameter.