inches. This study plot was burned in October 1986. As a result, all stems of *Rhamnus* were top killed.

The study plot was sampled again in October 1987. Results showed an overall increase of 33 percent in total stems in the plot. All size classes showed an increase in stems from 1986 to 1987. Specifically, there was a 56 percent increase in the less than 2-inch class, a 9 percent increase in the 2- to 6-inch class, a 40 percent increase in the 6- to 12-inch class, and a 42 percent increase in the greater than 12-inch class.

Results show that a single burn does not offer a reasonable method for controlling this plant. It appears that the burn prevented greater seed production than if the plot had not been burned. However, this was based on observation only with no data gathered to substantiate it.

The plot is scheduled for a spring 1988 burn with data to be collected in fall 1988. This will be an ongoing study to determine what, if any, fire rotation is successful for controlling this plant.

EXOTIC PLANT SPECIES RANKING SYSTEM

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Exotic plant species represent 23 percent of Indiana Dunes National Lakeshore's flora. Certain species like flower-of-an-hour (*Hibiscus trionum*) and velvet-leaf (*Abutilon theophrasti*) that occur in seral habitats will quickly disappear and represent no lasting threat to native communities. However, purple loosestrife (*Lythrum salicaria*) and black locust (*Robinia pseudo-acacia*) invade and replace native communities and therefore represent serious threats to natural communities.

To understand objectively an exotic plant species threat (or potential threat) to natural areas, a numerical ranking system for exotic plants was developed and presented by the senior author at the Fourteenth Annual Natural Areas Conference, October 1987. The numerical system is based on (1) significance of impact, (2) innate ability to be a pest, and (3) feasibility of control of the exotic species. High numerical values (up to 6) are placed on species found in high quality natural areas and on large populations that invade and replace native communities. For interpretive reasons, visual impact of the exotics also is considered.

Equally high values are given to pernicious species that are highly fecund, both sexually and asexually; have specialized dispersal abilities; and germinate in a wide range of conditions. Feasibility of control considers distribution of exotic species, seed bank viability, and levels of mechanical and chemical effort required to eliminate exotic species. Effects of delay in control action and the possibilities of biological control are considered as well.

Summing the totals of significance of impact, innate ability to be a pest, and feasibility of control, each exotic species is ranked in one of four categories:

(1) serious threat — immediate research and control measures needed;

(2) significant threat — research and control warranted in the near future;

(3) apparent potential threat to natural areas — insufficient information available, research encouraged;

(4) no significant threat to resources — limited to highly or frequently disturbed sites, has limited distribution, and/or is unable to reproduce.

The system was applied to the exotic plants of the Indiana Dunes. Of the 307 known exotic species, thirty were placed in categories 1 and 2. Abstracts are being prepared for these species. The results are being applied toward the development of an exotic species management program. Detailed results will be reported in a future issue of the *Natural Areas Journal*.

With the aid of the ranking system, site stewards and administrators can objectively plan eradication priorities and develop long-range management goals.

Copies of the Exotic Plant Species Ranking System are available upon request.

PROPAGATION TECHNIQUES USED IN ESTABLISHING A GREENHOUSE POPULATION OF *ASTRAGALUS TENNESSEENSIS* GRAY

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Astragalus tennesseensis, an Illinois endangered species, has been extirpated from northern Illinois and Indiana and now is restricted in these states to a single dry gravel prairie in Tazewell County, Illinois. Although dissimilar from the cedar glade habitat (Baskin et al. 1972) for *A. tennesseensis* in Tennessee and Alabama, dry gravel prairie may have been characteristic habitat in the northern portion of this species' range. A number of these prairies remain in northern Illinois and Indiana, and several are available for restoration purposes. We summarize propagation techniques used to initiate a greenhouse population for restoration work and breeding system research on this milkvetch.

Through hand pollinations, seed germination, and rooting of stem cuttings, we developed a greenhouse population of sixty-eight plants in two years from six

seedlings originally derived from the Illinois seed source. The initial breeding stock of two plants was grown in 1986 and supplemented in 1987 with four plants from seeds collected by John Schwegman in 1986. In 1987, 246 seeds were derived from pollinations of the original two plants. We successfully established thirty-four plants (13.8 percent survival) from this seed cohort. Rooting of stem cuttings from all adult plants resulted in an addition of twenty-eight plants to the greenhouse population.

Propagation from seed. Seeds were germinated without cold stratification (presumably some field-collected seeds had been exposed to winter temperatures) at The Morton Arboretum greenhouse. All seeds were filed through the inner seed coat (see Baskin and Quarterman 1969), imbibed, and sown on a well-drained soil mix of equal parts peatmoss, perlite, and calcined clay. To prevent damping off, all seeds were covered with a 0.125 inch "root collar" of Mason sand, and seedlings were treated with Benomyl fungicide, diluted 1 teaspoon/gallon of water. After development of leaves, seedlings were transplanted to a 1:1:1 soil mix of topsoil, perlite, and peatmoss; fertilized with phosphorus, gypsum, and sulfate; and treated with *Astragalus* inoculum. Once seedlings were well established, they were transferred to the University of Illinois at Chicago greenhouse for growth under sodium-vapor lights and supplemental fluorescent lighting. Mature plants were maintained under a 14-hour day-length at 80° F (day) and 64° F (night), watered as needed, and fertilized weekly with 20:20:20 (NPK).

Propagation from cuttings. Mature *A. tennesseensis* produce elongated decumbent semi-woody stems, which die back under drought conditions or are maintained as winter growth. At the University of Illinois, cuttings of these stems were found capable of producing meristematic root tissue and were treated with an auxin-based woody plant hormone. Rooting was most successful with a 2:1 shoot:root planting ratio. In 1987 twenty-seven such cuttings were rooted in sharp silica sand under clear plastic covers, with lighting from sodium-vapor lights. Rooting occurred in three to five weeks, after which the cuttings were transplanted to a 1:1:1 standard soil mix.

All plants now are maintained at the University of Illinois at Chicago greenhouse. We anticipate conducting breeding system studies with flowering plants and initiating population restoration in northern Indiana and Illinois during 1988-1989.

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STATUS AND RESTORATION OF *PLANTAGO CORDATA* IN THE SOUTHERN LAKE MICHIGAN REGION

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Plantago cordata Lam. (heart-leaved plantain) has declined throughout much of its range, primarily in response to destruction or alteration of its gravel-bed stream habitat (Tessene 1969). Within such streams, optimum plantain habitat is a gravel bar maintained under moderate stream erosion cycles; plantain mortality can result from runoff-accelerated stream erosion and bank slumping in agricultural watersheds (Bowles and Apfelbaum 1987).

Heart-leaved plantain is endangered in the southern Lake Michigan region, where no habitats with undisturbed intact watersheds are known to exist. One individual plantain is known to remain at a historic northwestern Indiana site (T. Post, pers. comm.). One Wisconsin population remains extant; however, it is vulnerable because of its small size and seedling mortality from high water debris, competition, and eutrophication (Stromberg et al. 1983). The last northeastern Illinois population was buried by silt released from subdivision construction in the upper portion of the watershed (M. Bowles, pers. obs.).

Two *Plantago cordata* restoration efforts have been initiated within this region. In Wisconsin, greenhouse-grown plants were transplanted to eight stream sites in five eastern counties (Stromberg et al. 1983); four of these transplanted populations now remain extant (F. Stearns, pers. comm.). In 1987 we initiated restoration projects on public land in two former plantain habitats: a silt/gravel-bottom stream in mesic flatwoods (Lake County Forest Preserve District, Illinois) and a gravel-bed stream in mesic upland forest (Forest Preserve District of Will County, Illinois). Both sites had been subjected to siltation episodes but are now relatively stable and appear suitable for studies of requirements for population restoration.

In spring 1986 seeds (provided by Forest Stearns from Wisconsin parent stock) were germinated without stratification on 2:2:2:1 growth medium (shredded peatmoss: coarse perlite: native topsoil: composted pinebark). Germination flats were maintained in an intermittent mist (about 3 seconds every 8 minutes) at about 70° F under natural daylight conditions. Over 80 percent germination occurred after five days, and seedlings were removed from the mist after twelve days. After development of two to three leaves, seedlings were transplanted to individual pots of the same growth medium, where they developed five to six leaves by late summer. These seedlings were stored in refrigeration at 44° F from December 1986 through April 1987.

In late April 1987, fifteen juveniles from the 1986 seedling cohort were planted at each of the two sites. Each planting consisted of three 1 m^2 plots (five plants/m^2 each), which were monitored monthly. Each of the six plots was located on available gravel-bar habitat, which then was inundated by high spring water levels. Through June 1987, survival was 80 percent, with losses of single plants in each of the six 1 m^2 quadrats. One Will County plant flowered, but the inflorescence was destroyed. Midsummer drought conditions and periodic late summer heavy precipitation events appear to have caused differential decline among plots. By October 1987, only four plants survived in a single 1 m^2 plot at the Will County site, while two plants survived in one plot at the Lake County site. Each of these plots represented the maximum exposure of gravel bar in the respective stream systems. These results suggest that even within suboptimal habitats, total subpopulation mortality is likely.

Both restored populations will be supplemented with additional seedlings in 1988. Plantings will be located in optimum habitats suggested by 1987 mortality patterns. If flowering and subsequent seedling establishment occur from the second year plants, we expect population survival to be enhanced. Critical factors in long-term population maintenance will be habitat stability, low siltation rates, and survival of catastrophic events by minimum population sizes required to recolonize optimum habitats.

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STATE AND PROVINCE REPORTS

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CONNECTICUT

The Connecticut Natural Heritage Program is part of the Connecticut Geological and Natural History Survey, which is located in the Department of Environmental Protection.

The Connecticut Natural Diversity Data Base compiles information on plants, animals, and natural communities of special concern in the state. The data base also responds to information requests from a growing number of state agencies, municipalities, conservation organizations, consultants, and private citizens.

Governor William O'Neill designated two new state natural area preserves in April 1987. Both preserves are examples of pitch pine sand barrens, and the management plans for the two preserves probably will call for portions of them to be burned. Connecticut now has a total of eight natural area preserves encompassing about 2089 acres. Several additional sites are being considered as possible preserves, including some areas of Atlantic white cedar wetlands and freshwater tidal marshes on the Connecticut River.

The state has adopted regulations guiding the management of all state natural area preserves. The regulations, which went into effect in June 1987, require a management plan to be prepared for each preserve. Management plans for existing natural area preserves are being drafted.

The Connecticut chapter of The Nature Conservancy has been working with the Department of Environmental Protection to acquire an 8-acre portion of barrier beach to be added to an existing state natural area preserve. This acquisition is the first joint public-private project under the matching provisions of the Recreation and Natural Heritage Trust set up in 1986.

The Natural Heritage Registry, operated jointly by the state and by The Nature Conservancy, registered more than twenty new properties in the past year. To date seventy-three tracts representing twenty-four different sites have been registered.

In June 1987 the Connecticut Natural Heritage Program hosted a meeting of natural area programs from New England, and last fall the Geological and Natural History Survey held the third annual Connecticut Natural Diversity Conference. *Natural History Notes*, our new newsletter reporting on interesting biological observations in the state, has been well received.

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GEORGIA

Inventory

The Georgia Natural Heritage Inventory (GNHI), a cooperative effort between the Department of Natural Resources (DNR) and The Nature Conservancy, began in