New England Plant Conservation Program
Conservation and Research Plan

Senna hebecarpa (Fern.) Irwin & Barneby
Northern Wild Senna

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SUMMARY

Senna hebecarpa (Fern.) Irwin & Barneby (Caesalpiniaceae), formerly *Cassia marilandica*, ranges from New England south to Georgia and west to Wisconsin. This species, similar in appearance to *C. marilandica*, a taxon not native to New England, was once relatively widespread throughout the New England states except Maine. Of 95 documented records, there are now only six extant populations, all of which are new discoveries since 1987. The New England Plant Conservation Program (NEPCoP) lists the species as Division 2; Connecticut and Massachusetts rank it as Endangered; Rhode Island, Vermont, and New Hampshire list the species as historic. New York does not list the taxon. The species' decline is due to succession, development, and perhaps changes in hydrology. Plants occur in disturbed habitats (roadsides, fields, and edges of streams) often in damp or alluvial soils. The robust plants, which grow 3-7 feet (2 m) tall, have showy yellow flowers in late July and early August. Seed is found on approximately 80% of mature plants. NEPCoP propagation trials indicate average germination rates of 10-30%. Cultivated plants are vigorous and can self-sow in garden conditions. Little information on the species biology is known, except that clouded sulfur butterfly larvae depend on *Senna* spp., and there are records of cows "shunning" *Senna*.

Out of six extant populations, two in Massachusetts and four in Connecticut, two occurrences are on protected property; four occurrences are on private property and are potentially vulnerable to development. NEPCoP has collected and seed banked seed for three out of the six populations. Conservation efforts have been limited to seed collection, educating landowners of the presence of the plants, and working with maintenance crews to change mowing regimes.

The highest conservation priority for *Senna hebecarpa* is to protect and maintain existing populations. There is potential for expanding small populations in Massachusetts through population augmentation and adding new populations nearby on publicly protected land. Connecticut populations require property restrictions or acquisition and prescribed mowing regimes along with some additional control of woody species. More seed should be collected from all populations to increase the limited genetic material for population augmentation and introduction efforts. Best mowing practices should be researched to maximize protection of the populations. Botanists in all states should be on the lookout for the showy plants in late July and August. Natural Heritage Programs should collect herbarium specimens for all the extant populations. Additional biological research on pollinators, the need for cross-fertilization for viability of seed, scarification requirements, and seed longevity would benefit population enhancement efforts. Ultimately seven new introductions -- one each in New Hampshire, Vermont and Rhode Island, two to three in Massachusetts, and two in Connecticut -- would help restore the species throughout its original New England range. However, few historical sites are precisely known and of those that are, many no longer support suitable habitat. Therefore, introduction to new sites on protected land may be necessary.

PREFACE

This document is an excerpt of a New England Plant Conservation Program (NEPCoP) Conservation and Research Plan. Full plans with complete and sensitive information are made available to conservation organizations, government agencies and individuals with responsibility for rare plant conservation. This excerpt contains general information on the species biology, ecology, and distribution of rare plant species in New England.

NEPCoP is a voluntary association of private organizations and government agencies in each of the six states of New England, interested in working together to protect from extirpation, and promote the recovery of the endangered flora of the region.

In 1996, NEPCoP published *Flora Conservanda*: New England, which listed the plants in need of conservation in the region. NEPCoP regional plant Conservation Plans recommend actions that should lead to the conservation of Flora Conservanda species. These recommendations derive from a voluntary collaboration of planning partners, and their implementation is contingent on the commitment of federal, state, local, and private conservation organizations.

NEPCoP Conservation Plans do not necessarily represent the official position or approval of all state task forces or NEPCoP member organizations; they do, however, represent a consensus of NEPCoP's Regional Advisory Council. NEPCoP Conservation Plans are subject to modification as dictated by new findings, changes in species status, and the accomplishment of conservation actions.

Completion of the NEPCoP Conservation and Research Plans was made possible by generous funding from an anonymous source, and data were provided by state Natural Heritage Programs. NEPCoP gratefully acknowledges the permission and cooperation of many private and public landowners who granted access to their land for plant monitoring and data collection. If you require additional information on the distribution of this rare plant species in your town, please contact your state's Natural Heritage Program.

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I. BACKGROUND

INTRODUCTION

Senna hebecarpa (Fern.) Irwin & Barneby (Caesalpiniaceae) is a large herbaceous perennial that is considered regionally rare (Brumback and Mehrhoff *et al.* 1996). The taxon's current distribution is limited to six occurrences in Connecticut and Massachusetts. The taxon is listed as Division 2 in the New England Plant Conservation Program's (NEPCoP) *Flora Conservanda*: New England, indicating fewer than 20 occurrences located since 1970 (Brumback and Mehrhoff *et al.*, 1996). Comments on frequency of occurrences taken from old floras and herbarium records indicate that while not common, the plant was once widespread in New Hampshire, Massachusetts, Rhode Island, and Connecticut in the 1800's (see Appendix). The Natural Heritage Programs and The Nature Conservancy in the New England states rank *Senna hebecarpa* as follows (The Nature Conservancy and the Association of Biodiversity Information 1999):

- **New Hampshire:** State historic; Endangered
- **Vermont:** State historic; Threatened
- **Massachusetts:** Endangered; 2 occurrences
- **Rhode Island:** Historic (the remaining one occurrence now considered eradicated by development; Threatened

The need for a conservation plan for this taxon is clear. The range and number of occurrences of this species in New England has declined dramatically. The intent of this conservation plant is to summarize the available information on the biology and ecology of this species, evaluate its current status of the species in New England and provide recommendations that will lead to the conservation and recovery of this species.

DESCRIPTION

Senna hebecarpa is described as an erect perennial, 0.5-2 meters tall, glabrous or villous above; stipules subsetaceous; petiolar gland clavate to obovoid, constricted at base into a short stipe; leaflets commonly 6-10 pairs, oblong or elliptic, 2-5 cm, acute or obtuse, mucronate; inflorescence of several axillary many-flowered racemes, forming a terminal panicle; buds nodding; sepals unequal; petals 10-15 mm. and slightly dissimilar; filaments about equaling the anthers; ovary densely villous; pods 7-12 cm x 5-9 mm, tardily dehiscent, sparsely villous, the joints nearly square; seeds nearly as wide as long, flat with a depressed center. The species blooms in July and August (Gleason and Cronquist 1991). The ovule number is 10-15 (18) (Isley 1990).

Senna hebecarpa is distinguished from the closely related *S. marilandica* (L.) Link. by the petiolar gland being clavate to obovoid on *S. hebecarpa* vs. short-cylindric, rounded, or dome-shaped in *S. marilandica*. Additionally, in *S. hebecarpa* the ovary is villous and the joints of the pod are about as long as wide vs. an appressed-hairy ovary and pod joints about twice as long as wide in *S. marilandica*. Newcomb (1977) describes the shape of the stipules of S. *hebecarpa* as very narrow and pointed whereas those of *S. marilandica* are narrowly lance-shaped. *S. hebecarpa* has 10-15 (18) ovules and *S. marilandica* has 20-25 (30) (Isley 1990).

Irwin and Barneby (1982) caution that the diagnostic features are not always clear. The glandular shape is not always distinctive, and the hairiness of the ovary varies. The number of ovaries and the shape of the seedpod are the best diagnostic characteristics.

There is no overlap in range in New England between these two similar-looking species. *Senna marilandica* has a more southern and western distribution, ranging from Pennsylvania to Iowa (Nebraska) and Kansas, south to Florida and Texas (Fernald 1970).

TAXONOMIC RELATIONSHIPS, HISTORY, AND SYNONYMY

The early floras for New England refer to *Senna hebecarpa* as *Cassia marilandica*. Taxonomic work by Fernald in 1937 separated *Cassia hebecarpa* from *Cassia marilandica* (Fernald 1937). More recent taxonomic work now refers to *Cassia* as *Senna.* Mitchell (1986) lists *S. hebecarpa*, but not *S. marilandica*, in the state of New York. As *Senna marilandica* does not extend into New England, all records of *Senna marilandica* in New England are considered to be *S. hebecarpa.* Old records of *Cassia marilandica* in New England are now considered *S. hebecarpa.*

Other similar species within the same range as *S. hebecarpa* include *Cassia fasciculata* now *Chamaecrista fasciculata* (Michx.) Green, the annual Partridge Pea, and the less similar *Chamaecrista nictitans* (L.) Moench., wild sensitive plant. At one time, all three herbs were located in the same genus; however, more recent treatments by Gleason and Cronquist (1991) separate them on the following features:

Stamens all with normal anthers, pod elasticity dehiscent -- *Chamaecrista*
Upper 3 stamens sterile; pod indehiscent or inertly dehiscent -- *Senna*

Newcomb (1977) provides some other obvious field trait differences between the two look-alike species:

Senna hebecarpa	*Chamaecrista fasciculata*
3-5 feet (0.9-1.5 m) tall	6-30 inches tall (0.15-0.8 m)
5-9 pairs leaflets	8-15 pairs of leaflets
Flowers ±3/4 inches (1.9 cm) wide	Flowers ± 1-1.5 inches (2.5-3.8 cm) wide
Flowers in racemes	Flowers in axils

SPECIES BIOLOGY

Little is known about the species biology of *Senna hebecarpa*. The species is a robust perennial growing in rich, alluvial soil. The plants bloom in July and August, can sometimes reach six to seven feet in height, and they develop thick rhizomes often forming large clonal colonies. Natural Heritage and NEPCoP field forms indicate that about 80% of all stems bear flowers. Fruit is set in late October with up to 12 seeds in each pod (Elizabeth Farnsworth, NEWFS, *personal communication*).

The life cycle of the plants is largely a mystery. Work conducted on closely-related *S. marilandica* indicates that the plants are most productive in their second year, and begin to decline after three to four years. However, a plant of *Senna hebecarpa* at the Garden in the Woods, the botanical garden of the New England Wild Flower Society, remained robust and productive for several years (Bill Cullina, NEWFS, *personal communication*). Other observers have also noted long-lived, robust plants.

From information gathered in the State Natural Heritage program files and other sources, it appears that *S. hebecarpa* is insect-pollinated. "Wild senna has organs on the leaf petioles [the glands so useful in identification] that exude copious sugary nectar. This nectar attracts ants and other potential insect pollinators to the showy flowers. The flower structure closely resembles that of its relative *Cassia fasciculata*, which requires insects to effect pollination" (Elizabeth Farnsworth, *personal communication*).

Initial propagation trials by the New England Wild Flower Society (NEWFS) indicate that seed germination percentages are low. Seed has been collected from four sites for NEPCoP since NEWFS began its seed banking and propagation program in 1991. Standard seed treatments of refrigeration for three months, placing flats outside for a natural cold period, and no cold period at all provided similar results: an average 10-30% germination. Furthermore, the seedlings struggled to grow. It is unclear whether the propagation methods or seed viability is the reason for the relatively low germination.

Piper (1992) indicates that plants of the closely related *C. marilandica* are most productive of seed in their second year, and by the third to fourth year, the individual plant is in decline. This is typical of many perennial species. Propagation trials indicate that germination is low -- between 6-30% -- even when seed production may be prolific. Consequently, older plants may die out before enough seed survives to replace the plants.

Other horticultural efforts using seed not collected as part of the NEPCoP collaborative reveal interesting aspects about the plant. Scarification by rubbing seeds with sandpaper, sowing them in flats and over wintering the flats outside has produced good results. Other methods of scarification used for propagating *Cassia nictitans* and *C. fasciculata* may be applicable to *S. hebecarpa*. Seed-coat imposed dormancy of *Cassia* species has been overcome by cutting the corner of the rhomboid seeds after soaking for one minute in 70% sulfuric acid (Elizabeth Farnsworth, *personal communication*). As with many legumes, *Senna hebecarpa* plants initially send their energy into their root system so that the top of the plant may be small or not appear for a year or two. Although slow growing in the early spring, once plants have become established, they are very robust (Bill Cullina, *personal communication*). Plants produced from seed bank trials are thriving and are self-seeding in the New England Garden of Rare and Endangered Plants at NEWFS in Framingham, Massachusetts (Chris Mattrick, NEWFS, *personal communication*). The seeds also seem to be long-lived in the soil seed bank. Bill Countryman, a botanist and horticulturist in Vermont, indicates that he has grown plants from wild seed in his garden. Although he has moved the plants into a field where they persist, and the seedlings continue to germinate in the original garden location.

Several *Senna* species are purgatives or mild laxatives depending on the dose. The active principal of sennas is cathartic acid which seems to be eliminated by digestion (Millspaugh 1974). This chemical property may be the reason that cows appear to shun the plants (Irwin and Barneby 1982). If the chemical properties of *S. marilandica* and *S. hebecarpa* are similar, the compound may explain why at one time so many botanists recorded the plants. These big showy plants were probably easy to see and identify in mid to late summer growing in wet meadows and pastures where livestock would leave then ungrazed.

HABITAT/ECOLOGY

Senna hebecarpa is usually found in disturbed, often moist, alluvial sites, amidst woody thickets, fields, or along roadsides or stream banks (Eaton 1974, Harris 1975, Weatherbee 1996). More unusual herbarium labels indicate moist or dry woods. Fernald distinguishes the habitat for *S. hebecarpa* as being found in alluvial soil and *S. marilandica* on dry roadsides and thickets (Fernald 1970).

More recent and detailed habitat descriptions also indicate occurrences in disturbed open areas. The Huntington, Massachusetts population (MA .022) grows in a field that is mowed annually and lies within the annual flood zone of a river. The frequent flooding has created rich alluvial deposits and the plants reach seven to eight feet (2+ m) in height and are surrounded by equally vigorous herbs and shrubs. Another site in Ayer, Massachusetts (MA .0250 is located along the lower slope of an esker at the edge of a stream valley. The plants are in open and filtered light on brushy cleared land. In both cases, the species is associated with a mix of upland and facultative wetland species. The occurrences in Connecticut include two roadsides, a farm field, a mown meadow, and the cobble edge of a river. Additional

information on associated plants, soils, pH, and disturbance factors needs to be gathered.

Senna hebecarpa is currently a popular native garden plant and is sold by various native plant nurseries. Its increasing use as a garden plant, in conjunction with a possibility of self-seeding, could be problematic in tracking native populations. Some herbarium records and notations in old *Rhodora* articles indicate that plants may have escaped from cultivation into nearby fields. Knowlton (1911) notes that the species grew near a roadside brook and had probably escaped from cultivation "as there is a house near." Another notation on populations around Boston states, "Moist soil in fifteen scattered locations, at some places probably introduced" (Anonymous 1918).

THREATS TO TAXON

Some the threats to this taxon are obvious, yet others may be more difficult to characterize. Many of the recorded sites in the 1800's were near population centers that have since expanded, such as Boston, Massachusetts, and Providence, Rhode Island. An excerpt from a *Rhodora* article in 1900 is informative:

> "*Cassia marilandica* L., grew in plenty about [Providence] -- my own original locality, found years after, without consultation with this record. These localities ... should be especially noted, for the city is fast encroaching upon them. Where less than ten years ago there were open fields and grassy lands, are now curbed streets and numerous cottages. Sewers, too, are draining the entire region (Bailey 1900)."

This historical observation indicates that populations often were present for several years; however, development of farmland and ditching has been a major threat historically.

Changes in hydrologic patterns may also detrimentally affect this taxon. Flooding regimes along rivers may have increased or decreased, altering scour patterns and alluvial deposits. Other disturbance regimes, such as fire and grazing, have been suppressed or limited in many areas. The once open fields and wet meadows, where the showy plants probably stood out to catch the botanist's eye, have grown in and become forests. The plants may have been shaded out or are now obscured from view by dense vegetation. The current populations are threatened by succession, competing vegetation, and mowing.

The reproductive biology of this taxon may also be a hindrance to its survival. The viability of the seed collected for NEPCoP appears to be low, usually 10-30%. Little is known about the role of pollinators, the need for cross-pollination, possible symbiotic associations, or the effects of inundation and scarification. Additionally, seed that is produced may be carried away to unsuitable locations by ants, other wildlife or flooding events. Many populations are noted near but not usually within the direct flow of streams.

DISTRIBUTION AND STATUS

General status

Beyond New England, *S. hebecarpa* ranges south into New York, west to Wisconsin and Illinois, and south into Tennessee and Georgia (Figure 1). Records and current occurrences for Georgia appear to be uncertain. Table 1 summarizes the distribution and status of the taxon in North America.

Table 1. Occurrence and status of *Senna hebecarpa* in the United States and Canada based on information from Natural Heritage Programs.

OCCURS & LISTED (AS S1, S2, OR T &E)	OCCURS & NOT LISTED (AS S1, S2, OR T & E)	OCCURRENCE UNVERIFIED	HISTORIC (LIKELY EXTIRPATED)
Massachusetts (S1): 2 extant and 21 historic occurrences	Connecticut (SU): 4 current and 36 historic occurrences	Delaware (SR)	New Hampshire (SH): 10 historic occurrences
Ontario (S1)	District of Columbia (S?)	Indiana (SR)	Rhode Island (SH): 6 historic occurrences
	Georgia (SE? -- exotic)	Maine (SR)	Vermont (SH): 4 historic occurrences
	Illinois (S?)	Maryland (SR)	
	Kentucky (S?)	New Jersey (SR)	
	Michigan (S?)	New York (SR)	
	North Carolina (S2S3)	Ohio (SR)	
	West Virginia (S?)	Pennsylvania (SR)	
		South Carolina (SR)	
		Tennessee (SR)	
		Virginia (SR)	
		Wisconsin (SR)	

The current distribution of *S. hebecarpa* in New England is drastically reduced compared with early herbarium records starting in 1869 (Table 1, Table 2). Indeed, the entire northern part of the range of *S. hebecarpa* in New England is historic. Research by Natural Heritage Programs in the New England states indicate the species extended into central New Hampshire and Vermont, Rhode Island and throughout Massachusetts and

Hillsborough County, New Hampshire. Central and southwestern Connecticut has an abundance of historical records, particularly in New Haven and Hartford Counties. It is unclear whether these clusters of occurrences are the result of botanical activity or ecological preference. The only New England state for which there is no herbarium record is Maine. However, in 1903 Fernald listed the species on a Josselyn Society field trip on the banks of the Kennebec River, Skowhegan, Maine (Moulton 1903). The current and historic range of *S. hebecarpa* in New England are depicted in Figures 2 and 3.

Figure 1. Occurrences of *Senna hebecarpa* in North America. Shaded states and provinces have 1-5 extant occurrences or are noted simply as occurring. States with the taxon reported as "SR" (see Table 1 and Appendix for explanation of ranks) are shaded with stippling on the map. States with diagonal hatching are designated "historic" or "presumed extirpated" (see Table 1), where *Senna hebecarpa* no longer occurs.

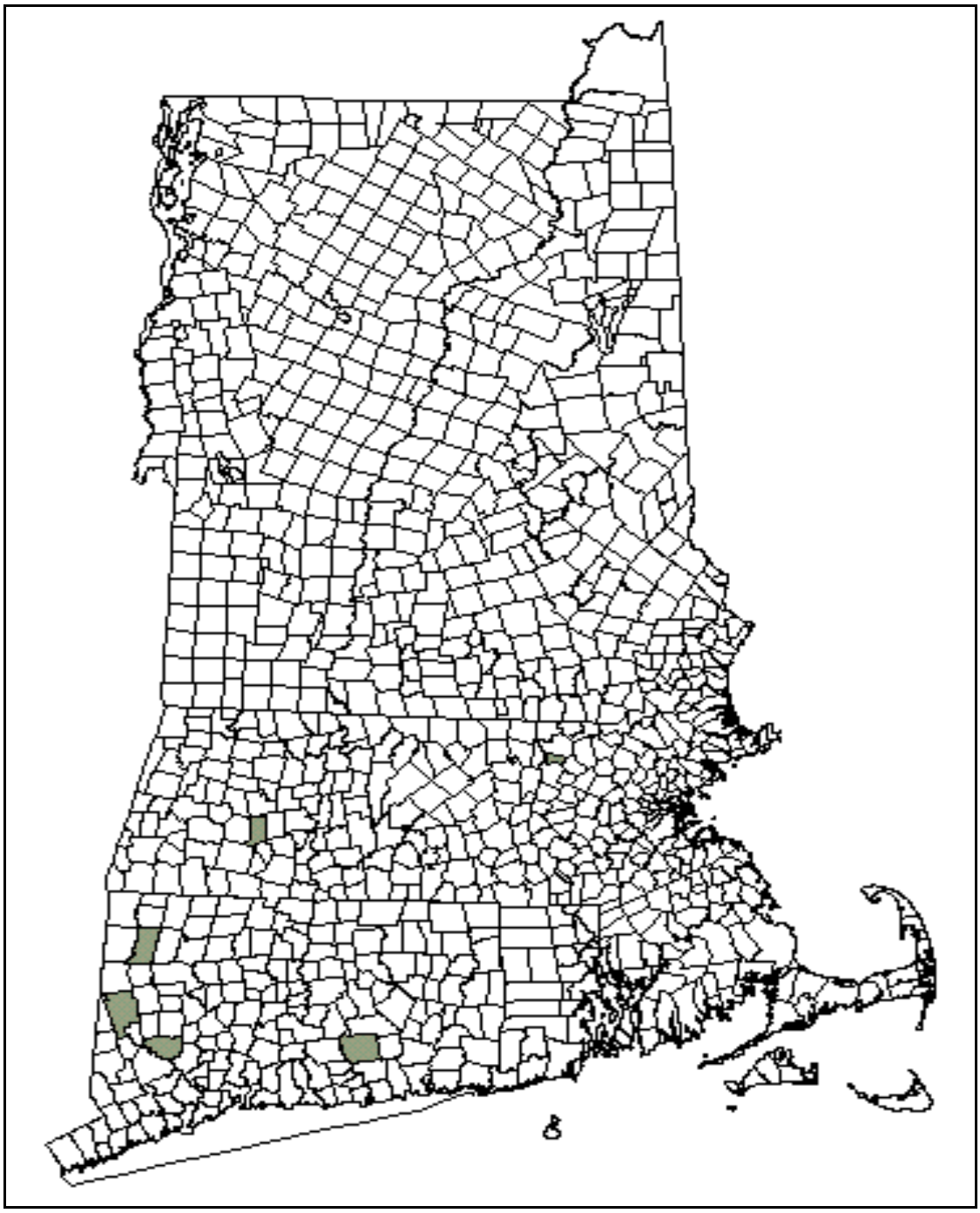

Figure 2. Extant occurrences of *Senna hebecarpa* in New England. Town boundaries for New England are shown. The towns shaded in gray have 1- 5 current occurrences.

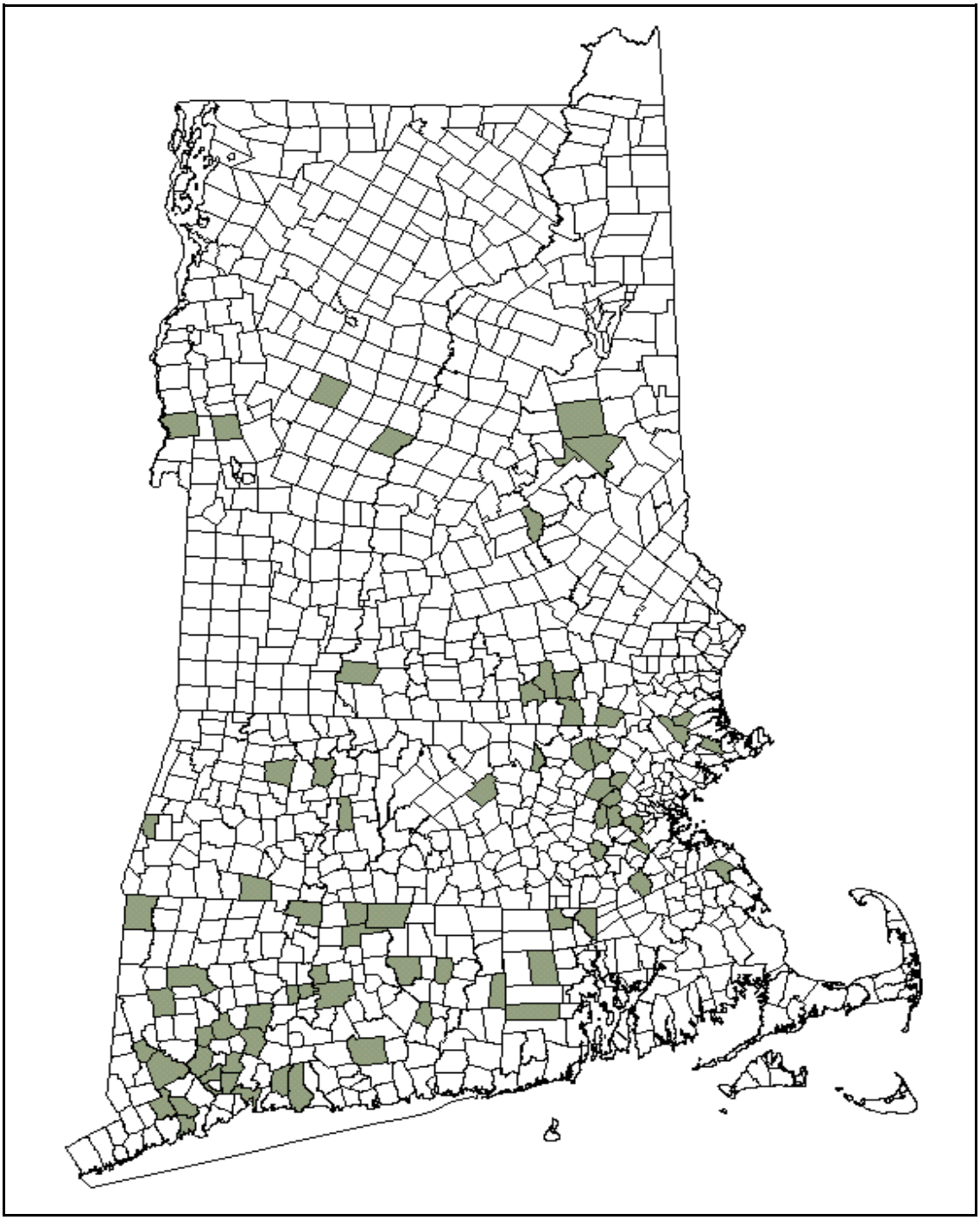

Figure 3. Historic occurrences of *Senna hebecarpa* in New England. Town boundaries for New England are shown. Towns shaded in gray have 1-5 historic occurrences.

Table 2. New England Occurrence Records for *Senna hebecarpa* based on data from State Natural Heritage Programs. Shaded occurrences are considered extant.

State	EO #	County	Town
NH	.001	Hillsborough	Merrimack
NH	.002	Hillsborough	Milford
NH	.003	Hillsborough	Amherst
NH	.004	Hillsborough	Nashua
NH	.005	Merrimack	Franklin
NH	.006	Hillsborough	Pelham
NH	.007	Cheshire	Chesterfield
NH	.008	Belknap	Center Harbor
NH	.009	Carroll	Moulton-boro
NH	.010	Carroll	Sandwich
VT	.001	Addison	Orwell
VT	.002	Orange	Randolph
VT	.003	Rutland	Brandon
VT	.004	Windsor	Norwich
MA	.001	Essex	Georgetown
MA	.002	Middlesex	Sherborn
MA	.003	Middlesex	Newton
MA	.004	Middlesex	Weston
MA	.005	Middlesex	Lincoln
MA	.006	Middlesex	Concord
MA	.007	Middlesex	Bedford
MA	.008	Middlesex	Chelmsford
MA	.009	Middlesex	Westford
MA	.010	Middlesex	Shirley
MA	.011	Middlesex	Wayland
MA	.012	Norfolk	Sharon
MA	.013	Norfolk	Dedham
MA	.014	Norfolk	Milton
MA	.015	Plymouth	Norwell
MA	.016	Worcester	Princeton
MA	.018	Franklin	Ashfield
MA	.019	Hampshire	Amherst
MA	.020	Hampden	Granville
MA	.021	Berkshire	West Stockbridge
MA	**.022**	**Hampshire**	**Huntington**
MA	.023	Franklin	Deerfield
MA	.024	Middlesex	Boxford
MA	**.025**	**Middlesex**	**Ayer**
RI	.001	Kent	West Greenwich
RI	.002	Providence	Providence

State	EO #	County	Town
RI	.003	Providence	Providence
RI	.004	Providence	Scituate
RI	.005	Providence	Scituate
RI	.006	Providence	Smithfield
CT	**.001**		**Cornwall**
CT	**.002**		**Southbury**
CT	.003	Hartford	Suffield
CT	.004	New Haven	Seymour
CT	.005	New Haven	Guilford
CT	.006	Tolland	Mansfield
CT	.007	Fairfield	Brookfield
CT	.008	Hartford	Southington
CT	.009	Hartford	East Hartford
CT	.010	New Haven	Oxford
CT	.011	New Haven	Middlebury
CT	.012	Fairfield	Newtown
CT	.013	Tolland	Stafford
CT	.014	Litchfield	Salisbury
CT	.015	Fairfield	Bridgeport
CT	.016	Hartford	East Hartford
CT	.017	Tolland	Ellington
CT	.018	Hartford	Glastonbury
CT	.019	Middlesex	East Haddam
CT	.020	Fairfield	Easton
CT	.021	Hartford	Newington
CT	.022	New Haven	Guilford
CT	.023	Windham	Hampton
CT	.024	Windham	Sterling
CT	.025	New Haven	Waterbury
CT	.026	Hartford	Wethers-field
CT	.027	Litchfield	Litchfield
CT	.028	Fairfield	Trumbull
CT	.029	New Haven	Derby
CT	.030	Fairfield	Newtown
CT	.031	New Haven	Cheshire
CT	.032	New Haven	Bethany
CT	.033	New Haven	Woodbridge
CT	.034	New Haven	New Haven
CT	.035	New Haven	Branford
CT	.036	Litchfield	Washington
CT	.037	New London	Franklin
CT	.038	Tolland	Somers
CT	**.039**	**Middlesex**	**East Haddam**
CT	**.040**	**Litchfield**	**New Milford**

II. CONSERVATION

CONSERVATION OBJECTIVES FOR TAXON IN NEW ENGLAND

The number of extant populations of *Senna hebecarpa* in New England has declined dramatically. Historically, the species was well distributed in New England, having stations in New Hampshire, Massachusetts, Rhode Island, and Connecticut. Based on information gathered from the state Natural Heritage programs and recent field surveys, it appears there are six extant occurrences restricted to Massachusetts and Connecticut. Following an evaluation of herbarium specimens, Natural Heritage program files and other relevant information, and in light of the current low number of occurrences, small population sizes, and current restriction to two states the following objectives are proposed:

1. **establish or maintain 15 populations** within the historic range of the taxon in New England (a figure that is conservative but on the order of magnitude of historic occurrences);
2. **maintain at least 8 of these populations at a level of 50 plants** with approximately 500 stems, (a figure that approximates the median size of existing, stable populations).

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IV. APPENDICES

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1. Herbarium records for *Senna hebecarpa*

2. Additional references not cited in text but useful to the research on *Senna hebecarpa*.

3. An explanation of conservation ranks used by The Nature Conservancy and the Association for Biodiversity Information

Appendix 1: *Senna hebecarpa* herbarium records

State	EO#	Town	Date	Herbarium reference
CT	.001	Cornwall	1990	Mehrhoff, L.; #113627 CONN
CT	.002	Southbury		none recorded
CT	.003	Suffield	1947	Smith; CONN
CT	.004	Seymour	1939	Eames, E..H.; CONN
CT	.005	Guilford	1941	Neale, J.J.; CONN, NCBS, NEBC
CT	.006	Mansfield	1903	Patterson, I.W.; CONN
CT	.007	Brookfield	1939	Eames, E.H.; CONN
CT	.008	Southington	1903	Clark, H.S.; CONN
CT	.009	E. Hartford	1898	Driggs, A.W.; NEBC
CT		E. Hartford		Driggs, A.W.; ?
CT		Bridgeport	1892	Eames, E.H.; CONN
CT	.010	Oxford	1889	Harger, E.B.; NEBC
CT	.011	Middlebury	1898	Shepardson, W.M.; NEBC
CT	.012	Newtown	1883	Morong, T.; NEBC
CT	.013	Stratford	1895	Eames, E.H.; NEBC
CT	.014	Salisbury	1904	Phelps, O.P.; CONN
CT	.015	Bridgeport	1909	Clark, H.S.; NCBS
CT	.016	E. Hartford	1903	Weatherby, C.A.; NCBS
CT	.017	Ellington	1953	Rossing, A.; NCBS (2)
CT	.018	Glastonbury	1903	Starmer, F.W.; NCBS (2)
CT		Glastonbury	1905	Starmer, F.W.; NCBS
CT	.019	East Haddam	1909	No collector; CONN.
CT		South Windsor	1905	CONN
CT	.020	Easton	1892	Eames, E.H.; CONN
CT	.021	Newington	1897	Clark, H.S. CONN
CT	.022	Guilford	1903	Bartlett, G.H.; NCBS
CT	.023	Hampton	1923	Weatherby, C.A.; NCBS, NEBC
CT		Hartford	1908	Clark, H.S. NCBS
CT	.024	Sterling	1895	Smith, J.F. NCBS
CT		Suffield	1941	Smith, J.F. NCBS
CT	.025	Waterbury	1907	Blewitt, A.E.; Blewitt??
CT	.026	Wethersfield	1957	O'Brien, J.B.; NCBS
CT	.027	Litchfield	1906	Buell, F. YU
CT	.028	Trumbull	1905	Godfrey, C.C.; YU (2)
CT	.029	Derby	1852	Brewer, W.H. YU
CT	.030	Newtown	1883	Winton, A.L. YU
CT	.031	Cheshire	1943	Upson, H.N. YU
CT	.032	Bethany	1901	Nichols, G.E. YU
CT	.033	Woodbridge	1885	Evans, A.W. YU
CT	.034	New Haven	1851	Dana, J.D. YU

State	EO#	Town	Date	Herbarium reference
CT		New Haven	1873	Hawes, N?H. YU
CT		New Haven	1856	Eaton, D.C. YU
CT		New Haven	1872	Easton, D.C. YU
CT	.035	Branford	1881	Dudley, W.R.; YU, NEBC
CT		Guilford	1871	Dudley, W.R. YU
CT	.036	Washington	1919	Evans, A.W. YU
CT	.037	Franklin	1869	Woodward, R.W.; NEBC
CT	.038	Somers	1902	Pease, A.S.; NEBC
CT	.039	East Haddam	1995	Ardwin, M.; no information
CT	.040	New Milford		none recorded
MA	.001	Georgetown	1872	Tenney, R.; NEBC
MA	.002	Sherborn	1911	Loomis, M.L.; NEBC #503
MA	.003	Newton	1911	Ware, R.A.; NEBC #4131
MA	.003	Newton	1911	Rich, W.P.; NEBC
MA	.003	Newton	1911	Harris, S.; NEBC
MA	.003	Newton	1911	Farlow, W.G. ; NEBC
MA	.004	Weston	1896	Williams E.F. NEBC
MA	.004	Weston	1897	Harris, S.; NEBC
MA	.005	Lincoln	1858	Hosmer. A.W.; NEBC
MA	.006	Concord	1886	Deane, W.; NEBC
MA	.007	Bedford	1883	Jenks, C.W.; NEBC
MA	.008	Chelmsford	1902	Knowlton, C.H.; NEBC
MA	.008	Chelmsford	1882	Dame, L.L. and W.H. Manning NEBC
MA	.009	Westford	ND	Fletcher, E.F.; NEBC
MA	.010	Shirley	1882	Dame, L.L, and W.H. Manning; NEBC
MA	.011	Wayland	1912	Forbes, F.F.; NEBC
MA	.012	Sharon	1886	Kidder, N.T.; NEBC
MA	.013	Dedham	1885	Faxon, E and Faxon, C.E.; NEBC
MA	.013	Dedham	1885	Fuller, T.O.; NEBC
MA	.013	Dedham	1878	Young, HA.; NEBC
MA	.013	Dedham	1874	Davenport, G.E.; NEBC
MA	.014	Milton	1885	Deane, W. NEBC
MA	.015	Norwell	ND	Brooks, W.P.; NEBC
MA	.016	Princeton	1879	Hope, T. NEBC
MA	.017			no information
MA	.018	Ashfield	1934	Anderson, C MA
MA	.019	Amherst	ND	Tuckerman, E.; Amherst College
MA	.020	Granville	1913	Seymour, F.C.; Amherst College #36
MA	.021	West Stockbridge	1916	Walters, F. NH
MA	.022	Huntington	1998	Lombardi, R. MASS
MA	.023	Deerfield	1977	Mass. Collection #1508; 1620.

State	EO#	Town	Date	Herbarium reference
MA	.023	Deerfield	1887	Churchill, J.R.; NEBC
MA	.024	Boxford	1882	Horner, C.N.S; PMS
MA	.025	Ayer	199?	Lombardi, R, Hunt, D., Searcy K., MASS
NH	.001	Merrimack	1921	CFB 5535, 4549; NHA
NH	.001	Merrimack	1917	#27653 NHA
NH	.002	Milford	1902	Wheeler, J.H. HNH
NH	.003	Amherst	1902	Wheeler, J.H.; HNH
NH	.004	Nahsua	1890	22221 MA
NH	.005	Franklin	1921	Batchelder, C.F.; CFB5537 NEBC
NH	.006	Pelham	1902	Batchelder, F.W.; #45643 NHA
NH	.007	Chesterfield	1942	Weatherbee, C.A.& VF, and Upham, A.W.; #22194 MASS
NH	.007	Chesterfield	1942	Weatherbee C.A.& V.F., and Upham, A.; W NHA
NH	.008	Center Harbor	1894	Sargent #35406; NHA
NH	.009	Mouton-borough	1862	Flint, W.F.; # 4577 NH
NH	.010	Sandwich	1885	Kennedy, G.G.; GH
RI	.001	West Greenwich	1971	
RI	.002	Providence	1890	Collins, J.F.; BR
RI	.003	Providence	1870	Bailey, W.W.; BRU
RI	.004	Scituate	1878	?? herb
RI	.005	Scituate	1900	??herb
RI	.006	Smithfield	ND	??herb
VT	.001	Orwell	ND	Dike, A.C.; VT
VT	.002	Randolph	1895	Bates, J.A.; GH
VT	.002	Randolph	ND	Bates J.A.; Where?
VT	.003	Brandon	1922	Dutton, D.L.; VT
VT	.003	Brandon	1910	Dutton, D.L.; VT??
VT	.004	Norwich and	ND	Dike, A.C.; VT

Appendix 2: Additional references not cited in text but useful to the research on *Senna hebecarpa*.

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Kartesz, John T. *A Synonymized Checklist of the Vascular Flora of the United States, Canada, and Greenland, Second Edition.* Biota of North America Program of the North Carolina Botanical Garden. 1994. Volume 1: Checklist. Timber Press, Portland, Oregon, USA.

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Appendix 3. An explanation of conservation ranks used by The Nature Conservancy and the Association for Biodiversity Information

The conservation rank of an element known or assumed to exist within a jurisdiction is designated by a whole number from 1 to 5, preceded by a G (Global), N (National), or S (Subnational) as appropriate. The numbers have the following meaning:

1 = critically imperiled
2 = imperiled
3 = vulnerable to extirpation or extinction
4 = apparently secure
5 = demonstrably widespread, abundant, and secure.

G1, for example, indicates critical imperilment on a range-wide basis—that is, a great risk of extinction. S1 indicates critical imperilment within a particular state, province, or other subnational jurisdiction—i.e., a great risk of extirpation of the element from that subnation, regardless of its status elsewhere. Species known in an area only from historical records are ranked as either H (possibly extirpated/possibly extinct) or X (presumed extirpated/presumed extinct). Certain other codes, rank variants, and qualifiers are also allowed in order to add information about the element or indicate uncertainty.

Elements that are imperiled or vulnerable everywhere they occur will have a global rank of G1, G2, or G3 and equally high or higher national and subnational ranks. (The lower the number, the "higher" the rank, and therefore the conservation priority.) On the other hand, it is possible for an element to be rarer or more vulnerable in a given nation or subnation than it is range-wide. In that case, it might be ranked N1, N2, or N3, or S1, S2, or S3 even though its global rank is G4 or G5. The three levels of the ranking system give a more complete picture of the conservation status of a species or community than either a range-wide or local rank by itself. They also make it easier to set appropriate conservation priorities in different places and at different geographic levels. In an effort to balance global and local conservation concerns, global as well as national and subnational (provincial or state) ranks are used to select the elements that should receive priority for research and conservation in a jurisdiction.

Use of standard ranking criteria and definitions makes Natural Heritage ranks comparable across element groups—thus G1 has the same basic meaning whether applied to a salamander, a moss, or a forest community. Standardization also makes ranks comparable across jurisdictions, which in turn allows scientists to use the national and subnational ranks assigned by local data centers to determine and refine or reaffirm global ranks.

Ranking is a qualitative process: it takes into account several factors, including total number, range, and condition of element occurrences, population size, range extent and area of occupancy, short- and long-term trends in the foregoing factors, threats, environmental specificity, and fragility. These factors function as guidelines rather than arithmetic rules, and the relative weight given to the factors may differ among taxa. In some states, the taxon may receive a rank of SR (where the element is reported but has not yet been reviewed locally) or SRF (where a false, erroneous report exists and persists in the literature). A rank of S? denotes an uncertain or inexact numeric rank for the taxon at the state level.

Within states, individual occurrences of a taxon are sometimes assigned element occurrence ranks. Element occurrence (EO) ranks, which are an average of four separate evaluations of quality (size and productivity), condition, viability, and defensibility, are included in site descriptions to provide a general indication of site quality. Ranks range from: A (excellent) to D (poor); a rank of E is provided for element occurrences that are extant, but for which information is inadequate to provide a qualitative score. An EO rank of H is provided for sites for which no observations have made for more than 20 years. An X rank is utilized for sites that known to be extirpated. Not all EO's have received such ranks in all states, and ranks are not necessarily consistent among states as yet.