Conservation Assessment

For

Purple milkweed (Asclepias purpurascens)

USDA Forest Service, Eastern Region
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This document is undergoing peer review, comments welcome

This Conservation Assessment was prepared to compile the published and unpublished information and serves as a Conservation Assessment for the Eastern Region of the Forest Service. It does not represent a management decision by the U.S. Forest Service. Though the best scientific information available was used and subject experts were consulted in preparation of this document, it is expected that new information will arise. In the spirit of continuous learning and adaptive management, if you have information that will assist in conserving the subject community, please contact the Eastern Region of the Forest Service **-** *Threatened and Endangered Species Program at 310 Wisconsin Avenue, Suite 580 Milwaukee, Wisconsin 53203.*

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EXECUTIVE SUMMARY

The National Forest Management Act and U.S. Forest Service policy requires that Forest Service lands be managed to maintain viable populations of all native plant and animal species. A viable population is one that that has the estimated numbers and distribution of reproductive individuals to ensure the continued existence of the species throughout its range within a given planning area (FSM 2670.5.22) (Brzeskiewicz, 2000).

This Conservation Assessment provides a review of the taxonomy, life history, habitat, distribution, and population viability of purple milkweed (*Asclepias purpurascens* L.), as well as potential threats to it, within Region 9. The body of information within this report comes from a detailed literature review, personal and written communication with state, federal, academic, and consulting botanists, and examination of specimens at the University of Michigan herbarium.

Region 9 is comprised of 20 states and 15 National Forests. The states include Connecticut, Delaware, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, and Wisconsin. The National Forests include the Allegheny, Chequamegon/Nicolet, Chippewa, Green Mountain/Finger Lakes, Hiawatha, Hoosier, Huron-Manistee, Mark Twain, Midewin (National Tallgrass Prairie), Monongahela, Ottawa, Shawnee, Superior, Wayne, and White Mountain (Figure 1).

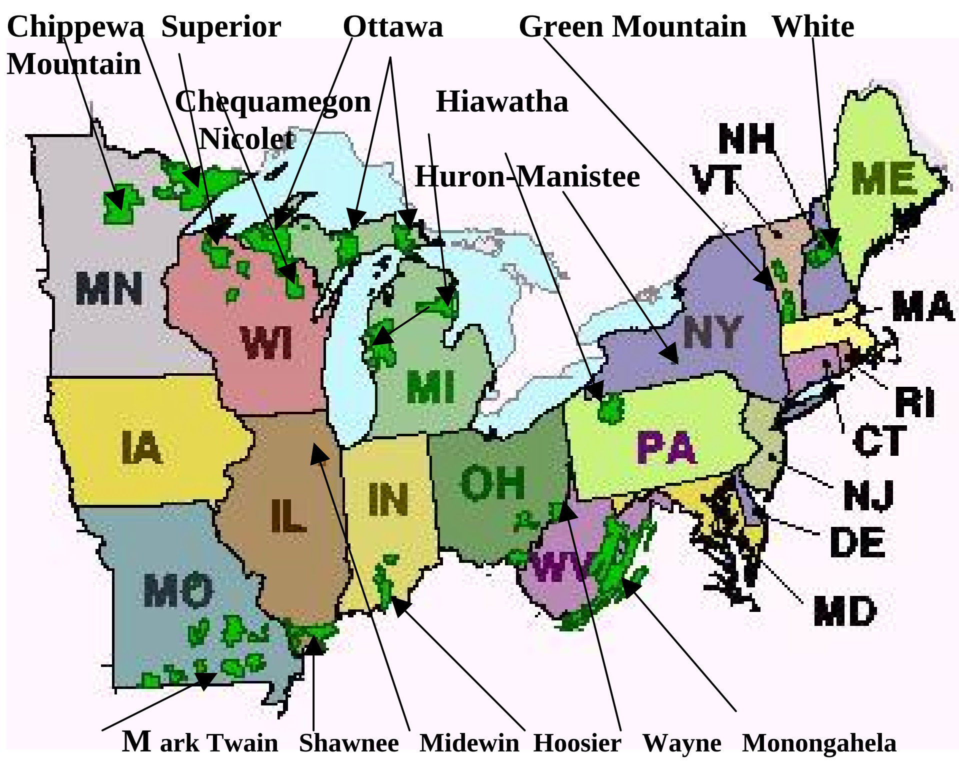

Figure 1: States and National Forests comprising Region 9.

Asclepias purpurascens has been assigned a conservation rank or status by eleven states including, Connecticut, Delaware, Maryland, Massachusetts, Michigan, New Hampshire, New

Jersey, New York, Rhode Island, Vermont, and Wisconsin (see Table 1). This species is considered to be relatively common in Illinois, Indiana, Missouri, and Ohio. Farnsworth and DiGregorio (2002) now consider the species extirpated in Maine, Vermont, and Rhode Island. It also appears to be extirpated in Minnesota.

Asclepias purpurascens has been documented in the Hoosier, Huron-Manistee, and Shawnee National Forests. It has a high probability of occurring in Midewin National Tall Grass Prairie, Mark Twain, and Wayne National Forests, however, data confirming this are not available. *Asclepias purpurascens* is designated as a Regional Forester Sensitive (R9) species on the Huron-Manistee National Forest (see Table 2).

INTRODUCTION

Asclepias purpurascens has a wide ecological tolerance (Woodson, 1954), occupying habitats such as dry semi-open woodlands, roadsides, open fields, moist meadows and fens. The species appears to display a preference for soils rich in calcium or magnesium, which may explain the species' flexible tolerance for a range of moisture conditions (Farnsworth, 2001. cf. Farnsworth and DiGregorio, 2002). The authors state that, "Throughout its range, the taxon occurs in widely-scattered, usually small populations, and has been undergoing general declines in abundance as reflected by its conservation ranks of S1-S3 or SH/SX in 21 states and provinces."

In New England, Farnsworth and DiGregorio (2002) provide a list of potential reasons for the decline in the species including, road improvement, roadside herbicide spraying, utility line easements, habitat conversion, succession, invasive species, and increasing inbreeding depression in shrinking populations. Numerous factors have been listed as possible reason for the typical low fruit set observed in this species including, fungal infection of the nectar and its affect on pollen tube growth, limited available nutrients, interbreeding breeding with cogeners, and pollen swamping from cogeners.

NOMENCLATURE AND TAXONOMY

Asclepias purpurascens is a member of the:
Family Asclepiadaceae
Order Gentianales

The family Asclepiadaceae, as defined in Cronquist (1981), consists of 250 genera and 2000 species, with the genera Asclepias consisting of 150 species. Members of the family typically have opposite or whorled entire leaves, rarely the leaves are alternate or lobed. The flowers are generally cymose or seldom racemose and are perfect or rarely unisexual. In North America, including the Antilles, the genus *Asclepias* consists of 108 species, which are distributed among nine subgenera (Woodson, 1954). The North American species of Asclepias form a coherent alliance quite independent of those indigenous either to Africa or to South America. The subgenus Asclepias is in turn subdivided into nine series, with *A. purpurascens* belonging to the series Purpurascentes.

In the genera Asclepias, the flowers are actinomorphic, consisting of five equal lobes. Five stamens are united with the fleshly stigma head to for the gynostegium, a feature typical of the family. The filaments are coherent into a column and adnate to the base of the corolla tube (Woodson, 1954). The anthers are bilocular and in each cavity the pollen grains at maturity are combined in a glutinous pollinium. Pollinia from adjacent pollen sacs of two different anthers are connected by a translator that attaches to visiting insect legs. The corona consists of five separate hoods borne at the summit of the column and subtending the anthers. The hoods serve as nectaries that attract pollinators and are a principal feature used to distinguish species. Alternating with the hoods are five-minute ligular organs or alternating lobules. The fruits of *Asclepias* consist of a simple dry follicle that dehisces along its ventral suture. These are erect on deflexed pedicels or, to a lesser degree erect on erect or pendulous pedicels. The base chromosome number is $n = 11$ (Woodson, 1954).

DESCRIPTION OF SPECIES

Asclepias purpurascens is a perennial herb emanating from a stout non-rhizomatous rootstock, ranging to one meter in height. The stems are minutely pilose when young, becoming glabrate. The leaves are approximately 6-18 cm long and 3-10 cm wide, broadly ovate to oblong lanceolate with an obtuse to acute apex and cuneate base (Figures 2-4). They are glabrate above with dense uniformly distributed short pubescence beneath. The leaf petioles are short, ranging from 0.2-2.5 cm long. The inflorescence is terminal and generally solitary or paired, but occasionally with additional ones in the upper nodes. The slender peduncles are 1.5 to 9.0 cm long. The flowers are typically large; 13-17 mm in length with hoods 3-7 mm long. The deep rose to purple lavender reflexed corolla lobes are ovate to elliptic-lanceolate and glabrous. The hoods conspicuously surpass the gynostegium and typically do not have median teeth. A 5-7 mm long, flattened, incurved horn is half adnate to and shorter that the hood. The glabrous gynostegium is deep rose colored and 1.5-2 mm tall and 1.5-3 mm wide. The pollinia are approximately 1.3 mm long. The fusiform follicles are 10-16 cm long and 1-2 cm thick, smooth, and minutely puberulent to glabrate. The follicles are erect on deflexed pedicels and the seeds have a tuft of comose hairs. This species has a superficial resemblance to *A. incarnata* and *A. syriaca*. However, the horns conspicuously surpass the hoods in *A. incarnata* and the flowers are generally much smaller, while the leaves are obtuse and prominently pinnate veined in *A. syriaca* versus acute and net veined in *A. purpurascens*.

Figure 2. Acute leaf of Asclepias purpurascens.

Figure 3. Large flowers; horn not exposed.

Figure 4. Single terminal umbel on left; additional umbels in upper axils on right.

LIFE HISTORY

The family Asclepiadaceae has evolved complex floral structures for maximizing the use of insects as pollinators. The gynostegium consists of five stamens united to form five lateral stigmatic surfaces. These are enclosed by wings of anthers to produce five stigmatic chambers. From the bases of these stamens extend the hoods with reservoirs for nectar secreted in the stigmatic chambers. There are five paired pollinia from adjacent anthers that are connected by translator arms to a corpuscular column that sits above a narrow opening in the stigmatic chamber. The pollinia are pulled from the flower when an insect leg bristle or leg slips into the fissure. It is inserted when the pollinium lodges in a stigmatic surface (Wyatt and Broyles, 1994). "The entomophilous pollination of the Asclepiads provides one of the most fascinating chapters in biology…(Woodson, 1954).

The insects observed by Charles Robertson (Woodson, 1954) to pollinate *A. purpurascens* include five species of Lepidoptera, one Hemiptera, one Hymenoptera, and one Diptera. Bumblebees (*Bombus* spp.) are common pollinators of *A. syriaca* in New England (Morse and Fritz, 1983, cf. Farnsworth and DiGregorio, 2001), and are likely to be the most frequent visitors to *A. purpurascens* in the areas in which the two species overlap. DiGregorio (Farnsworth and DiGregorio, 2002) documented both *Bombus* spp. and numerous flower-flies of the Syrphidae family (*Syrphus* spp.) feeding on the flowers of A. purpurascens in Falmouth, Massachusetts. Morse (Morse 1982, cf. Wyatt and Broyles, 1994) speculates that the durable covering of the milkweed pollinia should allow a long residence time on pollinators, thus enhancing pollen dispersal distances. This durability may be more profound in species that inhabit open environments versus moist woodlands.

Hybridization is uncommon in milkweeds due largely to mechanical and physiological isolation. Different shapes of the stigmatic chambers between species reduce the potential for pollinia to be inserted. For those that are successfully inserted, the pollen germinates and penetrates the ovules within the ovary, but seeds fail to develop (Kephart 1981 cf. Wyatt and Broyles 1994). When hybrid seeds do develop, it has been speculated that fruits may abort because they contain less than the full compliment of seeds (Wyatt and Broyles 1992 cf. Wyatt and Broyles 1994). Wyatt and Broyles (unpublished cf. Wyatt and Broyles, 1994) report that artificially produced hybrids between *A. exaltata* and *A. purpurascens* exhibited reduced pollen viability relative to parental plants.

Insect herbivory does not appear to be significant in milkweeds. Wilbur (1976, cf. Farnsworth and DiGregorio, 2002) found little evidence of herbivory on *A. purpurascens* in Oak-Hickory woodlands in Michigan. He documented a curculinoid beetle (*Ryssomatus* sp.) which feeds on leaves and chews holes in stems at the site but did not find it to significantly reduce the probability of flowering in the next growing season. Insects by in large have not evolved systems to overcome the secondary chemical defenses produced by milkweeds. Mammals on the other hand do affect milkweed development. Pollini and colleagues (Farnsworth and DiGregorio, 1994) observed white tailed deer eating *A. purpurascens* stems to the ground. Because *A. purpurascens* is non-rhizomatous and lacks the capacity to store large amount of food, deer herbivory may reduce the vigor of plants.

Milkweed populations appear to remain stable for many years and individuals are long lived. Wilbur (1976) noted that one small of population of thirty-two *A. purpurascens* plants had been known at his study site since 1961. Woodson (1962, cf. Farnsworth and DiGregorio, 2002) speculates that individual *A. tuberosa* plants may persist twenty-five years or more.

HABITAT

Asclepias purpurascens occurs in a wide range of habitats and soil moisture conditions including woodland edges and thickets on dry soils, roadsides, shorelines, prairies, sandy rocky calcareous soils of open deciduous woodlands, swamp forests and alluvial woods. Its frequent association with edges of woodlots, thickets, and roadsides suggests it is relatively shade intolerant. In Gray's Manual of Botany 8th Edition, Fernald (1950) characterizes the habitat as dry to damp woods, thickets and openings. Gleason and Cronquist (1991) simply noted it as an inhabitant of dry soil. Voss (1996) describes the habitat in Michigan as dry woodland and thickets, shores and prairies.

In Indiana, Deam (1940) described the habitat as rather dry, usually somewhat sandy soil in open woodland, along roadsides, and on damp open woodland around swamps and lakes and even in tamarack bogs. Cooperrider (1995) characterizes the principal Ohio habitat as open woods, fields, thickets, and roadsides. Swink and Wilhelm (1994) find the species in prairie associations in the Chicago Region, most often at the edges of woods that are open or somewhat disturbed. Here it is often in thickets that are undergoing fairly rapid ecological change and have partial sun and shade conditions. Sime (per comm. 2002) observed *A. purpurascens* in open oak woodlands and wood edges, on gentle (10 to 20%) slopes generally facing southward or southwest in Wisconsin. These sites have thin, well-drained soil of moderate fertility with neutral pH. Distinctive habitats noted for New York include, old fields with eastern red cedar; grassy openings in dry open woods; grassy serpentine barrens, fields in urban parks that are occasionally burned; a sedge meadow at the edge of a wetland; and openings in damp pine barrens (NYNHP web site). Steyermark (1963) described the Missouri habitat as consisting of rocky open woods, glades, prairie openings, stream banks, and wet meadows in valleys, upland dry ridge tops and thickets. Radford, Ahles, and Bell (1968) describe the habitat in the Carolinas as swamp forests and alluvial woods. Hartman, in the Flora of the Great Plains (1986), characterizes the habitat as sandy or rocky calcareous soils of open deciduous woodlands.

Habitat of recently observed extant populations in New England (Farnsworth and DiGregorio, 1994) included woodland edge, an island heatheland, a power line right-of-way, a mesic old field, a former airport situated on a sandy outwash plain, and a successional sedge meadow.

The frequency of occurrence in fire-dependent ecosystems (i.e. prairie, oak savanna) suggests it may have historically benefited by this type of disturbance. Pruka (1997, cf. Farnsworth and DiGregorio, 2002) points to this taxon as "one of several indicators plant species of "recoverable" (healthy or restorable) oak savannas and open oak woodlands in southern Wisconsin."

Based on a review of cited habitat Farnsworth and DiGregorio (2002) conclude that *A. purpurascens* may be loosely associated with circumneutral soil types that include, sandy, clayey, or rocky calcareous/gypseous soils of prairies and mid-western oak glades; the limestone area of the lower Illinois River Valley; wet soils derived from mafic bedrock in North Carolina; limestone formations in Tennessee; and soils overlying the New Haven arkose Formation and other circumneutral bedrock types in Connecticut. This preference for soils rich in calcium and magnesium may explain the species flexible tolerance for a range of moisture regimes characteristic of other calciphiles. It is noted, however, that not all New England populations appear to be found on circumneutral soils.

DISTRIBUTION AND ABUNDANCE

Woodson (1954) recognizes two disjunct populations of *A. purpurascens* in North America, the Ozarkian and Appalachia. Gleason and Cronquist (1991) describe the distribution as southern New Hampshire to Virginia, west to Wisconsin, Iowa, Kansas, and Oklahoma. This distribution includes all of the states that comprise Region 9. Woodson (1954, cf. Farnsworth and DiGregorio, 2002) viewed the Appalachian population as having "withdrawn almost completely from [their] putative refugium to the middle and northern Atlantic coast."

Farnsworth and DiGregorio (2002) indicate that this plant is now considered extirpated in Maine, New Hampshire, Rhode Island, and Vermont. The New England element occurrence records (Farnsworth and DiGregorio, 2002) indicate three extant and 36 historic sites in Massachusetts. Two of the extant populations are under industrial ownership and one is on a preserve. Massachusetts ranks this species as threatened. These records indicate Connecticut has two extant populations and 39 historic. It is currently ranked as Special Concern in Connecticut. One location occurs on state land and one is on a preserve. Farnsworth and DiGregorio (2002) believe that less than thirty plants exist in the entire New England region. In Delaware, this species was historically considered frequent in dry woods and fields, and roadsides in the Piedmont and northern portion of the coastal plain in New Castle and Cecile Counties (Tatnall, 1946). It is currently ranked as S2; indicating there is between 6-20 known occurrences in the state.
Asclepias purpurascens is ranked as a S3, S4 in New Jersey, with 21 and 51+ known historic occurrences. Hough (1983) considered it infrequent on the Inner Coast Plain, rare in Cape May and Atlantic counties of New Jersey. Stone (1973, cf. Farnsworth and DiGregorio, 2002) described it as "frequent in dry ground of the northern counties and rare southward."

Maryland has ranked the status of this species as currently uncertain. Brown and Brown (1984, cf. Farnsworth and DiGregorio, 2002) cited it as being, "Frequent in Piedmont and northern coastal plain, infrequent elsewhere." The Maryland County list of rare species (Maryland Natural Heritage web site, 2002) does not list this species. In New York there are eight historic locations in the lower Hudson region and around New York City (New York Heritage map, 2002). Although the vigor of the plants is considered normal the populations are low (i.e. 5-30 plants) due to small amount of available habitat. This species is currently on the New York watch list.

Pennsylvania has historical occurrence of this species in 22 counties (Rhoads and Block 2000), however, conservation botanists (Steve Grund and John Kunsman, per comm. 2002) believe that many of these populations no longer occur and that future consideration may be given to assessing the status of species in the state. Rhoads and Block (2000) consider it as rare in Pennsylvania, occurring chiefly in the southeastern portion of the state. Cooperrider (1995) has *A. purpurascens* mapped as occurring in 41 of the 88 counties comprising Ohio. Agency botanist Jim McCormac (per comm. 2002) indicates that in Ohio the species is not particularly rare, and is scattered throughout the state with most occurrences in southern Ohio. *Asclepias purpurascens* occurs throughout most of Indiana, Illinois and Missouri and has never been tracked. Homoya (per comm. 2002) states that in Indiana "Asclepias purpurascens is found throughout the state, although apparently absent in many of the central Indiana counties." Likewise, Smith (per comm. 2002) indicated that "Asclepias purpurascens is common enough in MO that we never tracked its occurrence."

Table 1: Status of *Asclepias purpurascens* Region 9 States.

State	State Rank	State Status	Comment
CT		SC	Two extant populations as of 2002; 39 historic locations
DE	S2		Historic mapped in two counties; 6-20 sites
IL			Not tracked; widespread, mapped in 75-counties
IN			Not tracked; widespread
IO			Not tracked; mapped in 14-counties
ME			Extirpated; historically mapped 1-county
MD	SU		Not listed by state
MA		T	Three extant populations as of 2002; 36 historic locations
MI	S3	SC	Historically mapped in 22-counties
MN			Extirpated
MO			Not tracked
NH	SH		Extirpated
NJ	S3,S4		Historically mapped in 15-counties.
NY	S3		Eight historic sites as of 2002
OH			Not tracked; widespread; mapped in 22-counties
PE			Not tracked; mapped in 20-counties
RI		SH	Extirpated; 4 historic sites
VT		SH	Extirpated
WV			Not tracked; mapped as occurring in 12-counties
WI	S2	E	Mapped in 13-counties harboring 22 populations

[1]Asclepias purpurascens is ranked as G4G5 for all states assigning a rank or status. Plants are considered globally secure. S2=rare, 6-20 occurrences; S3=uncommon, 21-100 occurrences dependent upon state; S4=apparently secure in state; SC=Special Concern (on watch list); SH=State Historical occurrence; SU=possibly in peril in state but status uncertain; T=State Threatened, possibility of becoming endangered; E=Endangered. NA=Not Available

The Illinois Plant Information Network (ILPIN web site, 2002) indicates that the species occurs in 75 Illinois counties. Mohlenbrock (1986) considers it occasional throughout the state. Onwbey and Morely (1991) do not show this species as currently occurring in Minnesota. It is known in Minnesota only from Wabasha County and was last collected in 1883 (Newman per comm. 2002). It is not listed in Iowa, though Eilers and Roosa (1994) characterized it as an infrequent to rare species. It is mapped as occurring in 14-counties (USDA-ASPU2) in Iowa. This species is listed as endangered in Wisconsin. A distribution map produced by the Wisconsin State Herbarium (WICOMP) indicates the species occurs in 14 counties, primarily in the southern portion of the state, with a total of 22 population sites. Of the 58 *A. purpurascens* records that the WIDNR has, 25 are considered historic or pre-1970. In Michigan this species is ranked as S3/SC indicating that there are 21 to 100 occurrences in the state and that additional data on the species needs to be collected. *Asclepias purpurascens* is known from more than 60 occurrences in southern Michigan; thirty-four of these records derived from collections made prior to 1930. It is concentrated in 19 counties in southwestern Lower Michigan, most counties tallying only a single occurrence (Choberka et al., 2000). An additional population was discovered in 2001 in Newaygo County (Ruta per comm., 2002).

Asclepias purpurascens is documented for the Huron-Manistee, Hoosier, and Shawnee National Forests (Ruta, Larson, and Shimp per comm., 2002). Although not documented, it has a high probability of occurring on the Mark Twain, and Wayne National Forests and Midewin National Tall Grass Prairie. However, because it is not rare in these areas, biologists have given little attention to it. It occurs occasionally as small populations at the edge of oak/hickory woodlands and in barrens in the Shawnee and is not considered rare (Shimp per comm., 2002). The botanist on the Wayne assumes it occurs sparingly in the Forest, citing the fact that it is not rare in Ohio (Larson per comm., 2002). *Asclepias purpurascens* occurs in one or more of the 30 counties in the Mark Twain proclamation boundary (Lane per comm., 2002). Though *Asclepias purpurascens* occurs in West Virginia it currently not known if it occurs on the Monongahela (Garrett per comm., 2002). It does not range as far north as the Hiawatha, Ottawa, Superior, Chippewa, or Chequamegon and Nicolet National Forests and is not known to occur on them (Newman, Trull, Spickerman, and Greenlee per comm., 2002). The atlas of Pennsylvania does not indicate any documented occurrences of Asclepias purpurascens in the counties comprising the Allegheny National Forest, suggesting it does not occur on the Forest (Moore per comm., 2002). It is currently considered extirpated in Maine, New Hampshire and Vermont and there are no records of occurrence on the White Mountain, Green Mountain, and Finger Lakes National Forests (Prout and Burbank per comm., 2002).

Asclepias purpurascens is designated as a Regional Forester Sensitive (R9) Species on the Huron-Manistee National Forest. One population was discovered in 2001. In 2002 this population contained 133 plants, of which 90 were sterile, 40 were flowering, and 3 were fruiting. The population had undergone considerable herbivory. The population occurs in an Oak/Jack Pine type with a predominance of oak and a fairly dense herbaceous cover. The water table is apparently close to the surface, at an average depth of approximately 2-3-feet. This site may occasionally have standing surface water (Ruta per comm., 2002).

Table 2: Status of *Asclepias purpurascens* within Region 9 National Forests.

National Forests	Comment

Allegheny	Doubtful; not mapped in PE atlas
Chequamegon-Nicolet	Not present
Chippewa	Not present
Green Mountain-Finger Lakes	Not present
Hiawatha	Not present
Huron-Manistee	R9 species; documented 2001
Hoosier	Documented but not tracked
Midewin	High probability of occurring, not tracked
Mark Twain	High probability of occurring, not tracked
Monongahela	IN WV, no information for Forest
Ottawa	Not present
Shawnee	Documented but not tracked
Superior	Not present
White	Not present
Wayne	High probability of occurring, not tracked

POPULATION BIOLOGY AND VIABILITY

Detailed studies of the population biology of *A. purpurascens* do not appear to have been completed. Wilbur (1976) looked at reproductive strategy and the impact of predation on seven milkweed species in Michigan, however, the small sample size (*n* = 30) for *A. purpurascens* limited comparative statistical analysis. *A. purpurascens* is perennial, does not propagate vegetatively, and is self incompatible, relying on insects to effect cross-pollination. The typical flowering time in its range is from May through July, with fruits maturing in late summer. In general milkweeds have long-lived flowers that produce copious amounts of nectar (Wyatt and Broyles, 1994).

Factors such as drought, flooding, nutrient availability, and interspecific and intraspecific competition could affect viability. Chaplin and Walker (1982) speculate that an observed decrease in number of flowering plants during one year of their study may have been attributable to drier conditions during the spring. Their studies indicate that individual flowers are energetically inexpensive to produce but that a single seedpod is expensive. Fruit set is generally low in natural populations, with averages ranging form 0.33% to 5.0%. Low fruit set may be due to lack of sufficient nutrients or light to produce mature fruits. Willson and Price (1980 cf. Farnsworth and DiGregorio, 2002) demonstrated that fertilization with nutrients and enhanced light availability improved fruit production in *A. syriaca* and *A. verticillata*. Chaplin and Walker (1982) found that the total number of flowers an individual *A. quadrifolia* plant produces appears to be determined by the size of the total plant or root. This appears to be true for other milkweeds as well; total number of flowers is significantly correlated with aboveground plant size (Wyatt 1980, cf. Chaplin and Walker, 1982).

The role herbivory plays in the long term viability of *Asclepias purpurascens* populations is in need of further study. Wilbur (1976) found no significant association between whether or not a plant was attacked by insect herbivores in one summer and whether or not it survived or flowered the next year. He concluded that this lack of association during his study suggested that mortality between years were due primarily to physical factors such as direct destruction of a stem. Conversely, Chaplin and Walker (1982) found that *A. quadrifolia* produced a significantly smaller stem with fewer flowers in the year following the production of a pod or major herbivore damage by a curculinoid beetle (*Rhyssomatus lineaticollis*) or monarch butterfly (*Danus plexippus*). The evolution and production of secondary defense chemicals has limited the number of insect herbivores on milkweeds, however, vertebrates such as deer may significantly effect a population through over-browsing.

A. purpurascens lacks a large underground rhizome for storage of critical food reserves, therefore stress from factors such as herbivory, insufficient available nutrients, drought, and interspecific competition for available nutrients with cogeners, could result in smaller plants and number of flowers the following year. Intraspecific competition may come from native and non-native species during the succession of early seral stage habitat to mid and late seral stages. The proliferation of non-native plants in habitat that may be suitable for *A. purpurascens* further reduces the potential for the species to colonize marginal or optimal sites.

The question concerning the long-term viability of extant populations will require detailed assessment of the potential limiting factors. The extant populations of this species appear to be rather small in most parts of its range. Though able to pioneer disturbed sites its frequency of occurrence has not increased. Direct destruction of populations and continued fragmentation of the landscape has left extant populations in New England separated by great distances thus reducing the chance that an insect pollinator will find multiple populations in the patchy environment. Even if such visitations do occur it is not known whether the pollinia are tolerant to desiccation that may occur during a long flight. The risk is great for small isolated populations to undergo inbreeding depression. This may be a significant factor in the decreased fruit set observed in New England populations by Farnsworth and DiGregorio (2002). Of 30 *A. purpurascens* plants in Wilbur's (1976) study only one produced fruit and many seeds.

Although mechanical and physical condition within the floral structure may serve to reduce the occurrence of hybridization in milkweeds, it can and does occur. Wyatt and Broyles (1994) reported that hybrids between *A. exaltata* and *A. purpurascens* exhibited reduced pollen viability relative to parent plants. *A. exaltata* and *A. syriaca* have been shown to exchange alleles via interbreeding (Broyles 1992, cf. Farnsworth and DiGregorio, 2002). Given that these species are often cogeners with *A. purpurascens*, the introgression is possible. Landscape fragmentation has likely stimulated the adventitious expansion of *A. syriaca* into many available pioneer habitats. Populations in close proximity to *A. purpurascens* could serve to swamp their flowers with pollinia, potentially affecting reproductive success.

The occurrence of a fungal infection of the nectar of *A. purpurascens*, similar to that found in *A. syraica* nectar (Eisikowitch et. al., 1990, Mclernon 1995, cf. Farnsworth and DiGregorio, 2002) needs to be investigated. This yeast infection is capable of breaking down lipids and proteins in the pollen tubes, which does not permit pollen germination of flowers.

POTENTIAL THREATS AND MONITORING NEEDS

There has been a general decline of *A. purpurascens* throughout its range resulting from both anthropogenic and natural processes. With limited regulations for rare species on private landholdings it is likely that additional populations will succumb to continued urban, industrial, or residential expansion. The natural and anthropogenic affects on *A. purpurascens* have been brought to light in the Conservation and Research Plan developed for New England populations (Farnsworth and DiGregorio, 2002). Many New England historical populations have disappeared, and it is probable that the remaining isolated populations are at long-term risk from the affects of inbreeding depression. Deleterious recessive alleles become more likely to be expressed when populations are reduced in number (Soule´ and Orians, 2001). Future studies may point to inbreeding depression as the principal reason for low fruit set observed in many extant populations. Small isolated populations in New England and Mid Atlantic states and Wisconsin, Michigan, New York and potentially Pennsylvania are all at risk from genetic and environmental stochastic events and natural catastrophe.

The primary conservation objective for *A. purpurascens* in the New England states (Farnsworth and DiGregorio, 2002) is to find, protect, maintain, or establish at least twenty separate occurrences in Massachusetts and Connecticut. At least ten of these populations should contain a minimum of 30 to 50 plants in order to maintain stable numbers and to increase the probability of successful pollination and fruit set (Farnsworth and DiGregorio, 2002). Populations of this magnitude at other North American sites apparently can remain stable for many years (Wilbur 1976, cf. Farnsworth and DiGregorio, 2002), and a theoretical minimum viable population size on the order of fifty plants is suggested as one means to reduce inbreeding (Frankel and Soule′, 1981, Shafer 1987, cf. Farnsworth and DiGregorio, 2002). These populations are still subject to environmental and catastrophic events that could quickly impact them. Lande (1998 cf. Soule′ and Orians, 2001) has shown that demographic stochasticity is unlikely to be important for any population that has more than 100 individuals, but random environmental variation or catastrophes are important for populations of all sizes, and they become more significant as environmental variability becomes large in relation to the population growth rate. Examples of this variability may include global warming, non-native insect infestation, and new parasites and viral infections. The minimum viable population needed to buffer environmental and natural catastrophes may be on the order of 10^3-10^6 individuals (Shafer, 1987 cf. Falk and Holsinger, 1991).

An assessment of the extant populations of *A. purpurascens* in all the Region 9 states and Forests has not been undertaken. Detailed comparative studies should be initiated in order to understand the species population dynamics as well as those factors that may limit its fruit set and population expansion into available and seemingly suitable habitat. It may prove beneficial to conduct these long-term studies in those states in which the species is still common and support an adequate sample size.

Farnsworth and DiGregorio (2002) have developed a prioritized strategy for the conservation of the taxon in New England. They have suggested that the general actions, in descending order of importance, include;

(1) land acquisition or protection of occurrences;
(2) regular surveys of known occurrences;
(3) de nova searches for new populations;
(4) ex-situ activities including seed banking, germination research and propagation;

(5) habitat and site management;
(6) species biology research; and
(7) augmentation, introduction, and reintroduction.

Acquiring land for protection of extant populations is a progressive approach, though often costly. Assessing the presence of populations at historically recorded sites may need to be conducted prior to land acquisition in order to prioritize those sites for purchase based the size of the population and surrounding habitat suitability. Searches for additional populations should be conducted in concert with those for the historic sites, extending to all potentially suitable habitats within the vicinity of the historic site. Extant populations should be monitored for fruit set and potential seed acquisition for artificial propagation. These sites should be assessed for the possible management and/or maintenance of existing habitat and the potential creation of additional suitable habitat. Examples of this include the reduction of competing woody and herbaceous material including other milkweed species and preventing, if necessary, deer from over browsing the plants by constructing a fence enclosure. Additional research on factors affecting fruit set and abiotic requirements for this species need to be conducted. Consideration needs to be given to creating new populations through planting of artificially propagated plants and infusing extant populations with plants from others genetic sources.

Monitoring and appropriate management of the habitat of the only known population of *A. purpurascens* on the Manistee portion of the Huron-Manistee National Forest seems to be a measure worth consideration. Likewise, additional field searches for other populations within suitable habitat in adjoining compartments should be completed. Elevating this species to Forest Deliberative in the Mark Twain, Shawnee, Hoosier, and Wayne would stimulate the collection of base line data on the frequency of occurrence of the species in these Forests.

In the short-term *A. purpurascens* appears to be secure in Missouri, Illinois, Indiana, and Ohio and uncommon to rare in Wisconsin, Michigan, Pennsylvania, New York, West Virginia, Maryland, Delaware, New Jersey, Connecticut, and Massachusetts. It is currently considered extirpated from Minnesota, Maine, Vermont, New Hampshire, and Rhode Island. At minimum, state and federal agencies should consider implementing strong conservation measures and population studies for this species in those states in which it is considered a species of concern.

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