Sensitive Joint-Vetch
(*Aeschynomene virginica*)

5-Year Review:
Summary and Evaluation

U.S. Fish and Wildlife Service
Virginia Field Office
Gloucester, Virginia

February 2012

5-YEAR REVIEW
Sensitive Joint-Vetch (*Aeschynomene virginica*)

1.0 GENERAL INFORMATION

1.1 Reviewers:

Lead Regional Office: Region 5

Lead Field Office: Virginia Field Office

Cooperating Field Offices(s):
Chesapeake Bay Field Office
New Jersey Field Office
Raleigh Field Office

Cooperating Regions: Region 4

1.2 Methodology used to complete the review: This 5 year status review consists of a summary and evaluation of information collected since the recovery plan was finalized in 1995. The information was gathered and a draft review was prepared under contract by Nancy E. Van Alstine of the Virginia Department of Conservation and Recreation, Division of Natural Heritage (DCR-DNH). A bibliography of reports and literature on sensitive joint-vetch (SJV) provided by the Virginia Field Office (VAFO), was initially reviewed and expanded with literature and reports held by DCR-DNH. The NatureServe website with Rangewide Element Occurrence (EO) data was accessed to begin updating occurrences by state which appeared in the recovery plan and continued in a 1998 revision of the table. To ensure that the most recent data available was included, email requests for comments and updated monitoring data, research, and current threats were then sent to Natural Heritage Program botanists in Maryland, New Jersey, and North Carolina, staff with The Nature Conservancy (TNC) knowledgeable about the SJV populations on TNC preserves, managers of public lands with SJV populations; and some researchers of current and past studies.

1.3 Background:

1.3.1 FR Notice announcing initiation of this review: 73 FR 76373-76375 (December 16, 2008) Endangered and Threatened Wildlife and Plants; Initiation of 5-Year Reviews of 7 Listed Species

1.3.2 Listing history
FR notice: 57 FR 21569-21574 (May 20, 1992)
Date listed: effective date June 19, 1992
Entity listed: species
Classification: threatened

1.3.3 Associated rulemakings: none

1.3.4 Review history: No five year reviews have been written for SJV.

1.3.5 Species' Recovery Priority Number at start of review: 2
This designation corresponds to a species experiencing a high degree of threat and a high recovery potential.

1.3.6 Recovery Plan
Name of Plan: Sensitive Joint-Vetch (*Aeschynomene virginica*) Recovery Plan
Date issued: September 29, 1995

2.0 REVIEW ANALYSIS:

2.1 Application of the 1996 Distinct Population Segment (DPS) policy: SJV is a plant; therefore, it is not covered by the DPS policy.

2.2 Recovery Criteria

2.2.1 Does the species have a final, approved recovery plan containing objective, measurable criteria? No. The recovery criteria require further definition or explanation to be considered objective and measurable. As written, they include subjective terms such as "stable" and "fully protected" which can be considered and analyzed, but are not objective.

2.2.2 Adequacy of recovery criteria

2.2.2.1. Do the criteria reflect the best available and most up-to-date information on the biology of the species and its habitat needs? No. The drainages in Virginia which are considered important for protection and annual monitoring do not include the James River where survey efforts from 1995-2001 identified one historical and one new occurrence (two subpopulations). This drainage should be added to the Recovery Criteria to reflect this new knowledge.

2.2.2.2. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria? The five listing factors are not directly referenced in the broadly written recovery criteria, but aspects of them would play a role, particularly in the Recovery Criterion (1) addressing the adequate protection of SJV and its ecosystems in the six watersheds described. Recovery Criterion (2), focusing on annual monitoring, is a vital tool needed to assist in detecting changes in population that result from four of the factors: present or threatened destruction, modification or curtailment of its habitat or range; overutilization; disease or predation; and other natural and manmade factors. However, criterion 2 does not distinguish which factor is affecting the species, and only identifies whether threats appear to be affecting populations. Understanding the life history and ecological requirements of the species (Recovery Criterion 3) is a basis for understanding what is needed to protect and manage populations of this species.

2.2.3 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information.

The Plan contains the following Delisting Criteria:

(1) The sensitive joint-vetch and the ecosystem upon which it depends are fully protected – including conservation of all extant sites (or a combination of extant and future sites identified as viable that is commensurate to at least the current known status of the species) -- within the following six watersheds: Manokin Creek in Maryland; Manumuskin River in New Jersey; Rappahannock, Pamunkey, Mattaponi, and Chickahominy Rivers in Virginia. These systems must be protected from present and foreseeable anthropogenic and natural threats that may interfere with the survival of the species. Adequate protection measures comprise protection of wetlands where the plant occurs, protection of water quality and quantity, and protection of an adequate upland buffer.

Criterion 1 has not been met.
Overall, SJV and the ecosystems upon which it depends are not yet adequately protected within the designated watersheds. Because most of the occurrences are on private lands, protection of this species must include a combination of the following: ownership, and where needed, management, of sites by conservation-minded private owners and conservation-mandated public land managers; legal protection through regulations; and actions to protect the species and its habitat from threats that originate outside of the occurrences of the species. All sites are vulnerable to threats to the habitat originating inside (*Phragmites australis*) and outside (climate change/sea level rise) of the site.

The protection status of the occurrences in each watershed designated in this Recovery Criterion follows:

<u>Manokin River, Maryland</u>
The Manokin Creek subpopulations in Maryland and their habitat remain unprotected on private property (W. Tyndall, Maryland Department of Natural Resources, pers. comm. 2010). However, regulations, described in the recovery plan, still provide protection from taking by someone without the permission of the landowner.

<u>Manumuskin River, New Jersey</u>
TNC owns and protects approximately 85% of the land (B. Allen, TNC, pers. comm. 2011) for the only viable extant occurrence on the Manumuskin. The numerous state and local regulations that provide protection are described in detail in the recovery plan and are presumably still in effect.

<u>Rappahannock, Pamunkey, Mattaponi, and Chickahominy Rivers plus James River, Virginia</u>
Few of the known Virginia occurrences on the Rappahannock, Pamunkey, Mattaponi and Chickahominy Rivers are on lands protected or managed for this species; no occurrences

on the Mattaponi or Chickahominy Rivers are protected. The major portion of the large population on the Pamunkey River, EO 001, already protected at the time of the recovery plan, lies within the Vandell Natural Area Preserve, owned and managed by TNC. Found since the recovery plan, the portion of EO 009 on the Virginia Department of Transportation (VDOT)-created wetland on the Rappahannock River is on land owned by the Commonwealth of Virginia, which therefore receives some protection under the state Endangered Plant and Insect Species Act.

(2) Annual monitoring over a 10-year period indicates that the populations in the six river systems are stable or increasing (expanding) and that threats have been alleviated and/or removed. General population, reproductive, and habitat trends should indicate a capacity for being self-sustaining in the wild over the long term with minimal management intervention.

Criterion 2 has not been met.
The definition of "stable" needs to be better defined as this is a species characterized by population numbers widely fluctuating from year to year, ranging from tens of plants to many thousands in a given population. This criterion has not been met fully across the species range due to lack of consistent monitoring, particularly in the Virginia drainages. Below is the status of this delisting criterion in each of the six river systems:

Manokin River (Maryland)
The two viable subpopulations of SJV in Maryland are on the Manokin River in Somerset County on the Eastern Shore of the Chesapeake Bay. They have been monitored for more than the 10 years, from 1994-2009, as reported in Tyndall (2011), with additional monitoring for both in 2010 and for Taylor Branch in 1991 and 1992. Both exhibit fluctuations in plant numbers, but while numbers for the Taylor Branch subpopulation are described by Tyndall as "low" (average 400 $\pm$ 122, ranging from 42 to 1,797), the plant numbers at the Manokin subpopulation have exhibited a significant increase over the monitoring period, tripling in size in the last 4 years of the survey and averaging 1,867$\pm$ 268 plants.

Manumuskin River (New Jersey)
In the past, annual monitoring of population numbers of SJV was conducted on the Manumuskin River by TNC (Service 1995). Total population numbers in the Manumuskin River occurrence were collected in 1982-1984 and 1988-2005 showing a pattern of widely fluctuating numbers of plants, although some differences between years may be due to different monitoring methodologies (Creveling 2005). In recent years, plants have not been counted and instead the upstream and downstream extents of the population are monitored; numbers over the last few years were generally estimated at well over 1,000 plants (L. Frie, TNC, pers. comm. 2010).

Chickahominy, Mattaponi, Pamunkey and Rappahannock Rivers, Virginia
Due largely to the greater number of occurrences in Virginia and the increased cost and logistical challenges of conducting comprehensive monitoring , annual monitoring is the

exception rather than the rule on the drainages in Virginia. Therefore our knowledge of the status of many of the occurrences is incomplete and we cannot say with confidence whether they are declining, stable, or expanding by watershed. Except for the formal monitoring studies on the Mattaponi River which included 1993-1994 and 1997-2001, most monitoring programs target single occurrences or portions of occurrences, and not all the occurrences or subpopulations in a river system. Additional visits were made to some Mattaponi River subpopulations, with the most extensive survey in 2010, although the focus of the 2010 surveys was more on distribution of plants; numbers of plants were not always recorded (Griffith 2010). The following summarizes the frequency of monitoring and results on the Virginia drainages designated in the recovery criteria.

Chickahominy River: No consistent monitoring has been conducted on this drainage. Two extant small occurrences have received only sporadic visits.

Mattaponi River: A multiple year monitoring program funded by the U.S. Fish and Wildlife Service (Service) and Virginia Department of Agriculture and Consumer Services (VDACS) was carried out by Rouse at all of the subpopulations on the Mattaponi River in 1993, 1994, 1997, 1998, 1999, 2000, and 2001 (Rouse 1994, 1995, 1998, 2000, 2001, 2002). During those years, total population numbers ranged from 78 in 1998 to 1,716 in 1999. A revisit to most subpopulations in 2010 (Griffith 2010) yielded a minimum of 365 plants, which is within the documented fluctuating range so no trend is evident across the Mattaponi occurrence. One of the more downstream subpopulations (Wakema), that was small when first observed, is probably extirpated as no plants have been seen since 1987. The most downstream site had low numbers (or 0) for 1997-2000, but rebounded in 2001.

Pamunkey River: The most consistent annual monitoring of populations in Virginia has been conducted at the portion of VA EO 001 that lies within the Vandell Natural Area Preserve at Cumberland Marsh within the Pamunkey River drainage. TNC has conducted annual monitoring of the portions of this occurrence on the Preserve from 1997-2010 (Dunscomb et al. 1997; Dunscomb 1998; Allen and SanJule 2003; TNC 2004, 2005, 2006; Griffith 2007; TNC 2008, 2009, 2010). The Cumberland Marsh monitoring results show a pattern of widely fluctuating numbers typical for this species with numbers ranging from 40 to 5,808. The population has been at least 1,000 plants since 2007. Other Pamunkey sites have not been monitored as consistently but many have not been observed on recent visits.

Rappahannock River: There has been no consistent monitoring of the sites except for the subpopulation of EO 009 in the created wetland which has been monitored by the VDOT annually since its discovery in 1997. It has consistently supported over 100 plants since 2001. Surveys were conducted at many of the Rappahannock River EO 028 subpopulations in 2010 and no plants were found (Griffith 2010). Because no consistent monitoring has been conducted within the Rappahannock River, it is not possible to determine a population trend or whether the recovery criterion has been met for this river.

(3) Life history and ecological requirements of the species are understood sufficiently to allow for effective protection, monitoring, and, as needed, management.

Criterion 3 has not been fully met.
Our knowledge of the life history and ecological requirements of this species has grown, particularly our understanding of the factors affecting seed germination and seedling establishment, characteristics of seed dispersal, and the existence of a seed bank. More work is needed related to habitat requirements across its range, including the importance of muskrat in creating open habitat and threats such as the effect of invasive non-native plant species.

2.3 Updated Information and Current Species Status

2.3.1 Biology and Habitat

2.3.1.1 New information on the species' biology and life history:

A. Improved Analysis
A population monitoring protocol was developed in 1997 (Dunscomb et al. 1997) by TNC for the annual monitoring program at Vandell Natural Area Preserve at Cumberland Marsh on the Pamunkey River and has been in place through 2010. Although recommendations were made that the monitoring protocol be adopted for the other Virginia drainages, no standard methodologies have been adopted. Standardization of monitoring methodology for annual counts was also developed for the occurrence on the Manumuskin Preserve in New Jersey (Creveling 2005), but has since been abandoned in favor of monitoring the upstream and downstream extents of the occurrence.

Population matrix models and life table response experiments have been used by Griffith and Forseth (2005) to identify the life history stages most important to observed population growth rate differences in SJV. From that work, Griffith and Forseth (2005) determined that increasing population size in a patch could be best accomplished by removing competing vegetation rather than by adding seeds.

B. Biology and Habitat
Characteristics of seed dispersal in SJV were studied by Griffith and Forseth (2002). Ninety-four percent of seeds were found to fall within 0.5 meters (m) of the maternal plant with none falling 1 m or farther away. Investigations of how long SJV seeds can float resulted in 50% of seeds floating after 28.4 hours, 25% of seeds floating after 46.7 hours and 5% floating after 81.8 hours. Although the majority of the plants were growing more than 1.25 m from the stream edge, 33% were within 1 m of the stream edge and 10% were within 0.5 m of the stream edge.

Griffith and Forseth (2003) investigated the effects of water depth and amount of standing vegetation on seedling establishment. Seedling establishment was found

to increase with decreasing water depth in both field and greenhouse studies. Field plots where all vegetation except SJV was removed had greater seedling establishment, higher seedling survival, and higher seed-set per plant than uncut plots, confirming the importance of disturbed, open patches for SJV. The authors point to these results in supporting the addition of seeds and removal of vegetation for the conservation and management of this species. Griffith and Forseth (2005) provided further refinement of this recommendation.

Studies of the seed bank of SJV looked at survivorship of seeds over winter, natural distribution of 1-year old seeds in soil, and potential for a multiple-year seed bank (Griffith and Forseth 2006). They found that there were no significant differences in the survival of seeds among a variety of microhabitats (different elevations, distances from the stream edge of the marsh), but seeds were not evenly distributed over the marsh, clumping close to standing SJV plants. The majority (60%) of seeds are lost during the winter, either disappearing or becoming unviable by spring. Most surviving seeds germinated the following spring, with a small number remaining viable but ungerminated and having the potential for surviving a second winter. Therefore, SJV appears to have a small but persistent seed bank allowing it to delay germination until favorable habitat conditions exist and also re-establish locally extirpated populations (Griffith and Forseth 2006).

Additional research on the impact of seed predation on population dynamics of SJV has been conducted (Griffith et al. unpublished manuscript). This research looked at the question of whether seed loss due to seed herbivory could be a reason for the large population fluctuations from year to year. Results of this 4 year study have not been published as of the date of this status review.

Research at a site on the James River focused on monitoring the population characteristics of the SJV (number, density, areal extent), collecting habitat data, and establishing a grazing experiment to test for the effect of the removal of competing vegetation on the presence of SJV (Bailey et al. 2006). Population data at the site from 2000-2004, suggests a positive relationship between high summer precipitation and the presence of SJV.

Population monitoring and habitat characterization studies were conducted on all of the Mattaponi River sites in 1993, 1994 and 1997-2001(Rouse 1994, 1995, 1998, 2000, 2001, 2002). The results of the 1993 and 1994 studies were reported in the recovery plan. A summary of some of the information in the reports/data for the 1997-2001 field seasons is provided here. Salinity levels in 1997, 1998, and 1999 were reported to be significantly higher than in 1993 and 1994; with the 1998 and 1999 years associated with drought. Downriver sites experience higher salinities but also greater variability in salinity from year to year. Population numbers in downriver sites were low or absent through 2000, and concern was expressed in Rouse (2000) for their long-term survival. In 2001, the last year of the study, most of these downstream populations remained low or absent, but the farthest

downstream site rose to more than what was seen in 1993. Seed predation by caterpillars of tobacco budworm and corn earworm significantly reduced reproductive output. High levels of seed predation represent a serious threat to the persistence of SJV, particularly to the small downriver populations. SJV plants germinate in the same location each year. It is speculated that this is a combination of limited seed dispersal and the specific ecological niche in which it grows.

2.3.1.2 Abundance, population trends (e.g. increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends: Due to the highly variable annual population numbers typical for this species coupled with the lack of consistent monitoring at many sites in Virginia and lack of standardized monitoring protocol among the states, an accurate assessment of abundance and population trends is difficult to compile. The available data for each occurrence (EO) across the range of this species are shown in Appendix 1. With data lacking for many sites for many years, total counts of plants rangewide can only be viewed as minimum numbers of plants (Table 1). Minimum numbers counted or estimated in a given year since 1991 have ranged from 1,580 – 24,073. Totals in both 1991 and 2010 were close to 8,000 plants, and no clear decline in numbers of plants is evident although plants likely occur in fewer locations rangewide.

The following is a summary of the available abundance and population trend data for each state in the SJV range:

Maryland: The two subpopulations on the Eastern Shore are robust in numbers of plants with annual totals between the two as high as 4,463 and no lower than 846 (Tyndall 2011).

New Jersey: The one confirmed New Jersey occurrence has numbered as high as 20,000 plants in 1996 and as low as 132 plants in 2003, with numbers of at least 1,000 for 14 of the 21 years of monitoring (Creveling 2005). Plant counts are no longer conducted.

North Carolina: Population numbers at all sites have been low since 1995 and all are vulnerable to extirpation. The species is currently considered extremely imperiled in the state (M. Buchanan, North Carolina Department of Environment and Natural Resources, pers. comm. 2011).

Virginia: Only the Virginia subpopulation within TNC's Vandell Natural Area Preserve on the Pamunkey River has been consistently monitored with a standard sampling protocol from 1997 through 2010 (Dunscomb et al. 1997). This subpopulation with multiple colonies often numbers 1,000 or more plants, but displays the wide fluctuations in numbers typical of this species. The subpopulations on the Mattaponi River have been the next most consistently monitored with surveys over seven years (Rouse 1994, 1995, 1998, 2000, 2001,

2002). These studies found mostly reduced populations in the downstream sites, although a rebound in the farthest downstream site occurred in 2001. Most of the plants on the Mattaponi River were in one upstream site. On the Rappahannock River, the subpopulations in the marshes just off the main stem of the river have never been observed to contain large numbers of plants, but may be supporting even fewer plants in recent years; no plants were observed in any of the locations that were revisited in 2010 (Griffith 2010) although a private landowner notes having seen SJV in a known subpopulation in 2010. Given the widely fluctuating numbers in this species, not enough annual monitoring has been conducted on the Rappahannock to confirm this trend. The subpopulation of EO 009 that has been monitored since 1997, further upstream in the created wetland on a tributary of the Rappahannock River, has remained stable at 100 to several hundred plants and another occurrence on a Rappahannock tributary remains stable based on the limited observations made. Monitoring on the James River has not been consistent enough to characterize any trends. Population numbers in the 2 extant Chickahominy River occurrences (EO 006 and 014) have been declining to fewer than 10 plants when last observed in 2003 and 1996, respectively, but recent and consistent monitoring has not been conducted.

Table 1. Estimated minimum number of SJV plants across the range of the species, 1991-2010.

Year	**Minimum Total Number of Plants Across the Range of SJV (Many sites lack data in a given year.)**
1991	7,953
1992	2,790
1993	3,749
1994	12,200
1995	3,924
1996	24,073
1997	9,092
1998	4,582
1999	10,267
2000	6,702
2001	7,197
2002	8,549
2003	1,580
2004	8,622
2005	5,271
2006	3,253
2007	5,888
2008	5,932
2009	7,631
2010	7,402

2.3.1.3 Genetics, genetic variation, or trends in genetic variation: No new information was discovered during the course of this review. The website for the Center for Plant Conservation notes that Dr. Peter Straub of Richard Stockton College in New Jersey is measuring homozygosity levels in populations of SJV, but no results from any such studies were located.

2.3.1.4 Taxonomic classification or changes in nomenclature: No changes in taxonomic classification or nomenclature have been published for this species since the recovery plan was completed in 1995.

2.3.1.5 Spatial distribution, trends in spatial distribution, or historical range: The known historical global distribution of SJV included tidal marshes of New Jersey, Pennsylvania, Delaware, Maryland, and Virginia, and ditches and agricultural fields in North Carolina. Overall, there has been a trend toward contraction of its range, but discovery of some additional populations within the known range, such as those in the James River, Virginia, represent new information on the status and distribution. Delaware and Pennsylvania occurrences have not been observed since the 1800's. Freshwater tidal marsh habitat has been drastically reduced or degraded in Pennsylvania but some is still present and surveys continue. Freshwater tidal habitat also persists in Delaware, but continuing annual surveys have not documented SJV. Provided below are updated summaries of the status of the species in each state where extant occurrences persist.

New Jersey: Only two of the nine New Jersey occurrences that formerly spanned seven counties in southern New Jersey are considered extant, one on the Wading River in Burlington County and one on the Manumuskin River in Cumberland County, although only the Manumuskin River occurrence is persistent and large. The recovery plan considered only the Manumuskin River occurrence to be extant. Although the Wading River site has not been observed since 1984, the New Jersey Natural Heritage Program has not designated it as historical as consistent annual monitoring has not been conducted and a seed bank may still exist (D. Snyder, New Jersey Natural Heritage, pers. comm. 2010a).

Maryland: The historical distribution of SJV in Maryland once spanned six counties on both sides of the Chesapeake Bay: Anne Arundel, Calvert, Charles, and Prince Georges west of the Chesapeake Bay and Somerset and Wicomico on the Eastern Shore. Eleven occurrences are recognized by the Maryland Natural Heritage Program (NatureServe 2010). Occurrences considered extant but of questionable long-term viability remain in three counties (Calvert, Charles, and Prince Georges) in the Potomac and Patuxent River drainages west of the Chesapeake Bay. Two of the three small populations rediscovered in Charles and Prince Georges counties in 1994 have not been observed since then. Only the two subpopulations on the Manokin River drainage in Somerset County on the Eastern Shore are considered viable (Tyndall 2011).

North Carolina: No populations in natural habitat are currently known. The disturbed habitats where it exists include roadside ditches and wet agricultural fields in the Coastal Plain. Fourteen occurrences are recognized in North Carolina. Of these, the seven that are considered extant include one in Beaufort County and six in Hyde County, including one newly found in 2010. This new occurrence is also in disturbed habitat between two agricultural fields. One of the extant occurrences, EO 012 has had seeds collected from it that have been identified as the non-native invasive *Aeschynomene indica*, so the identification of SJV plants at this occurrence may have been an error. Another three extant occurrences, all in Hyde County, have not been observed since 1991 or 1995. A Beaufort County occurrence, (EO 002), listed as historical in the summary table in the recovery plan, is now considered extant, with plants present as recent as 2006. Additional historical occurrences are from Beaufort, Craven and Hyde counties.

Virginia: SJV has been documented from six drainages: Potomac, Rappahannock, Mattaponi, Pamunkey, Chickahominy, and James, with multiple locations documented historically along stretches of all. Twenty mapped occurrences are currently recognized by the Virginia Natural Heritage Program with 12 of those considered extant. This is 8 fewer than reported in the recovery plan because some previously separate occurrences have been merged to conform to recent guidance from NatureServe on the delimitation of plant occurrences (DCR-DNH database, NatureServe 2004). Except for recent finds on the James River, the trend may be to a more contracted range within the Virginia drainages with possible dwindling or loss of the small subpopulations such as on the Rappahannock, Mattaponi, Chickahominy, and Pamunkey Rivers. Lack of consistent monitoring data from many of the Virginia sites makes it difficult to state this with complete confidence.

More details on the spatial distribution, trends in spatial distribution or historical range on the Virginia drainages follow:

Potomac River: One occurrence (EO 16) is known from a marsh along the main stem of the Potomac River, but was last surveyed in 1997. A collection apparently from the mouth of Aquia Creek along the Potomac River has not been relocated since its collection in 1939.

Chickahominy River: Distribution on the Chickahominy drainage has decreased from 26 river miles (14 linear miles) to slightly over 2 miles over the years it has been observed.

Mattaponi River: The Mattaponi River populations are grouped into one occurrence with subpopulations along approximately 10 river miles (close to 8 linear miles). Rouse (2000) reported downstream populations as having low to no plants, and he feared the distribution would be reduced to a 5 mile stretch, but the lowermost subpopulation rebounded in 2001 and had similar numbers in 2010.

Pamunkey River: Six occurrences were previously recognized along this river, spanning 23 river miles (10 linear miles) but the five uppermost occurrences, along a 6 mile stretch of the river, were merged between 2007 and 2008, leaving two occurrences. The most downstream occurrence, in a pocket marsh near or just west of a road across the marsh, has not been observed since 1999, and the uppermost known subpopulations have not been documented recently. Consequently, the distribution on this river may have contracted significantly.

Rappahannock River: The Rappahannock River subpopulations are currently grouped into three occurrences with one occurrence composed of all the subpopulations in marshes along or just off the main stem of the Rappahannock River, and the other two occurrences in tributaries. The subpopulations on the main stem span about 12 river miles (10 linear miles). The other two occurrences are found well up tributaries approximately 4 and 9 miles downstream from the furthest downstream main stem subpopulation; plants have been consistently monitored and observed in one of the tributaries, including in 2010, but the other has not been surveyed since 2003. No plants were seen by one researcher in the main stem subpopulations visited in 2010; however, a private landowner noted some plants in 2010 in the Occupacia Marsh area (A. Wellford, landowner, pers. comm. 2010). All but one of the subpopulations in the Rappahannock drainage have not been monitored consistently enough to assess the trends.

James River: Several occurrences on the James River found since the recovery plan further increase the number of extant occurrences at least partly protected on public lands. The James River has risen in importance for SJV since 1995, a result of extensive surveys from 1995-2001, mostly by boat, in an area spanning approximately 7 to 40 miles downstream from Richmond (Rouse and Belden 1995; Belden 1996, 2000). One historical occurrence was relocated (EO 18), and lies fully within the federally managed Colonial National Historical Park. This occurrence is near the farthest downstream site where the species has ever been found on the James River. Monitoring has been overseen by the National Park Service in most years since the rediscovery of this historical occurrence in 2000. Although a spike of over 400 plants was observed in 2004, plant numbers have been low to absent most years (Bailey et al. 2006, DeBerry 2008). A new occurrence with two subpopulations (EO 35) was found (Belden and Van Alstine 1998), increasing the importance of this drainage for protection and management concerns. A portion of EO 035 lies within the Service's Presquile National Wildlife Refuge. Significantly, the two subpopulations were found 21 river miles (10 linear miles) downstream of Richmond, representing the farthest upstream this species has ever been documented on the James River (Belden and Van Alstine 2003). These subpopulations have not been consistently monitored.

Therefore, despite apparent losses of five historical locations on the James River (Belden and Van Alstine 2003), the documented distribution of this species has

expanded in terms of its range along the James, which currently spans approximately 41 river miles. However, recent monitoring has not been conducted at several of the sites so our knowledge of the stability of the known distribution of SJV along the James River is incomplete.

2.3.1.6 Habitat or ecosystem conditions: Habitat and ecosystem conditions across the range of this species are well documented in the recovery plan (Service 1995). Tyndall (2011), however, stresses the need to recognize the variability in habitats across its range, citing the example of SJV being described in the recovery plan "as typically occurring in ecologically disturbed areas with little standing vegetation," [whereas, Tyndall notes] "plants in all Maryland occurrences typically occur in tall, dense, species-rich vegetation." Tyndall (2011) also finds negligible evidence in 19 years of study of the Manokin River subpopulations for the importance of muskrat activity, discussed in the recovery plan, in creating and maintaining SJV habitat by means of the removal of competing vegetation, and extends this lack of solid evidence to all populations.

While the majority of the occurrences or subpopulations outside of North Carolina are found in natural tidal marsh habitats, there have been some exceptions in a few finds made in Virginia since the recovery plan. A subpopulation was found in 1997 in Essex County along a tributary of the Rappahannock River in a pocket marsh wetland created by excavation of upland adjacent to a creek. In another location in the Rappahannock drainage, plants were found in 2001 "on the edge of a moist soybean field" and in 2000 "in a mowed grassy strip between the head of a manmade drainage channel and dirt road" (Virginia Department of Conservation and Recreation database, accessed 2010).

2.3.2 Five Factor Analysis

2.3.2.1 Factor A. Present or threatened destruction, modification, or curtailment of its habitat or range: The invasive marsh plant *Phragmites australis*, common reed, which destroys the diverse freshwater tidal marshes through forming dense monotypic stands by means of dispersed rhizome fragments and seeds, represents probably the most serious threat to SJV from an invasive species. However, the current level of threat from *Phragmites* across the range of SJV is unclear due to lack of recent monitoring data at many sites. In New Jersey, *Phragmites* was reported in 1993 as having expanded rapidly near the Manumuskin occurrence and it is reported to be invading portions of one of the occurrences (EO 006) still reported extant although not observed since 1984; its increased presence at this site makes it difficult to survey for the SJV (D. Snyder, pers. comm. 2010a). In Virginia, *Phragmites* is present in the marsh near EO 018 off the James River, and there is active control of the *Phragmites* underway by the land manager (D. Geyer, National Park Service, pers. comm. 2010). Expansion of the native *Spartina cynosuroides* in this marsh is a more immediate problem. The only consistently monitored Virginia subpopulation, and its largest, on the Pamunkey River continues

to report no *Phragmites* within the site and the nearest observed patch is four miles downstream (TNC 2010*). Phragmites* mapping conducted on the Rappahannock River in Virginia in 2006-2007 identified 134 acres of *Phragmites* in the marshes along Piscataway Creek with 2 acre size patches within 300 feet west of the extant subpopulation of EO 009 and several smaller patches within the area of the historical subpopulation. Small patches also were documented within 600 feet of the subpopulation at Mulberry Point, the lowermost subpopulation in EO 028 along the Rappahannock River (Wilson and Myers 2007).

Since the recovery plan was written, the non-native *Aeschynomene indica* (Indian joint-vetch) has been found in Virginia in a created non-tidal wetland in Southampton County, south of the James River, and at least 200 miles north of the northern most *A. indica* in North Carolina (Perry et al. 1998). In North Carolina *A. indica* shares the ditch and field habitat where SJV occurs, and one population thought to be SJV now has evidence that at least some of the population is *A. indica* (D. Suiter, Service, pers. comm. 2011). *A. indica* has not been documented in the natural tidal marsh habitat of SJV in Virginia or further north in other states with SJV (The Biota of North America Program 2010). However, with the finding of SJV in a created wetland in Essex County, Virginia (R. Pickett, VDOT, pers. comm. 2010), Perry et al. (1998), raises the possibility of SJV and *A. indica* meeting in created wetlands and the resulting potential threats from competition and hybridization.

The invasive marsh dewflower (*Murdannia keisak*) is monitored at the Vandell Natural Area Preserve at Cumberland Marsh subpopulation where it can have coverage in plots ranging from 0 to 100%. Between 2001 and 2003 its presence was found to increase from 76 to 93% in SJV sites. However, there is no evidence that it is a serious threat to SJV; additional studies are needed to determine to what extent marsh dewflower affects the survival, reproduction and population numbers of SJV (Allen and SanJule 2003).

North Carolina Natural Heritage cites the main threats to this species as being from anthropogenic factors including: changes in hydrology (ditching on private land, especially beside roads and farm fields) causing the habitat to dry out and support more aggressive early successional species that out-compete the SJV for habitat; herbicide use (beside roads, edges of farm fields, and in utility corridors) and right of way mowing (roadsides and utility corridors) that prevents the species from successfully setting seed (M. Buchanan, pers. comm. 2011).

In Virginia, approximately 60 projects have been reviewed since 1995 that intersected SJV occurrences or were thought to have some potential impact, some of which resulted in SJV surveys. Such proposed projects in recent years include construction of piers, bulkheads, boat ramps, reservoirs, shoreline hardening, subdivisions, trails, high speed rail, and bridge improvements (R. Hypes, Department of Conservation and Recreation, pers. comm. 2010). A major reservoir

project in King William County that proposed to withdrawal water from the Mattaponi River and was of concern due to the potential impact from salinity modifications/salt wedge migration, was abandoned in 2009. Development continues to pose a threat to SJV and its habitat. Sea level rise and increased residential development along the shorelines of the major rivers in Virginia likely results in an increasing level of threat under this factor. A trail was proposed near the occurrence in Colonial National Historical Park, and DCR-DNH stewardship biologists worked with the National Park Service to minimize the impact. When eventually built, the trail did not extend out through the marsh (D. Geyer, pers.comm. 2010).

Many historical occurrences have been impacted by development, dredging, and other habitat alteration, resulting in an overall reduced amount of suitable habitat. Habitat within remaining extant SJV populations in New Jersey and Maryland is threatened by *Phragmites* and other invasive species, changes in wetland character, and development. The combination of reduced number of extant occurrences and the noted effects of *Phragmites* and development on remaining populations (Appendix 1) results in an overall increasing level of threat under this factor in New Jersey and Maryland.

2.3.2.2 Factor B. Overutilization for commercial, recreational, scientific, or educational purposes: It is doubtful that overutilization of this species is a concern. Limited collection of seeds for scientific purposes has been done in Virginia (Griffith and Forseth 2003, 2005, 2006) and Maryland (Baskin et al. 1998, Baskin et al. 2005) at large subpopulations. Plant populations are typically in difficult to reach locations, making casual collection unlikely. The Piscataway VDOT site in Virginia is occasionally used for educational purposes (R. Pickett, pers. comm. 2010).

2.3.2.3 Factor C. Disease or predation: No disease has been identified as affecting SJV. Mostly limited predation on SJV plants by small mammals continued to be noted in Mattaponi River populations in Virginia in1998 and 1999 (Rouse 2000), the exception being one subpopulation where no plants remained standing late in the season; heavy foraging by insects may have contributed to this situation. Insect predation on seeds, included in the recovery plan, probably poses a bigger threat, but data are still lacking on the long-term effects of heavy predation; presumably a reduced seed bank would reduce a population's ability to rebound with the most serious impact on populations that are consistently small. The tobacco budworm (*Heliothis virescens*) and corn earworm (*Helicoverpa zea*), both non-native insects, continue to be identified as predators on SJV seeds in Virginia. Tobacco budworm was noted and collected at EO 035 on the James River in 2001 (Belden and Van Alstine 2003). Heavy predation by corn earworm was noted in 2009 on the large population at the Vandell Natural Area Preserve on the Pamunkey River in Virginia (TNC 2009). This heavy predation does not appear to have affected the 2010 plant numbers (TNC 2010), also large, but any impacts on

future population numbers from decreases in the seed bank remain to be determined. Insect predation is not currently noted as a serious threat in North Carolina; however there are so few plants to be found now that insect predation, noted as severe in Leonard (1985) in the recovery plan may possibly have played a role in the decrease in plants (M. Buchanan, pers. comm. 2011). Contacts in 2010 with Maryland and New Jersey Natural Heritage botanists also did not include insect predation as a threat but in the recovery plan it was regarded as minor in New Jersey and not even noted for Maryland.

2.3.2.4 Factor D. Inadequacy of existing regulatory mechanisms: SJV is listed as threatened under the Commonwealth of Virginia's Endangered Plant and Insect Species Act, as amended (Virginia Code Chapter 39). The state status is endangered in New Jersey based on the official Endangered Species List (N.J.A.C. 7:5C – 5.1) (Snyder 2010b), endangered in Maryland under the Non-Game and Endangered Species Conservation Act (Maryland Department of Natural Resources 2010), and threatened in North Carolina under the Plant Protection and Conservation Act (North Carolina General Statute 19B 106:202.12) Section 3 (Franklin and Finnegan 2010). All of the existing regulatory mechanisms in each state were discussed in detail in the recovery plan. Summaries by state of status and changes relating to the protection afforded to SJV by existing regulatory mechanisms follows:

Maryland: No changes in the status of protection by regulation reviewed in the recovery plan (W. Tyndall, pers. comm. 2010). Plants are vulnerable to actions by private landowners.

New Jersey: No change in status. The entire Burlington County site and half of the Manumuskin site (including all portions on private land) are in the New Jersey Pinelands Area. The Pinelands Comprehensive Management Plan prohibits development unless designed to avoid irreversible adverse impacts upon the survival of any local populations of federally or state-listed plant or animal species (N.J.A.C. 7:50-6.27 and 6.33). N.J.A.C. 7:50-6.14 establishes 300-foot buffers on wetlands in the Pinelands Area, unless an applicant can demonstrate that a proposed project would not result in a significant adverse impact on the wetland.

North Carolina: No new regulations have changed the status of protection by regulation reviewed in the 1995 recovery plan. The species is listed as Threatened by the NC Plant Conservation Program. Current regulations deal primarily with propagation, movement, and sale of rare plants (S. Mason, North Carolina Natural Heritage Program, pers. comm. 2010). The North Carolina Plant Protection and Conservation Act is administered by the North Carolina Department of Agriculture and Consumer Services' Plant Conservation Program. Since all known populations in North Carolina occur on private land, they are only protected by the Federal ESA if Federal permits or money were involved in any proposed actions that might threaten them.

Virginia: Since the recovery plan, numbers of occurrences on Federal lands have increased. One entire occurrence and parts of two occurrences of SJV are found on Federal lands and are subject to protection afforded by the ESA. However, as populations in Virginia are mostly on private lands, they would only be given some protection under ESA if Federal permits or money were involved in any proposed actions that might threaten them.

In 2004, SJV was included as a state listed threatened plant under the Endangered Plant and Insect Species Act (Virginia Register of Regulations 2004), a law administered by the Virginia Department of Agriculture and Consumer Services (VDACS). This act, however, exempts private landowners from the provisions of the law, while prohibiting others from actions that would harm a listed plant unless given permission by the landowner (Virginia Register of Regulations 2002); most Virginia populations are therefore vulnerable to landowner actions that would be detrimental to the plant. Two occurrences known on state owned land would have some protection; any proposed actions that could affect the plant would need to be reviewed by VDACS, who would determine whether there would be any impacts to the population, and then recommend actions to avoid taking plants. If destruction of plants is unavoidable, then VDACS would evaluate the project to determine if it meets the requirements for taking described in the state law, and if so, issue a permit for taking (L. Nichols, Office of Plant Industry Services, VDACS, pers. comm. 2011).

2.3.2.5 Factor E. Other natural or manmade factors affecting its continued existence: Sea level rise associated with climate change is the most serious long-term threat to this species, as the existing fresh tidal marshes become more oligohaline and unsuitable for SJV due to the sensitivity of the seeds to increasing salinity levels (Baskin et al. 1998). Tyndall (2011) discusses the varying capacity of some tidal freshwater marshes dominated by annual species to keep pace through sediment accretion with rising sea levels while at the same time noting the threat from seeds being buried too deeply by sediment. Studies of sediment accretion and hydrology are cited by Tyndall (2011) as needed to determine the viability of the Maryland Eastern Shore subpopulations, but this could be expanded to sites in New Jersey and Virginia as well.

In addition to sea level rise, other predicted changes in meteorological patterns such as increased frequency and/or severity of droughts, increased likelihood of flash flooding and significant rain events, and other factors are also likely to affect the species and its habitat, though it is unclear how these factors may affect populations and habitat. Hurricanes, nor'easters, and other severe storms have the potential to alter habitat and affect populations. The combination of these potential threats and the reduced number of occurrences may result in increasing level of threat from these factors by reducing the overall resiliency of the populations and habitats.

2.4 Synthesis

The number of extant populations appears to be continuing to decline, though the extent of the species distribution has not changed appreciably. Many small populations or subpopulations are dwindling or possibly disappearing, such as the subpopulations in the main stem of the Rappahannock River, and along the Chickahominy and Pamunkey Rivers, in Virginia. Small occurrences rediscovered in 1994 in the Potomac River and Patuxent River drainages in Maryland have mostly proven to be ephemeral in surveys in subsequent years. Its continued presence in North Carolina, only known in recent years in marginal, disturbed habitat, is tenuous, although a new occurrence was found in 2010. At the same time, occurrences/subpopulations on the Manumuskin River in New Jersey, the Manokin River in Maryland, and the Pamunkey River in Virginia, all with histories of fluctuating but at times large (at least several thousand plants) population sizes, are persisting. Other generally more modest populations, such as along the Mattaponi River and in a tributary of the Rappahannock River in Virginia, persist as well. A rediscovery of a historical occurrence and new finds along the James River in Virginia have increased the importance of this drainage since the recovery plan and extended its range farther upstream on the James. On the Pamunkey River in Virginia, new outlier subpopulations have been found near the large persistent subpopulation (Griffith 2010), while small previously known subpopulations farther upstream and downstream may have disappeared.

Annual monitoring has been conducted over at least 10 years at the most robust SJV populations / subpopulations in New Jersey, Maryland, and Virginia. The Mattaponi River in Virginia was also the target of multiple-year monitoring in the 1990s and early 2000s. One more modest but fairly stable subpopulation on state land in the Rappahannock River drainage in Virginia has also been monitored less rigorously for 10 years. Other populations have been visited more sporadically. Gaps in our knowledge of the status of many of the smaller subpopulations, particularly in Virginia which still supports the majority of the occurrences considered extant, makes it difficult to confirm with confidence some of the trends suggested above.

Most populations of SJV continue to be unprotected on private lands although additional finds on Federal and state lands have brought more SJV populations under some measure of regulatory protection. As was true at the time of the recovery plan, portions of two of the most robust occurrences are protected on Preserves owned and managed by TNC in New Jersey and Virginia. New since the recovery plan is the rediscovery of a historical record on National Park Service land and a new occurrence partially on a USFWS National Wildlife Refuge in Virginia. Their presence on Federal land should provide protection from actions that could have direct negative effects. In light of the designation in 2004 of SJV as a threatened species in Virginia under the Virginia Endangered Plant and Insect Species Act, two occurrences on state-owned lands would require a review process in the event of proposed actions that could be detrimental to the plants. However, ownership by a conservation-oriented or mandated entity, although it is beneficial in eliminating some of the anthropogenic threats, will not protect SJV from stressors arising outside the property, particularly sea-level rise and the associated changes in salinity levels along the sections of rivers where SJV is found.

Threat levels from invasive plant species, particularly *Phragmites*, and seed predation by the corn earworm and tobacco budworm, are not well documented across its range. The decline of the plant in North Carolina may be associated with severe insect predation levels noted there in the 1980s.

Recent observations about habitat in the Maryland populations stress the need to recognize the variability in habitats across its range; Maryland habitat of tall, dense, species rich vegetation does not conform to the recovery plan characterization of "disturbed areas with little standing vegetation." Monitoring work in Maryland also challenges the role of muskrats in creating and maintaining SJV habitat, finding little evidence for its importance. Outside of North Carolina, most new finds of SJV have been in natural tidal marsh habitat, but there have been a few exceptions in Virginia including a created pocket marsh habitat carved from adjacent upland, the edge of a soybean field, and a grassy strip between a drainage channel and a dirt road.

SJV should continue to be listed as threatened as delisting criteria have not been fully met across its range. This species is still prone to the wide variety of threats, both natural and anthropogenic, discussed in the recovery plan. Confirmation of a major contraction of its range and downstream losses linked to increased salinity levels would be needed to consider listing this species as endangered.

3.0 RESULTS

3.1 Recommended Classification: No change is warranted.
Rationale: Although some losses of small occurrences/subpopulations have likely occurred since 1995, and the North Carolina populations appear to be disappearing, there have been some new finds in natural habitat in Virginia. Some of the historically large populations, notably in New Jersey, Maryland, and one site in Virginia, although exhibiting over the years the large fluctuations in numbers characteristic of this species, contain large numbers of plants some years. In addition, the lack of recent data about many of the Virginia occurrences/subpopulations makes it difficult to accurately gauge how much the species range is contracting. The habitat changes that will occur if sea level rises and/or *Phragmites* expands unchecked into the known SJV occurrences are concerning, but do not warrant a change in classification of the species at this time.

3.2 New Recovery Priority Number: No change is warranted

3.3 Listing and Reclassification Priority Number: Not applicable

4.0 Recommendations for Future Actions

- More consistent monitoring of all of the Virginia occurrences is needed to confirm the population trends in the portion of its range that has the greatest number of extant occurrences/subpopulations. This monitoring can also serve to detect current threats and identify areas where management actions such as *Phragmites* control may be needed in Virginia.

- A review of the monitoring methodologies being used across the range of this species should be conducted with the purpose of increasing standardization. Monitoring protocols

likely vary across the species range. Although long-standing monitoring programs may not want to abandon established methodology for fear of making their year-to-year data less comparable, a review could highlight where changes might be made and lead to increased standardization and therefore more comparable data rangewide.

- Conduct genetic research to ensure that seeds representing the genetic diversity of SJV are in the collection of the National Center for Genetic Resources Preservation (Formerly National Seed Storage Laboratory) in Fort Collins, Colorado.

- Investigations should continue into the effects of invasive plants such as *Murdannia keisak* and the introduced insect species, tobacco budworm (*Heliothis virescens*) and corn earworm (*Helicoverpa zea*) on SJV.

- The role of muskrats in creating and maintaining SJV habitat needs to be investigated.

- Consideration should be given to what role proactive measures such as habitat management, seed additions, and introductions in upstream habitat should play in a long term management strategy for SJV in light of dwindling populations in parts of its range, the serious threat from sea level rise, and questions about the ability of this species to migrate to upstream habitat. Recent publications mention the use of vegetation management and seed additions for the conservation and management of SJV (Griffith and Forseth 2003, 2005) or recommend directing research efforts to introducing the species into new upstream sites (Rouse 2000). Guidelines should be developed in case more aggressive management strategies are warranted.

- Surveys should be conducted in potential habitat throughout the range of the species.

- Revise the recovery plan to update information and to consider the incorporation of the James River Basin in the Recovery Criteria.

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APPENDIX 1

2010 Summary of Sensitive Joint-Vetch (*Aeschynomene virginica*) Status by State

Population data, current status and other information from various sources: NatureServe web services / VA Biotics/ Recovery Plan/1998 revised table from C. Schulz/Tyndall (MD)/TNC-VFO annual reports/State Natural Heritage Programs/Alan Griffith 2010 surveys in VA/DeBerry 2008. Delaware, Maryland, New Jersey, North Carolina, and Pennsylvania are listed by county. Virginia data are organized by drainage.

STATE	EO NO.	COUNTY	SITE LOCATION	POPULATION DATA	CURRENT STATUS/OTHER INFORMATION
DE	001	New Castle	Wilmington, Delaware River	1846: Observed/collected. 1899: Observed/collected. 1988-2010: No plants found.	Historical. Historical collections range from 1846-1899, all from tidal marsh habitat on the Delaware River in New Castle County. Annual surveys have been conducted from 1988-2010 without success although freshwater tidal habitat still exists.
MD	002	Anne Arundel	Unknown	Observed (no date).	Historical
MD	007	Calvert	Unknown	1904: Observed.	Historical
MD	011	Calvert	Graham Creek Marsh	1904: Observed 1994: 3 1995: 6 plants 1996: 10 plants	Extant but long term viability questionable. Last surveyed for in 1996.
MD	005	Charles	Chicamuxen Creek Marsh (Potomac River)	1951: Observed 1994: 5 plants in 2 locations. 1995: 0 1996: 0 2000: 0 2004: 0	Extant but long term viability questionable. Last surveyed for in 2004.
MD	009	Charles	Unknown	1921: Observed.	Historical. Habitat degraded by *Phragmites* and partially developed.
MD	004	Prince Georges	Patuxent River	1947: Observed.	Historical. Converted to waterfowl pond surrounded by *Phragmites*. Habitat likely destroyed by development

STATE	EO NO.	COUNTY	SITE LOCATION	POPULATION DATA	CURRENT STATUS/OTHER INFORMATION
MD	006	Prince Georges	Middle Patuxent Marshes	1950: Observed. 1994: 1 1995: 0 1996: 0 2000: 0 2004: 0	Extant but long term viability questionable. Last surveyed for in 2004. Not on the Dec. 1998 summary table, but it is a good EO, according to Tyndall (pers. comm. 2010).
MD	010	Prince Georges	Magruder Ferry Seep	1949: Observed. 1994: 5 1995: 0 1996: 3 2000: 0 2001: 3 2004: 0	Extant but long term viability questionable. Last surveyed for in 2004.

STATE	EO NO.	COUNTY	SITE LOCATION	POPULATION DATA	CURRENT STATUS/OTHER INFORMATION
MD	001	Somerset	Upper Manokin River (Princess Anne Marshes)	1941: Abundant 1987: 100 +100 +? 1989: 1,000 + 1991: 786 1992: 751 1994: 1,086 1995: 832 1996: 1,458 1997: 715 1998: 999 1999: 1,852 2000: 1,069 2001: 2,108 2002: 1,861 2003: 719 2004: 2,498 2005: 1,416 2006: 2,242 2007: 3,441 2008: 3,179 2009: 4,394 2010: 2,808	Extant and viable. Average number of plants 1,867 in 1994-2009. Large annual fluctuations. Numbers of plants increased significantly over survey period. Effect of muskrat activity negligible.

STATE	EO NO.	COUNTY	SITE LOCATION	POPULATION DATA	CURRENT STATUS/OTHER INFORMATION
MD	008	Somerset	Taylor Branch (Princess Anne Marshes)	1991: 1,123 in 5 distinct areas. 1992: 1,307 in 3 distinct areas 1994: 125 1995: 239 1996: 587 1997: 131 1998: 170 1999: 42 2000: 84 2001: 310 2002: 48 2003: 160 2004: 1,797 2005: 766 2006: 49 2007: 88 2008: 113 2009: 69 2010: 31	Extant and viable. Average number of plants 1991-2009 was 400. No significant trend. Effect of muskrat activity negligible.
MD	003	Wicomico	Nanticoke River	1906: Observed. 1996: Surveyed extensively, no plants.	Historical. 1996: Plants may have been covered with fly ash and surrounded by *Phragmites*; more marsh to search.
NJ	008	Atlantic	Great Egg Harbor River	1937: Observed. 1985: 0 1991: 0 1992: 0	Historical. Developed with homes and marina facility.

STATE	EO NO.	COUNTY	SITE LOCATION	POPULATION DATA	CURRENT STATUS/OTHER INFORMATION
NJ	006	Burlington	Wading River Tidal Marsh	1914: Observed. 1970s: Extensive surveys in early 1970s were unsuccessful. 1984: 12 plants + 38 +1 1985: 0 1991: 0 1992: 0 1994: 0 1997: 0 2006: 0 2007: 0	Extant. Considered historical by Service's New Jersey Field Office due to its last observed date. However, New Jersey Natural Heritage Program considers it extant, suspecting that it is still present in the seed bank and likely that plants have been present over the years but missed because no thorough annual surveys have been conducted consistently. Parts of the site are being overrun by *Phragmites* which makes it difficult to survey, especially if there are only a few plants present at the time of the survey. Needs to be surveyed annually over 5-10 year period before decision made on whether it is extant. May have been exposed to herbicides in mid-1980s.
NJ	001	Camden	Unknown	1874: Collected. 3 old collections.	Historical. Possibly an introduced occurrence.
NJ	009	Cape May	Unknown	1892: Observed/collected.	Historical. Unable to relocate from directions.
NJ	002	Cumberland	Manumuskin River	1973: Observed. 1974: Observed. 1984: 0 1991: 0 1992: 0 2007: 0	Historical. Site has been impacted by dredging and channeling; suitable habitat does not exist.

STATE	EO NO.	COUNTY	SITE LOCATION	POPULATION DATA	CURRENT STATUS/OTHER INFORMATION
NJ	003	Cumberland	Manumuskin River	1973: Observed/collected. 1982: 229 1983: 1,498 1984: 2,085 [1985-1987: No data] 1988: 838 1989: 1,616 1990: 1,628 1991: 5,039 1992: 645 1993: 3,007; large patch plus single S side 1994: 10,714 1995: 1,800 1996: 20,000 + stems 1997: 6,800 1998: 3,265 1999: 6,300 2000: 3,100 2001: 800 2002: 775 2003: 132 2004: 574 2005: 2,804 2006: 25-50 (brief survey) 2007: 200 2007: 29 plants plus more uncounted. 2008-2010: well over 1,000 observed each year. No actual count made.	Extant. (Current USFWS NJ website considers this to be the only extant site in New Jersey.) Extensive occurrence along both sides of the river. Annual counts were done through 2005 by TNC. Great fluctuations documented, but changes in survey methods used could have exaggerated the differences from year to year also. Les Frie of TNC says they no longer do annual counts but monitor the upstream and downstream extent of the population to see what effects global warming might be having. No conclusions can be drawn yet.

STATE	EO NO.	COUNTY	SITE LOCATION	POPULATION DATA	CURRENT STATUS/OTHER INFORMATION
NJ	004	Gloucester	Oldman's Creek	1882: Observed/collected. 1897: Observed/collected. 1991: Site not thoroughly surveyed; habitat conditions appear suitable and further surveys are recommended.	Historical. (Several collections.) Now all dredge spoil.
NJ	005	Salem	Unknown.	1881: frequent 1992: 0	Historical. 1992: Much suitable habitat remains to be searched in part of the County.
NJ	007	Salem	Unknown	1934: Observed 1992: 0, but likely extant as much suitable habitat exists.	Historical.
NC	002	Beaufort	Near Washington (Whichards Beach Road)	1985: several thousand plants estimated. 1986: 200 large plants number visible 400 to500. 1991: 300 1996: several hundred to several thousand. (another source- 400 to 500 plants). 1997: 13 in July/300 in Sept. 1998: 0 2002: 7 2004: 0 2005: 3 2006: 14 2007: 0 (plants may have been mowed.)	Extant. (This is a change from the 1995 Recovery Plan where it was listed as Historical). 2004: Ditch where the plants occurred during the 1990's seems to be drier than it was in the past, with less standing water.
NC	008	Beaufort	South of Washington	1953: Observed/collected 1957: Observed/collected 1985: 0 1998: 0	Historical. 1998: Suitable habitat has been diminished by hardening of shoreline.
NC	009	Craven	Trent River	1949: Observed/collected 1983: 0 1985: 0	Historical. (Extirpated?) Realignment of US Rt. 70 and bypass may have destroyed this site.

STATE	EO NO.	COUNTY	SITE LOCATION	POPULATION DATA	CURRENT STATUS/OTHER INFORMATION
NC	010	Craven	Southwest of James City	1956: Observed/collected 1985: Could not verify.	(Historical?) [1985:] A pond was found southwest of James City, but disturbance around shoreline has made it unsuitable habitat
NC	001	Hyde	Lake Mattamuskeet	1990: 3 1995: 1 2007: 0	Extant. Roadside, weedy overgrown ditch.
NC	003	Hyde	Avenue Farm	1985: 60 (ditch) + 5 1986: 40 to 50, more vigorous than before 1988: 80 1990: 0 1991: 100+ in ditch, dry road shoulder. 2001: 0 and no suitable habitat 2004: No suitable habitat seen so did not explore further. 2007: 0	Extant. 2007: Ditches choked with weedy vegetation.
NC	004	Hyde	U.S. 264 West of Lake Landing	1985: 10 to 12 in ditch, 1,000s in field 1986: 0 1990: large (common) 1991: 40 + 4 1997: 66 2001: 0 2004: 0 2007: 0	Extant. 2007: Habitat in this area is within power line and road side rights of way, with evident herbicide use and many weedy species persisting along the ditches. 2004: The ditch immediately adjacent to soybean field is now fairly shallow, contains no standing water, and is completely covered with other low growing vegetation.
NC	005	Hyde	Engelhard	1985: 4 1986: 0 1990: 0 1991: 6 2001: 0 2004: 0 2007: 0	Extant. 2004: Some ditches mowed, herbicided regularly. 2007: Dense vegetation is present in ditch across from cemetery.

STATE	EO NO.	COUNTY	SITE LOCATION	POPULATION DATA	CURRENT STATUS/OTHER INFORMATION
NC	006	Hyde	State Route 1311	1985: 4 1986: 0 1990: 0 2001: 0 2004: 0 2007: 0	Historical. (Extirpated?) 1985: Recently scraped, moist ditch near road. 2007: Shallow ditches adjacent to agricultural fields with no standing water.
NC	007	Hyde	Near Fairfield	1985: 4 Probably sporadic here. 1986: 0 1990: 0 2007: 0	Historical. (Extirpated?) 1985: Deep ditch, overgrown 2007: much evident herbicide use
NC	011	Hyde	West of New Holland	1985: could not verify 2007: 0	Historical (Extirpated?). Site is a waste place. Habitat weedy, wet, agricultural fields drained by ditches.
NC	012	Hyde	Highway 264 North of Scranton Creek	1986: 40 1995: 0, plants may have been present before cornfield harvested. 2001: 30 2002: 12 2004: 5 2007: 0	Extant. Impacts from rutting, mowing? Seeds from this location were collected by Karen Lynch (North Carolina Department of Transportation). The progeny of these seeds were determined to be *Aeschynomene indica*. The EO may be misidentified.
NC	20	Hyde	Hwy. 264 near Lake Landing	2010: Present	Extant. This site is most likely to be disturbed as it is between two agricultural fields on Hwy. 264. The field on the north side of the road (where most of the plants were located) is fallow, and the field on the south side was planted in soybeans.
NC	013	Lenoir?		Pre-1900. No data	Historical
PA	502	Delaware	Tinicum Island (Little Tinicum Island)	1864: Observed/collected 1865: Observed/collected 1983: 0 1991: 0 2009: 0	Historical. Extirpated. Specimens collected at Tinicum Island (believed to be Little Tinicum Island) in 1864 and 1865. Probably other surveys have been conducted in the drastically reduced remaining potential habitat with 2009 the most recent.
PA	501	Philadelphia	Philadelphia	1827: Observed/collected. 1865: Observed/collected. 1983: 0 1991. 0 2008: 0	Extirpated. Numerous surveys in the Philadelphia area have failed to locate the species. Much habitat destruction. Probably other surveys have been conducted in the drastically reduced remaining potential habitat, with 2008 the most recent.

STATE	EO NO.	COUNTY	SITE LOCATION	POPULATION DATA	CURRENT STATUS/OTHER INFORMATION
VA	016	Stafford	Brent Marsh	1947: Occasional 1987: North - 30+ (predation on seeds), South - 5 plants on sunken barge 1995: 0 1996: 0 1997: 85	Extant. Potomac River Basin. Observed in three locations over the years. 1997: High population numbers believed to be a result of flooding along this portion of Potomac in September 1996 which scoured the site of any vegetation.
VA	017	Stafford	Youbedamn Landing? (Shore of Potomac River, 3.5 mi E of Brooke)	1939: Observed/collected 1987: Not seen in marsh habitat in area of historical record.	Historical. Potomac River Drainage. Exact area not known. Near mouth of Aquia Creek. Plant was collected at edge of thicket on sandy shore, and the shoreline in this area has undergone erosion.
VA	009	Essex	Piscataway Creek	North side subpopulation: 1984: 11 1987: 0 1991: 0 1996: 0 2001: 0 South side subpopulation (VDOT created marsh): 1997: less than 30 2001: 100 2003: Abundant, similar to 2001. 2004-2010: Several hundred individuals.	Extant. Rappahannock River Basin. There are two subpopulations here. The original 1984 number is from an occurrence in natural habitat on north side of creek. This has not been seen since 1984. The 1997-2010 data is from the VDOT mitigation site on the south side in which SJV came in on its own. VDOT monitors this southern subpopulation annually. Population stable and robust. Very minor predation by deer browse and occasional insect use observed. No competition from *Phragmites* to date.

VA	028	Essex, Westmoreland, Richmond	Occupacia, Drakes and Otterburn Marshes, Fones Cliff, Mulberry Island, Jones Landing	<u>Reported by Conservation Sites</u> **Drakes and Otterburn Marshes** (formerly Drakes) 2 overlapping population areas so data has been combined: 1987: 11 to 50, entire population cropped by muskrats 1989: 0 1993: 7 1995: 200+ 1998: approximately 22 2001: 15 2010: 0 **Fones Cliff** (Formerly Fones Cliff/Brockenbrough Creek) 1989: approximately 20 mature plants 2000: approximately 7 2001: 10 2003: 12 mature, 2 to 3 little plants **Occupacia Marshes** Consists of nine subpopulation polygons that have been grouped into Subpopulations A, B, C, and D for reporting purposes**.** **Subpopulation A (Beverly Marsh):** 1984: three subpopulations totaling 58 plants 2001: 0 2010: 0	Extant. Rappahannock River Basin. After mergings of seven EOs, now includes subpopulations in marshes of the Rappahannock River from Drakes Marsh to Mulberry Island, including marshes at the mouth of Occupacia Creek and Fones Creek. In 2008, four previously separate EOs were merged: 028 (Occupacia Marshes), 027 (Fones Cliff/Brockenbrough Creek), 021 (Drakes Marsh), and 036 (Mulberry Island), new in 2001. Occupacia Marshes itself is the result of the merging in 1995 of four previously separate EOs: 010 (Beverly Marsh), 011 (Occupacia Marshes), 012 (Jones Landing), and 028 (Occupacia Marshes).

				Subpopulation B: (Occupacia Marshes, southern cluster) 1984: 300 plants, most frequent near edge of marsh, esp. near points of land. 1986: 25 in four subpopulations. Seeds being eaten by insect larvae. 1987: 0 1993: 200+ plants noted from one subpopulation. 1995: Approximately 48 in four suboccurrences; plants did not reach maturity until late August/early September. Only 23 in main population. Plants diminutive (in September). 1998: 0 (in revised 1998 table, but source of info unknown) 2000: No plants seen but not all habitat checked. 2001: 0 2010: All but one of previously known source features were searched for and no plants were found. **Subpopulation C (Jones Landing)** 1984: 3 plants in two subpopulations. 2001: 0 2010: 0 **Subpopulation D (Occupacia Marshes, northern cluster)** 1984: Small colony 1998: 0 (in revised 1998 table but don't know source)	

				2000: 5 plants in two locations. Not all habitat checked. 2001: 50-100 in three locations. 2002: 38 (37 and 1) plants seen at two stations. Not all habitat checked. 2010: All but northernmost of these colonies checked by researcher, but no plants seen. However, landowner in area did see plants in 2010. No further details on location. **Mulberry Island** 2001**:** Approximately 24 (not yet in bloom in July) 2010: 0	
VA	034	Essex	Mount Landing Creek	1987: several excellent occurrences along Mount Landing Creek 2001: 21 2003: 20 to 25 plants	Extant. Rappahannock River Basin. No surveys done since 2003.
VA	038	Middlesex	Rappahannock River	1700s: Observed/collected.	Historical. Rappahannock River. Type Locality, collection by John Clayton. Locality unspecified. Within 15 to 20 miles farther downstream than recent Rappahannock River/tributary records. (This unmappable occurrence had not been previously included in the Virginia data.)
VA	003	King William, King and Queen	Mattaponi River-Horse Landing	1939: Observed 1987: 0 2010: 0	Historical. Mattaponi River basin.

VA	025	King William, King and Queen	Garnetts Creek, Gum Marsh, Wakema, Lower Mattaponi River Marshes (=Gleason Marsh/Melrose Landing)	<u>Reported by Conservation Site and arranged from most upstream to downstream.</u> **Garnetts Creek:** 1987: 11 to 50 1990: 27 - perhaps as many as 100. 1992: 75 1993: 49 1994: 88 1995: 200+ north side and 3 south side (Rouse 2000) 1996: 460+ and 6 south side = 466+ 1997: 134 north side + 0 south side = 134 1998: 69 north side + 3 south side=72 1999: 1,585 north side + 33 south side= 1618 2000: 1,481 north side + 3 south side = 1484 2001: 607 north side = 3 south side= 610 2003: 50 or more but not searched thoroughly. 2010: 131 (minimum number; not all plants counted) **Gum Marsh:** 1984: 200 1987: 101 to 1,000 1993: 362, predation H. virescens. 1994: 134 1997: 73 1998: 2 + 1(new single plant subpopulation at Sandy Point significantly further upstream from other Gum Marsh plants.	Extant. Mattaponi River Basin. This occurrence contains all of the Mattaponi subpopulations except one more upstream historical record. Four previous occurrences were merged with EO 025 on two different dates: Former EO 024 (Gleason Marsh) and 022 (Melrose Landing) were merged together into 022, then the new 022, and EOs 008 (Gum Marsh), and 026 (Wakema) were merged with 025 in 2007. The subpopulation at Wakema, not observed since 1987 and may have been extirpated by construction of a new dock and boathouse observed in 1992. A single plant subpopulation at Sandy Point apparently found by Garrie Rouse was designated as EO 010 in the revised 1998 table, but has been included here under the Gum Marsh site in the single extant Mattaponi River EO 025.

				1999: 85 2000: 149 (two subpopulations) 2001: 133 (two subpopulations) 2003: 10 to15, no thorough search. 2010: 39 **Wakema:** 1987: 1 to 10 1992: 0 1993: 0 1994: 0 1997: 0 1998: 0 1999: 0 2000: 0 2003: 0 2010: 0 **Lower Mattaponi River Marshes (=Gleason Marsh/Melrose Landing)** 1987: 1 to 10 + 11 to 50 (two subpopulations) 1988: 3 1992: 3 1993: 16 +82 = 98 1994: 0+30+14=44 1997: 0 (three subpopulations) 1998: 0+ 4 + 0 = 4 1999: 0+12+1= 13 2000: (0?)+23 + 13= 36 2001: (0?)+196+ 4= 200 2003: abundant, but many lying down. Difficult to count. 2010: 0+195+0 (only observed in one subpopulation of the three surveyed)	

VA	001	New Kent, King William	Clayborne Creek Wetlands, Cumberland Marsh-Chamberlayne Point, Macon Creek Marshes	Five previous EOs were merged. **Cumberland Marsh – Chamberlayne Point** 1949: specimen collected 1983: 300 (unclear if represents total count) 1986: 210 1987: 0 1990: 1,043 (unclear if represents total count.) 1991: 500 +8 1995: 589 1996: 509 1997: 758 1998: 58 (40? In annual report) 1999: 343 2000: 716 2001: 2,745 2002: 5,808, stunted, shriveled pods 2003: 374 2004: 3,092 2005: 76 2006: 698 2007: 1,957 + 2008: 1,440 2009: 1,968, heavy infestation/seed predation by corn earworm 2010: 2,998 (See Current Status/Other Information for details of what is included in this number.)	Extant. Pamunkey River basin. Now includes five previous occurrences. 2007 mergings of previously separate EOs: 001(Cumberland Marsh, 005 (Holts Creek Marsh/Cumberland Marsh) and 013 (Holts Creek Marsh/Cumberland Marsh). In 2008, EO 010 (Macon Marshes) and 015 (Clayborne Creek Wetlands) were also merged with EO 001. High number of plants in 2010 despite heavy infestation and predation by larvae of corn earworm in 2009. 2010 population numbers include TNC data; (2,937 plants) for portion on preserve plus data from A. Griffith from locations outside the preserve (61 plants). TNC data includes 22 plants seen in new location below dam on Holts Creek.

				MC Marshes: 1999: 9 2010: 0 **PR-CC Marsh:** 1986:2 subpopulations, 9+13 plants, seeds being eaten, most likely by insect larvae. 1987: 11-50 (southern subpopulation) 1992: 0, but only southern subpopulation checked. 1998: 0 1999: 0 2010: 0	
VA	023	King William	Sweet Hall Marsh	1987: 11 to 50 individuals. 1994: 0 despite monthly searches during growing season. Probably extirpated due to road work. 1998: 5 1999: 5 2006: 0 2007: 0 2008: 0 2009: 0 2010: 0	Extant? Pamunkey River Basin. 1987 location was on the bank of the causeway which crosses the marsh embayment. In 1998 and 1999, plants were a little farther west in the marsh embayment. 2006: Tidal marsh west of causeway was thoroughly surveyed on foot but no plants were found. Marsh had suffered blow-down of stands of *Zizania*, presumably from high winds, and invasive species *Murdannia keisak* was probably more common than it was in 1999. 2007: Jim Perry reports not finding plants over repeated visits. Original habitat damaged by private road work. Areas within the large main marsh to the south have been checked, too.
VA	006	James City	Yarmouth Creek	1984: 49 + 1 1991: 0 1995: 6 2003: 1	Extant. Chickahominy River Basin. However not visited since 2003.
VA	014	Charles City	Old Neck Creek	1991: two subpopulations, 40 + 7 1993:26 1996: 6	Extant. Chickahominy River Basin. Old Neck Creek appears to be manmade channel. Levee where SJV grows may be old dredge spoils. Not surveyed since 1996.
VA	019	Charles City	Morris Creek	1939: Observed/collected. 2004: 0	Historical. Chickahominy River Basin.
VA	031	New Kent	Windsor Shades	1939: Observed/collected.	Historical. Chickahominy River Basin.

VA	033	Charles City	Ferry Point	1938: Observed/collected.	Historical. Chickahominy River Basin.
VA	004	Charles City, Prince George	James River-near Hopewell	1937: Observed/collected. 1939: Observed/collected. 1981: 0 1996: 0 1998: 0	Historical. James River Basin. Previous historical EO 30 was merged with EO 004 in 2007. Includes collection locations at Jordan Point, Four Oaks, and near Harrison Point.
VA	007	Charles City	Kittewan Creek	1939: Observed/collected. 1985: Several subpopulations, total 8 plants 1996: 40 to 50 in western, only subpopulation located. 2000: 5 in two subpopulations.	Extant. James River Basin. 1985: Lateness of season evident; plants difficult to see. On land owned by Virginia Department of Game and Inland Fisheries and personnel have not surveyed for species in the years since DCR-DNH conducted the survey in 2000 so current status is unknown.
VA	018	James City		1938: Observed. 2000: 13 2001: 0 2003: 0 2004: > 456 2005: 6 2007: 2 2009: 0 2010: 0	Extant. James River Basin. Previous EO2 was merged with this. Various negative searches were conducted by boat in marshes in area prior to its rediscovery in back section of marsh near the berm of the old road to the ferry. *Spartina cynosuroides* has become exceptionally dominant at the historical site, presumably to the exclusion of SJV due to resource competition. *Phragmites* control is being conducted in the marshes in the area. Two highest population years coincide with 4th and 3rd wettest summers on record.
VA	029	Charles City	Wilcox Wharf	1936: Observed/collected. 1996: 0	Historical. James River Basin. 1996: Only narrow fringe of marsh observed.
VA	032	Surry	Crouch Creek	1939: Observed / collected. 1995: 0 1998: 0 (in 1998 revised table, but source of info unknown)	Historical. James River Basin. 1995: Low level density residential development at site.
VA	035	Charles City, Chesterfield, Henrico	Turkey Island Marshes	1998: two subpopulations, Northern=5, Southern=5 2000: Northern=34 2001: Southern=38.	Extant. James River Basin. Has not been resurveyed since 2001. 2001: Minor tobacco budworm predation observed
VA	020	Essex County?	Blaudfield Wharf/Blandfield? (Rappahannock River?)	1915: Collected. Unmappable. Location can't be determined.	Another source in DCR-DNH paper files refers to "Blandfield" in Essex County as the location for this collection. There is a Blandfield Point in Essex County opposite the Mulberry Island subpopulation (See EO 28 above), so it may have been collected in this area.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of the **Sensitive joint-vetch (*Aeschynomene virginica*)**

Current Classification: Threatened

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered

____ Delist
_X__ No change needed

Appropriate Listing/Reclassification Priority Number, if applicable:

Review Conducted By: Kimberly Smith, Virginia Field Office

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve Cynthia A Schmitz Date 9/25/2013

for

Cooperating Regional Director, Fish and Wildlife Service

_✓__Concur _____ Do Not Concur

Signature Aaron L Walton Date 9-17-13