# *Acorus americanus*

**American Sweetflag**

**Acoraceae**


*Acorus americanus* by Katy Chayka, 2010

## *Acorus americanus* Rare Plant Profile

New Jersey Department of Environmental Protection
State Parks, Forests & Historic Sites
Forests & Natural Lands
Office of Natural Lands Management
New Jersey Natural Heritage Program

501 E. State St.
PO Box 420
Trenton, NJ 08625-0420

Prepared by:
Jill S. Dodds
jsdodds@biostarassociates.com

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For:
New Jersey Department of Environmental Protection
Office of Natural Lands Management
New Jersey Natural Heritage Program
natlands@dep.nj.gov

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## Life History

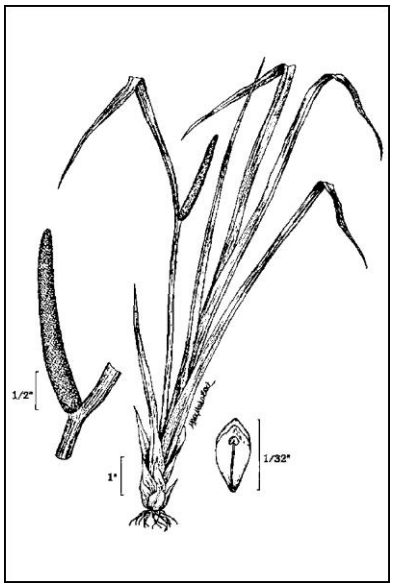
*Acorus americanus* (American Sweetflag) is a perennial rhizomatous monocot in the Acoraceae. *Acorus* was included in the Araceae up until the latter part of the 20th century but was separated on the basis of numerous characteristics that differed from those of other aroid plants (Grayum 1987, Zomlefer 1994). *Acorus* contains 3–6 species worldwide and it is the only genus in the Acoraceae, which is viewed as the basal or sister family to all other monocots (Duvall et al. 1993, Soltis et al. 2000, Borsch et al. 2003, Hilu et al. 2003, Thompson 2020).

*Acorus* plants arise from thick, branching rhizomes by which they can reproduce vegetatively, and they have narrow, swordlike, basal leaves. The leaves of *A. americanus* are bright green with a bit of white or reddish coloration at the base and they may reach nearly 1.5 meters in length. The inflorescence is a spike of small, densely crowded flowers known as a spadix. The spadix of *A. americanus* is 3.3–7.4 cm long and 4.7–10 mm wide in flower, while in fruit it is slightly longer and 6.9–18.2 mm wide (Wilson 1960, Les 2020, Thompson 2020).

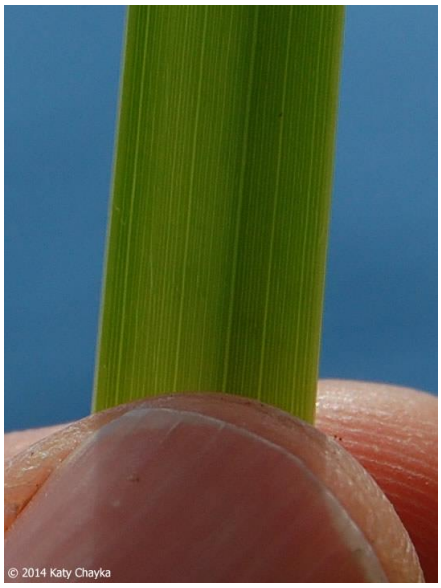
*Acorus americanus* can easily be confused with *Acorus calamus*, a non-native sweetflag that is widely introduced in North America. Although distinctions between the two species were noted two centuries ago by Rafinesque (1828, 1836) many botanists continued to treat all North American *Acorus* plants as a single species, lumping them together under either *A. calamus* or *A. americanus* (Thompson 2020). Consequently, many of the older herbarium records or distribution reports for North American *Acorus* species are unreliable (Hay et al. 1990, Haines 2000, Geiger and Banker 2012, Hough 2015, Weakley et al. 2022).

Despite the morphological similarity between *Acorus americanus* and *A. calamus* there is substantial support for their separation. *A. americanus* is a fertile diploid species (2n=24) while *A. calamus* is a sterile triploid (2n=36). Differences between the two in pollen stainability and bioactive compounds have also been documented (Packer and Ringius 1984, Romaniuk 2017). In the field, leaf venation can help to distinguish the species: In *A. calamus* the midvein is more prominent than any of the lateral veins whereas *A. americanus* has 1–5 lateral veins that are equally well-developed (Tiner 2009, Balakumbahan et al. 2010, Thompson 2020, Weakley et al. 2022). It has sometimes been noted at the veins become more distinct in dried specimens. Haines (2000) observed that both species may have notable secondary veins but the lateral veins of *A. americanus* are 0.75–1.0 times as wide as the midvein while the lateral veins of *A. calamus* are no more than 0.5 the width of the midvein. Positive identification of *Acorus americanus* can be made by the presence of mature fruits since *A. calamus* is sterile and the floral ovaries do not develop.

Throughout its range *Acorus americanus* may flower from May through August and the fruits ripen during the late summer and early fall (Haines 2000, Rhoads and Block 2007, Smreciu et al. 2014, Les 2020, Weakley et al. 2022). *Acorus* plants die back to the ground in the winter and produce new shoots around March or April. They typically reach maximum height early in the summer and continue to accumulate starch in their rhizomes throughout the growing season. New shoots develop late in the fall but remain dormant until the following spring (Morgan 1999, Leck et al. 2009).



USDA NRCS 2024a.



Katy Chayka, 2014.

Peter M. Dziuk, 2011.

## Pollinator Dynamics

The pollination mechanism of *Acorus americanus* has not been documented. Wind pollination was sometimes assumed for *Acorus* but Cook (1988) thought that the floral characteristics (eg. bisexual flowers, small anthers, sticky pollen, and relatively large perianth segments) were more indicative of insect pollination, and Les (2020) noted that the flowers of some diploid *Acorus* species emit volatile organic compounds which are probably attractive to insects. A gall midge in the genus *Contarinia* was recently found to be the pollinator of *Acorus gramineus* in China (Bogner 2011).

## Seed Dispersal and Establishment

A mature spadix of *Acorus americanus* contains many small, hard, multi-seeded fruits. The lens-shaped seeds are tan or cream-colored and 3–4 mm long. An individual fruit may hold up to 14 seeds but six is average (Packer and Ringius 1984, Smreciu et al. 2014, Thompson 2020). The primary means of dispersal is water (Les 2020) but the seeds can also be consumed by ducks (Wood et al. 2013), which might result in some distribution over longer distances. *A. americanus* can also regenerate readily from its rhizomes (Thompson 2020), which are used as food sources by muskrats and other mammals, and vegetative dispersal can occur when rhizome fragments are carried to new locations by water (Les 2020).

The seeds of *Acorus americanus* are initially dormant and require a period of cold stratification in order to germinate, although they lose viability if they dry out for too long (Les 2020). Germination requires light and is highest at warm (15/25 °C) temperatures (Smreciu et al. 2014, 2015). Mycorrhizae have been reported in *Acorus calamus* (Wang and Qiu 2006). No records of fungal relationships were found for *Acorus americanus* but the species can form loose associations with free-living nitrogen-fixing bacteria that live in the soil (Wickstrom and Garano

2007). The authors suggested that plants like *A. americanus* might release some compounds that encourage the bacteria to colonize their root zones.

## Habitat

*Acorus americanus* grows in sunny, wet places. The species is tolerant of standing water up to 50 cm deep in sites that are seasonally or permanently flooded. Reported habitats include marshes, herb- and shrub-dominated meadows, ditches and swales, ponds, lakes, reservoirs, and river edges, and tidal wetlands at elevations of 0–900 meters above sea level (Atkinson et al. 1990, Papoulias et al. 2006, Rhoads and Block 2007, Wood et al. 2013, Smreciu et al. 2014, Les 2020, Thompson 2020, Weakley et al. 2022). Substrate pH generally ranges from 5.0–7.0 (Wood et al. 2013). Experimental work demonstrated that *A. americanus* plants were most likely to thrive when the pH was close to 7.0 while growth was inhibited above 8.0 (Calvo-Polanco et al. 2013). In New Jersey, the only documented occurrence of American Sweetflag for which habitat information exists was found in an open calcareous marsh (NJNHP 2024).

Observations by Gara and Stuckey (1992) and by Whyte et al. (2003) suggest that *Acorus americanus* can readily colonize newly exposed sediments or mud flats. Once established in favorable habitats the plants are likely to persist for a long time. Soil cores taken in one marsh where *A. americanus* was present produced evidence that the species had been at that site for close to a millennium (Gill and Peteet 2018).

Typical associated species may include *Typha latifolia*, *Sparganium eurycarpum*, or *Cephalanthus occidentalis* (Taft and Solecki 1990, Gara and Stuckey 1992, Papoulias et al. 2006, Smreciu et al. 2014). *Acorus americanus* is a characteristic species of freshwater tidal communities such as *Zizania aquatica* Tidal Herbaceous Vegetation and may also be present in *Peltandra virginica—Pontederia cordata* Tidal Herbaceous Vegetation (Breden et al. 2001). Although low levels of salt may be tolerated by *A. americanus* plants that are growing at optimal pH, salinity is generally toxic to the species (Calvo-Polanco et al. 2013, Zwiazek 2014).

## Wetland Indicator Status

*Acorus americanus* is an obligate wetland species, meaning that it almost always occurs in wetlands (U. S. Army Corps of Engineers 2020).

## USDA Plants Code (USDA, NRCS 2024b)

ACAM

## Coefficient of Conservancy (Walz et al. 2020)

CoC = 7. Criteria for a value of 6 to 8: Native with a narrow range of ecological tolerances and typically associated with a stable community (Faber-Langendoen 2018).

## Distribution and Range

*Acorus americanus* is native in Canada and the United States, and possibly also in parts of Mongolia and Russia (Thompson 2020, POWO 2024). The map in Figure 1 depicts the extent of the species in North America. *A. americanus* was used extensively by many indigenous people for medicinal and spiritual purposes and the rhizomes were traded between groups, which probably helped to shape the current distribution of the species (Morgan 1999, Thompson 2020).

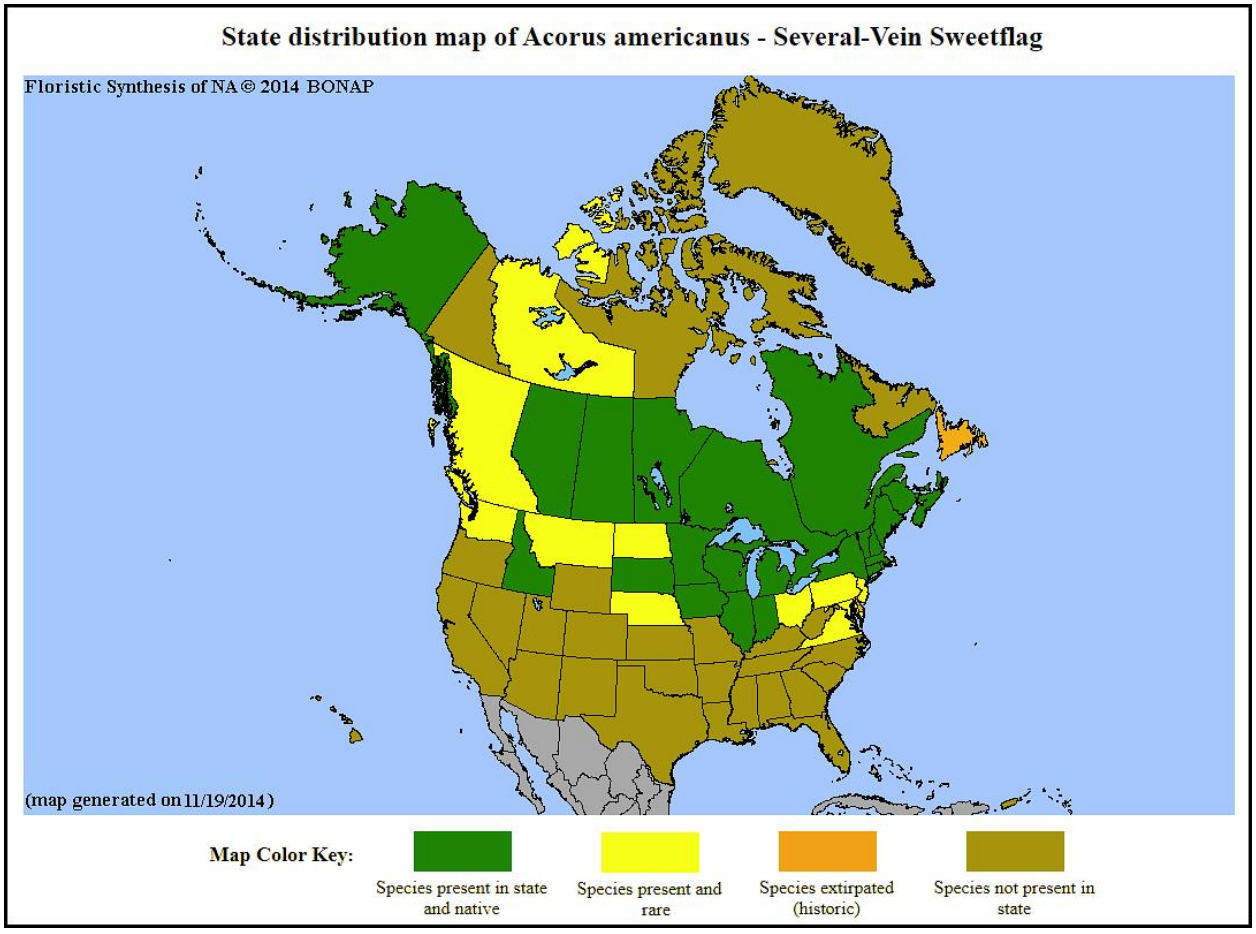



*Figure 1. Distribution of A. americanus in North America, adapted from BONAP (Kartesz 2015).*

The USDA PLANTS Database (2024b) shows records of *Acorus americanus* in 11 New Jersey counties: Bergen, Essex, Hunterdon, Mercer, Middlesex, Monmouth, Morris, Passaic, Somerset, Sussex, and Warren (Figure 2 below). *A. americanus* has also been reported in Gloucester County (Mid-Atlantic Herbaria 2024). The data do not reflect its current distribution in the state

and some specimens may have been mislabeled as a result of longstanding confusion regarding the two local *Acorus* species.

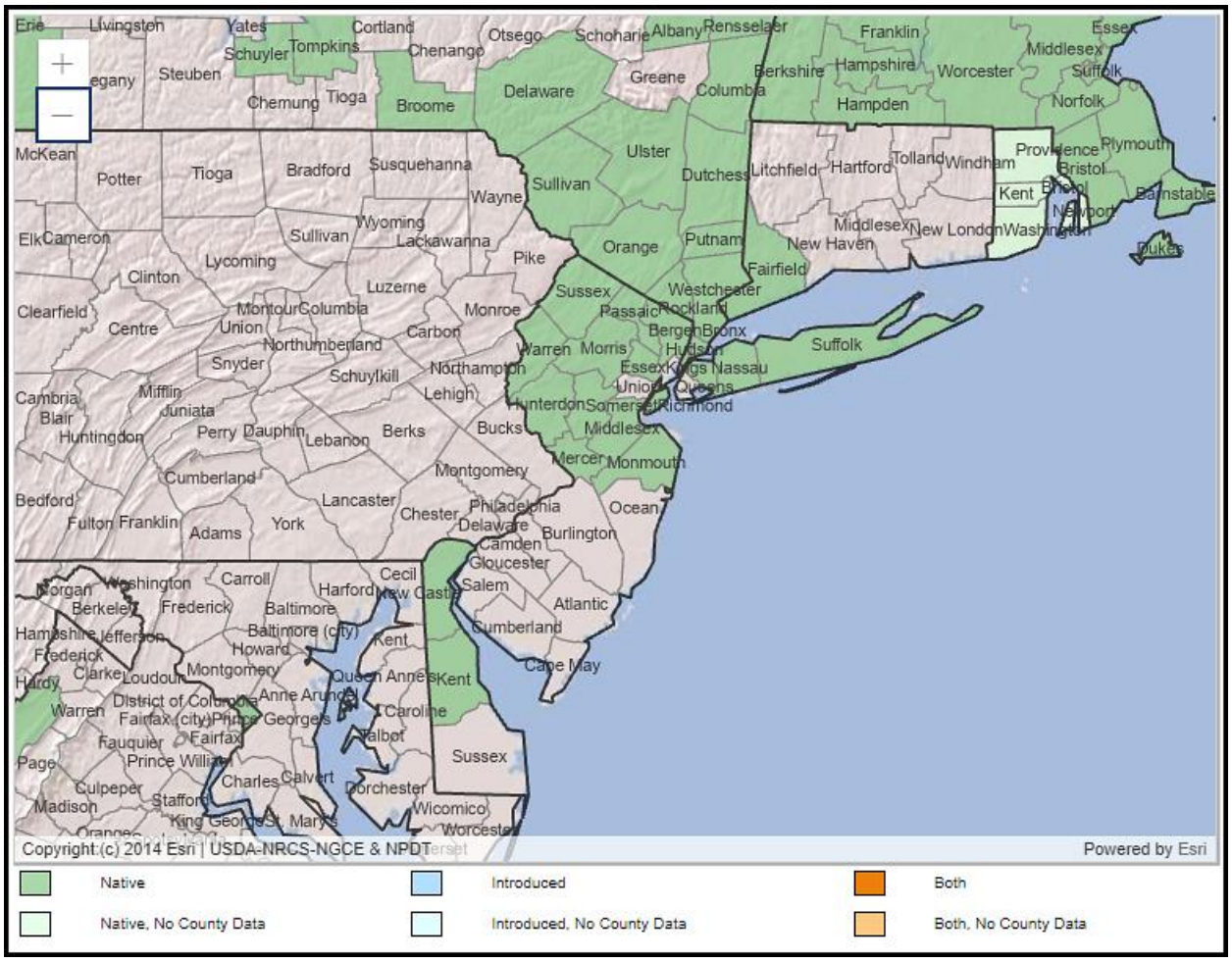



*Figure 2. County records of A. americanus in New Jersey and vicinity (USDA NRCS 2024b).*

## Conservation Status

*Acorus americanus* is considered globally secure. The G5 rank means the species has a very low risk of extinction or collapse due to a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats (NatureServe 2024). The map below (Figure 3) illustrates the conservation status of *Acorus americanus* in the United States and Canada. American Sweetflag is vulnerable (moderate risk of extinction) in three states and two provinces, imperiled (high risk of extinction) in two states, critically imperiled (very high risk of extinction) in four states and one province, and possibly extirpated in Delaware and Northwest Territories. The species is secure in one state and apparently secure throughout much of central and eastern Canada, and it remains unranked in a number of states where it occurs.

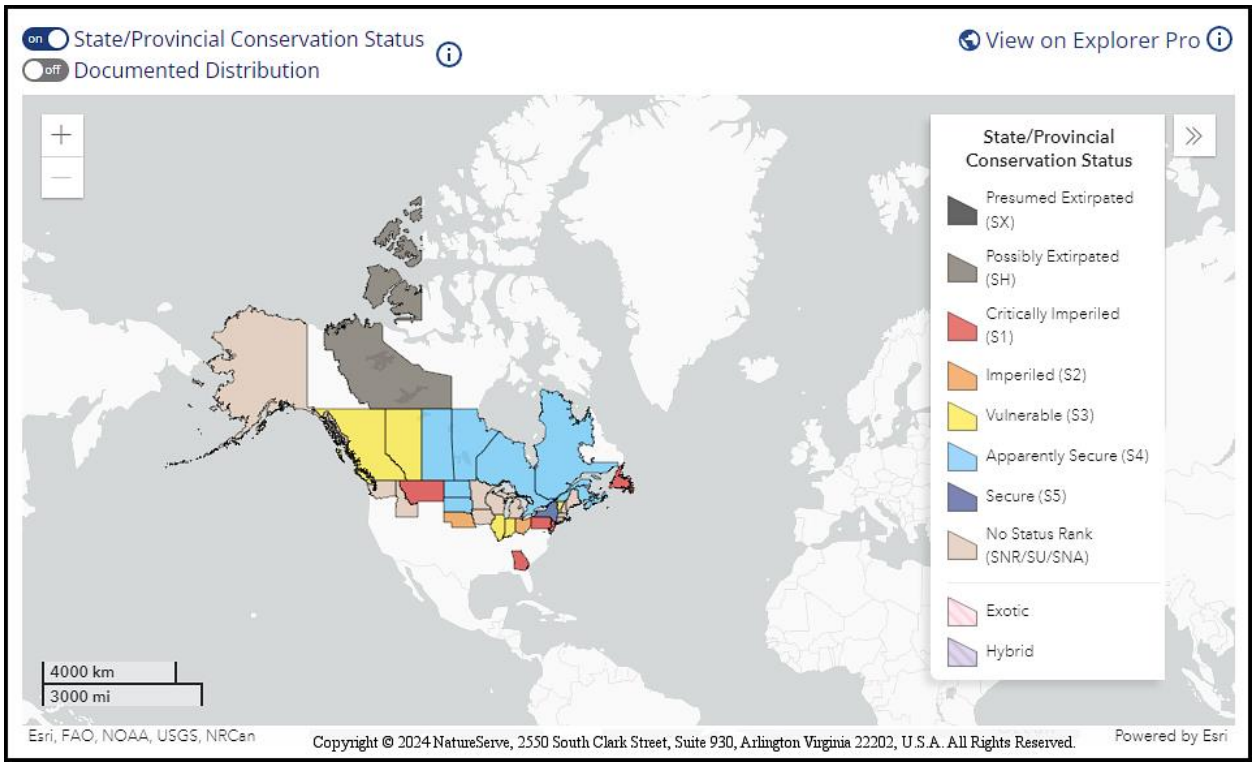



*Figure 3. Conservation status of A. americanus in North America (NatureServe 2024).*

New Jersey is one of the states where *Acorus americanus* is critically imperiled (NJNHP 2024). The S1 rank signifies five or fewer occurrences in the state. A species with an S1 rank is typically either restricted to specialized habitats, geographically limited to a small area of the state, or significantly reduced in number from its previous status. *A. americanus* has also been assigned a regional status code of HL, signifying that the species is eligible for protection under the jurisdiction of the Highlands Preservation Area (NJNHP 2010).

An 1861 specimen from Bergen County has been verified as *Acorus americanus* by the presence of fruit (Mid-Atlantic Herbaria 2024) but the occurrence is ranked as historical. The only other documented population in New Jersey was discovered by David Snyder in 1993, at which time *A. americanus* was noted to be abundant at the site. The population is still considered extant but its current status is uncertain (NJNHP 2024).

## Threats

No *Acorus americanus* plants were observed during a 2023 visit to New Jersey's extant occurrence but site conditions (flooding) did not permit a thorough search. Threats from woody succession and the presence of *Phragmites australis* ssp. *australis* were noted (NJNHP 2024). Although water depths of up to 50 cm are tolerated by *A. americanus* (Wood et al. 2013) long-term flooding at greater depths could be harmful: Whyte et al. (2003) observed that high waters may have restricted the growth of American Sweetflag at an Ohio site. Because *A. americanus* favors open, sunny locations, changes to its habitat resulting from dense growth of woody or invasive species are also likely to have a detrimental effect on the plants.

Habitat alterations resulting from human activity can be damaging to populations of *Acorus americanus*. Wetland drainage for agriculture and water level changes caused by regional development have eliminated the species or contributed to its decline in some other states (Whyte et al. 2003, Dolan 2014). Changes in water quality resulting from an overabundance of certain types of nutrients such as $NH_4^+$ can result in a rapid and significant decrease in the vigor of *A. americanus* plants (Equiza and Zwiazek 2014). American Sweetflag is still highly valued for traditional medicinal purposes so the overharvesting of rhizomes might threaten some populations (Morgan 1999).

*Acorus americanus* is susceptible to a rust fungus, *Uromyces sparganii* (Thompson 2020). Some types of *Uromyces* can complete their entire life cycle on a single plant species but others use alternate hosts. The alternate host for *U. sparganii* is *Hypericum virginianum*. Heavy infections of the rust have been observed on *Acorus calamus* (Parmalee and Saville 1954, Greene 1956). *Uromyces* fungi cause the formation of small rust-colored pustules that become surrounded by yellow rings as cells in the adjacent tissue die. Severe infections can reduce photosynthetic capacity, resulting in a decrease in overall plant performance (Gautam et al. 2022). Numerous other fungal infections have been reported on *A. calamus* and many of those can probably affect *A. americanus* as well. *Uromyces pyriformis* has been found on *A. calamus* in many locations around the globe, including the northeastern United States (Gautam et al. 2022). Kowalik (2011) detected 28 other fungal species in the leaves of *A. calamus* but noted that the health of the host plants was not significantly compromised.

## Climate Change Vulnerability

Information from the references cited in this profile was used to evaluate the vulnerability of New Jersey's *Acorus americanus* population to climate change. The species was assigned a rank from NatureServe's Climate Change Vulnerability Index using the associated tool (Version 3.02) to estimate its exposure, sensitivity, and adaptive capacity to changing climactic conditions in accordance with the guidelines described by Young et al. (2016) and the state climactic computations by Ring et al. (2013). Based on available data *Acorus americanus* was assessed as Less Vulnerable, meaning that climate change is not expected to have a notable detrimental impact on its extent in New Jersey by 2050. However, the results should be interpreted with caution due to the longstanding conflation of *A. americanus* and *A. calamus*. *Acorus americanus* is a northern species and New Jersey is near the southern end of its range. The range of *A. calamus* extends much further south, which suggests that the introduced species might have a greater tolerance for high temperatures.

In addition to elevated temperatures, some of the effects of changing climactic conditions in New Jersey include rising sea levels along the coast and an increase the frequency and intensity of both droughts and floods (Hill et al. 2020). *Acorus americanus* is known to be sensitive to drought (Wood et al. 2013). The plants modify their growth patterns in order to conserve water during dry periods by producing smaller and fewer stomata and making a smaller investment in new growth both above and below ground (Romanello et al. 2008). Didiano et al. (2018) reported a 25% reduction in the biomass of *A. americanus* plants that experienced a decrease in soil moisture availability over the course of a growing season.

Although it does not apply to New Jersey's extant occurrence of *Acorus americanus*, populations that are situated in tidally influenced habitats are likely to face a greater threat from climate change. The species experiences reduced growth in saline conditions and high levels of salinity can result in mortality (Calvo-Polanco et al. 2013, Zwiazek 2014).

## Management Summary and Recommendations

A complete survey is needed to evaluate the current status of New Jersey's single extant *Acorus americanus* population. Depending on the outcome of the monitoring visit, some management might be needed to maintain an open canopy in the vicinity of the plants or to prevent the further spread of *Phragmites* at the site.

It is possible that there are additional undetected populations of *A. americanus* in New Jersey. Because it can be challenging to discriminate between *A. americanus* and *A. calamus* when fruit is not present, some historical and/or recent occurrences may have been overlooked. Geiger and Banker (2012) emphasized the importance of reviewing the existing records of both species once clear methods for distinguishing them had been published, and Weakley et al. (2022) indicated that the improved understanding of the species' characteristics was expected to result in the discovery of additional *A. americanus* populations.

Disparities in the distribution of *Acorus americanus* and *A. calamus* in North America underscore the need for research that can pinpoint differences in the ways that the two species are influenced by environmental conditions. Identification of the factors that define the southern limits of American Sweetflag's range might establish a more reliable basis for predicting the species' response to climate change. Valuable information could also result from a pollinator study of *A. americanus*.

## Synonyms

The accepted botanical name of the species is *Acorus americanus* (Raf.) Raf. Orthographic variants, synonyms, and common names are listed below (ITIS 2024, POWO 2024, USDA NRCS 2024b).

| Botanical Synonyms | Common Names |
|---|---|
| *Acorus calamus* L. var. *americanus* (Raf.) H. D. Wulff. | American Sweetflag<br>Several-vein Sweetflag<br>Ratroot<br>Muskrat Root |

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Rafinesque (1828) featured the substantial rhizome of *Acorus* in his drawing of *A. calamus*.