

Stewardship Guidelines for Culturally Important Plants: Four Examples



Michelle Baumflek, Karim-Aly Kassam, Marla R. Emery & Clare Ginger in partnership with the Houlton Band of Maliseets and the Aroostook Band of Micmacs.

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Introduction

Why guidelines?

The creation of these guidelines is a response to recent work done in Maine (by Emery, Ginger, Putnam and Baumflek). In a two-year study funded by the Northeastern States Research Cooperative, Ginger et al (2011), found that access to culturally important plant species was shifting due to four interrelated factors: landowner regulations, social relations, environmental conditions and spatial proximity. They noted that Native American plant gatherers were negatively affected by these factors more than other cultural groups in northern Maine. In suggesting ways forward, Ginger et al (2011) proposed that sample management guidelines created by Native communities would be one way to increase communication between tribes and landowners, with the potential to positively affect access to culturally important plants.

What do these guidelines do? How are they different?

These guidelines are the product of a partnership between Maliseet and Mi'kmaq communities in Maine (Houlton Band of Maliseet Indians, Aroostook Band of Micmacs) and researchers from Cornell University, the US Forest Service, University of Vermont and University of Maine, Presque Isle. They seek to highlight Native perspectives on plant use and stewardship as a way of offering an alternative perspective to commonly-employed methods of natural resource management. They are made for Maliseet and Mi'kmaq communities with two purposes in mind:

1. To serve as a tool of communication between tribes, other landowners, agencies, and natural resource managers.
2. To act as an internal resource for community members.

Therefore, these guidelines are based on an alternative conception of the term *management*. When referring to natural resources, management usually refers to the regulation of human actions to produce a desired outcome. These outcomes are typically related to economic (ie maximized timber production), ecological (ie maintenance of species diversity, or a population of a rare plant) goals, and social (ie recreational opportunities, fishing access) but less frequently do they take cultural goals into account.

In creating management guidelines for culturally important plant species, a different, unique set of goals and perspectives must be employed. It is not just the conservation of a species that is important, but the maintenance of respectful relationships between people and plants that is the focus.

To cultivate these relationships, these guidelines:

- Are made with community members for community members.
- Incorporate socio-cultural as well as ecological aspects into recommendations.

- Combine traditional ecological knowledge with other ways of knowing, including natural history, botanical field work.
- Highlight sustainable gathering techniques currently being implemented by Maliseet and Mi'kmaq plant gatherers.
- Focus on plants that can be considered common, and therefore do not always receive attention, despite their cultural importance.
- Are grounded in the concept of *All My Relations*, a term used by Maliseet and Mi'kmaq people to acknowledge the interconnected nature of all life on the planet. *All My Relations* inherently encompasses principles of respect and reciprocity, which are integral to the sustainable use of plants.

Goldthread

Maliseet Name: wisawkeskil

Mi'kmaq Name: mali'japa'qawey

Scientific Name: *Coptis trifolia*

Family: Ranunculaceae

Common Names: Goldthread, goldenthread, yellowroot



Significance

- Goldthread is a popular medicinal plant used by Mi'kmaq and Maliseet community members
- It is mainly used to treat ailments of the mouth and throat, including mouth sores, toothaches and sore throats
- The rhizome of goldthread has traditionally been used as a yellow dye for quill work and basketry

Sociocultural and Ecological Issues of Concern with Recommendations

1. Maintaining appropriate habitat
 - a. Conserve old coniferous forest types.
 - b. Purchase land that contains appropriate goldthread habitat.
 - c. Create a long-term forest management plan that contains appropriate areas for goldthread.
 - d. In areas that are important for goldthread harvest, limit activities that could alter local hydrology.
 - e. In designated areas, use minimally-invasive tree harvesting methods.
2. Distance traveled to harvest
 - a. Share knowledge of gathering locations between communities.
 - b. Establish relationships with nearby landowners who may have a healthy population of goldthread on their land.
3. Long term sustainability of popular collection sites
 - a. Maintain several collection sites, to allow appropriate rotation time for plant regeneration
 - b. Set up monitoring plots to assess how long appropriate goldthread regeneration takes
4. Sharing knowledge about goldthread
 - a. Hold intra community workshops that teach about proper harvest and use.

Gatherer Management Techniques for Goldthread

- ***Replanting rhizomes:*** While it is the yellow rhizome that gatherers are harvesting, they replant any additional plant material.
- ***Choosing appropriate-sized collection sites:*** Gatherers harvest goldthread from locations that they feel have a large enough population of plants to support harvesting.
- ***Use of appropriate tools:*** Some gatherers use trowels or shovels to dig up small patches of goldthread. This action allows them to take up a clump of plants, and carefully loosen soil around the rhizomes instead of accidentally ripping them.
- ***Harvesting only what you need:*** Gatherers interviewed do not put a number on the amount of goldthread they harvest. They instead say that goldthread is potent, that a little goes a long way, and report taking only what they need.
- ***Intent in harvesting:*** Many gatherers talk about going out to gather plants for a specific person or group of people in mind (community elders). They believe that the positive intent they put into the plants make it stronger medicine.
- ***Choice of harvest time:*** While goldthread can be harvested from spring to fall, many people harvest in fall time. This gives goldthread fruits a chance to mature and disperse seeds, as well as allows rhizomes to spread throughout the growing season.
- ***Give thanks:*** Before harvesting, gatherers offer tobacco or a prayer, giving thanks to the medicine they are about to collect.

1. Maintaining appropriate habitat: Goldthread is extremely sensitive to changes in its environment. Gatherers report collecting goldthread in moist forests and swampy areas associated with moss and old trees. Ecological research has demonstrated that goldthread abundance is highest in older forests (over 100 years old). However, In addition, the average rotation for forestry practices in northern Maine and New Brunswick is around 40-60 years, far younger than the preferred age class for goldthread. Furthermore, activities associated with forestry, agriculture, recreation and development can negatively impact goldthread habitat. Specifically, goldthread rhizomes are shallow, and cannot withstand much soil compaction. Changes in canopy cover and moisture level may also negatively impact goldthread.

Recommendations to maintain goldthread habitat:

- a. Conserve old coniferous forest types
Involves: Landowners including tribes and the state, as well as potentially land trusts
Affects: Habitat, plant populations
Timeframe: Ongoing
- b. Purchase land that contains appropriate goldthread habitat
Involves: Tribal government
Affects: Habitat
Timeframe: Potentially short-term, one time
- c. Create a long-term forest management plan that includes appropriate areas for goldthread:
 - maintain stands of old coniferous trees
 - poorly drained acid soils
 - canopy cover of at least 60%
 - coarse woody debris
 - long rotations (greater than 100 year) or no rotationInvolves: Tribal government and resource managers
Affects: Habitat
Timeframe: Short term to design plan, Long term to implement and revisit
- d. In areas that are important for goldthread harvest, limit activities that could alter local hydrology
 - placement of culverts
 - road constructionInvolves: Gatherers to identify important harvest locations, tribal government, natural resource managers, and planners to make decisions regarding hydrology.
Affects: Habitat, plant populations
Timeframe: Ongoing, incorporate into decision making around planning
- e. In designated areas, use minimally-invasive tree harvesting methods:
 - selective harvests that preserve some tree canopy
 - avoid extremely heavy mechanical harvesting equipment which can disturb or compact soilInvolves: gatherers to identify important areas, natural resource managers and foresters to develop and implement best practices.
Affects: Habitat, plant populations.
Timeframe: Ongoing

2. Distance traveled to harvest: While goldthread is relatively common, access to nearby goldthread harvesting sites varies from community to community. For instance, in Maine, gatherers from the Aroostook Band of Micmacs have collecting sites on band land, while some gatherers from Tobique First Nation will travel two hours to Mount Carleton Provincial Park to harvest from healthy-sized populations.

Recommendations to minimize distance:

- a. Share knowledge of gathering locations between communities
Involves: gatherers from different communities
Timeframe: Ongoing, share knowledge both informally in conversation and formally through semi-annual workshops
- b. Establish relationships with nearby landowners who may have a healthy population of goldthread on their land
Involves: gatherers, local landowners, and potentially tribal officials to make contact or set up institutional arrangements with certain landowners
Timeframe: Ongoing, as needed

3. Long term sustainability of popular collection sites: Goldthread is a slow-growing plant that often spreads clonally through rhizomes. Research has shown that in the first two years after harvest, the rhizomes of goldthread take longer to grow back than the leaves do. Therefore, after harvests, it may take several years before the amount of leaves visible above ground reflect how many rhizomes are present belowground. More long term research is needed to assess how long it takes for goldthread to regenerate post harvest. This knowledge can help gatherers and managers choose appropriate collection sites that have healthy populations.

Recommendations:

- a. Maintain several collection sites, to allow appropriate rotation time for plant regeneration
Involves: Gatherers
Affects: Plant populations
Timeframe: Short term, can begin now, Ongoing
- b. Set up monitoring plots to assess how long appropriate goldthread regeneration takes
Involves: Gatherers and tribal natural resource managers to establish control and experimental plots, and monitor them. And/or, involves researcher to conduct study.
Affects: Plant populations
Timeframe: Short term to establish plots, Long-term, at least 5-10 years of yearly monitoring

4. Sharing knowledge about goldthread

Some community gatherers have expressed that they would like to know more about how to use and harvest goldthread. In particular, people view it as a potent plant, and are wary about using goldthread until they have more experience with it. Learning how to harvest and use plants is best accomplished through firsthand experience.

Recommendations for sharing knowledge:

- a. facilitate intra-community opportunities for learning, such as medicinal plant workshops.
 - o Several of these have happened in the past few years with good success (See photo, cleaning goldthread at a medicinal plant workshop hosted by the Houlton Band of Maliseets)

Involves: Gatherers from different communities to get together and share knowledge, Tribal governments to provide physical space for workshops or other activities to occur.

Timeframe: Short-term, can happen immediately, Ongoing, once a year or as needed.



Timeframe for recommendations

RECOMMENDATION	SHORT-TERM	LONG-TERM
Conserve old coniferous forest types		Incorporate into planning
Purchase land that contains appropriate goldthread habitat	As soon as is feasible	
Create a long-term forest management plan that contains appropriate areas for goldthread	Creation of an initial plan	Implementing and revisiting plan
Limit activities that may disrupt local hydrology		Ongoing
Use minimally-invasive tree harvesting methods		Ongoing
Share knowledge of gathering locations between communities.	Can start immediately	
Establish relationships with nearby landowners	Can start immediately	Ongoing as needed
Maintain multiple collection sites	Can start immediately	

Set up monitoring plots To assess regrowth	set up plots once	Monitor plots yearly
Set up teaching workshops	Can start immediately	Ongoing, repeat yearly

Species information

Physical Description: Goldthread is a small perennial herb that grows from 3-6 inches (7 to 15 cm) tall. Basal evergreen leaves are distinctively glossy, and are made up of 3 compound leaflets, with a toothed or crenate margin. Individual plants usually produce one flower in May to July, consisting of 4 to 7 white, petal-like sepals. Flowers contain 3-7 pistils and numerous stamens. The fruit is a follicle that splits open on one side. Rhizomes are shallowly-rooted, slender and bright yellow in color, giving the plant its common name.

Method of Reproduction: Goldthread spreads both vegetatively through rhizomes and sexually through seed production. Seed dispersal distances and mechanisms are currently unknown. However, many plants that are frequently found in older forest types of the northeast lack long-distance dispersal mechanisms.

Pollinators: Pollinators of goldthread are unknown.

Level of Rarity: *Habitat Specialist:* Wide geographic distribution, restricted habitat specificity, large populations somewhere in plant range.

Habitat: Moist, acidic conifer forests and swamps.

Associated Herbaceous Species: Sphagnum mosses *Sphagnum species*, Canada mayflower *Maianthemum canadense*, northern wood sorrel *Oxalis acetosella*, wild sarsaparilla *Aralia nudicaulis*, bunchberry *Cornus canadensis*, partridgeberry *Mitchella repens*.

Associated Overstory Species: Cedar *Thuja occidentalis*, hemlock *Tsuga canadensis*, red spruce *Picea rubens*, white pine *Pinus strobus*, balsam fir *Abies balsamea*.

Transplantability: Goldthread can be transplanted, but some techniques are more successful than others. Because goldthread is a clonal plant, it does better when transplanted in clumps, the larger the better. Planting a single plant (known as a ramet), can have very poor results and extremely low survivorship. In addition, goldthread may take a few years to get established after transplanting.

Plant Part Used: The rhizome.

Time of Harvest: Spring through fall, but often in the fall.

Who Harvests: While it is harvested by both men and women, in our interviews women collected goldthread more often. In some communities, certain families or individuals collect and then distribute goldthread throughout and across communities.

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Highbush Cranberry

Maliseet Name: Ipiminaks

Mi'kmaq Name: Nipanmaqsi'l

Scientific Name: *Viburnum opulus* subspecies *trilobum*

Family: Caprifoliaceae

Common Names: crampbark, cranberry bush



Significance

- Highbush cranberry is an important food and medicine in Maliseet and Mi'kmaq communities
- The berries of highbush cranberry are high in vitamin C, and are used to treat urinary tract infections, bladder infections, and high blood pressure
- The bark of highbush cranberry is a powerful antispasmodic, and used to treat a variety of muscle cramps

Sociocultural and Ecological Issues of Concern with Recommendations

1. Environmental Contamination

- a. Avoid collecting berries from plants located directly on roadsides or active agricultural field margins
- b. Locate and nurture existing highbush cranberries on band lands
- c. Establish populations of highbush cranberries on band lands

2. Viburnum Leaf Beetle

- a. Establish community monitoring for viburnum leaf beetle
- b. Treat viburnum plants that display signs of leaf beetle infestation

Gathering Practices for Highbush Cranberry

- **Harvesting only what you need:** Gatherers recognize that many types of animals also eat highbush cranberries and generally harvest no more than half of the fruit off of any given shrub.
- **Choosing branches:** Gatherers who collect bark choose side branches, avoiding main stems. They also choose branches that do not have berries on them.
- **Choice of harvest time:** Gatherers wait until after a hard frost to collect highbush cranberry bark. At this time, the plant is dormant, lessening the impact of branch cutting.
- **Intent in harvesting:** Many gatherers talk about going out to gather plants for a specific person or group of people in mind (community elders). They believe that the positive intent they put into the plants make it stronger medicine.
- **Give thanks:** Before collecting, gatherers offer tobacco or a prayer, giving thanks to the medicine they are about to collect.

1. Environmental contamination: Highbush cranberries grow in edge or open habitat. This means they can often be found along roadsides, field margins and forest edges. While these locations around roads and fields may be easy to access, gatherers have expressed concern about contamination from ice-melting chemicals and pollution from cars, as well as pesticides and herbicides applied onto fields.

In northern Maine and western New Brunswick, two main agricultural crops are potatoes and broccoli. These crops are often treated with a variety of pesticides throughout the growing season, as well as herbicides that reduce weeds and kill back potato plant tops before harvesting. Because of the timing of their application, these pesticides and herbicides are not intended for human consumption. However, drift from aerial applications of these chemicals may inadvertently land on nearby plants located in field margins, including highbush cranberry.

Recommendations to avoid environmental contamination

- a. Avoid collecting berries from plants located directly on roadsides or active agricultural field margins

Involves: Gatherers

Affects: Gatherers

Timeframe: Ongoing, can begin immediately

- b. Locate and nurture existing highbush cranberries on band lands
 - Plants are beneficial to people and wildlife
 - GPS locations of existing accessible plants/ create a map of locations available for gatherers.
 - If necessary, weed around highbush cranberry bushes to give them more light and room to grow.

Involves: Gatherers and tribal natural resource managers to locate plants, tribal resource management summer interns to GPS plant locations and weed.

Affects: Plants

Timeframe: short term, one time to locate plants, once a year for weeding/maintenance if necessary.

- c. Establish populations of highbush cranberries on band lands
 - Because highbush cranberry is important for wildlife, funding may be available to purchase plants for habitat improvement.
 - Plant away from active agricultural fields, but in locations that are easily accessible for community members.
 - Plant highbush cranberries in areas where they will receive abundant sunlight, and not be shaded, which reduces susceptibility to viburnum leaf beetle

Involves: Tribal natural resource managers

Affects: Plant populations, gatherers, wildlife

Timeframe: short term to plant, long term to monitor and establish

2. *Viburnum leaf beetle:* The viburnum leaf beetle is a leaf feeding beetle that specializes in the Viburnum family. The species, *Pyrrhalta viburni*, skeletonize leaves during the growing season, weakening the plant. Several consecutive years of severe defoliation can kill established viburnums. Viburnum leaf beetles are originally from Eurasia, and first appeared in Maine in 1994. The viburnum leaf beetle is found across the Northeast United States and in the Canadian Maritimes.

Highbush cranberry is a viburnum, and is considered highly susceptible to attack by the viburnum leaf beetle. Highly susceptible species are "the first to be attacked, and are generally destroyed in the first 2-3 years following infestation." (Weston et al, 2004, p. 1) Within Aroostook County, the viburnum leaf beetle is most abundant in southern townships. Cooperative extension agents in Aroostook County have noticed a rise in leaf beetle sightings in the past two years. They note that the majority of cases in which viburnums have been severely defoliated by the beetle are around Houlton, Maine.

Recommendations for Viburnum Leaf Beetle

- a. Establish community monitoring for viburnum leaf beetle
 - Create information sheets with pictures of the beetle, it's larvae, and defoliated leaves (an already made information sheet can be downloaded here for modification
<http://www.hort.cornell.edu/vlb/news/wantedlet.pdf>)
 - Ask gatherers, other community members to be on the lookout for signs of the beetle
 - Much more information about Viburnum Leaf Beetle can be obtained through local cooperative extensions and Cornell University.
 - Connect to the Viburnum Leaf Beetle Citizen Science page here:
<http://www.hort.cornell.edu/vlb/index.html>
 - Allows an opportunity to be connected to up to date information about the beetle, its spread and suggested treatments.

Involves: Tribal natural resource managers, gatherers, other interested community members

Affects: Individual plants, plant populations

Timeframe: short term to create information sheets, ongoing for monitoring

- b. Include article about viburnum leaf beetle in community news letter

Involves: Tribal natural resource managers or cooperative extension agent to write the article, tribal natural resources department or other institution to include in newsletter

Affects: Community members knowledge

Timeframe: short term, once

- c. Treat viburnum plants that display signs of leaf beetle infestation
 - Open canopy around existing plants to reduce shade. Research has shown that plants that receive more shade have more feeding damage than those in full sun.
 - Prune branches that have eggs on them, after egg laying season ends in October. Pruning can be done from October to April.
 - Remove leaf litter surrounding infested shrubs.

Involves: Tribal natural resource managers, interns, interested landowners.

Affects: Individual plants, plant populations.

Timeframe: Long term, as needed when infested plants are located.

Timeframe for recommendations

RECOMMENDATION	SHORT-TERM	LONG-TERM
1a. Avoid collecting berries from plants located directly on roadsides or active agricultural field margins		Ongoing
1b. Locate and nurture existing highbush cranberries on band lands	Once to locate plants	Check on plants yearly
1c. Establish populations of highbush cranberries on band lands	Plant highbush cranberries	Monitor plants yearly
2a. Establish community monitoring for viburnum leaf beetle	Can begin immediately	Monitoring can take place every summer
2a. Create information sheets with pictures of the beetle, it's larvae, and defoliated leaves	Once. Possible modes of distribution: listservs, blogs	Ensure that information sheets are available for distribution Ongoing.
2b. Include article about viburnum leaf beetle in community news letter	Once	
2c. Treat viburnum plants that display signs of leaf beetle infestation	Can begin immediately. Prune infected twigs between early October and mid-April	Ongoing

Species information

Physical Description: Highbush cranberry is a large shrub with many stems, growing up to 5 meters wide and tall. Branching is opposite. Leaves of highbush cranberry three-lobed, resembling a maple. Large flower clusters form at the tip of branches, and are comprised of an outer ring of large white blossoms which are sterile, and an inner ring of small, fertile flowers. Flowers are followed by a dense cluster of bright red fruit (drupes), each of which contain one flat white seed.

Method of Reproduction: Highbush cranberry reproduces sexually. Fruit are eaten by a variety of birds and mammals, which in turn disperse seeds.

Pollinators: bees, beetles

Level of Rarity: *Habitat Generalist:* Wide geographic distribution, broad habitat specificity, large populations somewhere in plant range

Habitat: Moist, forest edges, field margins, roadsides.

Associated Overstory Species: chokecherry *Prunus virginiana*, wild plum *Prunus americana*

Transplantability: May be transplanted, but takes several years to establish and set fruit.

Plant Part Used: The fruit and bark.

Time of Harvest: Fruit is harvested in late summer, late August through mid September, bark is harvested in early spring or fall, after leaves have fallen off the plant.

Who Harvests: Both men and women.

Literature Cited

Weston, P. 2004. *Susceptibility ratings to Viburnum Leaf Beetle of Common Species of Viburnum.* Department of Entomology, Cornell University: Ithaca NY.

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Muskrat Root

Maliseet Name: Kiwohosuwasq

Mi'kmaq Name: Ki'kasuwasw

Scientific Names: *Acorus americanus*, *Acorus calamus*

Family: Acoraceae

Common Names: Muskrat root, sweet flag, belle-angelique, flag root, calamus root



Significance

- Muskrat root is arguably the most important and widely used medicinal plant for Maliseet and Mi'kmaq communities in Maine and New Brunswick.
- It is used as a medicine to prevent and lessen the effects of colds and flus.
- Muskrat root is harvested by only a few community members, but widely shared within and across communities, particularly with elders who grew up using the plant, but are no longer physically able to gather it themselves.

Sociocultural and Ecological Issues of Concern and Recommendations:

1. Overharvest of rhizomes in certain gathering locations
 - a. Monitor population levels at popular collection sites
 - b. Locate new muskrat root collection sites and identify suitable sites where muskrat root can be planted
2. Access to populations that are close by
 - a. Locate new muskrat root collection sites and identify suitable sites where muskrat root can be planted
 - b. Transplant individuals from established populations
3. Access to different sites due to river erosion or yearly fluctuation in river levels
 - a. Identify new harvesting sites along lakes.
4. Plant contamination through uptake of heavy metals and pesticides
 - a. Test for heavy metal and pesticide content of muskrat root in Maine
5. Distinguishing between *Acorus calamus* and *Acorus americanus*

- a. If gatherers wish to avoid beta-asarone ingestion through use of *Acorus calamus*, there are certain habitats that appear to be safer than others
- b. Obtain samples of *Acorus calamus* rhizomes, and submit them for testing to determine the beta-asarone content of specific populations.
- c. Train members in each community to be able to identify the distinguishing morphological features between *Acorus americanus* and *Acorus calamus*.
- d. Establish a reference collection of muskrat root in each community.

Gathering Practices for Muskrat Root

- **Replanting rhizomes:** While it is the main rhizome that gatherers are harvesting, small rootlets are often present. If gatherers accidentally pull up too much rhizome, they replant it, along with any small rootlets to encourage next year's growth.
- **Harvesting with hands:** gatherers describe harvesting muskrat root with their hands, which can be an intense experience as water temperatures in October are cold. One gatherer noted that people who he felt were harvesting inappropriately were not using their hands, but employed shovels instead, and were taking up too much of the rhizome and plants.
- **Harvesting only what you need:** gatherers interviewed do not put a number on the amount of muskrat root they harvest. They instead report taking only what they need...
- **Site rotation/listening to the land:** Gatherers will often wait a season or two before returning to the same harvest site. In addition, some gatherers interviewed feel that not being able to access muskrat root collection sites due to high river levels is a punishment for mistreating the plants.
- **Intent in harvesting:** Many gatherers talk about going out to gather plants for a specific person or group of people in mind (community elders). They believe that the positive intent they put into the plants make it stronger medicine.
- **Only harvesting at certain times of the year:** Harvesting after one to three frosts reduces impact on both plants and their wetland habitats. After frosts, leaves die back and plants are induced into dormancy.

Some recommendations may address more than one issue of concern. Concerns addressed will be indicated by referring to the corresponding number above.

1. Overharvest of rhizomes in certain gathering locations

Some gatherers have expressed concern that popular muskrat root harvest sites, including Mars Hill, are being overpicked. However, these sites have been continuously used for over 60 years, and remain productive.

As a non-invasive way of examining *Acorus* abundance, we compared the percent cover (using meter-squared quadrats) of *Acorus* at the popular Mars Hill site versus other *Acorus* sites where no harvesting is known to take place. The percent cover of *Acorus* at the Mars Hill site ranged from less than 1% to 12%, with a mean of 7.5%. The percent cover of *Acorus* at non-harvesting locations was substantially greater and ranged from less than 1% to 80%, with a mean of 25%, however quadrat sites regularly exceeded 50%. This suggests that harvesting may be affecting the health of plant populations, in terms of above-ground biomass. However, research conducted in Manitoba has shown that there is no correlation between above-ground density of plant parts and density of underground rhizomes, so the health and abundance of underground parts remains unknown.

Recommendations for overharvesting

a. Monitor population levels at popular collection sites

Involves: gatherers who are willing to assist with monitoring, tribal resource managers or outside researcher to design and implement study

Affects: Plant populations

Timeframe: Ongoing, once a year

b. Locate new muskrat root collection sites and identify suitable sites where muskrat root can be planted

One solution to issues of access would be to locate both new *Acorus americanus* collecting sites, and suitable sites where *Acorus americanus* can be planted. One method of doing this is through creating a species distribution model (*In progress*). A species distribution model can capture the range of locations where a species is likely to be found. Optimal sites can then be identified through input from gatherers about preferred locations, as well as overlaying access information including distance to roads and land ownership.

Involves: a researcher, or tribal employee familiar (or trained to be familiar with) species modelling, landowners: to allow access to newly identified collecting sites if necessary

Affects: Plant populations

Timeframe: Short-term, once to develop and test model, Long term to revisit and determine if it is necessary to locate more sites

2. Access to populations that are close by and easy to get to

An issue for older gatherers or people with limited means of transportation is having access to nearby muskrat root harvesting sites. For example, gatherers in Maine frequently travel at least half an hour, but sometimes farther to harvest muskrat root. In addition to distance from home, ease of accessibility, including distance from the road, or need to cross a river are also factors.

Recommendations for ease of access

- a. Locate new muskrat root collection sites and identify suitable sites where muskrat root can be planted (See 1b)
- b. Transplant individuals from established populations
 - a. to areas with greater accessibility
 - b. to tribally owned lands
 - c. to areas with lower heavy metal contents

The fact that *Acorus* can spread quickly through rhizomatous growth makes it an ideal candidate for different types of *ex situ* management. The Houlton Band of Maliseets is already planting nursery-grown muskrat root on band lands (See Picture). A meeting about muskrat root in Tobique First Nation, New Brunswick, plant gatherers displayed an interest and willingness to transplant *A. americanus* to nearby locations.

Involves: plant gatherers: to identify locations where plants can be obtained, tribal natural resource managers: to cultivate plants until it is time to plant out, to assist with plantings on band land (example: Houlton Band of Maliseets, see Figure 1), landowners: if not on public land, to obtain permission to remove plants from their land.

Affects: Plant populations

Timeframe: Short-term to obtain plants during one growing season, Long-term to monitor the health of newly established sites once a year.



Figure 1 Houlton Band of Maliseet band members and natural resource manager planting muskrat root in an easily accessible spot on band lands.

3. Access to different sites due to river erosion or yearly fluctuation in river levels

Muskrat root sites near Tobique First Nation and other tribal lands are located along rivers. Gatherers have noted a loss of plants due to erosion caused by human and environmental factors. For example, the Tobique Narrows Dam has altered river levels, and submerged or eroded productive muskrat root sites. Despite the fact that the dam has been in place for over 50 years, the memory of the site still exists within the community. In addition, yearly fluctuations in river level can be prohibitive to

gathering. For instance, in the summer and fall of 2011, river levels remained consistently higher than normal, and medicine gatherers were not able to obtain muskrat root for the winter season. As mentioned above, some people feel that high river levels are Mother Earth's way of saying 'enough!', as it gives plant populations a chance to rest. However, inability to harvest meant that some community members went without this important medicine last winter.

Recommendations for access due to river fluctuation.

- a. Identify or establish new collecting areas around lakes or other areas that are not subject to dramatically fluctuating water levels.

Involves: gatherers, resource managers, researchers, landowners or others who are able to locate new areas, tribal resource managers to establish new populations on band lands

Affects: plant populations

Timeframe: Ongoing

4. Plant contamination through uptake of heavy metals and pesticides

Some gatherers have expressed concern about contamination of muskrat root due to environmental pollutants including agricultural and forestry related chemicals and heavy metals that get into water systems. In addition, certain heavy metals are abundant in Maine and New Brunswick due to the output of smelters from Ontario. Muskrat root is of particular concern because it is a wetland plant, and because the rhizome is used. Rhizomes are likely to be the place where chemicals uptaken from soil and water accumulate.

A toxicology study was just conducted in 2011, and looking at 10 muskrat root sites, 9 in New Brunswick on or near tribal lands, and the Mars Hill site in Maine. Samples were dried, and tested for 17 common organochlorine pesticides and 32 heavy metals. Thankfully, none of the muskrat root from any of the sites had any detectable levels of pesticides. Samples from certain sites did display heavy metal contents higher than the recommended safe daily intake for a variety of metals including aluminum, barium, chromium, lead, strontium and uranium. Furthermore, a 10 milligram sample of muskrat root exceeded recommended health levels of barium in 9 sites, Iron in 10 sites, manganese in 9 sites and thalium in 2 sites.

Recommendations for plant contamination

- a. Test for heavy metal and pesticide content of muskrat root in Maine

While testing for heavy metals and pesticides in muskrat root populations has been done in parts of New Brunswick, samples should be similarly tested in Maine.

Involves: tribal environmental managers or outside laboratories to conduct tests on chemical content of muskrat root, gatherers to determine which sites should be tested, and at what time of the year, and to potentially collect samples while they harvest

Affects: plant populations, community members

Timeframe: Ongoing, Bi-Yearly. Tribal environmental managers should work with gatherers to determine appropriate times of year for testing that correspond with harvest time

5. Distinguishing between *Acorus americanus* and *Acorus calamus*

While Mi'kmaq and Maliseet people recognize one type of muskrat root in their landscape, it has recently been brought to gatherer's attention that current botanical taxonomy distinguishes between two species. *Acorus americanus* is a circumboreal plant native to North America, while *Acorus calamus* is originally from Asia, and has been transported through Europe, and introduced into North America as early as the mid 1800s. While the two species look virtually identical, *A. calamus* contains the chemical beta-asarone, while *A. americanus* does not (see background information for more on the uncertainty surrounding health effects of beta-asarone). This may be an issue for Mi'kmaq and Maliseet gatherers because we have verified that the most popular muskrat root harvesting site for gatherers in northern Maine and western New Brunswick (Mars Hill, Maine) contains *A. calamus*.

Both species look very similar, unless someone is trained to distinguish morphological and reproductive differences. In general the best way to differentiate between the two species is in mid to late summer, when the spadix, the sexually reproductive part of the plant, has obvious differences between species. Because *A. calamus* is sterile, the spadix does not contain mature fruits. Instead, it turns brown and shrivels up. *A. americanus* is fertile, and produces mature fruit, which fill out on the spadix (See Figure 1 for photos of this difference).

Figure 1: Comparison of the Mid-August appearance of spadices of *A. calamus* and *A. americanus*



***Acorus calamus*, sterile triploid:
non-maturing fruits shrivel and dry on spadix
by mid-late summer**



***Acorus americanus*, fertile diploid:
Pollinated flowers produce mature fruits
which fatten on the spadix by mid-late
summer**

An issue with being able to accurately differentiate plant species is the time of year of harvest. As mentioned before, the best time of year to tell the two species apart by observing their spadices is mid to late summer. However, most gatherers only visit harvesting sites in late October or early November, when all the above ground parts of the plants are not present.

Recommendations for distinguishing between *Acorus americanus* and *Acorus calamus*

- a. **If gatherers wish to avoid beta-asarone ingestion through use of *Acorus calamus*, there are certain habitats that appear to be safer than others.** Specifically, harvest along rivers and lakeshores, and avoid wet fields.

We are suggesting a complementary way to distinguish species based on habitat. Field observations in Maine and New Brunswick, complemented by our analysis of over 200 regional herbarium specimens demonstrates a statistically significant difference in habitat preferences of the two species (See Figure 2). *A. americanus* is more closely associated with habitats along rivers and lakes, while *A. calamus* is found more frequently in wet fields, meadows and marshes. The two appear about equally along smaller streams.

Involves: gatherers

Affects: plant populations

Timeframe: Ongoing.

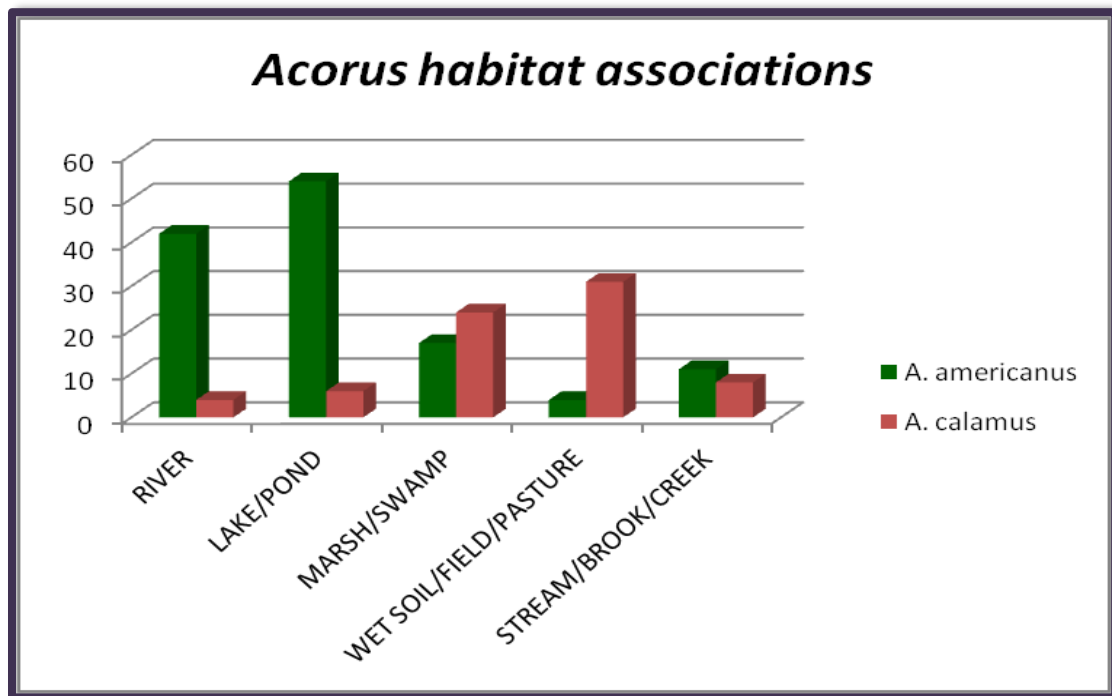


Figure 2: Differing habitat preferences of *A. americanus* and *A. calamus*

b. Obtain samples of *Acorus calamus* rhizomes, and submit them for testing to determine the beta-asarone content of specific populations.

This action could clarify some of the current uncertainty surrounding beta-asarone. If more information were available, some of the other suggested recommendations may not be necessary.

Involves: gatherers to obtain samples, tribal resource managers and an environmental laboratory to conduct testing.

Affects: Plant populations

Timeframe: short-term, once.

c. Train members in each community to be able to identify the distinguishing morphological features between *Acorus americanus* and *Acorus calamus*.

These community members will be able to teach other people what to look for, as well as verify which species collection sites contain.

Involves: plant gatherers: to teach each other about recognizing two different species and where they grow

Affects: community members

Timeframe: Ongoing, as long as there is a concern among gatherers.

a. Establish a reference collection of muskrat root in each community.

The collection should contain pressed specimens showing the differences between the spadices, and also specimens preserved with glycerin that preserve shape and color of plant features.

Involves: Tribal resource managers

Affects: community members

Timeframe: Short term to establish the collection, Ongoing to have it available

Recommendation Timeframes

RECOMMENDATION	SHORT-TERM	LONG-TERM
1a. Monitor population levels at popular collection sites		Once a year, ongoing
1b, 2a. Locate new muskrat root collection sites and identify suitable sites where muskrat root can be planted	One time to locate	Revisit in five years to determine if locating more sites is necessary
2b. Transplant individuals from established populations	One time to transplant	Once a year to monitor population health
3a. Identify or establish new harvesting sites along lakes and other areas not subject to fluctuating water levels	Once to locate or establish	
4a. Test for heavy metal and pesticide content of muskrat root in Maine		Bi-annually
5a. If gatherers wish to avoid beta-asarone ingestion through use of <i>Acorus calamus</i> , there are certain habitats that appear to be safer than others	Can start immediately	Ongoing, yearly
5b. Obtain samples of <i>Acorus calamus</i> rhizomes, and submit them for testing to determine the beta-asarone content of specific populations.	One time	
5c. Train members in each community to be able to identify the distinguishing morphological features between <i>Acorus americanus</i> and <i>Acorus calamus</i> .	Can start immediately	Ongoing
5d. Establish a reference collection of muskrat root in each community	One time to establish	Ensure availability, ongoing

Species Information

Physical Description: The two species of *Acorus* that occur in Maine and New Brunswick look extremely similar. Both have tall (up to 2m), sword shaped leaves, similar to that of an iris. Leaf bases may be pink. Rhizomes are cylindrical, and may have a pinkish tinge on the outside, while the insides are white. Rhizomes form a dense mat just under the soil surface, and may also emerge from

the soil, in which case they begin to turn green, and may generate new plants. Main rhizomes also support numerous small rootlets. Leaves release a strong citrusy-smell when crushed.

Method of Reproduction: *Acorus americanus* is a fertile diploid. It reproduces both through production of seeds, and vegetative reproduction through the spread of rhizomes. *Acorus calamus* is sterile, and only reproduces through vegetative means. Both species can form clonal colonies.

Level of Rarity: *Habitat Specialist:* Wide geographic distribution, restricted habitat specificity, large populations somewhere in plant range.

Habitat: Muskrat root is a wetland obligate. It's exact location depends on species, (see Table 1), and includes backwater of rivers, lake shores, streams, marshes, wet meadows.

Soil Characteristics: Ph 4.5-7, low organic matter content, high moisture content.

Associated Species for *A. americanus*: arrowhead *Sagittaria latifolia*, tussock sedge *Carex stricta*, bluejoint grass *Calamagrostis canadensis*, swamp St. Johnswort *Triadenum fraseri*, swamp loosestrife *Decodon verticillatus*, swamp smartweed *Polygonum coccineum* and bur-reed *Sparganium eucaurpum*.

Associated Species for *A. calamus*: more variable, but includes woolgrass *Scirpus cyperinus*, blue joint grass *Calamagrostis canadensis*, and sensitive fern *Onoclea sensibilis*.

Plant Part Used: the rhizome

Time of Harvest: late October/early November. Gatherers collect muskrat root after a hard frost, although some prefer to wait for three frosts. Some report harvesting only after the Harvest Moon, but note that the timing of the moon cycles change from year to year, so this is not the most reliable indicator of when muskrat root is ready to be harvested.

Table 1: Comparison of characteristics of *A. americanus* and *A. calamus*

Property	<i>Acorus americanus</i>	<i>Acorus calamus</i>
Leaf venation	2 or more midveins of approximately equal size	1 prominent midvein
Leaf margin	Entire	Sometimes undulate
Sympodial leaf	Shorter than or equal to vegetative leaves	Equal to or longer than vegetative leaves
Vegetative leaf	Relatively narrower, .3-1.2 cm wide	Relatively wider, .5-2.0 cm wide
Spadix	3.3-7.4cm long	4.9-8.9 cm long
Ploidy	Diploid, 2n=24	Triploid, 3n=36
Reproduction	Sexual and asexual	Asexual (sterile)
Flowers	3.0-4.0 mm long	2.0-3.0 mm long
Fruits	Obpyrimal berries	Non-maturing
β-asarone	absent	present
Uromyces sparganii infections	Susceptible	Unknown, unobserved as of 2000
Pollen staining (1% aniline blue)	>35.5%	0-3%
Origin	Native, likely circumboreal	Introduced from Europe

Uncertainty about beta asarone in *Acorus calamus*

Beta-asarone is of concern to certain plant gatherers, herbalists and medicinal plant users because it is a pro-carcinogen that can promote liver and skin cancer. However, there is a lot of uncertainty about the actual health impacts caused by beta-asarone. This uncertainty is amplified due to variations in plants and their use.

The beta asarone content of *A. calamus* varies between plant populations. Research has shown that different populations of *A. calamus* contain different levels of beta-asarone. In particular, tetraploid varieties from India and other parts of Asia have particularly high amounts of beta-asarone, up to 95% in some plants. Sterile triploids tested in Europe were found to have lower levels of beta-asarone, but little research has been done to assess beta -asarone content in North American populations.

Furthermore, testing of plants for beta-asarone generally occurs during the growing season, from late

spring to late summer. Gatherers in Maine and New Brunswick harvest their plants in mid fall, which may affect the concentration of beta-asarone present in rhizomes.

In addition, there is a spectrum of muskrat root use. Different people vary in the amount of muskrat root they use, as well as how often they use it. Some people chew a small piece of root everyday as a preventative, while others use it only once or twice during cold season. As with any medicine, dosage is key in distinguishing between a healing treatment and a harmful effect. This is the same for beta-asarone in muskrat root. Because of uncertainty in beta-asarone content of local plants as well as the amount needed to cause ill-effects, those who use muskrat root on more of a regular basis may want to take that into consideration when selecting harvesting sites.

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Sweetgrass

Maliseet Name: welimahaskil

Mi'kmaq Name: kjimskiku

Scientific Name: *Hierochloe odorata*

Family: Poaceae

Common Names: Sweetgrass



<http://www.ecoseeds.com/sweetgrass.htm>

Significance

- Sweetgrass is widely used throughout Maliseet and Mi'kmaq communities
- It is considered to be a powerful spiritual and medicinal plant, used in ceremonies as a smudge for purification
- Sweetgrass is frequently used to make traditional baskets, either alone or with ash.
- Sweetgrass is also incorporated into other crafts, including earrings and decorations
- Sweetgrass is shared throughout communities, and braids are often given as gifts.

Sociocultural and Ecological Issues of Concern with Recommendations

1. Destruction/contamination of plants due to herbicide treatments
 - a. Contact Maine Public Service and inquire about mechanical harvesting of sweetgrass collection sites.
 - b. Maintain contact with Maine Public Service to be informed about herbicide application schedule
2. Loss of sweetgrass habitat
 - a. Initiate channels of communication between gatherers, tribal officials and landowners where sweetgrass is found.
 - b. Maintain open meadows and fields
3. Sweetgrass population decline
 - a. Monitor populations

Gathering Practices for Sweetgrass

- ***Traditional harvesting techniques:*** Sweetgrass is a plant that benefits from human use. Gatherers collect sweetgrass leaves in two ways: by plucking the above ground leaf blade, leaving the roots undisturbed or by sometimes pulling up the entire plant, including some roots, making room for other plants to grow. Either of these techniques can be beneficial to plant populations. Research has shown that sweetgrass displays an herbivory response when it is disturbed. It actually grows back more vigorously when some of its roots are pulled up.
- ***Choice of harvest time:*** Many gatherers collect sweetgrass after the plant has flowered and set seed.
- ***Dispersing seeds:*** While picking, gatherers will shake sweetgrass seeds around collection sites. Although sweetgrass seeds do not have high rates of viability, this technique still provides an opportunity for the germination of new seedlings, and an increase in genetic diversity of populations.
- ***Rotating collection sites:*** Gatherers harvest sweetgrass from several different locations throughout the season, giving different sites an opportunity to regrow.
- ***Harvesting only what you need:*** Gatherers interviewed do not put a number on the amount of sweetgrass they harvest. Instead, they take only what they need, and make several return visits throughout the summer.
- ***Intent in harvesting:*** Many gatherers talk about going out to gather plants for a specific person or group of people in mind, such as community elders. They believe that the positive intent they put into the plants make it stronger medicine.
- ***Give thanks:*** Before harvesting, gatherers offer tobacco or a prayer, giving thanks to the medicine they are about to collect.

1. ***Destruction/contamination of plants due to herbicide treatments***

Several popular sweetgrass collection sites are located under active powerlines. These areas are ideal sweetgrass habitat because they are kept open and field-like to maintain access to powerlines when necessary. However, vegetation in these areas routinely treated with herbicides to eliminate small

trees and other vegetation that may interfere with powerlines. These treatments may also inadvertently kill or contaminate sweetgrass populations.

Maine Public Service, and other utilities are responsible for vegetation management under their powerlines. Any given area is scheduled for treatment approximately every five years.

The Aroostook Band of Micmacs has entered into an agreement with Maine Public Service in which they assume responsibility for mechanical removal of problem vegetation under powerlines on Micmac band lands. However, some sweetgrass sites are not on band lands, and are in areas that are due for treatment in the summer of 2012.

Recommendations to avoid destruction and contamination of sweetgrass due to herbicide treatments

- a. Contact Maine Public Service, Eastern Maine Electric Company and Houlton Water Company, and inform them about the location of sweetgrass collection sites under powerlines in Aroostook County. Discuss if there are other options for management that avoid herbicides.

Involves: Gatherers to identify sweetgrass harvesting locations, tribal officials to contact Maine Public Service, vegetation management personnel from Maine Public Service

Affects: Habitat, plant populations

Timeframe: short term to contact Maine Public Service

- b. Maintain contact with Maine Public Service to be informed about herbicide application schedule at sweetgrass harvesting locations.
 - o Treatment does not occur every year. Information about the month and year herbicide applications will take place is accessible to the public.
 - o Share this information with gatherers, so they know which areas to avoid.

Involves: Gatherers to identify sweetgrass harvesting locations, tribal officials to contact Maine Public Service, vegetation management personnel from Maine Public Service.

Affects: Habitat, plant populations

Timeframe: Short term to contact Maine Public Service, long term, once a year to inform gatherers of any upcoming herbicide applications (through a bulletin, newsletter, email).

2. Loss of sweetgrass habitat

Gatherers note loss of sweetgrass plants and habitat due to several inadvertent causes. Processes of erosion have caused the loss of sweetgrass habitat along rivers, while plowing of fields can sometimes destroy sweetgrass patches. Some gatherers feel that some of these losses may be prevented

suggesting that if farmers knew why sweetgrass was important to Native communities, they may leave patches undisturbed.

In addition, processes of vegetative succession also lead to a reduction in available sweetgrass habitat. Sweetgrass is found in habitats with abundant sunlight, including moist fields and meadows. The growth of raspberries, other shrubby species, and pioneer tree species may out-compete sweetgrass.

Recommendations to maintain sweetgrass habitat

- a. Initiate channels of communication between gatherers, tribal officials and landowners where sweetgrass is found.

- Enhanced communication may reduce damage to sweetgrass populations

Involves: gatherers, tribal natural resource managers or other tribal officials who can contact landowners, landowners

Affects: Habitat, plant populations

Timeframe: Ongoing, can start immediately

- b. Maintain open meadows and fields where sweetgrass is found on band lands and other properties if possible

Involves: Tribal natural resource managers, other land managers (potentially)

Affects: Habitat

Timeframe: Long-term, mechanical management (brush hog) once every several years as necessary if meadows begin to become overgrown.

3. Sweetgrass population decline

Some gatherers have noted that sweetgrass is not abundant as it used to be. In some cases, they attribute the decline to overharvesting or improper harvesting by people outside their communities. This may be the case in popular collecting spots. Recent research also suggests that another reason for sweetgrass decline may actually be caused by lack of harvesting. Harvesting of sweetgrass can increase light availability to plants, turn over soil, and give sweetgrass a competitive advantage against other successional species.

Recommendations for sweetgrass population decline

- a. Monitor sweetgrass population sites.

Involves: Tribal resource managers or outside researcher and gatherers to design and implement a monitoring study.

Affects: Plant populations

Timeframe: Ongoing, once a year

Timeframe for recommendations

RECOMMENDATION	SHORT-TERM	LONG-TERM
1a. Contact Maine Public Service and inform them about the location of sweetgrass collection sites under powerlines in Aroostook County. Discuss if there are other options for management that avoid herbicides.	Contact can occur immediately	
1b. Maintain contact with Maine Public Service to be informed about herbicide application schedule at sweetgrass harvesting locations	Make initial contact	Inform gatherers of upcoming herbicide applications once a year at the beginning of the summer
2a. Initiate channels of communication between gatherers, tribal officials and landowners where sweetgrass is found.		Ongoing
2b. Maintain open meadows and fields where sweetgrass is found on band lands and other properties if possible		Mechanical maintenance once every few years as needed
3a. Monitor sweetgrass population sites.	Establish monitoring sites	Monitor once a year

Species information

Physical Description: Sweetgrass is a perennial grass with bright green glossy leaves that can grow up to 36 inches long. Bases of grass blades often have a purple color, which is useful in identifying the species. Loose clusters of white flowers appear in early spring. The grass blades give off a pleasant smell when crushed, giving the plant its common name.

Method of Reproduction: Sweetgrass is a clonal species that mainly spreads vegetatively through rhizomes. This is in part due to the fact that sweetgrass seeds have a very low viability rate, of less than 5%.

Pollinators: Unknown.

Level of Rarity: *Habitat Specialist:* Wide geographic distribution, restricted habitat specificity, large populations somewhere in plant range.

Habitat: wet meadows, bogs, riverbanks, lake and ocean shorelines, salt marshes. Sweetgrass is found in a variety of moist soil types with a pH ranging from 5 to 7.6. Gatherers differentiate between freshwater sweetgrass and saltwater sweetgrass, and which they use is a matter of personal preference. Saltwater sweetgrass is collected near the ocean, and some people prefer it because the leaf blades are much longer and smell sweeter than freshwater sweetgrass. Others say that freshwater sweetgrass, which grows inland, dries and burns better, making it a more desirable smudge.

Associated Herbaceous Species: reed canary grass, quackgrass, red clover, switchgrass, Canada goldenrod, milkweed, sensitive fern, *Spartina* species.

Associated Overstory Species: none.

Mycorrhizal Associations : Unknown.

Transplantability: Highly transplantable, sweetgrass can establish well in suitable sites. However, some gatherers prefer to collect sweetgrass from 'natural' areas, which should be taken into consideration when selecting sites for transplanting.

Plant Part Used: The leaf blade.

Time of Harvest: Late July through early September.

Who Harvests: Men and women of all ages.

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