USDA Forest Service and Agricultural Research Service Strategy for the Complementary Conservation of Wild Cranberry (*Vaccinium macrocarpon* Ait. and *V. oxycoccos*) Genetic Resources *and* Protocols for Collecting Genetic Material, Germplasm, and Herbarium Vouchers

Goal

The goal of the project is to conserve the range of genetic variation in wild cranberry, starting with populations on United States National Forests.

In Situ Genetic Resource Reserves

A series of sites in National Forests will be designated as *In Situ* Genetic Resource Reserves (IGRRs) for two species of wild cranberry. An agreement between USDA Agricultural Research Service (USDA-ARS) and the National Forest Supervisor will designate each site. Samples of germplasm from each IGRR will be deposited in the USDA-ARS National Plant Germplasm System. A program to monitor and manage the IGRRs will be established to safeguard their security. Plans for monitoring and protecting the habitats and populations of wild cranberry in the IGRRs will be incorporated into the management plans of the national forests where the sites are located.

Justification

The large-fruited cranberry, *Vaccinium macrocarpon* Ait., is a commercially important native American species that occurs in bogs in eastern Canada and the northeastern and north-central United States, and south to the Appalachian Mountains of eastern Tennessee and North Carolina (Stewart 1993). Many of these habitats are in danger of being destroyed or altered. Although the large-fruited cranberry occurs in 21 states in the United States, six provinces in Canada, and the French overseas collectivities of St. Pierre and Miquelon, virtually all commercially cultivated clones were originally selected from wild populations in only three states (Massachusetts, New Jersey and Wisconsin). The large-fruited cranberry was carried west with pioneers in the 1800s and introduced to the western United States and Canada.

The small cranberry, *Vaccinium oxycoccos* L., is a secondary genetic relative of the cultivated cranberry, with a more widespread distribution in northern latitudes or high elevations. It occurs throughout Alaska and all across Canada, south through New England down to the Mid-Atlantic States, west to the Great Lakes states, and in the northwestern states as far south as the Oregon Cascade Mountains. It also occurs in northern Asia and Europe. In regions where they are sympatric in North America, large and small cranberry are often found growing together.

Native American Peoples have utilized both species of cranberry as a source of food, medicines, and dyes, and in some cases, actively managed the populations. Protection of wild populations of both large and small cranberries is significant to the preservation of traditions of Native American Peoples in several regions.

The proposed management plan will help to protect the sources of wild cranberry genetic resources for the future needs of cranberry researchers, ecological restorations, growers, and consumers. The conservation of the existing genetic diversity, both *ex situ* in USDA-ARS genebanks and *in situ* on USDA Forest Service (USDA-FS) lands, will ensure that these resources will be readily available to cranberry breeders whenever the need for them arises.

Preservation of wild populations will also ensure that they can continue to be used directly as sources of food.

The Significance of Crop Wild Relatives

In addition to being integral parts of natural ecosystems, crop wild relatives are important resources for the improvement of crop health and productivity. Crop wild relatives tend to have greater genetic variability than crop plants, and their genetic identities differ from those of crop plants in significant ways. Wild species evolve in response to changes in environmental conditions, pests, pathogens, and predators. Their genetic responses to these forces may be specific and diverse. When unanticipated problems arise with crop plants, the solutions may be found in the genes of wild relatives. Examples of beneficial genes likely to be encountered in wild populations of cranberry include disease, pest and environmental stress resistance, increased productivity, berry size and pigment content, and distinct blooming and maturation times.

Crop wild relatives offer an opportunity to expand the appreciation of visitors to National Forests for the importance of conserving natural ecosystems. The cranberry has a unique public appeal because of its history and special place in traditional holiday celebrations, especially the American Thanksgiving.

Wild plants, including some crop wild relatives, have been important sources of food for Native Americans for centuries, and still play a role in cultural traditions.

Complementary Conservation

In situ conservation refers to the maintenance of reproducing organisms in nature, specifically in the areas where they developed their distinctive properties. *Ex situ* conservation refers to the maintenance of germplasm (seeds, pollen, living plants and plant parts) in human-made sites, such as gene banks and botanical gardens.

In situ conservation allows plant populations to continue to evolve and adapt to changing environmental conditions in nature. By preserving entire populations rather than subsamples, a greater amount of genetic diversity can be conserved under *in situ* conditions than under *ex situ* conditions.

Ex situ conservation is required for purposes of research, ease of access, and secure storage of germplasm. *Ex situ* collections safeguard plant genetic resources against loss and provide the rapid access to germplasm needed by the research and conservation community. However, they are often expensive and difficult to maintain, and the plants do not evolve under natural forces and processes.

Conservation is most effective when a complementary approach involving both *in situ* and *ex situ* strategies is employed. The two strategies act as backups to each other and maximize the potential for cost-effective long-term conservation of alleles, genotypes, and populations.

Cooperation within the USDA

Within the USDA, the Forest Service (USDA-FS) and the Agricultural Research Service (USDA-ARS) are uniquely positioned to cooperate on the complementary conservation of crop wild relatives.

The USDA-FS has the responsibility for managing 193 million acres of National Forest System lands in 43 states and provides support in the management of the nation's privately owned forests. As part of this management responsibility, one of the Forest Service goals is to restore,

maintain and enhance forest ecosystems. The Forest Service, through federal law and regulations of the Secretary of Agriculture, has the major responsibility for conserving biodiversity through the management of fish, wildlife, and plant habitats, including providing special protection for threatened, endangered, and sensitive/rare plant and animal species. Populations of cranberry have been documented on many national forests.

USDA-ARS manages the US National Plant Germplasm System (NPGS), which has the responsibility to collect, maintain, distribute, evaluate and preserve genetic resources of plant species of interest to the United States. Current NPGS programs almost exclusively utilize *ex situ* conservation methods, in which the plant germplasm is preserved outside of its native habitat in gene banks. The USDA-ARS National Clonal Germplasm Repository in Corvallis, Oregon is responsible for the curation of cranberry germplasm. Information on their holdings may be found on their website.

The authority and framework for cooperation between the Forest Service and USDA-ARS on the complementary conservation of native plant genetic resources is provided by a Memorandum of Understanding (MOU) entitled "Conservation of Plant Germplasm" (10-MU-11132421-334). The MOU provides the basis for cooperation between the two agencies on the efficient and comprehensive management of the genetic resources. This cooperation will reduce the load on NPGS *ex situ* efforts by reducing the management costs of samples maintained in USDA-ARS facilities. If *in situ* populations on National Forests are lost, germplasm previously collected from I*n Situ* Genetic Resource Reserves will be available from the NPGS for reintroduction. Characterization of germplasm collected will provide information that will facilitate future use, as well as support improved management of the natural populations.

Designation of *In Situ* Genetic Resource Reserves (IGRRs)

Each *In Situ* Genetic Resource Reserve will be established by mutual agreement between USDA-Forest Service and USDA-ARS that includes the name of the taxon being preserved and the location of the population. The agreement will have the following provisions:

- The IGRR will be documented with written descriptions of the populations, maps, photographs, and herbarium vouchers.
- Forest Service will allow access to authorized personnel for research or for germplasm collection, with the proviso that these operations will be non-destructive of forest resources.
- USDA-ARS will maintain representative samples of seed and clonal germplasm collected at the NPGS National Clonal Germplasm Repository, Corvallis, Oregon. IGRRs will be identified in the publically available GRIN database. Details of specific locations may be kept private if necessary for security.
- Forest Service will determine the appropriate way to protect the designated IGRR and will evaluate individual Forest Plans to help determine necessary management actions.
- Forest Service will give notice to the USDA-ARS Plant Exchange Office and\or the responsible NPGS crop curator when threats to the IGRR become apparent.
- If reintroduction of cranberry to the IGRR becomes necessary, germplasm previously collected from the IGRR will be provided from the National Clonal Germplasm Repository, Corvallis, Oregon.

Site selection for *In Situ* Genetic Resource Reserves for Cranberry

To conserve the full range of genetic variation best in wild cranberry, it will be necessary to identify numerous populations on National Forests across the species' native ranges, assess the amount of diversity present, and then implement long-term management plans to preserve representative populations in the wild, as well as in gene banks. Tribal partners will be included as appropriate.

As many populations as possible will be assessed as possible IGRRs. For each population under consideration, the size, viability, accessibility, and potential threats will be described. USDA-ARS and/or Forest Service botanists will conduct one or more sampling transects of each population, documenting plant characteristics. Documentation may also include photographs, herbarium vouchers, and maps. Samples of leaf tissue will also be collected at each point along the transect for DNA analysis. The DNA analysis will be used to evaluate the genetic diversity within and between populations. The USDA-ARS Cranberry Genetics and Genomics Laboratory, Madison, Wisconsin will conduct the DNA analysis. When possible, germplasm and herbarium vouchers will be collected for each population being considered as an IGRR.

The protocols for sampling leaf tissue, germplasm collecting, herbarium voucher preparation, and documentation are described in appendices to this document:

Appendix 1: Protocol for Collecting Leaf Tissue of *Vaccinium macrocarpon* and *V. oxycoccos* for DNA Analysis

Appendix 2: Protocol for Collecting Fruit/Seed of *Vaccinium macrocarpon* and *V. oxycoccos*

Appendix 3: Protocol for Collecting Herbarium Specimens of *Vaccinium macrocarpon* and *V. oxycoccos*

Appendix 4: Data Collection Form: *Vaccinium macrocarpon* and *V. oxycoccos* and

Appendix 5: Field Descriptions for Data Collection Form

The suitability of these populations as *In Situ* Genetic Resource Reserves (IGRRs) will be assessed using the following criteria:

- Ecogeographic zone
- Location in relation to full distribution of the species (marginal vs. central population)
- Sustainability
- Adequacy of population size for conservation management
- Genetic profile (uniqueness, allelic diversity, etc.)
- Distance from other *in situ* reserves
- Ease of access for monitoring and germplasm collection
- Presence of both species of cranberry
- Cultural significance to Native Americans or others

Not all criteria will have to be considered for every site. Criteria may be determined to be of varying importance for different sites.

Protocol for Collecting Leaf Tissue of Vaccinium macrocarpon and V. oxycoccos for DNA Analysis

Objective: Sample leaf tissue at a resolution that allows genetic diversity analysis within the population.

Instructions for sample collection

1. Fill out a data collection form to record the location and characteristics of the site and population being sampled (Appendix 4). Only one copy of the form is needed to document all leaf samples from the population.
2. Collect 16-48 **leaf** samples per population to cover the **entire** site in > 5 m interval grid.

   Number the leaf samples as subsamples of the population (for example, leaf samples from site USFS-GWNF-2014 -1 would be numbered USFS-GWNF- 2014 -1-1, USFS-GWNF-2014 -1-2, USFS-GWNF- 2014-1-3, etc.
3. Collect GPS coordinates for **each** leaf sample, and do not collect samples too close to each other, but cover the site. Record the GPS reading for each sample on the sample envelope.
4. Each sample should be an upright (i.e., reproductive branch) or a runner (i.e., vegetative branch) containing at least 20 leaves (Fig. 1) from a single plant.
5. **No fruit should be sent for DNA analysis**, but any fruit characteristics or traits should be recorded whenever possible. Figure 1 below shows a picture of a Cranberry bush branch.

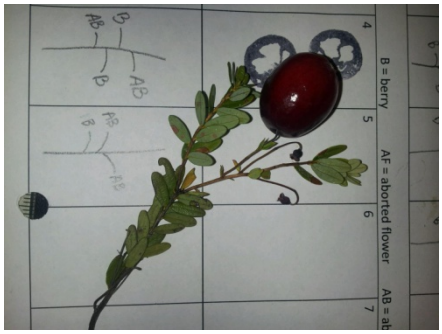

Figure 1: Cranberry upright sample example; fruit data should be collected and fruit discarded.

6. Each sample must be packaged separately in a paper envelope (**no plastic**), such as a coin envelope or standard letter envelope.
7. Label each envelope with the site name, date, collector name, sample number, GPS location, and any other pertinent information linking the sample to any other available data.
8. Place all the samples for each site in a larger paper envelope labeled with the site name, date, scientific name, and collector names, and mail to:

   Karen Williams
   USDA-ARS
   National Germplasm Resources Laboratory
   Bldg. 003, Rm. 329, BARC-West
   Beltsville, MD 20705
   Telephone: 301-504-5421
   Email: Karen.Williams@ars.usda.gov

   Re: Cranberry IGRR project

9. After mailing, please send an email to Karen Williams (Karen.Williams@ars.usda.gov) saying that the tissue samples and data collection form have been sent. Include a copy of the data collection form in the email.
10. For questions concerning the collection, please feel free to contact Karen Williams (301-504-5421).

Protocol for Collecting Fruit/Seed of Vaccinium macrocarpon and V. oxycoccos

Objective: Collect approximately 10,000 viable seeds from the IGRR for *ex situ* conservation in the US National Plant Germplasm System.

Instructions:

1. Assess the target population and confirm that mature fruit is available to ensure that adequate genetic diversity can be sampled from the population.
2. Carefully examine a small, representative sample of fruit and seeds to confirm that the majority of seeds are mature and fully formed.
3. Fill out a data collection form documenting the population, its location, and characteristics (Appendix 4).
4. Collect fruit equally and randomly across the extent of the population, in order to try and capture the widest possible genetic diversity from the plant population sampled.
5. Place all fruits in a large zip lock plastic bag labeled in permanent marker with the collection number and date. Try to collect at least 1,000 fruits from the population. Limit the collection to no more than 20% of the ripe fruit available on the day of collection to ensure that the sampled population is not over-collected. With approximately 10 viable seeds per fruit, we will need approximately 1,000 fruits (about 1.5 lbs.) in order to have 10,000 seeds. These can be collected over multiple years or in a single year if it won't threaten the population.
6. Seed extraction, cleaning, and packaging will be conducted at the NPGS repository. Make sure all bags are clearly labeled on the outside with the appropriate collection number and the bag is firmly closed. A strip of duct tape or similar material can be used to cover the bag closure to prevent opening during shipping.
7. Mail the seeds and data collection form to:

   Karen Williams
   USDA-ARS
   National Germplasm Resources Laboratory
   Bldg. 003, Rm. 329, BARC-West
   Beltsville, MD 20705
   Telephone: 301-504-5421
   Email: Karen.Williams@ars.usda.gov

   Re: Cranberry IGRR project
8. After mailing, please send an email to Karen Williams (Karen.Williams@ars.usda.gov) stating that the seeds and documentation have been sent.
9. For questions on the collection and shipment of fruits, please feel free to contact Karen Williams (Karen.Williams@ars.usda.gov).

Protocol for Collecting Herbarium Specimens of Vaccinium macrocarpon and V. oxycoccos

Objective: Document the IGRR with a herbarium voucher for each species preserved at site.

Background:

(Much of the following information comes directly from the University of Florida Museum, Preparation of Plant Specimens for Deposit as Herbarium Vouchers, Weblink to the University of Florida)
There are numerous instructions online, including YouTube videos, etc. that you may want to review:

- Weblink to the University of Florida)
- Weblink to An Herb Society of America Guide, Use and Methods of Making a Herbarium
- Weblink to Making Good Specimens
- Weblink to Chapter 16, Collecting and Preparing Plant Specimens and Producing an Herbarium
- Weblink to Plant Specimen Collecting and Press Guides

Figure 2. Herbarium press. Credit: UF Museum.

Herbarium vouchers are normally dried in a plant press, which consists of a wooden frame (for rigidity), corrugated cardboard ventilators (to allow air to flow through the press), blotter paper (to absorb moisture), and folded paper, typically a newspaper (to contain the plant material). The plant press is tightened using straps with buckles or bolts with wing nuts. The objective of pressing plants is to extract moisture in the shortest period of time, while preserving the morphological integrity of the plant, and to yield material that can be readily mounted on herbarium paper (an acid-free cardstock) for long-term storage. To fit on a standard herbarium sheet, a plant specimen should be pressed flat to no more than 11 x 16 inches.

Instructions:

Each specimen should consist of a stem with attached leaves and, if at all possible, flowers and/or fruits. The roots should also be included. Plant material for the herbarium voucher can be collected at the same time that the leaves are collected for the molecular analysis or the fruit is collected for seeds. Enough plant material should be collected to make 2-3 herbarium vouchers. We would like you to collect plant material for a herbarium voucher at each site that leaf tissue and fruits are collected. You do not need to take the plant press into the field. Instead carry a large plastic bag and some newspaper. At the site,

Collect the plant material and roll it gently in an open sheet of newsprint. Write on the outside of the newsprint the collection id number from the data collection form and place the paper in the plastic bag. The newsprint can be folded on one or both ends, reducing the likelihood that it will unravel and plant material from different sites will be mixed together.

Figure 3. Herbarium specimen, Credit: University of Florida Museum

If you have access to a plant press, it would be best if you could press the plant material the same day. Samples that are allowed to wilt prior to pressing will generally produce inferior specimens. Plants should be carefully arranged as they are placed in the press to maximize preservation of diagnostic features. Leaves, flowers, and fruits should be spread out so that they do not overlap and can be observed from different perspectives. The plant press must be kept tight; this prevents shrinkage and wrinkling of the plant material and yields specimens that are easier to mount securely on herbarium paper. The pressed plants must also be thoroughly dried prior to shipping them to the US National Arboretum Herbarium. As the specimens dry, it may be necessary to further tighten the straps on the press to minimize shrinkage and wrinkling. Rapid drying promotes the best retention of plant color, but excessively high temperatures or long drying periods can result in blackened, discolored, and brittle specimens.

If you do not have access to a plant press, please follow the steps above, but instead of placing the specimen in a press, weigh them down with heavy objects.

Fill out the data collection form (Appendix 4).

Packing and shipping the specimens:

Once the specimens are dry, they can be removed from the press and prepared for shipment by placing the specimens still in the newspaper between 2 sheets of cardboard and wrapping the bundle as illustrated in Figure 4.

To wrap bundles of plants use four pieces of full-sized paper. Overlap half of two sheets. Place a bundle of plants onto the paper and fold the edges of the paper firmly around the specimens and tape closed or tie with string.

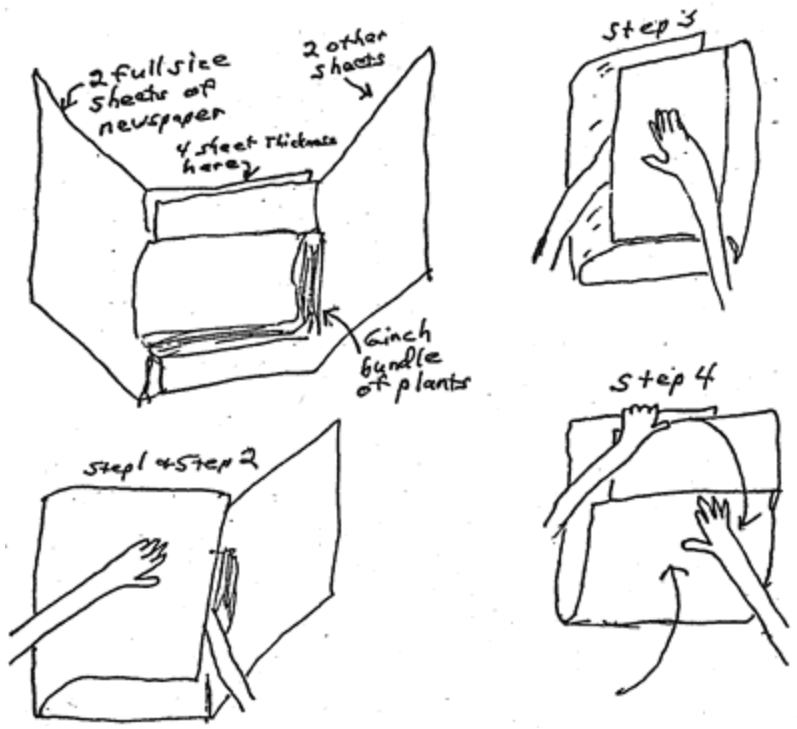

Figure 4. Technique for packing specimens. (Illustration from: Field Techniques Used by Missouri Botanical Garden, http://www.mobot.org/MOBOT/molib/fieldtechbook/welcome.shtml)

Pack the bundle of wrapped plants **tightly** in a box, rather than loosely. Even though a slight amount of damage may be incurred when packing the boxes tightly, plants in loosely packed boxes are much more easily damaged during shipping and the boxes more prone to being crushed.

Mail the herbarium voucher and a copy of the data collection form to:

Karen Williams
USDA-ARS
National Germplasm Resources Laboratory
Bldg. 003, Rm. 329, BARC-West
Beltsville, MD 20705
Telephone: 301-504-5421
Email: Karen.Williams@ars.usda.gov

Re: Cranberry IGRR project

After mailing, please send an email to Karen Williams stating that the herbarium voucher and documentation have been sent to the U.S. National Arboretum Herbarium, Washington, DC.

Data Collection Form: Vaccinium macrocarpon and V. oxycoccos

Collection Number:. _____**Species:** _____*V. macrocarpon* _____*V. oxycoccos*

National Forest: _____ **Ranger District:** _____

County: _____**State:** _____

Location details: _____

Land management designation: _____

GPS make\model: _____ **GPS geodetic datum:** _____

GPS uncertainty: _____ **Altimeter make\model** _____

Elev.(m) _____**Latitude** _____**Longitude** _____

Exposure/aspect _____**Slope**_____

Site physical description: ____Bog ____Pond____Fen____Other:_____

_____

Site vegetation: _____

_____

_____

Population status: __wild__cultivated __unknown __other (specify):_____**Population size (m^2)** _____

Frequency in area: __abundant __frequent __occasional __rare

Pop. Distrib.: __irregular__uniform__pure ___conforms to the following site feature:_____

Plant description: _____Typical for species_____Atypical for species:_____

_____

_____

Fruit present: ____yes ____no **Fruit size:** ____ Typical ___ Atypical:_____

Fruit shape: ___Typical ___Atypical:_____**Fruit color:** ___ Typical ___Atypical:_____

Flower color : ___ Typical ___Atypical: _____**Seed maturity**: __ mature __ immature __overmature

Material collected: ___leaves ___fruit ___ other :_____ **Herbarium voucher**: ____yes _____no

Evaluation of location suitability as an *in situ* genetic reserve:

Ease of access: ____easy ____moderate ____difficult

Distance from other populations: ____ far ____intermediate____ close____ unknown

Perceived health of population:____ robust ____intermediate ____ poor____ unable to determine

OTHER NOTES _____

_____

Collectors_____**Date**_____

Establishment of *In Situ* Genetic Resource Reserves (IGRRs) on US National Forests
USDA Forest Service and USDA Agricultural Research Service

Field Descriptions for Data Collection Form: *Vaccinium macrocarpon* and *V. oxycoccos*

Note: The same data collection form is used for leaf tissue samples, germplasm, and herbarium vouchers.

Collection number

Unique collection numbers are essential for identification of DNA and germplasm samples. Assign a number that combines the following elements, separated by hyphens:

1. USFS
2. Initials of the National Forest name
3. Year of collection
4. Site number

For example, a germplasm collection made from a site in the George Washington National Forest in 2013 would use a collection number of USFS-GWNF-2013-1.

When leaf samples are collected, assign sample numbers that include the collection site number followed by the leaf sample number. For example, leaf samples would be USFS-GWNF-2013-1-1, USFS-GWNF-2013-1-2, USFS-GWNF-2013-1-3, etc.
Recommended Fields (* = essential information)

**Collection number* – as described above

**Species – V. macrocarpon* or *V. oxycoccos*

**National Forest*

**Ranger District*

**County*

**State*

**Location details* – more specific information on the location

**Land management designation* – designation by the USFS as a Research Natural Area, Special Interest Area, Wilderness Area, etc.

GPS make/model

GPS geodetic datum – indicates the map datum or spheroid used. WGS84 is the commonly used spheroid for GPS. It may be found under "Position format" on a GPS. Coordinates without a geographic reference do not accurately specify a location.

GPS uncertainty – represents the potential horizontal error in the GPS coordinates. This is usually given in the manual under specifications. Record in meters.

Altimeter make/model – record the make of altimeter used (or if a GPS was used to determine elevation)

**Elevation* (m) – record using a barometric altimeter that is either part of a GPS or stand-alone unit. Do not use a GPS that uses triangulation to determine elevation. Calibrate the altimeter in advance.

**Latitude* – record from GPS in decimal degrees to five decimal points, if possible

**Longitude* – record from GPS in decimal degrees to five decimal points, if possible

Exposure (*aspect)* – compass direction towards which the slope faces

Slope – steepness of the land surface in degrees

Site Physical Description – description of the physical features of the site, such as land element, soil features (pH, color, texture, stoniness, moisture regime), soil sample number

Site Vegetation – give the names and descriptions of other plants associated with the target plants, if known

**Population status* – note whether population is wild, cultivated, or of unknown origin

Population size (m^2) – area of the population

Frequency in area – how common are populations of the species in the area (choose from abundant, frequent, occasional, or rare)

Population distribution – indicate how the population is distributed: irregularly distributed and mixed with other taxa; uniformly distributed, but mixed with other taxa; composed of a pure stand; or conforming to a site feature, such as a pond margin, bog, etc.

Plant description – indicate if it is typical or atypical for the species. Give a description of any unusual morphological features of the plants in the population, including variation in population.

Fruit present – yes or no.

Fruit size – typical or atypical (note if berries are of an unusual size)

Fruit shape – indicate if it is typical, or if there is anything unusual about it

Flower color – typical or atypical (note any unusual color)

Seed maturity – the maturity of the seed (mature, immature, or over-mature). The maturity of the fruit can be used as a guide.

**Material collected* – indicate whether you collected leaves, fruit, both or other material

**Herbarium voucher* – was a herbarium voucher made?

<u>Evaluation of suitability as an *in situ* genetic reserve:</u>

Ease of access – indicate access to the site is easy, moderate, or difficult

Isolation from other populations – indicate the proximity of the populations to other known populations: far, intermediate, close, or unknown

Perceived health of population – note whether the health of the plants appears to be robust, intermediate, poor, or cannot be determined

Other notes – include any other information, such as pests/pathogens that are noticed. This may also include land use, modifying factors, relation of this site to surrounding landscape, threats to the site.

**Collectors* – names of all collectors. Send full addresses separately.

**Date* – date of collection

Contacts: USDA/Agricultural Research Service

Karen Williams
Plant Exploration Coordinator
USDA/ARS/National Germplasm Resources Laboratory
Rm 329C, Bldg. 003, BARC-West
10300 Baltimore Avenue
Beltsville, MD 20705-2350
301-504-5421
Karen.Williams@ars.usda.gov

Juan E. Zalapa
Research Geneticist
USDA-ARS, Vegetable Crops Research Unit
Department of Horticulture
University of Wisconsin
1575 Linden Drive
Madison, WI 53706
Phone (608) 890-3997
Cell (608) 334-3649
Fax: (608) 262-4743
jezalapa@wisc.edu
Juan.Zalapa@ars.usda.gov

Kim E. Hummer
Research Leader
USDA ARS National Clonal Germplasm Repository Corvallis, Oregon
33447 Peoria Road
Corvallis, Oregon 97333-2521
phone 541.738.4201
work cell 541.224.4127
fax 541.738.4205
Kim.Hummer@ars.usda.gov

Contacts: US Forest Service

Larry Stritch, Ph.D.
National Botanist
US Forest Service
RGE Staff - 3S
201 14th Street, SW
Washington, DC
202-205-1279
lstritch@fs.fed.us

Alix Cleveland
Program Manager – Non-native Invasive Species Botany
US Forest Service
Southern Region
1720 Peachtree Rd. NW
Atlanta, GA 30309-2444
acleveland@fs.fed.us
404-347-3908

Jan Schultz
Eastern Region Botanist
US Forest Service
Botany, Non-native Invasive Species & Special Forest Products Program Leader
626 E. Wisconsin Ave.
Milwaukee, WI 53202
414 297 1189
jschultz@fs.fed.us