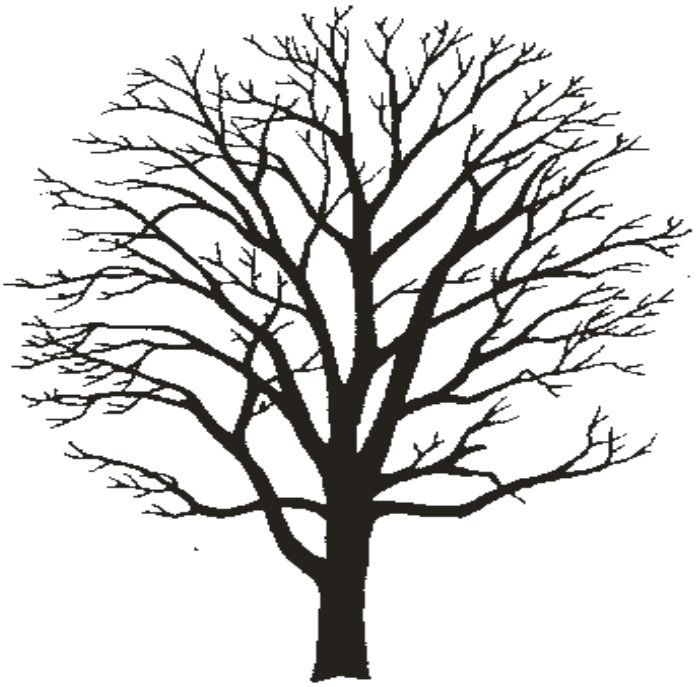
COSEWIC
Assessment and Status Report

on the

Butternut
Juglans cinerea

in Canada



ENDANGERED
2003

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE
IN CANADA

COSEPAC
COMITÉ SUR LA SITUATION DES
ESPÈCES EN PÉRIL
AU CANADA

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COSEWIC
Assessment Summary

Assessment Summary – November 2003

Common name
Butternut

Scientific name
Juglans cinerea

Status
Endangered

Reason for designation
A widespread tree found as single trees or small groups in deciduous and mixed forests of southern Ontario, Quebec, and New Brunswick. Butternut canker, which has caused high rates of infection and mortality in the United States, has been detected in all three provinces. High rates of infection and mortality have been observed in parts of Ontario and are predicted for the rest of the Canadian population.

Occurrence
New Brunswick, Ontario, Quebec

Status history
Designated Endangered in November 2003. Assessment based on a new status report.

COSEWIC
Executive Summary

Butternut
Juglans cinerea

Species Information

Butternut (*Juglans cinerea*) is a small to medium-sized tree of the walnut family that seldom exceeds 30 metres in height. In deeper soils it commonly has a central taproot and numerous widespread lateral roots. The densely hairy, alternate compound leaves have 11-17 pinnately arranged leaflets; these are nearly stalkless and attached opposite to one another. The yellowish-orange twigs are stout and hairy with a central pith that is divided into chambers. The ovoid fruit is a single-seeded nut with the husk covered with a dense layer of short sticky hairs and an inner shell with jagged ridges. The species is distinguished from the similar black walnut by such characteristics as its hairy twigs and leaves, terminal leaflet that is as large as the lateral leaflets, and oval hairy fruit with jagged ridges on the shell of the nut. In contrast, black walnut has smooth or only slightly hairy twigs and leaves with the terminal leaflet missing or smaller than the lateral ones; it has a globular, nearly hairless fruit with rounded ridges on the surface of the shell.

Distribution

Globally, butternut is found in northeastern North America, from Arkansas to Alabama north to Minnesota, and east to New Brunswick. The Canadian range runs through southern Ontario and southern Quebec to New Brunswick.

Habitat

Butternut is commonly found in riparian habitats, but is also found on rich, moist, well-drained loams, and well-drained gravels, especially those of limestone origin.

Biology

Butternut is a relatively short-lived, shade intolerant, monoecious (separate male and female flowers on the same tree) angiosperm. It bears fruit around age 20, with peak production between 30 and 60 years of age, and good seed crops every 2-3 years. Butternut is capable of vegetative propagation from stump sprouting. Evidence to date points to low levels of genetic diversity between and within populations, although further research would be required to verify the extent of genetic variation within the species in Canada.

Population sizes and trends

Within its Canadian range, butternut is widespread, primarily found as a minor component of hardwood stands, but also occurring as extensive pure stands on flood plains. Inventory efforts have been limited to date. Very conservative estimates of populations are 13,000 and 7,000 to 17,000 trees in Ontario and N.B. respectively. Quebec has documented 378 sites with butternut, 39 of which have butternut comprising 25% or more of the basal area. Available information in Ontario indicates high levels of incidence of butternut canker, poor health of many butternut trees and initial reports of mortality presumably due to the butternut canker.

Limiting factors and threats

Butternut canker (*Sirococcus clavigignenti-juglandacearum* V.M.G. Nair, Kostichka and Kuntz) is a serious threat to the species. Butternut mortality in the United States has been tracked through the Forest Inventory and Analysis (FIA) program, as well as targeted studies. Despite the potential error associated with any sampling technique, the FIA results indicate high mortality rates. For example, the estimated mortality rates of Butternut in North Carolina and Virginia is 77%. Targeted surveys in Wisconsin, where the canker was first reported, documented an increase in the percent of infected trees from 30% to 91% between 1976 and 1992.

The canker has spread north and east across the Canadian range and is present in all three Canadian provinces where butternut occurs. Accurate information on mortality rates in Canada is not available but observational data on butternut mortality and Canadian Forest Service data on the geographic extent of butternut canker throughout most of the Canadian range of butternut indicate that similar mortality rates to those experienced in the U.S. can be predicted.

No known naturally resistant strain of butternut has been identified. Canker-free individuals have been observed within infected stands, though these cases are very rare. Where the canker has been present for decades and mortality rates have been high, surviving individuals may represent some level of resistance even if they are not canker-free.

Special significance of the species

Butternut is known for its edible nuts, which have a high omega-3 fatty acid content. Wood is considered to be a specialty product; although not of major commercial importance, it is used for interior finishing and turnery. Butternut also has intrinsic and aesthetic value, and provides wildlife forage and cover.

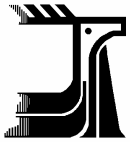
Existing protection or other status designations

Global: G3G4
Ontario: S3 ?
Quebec: S4
New Brunswick: S3 and a General Status Rank of *Sensitive*

Natural Heritage Ranks for adjoining states are as follows:

Minnesota: S3; Wisconsin: S3?; Michigan: S3; Ohio: S3; Pennsylvania: S4; New York: S4; Vermont: SU; New Hampshire: S1S2; Maine: SU. The highest rankings occur in Alabama and Georgia, both of which rank butternut as S1. In North Carolina and Virginia where serious losses have occurred it is ranked as S2S3 and S3?, respectively.

Butternut is still listed as a species of concern in many states and in Federal Region 9.



COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species and include the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal organizations (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biosystematic Partnership, chaired by the Canadian Museum of Nature), three nonjurisdictional members and the co-chairs of the species specialist and the Aboriginal Traditional Knowledge subcommittees. The committee meets to consider status reports on candidate species.

DEFINITIONS
(After May 2003)

Species	Any indigenous species, subspecies, variety, or geographically or genetically distinct population of wild fauna and flora.
Extinct (X)	A species that no longer exists.
Extirpated (XT)	A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A species facing imminent extirpation or extinction.
Threatened (T)	A species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk (NAR)**	A species that has been evaluated and found to be not at risk.
Data Deficient (DD)***	A species for which there is insufficient scientific information to support status designation.

* Formerly described as “Vulnerable” from 1990 to 1999, or “Rare” prior to 1990.

** Formerly described as “Not In Any Category”, or “No Designation Required.”

*** Formerly described as “Indeterminate” from 1994 to 1999 or “ISIBD” (insufficient scientific information on which to base a designation) prior to 1994.

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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

on the

Butternut

Juglans cinerea

in Canada

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2003

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SPECIES INFORMATION

Name and classification

Scientific name: *Juglans cinerea* L.
Common names: butternut, white walnut, lemonnut, oilnut, noyer cendré
Family: Juglandaceae (walnut family)
Major plant group: dicot flowering plant

Description

Butternut is a small to medium-sized tree with a broad spreading irregularly shaped crown. It is seldom more than 30 metres in height and 90 cm in diameter at maturity (Rink, 1990). Unless soils are shallow, a taproot is common, along with numerous deep, widespread lateral roots (Harlow *et al.*, 1979). The leaves are pinnately compound with 11-17 leaflets between 9 to15 cm long (Landowner Resource Centre, 1997) that are opposite and almost stalkless (Farrar, 1995). Leaves are yellowish-green and densely hairy on the underside (Farrar, 1995). Twigs are stout, hairy, and yellowish orange in colour (Farrar, 1995) with a chambered pith (Hosie, 1979). The terminal bud is elongated, about 1.0 to 1.5 cm long, somewhat flattened and blunt tipped with lobed outer scales (Farrar, 1995). Lateral buds are much smaller and rounded, often with more than one bud above the leaf scar (Hosie, 1979). The upper margin of the leaf scars are flat and bordered with hair (Farrar, 1995). On younger trees, the bark is grey and smooth while older individuals have bark that becomes separated by narrow, dark fissures into wide, irregular, flat-topped, intersecting ridges (Farrar, 1995). The ovoid fruit is a single-seeded nut with the husk covered with a dense layer of short sticky hairs and an inner shell with jagged ridges.

The species is distinguished from the similar black walnut by such characteristics as its hairy twigs and leaves, terminal leaflet that is as large as the lateral leaflets, and ovoid hairy fruit with jagged ridges on the shell of the nut. In contrast, black walnut has smooth or only slightly hairy twigs and leaves with the terminal leaflet missing or smaller than the lateral ones; the fruit is globular, nearly hairless, and has rounded ridges on the surface of the shell.

DISTRIBUTION

Global range

Butternut is native to north-eastern and north-central United States and reaches its northern limit in south-eastern Canada (Figure 1). In the United States it is found throughout the New England states except for northwest Maine and Cape Cod. The range then extends south to include northern New Jersey, western Maryland, Virginia, North Carolina, north-western South Carolina, northern Georgia, northern Alabama, northern Mississippi, and Arkansas. Westward the range extends to central Iowa and central Missouri and in the north to Minnesota, Wisconsin and Michigan (Rink, 1990).

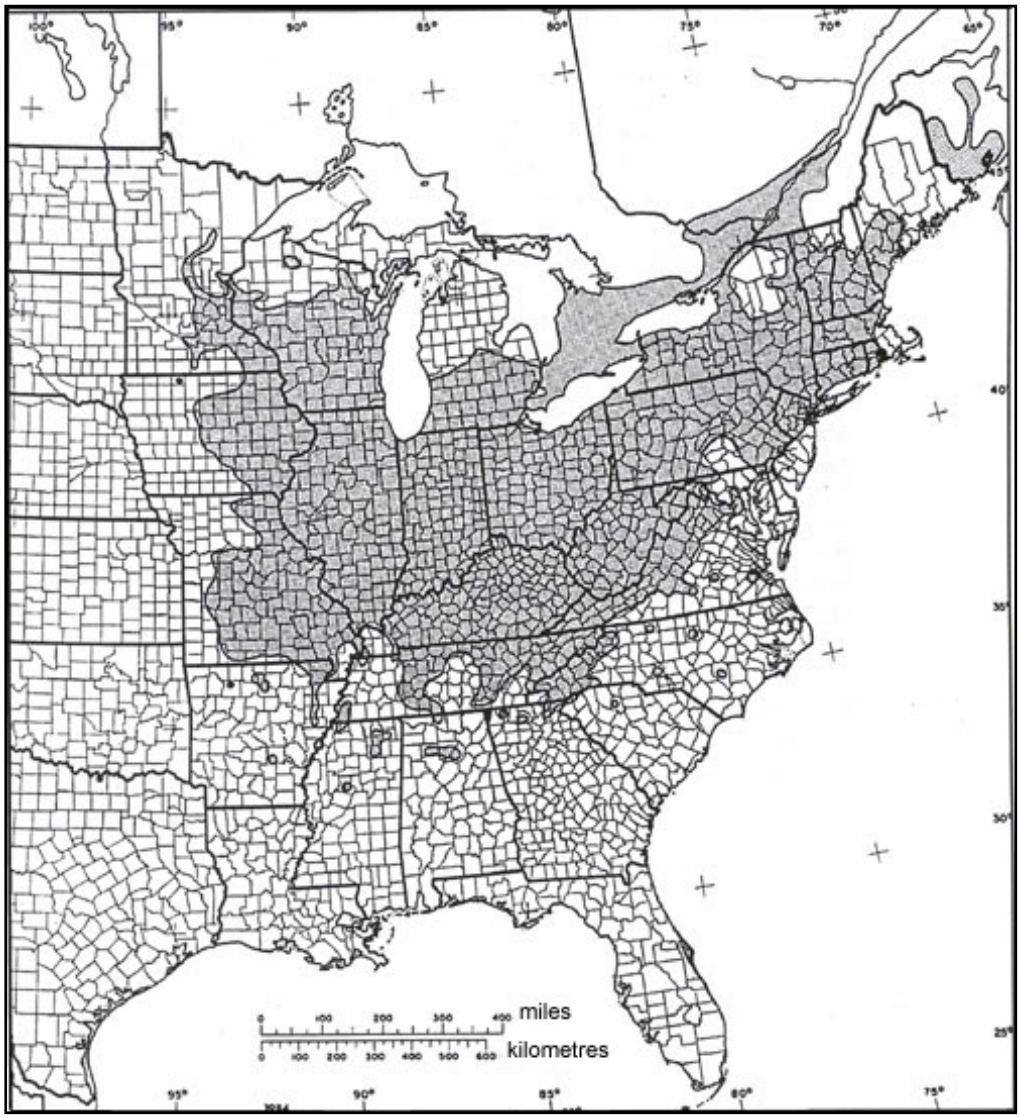

Figure 1. Native range of butternut (adapted from Rink, 1990 and Farrar, 1995).

Canadian range

The range of butternut in Canada spans the Deciduous Forest Region, the southeastern part of the Great Lakes St. Lawrence Forest Region along the St. Lawrence Seaway in Ontario and Quebec and the western section of the Acadian Forest Region in New Brunswick (Lauriault, 1989).

There is some debate over the occurrence of butternut in P.E.I. and N.S. According to the Atlantic Canada Conservation Data Centre there is insufficient evidence to suggest butternut occurred naturally in PEI (Blaney, pers. comm. 2002). No published records exist for butternut in the wild in N.S. although two small naturalized trees were found but suspected to be offspring of a tree planted in the past (Blaney, pers. comm. 2002).

HABITAT

Habitat requirements

Butternut grows best on rich, moist, well-drained loams often found on stream bank sites but may be found on well-drained gravelly sites, especially those of limestone origin (Rink, 1990). It is seldom found on dry, compact, or infertile soils (Rink, 1990). Common associates include basswood, black cherry, beech, black walnut, elm, hemlock, hickory, oak, red maple, sugar maple, yellow poplar (tulip-tree), white ash and yellow birch (Rink, 1990). Butternut is intolerant of shade (Rink, 1990). There have also been reports of butternut as an indicator/associate with the rare understory plant ginseng, *Panax quinquefolius* L. (OMNR, 2000).

The climate for butternut varies greatly within its range. Mean annual temperature ranges from a maximum of 16°C to a minimum of 4°C (Rink, 1990). Frost-free periods extend from 105 days in the north to 210 days in the south (Rink, 1990). Butternut is susceptible to late spring frosts (OMNR, 2000).

Trends

Trends in habitat vary across the range of butternut. Forest cover for the area within the Ontario range of butternut varies from less than 10% in most of southwestern Ontario to 35% in eastern Ontario. In southwestern Ontario, the amount of habitat for all forest-dependent species has been severely reduced and potentially resistant butternut trees have been and are being lost through forest conversion to agriculture and development. However, in eastern Ontario total forest area is increasing due to abandonment of marginal farmland. In N.B., ecodistricts that comprise the majority of butternut range within N.B. are Aukpaque and Meductic, which are 62 and 65 % forested respectively. Within the province overall, the area of agricultural land has declined from 367,000 ha in 1921 to 135,000 in 1996 due to abandonment of marginal lands. Aukpaque and Meductic Ecodistricts contain the richest farmland and therefore are assumed to have experienced a lower rate of decline in farmland. However, there is abandoned farmland within both ecodistricts that has been re-colonized with butternut (Sabine, pers.comm. 2003).

Protection/ownership

Butternut has been reported in Point Pelee and St. Lawrence Islands National Parks in Ontario. Kouchibouguac National Park, N.B. and Cape Breton Highlands, N.S. are outside the current species range, although archaeological evidence at the former park points to possible butternut inhabitance in the past. There are no records of butternut occurrence in the Bruce Peninsula, ON, Georgian Bay Islands, ON, and La Mauricie, Que., national parks; these national parks may be outside the species range. Information regarding population sizes and health status within each park has been requested but not yet received.

To date, St. Lawrence Islands National Park, ON, has reported populations on Grenadier and Hill Islands; field checks to determine size and health status are currently underway. At Point Pelee National Park, ON, small populations have been reported at 2 locations (13 trees in total), with trees ranging between 4 cm and 60 cm diameter at breast height. Younger trees appear healthy, but older trees show signs of crown dieback. The older trees are bearing fruit, and may have been planted, although records from 1905 list butternut as native to the area.

In Ontario, butternut has also been reported in the following provincial parks; Rondeau, Bronte Creek, Short Hills, Pinery, John E. Pearce, Earl Rowe, Mono Cliff, Forks of the Credit, Boyne Valley, Awenda, Fitzroy, Pretty Valley, Restoule, Sibbald, Voyageur, Westmeath, MacGregor and Provincial Nature Reserves; Nottawasaga Lookout, Trillium Woods, Morris Tract and Hockley Valley.

In New Brunswick, butternut occurs in the following protected areas: Grand Lake Meadows Protected Natural Area, Hal Hinds Forest, near Woodstock (N.B. Dept. Nat. Res. and Energy); Meduxnekeag River Preserve; Maquapit Lake; Sugar Island, (St. John River). The latter two are administered by the Nature Trust of New Brunswick (Zelazny, pers. comm. 2002).

The geographic range of butternut within Ontario coincides with the area where 90% of the land is under private ownership. Where butternut does occur on crown land in Ontario, management is controlled by Silvicultural Guidelines that recommend retention of viable populations for uncommon species, retention of healthy trees for pest threatened species and management to provide conditions for the regeneration of species of concern (Anderson and Nielsen, 1998a). A majority of land within the butternut range in N.B. and Quebec is also under private ownership. Although there are no guidelines specific to management of butternut in N.B., watercourse buffer zone guidelines for Crown Land forestry activities, which limit extent and type of forest overstory removal along watercourses on Crown Lands, might be of some benefit to butternut populations occurring on riparian sites. Watercourse Alteration Regulations under the Clean Water Act provide a similar function for areas within 30 m of watercourses on private lands.

BIOLOGY

General

Butternut is relatively short lived, rarely living more than 75 years. It is shade intolerant. Although young trees can tolerate shade from the side, butternut does not survive when shaded from above (Rink, 1990).

In Ontario, butternut is usually found as scattered individuals or in small groups in mixed hardwood stands, or as remnant or volunteer trees in fence lines or open fields. In N.B. butternut is scattered throughout the Grand Lake Ecoregion on flood plain soils

and is a common component of field hedgerows. A number of extensive pure stands occur on several flood plain islands. Butternut is also scattered throughout the upland hardwood forest in the Meductic Ecodistrict (Valley Lowlands Ecoregion), which is underlain with rich calcareous soils (Sabine, pers. comm. 2003).

Reproduction and genetics

Butternut flowers from April to June, depending on location. The species is monoecious (separate male and female flowers on the same tree), and wind-pollinated. The male flowers are thick, green catkins that develop from axillary buds. The female flowers are shorter than the male flowers and occur on short stems arising in the axils of new leaves. Flowers of both sexes on an individual tree usually mature at different times (Rink, 1990).

The fruit contains an oblong nut surrounded by a semi-fleshy indehiscent, pubescent husk (Harlow *et al*., 1979). The fruit matures in September and October in the year of pollination. Fruits occur singly or in clusters of 2 to 5. Mature fruits are 4-6 cm long, ovoid and green. Removal of the husk yields a nut containing an embryo with two large cotyledons surrounded by a seed coat and then a thick pericarp (outer husk). The cotyledons are sweet, oily and edible. The fruit usually remains on the tree until after leaf fall (Rink, 1990). Although the embryo can remain dormant for 2 years (OMNR, 2000) it usually germinates the following spring after seed fall (Rink, 1990).

Seed bearing starts at age 20 and peaks at age 30 to 60. Good seed crops occur every 2-3 years with light crops during intervening years. Low viable seed yields are usually caused by insect damage or lack of pollination (Rink, 1990). Seeds require cold stratification for 90 to 120 days to overcome dormancy (Young and Young, 1992).

The nut is considered to be intolerant of long-term storage and remains viable for 3 to 5 years if stored in sealed containers at temperatures just above freezing (Anonymous 1948; Wang 1974). Satisfactory storage can be obtained for at least 2 years if stored in closed containers at 80% to 90% relative humidity and +5 to 0°C. The nut cannot tolerate drying to low water contents (e.g. 5 % water content) and are sensitive to temperatures below -40°C (Wang *et al*. 1993). Stumps of young butternut trees are capable of sprouting (Rink, 1990) and can be propagated via rooted cuttings.

None of the species with which butternut hybridizes occur naturally within Canada. However, several of these species have been planted for nut production or landscaping. Butternut will hybridize with other species of *Juglans*, including heartnut (*J. cordiformis*) to produce buartnut (Millikan et al.1991); Japanese walnut (*J. ailantifolia*) to produce *J. x bixbyi*; and with English walnut (*J. regia*) to produce *J. x quadrangulata*. Butternut has also been reported to successfully hybridize with little walnut (*J. microcarpa*) and Manchurian walnut (*J. mandschurica*) (Rink, 1990). There have not been any confirmed reports of black walnut (*J. nigra*) and butternut hybridization.

Busov et al. (1997) compared allozyme variation within and among several Juglans species including butternut. Ostry (1998) reported that genetic diversity of butternut is limited. Morin et al. (2000a) investigated 12 isozyme loci of 9 butternut populations from the species' northeastern limit (7 from Quebec and one each from New Brunswick and Vermont). They observed low genetic diversity estimates compared to other species of the genus: only 3 of the 12 loci were polymorphic, and pairwise genetic distances were very low except for comparisons involving the population from Vermont. Population differentiation was estimated to be about 8%, but when the Vermont population was excluded, this estimate was reduced to 3%. One Quebec population, located over 100 km from the nearest sizable stand and thus with little to no gene flow with other populations, was completely monomorphic for those isozymes studied. The authors hypothesized that a combination of factors, including a genetic bottleneck occurring during the Pleistocene glaciation, influence of the butternut canker, and low migration distances of the gravity-dependent seed may have contributed to loss of diversity in butternut.

Movements/dispersal

Seeds are dispersed by gravity, water, squirrels and other small rodents. There is evidence to suggest that some populations of butternut, among other nut bearing trees, were introduced into northeastern North America by the Iroquois, before the arrival of Europeans (Wykoff, 1991).

Nutrition and interspecific interactions

Butternut grows best on fertile sites but also is found on dry rocky infertile sites. Butternut trees produce a substance called juglone, a naphthoquinone that is selectively toxic to associated vegetation (Rink, 1990). The Eastern Chapter of Ontario Nut Growers web site (http://ecsong.ca/vol15no4.html#M) provides a listing of species of trees, shrubs and herbaceous plants categorized as negatively or neutrally affected by the presence of butternut and walnut. The information is derived from the publication Black Walnut Toxicity by Olga Piedrahita, Factsheet No. 84-050, Ontario Ministry of Agriculture and Food, November 1984, and is as follows:

> "Plants reported as susceptible to black walnut toxicity include tomatoes, alfalfa, apple, pear, blackberry, blueberry, mountain laurel, azaleas, rhododendrons, shrubby cinquefoil (*Potentilla fruticosa*), red pine, white pine and other evergreens. Plants reported as showing toxicity symptoms occasionally include poverty grass (*Danthonia*), sweet peppers, common lilac, Persian lilac, viburnum, autumn crocus, peony, crabapple, magnolia, red raspberry, peach and *Euonymus* sp. Plants not affected or which have shown improved growth near walnut roots include Kentucky bluegrass, timothy, red top, orchard grass and other grasses, white clover, beets, snapbeans, lima beans, onions, parsnips, sweet corn, black raspberry, grapes, wild roses, forsythia, Virginia creeper, poison ivy, narcissus, salvia, impatiens, *Rudbeckia* sp., red cedar, oaks, maples, hickories and other native hardwoods. Other plants apparently tolerant to black walnut are anemone, jack-in-the-pulpit, lady fern, cyclamen, epimedium, dog's tooth violet, gentian, green hellebore, alumroot, plantain lily, iris, lilies, ostrich

fern, forget-me-not, narcissus, lily turf, may apple, Solomon's seal, Christmas fern, primroses, pilewort, nightshade, meadow rue, toad lily, white clover, trillium, bellwort, wild oats, periwinkle, burning bush, honey suckle, mock orange, oaks, and poison ivy."

POPULATION SIZES AND TRENDS

Ontario

A Tree Atlas program was initiated in 1996 to survey the distribution and abundance of all tree species in Ontario on a 10 km^2 grid system (Figure 2). Based on the number of surveyed grids within each respective abundance class, a very conservative estimate of the population of butternut in Ontario is approximately 13,000 trees. There are also 32 records for butternut in personal databases of Mike Oldham and Wasyl Bakowsky from the Ontario Natural Heritage Information Centre. The NHIC Natural Areas database (NADb) shows 32 areas where butternut has been recorded and 17 records for butternut in the Element Occurrence (EO) database.

There are also 500 records that were submitted to the FGCA by landowners as part of a voluntary survey completed from 1996 to 1998. These records were not added to the population estimate to avoid double counting.

New Brunswick

In N.B., butternut is listed as “Common and native in the Saint John River Valley and Upper Southwest Miramichi River valley” (Hinds, 2000). Hinds' map indicates that the species occurs throughout the above-named valleys, as well as within valleys of several of the major tributary rivers of the lower Saint John River. Relative to overall abundance of other tree species in the province, butternut might be better classed as uncommon, although it is locally abundant on some floodplain sites (Dwayne Sabine, pers. comm. 2003).

Butternut occurrence is not specifically tracked by the NB Department of Natural Resources. The species is coded for on DNR Permanent Sample Plot and Forest Development Survey (temporary sample plot) inventories. It has been recorded from 2 and 29 of these inventory plots respectively, representing approximately 2% of the total number of plots established within the primary portion of NB butternut range in each case.

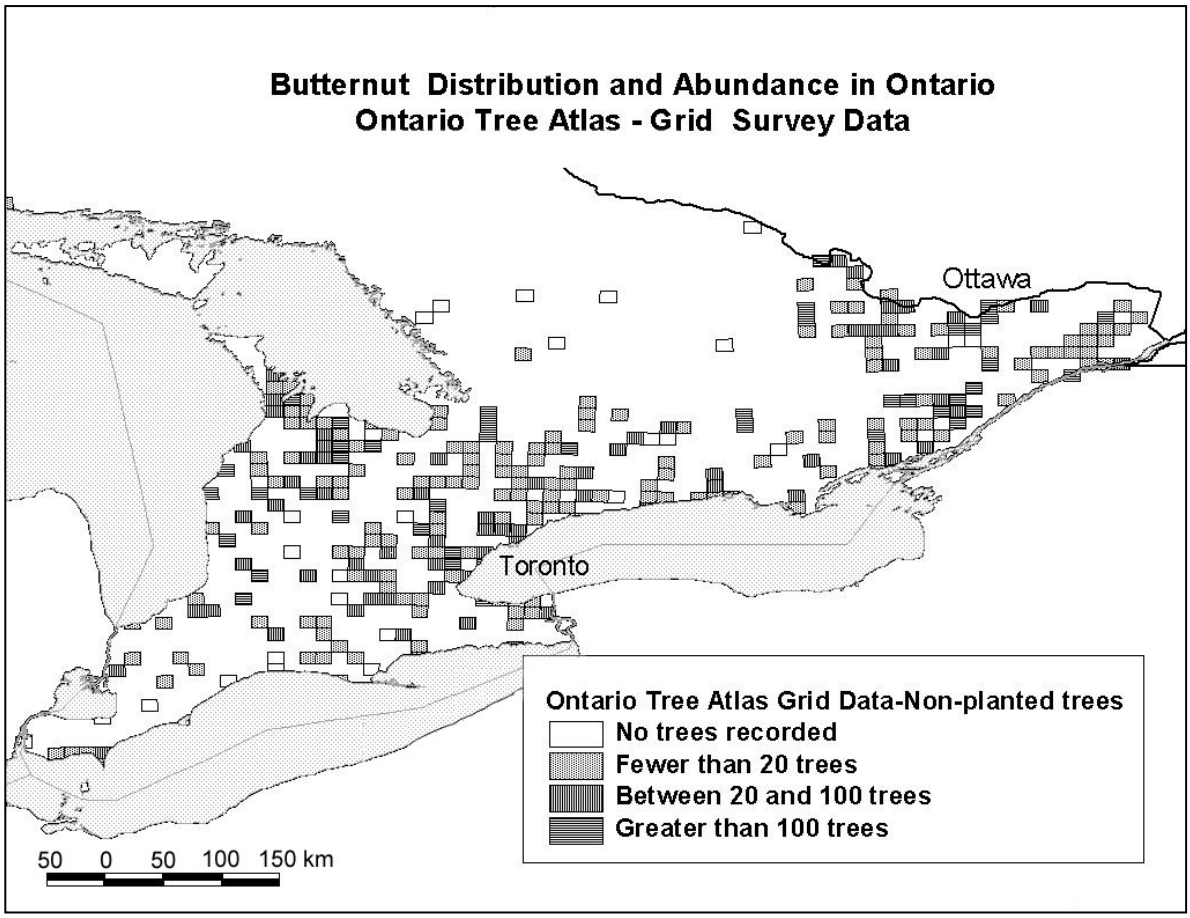

Figure 2. Ontario Tree Atlas results for non-planted butternut. Tree Atlas volunteers recorded abundance by class for each tree species within an assigned 10 X 10 km square during the period 1996 to 2000.

To further elaborate the number of butternut sites and population size in NB, five DNR staff members with extensive field experience within the butternut range, and who were familiar with the species, were interviewed to compile a list and map known sites of occurrence in the province. Because these recorded occurrences were based on memories of recent visits to sites for reasons other than recording butternut occurrence, data on abundance was difficult to obtain. Staff were asked to conservatively estimate numbers of mature trees in exponential categories: 1-10, 11-100, 101-1000, and 1000+. To compute estimated minimum and maximum numbers of mature trees, sites in the 1000+ category were conservatively considered to have both a minimum and maximum of 1000. Occurrence was recorded as discreet sites or forest stands except in areas where butternut was considered widespread and abundant. In the latter cases, presence of butternut was recorded as a broad area of occurrence, and the number of discreet sites or stands of butternut within these areas were conservatively estimated (Table 1).

Table 1. Compilation of known occurrences and estimated abundance of butternut in New Brunswick.

Area	Abundance	Number of Sites	Extent	River System
1	11-100	1		Saint John
2	101-1000	2	97 ha floodplain island	Saint John
3	101-1000	5	536 ha floodplain island	Saint John
4	11-100	1		Saint John
5	11-100	1		Saint John
6	11-100	1		Saint John
7	11-100	1		Saint John
8	11-100	1		Saint John
9	101-1000	4	220 ha floodplain area	Saint John
10	11-100	1		Saint John
11	11-100	1		Saint John
12	1000+	40	1700 ha floodplain area	Saint John
13	11-100	5	122 ha floodplain island	Saint John
14	1000+	10	312 ha floodplain island	Saint John
15	1-10	1		Saint John
16	101-1000	1		Saint John
17	1000+	30	1600 ha floodplain area	Saint John
18	1000+	40	2900 ha floodplain area	Saint John
19	101-1000	1		Saint John
20	11-100	5		Saint John
21	11-100	1		Saint John
22	11-100	1		Saint John
23	101-1000	10	900 ha urban & floodplain area	Saint John
24	1-10	1		Saint John
25	11-100	1		South West Miramichi
26	11-100	1		Saint John
27	11-100	1		Saint John
28	11-100	1		Saint John
29	101-1000	10	25 km of river valley	Saint John
30	11-100	1		Saint John
31	11-100	2		Saint John
32	11-100	5		Saint John
33	1-10	1		Saint John
34	1-10	1		Saint John
35	11-100	1		Saint John
36	1-10	1		Saint John
37	11-100	2		Saint John
38	101-1000	20	25 km of river valley & floodplain	Saint John
39	11-100	2		South West Miramichi
40	101-1000	20	65 km of river valley & floodplain	South West Miramichi
41	1-10	1		Saint John
42	1-10	1		Saint John
43	1-10	1		Saint John
44	11-100	1		Saint John
45	1-10	1		Saint John
46	1-10	1		Saint John
47	1000+	50	40 km of river valley	Saint John
48	1000+	50	40 km of river valley	Saint John
49	101-1000	30	45 km of river valley	Saint John
50	1-10	1		Saint John
Total	7241 - 17411	372		

Interviewed staff were familiar with 50 areas within which butternut occurs, and estimated a total number of discreet sites or stands of ~370 (Table 2). All of the areas with estimated abundance 1000+ were classed as broad areas of occurrence with multiple sites. These included four large floodplain intervals or islands totaling 6512 ha, and two linear stretches of river valley of unknown width totaling 80 km in length (Table 1). Of 10 areas with estimated abundance of 101-1000 mature trees, four were floodplain areas totaling 1753 ha, and four were linear stretches of river valley totaling 160 km in length.

Totaling the minimum and maximum estimates of butternut abundance at these sites indicates a population of between 7,000 and 17,000 mature trees. Because of the exponential nature of the abundance categories, the minimum estimate is probably closer to true abundance *at these known sites*. However, because sites known to the interviewed staff constitute an unknown subset of the true total number of sites of occurrence in NB, this minimum abundance estimate is conservative.

Subsequent discussions with the botanist with the Atlantic Canada Conservation Data Centre, local naturalists, and other DNR staff, as well as examination of the map in Hinds 2000, indicated that butternut occurs in at least 75 sites in addition to those discussed above. These include sites on the Kennebecasis and Cannan River drainages (tributary to the lower Saint John River) and a few planted sites scattered throughout the province (Sabine, pers comm. 2003).

Quebec

Information for the distribution and abundance of butternut in Quebec was derived from forest inventory plots and ecological inventory plots. Figure 3 shows the 378 stands in Quebec with a butternut component, based on forest inventory plots or ecological inventory plots. Figure 4 depicts 39 plots where butternut represents 25% or more of the basal area or canopy cover (Saucier, pers comm. 2002).

The Quebec natural heritage data centres do not currently track butternut (Labreque, pers. comm. 2002; Sean Blaney, 2002).

LIMITING FACTORS AND THREATS

The most serious and widespread pressure on butternut is the butternut canker, a disease that was first reported from Wisconsin in 1967 (Renlund 1971). It was originally believed that the causal agent was *Melanconis juglandis*, and it was not until 1979 that the true pathogen was identified as *Sirococcus clavigignenti-juglandacearum* (Nair et al. 1979).

Table 2. Summary of known occurrences of butternut in New Brunswick by estimated abundance class.

Abundance Class	Number of Areas	Number of sites
1000+	6	220
100-1000	11	104
10-100	22	37
1-10	11	11
Total	50	372

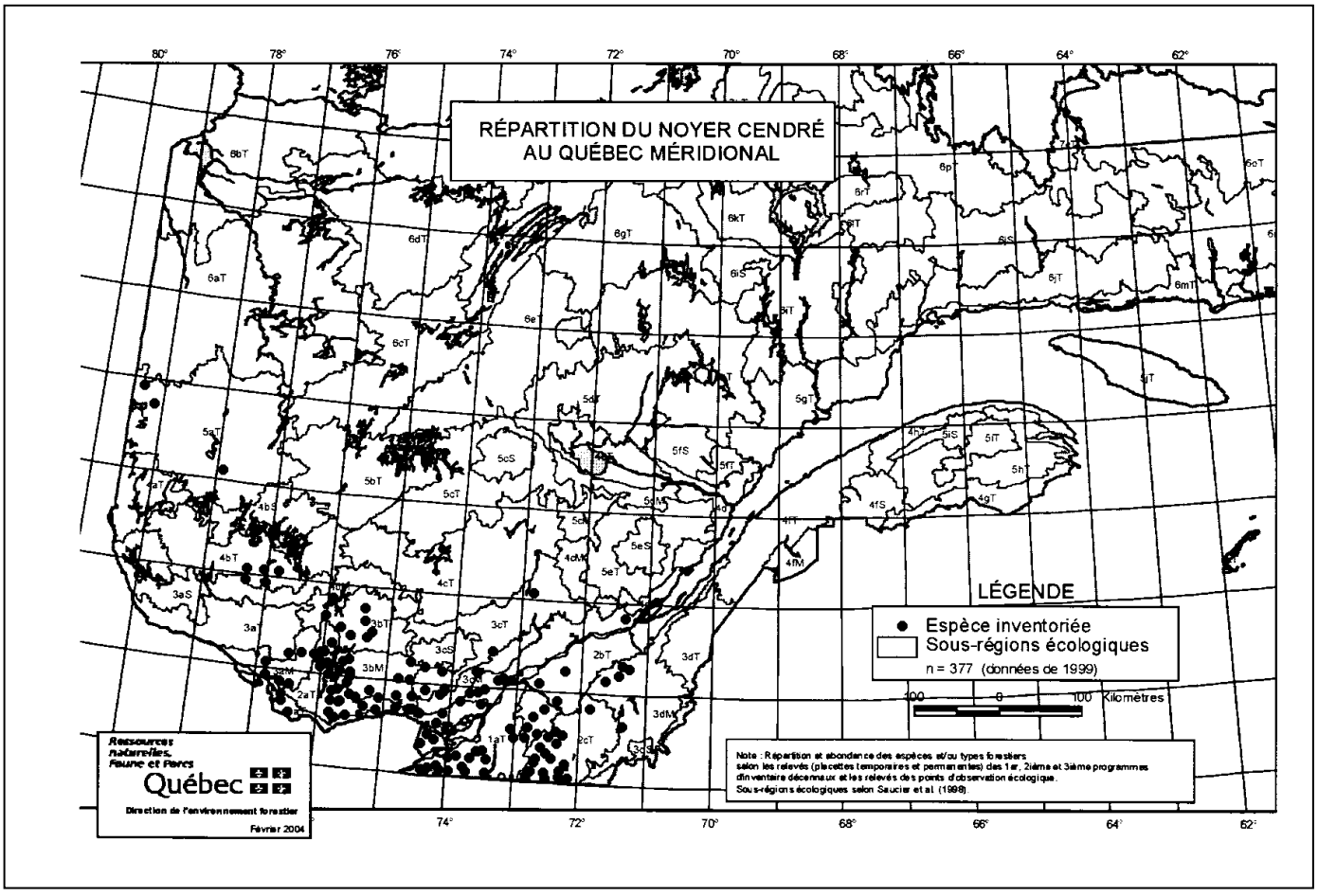

Figure 3. Butternut distribution in Quebec (Ministère des Ressources naturelles du Québec, 2002).

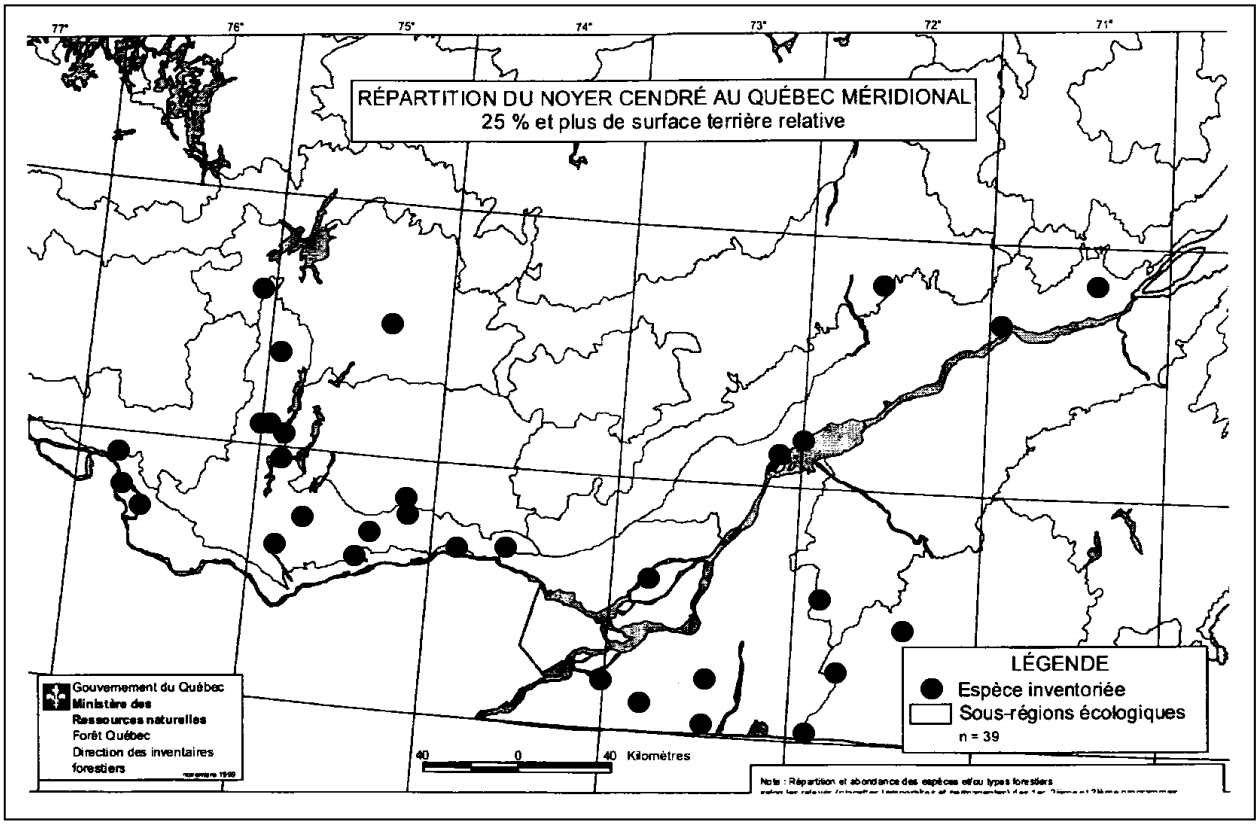

Figure 4. Quebec populations where butternut is ≥ 25% of basal area/canopy cover (Ministère des Ressources naturelles du Québec, 2002).

The origin of butternut canker is unknown. However, factors such as its rapid and aggressive spread, the scarcity of resistant trees, apparent lack of genetic diversity in the fungus, and the fact that the oldest cankers appear to be around 50 years old suggests that the disease is a recently introduced exotic (Anderson, 1996). Butternut canker infects all sizes and age classes of trees on all sites and infection can occur through buds, leaf scars and various wounds (Ostry 1995; Davis and Meyer 1997).

Butternut canker can infect and cause mortality in trees of all ages and sizes. Sprouts may be produced, but are generally also infected and do not grow to an appreciable age (Schlarbaum, pers com.).

The canker infects trees through leaf scars, buds, lenticels and wounds. Trees are killed by crown dieback or stem girdling. Hyphal pegs (also called stromatal columns) of the fungus rupture the outer bark on branches and stems of infected trees, exposing stromatic tissue and pycnidia of the fungus (Tisserat and Kuntz, 1983). Conidia require free water for release from a gelatinous matrix and are released from pycnidia during periods of rain or high relative humidity (Cree, 1995). Conidia may be carried from branch to branch by rainsplash (Tisserat and Kuntz, 1981). Spores are also carried

from the infected crown down the stem by rain wash, causing a number of stem cankers which eventually girdle the tree (Anderson, 1996; Ostry et al., 1994).

During rainstorms, conidia have been trapped in air samples as far as 40 m from the nearest source of inoculum, although spore numbers decreased exponentially with distance from an infected tree (Tisserat and Kuntz, 1983). There is evidence that conidia travel even greater distances (Tissert and Kuntz, 1981). Cankers resulting from natural infection have been found over 100 m from the nearest cankered tree (Tisserat and Kuntz, 1983). Tisserat and Kuntz (1983) concluded that small droplets or aerosols containing conidia could be distributed by wind for distances greater than 1 km. Conidia may survive in an airborne environment for at least 8 hours (Tisserat and Kuntz, 1981).

Following death of a tree, the fungus may continue to sporulate for 20 months (Tisserat and Kuntz, 1984). Several insect species have been found in association with fungus spores on infected trees (Katovich and Ostry, 1998). At least seventeen beetle species have been found to be disease vectors by carrying pathogen conidia (Halik and Bergdahl, 2002). Studies in Quebec have shown that the disease can be transported to new sites on the fruit of black walnut and butternut (Innes, 1998).

Artificial inoculation of black walnut with butternut canker has caused infections, but severe infections in natural stands or plantations have not been found in black walnut.

Resistance

It is not clear whether resistance to the canker occurs as complete immunity or is present in varying degrees. There are reports of individual trees in infected stands that show no signs of the canker (Ostrey et al. 1994), while other observations suggest trees of varying levels of resistance, but that are nonetheless infected. That is, given the length of time that the butternut canker has been present in the eastern United States, and the reduction in numbers or loss of trees from so many areas, the existence of surviving trees, though infected to some degree, may be evidence of some level of resistance (Schlarbaum, pers. comm.).

While Ostry et al. (1994) indicate that healthy butternut growing amongst diseased trees may be putatively resistant trees, it has not yet been shown that this putative resistance reflects actual genetic-based resistance.

Butternut canker in Canada

In Canada, butternut canker was first collected in Quebec in 1990 (Innes and Rainville, 1996), and then in Ontario in 1991 (Davis et al., 1992) and in New Brunswick in 1997 (Harrison *et al*. 1998). Butternut canker is currently known to exist throughout the range of butternut in Ontario and Quebec, with limited distribution, at present (see Figure 5), in New Brunswick (Hopkin *et al*. 2001).

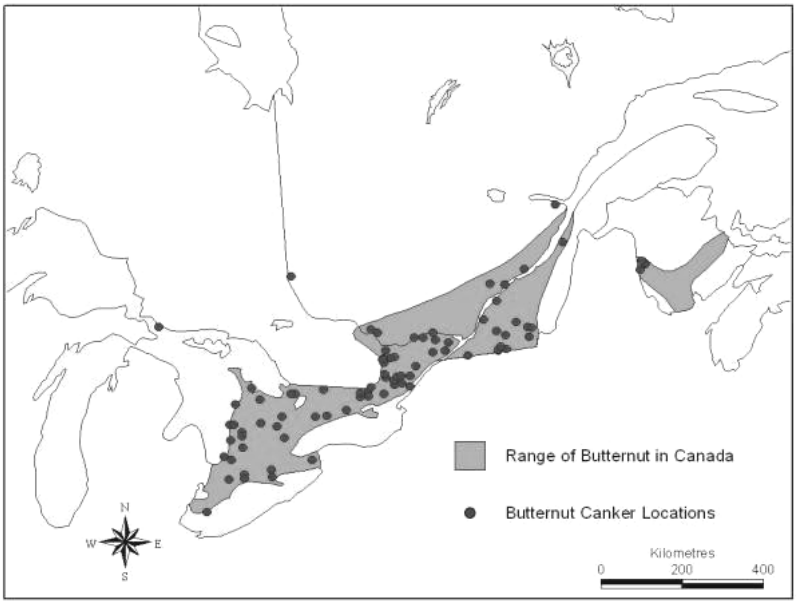

Figure 5. Distribution of butternut and butternut canker in Canada (Hopkin *et al.*, 2001).

In Ontario, butternut canker was first identified in 1991 by the Forest Insect and Disease Survey (FIDS) unit of the Canadian Forest Service. However, the age of cankers found indicates that the disease had been present in Ontario for at least 20 years. In 1992, the FIDS unit sampled 30 locations in south-western Ontario. The canker was present on 22 of those sites. Whole-tree mortality was most evident in the OMNR Cambridge District where 27% of the trees surveyed had been killed by the disease. Although there was no whole-tree mortality recorded in the eastern half of the province, greater than 90% of the trees examined were infected. Data on growth, health and mortality is collected on growth and yield plots across Ontario. Butternut canker was positively identified in only 3 trees; damage and mortality estimates caused by butternut canker were assumed in the other cases. Records show 40 live butternut trees distributed across 32 plots (Table 3), 17 of which were assessed as potentially infected by canker. Twenty-one dead trees were also recorded with butternut canker listed as the cause for 4 trees.

In Ontario, a voluntary survey of landowners was conducted between 1996 to 1998 to which approximately 500 landowners responded with reports of locations of butternut on their property. Responses from 304 participants provided geographic reference data accurate enough to allow mapping (Figure 6). Of the 500 reports, 263 included data on health of butternut. Trees were in poor condition at 47% of sites for which health was reported. In addition, butternut was identified as a species of concern for the Tree Atlas program conducted from 1996 to 2000. Separate forms were filled out for identified butternut trees with respect to health of the trees located (Figure 6). Tree atlas data indicates that 44% of the 170 individual trees reported on were in poor condition. Tree Atlas data is derived from individual tree forms submitted by volunteer tree atlas surveyors.

Table 3. Summary of OMNR growth and yield data for butternut in southern Ontario. Butternut canker was positively identified in only 3 trees; damage and mortality estimates caused by butternut canker were assumed in other cases.

OMNR District	Ontario Township	# plots	# live trees	Potentially cankered	# dead trees	Canker as possible cause of death
Aylmer	Colchester	2	3		1	
Aylmer	Dunwich	1	1	1		
Aylmer	Mosa	1			2	
	subtotal		**4**	**1**	**3**	
Cambridge	Lincoln	1			**1**	
Kemptville	Charlottenburgh	1	3			
Kemptville	Edwardsburgh	1	1	1		
Kemptville	Finch	1	1			
Kemptville	Kenyon	3	5	1	3	
Kemptville	Lancaster	1	1			
	subtotal		**11**	**2**	**3**	
Midhurst	Collingwood	1	1	1		
Midhurst	Glenelg	1			1	
Midhurst	Keppel	2	2	1		
Midhurst	Oro	2	3	2	1	
Midhurst	Osprey	2			5	2
Midhurst	Sullivan	1	1	1		
Midhurst	Sydenham	2			2	2
	subtotal		**7**	**5**	**9**	**4**
Tweed	Bedford	1	2	1		
Tweed	Dummer	2	10	4	1	
Tweed	Hungerford	2	2	2	1	
Tweed	Huntington	3	3	2	3	
Tweed	S. Fredericksburg	1	1			
	subtotal		**18**	**9**	**5**	
Total			**40**	**17**	**21**	**4**

Butternut canker in the United States

In the U.S., the factor having the greatest effect on population size is mortality caused by butternut canker (*Sirococcus clavigignenti-juglandacearum* V.M.G. Nair, Kostichka and Kuntz). Butternut canker was first reported in Wisconsin in 1967 (Renlund, 1971); but the causal agent was not described until 1979 (Nair, 1979). Sinclair (1987) has noted that butternut of all ages and sizes throughout most of its range have signs of the canker. Cankered trees are found growing in mixed and relatively pure stands, on dry, infertile ridgetops with shallow soils, and in moist, fertile bottomlands with deep soils. Infected trees were found in local pockets and over extensive areas (Kuntz *et al.* 1979, Prey and Kuntz, 1982). Although young butternut has the ability to produce sprouts, asexual sprouts are limited by the fungus and are usually killed in the first year (Ostry *et al*. 1994).

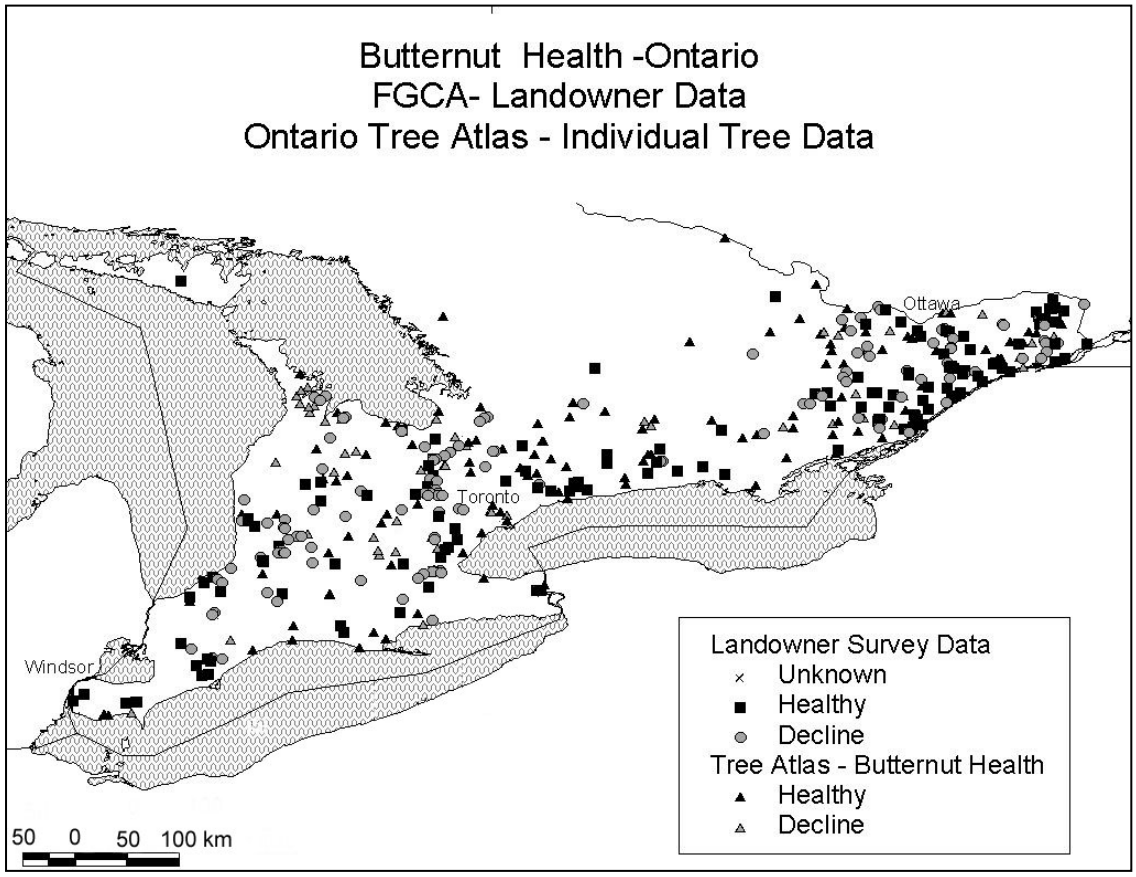

Figure 6. Tree Atlas data and landowner survey data for butternut health in Ontario.

Ostry et al. (1994) indicate that forest inventory data from the USDA Forest Service shows a dramatic decrease in the number of live butternut throughout the United States in the past 10-15 years. The Forest Inventory and Analysis group of the USDA Forest Service reported a 77% reduction in the number of butternut with diameter 5 inches and larger over a 30 year period in North Carolina and Virginia (USDA Forest Service, 2003). Although these results are based on samples, and therefore have some margin of error, they confirm the declines in additional or parallel studies. For example, estimates of the number of butternut infected with the canker in Wisconsin increased from 30 % to 91% between 1976 and 1992, and the number dead butternut trees in the sample areas increased from 8.5% to 27% over the same time period (Cummings Carlson et al. 2004).Tisserat (1984) reported an increase from 5% trees infected to 71% trees infected over a six year period, however this was within one plantation area, which may not be indicative of the natural forest situation. Skilling et al. (1993) have determined that additional surveys are needed to more accurately assess the health of butternut, and several states have now undertaken or are planning to conduct additional surveys.

Disease symptoms

The following description of butternut canker symptoms has been extracted from "Field Guide to Tree Diseases of Ontario (Davis and Meyer, 1997):

> "The most obvious symptoms of the disease are the elongated, sunken cankers, which commonly originate at leaf scars, buds, or wounds. In spring, an inky-black fluid exudes from cracks in the canker; in summer, the cankers appear as sooty black patches, often with a whitish margin. Peeling the bark away reveals brown to black areas of killed cambium. Older cankers can be perennial, are found in bark fissures or loosely covered with shredded bark, and are bordered by successive callous layers. Trees are usually first infected in the lower crown and then die downward as spores from the cankers are washed down. This disease infects trees of all ages and sizes and on all sites. Cankers spread around branches and trunks, eventually girdling and killing the tree".

Disease control

There is no known control for butternut canker and U.S. researchers suggest that selection of genetically resistant material offers the best potential for recovery programs.

Other damaging agents

In addition to butternut canker there are a number of insects and diseases that cause damage to butternut. Only those considered to cause significant damage are included here.

Aside from butternut canker, perhaps the most damaging disease reported on butternut is bunch disease, a witches' broom disease believed to caused by a mycoplasmalike organism (Rink, 1990). Normally-dormant axillary and adventitious buds develop prematurely and form brooms of sucker-like shoots and undersized chlorotic leaves on large limbs and the trunk (Seliskar 1976, Meador *et al.* 1986). This abnormal growth lacks cold-hardiness and suffers winter-kill. Branches infected with bunch disease do not produce normal nut crops (Berry 1973). In Quebec, one of the most damaging agents in young plantations is *Fusarium* canker. *Phomopsis* canker has also been identified in Quebec on tree branches and stems.

There are a number of foliage diseases that are common to butternut as well as to other *Juglans* species. The most damaging is an anthracnose leaf spot caused by *Marssonina juglandis* (Lib.) Magnus. This pathogen is reportedly infecting and killing young shoots as well as foliage (Myren 1991; CFS 1994; Black *et al.* 1977).

Armillaria gallica H. Marxm. & Romagn. has been reported as causing root disease on butternut (McLaughlin, 2001). This species of *Armillaria* favours hardwood hosts and infects and kills stressed trees. The decline of trees suffering from butternut canker will be accelerated by *Armillaria* root disease.

The most serious insect pest is the butternut curculio *(Conotrachelus juglandis),* a beetle that injures young stems and fruit, although damage is usually not major (Rink, 1990). Other insects found on butternut include woodborers, defoliators, nut weevils, lacebugs, and bark beetles (Rink, 1990). *Hyphantria cunea (Drury)*, fall webworm, causes defoliation to a broad range of hardwood trees including *Juglans* species (Nystron and Britnell 1994). A gregarious feeder (Cannon 1985) that can cause significant defoliation in localized areas when populations are high, it does not cause mortality to healthy trees, although control is sometimes recommended (Anderson 1978). *Datana integerrima* Grote & Robinson, walnut caterpillar, is common in southern Ontario and the northeastern U.S. (Anon 1985). It feeds on a variety of hardwoods but prefers *Juglans* species, and is considered an important defoliator of *Juglans* (Farris and Appleby 1979).

Acrobasis demotella Grt. is a shoot-borer and one larva can kill a shoot or leader and result in a crooked tree (Martinat and Wallner 1980). It is considered capable of causing serious damage to butternut and walnut in Canada (Nystrom and Britnell 1994).

The common grackle has been reported to destroy immature fruit (Rink, 1990). Butternut is very susceptible to fire and storm damage (Rink, 1990), and is also highly susceptible to frost damage in late spring (OMNR, 2000).

SPECIAL SIGNIFICANCE OF THE SPECIES

There are about 20 species within the genus *Juglans* (also referred to as walnuts) distributed in North and South America, Europe, Asia and India. Of the 6 species native to North America, only butternut and black walnut occur naturally in Canada (Farrar, 1995), with southern Ontario encompassing the entire Canadian portion of the range of black walnut, and approximately 60% to 70% of all butternut in Canada.

Butternut wood is lightweight, soft, low in strength, and coarse-grained. The wood is valued for interior finishing, cabinetwork and carving. It does not have high economic value in Canada but is valued in the U.S. as a timber species.

The nuts have a delicious buttery flavour and an oil content of up to 60% at peak ripeness (Rupp, 1990). More than 40 butternut cultivars have been described with a few gentoypes exhibiting good nut qualities for commercial production (large size and ease of cracking) (Ostry *et al.,* 2000). Nut growers value butternut as a cold-hardy, nut-producing species. Nuts are especially popular in New England for making maple-butternut candy. Additionally, there are reports that butternut trees were tapped by the pioneers and yielded an excellent syrup (Lauriault, 1989). However, the ratio of sap to syrup is four times higher than that of maple trees (Rupp, 1990). Nuts are also utilized by wildlife as a food source.

A dye can be extracted from the husks and the root bark and a tea can be brewed from the dried outside bark to cure toothaches and dysentery (Lauriault, 1989).

Juglone, which is a component of butternut, is antiseptic and herbicidal: some antitumor activity has also been reported. A recent animal study suggests that juglone possesses sedative activity comparable with diazepam (the prescription drug Valium) (Foster and Duke, 2000).

FIRST NATIONS TRADITIONAL KNOWLEDGE

Butternut (Akiehwa:ta in Mohawk) was an edible oil nut known and used by many First Nation peoples. This nut had to be harvested quickly, when it matured, because the oils in the nut would become rancid and inedible. As a result of this, Native people planted this tree anywhere that their villages were established. Like the Black Walnut, this species was brought north with the movement of the Haudenosaunee (People of the Longhouse, popularly known as the Iroquois).

The distribution of butternut was widespread over southern Ontario, southern Quebec and central Maritimes but occurred in dense clusters. Butternut's establishment in the Maritimes probably occurred within the last 600 years as the butternut was distributed among the different nations. Since the butternut is still traded among Native peoples, isolated trees can be found outside of the main range.

The butternut trees tend to become "grandfather" trees at 30-50 years. At this age, trees are used to propagate new trees within the area. Once the grandfathers are taken, it is hard to ensure that replacement stock is suitable for the area.

Butternut has been steadily declining since contact with Europeans in Canada and the United States. Many of the butternut stands were used for furniture but also were cleared from the best spots for villages. These sites in many cases were old Native village sites now occupied by Canadian cities and towns. Farming and other land uses also threaten the remaining stands of butternut. Currently butternut canker has been seen on most trees within the main range. Many Native peoples are searching for canker resistant butternuts to establish new butternut clusters and for future seed sources.

The Native peoples of North America had many medicinal and cultural uses for the butternut (Chandler *et al*., 1979; Gilmore, 1933; Hamel and Chiltoskey, 1975; Herrick, 1977; Smith, 1928; Smith, 1923; Smith, 1933). For further details see the website http://www-personal.umd.umich.edu/~dmoerman/.

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

Protection

Butternut has a Global Ranking of G3G4. It is ranked as SR in N.B, S4 in Quebec and S3? in Ontario. The effect of butternut canker on Canadian populations has only

become apparent over the last decade after the canker was first noted in this country. In Canada, butternut has no official status, although it is now being tracked by the NHIC and by the AC CDC as species of provincial conservation concern in Ontario and New Brunswick respectively.

Ostry *et al.* (1994) stated that butternut was listed under Category 2 on the list of Endangered and Threatened Plants under the Endangered Species Act in the United States. This category was for species that show evidence of vulnerability, but which need more background data. However, the species was delisted along with the entire Category 2. Butternut is still listed as a species of concern in many states and in Federal Region 9 (Ostry, pers. comm. 2002). In the U.S., restrictions on harvest of butternut on some public lands have been enacted and silvicultural guidelines for the management of butternut have been developed (Ostry *et al*., 1994).

TECHNICAL SUMMARY

Juglans cinerea
butternut noyer cendré
Range of Occurrence in Canada: Ontario, Quebec, New Brunswick

Extent and Area Information	
• *Extent of occurrence (EO)(km²)* (Approximation of the area occupied by the total range within the three provinces)	121,000 km²
• *Specify trend in EO*	Likely stable
• *Are there extreme fluctuations in EO?*	No
• *Area of occupancy (AO) (km²)*	Unknown; distribution is scattered, and species is primarily found as lesser associates in hardwood stands with some extensive pure stands on floodplains
• *Specify trend in AO*	Unknown
• *Are there extreme fluctuations in AO?*	No
• *Number of known or inferred current locations*	Unknown; over 500 locations (stands) reported by landowners in Ontario; 378 plots reported in Quebec, with 39 plots in which butternut makes up ≥ 25% basal area; 50 locations reported in N.B. with about 370 stands
• *Specify trend in #*	Unknown - trend data not available
• *Are there extreme fluctuations in number of locations?*	No (to date, trees within stands are affected; it is anticipated that eventually stands will be lost)
• *Specify trend in area, extent or quality of habitat*	Declining in southwest Ontario, stable in rest of range
Population Information	
• *Generation time (average age of parents in the population)*	30-60 years
• *Number of mature individuals*	Unknown
• *Total population trend:*	Anticipated decline
• *% decline over the last/next 10 years or 3 generations.*	No reliable data exist for calculating infection and mortality rates in Canada. Given the current geographic extent of the disease and based on available data for part of the range in Canada, Canadian populations may experience high rates similar to those in the USA (perhaps >70% decline).
• *Are there extreme fluctuations in number of mature individuals?*	No
• *Is the total population severely fragmented?*	No
• *Specify trend in number of populations*	Anticipated decline
• *Are there extreme fluctuations in number of populations?*	No
• List populations with number of mature individuals in each: No complete data set is available	
Threats (actual or imminent threats to populations or habitats)	
- butternut canker is the most imminent threat; harvesting and habitat conversion to alternate land uses are concerns for parts of the range.	

Rescue Effect (immigration from an outside source)	
• *Status of outside population(s)?* **USA:** up to 77% mortality in some states; continuing to decline	
• *Is immigration known or possible?*	Yes, possible, but major water barriers with few land bridges occur; potential recruitment populations are even more severely affected by canker than those in Canada
• *Would immigrants be adapted to survive in Canada?*	Yes, from selected climatic regions, however, all populations appear to be susceptible to canker, with some individuals showing putative resistance
• *Is there sufficient habitat for immigrants in Canada?*	Yes
• *Is rescue from outside populations likely?*	Unlikely
Quantitative Analysis	N/A
Current Status COSEWIC: Endangered	

Status and Reasons for Designation

Status: Endangered	**Alpha-numeric code:** A3e + 4e
Reasons for Designation: A widespread tree found as single trees or small groups in deciduous and mixed forests of southern Ontario, Quebec, and New Brunswick. Butternut canker, which has caused high rates of infection and mortality in the United States, has been detected in all three provinces. High rates of infection and some mortality have been observed in parts of Ontario and are predicted for the rest of the Canadian population.	
Applicability of Criteria **Criterion A** (Declining Total Population): Endangered under A3 and A4 (i.e, introduced pathogens). It is likely to be met in Canada based on the severity of infection and mortality rates seen in similar forests in the United States and on similar high rates in Canada, based at least on Ontario data and evidence of widespread occurrence of infection in Eastern Canada. **Criterion B** (Small Distribution, and Decline or Fluctuation): N/A. No overall decline figures and range too large and not severely fragmented **Criterion C** (Small Total Population Size and Decline): N/A. Total population too large. **Criterion D** (Very Small Population or Restricted Distribution): N/A. Population and area of occupancy too large. **Criterion E** (Quantitative Analysis): N/A	

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A number of authorities were contacted and provided information for the Butternut status report: Parks Canada (including representatives from a number of individual parks), provincial agencies (including representatives from provincial parks, forestry services, and wildlife conservation and management departments), conservation data centres, various arboreta, conservation associations and coalitions and the COSEWIC Secretariat. A full list is available on request from the COSEWIC Secretariat.

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BIOGRAPHICAL SUMMARY OF THE REPORT WRITERS

Cathy Nielsen has a Bachelor of Science in Forestry, specializing in Tree Biology, from the University of New Brunswick. In 1981, she began work as a forester with the New Zealand Forest Service then continued as the owner/operator of a landscaping business in Alice Springs, Australia. Cathy worked for OMNR from 1984 to 2004 and was most recently the Forest Specialist with the Science and Information Section of OMNR in Kemptville. She established the Forest Gene Conservation Association, and continues to serve as technical advisor. She has been active since 1996 in the conservation of butternut in Ontario. Currently she is with the Habitat Conservation Division, Canadian Wildlife Service.

Marilyn Cherry has a Ph.D. in Forest Genetics from the University of British Columbia and a BScF in Tree Biology from the University of New Brunswick. She is a Registered Professional Forester (B.C.). Marilyn has previous experience working for government and industry, has worked as an independent contractor for various clients, and benefited from an exchange program where she worked in Germany with the Institute of Forest Genetics, University of Göttingen. She is currently the Assistant Director, Pacific Northwest Tree Improvement Research Co-op in Corvallis, Oregon.

Barb Boysen coordinates the program of the Forest Gene Conservation Association (FGCA), a not-for-profit corporation dedicated to conserving genetic diversity of tree and shrub species in southern Ontario, with members from government, forest industry and conservation groups. The FGCA made initial efforts to study butternut and the effects of the canker in 1992 with the Ontario Ministry of Natural Resources Southern Ontario Forest Genetics Group. Most recently the FGCA initiated the formation of the Butternut Conservation Coalition to produce the status report and also develop and implement a butternut conservation strategy. Barb is a forester (Lakehead University, 1982) and has worked mainly in south-central Ontario on tree improvement, reforestation and conservation initiatives within the context of private land forest management.

Anthony Hopkin has a Ph.D. in plant pathology from the University of Manitoba. He has worked with forest diseases within the Canadian Forest Service for 13 years as

part of the Forest Insect and Disease Survey. Tony has specialized and published in the area of hardwood declines and causes. He has also published on introduced diseases in Ontario including butternut canker.

John McLaughlin is the OMNR's Forest Research Pathologist, working out of the Ontario Forest Research Institute in Sault Ste. Marie. He holds a Master of Science degree in Forest Pathology from Lakehead University. He has conducted research in Ontario, British Columbia and Latvia and published on several pathology problems including root diseases, needle casts, and wood decay associated with logging damage and bark-stripping by moose. He has great interest in the impacts of non-native pathogens on Canadian tree species. John has collaborated on projects involving chestnut blight, beech bark disease, and white pine blister rust. He has experience working with endangered species. In March 2002, he completed a pathology survey and disease management analysis for the endangered red mulberry in southern Ontario. This study was conducted for the Parks Canada Species at Risk Program (Project #2001:SARRFII-10).

Tannis Beardmore has a Ph.D. in seed science from the University of Guelph. She has worked for the Canadian Forest Service for 9 years conducting research in the area of biodiversity and seed storage. A component of her research has focused on developing methods for preserving hard-to-store germplasm (e.g., butternut).