

**Ontario Species at Risk Evaluation Report for
Butternut (*Juglans cinerea*)**

Committee on the Status of Species at Risk in Ontario
(COSSARO)

Assessed by COSSARO as Endangered

November 2017

Final

Noyer cendré (*Juglans cinerea*)

Le noyer cendré est l'un des deux noyers indigènes présents en Ontario. Cet arbre de courte durée, à croissance rapide et intolérant à l'ombre pousse dans les forêts riveraines ou en terres hautes. On le retrouve dans le Sud de l'Ontario, principalement au sud du Bouclier canadien. En temps normal, le noyer cendré pousse en petits regroupements dans des clairières éparées. On ne connaît pas la taille de la population restante en Ontario, mais on estime qu'elle pourrait se situer entre 10 000 individus au minimum et possiblement plus de 100 000. Cependant, le chancre du noyer cendré (*Ophiognomonia clavignenti-juglandacearum*), une maladie fongique exotique, a fait chuter massivement son nombre dans toute l'aire de répartition. Selon les tendances actuelles, le noyer cendré pourrait disparaître de l'Ontario d'ici 90 ans, puisqu'il est peu probable que les individus des territoires voisins soient d'un grand secours, étant eux-mêmes dans une situation précaire.

Le CDSEPO a classé le noyer cendré dans la catégorie des espèces en voie de disparition en raison du déclin enregistré et anticipé attribuable à un pathogène. Ce statut est le même que celui accordé par le CDSEPO en 2003, et par le COSEPAC dans le cadre de sa plus récente évaluation, réalisée en 2017.

Cette publication hautement spécialisée «COSSARO Candidate Species at Risk Evaluation for Butternut» n'est disponible qu'en anglais conformément au Règlement 671/92, selon lequel il n'est pas obligatoire de la traduire en vertu de la Loi sur les services en français. Pour obtenir des renseignements en français, veuillez communiquer avec le CDSEPO au COSSAROSecretariat@ontario.ca.

Executive summary

Butternut is one of two native walnuts in Ontario. It is a short-lived, fast-growing, shade-intolerant tree associated with riparian and upland forests. It is distributed across southern Ontario, mainly south of the Canadian Shield. Under normal circumstances, Butternut forms small clusters of trees in scattered forest gaps. The size of the remaining population in Ontario is unknown, but estimated to be at least 10,000, and possibly more than 100,000. However, Butternut Canker (*Ophiognomonia clavignenti-juglandacearum*), an apparently exotic fungal disease has caused a massive, range-wide decline in Butternut numbers. Current trends suggest Butternut may be extirpated in Ontario within 90 years, with little hope of rescue from adjacent jurisdictions where the situation is equally dire.

COSSARO has determined Butternut be listed as Endangered, based on an observed and projected population decline due to a pathogen. This is the same status assigned to this species by COSSARO in 2003, and the most recent COSEWIC evaluation in 2017.

1. Eligibility for Ontario status assessment

1.1. Eligibility conditions

1.1.1. Taxonomic distinctness

Butternut was first described by Linnaeus in 1753, and no evidence has been presented to question its validity as a species since that time. It can form hybrids with several other *Juglans* species, but not the only other walnut native to Ontario, Black Walnut (*Juglans nigra*).

1.1.2. Designatable units

There is only a single designatable unit in Ontario and Canada.

1.1.3. Native status

Linnaeus described Butternut from North American material, and the type specimen is from New York. Herbarium records document its presence at least as early as 1878 (specimen at MTMG, data accessed via canadensys.net on 07 November 2017). Paleocological studies in Wisconsin have documented Butternut pollen in peat samples from the early Holocene (Wilson and Webster 1942). There is no doubt that the species is endemic to eastern North America including Ontario, although it has been cultivated elsewhere in the world.

1.1.4. Occurrence

Butternut still occurs across its historic range in southern Ontario.

1.2. Eligibility results

Butternut (*Juglans cinerea*) is eligible for status assessment in Ontario.

2. Background information

2.1. Current designations

- GRANK: G4 (NatureServe November 2017)
- NRANK Canada: N3N4
- COSEWIC: Endangered (April 2017)
- SARA: Endangered (Schedule 1)
- ESA 2007: Endangered (June 2008)
- SRANK: S2? (ranked in 2015)

2.2. Distribution in Ontario

Butternut occurs across southern Ontario, north to the Bruce Peninsula in the west and Chalk River in the east (Figure 1). Additional isolated occurrences have been documented farther north in Sault Ste. Marie, North Bay and North Cobalt, but the native status of these sites is uncertain. The Extent of Occurrence of Butternut in Ontario is estimated at more than 170,000 km², and the Area of Occupancy at 2112 km² (Figure 1). The EOO is probably declining, but the available data is insufficient to quantify the loss. The available data likely greatly underestimates the AOO, although it is also probably declining.

As the primary threat to this species is the Butternut Canker, *Ophiognomonia clavignenti-juglandacearum* (Oc-j), and this threat has spread across the range of Butternut in Ontario, all Butternut sites in the province are treated as a single location.

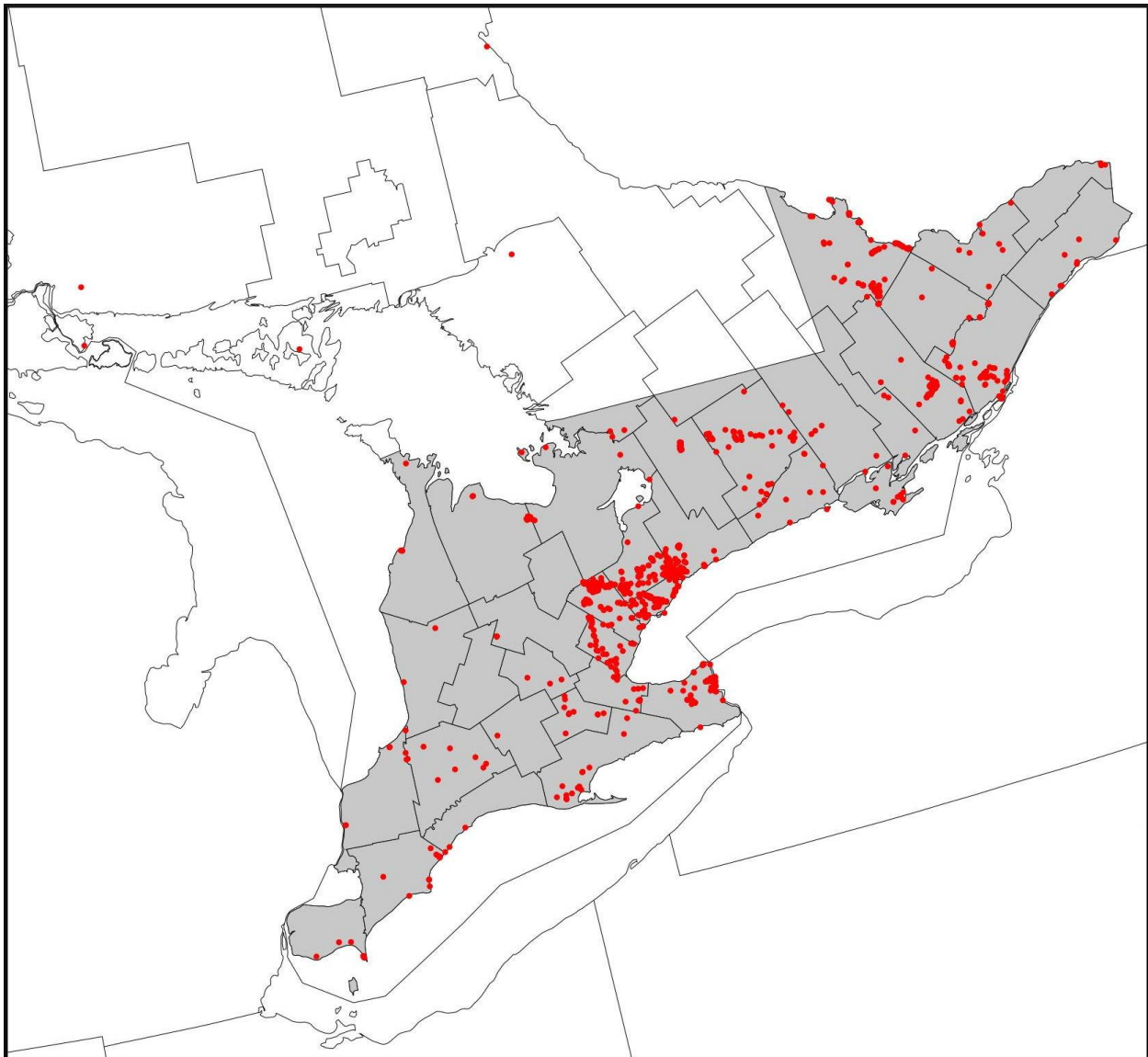


Figure 1. Approximate distribution of Butternut in Ontario. The shaded area is based on the map used in COSEWIC 2017, compiled from multiple sources cited therein. The red dots show the location of NHIC Element Occurrence records.

2.3. Distribution and status outside Ontario

The global range of Butternut extends from Minnesota east to Quebec and Maine, and south to Arkansas, Mississippi and Alabama. There are also disjunct sites in New Brunswick.

Butternut is suffering a massive, range-wide decline in population. The USDA Forest Service (1996) estimated that by 1994, the Butternut population in the southeastern US had declined by 77%, and in Michigan it had decreased by 84% over the previous 10-15 years (Ostry et al. 1994). Oc-j has since spread into New England, where a 2009 survey found 25% mortality due to the fungus (Bergdahl and Bergdahl 2009).

Butternut is not a listed species under the US Endangered Species Act. However, it is a Regional Forester Sensitive Species in 13 of 16 US National Forests in the northeastern USA (Region 9; Schultz 2003), and is listed in Kentucky (Special Concern), Tennessee (Threatened) and New York (Exploitably Vulnerable) (Schultz 2003).

2.4. Ontario conservation responsibility

Less than 25% of the global range of Butternut is in Ontario.

2.5. Direct threats

The principal threat to Butternut is the Butternut Canker Fungus, (Oc-j). The earliest observations of Butternut disease attributed to this organism were reported in the early 1920s (Broders et al. 2012). Oc-j was not identified as the causal agent until 1979 (Nair et al. 1979). Based on its sudden appearance and rapid spread, Oc-j is believed to be an introduced species. However, it is not known outside of North America, and it is also possible that it is a minor pest of other North American tree species that switched hosts to Butternut sometime prior to the observations made in the 1920s. Whatever its origin, genetic data indicate that there have been three distinct introductions (or host jumps, Broders et al. 2012).

Oc-j was first identified in Ontario in 1991, and the age of cankers observed at that time indicated that it had been spreading undetected since at least the early 1970s (Davis et al. 1992, COSEWIC 2003). MNRF surveys completed in 1992 documented infection rates greater than 90%.

Oc-j attacks trees of all ages, first by disintegrating the bark cells, and ultimately destroying the vascular cambium. Small trees are killed quickly, but mature trees may persist for many years before succumbing. Oc-j disperses as spores, which may be blown long distances on the wind or carried by insects. It will also disperse within Butternut nuts, infecting seedlings as they germinate, killing them before they can establish.

As mentioned above, Oc-j has had a devastating impact on Butternut across its native range in North America. In Ontario, MNRF established a monitoring program in 2008 (Wilson pers. comm., reported in COSEWIC 2017). They tracked 1221 trees at 60 sites

across the province. Of these trees, 38% were dead by 2015, and the only mature tree to have no sign of Oc-j infection was in fact a hybrid Butternut x Japanese Walnut (*Juglans ailantifolia*). COSEWIC (2017) noted that if this decline continues at the same rate (5.4% mortality per year), it would lead to the extirpation of Butternut in the study sites within two generations. However, mortality rate may not be stable; it may increase as mature trees succumb after years of infection, or decrease, should resistant genotypes emerge. Despite this uncertainty, the observed loss of nearly 2 in 5 trees over less than 10 years represents a massive loss to the Ontario population.

The dire outlook for Butternut may be tempered by observations of infected trees that nevertheless remain vigorous through southern Ontario (Boysen and Fleguel pers. comm., reported in COSEWIC 2017), and MNRF Butternut Health Assessors have identified 384 trees since 2013 that show no or limited symptoms of Oc-j infection. It is possible some of these trees may have some heritable resistance to, or tolerance of Oc-j infection. However, further data are necessary to determine whether the apparent health of these individuals is due to superior genetics, or if they are just in the early stages of infection, and will eventually suffer the same fate as their neighbours. Research in the USA and Canada directed at identifying resistant Butternut has so far been unsuccessful (COSEWIC 2017).

Genetic data indicate that many potentially resistant Butternuts are in fact hybrids with exotic *Juglans* species, and so are of debatable conservation value. In those studies in which hybridity testing provides a degree of confidence that this confounding factor can be discounted (e.g. LaBonte et al. 2015, Moore 2014, Moore et al. 2015), the question remains whether the expression of resistance is such that it provides a means of recovering butternut. Naphthoquinone extracts from butternut bark has been shown to inhibit conidia germination in Oc-j (Moore et al. 2015) but concentrations in bark vary with tree age and provenance. If the expression of resistance in young resistant trees is not strong enough to promote survival, heritable resistance may not be an effective mechanism of recovery.

In addition to the existential threat posed by Oc-j, Butternut also suffers from habitat loss, wood harvesting, hybridization with exotic species, deer browse and climate change. Prior to the emergence of Oc-j, Butternut was a relatively common and widespread species in the province, and it seems unlikely that these lesser threats would have led to it becoming Endangered in absence of the pathogen.

Given the pervasive distribution of Oc-j in Ontario, all Butternuts in the province are considered to form a single location for Endangered Species Act assessment purposes.

2.6. Specialized life history or habitat use characteristics

Butternut is a short-lived (up to 100 years), fast growing tree, associated with neutral or calcareous soils over limestone, and grows in a variety of mesic forest habitats. It is often found on floodplains and streambanks, but is not a wetland species. Its habitat preferences are not particularly specialized, and as a shade-intolerant species it likely benefits from low-level disturbances that create canopy gaps.

Like Black Walnut, Butternut is allelopathic. It releases juglone into the soil. This chemical inhibits the growth of many plant species, including Butternut seedlings. Consequently, Butternut may be unable to occupy the same site for two consecutive generations (Hepting 1971).

3. Ontario status assessment

3.1. Application of endangered/threatened status in Ontario

3.1.1. Criterion A – Decline in total number of mature individuals

Endangered A2ae+3e+4ae

Endangered A2ae: Population reduction over the past three generations (135 years) estimated from direct observation and based on the effects of a pathogen, where the cause of the reduction has not ceased and may not be reversible.

MNRF surveys of 60 sites across the province documented a 38% decline between 2008 and 2015. This meets the threshold for Threatened (30%). However, the relevant time period is three generations, extending the window back to 1882. Given the documented presence of Oc-j in Ontario since the 1970s, and the heavy impact of this pathogen observed by the 1990s, it is almost certain that the total population loss due to Oc-j since 1882 far exceeds the 50% threshold for Endangered. In addition, COSEWIC (2017) estimated that agricultural and urban development since 1882 reduced forest cover in the Canadian range of Butternut by approximately 25%. This habitat loss would have further contributed to the population decline over the past three generations.

Endangered A3e: Population reduction projected over the next 100 years, due to the effects of a pathogen.

Assuming a constant rate of decline, based on the MNRF surveys used for A2 above, the Ontario Butternut population is projected to be extirpated within two generations (90 years). As mentioned under “Direct Threats” (section 2.5) above, this is a very crude projection. However, the threshold for Endangered is a 50% reduction over 100 years. This would occur over only 14 years if the observed rate of decline (5%/year) is maintained. Alternatively, a decline of 0.7%/year over the next 100 years would also meet this threshold. In absence of any sign that the virulence of Oc-j is declining, it is highly likely that one or both of these conditions will occur.

Endangered A4ae: Population reduction projected over 135 years including the past and future, due to the effects of a pathogen.

Given we are in the middle of an ongoing decline, the rationale justifying A2ae and A3e also support A4ae.

While the MNRF survey data provides the clearest quantitative evidence of decline, qualitative observations across the province over the past several decades corroborate the widespread and ongoing decline of Butternut in Ontario.

3.1.2. Criterion B – Small distribution range and decline or fluctuation

Does not apply, as EOO and AOO are above thresholds. AOO is close to the Threatened threshold, but is based on incomplete data. The actual AOO is probably much above the threshold.

3.1.3. Criterion C – Small and declining number of mature individuals

Does not apply, as population is above thresholds.

3.1.4. Criterion D – Very small or restricted total population

Does not apply, as population is above thresholds.

3.1.5. Criterion E – Quantitative analysis

Insufficient data is available to complete a quantitative analysis.

3.2. Application of Special Concern in Ontario

Does not apply, as Butternut qualifies for Endangered status.

3.3. Status category modifiers

3.3.1. Ontario's conservation responsibility

Ontario is responsible for less than 25% of the global population. While populations are declining in the US, it is not yet listed as an Endangered species there, and its global status is G4. No category modification is necessary.

3.3.2. Rescue effect

Given the universal presence of Oc-j, and declining populations of this species in adjacent jurisdictions (Quebec, USA), rescue effect does not offer a plausible likelihood of countering the decline in Ontario.

3.4. Other status categories

3.4.1. Data deficient

Does not apply.

3.4.2. Extinct or extirpated

Does not apply.

3.4.3. Not at risk

Does not apply.

4. Summary of Ontario status

Butternut (*Juglans cinerea*) is classified as Endangered in Ontario based on meeting criterion A2ae+3e+4ae.

5. Information sources

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Appendix 1: Technical summary for Ontario

Species: Butternut (*Juglans cinerea*)

Demographic information

Demographic attribute	Value
Generation time. Based on average age of breeding adult: age at first breeding = X year; average life span = Y years.	45 years, median of the reported peak reproductive age range of 30-60 years
Is there an observed, inferred, or projected continuing decline in number of mature individuals?	Yes based on direct observation.
Estimated percent of continuing decline in total number of mature individuals within 5 years or 2 generations.	50-100% decline
Observed, estimated, inferred, or suspected percent reduction or increase in total number of mature individuals over the last 10 years or 3 generations.	>50% reduction
Projected or suspected percent reduction or increase in total number of mature individuals over the next 10 years or 3 generations.	50-100% reduction
Observed, estimated, inferred, or suspected percent reduction or increase in total number of mature individuals over any 10 years, or 3 generations, over a time period including both the past and the future.	>50% reduction
Are the causes of the decline (a) clearly reversible, and (b) understood, and (c) ceased?	a. No b. Yes c. No
Are there extreme fluctuations in number of mature individuals?	No

Extent and occupancy information in Ontario

Extent and occupancy attributes	Value
Estimated extent of occurrence (EOO).	171,645 km ² . COSEWIC map transferred manually to a GIS, converted to a minimum convex polygon, and the resulting area calculated
Index of area of occupancy (IAO).	2112 km ² , based on Element Occurrence records in the NHIC database, and almost certainly an underestimate
Is the total population severely fragmented?	a. No

Extent and occupancy attributes	Value
i.e., is >50% of its total area of occupancy is in habitat patches that are: (a) smaller than would be required to support a viable population, and (b) separated from other habitat patches by a distance larger than the species can be expected to disperse?	b. No
Number of locations.	1
Number of NHIC Element Occurrences	409. Note that there are many more observations that have not been associated with an Element Occurrence
Is there an observed, inferred, or projected continuing decline in extent of occurrence?	Probably – EOO is likely to contract as the southwestern populations, which have been suffering longest, will be lost first.
Is there an observed, inferred, or projected continuing decline in index of area of occupancy?	Yes
Is there an observed, inferred, or projected continuing decline in number of populations?	Yes
Is there an observed, inferred, or projected continuing decline in number of locations?	No, there is a single location
Is there an observed, inferred, or projected continuing decline in [area, extent and/or quality] of habitat?	Yes, ongoing development in southern Ontario is gradually reducing habitat
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of mature individuals in each sub-population or total population (if known)

No reliable estimates of total population size in Ontario are available, but the current number is probably 50,000-100,000 or more mature individuals.

Quantitative analysis (population viability analysis conducted)

Probability of extinction in the wild is unknown.

Threats

Butternut Canker, *Ophiognomonia clavignecti-juglandacearum* is the overwhelming

threat to this species. COSEWIC (2017) prepared a threats calculator, which assigned an overall threat impact of Very High for this species in Canada. That assessment accurately reflects the situation in Ontario.

Rescue effect

Rescue effect attribute	Value
Status of outside population(s) most likely to provide immigrants to Ontario	Quebec, S3, Endangered New York S4 Michigan S3
Is immigration of individuals and/or propagules between Ontario and outside populations known or possible?	Possibly
Would immigrants be adapted to survive in Ontario?	Probably, aside from the presence of Oc-j
Is there sufficient suitable habitat for immigrants in Ontario?	Probably
Are conditions deteriorating in Ontario?	Yes
Is the species of conservation concern in bordering jurisdictions?	Yes, Endangered in Quebec
Is the Ontario population considered to be a sink?	No
Is rescue from outside populations likely?	No, the species is declining range-wide

Sensitive species

Butternut is not a data sensitive species.

Appendix 2: Adjoining jurisdiction status rank and decline

Information regarding rank and decline for Butternut (*Juglans cinerea*)

Jurisdiction	Subnational rank	Population trend	Sources
Ontario	S2?	-38% since 2008	COSEWIC (2017), MNRF
Quebec	S3	80-90% infection with extensive (unquantified) mortality	NatureServe (2017)
Manitoba	Exotic	Not applicable	NatureServe (2017)
Michigan	S3	90% loss	NatureServe(2017), Freedman (2016)
Minnesota	S3	Unknown, probably declining	NatureServe (2017)
Nunavut	Not Present	Not applicable	NatureServe (2017)
New York	S4	Declining (25% mortality reported in 2009)	NatureServe (2017), Bergdahl & Bergdahl(2009)
Ohio	S4	Unknown, probably declining	NatureServe (2017)
Pennsylvania	S4	Unknown, probably declining	NatureServe (2017)
Wisconsin	S3?	>80% decline by 2016	NatureServe(2017), Cummings-Carlson et al. (2004)

Acronyms

AOO: Area of Occupancy

COSEWIC: Committee on the Status of Endangered Wildlife in Canada

COSSARO: Committee on the Status of Species at Risk in Ontario

ESA: Endangered Species Act

EO: Element occurrence (as defined by NHIC)

EOO: extent of occurrence

GRANK: global conservation status assessments

IAO: index of area of occupancy

MNRF: Ministry of Natural Resources and Forestry

NHIC: Natural Heritage Information Centre

NNR: Unranked

NRANK: National conservation status assessment

Oc-j: *Ophiognomonia clavignenti-juglandacearum*

SARA: Species at Risk Act

SNR: unranked

SRANK: subnational conservation status assessment

S1: Critically imperiled

S3: Vulnerable

S5: Secure

IUCN: International Union for Conservation of Nature and Natural Resources

CDSEPO: Le Comité de détermination du statut des espèces en péril en Ontario