

Ontario Species at Risk Evaluation Report for

Goldenseal

Hydraste du Canada

(Hydrastis canadensis)

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

Assessed by COSSARO as Special Concern

November 2020

Hydraste du Canada (*Hydrastis canadensis*)

L'hydraste du Canada est une herbacée vivace longévive endémique de la région de forêts de feuillus de l'est des États-Unis et du Canada. En Ontario, la présence de l'hydraste du Canada est connue sous la forme de 25 sous-populations extantes de la portion sud-ouest de la province. L'espèce occupe habituellement des emplacements mésiques situés dans des forêts de feuillus, et préfère les sols légèrement acides sous des canopées semi-ouvertes ou fermées. L'hydraste du Canada se reproduit au moyen de ses graines ainsi que par voie végétative, bien que la majorité des populations ontariennes semblent se propager par reproduction clonale grâce au bourgeonnement du rhizome souterrain.

Les populations d'hydraste du Canada de l'Ontario ont diminué dans le passé en raison de la perte de son habitat, puisqu'il resterait selon les estimations à peine 5 % des forêts originales du sud-ouest de l'Ontario où poussait l'espèce. Les plus importantes menaces pesant actuellement sur les populations ontariennes de l'espèce sont l'exploitation forestière et la récolte du bois, la récolte et la cueillette, et les activités récréatives. Même si plusieurs populations semblaient avoir diminué lors des périodes de relevés de 1991, de 1998 et de 2015, d'autres ont accru leur taille, de sorte que les populations d'hydraste du Canada de l'Ontario sont actuellement considérées comme stables. Le statut de l'hydraste du Canada varie, allant de gravement en péril à apparemment hors de danger dans son aire de répartition plus vaste pertinente sur le plan biologique (Michigan, Minnesota, New York, Ohio, Pennsylvanie et Wisconsin). Dans certaines régions de l'ARVPPB, les populations sont considérées comme naturellement rares, mais l'espèce est inscrite sur la liste des espèces en péril dans plusieurs États et provinces en raison des préoccupations soulevées par une exploitation forestière sauvage et la réduction du nombre d'habitats convenables.

L'hydraste du Canada ne répond pas aux critères des espèces en voie de disparition ou menacées en Ontario, puisque les populations sont actuellement considérées comme stables et que le nombre d'emplacements, la taille de la population et la zone d'occurrence dépassent les seuils d'inscription sur la liste. L'espèce a toutefois une petite zone d'occupation (< 500 km²) et pourrait éventuellement devenir menacée si certains facteurs qui influent sur sa persistance ne sont pas inversés ou gérés avec une efficacité probante. Par conséquent, après l'évaluation, l'hydraste du Canada est classée dans la catégorie des espèces préoccupantes en Ontario. La modification du statut de cette espèce par rapport à l'évaluation de 2007 constitue une modification à la fois véritable et illusoire, puisque le nombre d'individus matures semble stable depuis les dernières décennies et qu'un certain nombre de nouvelles sous-populations ont été découvertes depuis la dernière évaluation.

Cette publication hautement spécialisée «COSSARO Candidate Species at Risk Evaluation for Goldenseal» 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 ministère l'Environnement, de la Protection de la nature et des Parcs au cossarosecretariat@ontario.ca

Remarque :

L'acronyme ARVPPB correspond à « aire de répartition plus vaste pertinente sur le plan biologique » qui se retrouve à l'alinéa 5 (4) b) de la *Loi de 2007 sur les espèces en voie de disparition*.

Executive summary

Goldenseal (*Hydrastis canadensis*) is an herbaceous, long-lived perennial native to the eastern Deciduous forest area of the United States and Canada. In Ontario, Goldenseal is known to occur in 25 extant subpopulations from the southwestern portion of the province. The species generally occupies mesic deciduous forest sites and prefers slightly acidic soils under closed to semi-open forest canopies. It reproduces both vegetatively and through seed, although the majority Ontario populations appear to spread by clonal reproduction via sprouting of the underground rhizome.

Ontario Goldenseal populations have declined historically due to habitat loss, as only an estimated 5% of the original southwestern Ontario forests that support the species remain. Currently, the most significant threats facing Ontario populations are logging and wood harvesting, harvesting/gathering, and recreational activities. While several populations appear to have decreased between 1991, 1998, and 2015 survey periods, other populations have increased in size such that Goldenseal populations in Ontario are currently considered to be stable. The status of Goldenseal varies from critically imperiled to apparently secure across the broader biologically relevant geographic range (Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin). Populations in some areas of the BBRGR are considered naturally rare, but the species is listed as at-risk in several jurisdictions due to concerns over unsustainable exploitation and declines in suitable habitat.

Goldenseal does not meet the criteria for listing as endangered or threatened in Ontario, as populations are currently considered stable and the number of locations, population size, and extent of occurrence exceed thresholds for listing. However, the species has a small area of occupancy (<500 km²) and could potentially become threatened if factors influencing the persistence of the species are not reversed or managed with demonstrated effectiveness. Thus, Goldenseal is classified as Special Concern in Ontario. The change in the status of this species from the 2007 assessment is considered to represent both a genuine and non-genuine change as the number of mature individuals appears to be stable in recent decades, but a number of new subpopulations have been discovered since the last assessment.

1. Eligibility for Ontario status assessment

1.1. Eligibility conditions

1.1.1. Taxonomic distinctness

Goldenseal (*Hydrastis canadensis*) is recognized as a distinct taxon with no known subspecies (COSEWIC 2019).

1.1.2. Designatable units

Goldenseal populations in Canada are considered to represent a single designatable unit (COSEWIC 2019)

1.1.3. Native status

Goldenseal is native to Ontario, with numerous historic records and observations (COSEWIC 2019).

1.1.4. Occurrence

Numerous populations of Goldenseal have been recently confirmed as extant in Ontario (COSEWIC 2019).

1.2. Eligibility results

Goldenseal (*Hydrastis canadensis*) is eligible for status assessment in Ontario.

2. Background information

2.1. Current designations

- GRANK: G3G4 (NatureServe 2012)
- IUCN: Vulnerable (2017)
- NRANK Canada: N2
- COSEWIC: SC (May 2019)
- SARA: Threatened (Schedule 1)
- ESA 2007: Threatened (2008)
- SRANK: S2 (ranked in 2015)

2.2. Distribution in Ontario

Goldenseal occurs in southwestern Ontario (Figure 1) where the species is known to occur in 25 extant subpopulations (COSEWIC 2019). The 25 extant subpopulations

defined by COSEWIC are considered to represent 25 locations. A total of 29 element occurrence records currently exist for Goldenseal in the NHIC database, with 6 considered historic/extirpated and 23 considered extant.

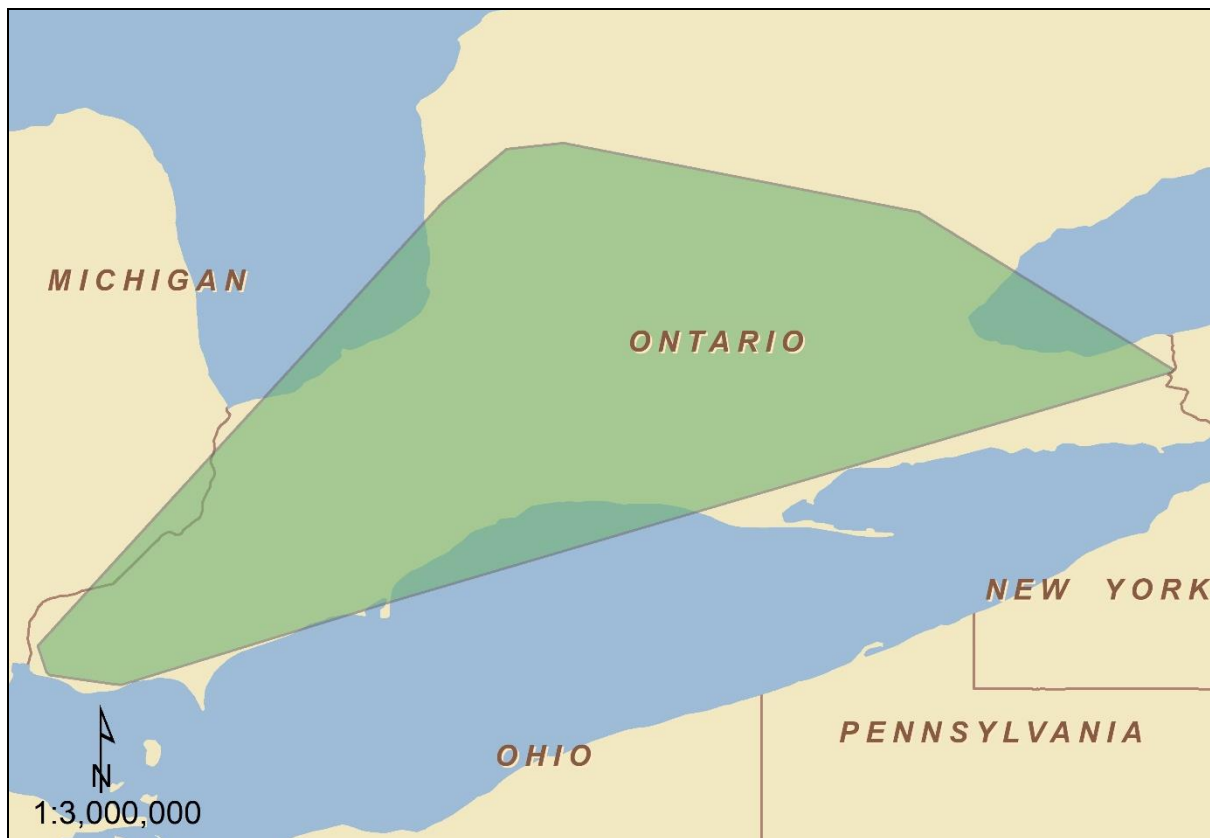


Figure 1. Minimum bounding polygon for element occurrence records for GoldenSeal in Ontario (EO data obtained from NHIC, November 2020). Note: Element occurrence records are not shown as Goldenseal is considered a data sensitive species.

2.3. Distribution, status and the broader biologically relevant geographic range outside Ontario

Goldenseal occurs in the eastern Deciduous forest area of the United States and Canada, ranging from Vermont and southern Ontario to Wisconsin and south to Arkansas and northern Georgia (Sinclair and Catling 2000a) (Figure 2). The species is reported as most abundant in the central portion of its range in Indiana, Kentucky, Ohio, and West Virginia.

Populations of Goldenseal from southern Ontario occupy North American Terrestrial Ecoregion 8.1, which extends into southern Minnesota, Wisconsin, and Michigan, northern Illinois, Indiana, Iowa, Ohio, New York, and Pennsylvania (Commission for Environmental Cooperation 2020).

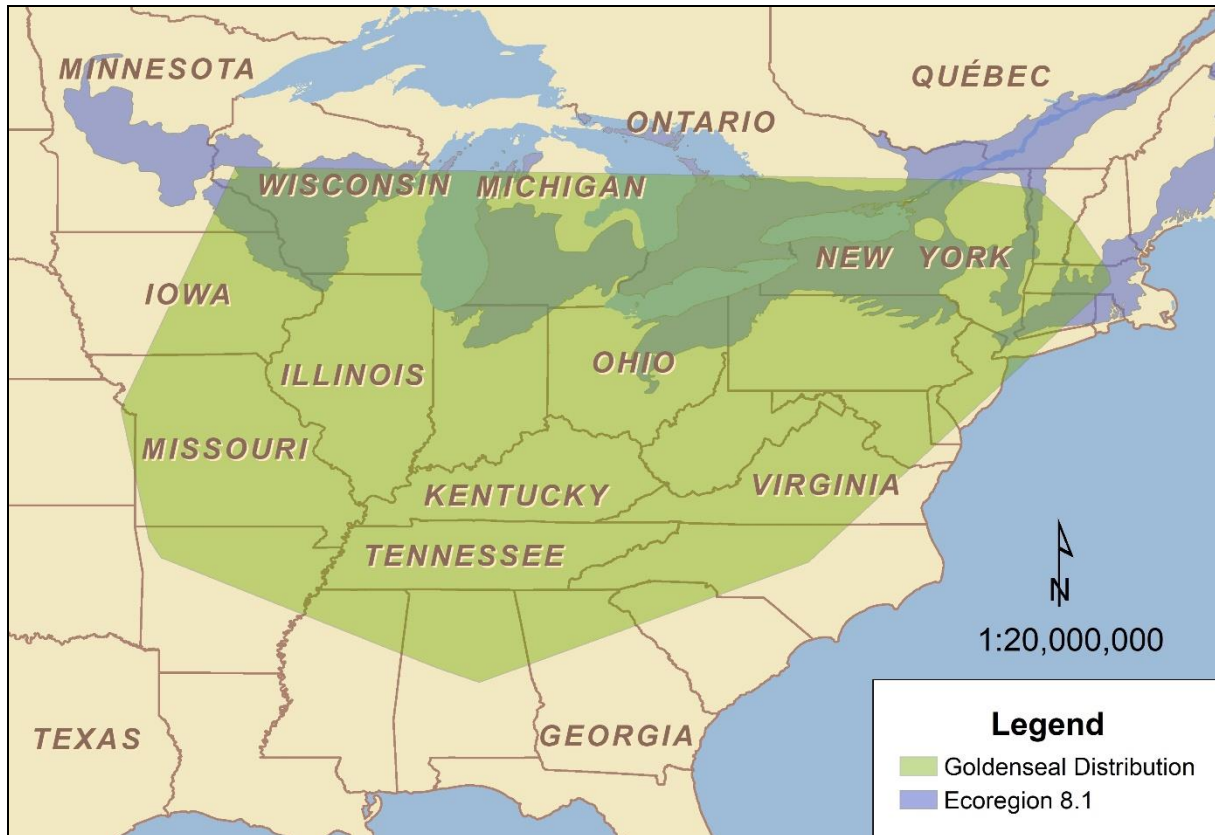


Figure 2. Global distribution of Goldenseal based on occurrence records obtained from the GBIF and iNaturalist databases using GeoCAT [website accessed November 17, 2020]. Geospatial data for Level II ecoregions obtained from the [CEC North American Environmental Atlas](#) [Accessed November 18, 2020]. **Note:** Occurrence points are not shown due to the data sensitive nature of this species.

Genetic studies of Goldenseal have thus far been limited to small portions of the geographic range, but generally indicate low levels of among-population variation at neutral genetic markers (Kelley 2009; Inoue et al. 2013). However, there is some indication of geographic structuring among populations, as populations located in close geographic proximity tend to cluster with one another (Inoue et al. 2013). To date, no studies have been conducted that explore adaptive genetic differentiation between populations from Ontario and other portions of the geographic range. Thus, it is currently unclear the extent to which populations from adjacent jurisdictions would suffer maladaptation if transferred to Ontario. However, populations from Michigan, Wisconsin, Minnesota, Ohio, Pennsylvania, and New York occupy similar environmental and ecological conditions as populations from southern Ontario (Ecoregion 8.1), suggesting that populations from these areas should be reasonably well adapted for survival in Ontario.

COSEWIC (2019) considered the potential for rescue effect to be low for Goldenseal because it is unlikely that seed dispersal would occur between Ontario and adjacent jurisdictions, and because seeds would be unlikely to reach suitable germination sites. However, it is important to note that seed dispersal distances for Goldenseal have not been investigated, so it is possible that rare long-distance transfer events could play a

role in the establishment of new Ontario populations.

For the purpose of this report, the broader biologically relevant geographic range for Goldenseal is defined as including populations from Ecoregion 8.1 in adjacent US states including: Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin (Table 1). The status of Goldenseal in these jurisdictions varies from S1 (critically imperiled) to S4 (apparently secure). In Minnesota, Goldenseal is considered naturally rare but the species is listed as endangered because of declining population sizes due to unsustainable exploitation and (to a lesser extent) declines in suitable habitat associated with residential/industrial development and land conversion for agriculture (Minnesota DNR 2020). In New York, Goldenseal is also considered historically rare, and most populations are believed to be stable despite the species threatened status (New York Natural Heritage Program 2020). It is unknown whether Goldenseal populations are stable, increasing, or declining in other jurisdictions due to a lack of population monitoring data. A conservation status of imperiled or vulnerable does not necessarily indicate that Goldenseal populations are in recent or current decline, as many jurisdictions have statuses of less-than-secure because Goldenseal has experienced historical habitat loss and/or because the species is naturally rare (Young 2019; Minnesota DNR 2020; NatureServe 2020; New York Natural Heritage Program 2020)

Table 1. Condition of the Species in Adjacent Jurisdictions and Broader Biologically Relevant Geographic Range

Adjacent Jurisdictions	Biologically Relevant to Ontario (n/a, yes, no)	Condition	Notes & Sources
Manitoba	N/A		
Nunavut	N/A		
Quebec	N/A		
Michigan	Yes	S2, listed as threatened in Michigan, unknown whether populations are currently stable, increasing, or declining	(Penskar et al. 2001; NatureServe 2020)
Minnesota	Yes	S1, listed as endangered in Minnesota, some indication that populations are declining due to unsustainable exploitation	(Minnesota DNR 2020; NatureServe 2020)
New York	Yes	S2, listed as threatened in New York, populations currently mostly stable	(Young 2019; New York Natural Heritage Program 2020)
Ohio	Yes	S4, populations are in significant decline based on recent surveys	(Mulligan and Gorchov 2004; NatureServe 2020)

Adjacent Jurisdictions	Biologically Relevant to Ontario (n/a, yes, no)	Condition	Notes & Sources
Pennsylvania	Yes	S4, unknown whether populations are currently stable, increasing, or declining	(Pennsylvania Natural Heritage Program 2019; NatureServe 2020)
Wisconsin	Yes	S2S3, listed as special concern in Wisconsin, unknown whether populations are currently stable, increasing, or declining	(NatureServe 2020; Wisconsin DNR 2020)

2.4. Ontario conservation responsibility

COSEWIC (2019) estimates that 1.6% of the global range of Goldenseal occurs in Ontario. The percentage of the global population that occurs in Ontario is unknown.

2.5. Direct threats

Goldenseal populations have declined historically due to habitat loss (COSEWIC 2019). Only an estimated 5% of the original southwestern Ontario forests that support Goldenseal remain (Sinclair and Catling 2000a).

Currently, the most significant threats facing Goldenseal populations in Ontario are logging and wood harvesting (medium to low impact), harvesting/gathering (low impact), recreational activities (low impact), water management (unknown impact), and invasive species (unknown impact) (COSEWIC 2019). Clearcutting is believed to be the most significant threat, although populations may be less impacted by selective logging. Although Sinclair and Catling (2000b) found a positive effect of minor disturbance (recreational paths and edges), Johnson (2017) reported significantly greater mortality of Goldenseal in canopy gaps compared to closed-canopy forest.

The leaves, stems, and roots of Goldenseal are valued in both domestic and international markets for their medicinal properties (Burkhart and Jacobsen 2006). While overexploitation appears to be a significant threat to Goldenseal populations in a number of US states (NatureServe 2020), there is currently limited evidence that Ontario populations are subject to harvesting or over-exploitation (COSEWIC 2019). However, harvesting and gathering are considered as conceivable threats to at least three Ontario subpopulations that are located close to recreational trails on public lands.

All-terrain vehicle (ATV) trails may pose a threat to three Ontario subpopulations (COSEWIC 2019). Although, no trails were observed running through patches of plants during 2015 surveys, one patch is believed to have been extirpated due to widening of

an existing ATV trail.

2.6. Specialized life history or habitat use characteristics

In southwest Ontario, Goldenseal occurs on mesic deciduous forest sites generally located on or near floodplains (Sinclair and Catling 2000a, b). The species prefers slightly acidic soils and may be found under closed to semi-open forest canopies. Goldenseal has been shown to be positively associated with paths and edges, suggesting that this species may benefit from periodic minor disturbances.

Goldenseal is considered a long-lived perennial with an estimated generation time of 40 years (COSEWIC 2019). The species reproduces both vegetatively and through seed (Sinclair and Catling 2000a). However, the majority Ontario populations do not appear to spread by seeds, with most stems originating from clonal reproduction via sprouting of the underground rhizome. Flowering and fruiting generally begin at four to five years (Burkhart and Jacobsen 2006). The species has a mixed breeding system and seeds produced from selfing and outcrossing appear to have equal viability (Sanders 2004). Pollinators include bees and flies, and fruit is dispersed primarily by birds (Sinclair et al. 2000).

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

Not applicable. Surveys suggest that populations have remained stable between 1991, 1998, and 2015 survey periods (Sinclair and Catling 2000a; COSEWIC 2019)

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

Not applicable. The extent of occurrence (28 821 km²) exceeds the threshold of 20,000 km². The area of occupancy (144 km²) is less than the threshold of 500 km² for endangered but there are >5 locations, there is no overall decline is inferred/observed/projected, and no evidence of extreme fluctuations.

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

Not applicable. The number of mature individuals exceeds the threshold of 10,000.

3.1.4. Criterion D – Very small or restricted total population

Not applicable. The number of mature individuals exceeds the threshold of 10,000 and the AOO is > 20km² and the number of locations is > 5.

3.1.5. Criterion E – Quantitative analysis

Not applicable. No quantitative analysis has been completed.

3.2. Application of Special Concern in Ontario

Applicable. The species has a small area of occupancy (<500 km²) and could potentially become threatened if factors influencing the persistence of the species (e.g. logging and wood harvesting, gathering terrestrial plants, recreational activities, dams and water management, and invasive non-native species) are not reversed or managed with demonstrated effectiveness.

3.3. Status category modifiers

3.3.1. Ontario's conservation responsibility

Does not apply. Although the species is globally at risk (G3G4, IUCN Rank = vulnerable), Ontario contains only 1.6% of the global range.

3.3.2. Status modification based on rescue effect or level of risk in broader biologically relevant geographic range

Does not apply. Populations in most adjacent jurisdictions of the BBGRR have status listings of S1-S3 (NatureServe 2020). Populations in Ohio are listed as apparently secure (S4), but recent surveys indicate significant declines (Mulligan and Gorchoff 2004; NatureServe 2020). Populations in Pennsylvania are listed as apparently secure (S4).

3.4. Other status categories

3.4.1. Data deficient

Not applicable.

3.4.2. Extinct or extirpated

Not applicable.

3.4.3. Not at risk

Not applicable.

4. Summary of Ontario status

Goldenseal (*Hydrastis canadensis*) is classified as Special Concern in Ontario. The status of this species is consistent with the definition of status under the Endangered Species Act, 2007.

The change in the status of this species from the 2007 assessment is considered to represent both a genuine and non-genuine change as the number of mature individuals appears to be stable in recent decades, but a number of new subpopulations have been discovered since the last assessment.

5. Information sources

- Burkhart EP, Jacobsen MG (2006) Nontimber Forest Products (NTFPs) from Pennsylvania: Goldenseal (*Hydrastis canadensis* L.).
- Commission for Environmental Cooperation (2020) Terrestrial Ecoregions: Level II. November 18, 2020.
- COSEWIC (2019) COSEWIC assessment and status report on the Goldenseal *Hydrastis canadensis* in Canada. Ottawa.
- Inoue M, Kelley KJ, Frary A, Craker LE (2013) A measure of genetic diversity of goldenseal (*Hydrastis canadensis* L.) by RAPD analysis. Genet Resour Crop Evol 60:1201–1207. doi: 10.1007/s10722-013-9962-7.
- Johnson BB (2017) Impacts of Forest Management on Medicinal Herbs in the Missouri Ozarks. MSc Thesis, University of Missouri-Columbia.
- Kelley KJ (2009) Genetic variability in *Hydrastis Canadensis* L. using RAPD analysis. 1–34. MSc Thesis, University of Massachusetts.
- Minnesota DNR (2020) *Hydrastis canadensis*. In: Minnesota Rare Species Guid. <https://www.dnr.state.mn.us/rsg/profile.html?action=elementDetail&selectedElement=PDRAN0F010>. Accessed 18 Nov 2020.
- Mulligan MR, Gorchov DL (2004) Population Loss of Goldenseal, *Hydrastis canadensis* L. (Ranunculaceae), in Ohio. J Torrey Bot Soc 131:305. doi: 10.2307/4126936.
- NatureServe (2020) *Hydrastis Canadensis*, Goldenseal. In: NatureServe Explor. [https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.154701/Hydrastis_canadensis#:~:text=NatureServe Status&text=Goldenseal%2C Hydrastis canadensis%2C an herbaceous,\(Sinclair and Catling 2000a\)](https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.154701/Hydrastis_canadensis#:~:text=NatureServe Status&text=Goldenseal%2C Hydrastis canadensis%2C an herbaceous,(Sinclair and Catling 2000a)). Accessed 18 Nov 2020.
- New York Natural Heritage Program (2020) Goldenseal (*Hydrastis canadensis* L.). <https://guides.nynhp.org/goldenseal/>. Accessed 18 Nov 2020.
- Pennsylvania Natural Heritage Program (2019) Goldenseal (*Hydrastis canadensis*). In: Plant Factsheets. <https://www.naturalheritage.state.pa.us/factsheets/14422.pdf>. Accessed 18 Nov 2020.
- Penskar MR, Choberka EG, Higman PJ (2001) Special Plant Abstract for *Hydrastis canadensis* (goldenseal). In: Michigan Nat. Featur. Invent. https://mnfi.anr.msu.edu/abstracts/botany/Hydrastis_canadensis.pdf. Accessed 18 Nov 2020.
- Sanders S (2004) Does breeding system contribute to rarity of Goldenseal (*Hydrastis canadensis*)? Am Midl Nat 152:37–42.
- Sinclair A, Catling PM (2000a) Status of Goldenseal, *Hydrastis canadensis* (Ranunculaceae) in Canada. Can F Nat 114:111–120.

Sinclair A, Catling PM (2000b) Ontario Goldenseal, *Hydrastis canadensis*, populations in relation to habitat size, paths, and woodland edges. Can F Nat 114:652–655.

Sinclair A, Catling PM, Dumouchel L (2000) Notes on the pollination and dispersal of Goldenseal, *Hydrastis canadensis* L., in southwestern Ontario. Can F Nat 114:499–501.

Wisconsin DNR (2020) Golden-seal (*Hydrastis canadensis*).

<https://dnr.wi.gov/topic/EndangeredResources/Plants.asp?mode=detail&SpecCode=PDRAN0F010>. Accessed 18 Nov 2020.

Young SJ (2019) New York Rare Plant Status Lists March 2019.

https://www.dec.ny.gov/docs/wildlife_pdf/2019rareplantlists.pdf. Accessed 18 Nov 2020.

Appendix 1: Technical summary for Ontario

Species: Goldenseal (*Hydrastis canadensis*)

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.	40 years
Is there an observed, inferred, or projected continuing decline in number of mature individuals?	No
Estimated percent of continuing decline in total number of mature individuals within 5 years or 2 generations.	Not applicable
Observed, estimated, inferred, or suspected percent reduction or increase in total number of mature individuals over the last 10 years or 3 generations.	Unknown, but substantial reductions are inferred based on historical forest loss.
Projected or suspected percent reduction or increase in total number of mature individuals over the next 10 years or 3 generations.	Unknown, but counts at a subset of population suggest recent increases of 7.4%.
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.	Unknown.
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). <i>If value in COSEWIC status report is not applicable, then use geocat.kew.org. State source of estimate.</i>	28 821 km ²
Index of area of occupancy (IAO). <i>If value in COSEWIC status report is not applicable, then use geocat.kew.org. State source of estimate.</i>	144 km ²
Is the total population severely fragmented? i.e., is >50% of its total area of occupancy in habitat patches that are: (a) smaller than would be required to support a viable	a. No b. No

Extent and occupancy attributes	Value
population, and (b) separated from other habitat patches by a distance larger than the species can be expected to disperse?	
Number of locations. <i>See Definitions and Abbreviations on COSEWIC and IUCN websites for more information on the term "location". Use plausible range to reflect uncertainty if appropriate.</i>	25
Number of NHIC Element Occurrences <i>Request data from MNRF.</i>	29 (23 extant, 6 extirpated).
Is there an observed, inferred, or projected continuing decline in extent of occurrence?	Yes
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 sub-populations or EOs?	No
Is there an observed, inferred, or projected continuing decline in number of locations?	No
Is there an observed, inferred, or projected continuing decline in [area, extent and/or quality] of habitat?	Yes
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)

Sub-population (or total population)	Number of mature individuals (based on 2015 survey)
SP1 Essex	6410
SP2 Lambton	56
SP3 Essex	757
SP4 Lambton	772
SP5 Lambton	Unknown
SP6 Lambton	Unknown
SP7 Lambton	47
SP8 Lambton	2580
SP9 Huron	4820
SP10 Chatham-Kent	62
SP11 Essex	Unknown
SP12 Chatham-Kent	998
SP13 Middlesex	272

SP14 Middlesex	57
SP15 Brant	24124
SP16 Wellington	990
SP17 Essex	100
SP18 Lambton	Unknown
SP19 Halton	Unknown
SP20 Halton	Unknown
SP21 Halton	Unknown
SP22 Halton	Unknown
SP23 Halton	Unknown
SP24 Niagara	Unknown
SP25 Chatham-Kent	Unknown
Total	42,045

Quantitative analysis (population viability analysis conducted)

Probability of extinction in the wild is unknown.

Threats

A threats calculator was prepared for Goldenseal by COSEWIC (2019):

- i. Logging & wood harvesting (Medium-Low impact)
- ii. Gathering terrestrial plants (Low impact)
- iii. Recreational activities (Low impact)
- iv. Dams & water management/use (Unknown impact)
- v. Invasive non-native species (Unknown impact)

Rescue effect

Rescue effect attribute	Value
Does the broader biologically relevant geographic range for this species extend beyond Ontario?	Yes
Status of outside population(s) most likely to provide immigrants to Ontario	Michigan (S2), New York (S2), Ohio (S4S5), Pennsylvania (S4)
Is immigration of individuals and/or propagules between Ontario and outside populations known or possible?	Immigration is not known but could be possible.
Would immigrants be adapted to survive in Ontario?	Probably
Is there sufficient suitable habitat for immigrants in Ontario?	Yes
Are conditions deteriorating in Ontario?	Yes, minimally
Is the species of conservation concern in bordering jurisdictions?	Yes

Rescue effect attribute	Value
Does the broader biologically relevant geographic range for this species extend beyond Ontario?	Yes
Is the Ontario population considered to be a sink?	No
Is rescue from outside populations likely?	Unlikely

Sensitive species

Goldenseal is considered a data sensitive species.

Acronyms

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

IUCN: International Union for Conservation of Nature and Natural Resources

MNRF: Ministry of Natural Resources and Forestry

NHIC: Natural Heritage Information Centre

NNR: Unranked

NRANK: National conservation status assessment

SARA: Species at Risk Act

SNR: unranked

SRANK: subnational conservation status assessment

S1: Critically Imperiled

S2: Imperiled

S3: Vulnerable

S4: Apparently Secure

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