5-YEAR REVIEW
Houghton's Goldenrod (*Solidago houghtonii* A. Gray, Asteraceae)

GENERAL INFORMATION:

Species: Houghton's goldenrod (*Solidago houghtonii*) (HOGO)
Date listed: July 18, 1988
FR citation(s): 53 FR 27134 – 27147
Classification: Threatened species

BACKGROUND:

Most recent status review: U.S. Fish and Wildlife Service. 2011. Houghton's Goldenrod (*Solidago houghtonii* A. Gray, Asteraceae) 5-Year Review: Summary and Evaluation. East Lansing Field Office, East Lansing, MI. 23 pp. Finalized –September 12, 2011.

FR Notice citation announcing this status review: 77 FR 38762 38764 5-Year Status Reviews of Seven Listed Species, June 29, 2012.

ASSESSMENT:

This 5-year review was conducted by the U.S. Fish and Wildlife Service's (USFWS) Michigan Ecological Services Field Office with assistance from the Region 3 Regional Office. Data for this review were solicited from interested parties through a Federal Register notice announcing this review on June 29, 2012. We also contacted the Michigan Natural Features Inventory, the Committee on the Status of Endangered Wildlife in Canada, and the New York Natural Heritage Program to request any data or information we should consider in our review. Additionally, we conducted a literature search and a review of information in our files. The New York Field Office provided new information (e.g., unpublished reports) and input on a draft of this 5-year review.

Information acquired since the last status review:

Summary of new information for U.S. populations

Since the last 5-year review, status assessments and research projects were conducted on a portion of the U.S. populations.

1) Count surveys were conducted for approximately 60% of the HOGO populations in Michigan (2015 and 2016) and the single population in New York (2013-2016), providing updated HOGO element occurrence (EO) rankings (Leopold and Weber 2019; Bassett and Higman 2019).
    a. Count surveys at 46 of the Michigan EOs and the New York EO (Bergen Swamp) were conducted. At each site, flowering stems were counted (or estimated if >1000 stems), estimates of percent flowering were made, and threats to each population were evaluated. The state Natural Heritage Programs updated their natural heritage databases using the NatureServe EO ranking system.
    b. There are 75 total EOs in Michigan. Of the 46 EOs surveyed from 2015-2016, two were determined to be close enough geographically to be merged into one EO (Bassett and Higman 2019). Ranks were based on Nature Serve's Element Occurrence ranking system (A – excellent estimated viability; B – good estimated viability; C – fair estimated viability; D – Poor estimated viability; see Nature Serve 2002 for additional information on the EO ranking system). Rank changes were made for roughly half of

the 45 EOs assessed, with 13% up-ranked, 38% down-ranked, and 49% maintaining their current rank. One historical EO was up-ranked to C based on current data, and 4 EOs were down-ranked to "Failed to find", suggesting extirpation from those locations. Prior to this assessment, the majority (69%) of EOs were ranked B, BC, or C, and despite the rank changes, after the assessment 67% were still ranked as B, BC, or C. Approximately 40% of the Michigan EOs were not surveyed due to access issues (private property, unable to get permission; high water levels; sites difficult to access such as islands; difficult to find due to poor directions or site information in the database) (Bassett and Higman 2019).

The threats to HOGO were moderate, overall (Bassett and Higman 2019). High lake levels are a potential threat to some population that occur along Great Lakes shorelines. Residential development continues to be a threat, especially along the shores of Lake Huron in Cheboygan and Presque Isle Counties, Michigan. Invasive species, including *Phragmites australis* (common reed) and *Typha spp.* (cattails) threaten some populations.

In New York, count surveys were conducted at Bergen Swamp from 2013 through 2016. The number of flowering stems ranged from 375 to 3400, and percent flowering ranged from 3.1% to 23.8% (Leopold and Weber 2019). Although flowering rates fluctuate dramatically between years, the total number of ramets (rosettes and flowering stems) remained stable (Leopold 2016). Deer browse is an ongoing threat at the Bergen Swamp site (Leopold 2016).

2) Research was conducted that examined niche requirements associated with HOGO abundance.
    a. Plots were established at 16 sites across the U.S. range of HOGO (15 in northern Michigan and 1 in New York) to test how HOGO abundance (density) varied as a function of vegetation community, nutrient availability, substrate condition, and flooding frequency and duration (Leopold and Weber 2019). Low correlations between HOGO abundance and the measured predictors were found, suggesting that other factors are driving HOGO abundance (Leopold and Weber 2019). Modeling results suggest that HOGO abundance will increase with increased microtopographical variability and marl and other smooth substrates (Leopold and Weber 2019).

3) Greenhouse and field experiments evaluated germination success with varying substrates and moisture treatments (Leopold and Weber 2019).

    a. Seeds collected from 27 HOGO populations were divided into sample groups for greenhouse (*ex situ*) experiments and field (*in situ*) experiments at 16 HOGO population locations to evaluate demographic transition success with varying substrates and moisture trials (volume and frequency) (Leopold and Weber 2019). In the greenhouse experiments, smoother substrates (i.e., marl, sand, and control) had significantly higher germination, with notable variability across populations within treatments (Leopold and Weber 2019). For the greenhouse moisture germination experiments, there was a significant interaction between water volume and water frequency (low volume with infrequent frequency having significantly lower germination), with notable variability across populations within treatments (Leopold and Weber 2019). For the field experiments, there was a similar trend seen for substrates as in the greenhouse trials, with smoother substrates having higher germination rates, but with much less germination success overall (Leopold and Weber 2019). Substrate texture relates to moisture contact for germination, with smooth textures providing more uniform contact

with a saturated surface (Leopold and Weber 2019). In the field, xeric habitats (e.g., dunes) likely limit germination success; in the field part of this study, moisture was difficult to track (Leopold and Weber 2019).

4) Using data from the 45 HOGO EOs sampled in 2015 and 2016, EOs were quantitatively ranked based on demographic and niche data (Leopold and Weber 2019).

    a. Using the Species Status Assessment (SSA) framework, Leopold and Weber (2019) evaluated resource needs for each stage of HOGO's life cycle; developed an influence diagram for HOGO that models sources, stressors, resource needs and their impact on demographic stages; and developed quantitative ranking criteria for resiliency using demographic data (abundance, trend, flowering percentage) and habitat factors (light condition, nutrient condition, hydrological condition, and substrate condition) which were used to rank all 45 EOs (Appendices A and B). EOs were given a rank of high, medium, or low for resiliency and an uncertainty ranking of low, medium or high. 6 EOs were ranked as having high resiliency, 22 had medium resiliency, and 17 have low resiliency, based on 2015-2016 data.

5) Finally, new genetics data since the last 5-year review determined three previously documented EOs located in Crawford and Kalkaska counties, Michigan, are not *S. houghtonii*, but instead belong to a new species of goldenrod, *Solidago vossii* (Laureto and Pringle 2010).

Summary of new information for populations in Canada

In Canada, a Recovery Strategy for Houghton's goldenrod was published for the Ontario populations (Jones 2015). There are 33 populations in Ontario occurring within three general geographic groupings – Cockburn Island, the eastern end of Manitoulin Island, and a single population on the Bruce Peninsula. Population status and trends of HOGO in Canada are not known due to limited data (i.e., few sites have multiple years of occurrence data or lacked abundance data; some sites have not been visited in decades; additional sites with potential habitat have never been surveyed) (Jones 2015).

Discussion

The Houghton's Goldenrod Recovery Plan (USFWS 1997) contains one delisting criterion: *Solidago houghtonii* will be considered for delisting when 30 distinct, self-sustaining occurrences are protected. Protection, as defined in the recovery plan, consists of all actions necessary to conserve known occurrences, maintain ecosystem processes for the perpetuation of essential habitat, and enable each occurrence to be naturally self-sustaining.

In our 2011 5-year review, we determined that the recovery plan and its criterion were adequately up to date. We intend to complete an SSA, however, to provide a more comprehensive analysis of the species' status and inform the adequacy of the existing recovery criterion. The recovery criterion focuses on "protection", but population resiliency will give a better measure of whether a population is self-sustaining. State and federal landownership was used previously to evaluate "protection" of HOGO populations; however, ownership is not necessarily a good measure of protection. Many HOGO populations occur on partially or fully owned State, Federal, or land conservancy properties, but most of these locations do not have restrictions on recreational traffic (Leopold and Weber 2019).

Recent status assessment efforts for a portion of the U.S. populations (45 out of 76 EOs) show many (28 out of 45) stable or increasing HOGO populations, with several locations having well over 10,000 flowering individuals (Leopold and Weber 2019). However, high lake levels, shoreline development, invasive plant species, recreation, and deer browse represent stressors to HOGO that need further evaluation (Leopold and Weber 2019).

In summary, recent efforts (Leopold and Weber 2019) provide an initial assessment of current condition (resiliency) for approximately 60% of the HOGO EOs (i.e., 45 out of 76 EOs), but additional work is needed to evaluate resiliency for the remaining EOs and consider redundancy and representation. This initial resiliency assessment reflects consideration of near-term future conditions for the species (e.g., adequacy of protection for future acute flood events). However, forecasting the species' response to additional probable future scenarios of environmental conditions and conservation efforts, within the SSA framework, will help us better understand HOGO's status (i.e., whether it meets the definition of a threatened or endangered species).

Conclusion:

After reviewing the best available scientific information, we conclude that a change in status is not indicated at this time based on the available data. However, prior to the next 5-year review, we intend to conduct a full status assessment within the SSA framework in order to provide a robust analysis of HOGO's status.

RECOMMENDATIONS FOR FUTURE ACTIONS:

- Conduct a Species Status Assessment to inform the next 5-year review
- Develop written agreements and management plans for protection on public lands (*Recovery plan task: 1.12*)
- Plan and implement regular surveys and monitoring of occurrences, including better documentation of habitat conditions and populations trends. (*Recovery plan tasks: 2.22, 4)*
    - In particular, surveys are needed for sites not visited in 2015-2016 in Michigan. Information on the Ontario populations would also be helpful in evaluating the species' status.
- Reassess ranks of known occurrences. (*Recovery plan task: 2.24)*
- Promote landowner involvement in a registry program. (*Recovery plan task: 14.143)*
- Develop strategies to protect occurrences and sites from ORV damage. (*Recovery plan task: 13.131)*

Lead Field Supervisor, Fish and Wildlife Service

Approve SCOTT HICKS Digitally signed by SCOTT HICKS Date: 2020.08.25 10:48:10 -04'00' Date _____

The lead Field Office must ensure coordination with other offices and regions within the range of the species to ensure that any new information they have has been adequately considered prior to the review's completion. The lead field office should document this coordination in the agency record.

REFERENCES

Bassett, T. and Higman, P. 2019. Updated rank assessment for *Solidago houghtonii* (Houghton's goldenrod): Individual element occurrences and subnational rank. MNFI Report No. 2019-06. Submitted to The Research Foundation for the State University of New York. 14pp.

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Leopold, D.J. and Weber, J. 2019. Range wide status assessment of Houghton's goldenrod (*Oligeneuron [=Solidago] houghtonii*) with a special emphasis on niche limits, demographic transitions, and population stability. Final Report to U.S. Fish and Wildlife Service. 27pp.

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U. S. Fish and Wildlife Service (USFWS). 1997. Recovery Plan Houghton's Goldenrod (*Solidago houghtonii* A. Gray). Ft. Snelling, Minnesota. vii + 58 pp.

U.S. Fish and Wildlife Service. 2011. Houghton's Goldenrod (*Solidago houghtonii* A. Gray, Asteraceae) 5-Year Review: Summary and Evaluation. East Lansing Field Office, East Lansing, MI. 23 pp.

Appendix A. Criteria for rankings of demographic data and habitat factors used in assessing resilience of HOGO populations. (Taken from Leopold and Weber 2019). *For additional information, see Leopold and Weber 2019.*

	Abundance	Trend	Flowering %	Light Condition	Nutrient Condition	Hydrological Condition	Substrate Condition
HIGH	The most recent survey results in greater than 5000 flowering stems.	Increasing	Greater than 33% of the population's ramets are flowering.	The population has less than 30% woody vegetation cover ***and*** less than 60% total vegetation cover.	The substrate contains **Ca** levels within the provided high-quality range, ***and*** at least two of **N, P, or K** within the provided high- **or** medium-quality ranges.	The population has near-constant substrate saturation during germination season (May-June) ***and*** protection from acute flooding events ***and*** is in close proximity to a Great Lake or has groundwater influence.	The population has greater than 50% smooth substrate cover (e.g., marl, sand, or soil), ***and*** less than 50% sand cover ***or*** east-facing coastline aspect.
MEDIUM	The most recent survey results in 500-5000 flowering stems.	Stable	Between 10-33% of the population's ramets are flowering.	The population has less than 30% woody vegetation cover ***but*** greater than 60% total vegetation cover.	The substrate contains **Ca** levels within the provided med-quality range, ***and*** at least two of **N, P, or K** within the provided high- **or** medium-quality ranges.	**Two of the following:** The population has near-constant substrate saturation during May-June ***and/or*** protection from acute flooding events, ***and/or*** is in close proximity to a Great Lake or has groundwater influence.	The population has greater than 50% smooth substrate cover, ***but*** greater than 50% sand cover ***and*** non-east-facing coastline aspect.
LOW	The most recent survey results in less than 500 flowering stems.	Decreasing	Less than 10% of the population's ramets are flowering.	The population has greater than 30% woody vegetation cover ***and*** greater than 60% total vegetation cover.	The substrate contains **Ca** levels within the provided low-quality range, ***and*** at least two of **N, P, or K** within the provided medium **or** low-quality ranges.	**At least two of:** The population is lacking near-constant substrate saturation during May-June, ***and/or*** is exposed to acute flooding events, ***and/or*** seems to be removed from groundwater or lake influence.	The population has greater than 50% rough substrate cover (e.g., litter, moss, or rocks).

Appendix B. Summary of Current Condition of HOGO for populations surveyed by J. Weber in 2015 and 2016. (Taken from Leopold and Weber 2019)

County	Population	EO#	EO Rank	Abundance Rank	Trend Rank	Flowering Rank	Light Rank	Nutrient Rank	Hydrological Rank	Substrate Rank	**RANK**	Uncertainty
Genesee, NY	Bergen Swamp	1	AB	Medium	Medium	Medium	High	High	High	Low	Medium	Low
Emmet	Wilderness SP	2	B	Medium	High	High	High	High	High	High	High	Low
Cheboygan	Grass Bay	3	A	High	Medium	High	High	High	High	High	High	Low
Presque Isle	Hammond Bay	5	B	Low	Medium	High					Medium	Medium
Presque Isle	Hammond Bay SH	6	B	Medium	Low	Medium					Low	Medium
Mackinac	Limekiln Point	7	CD	Low	Low	High					Low	Medium
Mackinac	Hog Island SF CG	10	B	High	Medium	Medium	High	High	Medium	Medium	High	Low
Mackinac	Castle Rock Road	12	BC	Medium	Medium	Medium					Medium	Medium
Chippewa	De Tour SP	15	B	Medium	Medium	Medium					Medium	Medium
Mackinac	Pointe Aux Chenes	17	AB	Low	Low	High					Low	Medium
Mackinac	Sand Bay	19	C	Low	High	Medium					Medium	Medium
Emmet	Big Stone Bay	20	C	Low	Low	High	High	none	Low	Low	Low	Low
Emmet	Sturgeon Bay, Lakeview	21	AB	Medium	Low	Medium	High	High	High	High	High	Low
Cheboygan	Cheboygan SP	22	B	Medium	Medium	Medium	High	High	High	Low	Medium	Low
Cheboygan	Pries Landing	24	C	Low	Low	Low					Low	High
Schoolcraft	Manistique Shores E	28	D	Low	Low	Low					Low	Medium
Mackinac	Pointe LaBarbe	30	B	Medium	Low	Medium					Low	Medium
Mackinac	Albany/Stevenson/Dudley Bay	31	BC	Medium	High	High	High	High	Medium	Low	High	Low
Chippewa	Albany Creek Mouth	32	B	Low	Low	High					Medium	Medium
Chippewa	Seymour Bay	34	BC	Medium	Low	Medium					Low	Medium
Chippewa	Rice Point	35	BC	Medium	Low	Medium					Low	Medium
Cheboygan	Stoney Point Road	36	C	Medium	Medium	Medium					Medium	Medium
Schoolcraft	Goudreau's Harbor	38	BC	Medium	Medium	Medium					Medium	Medium
Mackinac	Bois Blanc Island	39	F	Low	Low	Low					Low	Medium
Mackinac	Lower Millicoquins River	41	B	Medium	Medium	Medium					Medium	Medium
Mackinac	Big Knob SF CG	42	A	High	Medium	Medium	High	High	Medium	Low	Medium	Low
Mackinac	St. Martin Point	47	BC	Medium	Medium	Medium					Medium	Medium
Mackinac	Horseshoe Bay	49	A	Low	Medium	High					Medium	High
Mackinac	Summerby Fen	52	C	Low	Medium	High					Medium	Medium
Mackinac	West Epoufette	53	BC	Low	Low	Medium					Low	Medium
Presque Isle	Thompson's Harbor SP	55	F	Low	Low	Low					Low	Medium
Cheboygan	Mackinaw City	57	D	Low	Low	Medium					Low	Medium
Mackinac	Bush Bay	59	F	Low	Low	Low					Low	Medium
Mackinac	West Moran Bay	61	C	Low	Medium	High					Medium	Medium
Charlevoix	Fisherman's Island SP	62	B	Medium	Low	Medium	High	High	Medium	Medium	Medium	Low
Schoolcraft	Section 10 Dunes	68	C	Medium	Medium	Medium					Medium	Medium
Schoolcraft	Michibay Rd Township Pk	69	C	Medium	Medium	Medium					Medium	Medium
Mackinac	Fox-Grants Point	71	BC	Medium	High	Medium					Medium	Medium
Mackinac	Cozy Point	73	B	Medium	High	Medium					Medium	Medium
Emmet	Cross Village Shores	74	D	Low	Low	Low					Low	Medium
Mackinac	Brevort Lake Road	75	C	Low	Medium	High					Medium	Medium
Mackinac	Horseshoe Bay	76	BC	Low	Low	High					Low	Medium
Mackinac	Belonga Road East	78	BC	Low	High	Medium					Medium	Medium
Emmet	Sturgeon Bay	82	A	High	Medium	Medium	High	High	High	Medium	High	Low
Chippewa	Big Shoal Cove	84	F	Low	Low	Low					Low	Medium