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Standardized Survey Protocol for False Hop Sedge (*Carex lupuliformis*)

Prepared through the

Species at Risk Stewardship Program

north-south ENVIRONMENTAL

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Cover Photo: False Hop Sedge (*Carex lupuliformis*) by Pauline K. Catling.

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1. Introduction and Objective

The protection of Species at Risk (SAR) and their habitat requires comprehensive and up to-date knowledge of species identification, classification, distribution, occurrence, abundance, habitat and threats. When detailed occurrence data are unavailable, field surveys are necessary to determine if a species is present at a site and ascertain its abundance and threats in order to implement SAR protection. However, many SAR are rare, occur at low densities and may be cryptic, making detection difficult. Furthermore, some plant species can remain non-reproductive for extended periods of time limiting the opportunity to see identifying features, which increases the challenges associated with confirming presence and evaluating the status of the population. This survey protocol has been developed to address the need for reliable, consistent and science-based survey methods in Ontario for False Hop Sedge (*Carex lupuliformis* Sartwell ex Dewey), a vascular plant Species at Risk (SAR), which is listed as Endangered under Ontario's *Endangered Species Act* (ESA), 2007. Development of a standardized survey protocol for this species is identified as a high priority action in the False Hop Sedge Government Response Statement (Ministry of Natural Resources and Forestry [MNRF] 2018).

This document reviews existing information on False Hop Sedge including its identification, distribution, ecology, hybridization potential and threats. The survey protocol is based on the best available scientific information at the time of publication, including information in scientific publications, technical reports and consultation with botanical experts and species experts. The survey protocol should be reviewed and, if appropriate, refined should new information become available. This document presents a science-based survey protocol that identifies:

- How to evaluate potential habitat and determine survey locations;
- How to identify False Hop Sedge and a comparison of the features of similar species
- How to complete a presence/ no detection survey;
- How to complete monitoring;
- How to determine or estimate abundance;
- How to assess plant vigor;
- How to assess habitat quality and potential threats;
- How to assess site condition; and
- How to record and report data collected.

This document describes two different protocols. The objective of the first protocol (**Section 4.3**) is to detect presence and provides a methodology that aims to maximize detection of False Hop Sedge in

habitats where it may occur. The objective of the second protocol (**Section 4.4**) is to ensure population abundance and dynamics data are collected consistently at a site over time so these data are comparable. This protocol provides a standard method for monitoring known locations of False Hop Sedge.

Determining if there is habitat present under the ESA (general or regulated habitat) or the federal *Species at Risk Act* (SARA), 2002 at a site is a complex process that is not limited to presence/ no detection surveys. For example, even at sites where survey results are negative, general or regulated habitat may still be present based on 1) nearby occurrences of the species (e.g., on an adjacent property), and 2) the manner in which the habitat is defined within a regulation, habitat description or other policy. This document provides a protocol for surveying potential False Hop Sedge sites (as defined here) and monitoring known occurrences; however, it does not include consideration of whether habitat is protected under the ESA or SARA or a delineation of regulated habitat. This protocol should be implemented by field biologists with expertise in botany who have acquired all relevant permits and permissions for property access to complete surveys of False Hop Sedge.

2. Species Information

2.1. Taxonomy

False Hop Sedge is a member of the sedge family (Cyperaceae) in section *Lupulinae* Tuckerman ex J. Carey of the genus *Carex* (Reznicek 2002; Environment Canada 2014a). False Hop Sedge is morphologically similar to Hop Sedge (*Carex lupulina* Muhlenberg ex Willdenow) but is widely accepted as a distinct species (Reznicek and Ball 1974; Ostlie 1990; Reznicek 2002).

Section *Lupulinae* is endemic to central and eastern North America (Reznicek and Ball 1974). Other members of Section *Lupulinae* that are present in Canada are Hop Sedge, Bladder Sedge (*C. intumescens* Rudge) and Gray's Sedge (*C. grayi* J. Carey). The other two members of section *Lupulinae* – Louisiana Sedge (*C. louisianica* L. H. Bailey) and Giant Sedge (*C. gigantea* Rudge) – do not occur in Canada. No infraspecific taxa (subspecies or varieties) have been described for False Hop Sedge (Reznicek and Ball 1974; Reznicek 2002; COSEWIC 2011).

False Hop Sedge appears to hybridize with Retrorse Sedge (*C. retrorsa* Schweinitz – section *Vesicariae* Linnaeus) and members of section *Lupulinae* (Reznicek and Ford 2002; Hill 2006). However, hybridization is assumed to be rare to occasional (Reznicek, A. pers. comm. 2021). The hybrid between Retrorse Sedge and Hop Sedge looks quite similar to False Hop Sedge and has been noted in Ontario (Miller, B. pers. comm. 2021). Hybridization within sedges is still not well studied; however, Montreal University is currently looking into hybridization and introgression within section *Lupulinae* (Pellerin, S. pers. comm. 2021).

2.2. Identification

For an illustration of sedge morphology see **Figure 1**. For definitions of botanical terms see the **Glossary**. The Flora of North America key to section *Lupulinae* (Reznicek 2002) has been included in **Appendix 1**.

False Hop Sedge is a cespitose sedge that grows in tufts along a scaly rhizome (COSEWIC 2011). Each tuft consists of 5 to 30 stems that grow 50 to 130 cm tall (COSEWIC 2011). Leaves are smooth, erect, 6 to 15 mm wide and 30 to 80 cm long (Environment Canada 2014a). Basal sheaths are brownish (Reznicek 2002).

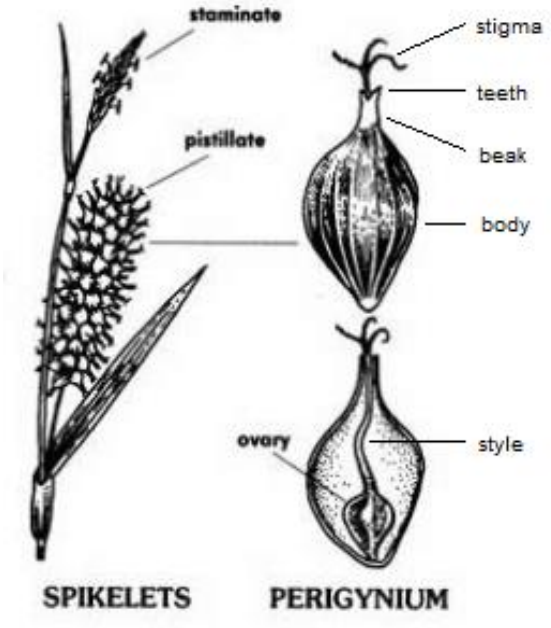


Figure 1. Sedge morphology (adapted from Delnor-Wiggins Pass State Park [Undated]).

Inflorescences are 6 to 40 cm long (Reznicek 2002). Plants are monoecious, with male (staminate) and female (pistillate) flowers occurring on the same plant. The male flowers occur on 1 to 2 terminal staminate spikes (containing only male flowers) and 2 to 6 densely flowered proximal pistillate spikes (containing solely female flowers) (Reznicek 2002). Pistillate spikes are composed of 8 to 90 flowers, each enclosed within ascending to spreading perigynia (sac that surrounds the achene) with 17 to 25 strong veins (Reznicek 2002). Perigynium are strongly inflated to aid in water dispersal. A single-seeded achene (a small, dry, seed-like fruit) is present within the air-filled perigynium. Achenes of False Hop Sedge are three-angled, trigonous (with a triangular cross-section) and rhomboid, with concave faces and a prominent hardened knob on the center of each angle (Environment Canada 2014a; Reznicek 2002). The presence of hardened, protruding nipple-like knobs on the achenes of False Hop Sedge is a diagnostic feature that separates it from similar species (see **Section 2.1.1**). Achene size and knob size may differ from year to year on the same individual; however, it is unknown if this is due to hybridization, plasticity, weather, hydrology or other factors (Pellerin, S. pers. comm. 2021). **Figure 2** shows a selection of False Hop Sedge characteristics. Additional morphological descriptions can be found in Reznicek and Ball (1974), Reznicek (2002) and COSEWIC (2000; 2011).

2.2.1. Similar Species

Species within the Section *Lupulinae* are very similar and features on a specimen may conflict with keys and descriptions, making positive identification of species challenging (Reznicek and Ball 1974). Similar species in Ontario include four of the *Carex* species in Section *Lupulinae* as well as Retrorse Sedge and Tuckerman's Sedge (*Carex tuckermanii* Dewey), which are in Section *Vesicariae*. The habitat and range of these species is overlapping with that of False Hop Sedge and cannot be used as

a distinguishing feature. A comparison of traits between False Hop Sedge and similar species is provided in **Table 1** and a photographic comparison is provided in **Table 2**. A comprehensive review of features that can be used for confident identification as well as a dichotomous key for identification of Section *Lupulinae* is found in Reznicek and Ball (1974) and Reznicek (2002) (see **Appendix 1**). It is recommended that this key be used to distinguish between members of Section *Lupulinae*. If surveyors are unfamiliar with recognizing Section *Lupulinae*, it is recommended that they use the full keys to *Carex* in Flora of North America (Ball and Reznicek 2002; Reznicek 2002) or Michigan Flora (Reznicek et al. 2011) for identification. The following paragraphs detail main identification characteristics for similar species that occur within Ontario.

Sedges in Section *Vesicariae* are characterized by yellowish, bladdery, few-veined, strongly inflated perigynia, 2.5-10mm long, with a very wide body tapering abruptly to a short beak. Retrorse Sedge has characteristics that align with Section *Lupulinae*, showing particular similarity to Hop Sedge, False Hop Sedge, Giant Sedge, and Louisiana Sedge (Reznicek and Ball 1974). Retrorse Sedge and Tuckerman's Sedge have been included in the comparison provided in **Table 1** and **Table 2** due to their similarity to members of the Section *Lupulinae*. Other members of section *Vesicariae* that occur in Ontario (e.g., *C. vesicaria* Linnaeus, *C. utriculata* Boott) may appear similar to False Hop Sedge to those who are unfamiliar with sedges but have not been included in the comparison table as it is assumed that surveyors will have botanical expertise and a familiarity with sedges.

Bladder Sedge and Gray's Sedge may be separated from the other members of Section *Lupulinae* by their apiculate achenes with shriveled styles and short beaked perigynia (Reznicek and Ball 1974). The beaks in Bladder Sedge and Gray's sedge may be poorly defined due to the long tapering body. Additionally, these species may be distinguished vegetatively from other members of *Lupulinae* by:

- The upper part of stem is usually scabrous on the angles in the former and smooth in the latter.
- The former species are not stoloniferous, solitary or cespitose, while the latter are stoloniferous, loosely tufted or solitary.
- The former species have rounded ligules that are wider than they are long, while the later have triangular ligules that are usually longer than they are wide.
- Bracts and the first leaf before the inflorescence are not sheathed or very short sheathed in the former, with the latter usually having sheathed bracts and leaves below the inflorescence sheathing for at least 2 cm.

Overall appearance is helpful in distinguishing several of the similar species even at a distance. Bladder Sedge and Gray's Sedge can usually be recognized by the arrangement of the perigynia on the rachis. There are generally fewer perigynia of Bladder Sedge in an inflorescence, forming a very short-cylindric to almost triangular spike, and the perigynia of Gray's Sedge are arranged in a ball, like a mediaeval mace. In False Hop Sedge and Hope Sedge, the perigynia form a long-cylindric spike. The key to this group in the former edition of Michigan Flora Volume I (Voss 1972) noted that the

spike of False Hop Sedge was longer than in Hop Sedge, but this character does not appear in the newer Michigan Flora (Reznicek and Voss 2012 and Michigan Flora Online) and spike length of False Hop Sedge was variable within Ontario (Catling Pers. Obs. 2021). Retrorse Sedge spikes are very crowded and have downward-pointing lower perigynia, and Tuckerman's Sedge is characteristically more highly inflated than other similar species. Giant Sedge and Louisiana Sedge are included in **Table 1** for comparison, but they do not occur in Canada and this protocol will not discuss the differentiation of these species further.

The above vegetative characteristics may assist in determining that an individual is not False Hop Sedge; however, it is recommended that perigynia and achenes be used to confirm identity whenever possible due to the similarity between Hope Sedge and False Hop Sedge. Vegetative characteristics alone are insufficient to confidently identify False Hop Sedge.

False Hop Sedge and Hop Sedge are easily misidentified as these two species are virtually identical without mature inflorescences. Although characters may differ based on site-specific environmental conditions (i.e., phenotypic plasticity), when these species co-occur it has been noted that False Hop Sedge if often more robust with larger, darker leaves and growing somewhat taller and in larger more isolated clumps than Hop Sedge (COSEWIC 2011; Pellerin, S. pers. comm. 2021). False Hop Sedge typically never grows less than 50 cm tall whereas Hop Sedge may be as short as 20 cm (Reznicek and Ball 1974). Due to the variability and overlap in characteristics between these two species it is recommended that vegetative characteristics not be used for identification purposes. Vegetative characters have been described in this document to aid surveyors in finding potential False Hop Sedge individuals but should not be used definitely for confirmation. When mature inflorescences are found on healthy specimens, two characteristics may be used to distinguish these species:

- False Hop Sedge has visibly prominent nipple-like knobs on the angles of its achenes (**Table 2**), which can often be felt through a light squeeze of the perigynium (when achenes are mature). To reliably confirm identification, mature achenes should be removed from the perigynium and examined at 2 to 10x magnification.
- False Hop Sedge spikes are longer and appear less crowded (the perigynia are more divergent, forming an angle greater than 45° -ascending) than Hop Sedge spikes (the perigynia are often more or less appressed to the axis of the inflorescence, forming an angle of 45° or less with it- appressed). Both species show variability in this trait and examination of achenes is still recommended to confirm any suspected False Hop Sedge individuals (COSEWIC 2011).

Identification of False Hop Sedge is made more challenging because achenes may vary in size and shape between individuals, culms and even within the same spike. Environmental conditions and achene maturity may influence these characteristics. It has previously been suggested that False Hop Sedge achenes are as wide as they are long; however, it has been demonstrated that

achene length to width ratios are variable and are not the best trait for confident ID (Reznicek and Ball 1974). It is recommended that achenes from the center of the spike should be examined when confirming identification (Ford, B. pers. comm. 2021). In general, a few achenes from multiple spikes should be examined to confidently identify an individual as False Hop Sedge. If characteristics are intermediate or uncertain, additional achenes may be checked to determine the identity or potential reasons for intermediate characteristics.

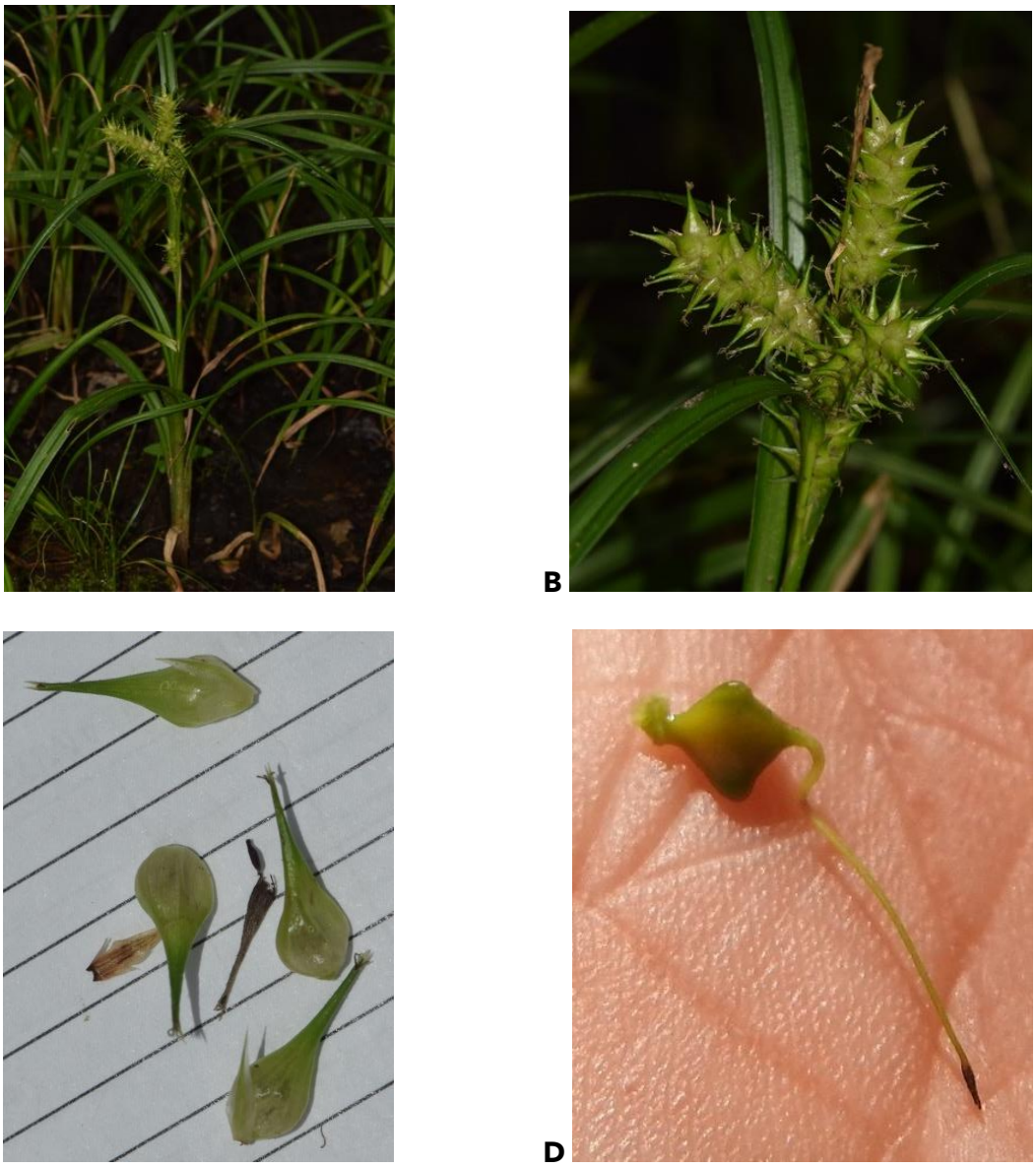


Figure 2. Image of False Hop Sedge (left) showing the A) growth habit, B) spike at seed-set, C) perigynium and D) achenes.

Table 1. Comparison of traits between False Hop Sedge and similar species in North America including all of the species in Section *Lupulinae* as well as Retrorse Sedge and Tuckerman's Sedge (Section *Vesicariae*).

Common Name (Latin Name)	Form	Leaves	Inflorescence	Spikes	Perygynia	Achenes
False Hop Sedge (*Carex lupuliformis*)	Loosely cespitose Stems: L 500-1,300 mm; bases brown	4-7 L 300-800 mm W 6-15 mm Distal sheath: L 30-210 mm Ligules: rounded-triangular; L 6.0-28.0 mm Somewhat darker green than Hop Sedge when growing in similar conditions.	60-400 mm Proximal peduncle: L 10-130 mm Bracts: L 200-700 m; W 4-11 mm; sheath L 10-90 mm	Pistillate spikes: 2-6; L 20-80 mm; W 15-30 mm Staminate spikes: 1-2; L 20-100 mm; W 2-5 mm	8-90 per spike Ascendent-spreading Bodies: 17-25 veined; L 12.0-18.5 mm; W 3.8-6.0 mm Beaks: L 6.0-9.0 mm Pistillate scales: 3-9 veined; L 6.0-13.0 mm; W 1.8-3.2 mm; awns <5.5 mm or absent	Rhomboid L 3.0-4.5 mm W 2.2-3.4 mm Faces: concave Angles: thickened with knobby protrusions Styles: persisting
Hop Sedge (*Carex lupulina*)	Loosely cespitose Stems: L 200-1,000 mm; bases reddish-brown	4-8 L 150-640 mm W 4-15 mm Distal sheath: L 17-100 mm Ligules: triangular; L 3.5-18.0 mm Somewhat lighter green than False Hop Sedge.	40-400 mm Proximal peduncle: L 5-200 mm Bracts: L 130-550 mm; W 3-11 mm; sheath L 5-150 mm	Pistillate spikes: 1-5; L 15-65 mm; W 13-30 mm Staminate spikes: 1-2; L 15-85 mm; W 1-5 mm	4-80 per spike Ascendent - appressed Bodies: 13-22 veined; L 11.0-19.0 mm; W 3.0-6.0 mm Beaks: L 6.0-10.0 mm Pistillate scales: 1-7 veined; L 6.0-15.0 mm; W 1.0-2.7 mm; awns <6.0 mm or absent	Rhomboid L 3.0-4.5 mm W 1.7-2.8 mm Faces: flat to concave Angles: thickened; knobby protrusions absent Styles: persisting
Giant Sedge (*Carex gigantea*)	Loosely cespitose Stems: L 350-1,200 mm; bases reddish-brown	4-8 L 200-600 mm W 5-16 mm Distal sheath: L 50-200 mm Ligules: triangular; L 4.5-35.0 mm	150-400 mm Bracts: L 300-600 mm; W 6-11 mm; sheath L 5-50 mm	Pistillate spikes: 2-5; L 30-80 mm; W 20-30 mm Staminate spikes: 1-5; L 20-80 mm; W 2-4 mm	20-75 per spike Spreading 90° to peduncle Bodies: L 11.0-18.0 mm; W 4.0-6.0 mm Beaks: L 6.0-9.0 mm Pistillate scales: 3-5 veined; L 4.5-10.5 mm; W 1.5-2.0 mm; awns absent	Obconic L 2.2-2.6 mm W 2.7-3.0 mm Faces: strongly concave Angles: thickened; knobby protrusions absent Styles: persisting
Gray's Sedge (*Carex grayi*)	Loosely cespitose Stems: L 250-1,100 mm; bases dark red	6-12 L 120-340 mm W 4-11 mm Distal sheath: L <25 mm or absent Ligules: rounded; 2.5-6.0 mm	25-170 mm Proximal peduncle: L 7-35 mm Bracts: L 80-260 mm; W 2-7 mm; sheath absent	Pistillate spikes: 1-3; L 25-42 mm; W 26-41 mm Staminate spikes: 1; L 5-65 mm; W 1-4 mm	4-35 per spike Radiating Bodies: 16-25 veined; L 12.5-20.0 mm; W 4.0-8.0 mm Beaks: L 1.5-3.0 mm Pistillate scales: 1-5 veined; L 4.0-11.0 mm; W 2.0-4.2 mm; awns <7.0 mm or absent	Obovoid L 3.3-4.8 mm W 2.6-3.7 mm Faces: convex Angles: not thickened Styles: withering
Bladder Sedge (*Carex intumescens*)	Loosely cespitose Stems: L 150-1,400 mm; bases dark red	6-12 L 80-270 mm W 4.5-8.0 mm Distal sheath: L <25 mm or absent Ligules: rounded; 1.0-8.0 mm	20-150 mm Proximal peduncle: L 3-15 mm Bracts: L 6-21 mm; W 2-6 mm; sheath absent	Pistillate spikes: 1-4; L 10-27 mm; W 10-28 mm Staminate spikes: 1; L 10-50 mm; W 1-3 mm	1-12 per spike Ascending-spreading (basal perigynia rarely reflexed) Bodies: 12-23 veined; L 10.0-16.5 mm; W 2.5-6.5 mm Beaks: L 2.0-4.2 mm Pistillate scales: 1-3 veined; L 4.0-9.5 mm; W 2.0-3.8 mm; awns <6.5 mm or absent	Obovoid L 3.5-5.7 mm W 2.2-3.9 mm Faces: flat-convex Angles: not thickened Styles: persisting

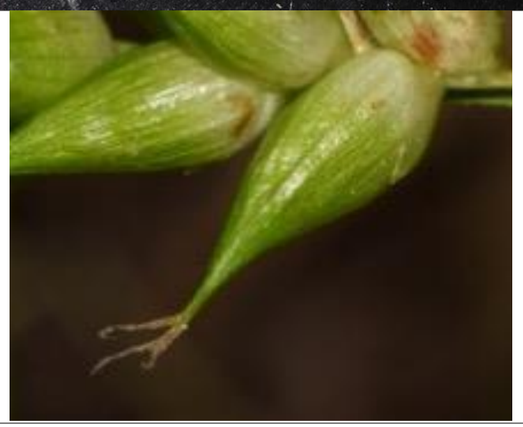
Common Name (Latin Name)	Form	Leaves	Inflorescence	Spikes	Peryginia	Achenes
Louisiana Sedge (*Carex louisianica*)	Colonial Stems: L 200-750 mm; bases reddish-brown	4-10 L 100-400 mm W 4.0-6.0 mm Distal sheath: L 20-100 mm Ligules: rounded-triangular; 2.0-7.0 mm	100-420 mm Proximal peduncle: L 5-105 mm Bracts: L 100-300 mm; W 2-4 mm; sheath L 5-50 mm	Pistillate spikes: 1-4; L 15-45 mm; W 15-30 mm Staminate spikes: 1; L 5-70 mm; W 2-3 mm	10-30 per spike Bodies: L 10.0-14.0 mm; W 3.5-6.0 mm Beaks: L 4.5-7.0 mm Pistillate scales: 3-7 veined; L 4.5-6.5 mm; W 1.5-2.0 mm; awns absent	Rhomboid L 2.5-3.5 mm W 1.7-2.0 mm Faces: flat Angles: thickened Styles: persisting
Retrorse Sedge (*Carex retrorsa*)	Cespitose Stems: L 100-1,050 mm; bases reddish-brown	W 3.0-10.0 mm	30-350 mm	Pistillate spikes: 2-6 Staminate spikes: 1-3	20-150 per spike Reflexed or spreading 90° to peduncle Bodies: 6-13 veined; L 6.0-10.0 mm; W 1.6-3.4 mm Beaks: 2.1-4.5 mm Pistillate scales: L 2.4-4.5 mm; W 1.1-1.8 mm; awns absent	Faces: convex Angles: not thickened
Tuckerman's Sedge (*Carex tuckermanii*)	Cespitose Stems: L 400-1,200 mm; bases dark red	W 2.0-5.0 mm	100-350 mm	Pistillate spikes: 1-4 Staminate spikes: 1-3	Ascendent Bodies: 7-12 veined; L 7.5-12.5 mm; W 4.0-7.0 mm Beaks: 2.4-4.8 mm Pistillate scales: L 3.9-5.2 mm; W 1.2-2.4 mm; awns absent	Faces: 1 face with distinct indentation; other faces flat Angles: not thickened

Notes: Louisiana Sedge and Giant Sedge do not occur in Canada but have been included for a complete comparison between members of the section *Lupulinae*. Retrorse Sedge and Tuckerman's Sedge have been included as the most similar looking species in Ontario outside of section *Lupulinae*. Louisiana Sedge does occur across Lake Erie in Ohio and climate change may facilitate northward range expansion into Ontario; however, this is unlikely.

Information included in the above table was gathered from keys and species descriptions in Flora of North America (Reznicek and Ball 2002; Reznicek 2002).

Table 2. Photographic comparison of False Hop Sedge and similar species in Ontario showing growth habit, mature female spikes, perygynia and achenes.

Species	Growth Habit	Mature Spikes	Perygynia	Achenes
False Hop Sedge (*Carex lupuliformis*)				
Hop Sedge (*Carex lupulina*)				

Species	Growth Habit	Mature Spikes	Perygynia	Achenes
Gray's Sedge (***Carex grayi***)				
Bladder Sedge (***Carex intumescens***)				

Species	Growth Habit	Mature Spikes	Perygynia	Achenes
Retrorse Sedge **(*Carex retrorsa*)**				
Tuckerman's Sedge **(*Carex tuckermanii*)**				

Photo Credits: Tuckerman's Sedge achene photo by Tyler Smith (used with permission: https://www.inaturalist.org/messages/1742288). All other photos were taken by Pauline Catling and Will Van Hemessen.

Note: Photos were taken of representative individuals; however, variability is present within each species.

2.2.2. Dipteran Parasite

Intermediate achene characteristics may be attributed to a dipteran parasite (see **Section 2.5.4**) (Reznicek and Ball 1974; Ostlie 1990; Thompson and Paris 2004; Hill 2006). The parasite, which completes its larval and pupal stages inside the achenes of all members of Section *Lupulinae* except Bladder Sedge and Gray's Sedge, may lead to misidentification of various species. This parasite distorts the achene shape to a longer, more ovoid appearance (Reznicek and Ball 1974). Colour of the achene has also been noted to change from brown to a creamy-whitish colour when infested with a parasite (Reznicek and Ball 1974). Presence of the parasite is usually occasional and does not distort all the achenes in a population (Reznicek, A. pers. comm. 2021). When infestation is severe the perigynia may turn to a straw-like colour and spread abnormally (Reznicek and Ball 1974).

If the parasite is not detected, one may be led astray when identifying members of Section *Lupulinae* (Reznicek and Ball 1974). Dipteran parasites may be responsible for specimens with intermediate characteristics, which could be misjudged as hybrids or misidentified (Reznicek and Ball 1974). The presence of distorted achenes has been observed at all Canadian sites (COSEWIC 2000; Nault 2006); however, the cause was not always determined. It is uncertain how common specimens with intermediate characteristics are in the Ontario population of False Hop Sedge and how often this is attributable to hybridization versus the dipteran parasite.

2.2.3. Genetics

It is possible to identify the species within Section *Lupulinae* based on chromosome counts as follows: Gray's Sedge (2n= 52), Bladder Sedge (2n = 48), Hop Sedge (2n = 56) and False Hop Sedge (2n=60) (Reznicek and Ball 1974). Sedge chromosomes are small and obtaining good results requires cultivating the plants (Reznicek, A. pers. comm. 2021). Other genetic analyses (e.g., genetic sequencing) may be costly and outside of the scope of surveys focused on conservation. It is recommended that identification based on achene characteristics is sufficient. However, if genetic analyses are desired for specific studies, suitable methodologies for genetic analysis of *Carex* can be found in Hipp et al. (2006) and Massatti et al. (2016).

2.3. Distribution

False Hop Sedge only occurs in eastern North America (**Figure 3**) within the Eastern Temperate Forests Ecological Region and extending across the Coastal Plain to the Atlantic coast (EPA 2021). It is considered to be rare or uncommon throughout its range (Reznicek 2002; NatureServe 2021; EPA 2021) and has a sporadic distribution across its range (Environment Canada 2014a). Southernmost occurrences are in Florida and Texas the northernmost occurrences are in Québec (**Figure 3**). The westernmost locations occur in eastern Oklahoma and Texas. The easternmost locations occur in New York, Connecticut and Massachusetts. Canadian populations represent the northern limit of its range (Environment Canada 2014a).

In Canada, False Hop Sedge occurs only in southwestern Ontario and southern Québec. A total of 24 natural subpopulations have been documented in Canada. Seven extant and three 'under restoration' populations occur in Québec (Pellerin, S. pers. comm. 2022). The three noted as 'under restoration' (one augmentation, one reintroduction and one introduction) include locations where transplanting has occurred. As of 2021, seventeen occurrences have been noted in Ontario (**Table 3**). Five subpopulations in Ontario are assumed extirpated due to time since last observation and land-use changes. Six subpopulations have an unknown status, four are considered extant and two have yet to be confirmed. As of 2011, there were at least 142 mature individuals in Canada, which increases to 361 individuals with the inclusion of transplanted individuals (COSEWIC 2011; Environment Canada 2014a).

In Québec, the species occurs within the Eastern Great Lakes and Hudson Lowlands level 3 ecoregion (EPA 2021). The extant locations occur along a 10 km stretch of the Ottawa River and along a 20 km stretch of the Richelieu River near Saint-Jean-sur-Richelieu, including the Marcel Raymond Ecological Reserve (Environment Canada 2014a). This reserve is located in the in the municipality of Henryville within the regional county municipality of Haut-Richelieu.

In Ontario, False Hop Sedge is found in the Lake Erie Lowlands level 3 ecoregion (EPA 2021). This region is also called Ecoregion 7E (Lake Erie-Lake Ontario) or the "Carolinian Forest Zone" (Wester et al. 2018). False Hop Sedge was first discovered in Ontario in 1902 in Waterloo County (now the Regional Municipality of Waterloo) by W. Herriot (Oldham et al. 1993). This population has not been seen since despite periodic attempts to relocate it (Oldham et al. 1993). Since being discovered in the province, False Hop Sedge has been noted in six municipalities including Elgin County, Essex County, Lambton County, Middlesex County, Niagara Regional Municipality and Waterloo Regional Municipality (**Figure 4**). There is also an unconfirmed historical record of the species from Wellington County (Reznicek and Ball 1974).

Table 3 provides a list of locations of False Hop Sedge in Ontario and their last observed date. Abundance is most concentrated in Middlesex and Elgin Counties (Environment Canada 2014a). The current fragmented distribution of False Hop Sedge is likely a result of landscape development (Environment Canada 2014a). Large-scale habitat alteration, including a high rate of wetland loss, has occurred in the Carolinian Forest Zone over the past century, which has resulted in fragmented occurrences with very few individuals (Environment Canada 2014a).

Table 3. Occurrences of False Hop Sedge in Ontario

County	Location (Site Name if Different from Location)	Abundance	Status	First/ Last Observed	Ownership
Essex	Amherstburg	0 to 100	Assumed Extirpated	1985/ 1985	Private
Lambton	Dresden	10 to 20 small plants	Unknown	2015	Private
Elgin	Southwold Township (Iona Station)	Few hundred stems present	Unknown	2012	Private
Elgin	Southwold Township (Shedden)	Unknown	Unknown	2011	Private
Elgin	Rodney	1 to 93	Extant	1993/**2021**	Private
Elgin	West Elgin	39	Extant	2005/**2021**	West Elgin Nature Club
Elgin	West Lorne	20 to 100	Unknown	1993/2009	Private
Middlesex	Lambeth	Unknown	Extirpated	2009/2009	Private
Middlesex	London	Varies from 5 to 28. Most recently 5	Assumed Extirpated	1902/2020	City of London
Middlesex	Thamesford	Unknown	Unknown	2012	Private
Middlesex	Ailsa Craig	19	Unknown	2009/2009	Private
Middlesex	Mount Brydges	Varied from 25 to 1,075 plants varying with logging activity. Most recently 29 plants were noted.	Assumed Extirpated	1992/2009	Private
Oxford	Unknown (in the vicinity of Woodstock)	Unknown	Assumed Extant	**2021**	Private
Waterloo	Galt	Unknown	Assumed Extirpated	1902/1902	Unknown
Welland	Niagara Falls	Three patches of ~50 clumps	Assumed Extant	2019/2019	Private
Brant	Burford	Unknown	Alleged	1994/ 1994	Private
Brant	Glen Morris	1	Alleged	2020/ 2020	GRCA

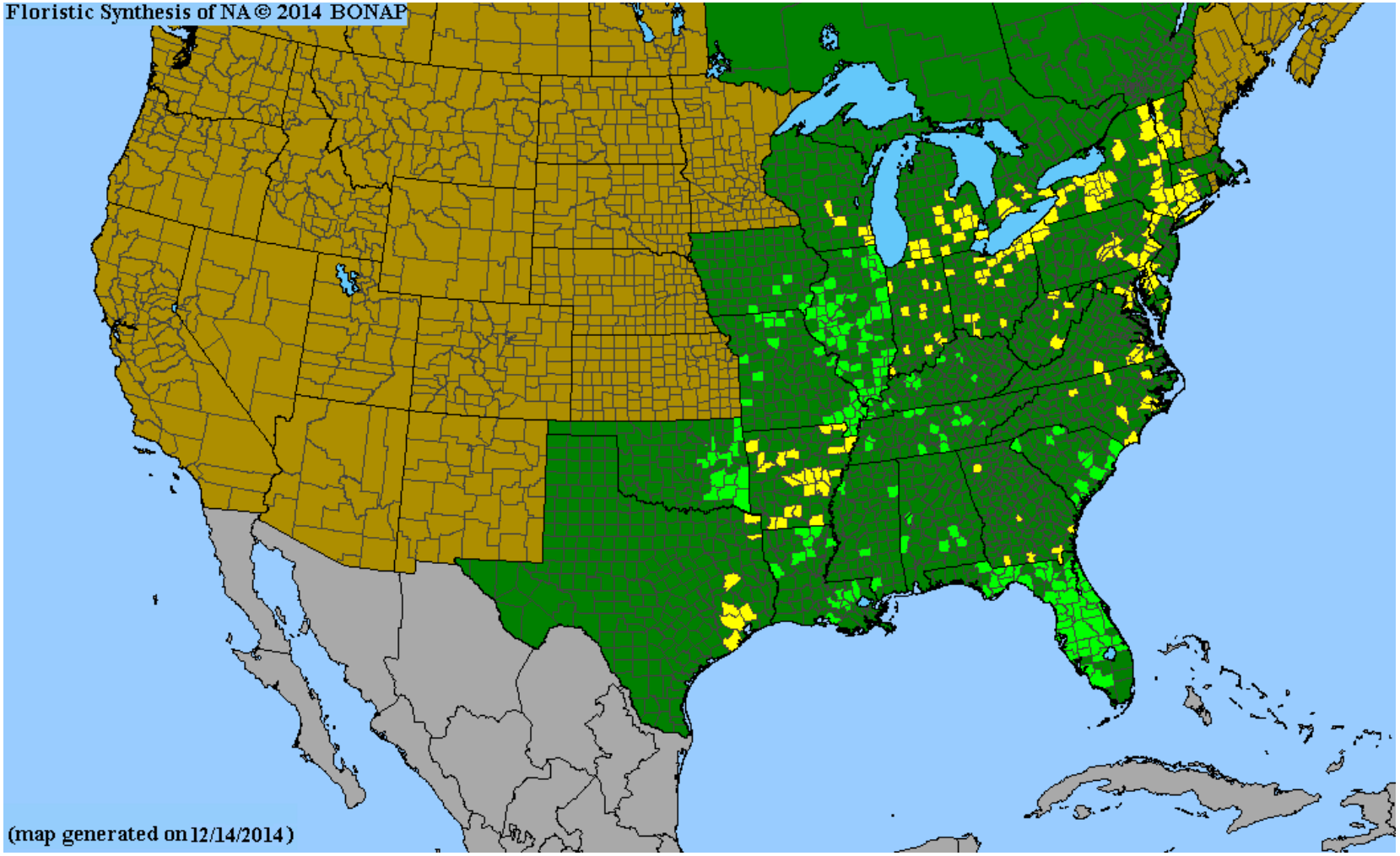


Figure 3. False Hop Sedge Distribution in North America (Kartesz 2015). Dark Green indicates the confirmed presence of False Hop Sedge in the State or Province. Light green and yellow colouration of counties indicate the species is present and not rare vs rare, respectively.

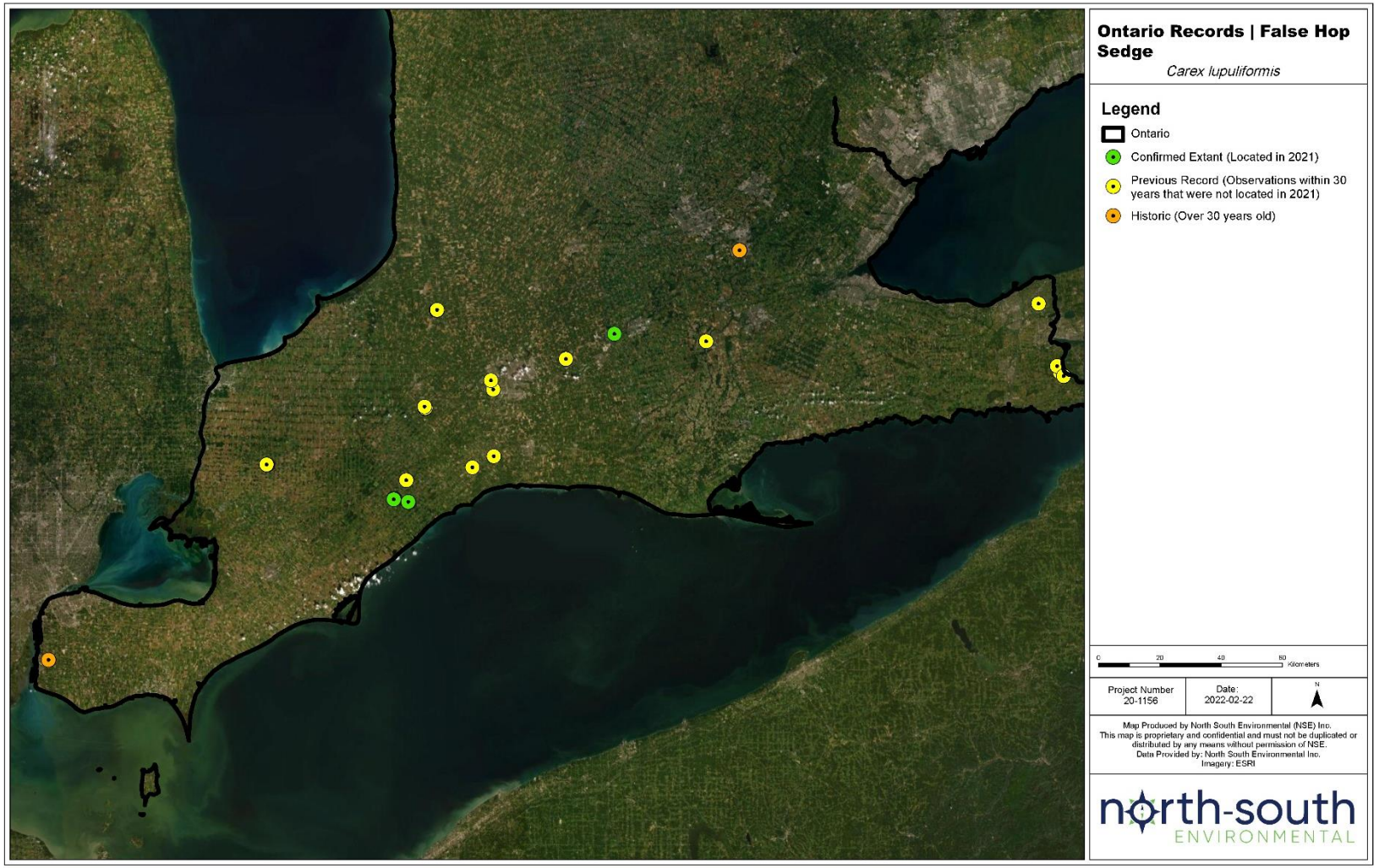


Figure 4. Range Map of all known False Hop Sedge locations in Ontario

2.4. Habitat

Sufficient light, reduced competition and a high water table that impedes growth of competitors have been noted as factors in critical habitat (Environment Canada 2014a). Knowledge of habitat and environmental requirements should be used to assist surveyors in site selection, targeted searching and assessment of suitability. A detailed assessment of these metrics has not been included in the monitoring protocol in order to keep the survey protocol focused on population monitoring and reduce the time requirements for its completion. Studies on these aspects should be completed to gain a better understanding of the specific ecological needs of False Hop Sedge in Ontario, but they do not necessarily need to be completed every year of monitoring.

2.4.1. Edaphic Conditions

Soils which support False Hop Sedge are typically poorly drained clay-loam (COSEWIC 2000) with high pH, but the species can also grow in acidic substrates (COSEWIC 2011). It is uncertain if the species is a calciphile or adaptable to both basic and acidic substrates (Ostlie 1990; Searcy *et al.* 2003; Thompson and Paris 2004; COSEWIC 2011).

An analysis of edaphic soil conditions at False Hop Sedge occurrences in Québec noted that there were no significant differences in cation exchange capacity (CEC), pH, calcium (Ca), phosphorus (P), aluminum (Al), potassium (K), magnesium (Mg), iron (Fe), Organic matter (MO) and the C/N ratio (Pichon 2009). **Table 4** shows the minimum, average and maximum values for soil conditions at naturally occurring False Hop Sedge plants in Québec (data summarized from Pichon 2009). No similar data are available for sites in Ontario.

Table 4. Edaphic conditions at naturally occurring False Hop Sedge occurrences in Québec (data summarized from Pichon 2009).

Factor	Min	Average	Max
Organic matter (%)	4.70	7.37	11.00
Iron (cmol (+).kg sol-1)	0.02	0.07	0.15
Cation Exchange Capacity	18.00	24.50	29.70
Water pH	5.00	5.52	5.90
Soil pH	6.10	6.37	6.60
Heat Index	61.00	63.68	66.00
Calcium(Kg/ha)	3240.00	4855.79	6510.00
Calcium Saturation (%)	37.10	44.01	50.80
Phosphorus (Kg/ha)	9.00	76.53	259.00
Saturation P-P/Al (%)	1.00	3.24	10.10
Aluminum (Kg/ha)	885.00	1016.47	1200.00
Potassium (Kg/ha)	68.00	110.74	179.00
Potassium Saturation (%)	0.40	0.53	0.80
Magnesium (Kg/ha)	545.00	890.26	1250.00

Factor	Min	Average	Max
Magnesium Saturation (%)	10.20	13.44	17.30
Nitrogen total (%)	0.20	0.26	0.40
Carbon total (%)	1.30	2.81	4.80
Carbon/ Nitrogen	10.80	11.49	12.30
Saturation (K+Mg+Ca) (%)	48.10	57.97	68.60

2.4.2. Hydrology and hydrogeology

False Hop Sedge prefers wet habitats that experience periodic flooding and transition zones along shorelines or wetlands that may experience ice scouring (COSEWIC 2011; Environment Canada 2014a). Soils it inhabits are consistently classified as wet to moist (Thompson and Paris 2004). It is an obligate wetland species with a Coefficient of Wetness of -5 (Reznicek et al. 2011). It grows on the edge of riverine swamps or partially shaded openings in swamps and vernal pools. In Ontario habitats include vernal pools and marsh inclusions within wooded swamps (Environment Canada 2014a). It has been noted in Québec that Hop Sedge and False Hop Sedge occur in different microhabitats with the former occurring further away from the shoreline and the latter occurring between the open swamp and shadier sections (Pellerin, S. pers. comm. 2021). Microhabitat preferences in Ontario have not yet been studied.

Despite a preference for seasonally flooded areas, soil moisture that is too high or prolonged flooding can kill individual plants (Langlois and Pellerin 2016). A major flood event in Québec in 2011 was thought to have caused 60% mortality of False Hop Sedge (COSEWIC 2011). Follow up monitoring in 2012 suggested that mortality rates were not as high as initially thought. A surviving clump found several metres away from its initial location suggests that the species may be able to survive being washed away if environmental conditions in the new location are still suitable (Pellerin, S. pers. comm. 2021). However, this makes assessing mortality from flood events in river habitats more challenging and the actual impact of these extreme events on mature individuals is unknown. Extreme flooding in Ontario is less likely to displace individuals because populations occur in isolated wetland habitats rather than along rivers and therefore do not experience scour from floodwaters.

A year after a major flooding event in Québec, many new naturally occurring individuals were noted suggesting that the flood may have facilitated seed germination (Pellerin, S. pers. comm. 2021). Germination and growth trials have indicated that this species germinates and grows optimally when substrates are moderately wet but not flooded (Langlois et al. 2017).

2.4.3. Irradiance level

Sufficient light is necessary to promote germination of False Hop Sedge (Environment Canada 2014a; Langlois and Pellerin 2016). However, growth experiments in Québec found that False Hop Sedge became yellow when in full sun (Pellerin, S. pers. comm. 2021). It is uncertain if this was caused by

other stressors (e.g., moisture availability), if individuals were not transitioned to a different level of light or if partial shade is consistently preferred by this species.

Logging at a site in Ontario caused a drastic (over 40x) increase in population size, which is assumed to be a result of increased light levels (COSEWIC 2011). The population decreased in subsequent years as other understory species became established and either outcompeted or shaded out False Hop Sedge. Opening the canopy may be a way to manage False Hop Sedge but opening it too much at once may alter hydrology (e.g., more rapid drying of soils) and increase the establishment of competitive species resulting in an overall decrease in abundance despite initial increases (Pellerin, S. pers. comm. 2021).

2.4.4. Disturbance and Competition

False Hop Sedge typically grows in areas with sparse ground cover where the disturbance regime of periodic inundation reduces competition (Thompson and Paris 2004; COSEWIC 2000; COSEWIC 2011). Soil disturbance is necessary to promote germination (Environment Canada 2014a; Langlois and Pellerin 2016). It is assumed that the species is intolerant of competition; however, this preference may be caused by other factors that correlate to more open understory habitats.

In transplant experiments, reduced competition volume and higher availability of light were shown to increase transplant survival; however, light was determined to be a more critical factor than competition (Langlois and Pellerin 2016). Competition alone showed no correlation with the survival and vigor of transplants suggesting that a lack of competition is not as vital as previously thought (Langlois and Pellerin 2016).

2.4.5. Ecological Classification and Associate Species

Throughout its global range False Hop Sedge habitat includes wet forests, openings around forest ponds, riverine wetlands, vernal pools, marshes, wet thickets, calcareous swamps, wet meadows, and wet prairies (Thompson and Paris 2004).

According to the Ecological Land Classification for Southern Ontario (Lee et. al. 1998) False Hop Sedge in Ontario primarily inhabits Deciduous Swamp (SWD), which is characterized by greater than 25% tree cover with a dominance of hydrophilic deciduous tree species (>75% of canopy cover). Environmental conditions of this community include variable flooding regimes and fluctuating water depths (typically being less than 2 m) with greater than 20% of the area experiencing standing water of vernal pooling intermittently or seasonally. Additionally, some communities where False Hop Sedge has been recorded are now Swamp Thickets (SWT) suggesting it may also be found in that community type. However, it is uncertain if it occurs in swamp thicket communities transiently (after a disturbance has occurred to expose bare soils) or if it is able to persist as the shrub cover increases. Where False Hop Sedge occurs, there is usually abundant bare ground; sparse shrub cover, and the canopy is often somewhat open or includes gaps. These swamp communities would best be

characterized as mineral; however, False Hop Sedge has been recorded occurring in a mineral habitat surrounding a larger organic wetland. Note that this species may be present within swamp inclusions created by vernal pools within deciduous forest communities as well.

Habitats where False Hop Sedge grows in Ontario typically have a canopy of Silver Maple (*Acer saccharinum* Linnaeus), Freeman's Maple (*Acer x freemanii* E. Murray), Red Maple (*Acer rubrum* Linnaeus), Green Ash (*Fraxinus pennsylvanica* Marshall), Black Ash (*Fraxinus nigra* Marshall) or a mix of the above. Other canopy associates include Eastern Cottonwood (*Populus deltoides* W. Bartram ex Marshall), Black Gum (*Nyssa sylvatica* Marshall) and Swamp White Oak (*Quercus bicolor* Willdenow). Northern Spicebush (*Lindera benzoin* (Linnaeus) Blume) and Buttonbush (*Cephalanthus occidentalis* Linnaeus) are the dominant subcanopy/understory shrubs at several Ontario locations (including historic and extant). It is possibly that increases in shrub cover may have extirpated an occurrence in London as it has been noted that this area has become very thick with Buttonbush in recent years.

Classification of False Hop Sedge's typical habitat according to Lee et. Al. (1998) is Red Maple Mineral Deciduous Swamp Type (SWD3-2) or Silver Maple Mineral Deciduous Swamp Type (SWD3-1); however, it may occur in other communities. Surrounding areas are typically mineral deciduous forest communities (FOD) ranging in moisture from dry to fresh-moist (Catling, P.K. pers. obs. 2021; Minielly, A. pers. com. 2021).

Figure 5. False Hop Sedge growing in open wet soils of a deciduous swamp

False Hop Sedge is found in areas with very sparse ground cover where periodic flooding maintains openness. Associate herbaceous vegetation is usually sparse or not present in the immediate vicinity of False Hop Sedge. Associate herbaceous species include Hop Sedge, Sensitive Fern (*Onoclea sensibilis* Linnaeus), False Nettle (*Boehmeria cylindrica* (Linnaeus) Swartz), Rice Cutgrass (*Leersia oryzoides* (Linnaeus) Swartz), Dwarf Clearweed (*Pilea pumila* (Linnaeus) A. Gray), beggarticks (*Bidens* spp. Linnaeus), Lady's-thumb (*Persicaria maculosa* Gray), Rough Cocklebur (*Xanthium strumarium* Linnaeus), Common Water- parsnip (*Sium suave* Walter) and Reed Canary Grass (*Phalaris arundinacea* Linnaeus) (COSEWIC 2011; Environment Canada 2014a; Catling, P.K. pers. obs. 2021; Minielly, A pers. com. 2021). Associate sedge species include Hop Sedge, Tuckerman's Sedge and Retrorse Sedge (Catling, P.K. pers. obs. 2021; Minielly, A. pers. com. 2021).

Figure 6. False Hop Sedge habitat within a deciduous swamp in Ontario.

A historical occurrence in Essex was noted as being in open ash-willow floodplain forest along a creek (Nature Serve 2021); however, the specific associate species at that location are unknown. The subpopulation in Niagara Region is more reflective of associates in the United States (Consiglio, J. pers. comm. 2022). Common associates of the nearby United States populations include Red Maple, Green Ash, Swamp Oak (*Quercus palustris* Münchhausen), Swamp White Oak (*Quercus bicolor* Willdenow), Black Gum and Silver Maple in the canopy; Common Winterberry (*Ilex verticillata* (Linnaeus) A. Gray), Coastal Sweet Pepperbush (*Clethra alnifolia* Linnaeus) and Northern Prickly Ash (*Zanthoxylum americanum* Miller) in the sparse shrub layer; and Marsh Fern, Hop Sedge, False Nettle, Dwarf Clearweed, Rice Cutgrass, Sensitive Fern, Common Wolly Bulrush (*Scirpus cyperinus* (Linnaeus) Kunth), beggarticks, Reed Canary Grass, Gray's Sedge, Tuckerman's Sedge, Royal Fern (*Osmunda regalis* Linnaeus), Common Water-parsnip (*Sium suave* Walter), Stout Woodreed (*Cinna arundinacea* Linnaeus), Purple Loosestrife (*Lythrum salicaria* Linnaeus), Tall Meadow Rue (*Thalictrum pubescens* Pursh), Bittersweet Nightshade (*Solanum dulcamara* Linnaeus), managrass (*Glyceria* spp. R. Brown), arrowheads (*Sagittaria* spp. Linnaeus) and forget-me-nots (*Myosotis* spp. Linnaeus) (Thompson and Paris 2004). Highbush Blueberry (*Vaccinium corymbosum* Linnaeus) is also a dominant understory shrub at the Niagara site (Consiglio, J. pers. comm. 2022).

2.5. Ecology

2.5.1. Life Cycle and Reproduction

Individuals of False Hop Sedge have been noted to reach at least 7 years of age and may reproduce every year due to their ability to reproduce both sexually and vegetatively from rhizomes (COSEWIC 2011). No patterns in sexual reproduction in relation to plant age or environmental conditions have been confirmed to date. Individuals may produce fruit every year, every other year or rarely (e.g., once in ten years) (Pellerin, S. pers. comm. 2021). Dormancy has not been studied in sedges, but it is widely thought that they cannot survive a dormancy period and are present vegetatively every year (Reznicek, A., Pellerin, S. and Ford, B. pers. comm. 2021).

False Hop Sedge plants have been noted to produce seeds within one year after germination (Langlois and Pellerin 2016). Flowering occurs in late June to August with flowers being wind pollinated (COSEWIC 2011; Ostile 1990). Fruit develops shortly after pollination occurs (COSEWIC 2000). In Ontario, mature achenes may be present from July to late October (Leslie 2018; Reznicek, A. pers. comm. 2021; Miller, B. pers. comm. 2021). The bladder-like perigynia of False Hop Sedge allows for water dispersal. False Hop Sedge is assumed to persist in the seed bank due to its hard-shelled achenes and studies on germination have noted that seeds kept for ten years may still germinate (Pellerin, S. pers. comm. 2021). Disturbance to upper soil layers is necessary to induce germination (Thompson and Paris 2004; COSEWIC 2011). Germination rates observed in greenhouse experiments ranged from 6 to 54% for seeds collected from Ontario and up to 70% for seeds collected in Québec (COSEWIC 2011).

2.5.2. Dispersal

Dispersal of False Hop Sedge may occur through gravity (i.e., falling to the ground near the parent plant), water, wind and, occasionally, on the feet of waterfowl (COSEWIC 2000; Thompson and Paris 2004; COSEWIC 2011). The persistent, inflated perigynia can be carried over large distances during flooding and water is likely the primary dispersal mechanism (Reznicek and Ball 1974; COSEWIC 2000; COSEWIC 2011; Environment Canada 2014a). Due to habitat fragmentation, there is unlikely to be dispersal or genetic exchange between most Ontario populations, which are hydrologically isolated (COSEWIC 2011). Sedge seeds are occasionally eaten by waterfowl, which could allow for long-distance dispersal; however, it is uncertain if seeds remain viable after being eaten (Mueller and van der Valk 2002; COSEWIC 2011).

2.5.3. Herbivory

Although the effects of herbivory from mammals and birds is unknown, it is expected to be insignificant (COSEWIC 2011). The primary herbivores of False Hop Sedge are insects. The exact impacts of insect herbivory are uncertain and additional information is needed to assess the effect these species have on False Hop Sedge individuals and occurrences. It is recommended that surveyors collect specimens of any insects observed feeding on False Hop Sedge to gain a better understanding of the distribution of these species in Ontario and to note any additional herbivore species.

2.5.3.1. Aphids

An exotic aphid (*Ceruraphis eriophori* Walker) poses the greatest threat as of herbivory on False Hop Sedge. Aphid infestation causes plants to dry out and may cause mortality within a year (COSEWIC 2011). Aphids cause direct damage by feeding on the phloem (sap) of the plant but are also vectors for many viruses (Langlois and Pellerin 2016). The exotic aphid was noted on transplanted individuals in Québec in 2007 and caused premature mortality of a large proportion of the 2006 transplants (COSEWIC 2011). It was later confirmed that the aphid was present in the greenhouses growing False Hop Sedge and all future transplants were treated with a synthetic insecticide prior to transplantation, which has drastically reduced aphid presence (Langlois and Pellerin 2016). This species of exotic aphid has been reported on other wild sedges in North America and transplant shock may have made these individuals more susceptible to infestation from a pest that was already present in the wild (Langlois and Pellerin 2016). The aphid has only been observed on naturally occurring individuals a few times (Pellerin, S. pers. comm. 2021). Aphid abundance may vary from year to year and the frequency and impact of major infestation events on False Hop Sedge is unknown (COSEWIC 2011). This aphid often hides between the leaves at the base of the stems (COSEWIC 2011). Surveyors should check False Hop Sedge in Ontario for the presence of aphids, collect them if they are present and send to an expert for identification. This aphid could have a significant impact on the long-term survival of False Hop Sedge and it is important to monitor the presence of its abundance and impact

to populations. The abundance of aphids or other insect predators should be noted during monitoring.

2.5.3.2. Diptera

A Dipteran parasite is known to complete its larval and pupal stages inside the achenes of Section *Lupulinae* (Reznicek and Ball 1974). The larvae of this parasite develop inside the achenes. Distortions to the achene caused by this parasite, which may lead to misidentification, have been discussed in **Section 2.2.2**. Other than sterility, the dipteran parasite does not appear to have other obvious impacts to plant health (Reznicek and Ball 1974). It is uncertain to what extent this parasite is present in the Ontario population and the impact it has on False Hop Sedge. The impact parasitism has on the long-term reproduction of False Hop Sedge at the individual and site level is also unknown (COSEWIC 2011). Distorted or discoloured achenes should be examined for the presence of this parasite and if found the insect should be sent to an expert for identification.

2.5.3.3. Hymenoptera

In Québec, a sawfly (*Pachynematus corniger* Norton complex) has been observed feeding on the leaves of False Hop Sedge (COSEWIC 2011). This sawfly feeds on the tips of the leaves and cuts them on an angle to form a point (COSEWIC 2011). The impact of sawfly on False Hop Sedge is unknown (COSEWIC 2011). This sawfly has not been noted on False Hop Sedge in Ontario, but surveyors should make note of any evidence of it or other insect species feeding on leaves.

2.6. Status

In the United States, False Hop Sedge is designated as Extirpated from one state, Endangered in eight states, Threatened in seven states and Rare in two states (COSEWIC 2011; Nature Serve 2021). Subnational ranks in the United States range from Presumed Extirpated (SX) to Apparently Secure (S4) (Nature Serve 2021). False Hop Sedge is not covered under the Convention on International Trade in Endangered Species (CITES) or the United States *Endangered Species Act* (COSEWIC 2011).

False Hop Sedge was first assessed as Threatened in Canada by COSEWIC in 1997; however, when the species was reassessed in 2000 it was evaluated as Endangered (SARA Registry 2019). False Hop Sedge has been listed as Endangered on Schedule 1 of the *Species at Risk Act* (S.C. 2002, c. 29) since 2003 with this rank being reconfirmed most recently in 2011 (SARA Registry 2019).

In Québec, False Hop Sedge is designated as Threatened under the *Act Respecting Threatened or Vulnerable Species* (R.S.Q. c. E-12.01) (COSEWIC 2011). This Act prevents harming or killing the species as well as the damage or destruction of its habitat (COSEWIC 2011). Note that in Québec Threatened is the highest rank, equivalent to Endangered in Ontario (Pellerin, S. pers. comm. 2022).

False Hop Sedge has been described as one of Ontario's rarest sedges in the Atlas of the Rare Vascular Plants of Ontario (Argus et al. 1982–1987). It is listed as Endangered under the provincial *Endangered Species Act* (S.O. 2007, c. 6) (2007). As in Québec, harming or killing the species as well as the damaging or destroying of its habitat is prohibited in Ontario by this Act. Since the first edition of the Rare Vascular Plants of Ontario in 1994, False Hop Sedge has been listed as having a subnational rank (SRank) of S1 (Critically Imperiled) (Oldham 1994; Oldham and Brinker 2009).

Table 5. Status of False Hop Sedge Including Global, National, Provincial and Ontario Local Ranks

Designation	Range	Rank	Date
G rank - Nature Serve	Global	G4 – Apparently Secure	2021
N rank – Nature Serve	National	N1N2- Critically Imperiled to Imperiled	2011
COSEWIC	National	Endangered	2011
SARA- Environment Canada	National	Endangered	2011
ESA – OMNRF	Provincial	Endangered	2011
S Rank	Provincial	S1- Critically Imperiled in Ontario and Québec	2011
Québec- *Respecting Threatened or Vulnerable Species Act*[1]	Provincial	Threatened	2005
Middlesex County[2]	Regional	R1	2003
Waterloo Region[3]	Regional	Rare	1999
Elgin County[4]	Regional	R3	2017
Essex County[4]	Regional	R1	2017
Lambton County[3]	Regional	?	2017
Niagara Region	Regional	Not assessed	n/a

2.7. Threats and Limiting Factors

False Hop Sedge is subject to threats including, but not limited to, habitat loss and degradation, habitat fragmentation, flooding and drought, anthropogenic alterations to hydrology, succession, invasive plant species, herbivory, exotic insects, pollution and run-off as well as landowner/ recreational activities (COSEWIC 2011; Environment Canada 2014a). Logging activities may have both positive and negative impacts to this species. A detailed description of threats to False Hop

[1] Québec. 2005. E-12.01, r. 3 - Regulation respecting threatened or vulnerable plant species and their habitats http://legisQuébec.gouv.qc.ca/en/ShowDoc/cr/E-12.01,%20r.%203

[2] Upper Thames River Conservation Authority. 2003. The Middlesex Natural Heritage Study Final Draft.

[3] Region of Waterloo. 1999. Significant Vascular Plants of the Region of Waterloo. 16pp.

[4] Oldham. 2017 List of the Vascular Plants of Ontario's Carolinian Zone Included Counties/Regional Municipalities

Sedge and its habitat is provided in COSEWIC 2011 and Environment Canada 2014a. Surveyors should become familiar with potential threats to complete a threat assessment as part of the monitoring protocol.

2.8. Recovery and Habitat Management

Recovery and habitat management for this species is discussed in the Recovery Strategy (Environment Canada 2014a) and Québec Conservation Plan (Jolicoeur and Couillard 2006). Details on actions already completed, currently underway and additional recommended actions are provided in the Recovery Strategy (Environment Canada 2014a). The history of recovery and management activities that have occurred at a site should be researched prior to completing inventory or monitoring of a site so that these activities can be related to population trends. Reintroduction activities that occurred prior to 2020 are summarized below.

2.8.1. Reintroductions

A recovery program including reintroduction (planting individuals on sites where the species was once present) and augmentation (planting individuals on sites where the species is still present) efforts was initiated in 2005 and continued until 2010. A total of 600 False Hop Sedge plants, which were raised in a greenhouse, were planted in Québec (Langlois and Pellerin 2016). A total of 370 False Hop Sedge plants (between 52 to 63 cm tall and with 11 to 13 shoots) were planted in Ontario between 2006 and 2009 (**Table 6**). The number of living greenhouse transplants in Ontario is unknown for most populations; however, in Québec 17 to 82% of transplants were successful. Transplants in Québec have been noted to be producing seed (COSEWIC 2011). When occurrences of aphid infestations are excluded, transplants live on average as long as naturally occurring individuals (Langlois and Pellerin 2016).

At the West Elgin population, 63 transplants (out of 112) were noted to be surviving, with a total of 91 fruiting stems present (COSEWIC 2011). Exact locations of planted individuals are unknown, but since planting occurred over 12 years ago it is expected that individuals present at these sites now are likely naturally established.

Table 6. Number of reintroduced plants per year in Ontario populations.

Population	Year of introduction	Number reintroduced
Rodney	2006	96
Rodney	2007	4
West Elgin	2006	112
West Lorne	2006	106
London	2006	17
London	2009	10
Mount Brydges	2006	24
Mount Brydges	2009	1

Population	Year of introduction	Number reintroduced
Total		**370**

3. Considerations for Implementing the Survey Protocol

3.1. Protocol Refinement

The monitoring protocol here is based on the review of the available literature on False Hop Sedge, consultation with the various experts who contributed advice and knowledge, the authors' own experience monitoring various rare plant species, including False Hop Sedge. An adaptive approach is recommended whereby the field protocol is refined and improved as data are collected, especially during the collection of baseline data. It is recommended that individuals who undertake the field work comment on the protocol and indicate where it was difficult to apply and to make suggestions for improvement. Given the substantially different distributions of plants in Canadian subpopulations, it is recognized that the monitoring protocol may need to vary among the three sites. However, in making refinements, it is essential that the overall objectives of monitoring population size and health, and documenting threats, be adhered to in order to provide sufficient consistency among sites to allow comparison of data and draw conclusions about the status, protection needs and management requirements of the population.

3.2. Management and Recovery Activities

Transplantation of False Hop Sedge has occurred across several of the sites in Ontario and Québec. Because the transplanted individuals are expected to be established and reproducing by this time, transplants from 2006 and 2009 should be included in population size estimates and mature stem counts. This inclusion is also beneficial for ongoing consistency in data collection because the majority of transplants in Ontario were not permanently marked and it is impossible to distinguish transplanted versus naturally occurring individuals.

Future transplants should be permanently marked and monitored over multiple years to determine their success at a new site. Transplants have proven successful, therefore re-introduction at additional sites where False Hop Sedge is not known to occur may be possible. Reporting transplanting is vital to determining the origin of newly discovered subpopulations.

3.3. Habitat and Species Sensitivity

The habitats in which False Hop Sedge occurs are not overly sensitive compared to other wetland habitats in Ontario that are highly impacted by trampling (e.g., *Sphagnum* bogs) during monitoring activities. False Hop Sedge plants are very easily observed in the sparse understory, reducing the potential for accidental trampling. Completing surveys later in the season when water levels are low will also ensure soils are more solid and footsteps will cause less damage compared to that of footsteps sinking into wet muddy substrates. Soil compaction in the habitat may still be a concern.

Surveyors should take care to avoid stepping close to the plant or stepping on other individuals while inspecting a plant. If researchers are careful, impacts to False Hop Sedge and its habitat from trampling associated with research activities can be negligible or none. If negative impacts do arise from monitoring activities, they should be noted, minimized to the greatest extent possible and used to inform frequency of surveys.

Invasive plant species are present at sites where False Hop Sedge occurs. Seeds of invasive plants may be accidentally transferred from site to site by surveyors. It is recommended that surveyors thoroughly wash off the mud from their clothing and footwear between visits to different sites to reduce the spread of invasive species.

False Hop Sedge is not likely to be subject to illegal collection by gardeners, foragers or herbalists; however, specific locations should be redacted or obscured from all reports that are to be made publicly available. This will also assist in maintaining long-term trust with private landowners who have granted permission to complete surveys on their lands.

3.4. Safety

False Hop Sedge occurs in areas where Black-legged Ticks are present. This species is a vector for Lyme Disease, which can have lifelong impacts on a person's health. Surveyors should take precautions and check for ticks after completing fieldwork.

Landowners should be notified when the surveys are to be completed prior to the visit and surveyors should wear high-visibility clothing on sites where hunting may occur.

3.5. Frequency of Survey

It is recommended that a thorough monitoring of existing populations occur every three to five years (Pellerin, S. pers. comm. 2021). Additional monitoring at the onset of studying a new location can help collect baseline data. It is believed that a minimum three years of baseline data collection would be sufficient for new locations. Follow up monitoring also assists with determining the identification of any uncertain individuals that did not set fruit in the first year of study. Monitoring after transplanting should occur annually for five years after transplant before resuming the regular schedule of once every three to five years.

As described in **Section 3.3**, there is minimal threat to the species, or its habitat associated with monitoring activities. Therefore, if budgets allow, monitoring may occur annually. Surveyors should still take precautions to avoid negative impacts such as trampling or soil compaction. If these impacts are noted, monitoring should cease for a few years to allow the subpopulation opportunity to recover.

3.6. Qualifications of Surveyors

Surveyor experience can significantly influence the probability of detection of False Hop Sedge and surveys completed by inexperienced surveyors can lead to inaccurate results. Surveys for False Hop Sedge should be led by individuals who understand the species' biology to assist with focusing search efforts to areas with the highest probability of locating the species. It is vital that one member of each search team be familiar with sedge identification and able to confidently identify the species when mature spikes are present.

Surveyors should also have the ability to interpret aerial imagery, navigate, record the survey track, geo-reference observations using a Global Positioning System (GPS) unit and classify vegetation communities.

Surveyors should have completed the Ontario Natural Heritage Information Centre (NHIC) data sensitivity training. Surveys for False Hop Sedge may require an authorization under the ESA. The Project Lead should contact the responsible biologist in the Ministry of Environment, Conservation and Parks (MECP) district where the survey is to be completed to determine if a permit is required or make an inquiry to SAROnatario@ontario.ca. Any permits required for the collection of False Hop Sedge specimens should be acquired prior to commencing fieldwork so that these are already in-hand if collection is needed. Additional permits may be required from Ontario Parks, Parks Canada Agency, Canadian Wildlife Service or Conservation Authorities if surveys are carried out in provincial parks and conservation reserves, national parks, national wildlife areas or conservation areas, respectively.

4. Standardized Survey Protocols for Inventory and Monitoring

4.1. Records Review

A records review should be carried out prior to undertaking an inventory or monitoring. Existing occurrence records may help to better scope the field survey or, if extensive data is already available for a site, existing records may eliminate the need for a field survey altogether. The absence of occurrence records from an area does not indicate that the species is absent; suitable habitat must be adequately surveyed before concluding that the species is unlikely to be present. The following sources can be consulted for information on snake distribution and occurrence records within Ontario:

- OMNRF Natural Heritage Information Centre (NHIC) www.ontario.ca/nhic; e-mail: nhicrequests@ontario.ca
- Local Conservation Authorities www.conservationontario.ca

- Status reports from the Committee on the Status of Endangered Wildlife in Canada (COSEWIC); available through the Species at Risk Act (SARA) Public Registry www.sararegistry.gc.ca/default.asp
- Other information sources such as, but not limited to species experts, OMNRF offices, site-related environmental impact or screening reports, published scientific literature and natural history inventories.

Additionally, recent observations on public biological databases such as iNaturalist may not be included in the NHIC database and inquiring with the observer can determine if the record is associated with a previously known occurrence.

4.2. Survey Timing

Examination of the achenes is the only way to positively identify False Hop Sedge in the field. Surveys and monitoring should occur during the period between when achenes reach maturity and when they fall off the spike. Fruiting period may vary year to year, but mature achenes can typically be found from July to early November. Therefore, all field surveys targeting False Hop Sedge (both presence/ no detection and long-term monitoring) should occur from mid-August to late-September to maximize the number of individuals that can be positively identified and capture a more accurate representation of population dynamics. If additional time is required for surveys, they should start no earlier than late-July and extend no later than mid-October to ensure plants have mature achenes.

Perigynia and achenes of False Hop Sedge persist later in the season than other sedges (Reznicek, A. pers. comm. 2021). However, this may vary by site, environmental conditions and annual weather differences. Plants found later in the season occasionally had fruiting stems that had very few perigynia remaining or were partially decomposing (Catling, P.K. pers. obs. 2020; Pellerin, S. pers. comm. 2022).

4.3. Presence/ No Detection Surveys

4.3.1. Identification of Survey Site Locations

Although habitat modeling has been completed for other SAR, this exercise has not yet been completed for False Hop Sedge. As part of the development of this survey protocol, potentially suitable habitat for False Hop Sedge in Ontario was mapped at a very high level. To identify potential suitable habitat for False Hop Sedge, soil classes were identified using known locations of the species and then overlapped with wetlands. Wetlands (2021) and the Soil Survey Complex (2019) were datasets obtained from Land Information Ontario (LIO). Soil characteristics from known locations of False Hop Sedge were used to identify soils where the species would be found, using the select by location, any soils that intersected with a species was identified ('NA' and 'VAR' were excluded due to a lack of specific data). From this resulting dataset, soil types included clay, clay loam, fine sand, loamy fine sand, fine sandy loam, sandy loam, silty clay loam, silt loam, and silty clay. These soil types were

exported and then clipped to the boundaries of wetlands in Ecoregion 7E using LIOs vector data. The resulting areas were identified as potential suitable habitat (**Figure 7**). This exercise identified a large number of potentially suitable areas, but future work could refine these based on ELC community mapping or aerial imagery and proximity to known occurrences.

Potential habitats based on the above mapping exercise should be prioritized for field work if they are in proximity to known occurrences of False Hop Sedge. The distance from known records to be included should be based on available budget, staff and timing. Community boundaries at the site should be delineated to the greatest extent possible based on aerial imagery to focus survey efforts to suitable habitat. Ecosites should be classified according to Lee *et al*. (1998) (MECP 2020). Priority should be given to large maple swamps with little anthropogenic disturbance. Canopy openings within in swamp habitats should be a focus of the search efforts if detailed aerial imagery is available that shows these features. A reconnaissance survey to further refine potentially suitable habitat boundaries may be completed prior to implementing the survey protocol if budget and timing allows.

Land ownership and access are important factors when selecting sites for consideration. Due to the cryptic nature of this species, it may be possible to locate additional populations in suitable habitat present on unstudied private lands adjacent to or near to extant or historic locations. Permission to access private land must be acquired prior to completing these surveys.

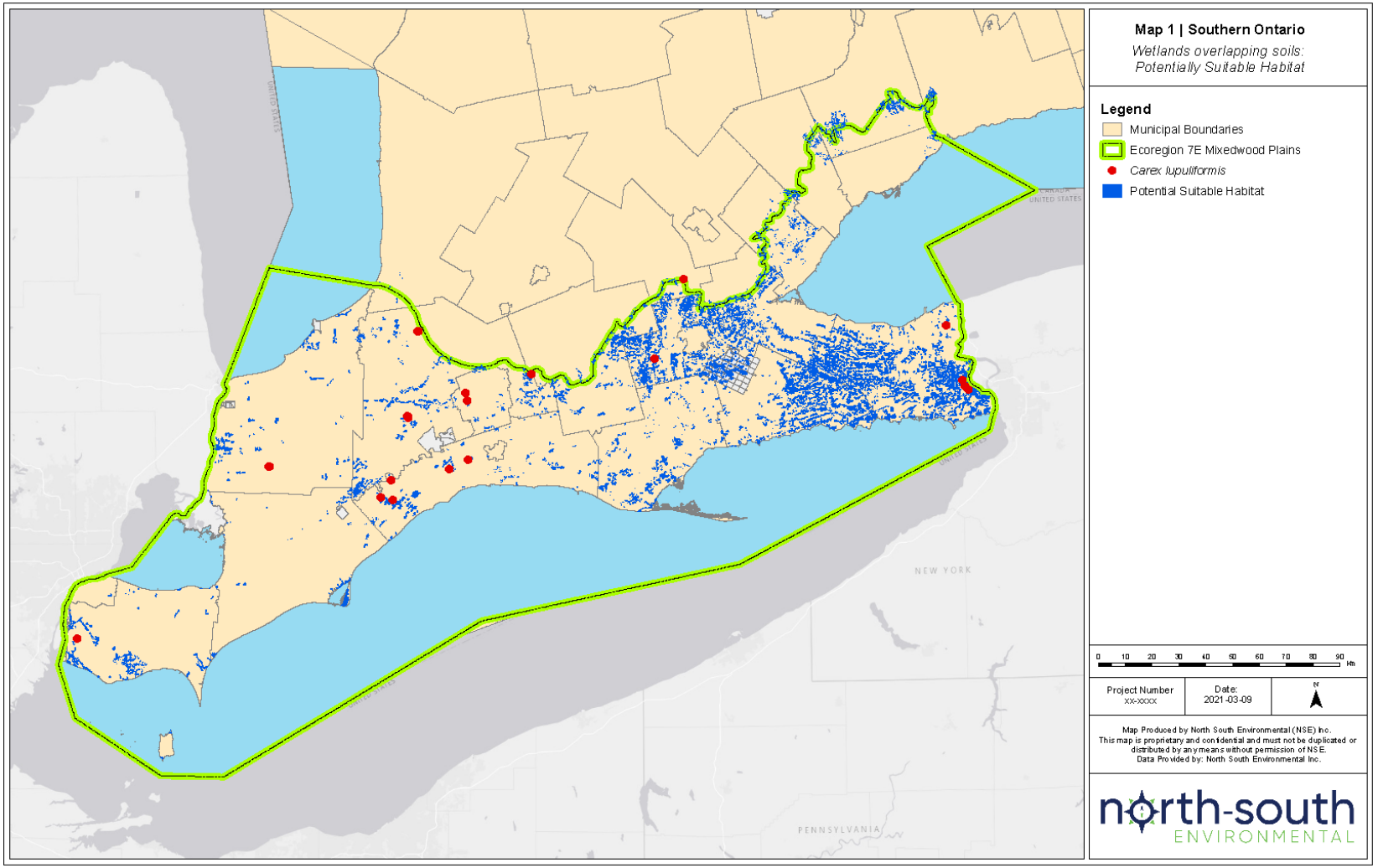


Figure 7. Potentially suitable habitat for False Hop Sedge in Ontario.

4.3.2. Method

To maximize the probability of detection, surveyors should walk in parallel transects through all areas with potentially suitable habitat. Transects in areas with little ground cover should be spaced 10 m apart. In areas with high amounts of ground cover, which decreases visibility, transects should be spaced 5 m apart. It is recommended that transects be oriented in a consistent compass direction (N, S, E or W) where possible. All areas of suitable habitat should be searched systematically. Multiple surveyors may spread out and complete separate transects at the same time; however, it is recommended they either walk adjacent transects at a similar pace or start at opposite ends of the suitable habitat area and work inward to avoid overlap. Flagging tape or survey flags may be used to temporarily mark transects as they are surveyed and may be particularly useful if multiple people are completing surveys. These markers should be removed after the survey has been completed. The survey route should be recorded with GPS track log or comparably accurate track log for data collection programs on tablets/ cellphones (e.g., ArcGIS Field Maps, etc.). All potential False Hop Sedge individuals along the transect should be examined to confirm identification. Individuals that have been documented may be temporarily flagged to avoid being checked twice if needed. Multiple consecutive years (three to five) of transect surveys with negative results may be used to indicate the absence of False Hop Sedge plants at a site. However, this species may persist in the seed bank and conservation or rehabilitation of these habitats should still be considered.

If project budget does not allow for a systematic search of the entire site, a more rapid controlled intuitive search can be used. This method requires that the surveyor be very familiar with sedge identification, have a search image for False Hop Sedge/Hop Sedge's growth habit and knowledge of the species' specific microhabitat preferences. Experienced surveyors may walk through the areas of suitable habitat and target the areas that look best for False Hop Sedge. Search routes should be recorded by GPS track log or comparably accurate track log on mobile devices. All potential False Hop Sedge individuals along the survey route should be examined to confirm identification. Individuals that have been documented may be temporarily flagged to avoid being checked twice if needed. Data collected from this controlled intuitive search surveys should not be used to indicate absence at the site.

If False Hop Sedge is encountered, GPS co-ordinates and photos should be taken of each patch and the number of individuals and flowering stems should be recorded. If long term monitoring is intended individual locations should be marked according to the monitoring protocol (**Section 4.3**). If plants with intermediate characteristics is encountered, the location should be recorded and flagged so that the individual(s) can be revisited in the future. If an individual does not show distinct characteristics across three years of study and experts are unable to confirm the identity, then it should be assumed to be Hop Sedge or a hybrid or sent for genetic testing.

A data sheet has been provided in **Appendix 2**. Surveyors should use this datasheet as a guideline for the minimum amount of data to collect; however, the datasheet may be revised to include additional data for specific survey needs or may be used to develop a digital data collected platform.

4.3.3. Survey Effort

Survey effort will be directly related to the amount of suitable habitat present at a site. Since False Hop Sedge is typically a robust plant and grows in areas with lower ground cover, a regular walking pace (~4 km per hour) or less is suitable. Survey effort will be higher at sites where similar species (**Section 2.2.1**) co-occur since surveyors may need to stop and confirm the identification between Hop Sedge and False Hop Sedge through the examination of mature achenes. This process may be time consuming at sites with an abundance of Hop Sedge.

4.3.4. Reporting

Reporting for presence/no detection surveys should include:

- a map of the sites surveyed showing the location of suitable habitat, survey route and location of any False Hop Sedge individuals or intermediate individuals,
- shapefiles or other digital data associated with mapping,
- estimated number of False Hop Sedge individuals,
- scans of datasheets or digital data files if collected via tablet,
- photos of each occurrence including vital identification features and habitat photos,
- surveyor names and contact information of the Project Lead,
- survey effort (duration and area covered),
- site description,
- general description of threats, anthropogenic impacts or other factors that might influence absence/ extirpation from the site,
- general site photos, and
- if the search result is negative, an assessment of if additional surveys are warranted and a detailed description or mapping of areas where future surveys should be focused. Details on potential unconfirmed False Hop Sedge (vegetative and unable to ID) should be provided if necessary.

Datasheets for consistent surveying have been provided in **Appendix 2**. All data should be shared with NHIC (https://www.ontario.ca/page/natural-heritage-information-centre). Information regarding the absence of False Hop Sedge at a site is important as well and should also be submitted to the NHIC. Data should be submitted in digital format (e.g., spreadsheet, shape files with associated tabular data) as per the instructions on NHIC's website. The local OMNRF/OMECP office should also be provided with a copy of the data submitted to NHIC. Additionally, landowners should be made aware of the presence of False Hop Sedge on their property if the species is located.

4.3.5. Voucher Specimens

Permits under the ESA are required for the collection of False Hop Sedge and it is recommended that the Project Lead acquire the appropriate permits for collection prior to completing presence/ no detection surveys in case collection is required.

Considering the rarity of the species it is not recommended that voucher specimens be taken for known occurrences. Conservation of SAR plants should be of primary concern when considering collecting; however, it is also important to ensure new locations are verifiable and supported by sufficient data, such as voucher specimens, and confirmed by experts. To prevent over-collection of this Endangered species, voucher specimens should only be collected at sites with no previous records. It is not recommended that voucher specimens be taken every time identification is in doubt. If identification is in doubt at a site with previous records, photo evidence documenting all identification characteristics should be taken and sent to experts for confirmation. Photos that clearly document all the identification features may be submitted to NHIC as an alternative to collection of a voucher specimen.

At sites where False Hop Sedge has not been previously recorded, a voucher specimen should be considered depending on the abundance of the occurrence. If less than ten plants occur at a site, extensive georeferenced photo evidence should be taken in place of voucher specimens. If the number of plants is between ten and twenty, a voucher specimen may include two to four stems cut above the rhizome (in order to reduce permanent harm to the plant) with at least one mature reproductive stem. If more than twenty plants occur at a site, voucher specimens should include at least two to four stems, with one to two stems having mature inflorescences, and may optionally include sections of rhizome.

Voucher specimens should be submitted to an herbarium with the following information provided:

- collector name,
- identifier name,
- collection date,
- location in GPS coordinates,
- location description,
- details on abundance, and
- a general habitat description including associate species.

To prevent multiple species from being combined in a voucher specimen, material collected from different individuals should be kept separate and submitted as separate collections. A recommended datasheet to fill out for collecting voucher specimens is provided in **Appendix 3**. This should be considered a baseline for the minimum data collected and may be modified to suit digital formats or for the collection of additional data.

4.4. Long-term Monitoring

The following monitoring protocol is to be used once False Hop Sedge has been confirmed at a site. It is recommended that, to the greatest extent possible, all False Hop Sedge individuals within an area be located prior to implementing this protocol so that the best method of permanently marking individuals can be chosen based on their proximity.

Locating individuals should follow the detection protocol outlined in **Section 4.2**. It is recommended that additional individuals may be monitored as they are located incidentally; however, a complete search of the site to locate additional individuals should occur every five years.

A group of stems occupying an area of 0.4 m² or more may be one individual. If stems are continuous the bases should be examined to distinguish separate individuals based on the location of young stems. New growth will occur on the edge of an individual. Alternatively, the methodology for large patches (**Section 4.3.2**) may be followed. Large patches may be defined as patches with over 500 stems where individuals are growing in close proximity and cannot easily be distinguished. Patches separated by one metre or more should be monitored separately and given unique identification numbers. The methodology for large patches measures the size of the False Hop Sedge patch and uses stem counts from a subset within it to estimate the number of stems and number of individuals in the patch.

Individuals with intermediate characteristics should be monitored over at least three years to see if achenes express more distinct characteristics allowing for confirmation in a following year. If identification cannot be confirmed, and funding is available, the specimen may be sent for genetic testing for confirmation. This level of strictness in identification aims to ensure that population size is not overestimated. To avoid future confusion, it is recommended that intermediate individuals and co-occurring Hop Sedge individuals remain marked with a marker distinct from False Hop Sedge individuals/ patches so that they are not re-counted in the future. Forestry tags attached to permanent markers are useful for giving individuals/ patches unique identifiers if necessary.

Wood markers are not recommended because of the seasonal flooding characteristic of the habitat. Rebar or pigtail stakes are recommended.

4.4.1. Data Collection

Example datasheets for monitoring individuals, transects or large populations have been provided in **Appendix 4**. If mobile devices are to be used for data collection, it is recommended that the program includes all fields on the datasheet provided.

4.4.2. Large Populations (Individuals not easily distinguishable)

Due to the difficulty distinguishing individuals when False Hop Sedge is growing in large patches stem counts within a subset of the patch are recommended to provide an estimate of population size. **Figure 8** provides a conceptual illustration of the monitoring protocol for large populations. Stem counts within a subset are likely the only practical way to monitor larger, fairly dense patches such as at the Niagara and West Elgin sites. This method also reduces likelihood of trampling individuals at sites with higher numbers of individuals.

In order to permanently mark a large population of False Hop Sedge a metal rebar (or other type of metal marker) should be placed in the approximate centre of the patch. Distance from the marker to the outermost False Hop Sedge individual should be recorded for each compass direction (NW, N, NE, E, SE, S, SW, W) and the patch shape and distances should be illustrated on the datasheet.

The total number of stems and the number of reproductive stems should be recorded within a subset of the patch and multiplied according to the plot vs patch size to provide an estimate for the total patch. For example, if a 1 m^2 plot is used for an 8 m^2 area it should be multiplied by eight, whereas if two 1 m^2 plots are used it should be multiplied by four to estimate for the total area. The location of the plots should be illustrated on the datasheet. The number of plots and location of plots used to estimate abundance should be comparable over time. It is recommended that plots be permanently marked where possible. Utilizing the same plots will allow for comparison and analysis of population trends.

A large patch at the West Elgin subpopulation had an average of 12 stems (flowering and non-flowering) per individual. This estimate is also consistent with the number of stems plants grown in the greenhouse for transplanting had at maturity (COSEWIC 2011). To estimate the number of individuals in the patch the total number of stems (including fruiting and non-fruiting) estimated in the patch should be divided by 12. Note that if this estimation method is used, it should be described clearly in any fieldwork reports.

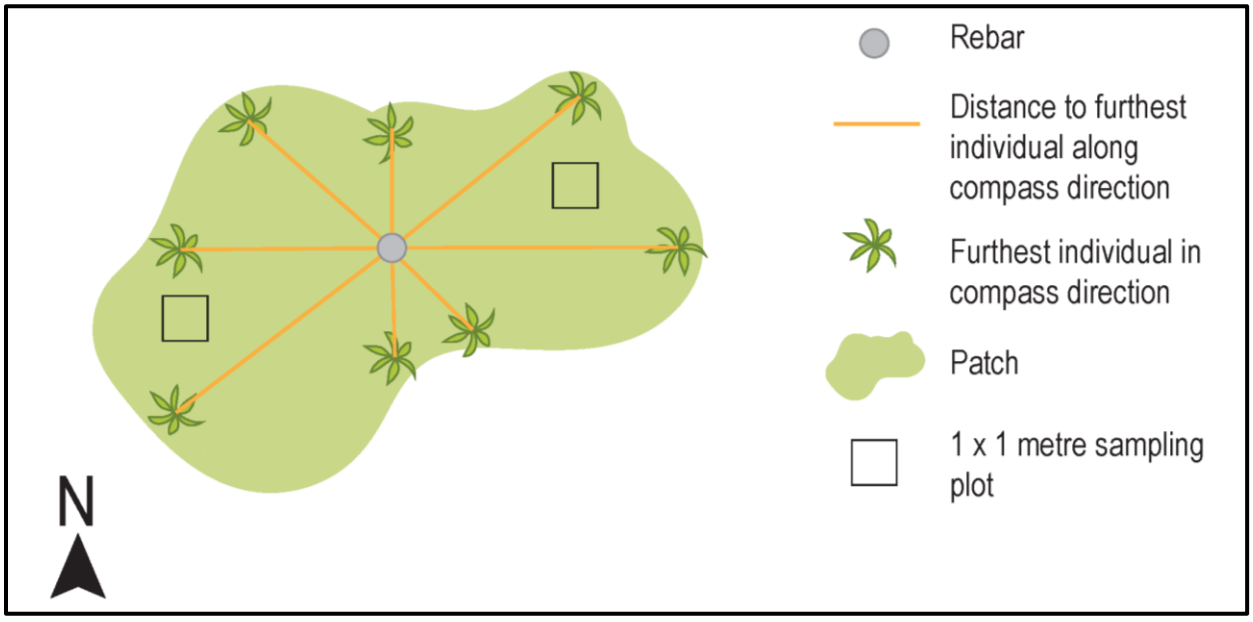


Figure 8. Conceptual drawing of the method for permanently marking and monitoring large patches.

4.4.3. Small Populations (Individuals easily distinguishable)

Where individuals can be easily distinguished, permanently marking each individual plant is the preferred method for rapid surveying because plants do not need to be identified every year of monitoring. Installing permanent markers should only be done with landowner permission. All individuals should be marked with a metal marker pushed into the ground (e.g., rebar, steel pigtail marker, etc.). For consistency, all markers should approximately 5 cm away so that it does not damage the rhizome. The compass direction from the marker to the individual should be recorded. A numbered metal tag attached to the marker can indicate the plant/patch ID number. GPS coordinates, photos and all data should be related to the plant/patch ID number. Flagging tape may be attached to increase visibility on sites where public interference is not expected. Flagging tape should be avoided where public interference is of concern.

If landowners are opposed to permanent marking, two alternatives are proposed based on the proximity of individuals to one another. For sites with a low density of individuals that are well spaced (over 10 m between each individual), individual locations may be marked with an accurate GPS device. Individuals should still be given a plant ID number so that data may be compared across years.

For sites with individuals occurring within a 10 m area, a transect method is recommended (**Figure 9**). In this method a transect should be created through the identified individuals with a landmark (e.g., tree) or other markers (e.g., if the landowner allows flagging tape but not metal stakes). GPS

coordinates should be taken at both ends of the transect. Photos of the transect with the measuring tape laid out should be taken for future reference. The starting point and direction of the transect should be clearly identified. Direction (left or right) and distance along and from the transect should be recorded for each individual and related to an assigned plant ID number. It is important that the distance from the transect be measured when the tape or metre stick is on a right angle to maintain consistency. When returning to the site, a chart with the plant ID numbers and coordinates along the transect will allow surveyors to relocate specific plants so that data can be compared over time (**Appendix 4**). Multiple transects may be used at a site if needed. Individuals over three metres away from the center transect line should be included in a different transect or recorded individually using the following method.

If an individual does not appear at a marked location for three consecutive years or two surveys three or more years apart, it is recommended that it be considered dead and the marker should be removed to avoid confusion with future seedling growth and to reduce the amount of anthropogenic material in the habitat.

If landowners do not permit any permanent markers, extremely accurate GPS units accompanied by a description and photos clearly demonstrating the transect start and end points or the individual's exact location may be used. Each individual plant should be clearly flagged (temporarily) in the photos and photos taken from each direction (N, E, S and W) should clearly show any obvious landmarks, which are to be detailed in a description of the plant location.

This method may also be used for large patches where it is impossible to distinguish individuals along a transect. In this case the centroid of the patch and furthest points in each compass direction should be recorded with an extremely accurate GPS unit.

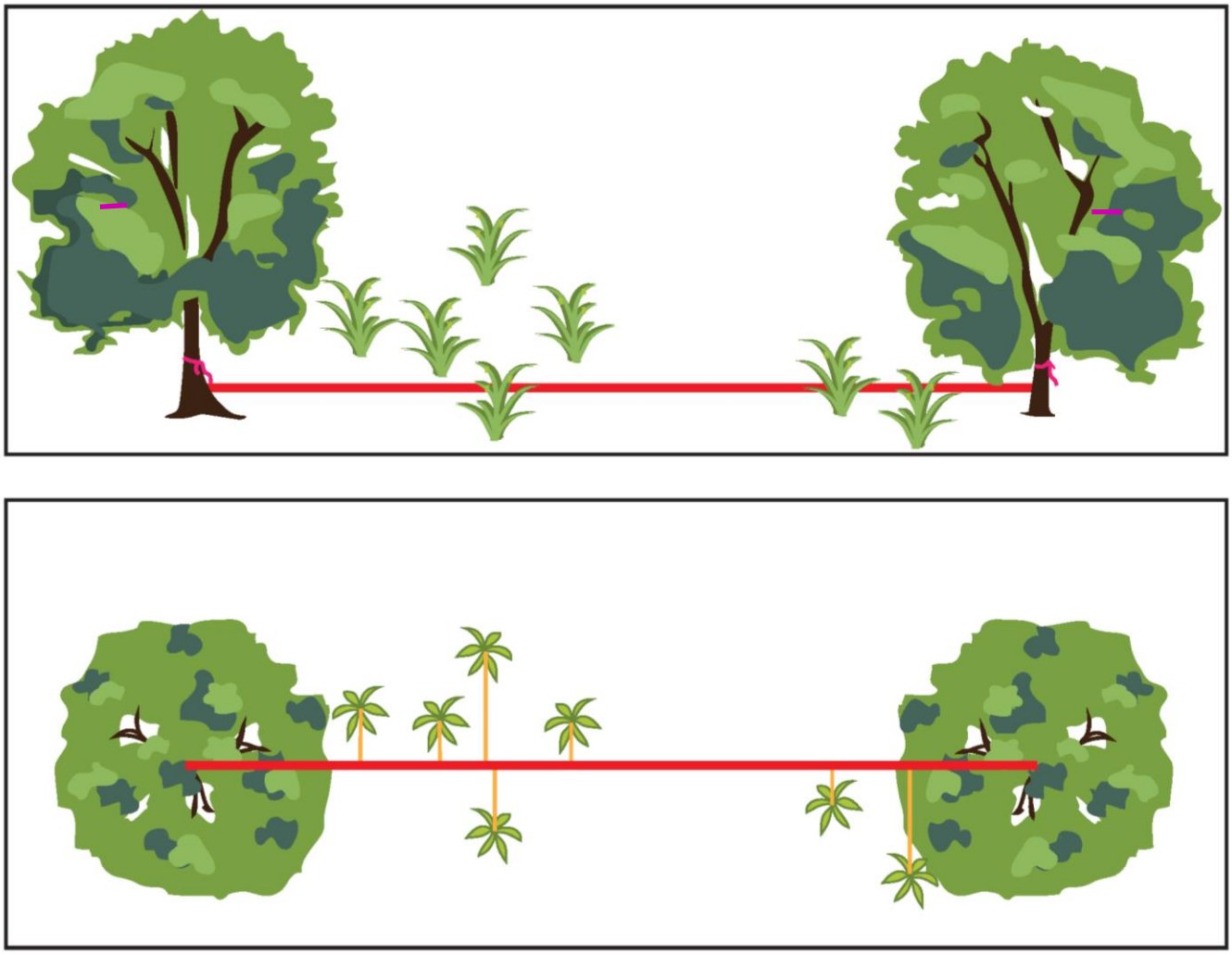


Figure 9. Conceptual drawing of the transect method of marking individuals.

In the conceptual example above two trees marked with flagging tape are used as the landmarks for either end of the transect and seven individual plants are noted along the transect. The distance along the red line, which would be the measuring tape and the distance from the measuring tape, as measured by a metre stick, is represented by the orange line would be recorded for each individual.

4.4.4. Population Demographics and Health

The number of vegetative stems, number of fruiting stems and plant height should be recorded for each marked individual. This data along with population size should be used to assess changes to the population over time. For large patches height should be recorded for the plots as a method of comparison over time.

Notes on individuals in poor health should be taken. Indicators of poor health to note include any evidence of decomposition, leaf discolouration (yellow or brown), leaf spotting or evidence of dehydration (weak stem or dry leaves). Evidence of browsing or the presence of insect herbivores or parasites (**Section 2.5.3**) should also be noted.

4.4.5. Associated Plant Community

The Ecological Land Classification system for southern Ontario's vegetation community description framework should be used to describe the associated plant community (Lee et al. 1998). For each community in which False Hop Sedge is present, the ELC community boundary should be mapped and the dominant species and cover of each vegetation layer should be recorded.

Species considered invasive in Ontario based on Weediness Index[5], exotic status (SE5) in the NHIC Database[6] or other invasive species list[7], should be noted. The abundance of all invasive species in the area of suitable habitat should be estimated (1 = 1-2 plants, 2 = 3-5, 3 = 6-20, 4 = 21-50, 5 = 51-100, 6 = 100+) and distribution described (L=localized, O=occasional, P=scattered patches, W=widespread). Location of invasive species should be recorded using a GPS or tablet. Polygons of larger patches of invasive species may be delineated. Proximity to False Hop Sedge should be noted.

4.4.6. Evaluating Threats

All threats to the habitat and species in and adjacent to the area of occurrence should be noted and ranked according to the COSEWIC guidelines for evaluating threats (COSEWIC 2012). Relevant pages of the COSEWIC guidelines have been included below. Where possible, the location and extent of threats should be mapped using a GPS or tablet. Where threats are not mappable (e.g., changes in hydrology, widespread distribution of an invasive plant species, evidence of widespread herbivory), they should be described. Adjacent land-uses should also be described.

4.4.6.1. COSEWIC Threat Evaluation

The text from this section was taken directly from page 9-12 of the COSEWIC guidelines for threats classification (COSEWIC 2012). Table numbers have been altered to fit this document.

Scope of a Threat

Scope is defined herein as the proportion of the species or ecosystem that can reasonably be expected to be affected by the threat within 10 years with continuation of current circumstances and

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[5] Oldham et al. 1995. Floristic Quality Assessment System for Southern Ontario. Natural Heritage Information Centre, Ontario Ministry of Natural resources. Peterborough, ON. 17pp.
[6] NHIC Database Available at: https://www.ontario.ca/page/get-natural-heritage-information
[7] Such as those developed by conservation authorities: CVC Invasive Species Lists and Factsheets https://cvc.ca/wp-content/uploads/2012/09/cvc-appendix-landowners-guide-to-invasives.pdf

trends (**Table 7**). Current circumstances and trends include both existing as well as potential new threats. The 10-year timeframe can be extended for some longer-term threats, such as global warming, that need to be addressed today. For species, scope is measured as the proportion of the species' population in the area of interest affected by the Threat. For ecosystems, scope is measured as the proportion of the occupied area of interest affected by the Threat. If a species or ecosystem is evenly distributed, then the proportion of the population or area affected is equivalent to the proportion of the range extent affected by the threat; however, if the population or area is patchily distributed, then the proportion differs from that of range extent.

Table 7. Scoring the scope of identified threats. Typically assessed within a 10-year timeframe.

Scope of threats scoring	
Pervasive	Affects all or most (71–100%) of the total population or occurrences
Large	Affects much (31–70%) of the total population or occurrences
Restricted	Affects some (11–30%) of the total population or occurrences
Small	Affects a small (1–10%) proportion of the total population or occurrences
Negligible	Affects a negligible (< 1%) proportion of the total population or occurrences

Severity of a Threat

Within the scope of the threat, severity is the level of damage to the species or ecosystem from the threat that can reasonably be expected with continuation of current circumstances and trends (including potential new threats) (**Table 8**). Note that severity of threats is assessed within a 10-year or three-generation timeframe, whichever is longer (up to 100 years).

For species, severity is usually measured as the degree of reduction of the species' population. Surrogates for adult population size (e.g., area) should be used with caution, as occupied areas, for example, will have uneven habitat suitability and uneven population density. For ecosystems, severity is typically measured as the degree of degradation or decline in integrity (of one or more key characteristics).

Table 8. Scoring the severity of a threat (within a 10-year or three-generation timeframe, whichever is longer [up to 100 years]).

Severity of threats scoring	
Extreme	Within the scope, the threat is likely to destroy or eliminate the occurrences of an ecological community, system, or species, or reduce the species population by 71–100%
Serious	Within the scope, the threat is likely to seriously degrade/reduce the affected occurrences or habitat or, for species, to reduce the species population by 31–70%
Moderate	Within the scope, the threat is likely to moderately degrade/reduce the affected occurrences or habitat or, for species, to reduce the species population by 11–30%
Slight	Within the scope, the threat is likely to only slightly degrade/reduce the affected occurrences or habitat or, for species, to reduce the species population by 1–10%
Negligible	Within the scope, the threat is likely to negligibly degrade/reduce the affected occurrences or habitat or, for species, to reduce the species population by < 1%.
Neutral or Potential Benefit*	Within the scope, the "threat" is likely to improve or not affect occurrences or habitat or, for species, to be neutral or to improve (a net benefit) the species population by > 0%).

*Threat may have some localized negative effects, but overall is thought to not affect or be a benefit to the species. For example, a forest fire may directly affect some individuals of a browsing ungulate, and produce a short term loss of habitat, however, over the three generation time window there is a benefit to the population as a whole due to regeneration of browse species post fire.

Impact of a Threat

Threat impact (or magnitude) is the degree to which a species or ecosystem is observed, inferred, or suspected to be directly or indirectly threatened in the area of interest. The impact of a threat is based on the interaction between assigned scope and severity values, and includes categories of very high, high, medium, and low.

Threat impact reflects a reduction of a species population or decline/degradation of the area of an ecosystem. As shown in **Table 9**, the median rate of population reduction or area decline for each combination of scope and severity corresponds to the following classes of threat impact: very high (75% declines), high (40%), medium (15%), and low (3%).

Table 9. The relationship of threat impact and population reduction or ecosystem decline or degradation

		Scope (%)			
		Pervasive	**Large**	**Restricted**	**Small**
Severity (%)	**Extreme**	50–100	22–70	8–30	1–10
	Serious	22–70	10–49	3–21	1–7
	Moderate	8–30	3–21	1–9	0.1–3
	Slight	1–10	0–7	1–3	< 1

Very High; High; Medium; Low

It is not always possible to assign an impact category of very high, high, medium, or low to a threat. For a complete list of impact categories, see **Table 10**. These additional categories include:

- Negligible: when the value for scope or severity is negligible.
- Unknown: used when impact cannot be determined (e.g., if values for either scope or severity are unknown).
- Not a Threat: when severity is scored as neutral or a potential benefit.
- Not Calculated: impact is not calculated if threat is outside the assessment timeframe (e.g., timing is insignificant/negligible or low, as threat is only considered to be in the past).

Table 10. Using scope and severity to derive the impact of a threat

		Pervasive	**Large**	**Restricted**	**Small**	**Negligible**	**Unknown**
Severity	**Extreme**	Very high	High	Medium	Low	Negligible	Unknown
	Serious	High	High	Medium	Low	Negligible	Unknown
	Moderate	Medium	Medium	Low	Low	Negligible	Unknown
	Slight	Low	Low	Low	Low	Negligible	Unknown
	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Unknown
	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
	Neutral or Potential Benefit	Not a threat	Not a threat	Not a threat	Not a threat	Not a threat	Unknown

Very High; High; Medium; Low

Timing of a Threat

Although timing (immediacy) is recorded for threats, it is not used in the calculation of threat impact. However, threat impact is not calculated for threats where timing values are low or negligible. See **Table 11** for guidance on determining the timing of the threat.

Table 11. Scoring the timing of a threat.

	Timing of threats scoring
High	Continuing
Moderate	Only in the future (could happen in the short term [< 10 years or three generations]), or now suspended (could come back in the short term)
Low	Only in the future (could happen in the long term), or now suspended (could come back in the long term)
Insignificant/Negligible	Only in the past and unlikely to return, or no direct effect but limiting

4.4.7. Documentation and Reporting

The following should be recorded and reported for each occurrence of False Hop Sedge:

- time and date of observation;
- name and contact information of observer(s);
- location description and directions;
- area of occurrence polygon and/or coordinates of centroid;
- map of distribution of plants within area of occurrence;
- photo records of occurrence and habitat;
- count or estimate of individuals;
- count or estimate of reproductive and non-reproductive stems;
- vegetation community description according to Lee et al. (1998);
- description and locations of nearby invasive species; and
- percent cover of non-native species in the vegetation community.

The following should be recorded and reported for each site:

- what method or markers were used to mark locations of individuals;
- if transects were used, their location and length;
- locations (GPS or transect references) and tag numbers of all permanently marked plants;
- an assessment of site wide threats.

This protocol is science-based and has been revised through an inventory of False Hop Sedge in Ontario. It is highly recommended that any issues with the survey method be recorded and reported so the protocol can be improved and adapted in the future.

SAR data should be reported to NHIC.[8] NHIC is Ontario's conservation data centre and maintains records of Ontario's SAR occurrences. Negative survey results should also be submitted to NHIC. Data should be submitted in digital format (spreadsheet or shape files with associated tabular data) as per the instructions on NHIC's website.[9] Incidental observations of other SAR or other provincially tracked species encountered during surveys should also be reported to NHIC, either in digital format or iNaturalist (by joining the NHIC Rare species of Ontario project).

If survey work is completed within a provincial park or conservation reserve, reporting requirements will be defined in the authorization to conduct the work. Reporting requirements or expectations for work completed on First Nations land should be established in consultation with the band council and any protocols for data transfer and use of data are to be followed. Distribution of data collected from First Nations lands is at the discretion of the band.

[8] www.ontario.ca/nhic
[9] https://www.ontario.ca/page/report-rare-species-animals-and-plants

5. Glossary

Achene – A small, dry, single-seeded fruit that does not release its seed at maturity

Apiculate – Ending at a short and pointed tip

Beak (Perigynium) – The abruptly pointed tip of the perigynium

Body (Perigynium) – Includes the entire perigynium excluding the beak

Bracts – A specialized leaf often positioned under the flower or inflorescence

Cespitose – Growing in thick, mat-like clumps

Conservation Ranks- Conservation ranks are designations assigned by NatureServe or local scientists to define how rare a species is on the global, national, provincial and local levels. See below for an example of global rank definitions from NatureServe (2022). National and provincial ranks typically follow the same classification. Local ranks may differ from the below.

- GX Presumed Extinct (species) – Not located despite intensive searches and virtually no likelihood of rediscovery. Presumed Eliminated (ecosystems, i.e., ecological communities and systems) – Eliminated throughout its range, due to loss of key dominant and characteristic taxa and/or elimination of the sites and ecological processes on which the type depends.
- GH Possibly Extinct (species) or Possibly Eliminated (ecosystems) – Known from only historical occurrences but still some hope of rediscovery. Examples of evidence include (1) that a species has not been documented in approximately 20-40 years despite some searching and/or some evidence of significant habitat loss or degradation; (2) that a species or ecosystem has been searched for unsuccessfully, but not thoroughly enough to presume that it is extinct or eliminated throughout its range.
- G1 Critically Imperiled – At very high risk of extinction or elimination due to very restricted range, very few populations or occurrences, very steep declines, very severe threats, or other factors.
- G2 Imperiled – At high risk of extinction or elimination due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.
- G3 Vulnerable – At moderate risk of extinction or elimination due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors.
- G4 Apparently Secure – At fairly low risk of extinction or elimination due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors.

- G5 Secure – At very low risk or extinction or elimination due to a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats.

Edaphic – Relating to the soil

Introgression – A genetic modification from the backcrossing of a hybrid with one of its parent species

Ligules – A scale-like outgrowth on the inner side where the leaf sheath meets the blade

Monoecious – Containing both male (staminate) and female (pistillate) flowers

Peduncle – The stalk of a flower

Perigynium – A sac that encases the achene

Pistillate – Containing only female flowers

Rachis – The main stem of a plant

Scabrous – Bumpy, rough

Staminate – Containing only male flowers

Stoloniferous – A method of propagation whereby a horizontal stem produces adventitious roots at its nodes.

Teeth (Perigynium) – Thin projections from the tip of the perigynium beak, often in pairs

6. Personal Communications

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Ford, Bruce. pers. comm. 2021. Email correspondence to P. K. Catling. March 18, 2021. Professor (Research focus on sedge taxonomy), University of Manitoba, Winnipeg, MB.

Miller, Brian. pers. comm. 2021. Email correspondence to P. K. Catling. March 4, 5 and 11, 2021. Botanist, Stantec, London, ON

Minielly, Andrew. pers. comm. 2021. Email correspondence to W.D. van Hemessen. September 2021. Ecologist, ON.

Pellerin, Stephanie. pers. comm. 2021. Email correspondence to P. K. Catling. March 8, 15 and 18, 2021. Adjunct Professor, Department of Biological Sciences, University of Montreal, Montreal, QC. Botanist, Jardin botanique de Montréal.

Reznicek, Anton. pers. comm. 2021. Email correspondence to P. K. Catling. March 18, 2021. Curator Emeritus (Vascular Plants), University of Michigan Herbarium, Ann Arbor, MI.

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APPENDIX 1 | Flora of North America Dichotomous Key to *Carex* section *Lupulinae* (Reznicek 2002)

To differentiate section *Vesicariae* from *Lupulinae* the following couplets have been taken from Flora of North America *Carex* Key F (Ball and Reznicek 2002).

1. Perigynia 7–11-, 5–12-, or 12–25-veined. ***Carex* sect. *Vesicariae***
\+ Perigynia 12–34-veined. ***(2)***

2. Basal and proximal leaf sheaths reddish or purplish. ***Carex* sect. *Lupulinae***
\+ Basal and proximal leaf sheaths yellowish to brown, without trace of red or purple. ***Carex* sect. *Rostrales***

The key to *Carex* sect. *Lupulinae* included below has been copied from:

Reznicek, A.A. 2002. *Carex* sect. *Lupulinae*, in Flora of North America Editorial Committee. Flora of North America, Vol. 23. Oxford University Press, Oxford. p. 511-514.http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=302713

1 Sheath of the distal nonbracteal leaf 0–1.5(–2.5) cm; beak of perigynium 1.5–4.2 mm; achenes elliptic or obovate; spikes globose to short-ovoid. **(2)**
\+ Sheath of the distal nonbracteal leaf usually 1.7 cm or longer; beak of perigynium 4.5–10 mm; achenes rhombic or nearly triangular; spikes ovoid to cylindric. **(3)**

2 (1) Perigynia radiating out in all directions to form globular spike, rhombic-ovoid, base cuneate, 8–35 per spike. ***Carex grayi***
\+ Perigynia ascending to spreading or, sometimes, the basal most reflexed to form an ovoid to obovoid spike, lanceoloid to ovoid, base convex, 1–12(–20) per spike. ***Carex intumescens***

3 (1) Achenes distinctly wider than long, widest beyond midle; perigynia stiffly spreading at right angles to rachis. ***Carex gigantea***
\+ Achenes as wide as long as or longer, widest near middle; perigynia ascending. **(4)**

4 (3) Angles of achenes pointed, often knobbed, with hard, nipplelike points; achenes (2.2–)2.4–3.4 mm wide, often nearly as wide as long. ***Carex lupuliformis***
\+ Angles of achenes smoothly curved, not pointed or knobbed; achenes 1.7–2.6(–2.8) mm wide, longer than wide. **(5)**

5 (4) Staminate peduncle 0.5–6(–7) cm, shorter than to exceeding distal pistillate spike by no more than 2 cm; plants loosely cespitose or not, short-rhizomatous. ***Carex lupulina***
\+ Staminate peduncle (3–)6–18 cm, usually exceeding distal pistillate spike by 2–12 cm; plants loosely colonial, long-rhizomatous. ***Carex louisianica***

APPENDIX 2 | Presence/ No-detection Data Form

Note: These datasheets provide a template for capturing all the information collected in this survey protocol and may be used as is or adapted by surveyors to suit personal preferences, site-specific needs or to the use of mobile devices for data collection, as long as data collection remains consistent.

False Hop Sedge: Presence/ No Detection Survey Data Form

DATE _____

SURVEYOR (S) _____

_____

START TIME_____ **END TIME** _____

TOTAL TIME _____ **PERSON HOURS** _____

LOCATION DESCRIPTION

SITE NAME _____

COUNTY/DISTRICT _____

NEAREST TOWN/CITY _____

CENTROID_____

_____

_____

_____

SURVEY TYPE ☐ Transect ☐ Targeted Search

WAS FALSE HOP SEDGE LOCATED? ☐ Yes ☐ No **ABUNDANCE** _____

ARE ANY UNCERTAIN INDIVIDUALS PRESENT ON SITE? ☐ Yes ☐ No **ABUNDANCE** _____

SEARCH EFFORT COMMENTS:

_____

_____

_____

POTENTIALLY SUITABLE HABITAT DATA

VEGETATION COMMUNITY

HT CODES: 1 = >25M 2 = 10-25M 3 = 2-10M 4 = 1-2M 5 = 0.5-1M 6 = 0.2-0.5M 7 = <0.2M

CVR CODES: 0 = NONE 1 = 1-10% 2 = 10-25% 3 = 25-60% 4 = >60%

LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (>> MUCH GREATER THAN; > GREATER THAN; = ABOUT EQUAL TO)
CANOPY			
SUB-CANOPY			
UNDERSTORY			
GROUND			

PERCENT COVER ESTIMATES THATCH: _____ LEAF LITTER: _____ BARE EARTH: _____ ROCK: _____

WOODY DEBRIS _____ NON-NATIVE SPECIES: _____

NON-NATIVE SPECIES:

_____

_____

HABITAT NOTES:

_____

_____

_____

_____

SITE NOTES (MANAGEMENT, THREATS, ETC.):

_____

_____

_____

_____

_____

False Hop Sedge: Presence/ No Detection Survey Individual Data Form

DATE ______________________________ SITE NAME ____

SURVEYOR (S) _______________________________________ SITE LOCATION ____

GPS ACCURACY__________

INDIVIDUAL LOCATIONS

WAYPOINT #	EASTING	NORTHING	TOTAL # STEMS	# FRUITING STEMS	HEIGHT (CM)	NOTES (INDICATION OF POOR HEALTH, INSECTS, ETC.)

NOTES

False Hop Sedge: Large Patch Data Collection Form (Individuals not Distinguishable)

PATCH CENTROID _____ _____ _____

PATCH MEASUREMENTS FROM CENTROID (M)

NW _____ **N** _____ **NE** _____ **E** _____

SE _____ **S** _____ **SW** _____ **W** _____

PATCH AREA _____ **PLOT AREA** _____

DRAWING AND MEASUREMENTS OF PATCH

PLOT LOCATION(S) _____ _____ _____ _____ _____ _____

_____ _____ _____ _____ _____ _____

MONITORING PLOT COUNTS

TOTAL STEM COUNTS	_____	_____	_____	_____
FRUITING STEM COUNTS	_____	_____	_____	_____

TOTAL PATCH ESTIMATES

ESTIMATED TOTAL STEMS _____

ESTIMATED TOTAL FRUITING STEMS _____

ESTIMATED TOTAL INDIVIDUALS _____

NOTES

APPENDIX 3 | Voucher Specimen Data Forms

Note: Datasheets provide a template for capturing all the information collected in this survey protocol and may be used as is or adapted by surveyors to suit personal preferences, site-specific needs or to the use of mobile devices for data collection, as long as data collection remains consistent

Collector's Name ____________________
Collection Date ____________________
Collection Number ____________________
Species ____________________
Location ____________________
Location Description
____
____
____
____
GPS co-ordinates _____ __________ __________
Site/Community Description
____
____
____
____
____
Notes
____
____
____
____

Collector's Name ____________________
Collection Date ____________________
Collection Number ____________________
Species ____________________
Location ____________________
Location Description
____
____
____
____
GPS co-ordinates _____ __________ __________
Site/Community Description
____
____
____
____
____
Notes
____
____
____
____

Collector's Name ____________________
Collection Date ____________________
Collection Number ____________________
Species ____________________
Location ____________________
Location Description
____
____
____
____
GPS co-ordinates _____ __________ __________
Site/Community Description
____
____
____
____
____
Notes
____
____
____
____

Collector's Name ____________________
Collection Date ____________________
Collection Number ____________________
Species ____________________
Location ____________________
Location Description
____
____
____
____
GPS co-ordinates _____ __________ __________
Site/Community Description
____
____
____
____
____
Notes
____
____
____
____

APPENDIX 4 | Monitoring Data Forms

Note: These datasheets provide a template for capturing all the information collected in this survey protocol and may be used as is or adapted by surveyors to suit personal preferences, site-specific needs or to the use of mobile devices for data collection, as long as data collection remains consistent.

False Hop Sedge: Long-Term Monitoring Data Form for Site

DATE _____

SURVEYOR (S) _____

_____

START TIME_____ **END TIME** _____

TOTAL TIME _____ **PERSON HOURS** _____

SITE NAME _____

COUNTY/DISTRICT _____

NEAREST TOWN/CITY _____

CENTROID_____

LOCATION DESCRIPTION _____

_____

_____

WAS FALSE HOP SEDGE RE-LOCATED? ☐ Yes ☐ No **ABUNDANCE** _____

ARE ANY UNCERTAIN INDIVIDUALS PRESENT ON SITE? ☐ Yes ☐ No **ABUNDANCE** _____

FALSE HOP SEDGE HABITAT DATA

VEGETATION COMMUNITY

HT CODES: 1 = >25M 2 = 10-25M 3 = 2-10M 4 = 1-2M 5 = 0.5-1M 6 = 0.2-0.5M 7 = <0.2M

CVR CODES: 0 = NONE 1 = 1-10% 2 = 10-25% 3 = 25-60% 4 = >60%

LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (>> MUCH GREATER THAN; > GREATER THAN; = ABOUT EQUAL TO)
CANOPY			
SUB-CANOPY			
UNDERSTORY			
GROUND			

PERCENT COVER ESTIMATES THATCH: _____ LEAF LITTER: _____ BARE EARTH: _____ ROCK: _____

WOODY DEBRIS _____ NON-NATIVE SPECIES: _____

NON-NATIVE SPECIES: _____

_____

HABITAT NOTES: _____

_____

_____

THREATS

THREAT TYPE	SCOPE	SEVERITY	THREAT IMPACT	TIMING	COMMENTS

SITE NOTES (MANAGEMENT, THREATS, ETC.):

_____

_____

_____

_____

_____

False Hop Sedge: Transect Monitoring Data Form

Date ______________________________

Surveyor (s) _______________________________________

Site ____

Transect ID____

Transect Start Location _____________________________

Transect END Location _____________________________

Transect Direction ___________

Transect Length (m) ___________

Number of False Hop Sedge _________

Number of Uncertain Plants _________

Number of Relocated Plants _________

Number of New Plants _________

Occurrence Size ____________________

Individual Locations

Plant ID #	New or Relocated (N/R)	Along transect (m)	Side of transect	From transect (m)	Total # Stems	# Fruiting Stems	Height (cm)	Notes (indication of poor health, insects, GPS if new, etc.)

Marker Description:

Notes:

False Hop Sedge: Data Form for Individuals

Date ____________________________

Surveyor (s) _____________________________________

Site ____

Occurrence Size ___________________________________

Number of False Hop Sedge ____________

Number of Uncertain Plants ___________

Number of Relocated Plants ___________

Number of New Plants ___________

Individual Locations

Plant ID #	Relocated (R) or New (N)?	Total # stems	# fruiting stems	Height (cm)	Notes (indication of poor health, insects, tag condition, GPS if new, etc.)

Notes

False Hop Sedge: Large Patch Data Collection Form (Individuals not Distinguishable)

PATCH LOCATION _____ _____ _____

MARKED WITH _____

PATCH MEASUREMENTS FROM CENTROID (M)

NW _____ **N** _____ **NE** _____ **E** _____

SE _____ **S** _____ **SW** _____ **W** _____

PATCH AREA _____

DRAWING AND MEASUREMENTS OF PATCH

PLOT LOCATION(S) _____ _____ _____ _____ _____ _____

_____ _____ _____ _____ _____ _____

MONITORING PLOT COUNTS

TOTAL STEM COUNTS	_____	_____	_____	_____
FRUITING STEM COUNTS	_____	_____	_____	_____

TOTAL PATCH ESTIMATES

ESTIMATED TOTAL STEMS _____

ESTIMATED TOTAL FRUITING STEMS _____

ESTIMATED TOTAL INDIVIDUALS _____

NOTES