# A Spatial Analysis of Rare Native Orchid Habitat Identification in Southeastern Manitoba

**Final Report**

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**Executive Summary**

The preservation of habitat for rare, native orchid species is necessary in Southeastern Manitoba. This need is in response to various human activities resulting in removal, fragmentation, and alteration of habitat, which threatens the biological diversity of Southeastern Manitoba. A tool to narrow the search in a large area for potential habitat and populations of rare, native orchids is required to help preserve these areas. The objective of this study is the potential identification of rare, native orchid sites in SE Manitoba, based on the attributes and habitat affinities of known native orchid sites within the same region, through the application of GIS software. Benefits of this study include the possibility of finding and preserving additional populations of rare, native orchids in SE Manitoba, as well as potential refinement of existing known habitat affinities and attributes of rare, native orchid species, with respect to SE Manitoba

The area of interest included Forest Management Unit 20 of the Pineland Forest Section in SE Manitoba. In this area there were 35 different orchids, and 13 species were considered very rare to uncommon in their provincial range. Five of these were chosen to examine more carefully based on the fact that they were the species with the most occurrences. Potential habitat for these species was determined individually. The habitat was defined as the forest covertype combined with the soil type at each site of the five species, with the resulting combinations being compiled for the given species. The map of potential habitat for any given orchid species highlights a significant portion of the study area.

Grass pink orchid preferred a very poorly drained organic soil in black spruce or a tamarack muskeg dominated covertype. Striped coral-root was found in black spruce or cedar covertypes, primarily on organic soiltypes. The showy lady's slipper was more varied in habitat preference, being found mostly in black spruce covertypes, but also in cedar, trembling aspen, and tamarack muskegs. Soiltypes for this species were either organic or mineral. Checkered rattlesnake plantain was in jack pine four out of five times, and black spruce the fifth time. This species was found on soiltype which ranged from rapidly drained mineral soil to very poorly drained organic soil. Lastly, Hooker's orchid seemed to prefer black

spruce dominated covertypes on organic or mixed soils, but was also found in jack pine as well as cedar covertypes, which also exhibited organic and some mineral soils.

For most of these orchids the coarse data that has been used resulted in extensive areas displayed as potential habitat. The usefulness of maps produced of potential rare orchid habitat is therefore questionable. Too few sites were used for any given species to be statistically confident that these are the actual preferred habitats. Additionally, the forest resource inventory is not detailed enough to use more than the basic tree species composition from the covertype codes. The revised forest resource inventory format will be more useful for future similar studies. Finer climate and precipitation data, as well as soil pH would be beneficial for similar studies. Future studies would also benefit from GPS co-ordinates taken not only at the entry point off the road to the orchid sites, but additional readings at the specific locations of the plants.

The maps of predicted habitat will likely be too coarse to be very helpful in the search for rare native orchids. However the model can be improved with more information, making it more applicable.

## Introduction

### Background Information

This project involves the identification of areas of habitat likely containing rare, native orchids, for the sake of preservation, in the southeastern Manitoba area. The human influence on the landscape is often at a large scale, which includes logging, agriculture, mining, peat harvesting, road creation, recreational trails and activity. These activities remove habitat directly, fragment the area, as well as alter many characteristics of adjacent habitat. Manitoba's native orchids, in general, are quite sensitive, and often require specific lighting, soil pH, and soil moisture conditions (Ames 2002). Additionally, mycorrhizal fungi are associated with the roots of most orchid species, increasing the absorption of nutrients and water. The mycorrhiza in turn may require specific soil, or climatic conditions, thereby predetermining where the orchids can be. Given these sensitivities, rarities are not surprising, and therefore, protection of known and future habitat of rare species is important.

Manitoba Conservation's Department of Forestry and the Native Orchid Conservation Inc. (NOCI) have worked together to ensure timber sales areas in the southeastern region are surveyed for rare, native orchids prior to harvesting, to enable habitat protection when and if possible. The current five-year harvest plan maps of the SE Manitoba area have been used by NOCI to identify areas of priority for inspection. This remarkable collaboration is a reactive approach to selected logging sites, which should continue, however it could be supplemented by surveys of identified potential rare native orchid habitats.

In order to identify habitat that potentially contains rare native orchids, the attributes of known orchid sites, and habitat affinities were used in this study. This data, specific for the study area, was analysed with GIS software in order to generate a comprehensive map of the SE Manitoba region displaying potential areas of equal weight to be surveyed. This will ideally lead to the discovery of populations of rare native orchids, which can then be protected. Forest management plans can thus be created to best accommodate sensitive areas, and these sites could enjoy large buffer zones of protection if in undisturbed areas, or the most appropriate sized buffers when adjacent to areas of various activities.

**Literature Review**

A number of studies have been done of the same nature as this one. Much of the information for this study was based on a report by Doris Ames (2002) of NOCI in which areas slotted for timber as well as peat harvesting in the SE region of Manitoba were surveyed for rare native plants. Ames' report identified and characterized the site locations used for this study. Many orchid species as well as culturally significant plant species were recorded, with the focus being on those orchid species at the highest risk. The project origin was in the realization of continual decline of rare native plants, especially orchid species, and the desire to protect them and their habitat. Locations containing any species of interest were marked off in the field and GPS coordinates were taken for plotting on a map. Manitoba Conservation Data Centre used the information recorded on the plant survey forms for database and GIS mapping purposes. This information was then passed on to the appropriate forestry personnel to be incorporated in to forest management plans. It is also suggested that preharvest surveys incorporate the identification of potential rare plant habitat with the aid of a guidebook of local habitat affinities. The continuation of the working relationship with the peat mining industry will also be very beneficial in preserving and protecting biodiversity in the area.

GIS was used to examine the small whorled orchid, the rarest in eastern North America, and its distribution in New Hampshire and Maine (Sperduto and Congalton 1996). In their study, twenty-seven locations of Istoria medeoloides (small whorled orchid) were examined in regards to physiography, soils and forest and herbaceous cover. These aspects of the model were weighted using a chi-square analysis. One model was made without weighting, and the other model was made with the weighting in mind. The equal weight models were able to predict 57% of sites used for model verification, and the weighted model predicted 78% of the sites. These sites included both sites that were used in the model creation and ones that were not. This study demonstrated the usefulness of using a GIS to create a predictive model using habitat characteristics, with sound methodology and statistical analysis.

A review of habitat-based models raised many of the same concerns that were mentioned in the above study of Istoria medeoloides (MacDougall and Loo 2002). This review also put forth the concern that habitat-directed search is not a tool that should be used in isolation. It is still necessary to use coarser-resolution analysis and more species-specific inventory procedures.

Weldon-Genge (2002) created a risk map and guidebook for rare and/or endangered plants in the Fundy Model Forest in southeastern New Brunswick. The goal was to identify candidate locations for protection and provide landowners with the information needed to reduce sensitive habitat destruction and preserve biodiversity. Habitat affinities (soil pH, canopy closure, development stage, and drainage) of the local native species of concern were compiled and mapped in GIS, followed by field verification of some of the highlighted areas. The accuracy varied by habitat type, with half of the sites used for verification being 50% or greater in accuracy.

## Project Area

The area of interest is the Manitoba Conservation, Department of Forestry's Southeastern region. The specific portion of this region used in the study is the Pineland Forest Section, Forest Management Unit 20. This is the area NOCI has been working in with the aid of the five-year harvest plan maps from Manitoba Conservation's Department of Forestry. This area is also nearly completely within the Boreal Shield Ecozone, with a little bit of Boreal Plain mixed in on the western boundary. Land use in the study area includes logging, agriculture, mining, cottaging and other recreational uses. There are many different types of vegetation and forest cover types in the area. See fig. 1 for a map of the study area.

## Species Description

Manitoba has about 4000 vascular plants, 1600 flowering plants, and 39 members of the Orchid, or Orchidaceae Family. At least 35 of these have been noted by NOCI in the study area. The known orchid locations of the study area, as provided by NOCI, contain two species that are very rare (S1 rank) in their provincial range, with one being nationally rare (Malaxis paludosa, denoted with an * in the list). Eleven more are ranked S2 or S3 (rare to uncommon in their provincial range), based on the Conservation Data Centre Ranking (range is from S1 - most rare, to S5 - least rare). The species of concern, ranked S1 to S3, were considered for the study, and are listed below.

| Rank | Common Name | Species |
|---|---|---|
| S2 | Dragon's Head | Arethusa bulbosa L. |
| S2 | Grass Pink | Calopogon tuberosus (L.) BSP. |
| S2 | Striped Coral-root | Corallorhiza striata Lindl. |
| S2 | Ram's Head | Cypripedium arientinum R. Br. |
| S3 | Showy Lady's-Slipper | Cypripedium reginae Walt. |
| S2 | Checkered Rattlesnake Plantain | Goodyera tesselata Lodd. |
| S3 | Loesel's Twayblade | Liparis loeselii (L.) Rich. |
| S2 | White Adder's Mouth | Malaxis monophylla (L.) var. brachypoda (Gray) Morris & Eames |
| S1* | Bog Adder's Mouth | Malaxis paludosa (L.) Sw. |

S2 Green Adder's Mouth Malaxis unifolia Michx.

S2 Hooker's OrchidPlatanthera hookeri (Torr.) Lindl.

S3 Large Round-leaved Orchid Platanthera orbiculata (Pursh) Torr.

S1 Rose Pogonia Pogonia ophioglossoides (L.) Juss.

Noted general habitat affinities of the various orchid species for the study area, as per field experience of NOCI, indicates a preference for coniferous forests and wetlands, while some like mixed coniferous-deciduous or just deciduous. A neutral to calcareous bog or forest floor is favoured by many rare species. Indicator plants, and even some animals, can be found with many rare orchids. However, sites unlikely to have orchids or other rare species are closed canopy, high density, coniferous forests, over mature stands, or "marshes with cattails or phragmites" (Ames 2002).

Due to a limited number of sites for most species ranked between S1 and S3, only five species were carefully examined. These species were grass pink (Calopogon tuberosus),striped coral-root (Corallorhiza striata),showy lady's slipper (Cypripedium reginae),checkered rattlesnake plantain (Goodyera tesselata), and Hooker's orchid (Platanthera hookeri). These species were found at somewhere between five and nine sites in the study area.

**Grass Pink**

Grass pink was found in five sites within the study area. Three of the sites were dominated by black spruce on very poorly drained organic soil, and two of these were mixed with tamarack. Two of the sites were in tamarack muskeg. This corresponds well to habitat affinities noted by NOCI (Ames 2002), the Manitoba Orchid Society (Heshka 2003), Smith's Orchids of Minnesota (1993), and the USDA (2002) PLANTS Database for grass pink. More specifically, these various sources observe favored habitat to be in wet sphagnum bogs, swamps, or marshes with black spruce, tamarack, or cedar. It is also noted that a neutral to high pH is preferred, as well as a more open canopy. The wetland indicator status from USDA (2002), in the Minnesota region, is OBL (obligate wetland). This means that grass pink occurs almost always (an estimated probability of 99%) under natural conditions in wetlands.

**Striped Coral-root**

Striped coral-root was found in six sites within the study area, all of which were on very poorly drained organic soil. Three of the sites were found to be in black spruce dominated stands, one of which was mixed with some eastern white cedar. Two sites were cedar dominated with some black spruce, and one site was a cedar/hardwood mixture. This species has been found in various habitats, including deciduous, mixedwood, and coniferous forests, and seeks out mildly acidic to neutral soil (Ames 2002; Heshka 2003; Smith 1993). The wetland indicator status is FACU- (facultative upland). This means that striped coral-root usually occurs in non-wetlands (an estimated probability of 67%-99%), but is occasionally found on wetlands (an estimated probability of 1%-33%) (USDA 2002). The `-` after FACU means that it leans further toward the non-wetland than the wetland habitat within the FACU range. This species does not display exclusive habitat preference based on literature, which is only somewhat reinforced by the known sites in the study area. The largest discrepancy is between the drainage of the soil at the sites and the stated preference for upland forests which are not too wet (FACU-).

### Showy Lady's-Slipper

Showy lady's-slipper was found in six sites within the study area. Three sites were black spruce dominated, one was mostly cedar with some black spruce and tamarack, another was a tamarack muskeg, and the last was trembling aspen dominated, with some other hardwoods. The soils in these locations were primarily organic and very poorly drained, except for the trembling aspen stand, which was imperfectly drained mineral soil. Habitat preferences of the showy lady's-slipper include black spruce, tamarack, cedar, as well as hardwood swamps, bogs, and fens (Ames 2002; Heshka 2003; Smith 1993). Additionally, this species welcomes organic or mineral soil, shade or full sun, and weakly acidic or weakly calcareous soil. The wetland indicator status by USDA (2002) for showy lady's slipper is FACW+ (facultative wetland), which means that it usually occurs in wetlands (an estimated probability of 67%-99%; the + indicates that it leans to the higher probability), but occasionally found in non-wetlands (an estimated probability of 1%-33%).

### Checkered Rattlesnake Plantain

Checkered rattlesnake plantain was found in five sites within the study area. Four of the sites were dominated by jack pine, and three of these were well or rapidly drained mineral soil, while the fourth was very poorly drained organic soil. The last site was also very poorly drained organic soil, but completely covered by black spruce. This corresponds with literature and field experience, which states that jack pine or coniferous forest in sandy, dry soil is most common, but that coniferous bogs or swamps and mossy rock have also been noted (Ames 2002; Heshka 2003; Smith 1993). The wetland indicator status for the checkered rattlesnake plantain is FACU (facultative upland). This means that it usually occurs in non-wetlands (an estimated probability of 67%-99%), but is occasionally found on wetlands (an estimated probability of 1%-33%) (USDA 2002).

### Hooker's Orchid

Hooker's orchid was found in nine sites within the study area, all were very poorly drained, and most were organic soils. Five of these were found in black spruce dominated stands. Two of the sites were jack pine dominated, one being on organic, and the other being on a mineral soil. Two more sites were cedar dominated stands, one being mixed with a variety of hardwoods. Literature points to upland pine being favored, some drier coniferous bogs, as well as some rich fens and swamps (Ames 2002; Heshka 2003; Smith 1993). It seems that the preferences have inverted themselves in the orchid sites sampled. However, the wetland indicator status by USDA (2002) for Hooker's orchid is FAC+ (facultative), which means that it is equally likely to occur in wetlands or non-wetlands (an estimated probability of 34%-66%; the + indicates that it leans more to the wetlands).

## Methodology

**Orchid Sites**

The known orchid sites were located by the Native Orchid Conservation Inc (NOCI) as a result of looking at proposed sites to be logged. NOCI was given the projected cut-blocks for the next five years. Within these areas they found most of these orchid sites by walking or driving through the area to be logged, looking for orchids. Once the orchids were located, they were documented for conservation purposes with GPS and plant survey forms.

A field study was conducted by Richard Reeves of the Native Orchid Conservation Incorporated to acquaint the authors with the study area. In mid February, Mr. Reeves lead the group members to site K and site L where nine dried orchid pods were recognized and collected. Through our field trip it was clear that site K was a meadow along the highway. This location on the forest cover map was labeled as a trembling aspen dominated stand which did not correspond with the actual cover seen at the site, and it was therefore removed from our study. Pineland has been a proactive area in conservation efforts toward native orchids.

**Cover type Data**

The cover-type data for the Pineland region was obtained through Tim Swanson, Forest Resources, Manitoba Conservation. The classifications were based on the Forest Resource Inventory. Only the nine cover-types containing known orchid sites were included in the analysis. Six of the covertypes were softwoods, where 76 per cent and over of the total basal area consists of coniferous species. Eastern cedar was the only mixedwood cover-type, where in this case 51-75 per cent of the total basal area consists of coniferous species. The only hardwood covertype was trembling aspen, where the basal area of all coniferous species was less than 25 per cent of the total basal area. The final covertype was a tamarack treed muskeg region, a wetland consisting mainly of sphagnum moss and heath plants with very scattered brush which supports semi-stagnated or stagnated trees.

The first three forest cover types were black spruce dominated at 71-100 per cent, and also at 40-70 per cent black spruce where the second major species was either jack pine or tamarack. These three cover-types were combined and considered as a black spruce cover-type. The next two cover-types were jack pine dominant at 71-100 per cent and also jack pine at 40-70 per cent cover, where the second major species was spruce. Both were combined and are considered as a jack pine cover-type. The sixth and seventh classes were comprised of eastern cedar dominant at 40-70 per cent and also where eastern cedar was 50 per cent or less and the second major species was hardwood. Both were collectively referred to as eastern cedar cover-type. The eighth class was the only hardwood dominant area with trembling aspen dominant at 70 per cent or greater. The last cover type was tamarack treed muskeg, consisting of 10-50 per cent tamarack and was referred to as muskeg.

**Soil Data**

The soil data was obtained from the Manitoba Lands Initiative website. The Manitoba Soil Survey Report number 14, from the Department of Forestry of Canada provided the codes to interpret the soil data map. The soil data covered the five Rural Municipalities within the study area (Piney, Lac du Bonnet, Reynolds, Stuartburn, and Whitemouth). However, one large area along the Manitoba Ontario border in the Sandilands area was lacking specific soil data, so instead, less refined data was used for this area. This coarse soil data in the missing area was primarily organic soil (BYH), which was the only soil of interest in the area. It was merged with the fine data to be useful for predictive purposes.

**Spatial Analysis**

The spatial analysis of the predictive model began with the basic theory that covertype plus soiltype will result in the highlighted orchid habitat. Each orchid species location was looked at individually, and layers were made of each dominant covertype and soiltype corresponding to the given site. This was achieved by querying each of the 95 townships to include only the main soiltype or covertype. After each individual township was queried for the specific cover and soil type, the results of the query were merged together. Therefore a layer was created for each classification of cover and for each soil classification of the study area. Next, each orchid species covertype and soiltype combination was reproduced throughout the study area. The covertype and soiltype map layers were intersected, through the Geoprocessor, to find the overlap. By intersecting the two layers, areas of overlap were produced. These areas of overlap were considered the areas of potential habitat for that rare orchid species. This was done for all the known locations and for each of the five rare orchid species in the study. Finally, all the combination of covertype and soiltype for each species were displayed together on one map for that species.

**Results**

Due to a limited number of sites for most species ranked between S1 and S3, only five species were carefully examined. It was also found that there were co-occurring orchids (rare or common) at many of the sites. In the tables to follow they are denoted as s#, with each number representing a given orchid species. It is evident that there are frequently many orchids within close proximity, favouring similar habitats.

**Grass Pink**

Grass pink was found in five sites within the study area. Three of the sites were dominated by black spruce, and two of these were mixed with tamarack, while the last two sites were in tamarack muskeg. All of the sites were also noted to be located in very poorly drained organic soil. All of the sites located in black spruce and muskeg/tamarack were noted to be in BYH dominated soil. This soil is an organic soil with a consistent water table present and a parent material of forest peat.

| Site | Covertype | Soil type | Soil Characteristics | Co-occurring Species |
|---|---|---|---|---|
| P | Black spruce | BYH | Organic, v p drained | s2,s8,s9,s10,s11,s19,s21 |
| AD | Black spruce | BYH | Organic, v p drained | none |
| AE | Black spruce | BYH | Organic, v p drained | none |
| AW | Muskeg- Tamarack | BYH | Organic, v p drained | none |
| Y | Muskeg- Tamarack | BYH | Organic, v p drained | s12 |

In fig. 2 grass pink highlighted habitat is shown. It was noted that all five of the study sites fall within this delineated area. This area is also noted to be extensive. The large area coverage is thought to be a result of black spruce being prolific throughout the study region in BYH soil. The extensive coverage of black spruce is pronounced on fig. 2 when only the muskeg highlighted areas are considered. This pronounced difference in coverage is also noted to be greater for other species such as the striped coral-root.

**Striped Coral-root**

Striped coral-root was found in six sites within the study area, all six of which were on very poorly drained organic soil. Three of the sites were found to be in black spruce dominated stands, one of which was mixed with some eastern white cedar. Two sites were cedar dominated with some black spruce; one site was located in a cedar/hardwood mixture. Of the three sites located in black spruce dominated stands two sites are on OOK - CAY- FYL dominated soil. These are soils that consist of 80% organic content and 20% Gleysolic mineral soil. There is a consistent water table present and a parent material of sphagnum peat and peat fen respectively. The other black spruce site was located on BYH dominated soil. This trend is reflected in the eastern cedar dominated sites with two of the three sites being in OOK - CAY - FYL soil and one in BYH soil.

| Site | Covertype | Soil type | Soil Characteristics | Co-occurring Species |
|---|---|---|---|---|
| J | Black spruce | OOK | Organic & Gleysolic | s8,s10,s20,s23 |
| E | Black spruce | BYH | Organic, v p drained | s1,s5,s7,s9,s10,s11,s12,s16,s18,s20,s21,s23 |
| H | Black spruce | OOK | Organic & Gleysolic | s7,s8,s10,s11,s12,s13,s15,s16,s17,s18,s24,s25 |
| N | Cedar | BYH | Organic, v p drained | s1,s4,s7,s9,s10,s11,s12,s13,s20,s21,s23,s24 |
| W | Cedar | OOK | Organic & Gleysolic | s8,s21,s25 |
| B | Cedar | OOK | Organic & Gleysolic | s10,s13,s20,s24 |

As seen in the table this species is only somewhat exclusive in habitat preference. In fig. 3 the preferred habitat for striped coral-root is shown, again this area is extensive. All six of the study sites are also within this area.

**Showy Lady's-Slipper**

Showy lady's-slipper was found in six sites within the study area. Three sites were black spruce dominated, one was mostly cedar with some black spruce and tamarack, another was a tamarack muskeg, and another site was trembling aspen dominated, with some other hardwoods. The soils in these locations were primarily organic and very poorly drained, except for the trembling aspen stand, which was imperfectly drained mineral soil. Two of the three sites located in black spruce are present on BYH soil with the other black spruce site being located on OOK - CAY - FYL. The cedar site is located on BYH soil also. The trembling aspen is located on PIY - MEB soil, which is a mineral soil consisting of a Luvisolic - Gleysolic mix. This soil has a water table present during unspecified times and has a morainal parent material. The muskeg-dominated site is also located on BYH soil.

| Site | Cover type | Soil type | Soil Characteristics | Co-occurring Species |
|---|---|---|---|---|
| O | Black spruce | BYH | Organic, v p drained | s8,s10,s11,s20,s21 |
| E | Black spruce | BYH | Organic, v p drained | s1,s5,s6,s7,s9,s10,s11,s16,s18,s20,s21,s23 |
| H | Black spruce | OOK | Organic & Gleysolic | s6,s7,s8,s10,s11,s13,s15,s16,s17,s18,s24,s25 |
| N | Cedar | BYH | Organic, v p drained | s1,s4,s6,,s7,s9,s10,s11,s13,s20,s21,s23,s24 |
| AX | Trembling Aspen | PIY | Luvosolic & Gleysolic | s10 |
| Y | Muskeg- Tamarack | BYH | Organic, v p drained | s3 |

On fig. 4, showy lady's slipper is noted to cover large areas. It is clear that this species is not exclusive to any given habitat characteristics within the study area, with five different covertype/soiltype preferences.

**Checkered Rattlesnake Plantain**

Checkered rattlesnake plantain was found in five sites. Four of the five sites were located in jack pine dominated stands. The only other site was in a black spruce dominated stand. Two of the four jack pine sites were in SDI soil which is a Brunisolic mineral soil, and one other jack pine site was also in a mineral soil although it is classified as WOG which is of the Luvisolic order. The fourth jack pine site is on OOK - CAY - FYL soil which is Organic. The fifth site is also on Organic soil (BYH). The drainage for this species varies from very poor to well to rapid. Both of the organic soils are very poorly drained, the Brunisolic is well drained and the Luvisolic is rapidly drained. For both the well drained Brunisolic and the rapidly drained Luvosolic there is no water table present.

| Site | Cover type | Soil type | Soil Characteristics | Co-occurring Species |
|---|---|---|---|---|
| AL | Jack Pine | OOK | Organic & Gleysolic | none |
| G | Jack Pine | WOG | Luvasolic rapid drained | s8,s13 |

| | | | | |
|---|---|---|---|---|
| M | Jack Pine | SDI | Brunisolic well drained | none |
| F | Jack Pine | SDI | Brunisolic well drained | s5,s7,s8,s13,s26,s27 |
| L | Black Spruce | BYH | Organic, v p drained | s8,s13,s20,s26 |

On fig. 5, checkered rattlesnake plantain highlighted areas are shown. It should be noted that without the black spruce habitat the majority of potential habitat are in the southwest corner of the study area. All five of the sites are within the highlighted area.

**Hooker's Orchid**

Of the five species looked at, Hooker's orchid was found at the most sites. There were nine recorded occurrences of Hookers orchid. Two of the sites were in jack pine dominated stands, five of the sites were in black spruce dominated stands and the other two were in cedar/hardwood mixes. All of the black spruce sites had Organic soil being either BYH or OOK - CAY - FYL. One of the jack pine sites was also on BYH soil and the other was on KRY - RTV - KIC, which is equal parts Gleysolic, and Organic with a constant water table present and parent material of peat and fluviolacustrine. The cedar sites are also both Organic being BYH and OOK - CAY - FYL

| **Site** | **Cover type** | **Soil type** | **Soil Characteristics** | **Co-occurring Species** |
|---|---|---|---|---|
| D2 | Jack Pine | BYH | Organic, v p drained | s8 |
| D | Jack Pine | KRY | Gleysolic & Organic | none |
| J | Black spruce | OOK | Organic & Gleysolic | s6,s8,s10,s23 |
| O | Black spruce | BYH | Organic, v p drained | s8,s10,s11,s12,s21 |
| E | Black spruce | BYH | Organic, v p drained | s1,s5,s6,s7,s9,s10,s11,s12,s16,s18,s21,s23 |
| L | Black spruce | BYH | Organic, v p drained | s6,s8,s13,s26 |
| A | Black spruce | OOK | Organic & Gleysolic | s4,s8,s10,s11,s23 |
| N | Cedar | BYH | Organic, v p drained | s1,s4,s6,s7,s9,s10,s11,s12,s13,s21,s23,s24 |
| B | Cedar | OOK | Organic & Gleysolic | s6,s10,s13,s24 |

On fig. 6, Hooker's orchid is shown. This orchid was the most prolific of the species studied. Although without the black spruce cover the potential habitat identified is very minimal. All of the sites do fall within the area shown as preferred habitat.

## Discussion

### Problems

The results of this predictive model provide much information about where rare species of orchid may possibly be found. Unfortunately, due to the nature of the information that went into the predictive model it is hard to know how exactly to interpret the results. The sites that were identified by NOCI as containing rare species of orchid are too few and far between for an appropriate statistical analysis to be performed. In the current study, it was found that the GPS coordinate was often taken on the road where the field trip began with orchid species being found on either side of the road. This made it difficult to pinpoint the location of the orchid species even when the additional information that was provided on the plant survey forms was used. The GPS co-ordinates were too inexact to correspond exactly to the data in the cover and soil type layers. Therefore there was some uncertainty as to the accuracy of the cover type and soil type information gathered from the data layers for some of the sites. One site was eliminated all together.

The statistical analysis that would be performed would be a chi-square analysis due to the ordinal nature of the data, but there are not enough sites for any one species of orchid to have the proper number of samples for an accurate statistical analysis. For this reason it is impossible to know that the sites where orchids were found are any more likely to have certain characteristics than randomly selected sites. It is also impossible to give weight to the characteristics for use in the model as this is done once again with a statistical test, such as the chi-square analysis.

As it stands, the results of the analysis provide maps of the research area with locations that correspond to characteristics that were found at the sites where the orchids were located. These maps have limited the areas in SE Manitoba where it is thought that these orchids could be found, but there are many things that could be done to add validity to this study. The areas highlighted on the maps still cover very large portions of southeastern Manitoba and it is doubtful that these maps would be very helpful to limit the search area for finding rare species of orchids.

### Recommendations

There are ways, however, that this particular predictive model could be enhanced. Although it might not be possible to collect the data randomly, it would be beneficial to have more sites. This would make it more likely that the patterns found among orchid sites were due to an affinity for the sites and were not just a random pattern that occurred. It would be beneficial to have the exact GPS location of each of the species at each of the sites in addition to an entry point GPS reading. If a GPS coordinate could be taken for each orchid species at its site it would be possible to be more certain that the data layers added afterwards matched with the appropriate site.

The predictive model could be enhanced by using layers of data with additional information and more detail than was provided by the layers used in this research. Cover and soil type information was used for the purpose of this research. The information regarding covertype was made into a shapefile in such a way that characteristics such as percent cover where not possible to extract. The climate and precipitation data that was available was far too coarse to be of any assistance. PH data regarding the sites where the orchids were found could also be beneficial, but only if it would be possible to find pH data for the entire study site, and if pH measurements were taken at existing sites.

With a larger number of sites and with more data layers to include it would be possible to perform a chi-square analysis to determine if there is any significant difference between the sites where orchids were observed and between a number of random sites chosen from the study area. Without the ability to perform this statistical analysis it cannot be determined for certain whether the pattern found among the orchid sites is a pattern that has occurred by chance or a pattern that has been observed due to the fact that orchids grow preferentially in areas with those specific characteristics. It would also be possible to weight the characteristics for use in the model.

With a statistically validated predictive model, ground truthing could be used to validate the model. A number of sites would be chosen randomly from the area predicted to have orchids by the model. These sites could be visited in order to determine whether or not they have orchids. If a high percentage of the visited sites had the orchids, it would lend much support to the model.

**Conclusion**

The methods that were used in the above study can be very beneficial for making a predictive model of where to find certain species. There were, however, limitations in the above study and therefore any research based upon the above methods must keep these limitations in mind.

With the proper predictive model there would be benefits for many different kinds of applications. This information could be used to designate sites that should be checked for rare orchid species before any disturbance is allowed. This information could be used to point out areas that would be beneficial to protect. This information could also pinpoint areas with suitable habitats for replanting programs.

With the proper information and method, as described above, a predictive model could be very helpful for those trying to manage resources in Manitoba and for those who are more particularly concerned with rare, native orchids.

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**Maps**