

# Ecological and Rare Species Surveys of the Gogomain Swamp



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**Michigan Natural Features Inventory**

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Cover photographs: The Gogomain Swamp is the largest documented high-quality rich conifer swamp in Michigan and supports the largest recorded population of Lapland buttercup (*Ranunculus lapponicus*, state threatened) in the state. (Top photo by Joshua G. Cohen and bottom photos by Bradford S. Slaughter.)

# TABLE OF CONTENTS

<b>INTRODUCTION</b> .....	1
<i>Landscape Setting</i> .....	1
Regional Landscape Ecosystems.....	1
Circa 1800 Vegetation.....	1
Present Land Cover.....	3
<b>METHODS</b> .....	3
<i>Rare Species Surveys</i> .....	3
<i>Ecological Surveys</i> .....	3
<b>RESULTS</b> .....	9
<i>Rare Species Surveys</i> .....	9
<i>Ecological Surveys</i> .....	9
Site Classification.....	9
Site Description.....	9
Abiotic Context.....	9
Ecological Processes.....	10
Vegetative Composition and Structure.....	10
Element Occurrence Ranking.....	14
Size.....	14
Landscape Context.....	14
Condition.....	14
Overall Rank.....	15
<i>Threats</i> .....	15
<i>Management Recommendations</i> .....	17
<b>DISCUSSION</b> .....	17
<b>REFERENCES</b> .....	19
<b>ACKNOWLEDGEMENTS</b> .....	20

## FIGURES

<b>Figure 1.</b> Ecoregions of Upper Michigan.....	2
<b>Figure 2.</b> Vegetation circa 1800 of the Gogomain Swamp.....	4
<b>Figure 3.</b> 1998 Aerial photograph of the Gogomain Swamp.....	5
<b>Figure 4.</b> Delineation of high-quality rich conifer swamp.....	6

## APPENDICES

<b>Appendix 1.</b> Plant species observed at Gogomain Swamp.....	21
<b>Appendix 2.</b> Animal species observed at Gogomain Swamp.....	26
<b>Appendix 3.</b> Global and State Element Ranking Criteria.....	27



## INTRODUCTION

During the summer of 2008, the Wildlife Division of the Michigan Department of Natural Resources (MDNR) commissioned Michigan Natural Features Inventory (MNFI) to conduct an ecological survey and a rare species survey of newly acquired state land in Chippewa County within the Sault Sainte Marie Management Unit falling within the Gogomain Swamp. The purpose of the MNFI survey was to 1) assess the ecological integrity of the swamp and determine if the swamp qualified for consideration as a high-quality example of rich conifer swamp as defined by MNFI's grading and ranking criteria and standard Natural Heritage methodology, and 2) search for populations of rare plant and animal species. This report describes the landscape setting of the Gogomain Swamp, summarizes the findings of MNFI's surveys, discusses the threats to the ecological integrity of the swamp, provides site specific management recommendations aimed at protecting biodiversity, and discusses the conservation context of the Gogomain Swamp.

### **Landscape Setting**

#### **Regional Landscape Ecosystems**

Regional landscape ecosystems of Michigan have been classified and mapped based on an integration of climate, physiography (topographic form and geologic parent material), soil, and natural vegetation (Albert 1995). The regional classification describes broad patterns of natural community and species occurrences and natural disturbance regimes across the state. Understanding these patterns is useful for integrated resource management and planning, and for biological conservation. The classification is hierarchically structured with three levels in a nested series, from broad landscape regions called sections, down to smaller subsections and sub-subsections.

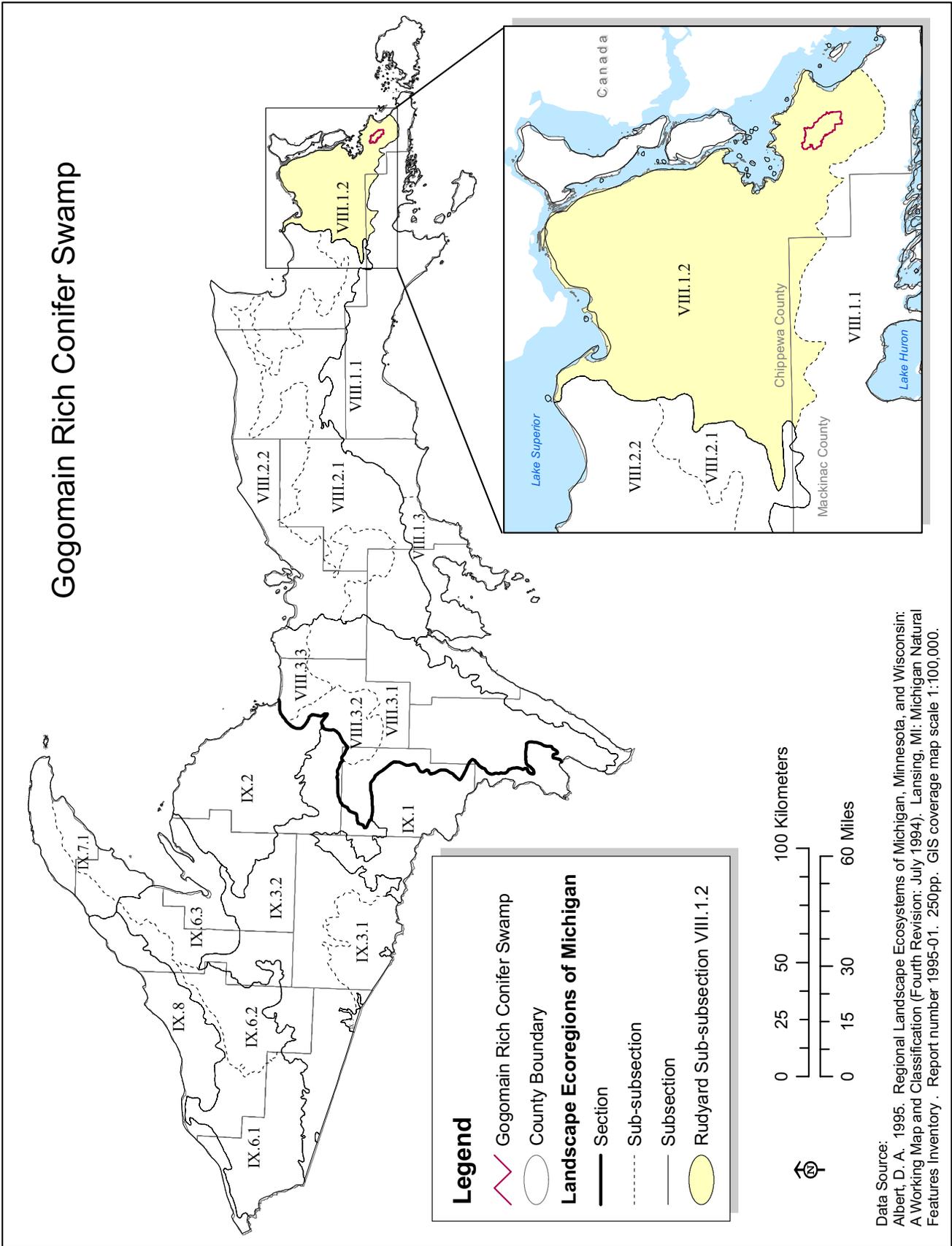
The Gogomain Swamp falls within Section VIII, Northern Lacustrine-Influence Upper Michigan and Subsection VIII.1, the Niagaran Escarpment and Lakeplain (Figure 1). Subsection VIII.1 consists primarily of sand and clay lacustrine deposits. Limestone and dolomite bedrock is exposed along the shorelines of both Lakes Michigan and Huron, and is also locally exposed several miles inland. A wide variety of landforms of glacial lacustrine origin characterize the subsection, including flat lakebed or lakeplain, deltaic deposits of sand, parabolic dune fields, and shallow embayments containing transverse dunes. Ground moraine is locally present. The Gogomain Swamp

occurs within Sub-subsection VIII.1.2, known as the Rudyard Sub-subsection (Figure 1). This small sub-subsection is characterized by broad clay lakeplains consisting of fine-textured lacustrine deposits and localized areas of water-reworked till or moraine. Soils within the Sub-subsection are primarily clays that range from somewhat poorly drained to poorly drained. Well drained sands and loamy sands occur on the moraines. Circa 1800, areas of poorly drained lakeplain supported extensive rich conifer swamps with northern white-cedar (*Thuja occidentalis*), tamarack (*Larix laricina*), and spruce (*Picea* spp.), and hardwood-conifer swamps with cedar, tamarack, spruce, hemlock (*Tsuga canadensis*), white pine (*Pinus strobus*), balsam fir (*Abies balsamea*), balsam poplar (*Populus balsamifera*), and quaking aspen (*P. tremuloides*). Poor drainage conditions within these swamps caused widespread windthrow. Areas with better drainage, including lakeplain and moraine, supported mesic northern forest of sugar maple (*Acer saccharum*), beech (*Fagus grandifolia*), basswood (*Tilia americana*), and yellow birch (*Betula alleghaniensis*). While this sub-subsection was originally largely forested by lowland conifers, forest clearing and swamp drainage has resulted in conversion of most of its surface area for agricultural production. The Rudyard Sub-subsection has been more intensively managed for agriculture than any other part of Upper Michigan. Swamps near the Great Lakes shoreline have been less modified than those in the interior of the sub-subsection (Albert 1995). The Gogomain Swamp, which occurs on a poorly drained portion of an extensive sandy/clay lakeplain, persists as one of the few remaining blocks of forested swamp within the Rudyard Sub-subsection.

#### **Circa 1800 Vegetation**

By interpreting the notes of the Michigan General Land Office surveyors (recorded from 1818-1856), MNFI ecologists produced a map depicting the state's hypothesized vegetation in the early 1800s (Comer et al. 1995). A digital map of vegetation encountered by the land surveyors during this period suggests that circa 1800, the Gogomain Swamp and surrounding poorly drained lakeplain were dominated by Mixed Conifer Swamp and the adjacent uplands were Sugar Maple-Hemlock Forest and Spruce-Fir-Cedar Forest (Figure 2). MNFI ecologists delineated an 11,447 acre polygon of Mixed Conifer Swamp that incorporates the Gogomain Swamp. Surveys described the area as a wet conifer swamp with extensive areas of windfall. Within

# Gogomain Rich Conifer Swamp



**Figure 1.** Ecoregions of Upper Michigan (Albert 1995). The Gogomain Swamp is the only documented high-quality rich conifer swamp in Sub-section VIII.1.2 and also the only high-quality rich conifer swamp recorded on State Forest land in Chippewa County.

the state-owned portion of the Gogomain Swamp, surveyors recorded the following tree species: northern white-cedar, tamarack, and spruce [surveyors did not always differentiate between white spruce (*Picea glauca*) and black spruce (*P. mariana*)]. Younger swamp was noted on the west side of the complex with cedar, tamarack, spruce, and balsam fir. The most prevalent species recorded within the swamp was cedar, which ranged in diameter from 15 to 76 cm (6 to 30 in) with an average diameter of 26.9 cm (10.6 in, N = 36). Tamarack ranged in diameter from 15 to 30 cm (6 to 12 in) with an average diameter of 21.6 cm (8.5 in, N = 22) and spruce diameters were comparable, ranging from 15 to 35 cm (6 to 14 in) with an average diameter of 23.2 cm (9.1 in, N = 25). Adjacent uplands were dominated by mesic northern forest with dominant overstory trees including sugar maple, hemlock, yellow birch, and basswood, and tree diameters ranging from 30 to 76 cm (10 to 30 in).

### Present Land Cover

Comparisons between circa 1800 vegetation (Figure 2) and present land cover, as captured in a 1998 aerial photograph (Figure 3), reveal dramatic changes across the landscape. The most drastic change is the conversion to agricultural lands of the upland forest and, to a lesser extent, swamp forest. Remaining upland forests have been converted to young northern hardwood forest, early-successional types, and conifer plantations. Large areas of conifer swamp within the sub-subsection have been logged and then drained and converted to agricultural lands. Much of the conifer swamp that was not converted has been managed for timber production through strip-cutting and clear-cutting, which often result in the conversion of cedar-dominated systems to hardwood swamp or hardwood-conifer swamp due to high deer browse pressure on cedar. Remnant native plant communities are concentrated within this sub-subsection along the shoreline and include rich conifer swamp, Great Lakes marsh, and poor fen. As noted above, the Gogomain Swamp represents one of the largest blocks of forested wetland remaining within the Rudyard Sub-subsection.

## METHODS

### Rare Species Surveys

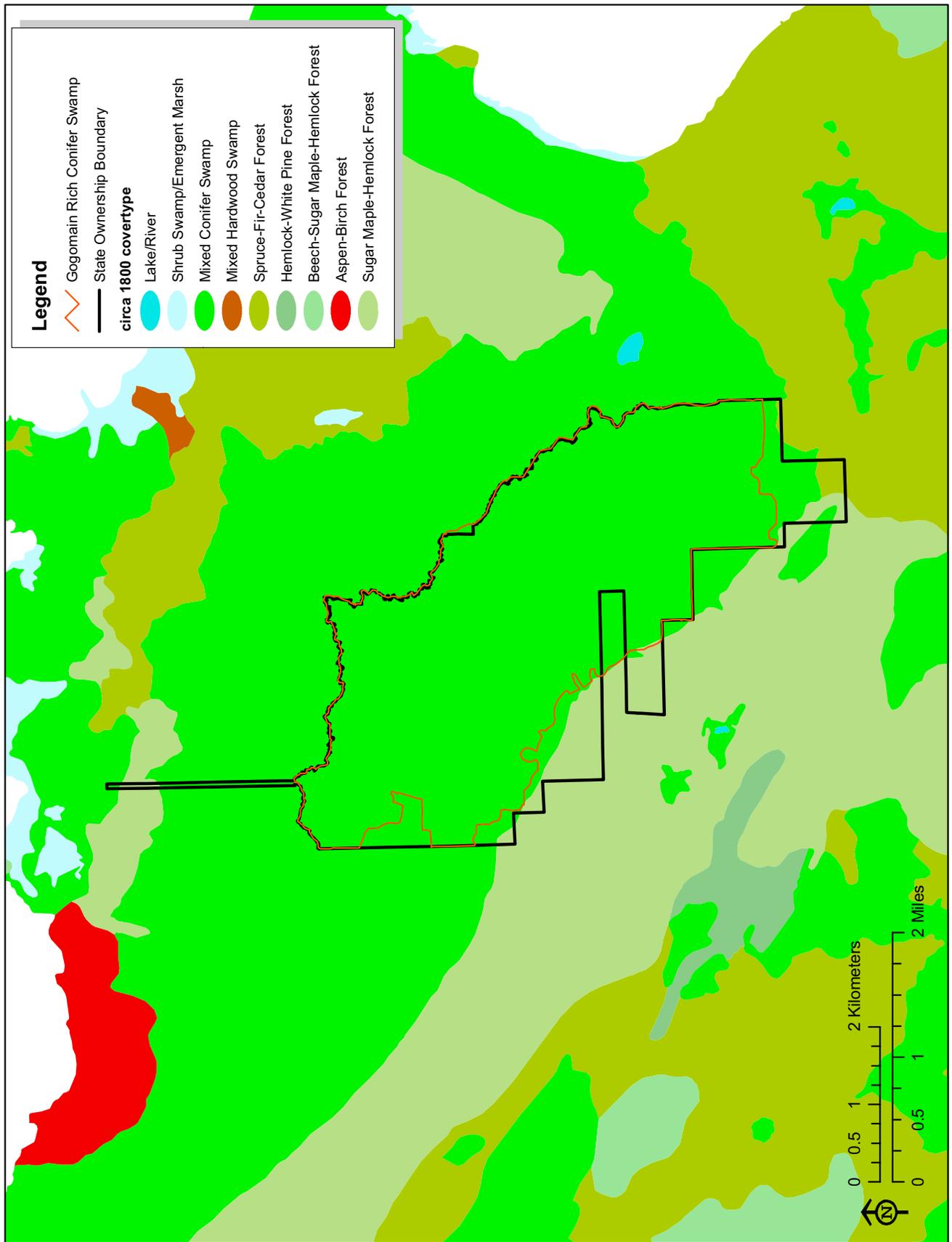
MNFI ecologists, botanists, and zoologists analyzed aerial photographs and MNFI's spatial database of rare species (MNFI 2008) to determine which rare plant and animal species could potentially occur within the Gogomain Swamp. Surveys for rare plants associated

with rich conifer swamp were conducted during selected periods during the growing season. Early season surveys were conducted June 2, 2008 – June 6, 2008 for Lapland buttercup (*Ranunculus lapponicus*, state threatened) and rare orchids that flower during this time period, including calypso orchid (*Calypso bulbosa*, state threatened), round-leaved orchid (*Amerorchis rotundifolia*, state endangered), and ram's head lady's-slipper (*Cypripedium arietinum*, state special concern). Subsequent surveys were conducted July 28, 2008 – August 1, 2008, and August 21, 2008 for Lapland buttercup and potential colonies of limestone oak fern (*Gymnocarpium robertianum*, state threatened). Rare plant surveys involved meander surveys, during which comprehensive species lists were compiled and microhabitats were systematically searched.

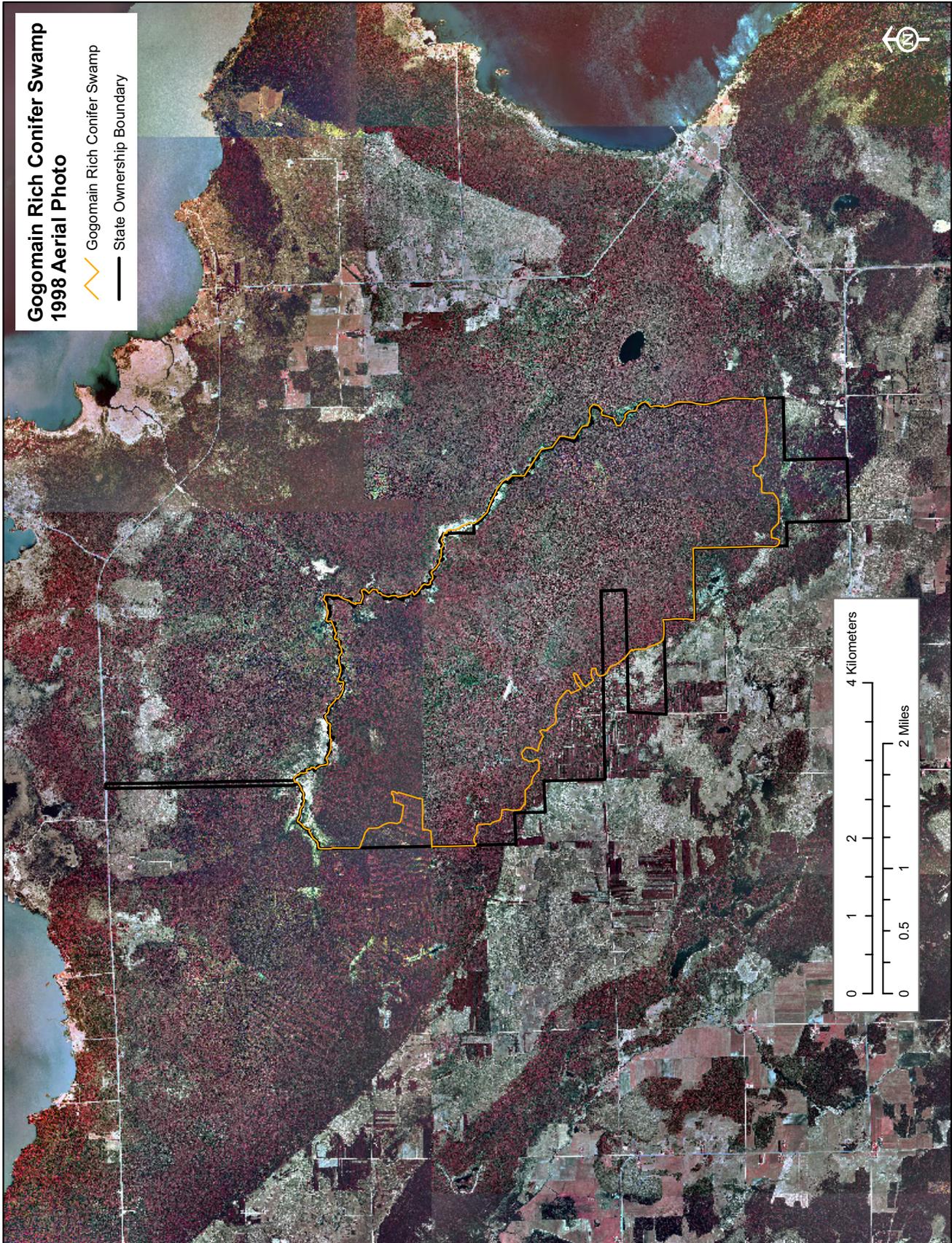
Rare animal surveys were conducted July 29, 2008 – July 31, 2008 and focused on rare bird species, especially raptors, including red-shouldered hawk (*Buteo lineatus*, state threatened), northern goshawk (*Accipiter gentilis*, state special concern), and merlin (*Falco columbarius*, state threatened). Rare bird surveys involved visual surveys for birds and stick nests as well as use of raptor calls to elicit responses from territorial raptors. Both rare plant and rare animal surveys relied on coverage of as much of the swamp complex as possible.

### Ecological Surveys

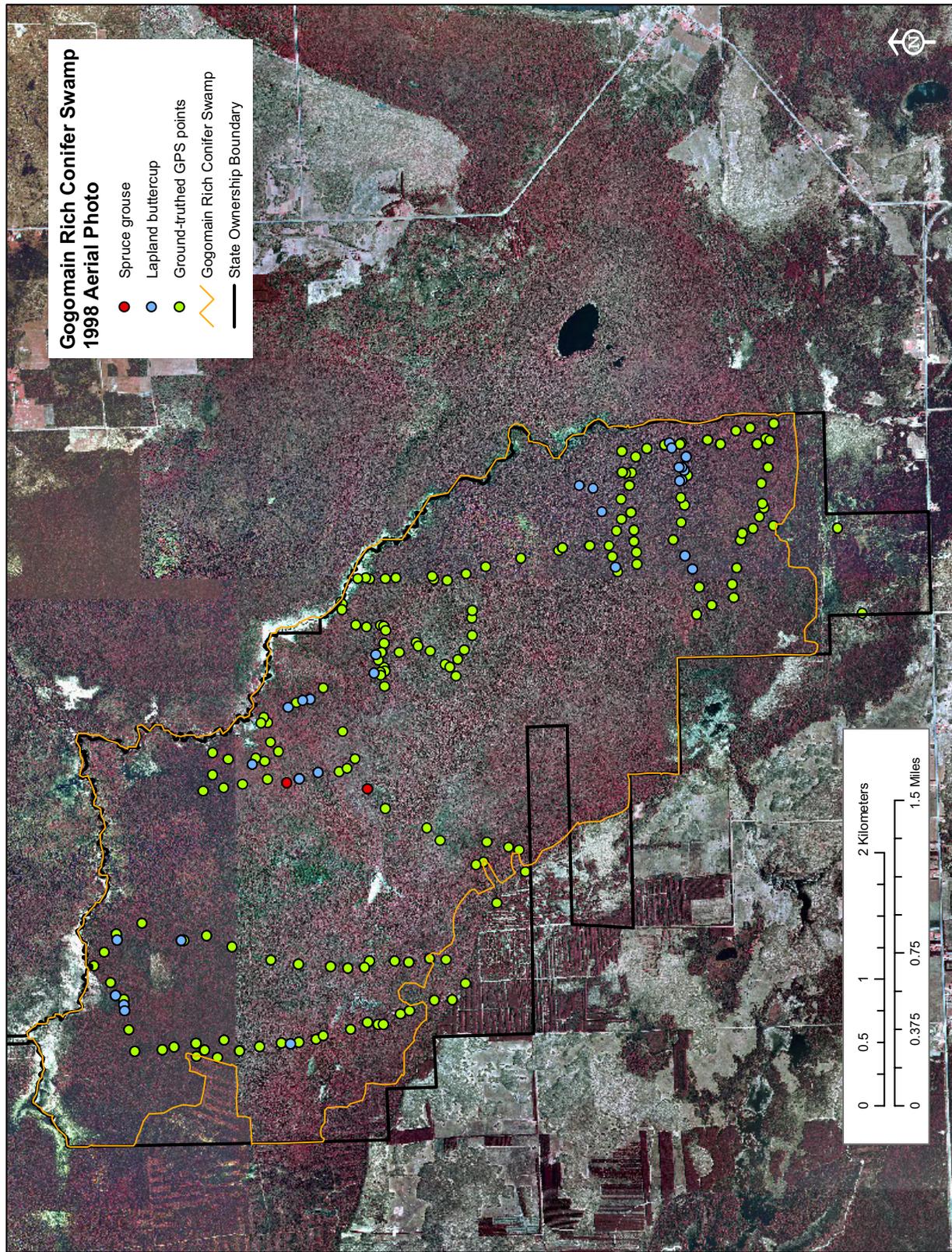
When applying Natural Heritage and MNFI methodology, three factors are considered when assessing a natural community's ecological integrity or quality: size, landscape context, and condition (Faber-Langendoen et al. 2008). If a site meets defined requirements for these three criteria it is categorized as a high-quality example of a specific natural community type, entered into MNFI's database as an element occurrence, and given a ranking based on the consideration of its size, landscape context, and condition. Growing season surveys were conducted to assess the condition of the portions of Gogomain Swamp occurring on state land, while a combination of ground surveys, aerial photographic interpretation, and Geographic Information System (GIS) analysis was employed to determine the size and the landscape context of the site. Ecological surveys were conducted June 2, 2008 – June 6, 2008, July 28, 2008 – August 1, 2008, and August 21, 2008. During the course of the surveys, an Ecological Community Field Survey Form was completed. Surveys involved compiling



**Figure 2.** Vegetation circa 1800 of the Gogomain Swamp and surrounding area. Based on interpretation of the notes of the land surveyors, the Gogomain Swamp and surrounding poorly drained lakeplain were dominated by Mixed Conifer Swamp with the adjacent uplands supporting Sugar Maple-Hemlock Forest and Spruce-Fir-Cedar Forest (Comer et al. 1995).



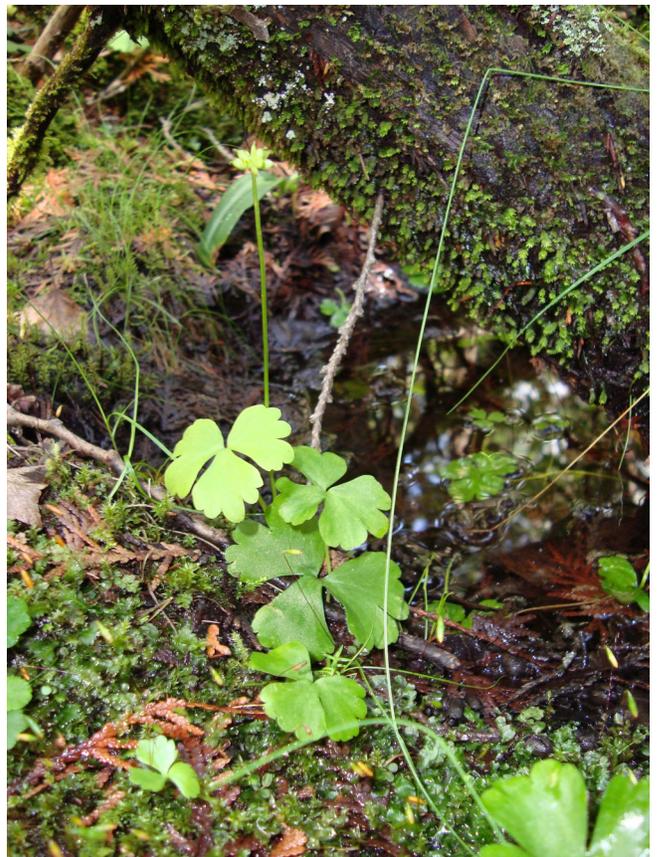
**Figure 3.** 1998 Aerial photograph of the Gogomain Swamp. Despite the widespread loss of forested uplands and swamp forest in the surrounding area, the Gogomain Swamp represents one of the largest blocks of forested wetland remaining within the Rudyard Sub-section.



**Figure 4.** The high-quality rich conifer swamp delineated within the state-owned portion of the Gogomain Swamp represents the largest documented occurrence of this natural community type in Michigan. The area was determined to be 4,427 acres based on aerial photographic interpretation of 1998 and 2005 imagery, GIS analysis, and ground-truthing techniques with GPS units (both Garmin and HP iPAQ units were utilized). Dots represent ground-truthed GPS points with blue dots marking Lapland buttercup colonies and red dots marking spruce grouse observations.



Hollows with pooled, cool groundwater seepage support populations of Lapland buttercup (*Ranunculus lapponicus*, state threatened), especially in areas of uneven-aged, old-growth cedar swamp and where lenses of wet sandy clay occur beneath the inundated peats. Photos by Joshua G. Cohen.





The Gogomain Swamp is distinguished by large tracts of uneven-aged, old-growth cedar swamp characterized by complex vertical structure and high species diversity. In these areas, canopy tree diameters typically range from 40 to 60 cm (15.7 to 23.6 in) with many 60+ cm (23.6+ in) cedar and white pine. Photos by Bradford S. Slaughter.



comprehensive plant species lists, describing the site's structural attributes and ecological processes, measuring diameter at breast height (DBH) of representative canopy trees and aging canopy dominants, analyzing the soils and hydrology, noting current anthropogenic disturbances, evaluating potential threats, ground-truthing aerial photographic interpretation using Global Positioning Systems (both Garmin and HP iPAQ units were utilized), taking digital photos and GPS points (226 points were taken), surveying adjacent lands to assess landscape context, assigning element occurrence ranks, and noting management needs and restoration opportunities. Following completion of the field surveys, the collected ecological data were analyzed and transcribed in MNFI's statewide biodiversity conservation database. Information from the field surveys was used to produce the site description, threat assessment, and conservation and management recommendations that appear within the following **Results** section.

## RESULTS

### *Rare Species Surveys*

Throughout the swamp, numerous colonies of the state threatened Lapland buttercup (*Ranunculus lapponicus*) were documented (Figure 4). Hollows with pooled, cool groundwater seepage support populations of Lapland buttercup, especially in areas of uneven-aged, old-growth cedar swamp and where lenses of wet sandy clay occur beneath the inundated peats. The Gogomain Swamp represents only the fifth known occurrence of this rare, largely boreal species and is the largest documented occurrence within Michigan (Penskar and Higman 2002, MNFI 2008).

In addition, spruce grouse (*Falci pennis canadensis*, state special concern) were documented within the swamp complex (Figure 4). Although this is only the second record for spruce grouse in MNFI's database (MNFI 2008) for Chippewa County, Michigan spruce grouse are thought to be concentrated in the eastern Upper Peninsula (Monfils 2007) and there are likely additional undocumented populations of spruce grouse within this region. In addition, scat from gray wolf (*Canis lupus*, state and federally threatened) was noted along the road within the swamp. No rare woodland raptors were documented during the course of the survey, although several broad-winged hawk (*Buteo platypterus*) were noted, one of which was carrying food. In addition, an old stick nest was found that was likely utilized by nesting broad-winged hawks. A total of thirty-four animal species were recorded

incidentally during the targeted rare species surveys including twenty-two birds, eight mammals, and four reptiles and amphibians (Appendix 2).

### *Ecological Surveys*

#### Site Classification

The Gogomain Swamp is dominated by rich conifer swamp with inclusions of northern shrub thicket, northern wet meadow, poor conifer swamp, and mesic northern forest. Rich conifer swamp is a groundwater-influenced, minerotrophic, forested wetland dominated by northern white-cedar (*Thuja occidentalis*) that occurs on organic soils (i.e., peat) primarily north of the climatic tension zone in the northern Lower and Upper Peninsulas. Rich conifer swamp occurs in outwash channels, outwash plains, glacial lakeplains, and in depressions on coarse- to medium-textured ground moraines. It is common in outwash channels of drumlin fields and where groundwater seeps occur at the bases of moraines. Rich conifer swamp typically occurs in association with lakes and cold, groundwater-fed streams. It also occurs along the Great Lakes shoreline in old abandoned embayments and in swales between former beach ridges where it may be part of a wooded dune and swale complex. Windthrow is common, especially on broad, poorly drained sites. Fire was historically infrequent. Rich conifer swamp is characterized by diverse microtopography and ground cover. The community is also referred to as cedar swamp (Kost 2002, Kost et al. 2007).

#### Site Description

##### Abiotic Context

The Gogomain Swamp, which occurs on an extensive poorly drained sandy/clay lakeplain, includes large areas of uneven-aged, old-growth (250+ years) rich conifer swamp as well as vast tracts of regenerating swamp in areas of blowdown, sites of former beaver (*Castor canadensis*) flooding, and where turn-of-the-century logging occurred. The organic soils are saturated to inundated peats that range widely in depth. Areas of uneven-aged cedar swamp with old-growth trees occur on 20 to 50 cm (7.9 to 19.7 in) of peat over sandy clay and/or sands, with pH throughout the soil profile being circumneutral to slightly alkaline (pH 7.0-7.8). Areas with deeper peats (>1 m or 3.3 ft) tend to have smaller diameter trees and pH typically of 7.0 but ranging from 7.0 to 7.5. Where conifer needle litter and sphagnum mosses develop hummocks, there are localized areas of slightly acidic surface conditions over the otherwise circumneutral peats. Well-developed sphagnum

hummock and hollow microtopography occurs throughout the swamp and is most pronounced in areas with older, uneven-aged canopy. This microtopography contributes to microsite heterogeneity since there are fine-scale gradients of soil moisture and chemistry along the sphagnum hummocks and hollows, with the hummocks tending to be slightly more acidic and drier than the hollows. Numerous streams (including disappearing streams) and headwater streams occur throughout the swamp. These cold streams are groundwater fed, with high levels of nutrients indicated by the circumneutral to alkaline soil conditions. The South Branch of the Gogomain River occurs along the eastern/northeastern boundary of the delineated swamp complex and the West Branch of the Gogomain River occurs along the northern boundary. These are slow moving and shallow rivers that are flanked by northern wet meadow and northern shrub thicket.

### Ecological Processes

The rich conifer swamp is characterized by high floristic diversity (over 200 plant species were identified, Appendix 1) and faunal diversity (Appendix 2) generated by microsite heterogeneity and high structural complexity at multiple scales. Small-scale windthrow has generated numerous tip-up mounds, which provide substrate for establishment of species such as white pine (*Pinus strobus*) and white spruce (*Picea glauca*). Larger areas of blowdown, beaver flooding, and turn-of-the-century cutting have contributed to the age-class diversity of the complex. Beaver-flooded areas are characterized by a flood-killed canopy and a prevalence of graminoids and aquatic plants in the ground cover. Small-scale windthrow gaps and ice damage and larger areas of blowdown generate substantial downed woody debris. Large-diameter conifer snags are also prevalent throughout the areas of uneven-aged, old-growth swamp. Cool groundwater seepage throughout the complex generates circumneutral to alkaline conditions that engender high plant species diversity. Throughout the swamp, cedar regeneration from seed and asexual layering is dense with localized areas lacking regeneration largely restricted to the margins and areas where white-tailed deer (*Odocoileus virginianus*) have been yarding in the winter. Cedar is one of the most important winter browse species for deer in the Lake States (Verme 1965, Ozoga 1968). Portions of the Gogomain Swamp are extremely critical to mid-snowfall zone wintering deer from eastern Chippewa and eastern Mackinac Counties (Scullon 2006). The conifer canopy

provides important thermal cover for yarding deer and other wintering animal species.

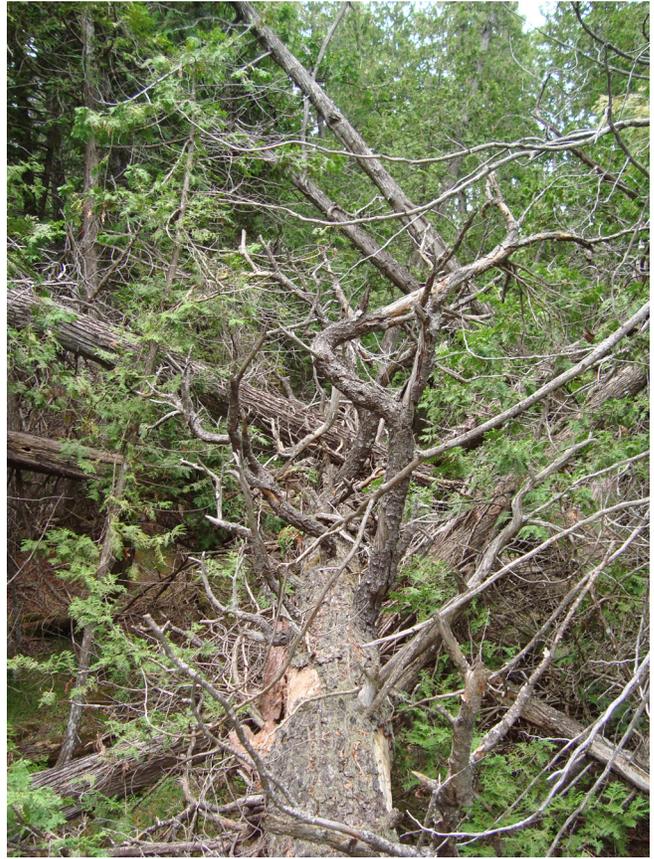
### Vegetative Composition and Structure

The overwhelming canopy dominant throughout the swamp complex is cedar, which is also prevalent in the subcanopy, understory, and ground layers. In areas of uneven-aged, old-growth cedar swamp, canopy associates of cedar include white pine, white spruce, and tamarack (*Larix laricina*). These old-growth areas typically occur on circumneutral to slightly alkaline peats (20 to 50 cm or 7.9 to 19.7 in deep) overlying sandy clays and/or sands. Canopy tree diameters typically range from 40 to 60 cm (15.7 to 23.6 in) with many 60+ cm (23.6+ in) cedar and white pine and 40+ cm (15.7+ in) tamarack and white spruce. Canopy tree heights of old-growth cedar, white spruce, and tamarack are often 21 to 24 m (70 to 80 ft) tall with an overtopping supercanopy of scattered white pine reaching 31 to 36 m (100 to 120 ft). In areas of blowdown and where logging historically occurred, paper birch (*Betula papyrifera*), balsam poplar (*Populus balsamifera*), and balsam fir (*Abies balsamea*) have become common canopy associates. In addition, areas closer to the Gogomain Rivers with surface deposits of sand and clay have more diverse canopies dominated by cedar along with white spruce, paper birch, white pine, balsam poplar, and balsam fir. Areas with wetter and deeper peats (> 1 m or 3.3 ft) are typically dominated by even-aged and smaller diameter (20-40 cm or 7.9-15.7 in) cedar and tamarack, with black spruce (*Picea mariana*) as a common canopy associate.

Cedar and balsam fir are subcanopy and understory dominants throughout the swamp. These understory conifers are densest in areas of open canopy and where there has been significant blowdown. As noted above, cedar drops out in the understory in areas where deer are yarding in the winter along the southern and western margins of the swamp. Also prevalent in the understory layer are tag alder (*Alnus rugosa*) (in wet areas) and mountain maple (*Acer spicatum*) along rises within the swamp. The sparse to patchy low shrub layer is characterized by alder-leaved buckthorn (*Rhamnus alnifolia*), gooseberries (*Ribes* spp.), and native honeysuckles (*Lonicera* spp.), with American fly honeysuckle (*L. canadensis*) and swamp fly honeysuckle (*L. oblongifolia*) being most prevalent. In addition, Labrador tea (*Ledum groenlandicum*) occurs in the low shrub layer in areas with deeper peats



Old-growth northern white-cedar, tamarack (pictured above), and white spruce reach 21 to 24 m (70 to 80 ft) with supercanopy white pine towering over them. Excellent growing conditions are likely due to stable substrate provided by the clays beneath the organic soils and high nutrient levels supplied by pervasive groundwater seepage. Photo by Joshua G. Cohen.



High structural diversity characterizes the uneven-aged swamp with supercanopy white pine (upper left), numerous windthrow gaps and high levels of woody debris (upper right), leaning and layering cedar (lower left), sphagnum hummock and hollow microtopography, and carpets of sphagnum mosses (lower right). Photos by Joshua G. Cohen.





Beaver flooding (above) and blowdown (below) are the primary large-scale disturbance factors influencing the composition and structure of the Gogomain Swamp. Photos by Bradford S. Slaughter.



and slightly acidic conditions. Sphagnum mosses (*Sphagnum* spp.) are prevalent in the ground layer with many areas dominated by a thick carpet of sphagnum and other areas with patches of sphagnum. Dominant species of the ground layer include dwarf raspberry (*Rubus pubescens*), goldthread (*Coptis trifolia*), false mayflower (*Smilacina trifolia*), creeping snowberry (*Gaultheria hispidula*), three-seeded sedge (*Carex trisperma*), naked miterwort (*Mitella nuda*), bunchberry (*Cornus canadensis*), and twinflower (*Linnaea borealis*). A diversity of orchids (*Listera* spp., *Platanthera* spp., and all four Michigan *Goodyera* spp.) occurs scattered throughout the swamp, especially in areas of uneven-aged, old-growth swamp with well-developed sphagnum hummock and hollow microtopography. Hollows with pooled, cool groundwater seepage support populations of Lapland buttercup (*Ranunculus lapponicus*, state threatened), especially in areas of old-growth swamp. Additional characteristic species include ebony sedge (*Carex eburnea*), sedge (*C. disperma*), sedge (*C. pedunculata*), kidney-leaved violet (*Viola renifolia*), swamp thistle (*Cirsium muticum*), oak fern (*Gymnocarpium dryopteris*), wild blue flag (*Iris versicolor*), fragrant bedstraw (*Galium triflorum*), cinnamon fern (*Osmunda cinnamomea*), starflower (*Trientalis borealis*), marsh marigold (*Caltha palustris*), and golden ragwort (*Senecio aureus*). A comprehensive list of the 206 plant species documented during the surveys is provided in Appendix 1.

### Element Occurrence Ranking

Based on the consideration of the site's size, landscape context, and condition, this rich conifer swamp was determined to be a high-quality example of this natural community type and has been entered into MNFI's database as an AB-ranked rich conifer swamp.

### Size

The size of the high-quality rich conifer swamp was determined to be 4,427 acres based on aerial photographic interpretation, GIS analysis, and ground-truthing using GPS units (Figure 4). The area of high-quality swamp was delimited using aerial photographic interpretation and 226 ground-truthed GPS points, which were overlaid in a GIS system and facilitated drawing a polygon depicting the extent of the occurrence (Figure 4). The delineation of the high-quality swamp was restricted to areas of swamp within state ownership, since surveys were not conducted within private lands to the east, northeast, and north. Aerial photographic

interpretation indicates that additional areas of potentially high-quality, rich conifer swamp are contiguous to the delineated occurrence to the east, northeast, and north. Based on MNFI ranking criteria, rich conifer swamps that are over 120 acres are classified as large (MNFI 1988). Compared to the historical extent of rich conifer swamps and other high-quality examples of this system, especially in the Upper Peninsula, this site is large and merits an A rank for size (prior to the documentation of this site, the largest example in MNFI's database in the Upper Peninsula was 988 acres, and the largest example in the state was 4,416 acres) (Comer et al. 1995, MNFI 2008).

### Landscape Context

This site occurs in a partially fragmented landscape with moderate road densities, scattered residential developments, and agricultural fields (Figure 3). Remaining upland forest is primarily early successional with some areas of conifer plantations. High-quality rich conifer swamp occurs on private lands to the east, northeast, and north. High-quality northern shrub thicket and northern wet meadow border the swamp to the east, northeast, and north along the Gogomain Rivers. Additional rich conifer swamp that has been managed through strip cuts and clear-cuts occurs to the northwest and west. Based on these considerations, the site was given a B/BC rank for landscape context.

### Condition

Natural processes are the primary driving factors determining the species composition and structure of this extensive swamp complex, which includes large areas of uneven-aged, old-growth cedar swamp as well as vast tracts of regenerating cedar swamp in areas of blowdown, sites of former beaver flooding, and where turn-of-the-century logging occurred. The swamp is characterized by high floristic and faunal diversity generated by microsite heterogeneity and high structural complexity at multiple scales. Throughout the swamp, cedar regeneration from layering and seeding is dense, with localized areas lacking regeneration restricted to the margins and areas where deer have been yarding in the winter. The swamp complex is bisected by several roads that were established for hunting access. These roads have locally altered the hydrology of the swamp, causing pooling along the road margins. The most developed road is the north-south road that passes through sections 24, 25, and 36 and was built on gravel fill with ditches lining both sides of the road (Scullon 2006). Seasonal streams have formed within the ditches

along the road and have caused localized erosion and deposition of the lacustrine deposits. Beaver flooding and damming activity is associated with the streams along these roads. Cut stumps occur within the swamp but are typically localized to areas near the swamp margins and along the rivers and roads. Throughout the complex, cut stumps are of the same diameter or smaller than the current canopy trees, suggesting that these areas were minimally disturbed and that the canopy has recovered following the anthropogenic perturbation. In addition, measured diameters of canopy conifers are within the range of diameters noted by the original land surveyors. Non-native species are primarily restricted to the road network, and no invasive species were documented within the interior of the swamp. Based on the above considerations, MNFI ecologists attributed an AB rank to this rich conifer swamp for its current condition.

### **Overall Rank**

As noted above, the consideration of the three factors of size (A rank), landscape context (B/BC rank), and condition (AB rank) resulted in the overall rank of an AB and the classification of this rich conifer swamp as an element occurrence or a high-quality example of this community type. The Gogomain Swamp has been incorporated into MNFI's database of high-quality natural communities.

As an AB-ranked rich conifer swamp, this forest qualifies for consideration as an Ecological Reference Area according to the Department of Natural Resources Conservation Area Management Guidelines and Work Instruction 1.4 on Biodiversity Management on State Forest Land (MDNR 2005). Within these documents it is stated that high-quality natural communities that are A- or B-ranked and are rare, imperiled, or critically imperiled globally or in the state (G1, G2, G3, and/or S1, S2, S3; see Appendix 3 for definition of global and state ranks) qualify for consideration as Ecological Reference Areas. Rich conifer swamps are rare within the state of Michigan (S3) and apparently secure globally (G4) (Kost et al. 2007, NatureServe 2008).

### **Threats**

The primary threat to the Gogomain Swamp is posed by potential logging of the private parcels and state lands. Logging often reduces the structural diversity of these swamp systems, especially when old-growth, uneven-aged swamp is logged and large-diameter, old-growth

conifers are harvested. In addition, logging can damage the organic soils through rutting, reduction of sphagnum carpets and hummock and hollow microtopography, and raising of the water table. Road construction associated with logging of swamps can drastically alter site hydrology by impeding flow and causing flooding. The swamp complex is bisected by several roads that were established for hunting access. These roads have locally altered the hydrology of the swamp, causing pooling and flow along the road margins where erosion of lacustrine deposits is pronounced. Logging in regions of high deer densities can result in the failure of cedar to regenerate. The most recent cutting in areas adjacent to the high-quality rich conifer swamp in the western portion of the parcel is associated with both the failure of cedar to regenerate and negative impacts to the organic soils from rutting and a raised water table.

A current threat that was documented during the course of the surveys within the high-quality rich conifer swamp was deer herbivory of regenerating cedar. Deer herbivory within this swamp complex is concentrated within areas where deer have yarded in the winter. Winter deer browse has greatly reduced advanced cedar regeneration along the southern and western margins of the swamp, with some portions of the swamp completely devoid of cedar regeneration > 1 m (3.3 ft). Numerous studies in the Great Lakes have indicated that the long-term sustainability of the remaining cedar swamps is threatened by a region-wide lack of cedar recruitment due to deer herbivory (Alverson et al. 1988, Van Deelen et al. 1996, Heitzman et al. 1997, Van Deelen 1999, Rooney et al. 2002). The high density of cedar recruitment within the interior of the Gogomain Swamp represents a regionally important advanced regeneration bank that could be jeopardized by fragmentation of the swamp complex and increased access to the swamp by wintering deer.

Reduction of cedar throughout the swamp's vegetative strata could ultimately endanger the long-term sustainability of the Gogomain Swamp as a high-quality rich conifer swamp and as a functional deer yard with ample winter browse and sufficient thermal cover.

Numerous non-native plant species were noted along the roads within the swamp and in the surrounding landscape. These species could increase within the swamp complex if logging occurs and additional roads are created within the rich conifer swamp.



Unique attributes of the Gogomain Swamp that merit careful management include extensive areas of uneven-aged, old-growth cedar swamp (above), the numerous cold, groundwater seepage streams (lower left), and the high density of cedar regeneration found throughout the swamp complex (lower right). Photos by Joshua G. Cohen.



### ***Management Recommendations***

The main management recommendations are to allow natural processes (i.e., windthrow, flooding, and fire) to operate unhindered, to maintain canopy closure of the surrounding uplands to minimize surface water flow into the swamp and to maintain groundwater seepage, to reduce deer densities in the surrounding landscape to dampen deer browse pressure, to monitor for invasive plant populations, and maintain the closure of the roads into the swamp to vehicular traffic. Deer densities could be reduced through direct measures and also by reducing early-successional habitat in the surrounding landscape. In addition, monitoring deer densities and deer herbivory will allow for the assessment of whether deer herbivory jeopardizes northern white-cedar regeneration throughout the complex and how herbivory is impacting overall species composition and structure. Finally, portions of the swamp occurring on private lands to the east, northeast, and north need to be surveyed to assess their quality and could be acquired or protected through conservation easements if they are of similar quality as suggested by aerial photographic interpretation.

If this complex is going to be managed for wintering deer or timber extraction, it is highly recommended that management activities avoid areas of uneven-aged, old-growth cedar swamp and portions of the swamp where Lapland buttercups are concentrated (these areas typically overlap, especially in the eastern and northeastern portion of the complex [Figure 4]) and that management activities focus on the western margins of the parcel in even-aged cedar swamp and along the slopes of the adjacent upland. In addition, harvesting during the winter months can help protect the hydrology and organic soils and limit the potential for damage to the peats and reduce the likelihood of invasive plant encroachment.

### **DISCUSSION**

A discussion of the current status of high-quality rich conifer swamps in Michigan and their distribution throughout Michigan will help elucidate the conservation importance of the Gogomain rich conifer swamp. A total of 55 other rich conifer swamp element occurrences have been documented and are tracked within MNFI's database (MNFI 2008). These 55 rich conifer swamps account for approximately 14,567 acres. The high-quality rich conifer swamp delineated by MNFI ecologists within the state-owned portion of the Gogomain Swamp is approximately 4,427 acres, which

accounts for nearly a quarter of the high-quality rich conifer swamp acreage within Michigan. Of the previously identified 55 rich conifer swamps, one is A-ranked and nine are AB-ranked, accounting for 3,385 acres, with six of the nine AB-ranked occurrences in the Upper Peninsula and the sole A-ranked occurrence also in the Upper Peninsula in Luce County. In addition to the Gogomain Swamp, twenty-two other rich conifer swamp element occurrences are known from the Upper Peninsula (totaling 3,490 acres), with fifteen element occurrences found in the Eastern Upper Peninsula (totaling 2,805 acres). Of those fifteen rich conifer swamps, one is A-ranked and three are AB-ranked. These four A- or AB-ranked rich conifer swamps in the Eastern Upper Peninsula account for approximately 1,731 acres. Within Chippewa County there are five other high-quality rich conifer swamps totaling approximately 350 acres. Among these five occurrences, there is only one AB-ranked rich conifer swamp (72 acres), with the remaining occurrences ranked C or lower.

Of the fifteen previously identified high-quality rich conifer swamps in the Eastern Upper Peninsula, five occur on State Forest land, five occur on State Park land, four occur on federal land within the Hiawatha National Forest, and one occurs on private land. Of the four A- or AB-ranked element occurrences within the Eastern Upper Peninsula, one occurs within Tahquamenon Falls State Park and three occur on State Forest land in Luce and Schoolcraft Counties. Within Chippewa County, there are no other high-quality rich conifer swamps on State Forest land: four of the five previously identified rich conifer swamps in the county occur within Tahquamenon Falls State Park (with one of those occurrences being AB-ranked), and the other occurrence is found in the Hiawatha National Forest. The Gogomain Swamp is the only high-quality rich conifer swamp occurring on State Forest land that has been documented in Chippewa County.

The Gogomain Swamp falls within Sub-Subsection VIII.1.2 of the regional landscape ecosystems of Michigan hierarchical landscape classification (Albert 1995) (Figure 1). Within Section VIII there are twenty other rich conifer swamp element occurrences; six of these occurrences are ranked AB or higher, and one of those occurrences is found on Bois Blanc Island. Within Subsection VIII.1 there are six other rich conifer swamp element occurrences, with the rich conifer swamp occurrence on Bois Blanc Island being the only AB occurrence. No other AB or higher ranked rich

conifer swamp element occurrences have been documented within Subsection VIII.1 within the Upper Peninsula, and only one other high-quality rich conifer swamp occurs on state land (a BC-ranked occurrence on State Forest land in Mackinac County). The Gogomain Swamp represents the only high-quality rich conifer swamp documented within Subsection VIII.1.2.

The above landscape level analysis at different ecological and jurisdictional scales emphasizes the uniqueness of this site and the importance of maintaining the ecological integrity of this high-quality example of rich conifer swamp by managing it as an Ecological Reference Area. The high-quality rich conifer swamp delineated by MNFI ecologists within the state-owned portion of the Gogomain Swamp represents the largest occurrence of high-quality rich conifer swamp in Michigan, the only documented high-quality rich conifer swamp on State Forest in Chippewa County, and the sole occurrence of high-quality rich conifer swamp recorded in Subsection VIII.1.2.



Photos by Bradford S. Slaughter.



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Photo by Bradford S. Slaughter.

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Photos by Joshua G. Cohen.



**Appendix 1. Plant species observed at Gogomain Swamp.** Capitalized scientific and common names indicate non-native species. Life form acronyms are as follows: Nt, native; P, perennial; Ad, adventive; B, biannual; A, annual. "C" is the Coefficient of Conservation for each species.

**Site:** Gogomain Swamp

**Locale:** Chippewa County, MI

**Date:** 06/02-06/08/2008 Approximately 10 hours per day

07/28-08/01/2008 Approximately 10 hours per day

08/21/2008 8 hours

**By:** Bradford Slaughter, Mike Penskar, Joshua Cohen, and David Cuthrell

**Notes:** Also: Salix sp., Carex spp., Hieracium sp., Actaea sp., and Amelanchier sp.

**FLORISTIC QUALITY DATA**

	Native	197	95.60%	Adventive	9	4.40%
197 NATIVE SPECIES	Tree	19	9.20%	Tree	0	0.00%
206 Total Species	Shrub	37	18.00%	Shrub	0	0.00%
5 NATIVE MEAN C	W-Vine	2	1.00%	W-Vine	0	0.00%
4.8 W/Adventives	H-Vine	0	0.00%	H-Vine	0	0.00%
70.4 NATIVE FQI	P-Forb	82	39.80%	P-Forb	6	2.90%
68.8 W/Adventives	B-Forb	2	1.00%	B-Forb	1	0.50%
-1.9 NATIVE MEAN W	A-Forb	6	2.90%	A-Forb	1	0.50%
-1.7 W/Adventives	P-Grass	8	3.90%	P-Grass	1	0.50%
AVG:	A-Grass	0	0.00%	A-Grass	0	0.00%
Fac. Wetland (-)	P-Sedge	20	9.70%	P-Sedge	0	0.00%
	A-Sedge	1	0.50%	A-Sedge	0	0.00%
	Fern	20	9.70%			

**ACRONYM**

ACRONYM	C	SCIENTIFIC NAME	W	WETNESS	PHYSIOGNOMY	COMMON NAME
ABIBAL	3	Abies balsamea	-3	FACW	Nt Tree	BALSAM FIR
ACEPEN	5	Acer pensylvanicum	3	FACU	Nt Tree	STRIPED MAPLE
ACERUB	1	Acer rubrum	0	FAC	Nt Tree	RED MAPLE
ACESAU	5	Acer saccharum	3	FACU	Nt Tree	SUGAR MAPLE
ACESPI	5	Acer spicatum	3	FACU	Nt Tree	MOUNTAIN MAPLE
AGRSTR	3	Agrimonia striata	1	FAC-	Nt P-Forb	AGRIMONY
AGRGIG	0	AGROSTIS GIGANTEA	0	FAC	Ad P-Grass	REDTOP
AGRHYE	4	Agrostis hyemalis	1	FAC-	Nt P-Grass	TICKLEGRASS
ALNRUG	5	Alnus rugosa	-5	OBL	Nt Shrub	TAG ALDER
ANAMAR	3	Anaphalis margaritacea	5	UPL	Nt P-Forb	PEARLY EVERLASTING
APOAND	3	Apocynum androsaemifolium	5	UPL	Nt P-Forb	SPREADING DOGBANE
ARANUD	5	Aralia nudicaulis	3	FACU	Nt P-Forb	WILD SARSAPARILLA
ARITRI	5	Arisaema triphyllum	-2	FACW-	Nt P-Forb	JACK IN THE PULPIT
ASTLAT	2	Aster lateriflorus	-2	FACW-	Nt P-Forb	SIDE FLOWERING ASTER
ASTMAC	4	Aster macrophyllus	5	UPL	Nt P-Forb	BIG LEAVED ASTER
ASTPUN	5	Aster puniceus	-5	OBL	Nt P-Forb	SWAMP ASTER
ASTSAG	2	Aster sagittifolius	5	UPL	Nt P-Forb	ARROW LEAVED ASTER
ASTUMB	5	Aster umbellatus	-3	FACW	Nt P-Forb	TALL FLAT TOP WHITE ASTER
ATHFIL	4	Athyrium filix-femina	0	FAC	Nt Fern	LADY FERN
BETALL	7	Betula alleghaniensis	0	FAC	Nt Tree	YELLOW BIRCH
BETPAP	2	Betula papyrifera	2	FACU+	Nt Tree	PAPER BIRCH
BIDCER	3	Bidens cernuus	-5	OBL	Nt A-Forb	NODDING BUR MARIGOLD
BOTVIR	5	Botrychium virginianum	3	FACU	Nt Fern	RATTLESNAKE FERN

**Appendix 1, continued. Plant species observed at Gogomain Swamp.**

ACRONYM	C SCIENTIFIC NAME	W WETNESS	PHYSIOGNOMY	COMMON NAME
BRAERE	7 Brachelytrum erectum	5 UPL	Nt P-Grass	LONG AWNED WOOD GRASS
BROCIL	6 Bromus ciliatus	-3 FACW	Nt P-Grass	FRINGED BROME
CALCAN	3 Calamagrostis canadensis	-5 OBL	Nt P-Grass	BLUE JOINT GRASS
CALLPA	10 Calla palustris	-5 OBL	Nt P-Forb	WILD CALLA
CALVER	6 Callitriche verna	-5 OBL	Nt P-Forb	WATER STARWORT
CALTPA	6 Caltha palustris	-5 OBL	Nt P-Forb	MARSH MARIIGOLD
CAMAPR	7 Campanula aparinooides	-5 OBL	Nt P-Forb	MARSH BELLFLOWER
CARPEN	1 Cardamine pensylvanica	-4 FACW+	Nt B-Forb	PENNSYLVANIA BITTER CRESS
CXCRYP	10 Carex cryptolepis	-5 OBL	Nt P-Sedge	SEDGE
CXDISP	10 Carex disperma	-5 OBL	Nt P-Sedge	SEDGE
CXEUBR	7 Carex eburnea	4 FACU-	Nt P-Sedge	SEDGE
CXGRAA	4 Carex gracillima	3 FACU	Nt P-Sedge	SEDGE
CXGYNA	3 Carex gynandra	-4 FACW+	Nt P-Sedge	SEDGE
CXGYNO	10 Carex gynocrates	-5 OBL	Nt P-Sedge	SEDGE
CXHYST	2 Carex hystericina	-5 OBL	Nt P-Sedge	SEDGE
CXINTE	3 Carex interior	-5 OBL	Nt P-Sedge	SEDGE
CXINTU	3 Carex intumescens	-4 FACW+	Nt P-Sedge	SEDGE
CXLEPA	5 Carex leptalea	-5 OBL	Nt P-Sedge	SEDGE
CXLIMO	10 Carex limosa	-5 OBL	Nt P-Sedge	BOG SEDGE
CXPAUP	8 Carex paupercula	-5 OBL	Nt P-Sedge	SEDGE
CXPEDU	5 Carex pedunculata	5 UPL	Nt P-Sedge	SEDGE
CXPSEU	5 Carex pseudo-cyperus	-5 OBL	Nt P-Sedge	SEDGE
CXTRIS	9 Carex trisperma	-5 OBL	Nt P-Sedge	SEDGE
CXVULP	1 Carex vulpinoidea	-5 OBL	Nt P-Sedge	SEDGE
CHACAL	8 Chamaedaphne calyculata	-5 OBL	Nt Shrub	LEATHERLEAF
CHRLEU	0 CHRYSANTHEMUM LEUCANTHEMUM	5 UPL	Ad P-Forb	OX EYE DAISY
CIRALP	4 Circaea alpina	-3 FACW	Nt P-Forb	SMALL ENCHANTER'S NIGHTSHADE
CIRMUT	6 Cirsium muticum	-5 OBL	Nt B-Forb	SWAMP THISTLE
CIRPAL	0 CIRSIUM PALUSTRE	-4 FACW+	Ad B-Forb	MARSH THISTLE
CLEVIR	4 Clematis virginiana	0 FAC	Nt W-Vine	VIRGIN'S BOWER
CLIBOR	5 Clintonia borealis	-1 FAC+	Nt P-Forb	BLUEBEAD LILY; CORN LILY
COPTRI	5 Coptis trifolia	-3 FACW	Nt P-Forb	GOLDTHREAD
CORCAA	6 Cornus canadensis	0 FAC	Nt Shrub	BUNCHBERRY
CORRUG	6 Cornus rugosa	5 UPL	Nt Shrub	ROUND LEAVED DOGWOOD
CORSTO	2 Cornus stolonifera	-3 FACW	Nt Shrub	RED OSIER DOGWOOD
CORCOR	5 Corylus cornuta	5 UPL	Nt Shrub	BEAKED HAZELNUT
CYPACA	5 Cypripedium acule	-3 FACW	Nt P-Forb	PINK LADY'S SLIPPER; MOCCASIN FLOWER
CYPREG	9 Cypripedium reginae	-4 FACW+	Nt P-Forb	SHOWY or QUEEN'S LADY SLIPPER
DIAARM	0 DIANTHUS ARMERIA	5 UPL	Ad A-Forb	DEPTFORD PINK
DROROT	6 Drosera rotundifolia	-5 OBL	Nt P-Forb	ROUND LEAVED SUNDEW
DRYCAR	5 Dryopteris carthuisiana	-2 FACW-	Nt Fern	SPINULOSE WOODFERN
DRYCRI	6 Dryopteris cristata	-5 OBL	Nt Fern	CRESTED SHIELD FERN
DRYINT	5 Dryopteris intermedia	0 FAC	Nt Fern	EVERGREEN WOODFERN
ELEOBT	3 Eleocharis obtusa	-5 OBL	Nt A-Sedge	SPIKE RUSH
EPIREP	7 Epigaea repens	5 UPL	Nt Shrub	TRAILING ARBUTUS
EPIANG	3 Epilobium angustifolium	0 FAC	Nt P-Forb	FIREWEED

Appendix 1, continued. Plant species observed at Gogomain Swamp.

ACRONYM	C SCIENTIFIC NAME	W WETNESS	PHYSIOGNOMY	COMMON NAME
EPICIL	3 Epilobium ciliatum	3 FACU	Nt P-Forb	WILLOW HERB
EPICOL	3 Epilobium coloratum	-5 OBL	Nt P-Forb	CINNAMON WILLOW HERB
EPHEL	0 EPIPACTIS HELLEBORINE	5 UPL	Ad P-Forb	HELLEBORINE
EQUARV	0 Equisetum arvense	0 FAC	Nt Fern Ally	COMMON HORSETAIL
EQUHYE	2 Equisetum hyemale	-2 FACW-	Nt Fern Ally	SCOURING RUSH
EQUPAL	10 Equisetum palustre	-3 FACW	Nt Fern Ally	MARSH HORSETAIL
EQUSCI	7 Equisetum scirpoides	-1 FAC+	Nt Fern Ally	DWARF SCOURING RUSH
EQUSYL	5 Equisetum sylvaticum	-3 FACW	Nt Fern Ally	WOODLAND HORSETAIL
EUPMAM	4 Eupatorium maculatum	-5 OBL	Nt P-Forb	JOE PYE WEED
EUPPER	4 Eupatorium perfoliatum	-4 FACW+	Nt P-Forb	COMMON BONESET
EUTGRA	3 Euthamia graminifolia	-2 FACW-	Nt P-Forb	GRASS LEAVED GOLDENROD
FRAVIR	2 Fragaria virginiana	1 FAC-	Nt P-Forb	WILD STRAWBERRY
FRANIG	6 Fraxinus nigra	-4 FACW+	Nt Tree	BLACK ASH
GALAPA	0 Galium aparine	3 FACU	Nt A-Forb	ANNUAL BEDSTRAW
GALTRR	4 Galium triflorum	2 FACU+	Nt P-Forb	FRAGRANT BEDSTRAW
GAUHS	8 Gaultheria hispida	-3 FACW	Nt Shrub	CREeping SNOWBERRY
GAUPRO	5 Gaultheria procumbens	3 FACU	Nt Shrub	WINTERGREEN
GLYCAN	8 Glyceria canadensis	-5 OBL	Nt P-Grass	RATTLESNAKE GRASS
GLYSTR	4 Glyceria striata	-5 OBL	Nt P-Grass	FOWL MANNA GRASS
GOOBL	6 Goodyera oblongifolia	5 UPL	Nt P-Forb	MENZIES' RATTLESNAKE PLANTAIN
GOOPUB	7 Goodyera pubescens	0 FAC	Nt P-Forb	DOWNY RATTLESNAKE PLANTAIN
GOOREP	9 Goodyera repens	3 FACU	Nt P-Forb	CREeping RATTLESNAKE PLANTAIN
GOOTES	6 Goodyera tessellata	3 FACU	Nt P-Forb	TESSELATED RATTLESNAKE PLANTAIN
GYMDRY	5 Gymnocarpium dryopteris	0 FAC	Nt Fern	OAK FERN
HALDEF	7 Halenia deflexa	0 FAC	Nt A-Forb	SPURRED GENTIAN
HIEAUR	0 HIERACIUM AURANTIACUM	5 UPL	Ad P-Forb	ORANGE HAWKWEED
HUPLUC	5 Huperzia lucidula	-1 FAC+	Nt Fern Ally	SHINING CLUBMOSS
IILEVER	5 Ilex verticillata	-4 FACW+	Nt Shrub	MICHIGAN HOLLY
IMPCAP	2 Impatiens capensis	-3 FACW	Nt A-Forb	SPOTTED TOUCH ME NOT
IRIVER	5 Iris versicolor	-5 OBL	Nt P-Forb	WILD BLUE FLAG
JUNEFF	3 Juncus effusus	-5 OBL	Nt P-Forb	SOFT STEMMED RUSH
KALPOL	10 Kalmia polifolia	-5 OBL	Nt Shrub	SWAMP LAUREL
LARLAR	5 Larix laricina	-3 FACW	Nt Tree	TAMARACK
LEDGRO	8 Ledum groenlandicum	-5 OBL	Nt Shrub	LABRADOR TEA
LINBOR	6 Linnaea borealis	0 FAC	Nt P-Forb	TWINFLOWER
LISCON	10 Listera convallarioides	-3 FACW	Nt P-Forb	BROAD LEAVED TWAYBLADE
LISCOR	10 Listera cordata	-3 FACW	Nt P-Forb	HEART LEAVED TWAYBLADE
LONCAN	5 Lonicera canadensis	3 FACU	Nt Shrub	AMERICAN FLY HONEYSUCKLE
LONDIO	5 Lonicera dioica	3 FACU	Nt W-Vine	RED HONEYSUCKLE
LONHIR	6 Lonicera hirsuta	0 FAC	Nt Shrub	HAIRY HONEYSUCKLE
LONOBL	8 Lonicera oblongifolia	-5 OBL	Nt Shrub	SWAMP FLY HONEYSUCKLE
LONVIL	8 Lonicera villosa	-3 FACW	Nt Shrub	FLY HONEYSUCKLE
LUDPAL	4 Ludwigia palustris	-5 OBL	Nt P-Forb	WATER PURSLANE
LYCANN	5 Lycopodium annotinum	0 FAC	Nt Fern Ally	STIFF CLUBMOSS
LYCCLA	4 Lycopodium clavatum	0 FAC	Nt Fern Ally	RUNNING GROUND PINE
LYCOBS	5 Lycopodium obscurum	3 FACU	Nt Fern Ally	GROUND PINE

Appendix 1, continued. Plant species observed at Gogomain Swamp.

ACRONYM	C SCIENTIFIC NAME	W WETNESS	PHYSIOGNOMY	COMMON NAME
LYCAME	2 <i>Lycopus americanus</i>	-5 OBL	Nt P-Forb	COMMON WATER HOREHOUND
LYCUNI	2 <i>Lycopus uniflorus</i>	-5 OBL	Nt P-Forb	NORTHERN BUGLE WEED
LYSTER	6 <i>Lysimachia terrestris</i>	-5 OBL	Nt P-Forb	SWAMP CANDLES
MAICAC	4 <i>Maianthemum canadense</i>	0 FAC	Nt P-Forb	CANADA MAYFLOWER
MENARV	3 <i>Mentha arvensis</i>	-3 FACW	Nt P-Forb	WILD MINT
MIMRIN	5 <i>Mimulus ringens</i>	-5 OBL	Nt P-Forb	MONKEY FLOWER
MITNUD	8 <i>Mitella nuda</i>	-3 FACW	Nt P-Forb	NAKED MITERWORT
MONOUN	8 <i>Moneses uniflora</i>	0 FAC	Nt P-Forb	ONE FLOWERED PYROLA
MONOUN	5 <i>Monotropa uniflora</i>	3 FACU	Nt P-Forb	INDIAN PIPE
MYRGAL	6 <i>Myrica gale</i>	-5 OBL	Nt Shrub	SWEET GALE
NEMMUC	7 <i>Nemopanthus mucronata</i>	-5 OBL	Nt Shrub	MOUNTAIN HOLLY
ONOUSE	2 <i>Onoclea sensibilis</i>	-3 FACW	Nt Fern	SENSITIVE FERN
ORTSEC	7 <i>Orthilia secunda</i>	-1 FAC+	Nt P-Forb	ONE SIDED PYROLA
OSMCIN	5 <i>Osmunda cinnamomea</i>	-3 FACW	Nt Fern	CINNAMON FERN
OSMREG	5 <i>Osmunda regalis</i>	-5 OBL	Nt Fern	ROYAL FERN
OXAACE	7 <i>Oxalis acetosella</i>	3 FACU	Nt P-Forb	NORTHERN WOOD SORREL
PETPAL	10 <i>Petasites palmatius</i>	-3 FACW	Nt P-Forb	SWEET COLTSFOOT
PHAARU	0 <i>Phalaris arundinacea</i>	-4 FACW+	Nt P-Grass	REED CANARY GRASS
PHTRAUS	0 <i>Phragmites australis</i>	-4 FACW+	Nt P-Grass	REED
PICGLA	3 <i>Picea glauca</i>	3 FACU	Nt Tree	WHITE SPRUCE
PICMAR	6 <i>Picea mariana</i>	-3 FACW	Nt Tree	BLACK SPRUCE
PINSTR	3 <i>Pinus strobus</i>	3 FACU	Nt Tree	WHITE PINE
PLACLA	6 <i>Platanthera clavellata</i>	-4 FACW+	Nt P-Forb	SM. GREEN WOOD ORCHID
PLAHYP	5 <i>Platanthera hyperborea</i>	-4 FACW+	Nt P-Forb	TALL NORTHERN BOG ORCHID
PLALAC	6 <i>Platanthera lacera</i>	-3 FACW	Nt P-Forb	GREEN FRINGED ORCHID
PLAOBT	10 <i>Platanthera obtusata</i>	-3 FACW	Nt P-Forb	BLUNT LEAVED ORCHID
POLPAU	7 <i>Polygala paucifolia</i>	3 FACU	Nt P-Forb	GAY WINGS
POPBAL	2 <i>Populus balsamifera</i>	-3 FACW	Nt Tree	BALSAM POPLAR
POPGRA	4 <i>Populus grandidentata</i>	3 FACU	Nt Tree	BIG TOOTHED ASPEN
POPTRE	1 <i>Populus tremuloides</i>	0 FAC	Nt Tree	QUAKING ASPEN
POTNAT	5 <i>Potamogeton natans</i>	-5 OBL	Nt P-Forb	PONDWEED
PRUVUL	0 <i>PRUNELLA VULGARIS</i>	0 FAC	Nt P-Forb	LAWN PRUNELLA
PRUVIR	2 <i>Prunus virginiana</i>	1 FAC-	Nt Shrub	CHOKO CHERRY
PYRASA	8 <i>Pyrola asarifolia</i>	-3 FACW	Nt P-Forb	PINK PYROLA
PYRROT	7 <i>Pyrola rotundifolia</i>	1 FAC-	Nt P-Forb	ROUND LEAVED PYROLA
QUERUB	5 <i>Quercus rubra</i>	3 FACU	Nt Tree	RED OAK
RANLAP	10 <i>Ranunculus lapponicus</i>	-5 OBL	Nt P-Forb	LAPLAND BUTTERCUP
RANREC	5 <i>Ranunculus recurvatus</i>	-3 FACW	Nt A-Forb	HOOKED CROWFOOT
RANSCE	1 <i>Ranunculus sceleratus</i>	-5 OBL	Nt A-Forb	CURSED CROWFOOT
RHAALN	8 <i>Rhamnus alnifolia</i>	-5 OBL	Nt Shrub	ALDER LEAVED BUCKTHORN
RIBAME	6 <i>Ribes americanum</i>	-3 FACW	Nt Shrub	WILD BLACK CURRANT
RIBHIR	6 <i>Ribes hirtellum</i>	-3 FACW	Nt Shrub	SWAMP GOOSEBERRY
RIBLAC	6 <i>Ribes lacustre</i>	-3 FACW	Nt Shrub	SWAMP BLACK CURRANT
RIBTRI	6 <i>Ribes triste</i>	-5 OBL	Nt Shrub	SWAMP RED CURRANT
RUBPUB	4 <i>Rubus pubescens</i>	-4 FACW+	Nt P-Forb	DWARF RASPBERRY
RUBSTR	2 <i>Rubus strigosus</i>	-2 FACW-	Nt Shrub	WILD RED RASPBERRY

Appendix 1, continued. Plant species observed at Gogomain Swamp.

ACRONYM	C SCIENTIFIC NAME	W WETNESS	PHYSIOGNOMY	COMMON NAME
RUMORB	9 Rumex orbiculatus	-5 OBL	Nt P-Forb	GREAT WATER DOCK
SAGLAT	1 Sagittaria latifolia	-5 OBL	Nt P-Forb	COMMON ARROWHEAD
SALBEB	1 Salix bebbiana	-4 FACW+	Nt Shrub	BEBB'S WILLOW
SALERI	2 Salix eriocephala	-3 FACW	Nt Shrub	WILLOW
SALLUC	3 Salix lucida	-4 FACW+	Nt Shrub	SHINING WILLOW
SALPET	1 Salix petiolaris	-4 FACW+	Nt Shrub	SLENDER WILLOW
SARPUP	10 Sarracenia purpurea	-5 OBL	Nt P-Forb	PITCHER PLANT
SCHACU	5 Schoenoplectus acutus	-5 OBL	Nt P-Sedge	HARDSTEM BULRUSH
SCHTAB	4 Schoenoplectus tabernaemontani	-5 OBL	Nt P-Sedge	SOFTSTEM BULRUSH
SCIATR	3 Scirpus atrovirens	-5 OBL	Nt P-Sedge	BULRUSH
SCICYP	5 Scirpus cyperinus	-5 OBL	Nt P-Sedge	WOOL GRASS
SCUGAL	5 Scutellaria galericulata	-5 OBL	Nt P-Forb	COMMON SKULLCAP
SCULAT	5 Scutellaria lateriflora	-5 OBL	Nt P-Forb	MAD DOG SKULLCAP
SENAUR	5 Senecio aureus	-3 FACW	Nt P-Forb	GOLDEN RAGWORT
SIUSUA	5 Sium suave	-5 OBL	Nt P-Forb	WATER PARSNIP
SMITRI	10 Smlacina trifolia	-5 OBL	Nt P-Forb	FALSE MAYFLOWER
SOLDUL	0 SOLANUM DULCAMARA	0 FAC	Ad P-Forb	BITTERSWEET NIGHTSHADE
SOLALT	1 Solidago altissima	3 FACU	Nt P-Forb	TALL GOLDENROD
SOLGIG	3 Solidago gigantea	-3 FACW	Nt P-Forb	LATE GOLDENROD
SOLRUG	3 Solidago rugosa	-1 FAC+	Nt P-Forb	ROUGH GOLDENROD
SOLULI	4 Solidago uliginosa	-5 OBL	Nt P-Forb	BOG GOLDENROD
SORAME	4 Sorbus americana	-1 FAC+	Nt Tree	AMERICAN MOUNTAIN ASH
SPAEUR	5 Sparganium eurycarpum	-5 OBL	Nt P-Forb	COMMON BUR REED
SPIALB	4 Spiraea alba	-4 FACW+	Nt Shrub	MEADOWSWEET
STRAMP	8 Streptopus amplexifolius	-1 FAC+	Nt P-Forb	TWISTED STALK
STRROS	5 Streptopus roseus	0 FAC	Nt P-Forb	ROSE TWISTED STALK
TAROFF	0 TARAXACUM OFFICINALE	3 FACU	Ad P-Forb	COMMON DANDELION
TAXCAN	5 Taxus canadensis	3 FACU	Nt Shrub	CANADIAN YEW
THADAS	3 Thalictrum dasycarpum	-2 FACW-	Nt P-Forb	PURPLE MEADOW RUE
THEPAL	2 Thelypteris palustris	-4 FACW+	Nt Fern	MARSH FERN
THEPHE	5 Thelypteris phegopteris	5 UPL	Nt Fern	NORTHERN BEECH FERN
THUOCC	4 Thuja occidentalis	-3 FACW	Nt Tree	ARBOR VITAE
TRIBOR	5 Trientalis borealis	-1 FAC+	Nt P-Forb	STARFLOWER
TRIREP	0 TRIFOLIUM REPENS	2 FACU+	Ad P-Forb	WHITE CLOVER
TRICER	5 Trillium cernuum	0 FAC	Nt P-Forb	NODDING TRILLIUM
TSUCAN	5 Tsuga canadensis	3 FACU	Nt Tree	HEMLOCK
VACANG	4 Vaccinium angustifolium	3 FACU	Nt Shrub	BLUEBERRY
VACMYR	4 Vaccinium myrtilloides	-2 FACW-	Nt Shrub	CANADA BLUEBERRY
VACOXY	8 Vaccinium oxycoccos	-5 OBL	Nt Shrub	SMALL CRANBERRY
VALULI	10 Valeriana uliginosa	-4 FACW+	Nt P-Forb	BOG VALERIAN
VIBCAS	6 Viburnum cassinoides	-3 FACW	Nt Shrub	NORTHERN HAW
VIBLEN	4 Viburnum lentago	-1 FAC+	Nt Shrub	NANNYBERRY
VIBOPA	5 Viburnum opulus var. americanum	-3 FACW	Nt Shrub	HIGHBUSH CRANBERRY
VIOMAC	6 Viola macloskeyi	-5 OBL	Nt P-Forb	SMOOTH WHITE VIOLET
VIOREN	6 Viola renifolia	-3 FACW	Nt P-Forb	KIDNEY LEAVED VIOLET

Appendix 2. Animal species observed at Gogomain Swamp.

GROUP	SCIENTIFIC NAME	COMMON NAME	LISTING
BIRDS (seen or evidence of)	<i>Aix sponsa</i>	WOOD DUCK	
	<i>Anas platyrhynchos</i>	MALLARD	
	<i>Archilochus colubris</i>	RUBY-THROATED HUMMINGBIRD	
	<i>Ardea herodias</i>	GREAT BLUE HERON	
	<i>Buteo platypterus</i>	BROAD-WINGED HAWK	
	<i>Catharus guttatus</i>	HERMIT THRUSH	
	<i>Carduelis tristis</i>	AMERICAN GOLDFINCH	
	<i>Colaptes auratus</i>	NORTHERN FLICKER	
	<i>Corvus brachyrhynchos</i>	AMERICAN CROW	
	<i>Cyanocitta cristata</i>	BLUE JAY	
	<i>Dendroica virens</i>	BLACK-THROATED GREEN WARBLER	
	<i>Falciennis canadensis</i>	SPRUCE GROUSE	state special concern
	<i>Grus canadensis</i>	SANDHILL CRANE	
	<i>Loxia leucoptera</i>	WHITE-WINGED CROSSBILL	
	<i>Perisoreus canadensis</i>	GRAY JAY	
	<i>Picooides pubescens</i>	DOWNY WOODPECKER	
	<i>Poecile atricapillus</i>	BLACK-CAPPED CHICKADEE	
	<i>Sitta carolinensis</i>	WHITE-BREADED NUTHATCH	
	<i>Troglodytes troglodytes</i>	WINTER WREN	
	<i>Turdus migratorius</i>	AMERICAN ROBIN	
	<i>Vireo olivaceus</i>	RED-EYED VIREO	
	<i>Zenaida macroura</i>	MOURNING DOVE	
	MAMMALS (seen or evidence of)	<i>Castor canadensis</i>	AMERICAN BEAVER
<i>Ursus americanus</i>		BLACK BEAR	
<i>Erethizon dorsatum</i>		COMMON PORCUPINE	
<i>Canis latrans</i>		COYOTE	
<i>Tamias striatus</i>		EASTERN CHIPMUNK	
<i>Canis lupus</i>		GRAY WOLF	state and federally threatened
<i>Tamiasciurus hudsonicus</i>		RED SQUIRREL	
<i>Odocoileus virginianus</i>		WHITE-TAILED DEER	
<i>Bufo a . americanus</i>		AMERICAN TOAD	
<i>Rana pipiens</i>		NORTHERN LEOPARD FROG	
<i>Thamnophis sirtalis</i>		COMMON GARTER SNAKE	
<i>Thamnophis sauritus septentrionalis</i>		NORTHERN RIBBON SNAKE	
AMPHIBIANS AND REPTILES (seen or heard)			

## APPENDIX 3

### Global and State Element Ranking Criteria

#### GLOBAL RANKS

- G1** = critically imperiled: at very high risk of extinction due to extreme rarity (often 5 or fewer occurrences), very steep declines, or other factors.
- G2** = imperiled: at high risk of extinction due to very restricted range, very few occurrences (often 20 or fewer), steep declines, or other factors.
- G3** = vulnerable: at moderate risk of extinction due to a restricted range, relatively few occurrences (often 80 or fewer), recent and widespread declines, or other factors.
- G4** = apparently secure: uncommon but not rare; some cause for long-term concern due to declines or other factors.
- G5** = secure: common; widespread.
- GU** = currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
- GX** = eliminated: eliminated throughout its range, with no restoration potential due to extinction of dominant or characteristic species.
- G?** = incomplete data.

#### STATE RANKS

- S1** = critically imperiled in the state because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state.
- S2** = imperiled in the state because of rarity due to very restricted range, very few occurrences (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the state.
- S3** = vulnerable in the state due to a restricted range, relatively few occurrences (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
- S4** = uncommon but not rare; some cause for long-term concern due to declines or other factors.
- S5** = common and widespread in the state.
- SX** = community is presumed to be extirpated from the state. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.
- S?** = incomplete data.