

Evaluation of the Ecological Significance of Gypsum and Other Calcareous Exposures in Nova Scotia



A report to the Nova Scotia Crown Share Land Legacy Trust

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Introduction

Project Background and Rationale

Due to the particular environmental conditions created by gypsum¹-influenced soils, areas with surficial deposits support distinct upland and wetland plant communities, some of which are of conservation concern. Gypsum-associated natural communities are globally uncommon and very rare in northeastern North America. Nova Scotia contains the region's largest and most widespread examples of these communities, despite the fact that its Windsor Group bedrock geology (which includes all provincial deposits of gypsum as well as deposits of limestone and other sedimentary bedrocks) only represents an estimated 5.5% of the total province area (see Figure 1). As a whole, Nova Scotia's occurrences of gypsum-associated communities are therefore of global significance and of conservation concern. Areas of gypsum bedrock in the province are almost completely on private land, and are thus not well represented within the provincial protected areas system. Less than 1% presently lies within federal, provincial or privately-owned protected areas (see Figure 2). Gypsum mining has a long history in the province and large open pit mines have already removed many of the most significant examples of gypsum landscapes, with gypsum mining companies owning large portions of undeveloped gypsum land. Expansion of gypsum mining thus represents a major ongoing threat to gypsum-associated natural communities. Although gypsum karst areas are sometimes protected from forestry activities by their rugged sinkhole topography, wood harvesting is also a significant threat to all gypsum areas of gentler topography.

In 2012, the Nova Scotia Department of Environment, Protected Areas and Ecosystems Branch initiated a project through which AC CDC botanists documented plant communities and rare species occurrences in a large number of gypsum sites in order to identify high-priority conservation areas and garner a better understanding of the province's gypsum-associated flora. With the objective of building on this highly successful effort, project funding was provided in 2014 by the Nova Scotia Crown Share Land Legacy Trust (NS CSLLT), whose primary purpose is to *"provide funds to non-governmental organizations for the securement and protection of ecologically significant, threatened and irreplaceable natural areas on private lands in Nova Scotia"*. Potential survey sites on private lands were identified and prioritized based on input and recommendations from the Nova Scotia Department of Natural Resources, the Nova Scotia Department of Environment, the AC CDC and non-governmental land conservation organizations. Surveys focused on collecting detailed data on vascular plants, vegetation communities and karst topography features (large bedrock exposures, sinkholes, caves, underground streams) were carried out at 36 separate sites throughout the geographic range of Nova Scotia's gypsum occurrences, from western Hants County to northern Cape Breton.

This project and the similar field effort carried out by the AC CDC in 2012 collectively represent the most geographically extensive investigation ever undertaken on the plant species and communities of Nova Scotia gypsum areas.

¹ In this report, the term "gypsum" refers to gypsum, anhydrite and selenite.

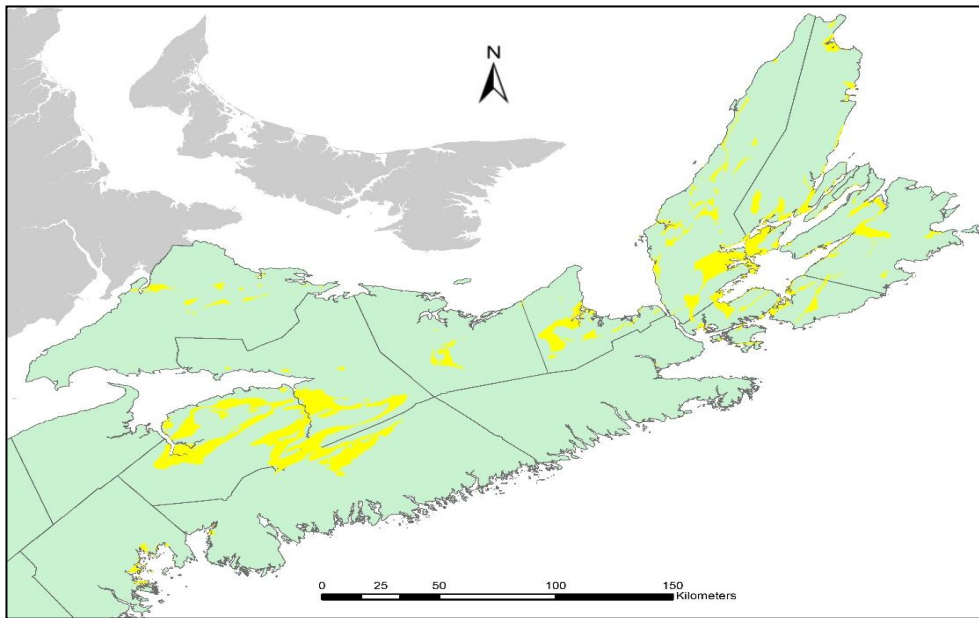


Figure 1. Known extent of Windsor Group bedrock geology in Nova Scotia, from NS DNR geological mapping (NS DNR 2000).

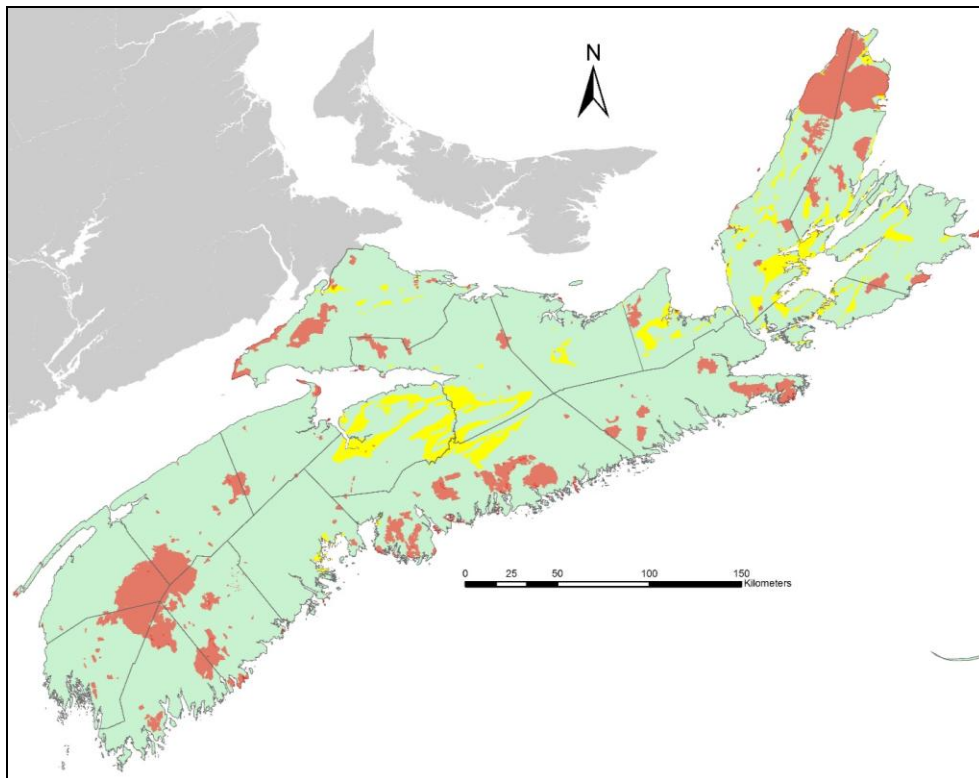


Figure 2. Known extent of Windsor Group bedrock geology (yellow shading; NS DNR 2000), with distribution of federal, provincial and private protected natural areas (red shading) in Nova Scotia.

Gypsum flora – An Overview [from Blaney and Mazerolle 2013]

Gypsum bedrock is widespread globally, with commercial exploitation occurring in at least 90 countries (USGS 2006). The chemistry of gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) presents physiological challenges for plants growing on gypsum outcrops or in soils with a high proportion of gypsum (Parsons 1976; Palacio *et al.* 2007, with citations below mostly from that reference). Gypsum soils contain very low levels of nitrogen and phosphorus, and their very high concentration of soluble calcium interferes with the uptake of the macronutrients phosphorus, potassium and magnesium and reduces availability of some micronutrients (Meyer *et al.* 1992; Guerrero Campo *et al.* 1999b). Toxicity due to high concentrations of sulfate ions can also occur (Duvigneaud 1968; Ruiz *et al.* 2003). These effects on plant growth are especially acute in arid environments (Palacio *et al.* 2007) where several physical properties that may be present in gypsum soils (mechanical instability due to weak aggregation and cohesion of soil particles, poor water retention and formation of hard gypsum crusts impeding root development) create further difficulties for plant growth (Guerrero Campo *et al.* 1999a,b; Romao and Escudero 2005).

The harsh and particular conditions of gypsum soils, along with their occurrence as isolated “islands” within a non-gypsum matrix, have resulted in the evolution of many narrow endemic plant species in arid gypsum regions [*i.e.* southwestern United States and Mexico (Johnston 1941; Meyer 1986; Meyer and García-Moya 1989; Moore and Jansen 2007 and references therein), southern Spain (Cerillo *et al.* 2002; Mota *et al.* 2004) and Australia (Symon 2007); see also Turner and Powell 1979]. Almost all the readily available scientific literature on gypsum-adapted flora has focused on arid regions, often with a focus on narrow endemic species having an obligate or near-obligate relationship with gypsum soils (gypsophiles), and references tend to define gypsum or “gypsiferous” soils as requiring semi-arid or arid climates for their formation (*i.e.* FAO UN 1990).

We were unable to find any English literature on plant physiology relative to gypsum in non-arid regions like Nova Scotia or northern Europe, but some or most of the same factors noted above likely apply when plants are growing directly on gypsum outcrops or on gypsum scree slopes. We were also unable to find any more than very cursory information on plant communities of gypsum regions in northern European sites (*i.e.* Great Britain, France and Germany, Schmeisky *et al.* 2002; Eurogypsum 2010), having climates similar to Nova Scotia. In those countries, while some rare plant species occur in areas of gypsum bedrock, the gypsum flora appears to be a subset of species requiring calcareous (basic) soils.

In the Canadian Maritimes, the existence of a distinctive flora occurring on gypsum has been fairly well known to botanists at least since Fernald’s (1921) description of collections made by Arthur Pease and Bayard Long along the Five Mile River in Hants County. Further notes on the flora of Nova Scotia’s gypsum are found in Roland and Smith (1969, and earlier editions) and Erskine (1976), and a description of some of the unique flora of the Albert Mines gypsum site in New Brunswick is given in Clayden (1994). None of the plant species found in gypsum sites in the Canadian Maritimes are endemics (not unexpected given the limited evolutionary time since glaciation and the very limited number of endemics in our flora as a whole), and none are obligate gypsophiles. Relatively few of our gypsum-associated plant species are restricted to gypsum sites within the Maritimes, with most species also occurring in other calcareous habitats. Rare and uncommon plant species associated with gypsum include species with Arctic or northern affinity [Mountain Avens (*Dryas integrifolia*), Myrtle-leaved Willow (*Salix myrtillifolia*), Mountain Goldenrod (*Solidago multiradiata*) and Northern Anemone (*Anemone parviflora*) in Albert County, New Brunswick (Clayden 1994) and Hyssop-leaved Fleabane (*Erigeron hyssopifolia*) in Nova Scotia] and species of the eastern deciduous forest region with more southern affinity, *i.e.* Canada Violet (*Viola canadensis*) and Ram’s-head Lady’s-slipper (*Cypripedium*

arietinum), as well as some very widely distributed species (Ebony Sedge – *Carex eburnea*, Soapberry – *Shepherdia canadensis*, Balsam Ragwort – *Packera paupercula*).

The most important factor in rare plant occurrence on Maritimes gypsum appears to be basic soil as virtually all rare species with a strong affinity for gypsum sites are more broadly associated with calcareous soils. The high light levels associated with frequent erosion and the consequent lack of forest development on gypsum outcrops are likely also an important factor in the persistence of many rare gypsum-associated plants, both for Arctic species (Clayden 1994) and for many others (*i.e.* Soapberry – *Shepherdia canadensis* and Balsam Ragwort – *Packera paupercula*). The particular soil chemistry of gypsum sites, however, may restrict some calciphilic plants, as many rare deciduous forest plants that occur on non-gypsum calcium rich soils in Nova Scotia (Hill and Garbary 2011) tend to be absent in deciduous forest on gypsum in the same regions of the province (Blaney, pers. obs.). Thus in the Maritimes, as with northern Europe, the specialist gypsum flora is basically a subset of a larger calcareous flora.

Gypsum Occurrence in NS [from Blaney and Mazerolle 2013]

Nova Scotia is unique in northeastern North America for the number and extent of sites having gypsum bedrock at or near the soil surface. Although exposed gypsum and karst landscapes (sinkhole topography formed by dissolution of subsurface gypsum) are uncommon in Nova Scotia, occupying only a tiny portion of the landscape, they are still far more widespread and frequent in the province than in any other jurisdiction in the glaciated portion of northeastern North America.

There are localized gypsum karst sites in New Brunswick near Hillsborough in Albert County, Plaster Rock in Victoria County and to a lesser extent near Havelock in Kings County. Surface or near-surface exposure is also known from Newfoundland in the Codroy Valley (House and Catto 2004) and very locally from the Magdalen Islands in Quebec (Tiphane 1970), but in Nova Scotia areas of gypsum karst larger than any of the preceding out-of-province examples occur in Hants, Colchester, Halifax, Antigonish, Inverness, Richmond and Cape Breton Counties. Smaller but still extensive areas of karst topography also occur in Cumberland and Pictou Counties.

Nova Scotia's gypsum cave systems were described by Moseley (1996) as internationally significant examples resulting from globally rare cave formation processes, and he noted the high level of threat faced by the province's gypsum caves as a result of quarrying. The rarity and significance of Nova Scotia's gypsum is also evident from mining statistics. Nova Scotia produces 75% of Canadian mined gypsum (Adams 1993; The Canadian Encyclopedia 2013), with the only other Canadian mining east of Manitoba occurring in the vicinity of Paris in southwestern Ontario. In the northeastern United States gypsum is currently mined only at Oakfield in western New York state, and Aliquippa in western Pennsylvania.

The relative frequency of gypsum features and their associated natural communities in Nova Scotia has probably resulted in a lack of understanding and an undervaluing of their global uniqueness and significance. This issue, along with the difficulty of enacting conservation action on sites largely held by smaller private landowners has meant that gypsum sites are under-represented in provincial and land trust nature reserve portfolios, which recent actions [especially the prioritization of calcareous

soil sites in the Colin Stewart Forest Forum (2009) process and in Nova Scotia's new parks and protected areas plan, NS DOEL 2013] have only begun to address.

Methods

Site Selection

Potential sites were initially selected based primarily on Adams (1991), a report on fieldwork investigating potential commercially exploitable occurrences of gypsum in Nova Scotia. This report describes gypsum sites throughout Nova Scotia and includes drill core information on thickness and depth of gypsum deposits as well as general descriptions of the nature of gypsum karst topography by site. Based on this information and previous fieldwork carried out by the AC CDC, the Nova Scotia Department of Natural Resources and the Nova Scotia Department of Environment, potential survey sites were identified by the scientific advisory committee of the NS CSLLT. In accordance with the mission of the NS CSLLT, site selection was strongly focused on privately owned land. The most promising sites were examined by the committee and prioritized based on site condition (mainly evaluated from aerial photography), existing botanical knowledge, prior survey effort and land ownership. From a list of roughly 40 sites identified as being of medium or high priority through this process, 36 sites were selected by the AC CDC for survey.

Field Survey

Fieldwork was conducted over 25 calendar days between June 30th and September 19th, 2014 by Sean Blaney, David Mazerolle and Alain Belliveau of the AC CDC, with Sean Basquill (NS DNR) accompanying one of the AC CDC botanists on four field days and Patrick Nussey (Nature Conservancy Canada) accompanying one of the AC CDC botanists on two field days.

Each field site was covered by one AC CDC botanist over one field day, with the exception of three sites surveyed in Victoria County: Beinn Bhreagh (covered by both David Mazerolle and Alain Belliveau, each surveying separate sections of the site), Hunters Mountain (covered by David Mazerolle over half a day) and McRae Brook (covered by David Mazerolle over half a day). In total, AC CDC botanists devoted 36 person days (amounting to about 58 work days, including overtime) to fieldwork for this project. Figure 3 maps the general location of the 36 survey sites. Observers and survey dates for each site are compiled in Table 1.

During surveys, botanists focused on areas showing evidence of surficial gypsum deposits (sinkhole topography, cliffs, outcrops) and wetland habitats potentially influenced by underlying calcareous bedrock, but we generally also covered other nearby habitats, especially where those had a high potential for supporting rare species occurrences. Each botanist utilized a GPS unit to precisely document survey coverage while in the field; track logs recorded by these units are mapped in Figures 4 to 39 under "Results - Site Summaries". Karst features of interest, including caves, large gypsum exposures and emerging / submerging streams, were documented, as were any significant plant communities encountered. We compiled full vascular plant species lists for each site (with the exception of site #6 - Five Mile River), and a general description of abundance for each observed species was noted for most sites. For provincially rare species (those with provincial status ranks, or

S-ranks, of S1 to S3S4; see Appendix 1 for rank definitions), we recorded precise locations by GPS, along with information on population size and extent, habitat and associated species. In the documentation of rare species occurrences, each individual or group of individuals separated by others by a distance of more than 10 m was recorded separately. Most rare species were also documented by voucher specimens that will be deposited at the E.C. Smith Herbarium (ACAD) at Acadia University and the Nova Scotia Museum of Natural History Herbarium (NSPM) in Halifax.

In addition to vascular plant data, incidental observations for rare or COSEWIC (Committee on the Status of Endangered Wildlife in Canada)-listed animals were recorded whenever these species were detected. Sean Blaney also recorded breeding birds using breeding status codes of the Maritimes Breeding Bird Atlas during early and mid-summer fieldwork.

All species data (species lists by site with generalized locations and precisely documented records of rare species and collections) have been permanently documented in the Atlantic Canada Conservation Data Centre database.

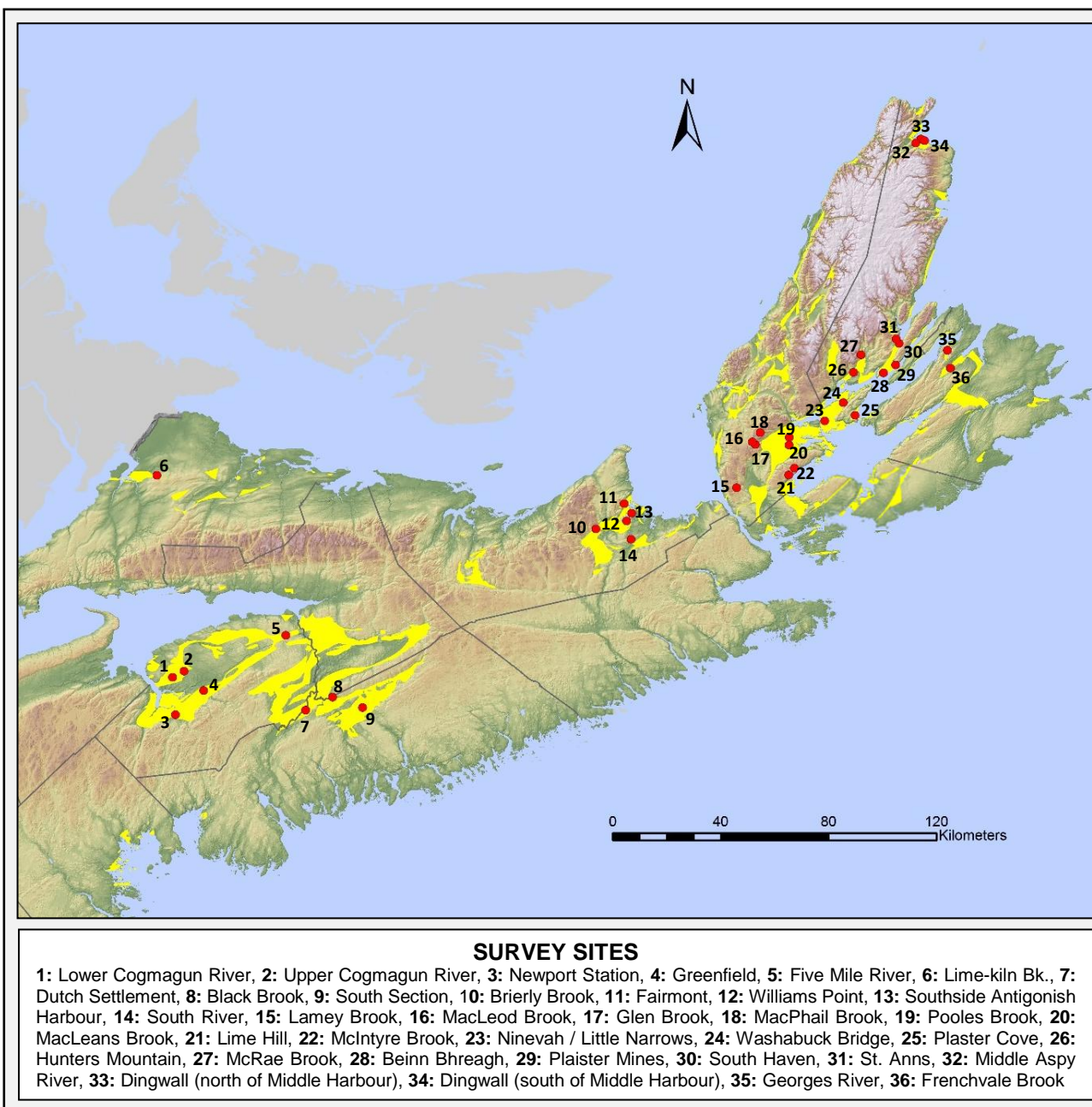


Figure 3. Location of selected survey sites. Yellow shading indicates mapped occurrences of Windsor Group bedrock (NS DNR 2000).

Table 1. Sites surveyed through this project, with county, survey date, observer(s) and statistics on observed vascular plant diversity. [Observer initials – DMM = Mazerolle, D.M.; CSB = Blaney, C.S.; AGB = Belliveau, A.G.; SPB = Basquill, S.P.; PN = Nussey, P.]

SURVEY SITE	COUNTY	DATE	Obs.	Total Spp.	Native Spp.	Exotic Spp.	Rare Spp.	% Native	% Exotic
#1 Lower Cogmagun River	Hants	07 15	DMM	278	226	54	5	81	19
#2 Upper Cogmagun River	Hants	07 16	DMM	199	179	20	5	90	10
#3 Newport Station	Hants	07 17	DMM	227	179	48	6	79	21
#4 Greenfield	Hants	07 18	DMM	210	189	21	2	90	10
#5 Five Mile River	Hants	08 04	AGB	n/a	n/a	n/a	5	n/a	n/a
#6 Lime-kiln Brook	Cumberland	09 04	DMM	181	140	41	3	77	23
#7 Dutch Settlement	Halifax	08 12	DMM	277	236	41	9	85	15
#8 Black Brook	Halifax	08 13	DMM	248	214	34	6	86	14
#9 South Section	Halifax	08 14	DMM	208	188	20	12	90	10
#10 Brierly Brook	Antigonish	08 15	DMM	228	191	37	9	84	16
#11 Fairmont	Antigonish	07 24	CSB	311	240	71	10	77	23
#12 Williams Point	Antigonish	07 23	CSB	387	299	88	15	77	23
#13 Southside Antigonish Harbour	Antigonish	06 30	CSB	303	233	70	9	77	23
#14 South River	Antigonish	07 25	CSB	237	174	63	12	73	27
#15 Lamey Brook	Inverness	09 16	AGB; PN	170	141	29	3	83	17
#16 MacLeod Brook	Inverness	09 19	DMM	192	173	19	3	90	10
#17 Glen Brook	Inverness	09 19	AGB	115	108	7	3	94	6
#18 MacPhail Brook	Inverness	09 19	CSB	212	178	34	6	84	16
#19 Pooles Brook	Inverness	09 11	AGB	190	177	13	7	93	7
#20 MacLeans Brook	Inverness	09 11	DMM	241	204	37	5	85	15
#21 Lime Hill	Inverness	09 16	DMM	221	201	20	2	91	9
#22 McIntyre Brook	Inverness	09 16	CSB; SPB	293	242	51	5	83	17
#23 Ninevah / Little Narrows	Victoria	09 17	CSB; SPB	343	275	68	20	80	20
#24 Washabuck Bridge	Victoria	09 10	DMM	233	200	33	5	86	14
#25 Plaster Cove	Victoria	09 10	AGB	179	151	28	8	84	16
#26 Hunters Mountain	Victoria	08 27	DMM	202	172	30	9	85	15
#27 McRae Brook	Victoria	08 27	DMM	182	161	21	3	88	12
#28 Beinn Bhreagh	Victoria	09 17	DMM; AGB; PN	264	214	50	12	81	19
#29 Plaister Mines	Victoria	08 29	DMM	236	195	41	9	83	17
#30 South Haven	Victoria	08 28	DMM	236	190	46	2	81	19
#31 St. Anns	Victoria	08 26	DMM	263	200	63	3	76	24
#32 Middle Aspy River	Victoria	09 18	AGB	136	120	16	8	88	12
#33 Dingwall (north)	Victoria	09 18	CSB	261	212	49	11	81	19
#34 Dingwall (south)	Victoria	09 18	DMM; SPB	195	161	34	8	83	17
#35 Georges River	Cape Breton	09 09	AGB	219	183	36	7	84	16
#36 Frenchvale Brook	Cape Breton	09 09	DMM	276	230	46	4	83	17

Results and Discussion

Vascular Plant Species Richness

Across all surveyed sites, we documented 8,145 vascular plant records of approximately 857 taxa, 673 of which are native to Nova Scotia and 184 of which are exotic. Appendix 3 lists all vascular plants documented by site, along with general indication of on-site abundance (where noted). Statistics summarizing plant diversity at each site are compiled in Table 1.

Native species richness ranged from 108 at the Glen Brook (site #17) to 299 at Williams Point (site #12) and averaged 194 across all sites. Native species counts equalling or exceeding 200 taxa were recorded at fourteen additional sites; Ninevah / Little Narrows (site #23), McIntyre Brook (site #22), Fairmont (site #11), Dutch Settlement (site #7), Southside Antigonish Harbour (site #13), Frenchvale Brook (site #36), Lower Cogmagun River (site #1), Beinn Bhreagh (site #28), Black Brook (site #8), Dingwall - north of Middle Harbour (site #33), MacLeans Brook (site #20), Lime Hill (site #21), St. Anns (site #31) and Washabuck Bridge (site #24).

Exotic species richness was also lowest at Glen Brook (site #17), with 7 species and highest at Williams Point (site #12), with 88 species. As was noted in 2012 (Blaney and Mazerolle 2013), the proportion of exotic species by site was relatively consistent, varying from 6% to 23%, with an average of roughly 16% among all sites.

Although it provides a general indication of a site's habitat diversity and richness, native plant count should not be considered a robust indicator of site condition or relative conservation value. Likewise, exotic species counts do not always provide an accurate measure of the level of disturbance and ecological integrity of a site. Both metrics are influenced by factors such as search effort, survey coverage, the extent to which anthropogenic habitats were traversed and the observer's level of expertise.

Exotic Invasive Species

In general terms, an exotic species' invasive potential is a measure of its ability to disperse, colonize and become locally dominant in natural habitats undisturbed by human activity. Habitats which are subjected to frequent natural disturbances, such as shorelines, are often more prone to invasion and can become dominated not only by highly invasive species but also by ruderal species which are largely restricted to anthropogenic habitats elsewhere on the landscape. In highly karstic areas, openings created through outcrop erosion and sinkhole collapse likely contribute to making habitats more susceptible to invasion. Due to their productive soils, areas with surficial or near-surface calcareous bedrock also often support a higher diversity of species (both native and exotic) and tend to have a greater history of agricultural disturbance as well as associated intentional or accidental species introductions. For these reasons, even gypsum lands untouched by intensive anthropogenic disturbance may present relatively higher exotic species richness and dominance than other types of natural landscapes in Nova Scotia.

Throughout this project, we documented occurrences of over 40 different species which have been noted as having at least some invasive potential in the Maritimes Region or elsewhere in temperate North America. These range from species that are highly invasive and regarded as being of

great concern for biodiversity conservation in the region to species mainly limited to highly disturbed sites. The following species were documented at over 10 survey sites and noted as being at least locally common at one site or more: Colt's Foot (*Tussilago farfara*), Creeping Buttercup (*Ranunculus repens*), Black Starthistle (*Centaurea nigra*), Common Hawkweed (*Hieracium lachenalii*), Creeping Thistle (*Cirsium arvense*), Kentucky Bluegrass (*Poa pratensis*), Tansy Ragwort (*Senecio jacobaea*), Tall Rye Grass (*Lolium arundinaceum*), Meadow Hawkweed (*Hieracium caespitosum*), Reed Canary Grass (*Phalaris arundinacea*), Field Sowthistle (*Sonchus arvensis*), White Sweetclover (*Melilotus albus*), and Purple Loosestrife (*Lythrum salicaria*). Most of these represent species that are often restricted to anthropogenic habitats but readily spread and become common in natural habitats where frequent disturbances create suitable microsites for their establishment.

Glossy Buckthorn (*Frangula alnus*), an aggressively-spreading shrub that represents one of the most problematic invasive species in the Maritimes Region, was detected at Lime-kiln Brook (site #6) in Cumberland County and at Dutch Settlement (site #7) in Halifax County. At the former site, the species was found to be widespread and abundant in a wide variety of anthropogenic and natural wet to mesic habitats, including mature forest understories.

Other notable invasive species documented include Woodland Angelica (*Angelica sylvestris*), which was found to be rare at eight survey sites and Rugosa Rose (*Rosa rugosa*), which was noted as locally common in coastal habitats at two sites in Victoria County.

We also documented occurrences of two provincially rare moderately invasive exotic species: Forest Woodrush (*Luzula luzuloides*) and Marsh Thistle (*Cirsium palustre*). Forest Woodrush, which was found to be locally dominant in mature hardwood and Eastern Hemlock (*Tsuga canadensis*) forest at Beinn Bhreagh (site #28), had only previously been reported in Nova Scotia from a site in Pictou County (found by M.L. Fernald in the 1920s) and from Kejimikujik National Park (found by A.E. Roland in the 1970s). Prior to 2012, Marsh Thistle had only been reported from two locations in Nova Scotia, in Inverness County and Halifax County. Through fieldwork carried out in gypsum areas in 2012, AC CDC botanists discovered an additional 4 sites for this species in Victoria and Inverness counties (Blaney and Mazerolle 2013). The species, which seems to have an affinity for high-pH wetland habitats, was discovered at four more sites in 2014, in Hants, Inverness and Victoria counties.

Rare Vascular Plant Species

Through this project, AC CDC botanists discovered populations of 83 provincially rare vascular plant species, including 13 critically imperiled species (S1 and S1S2), 28 imperiled species (S2 and S2S3) and 42 vulnerable species (S3 and S3S4). Across all sites, we documented 1,330 rare plant locations, comprising 54 locations for critically imperiled species, 359 locations for imperiled species and 917 locations for vulnerable species. These recorded occurrences represent 245 species x survey site combinations. Numbers presented here only reflect occurrences for which we were able to provide a confident identification; expert review of some difficult specimens will slightly increase the total number of rare species discovered through this project. Information on rare plants found at each survey site, including Nova Scotia status ranks, is compiled in Table 2. Additional notes on significant species are also provided in the "Site Summaries" section below.

Rare species diversity was found to be highest at Ninevah / Little Narrows (site #23) and Williams Point (site #12), with 20 and 15 species respectively, and lowest at Greenfield (site #4), Lime Hill (site #30) and South Haven (site #30), which each had 2 species. Average provincially rare plant diversity among all 36 survey sites was roughly 7 species. Variability between sites is likely a function of habitat diversity, amount of exposed calcareous bedrock, depth of overburden, nature of surrounding bedrock, soil and till, as well as search effort.

Our fieldwork led to the discovery of three species that were not previously known to occur in Nova Scotia: Autumn Willow (*Salix serissima*), Myrtle-Leaf Willow (*Salix myrtillifolia*) and American Yellow Rocket (*Barbarea orthoceras*). Small populations of Autumn Willow and Myrtle-Leaf Willow, each comprised of very few individuals, were found in close proximity to one another in a rich calcareous swamp at South Section (site #9). Both of these mainly boreal willow species are rare east of Ontario and each was previously only known in the Maritimes Region from a single population in New Brunswick. The identification of the Myrtle-Leaf Willow occurrence is less than 100% certain since it , could instead be the very similar Ball's Willow (*Salix ballii* – called *Salix myrtillifolia* var. *brachypoda* in some taxonomic treatments). Ball's Willow is only known from the Northwest Territories, Ontario, Quebec, Labrador and Newfoundland, but could also occur in the Maritimes. Collected specimens were verified by willow specialist George W. Argus (Canadian Museum of Nature), but a definitive identification could not be reached. Based on various leaf characteristics and habitat, however, the occurrence is most likely Myrtle-Leaf Willow (G.W. Argus, pers. comm.). American Yellow Rocket, a species of open high-pH shores, is widespread in northern and western North America but rare in Quebec, New England and the Atlantic Provinces. This species was discovered at Southside Antigonish Harbour (site #13), where it was found at several locations on the upper margins of brackish marsh and along small streams over a 1 km stretch of shoreline.

Provincially rare species encountered at the most sites during this project were Bulblet Fern (*Cystopteris bulbifera*), Woodland Strawberry (*Fragaria vesca* ssp. *americana*), Alderleaf Buckthorn (*Rhamnus alnifolia*), Balsam Groundsel (*Packera paupercula*), Ebony Sedge (*Carex eburnea*), Hyssop-leaved Fleabane (*Erigeron hyssopifolius*), Small Yellow Lady's-Slipper (*Cypripedium parviflorum*), Small Yellow Water-Crowfoot (*Ranunculus gmelinii*), Tall Hairy Groovebur (*Agrimonia gryposepala*), Black Ash (*Fraxinus nigra*) and Dwarf Scouring Rush (*Equisetum scirpoides*). The first eight species occur in close association with surficial or near-surface gypsum and limestone deposits in Nova Scotia, while the latter four occur in a wider range of habitats but show some affinity for high-pH soils.

Of the thirteen critically imperiled (S1 and S1S2) species discovered through this project, eight represent calciphiles with provincial distributions that are very strongly associated with gypsum and limestone exposures or seepage wetlands influenced by underlying Windsor Group bedrock: Autumn Willow (*Salix serissima*), Myrtle-Leaf Willow (*Salix myrtillifolia*), Meadow Sedge (*Carex granularis*), Ram's Head Lady's-Slipper (*Cypripedium arietinum*), Bald Spikerush (*Eleocharis erythropoda*), Northern Bog Sedge (*Carex gynocrates*), Long-Stalked Yellow Sedge (*Carex viridula* var. *elator*) and Marsh Grass-of-Parnassus (*Parnassia palustris* var. *parviflora*). Out of the 83 rare species found, roughly 30 have a fairly high affinity for calcareous habitats as well as provincial distributions showing some association with Windsor Group bedrock. These species are highlighted in Table 2.

A brief examination of previous botanical knowledge and plant occurrence data collected through AC CDC fieldwork in 2012 and 2014 shows several differences between the rare gypsum-associated

floras of different regions within Nova Scotia. The distinctiveness of karst communities between regions is especially evident in terms of the rarest species, several of which are restricted to one or very few sites in a single region. A detailed multivariate analysis using all data collected to date would provide greater insight into the level of distinctiveness of regional karst floras.

Animals

We documented 210 incidental animal observations during site surveys (Table 3). Of these, 198 were records of 72 different bird species, including 42 records for 13 provincially rare breeding birds and 15 site occurrences for the COSEWIC-listed Olive-sided Flycatcher (*Contopus cooperi*, Threatened), Bank Swallow (*Riparia riparia*, Threatened), Barn Swallow (*Hirundo rustica*, Threatened) and Eastern Wood-Pewee (*Contopus virens*, Special Concern).

Table 2. Provincially rare vascular plant species documented during site surveys, with Nova Scotia status ranks and sites where occurrences were detected. Shading indicates calciphiles that also have a provincial distribution suggesting some association with Windsor Group Bedrock. See appendices 1 and 2 for rank definitions.

SITE # 1: Lower Cogmagun River, 2: Upper Cogmagun River, 3: Newport Station, 4: Greenfield, 5: Five Mile River, 6: Lime-kiln Bk., 7: Dutch Settlement, 8: Black Brook, 9: South Section, 10: Brierly Brook, 11: Fairmont, 12: Williams Point, 13: Southside Antigonish Harbour, 14: South River, 15: Lamey Brook, 16: MacLeod Brook, 17: Glen Brook, 18: MacPhail Brook, 19: Pooles Brook, 20: MacLeans Brook, 21: Lime Hill, 22: McIntyre Brook, 23: Ninevah / Little Narrows, 24: Washabuck Bridge, 25: Plaster Cove, 26: Hunters Mountain, 27: McRae Brook, 28: Beinn Bhreagh, 29: Plaister Mines, 30: South Haven, 31: St. Anns, 32: Middle Aspy River, 33: Dingwall (north of Middle Harbour), 34: Dingwall (south of Middle Harbour), 35: Georges River, 36: Frenchvale Brook					
SCIENTIFIC NAME	COMMON NAME	FAMILY	NS S-Rank	NS GS-Rank	SITES WHERE SPECIES WAS DOCUMENTED
<i>Salix myrtillofolia</i>	Myrtle-Leaf Willow	Salicaceae	S1	May Be At Risk	9 – first provincial record
<i>Salix serissima</i>	Autumn Willow	Salicaceae	S1	May Be At Risk	9 – first provincial record
<i>Barbarea orthoceras</i>	American Winter-Cress	Brassicaceae	S1	May Be At Risk	13 – first provincial record
<i>Boehmeria cylindrica</i>	False Nettle	Urticaceae	S1	May Be At Risk	7
<i>Carex granularis</i>	Meadow Sedge	Cyperaceae	S1	May Be At Risk	23
<i>Carex grisea</i>	Narrowleaf Sedge	Cyperaceae	S1	May Be At Risk	12
<i>Carex gynocrates</i>	Northern Bog Sedge	Cyperaceae	S1	May Be At Risk	9, 19
<i>Carex viridula</i> var. <i>elatior</i>	A Sedge	Cyperaceae	S1	May Be At Risk	23, 26
<i>Cypripedium arietinum</i>	Ram's-Head Lady's-Slipper	Orchidaceae	S1	At Risk	1
<i>Eleocharis erythropoda</i>	Bald Spikerush	Cyperaceae	S1	May Be At Risk	31
<i>Fraxinus nigra</i>	Black Ash	Oleaceae	S1S2	At Risk	3, 9, 10, 14, 23, 26, 32, 36
<i>Juncus alpinoarticulatus</i> ssp. <i>nodulosus</i>	Richardson's Rush	Juncaceae	S1S2	May Be At Risk	25
<i>Parnassia palustris</i> var. <i>parviflora</i>	Marsh Grass-of-Parnassus	Saxifragaceae	S1S2	May Be At Risk	29
<i>Carex vacillans</i>	Estuarine Sedge	Cyperaceae	S1S3	Undetermined	33
<i>Anemone virginiana</i>	Virginia Anemone	Ranunculaceae	S2	Sensitive	11, 12, 13
<i>Asplenium trichomanes-ramosum</i>	Green Spleenwort	Aspleniaceae	S2	Sensitive	15, 18, 35
<i>Carex bebbii</i>	Bebb's Sedge	Cyperaceae	S2	Sensitive	23
<i>Carex castanea</i>	Chestnut-Colored Sedge	Cyperaceae	S2	May Be At Risk	9
<i>Carex hystericina</i>	Porcupine Sedge	Cyperaceae	S2	May Be At Risk	35
<i>Carex tuckermanii</i>	Tuckerman Sedge	Cyperaceae	S2	Sensitive	1, 2, 27
<i>Caulophyllum thalictroides</i>	Blue Cohosh	Berberidaceae	S2	May Be At Risk	14
<i>Cypripedium parviflorum</i> var. <i>makasin</i>	Small Yellow Lady's-Slipper	Orchidaceae	S2	Sensitive	33
<i>Cypripedium reginae</i>	Showy Lady's-Slipper	Orchidaceae	S2	May Be At Risk	9, 19
<i>Galium labradoricum</i>	Bog Bedstraw	Rubiaceae	S2	Sensitive	9, 23
<i>Lilium canadense</i>	Canada Lily	Liliaceae	S2	May Be At Risk	14
<i>Lobelia kalmii</i>	Kalm's Lobelia	Campanulaceae	S2	May Be At Risk	19, 20, 22, 23
<i>Myriophyllum verticillatum</i>	Whorled Water-Milfoil	Haloragaceae	S2	Sensitive	24, 26
<i>Osmorhiza longistylis</i>	Smother Sweet-Cicely	Apiaceae	S2	May Be At Risk	14
<i>Polystichum lonchitis</i>	Northern Holly-Fern	Dryopteridaceae	S2	Sensitive	33, 34
<i>Symphyotrichum ciliolatum</i>	Lindley's Aster	Asteraceae	S2	Sensitive	9
<i>Scirpus pedicellatus</i>	Stalked Bulrush	Cyperaceae	S2?	Sensitive	7
<i>Symphyotrichum boreale</i>	Boreal American-Aster	Asteraceae	S2?	Sensitive	19, 20, 23

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SCIENTIFIC NAME	COMMON NAME	FAMILY	NS S-Rank	NS GS-Rank	SITES WHERE SPECIES WAS DOCUMENTED
<i>Carex hirtifolia</i>	Pubescent Sedge	Cyperaceae	S2S3	Sensitive	14
<i>Cypripedium parviflorum</i>	Small Yellow Lady's-Slipper	Orchidaceae	S2S3	Sensitive	10, 12, 16, 21, 23, 25, 29
<i>Elodea canadensis</i>	Broad Waterweed	Hydrocharitaceae	S2S3	Secure	7
<i>Galium aparine</i>	Catchweed Bedstraw	Rubiaceae	S2S3	Sensitive	12
<i>Halenia deflexa</i>	Spurred Gentian	Gentianaceae	S2S3	Sensitive	15, 18
<i>Shepherdia canadensis</i>	Canada Buffalo-Berry	Elaeagnaceae	S2S3	Sensitive	28, 29, 32, 33, 34
<i>Stuckenia filiformis</i>	Slender Pondweed	Potamogetonaceae	S2S3	Sensitive	23, 24, 28
<i>Triosteum aurantiacum</i>	Coffee Tinker's-Weed	Caprifoliaceae	S2S3	Sensitive	12, 14
<i>Agrimonia gryposepala</i>	Tall Hairy Groovebur	Rosaceae	S3	Secure	3, 8, 11, 12, 13, 14, 20, 23, 27, 28, 31, 32, 35, 36
<i>Alopecurus aequalis</i>	Short-Awn Foxtail	Poaceae	S3	Secure	11
<i>Asplenium trichomanes</i>	Maidenhair Spleenwort	Aspleniaceae	S3	Secure	18
<i>Carex eburnea</i>	Ebony Sedge	Cyperaceae	S3	Sensitive	5, 10, 11, 23, 25, 28, 29, 32, 33, 34
<i>Carex lupulina</i>	Hop Sedge	Cyperaceae	S3	Secure	1, 2, 9, 10, 11
<i>Carex rosea</i>	Rosy Sedge	Cyperaceae	S3	Secure	5, 14
<i>Carex wiedgandii</i>	Wiegand's Sedge	Cyperaceae	S3	Sensitive	1
<i>Dichanthelium clandestinum</i>	Deer-Tongue Witchgrass	Poaceae	S3	Secure	7
<i>Equisetum pratense</i>	Meadow Horsetail	Equisetaceae	S3	Sensitive	17
<i>Equisetum variegatum</i>	Variegated Horsetail	Equisetaceae	S3	Secure	11, 28, 33
<i>Erigeron hyssopifolius</i>	Hyssop-leaved Fleabane	Asteraceae	S3	Sensitive	5, 10, 12, 23, 25, 29, 32, 33, 34
<i>Goodyera repens</i>	Dwarf Rattlesnake-Plantain	Orchidaceae	S3	Sensitive	2, 29
<i>Juncus dudleyi</i>	Dudley's Rush	Juncaceae	S3	Secure	6, 23
<i>Laportea canadensis</i>	Wood Nettle	Urticaceae	S3	Sensitive	7, 14
<i>Packera paupercula</i>	Balsam Groundsel	Asteraceae	S3	Secure	5, 10, 11, 12, 13, 23, 25, 28, 29, 32, 33, 34
<i>Platanthera grandiflora</i>	Large Purple-Fringe Orchis	Orchidaceae	S3	Secure	4, 9, 14
<i>Platanthera hookeri</i>	Hooker Orchis	Orchidaceae	S3	Secure	4
<i>Polygonum pennsylvanicum</i>	Pennsylvania Smartweed	Polygonaceae	S3	Secure	12
<i>Polygonum scandens</i>	Climbing False-Buckwheat	Polygonaceae	S3	Sensitive	12
<i>Proserpinaca palustris</i> var. <i>crebra</i>	Marsh Mermaid-Weed	Haloragaceae	S3	Secure	3, 8, 19, 26
<i>Pyrola asarifolia</i>	Pink Wintergreen	Pyrolaceae	S3	Secure	18
<i>Ranunculus gmelinii</i>	Small Yellow Water-Crowfoot	Ranunculaceae	S3	Secure	2, 3, 10, 11, 23, 24, 26, 27, 30
<i>Rhamnus alnifolia</i>	Alderleaf Buckthorn	Rhamnaceae	S3	Secure	8, 9, 16, 18, 19, 20, 21, 22, 23, 26, 36
<i>Samolus valerandi</i> ssp. <i>parviflorus</i>	Water Pimpernel	Primulaceae	S3	Sensitive	12,23

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SCIENTIFIC NAME	COMMON NAME	FAMILY	NS S-Rank	NS GS-Rank	SITES WHERE SPECIES WAS DOCUMENTED
<i>Sparganium natans</i>	Small Bur-Reed	Sparganiaceae	S3	Secure	22, 33, 35
<i>Teucrium canadense</i>	American Germander	Lamiaceae	S3	Sensitive	12, 13, 28, 31
<i>Verbena hastata</i>	Blue Vervain	Verbenaceae	S3	Secure	5, 12, 14
<i>Amelanchier stolonifera</i>	Running Serviceberry	Rosaceae	S3?	Secure	1
<i>Asclepias incarnata</i> ssp. <i>pulchra</i>	Swamp Milkweed	Asclepiadaceae	S3?	Undetermined	8, 20, 24, 26, 28
<i>Carex cryptolepis</i>	Northeastern Sedge	Cyperaceae	S3?	Secure	9, 22, 33, 36
<i>Carex tribuloides</i>	Blunt Broom Sedge	Cyperaceae	S3?	Secure	2, 3, 28
<i>Polygonum amphibium</i> var. <i>emersum</i>	Water Smartweed	Polygonaceae	S3?	Undetermined	7
<i>Polypodium appalachianum</i>	Appalachian Polypody	Polypodiaceae	S3?	Undetermined	25, 32
<i>Cystopteris bulbifera</i>	Bulblet Fern	Dryopteridaceae	S3S4	Secure	7, 8, 10, 11, 12, 13, 17, 18, 23, 24, 25, 26, 28, 29, 30, 34, 35
<i>Equisetum hyemale</i> var. <i>affine</i>	Scouring Rush	Equisetaceae	S3S4	Secure	32, 33
<i>Equisetum scirpoides</i>	Dwarf Scouring Rush	Equisetaceae	S3S4	Secure	6, 16, 17, 28, 33, 35
<i>Fragaria vesca</i> ssp. <i>americana</i>	Woodland Strawberry	Rosaceae	S3S4	Secure	6, 7, 8, 10, 11, 15, 19, 23, 25, 29, 34, 35
<i>Juncus acuminatus</i>	Sharp-Fruit Rush	Juncaceae	S3S4	Secure	7
<i>Myriophyllum sibiricum</i>	Common Water-Milfoil	Haloragaceae	S3S4	Secure	13, 26, 28
<i>Panicum tuckermanii</i>	Philadelphia Panic Grass	Poaceae	S3S4	Secure	22
<i>Polygonum fowleri</i>	Fowler's Knotweed	Polygonaceae	S3S4	Secure	13
<i>Sanguinaria canadensis</i>	Bloodroot	Papaveraceae	S3S4	Secure	12, 14
<i>Carex tonsa</i> var. <i>rugosperma</i>	Umbel-Like Sedge	Cyperaceae	SNR	Undetermined	10
<i>Chenopodium berlandieri</i> var. <i>macrocalycium</i>	Large-calyx Goosefoot	Chenopodiaceae	SNR	Undetermined	30, 31
<i>Galium trifidum</i> ssp. <i>halophilum</i>	Saline Three-Petaled Bedstraw	Rubiaceae	SNR	Secure	28, 30
<i>Antennaria</i> cf. <i>neglecta</i>	-	Asteraceae	-	-	13
<i>Carex aurea</i> / <i>garberi</i>	-	Cyperaceae	-	-	10
<i>Carex flava</i> / <i>viridula</i> var. <i>elatior</i>	-	Cyperaceae	-	-	21
<i>Carex</i> poss. <i>peckii</i>	-	Cyperaceae	-	-	11
<i>Carex</i> poss. <i>rostrata</i> x <i>utriculata</i>	-	Cyperaceae	-	-	22
<i>Cuscuta</i> sp.	-	Cuscutaceae	-	-	12
<i>Epilobium ciliatum</i> / <i>coloratum</i>	-	Onagraceae	-	-	12, 20
<i>Hypericum</i> cf. <i>dissimulatum</i>	-	Clusiaceae	-	-	22
<i>Platanthera psycodes</i> / <i>grandiflora</i>	-	Orchidaceae	-	-	29, 30, 36
<i>Rubus pubescens</i> cf. var. <i>scius</i>	-	Rosaceae	-	-	34
<i>Spiranthes cernua</i> / <i>ochroleuca</i>	-	Orchidaceae	-	-	22
<i>Suaeda</i> sp.	-	Chenopodiaceae	-	-	13

Table 3. Provincially rare bird species documented incidentally during site surveys, with Nova Scotia status ranks and sites where occurrences were detected. See appendices 1 and 2 for status rank definitions and <http://www.cosewic.gc.ca> for special national status definitions.

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SCIENTIFIC NAME	COMMON NAME	NS S-Rank	NS GS-Rank	SPECIAL NATIONAL STATUS (COSEWIC)	SITES WHERE SPECIES WAS DOCUMENTED
<i>Tringa semipalmata</i>	Willet	S2S3B	May Be At Risk	-	12
<i>Poecile hudsonica</i>	Boreal Chickadee	S3	Sensitive	-	11, 16, 22, 28
<i>Contopus cooperi</i>	Olive-sided Flycatcher	S3B	At Risk	Threatened	11, 13
<i>Riparia riparia</i>	Bank Swallow	S3B	May Be At Risk	Threatened	13, 14
<i>Hirundo rustica</i>	Barn Swallow	S3B	At Risk	Threatened	13, 14
<i>Dumetella carolinensis</i>	Gray Catbird	S3B	May Be At Risk	-	14
<i>Gavia immer</i>	Common Loon	S3B,S4N	May Be At Risk	-	13
<i>Perisoreus canadensis</i>	Gray Jay	S3S4	Sensitive	-	23
<i>Charadrius vociferus</i>	Killdeer	S3S4B	Sensitive	-	12
<i>Actitis macularius</i>	Spotted Sandpiper	S3S4B	Sensitive	-	12, 13
<i>Contopus virens</i>	Eastern Wood-Pewee	S3S4B	Sensitive	Special Concern	1, 3, 4, 7, 8, 9, 11, 12, 13
<i>Empidonax flaviventris</i>	Yellow-bellied Flycatcher	S3S4B	Sensitive	-	11, 12, 28
<i>Tyrannus tyrannus</i>	Eastern Kingbird	S3S4B	Sensitive	-	14
<i>Pheucticus ludovicianus</i>	Rose-breasted Grosbeak	S3S4B	Sensitive	-	13, 14

#1. Lower Cogmagun River

Observer(s): Mazerolle, D.M.

Survey date: July 15th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Cypripedium arietinum</i>	Ram's-Head Lady's-Slipper	S1	At Risk	4
<i>Carex tuckermanii</i>	Tuckerman's Sedge	S2	Sensitive	2
<i>Carex lupulina</i>	Hop Sedge	S3	Secure	1
<i>Carex wiegandii</i>	Wiegand's Sedge	S3	Sensitive	1
<i>Amelanchier stolonifera</i>	Running Serviceberry	S3?	Secure	4

Site Summary

Though the entire 4.6 km-long section surveyed along the lower Cogmagun River is underlain by Windsor Group sedimentary rock, few signs of surficial gypsum were observed at this site. Subtle karst topography was noted at several locations along the river valley slopes and in adjacent forest within a few hundred meters of the valley bottom. These very subdued features, which suggest that any gypsum deposits in this area are covered by a significant amount of overburden, included very shallow sinkhole-like depressions and somewhat pronounced runoff gulleys and intermittent brook gulleys. Shallow depressions were also noted at a few locations within the wide marshy river floodplain.

The river valley bottom along this section of the Cogmagun River is generally fairly wide (varying from 100 m to 500 m in width), with an extensive open graminoid marsh floodplain that gradually transitions from tidal saltmarsh communities to freshwater marsh communities within the surveyed area. Forest throughout much of the area has been heavily degraded by clear cutting, selective wood harvesting and to a lesser extent, agricultural use. Stands of intact mature forest form narrow bands adjacent to the river floodplain and can be found in isolated locations further away from the river, mainly in seepage wetlands. Red Maple (*Acer rubrum*) and Black Spruce (*Picea mariana*) seepage swamps are fairly common throughout and are prevalent in the eastern half of the surveyed area, where some areas of heavy seepage still contain stands of mature forest. Mature upland forest along the lower Cogmagun River mainly consists of mixed hardwood and coniferous stands dominated by Red Maple, Eastern Hemlock (*Tsuga canadensis*), Red Spruce (*Picea rubens*), Balsam Fir (*Abies balsamea*), Yellow Birch (*Betula alleghaniensis*) and Large-Tooth Aspen (*Populus grandidentata*). The most notable discovery at this site was four small colonies of the globally rare and provincially endangered Ram's-Head Lady's-Slipper (*Cypripedium arietinum*, G3, S1, At Risk) in a small remnant band of mature Sugar Maple (*Acer saccharum*), Red Oak (*Quercus rubra*), Eastern Hemlock and White Ash (*Fraxinus americana*) forest. Other notable finds include small populations of the very rare Tuckerman's Sedge (*Carex tuckermanii*, S2, Sensitive) and rare Hop Sedge (*Carex lupulina*, S3, Secure) in seepy forested backwaters and depressions within the river floodplain.

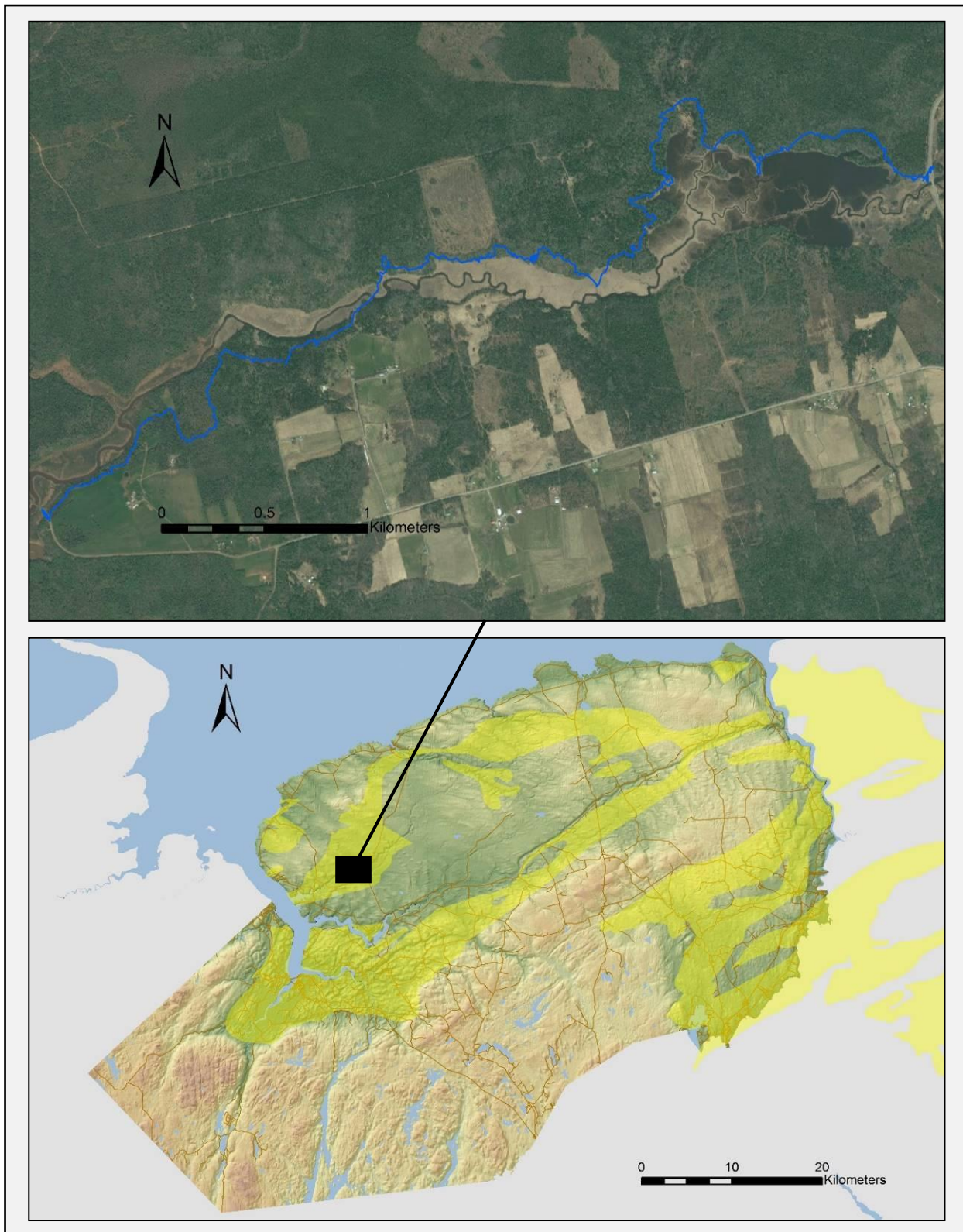


Figure 3. Survey coverage on the lower Cogmagun River (site #1), Hants County, NS. Blue line represents track file logged by GPS unit. Survey carried out on July 15th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#1. Lower Cogmagun River (clockwise from top left)

1 – Ram's Head Lady's-Slipper (*Cypripedium arietinum*, S1, At Risk) in mature hardwood forest. 2 – Tuckerman's Sedge (*Carex tuckermanii*, S2, Sensitive) in seepy forested backwater. 3 – Brackish tidal riparian marsh and mature mixedwood forest along the Cogmagun River. 4 – Wiegand's Sedge (*Carex wiegandii*, S3, Sensitive) in Black Spruce / Red Maple swamp.

#2. Upper Cogmagun River

Observer(s): Mazerolle, D.M.

Survey date: July 16th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Carex tuckermanii</i>	Tuckerman's Sedge	S2	Sensitive	6
<i>Carex lupulina</i>	Hop Sedge	S3	Secure	10
<i>Goodyera repens</i>	Dwarf Rattlesnake-Plantain	S3	Sensitive	1
<i>Ranunculus gmelinii</i>	Small Yellow Water-Crowfoot	S3	Secure	1
<i>Carex tribuloides</i>	Blunt Broom Sedge	S3?	Secure	1

Site Summary

The Cogmagun River valley along this 3 km-long section is generally much narrower and more deeply incised than in the area surveyed further downstream. Few signs of surficial gypsum deposits were observed, except for the presence of numerous shallow round depressions forming small backwater ponds and marshy vernal pools in the river floodplain and the presence of gypsum on a logging road just north of the surveyed area.

Wood harvesting has been extensive along this section of the Cogmagun River; many areas are presently in early stages of regeneration and most standing forest is fairly young. Due in part to the presence of steep slopes and seepage swamps, mature intact forest forms a wide band along the river, extending well beyond the regulated 20 m vegetated riparian buffer. In some areas, the valley bottom widens sufficiently to contain pockets of well-developed mixed-wood forested floodplain communities. These areas are not exceptionally rich, however, and much of the low-lying flat areas on the valley bottom are occupied by mesotrophic seepage swamps dominated by Black Spruce (*Picea mariana*), Red Maple (*Acer rubrum*) and Balsam Fir (*Abies balsamea*). Similar seepage swamp communities were also observed at several locations above the river valley. Some of the more abrupt slopes support mature to old stands of Eastern Hemlock (*Tsuga canadensis*) and Red Maple, as well as small isolated stands of Yellow Birch (*Betula alleghaniensis*), Red Oak (*Quercus rubra*), Red Maple and Sugar Maple (*Acer saccharum*). Open acidic ericaceous shrub bog was also noted at a single location at the southern end of the surveyed area.

Species of conservation concern discovered at this site include the very rare Tuckerman's Sedge (*Carex tuckermanii*, S2, Sensitive) and the rare Hop Sedge (*Carex lupulina*, S3, Secure), Blunt Broom Sedge (*Carex tribuloides*, S3?, Secure) and Small Yellow Water-Crowfoot (*Ranunculus gmelinii*, S3, Secure), all of which were in seepy forested backwaters and marshy depressions within the river floodplain. A few individuals of Dwarf Rattlesnake-Plantain (*Goodyera repens*, S3, Sensitive) were also found in the mossy understory of mature Eastern Hemlock and Red Maple forest.

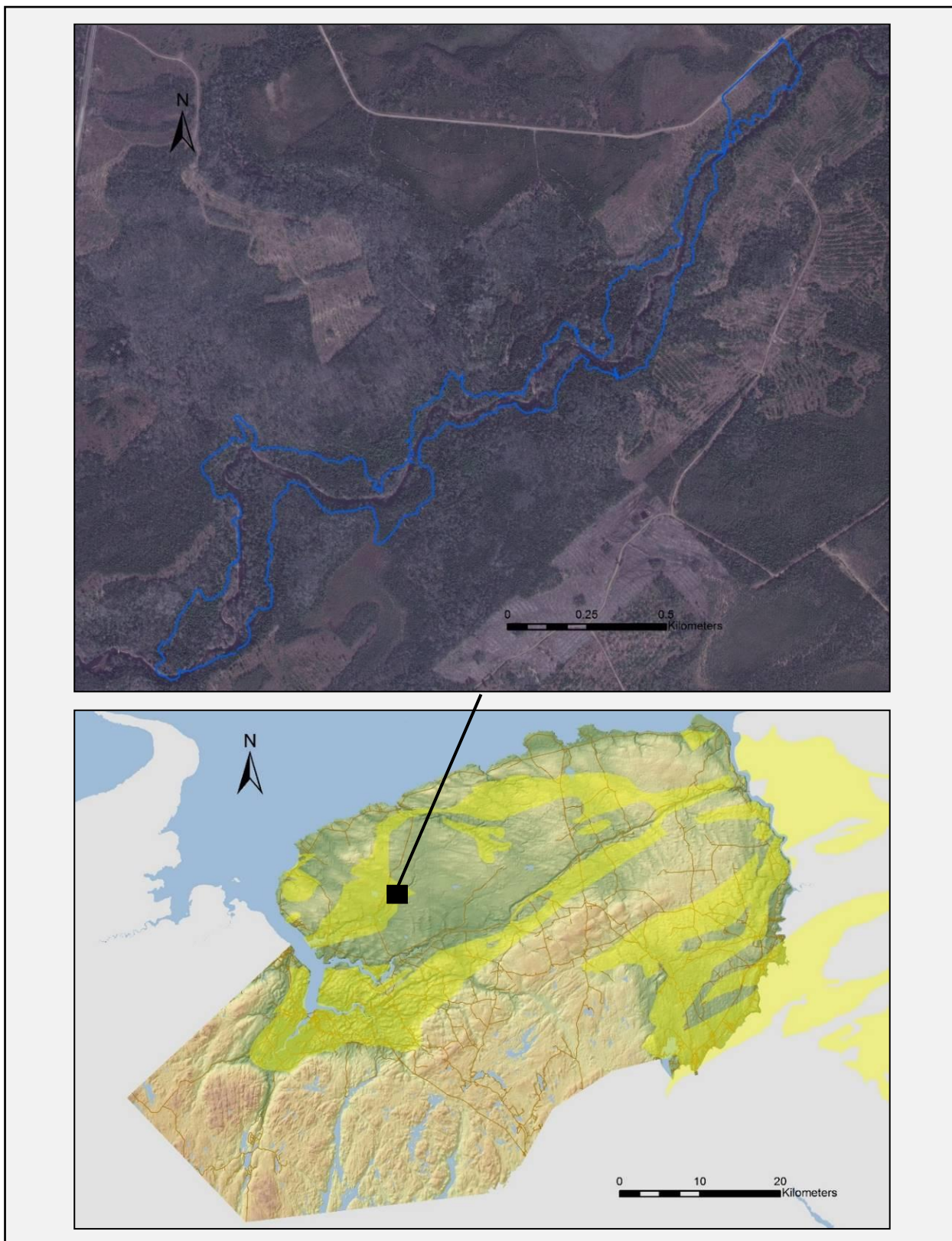


Figure 4. Survey coverage on the upper Cogmagun River (site #2), Hants County, NS. Blue line represents track file logged by GPS unit. Survey carried out on July 16th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#2. Upper Cogmagun River (clockwise from top left)

1 – Hop Sedge (*Carex lupulina*, S3, Secure) in small sinkhole-like depression within river floodplain. 2 – Remnant old Eastern Hemlock / Sugar Maple forest on steep valley slope. 3 – Mature Black Spruce swamp on plateau above river valley. 4 – Dense patch of Small Yellow Water-Crowfoot (*Ranunculus gmelinii*, S3, Secure) in marshy backwater within river floodplain.

#3. Newport Station

Observer(s): Mazerolle, D.M.

Survey date: July 17th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Fraxinus nigra</i>	Black Ash	S1S2	At Risk	2
<i>Carex bebbii</i>	Bebb's Sedge	S2	Sensitive	1
<i>Agrimonia gryposepala</i>	Tall Hairy Groovebur	S3	Secure	2
<i>Proserpinaca palustris</i> var. <i>crebra</i>	Marsh Mermaid-Weed	S3	Secure	5
<i>Ranunculus gmelinii</i>	Small Yellow Water-Crowfoot	S3	Secure	1
<i>Carex tribuloides</i>	Blunt Broom Sedge	S3?	Secure	1

Site Summary

Located between Newport Station and Gypsum Mines, the surveyed area at this site is delimited by Route 14, Wentworth Road and Irishmans Road. The site is on privately owned land adjacent to a large gypsum quarry held by the Fundy Gypsum Company (presently not in operation) and lies within what was historically one of Nova Scotia's most extensively quarried gypsum areas. Moderate to heavy karst topography extends over the majority of the surveyed area, with several large ridges and numerous medium to large sinkholes found throughout. Exposed outcrops of fine-grained very friable gypsum are fairly common and particularly abundant at the site's northwest end, in a fairly extensive area of very pronounced karst characterized by successive abrupt sinkholes, pits and ridges. The eastern half of the site also includes several sinkhole ponds ranging from 50 to over 100 m in width.

Most mature karst forest in the surveyed area consists of nearly pure Eastern Hemlock (*Tsuga canadensis*) stands and mixed stands of Eastern Hemlock, Red Maple (*Acer rubrum*), White Spruce (*Picea glauca*), Balsam Fir (*Abies balsamea*), Trembling Aspen (*Populus tremuloides*), Large-Toothed Aspen (*Populus grandidentata*) and Sugar Maple (*Acer saccharum*). The site's central section includes a fairly large area of Red Maple (*Acer rubrum*) / Tamarack (*Larix laricina*) / Speckled Alder (*Alnus incana* ssp. *rugosa*) seepage swamp and Black Spruce (*Picea mariana*) / American Elm (*Ulmus americana*) / Yellow Birch (*Betula alleghaniensis*) seepage swamp. The latter, which represents a provincially rare or uncommon wetland forest community type, contained a small population of the provincially protected Black Ash (*Fraxinus nigra*, S1S2, At Risk). Sinkhole ponds and sinkhole wetlands at the site include various graminoid and forb marsh communities and support large populations of Marsh Mermaid-Weed (*Proserpinaca palustris* var. *crebra*, S3, Secure) as well as small populations of Bebb's Sedge (*Carex bebbii*, S2, Sensitive), Blunt Broom Sedge (*Carex tribuloides*, S3?, Secure) and Small Yellow Water-Crowfoot (*Ranunculus gmelinii*, S3, Secure).

This site represents a somewhat intact remnant natural area within a highly fragmented landscape. Moderate anthropogenic disturbance is evident throughout the site, mainly in the form of numerous walking trails, and a few areas show signs of historic agricultural use. Selective wood harvesting has also significantly degraded the forest at the western end of the surveyed area.

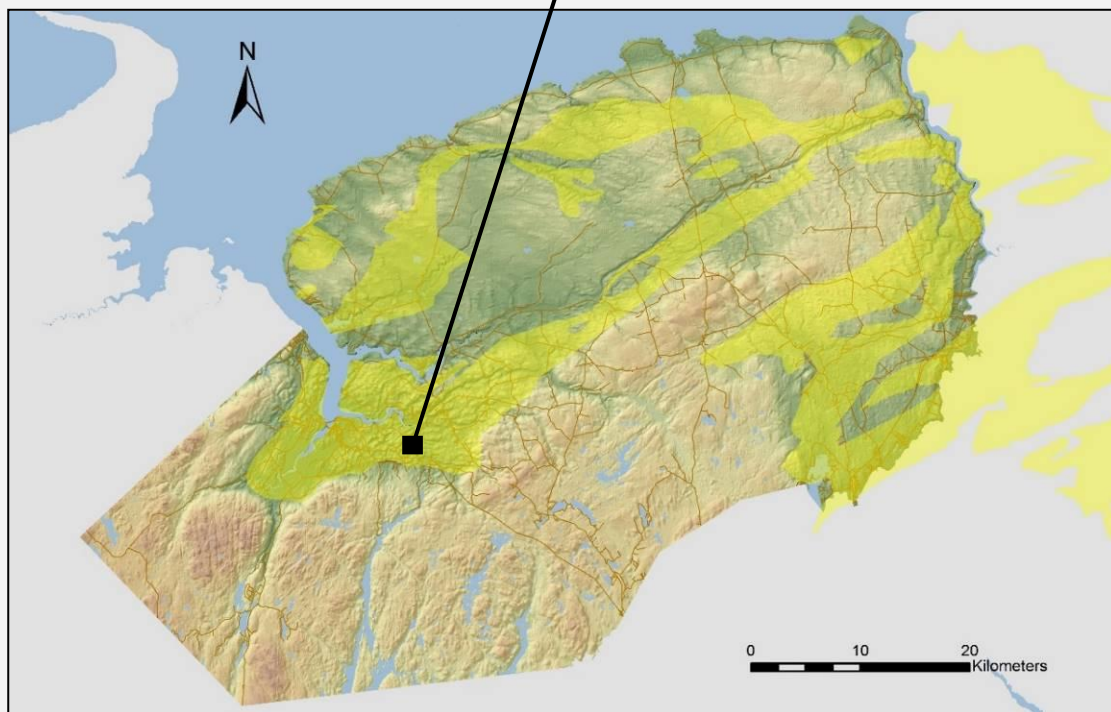
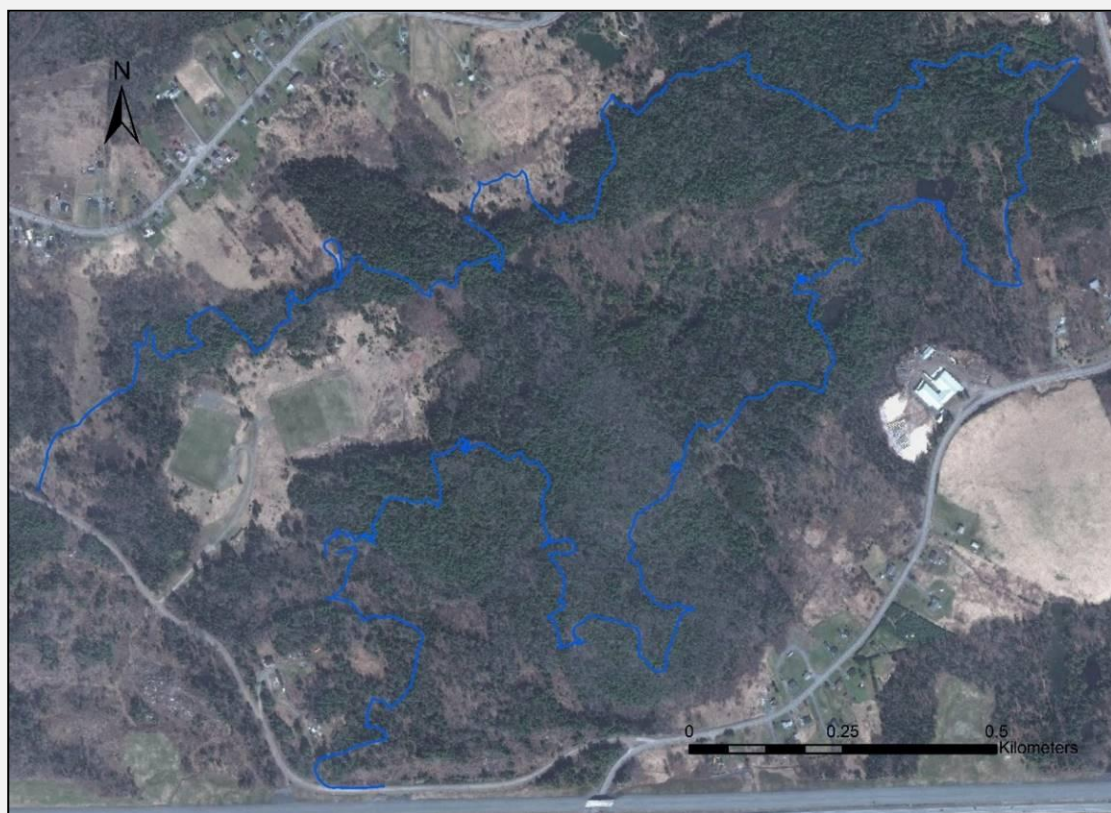


Figure 5. Survey coverage at Newport Station (site #3), Hants County, NS. Blue line represents track file logged by GPS unit. Survey carried out on July 17th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#3. Newport Station (clockwise from top left)

1 – Mature Eastern Hemlock forest on pronounced karst topography. 2 – Bebb's Sedge (*Carex bebbii*, S2, Sensitive) in marshy sinkhole meadow. 3 – Black Ash (*Fraxinus nigra*, S1S2, At Risk) in Black Spruce / American Elm / Yellow Birch swamp. 4 – Fairly large sinkhole pond bordered by mature Black Spruce / Red Maple swamp.

#4. Greenfield

Observer(s): Mazerolle, D.M.

Survey date: July 18th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Platanthera grandiflora</i>	Large Purple-Fringe Orchis	S3	Secure	1
<i>Platanthera hookeri</i>	Hooker's Orchis	S3	Secure	2

Site Summary

This survey site is approximately halfway between Mosherville and Greenfield, just north of the Herbert River's rich karst valley. Survey coverage in this area was focused around a series of sinkhole ponds visible in aerial photography. Karst topography, consisting of small to fairly large sinkholes and pronounced brook gulleys, was observed at three separate locations within a 1 km by 0.3 km area. Although several of the sinkholes at the site have moderately abrupt slopes, no gypsum or limestone exposures were noted and all observed instances of exposed rock consist of non-calcareous glacial till. This suggests that deposits of carbonate bedrock in the area may lie under significant overburden. Six sinkhole ponds, ranging from 20 m to nearly 140 m wide, were surveyed.

Forest at the site's north end is mostly intermediate aged and largely dominated by shade-intolerant hardwoods, with several areas apparently recovering from historic agricultural use. Extensive recent wood harvesting (post-dating the aerial photography shown in this report) has eliminated a large tract of forest in the site's northeastern section. Heavy disturbance is largely restricted to the northern half of the site, however, and forest over the remainder of the surveyed area is intermediate to mature and relatively intact. Mesotrophic stands of Red Maple (*Acer rubrum*) / Large-Toothed Aspen (*Populus grandidentata*) / Trembling Aspen (*Populus tremuloides*) / Red Spruce (*Picea rubens*) / White Spruce (*Picea glauca*) are prevalent. The site also contains scattered much older stands of pure Eastern Hemlock (*Tsuga canadensis*) and Eastern Hemlock mixed with Red Maple, Yellow Birch (*Betula alleghaniensis*), White Ash (*Fraxinus americana*), Eastern White Pine (*Pinus strobus*) and Northern Red Oak (*Quercus rubra*). A fairly large area of mature Red Maple and Balsam Fir (*Abies balsamea*) slope seepage swamp was observed at the site's southeast end. Larger sinkholes support various wetland communities including pockets of acidic bog, circumneutral fen, Speckled Alder (*Alnus incana* ssp. *rugosa*) swales and graminoid / forb marsh.

Only two provincially uncommon species were detected during the survey; very small populations of Large Purple-Fringe Orchis (*Platanthera grandiflora*, S3, Secure) and Hooker's Orchis (*Platanthera hookeri*, S3, Secure) were discovered in deciduous and mixed-wood forest at the edge of karst topography.

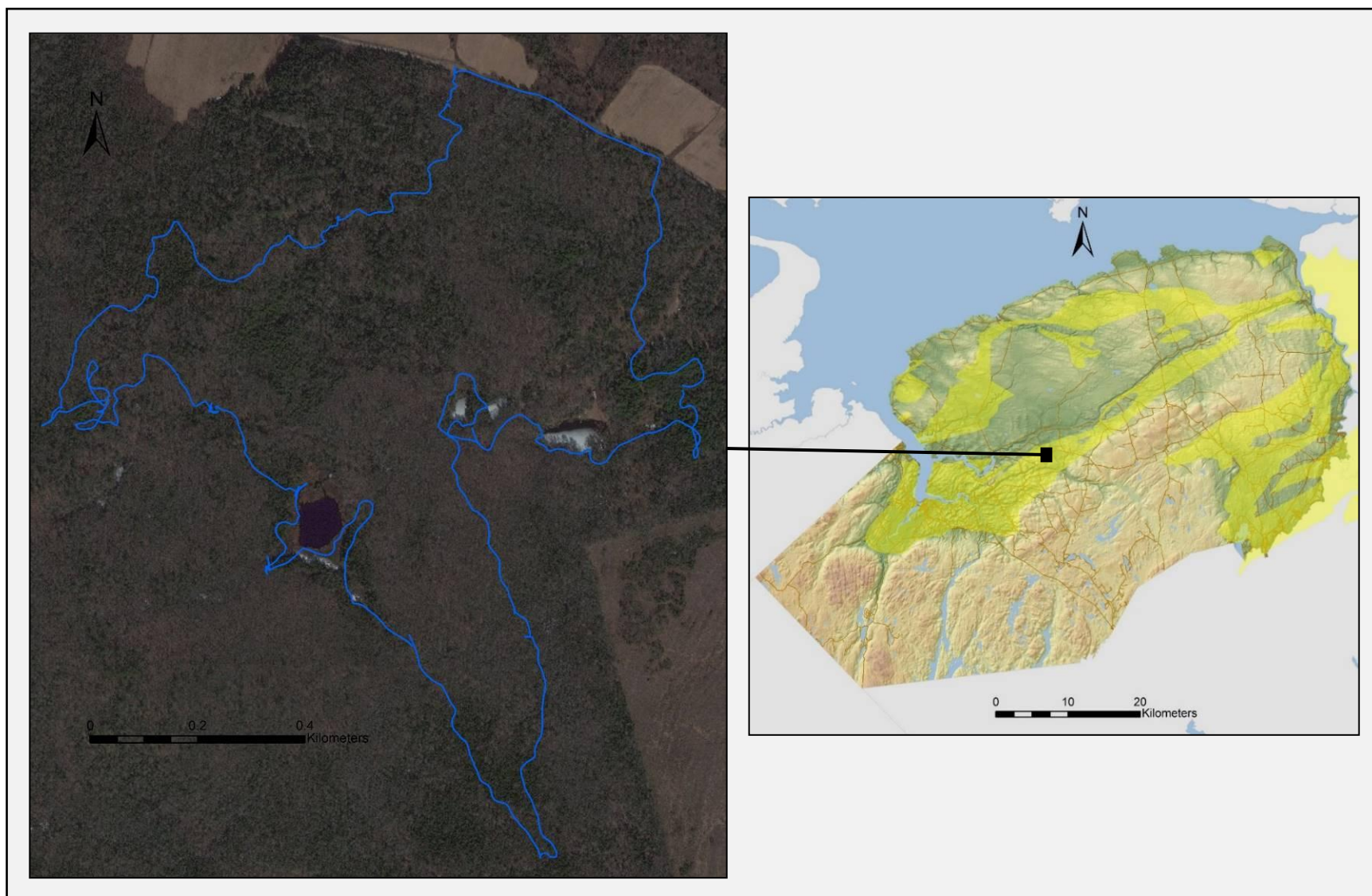


Figure 6. Survey coverage at Greenfield (site #4), Hants County, NS. Blue line represents track file logged by GPS unit. Survey carried out on July 18th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).

#5. Five Mile River

Observer(s): Belliveau, A.G.

Survey date: August 4th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Packera paupercula</i>	Balsam Groundsel	S3	Secure	9
<i>Verbena hastata</i>	Blue Vervain	S3	Secure	3
<i>Carex eburnea</i>	Ebony Sedge	S3	Sensitive	2
<i>Erigeron hyssopifolius</i>	Hyssop-leaved Fleabane	S3	Sensitive	3
<i>Carex rosea</i>	Rosy Sedge	S3	Secure	1

Site Summary

Gypsum features along the Five Mile River in the vicinity of Hayes Cave – reportedly the largest cave in Nova Scotia, at over 350 m long (The Canadian Caver, 1988) – are spread over an area roughly 3 km in length and a few hundred meters in width along the river. Although only three were surveyed, at least five areas of exposed gypsum protrusions are present, represented by tall (5 to 25 m) cliffs with thick accumulations of scree and by variably pronounced sinkhole topography in areas adjacent to these cliffs. Areas immediately behind or uphill from cliffs are typically highly karstic, with exposed steep-sided small sinkholes, while areas further away from cliffs have less-pronounced topography, with wider till-covered sinkholes. Shallow beaver ponds were found at the bottom of two of the gypsum cliffs. The river and its relatively narrow floodplain are influenced by surrounding high-pH bedrock, which includes both gypsum and small amounts of limestone.

Areas with exposed gypsum at this site are generally characterized by gypsum-associated species, including Roundleaf Dogwood (*Cornus rugosa*), Balsam Groundsel (*Packera paupercula*, S3, Secure), Ebony Sedge (*Carex eburnea*, S3, Sensitive), and Hyssop-leaved Fleabane (*Erigeron hyssopifolius*, S3, Sensitive). Areas with pronounced sinkholes are sparingly forested by a mix of Balsam Fir (*Abies balsamea*) and Paper Birch (*Betula papyrifera* var. *papyrifera*), with occasional patches of Eastern Hemlock (*Tsuga canadensis*) and Red Spruce (*Picea rubens*) further away from exposed cliff tops. Sporadic occurrences of Balsam Poplar (*Populus balsamifera*) are also present. Further away from pronounced sinkhole topography, the forest turns to mature, mixedwood stands comprised of larger Sugar Maple (*Acer saccharum*), Red Maple (*Acer rubrum*), White Ash (*Fraxinus americana*), Eastern Hemlock, and Red Spruce. The rare Rosy Sedge (*Carex rosea*, S3, Secure) was found in a seepy mature mixedwood forest on a gently sloping hillside sinkhole, along with the closely related Stellate Sedge (*Carex radiata*) and Beaked Hazel (*Corylus cornuta*). The forested floodplains of the Five Mile River are comprised of White Ash, Yellow Birch (*Betula alleghaniensis*), and White Elm (*Ulmus americana*). The river meanders and produces coarse sand and cobble bars, where various graminoid and shrubby plant communities were noted. These were home to many exotic species such as Coltsfoot (*Tussilago farfara*) and Bouncing-Bet (*Saponaria officinalis*), and to at least one rare species in Blue Vervain (*Verbena hastata*, S3, Secure).

With the exception of an abandoned railway and one ATV trail near the cave, the area is free from recent major disturbances such as gypsum mining or forest harvesting.

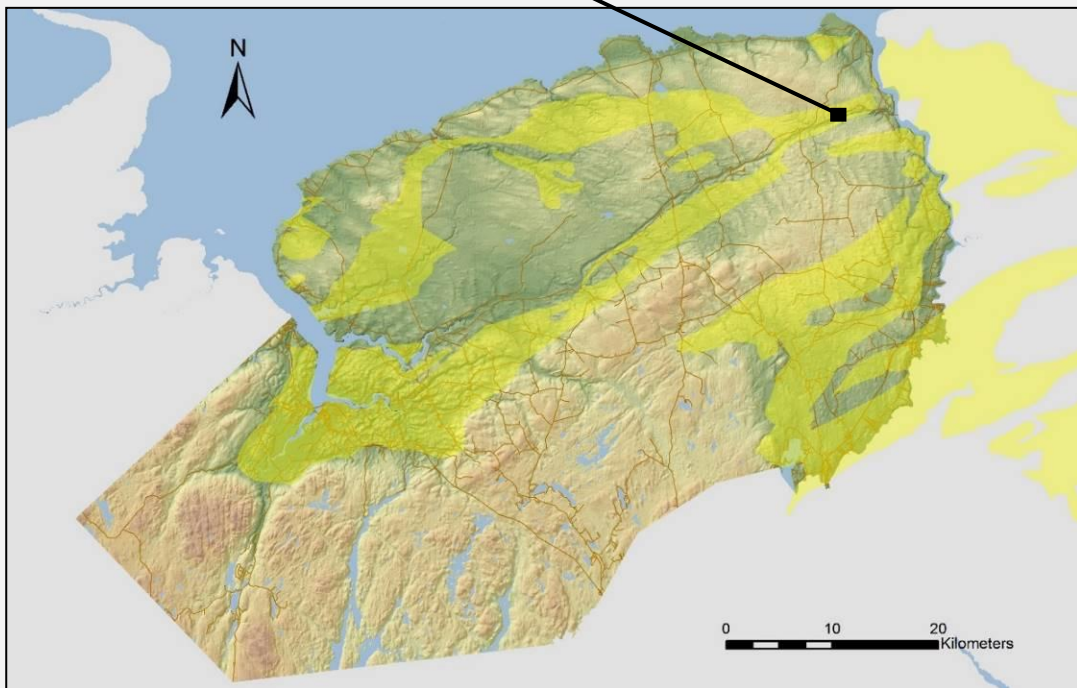
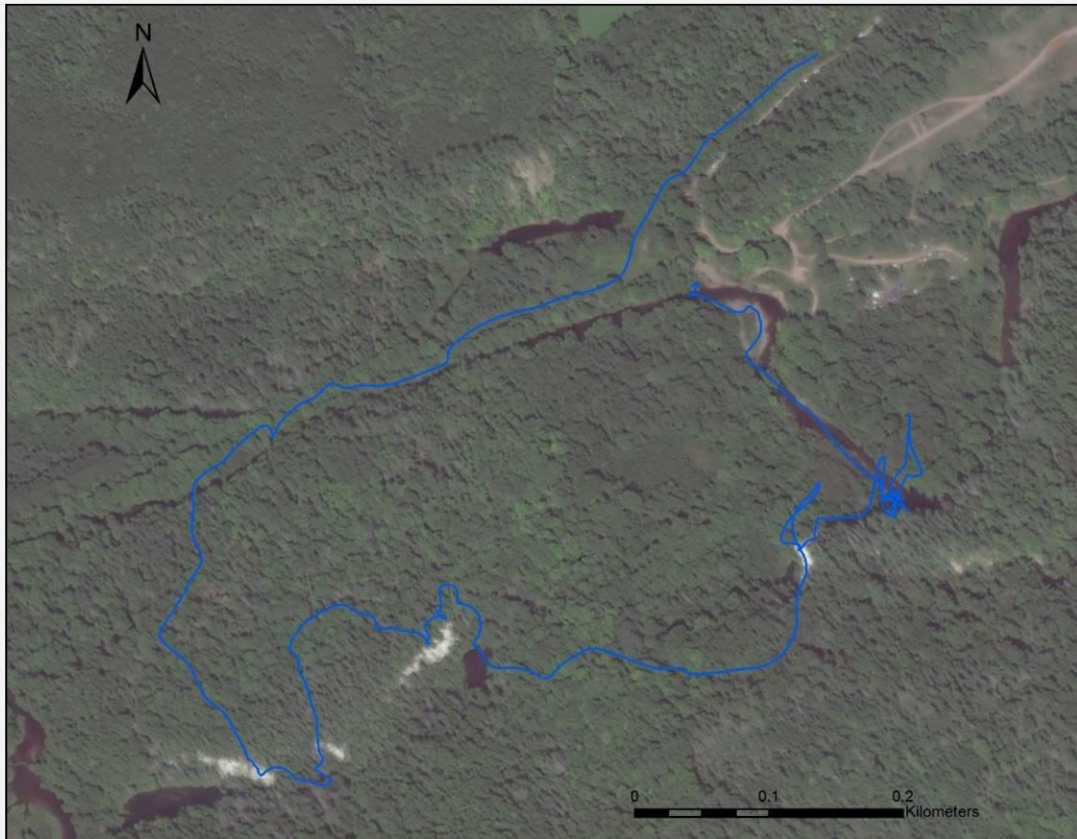
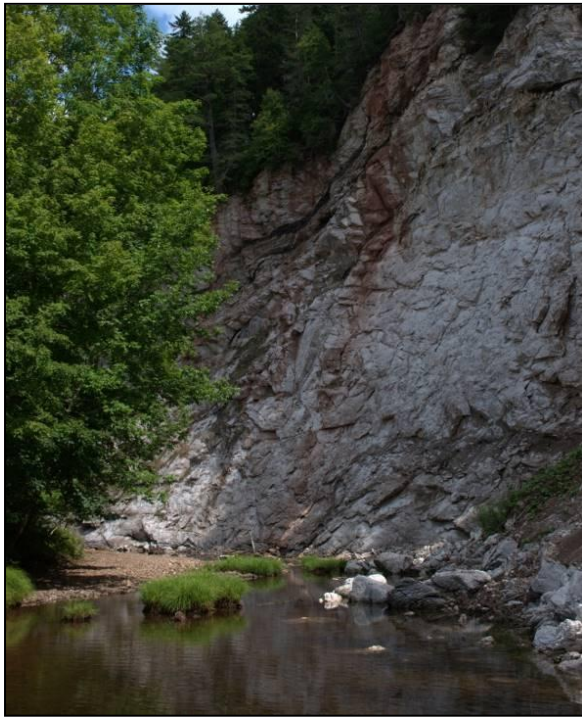


Figure 7. Survey coverage along Five Mile River (site #5), Hants County, NS. Blue line represents track file logged by GPS unit. Survey carried out on August 4th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#5. Five Mile River (clockwise from top left)

1 – Tall eroding gypsum cliffs along Five Mile River 2 – Occurrence of Balsam Groundsel (*Packera paupercula*, S3, Secure) on exposed gypsum cliff top. 3 – Eroding gypsum cliff top and small cave near Hayes Cave, with small amounts of loose gypsum substrate supporting Balsam Groundsel (*Packera paupercula*, S3 – Secure), Ebony Sedge (*Carex eburnea*, S3, Sensitive), and Hyssop-leaved Fleabane (*Erigeron hyssopifolius*, S3, Sensitive). 4 – Balsam Fir forest among small, pronounced sinkholes with exposed gypsum.

#6. Lime-kiln Brook

Observer(s): Mazerolle, D.M.

Survey date: September 4th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Juncus dudleyi</i>	Dudley's Rush	S3	Secure	1
<i>Equisetum scirpoides</i>	Dwarf Scouring Rush	S3	Secure	1
<i>Fragaria vesca</i> ssp. <i>americana</i>	Woodland Strawberry	S3S4	Secure	2

Site Summary

Survey coverage at this site was focused on a 2 km-long section of Lime-kiln Brook, a tributary of the Nappan River that flows through a deeply incised valley underlain by limestone. The valley reaches its deepest point at the western end of the surveyed area, with 40 m tall slopes rising abruptly from the river banks. Limestone outcrops are common along the ravine bottom and form the brook bed at a few locations.

Plateaus on both sides of the brook at the western end of the site are highly disturbed. A significant portion of the forest in this area has been cleared through recent wood harvesting and now consists of early-successional shrubby regeneration and moist swales of young Speckled Alder (*Alnus incana* ssp. *rugosa*), Red Maple (*Acer rubrum*) and American Elm (*Ulmus americana*). At the upstream end of the survey site, a blueberry growing operation occupies a large deforested area. North-facing slopes support mature Eastern Hemlock (*Tsuga canadensis*), Eastern Hemlock / Yellow Birch (*Betula alleghaniensis*) and Red Maple / Yellow Birch forest. Similar stands were also observed on the brook's north side, but these are smaller and less intact. The brook valley bottom is generally very narrow, only allowing for well-developed floodplain at the downstream end of the site, where small pockets of Yellow Birch and White Ash (*Fraxinus americana*) floodplain forest were observed.

Dudley's Rush (*Juncus dudleyi*, S3, Secure) and Dwarf Scouring Rush (*Equisetum scirpoides*, S3, Secure) were both found in the central section of the surveyed area, on a mossy brookside ledge and limestone outcrop respectively. Two small populations of Woodland Strawberry (*Fragaria vesca* ssp. *americana*, S3S4 – Secure) were also documented on limestone outcrops near the upstream limit of the surveyed area.

The aggressively invasive Glossy Buckthorn (*Frangula alnus*), one of the Maritimes Region's foremost exotic invasive species, is very common throughout and locally abundant. It has become dominant in many highly disturbed areas and was only absent from areas of mature forest along the brook's south side.

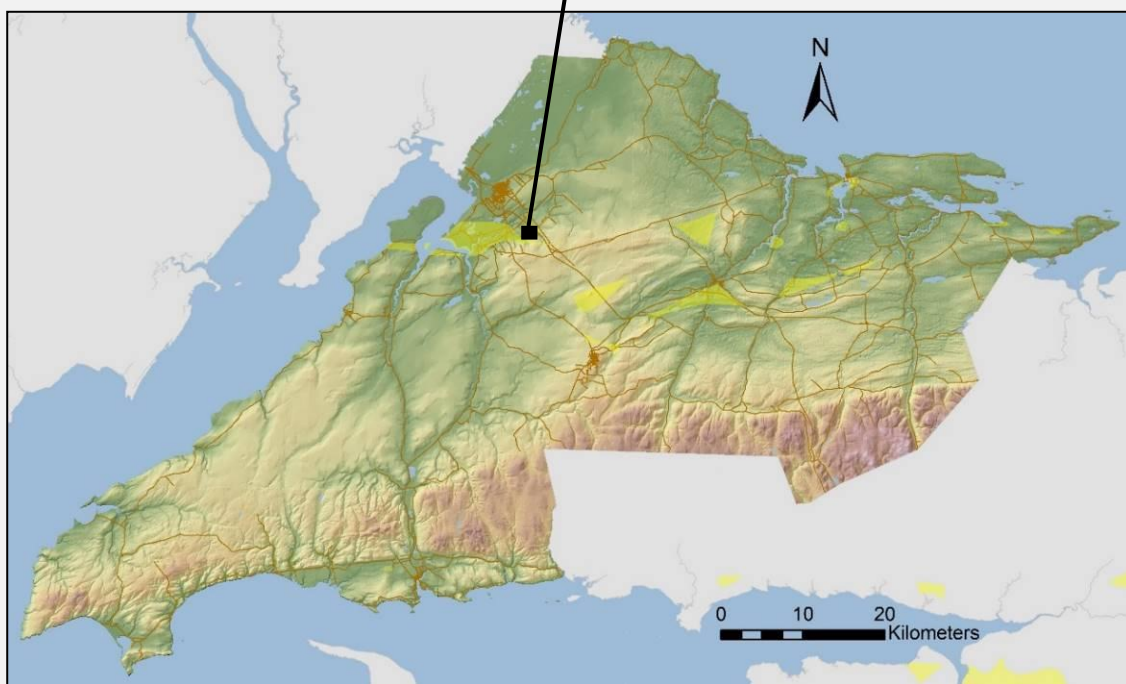
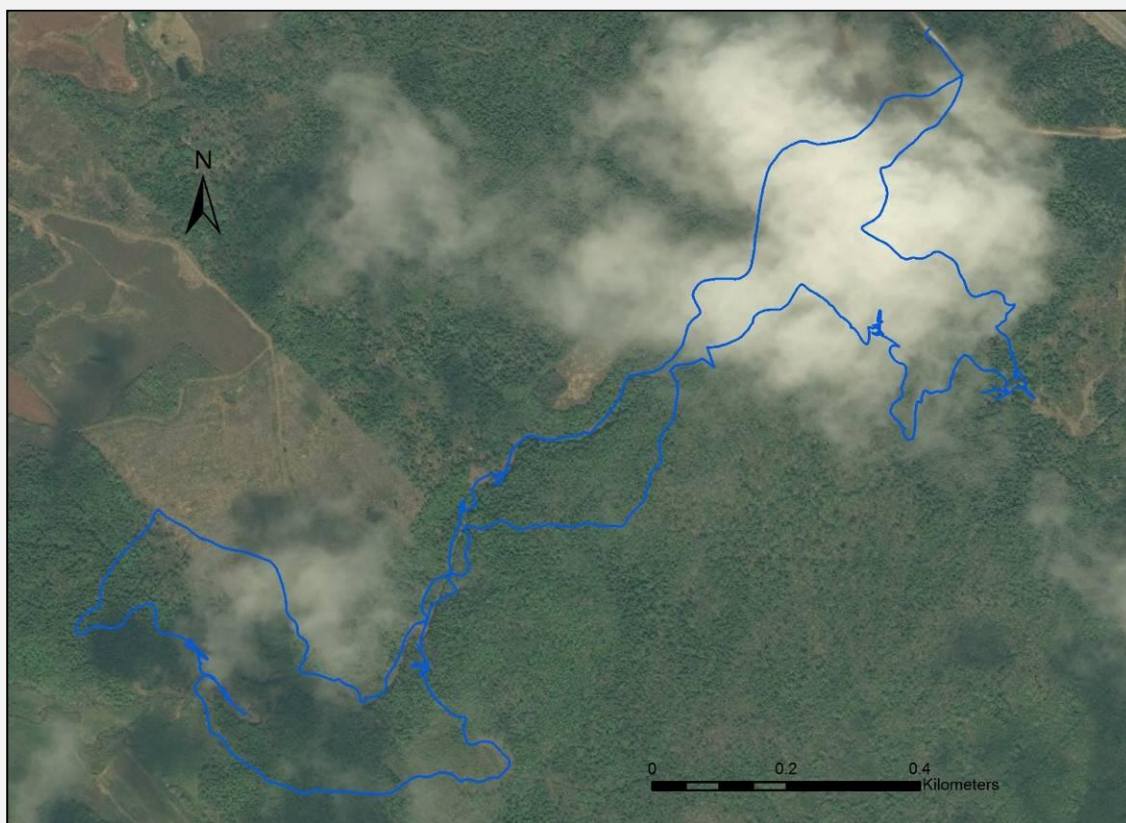
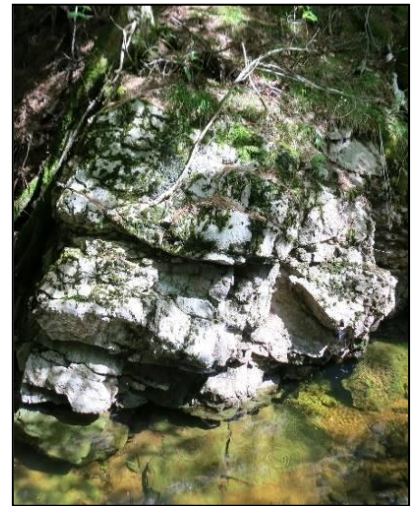


Figure 8. Survey coverage at Lime-Kiln Brook (site #6), Cumberland County, NS. Blue line represents track file logged by GPS unit. Survey carried out on September 4th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#6. Lime-kiln Brook (clockwise from top left)

1 – Dwarf Scouring Rush (*Equisetum scirpoides*, S3, Secure) on moist shaded ledge along brook. 2 – Steep valley slope dominated by mature Eastern Hemlock. 3 – Limestone outcrop at bottom of brook valley. 4 – Dudley's Rush (*Juncus dudleyi*, S3, Secure) on exposed bedrock along brook. 5 – Ostrich Fern (*Matteuccia struthiopteris*)-dominated understory in White Ash / Yellow Birch floodplain forest.

#7. Dutch Settlement

Observer(s): Mazerolle, D.M.

Survey date: August 12th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Boehmeria cylindrica</i>	False Nettle	S1	May Be At Risk	2
<i>Scirpus pedicellatus</i>	Stalked Bulrush	S2?	Sensitive	3
<i>Elodea canadensis</i>	Broad Waterweed	S2S3	Secure	2
<i>Dichanthelium clandestinum</i>	Deer-Tongue Witchgrass	S3	Secure	1
<i>Laportea canadensis</i>	Wood Nettle	S3	Sensitive	2
<i>Polygonum amphibium</i> var. <i>emersum</i>	Water Smartweed	S3?	Undetermined	1
<i>Cystopteris bulbifera</i>	Bulblet Fern	S3S4	Secure	7
<i>Fragria vesca</i> ssp. <i>americana</i>	Woodland Strawberry	S3S4	Secure	4
<i>Juncus acuminatus</i>	Sharp-Fruit Rush	S3S4	Secure	1

Site Summary

The Dutch Settlement site is situated just a few hundred meters southwest of National Gypsum Ltd.'s East Milford quarry, which has been in operation since 1953 and is said to be the western world's largest and most productive open pit gypsum mine (Adams 1991). Survey coverage at this site extends over a relatively intact 2 km by 1 km area along the south side of the Shubenacadie River. Karst topography occurs over the entire eastern half of the survey site, gradually becoming more pronounced moving eastward and apparently extending out to the East Milford quarry. Sinkholes generally ranging from 5 to 20 m in diameter are nearly continuous throughout this section and gypsum exposures are common. Exposed gypsum varies from loose and highly friable to well-consolidated and bouldery, at some locations mixed with selenite and possible mica. A few sizeable cliff outcrops (to 8 m in height) were observed along the river as well as further inland, including one composed of a mix of gypsum and apparent limestone. Other karst features of interest in this area include two small brooks emanating from sinkhole outcrops and a single small cave (likely too small to serve as a bat hibernaculum). A much smaller isolated concentration of sinkholes was also found at the western edge of the survey site.

Disturbance related to wood harvesting and agricultural use is significant at this site, but largely limited to areas lacking karst topography, which are for the most part forested with mature stands of Eastern Hemlock (*Tsuga canadensis*) and mixed stands of Eastern Hemlock, Yellow Birch (*Betula alleghaniensis*), Sugar Maple (*Acer saccharum*), Red Maple (*Acer rubrum*), Balsam Fir (*Abies balsamea*) and Large-Toothed Aspen (*Populus grandidentata*). Occurrences of undisturbed Black Spruce (*Picea mariana*) / Red Maple seepage swamp and ericaceous shrub bog were also found at the western end of the surveyed area.

Banks and terraces along the Shubenacadie River support rich communities, including narrow but fairly continuous graminoid / fern floodplain meadows and small occurrences of American Elm (*Ulmus americana*) / Ostrich Fern (*Matteuccia struthiopteris*) floodplain forest. Seven of the nine provincially rare species documented at this site were found in riparian floodplain habitats, including the extremely rare False Nettle (*Boehmeria cylindrica*, S1, May Be At Risk), a species previously only known in Nova Scotia from the Annapolis and LaHave rivers.

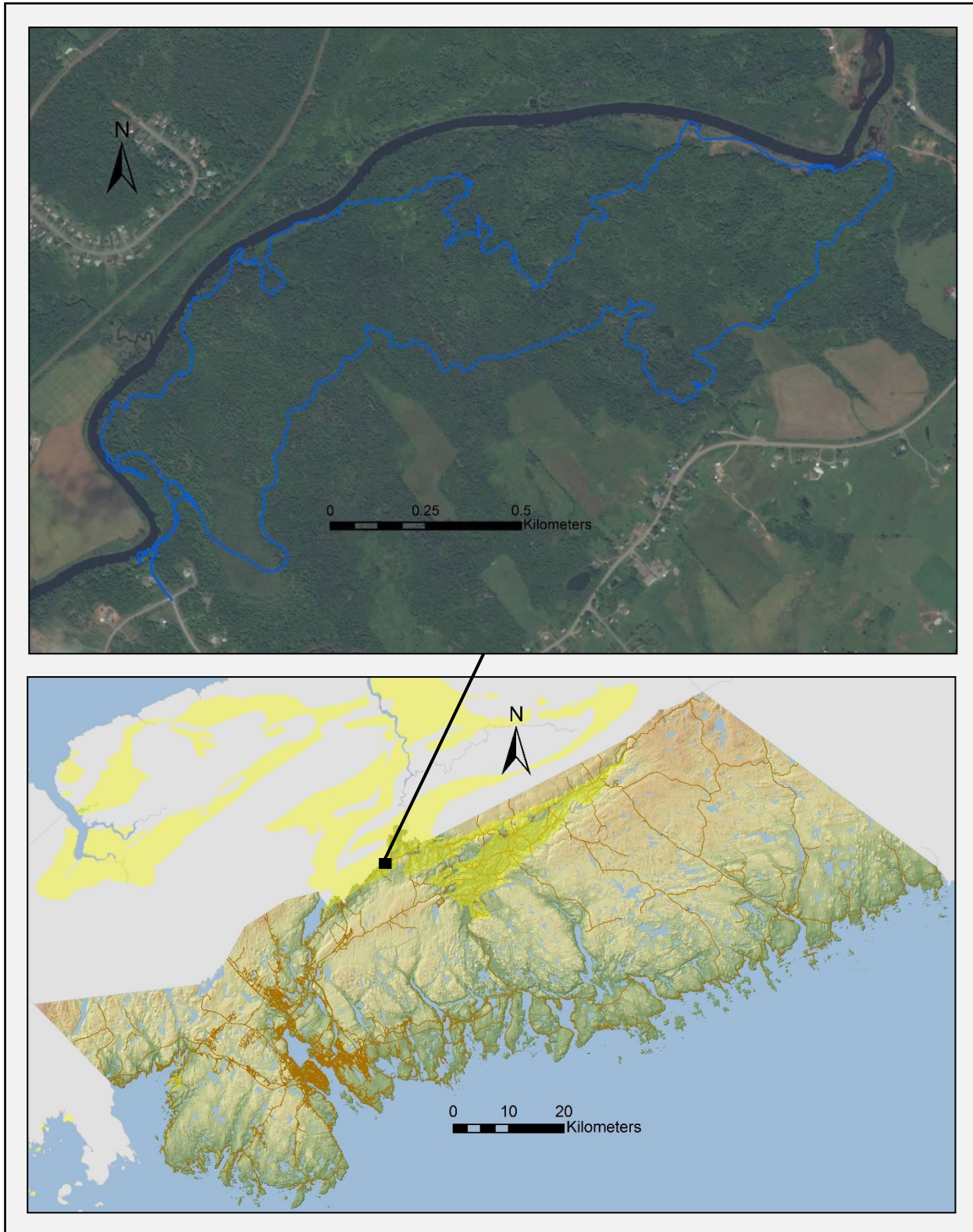


Figure 9. Survey coverage at Dutch Settlement (site #7), Halifax County, NS. Blue line represents track file logged by GPS unit. Survey carried out on August 12th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#7. Dutch Settlement (clockwise from top left)

1 – False Nettle (*Boehmeria cylindrica*, S1, May Be At Risk) on a rich graminoid-dominated floodplain terrace along the Shubenacadie River. 2 – Stalked Bulrush (*Scirpus pedicellatus*, S2?, Sensitive) in rich riparian meadow along the Shubenacadie River. 3 – Old growth Eastern Hemlock forest on steep river valley slope. 4 – Selenite crystals in gypsum outcrop. 5 – Large gypsum outcrop and mature to old Yellow Birch / Sugar Maple / Eastern Hemlock forest in area of pronounced karst topography.

#8. Black Brook

Observer(s): Mazerolle, D.M.

Survey date: August 13th 2014

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Agrimonia gryposepala</i>	Tall Hairy Groovebur	S3	Secure	1
<i>Proserpinaca palustris</i> var. <i>crebra</i>	Marsh Mermaid-Weed	S3	Secure	1
<i>Rhamnus alnifolia</i>	Alderleaf Buckthorn	S3	Secure	2
<i>Asclepias incarnata</i> ssp. <i>pulchra</i>	Swamp Milkweed	S3?	Undetermined	28
<i>Cystopteris bulbifera</i>	Bulblet Fern	S3S4	Secure	3
<i>Fragaria vesca</i> ssp. <i>americana</i>	Woodland Strawberry	S3S4	Secure	8

Site Summary

Survey coverage at this site was focused on a 2 km section of Black Brook, a small tributary of the main branch of the Gays River. The slow-flowing brook originates at the eastern end of the surveyed area, where it is fed by abundant groundwater seepage and several springs, some of which emanate from the base of gypsum cliff outcrops on the valley bottom. Sinkholes and gypsum outcrops are both fairly continuous over the eastern half of the site and especially evident along the brook's north side. This area contains a difficult-to-traverse zone of very pronounced sinkhole and pit karst, numerous sinkhole ponds and five separate gypsum cliffs, some reaching heights of 15 m or more with significant talus accumulations. Several small cave openings were noted at the base of these cliffs, including one with an entrance roughly 1 m in width and 0.2 m in height. Large deep sinkholes with exposed outcrop bottoms and diameters ranging up to 40 m were observed at the eastern end of the surveyed area. At a few locations, well-developed runoff gulleys channel water into small caves at the bottom of sinkholes; the largest of these sinkhole cave entrances was measured at roughly 70 cm in diameter. Karst features on the south side of the brook are generally much more subtle and span a smaller area than those on the north side.

Wood harvesting has been extensive along Black Brook; large swaths have recently been clearcut and most remaining forest is early-successional. Intact mature forest communities are largely restricted to areas of moderate to pronounced karst topography, which support fairly old stands of Eastern Hemlock (*Tsuga canadensis*), Eastern Hemlock / Yellow Birch (*Betula alleghaniensis*) / Sugar Maple (*Acer saccharum*) and Eastern White Pine (*Pinus strobus*) / Sugar Maple / Yellow Birch / Eastern Hemlock. Areas of abundant exposed gypsum also contain shrubby karst communities dominated by Roundleaf Dogwood (*Cornus rugosa*), stunted hardwoods and Red Spruce (*Picea rubens*) that also contain populations of Bulblet Fern (*Cystopteris bulbifera*, S3S4, Secure) and Woodland Strawberry (*Fragaria vesca* ssp. *americana*, S3S4, Secure).

The surveyed area contains an extensive riparian marsh and fen complex comprised of open Blue-Joint Reedgrass (*Calamagrostis canadensis*) / Water Sedge (*Carex aquatilis*) / Tussock Sedge (*Carex stricta*) / Sweet gale (*Myrica gale*) fen, slightly calcareous Speckled Alder (*Alnus incana* ssp. *rugosa*) swamp and beaver meadows. Most sinkhole ponds found at the site are situated along the brook in these riparian wetlands.

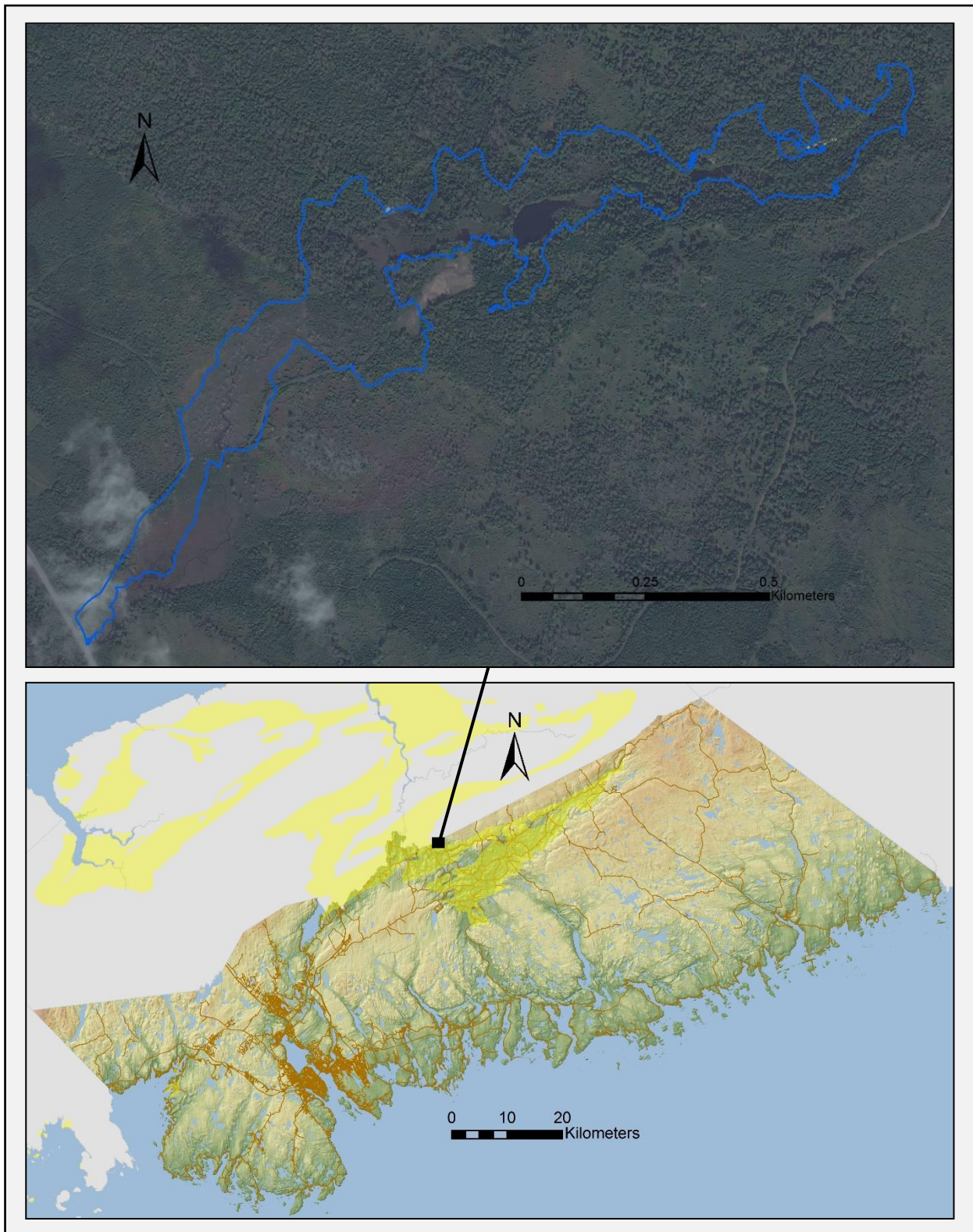
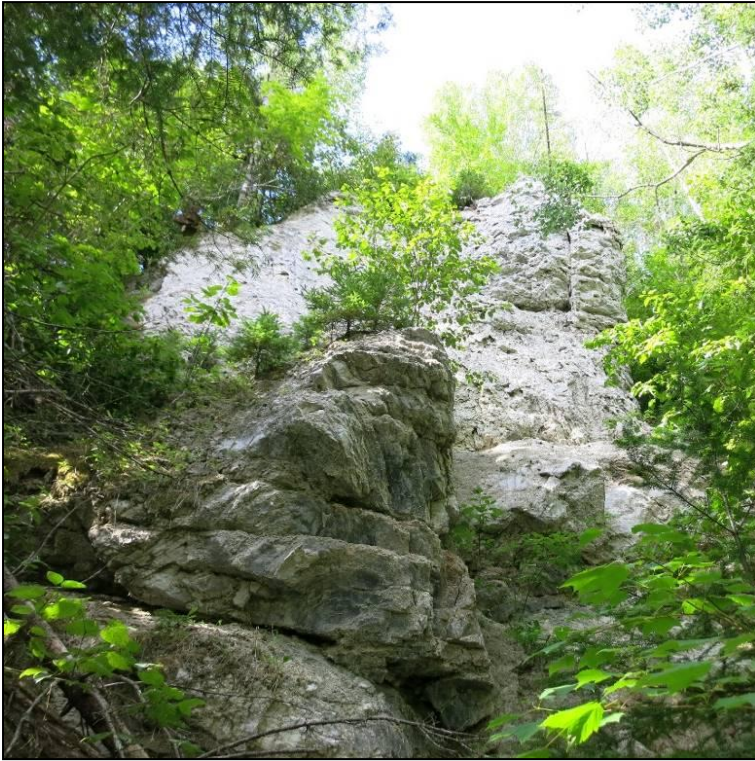


Figure 10. Survey coverage at Black Brook (site #8), Halifax County, NS. Blue line represents track file logged by GPS unit. Survey carried out on August 13th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#8. Black Brook (clockwise from top left)

1 – Fairly large gypsum outcrop cliff, with shrubby Roundleaf Dogwood- and White Spruce-dominated karst community. 2 – Mature Sugar Maple and Yellow Birch karst forest on slope of large sinkhole. 3 – Gypsum outcrop seen from across a sinkhole pond and fen complex along the brook. 4 – Small cave opening in gypsum bedrock at bottom of large sinkhole. 5 – Alderleaf Buckthorn (*Rhamnus alnifolia*, S3, Secure) in alkaline shrub and graminoid fen.

#9. South Section

Observer(s): Mazerolle, D.M.

Survey date: August 14th 2014

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Salix serissima</i>	Autumn Willow	S1	May Be At Risk	1
<i>Salix myrtillofolia</i>	Myrtle-Leaf Willow	S1	May Be At Risk	1
<i>Carex gynocrates</i>	Northern Bog Sedge	S1	May Be At Risk	2
<i>Fraxinus nigra</i>	Black Ash	S1S2	At Risk	12
<i>Carex castanea</i>	Chestnut-Colored Sedge	S2	May Be At Risk	2
<i>Cypripedium reginae</i>	Showy Lady's-Slipper	S2	May Be At Risk	14
<i>Galium labradoricum</i>	Bog Bedstraw	S2	Sensitive	24
<i>Symphotrichum ciliolatum</i>	Lindley's Aster	S2	Sensitive	6
<i>Carex lupulina</i>	Hop Sedge	S3	Secure	1
<i>Platanthera grandiflora</i>	Large Purple-Fringe Orchis	S3	Secure	1
<i>Rhamnus alnifolia</i>	Alderleaf Buckthorn	S3	Secure	31
<i>Carex cryptolepis</i>	Northeastern Sedge	S3?	Secure	1

Site Summary

Survey coverage at South Section was limited to an area 1.3 by 1 km and almost entirely focused on rich alkaline wetlands along the periphery of a Crown-owned parcel of land. No outcrops or evidence of karst topography were detected at this site, which conforms with geological survey findings suggesting that gypsum and anhydrite deposits in the area are deep underground and highly dissolved (Adams 1991). This site represents a relatively intact remnant within the highly fragmented Musquodoboit River Valley and is bordered on all sides by agricultural land, clear cut areas and young to intermediate-aged mixed-wood swamp recovering from wood harvesting. Along the south side of the surveyed area, rich fen and swamp habitat is also bisected by an old rail bed.

Southern, eastern and northwestern portions of the site are occupied by nutrient-rich high-pH seepage fens and swamp communities dominated by Tamarack (*Larix laricina*), Black Spruce (*Picea mariana*) and Red Maple (*Acer rubrum*). Open fens and swamp understories in these areas have an abundance of Shrubby Cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*) and Alderleaf Buckthorn (*Rhamnus alnifolia*, S3, Secure) as well as large populations of Black Ash (*Fraxinus Nigra*, S1S2, At Risk), Showy Lady's-Slipper (*Cypripedium reginae*, S2, May Be At Risk) and Bog Bedstraw (*Galium labradoricum*, S2, Sensitive). The south end of the surveyed area contains a small area of exceptionally rich calcareous Tamarack / Shrubby Cinquefoil / Creeping Juniper (*Juniperus horizontalis*) / Labrador Tea (*Ledum groenlandicum*) fen that supports small populations of two willow species never before seen in Nova Scotia: Autumn Willow (*Salix serissima*, S1, May Be At Risk) and Myrtle-leaf Willow (*Salix myrtillofolia*, S1, May Be At Risk). Both willows are extremely rare in the Maritimes, each of them only previously known from a single location in New Brunswick. This fen also contains the only known mainland Nova Scotia population of Northern Bog Sedge (*Carex gynocrates*, S1, May Be At Risk). The extensive Shrubby Cinquefoil-dominated alkaline wetlands at this site are rare provincially and extremely rare on mainland Nova Scotia. These have a high potential to support Dorcas Copper (*Lycaena dorcas*, S1, Not Assessed), a rare butterfly thus far only known in the province from a few sites in Cape Breton. Towards the Crown-owned parcel that makes up the central portion of the site, seepage wetlands become circumneutral, eventually grading into acidic ericaceous shrub bog. Intact nutrient-rich alkaline wetlands are almost entirely situated on privately-owned land.

The alkaline fens and swamps surveyed at South Section support a diversity of rare species and provincially unique plant communities. The site represents one of mainland Nova Scotia's most significant wetlands and should be a very high priority for land acquisition or stewardship.

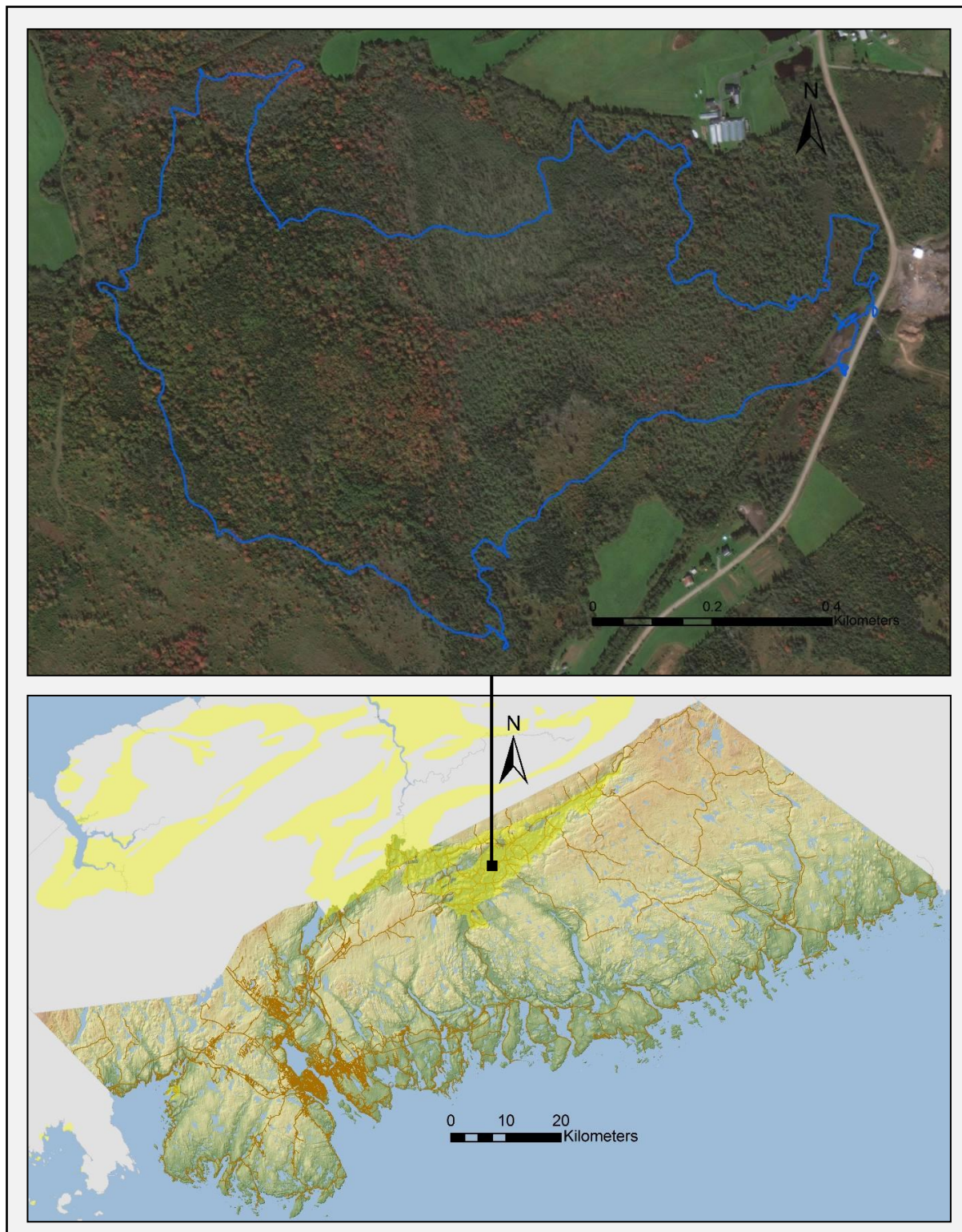


Figure 11. Survey coverage at South Section (site #9), Halifax County, NS. Blue line represents track file logged by GPS unit. Survey carried out on August 14th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#9. South Section (clockwise from top left)

1 – Nutrient-rich alkaline fen dominated by Shrubby Cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*), in an area supporting a large population of Showy Lady's-Slipper (*Cypripedium reginae*, S2, May Be At Risk). 2 – Myrtle-Leaf Willow (*Salix myrtillofolia*, S1, May Be At Risk), a species never before seen in NS, in nutrient-rich alkaline fen / swamp. 3 – Autumn Willow (*Salix serotina*, S1, May Be At Risk), a species never before seen in NS, in nutrient-rich alkaline fen / swamp. 4 – Chestnut-Colored Sedge (*Carex castanea*, S2, May Be At Risk) at the edge of alkaline fen / swamp. 5 – Bog Bedstraw (*Galium labradoricum*, S2, Sensitive) in nutrient-rich alkaline fen / swamp. 6 – Northern Bog Sedge (*Carex gynocrates*, S1, May Be At Risk) in nutrient-rich alkaline fen / swamp.

#10. Brierly Brook

Observer(s): Mazerolle, D.M.

Survey date: August 15th 2014

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Fraxinus nigra</i>	Black Ash	S1S2	At Risk	1
<i>Cypripedium parviflorum</i>	Small Yellow Lady's-Slipper	S2S3	Sensitive	4
<i>Carex eburnea</i>	Ebony Sedge	S3	Sensitive	1
<i>Carex lupulina</i>	Hop Sedge	S3	Secure	1
<i>Erigeron hyssopifolius</i>	Hyssop-leaved Fleabane	S3	Sensitive	3
<i>Packera paupercula</i>	Balsam Groundsel	S3	Secure	3
<i>Ranunculus gmelinii</i>	Small Yellow Water-Crowfoot	S3	Secure	1
<i>Cystopteris bulbifera</i>	Bulblet Fern	S3S4	Secure	7
<i>Fragaria vesca</i> ssp. <i>americana</i>	Woodland Strawberry	S3S4	Secure	1
<i>Carex tonsa</i> var. <i>rugosperma</i>	Umbel-Like Sedge	SNR	Undetermined	1
<i>Carex aurea</i> / <i>garberi</i>	sedge sp.	-	-	1

Site Summary

Located roughly 6 km west-southwest of Antigonish at the foot of the Pictou-Antigonish Highlands, the area surveyed along Brierly Brook extends 2 km from Deadman Lake to the Nova Construction gypsum quarry at the settlement of Brierly Brook. Karst topography is evident throughout the site and varies in nature from very large sinkholes and sinkhole ponds around Deadman Lake to very pronounced pit karst and gypsum cliffs in the central portion of the surveyed area. The 400 m-long Deadman Lake, itself the result of gypsum subsidence, is bordered to the east and west by other large sinkholes and sinkhole ponds reaching diameters of 130 m. Marshy wetlands and sinkhole ponds in this area constitute the headwaters of both Brierly Brook and Pushies brook. The central portion of the surveyed area, situated on the valley slope south of Brierly Brook, includes a sizeable area of very pronounced sinkholes, pits and gypsum cliffs. Exposed bedrock is abundant in this section, with some gypsum slopes and cliffs rising nearly 30 m. Most provincially rare species documented at Brierly Brook were found within this area of pronounced karst, which supports populations of Black Ash (*Fraxinus nigra*, S1S2, At Risk), Small Yellow Lady's-Slipper (*Cypripedium parviflorum*, S2S3, Sensitive), Ebony Sedge (*Carex eburnea*, S3, Sensitive), Hyssop-leaved Fleabane (*Erigeron hyssopifolius*, S3, Secure), Balsam Groundsel (*Packera paupercula*, S3, Secure), Bulbet Fern (*Cystopteris bulbifera*, S3S4, Secure) and Woodland Strawberry (*Fragaria vesca* ssp. *americana*, S3S4, Secure). Karst topography remains very evident and locally pronounced along the abrupt valley slope throughout the eastern half of the surveyed area, although outcrops become scarce.

Disturbances related to quarrying, agriculture, wood harvesting, road and railroad construction have collectively had a significant impact in the area. Remnant stands of mature late-seral forest are restricted to abrupt slopes and areas of pronounced karst. These mainly consist of pure Eastern Hemlock (*Tsuga canadensis*), Eastern Hemlock / Sugar Maple (*Acer saccharum*) / Yellow Birch (*Betula alleghaniensis*) / White Ash (*Fraxinus americana*) and White Ash / Yellow Birch karst forest communities. A small stand of old Eastern White Pine (*Pinus strobus*) / Eastern Hemlock / White Ash / Red Spruce (*Picea rubens*) was also seen on a steep slope at the eastern end of the surveyed area and scattered intact stands of mesic Red Maple (*Acer rubrum*) / White Ash were observed near Deadman Lake as well as along the brook.

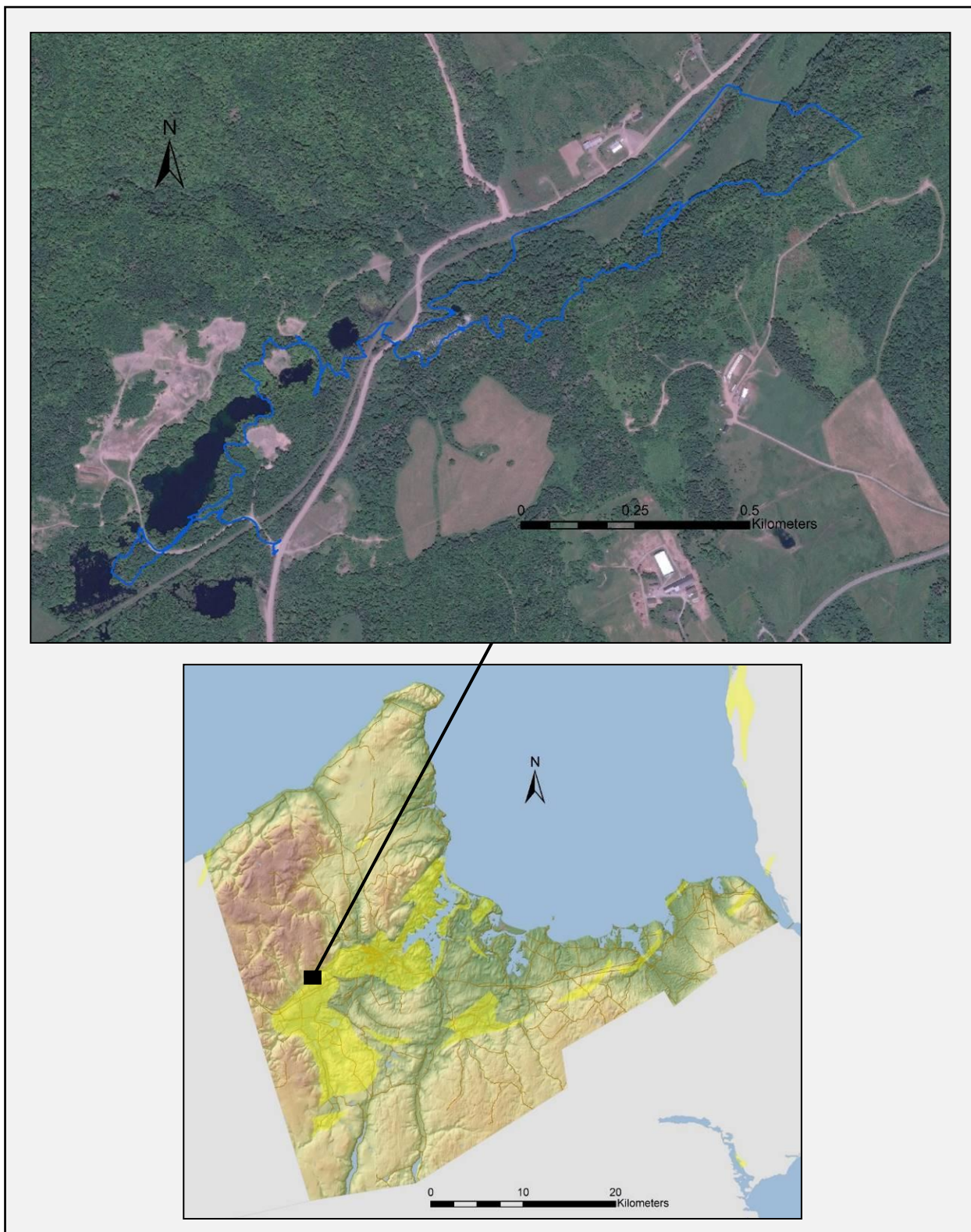


Figure 12. Survey coverage at Brierly Brook (site #10), Antigonish County, NS. Blue line represents track file logged by GPS unit. Survey carried out on August 15th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from ESRI World Imagery basemap (accessed in winter 2015).



#10. Brierly Brook (clockwise from top left)

1 – Large sinkhole pond with slopes dominated by fairly old Eastern Hemlock, Sugar Maple and Yellow Birch. 2 – Area of very pronounced exposed gypsum karst topography with community dominated by Roundleaf Dogwood and White Spruce. 3 – Ebony Sedge (*Carex eburnea*, S3, Sensitive) occurring with Balsam Groundsel (*Packera paupercula*, S3, Secure) on gypsum scree slope. 4 – Hyssop-leaved Fleabane (*Erigeron hyssopifolius*, S3, Sensitive) on gypsum outcrop. 5 – Large very abrupt gypsum sinkhole in area of very pronounced karst with mature White Ash, Yellow Birch and Sugar Maple forest.

#11. Fairmont

Observer(s): Blaney, C.S.

Survey date: July 24th 2014

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Anemone virginiana</i>	Virginia Anemone	S2	Sensitive	1
<i>Agrimonia gryposepala</i>	Tall Hairy Groovebur	S3	Secure	2
<i>Alopecurus aequalis</i>	Short-Awn Foxtail	S3	Secure	2
<i>Carex eburnea</i>	Ebony Sedge	S3	Sensitive	5
<i>Carex lupulina</i>	Hop Sedge	S3	Secure	5
<i>Equisetum variegatum</i>	Variegated Horsetail	S3	Secure	1
<i>Packera paupercula</i>	Balsam Groundsel	S3	Secure	10
<i>Ranunculus gmelinii</i>	Small Yellow Water-Crowfoot	S3	Secure	3
<i>Cystopteris bulbifera</i>	Bulblet Fern	S3S4	Secure	11
<i>Fragaria vesca ssp. americana</i>	Woodland Strawberry	S3S4	Secure	2
<i>Carex poss. peckii</i>	White-Tinged Sedge	[S2?]	[May Be At Risk]	1

Site Summary

This site extends southwest from the Harbour Centre survey site visited during 2012 gypsum fieldwork (Blaney and Mazerolle 2012). The area surveyed in 2014 includes several spectacular gypsum escarpments with good representation of open forest on severe gypsum karst, as well as a number of sinkhole ponds. The high gypsum cliffs at this site seem unusual because they are not associated with any current sizable watercourse or waterbody that would be providing the erosive force to have created them, and in some cases they are isolated by several hundred metres from other major gypsum features in areas of otherwise fairly moderate topography.

Excepting some areas on the more severe gypsum karst terrain, most forest in the site is young to intermediate aged and there has been extensive recent cutting, especially in the western portion of the site. Some older Eastern Hemlock – White Pine – Red Maple forest occurs on gypsum bedrock and an unusual open dryish Black Spruce – Balsam Fir – White Birch – Rough Dogwood (*Cornus rugosa*) forest, very similar to that found at the Williams Point site, was also documented on severe gypsum karst in one area.

Five of the rare species are typical of exposed gypsum sites (Ebony Sedge, Bulblet Fern, Woodland Strawberry, Balsam Groundsel and Virginia Anemone), three are calcareous pond and shore species found around sinkhole wetlands (Short-awn Foxtail, Hop Sedge and Small Yellow Water-Crowfoot) or disturbed ground (Variegated Horsetail). The remainder are species of calcareous forest (Tall Hairy Groovebur, and Peck's Sedge (which could not be identified with certainty because its fruit had dispersed).

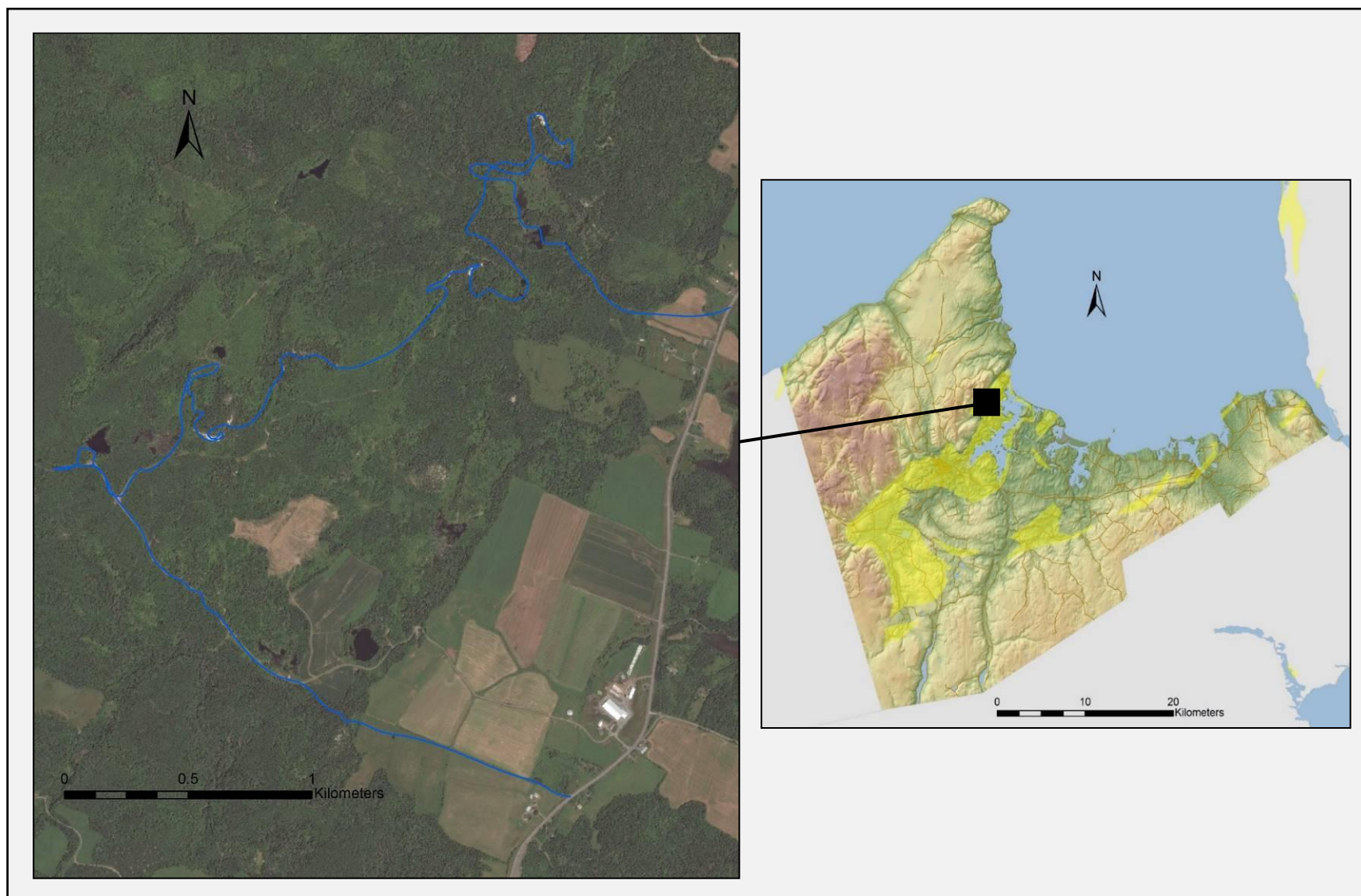


Figure 13. Survey coverage at Fairmont (site #11), Antigonish County, NS. Blue line is an approximate representation of survey coverage and based on GPS-recorded waypoints. Survey carried out on July 24th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from ESRI World Imagery basemap (accessed in winter 2015).



#11. Fairmont (clockwise from top left) 1. Rich streambed at base of gypsum cliff; 2. High gypsum cliff with mesic Eastern White Pine – Eastern Hemlock – Red Spruce – Red Maple forest at crest. 3. Gypsum sinkhole pond in mixed forest. 4. Ebony Sedge (*Carex eburnea*, S2 – Sensitive) dominated community on very steep slope of loose gypsum scree; 5 and 6. Open Black Spruce – Balsam Fir – White Birch forest on severe karst topography at top of gypsum cliff. The common shrub in photo 5 is Rough Dogwood (*Cornus rugosa*).

#12. Williams Point

Observer(s): Blaney, C.S.

Survey date: July 23rd 2014

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Carex grisea</i>	Narrowleaf Sedge	S1	May Be At Risk	1
<i>Anemone virginiana</i>	Virginia Anemone	S2	Sensitive	3
<i>Cypripedium parviflorum</i>	Small Yellow Lady's-Slipper	S2S3	Sensitive	7
<i>Galium aparine</i>	Catchweed Bedstraw	S2S3	Sensitive	1
<i>Triosteum aurantiacum</i>	Coffee Tinker's-Weed	S2S3	Sensitive	2
<i>Agrimonia gryposepala</i>	Tall Hairy Groovebur	S3	Secure	9
<i>Erigeron hyssopifolius</i>	Hyssop-leaved Fleabane	S3	Sensitive	2
<i>Packera paupercula</i>	Balsam Groundsel	S3	Secure	3
<i>Polygonum pensylvanicum</i>	Pennsylvania Smartweed	S3	Secure	1
<i>Polygonum scandens</i>	Climbing False-Buckwheat	S3	Sensitive	3
<i>Samolus valerandi</i> ssp. <i>parviflorus</i>	Water Pimpernel	S3	Sensitive	2
<i>Teucrium canadense</i>	American Germander	S3	Sensitive	3
<i>Verbena hastata</i>	Blue Vervain	S3	Secure	2
<i>Cystopteris bulbifera</i>	Bulblet Fern	S3S4	Secure	3
<i>Sanguinaria canadensis</i>	Bloodroot	S3S4	Secure	3
<i>Cuscuta</i> sp.	dodder sp.	-	-	1
<i>Epilobium ciliatum</i> / <i>coloratum</i>	willowherb sp.	-	-	1

Site Summary

Surveys at Williams Point extended from the lowermost portion of the South River near its mouth northwest about 3 km to the area around Plaster Cove on Antigonish Harbour. The site has good representation of gypsum landforms and gypsum-associated plant species, the most significant of which were just west of the southernmost tip of Antigonish Harbour, where severe gypsum karst is present with an unusual dryish open community of Black Spruce – Balsam Fir – White Birch and Rough Dogwood (*Cornus rugosa*), along with good populations of the provincially uncommon gypsum associates Bulblet Fern, Hyssop-leaved Fleabane, Balsam Ragwort, Yellow Lady's-Slipper and Virginia Anemone. Further north at Plaster Cove, gypsum exposure is less extensive and mostly limited to cliffs along the harbour shore. Topography away from the shore is gently to strongly undulating with some deep sinkholes and sinkhole ponds. The forest in this area is mostly hemlock-dominated and was the most mature observed on site. Elsewhere in the surveyed area, forest is mostly young to intermediate-aged, with the most western areas especially young. The ponds in the southwestern part of the area were anthropogenic, or at least anthropogenically enhanced, rather than natural sinkholes.

The South River floodplain had some highly disturbed remnant rich floodplain communities that supported a number of rare species. The most significant of these is Narrow-leaved Inflated Sedge (*Carex grisea*, S1 – May Be At Risk), first found nearby by 2012 AC CDC fieldwork surveying the site of the new TransCanada Highway crossing. We found a small population in a hawthorn (*Crataegus* sp.) – Choke Cherry floodplain thicket on an island just downstream of the new bridge. Other significant rich floodplain species in this area were Bloodroot, Blue Vervain and Climbing False-Buckwheat.

Near the mouth of the South River, the site has good representation of estuarine brackish marsh communities of Tall Cordgrass (*Spartina pectinata*) and Three-square Bulrush (*Schoenoplectus pungens*), with large numbers of Water Pimpernel (*Samolus valerandi* ssp. *parviflorus*, S3 – Sensitive), a specialist of this type of habitat. These brackish marsh communities grade directly into the severe gypsum karst in some areas forming transitional calcareous wetland communities.

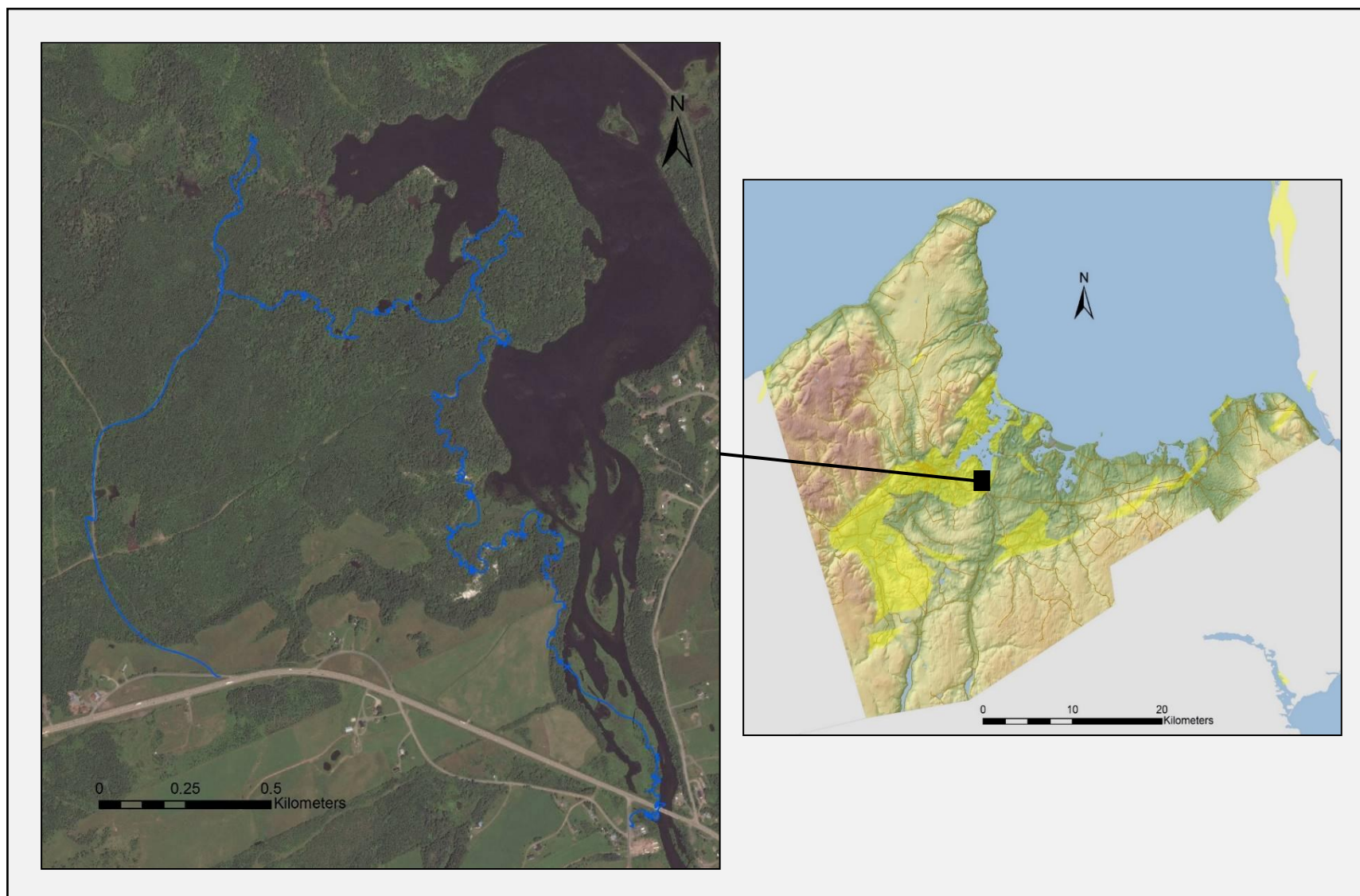


Figure 14. Survey coverage at Williams Point (site #12), Antigonish County, NS. Blue line represents track file logged by GPS unit. Survey carried out on July 23rd 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from ESRI World Imagery basemap (accessed in winter 2015).



#12. Williams Point (clockwise from top left) 1. Inflated Narrow-leaved Sedge (*Carex grisea*, S1 – May Be At Risk) from an island in the South River at the TransCanada Highway, the only known Nova Scotia location for the species; 2 and 3. Dry, open Black Spruce – White Birch – Balsam Fir forest on severe gypsum karst just northwest of the mouth of the South River at Antigonish Harbour; 4. Gypsum cliff on the shore of Plaster Cove, Antigonish Harbour; 5. Brackish marsh in Antigonish Harbour at the mouth of South River; 6 and 7. Dried sinkhole pond and seepy sinkhole wetland in mature Eastern Hemlock-dominated karst forest.

#13. Southside Antigonish Harbour

Observer(s): Blaney, C.S.

Survey date: June 30th 2014

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Barbarea orthoceras</i>	American Winter-Cress	S1	May Be At Risk	7
<i>Anemone virginiana</i>	Virginia Anemone	S2	Sensitive	3
<i>Eleocharis ovata</i>	Ovate Spikerush	S2?	Sensitive	1
<i>Agrimonia gryposepala</i>	Tall Hairy Groovebur	S3	Secure	13
<i>Packera paupercula</i>	Balsam Groundsel	S3	Secure	4
<i>Teucrium canadense</i>	American Germander	S3	Sensitive	7
<i>Cystopteris bulbifera</i>	Bulblet Fern	S3S4	Secure	7
<i>Polygonum fowleri</i>	Fowler Knotweed	S3S4	Secure	1
<i>Antennaria neglecta</i>	Field Pussytoes	SNR	Undetermined	1
<i>Myriophyllum sibiricum</i>	Siberian Water-Milfoil	S3S4	Secure	1

Site Summary

Gypsum karst features are quite evident at this site, with limestone outcrops also present locally around the sand and gravel quarry in the north end of the property and on the island just to the north. Most of the area covered appears to have regenerated following clearance for agriculture, and north of the road accessing the quarry some of the forest is in current use as cow pasture. As a result of the site's agricultural use and history, much of the forest understory is quite exotic-dominated. Forest of more natural composition including various combinations of Eastern Hemlock, Red Spruce, White Spruce, Red Maple and White Ash is present in some of the most severe gypsum karst in the south end of the area. Impressive gypsum cliffs occur along the harbour shore in this area. A new road (purpose unknown, but suggestive of cottage development based on the effort involved) was in the process of being bulldozed through the middle of the site's best gypsum karst forest during the site visit.

The most significant species observed was the first Nova Scotia record of American Winter-Cress (*Barbarea orthoceras*, S1 – May Be At Risk), which was present at seven locations along the upper margins of beaches and saltmarshes and along small streams near the harbour shore. Another noteworthy feature of the site was the large colony (65 nest holes) of Bank Swallows (S3 – At Risk; COSEWIC Threatened) in the large sand and gravel pit at the north end of the area.

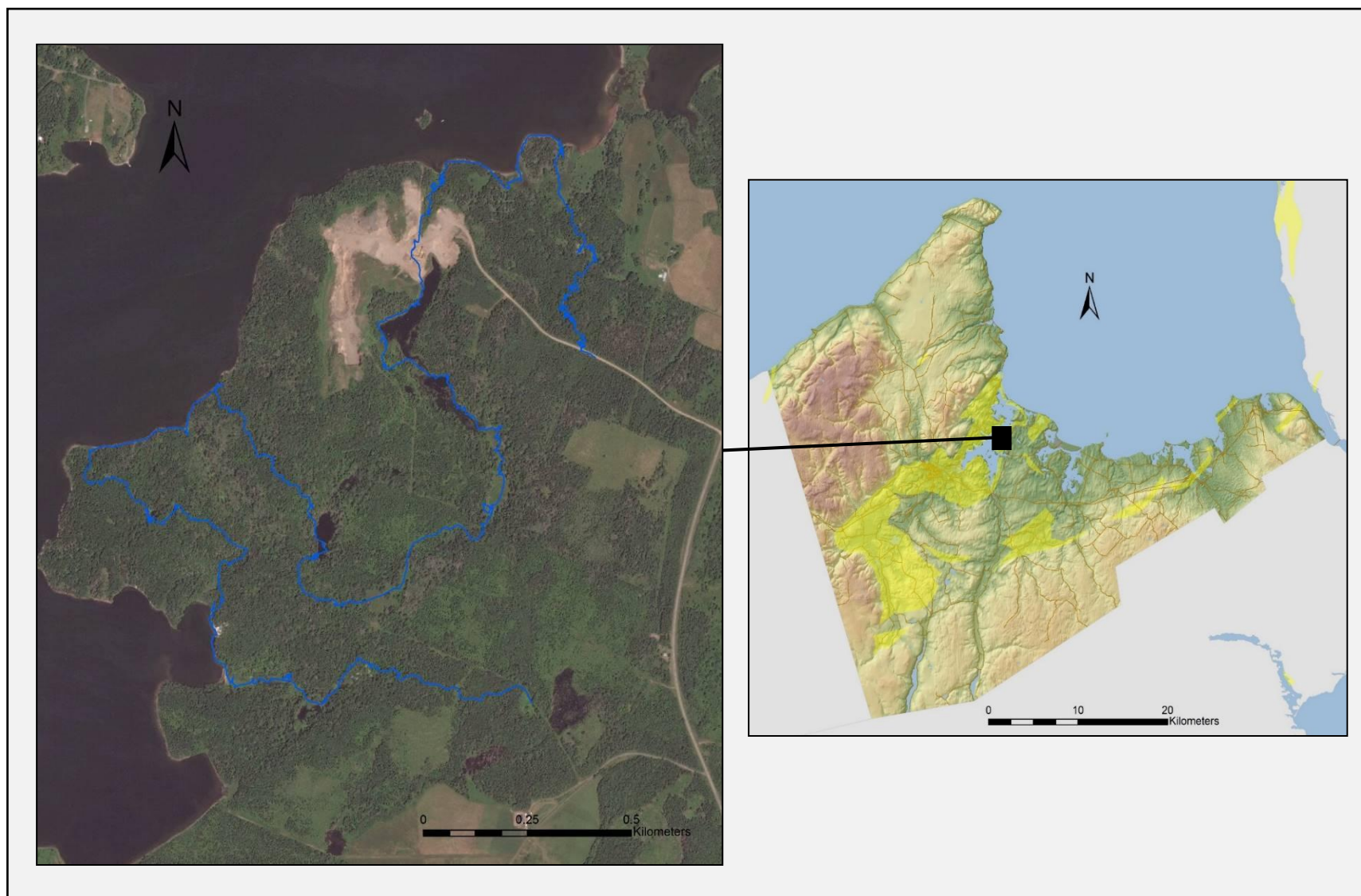


Figure 15. Survey coverage at Southside Antigonish Harbour (site #13), Antigonish County, NS. Blue line represents track file logged by GPS unit. Survey carried out on June 30th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from ESRI World Imagery basemap (accessed in winter 2015).



#13. Southside Antigonish Harbour (clockwise from top left).

1. American Yellow Rocket (*Barbarea orthoceras*, S1 – May Be At Risk). Records at this site represent the first documentation of this species in Nova Scotia; 2. Gypsum cliff at shore of Antigonish Harbour, north of Pomquet Cove; 3. Gravel beach at shore of Antigonish Harbour across from Dunns Cove; 4. Remnant old Sugar Maple trees in an otherwise young White Birch – White Ash – Red Maple – Balsam Fir forest on gypsum karst; 5. Calcareous pond with intermediate-aged mixed forest on thin soil over limestone bedrock, just south of large quarry at north end of surveyed area; 6. Shaded gypsum sinkhole with abundant Bulblet Fern (*Cystopteris bulbifera*, S3S4 – Secure).

#14. South River – Frasers Mills

Observer(s): Blaney, C.S.

Survey date: July 25th 2014

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Fraxinus nigra</i>	Black Ash	S1S2	At Risk	3
<i>Caulophyllum thalictroides</i>	Blue Cohosh	S2	May Be At Risk	3
<i>Lilium canadense</i>	Canada Lily	S2	May Be At Risk	1
<i>Osmorhiza longistylis</i>	Smoother Sweet-Cicely	S2	May Be At Risk	2
<i>Carex hirtifolia</i>	Pubescent Sedge	S2S3	Sensitive	5
<i>Triosteum aurantiacum</i>	Coffee Tinker's-Weed	S2S3	Sensitive	31
<i>Agrimonia gryposepala</i>	Tall Hairy Groovebur	S3	Secure	19
<i>Carex rosea</i>	Rosy Sedge	S3	Secure	1
<i>Laportea canadensis</i>	Wood Nettle	S3	Sensitive	2
<i>Platanthera grandiflora</i>	Large Purple-Fringe Orchis	S3	Secure	2
<i>Verbena hastata</i>	Blue Vervain	S3	Secure	15
<i>Sanguinaria canadensis</i>	Bloodroot	S3S4	Secure	25

Site Summary

Survey coverage at this site extended over about 3.5 km of river distance downstream from the Frasers Mills bridge on Old Pinevale Road at the provincial fish hatchery. Much of the land between Dunmore Road on the west side of the river and Highway 316 on the east has been converted to agriculture, or is regenerating after past clearance. High quality natural areas in this stretch are limited to narrow bands along the river (generally less than 200 m wide) and to few larger patches, mostly in the upstream (southern) half of the area surveyed.

The southernmost patch of more extensive forest just north of the Frasers Mills bridge included some excellent remnant mature hardwood floodplain terrace forest of White Ash – Sugar Maple – Ironwood – Beech. Although bedrock outcrops were not present anywhere in the surveyed area, bedrock effects on the flora are evident. This southernmost area of mature remnant floodplain hardwoods had limited representation of the significant rich forest flora found further downstream in the zone noted as being underlain by Windsor Group bedrock (probably limestone in this site). The small mature floodplain hardwood forest remnants over Windsor Group bedrock supported massive patches of Bloodroot (*Sanguisorba canadensis*, S3S4 – Secure), frequent Coffee Tinker's-Weed (a.k.a. Wild Coffee; *Triosteum aurantiacum*, S2S3 – Sensitive), and smaller amounts of Pubescent Sedge (*Carex hirtifolia*, S2S3 – Sensitive; locally abundant), Blue Cohosh (*Caulophyllum thalictroides*, S2 – May Be At Risk; rare), and Canada Lily (*Lilium canadense*, S2 – May Be At Risk; rare) under Sugar Maple – White Ash forest. The presence of this suite of species and the abundance of Bloodroot and Orange-fruited Tinker's-Weed suggests soils as rich as any in Nova Scotia. The most significant of these remnant rich floodplain habitats were concentrated in a short stretch of river within about 250 m of the sharp bend 900 m northeast of the Frasers Mills bridge.

Most of the habitat along the river has been subject to a history of intensive human disturbance, and much of the unmanaged vegetation within the floodplain is Speckled Alder (*Alnus rugosa* ssp. *incana*), Choke Cherry (*Prunus virginiana*) and hawthorn (*Crataegus* spp.) thicket regenerating after past agricultural use, or in slightly drier areas various combinations of White Spruce, White Ash, Apple (*Malus pumila*), and other shade intolerant trees. The presence of numerous wild, mature and extensively reproducing European Linden (*Tilia x vulgaris*) over at least 1.5 km of river was an unusual feature of the site. We have not noted this exotic species being as thoroughly established in the wild anywhere else in Nova Scotia. Exotic herbaceous species are frequent throughout, especially on the gravel river bars.

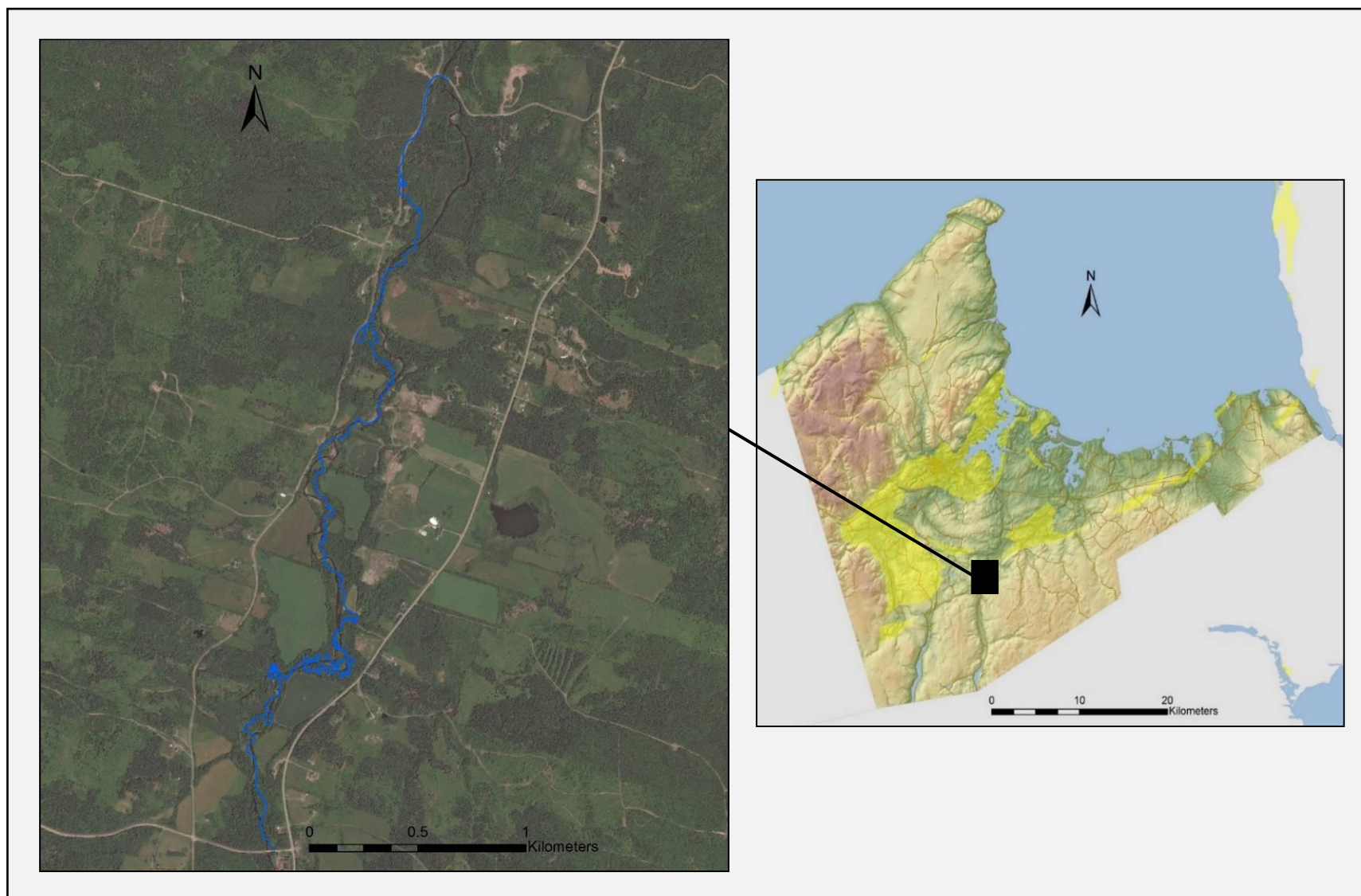


Figure 16. Survey coverage along the South River (site #14), Antigonish County, NS. Blue line represents track file logged by GPS unit. Survey carried out on July 25th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from ESRI World Imagery basemap (accessed in winter 2015). Note: southernmost 800 m of illustrated survey coverage is approximate and based on GPS-recorded waypoints.



#14. South River – Frasers Mills (clockwise from top left)

1 and 2. Calcareous Sugar Maple – White Ash – Ironwood – Beech floodplain and upper floodplain terrace forest along South River near Frasers Mills; 3. Large Purple-fringed Orchid (*Platanthera grandiflora*, S3 – Secure), which was observed at two nearby sites on the banks of the South River; 4. Blue Cohosh (*Caulophyllum thalictroides*, S2 – May Be At Risk), which was present at three nearby sites in rich floodplain forest remnants along the South River.

#15. Lamey Brook

Observer(s): Belliveau, A.G., Nussey, P.

Survey date: September 16th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Asplenium trichomanes-ramosum</i>	Green Spleenwort	S2	Sensitive	1
<i>Halenia deflexa</i>	Spurred Gentian	S2S3	Sensitive	18
<i>Fragaria vesca</i> ssp. <i>americana</i>	Woodland Strawberry	S3S4	Secure	1

Site Summary

The Lamey Brook site is underlain by a mixture of parent material including granodiorite, shale, and limestone, among other rock types. Soils in this area are generally mesotrophic, or slightly rich in places. Most of the brook is a shallow to moderately deep-cut valley, with few well-developed floodplain sections. Shore along the brook varies between gravelly-cobbly bars of mixed composition and more deeply-cut banks, with occasional beaver dams slowing flow. The middle section of the surveyed area includes an exposed band of what appears to be limestone (easily scratched with nail), which features waterfalls, small moist caverns, deep bedrock crevices, and a few deep pools in the brook.

The forests along the valley slopes surrounding the brook are mostly mature shade-tolerant hardwoods and mixedwoods among smaller patches of young forest. A few older patches of Yellow Birch (*Betula alleghaniensis*) and Sugar Maple (*Acer saccharum*) forests were also present, with understories characterized by Common Wood Sorrel (*Oxalis montana*) and Northern Beech Fern (*Phegopteris connectilis*). Many of the gravelly-cobbly bars are vegetated by common and weedy species such as Coltsfoot (*Tussilago farfara*), Virginia Strawberry (*Fragaria virginiana*), Parasol White-Top (*Doellingeria umbellata*), Oxeye Daisy (*Leucanthemum vulgare*), and Woodland Angelica (*Angelica sylvestris*). Most bars, however, also include occurrences of Spurred Gentian (*Halenia deflexa*, S2S3, Sensitive). Steeper brook banks are generally vegetated by various bryophytes and ferns, and support at least one occurrence of Woodland Strawberry (*Fragaria vesca* ssp. *americana*, S3S4, Secure). The middle section of the surveyed area, of more calcareous geology, was only sparsely vegetated given the deep shade and frequent flooding disturbance; however, one concave, cool, and seepy cliff face along this section was found to support a dense patch of Green Spleenwort (*Asplenium trichomanes-ramosum*, S2 – Sensitive) and MacKay's Brittlefern (*Cystopteris tenuis*).

Major disturbances noted at this site include recent clearcutting of forests adjacent to the brook valley, the presence of an ATV trail and bridge, and an old cabin along the brook.

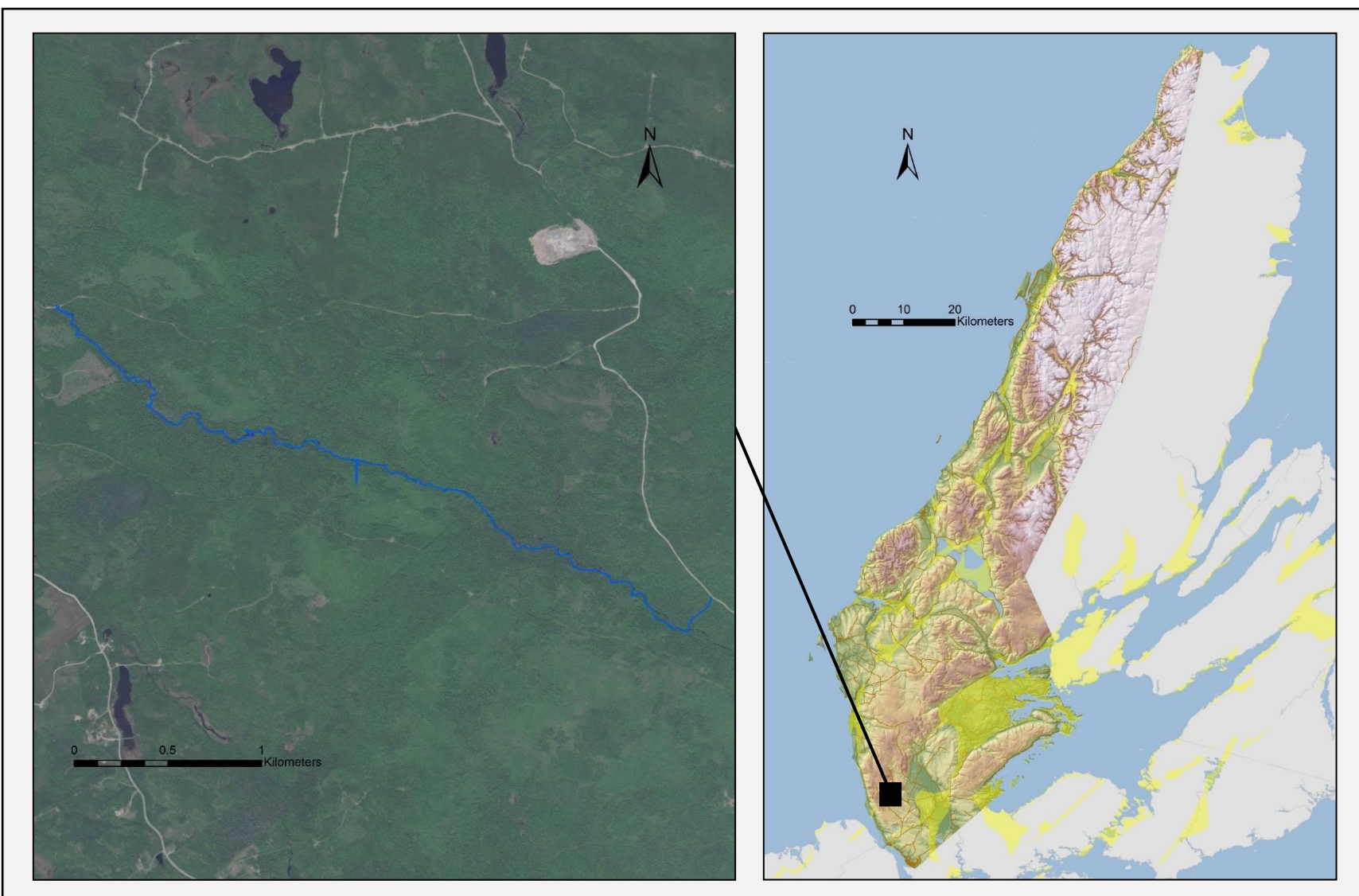


Figure 17. Survey coverage at Lamey Brook (site #15), Inverness County, NS. Blue line represents track file logged by GPS unit. Survey carried out on September 16th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#15. Lamey Brook (clockwise from top left)

1 – Gravel and cobble bars along Lamey Brook, along with more deeply-cut banks further downstream. 2 – Section of Lamey Brook with more calcareous geology and features such as waterfalls, small moist caverns, deep bedrock crevices, and deep pools. 3 – Dense patch of Green Spleenwort (*Asplenium trichomanes-ramosum*, S2, Sensitive) and Makay's Brittlefern (*Cystopteris tenuis*) on a cool and seepy cliff face along Lamey Brook. 4 – Spurred Gentian (*Halenia deflexa*, S2S3 – Sensitive) from a gravel and cobble bar along Lamey Brook.

#16. MacLeod Brook

Observer(s): Mazerolle, D.M.

Survey date: September 19th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Cypripedium parviflorum</i>	Small Yellow Lady's-Slipper	S2S3	Sensitive	10
<i>Rhamnus alnifolia</i>	Alderleaf Buckthorn	S3	Secure	1
<i>Equisetum scirpoides</i>	Dwarf Scouring Rush	S3S4	Secure	2

Site Summary

Survey coverage at this site was focused on a 3 km by 1.5 km area situated on the Big Ridge in southern Inverness County, to the northwest of the junction of River Denys Road and Bornish Road. Most of the surveyed area is on gently sloping west-facing terrain in the upper reaches of the broad Southwest Mabou River valley. The site lies roughly 3 km from the nearest mapped occurrence of Windsor Group bedrock and no signs of karst topography were detected during the survey. Moderately alkaline conditions observed in several of the area's seepage wetlands, however, suggest the presence of underlying calcareous bedrock, most likely limestone (as was observed at the nearby Glen Brook site).

Although significant areas have been cleared through recent wood harvesting, the site remains largely forested and includes a wide variety of early-, mid- and late-seral forest communities. Well-drained mesotrophic Sugar Maple (*Acer saccharum*) / Yellow Birch (*Betula alleghaniensis*) / Red Maple (*Acer rubrum*) forest with Northern Beech (*Fagus grandifolia*) and Balsam Fir (*Abies balsamea*) understory constitutes the predominant forest community over the site's southern half. Pure Northern Beech and Sugar Maple / Northern Beech stands are also common throughout. The central portion of the surveyed area contains fairly extensive Black Spruce (*Picea mariana*) / Red Maple / Tamarack (*Larix laricina*) circumneutral to acidic seepage swamp, often occurring with Cinnamon Fern (*Osmunda cinnamomea*) understories. With the exception of a few small old growth stands of upland hardwoods and coniferous swamp, most forest is shows signs of historic harvesting.

A few small pockets of moderately rich sloping alkaline fen and sparsely treed seepage swamp were found in the central portion of the surveyed area, scattered at the periphery of more acidic seepage swamps and along small tributaries of the Southwest Mabou River. All three provincially rare plant species documented at this site [Small Yellow Lady's-Slipper (*Cypripedium parviflorum*, S2S3, Sensitive), Alderleaf Buckthorn (*Rhamnus alnifolia*, S3, Secure) and Dwarf Scouring Rush (*Equisetum scirpoides*, S3S4, Secure)] were observed within these habitats.

Though it is likely more botanically diverse and potentially home to a greater number of provincially rare species, the largely Crown-owned MacLeod Brook valley to the northeast was avoided in an effort to focus the survey on private land.

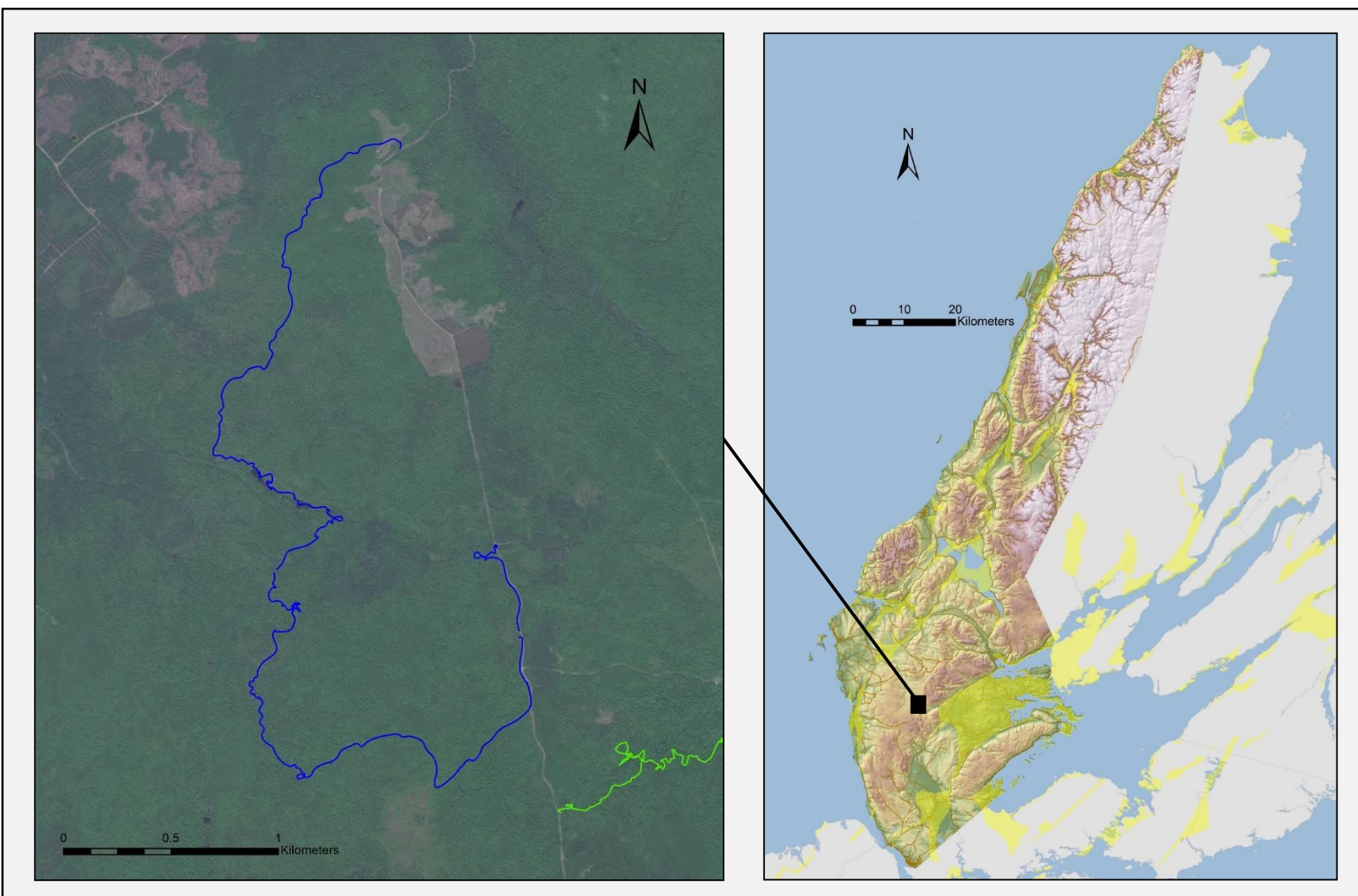


Figure 18. Survey coverage at MacLeod Brook (site #16), Inverness County, NS. Blue line represents track file logged by D.M. Mazerolle's GPS unit; green line represents track file logged by A.G. Belliveau's GPS unit (from site #17 survey coverage). Survey carried out on September 19th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#16. MacLeod Brook (clockwise from top left)

1 – Mature forest of Sugar Maple, Yellow Birch, American Beech and Red Maple. 2 – Small Yellow Lady's-Slipper (*Cypripedium parviflorum*, S2S3, Sensitive) in alkaline seepage fen. 3 – Black Spruce/ Tamarack / Red Maple seepage swamp with Cinnamon Fern (*Osmunda cinnamomea*) understory. 4 – Slightly calcareous graminoid-dominated seepage slope fen at head of small tributary of the Southwest Mabou River.

#17. Glen Brook

Observer(s): Belliveau, A.G.

Survey date: September 19th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Equisetum pratense</i>	Meadow Horsetail	S3	Sensitive	7
<i>Cystopteris bulbifera</i>	Bulblet Fern	S3S4	Secure	2
<i>Equisetum scirpoides</i>	Dwarf Scouring Rush	S3S4	Secure	22

Site Summary

Survey coverage at this site was focused on the main branch of Glen Brook, which flows west to east, eventually emptying into River Denys. The surveyed brook section is generally nestled between steep river valley slopes of mesotrophic to slightly rich soil and till of mixed parent material origin. Along the brook, several protrusions, exposed limestone faces, and barely discernible sinkholes are present. Brooks and rivulets flowing into Glen Brook are typically very deeply cut. Despite the steep valley slopes, developed floodplains line most of the surveyed portion of Glen Brook. One deep cave was observed, extending at least 20 m into bedrock, along a small, tumbling brook.

The middle and upper valley slopes are mostly dominated by Red Maple (*Acer rubrum*), Sugar Maple (*Acer saccharum*), Yellow Birch (*Betula alleghaniensis*), and American Beech (*Fagus grandifolia*) with an understory of Christmas Fern (*Polystichum acrostichoides*). Lower slopes support old growth stands composed of the same suite of species plus White Ash (*Fraxinus americana*). Floodplain understories in the surveyed area include species such as Northern Beech Fern (*Phegopteris connectilis*), woodferns (*Dryopteris* spp.), and Zigzag Goldenrod (*Solidago flexicaulis*). Many large patches of Dwarf Scouring-Rush (*Equisetum scirpoides*, S3S4, Secure), and a few occurrences of Meadow Horsetail (*Equisetum pratense*, S3, Sensitive) were also documented in floodplain habitats. Both of the exposed limestone faces found within the surveyed area are sparsely vegetated, one of them supporting a few calcareous rock-associated species such as Bulblet Fern (*Cystopteris bulbifera*, S3S4, Secure) and Makay's Brittlefern (*Cystopteris tenuis*), alongside other unusual species such as Braun's Holly Fern (*Polystichum braunii*) and Male Fern (*Dryopteris filix-mas*).

Several disturbances were noted at this site, including small patches of clearcutting, a new woods road, vehicle trails fording the brook, and an older woods road that follows the brook along its north side over much of its length.

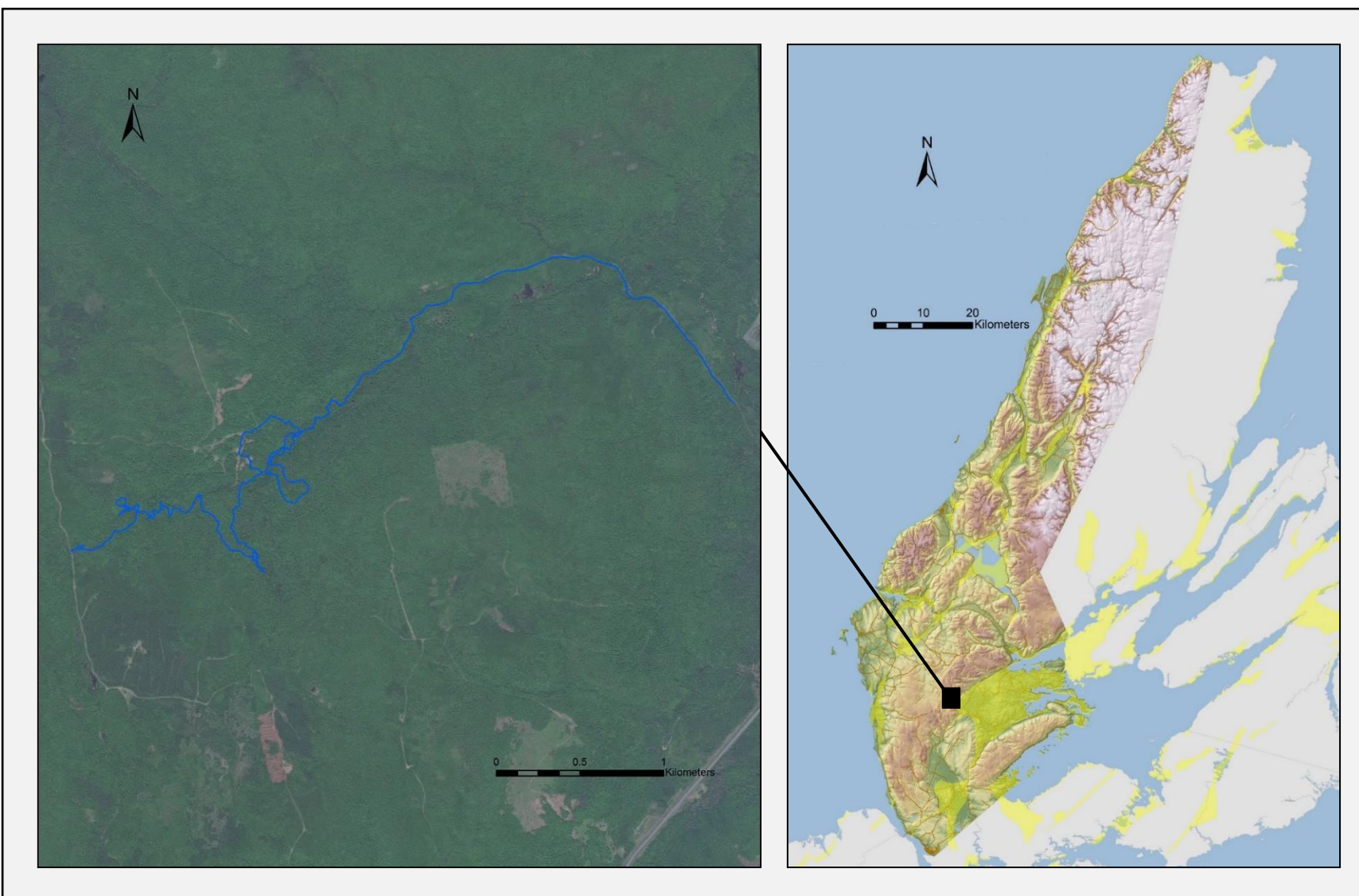


Figure 19. Survey coverage at Glen Brook (site #17), Inverness County, NS. Blue line represents track file logged by GPS unit. Survey carried out on September 19th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#17. Glen Brook (clockwise from top left)

1 – Section of Glen Brook carved deeply through carbonate stone, producing very steep slopes. 2 – Limestone rock face, with trickling rivulet and an occurrence of Bulblet Fern (*Cystopteris bulbifera*, S3S4, Secure). 3 – Lower slope and floodplain forest with old growth characteristics, supporting several rare species including Dwarf Scouring Rush (*Equisetum scirpoides*, S3S4, Secure) and Meadow Horsetail (*Equisetum pratense*, S3, Sensitive).

#18. MacPhail Brook

Observer(s): Blaney, C.S.

Survey date: September 19th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Asplenium trichomanes-ramosum</i>	Green Spleenwort	S2	Sensitive	2
<i>Halenia deflexa</i>	Spurred Gentian	S2S3	Sensitive	1
<i>Asplenium trichomanes</i>	Maidenhair Spleenwort	S3	Secure	2
<i>Pyrola asarifolia</i>	Pink Wintergreen	S3	Secure	3
<i>Rhamnus alnifolia</i>	Alderleaf Buckthorn	S3	Secure	2
<i>Cystopteris bulbifera</i>	Bulblet Fern	S3S4	Secure	21

Site Summary

Survey coverage at this site was focused primarily along 2.7 km of the MacPhail Brook valley. The stream runs almost due east in this area in a deep, narrow, steep-sided valley. The south-facing slope is dominated by Sugar Maple with varying proportions of Beech and Yellow Birch, while the north facing slope has more spruce (probably mostly Red Spruce, although attention to spruces was limited). Almost all of the stream distance surveyed was underlain by limestone, with extensive outcrops present immediately along MacPhail Brook and forming several small waterfalls. Bulblet Fern was common over much of the stream distance surveyed on mossy shoreline limestone outcrops. Some larger outcrops partway up the steep valley slopes supported two additional rare ferns (Green and Maidenhair Spleenwort, *Asplenium trichomanes-ramosum* and *A. trichomanes*). Because site coverage was mostly along the stream and outcrops partway up the forested slopes were generally not visible from the valley bottom, it is likely that additional interesting limestone outcrops are present in the area but undocumented. The stream valley is mostly too narrow and steep sided to have well-developed floodplain communities, but we did document a few locations for Pink Wintergreen (*Pyrola asarifolia*, S3 – Secure), typical of calcareous floodplain terraces, and fairly rich calcareous seepage communities were frequent near the slope bases just up from the brook.

A small pond occurs at the far northwest end of the surveyed area. Water levels there were reduced because of a recently broken beaver dam. The pond margins were mostly marshy to peaty sedge and shrub dominated communities, and the area supported a small population of Alderleaf Buckthorn (*Rhamnus alnifolia*, S3 – Secure) which was also locally present further northwest in a seepy side channel stream within a cut-over area.

The steep valley slopes along MacPhail Brook were generally in excellent condition with little or no human disturbance, many old trees and some portions that would likely qualify as old growth. Forest on the north side of the plateau along the Upper Glencoe Road, and along the western most area surveyed is more disturbed, with extensive heavy selective cutting for firewood and local regenerating clearcuts of various ages. Aerial photos suggest that unsurveyed forest on the plateau south of the MacPhail Brook valley appears to include extensive mature, undisturbed hardwood and mixed stands.

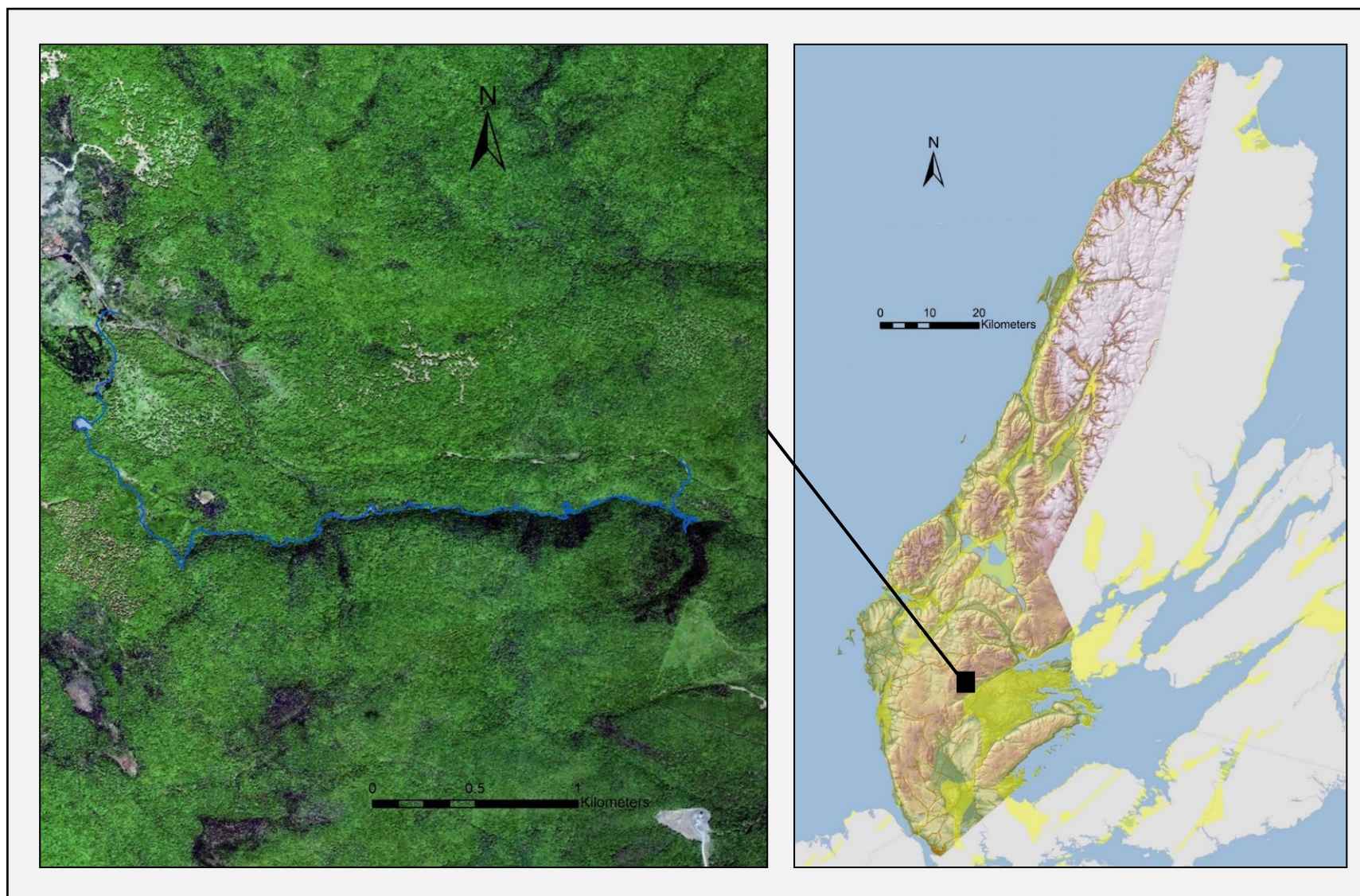


Figure 20. Survey coverage at MacPhail Brook (site #18), Inverness County, NS. Blue line represents track file logged by GPS unit. Survey carried out on September 19th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from ESRI World Imagery basemap (accessed in winter 2015).



#18. MacPhail Brook (clockwise from top left) 1. Very mature Sugar Maple – Beech – Yellow Birch forest on valley slope; 2. Small waterfall and mature deciduous forest over limestone bedrock in MacPhail Brook valley; 3. Limestone outcrops along MacPhail Brook; 4 and 5. Green Spleenwort (*Asplenium trichomanes-ramosum*, S2 – Sensitive) and Maidenhair Spleenwort (*Asplenium trichomanes*, S3 – Secure) on limestone outcrop in MacPhail Brook valley; 6. Very mature Sugar Maple – Beech – Yellow Birch valley slope forest with limestone outcrops.

#19. Pooles Brook

Observer(s): Belliveau, A.G.; Basquill, S.P.

Survey date: September 11th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Carex gynocrates</i>	Northern Bog Sedge	S1	May Be At Risk	2
<i>Cypripedium reginae</i>	Showy Lady's-Slipper	S2	May Be At Risk	31
<i>Lobelia kalmii</i>	Kalm's Lobelia	S2	May Be At Risk	10
<i>Symphyotrichum boreale</i>	Boreal American-Aster	S2?	Sensitive	14
<i>Proserpinaca palustris</i> var. <i>crebra</i>	Marsh Mermaid-Weed	S3	Secure	1
<i>Rhamnus alnifolia</i>	Alderleaf Buckthorn	S3	Secure	71
<i>Fragaria vesca</i> ssp. <i>americana</i>	Woodland Strawberry	S3S4	Secure	1

Site Summary

Although located over Windsor Group geology, this surveyed area is generally circumneutral, likely due to the presence of very thick till derived from more acidic parent material. Uplands at this site are characterized by hummocky, dry to moist, mesotrophic soils. Only one sinkhole was noted, and it did not exhibit any signs of surface calcareousness. Low-lying areas, however, abruptly develop into nutrient-rich, calcareous wetland, from a narrow edge of forested swamp to a fen, pond and stream complex in the wetland's open center. The wetland complex is part of the Pooles Brook watershed, which flows and empties north into Whycocomagh Bay.

Upland forest at this site consists of a mix of shade-tolerant and intolerant species, including an abundance of Red Maple (*Acer rubrum*), with scattered occurrences of Sugar Maple (*Acer saccharum*) and Yellow Birch (*Betula alleghaniensis*). The northwestern section of the wetland complex, along with some of the narrow band of swamp surrounding the open fens, are dominated by Tamarack (*Larix laricina*) and Black Spruce (*Picea mariana*), with a dense shrub layer of Speckled Alder (*Alnus incana* ssp. *rugosa*), Alderleaf Buckthorn (*Rhamnus alnifolia*, S3 - Secure), and Shrubby Cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*). An occurrence of Northern Bog Sedge (*Carex gynocrates*, S1 – May Be At Risk) and an occurrence of Woodland Strawberry were also observed within these swamp communities. Most of the open wetland complex is a provincially rare graminoid fen community dominated by species such as clubrush (*Trichophorum alpinum* and/or *caespitosum*), White Beakrush (*Rhynchospora alba*), Slender Sedge (*Carex lasiocarpa* var. *americana*) and Hardstem Bulrush (*Schoenoplectus acutus*), with a significant shrub component of Shrubby Cinquefoil, Creeping Juniper (*Juniperus horizontalis*), and Alderleaf Buckthorn. The rare hydrophytic calciphiles Boreal American-Aster (*Symphyotrichum boreale*, S2? - Sensitive) and Northern Bog Sedge were found in open areas, while partially shaded areas included an abundance of Showy Lady's-Slipper (*Cypripedium reginae*, S2 – May Be At Risk). Ice-scoured areas adjacent to open water in the middle of the open fen are dominated by *Sphagnum* spp. and a graminoid community of White Beakrush, Horned Bladderwort (*Utricularia cornuta*), White Buttons (*Eriocaulon aquaticum*), and Kalm's Lobelia (*Lobelia kalmii*, S2 - May Be At Risk). The beaver dam-influenced wetland outflow to the north is densely vegetated by species tolerant to hydrological change such as Steeplebush (*Spiraea tomentosa*), mints (*Mentha* spp.), Leatherleaf (*Chamaedaphne calyculata*), and aquatic bladderworts (*Utricularia* spp.), and also included one large patch of Marsh Mermaid-Weed (*Proserpinaca palustris* var. *crebra*, S3 -Secure).

With the exception of small areas affected by wood harvesting activities north of the wetland complex, no anthropogenic disturbances were noted.

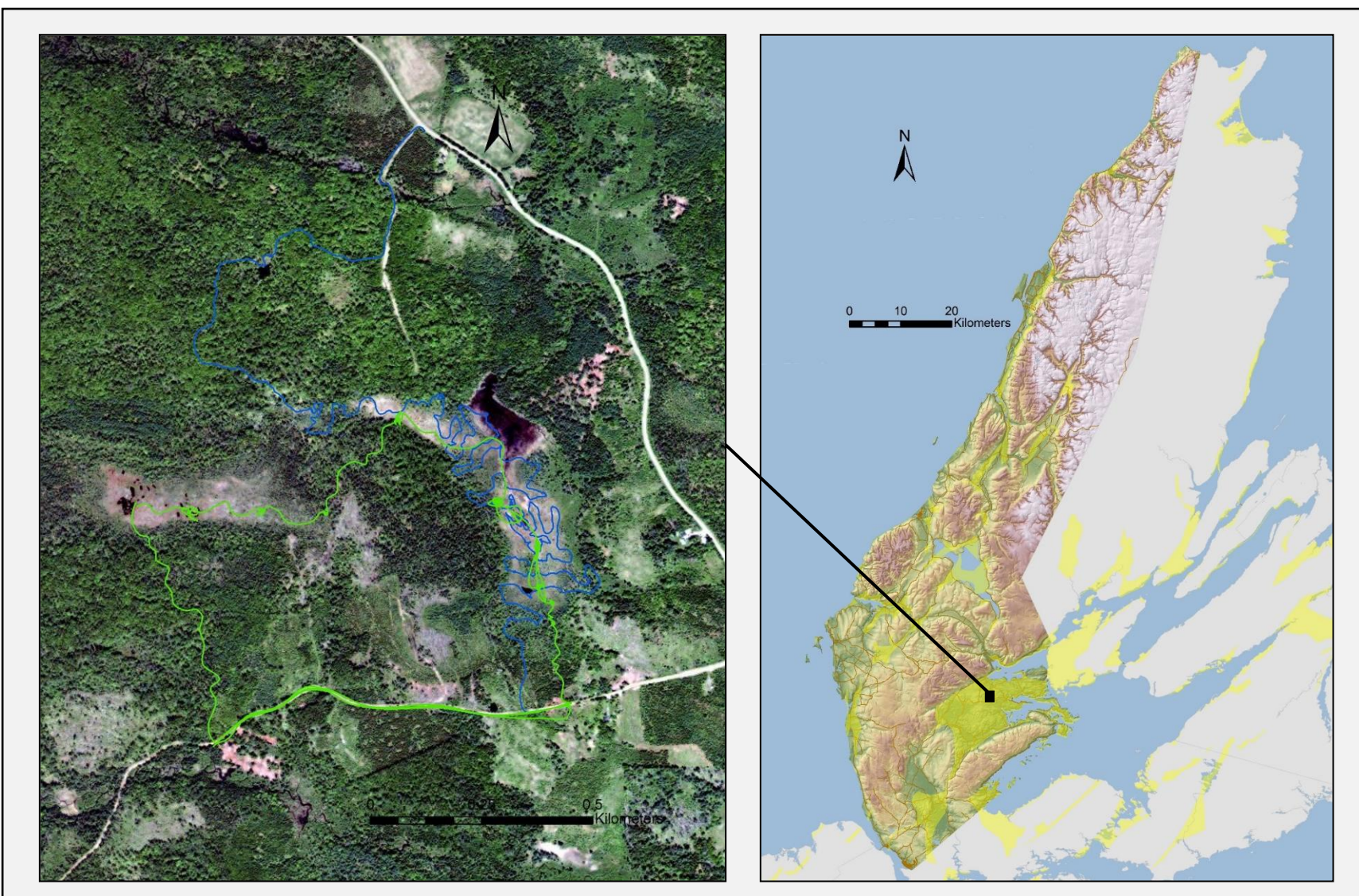


Figure 21. Survey coverage at Pooles Brook (site #19), Inverness County, NS. Blue line represents track file logged by A.G. Belliveau's GPS unit; green line represents track file logged by S.P. Basquill's GPS unit. Survey carried out on September 11th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from ESRI World Imagery basemap (accessed in winter 2015).



#19. Pooles Brook (clockwise from top left)

1 – Open graminoid-dominated calcareous fen at southern end of Pooles Brook watershed. 2 – Occurrence of Northern Bog Sedge (*Carex gynocrates*, S1, May Be At Risk) growing under Shrubby Cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*) in calcareous swamp. 3 – Kalm's Lobelia (*Lobelia kalmii*, S2, May Be At Risk) along edge of linear areas of open water in middle of calcareous fen.

#20. MacLeans Brook

Observer(s): Mazerolle, D.M.

Survey date: September 11th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Lobelia kalmii</i>	Kalm's Lobelia	S2	May Be At Risk	3
<i>Symphyotrichum boreale</i>	Boreal American-Aster	S2?	Sensitive	2
<i>Agrimonia gryposepala</i>	Tall Hairy Groovebur	S3	Secure	2
<i>Rhamnus alnifolia</i>	Alderleaf Buckthorn	S3	Secure	11
<i>Asclepias incarnata</i> ssp. <i>pulchra</i>	Swamp Milkweed	S3?	Undetermined	1
<i>Epilobium ciliatum</i> / <i>coloratum</i>	willowherb sp.	-	-	2

Site Summary

Situated near Seal Cove at the eastern end of Denys Basin, surveys at this site extended over 3.5 km along MacLeans Brook and included an area of open peatland south of Ashfield. Small occurrences of light karst topography are evident roughly 1 km northwest of the mouth of MacLeans Brook and 1.5 km further to the southwest, where gentle sinkholes, shallow sinkhole ponds and moderately incised gulleys were observed. These karstic areas also include small pockets of fairly alkaline seepage wetland, which provide further evidence of underlying calcareous bedrock. The very limited surficial expression of Windsor Group bedrock at this site, however, suggests the presence of significant overburden.

A large majority of the MacLeans Brook area has been heavily disturbed through extensive wood harvesting activities which have cleared large swaths of forest, leaving very few intact mature stands. Much of the remaining forest along the brook is second growth and presently dominated by Red Maple (*Acer rubrum*), White Spruce (*Picea glauca*) and shade intolerant hardwoods such as Trembling Aspen (*Populus tremuloides*) and Paper Birch (*Betula papyrifera* var. *papyrifera*). Oligotrophic acidic Black Spruce (*Picea mariana*) seepage swamp is also locally common. Along the upper surveyed section of the brook, remnant riparian bands and sheltered gulleys contain small stands of mature shade-tolerant hardwoods and mixedwood forest composed of Red Maple, Yellow Birch (*Betula alleghaniensis*), Sugar Maple (*Acer saccharum*), Eastern Hemlock (*Tsuga canadensis*) and Eastern White Pine (*Pinus strobus*).

The western end of the surveyed area includes a nutrient-rich alkaline fen fed by groundwater seepage through calcareous bedrock and characterized by a community of Alpine Cotton-Grass (*Trichophorum alpinum*), Creeping Juniper (*Juniperus horizontalis*), Twig Rush (*Cladium mariscoides*), Sweet Gale (*Myrica gale*) and Shrubby Cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*). This small graminoid and low shrub peatland (roughly 350 m x 100 m in size), which represents the most floristically significant area at the site, supports small populations of the very rare Kalm's Lobelia (*Lobelia kalmii*, S2, May Be At Risk) and Boreal American-Aster (*Symphyotrichum boreale*, S2?, Sensitive). Moderately calcareous Speckled Alder (*Alnus incana* ssp. *rugosa*) swales and shrubby fens, some of which contain large populations of Alderleaf Buckthorn (*Rhamnus alnifolia*, S3S4, Secure), were also observed at the western and southern ends of the surveyed area.

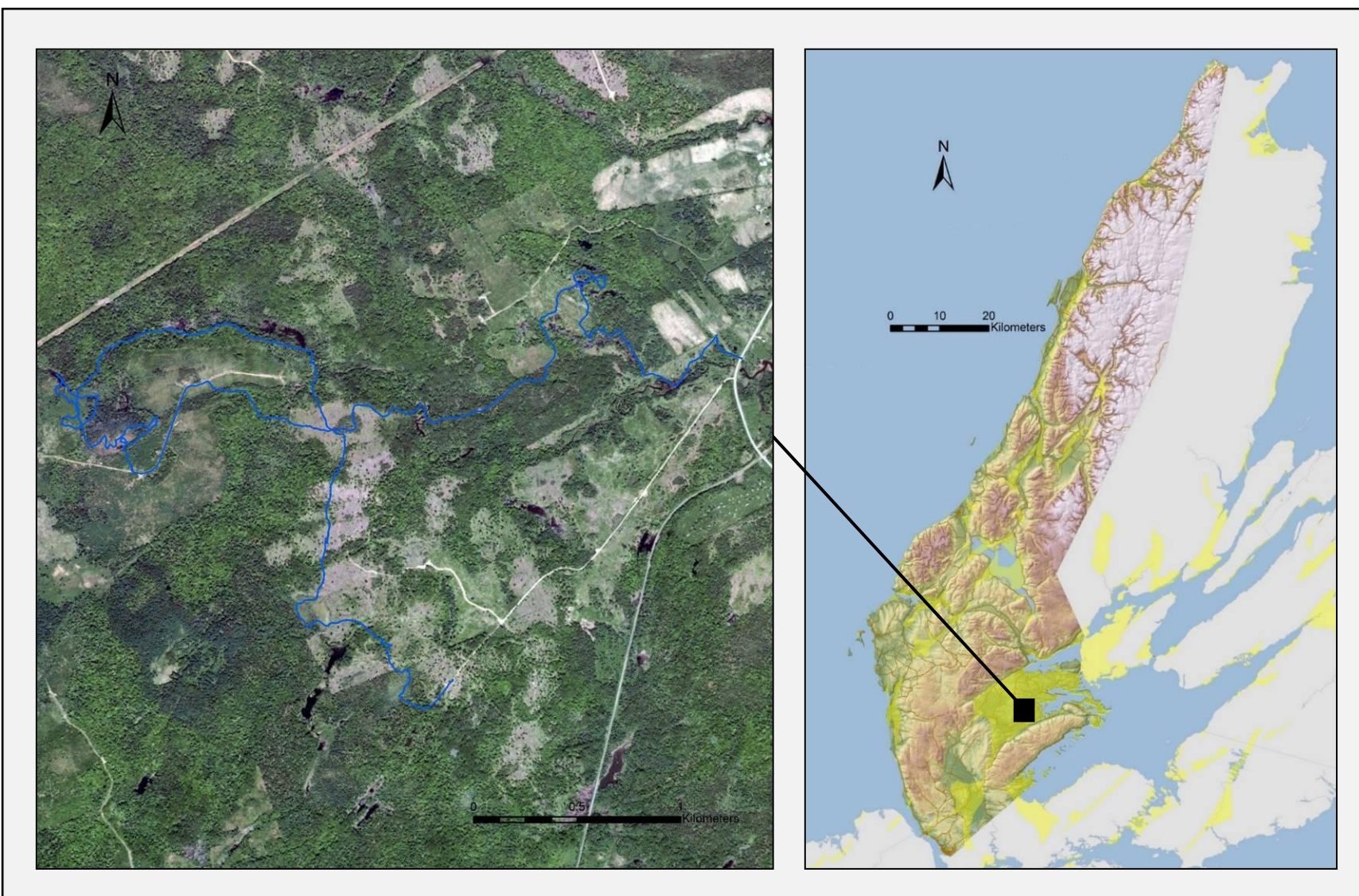


Figure 22. Survey coverage at MacLeans Brook (site #20), Inverness County, NS. Blue line represents track file logged by GPS unit. Survey carried out on September 11th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from ESRI World Imagery basemap (accessed in winter 2015).



#20. MacLeod Brook (clockwise from top left)

1 – Beaver-dammed area along small tributary of MacLeod Brook, in a wide shallow sinkhole basin. 2 – Extensive population of Alderleaf Buckthorn (*Rhamnus alnifolia*, S3, Secure) in calcareous Black Spruce / Red Maple seepage swamp. 3 – Boreal American-Aster (*Symphyotrichum boreale*, S2?, Sensitive) in nutrient-rich alkaline fen. 4 – Kalm's Lobelia (*Lobelia kalmii*, S2, May Be At Risk) in nutrient-rich alkaline fen. 5 – Nutrient-rich and graminoid-dominated open alkaline fen south of Ashfield.

#21. Lime Hill

Observer(s): Mazerolle, D.M.

Survey date: September 16th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Cypripedium parviflorum</i>	Small Yellow Lady's-Slipper	S2S3	Sensitive	3
<i>Rhamnus alnifolia</i>	Alderleaf Buckthorn	S3	Secure	4
<i>Carex flava</i> / <i>viridula</i> var. <i>elatior</i>	sedge (sect. <i>Ceratocystis</i>) sp.	-	-	1

Site Summary

Situated on the slopes and plateau of the North Mountain just southwest of the settlement of Lime Hill, this survey site extends from the mouth of MacCuspics Brook to the Beaver Lakes. Although the area is located well within an extensive mapped occurrence of underlying Windsor Group bedrock, very few karst topography features were observed. These were limited to a few wide shallow sinkhole-like depressions in gently rolling terrain and a number of limestone outcrops co-occurring with other circumneutral bedrocks in the deeply incised ravine of MacCuspics Brook.

Mature mesotrophic hardwood forest of Sugar Maple (*Acer saccharum*), Yellow Birch (*Betula alleghaniensis*) and American Beech (*Fagus grandifolia*) occupies much of the steep southeast-facing mountain slope and abrupt brook ravine. Understory communities vary greatly based on site hydrology but are largely fern-dominated, often with large components of Evergreen Wood Fern (*Dryopteris intermedia*) and New York Fern (*Thelypteris noveboracensis*). Mid-seral forest of Red Maple (*Acer rubrum*), American Beech, White Spruce (*Picea glauca*), Paper Birch (*Betula papyrifera* var. *papyrifera*) and Balsam Fir (*Abies balsamea*) also occupies a significant area.

The area surveyed on the plateau is largely open acidic bog, nutrient-poor acidic fen and mesotrophic Black Spruce (*Picea mariana*) / Red Maple seepage swamp with Cinnamon Fern (*Osmunda cinnamomea*) / Inland Sedge (*Carex interior*) understory. Several small fen and swamp areas are influenced by seepage from underlying calcareous rock, as evidenced by the presence of several calciphilic species. One such fen, found roughly 2 km west-northwest of the mouth of MacCuspics Brook, was quite nutrient-rich and supports most of the rare plant occurrences documented at this site. Most occurrences of calcareous wetlands, however, have been impacted by beaver activity.

Evidence of recent wood harvesting was observed at several locations (mainly on the west side of MacCuspics Brook) but impacts from these activities are localized. The upper slope and plateau along the west side of MacCuspics Brook also have a considerable number of old trenches (reaching depths of 3 m and lengths of over 20 m) which may have been related to aggregate or mineral exploration.

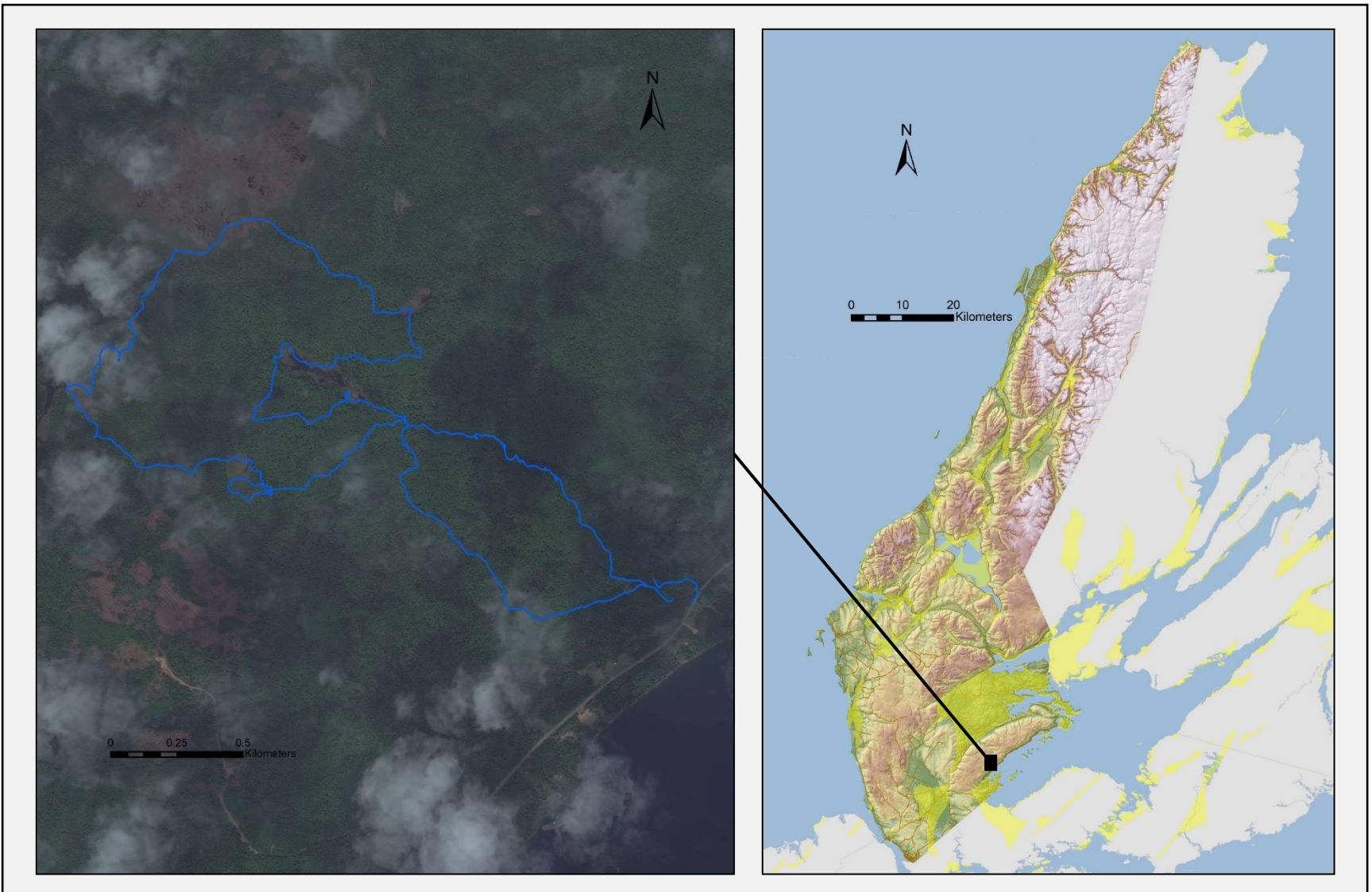


Figure 23. Survey coverage at Lime Hill (site #21), Inverness County, NS. Blue line represents track file logged by GPS unit. Survey carried out on September 16th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#21. Lime Hill (clockwise from top left)

1 – Mature Sugar Maple / Yellow Birch / American Beech forest on plateau. 2 – Small Yellow Lady's-Slipper (*Cypripedium parviflorum*, S2S3, Sensitive) in fairly rich calcareous seepage swamp. 3 – Dense population of Alderleaf Buckthorn (*Rhamnus alnifolia*, S3, Secure) in rich shrubby understory of calcareous Black Spruce seepage swamp. 4 – Circumneutral nutrient-poor graminoid fen on plateau. 5 – Limestone outcrop along MacCuspics Brook. 6 – Deeply incised ravine of MacCuspics Brook, with abundant bedrock outcrops and old late-successional hardwood forest.

#22. McIntyre Brook

Observer(s): Blaney, C.S.; Basquill, S.P.

Survey date: September 16th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Lobelia kalmii</i>	Kalm's Lobelia	S2	May Be At Risk	2
<i>Rhamnus alnifolia</i>	Alderleaf Buckthorn	S3	Secure	1
<i>Sparganium natans</i>	Small Bur-Reed	S3	Secure	1
<i>Carex cryptolepis</i>	Northeastern Sedge	S3	Secure	3
<i>Panicum tuckermanii</i>	Philadelphia Panic Grass	S3S4	Secure	1
<i>Hypericum cf. dissimulatum</i>	Disguised St. John's-Wort	[S2S3]	[Sensitive]	2
<i>Carex poss. rostrata x utriculata</i>	hybrid sedge sp.	-	-	1
<i>Spiranthes cernua / ochroleuca</i>	ladies'-tresses sp.	-	-	1

Site Summary

Coverage at McIntyre Brook involved overlapping surveys by Sean Basquill and Sean Blaney. The site did not include any exposed bedrock, but calcareous soil conditions were locally present in and around the fen at the north end of the area. This site was significant in supporting good examples of a provincially rare calcareous Shrubby Cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*)-dominated fen that would be a good site for Dorcas Copper butterfly (*Lycaena dorcas*, S1 and only recently documented for Nova Scotia from several similar sites in southern Cape Breton). The wetter, graminoid-dominated parts of this fen had a large population of a curious hybrid sedge that may have been *Carex rostrata* x *utriculata*, a hybrid never before documented in Nova Scotia. *Carex rostrata* (Narrow-leaved Beaked Sedge, S1? – May Be At Risk) is a somewhat calciphilic boreal species that is otherwise known in Nova Scotia from only one record on St. Paul Island off the northern tip of Cape Breton. This fen was also the location for the records of Kalm's Lobelia (*Lobelia kalmii*, S2 - May Be At Risk), Alderleaf Buckthorn (*Rhamnus alnifolia*, S3 – Secure) and Small Bur-Reed (*Sparganium natans*, S3 – Secure)

The two larger ponds south of the fen may be of sinkhole origin. Shoreline at these ponds exposed by receding water levels supported the occurrences of Northeastern Sedge (*Carex cryptolepis*, S3 – Secure), St. John's-Wort (grading toward Disguised St. John's-Wort, *Hypericum dissimulatum*, S2S3 – Sensitive) and ladies'-tresses (possibly *Spiranthes ochroleuca*, S3 – Secure, but not yet in flower).

The forest at the site included some good intermediate to mature Beech – Sugar Maple – Yellow Birch upland forest on the upper slopes of North Mountain, and some calcareous Black Spruce – Tamarack swamp forest around the calcareous fen margins. The lower slopes of North Mountain were younger, open, post-agricultural mixed forest regeneration with an understory that included a large portion of exotic species in some areas.

The occurrence of Philadelphia Panic Grass (*Panicum tuckermanii*, S3S4 – Secure) was an introduced population along Marble Mountain Road that represented the first Cape Breton record.

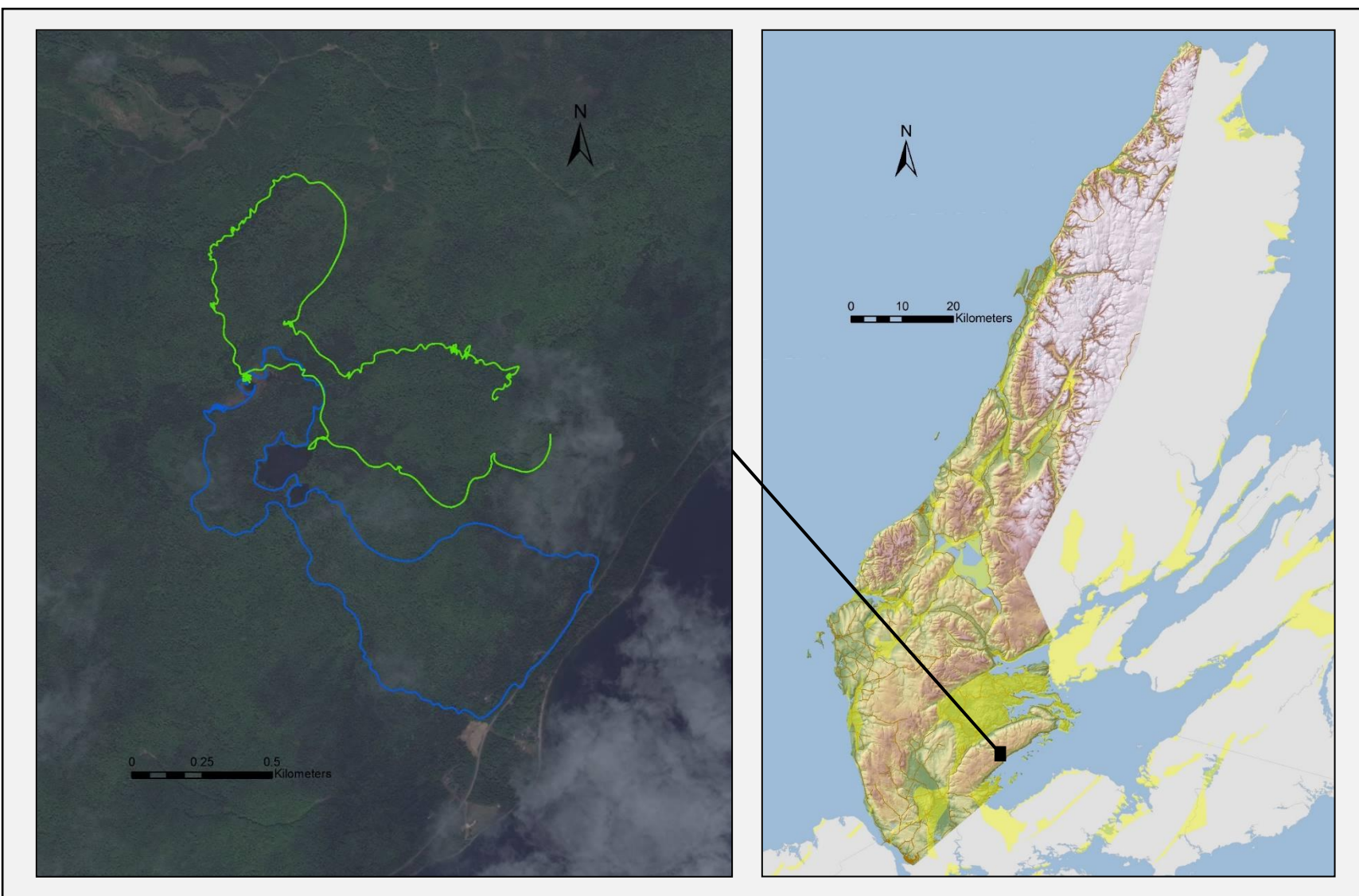


Figure 24. Survey coverage at McIntyre Brook (site #22), Inverness County, NS. Blue line represents track file logged by C.S. Blaney's GPS unit; green line represents track file logged by S.P. Basquill's GPS unit. Survey carried out on September 16th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#22. McIntyre Brook (clockwise from top left)

1. Intermediate-aged Beech – Sugar Maple forest on the southern slope of North Mountain at Lime Hill;
 2 & 3. Large sinkhole ponds with broad shoreline zones exposed by receding water levels (the southern 2 of 3 ponds surveyed). 4 & 5. Calcareous graminoid fen (around the northernmost pond) in which Kalm's Lobelia (*Lobelia kalmii*, S2 – May Be At Risk) was found.

#23. Ninevah / Little Narrows

Observer(s): Blaney, C.S.; Basquill, S.P.

Survey date: September 17th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Carex granularis</i>	Meadow Sedge	S1	May Be At Risk	2
<i>Carex viridula</i> var. <i>elatior</i>	Long-Stalked Yellow Sedge	S1	May Be At Risk	1
<i>Fraxinus nigra</i>	Black Ash	S1S2	At Risk	2
<i>Carex bebbii</i>	Bebb's Sedge	S2	Sensitive	1
<i>Galium labradoricum</i>	Bog Bedstraw	S2	Sensitive	4
<i>Lobelia kalmii</i>	Kalm's Lobelia	S2	May Be At Risk	2
<i>Symphyotrichum boreale</i>	Boreal American-Aster	S2?	Sensitive	7
<i>Cypripedium parviflorum</i>	Small Yellow Lady's-Slipper	S2S3	Sensitive	3
<i>Stuckenia filiformis</i>	Slender Pondweed	S2S3	Sensitive	1
<i>Agrimonia gryposepala</i>	Tall Hairy Groovebur	S3	Secure	2
<i>Carex eburnea</i>	Ebony Sedge	S3	Sensitive	4
<i>Erigeron hyssopifolius</i>	Hyssop-leaved Fleabane	S3	Sensitive	3
<i>Juncus dudleyi</i>	Dudley's Rush	S3	Secure	2
<i>Packera paupercula</i>	Balsam Groundsel	S3	Secure	3
<i>Ranunculus gmelinii</i>	Small Yellow Water-Crowfoot	S3	Secure	5
<i>Rhamnus alnifolia</i>	Alderleaf Buckthorn	S3	Secure	2
<i>Samolus valerandi</i> ssp. <i>parviflorus</i>	Water Pimpernel	S3	Sensitive	2
<i>Cystopteris bulbifera</i>	Bulblet Fern	S3S4	Secure	2
<i>Fragaria vesca</i> ssp. <i>americana</i>	Woodland Strawberry	S3S4	Secure	2

Site Summary

Survey effort at this site involved separate surveys by Sean Basquill and Sean Blaney at sites about 2 km apart. Sean Basquill covered the site near Little Narrows about 2 km northeast of Campbells Cove and Sean Blaney covered the Ninevah area from Campbells Cove, south and east to Campbells Road near Whycocomagh Portage. Sean Basquill's Little Narrows site included good representation of exposed gypsum features and a number of sinkhole ponds and supported the provincially rare gypsum associates Ebony Sedge, Balsam Groundsel, Yellow Lady's-Slipper, Bulblet Fern and Woodland Strawberry that were not present in the Ninevah area covered by Sean Blaney.

The Ninevah site included calcareous brackish marsh around Campbells Cove, grading landward into significant calcareous fen communities that supported good populations of the rare species Long-stalked Yellow Sedge (*Carex viridula* var. *elatior*, S1 – May Be At Risk), Bog Bedstraw (*Galium labradoricum*, S2 – Sensitive), Kalm's Lobelia (*Lobelia kalmii*, S2 – May Be At Risk), and Boreal American-Aster (*Symphyotrichum boreale*, S2? – Sensitive). Small numbers of Water Pimpernel (*Samolus valerandi* ssp. *parviflorus*, S3 – Sensitive; second Cape Breton record) were present on brackish tidal shores and calcareous streams supported Slender Pondweed (*Stuckenia filiformis*, S2S3 – Sensitive) and Small Yellow Water Crowfoot (*Ranunculus gmelinii*, S3 – Secure). A single, fairly healthy Black Ash (*Fraxinus nigra*, S1S2 – At Risk) large enough to reproduce (18cm diameter) was also present in a rich thicket swamp near a fen margin on Campbells Cove.

The remaining rare species documented at the site were mostly from calcareous disturbed ground along logging trails in the southernmost part of the area covered. These were:

Meadow Sedge (*Carex granularis*, S1 – May Be At Risk and otherwise known in Nova Scotia only from adjacent areas near Plaster Ponds), Bebb's Sedge (*Carex bebbii*, S2 – Sensitive), Dudley's Rush (*Juncus dudleyi*, S3 – Secure) and Tall Hairy Groovebur, (*Agrimonia gryposepala*, S3 – Secure).

The flora of the site indicates strongly calcareous soils around Campbells Cove and in the southern area near Campbells Road. There was, however, no exposed bedrock observed and little evidence of karst features although some gently pitted topography and the occurrence of several small ponds in the southern part of the survey area likely the result of gypsum sinkholes buried under till. The elongated pond 500 m southeast of Campbells Cove had a narrow band of slightly calcareous peaty marsh around much of its shore, and the smaller pond a further 500 m southwest of there was within a shrubby acidic peatland. The southernmost ponds were more disturbed, with water levels altered by berms associated with the logging road.

Forests on the site were not especially noteworthy, including various intermediate aged stands, some young post-agricultural regeneration around the southeast end of Campbells Cove, and some younger stands regenerating from agriculture and/or forest harvesting in the southern end.

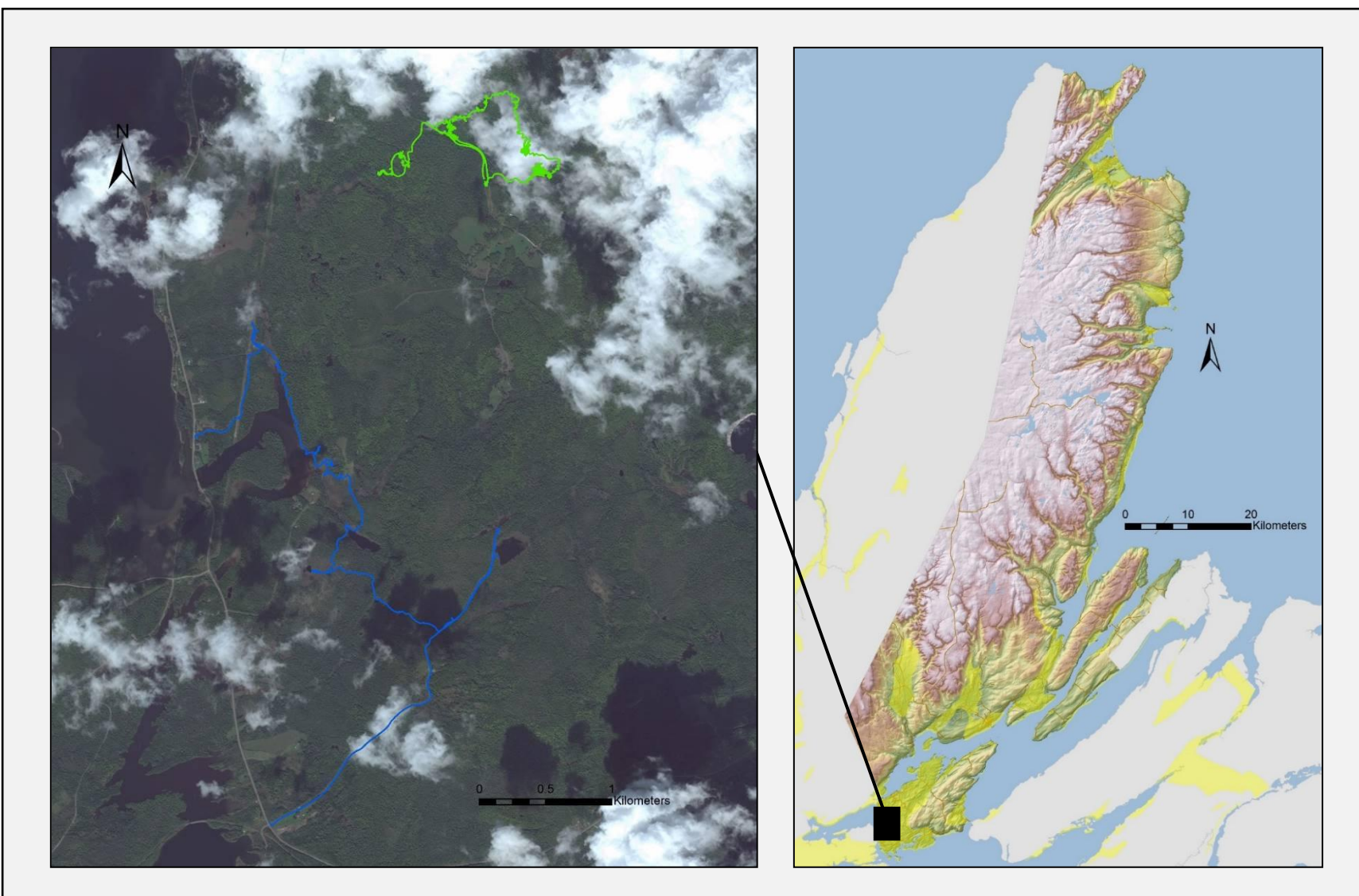


Figure 25. Survey coverage at Ninevah / Little Narrows (site #23), Victoria County, NS. Blue line represents track file logged by C.S. Blaney's GPS unit; green line represents track file logged by S.P. Basquill's GPS unit. Survey carried out on September 17th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#23. Ninevah / Little Narrows (clockwise from top left)

1 and 2. Calcareous brackish marsh at N end of Campbells Cove; 3. Calcareous freshwater marsh grading to fen at head of tide on Campbells Cove; 4. Calcareous pond with fen-like border, between Ninevah and Rear Estmere; 5. Highly calcareous fen at upper margin of tidal influence on Campbells Cove at Ninevah; 6. Calcareous freshwater marsh grading toward fen at head of tide on Campbells Cove.

#24. Washabuck Bridge

Observer(s): Mazerolle, D.M.

Survey date: September 10th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Myriophyllum verticillatum</i>	Whorled Water-Milfoil	S2	Sensitive	2
<i>Stuckenia filiformis</i>	Slender Pondweed	S2S3	Sensitive	1
<i>Ranunculus gmelinii</i>	Small Yellow Water-Crowfoot	S3	Secure	3
<i>Asclepias incarnata</i> ssp. <i>pulchra</i>	Swamp Milkweed	S3?	Undetermined	5
<i>Cystopteris bulbifera</i>	Bulblet Fern	S3S4	Secure	5

Site Summary

Survey coverage at this site spans a 2 km by 1 km area southeast of the Hazeldale gypsum quarry along the lower Washabuck River and is centered on karst features documented in Adams (1991). Karst topography is evident throughout most of the area in the form of wide poorly-defined sinkholes, ridges, gulleys and small to medium-sized sinkhole wetlands and ponds. Pronounced sinkhole topography and sizeable gypsum exposures were, however, only observed on the east side of St. Columba Road and in a small area at the southeast end of the Hazeldale quarry. These two areas contain fairly large steep-sided sinkholes (to > 15 m in diameter), successive pits, abrupt gulleys, and medium-sized outcrops of loose highly friable gypsum and bouldery gypsum. Subdued terrain observed over the remainder of the area is consistent with exploratory drillhole data, which indicates that gypsum deposits in the vicinity are covered by a >30 m-deep overburden of soil and siltstone (Adams 1991).

The karstic area surveyed east of St. Columba Road is chiefly dominated by Red Maple (*Acer rubrum*), White Spruce (*Picea glauca*), Red Spruce (*Picea rubens*), Striped Maple (*Acer pensylvanicum*) and Balsam Fir (*Abies balsamea*), with one occurrence of mature Eastern Hemlock (*Tsuga canadensis*) forest in an area of steep sinkhole terrain. West of St. Columba Road, mature upland forest is predominantly composed of Sugar Maple (*Acer saccharum*), Yellow Birch (*Betula alleghaniensis*), Eastern Hemlock and Red Maple. Outside of pronounced karst topography, the site holds very little intact forest; many stands consist of early-seral forest recovering from past wood harvesting and nearly all mature to old hardwoods have been heavily impacted by recent clearcutting and selective cutting.

Low-lying seepage areas and sinkhole wetlands are largely occupied by Black Spruce (*Picea mariana*) / Red Maple / Cinnamon Fern (*Osmunda cinnamomea*) swamps and Broad-Leaf Cattail (*Typha latifolia*), Bluejoint Reed Grass (*Calamagrostis canadensis*) and Speckled Alder (*Alnus incana* ssp. *rugosa*) marsh and shrub swamp. Leatherleaf (*Chamaedaphne calyculata*) and Sweet Gale (*Myrica gale*) communities were fairly common at the periphery of sinkhole ponds. Based on vegetation indicators, wetlands in the area are generally acidic to circumneutral, except for a few alkaline ponds and fens adjacent to the river estuary and sparsely scattered inland. These latter habitats support most of the provincially rare species observed at the site.

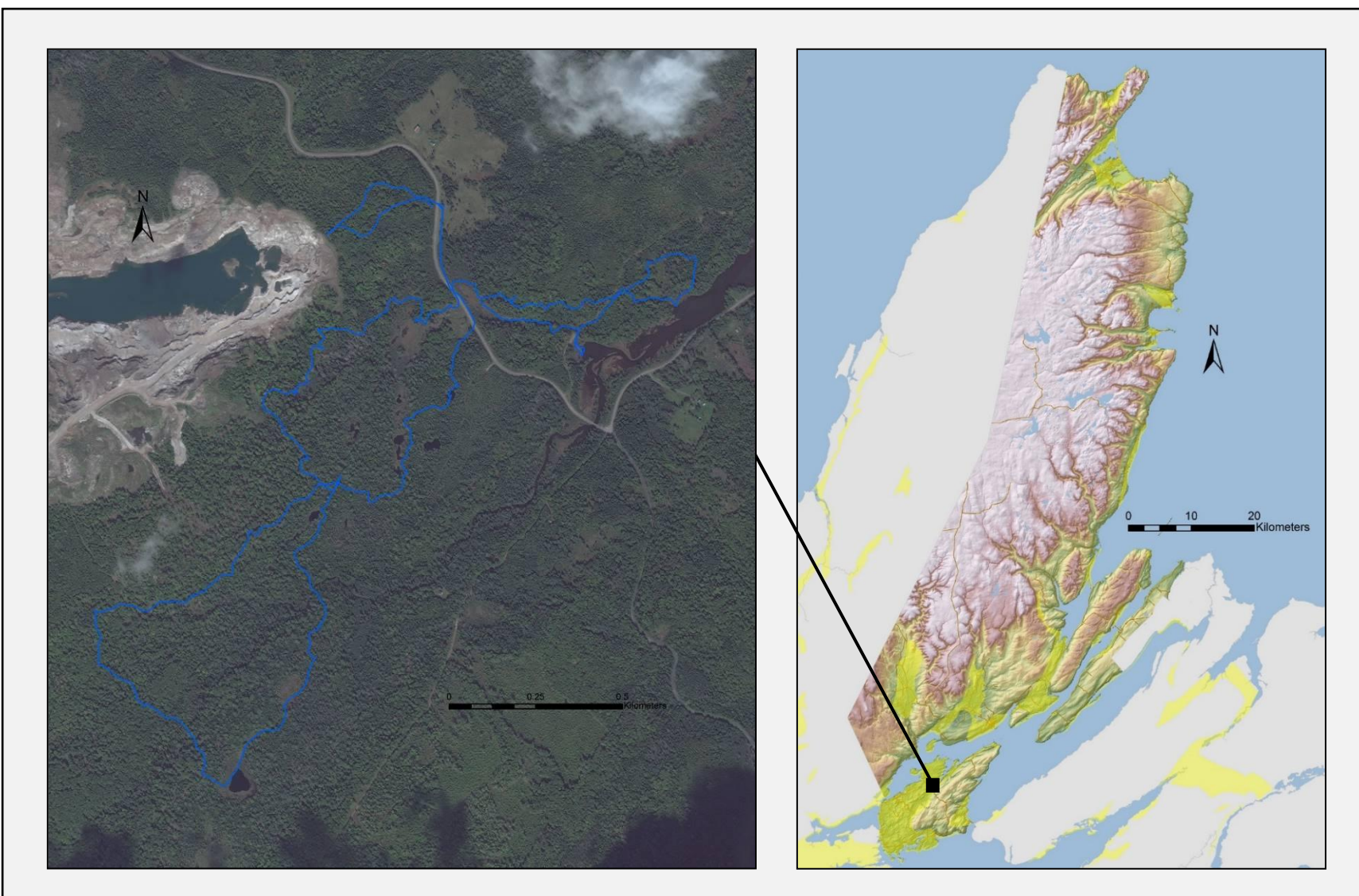


Figure 26. Survey coverage at Washabuck Bridge (site #24), Victoria County, NS. Blue line represents track file logged by GPS unit. Survey carried out on September 10th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#24. Washabuck Bridge (clockwise from top left)

1 – Mature to old Eastern Hemlock-dominated forest in area of fairly pronounced sinkhole karst topography. 2 – Fairly old Yellow Birch / Sugar Maple / Red Maple / Eastern Hemlock / Balsam Fir karst forest in area of abrupt sinkholes and gypsum outcrops. 3 – Whorled Water-Milfoil (*Myriophyllum verticillatum*, S2, Sensitive) in alkaline sinkhole pond. 4 – Slender Pondweed (*Stuckenia filiformis*, S2S3, Sensitive) in alkaline sinkhole pond. 5 – Broad-Leaf Cattail (*Typha latifolia*), sedge (*Carex* spp.), Hardstem Bulrush (*Schoenoplectus acutus*) and Twigrush (*Cladium mariscoides*) fen at edge of alkaline sinkhole pond.

#25. Plaster Cove

Observer(s): Belliveau, A.G.

Survey date: September 10th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Juncus alpinoarticulatus</i> ssp. <i>nodosus</i>	Richardson's Rush	S1S2	May Be At Risk	1
<i>Cypripedium parviflorum</i>	Small Yellow Lady's-Slipper	S2S3	Sensitive	7
<i>Carex eburnea</i>	Ebony Sedge	S3	Sensitive	35
<i>Erigeron hyssopifolius</i>	Hyssop-leaved Fleabane	S3	Sensitive	9
<i>Packera paupercula</i>	Balsam Groundsel	S3	Secure	28
<i>Polypodium appalachianum</i>	Appalachian Polypody	S3?	Undetermined	1
<i>Cystopteris bulbifera</i>	Bulblet Fern	S3S4	Secure	56
<i>Fragaria vesca</i> ssp. <i>americana</i>	Woodland Strawberry	S3S4	Secure	1

Site Summary

As its name implies, Plaster Cove has prominent gypsum exposures situated around a brackish pond, with sinkholes, deep vertical pits, thick scree accumulations and tower-like gypsum formations. Surficial and near-surface gypsum extends northward and westward from the cove to just north of Barra Glen Road and Nashs Brook. This karst occurrence is characterized by a large area (at least ~500 m x ~500 m) of variably pronounced sinkholes, at least three gypsum cliffs (5 to 25 m in height) with large accumulations of gypsum scree, and several sinkhole pond complexes. Exposed gypsum is present in approximately half of all sinkholes, either along the upper sinkhole edges or as scree along inner slopes. At least one deep cave was noted from the side and bottom of a large sinkhole.

The surveyed gypsum formation in Plaster Cove is sparsely forested with White Spruce (*Picea glauca*), Balsam Fir (*Abies balsamea*) and American Mountain Ash (*Sorbus americana*). The understory is characterized by Northern Bayberry (*Morella pensylvanica*), Common Juniper (*Juniperus communis* var. *depressa*), and an unusual abundance of exotic Fairy Flax (*Linum catharticum*). Areas of exposed gypsum support substantial amounts of Balsam Groundsel (*Packera paupercula*, S3, Secure) and Hyssop-leaved Fleabane (*Erigeron hyssopifolius*, S3, Sensitive). The large area just north of Nashs Brook is a mosaic of mostly old forest composed of Yellow Birch (*Betula alleghaniensis*), Sugar Maple (*Acer saccharum*), and Eastern Hemlock (*Tsuga canadensis*), with occasional small young patches of Balsam Fir. Gypsum cliffs and adjacent outcrop sinkholes support a suite of gypsum-associated species, including Bulblet Fern (*Cystopteris bulbifera*, S3S4, Secure), Small Yellow Lady's-Slipper (*Cypripedium parviflorum*, S2S3, Sensitive), Roundleaf Dogwood (*Cornus rugosa*), Balsam Groundsel and Ebony Sedge (*Carex eburnea*, S3, Sensitive). In shaded forested sinkhole areas, Bulblet Fern is dominant – often carpeting large areas of the forest floor – and a few other gypsum-related species were observed, including Appalachian Polypody (*Polypodium appalachianum*, S3, Undetermined), Woodland Strawberry (*Fragaria vesca* ssp. *americana*, S3S4, Secure), and American Spikenard (*Aralia racemosa*). The peaty shore of one sinkhole pond had a dense patch of Richardson's Rush (*Juncus alpinoarticulatus* ssp. *nodulosus*, S1S2, May Be At Risk), a rare species associated with alkaline shores.

Of the three large gypsum formations in Plaster Cove, one has been quarried and another has been developed residentially, while the third is still fully intact. The area of karst topography just north of Nashs Brook is almost completely intact, with one old field and one old abandoned road noted at its periphery.

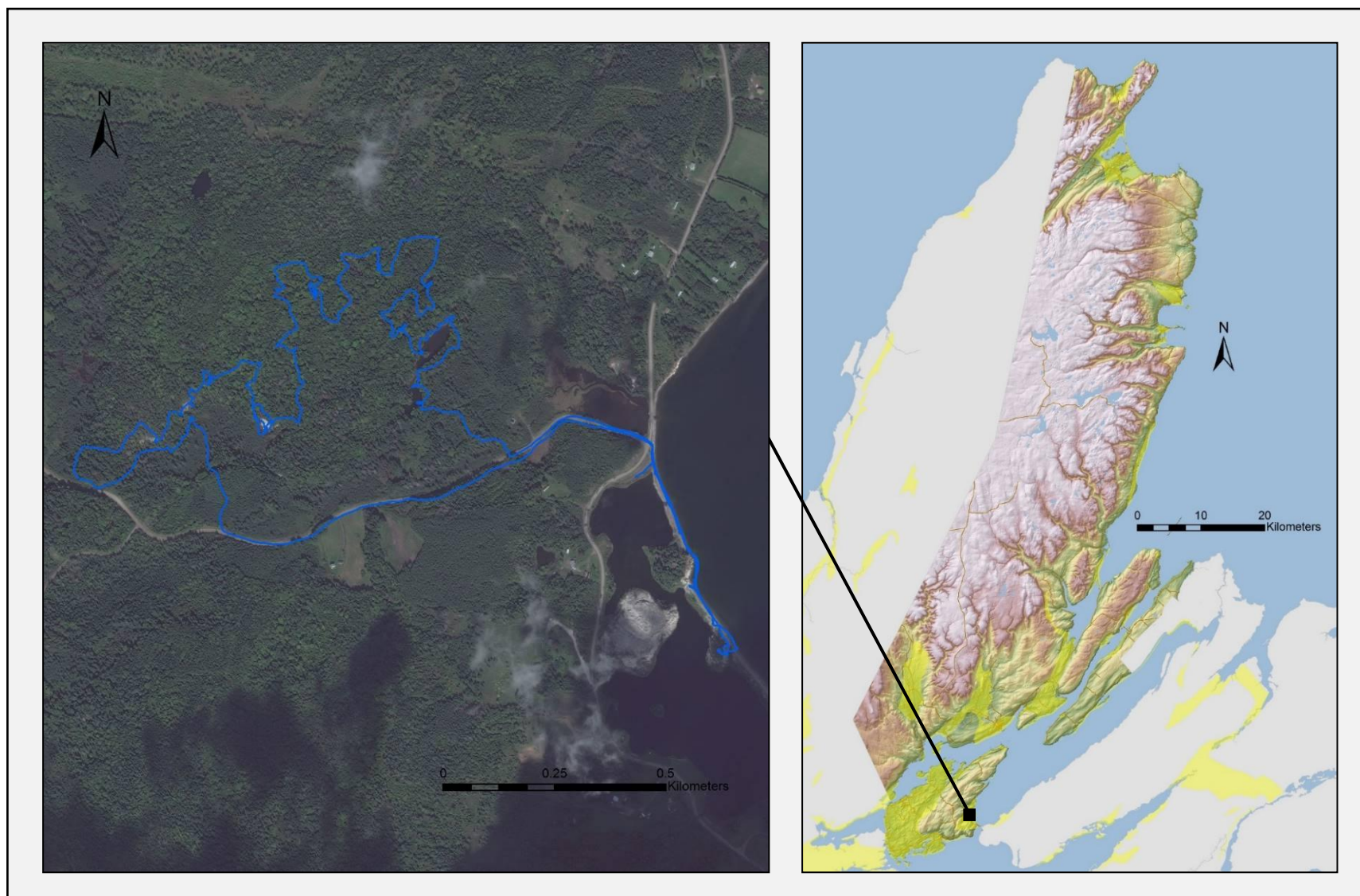


Figure 27. Survey coverage at Plaster Cove (site #25), Victoria County, NS. Blue line represents track file logged by GPS unit. Survey carried out on September 10th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#25. Plaster Cove (clockwise from top left)

1 – One of three large gypsum exposures (two are still relatively intact) in Plaster Cove along Bras d'Or Lake. 2 – Very deep vertical cave in narrow sinkhole atop large gypsum outcrop in Plaster Cove, with Hyssop-leaved Fleabane (*Erigeron hyssopifolius*, S3, Sensitive) and Northern Bayberry (*Morella pensylvanica*). 3 – Area just north of Nashs Brook with pronounced sinkholes and exposed gypsum. 4 – Occurrence of American Spikenard (*Aralia racemosa*) among an abundance of Bulblet Fern (*Cystopteris bulbifera*, S3S4, Secure) at the edge of a gypsum sinkhole just north of Nashs Brook.

#26. Hunters Mountain

Observer(s): Mazerolle, D.M.

Survey date: August 27th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Carex viridula</i> var. <i>elator</i>	Long-Stalked Yellow Sedge	S1	May Be At Risk	3
<i>Fraxinus nigra</i>	Black Ash	S1S2	At Risk	2
<i>Myriophyllum verticillatum</i>	Whorled Water-Milfoil	S2	Sensitive	1
<i>Proserpinaca palustris</i> var. <i>crebra</i>	Marsh Mermaid-Weed	S3	Secure	1
<i>Ranunculus gmelinii</i>	Small Yellow Water-Crowfoot	S3	Secure	1
<i>Rhamnus alnifolia</i>	Alderleaf Buckthorn	S3	Secure	2
<i>Asclepias incarnata</i> ssp. <i>pulchra</i>	Swamp Milkweed	S3?	Undetermined	2
<i>Cystopteris bulbifera</i>	Bulblet Fern	S3S4	Secure	4
<i>Myriophyllum sibiricum</i>	Common Water-Milfoil	S3S4	Secure	1

Site Summary

The Hunters Mountain site, located on the north side of the Baddeck River estuary between Cains Pond Road and Old Margaree Road, contains a fairly extensive zone of pronounced karst terrain which includes successive medium to large sinkholes, scattered sinkhole ponds, and an area of severe karst topography. The latter area spans at least 600 m and is characterized by abundant exposed gypsum (including large outcrops), abrupt pits and ridges, several small caves and deep, narrow trench-like formations, one of which still contained ice in late August.

Karst communities at this site are largely untouched by anthropogenic disturbance; signs of past or recent wood harvesting were only observed in areas of more moderate topography. The most prevalent forest communities are composed of Sugar Maple (*Acer saccharum*) / Yellow Birch (*Betula alleghaniensis*) and Yellow Birch / Eastern Hemlock (*Tsuga canadensis*) / Red Maple (*Acer rubrum*) / Sugar Maple. In areas of dry pronounced karst terrain, coarse woody debris is abundant and forest understories are dominated by Roundleaf Dogwood (*Cornus rugosa*), Balsam Fir (*Abies balsamea*) and Evergreen Wood Fern (*Dryopteris intermedia*).

The most floristically significant area found at the Hunters Mountain site is located in the southeast, where narrow, apparently karstic ridges concentrate groundwater seepage and runoff into rich alkaline wetlands. Wetland communities at this location grade from Red Maple / Black Spruce (*Picea mariana*) / Black Cherry (*Prunus serotina*; representing what is probably the northernmost site for the species in Nova Scotia) / Black Ash (*Fraxinus nigra*, S2S2, At Risk) seepage slope swamp to nutrient-rich and very speciose open fens that support numerous calciphilic species including the extremely rare Long-Stalked Yellow Sedge (*Carex viridula* var. *elator*, S1, May Be At Risk) as well as fairly large stands of Alderleaf Buckthorn (*Rhamnus alnifolia*, S3, Secure). Populations of Whorled Water Milfoil (*Myriophyllum verticillatum*, S2, Sensitive), Siberian Water Milfoil (*Myriophyllum sibiricum*, S3S4, Secure), Marsh Mermaid-Weed (*Proserpinaca palustris* var. *crebra*, S3, Secure) and Swamp Milkweed (*Asclepias incarnata* ssp. *pulchra*, S3?, Undetermined) occur where this fen meets a creek that flows into Back Bay.

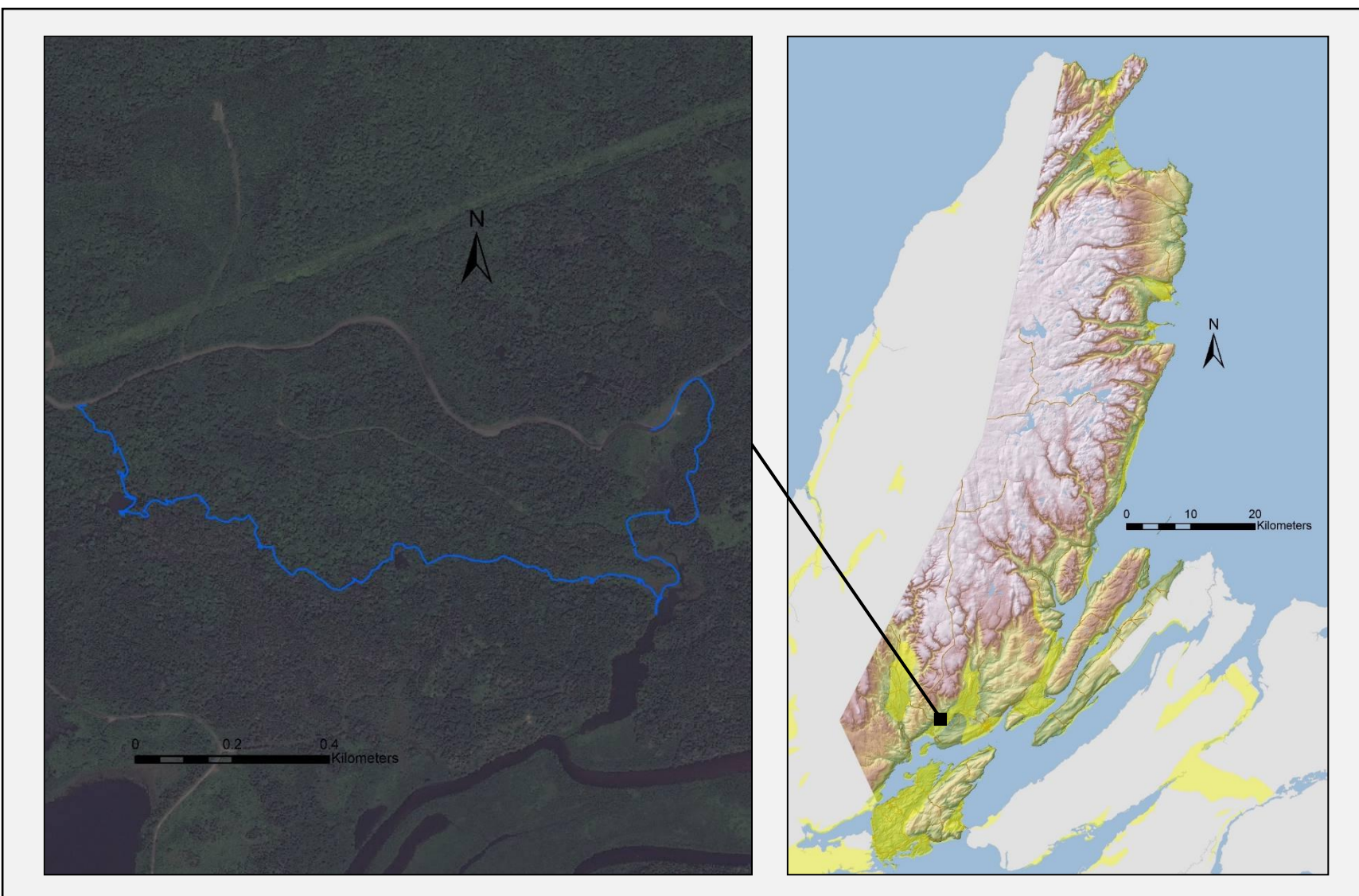


Figure 28. Survey coverage at Hunters Mountain (site #26), Victoria County, NS. Blue line represents track file logged by GPS unit. Survey carried out on August 27th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#26. Hunters Mountain (clockwise from top left)

1 – Highly eroded outcrop of friable gypsum in area of very pronounced karst with deep abrupt trench-like formations. 2 – Nutrient-rich open alkaline fen and Black Spruce / Red Maple swamp. 3 – Long-Stalked Yellow Sedge (*Carex viridula* var. *elator*, S1, May Be At Risk) in rich alkaline fen. 4 – Black Ash (*Fraxinus nigra*, S1S2, At Risk), occurring in a seepage swamp along with Red Maple, Balsam Fir and Black Cherry. 5 – Mature Sugar Maple / Red Maple / Yellow Birch forest in area of fairly pronounced karst topography.

#27. MacRae Brook

Observer(s): Mazerolle, D.M.

Survey date: August 27th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Carex tuckermanii</i>	Tuckerman's Sedge	S2	Sensitive	2
<i>Agrimonia gryposepala</i>	Tall Hairy Groovebur	S3	Secure	1
<i>Ranunculus gmelinii</i>	Small Yellow Water-Crowfoot	S3	Secure	2

Site Summary

We devoted a half a day to the survey of the MacRae Brook area, situated west of Forks Baddeck in the upper Baddeck River valley. The entire surveyed area is karstic to some extent, with regions of moderate karst topography linked by regions of very shallow sinkholes and gently rolling terrain. The site contains numerous sinkhole ponds reaching diameters of over 150 m, many of which collect water from springs and groundwater seepage and form the headwaters of small tributaries of MacRae Brook. The wide gently-sloped sinkholes observed at the site support various pond, marsh, bog and fen communities and experience significant seasonal water level fluctuations, collectively representing significant vernal pool habitat. The area bounded by MacRae Brook to the south and a small logging road to the north contains large abrupt-sided sinkholes scattered in otherwise fairly flat terrain. These features, some of which have mostly unvegetated slopes of loose soil and till and contain an abundance of coarse woody debris, may represent sites of recent collapse or further subsidence. Small gypsum and limestone outcrops were also observed in a few sinkholes in this section of the site. Based on the presence of sinkhole ponds visible on aerial photography, the MacRae Brook karst occurrence apparently extends further northwest past the area surveyed to the foot of the east-facing slopes of Crowdis Mountain.

Mature and mostly intact forest of Sugar Maple (*Acer saccharum*) / Red Maple (*Acer rubrum*) / Yellow Birch (*Betula alleghaniensis*) / Balsam Fir (*Abies balsamea*) is prevalent south of MacRae Brook. North of the brook, a few small stands of mature Red Maple / Yellow Birch / Evergreen Wood Fern (*Dryopteris intermedia*) / Wild Sarsaparilla (*Aralia nudicaulis*) forest are scattered within a matrix of young- to intermediate-aged shade-intolerant hardwoods and young regenerating Balsam Fir. At one location, the narrow bottom of the brook valley widens sufficiently to include pockets of moderately rich floodplain forest. A fairly extensive occurrence of Black Spruce (*Picea mariana*) / Red Maple / Cinnamon Fern (*Osmunda cinnamomea*) swamp was also observed at the south end of the surveyed area.

The most notable find at this site was a small population of Tuckerman's Sedge (*Carex tuckermanii*, S2, Sensitive) in a marshy sinkhole meadow of Sensitive Fern (*Onoclea sensibilis*) and Cottongrass Bulrush (*Scirpus cyperinus*). This species had never before been documented in Cape Breton.

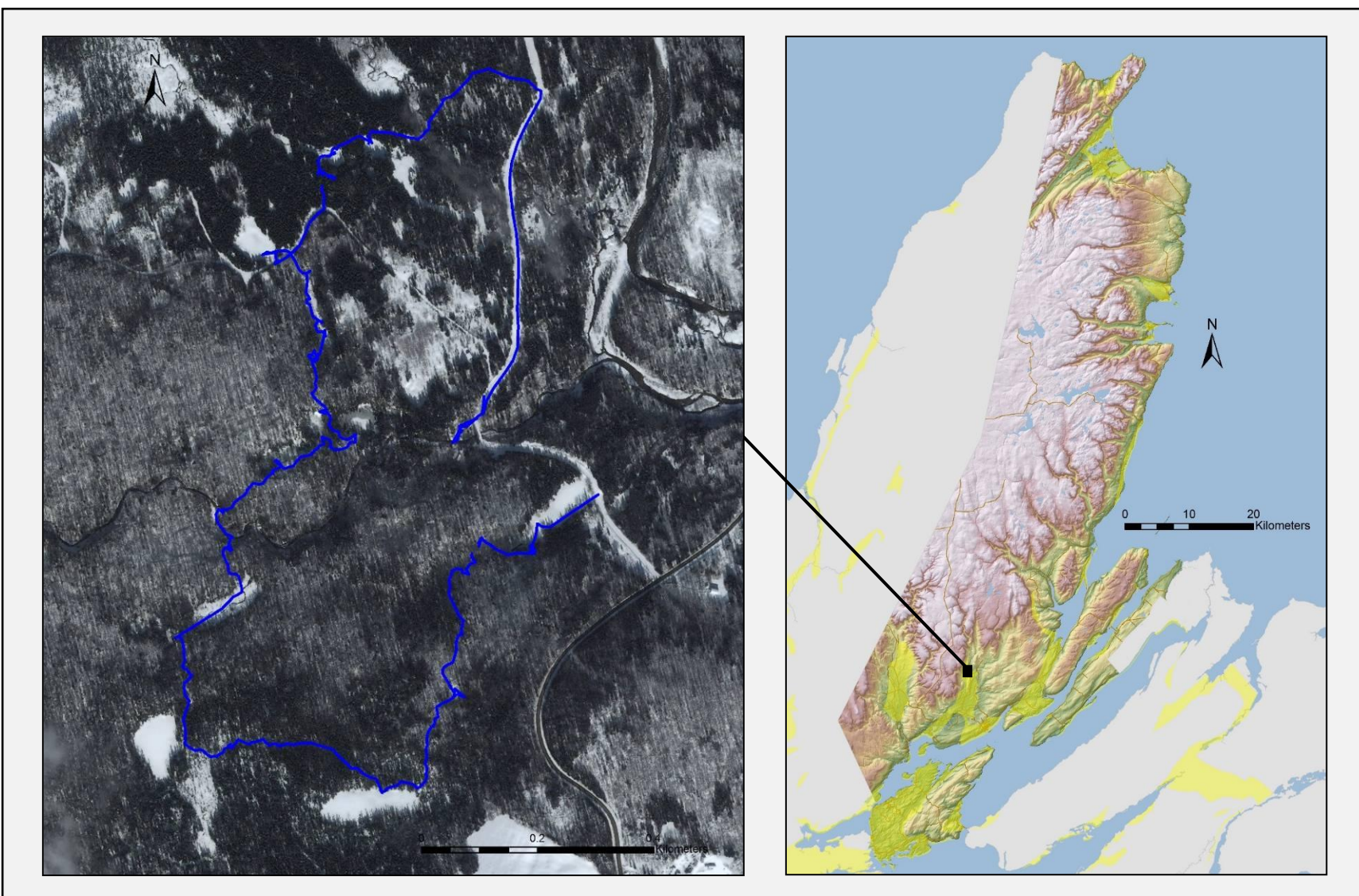


Figure 29. Survey coverage at MacRae Brook (site #27), Victoria County, NS. Blue line represents track file logged by GPS unit. Survey carried out on August 27th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from ESRI World Imagery basemap (accessed in winter 2015).



#27. MacRae Brook (clockwise from top left)

1 – Sinkhole basin pond and wetland showing significant late-summer draw-down. Several vernal pools were found in this area. 2 – Mature Red Maple / Sugar Maple / Yellow Birch / Balsam Fir forest in area of gentle karst topography. 3 – Limestone and gypsum outcrop along slow-flowing brook emanating from bottom of sinkhole. 4 – Tuckerman's Sedge (*Carex tuckermanii*, S2, Sensitive) in sinkhole meadow. This species had not previously been reported in Cape Breton. 5 – Large sinkhole with signs of recent expansion and possible further subsidence (mostly unvegetated slopes of loose soil and till, abundance of coarse woody debris in pond – including rooted trees).

#28. Beinn Bhreagh

Observer(s): Mazerolle, D.M.; Belliveau, A.G.; Nussey, P.

Survey date: September 17th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Shepherdia canadensis</i>	Soapberry	S2S3	Sensitive	20
<i>Stuckenia filiformis</i>	Slender Pondweed	S2S3	Sensitive	2
<i>Agrimonia gryposepala</i>	Tall Hairy Groovebur	S3	Secure	1
<i>Carex eburnea</i>	Ebony Sedge	S3	Sensitive	1
<i>Equisetum variegatum</i>	Variegated Horsetail	S3	Secure	2
<i>Packera paupercula</i>	Balsam Groundsel	S3	Secure	7
<i>Teucrium canadense</i>	American Germander	S3	Sensitive	3
<i>Asclepias incarnata</i> ssp. <i>pulchra</i>	Swamp Milkweed	S3?	Undetermined	1
<i>Carex tribuloides</i>	Blunt Broom Sedge	S3?	Secure	1
<i>Cystopteris bulbifera</i>	Bulblet Fern	S3S4	Secure	4
<i>Equisetum scirpoides</i>	Dwarf Scouring Rush	S3S4	Secure	1
<i>Myriophyllum sibiricum</i>	Common Water-Milfoil	S3S4	Secure	3
<i>Galium trifidum</i> ssp. <i>halophilum</i>	Saline Three-Petaled Bedstraw	SNR	Secure	1

Site Summary

This site represents the southwestern end of the extensive and dramatic Plaister Mines - Beinn Bhreagh karst occurrence. Sinkholes and gypsum outcrops are found throughout the eastern half of the surveyed area but are restricted to the coast in the western half. The site's karstic portion is mainly characterized by a series of alkaline and slightly brackish coastal sinkhole ponds sheltered by cobble, gravel and sand bars. The largest of these, MacKillops Pond and Poker Dans Pond, are mostly encircled by areas of pronounced sinkhole, pit and ridge topography. Numerous outcrops occur along the northern and eastern shores of MacKillops Pond, on the steep slopes of a highly karstic peninsula. The southwestern end of Poker Dans Pond contains a striking 50 m by 75 m exposed gypsum island that stands roughly 15 m-tall with cliff walls along most of its periphery. Outcrops observed along the shore of Great Bras D'Or Channel feature a mix of gypsum and Horton Group siltstone.

Most intact late-successional karst forest at the site is composed of Red Maple (*Acer rubrum*), Sugar Maple (*Acer saccharum*), Yellow Birch (*Betula alleghaniensis*) and Balsam Fir (*Abies balsamea*), with scattered stands of old Eastern Hemlock (*Tsuga canadensis*). A fairly small occurrence of mature American Beech (*Fagus grandifolia*) karst forest was also observed at the northeast end of Poker Dans Pond. Based on fieldwork carried out in gypsum lands in 2012 (Blaney & Mazerolle 2012) and 2014, this karst forest community type appears to be quite uncommon. The non-karstic south-facing slope of Beinn Bhreagh largely consists of mature Sugar Maple / Red Maple / Yellow Birch forest, which grades into narrow bands of old growth pure Eastern Hemlock on the lower slope at the upper margin of karst terrain.

Sparsely vegetated gypsum outcrops, gypsum-influenced till slopes and alkaline ponds found at this site are floristically significant, supporting a number of provincially rare species. Larger coastal sinkhole ponds had a particularly wide range of wetland and shoreline communities.

The northeastern portion of the site and the area between MacKillops and Poker Dans ponds are heavily disturbed due to residential / cottage development, historical wood harvesting and historical agricultural activity. Several areas were quite weedy and we noted four moderately invasive species: Common Hawkweed (*Hieracium lachenalii*), Japanese Barberry (*Berberis thunbergii*), Rugosa Rose (*Rosa rugosa*) and Forest Woodrush (*Luzula luzuloides*).

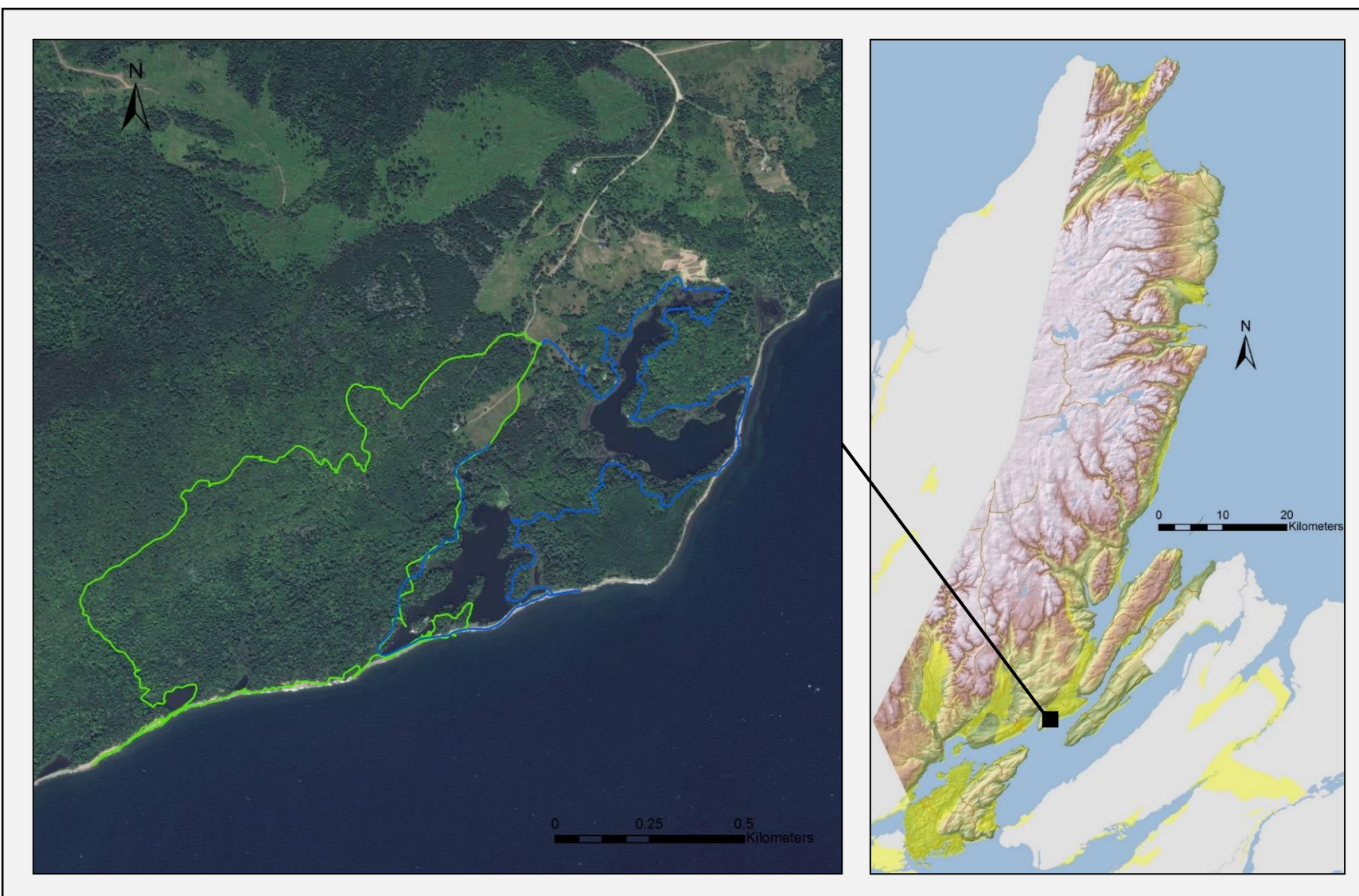


Figure 30. Survey coverage at Beinn Bhreagh (site #28), Victoria County, NS. Blue line represents track file logged by GPS unit. Survey carried out on September 17th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#28. Beinn Bhreagh (clockwise from top left)

1 – Old growth Eastern Hemlock forest at the edge of karst topography. 2 – Red Maple / Balsam Fir / White Spruce forest on exposed gypsum karst. 3 – Siltstone outcrop near Poker Dans Pond, containing fossilized bivalves. 4 – Horton Group till and scree slope supporting dense patches of Variegated Horsetail (*Equisetum variegatum*, S3, Secure). 5 – Soapberry (*Shepherdia canadensis*, S2S3, Sensitive) along top of gypsum cliff at MacKillops Pond. 6 – Large steep-sided gypsum formation at south end of Poker Dans Pond. 7 – Shore of Great Bras d'Or west of Poker Dans Pond, with scattered gypsum outcrops.

#29. Plaister Mines

Observer(s): Mazerolle, D.M.

Survey date: August 29th 2014

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Parnassia palustris</i> var. <i>parviflora</i>	Marsh Grass-of-Parnassus	S1S2	May Be At Risk	1
<i>Cypripedium parviflorum</i>	Small Yellow Lady's-Slipper	S2S3	Sensitive	2
<i>Shepherdia canadensis</i>	Soapberry	S2S3	Sensitive	6
<i>Carex eburnea</i>	Ebony Sedge	S3	Sensitive	16
<i>Erigeron hyssopifolius</i>	Hyssop-leaved Fleabane	S3	Sensitive	4
<i>Goodyera repens</i>	Dwarf Rattlesnake-Plantain	S3	Sensitive	2
<i>Packera paupercula</i>	Balsam Groundsel	S3	Secure	7
<i>Cystopteris bulbifera</i>	Bulblet Fern	S3S4	Secure	23
<i>Fragaria vesca</i> ssp. <i>americana</i>	Woodland Strawberry	S3S4	Secure	5
<i>Platanthera psycodes</i> / <i>grandiflora</i>	purple-flowered orchis sp.	-	-	1

Site Summary

This surveyed area extends 3.6 km from MacAulays Hill to Bevis Point, just south of the Big Harbour site surveyed in 2012 (Blaney & Mazerolle 2012). The entire area is karstic to varying degrees. Terrain in the area's northwest end is relatively subdued with scattered wetland sinkhole ponds, and the remainder features heavy karst terrain of pronounced sinkholes, pits, ridges and outcrops. Intermittent outcrop slopes and cliffs were found over a kilometer along the steep south shore of Big Harbour. The Plaister Mines area includes one of the largest gypsum cliffs in Nova Scotia, which extends over roughly 450 m on the north side of Starks Pond and reaches heights estimated at roughly 40 m. Extensive slopes of accumulated gypsum talus and scree were observed at the base of this imposing west-facing wall. At the eastern end of the surveyed area, a zone of relatively flat terrain is characterized by very narrow (1-2 m diameter) sheer vertical wells reaching depths of 10 to 15 m. These types of karst features, which sometimes lie hidden under coarse woody debris, are noteworthy both for their rarity and for the safety hazard they represent. Very large sinkholes (to ~40 m diameter) containing sizeable outcrops and small caves were also seen just south of Bevis Point.

Most of the northern and eastern portion of the peninsula bounded by Big Harbour and Great Bras d'Or is untouched by major past or present anthropogenic disturbance. This area is largely dominated by mature to old karst forest of Sugar Maple (*Acer saccharum*), Yellow Birch (*Betula alleghaniensis*), Eastern Hemlock (*Tsuga canadensis*), Eastern White Pine (*Pinus strobus*) and White Spruce (*Picea glauca*), with stands of old growth climax forest commonly scattered throughout. The low-lying areas near the junction of Old Big Harbour Road and Plaister Mines Road include fairly extensive stands of Black Spruce (*Picea mariana*) / Tamarack (*Larix laricina*) / Cinnamon Fern (*Osmunda cinnamomea*) / Sheep Laurel (*Kalmia angustifolia*) swamp, as well as circumneutral to slightly calcareous Bluejoint Reed Grass (*Calamagrostis canadensis*) / Water Sedge (*Carex aquatilis*) / Broad-Leaf Cattail (*Typha latifolia*) riparian meadows and fens.

Marsh Grass-of-Parnassus (*Parnassia palustris* var. *parviflora*, S1S2, Sensitive), an extremely rare species not documented in Nova Scotia since 1976, was at one location on a seepy gypsum cliff. Shrubby areas of dry exposed gypsum, often dominated by Roundleaf Dogwood (*Cornus rugosa*), support large populations of Soapberry (*Shepherdia canadensis*, S2S3, Sensitive), Ebony Sedge (*Carex eburnea*, S3, Sensitive), Hyssop-leaved Fleabane (*Erigeron hyssopifolius*, S3, Sensitive), Balsam Groundsel (*Packera paupercula*, S3, Secure) and Bulblet Fern (*Cystopteris bulbifera*, S3S4, Secure) as well as small occurrences of Small Yellow Lady's-Slipper (*Cypripedium parviflorum*, S2S3, Sensitive).

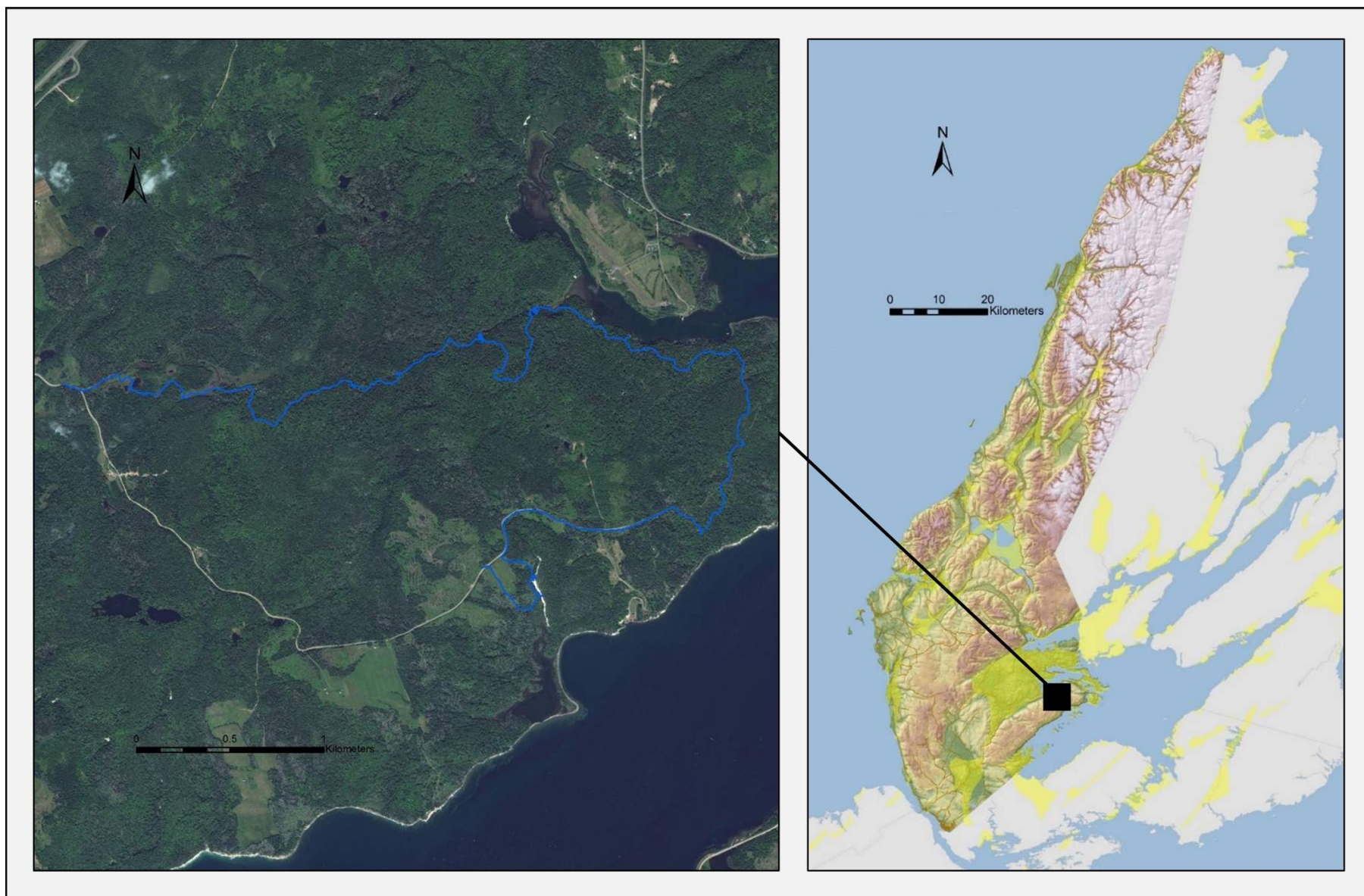


Figure 31. Survey coverage at Plaister Mines (site #29), Victoria County, NS. Blue line represents track file logged by GPS unit. Survey carried out on August 29th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#29. Plaister Mines (clockwise from top left)

1 – Extensive ~40 m-tall gypsum cliff just north of MacDonald Point. 2 and 3 – Marsh Grass-of-Parnassus (*Parnassia palustris* var. *parviflora*, S1S2, May Be At Risk) on partially-shaded slightly seepy gypsum cliff. 4 – Fairly old Sugar Maple / Balsam Fir / Eastern Hemlock karst forest. 5 – Soapberry (*Shepherdia canadensis*, S2S3, Sensitive) in shrubby exposed gypsum karst forest. 6 – Cave opening in gypsum and limestone outcrop at bottom of large sinkhole.

#30. South Haven

Observer(s): Mazerolle, D.M.

Survey date: August 28th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Ranunculus gmelinii</i>	Small Yellow Water-Crowfoot	S3	Secure	2
<i>Cystopteris bulbifera</i>	Bulblet Fern	S3S4	Secure	11
<i>Chenopodium berlandieri</i> var. <i>macrocalycium</i>	Large-calyx Goosefoot	SNR	Undetermined	1
<i>Galium trifidum</i> ssp. <i>halophilum</i>	Saline Three-Petaled Bedstraw	SNR	Secure	1
<i>Platanthera psycodes</i> / <i>grandiflora</i>	purple-flowered orchis sp.	-	-	2

Site Summary

The entire 3.5 km length of this surveyed area, extending from the tip of MacKillops Point southward towards Glen Tosh along the west side of Highway 105, features moderate to pronounced karst topography. This karst occurrence forms a nearly continuous band up to several hundred meters wide running along the west shore of South Gut (north of the Cabot Trail) and along the valley of an unnamed brook flowing southwest to northeast (south of the Cabot Trail). The west shore of South Gut includes an extensive shoreline gypsum outcrop cliff that spans roughly 500 m and is overtopped by a zone of abrupt sinkholes and shrubby exposed gypsum pit karst. MacKillops Pond and Black Cove, two large sharply indented tidal bays, are also prominent features along this shore. Both are at least partially bounded by heavy karst and may be the result of sinkhole subsidence. The pronounced terrain along the shore of South Gut grades inland into zones of less clearly defined sinkholes.

South of the Cabot Trail, nearly continuous heavy karst topography of large uniform sinkholes (to 40 m diameter), outcrops and very pronounced pits and ridges occurred over 2 km, mainly along the south side of a small unnamed brook. One area of abundant exposed gypsum in this section of the site contained several small caves and impressive column-like formations. Based on the numerous sinkhole ponds and rugged terrain evident on aerial photography, karst topography likely extends, at least intermittently, for several kilometers further southward to Glen Tosh.

Forest composed of Red Maple (*Acer rubrum*), White Spruce (*Picea glauca*), Yellow Birch (*Betula alleghaniensis*) and Balsam Fir (*Abies balsamea*) is most prevalent throughout the surveyed area, with White Spruce being a major component of most forest communities observed. Heavy karst areas at the south end of the site contain intact mature Sugar Maple (*Acer saccharum*) / Yellow Birch communities, including stands of old growth forest. Forest in the site's north half is generally younger, weedier and moderately disturbed through cottage development and wood harvesting. Recent blowdowns have also affected sizeable portions of mature karst forest in this area. Other localized habitats and plant communities noted include Black Spruce (*Picea mariana*) swamp, Red Maple / Speckled Alder (*Alnus incana* ssp. *rugosa*) swamp, graminoid-dominated sinkhole basin meadows and sinkhole ponds.

Though not exceptional in terms of provincially rare species, the South Haven site is significant for its extensive area of relatively intact karst landscape.

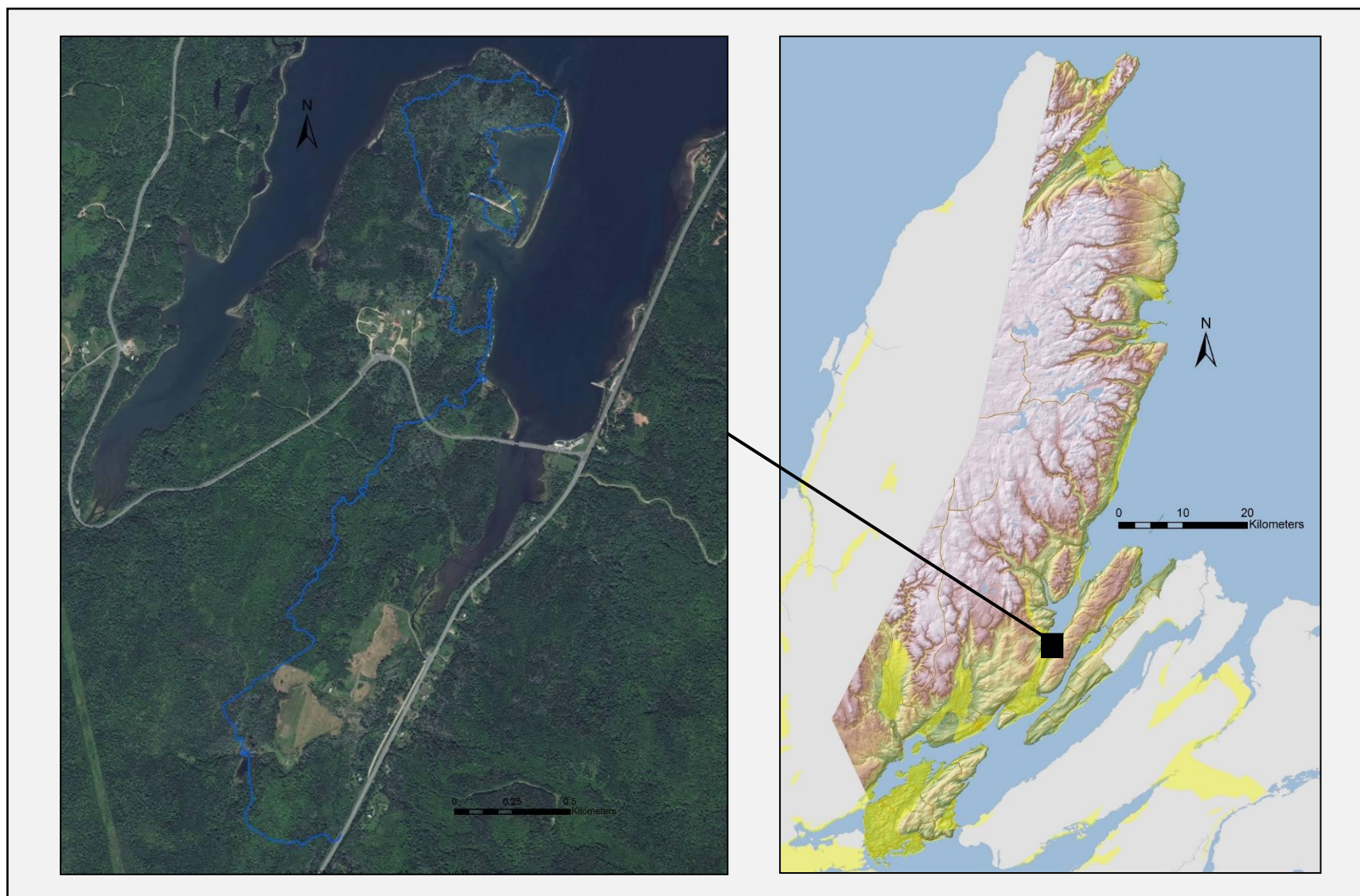


Figure 32. Survey coverage at South Haven (site #30), Victoria County, NS. Blue line represents track file logged by GPS unit. Survey carried out on August 28th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#30. South Haven (clockwise from top left)

1 – Extensive gypsum outcrop along western shore of South Gut. 2 – Mossy gypsum outcrops in area of pronounced pit karst, supporting a population of Bulblet Fern (*Cystopteris bulbifera*, S3S4, Secure). 3 – Old growth Yellow Birch / Sugar Maple karst forest, with secondary canopy of Balsam Fir. 4 – Sheltered brackish tidal marsh in deeply indented cove.

#31. St. Anns

Observer(s): Mazerolle, D.M.

Survey date: August 26th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Eleocharis erythropoda</i>	Bald Spikerush	S1	May Be At Risk	3
<i>Agrimonia gryposepala</i>	Tall Hairy Groovebur	S3	Secure	1
<i>Teucrium canadense</i>	American Germander	S3	Sensitive	2
<i>Chenopodium berlandieri</i> var. <i>macrocalycium</i>	Large-calyx Goosefoot	SNR	Undetermined	1

Site Summary

Survey coverage at this site included areas on both sides of the Cabot Trail, between Mill Cove Brook and St. Anns Provincial Park along the west side of North Gut. Extensive moderate to heavy sinkhole topography was observed on the east side of the Cabot Trail; this area includes several large elongate sinkhole ponds, numerous occurrences of exposed gypsum and a small area of pronounced shrubby pit karst. Medium-sized and large gypsum outcrops were also observed along the shore of North Gut. One of these shoreline outcrops, sculpted by wave and ice erosion, forms an island that is connected to land by a cobble berm and partially shelters a coastal pond. The northern section of the surveyed area contains an isolated occurrence of heavy karst with abrupt sinkholes and outcrops (including a 15 m-high sheer sinkhole outcrop wall). This small area of pronounced topography, along with several areas of potentially karstic rolling terrain and probable sinkholes, was near a large sinkhole pond visible from aerial photography.

Late-successional stands of mature Yellow Birch (*Betula alleghaniensis*) / Sugar Maple (*Acer saccharum*) / Evergreen Wood Fern (*Dryopteris intermedia*) with minor components of Balsam Fir (*Abies balsamea*) and Red Maple (*Acer rubrum*) are prevalent in heavily karstic areas. Although these stands seem to be fairly uniform in age (possibly evidence of widespread historic disturbance), a few scattered very old trees were also noted. Except for localized disturbance related to cottages, road construction and wood harvesting, much of the sites' standing karst forest is intact. Areas of more gentle terrain, however, are generally occupied by younger mid-successional mixedwood forest. Large sinkholes support graminoid and forb marsh communities as well as Black Spruce (*Picea mariana*) / Cinnamon Fern (*Osmunda cinnamomea*) basin swamp and pockets of moderately rich alkaline fen. Coastal habitats mainly consist of sparsely vegetated cobble and sand shores, with scattered occurrences of tidal bay marsh, tidal basin marsh and brackish ponds.

Three small colonies of the extremely rare Bald Spikerush (*Eleocharis erythropoda*, S1, May Be At Risk) were found at the edge of sparsely treed alkaline Black Spruce (*Picea mariana*) fen along the shore of a large sinkhole pond north of Ross Cove. This represents only the second documented population of this species since it was first reported from the province in the early 1900s.

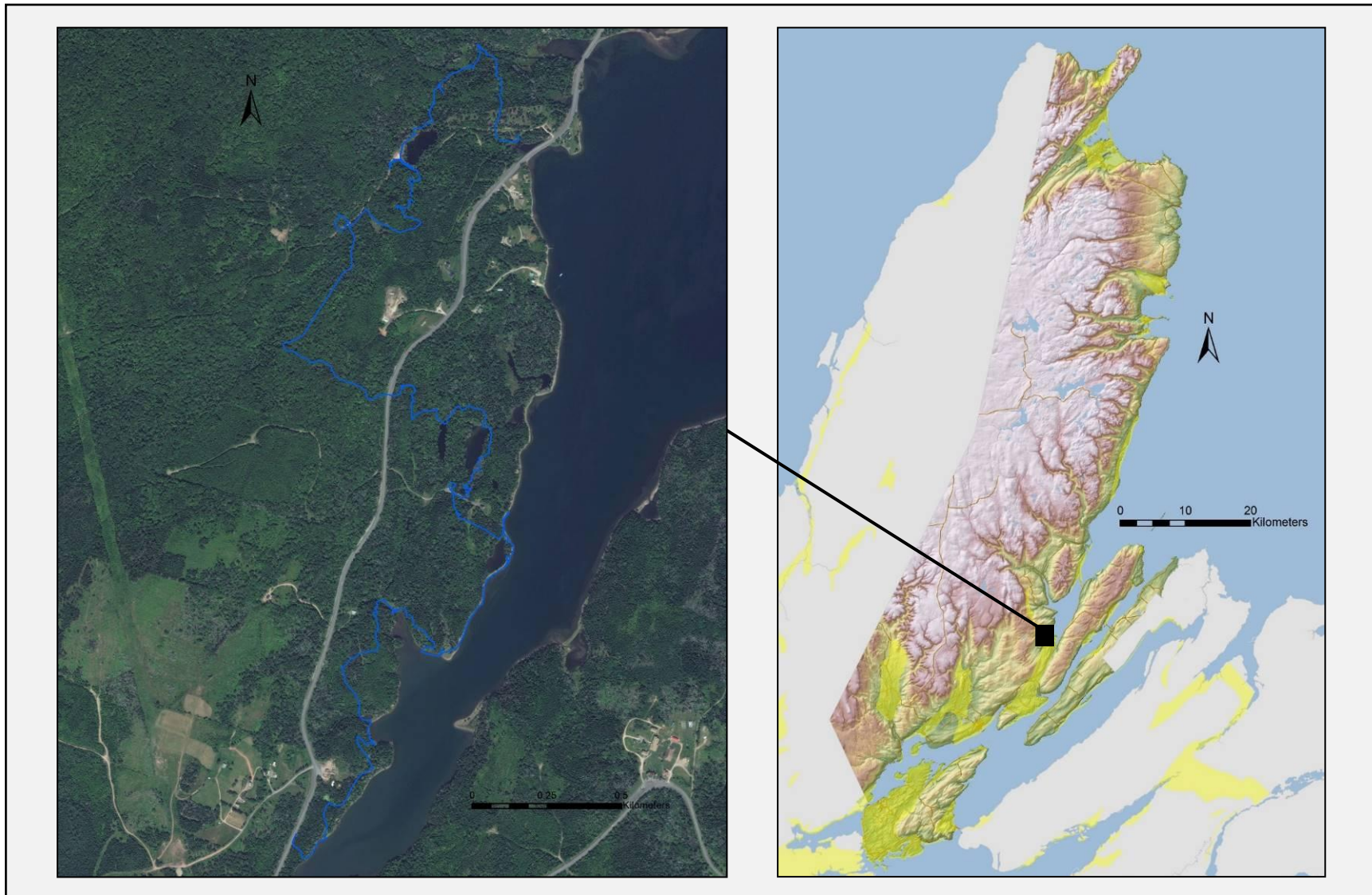


Figure 33. Survey coverage at St. Anns (site #31), Victoria County, NS. Blue line represents track file logged by GPS unit. Survey carried out on August 26th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#31. St. Anns (clockwise from top left)

1 – Fairly calcareous Broad-Leaf Cattail (*Typha latifolia*) and Black Spruce fen at margin of large sinkhole pond, with gypsum outcrop visible in the distance. 2 – Bald Spikerush (*Eleocharis erythropoda*, S1, May Be At Risk) in calcareous fen along shore of large sinkhole pond. 3 – Large gypsum outcrop along western shore of North Gut. 4 – American Germander (*Teucrium canadense*, S3, Sensitive) on cobble bar along western shore of North Gut. 5 – Old Growth Sugar Maple / Yellow Birch / Balsam Fir karst forest.

#32. Middle Aspy River

Observer(s): Belliveau, A.G.

Survey date: September 18th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Fraxinus nigra</i>	Black Ash	S1S2	At Risk	1
<i>Shepherdia canadensis</i>	Soapberry	S2S3	Sensitive	22
<i>Agrimonia gryposepala</i>	Tall Hairy Groovebur	S3	Secure	1
<i>Carex eburnea</i>	Ebony Sedge	S3	Sensitive	8
<i>Erigeron hyssopifolius</i>	Hyssop-leaved Fleabane	S3	Sensitive	17
<i>Packera paupercula</i>	Balsam Groundsel	S3	Secure	2
<i>Polypodium appalachianum</i>	Appalachian Polypody	S3?	Undetermined	1
<i>Equisetum hyemale</i> var. <i>affine</i>	Common Scouring-Rush	S3S4	Secure	3

Site Summary

The Middle Aspy River is approximately 20 km long and flows northeast from the Cape Breton highlands to Aspy Bay. In the river section between Sunrise and Dingwall, the river valley is deep and meandering, with occasional exposed cliff faces. The river is mostly shallow (less than a meter deep) in the summer, except in a few places where it splits and trickles through an expansive bed of cobbly rubble. Large floodplains – sometimes with several terraces along the adjacent slope – are well-developed along the side opposite the steeper river valley slope in each major river bend. Just over 1km upstream from the Cabot Trail, Windsor Group gypsum cliffs (~5m to ~25m tall) and very pronounced sinkhole topography are apparent along and parallel to the river to the south. Similar to other areas of gypsum cliffs, the sinkholes are wider, less pronounced, and more till-covered further away from the cliffs. Several very deep vertical caves and one horizontal cave were also noted from this karst area.

The wooded slopes along the river were dominated by shade-tolerant hardwood communities of Sugar Maple (*Acer saccharum*), Yellow Birch (*Betula alleghaniensis*), and White Ash (*Fraxinus americana*). Nearly all the forests along the steeper slopes and floodplain away from road access were old growth in nature. One floodplain, accessible by an old woods road, was an old field forest dominated by White Spruce. Floodplain forest understories were mainly composed of woodferns, Beaked Hazel (*Corylus cornuta*), avens (*Geum* spp.), Ostrich Fern (*Matteuccia struthiopteris*), occasional Male Fern (*Dryopteris filix-mas*), Coltsfoot (*Tussilago farfara*) and other typical floodplain ruderals. Rare species in the floodplains were: Black Ash (*Fraxinus nigra*, S1S2, At Risk), Tall Hairy Groovebur (*Agrimonia gryposepala*, S3, Secure) and Common Scouring-Rush (*Equisetum hyemale* var. *affine*, S3S4, Secure). The gypsum cliffs and nearby exposed gypsum edges of sinkholes support the gypsum-associates Balsam Groundsel (*Packera paupercula*, S3, Secure), Ebony Sedge (*Carex eburnea*, S3, Sensitive), Soapberry (*Shepherdia canadensis*, S2S3, Sensitive), Hyssop-leaved Fleabane (*Erigeron hyssopifolius*, S3, Sensitive), and Roundleaf Dogwood (*Cornus rugosa*). Forests atop the cliffs and in nearby pronounced sinkholes are generally dominated by Balsam Fir (*Abies balsamea*) and Paper Birch (*Betula papyrifera* var. *papyrifera*), while further away from cliffs the forests are dominated by Sugar Maple, Red Maple (*Acer rubrum*), Yellow Birch, Striped Maple (*Acer pensylvanicum*) and Balsam Fir. One occurrence of Appalachian Polypody (*Polypodium appalachianum*, S3?, Underdetermined) was noted in an area of particularly pronounced sinkholes with large amounts of exposed gypsum.

Several disturbances were observed, including the old field forest, several small old woods roads, and an old gypsum quarry near the Cabot Trail.

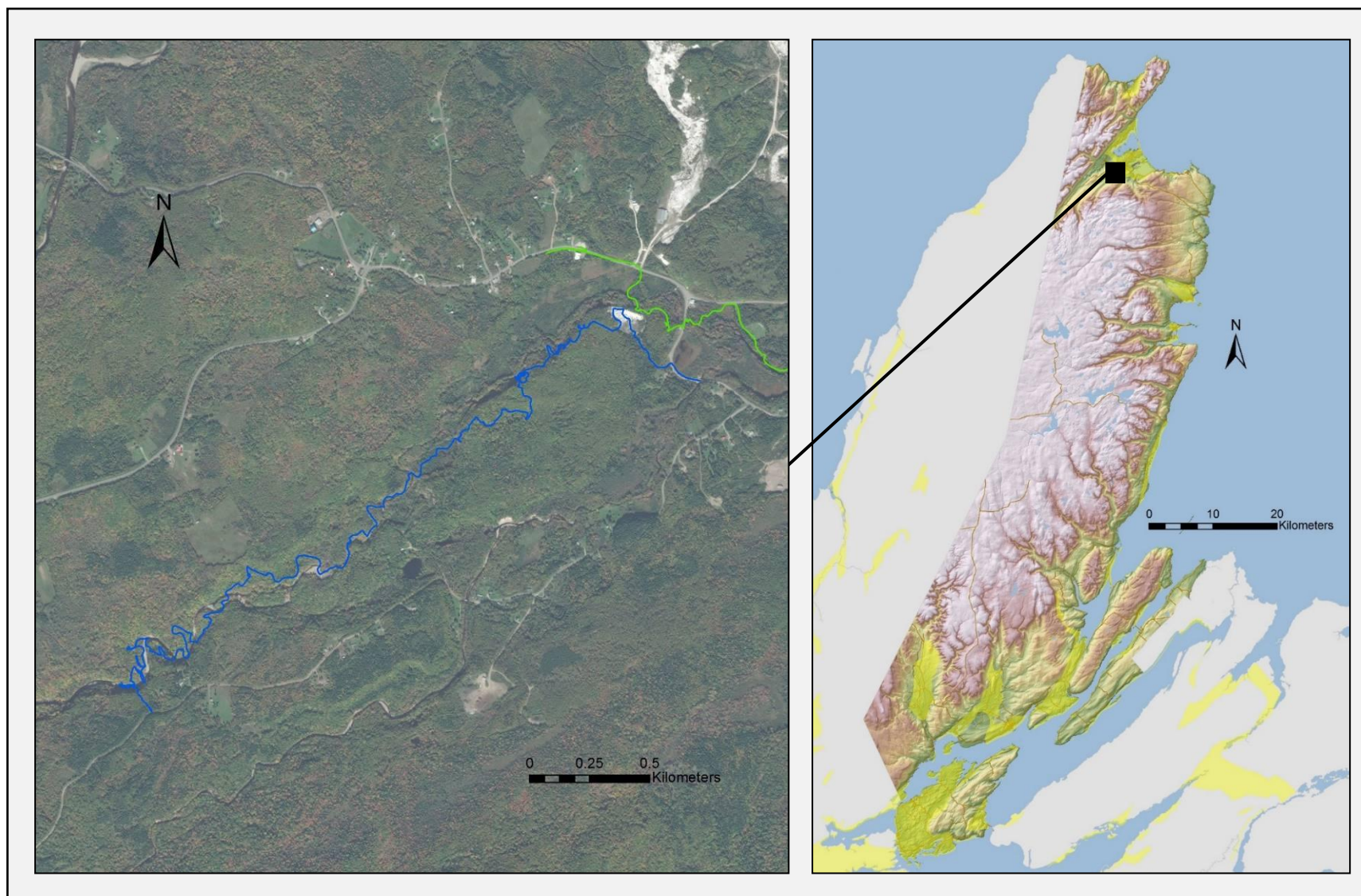
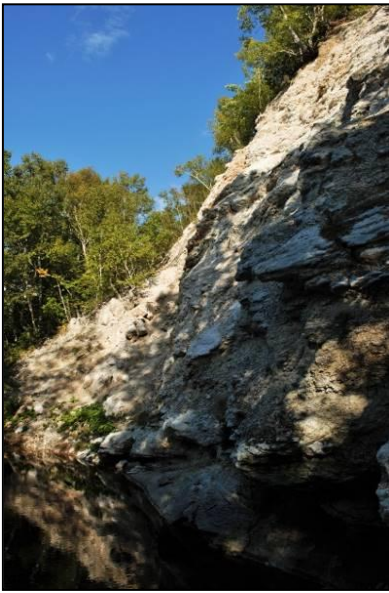


Figure 34. Survey coverage along the Middle Aspy River (site #32), Victoria County, NS. Blue line represents track file logged by A.G. Belliveau's GPS unit; green line represents track file logged by C.S. Blaney's GPS unit (from site #33 survey coverage). Survey carried out on September 18th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#32. Middle Aspy River (clockwise from top left)

1 – Tall gypsum cliffs along south side of Middle Aspy River, supporting Balsam Groundsel (*Packera paupercula*, S3, Secure), Ebony Sedge (*Carex eburnea*, S3, Sensitive), Soapberry (*Shepherdia canadensis*, S2S3, Sensitive) and Hyssop-leaved Fleabane (*Erigeron hyssopifolius*, S3, Sensitive). 2 – Dense patch of Common Scouring Rush (*Equisetum hyemale* var. *affine*, S3S4, Secure) among old shade-tolerant trees in the floodplain of the Middle Aspy River. 3 – View of the Middle Aspy River, with steep slope and abrupt shore on right and well-developed floodplain on left. 4 – Pronounced gypsum sinkhole with abundance of exposed gypsum, and a deep (>5m) vertical cave below.

#33. Dingwall (North of Middle Harbour)

Observer(s): Blaney, C.S.

Survey date: September 18th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Carex vacillans</i>	Estuarine Sedge	S1S3	Undetermined	3
<i>Cypripedium parviflorum</i> var. <i>makasin</i>	Small Yellow Lady's-Slipper	S2	Sensitive	1
<i>Polystichum lonchitis</i>	Northern Holly-Fern	S2	Sensitive	2
<i>Shepherdia canadensis</i>	Soapberry	S2S3	Sensitive	18
<i>Carex eburnea</i>	Ebony Sedge	S3	Sensitive	4
<i>Equisetum variegatum</i>	Variegated Horsetail	S3	Secure	4
<i>Erigeron hyssopifolius</i>	Hyssop-leaved Fleabane	S3	Sensitive	5
<i>Packera paupercula</i>	Balsam Groundsel	S3	Secure	1
<i>Sparganium natans</i>	Small Bur-Reed	S3	Secure	1
<i>Carex cryptolepis</i>	Northeastern Sedge	S3?	Secure	1
<i>Equisetum hyemale</i> var. <i>affine</i>	Common Scouring-Rush	S3S4	Secure	1
<i>Equisetum scirpoides</i>	Dwarf Scouring Rush	S3S4	Secure	1

Site Summary

This site includes extensive estuarine wetland and some remnant gypsum karst forest within an area in which much of the original gypsum karst habitat has been removed by past mining.

The salinity of the inner part of Middle Harbour is strongly moderated by freshwater inflow from the Middle Aspy River and surrounding land. Only the outermost parts of the estuarine marsh had strongly halophytic species (Saltmarsh Cordgrass – *Spartina alternifolia*, Chaffy Sedge – *Carex paleacea*, Saltmarsh Bulrush – *Schoenoplectus maritimus*) dominant, and the extensive marshes were largely dominated by the brackish to freshwater species, Three-square Bulrush (*Schoenoplectus pungens*), Hardstem Bulrush (*Schoenoplectus acutus*), Broad-leaved Cattail (*Typha latifolia*), Baltic Rush (*Juncus balticus* var. *littoralis*), Tall Cordgrass (*Spartina pectinata*), and more locally Estuarine Sedge (*Carex vacillans*, S1S3 – Undetermined). Sweet Gale (*Myrica gale*) and a diversity of herbaceous species (including Canada Burnet – *Sanguisorba canadensis*, not usually in this habitat and restricted to Cape Breton in Nova Scotia) were abundant in more landward portions. These freshwater to slightly brackish wet meadow habitats over gypsum bedrock along the upper margins of the estuary are especially interesting and unusual for Nova Scotia. In areas near the abandoned gypsum mine directly south of Dingwall, extensive areas are dominated by Baltic Rush and Variegated Horsetail (*Equisetum variegatum*, S3 – Secure), sometimes in combination with Common Scouring-Rush (*Equisetum hyemale* var. *affine*, S3S4 – Secure) and their hybrid (*E. x mackaii*). These communities extend into the mined lands, where they have clearly developed after gypsum was removed down to a flat base just above sea level. Some of the horsetail-dominated wet meadow that appears to be of natural origin may actually be post-mining communities that have developed over a longer period than those in the obviously mined sites. The relatively barren old mine land includes large populations of several gypsum associated species – Ebony Sedge (*Carex eburnea*, S3 – Sensitive), Balsam Ragwort (*Packera paupercula*, S3 – Secure), Soapberry (*Shepherdia canadensis*, S3 – Sensitive) and Hyssop-leaved Fleabane (*Erigeron hyssopifolius*, S3 – Sensitive).

Forests on the site are mostly fragmented and generally relatively young, with large amounts of White Spruce, Balsam Fir, Red Maple, and White Birch and lesser amounts of Black Spruce, White Ash, Sugar Maple and other deciduous species. Severe gypsum sinkhole topography was well represented in forest directly south of Dingwall along the old quarry margins and between the second (western) old

gypsum mine south of the river and the Cabot Trail. The first of these locations supported two locations of Northern Holly Fern (*Polystichum lonchitis*, S2 – Sensitive, a rare species restricted in Nova Scotia to northern Cape Breton and not known on gypsum outside the Dingwall area).

The north margin of the Middle Aspy River has a slightly raised terrace that has allowed a very narrow band (generally 5 to 20 m) of rich hardwood floodplain forest to develop between the river and the lower wet meadow / rough hayfield habitats just northward. This terrace supports some indicator plants of calcareous soils but few significant species. The aggressively invasive exotic shrub honeysuckle *Lonicera x xylosteoides*, which was never previously documented for Nova Scotia, is established and clearly spreading in this area.

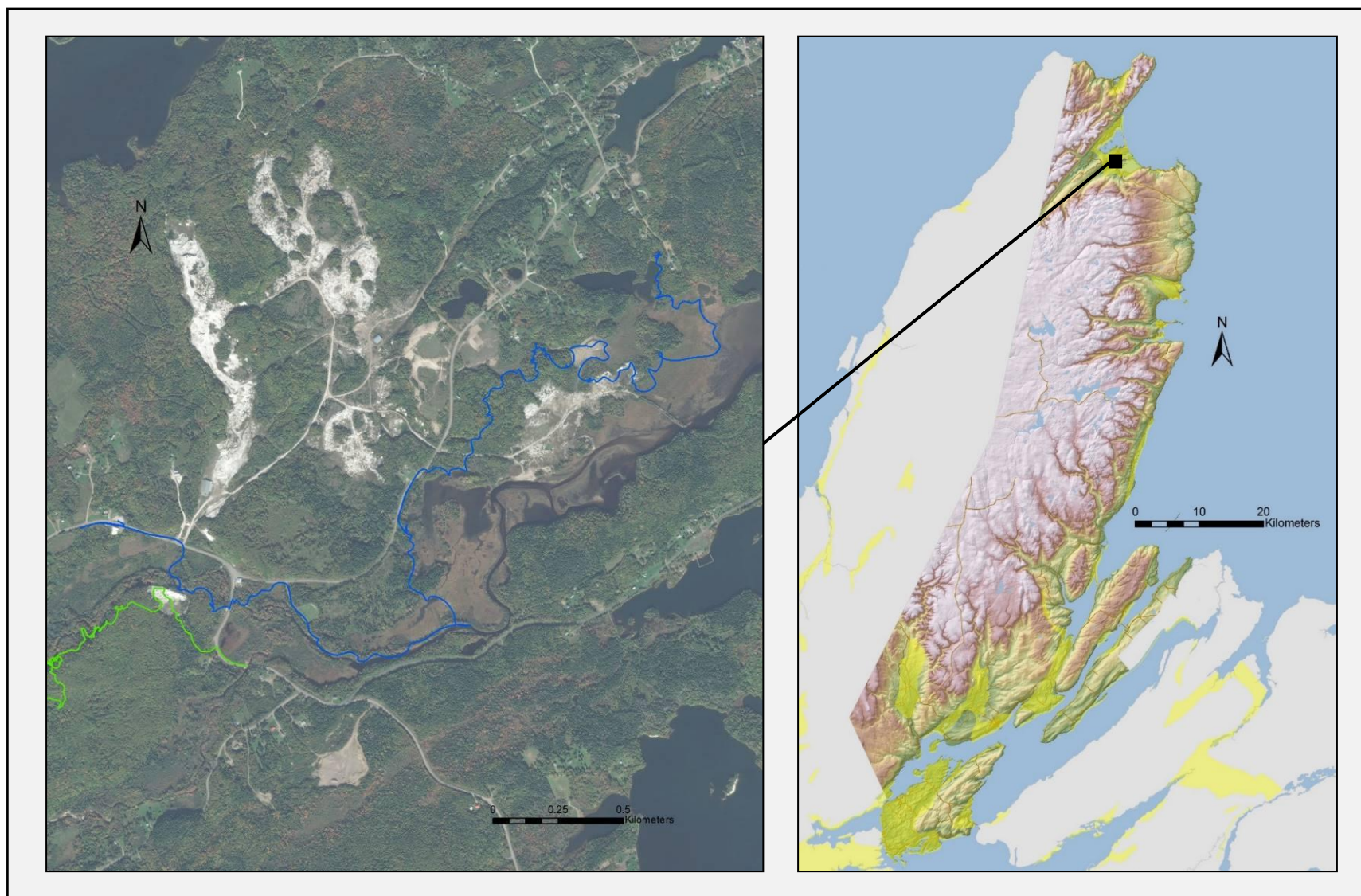


Figure 35. Survey coverage at Dingwall (north of Middle Harbour) (site #33), Victoria County, NS. Blue line represents track file logged by C.S. Blaney's GPS unit; green line represents track file logged by A.G. Belliveau's GPS unit (from site #32 survey coverage). Survey carried out on September 18th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#33. Dingwall (North of Middle Harbour) (clockwise from top left)

1. Fen-like, slightly brackish marsh at north margin of Middle Harbour, south of Dingwall; 2. Saltmarsh at margin of Middle Harbour, with gypsum cliffs on the south side of the harbour in the background. 3. Calcareous wet meadow of mostly native species, on flat gypsum bedrock in an abandoned gypsum quarry at Dingwall; 4. Gypsum cliffs at margin of abandoned quarry area; 5. Northern Holly Fern (*Polystichum lonchitis*, S2 – Sensitive) from gypsum karst orest at Dingwall. 6. Unusual calcareous wet meadow community at upper edge of saltmarsh on Middle Harbour south of Dingwall. The white flowers are Canada Burnet (*Sanguisorba canadensis*), which is essentially restricted in Nova Scotia to northern Cape Breton. This community may have developed after gypsum was mined down to just above sea level long ago.

#34. Dingwall (South of Middle Harbour)
Observer(s): Mazerolle, D.M.; Basquill, S.P.
Survey date: September 18th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Polystichum lonchitis</i>	Northern Holly-Fern	S2	Sensitive	3
<i>Shepherdia canadensis</i>	Soapberry	S2S3	Sensitive	29
<i>Carex eburnea</i>	Ebony Sedge	S3	Sensitive	24
<i>Erigeron hyssopifolius</i>	Hyssop-leaved Fleabane	S3	Sensitive	12
<i>Packera paupercula</i>	Balsam Groundsel	S3	Secure	14
<i>Cystopteris bulbifera</i>	Bulblet Fern	S3S4	Secure	9
<i>Fragaria vesca</i> ssp. <i>americana</i>	Woodland Strawberry	S3S4	Secure	1
<i>Rubus</i> cf. <i>pubescens</i> var. <i>scius</i>	Dwarf Raspberry	SNR	Undetermined	1

Site Summary

Survey effort at this site was focused on a heavily karstic peninsula separating Middle Harbour from South Harbour. This point of land contains numerous large gypsum exposures and features several deeply indented coves bounded by steep gypsum outcrop slopes and areas of very pronounced karst topography.

Among the most prominent features at this site is a 450 m by 300 m steeply-sloped peninsula of extreme gypsum outcrop karst, with continuous sinkholes, pits and ridges. Located at the western end of the surveyed area, this impressive formation is mainly bordered by sharp slopes of loose gravel-sized scree and almost exclusively consists of exposed very friable gypsum, with only a few small areas having a reasonably well-developed soil layer. Much of this formation is covered by a shrubby community of Ground Juniper (*Juniperus communis*), Creeping Juniper (*Juniperus horizontalis*), Roundleaf Dogwood (*Cornus rugosa*), Twinflower (*Linnaea borealis* ssp. *americana*), Northern Bush-Honeysuckle (*Diervilla lonicera*), Canada Buffalo-Berry (*Shepherdia canadensis*, S2S3, Sensitive), Hyssop-leaved Fleabane (*Erigeron hyssopifolius*, S3, Sensitive), Ebony Sedge (*Carex eburnea*, S3, Sensitive) and Balsam Groundsel (*Packera paupercula*, S3, Secure). Treed karst communities dominated by small but apparently quite mature Paper Birch (*Betula papyrifera* var. *papyrifera*), Red Maple (*Acer rubrum*), White Spruce (*Picea glauca*), Eastern White Pine (*Pinus strobus*) and Sugar Maple (*Acer saccharum*) also occupy a significant portion of this peninsula. Smaller examples of this type of extreme karst were seen at three other locations and contained similar communities.

Although a significant portion of the site has been disturbed by recreational development (campground, cottages), wood harvesting and historical agriculture (old fields now dominated by mature White Spruce), the area still contains late-successional forest of Sugar Maple / Yellow Birch (*Betula alleghaniensis*) / White Spruce / Striped Maple (*Acer pensylvanicum*) and mid-successional forest of Red Maple / Trembling Aspen (*Populus tremuloides*) / Paper Birch / White Spruce. Intact late-successional forest is, however, mainly restricted to steeper slopes and areas of moderate to heavy karst. Other community types observed included White Spruce / Balsam Fir coastal forest, dynamic low-profile coastal dune and tidal bay salt marsh.

We documented three small occurrences of Northern Holly-Fern (*Polystichum lonchitis*, S2, Sensitive) in the understory of mature karst forest on partially shaded gully and sinkhole slopes, and a small occurrence provisionally identified as a globally rare northeastern variety of Dwarf Red Raspberry (*Rubus pubescens* var. *scius*, G5T3?, SNR, Undetermined) in an area of pronounced exposed gypsum karst.

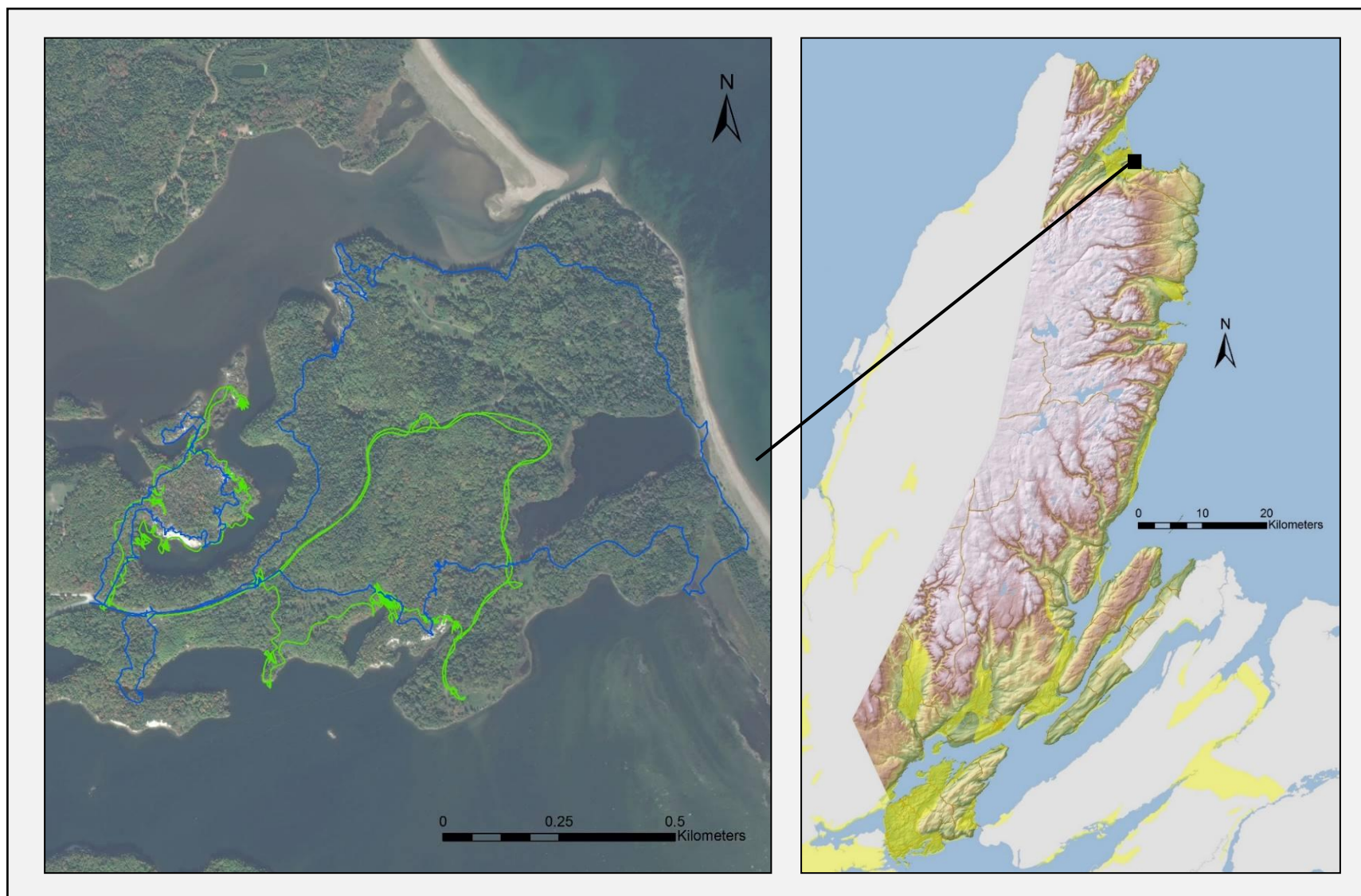


Figure 36. Survey coverage at Dingwall (south of Middle Harbour) (site #34), Victoria County, NS. Blue line represents track file logged by D.M. Mazerolle's GPS unit; green line represents S.P. Basquill's GPS unit. Survey carried out on September 18th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#34. Dingwall (south of Middle Harbour) (clockwise from top left)

1 – Peninsula of extremely pronounced exposed gypsum karst across deep cove. 2 – Extreme exposed gypsum karst area with a community of Ground Juniper (*Juniperus communis*), Creeping Juniper (*Juniperus horizontalis*), Roundleaf Dogwood (*Cornus rugosa*), White Spruce, Paper Birch, Balsam Groundsel (*Packera paupercula*, S3, Secure) and Hyssop-leaved Fleabane (*Erigeron hyssopifolius*, S3, Sensitive). 3 – Northern Holly-Fern (*Polystichum lonchitis*, S2, Sensitive), found on a shaded sinkhole slope in an area of pronounced gypsum karst. 4 – An occurrence of Dwarf Raspberry, tentatively identified as being of the globally rare variety *scius* (*Rubus pubescens* var. *scius*), found in an area of pronounced exposed gypsum karst. 5 – Extensive tidal bay brackish marsh at eastern end of surveyed area. 6 – Extensive low-profile coastal dune. A variety of dune, salt marsh and brackish marsh communities occur along this sandspit.

#35. Georges River

Observer(s): Belliveau, A.G.

Survey date: September 9th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Asplenium trichomanes-ramosum</i>	Green Spleenwort	S2	Sensitive	1
<i>Carex hystericina</i>	Porcupine Sedge	S2	May Be At Risk	1
<i>Agrimonia gryposepala</i>	Tall Hairy Groovebur	S3	Secure	2
<i>Sparganium natans</i>	Small Bur-Reed	S3	Secure	1
<i>Cystopteris bulbifera</i>	Bulblet Fern	S3S4	Secure	35
<i>Equisetum scirpoides</i>	Dwarf Scouring-Rush	S3S4	Secure	2
<i>Fragaria vesca</i> ssp. <i>americana</i>	Woodland Strawberry	S3S4	Secure	1

Site Summary

The Georges River cuts through gypsum and limestone between slopes of non-calcareous till, and several outcrops occur along the surveyed portion of the river, mostly in steep-sloped, shady forested habitats. One cave, known locally as MacLeod Cave, extends about 10 m into gypsum bedrock. Larger, relatively shallow sinkholes, mostly lacking exposed gypsum, line the bottom and edge of the river valley. Coarse gypsum and limestone rubble dots the clear waters and shores of the river from the large open wetland in the southwest to the large quarry in the northeast. Further downstream, the river slows and meanders with some floodplain terraces and finer substrates forming occasional gravel bars. The northern shore below the quarry rises steeply and is mostly of coarse, less calcareous scree. Less pronounced karst topography occurs to the northeast end of the area.

The river valley is dominated by older forests of Eastern Hemlock (*Tsuga canadensis*), Sugar Maple (*Acer saccharum*), Yellow Birch (*Betula alleghaniensis*), and American Beech (*Fagus grandifolia*) which grades into younger, less shade-tolerant forests further upslope and north of the quarry. Although understory diversity is fairly low, a few areas of dry, sloped forest included Dwarf Scouring-Rush (*Equisetum scirpoides*, S3S4, Secure) and Woodland Strawberry (*Fragaria vesca* ssp. *americana*, S3S4, Secure). The open wetland at the southwest end of the surveyed area is dominated by graminoid species such as Bluejoint Reed Grass (*Calamagrostis canadensis*), Slender Sedge (*Carex lasiocarpa* var. *americana*), Cottongrass Bulrush (*Scirpus cyperinus*), Leatherleaf (*Chamaedaphne calyculata*), Broad-leaved Cattail (*Typha latifolia*), and Softstem Bulrush (*Schoenoplectus tabernaemontani*). Bulblet Fern (*Cystopteris bulbifera*, S3S4, Secure) is often the prevalent species on exposed gypsum and limestone along the river and adjacent steep slopes. A few fairly deep, seepy, cool sinkholes are home to species such as Braun's Holly Fern (*Polystichum braunii*), Silvery Spleenwort (*Deparia acrostichoides*), and Herb Robert (*Geranium robertianum*). The largest exposed face of limestone noted along the river also supports one occurrence of Green Spleenwort (*Asplenium trichomanes-ramosum*, S2, Sensitive) and one occurrence of Dwarf Scouring-Rush (*Equisetum scirpoides*, S3S4, Secure). Two occurrences of Hooked Agrimony (*Agrimonia gryposepala*, S3, Secure) and a single plant of Porcupine Sedge (*Carex hystericina*, S2, May Be At Risk) were noted from the edge of the river in narrow sections of open, somewhat rich floodplains. Small Burreed (*Sparganium natans*, S3 – Secure) was also found in the clear shallow waters of a slow-flowing section of the river.

Recent disturbances to the site include an old woods road and bridge, an abandoned field edging the river valley, the large limestone quarry (with access road and bridge), and a small, abandoned log-driving dam. The ~1 km stretch of river in which rare species and exposed gypsum and limestone occur is, however, relatively unaffected by any recent disturbance.

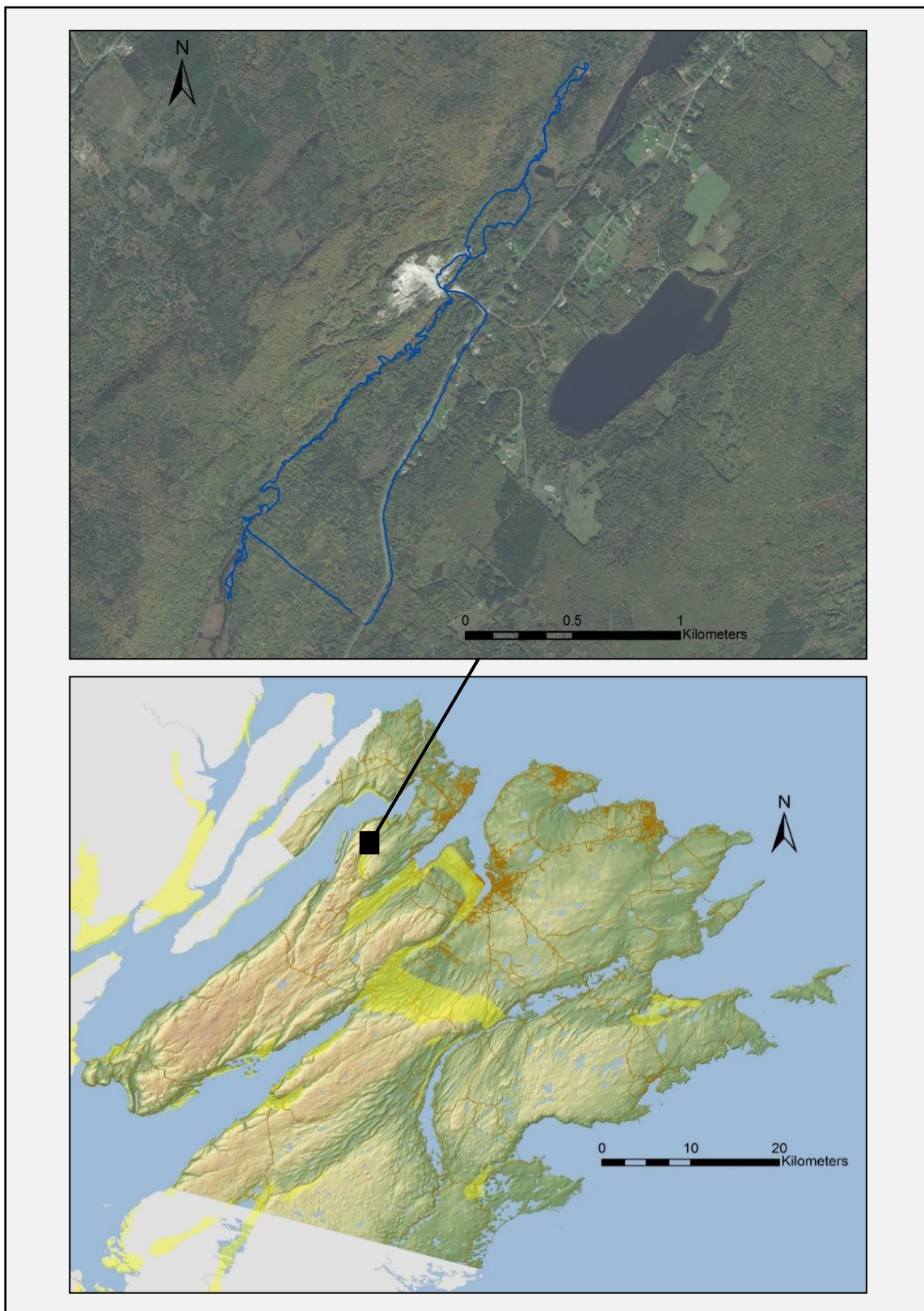
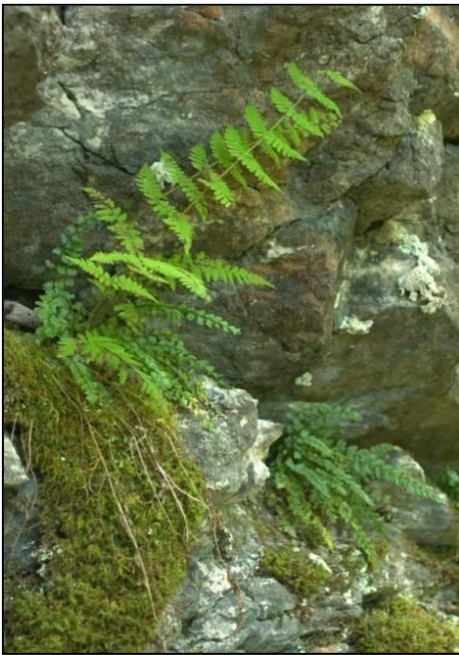
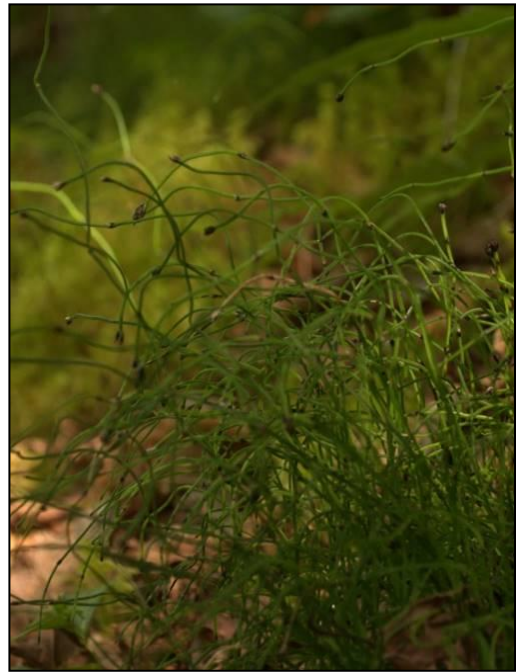


Figure 37. Survey coverage along Georges River (site #35), Victoria County, NS. Blue line represents track file logged by GPS unit. Survey carried out on September 9th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (accessed in winter 2015).



#35. Georges River (clockwise from top left)

1 – Open graminoid-dominated wetland in upper reaches of Georges River watershed. 2 – Dwarf Scouring-Rush (*Equisetum scirpoides*, S3S4, Secure) in dry, sloped forest of sinkhole. 3 – Coarse gypsum and limestone rubble in and along Georges River, and opening to MacLeods Cave (far left). 4 – Green Spleenwort (*Asplenium trichomanes-ramosum*, S2, Sensitive) and Bulblet Fern (*Cystopteris bulbifera*, S3S4, Secure) in cracks of exposed calcareous bedrock along steep slope of Georges River valley.

#36. Frenchvale Brook

Observer(s): Mazerolle, D.M.

Survey date: September 9th 2014

Rare Species

Scientific Name	Common Name	S-Rank	GS-Rank	Records
<i>Fraxinus nigra</i>	Black Ash	S1S2	At Risk	1
<i>Agrimonia gryposepala</i>	Tall Hairy Groovebur	S3	Secure	2
<i>Rhamnus alnifolia</i>	Alderleaf Buckthorn	S3	Secure	1
<i>Carex cryptolepis</i>	Northeastern Sedge	S3?	Secure	3

Site Summary

Survey effort at this site was focused on a 5.5 km section of the shallow and gently-sloping Frenchvale Brook valley, from Rear Balls Creek to Gouthro Lake. Despite the large area covered, very little surface gypsum was seen. Gypsum features were limited to scattered occurrences of small sinkholes in the brook floodplain, a few wide shallow depressions forming basin wetlands, and a few small areas of calcareous riparian wetland.

Due in part to its gentle terrain and proximity to Cape Breton's most densely populated centre, the Frenchvale Brook valley has been highly disturbed through wood harvesting. Extensive areas are presently regenerating from recent clear-cutting and most standing forest in the surveyed area consists of early- and mid-successional mixedwood communities. Quarrying and agricultural activities have also cumulatively caused significant deforestation. Stands of mature mesic Red Maple (*Acer rubrum*), White Ash (*Fraxinus americana*) / Red Maple and Red Maple / Balsam Fir (*Abies balsamea*) are common throughout, though mostly restricted to lower valley slopes and riparian areas. The site's northeastern end contains a few very localized occurrences of moderately rich mature floodplain hardwoods dominated by Red Maple (*Acer rubrum*), White Ash (*Fraxinus americana*) and Yellow Birch (*Betula alleghaniensis*). Remnant stands of mature to old pure Eastern Hemlock (*Tsuga canadensis*) and Eastern Hemlock / Red Maple / Eastern White Pine (*Pinus strobus*) were also found at two locations.

A sizeable area of Red Maple / Black Spruce (*Picea mariana*) / Tamarack (*Larix laricina*) / Balsam Fir (*Abies balsamea*) swamp was observed south of the brook in the eastern half of the site, in an area characterized by large shallow sinkhole-like depressions. Black Ash (*Fraxinus nigra*, S1S2, At Risk, Threatened) was found within this swamp, in an area locally influenced by calcareous groundwater seepage. Wetlands around MacMullin Lake are moderately calcareous, supporting shrubby Red Maple riparian swamp and Shrubby Cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*) / Broad-Leaf Cattail (*Typha latifolia*) / Slender Sedge (*Carex lasiocarpa*) / Royal Fern (*Osmunda regalis* var. *spectabilis*) fen communities, as well as a number of calciphilic species including Buxbaum's Sedge (*Carex buxbaumii*). Extensive Beaver-influenced Speckled Alder (*Alnus incana* ssp. *rugosa*) / Blue Joint Reed Grass (*Calamagrostis canadensis*) meadows were observed where Frenchvale Brook meets a small tributary from MacMullin Lake. Shallow sinkhole basins, mainly observed in the site's north end, also include vernal pools and various marsh and fen communities.

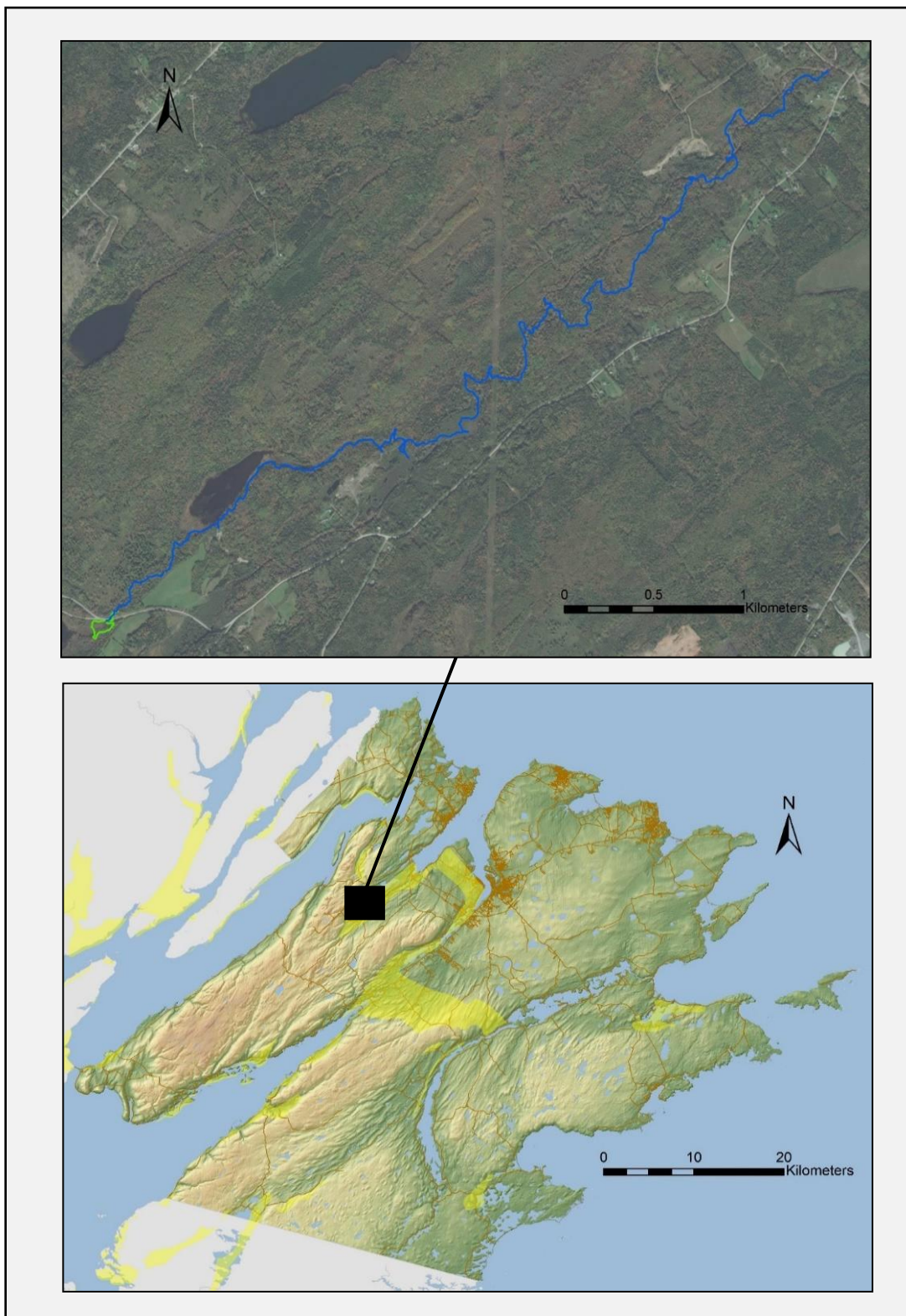


Figure 38. Survey coverage along Frenchvale Brook (site #36), Cape Breton County, NS. Blue line represents track file logged by GPS unit. Survey carried out on September 9th 2014. Yellow shading on county map indicates mapped occurrence of Windsor Group bedrock (NS DNR 2003). Aerial imagery from Bing Maps (2015).



#36. Frenchvale Brook (clockwise from top left)

1 – Cobble-gravel shores and moderately-rich floodplain forest along Frenchvale Brook. 2 – Calcareous Shrubby Cinquefoil (*Dasiphora fruticosa* ssp. *floribunda*) and Broad-Leaf Cattail (*Typha latifolia*) fen. 3 – Slender Sedge (*Carex lasiocarpa* var. *americana*), Sweet Gale (*Myrica gale*) and Northern Meadow-Sweet (*Spiraea alba* var. *latifolia*) shoreline fen at MacMullin Lake. 4 – Mature mid-successional forest dominated by Red Maple and Paper Birch. 5 – Red Maple and Balsam Fir seepage swamp with Cinnamon Fern (*Osmunda cinnamomea*) understory. 6 – Northeastern Sedge (*Carex cryptolepis*, S3?, Secure) on cobble shore along Frenchvale Brook.

Conclusions

Nova Scotia is unique in northeastern North America for the number and extent of sites having gypsum bedrock at or near the soil surface. Although exposed gypsum and karst landscapes are uncommon in Nova Scotia, occupying only a tiny portion of the landscape, they are still far more widespread and frequent in the province than in any other jurisdiction in the glaciated portion of northeastern North America.

Surficial gypsum and limestone deposits in Nova Scotia provide particular environmental conditions that support provincially uncommon plant communities and a suite of rare plant species with provincial distributions mainly or entirely restricted to karstic habitats. Additionally, because the rugged topography of severe karst occurrences can preclude any significant human activity, these areas often contain old forests and likely act as refuges for species dependent on these habitats (Blaney and Mazerolle 2013). The national and global conservation significance of Nova Scotia's karst landscapes, long poorly understood, is now recognized by provincial agencies and private land conservation organizations such as the Nature Conservancy of Canada.

Large expanses of natural gypsum karst have been lost to other land uses, predominantly quarrying, farming and forestry. Gypsum mining has a long history in the province of Nova Scotia and large open pit mines have already removed many of the most significant examples of gypsum landscapes, with mining companies presently owning large portions of undeveloped gypsum land. The expansion of existing mines and establishment of new operations thus represent a major ongoing threat to natural gypsum-associated communities. A large majority of Nova Scotia's Windsor Group geology lies under privately-owned land, with only an estimated 1% of its total mapped area presently included within protected natural areas. All of Nova Scotia's remaining examples of natural gypsum karst habitats are thus of conservation significance.

Our fieldwork was exceptionally successful in documenting an very high number of rare species occurrences and in identifying many high-priority sites for land conservation in Nova Scotia. Surveys were generally carried out in areas with little or no pre-existing botanical information, therefore maximizing the value of collected data. This project and the similar field effort carried out by the AC CDC in 2012 collectively represent the most geographically extensive investigation ever undertaken on the plant species and communities of Nova Scotia gypsum areas. The substantial data recorded through these two efforts has made a significant contribution to our understanding of these highly threatened habitats, clearly demonstrating their significance and providing necessary context to evaluate the relative conservation value of specific gypsum areas in the province.

The precisely geo-located rare species data collected allows the identification of particular areas of significance at a fine scale, thereby providing an excellent means for prioritizing any future conservation efforts. On a provincial scale, the increased understanding of rare species' status generated by this project will improve land use decisions related to those species' habitats throughout Nova Scotia, allowing scarce conservation resources to be focused where they are most needed. All species data collected in this project has been permanently documented via incorporation into the AC CDC's GIS-linked database, where it will be available to inform conservation and land use decisions in or near our study areas, and in response to any species-specific data requests.

The following conclusions can be derived from survey data collected to date: 1) Presence of underlying Windsor Group bedrock and karst topography are not highly reliable predictors of the occurrence of rare gypsum-associated flora. 2) Rare gypsum-associated species show various distribution patterns within Nova Scotia and several of the rarest species in the province apparently only occur in a single region. These distribution patterns result in regionally distinct species assemblages. 3) Future conservation efforts should therefore aim to protect high-quality examples of gypsum karst communities in various regions, focusing first on higher-priority areas identified to date (Windsor area in western Hants County, Baddeck area in southern Victoria County, Ninevah area in southern Inverness County, South Section area in Halifax County, Antigonish area in Antigonish County and others).

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APPENDIX 1. NatureServe Status Rank Definitions.

Source: <http://www.natureserve.org/conservation-tools/conservation-status-assessment>

Global Rank	National Rank	Provincial Rank	DEFINITION
GX	NX	SX	Presumed Extinct (G-rank) / Extirpated (N- and S-ranks) — Species or ecosystem not located despite intensive searches and virtually no likelihood of rediscovery.
GH	NH	SH	Possibly Extinct (G-rank) / Extirpated (N- and S-ranks) — Known from only historical occurrences but still some hope of rediscovery. There is evidence that the species may be extinct or the ecosystem may be eliminated throughout its range, but not enough to state this with certainty.
G1	N1	S1	Critically Imperiled — At very high risk of extinction (G-rank) / extirpation (N- and S-ranks) due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
G2	N2	S2	Imperiled — At high risk of extinction (G-rank) / extirpation (N- and S-ranks) due to very restricted range, very few populations, steep declines, or other factors.
G3	N3	S3	Vulnerable — At moderate risk of extinction (G-rank) / extirpation (N- and S-ranks) due to a restricted range, relatively few populations, recent and widespread declines, or other factors.
G4	N4	S4	Apparently Secure — Uncommon but not rare; some cause for long-term concern due to declines or other factors.
G5	N5	S5	Secure — Common; widespread and abundant.

APPENDIX 2. General Status Ranks Definitions

Source: <http://www.wildspecies.ca>

RANK	DEFINITION
Extinct	Species that are extirpated worldwide (<i>i.e.</i> , they no longer exist anywhere).
Extirpated	Species that are no longer present in a given geographic area, but occur in other areas.
At Risk	Species which have been determined to be at risk of extinction (<i>i.e.</i> Endangered or Threatened) by a formal, detailed risk assessment (COSEWIC status assessment or provincial or territorial equivalent).
May Be At Risk	Species that may be at risk of extirpation or extinction and are therefore candidates for a detailed risk assessment by COSEWIC, or provincial or territorial equivalents.
Sensitive	Species that are not believed to be at risk of immediate extirpation or extinction but may require special attention or protection to prevent them from becoming at risk.
Secure	Species that are not believed to belong in the categories Extinct, Extirpated, At Risk, May Be At Risk, Sensitive, Accidental or Exotic. This category includes some species that show a trend of decline in numbers in Canada but remain relatively widespread or abundant.
Undetermined	Species for which insufficient data, information, or knowledge is available with which to reliably evaluate their general status.
Not Assessed	Species that are known or believed to be present regularly in the geographic area in Canada to which the rank applies, but have not yet been assessed by the general status program.
Exotic	Species that have been moved beyond their natural range as a result of human activity. In this report, Exotic species have been purposefully excluded from all other categories.
Accidental	Species occurring infrequently and unpredictably, outside their usual range.

APPENDIX 3. Vascular plant species documented at survey sites, with Nova Scotia status ranks (S-r = S-rank) and general indication of on-site abundance (c – common, f – fairly common, l – locally common, r – rare, rl – rare but locally common, u – uncommon, x – abundance not recorded). See appendices 1 and 2 for rank definitions.

SITE #1: Lower Cogmagun River, 2: Upper Cogmagun River, 3: Newport Station, 4: Greenfield, 5: Five Mile River, 6: Lime-kiln Bk., 7: Dutch Settlement, 8: Black Brook, 9: South Section, 10: Brierly Brook, 11: Fairmont, 12: Williams Point, 13: Southside Antigonish Harbour, 14: South River, 15: Lamey Brook, 16: MacLeod Brook, 17: Glen Brook, 18: MacPhail Brook, 19: Pooles Brook, 20: MacLeans Brook, 21: Lime Hill, 22: McIntyre Brook, 23: Ninevah / Little Narrows, 24: Washabuck Bridge, 25: Plaster Cove, 26: Hunters Mountain, 27: McRae Brook, 28: Beinn Bhreagh, 29: Plaister Mines, 30: South Haven, 31: St. Anns, 32: Middle Aspy River, 33: Dingwall (north of Middle Harbour), 34: Dingwall (south of Middle Harbour), 35: Georges River, 36: Frenchvale Brook																																					
Species	S-r	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Lycopodiaceae																																					
<i>Huperzia lucidula</i>	S5									r						r		r	x					c			r		u		c	r					u
<i>Lycopodiella inundata</i>	S5																					r	r														
<i>Lycopodium annotinum</i>	S5	c	c		f				r		c	r	x				u				u	f				u					f				r		
<i>Lycopodium clavatum</i>	S5	f	r		c															u			u		u			r		u							
<i>Lycopodium dendroideum</i>	S5	c	f		c		c	u	f							u	c					c	c		r	u			u	c						c	
<i>Lycopodium digitatum</i>	S5																						f		r	r		u		r							
<i>Lycopodium hickeyi</i>	S4 ?		r		r						u												r	r				r									
<i>Lycopodium lagopus</i>	S4																																				
<i>Lycopodium obscurum</i>	S5		u										x													r			r	r							
Isoetaceae																																					
<i>Isoetes echinospora</i>	S5							r																													
<i>Isoetes sp.</i>																							u													l	
Equisetaceae																																					
<i>Equisetum arvense</i>	S5	c		f	c		f	c	c	f	f	c	x	x	x	u	f	u	x			f	f	c		u	c	c	f	c	c	c		c	f	c	c
<i>Equisetum fluviatile</i>	S5		u					c		c			x	x					x																		
<i>Equisetum hyemale</i> var. <i>affine</i>	S3 S4																															r	r				
<i>Equisetum pratense</i>	S3																	r																			
<i>Equisetum scirpoides</i>	S3 S4						r										r	c										r				r		r			
<i>Equisetum sylvaticum</i>	S5	c	c	f	c		c	c	f			u	x	x	x	u	f	f	x	u	c		r	u	f	u	l		u	c	c	f	u	u	u	u	c
<i>Equisetum variegatum</i>	S3											r																r					r				
<i>Equisetum x mackaii</i>	SNA																																	u			
Ophioglossaceae																																					
<i>Botrychium virginianum</i>	S4																		x							r											

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Species	S-r	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Osmundaceae																																					
<i>Osmunda cinnamomea</i>	S5	c	c	l	u		c	l	c	c	l	c	x	x			l	f	x	f	c	c	c	c	c	u	l	c	c	c	c	l	f	c	l		c
<i>Osmunda claytoniana</i>	S5	c	r	c	c		f	c	f	c	c	u	x	x		u	f	u	x	u		c	u	f	f		c				c	c	f	u		f	c
<i>Osmunda regalis</i> var. <i>spectabilis</i>	S5	c	l	rl				u	f	c			x							u	f		r				l	r						r	r	u	c
Polypodiaceae																																					
<i>Polypodium appalachianum</i>	S3 ?																									r						r					
<i>Polypodium virginianum</i>	S5						rl	u								r		u	x			r			r		r			r	l	u			r		
Dennstaedtiaceae																																					
<i>Dennstaedtia punctilobula</i>	S5		l	c	f				u		c	f	x	x			c	c	x	u		u	c	f	c	f	c	c	f	c	c	c				u	
<i>Pteridium aquilinum</i> var. <i>latiusculum</i>	S5	c	c	c	c		c	c	c	l	c	c	x	x		u	c			u	c	c	c	c	c	u	c	c	c	c	c	c	f	c	c	f	c
Aspleniaceae																																					
<i>Asplenium trichomanes</i>	S3																		r																		
<i>Asplenium trichomanes-ramosum</i>	S2															r			r																	r	
Thelypteridaceae																																					
<i>Phegopteris connectilis</i>	S5	c	c	c	c			c	u	u		f	x	x		f	c	f	x		c	c	c	r	c	f	c	c	c	c	c	c	f	f	c	c	l
<i>Thelypteris noveboracensis</i>	S5	c	c	c	c		c	c	c	u	c	c	x	x	x	f	c	c	x	u	c	c	c	c	u	f	c	c	c	c	c	c	f	c	f	c	l
<i>Thelypteris palustris</i> var. <i>pubescens</i>	S5			l					c	c	u	u	x	x						c	f	u	f	c	f		c		r			f			r	u	l
Dryopteridaceae																																					
<i>Athyrium filix-femina</i> ssp. <i>angustum</i>	S5	u		c	f		c	c	c	u	u	c	x	x	x	u	c	f	x				f		c	c	f	c	c	c	c	c	c	f	f	c	c
<i>Cystopteris bulbifera</i>	S3 S4							l	r		l	f	r	f				c	c					r	r	c	r		rl	c	l				r	c	
<i>Cystopteris tenuis</i>	S4															r		r																			
<i>Deparia acrostichoides</i>	S4															r		r	x			r				x										r	
<i>Dryopteris campyloptera</i>	S5	c		c			c					f	x	x			c		x			c	c		c	f	u	c	c	c	c	f	f	u	f		f
<i>Dryopteris carthusiana</i>	S5	c	c	f	c					c	c	f	x	x	x						r			r				r	u		c	f				u	
<i>Dryopteris cristata</i>	S5	f	c	l			c	r	c	c	l	r	x	x			u			f	c	r	f	u	f			u		c	c	r					l

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<i>Dryopteris filix-mas</i>	S4																	r														r	f	u				
<i>Dryopteris intermedia</i>	S5	f		c	c		c	c	f	f	c	c	x	x	x	f	c	c	x	u	c	c	c	c	c	c	c	c	c	c		c	f	c	c	c	c	
<i>Dryopteris marginalis</i>	S5			u	u		u	f	u		u	c	x	x															r							u	r	
<i>Dryopteris x boottii</i>	SNA																						r															
<i>Gymnocarpium dryopteris</i>	S5	c	c	f	f		c	c	c	u	l	u	x	x	x	u	f	f	x		u	u			f	u				f	l	c	c	c	f	c	u	f
<i>Matteuccia struthiopteris</i>	S5		u	r			c	c	r		l	c	x	x	x	f	l	f	x		l				r	u	u	c	u	f	l	f	f	c			c	
<i>Onoclea sensibilis</i>	S5	c	c	c	c		c	c	c	c	l	c	x	x	x	f	c	f		u	c	c	c	f	c	f	c	c	c	c	c	c	f	c	c	f	c	
<i>Polystichum acrostichoides</i>	S5	f	c	c	u		c	c	c	u	c	c	x	x	x	f	u	c	x	u	f	c	f		l	c	c		c	c	c	c	c	f	c	x		
<i>Polystichum braunii</i>	S4																	r	x			u				x	r		r	f					u			
<i>Polystichum lonchitis</i>	S2																																r	r				
Blechnaceae																																						
<i>Woodwardia virginica</i>	S4				r																																	
Taxaceae																																						
<i>Taxus canadensis</i>	S5						l		r		f		x			u		u	x	u	r	r	u			r	u			r								
Pinaceae																																						
<i>Abies balsamea</i>	S5	c	c	c	c		c	c	c	c	c	c	x	x	x	c	c	c	x	f	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c		
<i>Larix laricina</i>	S5		c	f			c	c	c	c				x			l			c	c	l	c	c	c				u	l	c	u				c		
<i>Picea glauca</i>	S5	c	c	c	c		c	c	c	l	c	c	x	x	x	f	c	u		u	c	c	c	c	c	f	c	c	c	c	c	c	c	c	c	c		
<i>Picea mariana</i>	S5	c	c	l	u		u	l	c	c	l	c	x	x			c				c	c	c	c	c		l	rl		l	c	l		c	c	c		
<i>Picea rubens</i>	S5	c	c		c		c	c	c	r	c	f						u	x	u				x	u	f									f	r		
<i>Pinus resinosa</i>	S4 S5																												l									
<i>Pinus strobus</i>	S5	c	c	c	f		c	c	f	u	c	c	x	x		r	u	u	x	u	c	u	r	c	c		f		u			c	u		f		c	
<i>Pinus sylvestris</i>	SNA																																					
<i>Tsuga canadensis</i>	S4 S5	c	c	c	l		c	c	l	r	c	c	x	x	x			u		u	l	r	r	r	l	u	c		c	l	c	c				c	c	
Cupressaceae																																						
<i>Juniperus communis</i>	S5												x	x										r									u					
<i>Juniperus communis</i> var. <i>depressa</i>	S5						r	r											f	r	r				u			r	l	r		r		l	u	r		
<i>Juniperus horizontalis</i>	S4									rl										c	r												r	l				

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Nymphaeaceae																																						
Nuphar lutea ssp. rubrodisca	S4								r																													
Nuphar lutea ssp. variegata	S5	u			r			c	c		u			x					x			r	r	r				u	r			f				r	r	
Nymphaea odorata	S5				r															r	r		f	r	r												l	
Cabombaceae																																						
Brasenia schreberi	S5				r																																	
Ranunculaceae																																						
Actaea pachypoda	S4													x		r		r								f												
Actaea rubra	S5	c		r					c		c	r	x	x	x	u		u	x			l				u	u	f			c	c	u	u	f	f	f	
Anemone virginiana	S2											r	r	r																								
Aquilegia vulgaris	SNA					r							x																								r	
Clematis virginiana	S5	r	r					c	c				x		x	u	u				f				u	c	r			c				r			u	c
Coptis trifolia	S5	c	c		c			u	c	u		u	x	x		f	c	u	x	u	f	c	f	c	f	u	r	l	u	c	c						r	
Ranunculus abortivus	S4 S5	l																	x																			
Ranunculus acris	SNA	f		u	u			u	r		c	f	x	x	x	r				r		r	r	f	f	u	c		r	f		r	u			f		
Ranunculus cymbalaria	S5	c											x	x														u	r	l								
Ranunculus flammula var. filiformis	S5																						c															
Ranunculus gmelinii	S3		r	r							r	r												r	r		r	r			r							
Ranunculus recurvatus	S4										r							u	x																		r	
Ranunculus repens	SNA	c	c	c	c		c	c	f	f		c	x	x	x	f	c	f	x	u	c	f	c	c	f	f	c	c	f	f	c	c	u	f	f	f	c	
Ranunculus trichophyllus	S4												x		x																						l	
Thalictrum pubescens	S5	c	c				c	c	f	c	c		x	x	x	f	c	f	x	f	u	l	u	f	c	f	l	f	u	c	c	c	f	f	f	f	c	
Berberidaceae																																						
Berberis thunbergii	SNA																												l									
Caulophyllum thalictroides	S2														r																							
Papaveraceae																																						
Sanguinaria canadensis	S3 S4												r		c																							

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Hamamelidaceae																																						
<i>Hamamelis virginiana</i>	S5				r				r																													
Ulmaceae																																						
<i>Ulmus americana</i>	S4			r			u	u			f		x		x									x				f				u	r			r		
Cannabaceae																																						
<i>Humulus lupulus</i> var. <i>lupulus</i>	SNA																																			r		
Urticaceae																																						
<i>Boehmeria cylindrica</i>	S1							r																														
<i>Laportea canadensis</i>	S3							r							r																							
Myricaceae																																						
<i>Comptonia peregrina</i>	S5	c	u	u	f			u	c	l																												
<i>Morella pensylvanica</i>	S5										u	f	x	x						u	r			c		c			c	r	r			c	l			
<i>Myrica gale</i>	S5	c							c		l					u				f	u	l	c	c	l		l	l	r		c	c		c	l	c	l	
Fagaceae																																						
<i>Fagus grandifolia</i>	S5			f					r		c	u		x	x	u	c	c	x	u		c	c		l	f	c	l	f	c	c	l	f	u	l	c		
<i>Quercus robur</i>	SNA												x																									
<i>Quercus rubra</i>	S5	c	c	c	c			c	r	u		u	x	x										u								u	u	f				
Betulaceae																																						
<i>Alnus incana</i> ssp. <i>rugosa</i>	S5	c	c	c	c		c	c	c	c	c	c	x	x	x	f	l	u	x	c	c	c	c	c	c	f	c	c	c	c	c	c	c	c	c		f	c
<i>Alnus viridis</i> ssp. <i>crispa</i>	S5										c	c	r	x	x							r			c					c	f	u	f	f	l	u		
<i>Betula alleghaniensis</i>	S5		c	c	c		c	c		l	c	c	x	x	x	f	c	c	x	u	l	c	c		c	c	c		c	c	c	c	c	r		c	c	
<i>Betula papyrifera</i> var. <i>cordifolia</i>	S5																u												f				r			r		
<i>Betula papyrifera</i> var. <i>papyrifera</i>	S5	c	c	c	c		c	c	f	c	c	c	x	x	x	f	c			f	c	c	c	c	c	f	c	c	c	c	c	c	f	c	c	c	c	
<i>Betula populifolia</i>	S5	f	u	f	f				c	u		f																									u	
<i>Betula x caerulea</i>	SNA											r																										
<i>Corylus cornuta</i>	S5	c		c			f	f		c		c	x	x	x	f	u	f	x							c	u	r		f		f	f	c	f	c	c	
<i>Ostrya virginiana</i>	S5			r			f	u				f	x		x																							

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Chenopodiaceae																																					
<i>Atriplex glabriuscula</i>	S4 S5																														u	u					
<i>Atriplex prostrata</i>	S5	l											x													l								r	r		
<i>Atriplex</i> sp.														x															r	r							
<i>Atriplex subspicata</i>	S5 ?	l																										r			u	u					
<i>Chenopodium album</i>	SNA	r													x																					r	
<i>Chenopodium berlandieri</i> var. <i>macrocalycium</i>	SN R																															r	r				
<i>Salicornia maritima</i>	S5																																r				
<i>Suaeda maritima</i>	S5																															r	r				
<i>Suaeda</i> sp.														x																							
Caryophyllaceae																																					
<i>Cerastium fontanum</i> ssp. <i>vulgare</i>	SNA											r	x	x	x				x					r								r					
<i>Dianthus armeria</i>	SNA	r	r																			r	r	r				r				r					
<i>Honckenya peploides</i> ssp. <i>robusta</i>	S5																									l		r			r	l					
<i>Moehringia lateriflora</i>	S5							f					x	x	x																						
<i>Sagina procumbens</i>	S5						c					r		x		r																r					r
<i>Saponaria officinalis</i>	SNA																																r				
<i>Silene vulgaris</i>	SNA														x																						
<i>Spergularia canadensis</i>	S4													x											x									r	r		
<i>Spergularia rubra</i>	SNA																							r													
<i>Stellaria borealis</i>	S4																			r								r				r					
<i>Stellaria graminea</i>	SNA							f				r	x	x																							
<i>Stellaria media</i>	SNA												x																								
Polygonaceae																																					
<i>Polygonum amphibium</i>	S4 S5									u																											
<i>Polygonum amphibium</i> var. <i>emersum</i>	S3 ?							r																													

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Species	S-r	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
<i>Polygonum amphibium</i> var. <i>stipulaceum</i>	S4 S5			u					l		u		x	x					x					r	r					r							
<i>Polygonum aviculare</i>	S5						r						x											x							r	r		r			
<i>Polygonum cilinode</i>	S5						f				r	r																									
<i>Polygonum cuspidatum</i>	SNA														x									r		l											
<i>Polygonum fowleri</i>	S3 S4													r																							
<i>Polygonum hydropiper</i>	SNA	c					c		c	u	c	u	x	x	x	u	f				f	u	r	u	c	u	u	c	u	u	f	c				u	c
<i>Polygonum hydropiperoides</i>	S5							c																													
<i>Polygonum lapathifolium</i>	S5							u					x		x																						
<i>Polygonum pennsylvanicum</i>	S3												r																								
<i>Polygonum persicaria</i>	SNA							f				r	x		x						r			r				r			r		r		r	u	u
<i>Polygonum punctatum</i>	S5								r			r	x											r					r								
<i>Polygonum robustius</i>	S4										r				r																						
<i>Polygonum sachalinense</i>	SNA																													r							
<i>Polygonum sagittatum</i>	S5	f			r		f	c	c	f	c	c	x	x	x	u	u		x	r	c	u	u	f	f	r	u		r	u	r	r				u	c
<i>Polygonum scandens</i>	S3												r																								
<i>Rumex acetosella</i>	SNA	r		r							r			x			l											l		r		r					
<i>Rumex crispus</i>	SNA			r							u	u		x	x	r			x				r	r					r		r	c					
<i>Rumex obtusifolius</i>	SNA						u				r	r	x	x	x		r												r			r		r			f
<i>Rumex orbiculatus</i>	S5	c						f	c	f	f	u	x	x							u			u	u				r	r	f	c		c	r		
Plumbaginaceae																																					
<i>Limonium carolinianum</i>	S5													x																	l	l					
Clusiaceae																																					
<i>Hypericum boreale</i>	S5			r					l								r						r					r		u							l
<i>Hypericum canadense</i>	S5	f					c	r									r			u	r		r						u							l	r
<i>Hypericum</i> cf. <i>dissimulatum</i>																							r														
<i>Hypericum ellipticum</i>	S5														x																						
<i>Hypericum mutilum</i>	S4 S5											r																									

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Species	S-r	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
<i>Hypericum perforatum</i>	SNA	l		c	f		f		c	u	c	u	x	x	x	u	u		x		u		r	f	f					f	c	l			r	l	r
<i>Triadenum fraseri</i>	S5	c	r		u				c		l	f	x	x		u	u		x	f	f	r	c	c	c	u		f	u	c		f		c	r	u	l
Tiliaceae																																					
<i>Tilia cordata</i>	SNA														r																						
Sarraceniaceae																																					
<i>Sarracenia purpurea</i>	S5				r					l										f	r	l	c	c													r
Droseraceae																																					
<i>Drosera intermedia</i>	S5																			u	r		r	r													
<i>Drosera rotundifolia</i>	S5		r		r			rl	r	l	r	r	x			r			u		l	u	u	r			rl		r		r						
Violaceae																																					
<i>Viola blanda</i> var. <i>palustriformis</i>	S5	r	u		f							u									r	u	c		r					r						u	
<i>Viola cucullata</i>	S5	c	c						c	f	c					u			x		u	r	c		u			u		u		f	u	r	r		f
<i>Viola labradorica</i>	S5				r					r		r	x			r			x	r	r			r							r	r			r		
<i>Viola macloskeyi</i> ssp. <i>pallens</i>	S5		f		u			f					x			r			x	u	r	r	f	c			r	u							u	r	
<i>Viola renifolia</i>	S4																		x							r											
<i>Viola sororia</i>	S5	f	u	c						c	r		x	x		u			x						r					r	c	f		u	r	u	
Cucurbitaceae																																					
<i>Echinocystis lobata</i>	SNA			u			u	f		r				x																							
Salicaceae																																					
<i>Populus alba</i>	SNA																							x									r				
<i>Populus balsamifera</i>	S4																			r	r			r	u		u		f	f	u	r	u	c		f	
<i>Populus grandidentata</i>	S5	c	c	c	c		l	l	l		c	u	x	x	x										u								u				
<i>Populus tremuloides</i>	S5	c	c	c	c		c	c	u	l	c	c	x	x	x						c			c	c	u	c	c			c	c		c	c	c	c
<i>Populus x canescens</i>	SNA																							r													
<i>Salix alba</i>	SNA														x																						
<i>Salix bebbiana</i>	S5			u			c		u	c	f	c	x	x		u			x	u	u	r	x	c	f	u	f	c	f	f	f	r	f	c	c	f	u
<i>Salix discolor</i>	S5		u	u			f		c		c	x			u			x					r	f			r		r				r		f	f	

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<i>Salix eriocephala</i>	S5			u				u			l	f	x	x	x	u	r							r				f					f	f	r		
<i>Salix humilis</i>	S5	f	f				u			c	f		x	x							u			r	r							f					
<i>Salix lucida</i>	S5																																			r	
<i>Salix myrtilifolia</i>	S1									r																											
<i>Salix pyrifolia</i>	S5			r			r		c	u		r															u										
<i>Salix serissima</i>	S1									r																											
<i>Salix viminalis</i>	SNA																							x													
<i>Salix x rubens</i>	SNA							r					x	x																							
<i>Salix cf. x sericans.</i>	SNA																																	r			
Brassicaceae																																					
<i>Barbarea orthoceras</i>	S1													u																							
<i>Barbarea vulgaris</i>	SNA						u	r			r	r	x	x	x				x												r						r
<i>Cakile edentula</i>	S5																									l			l		l	l					
<i>Cardamine diphylla</i>	S4																		x																		
<i>Cardamine pensylvanica</i>	S5		f	r			c	c			u			x	x		r						r	r	r		r	f	r		r			r		r	c
<i>Cardamine pratensis</i>	SNA												x		x																						
<i>Erysimum cheiranthoides</i>	SN R			r									x		x																						
<i>Hesperis matronalis</i>	SNA												x		x																						
<i>Lepidium campestre</i>	SNA													x	x																						
<i>Raphanus raphanistrum</i>	SNA	r						r					x	x															l								
<i>Rorippa palustris</i>	S4							u					x										u	r													
<i>Sisymbrium officinale</i>	SNA											r																									
<i>Thlaspi arvense</i>	SNA											r																									
Empetraceae																																					
<i>Empetrum nigrum</i>	S5									l										r		l		r													
Ericaceae																																					
<i>Andromeda polifolia</i> var. <i>glaucophylla</i>	S5																			x	r	l	u													r	
<i>Arctostaphylos uva-ursi</i>	S4																																		r		

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<i>Chamaedaphne calyculata</i>	S5		rl	rl	u			rl	l	l		r	x							f	r	l	f	c	rl		l	l						r		u	rl	
<i>Epigaea repens</i>	S5	f	c					c									u	r	x		u	u	u	f					c	u	c	r	f	f	r	u		
<i>Gaultheria hispidula</i>	S5	c	c		r					c			x				c	u		u	f	c	c	c	u		c	l	u	c	l	c					r	
<i>Gaultheria procumbens</i>	S5	c	c					c	c				x				u			r	u	u		c				f		c	r			f			l	
<i>Gaylussacia baccata</i>	S5		rl	rl	u								x							u		rl		r														
<i>Gaylussacia bigeloviana</i>	S5																			r				r														
<i>Kalmia angustifolia</i>	S5	c	c	rl	c		f	l	c	c			x				l			f	c	l	r	f	rl		l	l		c	l			c			l	
<i>Kalmia polifolia</i>	S5																			u	r	l		r														
<i>Ledum groenlandicum</i>	S5	l	rl	rl	r		c	rl		c			x				l			f		l	u	f	rl		l	l		l							c	
<i>Rhododendron canadense</i>	S5			l			c	rl		l			x							u		l		r				l			r							
<i>Vaccinium angustifolium</i>	S5	c		c	c		c	f	c				x		x		c		x	u	r		f	c					c		l	c	u	c	c			
<i>Vaccinium macrocarpon</i>	S5	l			r				u	l		r	x								l		u	f	r				r						r			
<i>Vaccinium myrtilloides</i>	S5	c	c	c	c			c	c	u	c		x				c				c	f	r	r	f		u	c		c	c						c	
<i>Vaccinium oxycoccos</i>	S5		r					rl		l							r			c		l	f	f	r		l											
<i>Vaccinium vitis-idaea</i> ssp. <i>minus</i>	S5																													r								
Pyrolaceae																																						
<i>Chimaphila umbellata</i> ssp. <i>cisatlantica</i>	S4										l																			r				x	r	r		r
<i>Moneses uniflora</i>	S5											r		x					x																r			
<i>Orthilia secunda</i>	S5		c							u	c	r				r	r	u	x		u	u	u	r	r	u			u	u	r			u	r	u		
<i>Pyrola americana</i>	S5		r																																			
<i>Pyrola asarifolia</i>	S3																		r																			
<i>Pyrola chlorantha</i>	S4		r																								r				r							
<i>Pyrola elliptica</i>	S5	f		f	r			u			c	r		x	x	u	f	u	x			r	u		r	u	c	r	u		r	c	u	r		u	u	
Monotropaceae																																						
<i>Monotropa hypopithys</i>	S4			r					r										x				r								r	r		r	r			
<i>Monotropa uniflora</i>	S5	r		f			f	f				r	x				u	r	x			r	f		u	u		u	r	r	r	c		r	r		c	

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Primulaceae																																					
<i>Glaux maritima</i>	S5													x																							
<i>Lysimachia ciliata</i>	S4	c						f		f			x	x	x																						f
<i>Lysimachia nummularia</i>	SNA													x																							
<i>Lysimachia punctata</i>	SNA																															r					
<i>Lysimachia terrestris</i>	S5	c	c		u		u	c	c	c			x	x	x	u	r					f							u	c	c	c	u	c	u		c
<i>Lysimachia thyrsiflora</i>	S4												x	x							r			r					u			r			r		
<i>Lysimachia vulgaris</i>	SNA												x																								
<i>Samolus valerandi</i> ssp. <i>parviflorus</i>	S3												r											r													
<i>Trientalis borealis</i>	S5	c	c	f	c		c	c	l	l	l	c	x	x	x		c		x	u		c	f	c	c	f	c		f	c	c	c	f	c		f	l
Grossulariaceae																																					
<i>Ribes glandulosum</i>	S5	r																	x			r													r		
<i>Ribes hirtellum</i>	S5							u		r		f	x	x	x				x	u			r	f	r				r					r	r		
<i>Ribes lacustre</i>	S5						c	u	r		c	u	x			u		u	x	u	f	c			c	f	c		r	f	f	f		r		u	r
<i>Ribes rubrum</i>	SNA							r					x		x																		r				r
<i>Ribes triste</i>	S4							r		u							r	r	x		u	r		r			u			r							
Crassulaceae																																					
<i>Hylotelephium telephium</i>	SNA							u					x	x	x																						r
Saxifragaceae																																					
<i>Chrysosplenium americanum</i>	S5			u					r		r	r		x	x	r	r	u	x				r	r		u				r							
<i>Mitella nuda</i>	S5		f					l	f			r	x	x				u	x	u		f	f	u	u	u	f		r			l			r		f
<i>Parnassia palustris</i> var. <i>parviflora</i>	S1 S2																													r							
Rosaceae																																					
<i>Agrimonia gryposepala</i>	S3			r					r			r	f	f	f						r			r				r	r			r	r			r	r
<i>Agrimonia striata</i>	S5	r		r			r				f	u	x	x	x	f	r	u	x		u			r	u	u	r	f		r	r	f	r	c		u	c
<i>Amelanchier bartramiana</i>	S5																			r																	
<i>Amelanchier</i> sp.		u	r	c	c					f	c	c	x		x	x			x		f	r	f	c				f				x	c	f			c

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<i>Amelanchier stolonifera</i>	S3 ?	r																																			
<i>Argentina anserina</i>	S5																											r	r		r						
<i>Argentina egedii</i>	S5	c											x	x									u					r		l	r		r	u			
<i>Argentina egedii ssp. groenlandica</i>	S5																									l		l									
<i>Comarum palustre</i>	S5	l		u					c		r										u			f	l	r		r			l		u	r			
<i>Crataegus monogyna</i>	SNA			r								x	x																								
<i>Crataegus sp.</i>		u		r				u				r	x	x	x															r			c			f	
<i>Dalibarda repens</i>	S5		c		u			u																													f
<i>Dasiphora fruticosa ssp. floribunda</i>	S4					r			r	c										c	r	r	c	c						r			r	u		r	rl
<i>Fragaria vesca ssp. americana</i>	S3 S4						r	u	l		r	r				s				r				r		r			r					r	r		
<i>Fragaria virginiana</i>	S5				c		c	c	c	c	c	c	x	x	x	f	c		x	r	c	c	c	c	c		f	c	u	c	c	c	u	c	c	f	c
<i>Geum aleppicum</i>	S5				c		r				c	c	c	x	x	x		u			u	u			f		r				f	r				f	
<i>Geum canadense</i>	S4 S5	u		r				c				r	x		x													r			f					f	
<i>Geum laciniatum</i>	S5			r								r	x	x	x					x						u		r					r		u	c	
<i>Geum macrophyllum</i>	S5							f	f		r	f				r	u	u	x	u		r				u					u			r	r	u	
<i>Geum rivale</i>	S5				f							f	x			r			x	r			c	c	f												
<i>Malus pumila</i>	SNA	r		r			r	u	r			u	x	x	x				x		r		r	f		l				r	u	r		u	r	c	l
<i>Photinia floribunda</i>	S5			u	u		c	rl		l											r			r													
<i>Photinia melanocarpa</i>	S5	f		r																u		l	r	r													
<i>Potentilla anglica</i>	SNA																		x				r	r													
<i>Potentilla norvegica ssp. monspeliensis</i>	S5				r								x	x	x	r			x				r	u							u	r			l		
<i>Potentilla anglica</i>	SNA																															r					
<i>Potentilla simplex</i>	S5	c		c	f		c	c	c	f	r	f	x	x	x		c			l		f	r	r							f				l	r	
<i>Prunus pensylvanica</i>	S5	u									f	f	x	x							f			x	l				r	r	f			f	f		
<i>Prunus serotina</i>	S5	f	u	f	f			l		l					x												c					f			r		
<i>Prunus virginiana</i>	S5	u		c	c		c	c	c	l	f	c	x	x	x	u					c		r	c	c	u	c	f		l				f		u	f

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<i>Rosa carolina</i>	S4 S5	f	c	f	f			c		c			x	x	x								r														
<i>Rosa multiflora</i>	SNA	r													x											r							r		r		
<i>Rosa nitida</i>	S4									c										u	r	u	r	r								r			r	r	
<i>Rosa rugosa</i>	SNA																									l			r								
<i>Rosa sp., exotic</i>	SNA																													r							
<i>Rosa virginiana</i>	S5											c	x		x					u	c	f	f	c	f		u		r	r	u			c	c	u	f
<i>Rubus allegheniensis</i>	S5			f	c			f		u	c	f		x		u		u								u				u	c	u			f		
<i>Rubus canadensis</i>	S5							c		c	f	u			x		f		x		f	f	r	u	f		c	f	r	u	c	f				c	
<i>Rubus chamaemorus</i>	S4																					rl															
<i>Rubus hispidus</i>	S5	f	c	l	u		f	u	c	u	r						r				r		r	c												r	
<i>Rubus idaeus</i>	S5	l		c	f		c	c	c	c	l	c	x	x	x	u	c	u	x	u	c	f	f	c	c	f	f	l	c	c	c	l	u		u	f	c
<i>Rubus pubescens</i>	S5	c	c	c	c		u	f	c	c	l	c	x	x	x	f	c	c	x	u	c	c	c	c	c	f	c	c	f	c	c	c	f	c	c	f	c
<i>Rubus pubescens</i> cf. <i>var. scius</i>																																			r		
<i>Rubus setosus</i>	S4 ?													x											r												
<i>Sanguisorba canadensis</i>	S4																															r	c	r			
<i>Sanguisorba minor</i> ssp. <i>muricata</i>	SNA									r																											
<i>Sorbus americana</i>	S5	f	r	c	f			u	c	u			x	x		r	f	r	x		u	u	u	r	f	u		f	f	f	c	f	f		r	u	f
<i>Sorbus aucuparia</i>	SNA											r	x	x	x																						
<i>Sorbus decora</i>	S4											r																						f			
<i>Spiraea alba</i> <i>var. latifolia</i>	S5	c	c	f	c		c	c	c	c		u	x		x		c			f	c	u	u		c				c	f		u	c	c	f	c	
<i>Spiraea tomentosa</i>	S5	l	l		u		r	f	c	c																											
Fabaceae																																					
<i>Lathyrus japonicus</i>	S5																									l			l		l			l			
<i>Lathyrus palustris</i>	S5												x	x										r					r				u				
<i>Lotus corniculatus</i>	SNA	r		r				r	r			u	x	x	x									r						r					l		
<i>Lupinus polyphyllus</i>	SNA											r																r	r		r						
<i>Medicago lupulina</i>	SNA			f					r				x	x	x								u	r			r			r		r				r	

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<i>Medicago sativa</i>	SNA												x														r			r		r						
<i>Melilotus albus</i>	SNA	l	r	c					r			u	x	x	x						l		u	f			l				l				r		l	
<i>Melilotus officinalis</i>	SNA		r	r																			u			l										u		
<i>Trifolium arvense</i>	SNA						u		r		f				x						c		u	x	r						rl			r			r	
<i>Trifolium aureum</i>	SNA	rl							r			r	x	x									r	r					r									
<i>Trifolium campestre</i>	SNA				r						r		x		x						r			u		l					r	l			r			r
<i>Trifolium hybridum</i>	SNA											r	x		x								r	u														
<i>Trifolium pratense</i>	SNA			c	f			r	u	r	f	f	x	x	x					l	l		r	f	r		l	l	r	l	l	c		u	u	l	f	
<i>Trifolium repens</i>	SNA			c	c				r			u	x	x	x	r			x		r		r	u				c	u		l	l	r	r	r			
<i>Vicia cracca</i>	SNA	f	r	c	r		r		u		l	f	x	x		u				l	l		r	u	u	l	l		l		c	l	u	f	f	l	l	
<i>Vicia sepium</i>	SNA											u																										
<i>Vicia tetrasperma</i>	SNA													x																								
Elaeagnaceae																																						
<i>Shepherdia canadensis</i>	S2 S3																												c	r			l	l	r			
Haloragaceae																																						
<i>Myriophyllum sibiricum</i>	S3 S4													r													r		r									
<i>Myriophyllum verticillatum</i>	S2																								r													
<i>Proserpinaca palustris</i> var. <i>crebra</i>	S3			l					r											r						r												
Lythraceae																																						
<i>Lythrum salicaria</i>	SNA	r										r		x		u			x	r	u	r	r	r													c	
Thymelaeaceae																																						
<i>Daphne mezereum</i>	SNA	l		r					r				x																									
Onagraceae																																						
<i>Chamerion angustifolium</i>	S5			r		c					r	u	x	x	x	u		r	x	u	c					c	r	r	l	u	f		u	f	r	c	f	f
<i>Circaea alpina</i>	S5	l	c		c				u		c	u	x	x	x	u	l	u	x	u		f	r			u	c		u	c	c	c				u	c	
<i>Circaea lutetiana</i> ssp. <i>canadensis</i>	S5										r		x		x																						r	
<i>Circaea</i> x <i>intermedia</i>	SNA																																u					

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<i>Epilobium ciliatum</i>	S5						f	c	c	c	c	c	x	x	x	r			x		f	u	r	u	f	r	c		r	f	c	f		r	u	u	c	
<i>Epilobium ciliatum / coloratum</i>													r								r													r	u	u		
<i>Epilobium leptophyllum</i>	S5			r			r		c	c		r	x	x			r		x		u	r	r	r	r		f			u		u		u			u	
<i>Epilobium palustre</i>	S5									f																				u								
<i>Epilobium parviflorum</i>	SNA											r		x							r																	
<i>Ludwigia palustris</i>	S5	u			r			c	l		l		x	x	x						r		u	r			r									u	c	
<i>Oenothera biennis</i>	S5						u	r	f			u			x						f		r	x	f	l			l			l			r	l		
<i>Oenothera biennis / parviflora</i>														x																								
<i>Oenothera parviflora</i>	S4 ?	r											x										r	x							u				r			
<i>Oenothera perennis</i>	S5									r		r		x			r		x				u							r	r							
Cornaceae																																						
<i>Cornus alternifolia</i>	S5	u		f			u				c	u	x	x	x		r	u	x			l				u	l	c				f	u		r	f	c	
<i>Cornus canadensis</i>	S5	l	c	c	c		c	c		l	c	c	x	x		f	c	c	x	u	c	c	f	c		f	c	l	f	c	c	c	c	f	c			c
<i>Cornus rugosa</i>	S4						r	c	rl	l		c	x	x						r				x	l	u	c		l	c	c		r	c	c		c	
<i>Cornus sericea</i>	S5			l			c		c	c	c	c	x	x	x		r		x	c	c			c	c	c		c	u	c			f	c	f	c	f	
Viscaceae																																						
<i>Arceuthobium pusillum</i>	S5									r			x											r	r								u			r		
Aquifoliaceae																																						
<i>Ilex verticillata</i>	S5	l		l	l			rl	c			r	x	x						f	rl	l	c	c	c			c	u	l				r			c	
<i>Nemopanthus mucronatus</i>	S5		rl	rl	r			l	c	c	l		x	x			l	u		u	l	l	r	f				l	u	l	l		u	r			u	
Euphorbiaceae																																						
<i>Chamaesyce vermiculata</i>	SNA																				r		r															
Rhamnaceae																																						
<i>Frangula alnus</i>	SNA						c	r																														
<i>Rhamnus alnifolia</i>	S3								r	c							r		r	c	l	r	r	r			r									r		
Vitaceae																																						
<i>Parthenocissus sp.</i>	SNA																																					

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Linaceae																																						
<i>Linum catharticum</i>	SNA	r		r				u			r	c	x	x					x				r	f		c								u		f		
Aceraceae																																						
<i>Acer negundo</i>	SNA	r																																				
<i>Acer pensylvanicum</i>	S5			rl	c		c	l			c	c	x	x		f	c	f	x		l	c	f	f	c	c	c	c	f	c	c	c	f	c	c	f	f	
<i>Acer rubrum</i>	S5	c	c	c	c		c	c	c	c	c	c	x	x	x	c	c	c	x	u	c	c	c	c	c	c	c	c	c	c	c	c		c	c	c	c	
<i>Acer saccharum</i>	S5	c	c	c	c		f	l			c	f	x	x	x	f		c	x	u	l	c	c	r	c	f	x	c	c	c	c	c	c	c	c	c	c	
<i>Acer spicatum</i>	S5			u			u		r		u	c	x		x	f	f	f	x	u		r				f	f	f	r	c	c	c	c	c	r	f	f	
Anacardiaceae																																						
<i>Rhus typhina</i>	S4																																					
	S5	r		r				r	r		r	r	x																									
<i>Toxicodendron rydbergii</i>	S5		r	r				c		c	f	r	x	x										r										r	u			
Oxalidaceae																																						
<i>Oxalis montana</i>	S5	c	c		c			c	u			u	x			f	c	f	x	u	r	f	c			u	f	c	u	c	c	f				u		
<i>Oxalis stricta</i>	S5				f		c	f			f		x	x	x	u		r	x			f	u									f	f	r		u	c	
Geraniaceae																																						
<i>Geranium robertianum</i>	S4										u	c	x	x	x			u	x					x		r		u	r		r		u	r	r	u		
Balsaminaceae																																						
<i>Impatiens capensis</i>	S5	c	c	l	c		c	c	c	c	c	c	x	x	x	u	c	f	x		c	c	c	c	c	u	u	c	f	f	c	f	u	c	c	u	c	
Araliaceae																																						
<i>Aralia hispida</i>	S5		r																																			
<i>Aralia nudicaulis</i>	S5	c	c	c	c		c	c	c	l	c	c	x	x	x	f	c	c	x	u	c	c	c	c	f	f	l	c	c	c	c	c	c	f	c	c	f	c
<i>Aralia racemosa</i>	S4																									r										r		
Apiaceae																																						
<i>Aegopodium podagraria</i>	SNA			r																				r														
<i>Angelica sylvestris</i>	SNA															r					r								r	r	r	r			r		r	
<i>Cicuta bulbifera</i>	S5	c		r	r				c		f	u	x											u	u		u		r	u		u		f	r	u		
<i>Cicuta maculata</i>	S5							c				r	x	x																		r						
<i>Daucus carota</i>	SNA	l	r	l				r	r	r	u	r	x	x	x	r	r				u	r	u	f	r	u	l			r		l		f		u	r	
<i>Heracleum maximum</i>	S5										r		x	x	x	r			x							u		r				u	u	f		f		

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<i>Hydrocotyle americana</i>	S5				r						r			x		r	r		x			r	f														
<i>Ligusticum scoticum</i>	S5												x	x																	l	l			r		
<i>Osmorhiza berteroi</i>	S4																					r															
<i>Osmorhiza claytonii</i>	S4																									r			r								
<i>Osmorhiza longistylis</i>	S2														r																						
<i>Pastinaca sativa</i>	SNA												x	x																							
<i>Sanicula marilandica</i>	S4											r	x			r	r		x			r											r				
<i>Sium suave</i>	S5	c	c		r				c		c	c	x	x	x						f		f	u	f	u		c	r	f	f	c		r		u	f
Gentianaceae																																					
<i>Bartonia paniculata</i> ssp. <i>iodandra</i>	S4 S5 S2																					r	r		r												
<i>Halenia deflexa</i>	S3															f			r																		
Apocynaceae																																					
<i>Apocynum androsaemifolium</i>	S5	c		f															x																		r
<i>Apocynum cannabinum</i>	S4							c					x		x																						
Asclepiadaceae																																					
<i>Asclepias incarnata</i>	S4																							c					x								
<i>Asclepias incarnata</i> ssp. <i>Incarnata</i>	S4													x																							
<i>Asclepias incarnata</i> ssp. <i>pulchra</i>	S3 ?								l											r					r		r		r								
Solanaceae																																					
<i>Solanum dulcamara</i>	SNA	u		c	f		c	c	f	u	c	c	x	x	x	u	u				f	r	f	f	f	u	u	c	u	u	c	f	u			f	c
Convolvulaceae																																					
<i>Calystegia sepium</i>	S5	c						c					x	x	x									r		l			l		l	l		r	l		
Cuscutaceae																																					
<i>Cuscuta</i> sp.													r																								
Menyanthaceae																																					
<i>Menyanthes trifoliata</i>	S5																						r														

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Boraginaceae																																					
<i>Echium vulgare</i>	SNA										r																										
<i>Myosotis arvensis</i>	SNA											r																									
<i>Myosotis laxa</i>	S5	rl					f	c			c	c	x	x	x	u	f		x		l		f	f	f	u	l	f	f	u	f	l				c	c
<i>Myosotis scorpioides</i>	SNA												x																		r						
<i>Myosotis sp.</i>																													r			r					
Verbenaceae																																					
<i>Verbena hastata</i>	S3					u							r		f																						
Lamiaceae																																					
<i>Clinopodium vulgare</i>	S5											u	x	x	x			r	x															r			
<i>Galeopsis tetrahit</i>	SNA	f					c	c			r	u	x	x	x	u			x		c	f	r	r	f	f		f	f	c	f	f				r	f
<i>Glechoma hederacea</i>	SNA																								r												
<i>Lycopus americanus</i>	S5			u				f	f					x	x	r	u						r	f	f				r	c				f			u
<i>Lycopus uniflorus</i>	S5	c	c		u				f	c	c	f	x			f	u		x	f	u	c	c	c				c	u			c	u	c	f	f	c
<i>Mentha arvensis</i>	S5	r		r				c	c		u	u	x	x	x	u	f			r			f	c	f			f	r	f	f	r		c	f		c
<i>Mentha x piperita</i> or other hybrid	SNA										r								x					r		r										r	
<i>Prunella vulgaris</i>	S5	c	c	u	c		c	r		r	c	c	x	x	x	u	u	u		u	c	u	c	u			f		u		c	c	u	c	c	f	f
<i>Scutellaria galericulata</i>	S5	c	c	c					c		c	u	x	x	x			u	x		f	r	u	f	c			u	u	c	c	c		f	r	u	c
<i>Scutellaria lateriflora</i>	S5	c	c	c	r		r	c		c	c		x		x		f		x	r		c	u		c	u		c	r	c		c				l	c
<i>Stachys palustris</i>	SNA												x																								
<i>Teucrium canadense</i>	S3												r	f															r			r					
<i>Thymus pulegioides</i>	SNA						r																														
Callitrichaceae																																					
<i>Callitriche palustris</i>	S5											r		x													u										
<i>Callitriche sp.</i>		f						u			x		x		x	r					r				r	r	r	r		f	r		x			r	c
Plantaginaceae																																					
<i>Plantago lanceolata</i>	SNA	u		r			r				l	u	x	x	x	r	r		x		r		u	f	r			u	r	r	u	u	u	u	r	u	
<i>Plantago major</i>	SNA	l	r	l	r		u	u			u	c	x	x	x	r	l		x	l	l		u	u	r			f	r	r		c		f	u	l	c

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Species	S-r	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
<i>Plantago maritima</i> var. <i>juncoides</i>	S5	c												x											r						r						
Oleaceae																																					
<i>Fraxinus americana</i>	S5	c		l	f		c	l	l	rl	c	c	x	x	x	f	c	c		u	f	c	c	u	r		l	l	f	r		c	c	f		u	u
<i>Fraxinus nigra</i>	S1																																				
	S2			r						c	r				r									r			r						r				r
Scrophulariaceae																																					
<i>Chaenorhinum minus</i>	SNA												x																		r						
<i>Chelone glabra</i>	S5		c	u			r		u	c		u	x	x	x	u	f	u	x			r		r	c		r		r			u				f	c
<i>Euphrasia nemorosa</i>	S5																								u											u	
<i>Euphrasia stricta</i> / <i>nemorosa</i>	SNA						r	r	l			u		x						r	r	u	c	r				r		r	r		f				
<i>Linaria vulgaris</i>	SNA												x	x	x										u											u	
<i>Melampyrum lineare</i>	S5	u	f																															f			
<i>Mimulus moschatus</i>	SNA																	l													r						
<i>Mimulus ringens</i>	S4 S5							r							x								u								r						r
<i>Odontites vernus</i> ssp. <i>serotinus</i>	SNA																				r																
<i>Rhinanthus minor</i>	S5	r										r	x	x																							
<i>Verbascum thapsus</i>	SNA			c			f					r	x											r		r										l	
<i>Veronica americana</i>	S5						r				r						r	u	x							r											
<i>Veronica arvensis</i>	SNA												x																								
<i>Veronica officinalis</i>	S5	c	u	c			c	c	c		c	c	x	x	x	u	c		x	u	f	c	u	r	f	u	c		c	f	f	c	u	r	f	c	c
<i>Veronica scutellata</i>	S5							r																													
<i>Veronica serpyllifolia</i> ssp. <i>serpyllifolia</i>	SNA	r	r				r	r					x	x					x			r	r	r		r					r		r				f
Orobanchaceae																																					
<i>Epifagus virginiana</i>	S4														x								u			r			r								
Lentibulariaceae																																					
<i>Utricularia cornuta</i>	S5																			f		r	f														
<i>Utricularia geminiscapa</i>	S4																			r																	

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<i>Utricularia intermedia</i>	S5										r									u	r	l	c	f												u	r
<i>Utricularia macrorhiza</i>	S5				r				u															r						r					r		
<i>Utricularia minor</i>	S4													x																							
Campanulaceae																																					
<i>Campanula rotundifolia</i>	S5						r	u				f	x																r	r			r		r		
<i>Lobelia inflata</i>	S5								r	r								r		r			r							r	u						
<i>Lobelia kalmii</i>	S2																			r	u		r	r													
Rubiaceae																																					
<i>Galium aparine</i>	S2 S3												r																								
<i>Galium asprellum</i>	S5	c	c	c				c	c	c					x	r	u		x		l		c	c	f	u	f			c						u	c
<i>Galium labradoricum</i>	S2									c														r													
<i>Galium mollugo</i>	SNA											u	x	x	x	u													r								
<i>Galium palustre</i>	S5	f	f	c				f	f		f	c	x	x	x	u			x		u			r		u	f	f		c	f	f					c
<i>Galium tinctorium</i>	S5	c		r				f	f												r										r						
<i>Galium tinctorium / trifidum</i>	S5								r													c	r					f	f								
<i>Galium trifidum</i>	S5											c	x											u											c		
<i>Galium trifidum ssp. halophilum</i>	SN R																												r		r						
<i>Galium trifidum ssp. trifidum</i>	S5	c	c	f	r		u			c	f						r	u		u					c		f	f	u	f		c				l	c
<i>Galium triflorum</i>	S5	c								f	c	c	x	x		r		r	x			c	r		u	u	f		u	f	f	f		r	u	u	r
<i>Houstonia caerulea</i>	S5	r								r											r																
<i>Mitchella repens</i>	S5	c	c	f	c		f	c	r	r	c	u	x	x		f	r	u	x		u	u	r	u				u				u	f	f			c
Caprifoliaceae																																					
<i>Diervilla lonicera</i>	S5		f	f			u	c	c	r	u	u	x	x					x							u			f	c			u	r	f	u	
<i>Linnaea borealis ssp. americana</i>	S5	c	c		c				c	l	c	c	x	x		f	f			f	f	c	c	c	c	f	c	c	l	c	c	c	f	c	c	u	c
<i>Lonicera canadensis</i>	S5 S4 S5	u	f	f	c			c	c	r	u	f	x	x		u	u	f	x	f	f	f	r	r	u	f	c	c	c	c	u	c	c	f	c	f	r
<i>Lonicera villosa</i>	S4 S5	l							c	c										f	r	u	f	c	r		l									u	
<i>Lonicera x xylosteoides</i>	SNA																																	u			

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<i>Sambucus nigra</i> ssp. <i>canadensis</i>	S5	r							u	c	f				x		r															c					
<i>Sambucus racemosa</i>	S5			c				r	c			c	x	x	x		u		x			f	u		f	u	c	c	u	c	c			u	f	u	
<i>Sambucus racemosa</i> ssp. <i>pubens</i>	S5																	u		r									u				u				
<i>Triosteum aurantiacum</i>	S2 S3												r		c																						
<i>Viburnum lantanoides</i>	S5						f	l			u					f	f	f	x			r	r														f
<i>Viburnum nudum</i> var. <i>cassinoides</i>	S5	c	l	c	c		c	c	c	c		r	x	x			l			f	f	c	r	f	c	u	rl	c	u	c		u		c	c		l
<i>Viburnum opulus</i>	S4																									r										r	
<i>Viburnum opulus</i> var. <i>americanum</i>	S4									u		r	x		x						u			r				r			u			c	f		f
Valerianaceae																																					
<i>Valeriana officinalis</i>	SNA						u																														
Asteraceae																																					
<i>Achillea millefolium</i>	S5	l		c				u	c	u		u		x									r	r	f	u		r	c	u	f	l	u	u		r	r
<i>Achillea ptarmica</i>	SNA												x																		r						
<i>Ambrosia artemisiifolia</i>	S5	l										r	x																								
<i>Anaphalis margaritacea</i>	S5	c	u	c			c	f	f	r	c	f	x	x		u	c		x	l	u	r	f	f	f	u	r	u	f	r	f	f	r	u	u	u	f
<i>Antennaria cf. neglecta</i>	SN R													r																							
<i>Antennaria howellii</i>	S4 ?			r			r	r	c	r	r		x													r											
<i>Anthemis cotula</i>	SNA	r																																			
<i>Arctium lappa</i>	SNA																																				u
<i>Arctium minus</i>	SNA	l					c				l	c	x	x	x	r		r	x					x				rl	r					r			
<i>Artemisia stelleriana</i>	SNA													x												r					r				rl		
<i>Artemisia vulgaris</i>	SNA	r													x																						
<i>Bidens cernua</i>	S5							c	f		l		x	x														r			r						
<i>Bidens connata</i>	S4				r			c	l	r	u	c	x												r												
<i>Bidens frondosa</i>	S5	f						f			c	u	x	x	x								r	u		u		l	f			r				r	
<i>Centaurea nigra</i>	SNA	l	f	c	c			c	f	u		x	x	x	x	f	u		x	l	c	r	x	c	c	u	l	c	l	u	f	c	f	c	c	f	c

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<i>Cichorium intybus</i>	SNA	r		r																				r													
<i>Cirsium arvense</i>	SNA	rl	f	r					r		l	u	x	x	x	r			x		u		u	f	u	u	u		u	l	f	f		c	l	r	c
<i>Cirsium muticum</i>	S5																r						r					r									
<i>Cirsium palustre</i>	SNA	r			r																	r					r										
<i>Cirsium vulgare</i>	SNA	r						r				r		x			r				r		r	x	r				r	r	r						
<i>Conyza canadensis</i>	S5	l							r					x									u	u	r				r	l	r	l		u			r
<i>Dittrichia graveolens</i>	SNA																																				
<i>Doellingeria umbellata</i>	S5	c	c	c	c		c	c	c	c		c	x	x	x	f	c		x	f	c	c	c	c	c	f	c		c	c	c		f	c		f	c
<i>Erechtites hieraciifolia</i>	S5	r										r					r		x		r			r													
<i>Erigeron annuus</i>	S4 S5							r				u	x																								
<i>Erigeron hyssopifolius</i>	S3				r						l		r											r		u			r			r	u	l			
<i>Erigeron strigosus</i>	S5	l		rl				x	l	r	f	r	x	x	x				x		r		x	u			l		r			c				u	r
<i>Eupatorium maculatum</i>	S5								c	c	c	c	x	x	x	f	f		x	f	c	l	f	c	c	f	c		r	c	c			c	c	f	c
<i>Eupatorium perfoliatum</i>	S5		c									u		x		r	r			u	r		r	r	r	r			r						c	c	
<i>Eurybia macrophylla</i>	S5	f	f	f			r	f	f	u			x	x								r															
<i>Eurybia radula</i>	S5							u		f										f	u		u	f			u					r				c	
<i>Euthamia graminifolia</i>	S5	c	c	c	c		c	f	c			c	x	x	x	u	c	r	x	l	f	r	u	c	l	u		c	c	l	c	c	u	c	c	l	c
<i>Gnaphalium uliginosum</i>	SNA	u					r	c					x		x	r				r			r	x	r					rl		f		r		l	
<i>Helianthus tuberosus</i>	SNA																													r							
<i>Hieracium aurantiacum</i>	SNA													x	x														r								
<i>Hieracium aurantiacum / caespitosum</i>	SNA											u	x	x					x				r											u			
<i>Hieracium caespitosum</i>	SNA			c			c	f	f		c	r		x		r						f					f		r	f	c	c			r	f	f
<i>Hieracium canadense</i>	S4 S5													x			r														r			u	u		
<i>Hieracium cf. tridentatum</i>	SNA																			x																	
<i>Hieracium lachenalii</i>	SNA		rl	f			c	c	c		c	c	x	x	x	u	u	u	x			f	u	r	l	f	c		c	u	c	c		r	r	c	c
<i>Hieracium murorum</i>	SNA	r																											u		r	r				r	u
<i>Hieracium pilosella</i>	SNA	l								u		f	x	x	x		u						u	r	f			u	f	l	l	r		f	f		f

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<i>Hieracium piloselloides</i>	SNA	u										x	x	x																							
<i>Hieracium piloselloides</i> / <i>x floribundum</i>	SNA								x																												
<i>Hieracium scabrum</i>	S5							r																	r			r	r		u	r	r	r			
<i>Hieracium</i> sp.	SNA																							r													
<i>Hieracium x flagellare</i>	SNA				f				c												r				u			u				r					
<i>Hieracium x floribundum</i>	SNA			u			f	f											x												f						
<i>Hypochaeris radicata</i>	SNA																																	u	r		
<i>Inula helenium</i>	SNA																								r												
<i>Lactuca biennis</i>	S5								r			r	x	x	x	r									r	r			r								
<i>Lactuca canadensis</i>	S5				r	r						u	x	x											r	r											
<i>Lactuca serriola</i>	SNA											r																	r								
<i>Lapsana communis</i>	SNA												r		x																						
<i>Leontodon autumnalis</i>	SNA	l			u						l	r	x	x	x				x	l			u	c		l			r		u	r		c	r		
<i>Leucanthemum vulgare</i>	SNA		r	c	r		r	u	c			u	x	x	x	u	u		x		l		r	f	u	f	l	c	u	l	c	c	u	u	u	u	
<i>Matricaria discoidea</i>	SNA						r					r												x	r			r		l		l		r			r
<i>Oclemena acuminata</i>	S5	c	f	c	c		c	u	u	f	c	c	x	x	x	u	c	f	x	u	f	c	c	c	f	f	l	c	c	f	c	c	f	c	c	u	f
<i>Oclemena nemoralis</i>	S5				r														f	r	l	r	u	r					c	rl					l		
<i>Oclemena x blakei</i>	S5																						u	r								r				r	
<i>Omalothea sylvatica</i>	S4 S5																	r	x																		
<i>Packera aurea</i>	S4																			u		r	c														
<i>Packera paupercula</i>	S3					l					l	f	r	r										r		c			u	l			r	r	l		
<i>Packera schweinitziana</i>	S4								c	c		u	x	x		r		x	u	rl	rl	u	r	l		l			rl								r
<i>Petasites frigidus</i> var. <i>palmaris</i>	S4	u	u		u																																
<i>Prenanthes altissima</i>	S5								r			f	x	x		u		u	x				u	u		f		r	u			u	f		u		
<i>Prenanthes trifoliolata</i>	S5	c	c	f	l			c		r	r					u	u				u	r		r	u	u		f	r	l		u			u	u	f
<i>Rudbeckia hirta</i> var. <i>pulcherrima</i>	SNA									r																						r					
<i>Senecio jacobaea</i>	SNA										r	r	x	x	x	r			x		r		r	r		r	f		l	r	f	c	r	r	r		r

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<i>Senecio viscosus</i>	SNA								r				x																				l					
<i>Senecio vulgaris</i>	SNA												x																									
<i>Solidago bicolor</i>	S5	c	f	c			c	c	u	f	c		x		x											r								r	f	f		
<i>Solidago canadensis</i>	S5	f	c	c	c		f	c	c	c	c	c	x	x	x	u			x	l	c	f	c		c	l	c	c	f	c	c	c	c	u	c	c	l	c
<i>Solidago flexicaulis</i>	S5			c			r	c	r		l	f	x	x	x	f	f	c	x		u	c	f			f	f		c	c	l	l	c	c	c	c	c	c
<i>Solidago gigantea</i>	S5			r	r			u				r	x	x							r		r	u												u	u	
<i>Solidago juncea</i>	S5											u	x	x	x									x														
<i>Solidago macrophylla</i>	S4															r			x			r												r				
<i>Solidago nemoralis</i>	S4 S5	r	f	u					f	r	u																											
<i>Solidago puberula</i>	S5	f	c					f	f	f	c	f	x	x			c			r	u		f	c	f				r								f	
<i>Solidago rugosa</i>	S5	c		c	c		c	c	c	c	f	c	x	x	x	f	c		x	u	c	c	c	c	c	u	l	c	c	c	c	c	u	c	c	f	c	
<i>Solidago sempervirens</i>	S5	l											x	x											l			r		r				u	l			
<i>Solidago uliginosa</i>	S5								u	c		r					r		x	c	r	l	c	f	u		l			r							r	
<i>Solidago x erskinei</i>	SNA																																		r			
<i>Sonchus arvensis</i>	SNA	rl		r								r	x	x					x					r	r	l			l		l	l		c	c	r		
<i>Sonchus asper</i>	SNA							r					x										r											r				
<i>Sonchus oleraceus</i>	SNA												x																									
<i>Symphyotrichu m boreale</i>	S2 ?																			u	r			r														
<i>Symphyotrichu m ciliolatum</i>	S2									r																												
<i>Symphyotrichu m cordifolium</i>	S4 S5	f		f	f		f	x			c	c	x	x	x	r			x																	u		
<i>Symphyotrichu m lanceolatum</i>	S4 S5														x						r			r										c				
<i>Symphyotrichu m lateriflorum</i>	S5	c	c	f	c		c	c	c	c	f	c	x	x	x	f	f	u	x	u	f	f	c	c	c	u	f	f	f		c	c	f	c	c	f	c	
<i>Symphyotrichu m novi-belgii</i>	S5						c	c	c			r	x	x	x				x		u	r	c	c	u		f		c	u	l	l		c	c			
<i>Symphyotrichu m novi-belgii var. novi-belgii</i>	S5																									u			u							u		
<i>Symphyotrichu m puniceum</i>	S5						c	f	r	c	c	c	x	x	x	u	u	u	x	u	c	f	u	u	c	u	u	f	r	f		f			u	u	c	
<i>Tanacetum vulgare</i>	SNA	r										r	x		x														r									
<i>Taraxacum officinale</i>	SNA	l	r	c	u		f		u			f	x	x	x				x			r	r	u	u		f				l	u		u	u		f	

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Species	s-r	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
<i>Tragopogon pratensis</i>	SNA	l					r					u	x		x									x								r						
<i>Tussilago farfara</i>	SNA	l	f	c	c		c	c	f	u	c	c	x	x	x	c	c	u	x	l	c	f	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c	c
<i>unknown cultivated and escaped asteraceae</i>	SNA	r																																				
<i>Xanthium strumarium</i> var. <i>canadense</i>	S4																										l			r								
Alismataceae																																						
<i>Alisma triviale</i>	S5	r						f					x	x		r																				u		
<i>Sagittaria cuneata</i>	S5		u		r						l		x	x							u																	
<i>Sagittaria latifolia</i>	S5							f																														
<i>Sagittaria</i> sp.													x		x																							
Hydrocharitaceae																																						
<i>Elodea canadensis</i>	S2 S3							r																														
Juncaginaceae																																						
<i>Triglochin maritima</i>	S5	l											x	x							r	r		c	r				r	r	r	l		u	rl			
<i>Triglochin palustris</i>	S4																		r				c			r						r						
Potamogetonaceae																																						
<i>Potamogeton alpinus</i>	S4														x					r					r													
<i>Potamogeton amplifolius</i>	S4										rl													r														
<i>Potamogeton epihydrus</i>	S5				r				u					x	x								c					r										
<i>Potamogeton foliosus</i>	S4 S5												r																									
<i>Potamogeton gramineus</i>	S5		l					c	c		l					r			x		r	r		r	u					r	r					c		
<i>Potamogeton natans</i>	S5								u	r	rl				x							r		r														
<i>Potamogeton oakesianus</i>	S4 S5		r																				r															
<i>Potamogeton perfoliatus</i>	S5							c					x													u		r			r					f		
<i>Potamogeton pusillus</i>	S5		r	r					r			u		x	x									r			r											
<i>Potamogeton</i> sp.									r																													
<i>Potamogeton spirillus</i>	S5							c																														

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<i>Stuckenia filiformis</i>	S2 S3																							r	r			r									
<i>Stuckenia pectinata</i>	S4 S5													x	x									f	l		rl		rl					c	rl		
Ruppiaceae																																					
<i>Ruppia maritima</i>	S5												x																rl			r		r			
Najadaceae																																					
<i>Najas flexilis</i>	S5								r		rl			x									r														
Zannichelliaceae																																					
<i>Zannichellia palustris</i>	S4																											r					r				
Zosteraceae																																					
<i>Zostera marina</i>	S5												x																			l	l			l	
Acoraceae																																					
<i>Acorus americanus</i>	S4	l						r					x	x															r								
Araceae																																					
<i>Arisaema triphyllum</i>	S4 S5	c						c	r					x	x																						
<i>Arisaema triphyllum</i> ssp. <i>triphyllum</i>	SN R						c																														
<i>Calla palustris</i>	S4				u					r										r					r			r									
Lemnaceae																																					
<i>Lemna trisulca</i>	S4										r	r																					r				
<i>Lemna turionifera</i>	S5	l		r				r	r		l	c	x	x										r		u			r	r	r	u					
<i>Spirodela polyrrhiza</i>	S4 ?										rl																										
Eriocaulaceae																																					
<i>Eriocaulon aquaticum</i>	S5				r															f	r			f	r				r								
Juncaceae																																					
<i>Juncus acuminatus</i>	S3 S4							r																													
<i>Juncus alpinoarticulatus</i> ssp. <i>nodulosus</i>	S1 S2																										r										
<i>Juncus articulatus</i>	S5							r		r		u	x		x	u		r	x	l	r		r	f	r		r	r	u	r	r	u	c	f	f	r	
<i>Juncus balticus</i> var. <i>littoralis</i>	S5			r								r	x	x										r							l			c	c		

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<i>Juncus brevicaudatus</i>	S5		f						c	f		r		x			r			u	r	u		u				f	r	c	f	f					c
<i>Juncus bufonius</i>	S5							r				r	x										r						r								
<i>Juncus canadensis</i>	S5				u				c		f	r					r			u	u	r	r	f	r		r		u	r					r	f	r
<i>Juncus cf. canadensis x articulatus</i>																								u													
<i>Juncus dudleyi</i>	S3						r																	r													
<i>Juncus effusus</i>	S5	u	c	l	f		r	c	c	c	f	c	x	x		r	f	l	x	u	c	u	c	c	c		c	c	f	f	c	c	r		r	u	c
<i>Juncus effusus</i> var. <i>conglomeratus</i>	S4 ?							r																													
<i>Juncus filiformis</i>	S5	l																										u									
<i>Juncus gerardii</i>	S5	l											x	x																	l	l			r	r	
<i>Juncus militaris</i>	S5																						r	r													r
<i>Juncus nodosus</i>	S4									r		r					r				r	r		r			r			r					r	r	
<i>Juncus pelocarpus</i>	S5								l													r		r	r				r								
<i>Juncus sp.</i>					r																																
<i>Juncus tenuis</i>	S5	c		r	c		r	f				c	x		x		c	l	x	l	r	r	u	c	u			f	f	u	r	f			u	l	
<i>Luzula acuminata</i>	S5	f	c	l	f		c		u				x		x												c										f
<i>Luzula luzuloides</i>	SNA																												l								
<i>Luzula multiflora</i>	S5	c	c	f	c		u	c			c	f	x	x	x		f		x			f	r	r	c	u			f		c	c		u	f	r	
Cyperaceae																																					
<i>Carex aquatilis</i>	S5	c							c	r										u	r	r	f	c	rl		l		r	l		r		c			
<i>Carex arctata</i>	S5		r	c	u		c				c	f	x	x		r		x								u			u	c		c		u		f	
<i>Carex atlantica</i> ssp. <i>atlantica</i>	S4	r			r				c													r		u													
<i>Carex atlantica</i> ssp. <i>capillacea</i>	S4																											r									
<i>Carex aurea</i>	S4												x																							r	
<i>Carex aurea / garberi</i>											r																										
<i>Carex bebbii</i>	S2																							r													
<i>Carex bromoides</i>	S4							u					x		x																						

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<i>Carex brunnescens</i> ssp. <i>sphaerostachya</i>	S5	c	c	c	f		u	f	f	c	c					f		x			f	r	r	f		c	c			r	c		u	f		c	
<i>Carex buxbaumii</i>	S4																																				r
<i>Carex canescens</i>	S5				r							f	x			r				u				u			u	r				r				r	
<i>Carex castanea</i>	S2									r																											
<i>Carex cf. lurida</i> x <i>lupulina</i>												x																									
<i>Carex communis</i>	S5	f		u				f	r		u	r	x	x					x				c					u			f		r			r	
<i>Carex crawfordii</i>	S5			r																							r										
<i>Carex crinita</i>	S5	c	c		u		c	f	c				x	x	x	u	f			u	f						f	u			c	f		r			
<i>Carex cryptolepis</i>	S3 ?									r													r										r			r	
<i>Carex debilis</i> var. <i>rudgei</i>	S5	c	c		c				c	r	f		x			u		x		f			c							c	u		u			u	
<i>Carex deflexa</i>	S4	r	f		c		u	u					x	x																							
<i>Carex deweyana</i>	S5										r		x										r			r			r			r		u		u	
<i>Carex diandra</i>	S4										r	r												r		r											
<i>Carex disperma</i>	S5	c		rl			r		r	l		r																		u							
<i>Carex eburnea</i>	S3					r					r	r												r		c			r	l			r	u	l		
<i>Carex echinata</i>	S5				r				r				x			r				r			r	u				r	r		r					r	
<i>Carex exilis</i>	S4																			u	r	l	u	u	r												
<i>Carex flacca</i>	SNA			u																																	
<i>Carex flava</i>	S5	r	f		f			u	c	c		r	x	x		u	r		x	f	r		r	c	u		rl			f		u			c	c	
<i>Carex flava</i> / <i>viridula</i> var. <i>elator</i>																																					
<i>Carex folliculata</i>	S5		f					u		r													r													r	
<i>Carex gracillima</i>	S4																																				
<i>Carex granularis</i>	S5	f		f	r		f					f	x		x				x			c			r		r			r			r		r	f	
<i>Carex grisea</i>	S1																																				
<i>Carex gynandra</i>	S5	c	c		c		u	c	c	f	c	c	x			u	c	u	x	r	f	c	c	u	f		f			r	f	c	u			l	c
<i>Carex gynocrates</i>	S1									r											r																
<i>Carex hirtifolia</i>	S2 S3														r																						

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<i>Carex hormathodes</i>	S4 S5	l											x	x															u	r	r	r						
<i>Carex hystericina</i>	S2 S4 S5																																				r	
<i>Carex interior</i>	S5	l	c	rl	r				l	c	r	r	x				rl		x	u	f	l	c	c			l	rl	r	r	u	l					u	l
<i>Carex intumescens</i>	S5	c	c	f	u		f	f	f	r	c	f	x	x	x	f	c	u		u	r	c	c	c	c	x	f	c	u	f		c	f	c		f	c	
<i>Carex lacustris</i>	S4	l		r					c											u				c	r		r			r								
<i>Carex lasiocarpa</i> var. <i>americana</i>	S5										r								x	c		rl	c		l				r							c	rl	
<i>Carex leptalea</i>	S5		c	rl	l			r	u	l		u	x	x				r	x		c	u	f	c	f	u			r							u	r	
<i>Carex leptoneuria</i>	S5		f		u				f					x	x		f						r	f				f	f		c				u		u	
<i>Carex lucorum</i>	S4				r																																	
<i>Carex lupulina</i>	S3	r	l							r	r	r																										
<i>Carex lurida</i>	S5	u	f					u	c	u		x	x			r					r																f	
<i>Carex magellanica</i> ssp. <i>irrigua</i>	S5									r									u	r	l		r	rl			r			r								
<i>Carex nigra</i>	S5	r	l	u								f	x	x										r				u			r	r				r		
<i>Carex novae-angliae</i>	S5	u							u			u	x			c				u	f	f	r	u		r		r			u	f					u	
<i>Carex paleacea</i>	S5	l											x																		l	r		f	r			
<i>Carex pallescens</i>	S5	u		u				f				r		x									r					u		r						r		
<i>Carex panicea</i>	SNA											r		x																								
<i>Carex pedunculata</i>	S4	rl	r		u		f	u	r			u	x		x	u		f	x			r										u	r		x			
<i>Carex</i> poss. <i>peckii</i>												r																										
<i>Carex</i> poss. <i>rostrata</i> x <i>utriculata</i>																							r															
<i>Carex projecta</i>	S5	f	u	l	c			c	u		c	u	x	x	x		r		x	r					f		u	u		f								
<i>Carex pseudocyperus</i>	S4 S5		r	u	r			r	f	c	c	c	x	x		u	u			u	u			f	r	u		u	r	r	u	f	u	c	u	u	c	
<i>Carex radiata</i>	S4							l							x																							
<i>Carex recta</i>	S4 ?	r																																				
<i>Carex retrorsa</i>	S4							r				r	x	x	x										r	r		r									u	
<i>Carex rosea</i>	S3					r										r																						
<i>Carex scabrata</i>	S5						r					u				f	u	f	x			f	c				c	u	r			r	u	u		f	u	

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Species	s-r	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36		
<i>Carex scoparia</i>	S5	f	r	f	f		r	f	f	u		c	x	x	x		r						f	f	r				r	r	r	u							
<i>Carex silicea</i>	S4 S5																																				l		
<i>Carex spicata</i>	SNA			f																																			
<i>Carex stipata</i>	S5	c	c	u	r		f		c	f	f	c	x				f				f		u	u	r		u		r	r	c	r				r	u		
<i>Carex stricta</i>	S5	c	c						c								r					r	u				c												
<i>Carex tonsa</i>	S5						r																																
<i>Carex tonsa</i> var. <i>rugosperma</i>	SN R										r																												
<i>Carex torta</i>	S5		l				f				r				x	c																u	r		u	l			
<i>Carex tribuloides</i>	S3 ?		r	r																									r										
<i>Carex trisperma</i> var. <i>billingsii</i>	S4 ?							r																				r				r							
<i>Carex trisperma</i> var. <i>trisperma</i>	S5	c	c	rl	r			rl	rl	c		u	x	x		u	rl			f	f	l		r	rl			l	r	c	l	l							
<i>Carex tuckermanii</i>	S2	r	u																									r											
<i>Carex umbellata</i>	S4												x																										
<i>Carex utriculata</i>	S5				r			u	l	c									x	u	r	rl	f	f	r											r			
<i>Carex vacillans</i>	S1 S3 S4																																		r				
<i>Carex vesicaria</i>	S5							f				r																u											
<i>Carex viridula</i> ssp. <i>viridula</i>	S4																							r										c			r		
<i>Carex viridula</i> var. <i>elator</i>	S1																							r			r												
<i>Carex vulpinoidea</i>	S4 ?			r	r			r					x	x							r			u															
<i>Carex wiegandii</i>	S3	r																																					
<i>Cladium mariscoides</i>	S5																			f	r		f	c	r		rl												
<i>Dulichium arundinaceum</i>	S5		c		r															u			u	r												u	r		
<i>Eleocharis acicularis</i>	S5							u	l		u		x																								l		
<i>Eleocharis elliptica</i>	S5																		x				r	f															
<i>Eleocharis erythropoda</i>	S1																															r							
<i>Eleocharis halophila</i>	S4 S5												x	x										r					r		r				u	r			
<i>Eleocharis obtusa</i>	S5						r	r				r		r	x		r		x		r			r			r			u							f		
<i>Eleocharis palustris</i>	S5			rl	r				c		l		x	x					x				r			u	r	r	r	rl				r				rl	

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Species	s-r	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
<i>Eleocharis parvula</i>	S4												x																r					r				
<i>Eleocharis robbinsii</i>	S4				r																															r		
<i>Eleocharis tenuis</i>	S5							u								u	r										rl									u	r	
<i>Eriophorum angustifolium</i>	S5		r																	u																		
<i>Eriophorum tenellum</i>	S4 S5				r												r			r																		
<i>Eriophorum vaginatum</i> var. <i>spissum</i>	S5		r							l														r														
<i>Eriophorum virginicum</i>	S5				r			rl									r				r	l	r	u	rl			r		r								
<i>Eriophorum viridicarinatum</i>	S4									u							r			r																		
<i>Rhynchospora alba</i>	S5		r		r												r			c	r	l	c	c	r		l											r
<i>Rhynchospora fusca</i>	S4																				r																	
<i>Schoenoplectus acutus</i>	S4	l		r									x							f	r	r	r	f	l		l		rl	u				c	l		r	
<i>Schoenoplectus maritimus</i>	S4 S5	c											x																					r	rl			
<i>Schoenoplectus pungens</i>	S5												x										r	f										c	l	r		
<i>Schoenoplectus subterminalis</i>	S5																						r														r	
<i>Schoenoplectus tabernaemontani</i>	S5	l						u	r				x													r			r							l	r	
<i>Scirpus atrocinctus</i>	S5	r	u	u	r		f				l	r			x		r				u							f	r	r	u					r	f	
<i>Scirpus</i> cf. <i>cyperinus</i> x <i>atrocinctus</i>	SNA						r	r												r						r	r	r			r							
<i>Scirpus cyperinus</i>	S5	c		f	c		f	c	c	f	f	c	x	x	x	u	f	u		u	c	c	c	c	c		f	c	c	c	f	c	u	c		f	c	
<i>Scirpus hattorianus</i>	S5	f	u	f	f		r	c		r	r	f	x					r	x	l	r	u	u	c					u		f					l	f	
<i>Scirpus microcarpus</i>	S5			r				u				r	x	x		r	r		x		u			r	u		r	u									r	
<i>Scirpus pedicellatus</i>	S2 ?							r																														
<i>Trichophorum alpinum</i>	S4																			f	r		f				rl											
<i>Trichophorum caespitosum</i>	S5																			x	r	l																
Poaceae																																						
<i>Agrostis capillaris</i>	SNA	r		l	f			u		r	c	f	x		x	r	l		x	l		r	f	c					r	rl	f	u		c		l	c	
<i>Agrostis gigantea</i>	SNA							r		r	l		x			r					r		u	u	r		r	r		r		l		u	r			

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<i>Agrostis perennans</i>	S4 S5	r	r															r				r	r														u	
<i>Agrostis scabra</i>	S5	c			r		c	f	r		f	r	x				u			r		r	f	f	u		u	f	r	r	r			r				
<i>Agrostis stolonifera</i>	S5	c	l	r						r	l	c	x	x	x		r		x		r			u	f	r		c	u	c	l	u		c	c	u		
<i>Alopecurus aequalis</i>	S3											u																										
<i>Alopecurus geniculatus</i>	SNA																																				r	
<i>Alopecurus pratensis</i>	SNA			r				r															r															
<i>Ammophila breviligulata</i>	S5													x											r				l		r	r		r	l			
<i>Anthoxanthum odoratum</i>	SNA	l	u	f	r		c	f	r		f	c	x	x	x	u	r		x	l			u	u	r		r	r	f	rl	f	f	u	u		u	u	
<i>Brachyelytrum septentrionale</i>	S5	c	c		f			u	c	r		r	x		x	f	c	u	x	u	f	c			u	u						c	f	f		u	c	
<i>Bromus ciliatus</i>	S5	c	c				f	f	u	r		r			x	r	r		x		u	r		r			u		r	f				u	u	l	c	
<i>Bromus inermis</i>	SNA	r							r			r	x	x																								
<i>Calamagrostis canadensis</i>	S5	c	c	l	rl		l	c	c		c		x		x	f	rl		x	f		l	c	c	l	u	l	c	u	c	l	f	u	c	f	c	c	
<i>Cinna latifolia</i>	S5								u				x				c	f	x			c	c					c	r	c		f	f					
<i>Dactylis glomerata</i>	SNA	l		l							c	u	x	x	x						u		r	r	r		l		r	r	r	r	r	u	r		u	
<i>Danthonia compressa</i>	S5	f	f	f	c			f	r	f							f		x			u																
<i>Danthonia spicata</i>	S5	c	c	c	f		c	c		l	c	c	x	x	x	u		r	x		u	r	f	u	u		c	u	f		c	f	f	c	c	f	c	
<i>Deschampsia caespitosa</i>	S4							u																														
<i>Deschampsia flexuosa</i>	S5		l											x															r		u			r		r		
<i>Dichanthelium acuminatum</i>	S5				r				r			r	x	x	x		r		x				f	u			r	r				r					f	
<i>Dichanthelium boreale</i>	S5	u	f		f							r		x									u		r			r				r					f	
<i>Dichanthelium clandestinum</i>	S3							r																														
<i>Digitaria ischaemum</i>	SNA						r			r	r	u											u	x							r	r		r				
<i>Distichlis spicata</i>	S4																															r						
<i>Echinochloa crus-galli</i>	SNA																																					
<i>Elymus repens</i>	SNA			l					r				x	x	x												l	r	f	rl	f	u		r	f		u	
<i>Elymus trachycaulus</i>	S4 ?												x						x												r		u					
<i>Elymus virginicus</i>	S5							c					x	x	x									r								r					f	
<i>Festuca filiformis</i>	SNA			c			c	l		r	c	c	x	x										r	c		l		f		c	r		r	u			r

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<i>Festuca heteromalla</i>	SNA			c																																	
<i>Festuca rubra</i>	S5											r	x	x	x								r	f	r		r		u		r			r	r		
<i>Festuca trachyphylla</i>	SNA												x																								
<i>Glyceria borealis</i>	S5								f			r	x	x									r					r									
<i>Glyceria canadensis</i>	S5	f	l		u		r	c	c	f	c			x		u	u			u	f	u	u							f	c				f	l	
<i>Glyceria grandis</i>	S4	f			r			u		r		c	x	x	x		r			r							u										
<i>Glyceria laxa</i>	S4																																				
<i>Glyceria melicaria</i>	?																								u												r
<i>Glyceria striata</i>	S4										r											u						u									
<i>Hierochloa odorata</i>	S5	c	c	l	c		c	c	c	c	c	c	x	x	x	f	c	f	x	u	c	c	f	c	c	u	c	c	u		r	c	u		u	f	c
<i>Hordeum jubatum</i>	S5	r											x	x																							
<i>Leersia oryzoides</i>	S5	l					u	c	l		f	f	x	x	x						u						u		u						l	u	
<i>Leymus mollis</i>	S5													x															l		l	r					
<i>Lolium arundinaceum</i>	SNA	l	r	l	r		r			r	l	u	x	x	x							r	r	r	f	r			r	r					r		r
<i>Lolium perenne</i>	SNA	r											x														r										
<i>Lolium pratense</i>	SNA							r				u		x					x										r								
<i>Milium effusum</i> var. <i>cisatlanticum</i>	S4																												r								
<i>Muhlenbergia glomerata</i>	S4								r	c									x	r	r	r	u	c									r			r	
<i>Muhlenbergia mexicana</i>	S4								f		u				x						r											r					
<i>Muhlenbergia uniflora</i>	S5																			r	r	r	r	f			r									r	
<i>Oryzopsis asperifolia</i>	S5	f	u	c	r			f	r				x	x																		u					
<i>Panicum capillare</i>	SNA						r	r															r	r			r			r	r					r	
<i>Panicum dichotomiflorum</i>	S5																						u	x										r			
<i>Panicum dichotomiflorum</i> var. <i>dichotomiflorum</i>	S5																																				
<i>Panicum tuckermanii</i>	S3																										r						r				
<i>Phalaris arundinacea</i>	S4																						r														
<i>Phalaris arundinacea</i>	S5	c	u					c		r	l	c	x	x	x	r					l			u		u	l		l							c	

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<i>Phleum pratense</i>	SNA	l	r	l	l		r	u	r	r	f	u	x	x	x				x		l	r	r	u			l		l	r	l		r	r		u	
<i>Phragmites australis</i> ssp. <i>americanus</i>	S4	u																																			
<i>Poa alsodes</i>	S4																		x																		
<i>Poa annua</i>	SNA						r					r			x		l							r					r	rl	rl	l		r			
<i>Poa compressa</i>	SNA	r	r	c			c	l	u	r	u	f	x	x				u				r	r	u	f				u	f		r	u	f	f	r	r
<i>Poa nemoralis</i>	SNA												x		x																						
<i>Poa palustris</i>	S5			u				f				c		x	x				x				r				u	u		f				u			r
<i>Poa pratensis</i>	S5	f	c	c	u				u	r	c	u	x	x	x		u					c	r	r	r		u		c	l	l	l		u	f		
<i>Poa saltuensis</i>	S5	rl	u		u				r				x																								
<i>Poa trivialis</i>	SNA												x	x	x																						
<i>Puccinellia americana</i>	S4 S5																																				
<i>Schizachne purpurascens</i>	S4								r														r													r	
<i>Setaria viridis</i>	SNA									r																											
<i>Spartina alterniflora</i>	S5												x	x																	l	l		r	l		
<i>Spartina patens</i>	S5	l																													r	r			r		
<i>Spartina pectinata</i>	S5	c						c	c				x	x										r	u			r					c	c			
<i>Sphenopholis intermedia</i>	S4				r			r	r			u	x		x				x					x													
<i>Sporobolus vaginiflorus</i>	SNA											r	x									r		r	x					r				r			
<i>Torreyochloa pallida</i> var. <i>fernaldii</i>	S4 S5			r	r			u	l			c	x		x																						
<i>Zizania palustris</i>	SNA																																				
Sparganiaceae																																					
<i>Sparganium americanum</i>	S5				rl						f					r				u	r	r			l	l		l		l		u				l	r
<i>Sparganium angustifolium</i>	S5																					r	r				rl	r								u	
<i>Sparganium emersum</i>	S5		l									c		x			rl		x		u				r												
<i>Sparganium eurycarpum</i>	S4																												r			r					
<i>Sparganium natans</i>	S3																							r										r		r	
<i>Sparganium</i> sp.						c						x	x		x									c	c												

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Typhaceae																																					
<i>Typha angustifolia</i>	S5	r																						r									r				
<i>Typha latifolia</i>	S5	c		u	rl		l	l	c	c	l	c	x	x		r	f		x	c	c	f	c	c	c	r	l	l	f	l	f	c	u	c	l	u	l
Pontederiaceae																																					
<i>Pontederia cordata</i>	S5				r			l																													
Liliaceae																																					
<i>Asparagus officinalis</i>	SNA																												r								
<i>Clintonia borealis</i>	S5	f	c	c	c			f		f	c	c	x	x	x	u	f	f	x	u	f	u	u	c	c	f	l	f	u	l	c	c	f	c	c	f	f
<i>Convallaria majalis</i>	SNA												x																								
<i>Lilium canadense</i>	S2														r																						
<i>Maianthemum canadense</i>	S5	c	c	c	c		c	c	c	l	c	c	x	x	x	f	c	c		u	u	c	c	c	l	f	l	c	c	c	c	c		c	c	f	c
<i>Maianthemum racemosum</i>	S4 S5						r								x	u		f	x			u						u			r	f				r	
<i>Maianthemum stellatum</i>	S4																																			r	
<i>Maianthemum trifolium</i>	S5		r		r			rl		c							r			f	r	l		f	r												u
<i>Medeola virginiana</i>	S5	c	f		f								x			u		u	x			r	r	r		f	u	u	r	r		r					
<i>Polygonatum pubescens</i>	S4 S5														x																						
<i>Streptopus amplexifolius</i>	S4 S5															r		r	x			r				x		u				r				u	
<i>Streptopus lanceolatus</i>	S5		f		u							r						u	x			r	u		u			f	r	u				r			
<i>Trillium cernuum</i>	S4	u											x		x	r							r					r				r				r	
<i>Trillium undulatum</i>	S5	c	f	u												r						r			u												
<i>Uvularia sessilifolia</i>	S4 S5				r			u							x																						
Iridaceae																																					
<i>Iris versicolor</i>	S5	c	c	l				c	c	c	l	f	x	x	x	u	f		x	f		u	c	c	c						f	u		c	c	l	c
<i>Sisyrinchium angustifolium</i>	S4	l	r																																		
<i>Sisyrinchium montanum</i>	S5		r										x	x					x		r			r							r			r			
Orchidaceae																																					
<i>Calopogon tuberosus</i>	S4		r		r																			r													

SITE #1: Lower Cogmagun River, 2: Upper Cogmagun River, 3: Newport Station, 4: Greenfield, 5: Five Mile River, 6: Lime-kiln Bk., 7: Dutch Settlement, 8: Black Brook, 9: South Section, 10: Brierly Brook, 11: Fairmont, 12: Williams Point, 13: Southside Antigonish Harbour, 14: South River, 15: Lamey Brook, 16: MacLeod Brook, 17: Glen Brook, 18: MacPhail Brook, 19: Pooles Brook, 20: MacLeans Brook, 21: Lime Hill, 22: McIntyre Brook, 23: Ninevah / Little Narrows, 24: Washabuck Bridge, 25: Plaster Cove, 26: Hunters Mountain, 27: McRae Brook, 28: Beinn Bhreagh, 29: Plaister Mines, 30: South Haven, 31: St. Anns, 32: Middle Aspy River, 33: Dingwall (north of Middle Harbour), 34: Dingwall (south of Middle Harbour), 35: Georges River, 36: Frenchvale Brook																																					
Species	s-r	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
<i>Corallorhiza maculata</i> var. <i>maculata</i>	S4								r																												
<i>Cypripedium acaule</i>	S5	f	c	u	c		f	r		r	f				x	r	f			r	u	r	f	f	u			f		r				u			
<i>Cypripedium arietinum</i>	S1	r																																			
<i>Cypripedium parviflorum</i>	S2																																				
<i>Cypripedium parviflorum</i> var. <i>makasin</i>	S3										r		u				s					r		r		r				r							
<i>Cypripedium parviflorum</i> var. <i>makasin</i>	S2																																		r		
<i>Cypripedium reginae</i>	S2									l										l																	
<i>Epipactis helleborine</i>	SNA	u	u	f	c		c	c	u		f	f	x	x				u	x						f	c	u		u	c		r	u	c	f	c	
<i>Goodyera repens</i>	S3		r																											r							
<i>Goodyera tessellata</i>	S4		r																					r													
<i>Platanthera aquilonis</i>	S4 ?	r		r	r				r			r	x	x		r		r	x						r	r		r			r		u		r		
<i>Platanthera blephariglottis</i>	S4		r																					r													
<i>Platanthera clavellata</i>	S5	r	r		r							r									r	r	r	r			r				c						
<i>Platanthera dilatata</i>	S4 S5																			u				r											r		
<i>Platanthera grandiflora</i>	S3				r					r					r																						
<i>Platanthera hookeri</i>	S3				r																																
<i>Platanthera lacera</i>	S4 S5								r				u	x																						r	
<i>Platanthera obtusata</i>	S4																								r												r
<i>Platanthera psycodes</i>	S4											u	x		x								u		r						r						
<i>Platanthera psycodes</i> / <i>grandiflora</i>																													r	r						r	
<i>Platanthera</i> sp.																	r	r				r							r								
<i>Pogonia ophioglossoides</i>	S4				r															r	r		r	r	r												
<i>Spiranthes cernua</i>	S5																											r									
<i>Spiranthes cernua</i> / <i>ochroleuca</i>																																					
<i>Spiranthes lacera</i>	S5											r																									