Proceedings of the Nova Scotian Institute of Science (2012)
Volume 47, Part 1, pp. 33-57

BIOBLITZ OF THE LAKE ROSSIGNOL WILDERNESS AREA

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ABSTRACT

The Lake Rossignol Wilderness Area is a 4100 ha protected area in Queens County, Nova Scotia. In July, 2006, the Protected Areas Branch of Nova Scotia Environment invited 34 scientists, students and volunteers to conduct a four day bioblitz of this little studied protected area. Surveys were conducted for reptiles, fish, vascular plants, fungi, lichens and bryophytes. Physical and biological attributes of peatlands and dendrochronological studies were also conducted. A total of 294 species were identified during the survey, 285 of which are new records for the Wilderness Area. Dendrochronological analysis suggests trees at the site have been growing in place for at least the last 350 years.

Keywords: Lake Rossignol Wilderness Area, bioblitz

INTRODUCTION

The term bioblitz was first used during an event held at the Kenilworth Aquatic Gardens in Washington, D.C. in 1996 (Shorthouse 2010). Since then, the bioblitz has become a useful technique for scientists to rapidly assess the biodiversity of protected areas, establish new species records and in some cases identify new species to science. A new species of fungus, *Trifoliellum bioblitzii,* was found in 2009 during a bioblitz of the Blue Mountain-Birch Cove Lakes Wilderness Area in Nova Scotia. Other events have also revealed significant new

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species. For example Harper et al. (2009) described two species of a newly identified genus as a result of a marine bioblitz in New Zealand (2009). In addition to establishing new species records (for example see Lewington and West 2008, Karns et al. 2006) the bioblitz can lead to the discovery of biodiversity hotspots (Graham et al. 2010). Some bioblitzes are taxa specific such as the annual Biological Survey of Canada insect blitz (Shorthouse 2010), the Tuckerman workshop survey for lichens and bryophytes (Lendemer and Hodkinson 2009) or the more specific exotic herpeto-faunal bioblitz in Barnacle Historic State Park in 2005 (Meshaka et al. 2008).

There are several reasons for conducting bioblitzes in Nova Scotia. Foremost is to increase knowledge about the biota found in little studied protected areas of Nova Scotia. The opportunity for scientists of different disciplines to interact and learn about other specialities has often been cited by participants as an important part of the survey event. The survey can also be a useful learning experience for students and volunteers who participate.

In 2004 the Protected Areas Branch of Nova Scotia Environment, in conjunction with the Biology Department of St. Francis Xavier University, conducted the first multi-disciplinary bioblitz in Nova Scotia at Canso Coastal Barrens Wilderness Area. Ten scientists and students conducted an inventory of a variety of species groups over a single day. Since then, the Protected Areas Branch has conducted three more bioblitzes in other protected areas (Scatarie Island, Lake Rossignol, Tangier Grand Lake) ranging from two to four days.

In 2006, the Protected Areas Branch invited 34 scientists, students and volunteers to a bioblitz in the Lake Rossignol Wilderness Area. Participants conducted inventories between 26 and 29 July 2006 in a variety of disciplines. Some sampling was also conducted in 2007 and 2008.

The Lake Rossignol Wilderness Area is a 4100 ha protected area in Queens County, Nova Scotia. The area was designated in 1998 under the provincial Wilderness Areas Protection Act. This Act restricts activities such as development, forestry, mining and destruction or removal of natural materials. The Lake Rossignol Wilderness Area was designated in part to protect representative ecosystems of the LaHave Drumlins and Lake Rossignol Hills Natural Landscapes (Cameron 2004, Lynds and LeDuc 1995).

Historical human impacts to North Queens County have included forestry and agriculture. Forest was cleared for agriculture with about 4.4 % of North Queens under agriculture in 1870, although this declined to about 1.1% by 1966 (Telfer 2004). Forestry in the area was historically limited to small patches and individual trees but more recently has included larger clearcuts and conversion of mixed forest to plantations (Telfer 2004). Lake Rossignol was dammed in the 1920's by forestry companies which considerably enlarged the lake converting previous forest to lake (Davis and Browne 1996). Lake Rossignol Wilderness Area is relatively remote and has seen little recent human activity. However, there has been some recent forest harvesting and road construction around the Wilderness Area (Cameron 2004). There is also some evidence of past forest harvesting and farming in the Wilderness Area (R. Cameron pers. comm.). Atmospheric deposition of non-marine SO_4 and NO_3 between 1977–1980 has led to the acidification of lakes in southwest Nova Scotia (Underwood et al. 1987). Although SO_4 and NO_3 have declined in the last several decades, deposition has continued to exceed critical loads for upland forest soils and aquatic ecosystems (Ouimet et al. 2006, Environment Canada 2004). The susceptibility to acid precipitation is largely due to the low buffering capacity of acid bedrock and soils in that part of Nova Scotia (Davis and Browne 1996).

Although the Lake Rossignol Wilderness Area was designated to protect representative ecosystems, there have been no systematic biological surveys of the area with the exception of some vegetation surveys collected in 1992 and 2003 (Cameron 2004). These data collections were confined to forest ecosystems and no study had been conducted in the large area of wetland in the southern portion of the protected area (Davis and Browne 1996).

Lake Rossignol Wilderness Area was considered a likely candidate to provide habitat for a variety of rare species. Two lakes within the Wilderness Area and six lakes that border it provide potential habitat for coastal plain flora, eastern ribbon snake (*Thamnophis sauritus*) and Blanding's turtle (*Emydoidea blandingii*). Large wetlands in the Wilderness Area are also potential habitat for coastal plain flora.

METHODS

Study Area

The Lake Rossignol Wilderness Area is between 44°18´ and 44°11´ north latitude and 65°8´ and 64°59´ west longitude in Queens County, Nova Scotia (Figure 1). The Wilderness Area is in the north temperate forest region with high annual precipitation (1200 to 1400 mm) and relatively warm summer temperatures (average July temperature of 18°C). Underlying geology is mainly quartzite overlain with stony or silty till, silty till drumlins and organic material. Mature mixed forests dominate much of the protected area but large wetlands are found in the south-eastern portion. There are three lakes within the protected area, Big Rocky, Little Rocky and Moccasin Lakes with an area of 263 ha, 51 ha and 73 ha respectively (Cameron 2004).

Adjacent to Lake Rossignol Wilderness Area is property owned by Bowater Mersey and under conservation easement with the Nature Conservancy of Canada. This area was visited on 27 July 2006 by the survey participants. Data from this area are included in this study.

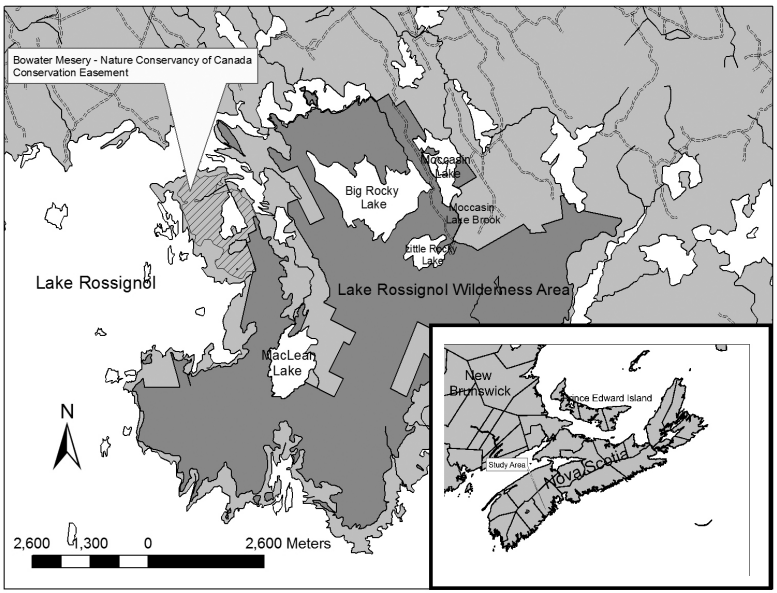

Fig 1 Map of Lake Rossignol Wilderness Area, Nova Scotia showing general location and major features.

Biological Sampling

Fish

Standard minnow traps and fyke nets (length 3 m; mouth 0.40 m^2; mesh size 1.5 cm) were set between 26 and 28 July in three lakes within the Wilderness Area – Big Rocky Lake, Moccasin Lake, and Apple Tree Lake. Minnow traps were baited with beef liver. Captured fish were identified to species, measured for length and either returned unharmed to the water or sacrificed (two fish) to be archived in the collection at St. Francis Xavier University, Antigonish, Nova Scotia.

Turtles

A combination of visual surveys and live-trapping was employed. Visual surveys were conducted each day for about 2 hours, while setting, checking, and removing aquatic hoop-net live-traps baited with sardines. On July 26, 2007, 12 live-traps were set and baited along the length of Moccasin Lake Brook, in suitable turtle habitat (stillwaters with dense aquatic vegetation). The traps were checked once a day, for three days, and were removed on July 29, 2007. Setting 12 traps for 3 nights yielded a total of 36 trap-nights, and about 8 hours of visual survey time. All trap-captured turtles were identified and released immediately after capture.

Snakes

Visual surveys were conducted on July 28 and 29, 2006, along the shore of Lake Rossignol, Moccasin Lake Brook, and in a swamp adjacent to Lake Rossignol. These surveys involved observers walking or canoeing in parallel transects through the wetland with 1-10 m between each observer. Attempts were made to catch eastern ribbon snakes when observed; all snakes were released at the point of capture. A total distance of 6009 m was covered by walking, 499 m covered by canoe, and 9.7 hr of observer effort was exerted.

Vascular Plants

Vascular plants were identified and collected between 26 and 28 July, 2006. Five to seven observers with one recorder visited different areas of the Wilderness Area each day and a separate species list was generated for each day. If a plant species was encountered on more than one day, duplicate specimens were not collected. Digital photos and Global Positioning System (GPS) coordinates were taken at collection sites with rare or unusual species or particularly rich

sites. Collections were made of each species encountered and were later pressed and deposited at the E.C. Smith Herbarium at Acadia University or the Nova Scotia Museum of Natural History Herbarium. Nomenclature follows Zinck (1998).

Fungi

The collections of fruiting bodies of fungi were made on 26 July, on the west facing hillside in the north eastern end of the Wilderness Area and on 27 July in the Bowater Mersey - Nature Conservancy of Canada conservation easement.

Photographs were taken of the cap, gills, and stipe of each specimen. Specimens could not be preserved, but spores were kept when spore prints were produced. Measurements of cap diameter and of stipe length and diameter were recorded. Identification to species was done in the field and later with photographs and spore prints.

Lichens

Two habitat types were selected for intensive survey; a small unnamed brook connecting Carrigan Lake and Big Rocky Lake and a treed swamp south of Little Rocky Lake. These habitat types are commonly targeted by the authors for surveys because of the high diversity of macrolichens expected to be found on both hardwood and coniferous species. Although most of the surveying occurred in these two habitats, observations were not limited to them and opportunistic collections were also made in other locations. Identifications were made in the field. Those species that could not be identified in the field were collected and later identified in a labratory using various keys. Collections were made of thirty-nine specimens which were later deposited in the Nova Scotia Museum of Natural History.

Bryophytes

Bryophytes were identified or collected between 26 and 29 July, 2006, and 22 April, 2008. Species identified in the field were recorded by substrate on which they occurred. Species that could not be identified in the field were collected and later identified in the laboratory using Ireland (1982). Collected specimens were deposited at the Nova Scotia Museum of Natural History. Searches for bryophytes were conducted such that a variety of habitats and substrates were visited. Habitat types visited included mature mixedwood and hemlock forest, treed fen, brook and lake riparian zones.

Dendrochronology

Standard dendrochronology practices were used to sample 24 eastern hemlock (*Tsuga canadensis*) trees at the Bowater Mersey - Nature Conservancy of Canada conservation easement. Two cores were taken at breast height for each tree. Cores were taken at 180° to one another since the trees were found growing on a slope. This was done to acquire cores that could be used together to derive the average growth of the tree species at the site.

All cores taken were transported back to the Mount Alison Dendrochronology Labratory, air dried, and glued into slotted mounting boards. The cores were then sanded to a 600 grit polish. The ring widths of each sample were measured using a WinDendro computer software system and a high resolution flatbed scanner. All ring widths were measured to 0.001 mm. Ring width patterns for each species were cross dated both visually and statistically using program COFECHA (Holmes et al., 1986). COFECHA correlations were derived using 50 year segments lagged successively by 25 years. Tree patterns that exhibited correlation coefficients greater than 0.3281 were significant to the 99% level. Each data set was then analyzed with program ARSTAN (Cook 1999) with a single detrending method to derive a master average chronology that illustrated the unified growth signal of all trees.

Intensive focus of a Peatland

The diversity of four different taxonomic groups was surveyed within the peatland using standardized methods:

Odonate Sampling – Sampling took place as observers moved through the study site in a semi-random fashion. Upon entering a bog, a random direction was chosen from all possible directions that led away from the edge of the bog. This direction represented a linear transect which was walked by the observer until an adult odonate was encountered. Odonates encountered were captured using white 33 cm diameter aerial insect nets with a 1.5 or 0.6 m handle. When possible, odonates were identified in the field and released after adding a small mark to their wing using a waterproof pen to prevent double counting. However, when field identification was not possible, specimens were collected and preserved for later identification. After capture, a new random direction was chosen and this process was continued. When observers encountered the bog edge during transects, a new random direction was chosen that led away from the edge of the bog.

Collected specimens were defatted using a 24-36 hour acetone bath and then air dried for preservation. Odonates were identified using a standard dissecting microscope and a range of taxonomic keys.

Tabanids (horse and deerflies) of the family Tabanidae were sampled by hand netting and with modified Manitoba traps. Manitoba traps are plastic and wooden cones that were baited with a suspended beach ball covered by a garbage bag and Octanol, a tabanid attractant. Female tabanids attracted to the trap tend to fly upwards, funneled by the cone shape of the trap, into the collecting head. A 2 cm^3 cube of Vapona (Scotts Canada Ltd.) was placed in the collecting head to act as an insecticide. Males were captured by aerial net as they are not attracted to traps. A trap was placed in an open area of the bog, approximately 10 m from the tree-line for approximately 3 hours. Typically, sampling occurs for longer trap sessions and for a minimum of three periods during the summer; late May-early June, early-mid July, and early-mid August. The extended trapping time was not done in this study because of the short duration of the survey.

Collected specimens were initially frozen. Individual specimens were prepared and pinned within three weeks and subsequently identified to species with a binomial key. Individuals of the genus *Atylotus* were not identified due to a small number of specimens to examine, and lack of access to reference material.

Vegetation – Woody vegetation and *Sphagnum* moss diversity was surveyed using three 2 X 50-m belt transects. Each transect was established in random directions from the peatland edge in different sub-habitats within each bog (e.g. lag swamp, open bog, shrub bog, treed bog, poor fen). All species of woody vegetation under 2-m and *Sphagnum* mosses that were encountered within the belt transect were recorded and relative abundance scored. Habitat and habit of each recorded *Sphagnum* species was noted (e.g. hummock, hollow, lawn, submerged, etc.).

Other Species – All observations of orchids, reptiles and amphibians were recorded during other activities. Additional time was spent around pools searching for amphibians.

RESULTS AND DISCUSSION

Turtles

Two snapping turtles (*Chelydra serpentine* L.) and twelve painted turtles (*Chrysemys picta* Sch.) were captured in the aquatic live-traps. No turtles were seen during visual surveys.

Two of the four species of freshwater turtle known to exist in Nova Scotia were confirmed to reside in the Lake Rossignol Wilderness Area. Even though no wood or Blanding's turtles were seen or captured, we cannot prove their absence, and more time and effort would be required to be conclusive. The nearest Blanding's turtle population is in Kejimkujik National Park, roughly 9 km northwest of Lake Rossignol Wilderness Area (McMaster and Herman 2000). Wood turtles are better known from northern Nova Scotia and southern Cape Breton Island (Gilhen 1984), although there are some records for Annapolis County in the Atlantic Canada Conservation Data Centre Records.

Snakes

Although surveys were targeted for the eastern ribbon snake (*Thamnophis sauritus*), a threatened species in Nova Scotia under the Nova Scotia Endangered Species Act, three of the other four snake species found in this province were also observed (Table 1). The eastern ribbon snake is a cryptic species making sightings infrequent. There were two observations of eastern ribbon snakes – at Moccasin Lake Brook and Little Rocky Lake. Although these two sightings provide us with little information on the density of eastern ribbon snakes in this area, it does provide us with more information on the distribution of the species.

Eastern garter snakes (*Thamnophis sirtalis*), eastern smooth green snakes (*Opheodrys vernalis*), and redbelly snakes (*Storeria occipitomaculata*) are fairly common throughout their range (Gilhen 1984). During the survey 2 eastern garter snakes, 4 smooth green snakes,

Table 1 Species and number of snakes observed during the 2006 Lake Rossignol Wilderness Area Bioblitz.

Snake Species	Number Observed
Eastern Ribbonsnake (Thamnophis sauritus) L.	2
Eastern Garter Snake (Thamnophis sirtalis) Allen	2
Smooth Green Snake (Opheodrys vernalis) Harlan	4
Redbelly Snake (Storeria occipitomaculata) Storer	1

and 1 redbelly snake were observed. Although our surveys were not targeted for these species, multiple observations suggest that these populations may be healthy.

Fish

From a total of 327 trap-hours (32% at each of Apple Tree and Moccasin Lakes, 36% at Big Rocky Lake) and 80 fyke net-hours (all at Big Rocky Lake), 30 individual fish were captured (Table 2). Within Apple Tree Lake, American eel (*Anguilla rostrata* Lesueur) and yellow perch (*Perca flavescens* Mitchell) were captured. In Moccasin Lake, yellow perch and golden shiner (*Notemigonus crysoleucas* Mitchell) were collected while in Big Rocky Lake, American eel, white perch (*Morone americana* Gmelin) and brown bullhead (*Ameiurus nebulosus* Lesueur) were captured in the fyke nets.

Captured fish, except American eel, were selectively measured (not every individual measured) and displayed mean size (+SD; sample size) of 19.0 cm (+3.6; N=4) for white perch, 7.45 cm (+2.4; N=10)

Table 2 Fish sampling results from three lakes within the Lake Rossignol Wilderness Area between 26 and 28 July, 2006.

Date	Location(s) [1]	Gear type and effort	Species captured	Number captured
26-27 July	Apple Tree Lake	Minnow traps (X3); 37.5 trap-hours	American eel	3
	Big Rocky Lake	Minnow traps (X3); 57 trap-hours	–	0
		Fyke net (X1); 19 hour soak time	White perch	4
			Brown bullhead	1
	Moccasin Lake	Minnow traps (X2); 39 trap-hours	Yellow perch	2
			Golden shiner	2
27 July	Apple Tree Lake	Minnow traps (X2); 24 trap-hours	Yellow perch	3
27-28 July	Apple Tree Lake	Minnow traps (X2); 42 trap-hours	Yellow perch	1
	Big Rocky Lake	Minnow traps (X3); 63 trap-hours	–	0
		Fyke net (X1); 21 hour soak time	White perch	5
			American eel	2
	Moccasin Lake	Minnow traps (X3); 64.5 trap-hours	Yellow perch	7

[1] Geographic coordinates of sampled locations:

Apple Tree Lake	4905500N 336500E
Big Rocky Lake	4903400N 337000E
Moccasin Lake	4903400N 337300E

for yellow perch, and 7.75 cm (+0.35; N=2) for golden shiner. Eels were not measured but length of sampled eels were estimated at ~40 cm. The sole brown bullhead was 13.5 cm (TL).

This survey of the three lakes found only five fish species. Alexander et al. (1986) list 14 fish species found in 58 lakes in Queens County, of which eight species were found in more than 5 of the 58 lakes. In addition to the five species presented here, the other three species listed by those authors were brook charr (*Salvelinus fontinalis*), white sucker (*Catastomus commersoni*), and banded killifish (*Fundulus diaphanous*). Peterson and Martin-Robichaud (1989) attempted to define fish assemblages in lakes of Nova Scotia and the sampled lakes reported here would likely fall within their Assemblage 3 (white sucker, brown bullhead, yellow perch; also containing golden shiner, pumpkinseed sunfish (*Lepomis gibbosus*), and chain pickerel (*Esox niger*)). Alexander et al. (1986) also reported significant positive correlations between presence of yellow perch and each of golden shiner and brown bullhead, and between brown bullhead and each of golden shiner and white sucker. Thus, we suspect that the community of these lakes most closely resembles Assemblage 3 of Peterson and Martin-Robichaud with the sampling missing the presence of the white sucker. Alexander et al. (1986) also showed significant negative correlations for presence between brook charr and each of yellow perch and golden shiner, therefore, their absence in the sample results is expected. Big Rocky Lake, with its presence of white perch, may represent a slightly different fish assemblage, or the capture of this species may simply reflect the different sampling methods (fyke net rather than minnow traps).

Future sampling in this area should include multiple methods (fyke net, beach seine, minnow traps, angling) in each lake and the collection of basic water chemistry data (pH, color, Secchi depth).

Vascular Plants

One hundred species of vascular plants were found (Table 3). Plant species were typical of the various habitats visited and no at-risk species were encountered within the Protected Area. An unusual hybrid was collected in the bog on July 28th : *Platanthera blephariglottis* X *dilitata*. This hybrid was later confirmed by M. Zinck, botanist at the Nova Scotia Museum of Natural History and the specimen is now held in the museum collection. An incidental collection of downey rattlesnake plantain (*Goodyera pubescens*), was made just outside

Table 3 Vascular plants recorded during the Lake Rossignol Wilderness Area bioblitz in 2006. Plant species are recorded by the day they were observed during the bioblitz.

Plant Species Day 1	Plant Species Day 2	Plant Species Day 3
Abies balsamea (L.) Mill.	*Abies balsamea*	*Acer pensylvanicum*
Acer saccharum Marshall	*Acer pensylvanica* L.	*Acer rubrum*
Aralia nudicaulis L.	*Acer rubrum* L.	*Amelanchier sp*. Medicus
Betula papyrifera Marshall	*Betula papyrifera*	*Antennaria neglecta* E. Greene
Clintonia borealis (Aiton) Raf.	*Clintonia borealis*	*Aralia nudicaulis*
Coptis trifolia (L.) Salisb.	*Corallorhiza maculata*	*Aronia sp*. Medicus
Corallorhiza maculata (Raf.) Raf	*Cornus canadensis*	*Betula alleghaniensi* Britton
Cornus canadensis L.	*Cypripedium acaule*	*Betula papyrifera*
Cypripedium acaule Aiton	*Dryopteris marginalis* (L.) A. Gray	*Chamaedaphne calyculata* (L.) Moench
Diphasiastrum tristachyum (Pursh) Holub	*Epigaea repens* L.	*Chimaphila umbellate* (L.) Barton
Epigaea repens L.	*Eriocaulin aquaticum* (Hill) Druce	*Coptis trifolia*
Gaultheria hispidula (L.) Muhlenb. ex Bigelow	*Gaultheria procumbens* L.	*Cornus canadensis*
Gaultheria procumbens L.	*Gaultheria hispidula*	*Diervilla lonicera* Miller
Gaylussacia baccata (Wang.) K.Koch	*Gaylussacia baccata*	*Epigaea repens*
Goodyera tesselata Lodd.		*Eriophorum virginicum* L.
Hamamelis virginiana L.	*Goodyera tesselata*	*Fagus grandifolia* Ehrh
Ilex glabra (L.) Gray	*Hamamelis virginia*	*Fragaria sp*. L.
Iris versicolor L.	*Huperzia lucidula* (Michuax) Trevisan	*Galium mollugo* L.
Kalmia angustifolia L.	*Ilex glabra*	*Gaultheria hispidula*
Linnaea borealis L.	*Kalmia angustifolia*	*Gaultheria procumbens*
Lycopodium annotinum L.	*Ledum groenlandicum* Oeder	*Gaylussacia baccata*
Medeola virginiana L.	*Linnea borealis*	*Goodyera tesselata*
Mitchella repens L.	*Lobelia dortmanna* L.	*Gymnocarpium dryopteris* (L.) Newman
Monotropa hypopythis L.	*Lycopodium clavatum* L.	*Hamamelis virginiana*
Monotropa uniflora L.	*Medeola virginiana*	*Hieracium paniculatum* L.
Myrica pensylvanica Mirbel.	*Mitchella repens*	*Ilex glabra*
Osmunda cinnamomea L.	*Monotropa hypopithys*	*Kalmia angustifolia*
Osmunda regalis L.	*Monotropa uniflora*	*Kalmia polifolia* Wangenh.
Pinus strobes L.	*Nymphea odorata* Aiton	*Lobelia inflate* L.
Platanthera clavellata (Michx.) Luer	*Picea rubens* Sarg.	*Medeola virginiana*
Polypodium virginianum L.	*Pinus resinos* Aiton	*Mitchella repens*
Prenanthes sp. L.	*Pinus strobes* L.	*Monotropa hypopythis*
Pteridium aquilinum (L.) Kuhn	*Polyganun cilinode* Michx.	*Monotropa uniflora*
Pyrola eliptica Nutt.	*Polypodium virginianum* L.	*Myrica gale* L.
Rubus sp. L.	*Pontedaria cordata* L.	*Myrica pensylvanicum*
Spirea alba Duroi	*Populus tremuloides* Michaux	*Nemopanthus mucronata* (L.) trel.

Table 3 *Continued*

Plant Species Day 1	Plant Species Day 2	Plant Species Day 3
Spirea tomentosa L.	*Pteridium aquilinum* (L.) Kuhn.	*Nymphea odorata*
Thelypteris palustris Shott.		*Osmunda cinnamomea*
Toxicodendron sp. L.	*Pyrola elliptica* Nutt.	*Osmunda regalis*
Triadenum virginicum (L.) Raf.	*Quercus rubra* L.	*Oxalis stricta* L.
Trientalis borealis Raf.		*Picea sp*. Dietr.
Trillium undulatum Willd.	*Spirea tomentosa*	*Pinus strobus*
Tsuga Canadensis (L.) Carriere	*Thelypteris noveboracensis* (L.) Nieuwl.	*Plantago major* L.
Viburnum cassinoides L.	*Trientalis borealis*	*Platanthera hookeri* (Willd.) Lindley
	Tsuga Canadensis (L.) Carrière	*Pontedera cordata*
	Vaccinium macrocarpon Aiton	*Populus sp*. L.
	Vaccinium sp. L.	*Prenanthes sp*. L.
	Populus grandidentata Michaux	*Prunella vulgaris* L.
	Acer pensylvanicum	*Pteridium aquilinum*
	Vaccinium angustifolium Aiton	*Pyrola eliptica*
	Achillea millefolium L.	*Quercus rubra*
	Actaea sp. L.	*Ranunculus repens* L.
	Aster accuminatus Michx.	*Rhododendron canadense* (L.) Torr.
	Aster macrophyllus L.	*Rosa sp*. L.
	Dennstaedtia punctolobula (Michaux) T.Moore	*Sagittaria latifolia* Willd.
	Luzula multiflora (Retz.) Lej.	*Sium suave* Walter
	Melampyrum lineare Desr.	*Smilax rotundifolia* L.
	Phegopteris connectilis (Michaux) Watt	*Spirea tomentosa*
	Polystichum acrostichoides (Michaux) Schott	*Toxicodendron radicans* (L.) Kuntz(L.) Kuntse
	Streptopus amplexifolius (L.) DC.	*Trifolium repens* L.
		Vaccinium macrocarpon
		Veronica officinalis L.
		Veronica serpyllifolia L.
		Viburnum cassinoides
		Viola sp. L.

the protected area. This orchid is currently designated red (at-risk or may be at-risk) by Nova Scotia Department of Natural Resources. A subsequent visit to the site of this orchid, revealed it to be present in abundance (about 200 plants).

Fungi

Thirty-four species of fungi were identified (Table 4). Most of the fungi were mycorrhizal and common. One identification is still in question and may not be common. Ten specimens on day one and 15 specimens on day two produced spore prints to help with identification.

Lichens

Sixty-one macrolichen species were recorded (Table 5). The most significant species observed along the brook site was *Anzia colpodes,* which is known from most of eastern North America (Brodo 2001) but has been reported from only eight counties in Nova Scotia (Anderson, in prep.) and is not considered widespread in those areas. Cyanolichens of interest observed included *Coccocarpia palmicola* and *Leptogium corticola*, both designated Yellow or Sensitive species by Nova Scotia Department of Natural Resources (Anderson 2007).

The treed swamp selected for the survey proved less interesting due to immaturity of tree species and soil dryness, however *Fuscopannaria ahlneri* listed as Red or At Risk or May Be At Risk was observed on rock. No specimen was collected at the time due to its rarity.

Bryophytes

Forty-eight species of bryophytes were identified and collected (Table 6). All species were mosses with the exception of four liverworts. All species are relatively common in the province (Ireland 1982) with the exception of *Buxbaumia aphylla* and *Sphagnum torreyanum* which are considered S2 (May be vulnerable to extirpation due to rarity or other factors, 6 to 20 occurrences or few remaining individuals) and *Mnium stellare* and *Sphagnum angustifolium* which are considered S1 (Extremely rare—may be especially vulnerable to extirpation, typically 5 or fewer occurrences or very few remaining individuals) by the Atlantic Canada Conservation Data Centre. Thirty-six species are terricolous, eight species are epiphytic, two species were found on rotted wood, one was found on rock and one species on rock in water.

Table 4 Fungi species identified during the Lake Rossignol Wilderness Area bioblitz 2006. Species are organized by area in which they were found and whether a spore print was produced.

Species Rossignol Wilderness Area	Spore Prints	Species Bowater Abitibi Conservation Easement, Lake Rossignol	Spore Prints
Amanita brunnescens G.F.Atk.	No	*Austroboletus gracilis* (Peck) Wolfe	Yes
Amanita ceciliae (Beck&Broome) Bas	Yes	*Boletus cf minato-olivaceus* Frost	No
Amanita frostiana Peck	Yes	*Cantharellus ignicolor* R.H.Petersen	No
Boletus subglabripes Peck	Yes	*Craterellus fallax* A.H.Sm.	No
Hygrocybe irrigata (Pers.) Bon	No	*Hygrocybe irrigata* (Pers.) Bon	No
Hygrocybe miniata (Fr.) P. Kumm.	No	*Leotia lubrica* (Scop.) Pers.	No
Hygrophorus marginatus var. concolor A.H. Sm.	No	*Lactarius uvidus* (Fr.) Fr.	No
Hygrophorous marginatus var marginatus Peck	No	*Ramaria stricta* (Pers.) Quel.	No
Lactarius camphoratus (Bull.)Fr.	No	*Nolanea strictia* (Peck) Largent	Yes
Lactarius cinereus Peck	No	*Pluteus salicinus* (Pers.) P. Kumm.	
Lactarius subvellereus Peck	Yes	*Hydnellum caeruleum* (Hornem.) P.Karst.	No
Pluteus salicinus (Pers.) P.Kumm.	Yes	*Russula claroflava* Grove	No
Russula silvicola Shaffer	Yes	*Russula brunneola* Burl.	No
Russula variata Banning	Yes	*Russula fragilis* Fr.	No
Strobilomyces strobilaceus (Scop.) Berk.	Yes	*Russula heterophylla* (Fr.) Fr.	Yes
Suillus pictus (Peck) A.H.Sm.&Thiers	No	*Russula variata* Banning	Yes
Tylopilus felleus (Bull.) P. Karst	No	Suillus americanus (Peck) Snell	No
Xanthoconium affine (Peck) Singer	No	*Tapinella atrotomentosa* (Batsch) Sutara	Yes
		Tylopilus chromapes (Frost) A.H. Sm. And Thiers	No
		Xanthoconium affine (Peck) Singer	Yes

Dendrochronology

Thirty-eight of the 42 cores collected during the Bio-Blitz project illustrated a radial growth pattern and were averaged into a master chronology for the site. The chronology illustrates a similar growth trend to other eastern hemlock found in the region (Robichaud and Laroque 2008, Campbell and Laroque 2007) and spans the time frame from 1661 to 2006, a 346 year interval.

In general, during the last ~100 years, radial growth changed from a low at the end of the 19th century, to its best growth during the 1930s and 1940s. From that period until the mid-1970s radial growth was reduced, but it has since taken a marked upturn and is again exhibiting some wide radial growth in the last 30 years, coinciding with recent warming trends in the climate.

Table 5 **Lichen species identified during the Lake Rossignol Wilderness Area bioblitz 2006 with substrate on which they were found. Position is Universal Trans Mercator Zone 20 T.**

Species	Position	Substrate	Habitat
Anaptychia palmulata (Michx.)Vain.	20 T 336701 4903825	White Ash	inlet to Big Rocky Lake
Anaptychia palmulata (Michx.)Vain.	20 T 336394 4904440	Red Maple	
Anaptychia palmulata (Michx.)Vain.	20 T 336016 4905052	Red Maple	
Anaptychia palmulata (Michx.)Vain.	20 T 336015 4905359	Red Maple	
Anaptychia palmulata (Michx.)Vain.	20 T 336183 4904871	Red Maple	
Anzia colpodes (Ach.) Stizenb.	20 T 335905 4904016	Red Maple	
Anzia colpodes (Ach.) Stizenb.	20 T 336374 4904415	Red Maple	
Anzia colpodes (Ach.) Stizenb.	20 T 336506 4904197	Red Maple	
Anzia colpodes (Ach.) Stizenb.	20 T 336473 4904231	Red Maple	
Anzia colpodes (Ach.) Stizenb.	20 T 336461 4904291	Red Maple	
Anzia colpodes (Ach.) Stizenb.	20 T 336212 4904841	White Ash	
Arctoparmelia incurva (Pers.)Hale	20 T 336150 4904331	rock	
Cetrelia chicitae (W.L.Culb.)W.L.Culb & C.F.Culb.	20 T 336701 4903825	rock	inlet to Big Rocky Lake
Coccoarpia palmicola (Sprengel) Arv. & D. J. Galloway	20 T 336405 4904363	Red Maple	
Coccoarpia palmicola (Sprengel) Arv. & D. J. Galloway	20 T 336415 4904310	Red Maple	
Coccoarpia palmicola (Sprengel) Arv. & D. J. Galloway	20 T 336418 4904327	Red Maple	
Coccoarpia palmicola (Sprengel) Arv. & D. J. Galloway	20 T 336381 4904337	Red Maple	
Coccoarpia palmicola (Sprengel) Arv. & D. J. Galloway	20 T 336352 4904482	Red Maple	
Coccoarpia palmicola (Sprengel) Arv. & D. J. Galloway	20 T 336472 4904196	Red Maple	
Collema nigrescens (Hudson) DC.	20 T 336495 4904151	Red Maple	
Collema subflaccidum Degel.	20 T 336093 4904317	Red Maple	at edge of treed swamp, RM, WA, Yellow Birch
Collema subflaccidum Degel.	20 T 336192 4904519	White Ash	
Collema subflaccidum Degel.	20 T 336092 4904351	White Ash	
Collema subflaccidum Degel.	20 T 336425 4904382	Red Maple	
Collema subflaccidum Degel.	20 T 336205 4904860	Red Maple	
Dendriscocaulon intriculatum (Nyl.) Henssen	20 T 336095 4904326	White Ash	

Table 5 *Continued*

Species	Position	Substrate	Habitat
Dendriscocaulon intriculatum (Nyl.) Henssen	20 T 336093 4904317	Red Maple	at edge of treed swamp, RM, WA, Yellow Birch
Heterodermia neglecta Lendemer, R. C. Harris & E. Tripp (Lendemer et al. 2007)	20 T 336374 4904415	Red Maple	
Heterodermia neglecta Lendemer, R. C. Harris & E. Tripp (Lendemer et al. 2007)	20 T 336592 4904091	Red Maple	
Hypogymnia incurvoides Rass. (McCune et al. 2006)	20 T 336588 4904093	Red Spruce	
Hypogymnia physodes (L.) Nyl.	20 T 336449 4904284	White Pine	
Imshaugia aleurites (Ach.) S. F. Meyer	20 T 336422 4904248	Red Maple	
Leptogium corticola (Taylor) Tuck.	20 T 336689 4903918	Red Maple	
Leptogium corticola (Taylor) Tuck.	20 T 336487 4904246	Red Maple	
Leptogium corticola (Taylor) Tuck.	20 T 336327 4904470	Red Maple	
Leptogium corticola (Taylor) Tuck.	20 T 336201 4904864	Red Maple	
Leptogium cyanescens (Rabenh.) Körber	20 T 336182 4904532	White Ash	
Leptogium laceroides (B. de Lesd.) P. M. Jørg.	20 T 336093 4904317	Red Maple	at edge of treed swamp, RM, WA, Yellow Birch
Leptogium laceroides (B. de Lesd.) P. M. Jørg.	20 T 336473 4904231	Red Maple	
Leptogium laceroides (B. de Lesd.) P. M. Jørg.	20 T 336461 4904291	Red Maple	
Leptogium laceroides (B. de Lesd.) P. M. Jørg.	20 T 336182 4904532	White Ash	
Lobaria pulmonaria (Mull) Ag.	20 T 336636 4904042	Red Maple	
Lobaria pulmonaria (Mull) Ag.	20 T 336461 4904291	Red Maple	
Lobaria pulmonaria (Mull) Ag.	20 T 336182 4904532	White Ash	
Lobaria pulmonaria (Mull) Ag.	20 T 336240 4904711	Red Maple	
Lobaria pulmonaria (Mull) Ag.	20 T 336235 4904726	Red Maple	
Lobaria pulmonaria (Mull) Ag.	20 T 336473 4904231	Red Maple	
Lobaria pulmonaria (Mull) Ag.	20 T 336096 4904358	White Ash	
Lobaria quercizans Michaux	20 T 336636 4904042	Red Maple	
Lobaria quercizans Michaux	20 T 336182 4904532	White Ash	
Lobaria scobiculata (Scop.) DC.	20 T 336701 4903825		inlet to Big Rocky Lake

Table 5 *Continued*

Species	Position	Substrate	Habitat
Lobaria scobiculata (Scop.) DC.	20 T 336636 4904042	Red Maple	
Lobaria scobiculata (Scop.) DC.	20 T 336436 4904273	Red Maple	
Lobaria scobiculata (Scop.) DC.	20 T 336415 4904310	Red Maple	
Lobaria scobiculata (Scop.) DC.	20 T 336275 4904537	Red Maple	
Lobaria scobiculata (Scop.) DC.	20 T 336235 4904726	Red Maple	
Lobaria scobiculata (Scop.) DC.	20 T 336240 4904711	Red Maple	
Menengazia terebrata (Hoffm.) A. Massal.	20 T 336705 4903898	Yellow Birch	
Nephroma helveticum Ach.	20 T 336701 4903825	rock	inlet to Big Rocky Lake
Nephroma helveticum Ach.	20 T 336031 4904341	Red Maple	
Nephroma lavaiegatum Ach.	20 T 336689 4903918	Red Maple	
Nephroma sp	20 T 336015 4905359	Red Maple	
Nephroma sp	20 T 336615 4904042	Red Maple	
Normandina pulchera (Borrer) Nyl.	20 T 336352 4904482	Red Maple	
Fuscopannaria ahlneri (P. M. Jørg.) P. M. Jørg.	20 T 337130 4900894	rock	
Pannaria conoplea (Ach.) Bory	20 T 336096 4904358		
Pannaria conoplea (Ach.) Bory	20 T 336592 4904091	Red Maple	
Pannaria conoplea (Ach.) Bory	20 T 336461 4904291	Red Maple	
Pannaria conoplea (Ach.) Bory	20 T 336490 4904357	Red Maple	
Pannaria conoplea (Ach.) Bory	20 T 336394 4904440	Red Maple	
Pannaria conoplea (Ach.) Bory	20 T 336352 4904482	Red Maple	
Pannaria conoplea (Ach.) Bory	20 T 336235 4904726	Red Maple	
Pannaria conoplea (Ach.) Bory	20 T 336130 4904905		
Pannaria conoplea (Ach.) Bory	20 T 336477 4904227	Red Maple	
Pannaria rubiginosa (Ach.) Bory	20 T 336592 4904091	White Ash	
Parmelia squarrosa Hale	20 T 336449 4904284	White Pine	
Parmeliella tryptophylla (Ach.) Müll. Arg.	20 T 336304 4904576	Red Maple	
Parmeliella tryptophylla (Ach.) Müll. Arg.	20 T 336182 4904532	White Ash	

Table 5 *Continued*

Species	Position	Substrate	Habitat
Parmeliella tryptophylla (Ach.) Müll. Arg.	20 T 336638 4903942	Red Maple	
Parmeliella tryptophylla (Ach.) Müll. Arg.	20 T 336636 4904042	Red Maple	
Parmotrema crinitum (Ach.) M. Choisy	20 T 336031 4904341	Red Maple	
Parmotrema crinitum (Ach.) M. Choisy	20 T 336705 4903898	Yellow Birch	
Peltigera aphthosa (Ach.) M. Choisy	20 T 336592 4904091	White Ash	
Peltigera evansiana Gyelnik	20 T 336506 4904197	Red Maple	
Platismatia glauca (L.) W. L. Culb.. & C. F. Culb.	20 T 336449 4904284	White Pine	
Protopannaria pezizoides (Weber) P. M. Jørg. & S. Ekman (Jørgensen 2000c)	20 T 336095 4904326	White Ash	
Protopannaria pezizoides (Weber) P. M. Jørg. & S. Ekman (Jørgensen 2000c)	20 T 336472 4904196	Red Maple	
Pseudocyphellaria perpetua McCune & Miadl. (Miadlikowska et al. 2002)	20 T 336636 4904042	Red Maple	
Pseudocyphellaria perpetua McCune & Miadl. (Miadlikowska et al. 2002)	20 T 336436 4904273	Red Maple	
Pseudocyphellaria perpetua McCune & Miadl. (Miadlikowska et al. 2002)	20 T 336461 4904291	Red Maple	
Pseudocyphellaria perpetua McCune & Miadl. (Miadlikowska et al. 2002)	20 T 336415 4904310	Red Maple	
Pseudocyphellaria perpetua McCune & Miadl. (Miadlikowska et al. 2002)	20 T 336192 4904519	White Ash	
Pseudocyphellaria perpetua McCune & Miadl. (Miadlikowska et al. 2002)	20 T 336235 4904726	Red Maple	
Pyxine soridiata (Ach.) Mont.	20 T 336487 4904246	Red Maple	
Ramalina roesleri (Hochst. ex Schaerer) Hue	20 T 336031 4904341	Red Maple	
Tuckermanopsis orbata (Nyl.) M. J. Lai	20 T 336449 4904284	White Pine	
Usnea strigosus (Ach.) Eaton	20 T 336449 4904284	White Pine	

Table 6 Bryophytes identified during the Lake Rossignol Wilderness Area bioblitz, 2006.

Species
Anomodon rostratus (Hedw.) Schimp.
Atrichum alteroristatum
Bazzania trilobata
Bryum argentums
Buxbaumia aphylla Hedw.
Ceptialozia lunulifolia
Dicranum flagellare Hedw.
Dicranum fuscescens Turn.
Dicranum polysetum Sw.
Dicranum scroparium Hedw.
Dicranum viride (Sull. & Lesq. *ex* Sull) Lindb.
Diphyscium folusom
Fontinalis novae-angliae
Hylocomium splendens (Hedw.) B.S.G.
Leocobryum glaucoma (Hedw.) Ångstr. *ex* Fries
Leucodon brachypus var. *andrewsianus* Crum & Anderson
Metzgeria conjugate
Mnium hornum Hedw.
Mnium stellare
Neckera pennata Hedw.
Pallavicinia lyellis
Pleurozium schreberi (Brid.) Mitt.
Pohlia nutans (Hedw.) Lindb.
Polytrichum commune
Polytrichum juniperinum
Polytrichum strictum Brid.
Porella platyphylloidea
Ptilium cilare
Ptilium crista-castrensis (Hedw.) De Not.
Rhacomitrium aciculare
Rhizomnium appalachiam
Rhizomnium punctatum
Rhytidiadelphus triquetrus (Hedw.) Warnst.
Sphagnum angustifolium
Sphagnum capifolium
Sphagnum cuspidatum Ehrh. *ex* Hoffm.
Sphagnum fuscum
Sphagnum girgensohnii Russ.
Sphagnum magellanicum Brid
Sphagnum russowii
Sphagnum squarrosum Crome
Sphagnum torreyanum
Thuidium delicatulum (Hedw.) B.S.G.
Tortella tortuosa (Hedw.) Limpr.
Ulota crispa (Hedw.) Brid.
Ulota coarctata
Ulota hutchinsiae

Table 7 Species documented in a treed peatland near Little Rocky Lake, Lake Rossignol Wilderness Area, Nova Scotia. Note: Coastal Plain species are noted with an asterisk (*).

Taxon	Species Observed in Bog
Odonates	Variable Darner *(Argia fumipennis* **Burmeister***)*
	Calico Pennant *(Celithemis elisa* Hagen*)*
	Petite Emerald *(Dorocordulia lepida* Hagen*)*
	Hagen's Bluet *(Enallagma hageni* Walsh*)*
	Orange Bluet *(Enallagma signatum* Hagen*)*
	Eastern Forktail *(Ischnura verticalis* Say*)*
	Sphagnum Sprite *(Nehalennia gracilis* Morse*)*
	Cherry-faced / Ruby Meadowhawk *(Sympetrum internum/ rubicundulum* Montg.*)*
	Band-winged Meadowhawk *(Sympetrum semicinctum* Say*)*
Tabanid Flies	*Chrysops delicatulus* Osten Sacken
	Chrysops vittatus Weideman
	Hybomitra microcephala Osten Sacken
	Hybomitra pechumani Teskey and Thomas
Sphagnum Mosses	*Sphagnum angermanicum* Melin
	Sphagnum angustifolium (Russ) J. Jens
	Sphagnum austinii
	Sphagnum capillifolium
	Sphagnum cuspidatum
	Sphagnum fallax Klinggr.
	Sphagnum flavicomans (Card.) Warnst.
	Sphagnum flexuosum Dozy & Molk.
	Sphagnum fuscum
	Sphagnum girgensohnii
	Sphagnum magellanicum
	Sphagnum majus (Russ) J. Jens
	Sphagnum quinquefarium (Lindb. *ex* Braithw.) Warnst.
	Sphagnum warnstorfii Russ.
Woody Vegetation (in Peatland)	Larch (*Larix laricina* (DuRoi) K.Koch)
	Black Spruce (*Picea mariana* (Mill.) BSP.)
	White pine (*Pinus strobus*)
	Red Maple (*Acer rubrum*)
	Red Chokeberry (*Aronia arbutifolia* (L.) Ell.)*
	Black Chokeberry (*Aronia melanocarpa* (Michx.) Ell.)
	Huckleberry (*Gaylussacia baccata*)
	False Holly (*Nemopanthus mucronata)*
	Lambkill (*Kalmia angustifolia*)
	Bog Laurel (*Kalmia polifolia*)
	Blueberry (*Vaccinium angustifolium*)
	Wild Raison (*Viburnum cassinoides*)
	Labrador Tea (*Ledum groenlandicum*)
	Sweet gale (*Myrica gale*)
	Rhodora (*Rhododendron canadense*)
	Common Juniper (*Juniperus communis* L.)
	Leatherleaf (*Chamaedaphne calyculata*)
	Large Cranberry (*Vaccinium macrocarpon*)
	Small Cranberry (*Vaccinium oxycoccos* L.)
	Serviceberry (*Amelanchier sp.)*

Table 7 *Continued*

Taxon	Species Observed in Bog
	Tea berry (*Gaultheria procumbens*)
	Black Crowberry (*Empetrum nigrum* L.)
Woody Vegetation	Speckled Alder (*Alnus incana* (L.) Moench)
(from Lagg)	Inkberry* (*Ilex glabra*)
	Bayberry* (*Myrica pensylvanica*)
	Steeplebush (*Spirea tomentosa*)
	Poison Ivy* (*Toxicodendron radicans*)
Other Species	Orchid hybrid
	(*Platanthera blephariglottis X P. dilatata* (Wild.) Lindl.)
	Rose Pogonia (*Pogonia ophioglossoides* (L.) Ker-Gawler)
	White-fringed Orchid*
	(*Platanthera blephariglottis* (Wild.) Lindl.)
	Pink Lady Slipper (*Cypripedium acaule)*
	Round-leafed Sundew (*Drosera rotundifolia* L.)
	Pitcher Plant (*Sarracenia purpurea* L.)
	Bog Goldenrod (*Solidago uliginosa* Nutt.)*
	Marsh St Johns-wort* (*Triadenum virginicum* (L.) Raf.)

The data collected at the Bio-Blitz site contributes to understanding the protected area. Trees at the site have been growing in place for at least the last 350 years.

Peatland

The peatland had vegetation suggestive of a fen such as sedges and grasses. However, it also contained several plant species that are more typical of poor-nutrient ombrotrophic bogs, including black crowberry (*Empetrum nigrum*) and lambkill (*Kalmia angustifolia*) (Crum 1992).

Plant species richness of the Lake Rossignol Wilderness Area was high compared to other peatlands in the region (D. Hurlburt, unpublished data) (Table 7). Fourteen *Sphagnum* species (44 % of Nova Scotia total) and 22 woody vegetation species (14 % of Nova Scotia total) were observed. However, tabanid and odonate diversities were lower than expected with only nine species of odonates and four species of tabanid flies recorded. It is suspected that the overcast, wet and cool weather on the sampling day was not amenable to insect emergence and flight.

Seven of thirty-five species of vascular plants found are of a Coastal Plain Distribution. All of these species are both locally and globally secure (Zinck 1998).

CONCLUSION

The scientific usefulness of the bioblitz was clearly demonstrated. A total of 294 species were identified during the survey, 285 of which are new records for the Wilderness Area. The identification of sites of five species-at-risk will enable protected areas managers to tailor management plans to ensure their conservation. These findings also highlight the importance of protected areas to species-at-risk conservation. The data from this study can also provide a base from which to build a more complete inventory of the Wilderness Area. Another area where bioblitzes can be useful is the identification of invasive species which require monitoring or control (Meshaka et al. 2008, Karns et al. 2006). Although this study did not result in the identification of invasive species in the Wilderness Area, more intensive surveys may be needed. This bioblitz brought together scientists from a variety of disciplines that might not normally interact and may result in further collaborations among disciplines and agencies.

Acknowledgements We would like to thank Protected Areas and Wetlands Branch of Nova Scotia Environment for organizing the event. We would also like to thank Mersey Tobeatic Research Institute, particularly Amanda Lavers, for hosting an evening and promoting the event and David Garbary for providing helpful review of the manuscript.

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