

STATUS REPORT: An Operational Methodology for Measuring and Analysing Bio-indicators to Support Sustainable Forest Management (07-004 re-sub)

Due February 15, 2002

Submitted January 31, 2002

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1. OVERVIEW OF PROJECT ACTIVITIES BY DATE

April 2001 : We conducted the project establishment which involved hiring of staff, buying of equipment (see budget summary), planning field camp establishment, planning details of study design, finalizing criteria for overall site selection, compiling geographic coverages of study area, finalizing collaboration details with OMNR, Domtar and Pukaskwa National Park.

May 2001 : Field Camp Set Up (Towing Trailers, Electrical/Generator set up, Digging Pit Toilet and Gray Water disposal pits, Lab Trailer Set up, Construction of Fuel Boxes, Tent Platforms)

Site selection, choosing sites, flagging sites for bird, mammal, pitfall and salamander sampling, pitfall traps installation, some salamander board installation. Dean Phoenix from OMNR worked for 1 week on site selection, 6 additional crew provided by OMNR for 1 week of site selection and site set up.

June 2001: Set pitfall traps, collected pitfall traps approximately bi-weekly, conducted bird surveys (point counts and playbacks). Two additional students working through June provided by the OMNR.

July 2001: Pitfall trapping ongoing, bird surveys conducted until July 10, small mammal live trapping began on July 16. Training provided by Brian Hutchinson from Parks Canada.

August 2001: Pitfall trapping stopped during August. Small mammal live trapping continued through August.

September 2001: Small mammal live trapping, salamander board installation, camp disassembly. Equipment clean up and organization. Pitfall trap sample sorting.

October 2001 - January 2002:

Pitfall trap sorting; all trap contents have now been sorted and are ready for identification

Salamander identification from pitfall trap collection (completed)

Small mammal identification from pitfall catch (completed)

Carabid beetle identification (in progress)

Transcription of all data collected in the field to digital format (completed)

Initial summaries of all data being conducted (completed)

Updates on web page

Writing of draft of Bio-indicators Report

Writing of draft Spider and Carabid Indicators Review

Writing and compiling of status report for year 1

2. OVERVIEW OF MILESTONES FOR FIRST YEAR

Year 1, March 2002

Milestone 1: Completion of web page to include all reports and data produced by the project.

The web page is up and includes all reports and project information to date including the proposal. It will be updated as new information becomes available. Please note that this is a new web address since the Interim Report.

<http://www.glfc.cfs.nrcan.gc.ca/index-en/research-e/ForestLandMgmnt-e/Bioindicators-en.html>

Milestone 2: Annual (Status) report including complete summary of field work, costs, and data summaries, and cumulative inventory of species. To be published on web site.

Annual report completed and submitted to LLT ahead of schedule

Milestone 3: Completion of first stage of monitoring report identifying monitoring questions (hypotheses), prioritizing those questions and developing an operational monitoring framework to address those questions. Document prepared for peer reviewed journal and to be included on the web.

This report is in a draft stage and has had an initial review by collaborators. The draft manuscript is included in Appendix 1 here and will be password accessible on the web before the end of March. We will be sending the manuscript out for more input in Feb. 2002. Expected date for submission to a journal is March 31, 2002.

Milestone 4 and 5: Review paper of carabids and spiders as indicators in Canada for peer reviewed publication. *Draft manuscript included here in Appendix 2. Expected completion date is March 31, 2002 for submission to a journal.*

3. SUMMARY OF DATA COLLECTED TO DATE

Overview of Study and Plot Design (from Interim Report)

Question A: Comparison of forest fauna communities within a disturbed versus undisturbed landscape.

We have 17 sites established in mature forest within Pukaskwa Park. These are our forested plots within an undisturbed landscape treatment. These are predominantly jackpine dominated mixedwood forest.

We have 19 sites established in large mature forest patches within the DOMTAR SFL. These are our forested plots within a disturbed landscape. These are predominantly mixedwood forest, although not always jackpine dominated as most of this forest type has been removed through logging. We had difficulty finding forest patches of a sufficient size to allow our plots to be established.

Question B: How does the fauna community change as regenerating forest matures? How quickly does it provide habitat for mature forest specialists?

We have

- 10 plots established in 0-5 years post logging stands
- 10 plots established in 5-10 years post logging stands
- 10 plots in 10-15 years post logging stands
- 9 plots in 15-20 years post logging stands
- 8 plots in 20-25 years post logging stands

The majority of these regenerating stands have been replanted with jackpine, and been treated at approx 5 years to reduce deciduous plant competition. Some sites were selected to provide a comparison with natural regeneration, although very few stands were available to choose from for this comparison.

Summary of Data Collection

One hundred and three sites were established (Table 1, Figure 1). Birds were sampled using point counts in all established sites. Mammals and invertebrates were sampled in 83 of the sites. Salamanders sampling has been set up in 75 of these sites. See Table 1 for a complete accounting of sampling intensity for different taxa.

Bird Data Collection

Protocol

Bird species and numbers were sampled by point counts (Welsh 1995) using a 10-minute sample time for two visits. The first visits occurred early to mid June, the second visits, mid June to early July. Counts were performed between dawn and 9:30am Eastern Daylight Savings Time (Welsh 1995, Howe et al. 1997). The 10-minute count was divided into two consecutive 5-minute periods to allow the examination of the additional data gathered during the second 5 minutes. This also made the data compatible with the Forest Bird Monitoring Program (Canadian Wildlife Service), the Ontario Ministry of Natural Resources Wildlife Assessment Program protocol, and the new Breeding Bird Atlas of Ontario protocol. Point counts were not conducted during windy conditions and precipitation. All bird species seen or heard were recorded, as well as a distance estimate of observation as within 50m, between 50 and 100m and outside 100m from the observer. Table 1 lists the geographic locations, treatment types and dates/times each site was sampled for birds. A map of these sites is displayed in Figure 1. 103 sites in total were sampled, each within a distance of 500m or more.

A playback sample was also conducted immediately after the point count for a select number of sites. A one minute tape of the playback of the Cape May Warbler was played and responses from bird species to the song were recorded for 2 minutes after the playback. No Cape May Warblers responded to the playbacks. We will review the method in the next field season.

Summary of Progress to Date

Field data of bird observations has been entered into the Bioindicators database and summary statistics have been performed. The first five-minute data was compiled and given to the Bird Studies Canada for the Breeding Bird Atlas project.

See Table 2 for summary of mean abundance of birds by species and treatment group.

Mammal Data Collection

Protocol

Small mammals were captured using Sherman live traps (7.5 x 7.5 x 30 cm) during mid July through September. The trap operates by capturing mammals that enter the trap, triggering the treadle and causing the door to shut. A 0.032 gauge aluminum trap cover was placed over exposed traps to limit temperature increases on warm days, and shelter

the traps from precipitation. Small mammals were surveyed along a 90-m trapline established 100m from the treatment type edge. Two live traps were placed at 10m intervals along the trapline, with a total of 20 traps/line (occasionally this number differed due to trap damage or loss). Traps were placed on the ground adjacent to suitable cover (e.g. stump or fallen log) and baited with approximately 1 teaspoon of peanut butter, rolled oats and sunflower seeds. A 1-cm³ slice of potato was provided for moisture. A fist-sized wad of cotton quilt batting was also added to each trap as nesting material for warmth.

Each site was trapped twice during the trapping period for 3 consecutive nights each time. Traps were checked in the morning before noon, and captured small mammals were identified to species, their sex and age determined where possible, then released. The fur on the dorsal side of the animal was clipped to identify recaptures. The species, date, time, site, trap number, and condition of the animal (i.e. alive or dead) were recorded for each capture and recapture. After each trapping period, traps were scrubbed with a diluted chlorine bleach solution.

Small mammals were also captured in the pitfall traps. See the Invertebrates section for pitfall methods. The mammal trapping protocol is based generally on the sampling protocol for small mammal populations in Ontario by Alissa Sugar et al. Wildlife Assessment Program.

Summary of Progress to Date

Most of the 103 sites were trapped twice between mid July and September 2001. Data collected from trapping as well as from mammals captured in pitfalls have been entered into the Pukaskwa database. Small mammals from pitfall traps were identified to species in the lab. This data has also been summarized. Since some of the sites were only trapped once (therefore had only 60 trap days), data from all sites had to be standardized to 60 trap days to allow comparisons. Abundance of mammals captured in pitfall traps were also standardized to 60 trap days to allow comparisons with the live trap data. Table 3 lists the species captured during the study. The mean number of individuals of each species captured in pitfall and live traps is summarized in Table 4.

A literature search for similar studies and background information on particular small mammal species was conducted. Information gathered from the scientific papers was recorded in a spreadsheet to be used later in species modeling.

Salamander Data Collection

Protocol

Modified cover boards are being used to sample salamanders. These boards consist of a plain board (8" x 30") with two half-sized boards (4" x 30") suspended by spacers, creating an interstitial space. Board placement to date is detailed in Table 1. Board transects were at least 20 m away from pitfall traps and 10 m away from mammal traps. Sampling of salamanders will start in the spring of 2002.

Summary of Progress to Date

Salamander boards have been installed into 75 sites (Table1), awaiting the survey beginning in spring 2002. Some salamanders were captured within the pitfall traps during the 2001 field season. These individuals have been identified and entered into the Bioindicators Project database. The number of individuals of each species captured in each treatment type was also computed and summarized below.

See Table 5 for summary of data collected so far from pitfall trapping.

Invertebrate Data Collection

Protocol

The number of trap nights for the pitfall sample is in Table 1. All samples have been washed with ethanol and stored in ethanol. Sorting and identification of trap contents began in October 2001.

Ground active invertebrates were captured using pitfall traps. These traps consist of a 1 litre plastic cup (diameter 10.5cm) inserted inside of a 20cm section of PVC pipe. These traps were dug into the ground so that the top of the trap was flush with the soil surface. Each trap was covered by a 20cm diameter plastic dinner plate, suspended approximately 1cm above the trap, to prevent rainwater entry. At each site, a transect was established containing 9 traps, each trap 20m apart. This transect was 20m from either the salamander or small mammal lines. Traps were filled to a depth of 1 inch with propylene glycol diluted by 50% with water to act as a preservative and to prevent invertebrate escape from the traps. Traps were emptied every two weeks from early June to late August. The invertebrate sample was washed and stored in 95% ethanol. Carabid beetles and ground spiders will be separated from this sample and identified to species.

The standard and most efficient survey method for ground invertebrates is pitfall trapping. Pitfall trapping is also the most efficient method to sample small mammals such as shrews, which are not well surveyed in live traps. Therefore, as part of any pitfall trapping study for invertebrates, small mammals (especially shrews) are a significant bycatch. In this study we were also interested in surveying for shrew populations.

However, studies on public land that impact on vertebrates are required to undergo a review through an animal care committee (ACC). We did this through the OMNR review procedure. As part of this review the ACC expressed concern that vertebrates (primarily shrews) would be killed during the survey. Approval was only given under the provision that we would conduct a study in the second year into methods to minimise vertebrate entry into the pitfall traps. This is not an easy task, and hasn't been well tackled in the literature. To address these concerns, we have planned a study to investigate pitfall trap modifications that may reduce vertebrate entry into traps without reducing the efficiency of the trap for invertebrate surveys. As part of this study we plan to establish a replicated trap experiment at the Greater Pukaskwa Study area.

Summary of Progress to Date

Carabid beetles and ground spiders have been separated from the complete pitfall samples. Carabid beetles are currently being identified. Approximately one quarter of the total carabid beetle specimens has been identified.

See Table 6 for summary of data collected so far.

4. UPDATED WORK PLAN

Sept 2001 – April 2002.

Assess error description and visualization techniques for statistical models. Identify carabid and spider samples to species level.

Preliminary investigations into bioindicator relationships.

Prepare for second field season.

Hire field staff.

Design pitfall trapping mammal exclusion study.

Complete invertebrate review.

May – Aug 2002. 2nd year of field work (Objectives 1-2):

Continue songbird, small mammal, salamander and pitfall trapping.

Conduct vegetation surveys and measurement.

Establish and conduct pitfall trapping mammal exclusion study.

Sort and prepare invertebrate samples. Enter data.

Begin developing habitat models.

Sept 2002– April 2003. Conduct computer intensive simulation to examine issues of bioindicator sensitivity, monitoring study design and sample size. Identify invertebrate samples from 2nd field season to species level. Develop modeling techniques using 2 years of data, and continue exploring bioindicator relationships.

May – Aug 2003. 3rd year of field work (Objectives 1–2): Continue songbird, small mammal, salamander and pitfall trapping.

Sort and prepare invertebrate samples. Enter data.

Sept 2003– April 2004. Completion of data analysis incorporating third year field data and bioindicator models. Completion of reports

7. Listing of Project Information and Publications

All project information is being published as available on the following web site

<http://www.glf.cfs.nrcan.gc.ca/index-en/research-e/ForestLandMgmt-e/Bioindicators-en.html>

The following documents are currently available online.

1. Project Proposal to LLT, January 2001
2. Interim Report to LLT, October 2001
3. Status Report to LLT, Year 1 January 2002

The following documents have been provided in draft form in the current report, and will be available online (password accessible) in draft form by Feb 15, 2002.

1. Draft manuscript titled *A Draft Framework for Using Ecological Indicators To Inform Sustainable Forest Management at an Operational Level*
2. Draft manuscript titled *Carabids and ground spiders: potential bioindicators of sustainable forests in Canada?*

Final Drafts of these reports are expected to be online and publicly available by March 31, 2002, and will be submitted to refereed journals by that time.

8. Synopsis of Project Results for Posting on LLT Web Site.

An Operational Methodology for Measuring and Analyzing Bioindicators to Support Sustainable Forest Management. Principle Researchers: Dr. Lisa Venier , Dr. Jennie Pearce and, Dr. Dan McKenney, Great Lakes Forest Research Centre, Canadian Forest Service, Sault Ste. Marie, Ontario, P6A 2E5.
Partners: Chris Grant, Domtar; Keith Wade and Jen Theberge, Pukaskwa National Park; Scott Jones and Dean Phoenix, Wildlife Assessment Program, Ontario Ministry of Natural Resources.

This project was initiated in response to the widely promoted notion that biota can be used as indicators of forest sustainability in a forest management context, and that forest managers and forest ecologists do not yet have the information and methods necessary to accomplish this. The objectives of our project are to identify the specific monitoring or research questions that need to be asked to address sustainable forest management needs and that can be answered using the indicator approach. Through the collection and analysis of field data we will also generate recommendations of which data to collect, how best to collect it and how much it will cost to collect and analyse. Also we will examine the importance of the development of spatial and temporal models to extrapolate indicator information in both space and time.

As of January 2002, we have written drafts of reports that develop the concept of ecological indicators for informing sustainable forest management and a review of the use of ground beetles (carabids) and ground spiders as indicators. These reports will be available online by April 2002.

We have also conducted our first field season at our study area at the northern border of Pukaskwa Park and the White River Forest. We have collected data on forest birds (point counts), invertebrates (pitfall trapping) and small mammals (live trapping). We have placed salamander boards for sampling in the spring of 2002.

Details of the proposal, study design and data collected to date can be found on our Project Web Page at <http://www.glfc.cfs.nrcan.gc.ca/index-en/research-e/ForestLandMgmnt-e/Bioindicators-en.html>

List of Tables:

Table 1. Summary of sites, locations, treatments, sampling conducted.

Table 2. Mean number of birds observed in 10-minute point counts within 100 m of the observer by species and by treatment group.

Table 3. Mammal species list.

Table 4. Mean number of mammals of each species in each treatment type, captured in livetraps and pitfall traps in each treatment type.

Table 5. Total number of individuals of salamander species captured within each treatment type in pitfall traps.

Table 6. Number of individuals of each carabid species captured in pitfall traps, identified to date

List of Appendices:

Appendix 1: Draft of Bio-indicators Overview Paper

Appendix 2: Draft of Carabid and Spider Indicators Review

Appendix 3: Addition to Living Legacy Trust proposal

Title: Spatially-explicit population analysis tools for examining impact of logging

Appendix 4: Supplemental budget information

List of Figures:

Figure 1: Map of sites coded for treatment type activities on indicator species

Table 1 : Summary of sites, locations, treatments, sampling conducted

Site Name	Location		Treatment Type	Birds Point Count	Birds PlayBack	Salamandar Boards	Mammal Trapping Days	Pitfall Trapping Days
	UTM Easting	UTM Northing						
APUK01	587524	5368604	Forest in Unlogged Landscape	1	1	20	120	473
APUK02	587021	5368359	Forest in Unlogged Landscape	1	1	20	120	540
APUK03	586769	5367513	Forest in Unlogged Landscape	2	1	20	120	594
APUK04	586091	5367354	Forest in Unlogged Landscape	2	1	20	120	583
APUK05	585950	5366680	Forest in Unlogged Landscape	2	1	20	120	576
APUK06	585928	5365965	Forest in Unlogged Landscape	2	1	20	120	373
APUK07	585736	5365405	Forest in Unlogged Landscape	2	1	20	120	287
APUK08	585267	5364544	Forest in Unlogged Landscape	2	1	20	120	309
APUK09	585371	5363806	Forest in Unlogged Landscape	2	1	20	120	147
APUK10	585031	5363044	Forest in Unlogged Landscape	2	1	20	120	565
APUK11	585042	5362300	Forest in Unlogged Landscape	2	2	20	120	210
APUK12	584653	5361605	Forest in Unlogged Landscape	2	1	20	120	528
APUK13	584660	5361182	Forest in Unlogged Landscape	2	2	20	120	70
APUK14	585406	5361191	Forest in Unlogged Landscape	2	1	20	120	273
APUK15	586382	5360665	Forest in Unlogged Landscape	2	1	20	120	377
APUK16	586987	5360084	Forest in Unlogged Landscape	1	1	0	120	174
APUK17	587738	5360106	Forest in Unlogged Landscape	1	1	0	120	99
FOR001	586224	5377299	Forest in Logged Landscape	2	1	50	120	498
FOR002	586301	5376772	Forest in Logged Landscape	2	1	50	120	267
FOR003	588269	5376102	Forest in Logged Landscape	2	1	50	117	359
FOR004	615738	5382134	Forest in Logged Landscape	1	1	50	120	658
FOR005	586021	5375408	Forest in Logged Landscape	2	1	50	117	387
FOR006	594621	5381264	Forest in Logged Landscape	2	1	50	120	351
FOR007	596213	5378356	Forest in Logged Landscape	2	1	50	114	594
FOR008	593822	5374147	Forest in Logged Landscape	2	1	0	117	516
FOR009	623140	5377012	Forest in Logged Landscape	2	1	50	120	307
FOR010	613638	5373587	Forest in Logged Landscape	2	1	50	60	51
FOR011	594616	5383571	Forest in Logged Landscape	2	1	50	117	428
FOR013	586154	5374784	Forest in Logged Landscape	2	1	50	120	309
FOR014	603828	5386611	Forest in Logged Landscape	2	1	50	111	288
FOR015	592169	5387267	Forest in Logged Landscape	2	1	50	117	414

Site Name	UTM		Treatment Type	Birds Point Count	Birds PlayBack	Salamandar Boards	Mammal Trapping Days	Pitfall Trapping Days
	Easting	Northing						
FOR016	603642	5382241	Forest in Logged Landscape	2	1	50	120	226
FOR017	603597	5376169	Forest in Logged Landscape	2	1	50	117	507
FOR018	601974	5377558	Forest in Logged Landscape	2	1	50	117	435
FOR019	617454	5384926	Forest in Logged Landscape	2	1	50	120	68
FOR020	618278	5384037	Forest in Logged Landscape	2	1	50	114	499
R0A01	597605	5376990	0-5 years	2	1	20	111	494
R0A02	602691	5383429	0-5 years	2	1	0	108	711
R0A03	593320	5384690	0-5 years	2	1	20	120	550
R0A04	593372	5385652	0-5 years	2	1	20	117	225
R0A05	585463	5384094	0-5 years	2	1	20	117	236
R10A01	597240	5376385	10-15 years	2	1	20	114	297
R10A02	598353	5376781	10-15 years	1	1	20	117	445
R10A03	600099	5377526	10-15 years	1	1	0	117	367
R10A04	627327	5387029	10-15 years	2	1	20	60	199
R10A05	606257	5375430	10-15 years	3	1	20	120	399
R10A06	606251	5372177	10-15 years	2	1	0	60	128
R10A07	605066	5378224	10-15 years	2	1	0	120	334
R10A08	620047	5367986	10-15 years	2	1	20	120	30
R10A09	616416	5384407	10-15 years	2	1	20	120	72
R10A10	615052	5383116	10-15 years	1	2	0	114	0
R15A01	606592	5372815	15-20 years	2	1	0	114	347
R15A02	607420	5371998	15-20 years	2	1	0	60	150
R15A03	608665	5372408	15-20 years	2	1	20	120	17
R15A04	614812*	5373818*	15-20 years	2	1	20	60	44
R15A05	617164	5376447	15-20 years	2	1	20	108	128
R15A06	614751	5373914	15-20 years	2	0	20	60	293
R15A07	615673	5371407	15-20 years	2	1	20	60	121
R15A08	616245	5374559	15-20 years	2	1	20	120	51
R15A10	614423	5375527	15-20 years	2	1	20	60	136
R1A01	593319	5379238	0-5 years	2	1	20	111	608
R1A02	593724	5379145	0-5 years	1	1	20	120	544
R1A03	605180	5375846	0-5 years	3	1	20	114	192
R1A04	596802	5383880	0-5 years	1	1	0	114	711
R1A05	614845	5370635	0-5 years	2	1	20	120	279

Site Name	UTM		UTM Northing	Treatment Type	Birds Point Count	Birds PlayBack	Salamandar Boards	Mammal Trapping Days	Pitfall Trapping Days
	Easting	Northing							
R20A01	623783	5374935		20-25 years	2	1	20	60	536
R20A03	620834*	5372193*		20-25 years	2	1	20	111	279
R20A04	628150	5389896		20-25 years	2	1	20	60	50
R20A05	631756	5369196		20-25 years	2	1	20	60	22
R20A06	632755	5368242		20-25 years	2	1	20	60	44
R20A07	635060	5369497		20-25 years	2	1	20	60	44
R20A08	632555	5380837		20-25 years	2	1	20	60	143
R20A09	617272	5383579		20-25 years	1	1	0	114	191
R5A01	590923	5376084		5-10 years	2	1	20	117	147
R5A02	594343	5378068		5-10 years	2	1	20	108	560
R5A03	590788	5374900		5-10 years	2	1	20	117	380
R5A04	592811	5378618		5-10 years	2	1	20	114	651
R5A05	594162	5379990		5-10 years	1	1	20	120	579
R5A06	600975	5382854		5-10 years	2	1	15	120	304
R5A07	595060	5382460		5-10 years	2	1	20	120	165
R5A08	590710	5386246		5-10 years	2	1	20	120	447
R5A09	585630	5376523		5-10 years	2	1	20	120	469
R5A10	586939	5376775		5-10 years	2	1	20	120	459
BRD001	589371	5376012	Forest in Logged Landscape-Bird Only		2	1	-	-	-
BRD002	589782	5376161	Forest in Logged Landscape-Bird Only		2	1	-	-	-
BRD003	587180	5376683	Forest in Logged Landscape-Bird Only		2	1	-	-	-
BRD004	590559	5376031	Forest in Logged Landscape-Bird Only		2	2	-	-	-
BRD005	601774	5378312	Forest in Logged Landscape-Bird Only		2	1	-	-	-
BRD006	602712	5385641	Forest in Logged Landscape-Bird Only		2	1	-	-	-
BRD007	602676	5384939	Forest in Logged Landscape-Bird Only		2	1	-	-	-
BRD008	602527	5384534	Forest in Logged Landscape-Bird Only		2	1	-	-	-
BRD009	598898	5383756	Forest in Logged Landscape-Bird Only		1	1	-	-	-
BRD010	604618	5378806	Forest in Logged Landscape-Bird Only		2	1	-	-	-
BRD011	603955	5379123	Forest in Logged Landscape-Bird Only		2	0	-	-	-
BRD012	599348	5377288	Forest in Logged Landscape-Bird Only		2	1	-	-	-
BRD013	607346	5381157	Forest in Logged Landscape-Bird Only		2	1	-	-	-
BRD014	606728	5379757	Forest in Logged Landscape-Bird Only		2	1	-	-	-
BRD015	606669	5379266	Forest in Logged Landscape-Bird Only		2	1	-	-	-
BRD016	605762	5373716	Forest in Logged Landscape-Bird Only		2	1	-	-	-

Site Name	UTM		Treatment Type	Birds Point Count	Birds PlayBack	Salamandar Boards	Mammal Trapping Days	Pitfall Trapping Days
	Easting	Northing						
BRD017	606644	5374810	Forest in Logged Landscape-Bird Only	2	1	-	-	-
BRD018	601113	5377630	Forest in Logged Landscape-Bird Only	1	1	-	-	-
BRD019	598108	5381305	Forest in Logged Landscape-Bird Only	1	1	-	-	-
BRD020	592172	5382987	Forest in Logged Landscape-Bird Only	2	1	-	-	-

Field Descriptions

Location UTM zone 16 NAD83 coordinates of bird count station (asterix denotes that road-side site entry coordinates are listed)

Treatment Type Forest in Unlogged Landscape Sites located within Pukaskwa National Park
 Forest in Logged Landscape No logging has ever occurred inside the forest
 Forest in Logged Landscape-bird Only No logging has ever occurred inside the forest, surveyed for birds only.
 0-5 years 0-5 year regeneration
 5-10 years 5-10 year regeneration
 10-15 years 10-15 year regeneration
 15-20 years 15-20 year regeneration
 20-25 years 20-25 year regeneration

Bird Point Count Number of 10 minute point counts conducted during field season

Bird PlayBack Number of 10 minute playback counts conducted during field season

Salamander Boards Number of salamander boards installed

Mammal Trapping Number of trap nights during field season (Number of traps at a site X number of nights trapped)

Pitfall Trapping Number of days site was trapped (Number of traps at a site X number of days trapped). If no sample was taken from the trap, due to trap being destroyed by an animal, the days the sample were missing was subtracted from the total days trapped.

Treatment Types

Common Name	Latin Name	Codes	5-10 yrs				10-15 yrs				15-20 yrs				20-25 yrs		Forest in logged Landscape	Forest in logged Landscape- Only sites	Forest in Unlogged Landscape
			0-5 yrs	5-10 yrs	10-15 yrs	15-20 yrs	15-20 yrs	10-15 yrs	5-10 yrs	0-5 yrs	20-25 yrs	20-25 yrs	Forest in logged Landscape	Forest in logged Landscape- Only sites	Forest in Unlogged Landscape				
Golden-crowned Kinglet	<i>Regulus satrapa</i>	GCKI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.74	1.00	0.47		
Gray Jay	<i>Perisoreus canadensis</i>	GRAJ	0.60	0.00	0.20	0.56	0.13	0.16	0.25	0.24									
Hairy Woodpecker	<i>Picoides stricklandi</i>	HAWO	0.00	0.10	0.10	0.22	0.38	0.21	0.10	0.06									
Hermit Thrush	<i>Catharus guttatus</i>	HETH	0.00	0.20	0.60	0.67	0.63	0.11	0.70	0.29									
House Wren	<i>Troglodytes aedon</i>	HOWR	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00									
Least Flycatcher	<i>Empidonax minimus</i>	LEFL	0.20	0.00	0.20	0.00	0.00	0.05	0.30	0.18									
Lincoln's Sparrow	<i>Melospiza lincolnhii</i>	LISP	0.40	0.90	0.30	0.11	0.00	0.00	0.00	0.00									
Magnolia Warbler	<i>Dendroica magnolia</i>	MAWA	0.30	0.60	1.30	1.00	1.25	1.79	0.85	1.06									
Mourning Warbler	<i>Oporornis philadelphia</i>	MOWA	1.30	0.50	0.20	0.00	0.25	0.26	0.10	0.06									
Nashville Warbler	<i>Vermivora ruficapilla</i>	NAWA	0.10	0.20	0.60	1.11	1.13	0.84	1.10	0.82									
Northern Flicker	<i>Colaptes auratus</i>	NOFL	0.10	0.30	0.50	0.22	0.25	0.11	0.10	0.06									
Northern Parula	<i>Parula americana</i>	NOPA	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00									
Olive-sided Flycatcher	<i>Contopus borealis</i>	OSFL	0.10	0.00	0.10	0.00	0.00	0.05	0.10	0.06									
Ovenbird	<i>Seiurus aurocapillus</i>	OVEN	0.00	0.00	0.00	0.11	0.63	0.89	0.35	1.00									
Palm Warbler	<i>Dendroica palmarum</i>	PAWA	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00									
Philadelphia Vireo	<i>Vireo philadelphicus</i>	PHVI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06									

Treatment Types

Common Name	Latin Name	Codes	0-5 yrs	5-10 yrs	10-15 yrs	15-20 yrs	20-25 yrs	Forest in logged Landscape		Forest in logged Landscape- Bird Unlogged Landscape	
								0.00	0.00	0.00	0.10
Tree Swallow	<i>Tachycineta bicolor</i>	TRSW	0.10	0.00	0.00	0.22	0.00	0.00	0.10	0.10	0.12
Veery	<i>Catharus fuscescens</i>	VEER	0.00	0.10	0.30	0.22	0.00	0.11	0.10	0.00	0.00
Warbling Vireo	<i>Vireo gilvus</i>	WAVI	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wilson's Warbler	<i>Wilsonia pusilla</i>	WIWA	0.00	0.10	0.00	0.00	0.13	0.00	0.05	0.00	0.00
Winter Wren	<i>Troglodytes troglodytes</i>	WIWR	0.10	0.10	0.00	0.11	0.13	0.53	0.45	0.29	0.29
White-throated Sparrow	<i>Zonotrichia albicollis</i>	WTSP	2.50	2.30	1.70	0.78	1.00	0.74	1.45	0.53	0.53
White-winged Crossbill	<i>Loxia leucoptera</i>	WWCR	0.00	0.20	0.20	0.00	0.00	0.11	0.15	0.12	0.12
Yellow-bellied Flycatcher	<i>Empidonax flaviventris</i>	YBFL	0.00	0.00	0.10	0.33	0.13	0.47	0.55	0.53	0.53
Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>	YBSA	0.00	0.20	0.20	0.00	0.00	0.32	0.20	0.06	0.06
Yellow Warbler	<i>Dendroica petechia</i>	YEWA	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00
Yellow-rumped Warbler	<i>Dendroica coronata</i>	YRWA	0.00	0.10	0.60	0.78	1.50	0.68	0.70	0.71	0.71

Table 3 : Mammal species list

Common Name	Code	Latin Name
Boreal red-backed vole	BRBV	<i>Clethrionomys gapperi</i>
Deer mouse	MOUSE	<i>Peromyscus maniculatus</i>
Eastern Chipmunk	EACH	<i>Eutamias striatus</i>
Hairy-tailed mole	HTMO	<i>Parascalops breweri</i>
Heather Vole	HEVO	<i>Phenacomys intermedius</i>
Least Chipmunk	LECH	<i>Tamias minimus</i>
Masked Shrew	MASH	<i>Sorex cinereus</i>
Meadow Jumping Mouse	MJMO	<i>Zapus hudsonicus</i>
Meadow Vole	MEVO	<i>Microtus pennsylvanicus</i>
Northern flying Squirrel	NFSQ	<i>Glaucomys sabrinus</i>
Northern Short-tailed Shrew	NSTS	<i>Blarina brevicauda</i>
Pygmy Shrew	PYSH	<i>Sorex hoyii</i>
Red Squirrel	RESQ	<i>Tamiasciurus hudsonicus</i>
Rock Vole	ROVO	<i>Microtus chrotorrhinus</i>
Short-tailed Weasel	SHWE	<i>Mustela erminea</i>
Smoky Shrew	SMSH	<i>Sorex fumeus</i>
Snowshoe Hare	SNHA	<i>Lepus americanus</i>
Southern Bog Lemming	SBLE	<i>Synaptomys cooperi</i>
Water Shrew	WASH	<i>Sorex palustris</i>
Woodland Jumping Mouse	WJMO	<i>Napaeozapus insignis</i>
Unidentified Vole	VOLE	
Unidentified Shrew	SHREW	

Table 4 : Mean mammal abundance in traps by species and treatment type

Species	Treatment Type												Forest in logged landscape		Forest in unlogged landscape	
	0-5 yrs N=10		5-10 yrs N=10		10-15 yrs N=10		15-20 yrs N= 9		20-25 yrs N=8		N=19		N=17			
	Live Trap	Pitfall	Live Trap	Pitfall	Live Trap	Pitfall	Live Trap	Pitfall	Live Trap	Pitfall	Live Trap	Pitfall	Live Trap	Pitfall		
BRBV	1.32	0.21	1.25	0.29	1.48	0.42	3.28	1.33	2.48	1.35	2.21	0.60	1.43	0.38		
EACH	0.50	0.00	1.03	0.00	1.03	0.00	1.25	0.00	0.90	0.00	0.75	0.00	0.60	0.00		
HEVO	0.00	0.26	0.00	0.11	0.00	0.20	0.56	0.00	0.00	0.00	0.00	0.16	0.00	0.00		
LECH	0.86	0.00	1.07	0.00	0.70	0.00	0.61	0.00	1.06	0.00	0.00	0.00	0.00	0.00		
MEVO	0.57	0.21	0.58	0.16	0.93	0.15	1.00	0.20	1.00	0.00	0.71	0.18	0.00	0.38		
MJMO	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	1.08	0.00	0.00	0.00	0.00	0.00		
MOUSE	2.27	0.21	1.94	0.19	1.45	0.20	1.90	0.00	0.96	0.00	1.45	0.13	1.18	0.10		
NFSQ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.00	0.00	0.00	0.50	0.00		
NSTS	0.00	0.43	0.00	0.16	0.00	1.21	0.00	0.00	0.00	0.21	0.50	0.16	0.50	0.11		
PYSH	0.00	0.25	0.00	0.25	0.00	0.34	0.00	0.49	0.00	0.35	0.00	0.24	0.00	0.40		
RESQ	0.51	0.00	0.50	0.00	0.53	0.00	0.50	0.00	1.18	0.00	0.63	0.00	0.50	0.00		
ROVO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.00	0.00	0.00		
SBLE	0.00	0.17	0.00	0.18	0.00	0.18	1.00	0.29	1.00	0.87	0.50	0.24	0.50	0.14		
SHREW	0.00	0.95	0.50	0.87	1.16	0.98	1.58	1.33	0.54	1.34	1.28	1.17	0.63	1.24		
SNHA	0.00	0.00	0.00	0.00	0.50	0.00	1.13	0.00	1.00	0.00	0.00	0.00	0.00	0.00		
STWE	0.53	0.00	0.50	0.00	0.84	0.00	0.53	0.00	1.00	0.00	0.00	0.00	0.00	0.00		
VOLE	1.58	0.15	0.00	0.12	0.00	0.13	1.00	0.00	0.77	0.00	0.51	0.16	0.00	0.25		
WASH	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.10		
WJMO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.54	0.00	0.00	0.00	0.50	0.00		

* Because park sites were surveyed in September, while all other sites were surveyed between June and August, the data may not be comparable.

Table 5. Total number of individuals of salamander species captured within each treatment type in pitfall traps.

Salamander species	Treatment Types					Forest in Logged Landscape	Forest in Unlogged Landscape
	0-5 yrs	10-15 yrs	15-20 yrs	20-25 yrs	5-10 yrs		
Blue-spotted	3	0	0	0	1	6	3
Eastern Newt	0	0	0	0	0	0	1
Red-backed (lead-backed morph)	1	0	0	0	0	5	7
Red-backed (striped morph)	6	2	3	1	1	11	25
Spotted	1	0	0	0	0	0	1
Grand Total	11	2	3	1	2	22	37

Table 6. Number of individuals of each carabid species captured in pitfall traps, identified to date.

Species	Number
<i>Agonum cupripenne</i> (Say)	1
<i>Agonum gratiosum</i> (Mannerheim)	28
<i>Agonum retractum</i> Leconte	278
<i>Agonum sordens</i> Kirby	1
<i>Badister obtusus</i> LeConte	4
<i>Bembidion mutatum</i> Gemminger & Harold	2
<i>Bembidion wingatei</i> Bland	1
<i>Bradycellus lugubris</i> (LeConte)	5
<i>Calathus ingratus</i> Dejean	225
<i>Carabus serratus</i> Say	3
<i>Cymindis cribricollis</i> Dejean	22
<i>Myas cyanescens</i> Dejean	5
<i>Patrobus foveocollis</i> (Eschscholtz)	7
<i>Platynus decentis</i> (Say)	34
<i>Poecilus lucublandus lucublandus</i> (Say)	10
<i>Pterostichus adstrictus</i> Eschscholtz	364
<i>Pterostichus coracinus</i> (Newman)	270
<i>Pterostichus leconteianus</i> Lutshnik	1
<i>Pterostichus pensylvanicus</i> LeConte	169
<i>Pterostichus punctatissimus</i> (Randall)	18
<i>Scaphinotus bilobus</i> (Say)	38
<i>Sphaeroderus stenostomus lecontei</i> Dejean	44
<i>Syntomus americanus</i> (Dejean)	18
<i>Synuchus impunctatus</i> (Say)	183
<i>Trechus apicalis</i> Motschulsky	5
? <i>Amara erratica</i> Duftschmid	1
? <i>Amara</i> sp.	23
? <i>Bembidion incrematum</i> LeConte	3
? <i>Calathus/Synuchus</i>	5
? <i>Carabus sylvosus</i> Say	1
? <i>Cicindela</i> sp.	1
? <i>Harpalus</i> sp.	32
? <i>Pterostichus ads/pen</i>	17
? <i>Pterostichus coracinus</i> (Newman)	2
? <i>Synuchus impunctatus</i> (Say)	2
Grand Total	1823