Saproxylic Beetles (Coleoptera) of Nova Scotia

CHRISTOPHER G. MAJKA

Research Associate
Nova Scotia Museum
1747 Summer Street, Halifax
Nova Scotia, Canada B3H 3A6
c.majka@ns.sympatico.ca

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ABSTRACT

The saproxylic beetle (Coleoptera) fauna of Nova Scotia is surveyed. The fauna consists of 790 species in 53 families and includes 709 Nearctic species (89.8% of the fauna); 37 Holarctic species (4.6% of the fauna) (i.e., a total of 94.4% native species); and 44 adventive Palaearctic species (5.6% of the fauna). For each species the county-by-county distribution in the province is provided ranging from a high of 461 species in Halifax County to 59 species in Richmond County. Species diversities range from 0.143-0.144 species/km^2 in Queens and Kings counties to 0.032 species/km^2 in Shelburne county.

A calculation of regional diversities in the province shows that values range from > 0.043 species/km^2 in the Eastern Shore, South Shore, and Bay of Fundy regions, to 0.032 species/km^2 in Cape Breton and 0.036 species/km^2 in the Northern Shore regions. Of the 790 species of saproxylic beetles in the province, 43 (5.5%) have only been recorded only on Cape Breton Island; 77 species (9.8%) have been recorded only from the southern counties of Nova Scotia; and 16 species (2.0%) have only been recorded from western areas in the province. These values may be the result of insufficient collecting, however, they may also reflect a suite of species that are restricted to those portions of the province as a result of climatic and physiographic factors, the habitats available there, and factors pertaining to historical dispersal.

For each species its distribution in northeastern North America, and on the continent as a whole are provided, as is information on their zoogeographical origins.

Preliminary risks assessments of these saproxylic Coleoptera were also conducted, based primarily on their abundance and distribution within the province. Of the 790 species, 269 were placed in the most vulnerable "May be at risk" category. While it is clear that a percentage of species likely fall into this category as a result of insufficient collection effort, this is nonetheless, an apparently high proportion of the saproxylic fauna; a fauna that is apparently rare and thus potentially at risk. All these findings are discussed in a broader context of what other studies in Atlantic Canada and further afield have indicated about the nature and importance of saproxylic faunas, and their vulnerability as a result of historical forest management practices and other ecological and evolutionary factors

Note: *The original version of this report was prepared in 2009; the current version (1.2) from 2013 includes some minor revision, corrections and updates, principally to reflect some changes in systematics. It also includes a number of new references that deal with these groups of saproxylic beetles in Nova Scotia which have been published in the intervening four years.*

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Research Associate, Nova Scotia Museum, 1747 Summer Street, Halifax, Nova Scotia, Canada B3H 3A6.
E-mail: c.majka@ns.sympatico.ca

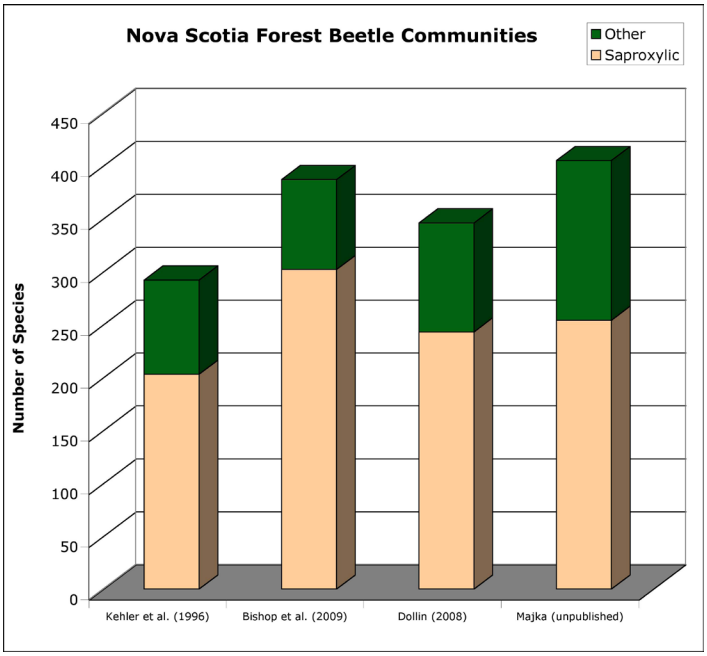
INTRODUCTION

Saproxylic beetles are a functional group of Coleoptera that depend, at some point in their life cycle, on dead or decaying wood or fungi associated with deadwood (Speight 1989). Not only do these insects comprise a large proportion of the total forest species richness, but they also play an important role in decomposition and nutrient cycling in forest ecosystems (Siitonen 2001; Grove 2002b). Saproxylic beetles are considered pioneers, as they are often the first to colonize dead wood. Early colonization by wood-boring species is thought to precondition the wood for succeeding species (Hammond *et al.* 2001). Saproxylic beetles are, in large part, responsible for the mechanical breakdown of coarse woody debris (Hickin 1963). These beetles also demonstrate sensitivity to timber-harvest practices (Simila *et al.* 2002).

Speight (1989), Grove (2002a), and Dudley and Vallauri (2004) discussed the importance of saproxylic insects in the dynamics of forest ecosystems. In general, upwards of 30% of plant biomass produced annually in forests is in the form of woody tissue and the quantity of plant nutrients recycled annually by saproxylics in forests is roughly 50% of that recycled from the annual leaf fall (Swift 1977; Speight 1989). A number of studies have drawn attention to the importance of this group in the trophic dynamics of forests. Siitonen (2001) found that 20-25% of all forest-dwelling invertebrates in Fennoscandia were saproxylic. Martikainen *et al.* (2000) found that 42% of the 553 species of beetles collected in a spruce forest in Finland were saproxylic. Köhler (2000) considered 56% of all forest-dwelling beetle species in forests in north Rhineland to be saproxylic.

Majka (2009a) summarized results from four studies of forest beetles in Nova Scotia (Kehler *et al.* 1996; Bishop *et al.* 2009; Dollin *et al.* 2008; Majka unpublished). The proportion of saproxylic beetles of the total forest beetle fauna ranged from 62.7% to 78.0% (Figure 1.)

Figure 1. Nova Scotia forest beetle communities



SAPROXYLIC BEETLES IN NOVA SCOTIA

There are few studies of saproxylic invertebrates in Atlantic Canada compared to many areas of northern Europe. Only in the last decade have serious investigations of the Nova Scotia saproxylic fauna been undertaken. The relationship between forest disturbance, whether anthropogenic or not, and saproxylic beetle diversity is of growing importance.

Nova Scotia forests have been subjected to a long history of human activity (Lynds 1989). This ranges from land clearing by early settlers, to forest "highgrading" between the 17th and 19th centuries, and finally clearcutting by the timber industry (Lynds 1989). Due to intensive management, 91% of the forested landscape is made up of young (less than 100 years) even-aged stands (Stewart *et al.* 2003). Few examples of really old forests with canopy trees of 250-300+ years old still exist. Although 73% of the land base is forested, no more than 0.6% of that land is comprised of old-growth forests (McMahon 1989; Loo and Ives 2003).

Nova Scotian old-growth forests are typically comprised of uneven-aged, multi-layered stand structures and contain large quantities of coarse woody debris (Stewart *et al.* 2003). Although old growth stands are rare in the Acadian forest region, their contribution to biodiversity may be significant (Loo and Ives 2003; Stewart *et al.* 2003; McMullin *et al.* 2008). The structural heterogeneity provided by coarse woody debris in forest ecosystems also gives rise to a wide range of ecological niches at the small-scale level. Coarse woody debris and other deadwood materials in forests provide a multitude of habitats for numerous plant and animal species (Speight 1989; Franklin 1990; Grove 2002a). Although

the study of saproxylic insects in the Maritime Provinces is relatively young, and old-growth forests have been little investigated in this regard, there are already preliminary indications that these same principals apply to forests in this region.

Majka and Pollock (2006) reported the results of four studies of forest beetles that found between 54 and 76% of forest species were saproxylic. In Nova Scotia, C.G. Majka (in preparation), in a study of a forested park found 484 species of beetles, 259 (54%) of which can be considered saproxylic. In a study of 11 coniferous forest stands in southwestern Nova Scotia, Dollin *et al.* (2008) found 264 species of saproxylic beetles. In a study of 30 coniferous forest stands in central Nova Scotia Bishop *et al.* (2009) found 296 species of saproxylic beetles. Although Kehler *et al.* (1996, 2004) identified beetles only to morphospecies in the 25 coniferous forest stands in central Nova Scotia that they examined, subsequent taxonomic work by Majka and Bondrup-Nielsen (2006) revealed that 203 saproxylic species are present. Although the scale of studies and their sampling methodologies differ, these results indicate that saproxylic beetles are an important component of forest communities in the province.

Majka (2007c) examined 14 families, subfamilies, and tribes of saproxylic beetles and found 59 "apparently rare" species that comprise 33% of the 178 species within these groups – a large proportion of the saproxylic fauna. Majka (2007c) proposed that this apparent scarcity may be due to the history of forest management practices in the region. These preliminary indications of the importance of saproxylic beetles, the scarcity of many species, and the very low fraction of old-growth forests in the region, together suggest that the virtual disappearance of microhabitats found in old growth forests may have affected a substantial proportion of Nova Scotia's native saproxylic fauna.

OBJECTIVES

The principal objectives of this study were to:
a) compile information to determine the composition of the saproxylic beetle fauna of Nova Scotia;
b) compile available information on the distribution of these species in the province;
c) situate this information within a regional and North American distributional context; and
d) based on the aforementioned information, make a preliminary assessment of the risk categories of these species in the province.
These objectives were met and the information is presented in the following pages.

METHODOLOGY & CONVENTIONS

1) Definition and delineation of the saproxylic fauna

What is a saproxylic beetle? According to the generally accepted definition by Speight (1989), saproxylic beetles are a functional group of Coleoptera that depend, at some point in their life cycle, on dead or decaying wood or fungi associated with deadwood. As such, it includes not only phloeophagous and xylophagous beetles that feed directly on decomposing wood, but also mycetophagous species that feed on fungal mycelia that group in such environments, bolitophagous species that feed on the fruiting bodies of fungi (whether saprophytic and/or mycorrhizal), and predators which feed on all such species. This is an excellent functional, ecological definition; applying it in a particular context, however, involves complexities, uncertainties, and judgment calls. Chief amongst these are the following:

1) In the case of some groups or species, knowledge of their bionomics is limited or non-existent. In the context of this study, this applies particularly to many species of Staphylinidae (rove beetles) and Elateridae (click beetles), and some genera in the Leiodidae (round fungus beetles). Consequently, their inclusion or exclusion from the saproxylic fauna is fraught with varying degrees of uncertainty.

2) In a considerable number of instances, groups or species are polyphagous, living and feeding in part in saproxylic environments, but also feeding on other food sources, or venturing into other non-saproxylic environments. In the case of this study, this applies to some species of Carabidae (ground beetles) and Staphylinidae (rove beetles) many of which are large generalist, opportunistic forest floor predators. In some situations they may prey on other saproxylic species; in other instances they may be feeding on species not specifically associated with saproxylic environments.

Species in genera such as *Tachinus* and *Sepidophilous* (Staphylinidae) are often associated with decomposing fungi (and hence are members of the saproxylic fauna), but also venture into other decomposing environments such as dung and carrion, not part of the saproxylic system. Some species in genera such as *Quedius* and *Philonthus* (Staphylinidae) are

predators which can be found in rotten logs, however, they also frequent other forest environments not directly connected to decaying wood.

In this study we have taken a conservative approach and have not included generalist forest floor predators in the Carabidae and Staphylininae which are not strongly associated with saproxylic environments, even though it is recognized that some of these sporadically enter the saproxylic system. Included are all species that are strongly associated with living and decomposing fungi (which are in important measure saprophytic on decaying wood), even though it is recognized that some of these fungi may be mycorrhizae associated with the roots of trees, or saprophytic (at least in part) on dead leaves and/or vegetation.

3) Not only are some species polyphagous, but also in the case of certain groups of Coleoptera, different life stages of individuals feed on different food sources. For example, the larvae of Cerambycidae (longhorn beetles) are phloeophagous, feeding on the phloem of dead and dying trees, and hence are clearly a part of the saproxylic processes of wood decay. The adults of many species (i.e., in the subfamily Lepturinae) feed on the pollen of a variety of woodland and open-environment trees, bushes, and even herbaceous plants – not a saproxylic diet. Similarly, larvae of the Buprestidae are xylophagous, feeding on the wood of various dead and dying trees, whereas adults feed on the foliage of their hosts, or else visit flowers to feed on pollen and/or nectar – again, exiting the saproxylic system.

In this study I have included as saproxylic, species in which at least one life stage (usually the larvae) is associated with dead, dying, or decomposing wood. Larvae are generally longer-lived than adults in many groups, and hence their ecological impact in the environments that they inhabit extends over a lengthy period (and, in some instances, adult beetles feed little or not at all).

2) The Distribution of Saproxylic Beetles in Nova Scotia

In Table 4 of this report, which is the species-by-species compilation of information on all saproxylic species in the province, the occurrence of each species in Nova Scotia is indicated on a county-by-county basis. These counties are grouped into the following five provincial regions:

1) Northern Shore: Antigonish, Cumberland, Colchester, Pictou, and Antigonish;
2) Cape Breton: Cape Breton, Inverness, Richmond, and Victoria;
3) Eastern Shore: Guysborough and Halifax;
4) South Shore: Lunenburg, Queens, Shelburne, and Yarmouth;
5) Bay of Fundy: Annapolis, Digby, Hants, and Kings.

While these are simple approximations they do allow for a ready way to represent distributions that mirror (albeit imperfectly) some of the physiographic eco-districts within the Nova Scotia portion of Atlantic Maritime Ecozone.

Shown in the tables are the number of county records for each species, and the number of regions (of the five above) in which the species have been found. In addition to this strictly empirical information, the "Nova Scotia Distribution" column indicates (where sufficient information is available and where a potential interpretation can be made) a provisional summary interpretation of the species' distribution in the province. The main categories employed are:

1) Widespread: found in all five regions of the province;
2) Mainland: found in the four mainland regions of NS, but not on Cape Breton Island;
3) Cape Breton: found on Cape Breton Island, but not on the mainland of NS;
4) Northern NS: found in the northern mainland of Nova Scotia;
6) Southern NS: found in the southern mainland of Nova Scotia;
6) Western NS: found in the western mainland of Nova Scotia;
8) Annapolis V.: found in the Annapolis Valley of Nova Scotia.

Question marks (?) following categories indicate that such interpretations are provisional. In general, such characterizations, particularly in the case of species that appear to be restricted to one or other area of the province, should be regarded as provisional, based as they are on available data that may be insufficient to fully characterize their distribution in the province. In the case of many saproxylic species, sampling effort to date has been less than thorough and consequently their apparent absence from counties or regions of the province may simply be due to this paucity of collecting effort.

To give a context to the occurrence of these species in Nova Scotia, their distribution is also indicated within northeastern North America. For the purposes of this treatment, northeastern North America is taken to consist of the following jurisdictions: CT, Connecticut; LB, Labrador; MA, Massachusetts; ME, Maine; NB, New Brunswick; NF, insular Newfoundland; NH, New Hampshire; NS, Nova Scotia; NY, New York; ON; Ontario; PE, Prince Edward Island; QC, Québec; RI Rhode Island; PM, Saint-Pierre et Miquelon; and VT, Vermont.

To give an even wider context to the distribution of the species, their distribution within North America is indicated in the Continental Distribution column. The categories employed are:

1) Northeastern
2) Southeastern
3) Southwestern
4) Northwestern
5) Central
6) Mexico
7) Central America
8) The Caribbean

Note: "Northeastern" in this context is a wider category than in the "northeastern North America distribution" column (as defined above). It additionally includes states south to Maryland on the Atlantic coast, and west to Illinois and Wisconsin.

Finally, the zoogeographic origin of the species are indicated beside each species in the species column. The categories employed are:

1) Nearctic, no entry
2) Holarctic, *****
3) Palaearctic, †
4) Oriental, §

PRELIMINARY ASSESSMENT OF RISK CATEGORIES

The risk categories employed for this study are the same as those employed by COSEWIC (2009) (Committee on the Status of Endangered Wildlife in Canada), namely:

1) Extinct
2) Extirpated
3) At Risk
4) May Be At Risk
5) Sensitive
6) Secure
7) Undetermined
8) Not Assessed
9) Exotic
10) Accidental

In practice, only five of these categories (May be at risk, Sensitive, Secure, Undetermined, and Exotic) were actually employed in this study. No species of beetles from Nova Scotia are known to be extinct or extirpated in Nova Scotia, and the "at risk" category is limited only to those species which have had a formal risk assessment conducted (which has not taken place for any Nova Scotia Coleoptera). All species were assessed and accidental species were not included in the analysis.

In any preliminary assessment of risk categories there is, of course, some degree of subjectivity and interpretation associated with the process of assignments. In assigning species to the "May Be At Risk" category, it is recognized that this is an initial assessment, which in some instances is certainly influenced by insufficient collecting effort. In many cases, further research will be necessary to confidently discriminate between species that are actually rare and local – and hence may be at risk – from those that are simply apparently so as a result of a paucity of collecting effort. This is certainly apt to be the case for a number of species in poorly known groups such as the Aleocharinae, Corylophidae, Cryptophaginae, Endomychidae, Eustrophinae, Scydmaeninae, certain Leiodidae, Trogossitidae, and Zopheridae which have been relatively little investigated and/or are not frequently collected using common techniques.

In approaching the task of assigning general status categories to species for which there are relatively few records, the question also arises as to whether to categorize such species as "Undetermined" (i.e., with little data resulting from of a paucity of collecting effort) or "May Be At Risk" species (i.e., those which appear to be actually rare and local, and hence at some potential risk). It is almost certainly the case that both such categories exist amongst the "May Be At Risk" saproxylic beetle fauna of Nova Scotia, and in most instances there is no *a priori* method of being able to distinguish between these two components. Reasonable arguments can be made for taking both approaches.

In the case of the saproxylic beetle fauna of Nova Scotia, I have elected to place these species in the "May Be At Risk" category, employing the "Undetermined" category in a much more restricted sense (as outlined above). In part, I

have interpreted this as erring on the side of caution and letting the empirical data speak for itself. If there are only a few specimens from a very restricted number of localities, it might be judicious to regard such a species as being at possible risk, until further research confirms or disproves this supposition.

In part, it is also my assessment that the collecting history for saproxylic Coleoptera in Nova Scotia, while imperfect, is nonetheless extensive enough both temporally [spanning as it does 170 years since the account published by Kirby 1837], spatially (with 1,997 county records), and numerically (with over 26,000 specimen records) that it is reasonable to suppose that some degree of coverage has been achieved for most of the province, and hence that at least a non-insignificant number of species that appear to be rare and local, may actually be so. Having said this, it is possible to argue that the present knowledge of Nova Scotia saproxylic Coleoptera is still too imperfect to make such a preliminary determination, and that a higher bar of knowledge needs to be achieved before one can make such assignments.

A short explanation of how these risk categories were interpreted for the present study:

4) May Be At Risk - as mentioned above, this category as employed is effectively a concatenation of the "At Risk" and "May Be At Risk" categories since no formal risk assessments on Nova Scotia Coleoptera have been conducted. In general, species that have been found in only one or two of the 18 counties in Nova Scotia were included in this category. In rare instances, where other information on the habitat and/or local, regional, or continental scarcity so indicated, species found slightly more widely were placed in this category.

5) Sensitive - In general, species that have been found in only three or four of the 18 counties in Nova Scotia were included in this category.

6) Secure - In general, species that have been found in five or more of the 18 counties in Nova Scotia were included in this category.

7) Undetermined - a small number of species (2) for which distributional data for the provinces was lacking were placed in this category.

9) Exotic - Adventive (in all cases in this study, Palaearctic) species now naturalized in the forests of Nova Scotia, were placed in this category.

RESULTS & DISCUSSION

1) Composition of Species

As a result of this study 790 species of saproxylic beetles in 53 families are now known to occur in Nova Scotia (Table 1). This is 33.1% of the 2,389 species of Coleoptera recorded in Nova Scotia. The saproxylic fauna includes 709 Nearctic species (89.8%); 37 Holarctic species (4.6%) (i.e., a total of 94.4% native species); and 44 adventive Palaearctic species (5.6%). The percentage of native saproxylic species is greater than the 84.3% of the overall Nova Scotia beetle fauna, which is comprised of native species (which consists of 78.3% Nearctic species; 6.0% Holarctic species; 15.2% adventive Palaearctic species; and 0.5% adventive Oriental species) (C.G. Majka, unpublished data). Although there has been some penetration of native forested habitats by adventive species (5.6%), this is only 1/3 of the proportion of adventive species overall in the Nova Scotia beetle fauna (15.7%).

Table 1. Species by Family Summary

Family		# sp
Aederidae	Ant-like Leaf Beetles	3
Anobiidae	Death Watch Beetles	25
Anthribidae	Fungus Weevils	4
Boridae	Conifer-bark Beetles	1
Bostrichidae	Bostrichid Beetles	4
Brentidae	Straight-snouted Weevils	1
Buprestidae	Jewel Beetles	41
Carabidae	Ground Beetles	2
Cerambycidae	Longhorn Beetles	99
Cerylonidae	Minute bark Beetles	3
Ciidae	Minute Tree-fungus Beetles	13
Clambidae	Minute Beetles	1
Cleridae	Checkered Beetles	6
Corylophidae	Minute Fungus Beetles	5
Cryptophagidae	Silken Fungus Beetles	18
Cucujidae	Flat Bark Beetles	1

Curculionidae	Weevils & Bark Beetles	69
Dryophthoridae	Dryophthorid Weevils	1
Elateridae	Click Beetles	77
Endomychidae	Handsome Fungus Beetles	6
Erotylidae	Pleasing Fungus Beetles	7
Eucinetidae	Plate-thigh Beetles	3
Eucnemidae	False Click Beetles	10
Histeridae	Hister Beetles	8
Laemophloeidae	Lined Flat Bark Beetles	6
Latridiidae	Minute Brown Scavenger Beetles	9
Leiodidae	Round Fungus Beetles	39
Lucanidae	Stag Beetles	3
Lycidae	Net-winged Beetles	12
Lymexilidae	Ship-timber Beetles	1
Melandryidae	False Darkling Beetles	24
Monotomidae	Root-eating Beetles	4
Mordellidae	Tumbling Flower Beetles	5
Mycteridae	Palm and Flower Beetles	1
Nitidulidae	Sap Beetles	30
Oedemeridae	False Blister Beetles	5
Ptiliidae	Featherwing Beetles	25
Pyrochroidae	Fire-coloured Beetles	5
Pythidae	Dead Log Beetles	4
Salpingidae	Narrow-waisted Bark Beetles	2
Scarabaeidae	Scarab Beetles	5
Scraptidae	False Flower Beetles	5
Scydmaeninae	Ant-like Stone Beetles	16
[now considered a subfamily of the Staphylinidae]		
Silvanidae	Silvanid Flat Bark Beetles	4
Sphindidae	Cryptic Slime Mold Beetles	3
Staphylinidae	Rove Beetles	120
Stenotrachelidae	False Longhorn Beetles	2
Synchroidae	Synchroa Bark Beetles	1
Tenebrionidae	Darkling Beetles	30
Tetratomidae	Polypore Fungus Beetles	8
Throscidae	Throscid Beetles	3
Trogossitidae	Bark-gnawing Beetles	6
Zopheridae	Zopherid Beetles	3
Total		**790**

2) Distribution Within the Province

Table 2. NS saproxylic beetles in each county

County	# species	km2	sp/km2
Cumberland	271	4271	0.063
Colchester	318	3627	0.088
Pictou	194	2845	0.068
Antigonish	151	1458	0.104
Inverness	182	3830	0.048
Victoria	181	2871	0.063
Cape Breton	137	2471	0.055
Richmond	59	1244	0.047
Guysborough	255	4044	0.063
Halifax	461	5496	0.084
Lunenburg	261	2908	0.090
Queens	343	2392	0.143
Shelburne	79	2465	0.032
Yarmouth	172	2123	0.081
Digby	105	2515	0.042
Annapolis	193	3184	0.061
Kings	306	2122	0.144
Hants	226	3049	0.074

Table 2 indicates the number of species of saproxylic beetles found in each of the counties of Nova Scotia. There is a considerable range in values from a high of 461 species in Halifax County (58.8% of the provincial total), to 59 species in Richmond County (7.5% of the provincial total). There is a relatively strong proportional representation in Cumberland, Colchester, Halifax, Lunenburg, Queens, and Kings counties – where 33% (260 species) or more of the provincial total of saproxylic beetles have been found. At the low end of the spectrum are Richmond, Shelburne, and Digby counties where less than half this number (i.e., 16% or 126 species) of the provincial total of saproxylic beetles have been found. These differences are likely attributable to a combination of both variation in collecting effort between counties, as well as actual differences in the faunas as a result of climate, geography, vegetation, and other physiographic factors. In particular, Halifax and Kings counties, where the largest numbers of species have been found, are and have been historically, the centers of the entomological communities in the province, and so it is unsurprising to find relatively high numbers of species recorded from these two areas.

However, since there are differences in the land areas of the counties, and since species composition is a non-linear function of area, a better representation of variation between counties can be discerned when these values are normalized as species/km^2 (Table 2; Figure 2). Figure 2 illustrates the variability clearly, with values ranging from 0.032 species/km^2 in Shelburne County and 0.042 species/km^2 in Digby County to 0.143 species/km^2 in Queens County and 0.144 species/km^2 in Kings County – a four and a half-fold difference in values. Such differences are in part also a reflection of variation in collecting effort from county to county and it would be reasonable to assume that values in excess of 0.100 species/km^2 are better reflective of the actual population density of saproxylic beetles in Nova Scotia, and that with sufficient collecting effort such values could be achieved in most, if not all, of the counties of the province.

The high apparent species diversity of saproxylic Coleoptera in Queens County, 0.143 species/km^2, is noteworthy however. It part, this may reflect a particular focus on saproxylic Coleoptera in that county (i.e., Dollin *et al.* 2008), however it may also, in part, reflect the diverse forest communities of southwestern Nova Scotia where there are a greater numbers of deciduous forests, and old growth forest stands. The species diversity of neighbouring Shelburne County, 0.032 species/km^2, stands in stark contrast to the high level in Queens County, however, this difference is certainly ascribable to the very limited collecting effort for Coleoptera in the former county, the second lowest in the province after Richmond County. It would be worthwhile to conduct a focused investigation of the saproxylic beetle fauna of Shelburne County to better ascertain its species diversity.

Figure 2. Species/km^2 of Nova Scotia saproxylic Coleoptera in each county

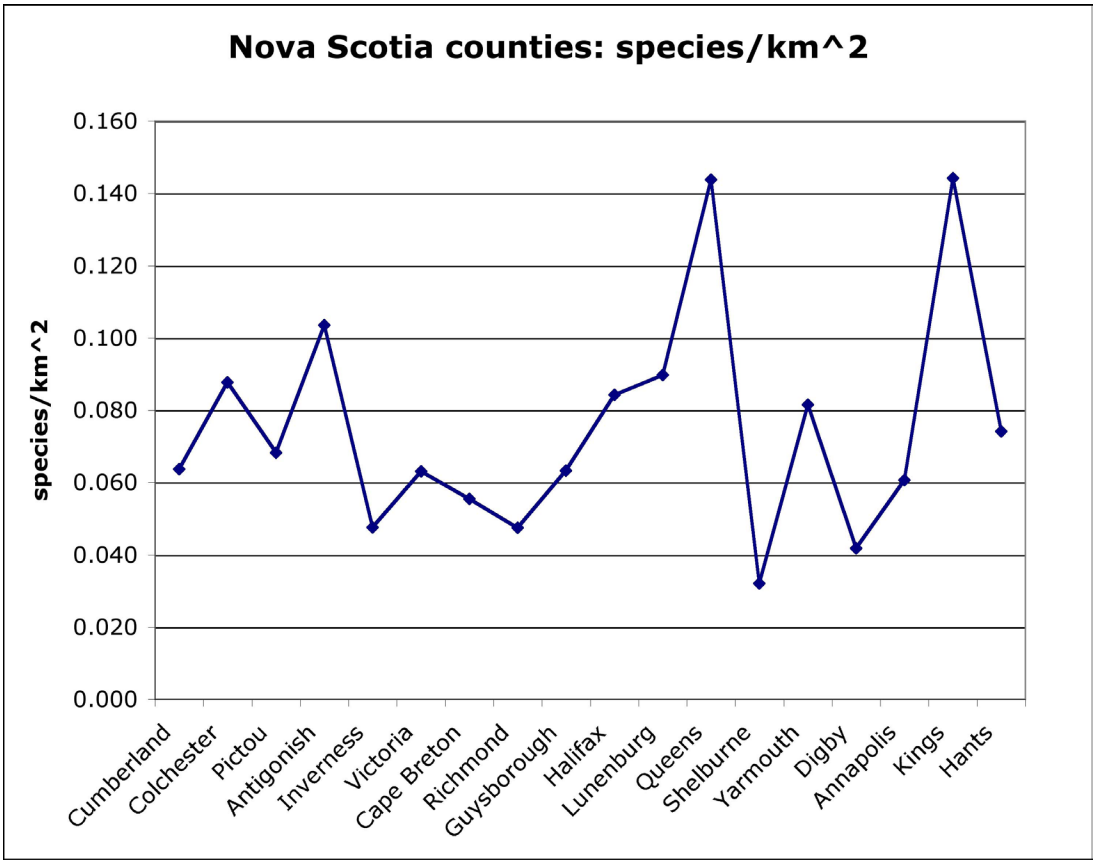


Table 3. NS saproxylic beetles in each region

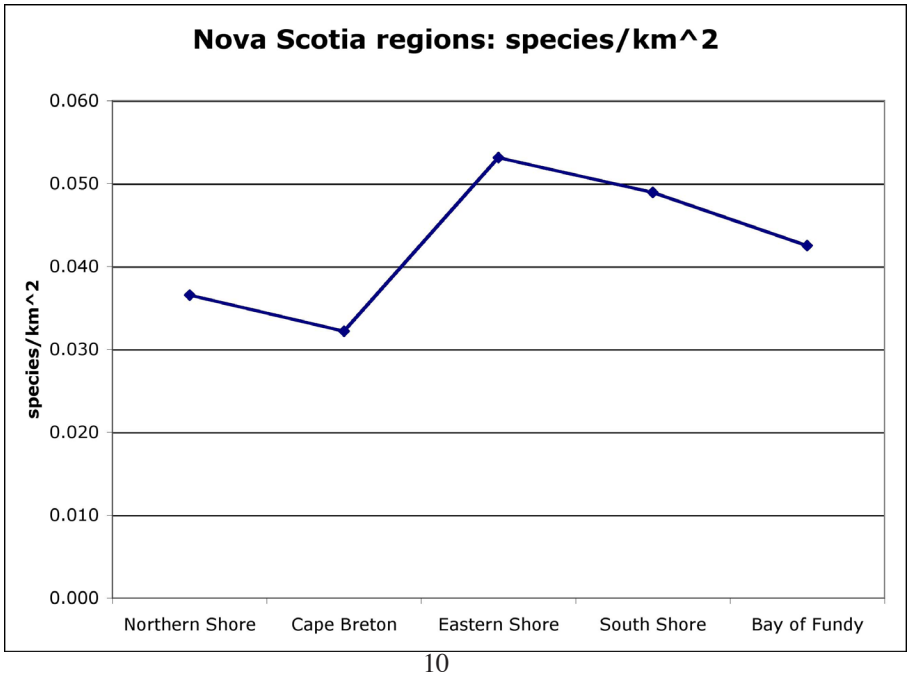
Region	# species	km2	sp/km2
Northern Shore	445	12201	0.036
Cape Breton	335	10416	0.032
Eastern Shore	505	9540	0.053
South Shore	482	9888	0.049
Bay of Fundy	462	10870	0.043

Considerably less variability (less than a two-fold difference) is exhibited one examines the saproxylic fauna on a region-by-region basis rather than a county-by-county basis (Table 3; Figure 2), however, there are nonetheless some noteworthy differences deserving of attention. High values of > 0.043 species/km^2 are found in the Eastern Shore, South Shore, and Bay of Fundy regions; Cape Breton exhibits a significantly lower species diversity with a level of 0.032 species/km^2 as does the Northern Shore with a level of 0.036 species/km^2 (Table 3; Figure 2). [Note: as pointed out earlier, the species/area relationship is non-linear so the absolute values of species/km^2 are significantly lower on a regional basis than they are on a county basis.]

Since collecting effort variability is significantly reduced on a region-by-region basis compared to a county-by-county basis, this degree of provincial variation might be actually be indicative of differences in saproxylic faunas within Nova Scotia. In particular, the lower species diversity on Cape Breton Island (42.6% of the Nova Scotia total) is in keeping with both its insular status (*sensu* MacArthur and Wilson 1967), and with other studies of the Coleoptera of Nova Scotia. For instance Majka *et al.* (2007) found that only 68.4% of the Carabidae (ground beetles) found in Nova Scotia occur on Cape Breton Island. Nonetheless, it is noteworthy that of the 790 species of saproxylic beetles in Nova Scotia, 43 (5.4%) have only been recorded on Cape Breton Island and not on the mainland of the province (Table 4). This result may also, in part, be the result of insufficient collecting, however, in may also reflect a suite of species that are restricted in the province to the more northerly climatic and physiographic environments of Cape Breton Island, and the habitats available there (Davis and Brown 1996).

Similarly, there are 77 species (9.7%) that have been recorded in the province only from the southern counties of Nova Scotia (Table 4). This may also, in part, be the result of insufficient collecting, however, in may also reflect a suite of species that are restricted in the province to the warmer climatic and physiographic environments of this portion of the province, and the habitats available there (Davis and Brown 1996). There are also 18 species (2.3%) that have been recorded solely from areas in the Annapolis Valley region of Nova Scotia and 11 species (1.4%) that have been recorded only from the northern portions of the province (including Cape Breton island) (Table 4). Finally, there is a suite of 16 species (2.0%) that have only been recorded from western areas in the province (Table 4). They may be species that have found the Cobequid Highlands an obstacle to further dispersal in the province, or indeed they may be species that have more recently dispersed into the province and have only started to colonize it (or, again, this apparent distribution could simply be the result of insufficient collecting effort).

Figure 3. Species/km^2 of Nova Scotia saproxylic Coleoptera in each provincial region



3) Preliminary Assessment of Risk Categories

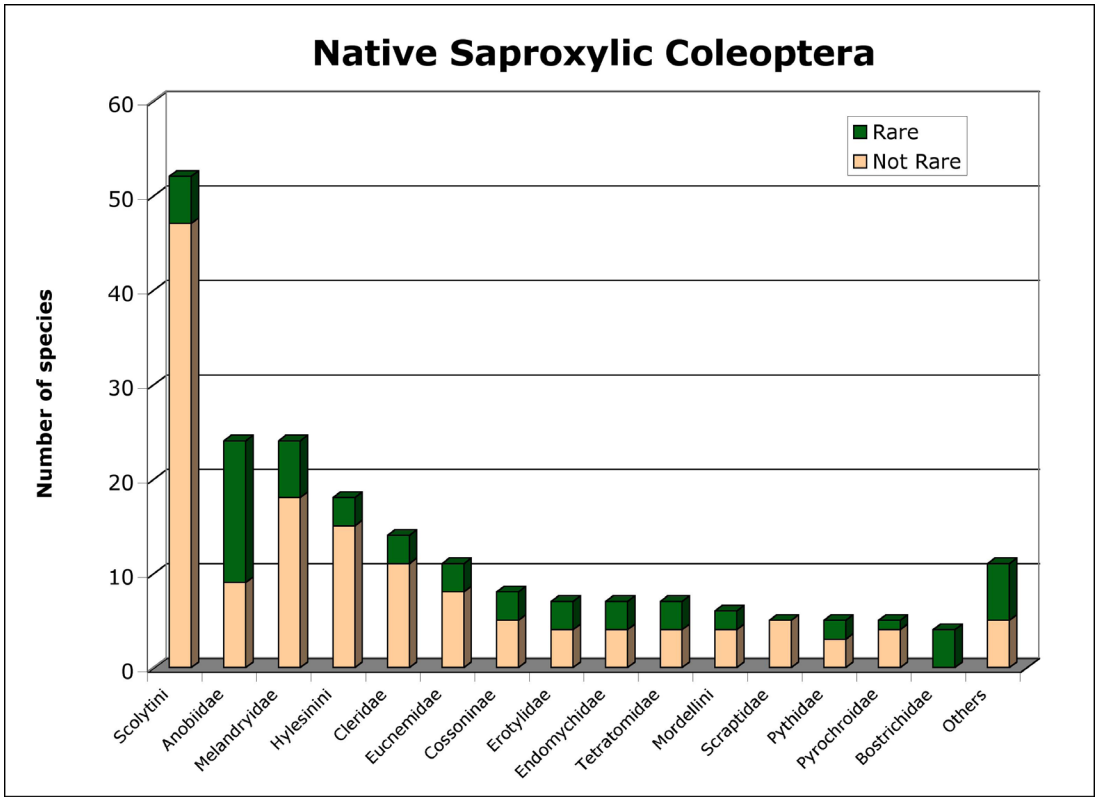
Table 4 shows the number of species assessed in each of the risk categories:

Table 4. Saproxylic species in each risk category

Category	# of species
May be at risk	267
Sensitive	150
Secure	3326
Exotic	45
Undetermined	2
Total	790

Noteworthy is the fact that 267 species (33.8%) of the saproxylic species were assessed in the most vulnerable "May be at risk" category. This is similar to the proportion of 33.0% (59 species) of "apparently rare" saproxylic beetles (from 14 Coleoptera families) highlighted by Majka (2007). "Apparently rare" species were defined by Majka (2007c, 2009a) as those representing ≤ 0.005% of specimens examined from within the region (Figure 4). While it is clear in both instances that a percentage of species likely fall into these respective categories as a result of insufficient collection effort, this is, nevertheless, a seemingly high proportion of the saproxylic fauna; a fauna that is apparently rare and thus potentially at risk. I'm not aware of similar studies in other jurisdictions that would provide a direct basis of comparison, however, a slightly different perspective on this topic is offered by Alexander (2004).

Figure 4. Rare and not rare Nova Scotia native saproxylic beetles by family



In his revision of the species of Coleoptera used to calculate the Index of Ecological Continuity (an inverse of disturbance) for saproxylic beetles in Great Britain, Alexander (2004) included 180 of the 700 saproxylic species found in Great Britain (i.e., 25.7% of the saproxylic fauna). These 180 are species that are very sensitive to disturbance in forested environments, and hence are found largely or exclusively in forested environments that exhibit "ecological continuity" (i.e., are largely ecologically undisturbed). While the specifics of the Index of Ecological Continuity are slightly different from those of the present study, the focus of both is largely similar. Both approaches highlight rare saproxylic Coleoptera, vulnerable to disturbance, confined (at least to some degree) to relict forested environments that exhibit ecological continuity, and are consequently vulnerable to disturbance. Indeed, the Index of Ecological Continuity was developed in Great Britain as a quantitative way of assisting in site assessment to promote site conservation. In that light, the relatively similar proportions (33.8% vs. 25.7%) in both studies are noteworthy, and perhaps indicative of the overall scarcity of

saproxylic beetles on both sides of the Atlantic.

Studies such as Majka (2006, 2007a, 2007b, 2007c, 2007d), Majka and Pollock (2006), and Majka *et al.* (2006) have all noted the apparent scarcity of certain saproxylic beetles in the Maritime Provinces and all have noted that such scarcity could be indicative of a diminution of habitat as a result of the history of forest management practices in the region. As noted in the introduction, Nova Scotia forests have been subjected to a long history of human activity (Lynds 1989). Although 73% of the land base is forested, no more than 0.6% of that land is comprised of old-growth forests (McMahon 1989; Loo and Ives 2003). It is important to bear in mind that diversity of saproxylic species may depend on subtle variation in habitat characteristics, that are not apparent at a landscape-level analysis of forest diversity (Hammond *et al.* 2004). Consequently, there are reasonable grounds to believe that anthropogenic factors have had a strong impact on the biodiversity of Nova Scotia forests, to the detriment of a not insignificant proportion of the Coleoptera fauna.

However, it is important to note that not all "apparently rare" saproxylic beetles are necessarily so for anthropogenic reasons. Indeed, for both ecological and evolutionary reasons, one would expect that a certain proportion of the fauna in any environment would be rare (Muona 1999). Any habitat is partitioned into a myriad of ecological niches, some of which are relatively infrequent, and hence species that are specialized inhabitants of such niches would be correspondingly infrequent. Furthermore, differences in biology of species also mean that some species are inherently less abundant than others. For example, amongst saproxylic Coleoptera, species that inhabit long-lived stable environments such as decaying polypore fungi (which may persist for many years), may be correspondingly long-lived, exhibit low rates of dispersion, and low population levels. On the other hands, phloeophagous species that inhabit short-lived environments in which cambium utilization, decomposition, and degradation are such that the microhabitat persists for only for 1-2 years, tend to have shorter population turnovers, exhibit rapid rates of dispersal, and can (in the right circumstances) build to high population levels (as is the case with certain species of Scolytinae and Cerambycidae).

Whether anthropogenic or not, species which are rare and seemingly restricted to a small number of sites (relict or not) are nonetheless vulnerable to disturbance, and even to extirpation, simply as a result of stochastic processes and events. Consequently, the imperatives of environmental (and hence species) conservation are just as urgent, irrespective of the reasons underlying the scarcity.

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Summary of the Nova Scotia Saproxylic Coleoptera Fauna

1) Aederidae: Ant-like leaf beetles

Aderus populneus (Panzer)

Bionomics: Adults are commonly found on the foliage of various trees, particularly angiosperms with broad leaves. Larvae are found on rotting wood, in leaf litter, and under the bark of trees (Chandler 2002).

Number of saproxylic species in Nova Scotia: 3

References on the Nova Scotia fauna:

Majka, C.G. 2011. The Aderidae (Coleoptera) of the Maritime Provinces of Canada. Journal of the Acadian Entomological Society 7: 65–79.

2) Anobiidae: Death watch beetles

Anobium punctatum (DeGeer)

Bionomics: The larvae of Anobiidae bore in the bark of dry wood, twigs, seeds, woody fruits, galls, and polypore fungi. The name derives from the habit of males of *Anobium punctatum* (DeGeer) and *Xestobium rufovillosum* (DeGeer) of repeatedly striking the anterior margin of the pronotum against wood, producing an audible "tick"; a habit which gave rise to the superstition that this "ticking" was an ominous portent of death (Phillips 2002).

Number of saproxylic species in Nova Scotia: 25

References on the Nova Scotia fauna:

Majka, C.G. 2007b. The Derodontidae, Dermestidae, Bostrichidae, and Anobiidae of the Maritime Provinces of Canada (Coleoptera: Bostrichiformia). Zootaxa 1573: 1–38.

3) Anthribidae: Fungus Weevils

Euparius marmoreus (Olivier)

Bionomics: The larvae are either fungivorous on various species of polypores or other woody fungi, or bore into the wood of dead or dying tree trunks or branches. Adults are found on the same hosts frequented by the larvae (Valentine 2002).

Number of saproxylic species in Nova Scotia: 4

References on the Nova Scotia fauna:

Majka, C.G., Anderson, R.S., and McCorquodale, D.B. 2007. The weevils (Coleoptera: Curculionoidea) of the Maritime Provinces of Canada, II: new records from Nova Scotia and Prince Edward Island and regional zoogeography. The Canadian Entomologist 139: 397–442.

4) Boridae: Conifer-bark Beetles

Boros unicolor Say

Bionomics: The larvae of *Boros unicolor* Say are found in the subcortical region of dead (often standing or leaning) coniferous trees. Adults are also associated with dead coniferous trees (Pollock 2002c).

Number of saproxylic species in Nova Scotia: 1

References on the Nova Scotia fauna:

Majka, C.G. 2006a. The Mycteridae, Boridae, Pythidae, Pyrochroidae, and Salpingidae (Coleoptera: Tenebrionoidea) of the Maritime Provinces of Canada. Zootaxa 1250: 37–51.

5) Bostrichidae: Bostrichid Beetles

Prostephanus punctatus (Say)

Bionomics: The larvae are wood borers that receive their actual nutrition from the starch content of the wood they consume (Ivie 2002b).

Number of saproxylic species in Nova Scotia: 4

References on the Nova Scotia fauna:

Majka, C.G. 2007b. The Derodontidae, Dermestidae, Bostrichidae, and Anobiidae of the Maritime Provinces of Canada (Coleoptera: Bostrichiformia). Zootaxa 1573: 1–38.

6) Brentidae: Straight-snouted Weevils

Arrenodes minutus (Drury)

Bionomics: Brentidae are large, elongate weevils found under the bark of various dead and dying deciduous trees. Females excavate a hole with their rostrum into which they deposit their eggs. Larvae bore deep into the heartwood where they appear to feed on wood and fungal mycelia (Anderson and Kissinger 2002).

Number of saproxylic species in Nova Scotia: 1

References on the Nova Scotia fauna:

Majka, C.G., Neil, K., and Webster, R.P. 2008. *Arrenodes minutus* (Drury, 1773) (Coleoptera: Brentidae) discovered in the Maritime Provinces of Canada. Journal of the Acadian Entomological Society 4: 32–35.

7) Buprestidae: Jewel beetles

Chalcophora virginiensis (Drury)

Bionomics: Buprestid larvae feed on the cambial layer, and/or the bark, and/or the heartwood of a wide variety of coniferous and deciduous trees. Adults are found on these host plants, and also a variety of non-host species, where they feed on foliage or visit flowers to feed on energy-rich pollen or nectar, except for some species of *Chrysobothris* and *Agrilus* that feed on fungi (Bright 1987; Bellamy and Nelson 2002.

Number of saproxylic species in Nova Scotia: 41

References on the Nova Scotia fauna:

The most recent publication to treat the Nova Scotia fauna is Bright (1987), although there are records of 16 as yet unpublished additional species in the province. C. G. Majka is currently working on a paper which will publish these additional records and review the status of this family in the Maritime Provinces

Bright, D.E. 1987. The metallic wood-boring beetles of Canada and Alaska - Coleoptera: Buprestidae. The Insects and Arachnids of Canada: Part 15. Agriculture Canada, Ottawa, Ontario. Research Branch Publication 1810: 1– 334.

8) Carabidae: Ground beetles

Mioptachys flavicauda (Say)

Bionomics: Most carabids are either ground-feeding predators or feed largely on seeds and are opportunistic predators. Although many inhabit forested environments, and may periodically enter the saproxylic system by feeding on other saproxylic species, the vast majority are not restricted to such environments and range widely in forest-floor habitats. The present study includes only two species of carabids, *Mioptachys flavicauda* (Say) and *Dromius fenestratus* (Fabricius), that are particularly

associated with subcortical forest environments.

Number of saproxylic species in Nova Scotia: 2

References on the Nova Scotia fauna:

Majka, C.G., Bousquet, Y., and Westby, S. 2007. The ground beetles (Coleoptera: Carabidae) of the Maritime Provinces of Canada: review of collecting, new records, and observations on composition, zoogeography, and historical origins. Zootaxa 1590**:** 1–36.

9) Cerambycidae: Longhorn beetles

Callidium violaceum (Linnaeus)

Bionomics: Larvae are phloeophagous and are found on a wide variety of coniferous and deciduous trees. Adults feed on pollen and parts of flowers (e.g., the subfamily Lepturinae); on the leaves and needles of herbaceous and woody plants (e.g., *Saperda* spp.), or on the bark of twigs, leaf-stems, and leaf ribs (e.g,, *Monochamus* spp.) (Turnbow and Thomas 2002).

Number of saproxylic species in Nova Scotia: 96

References on the Nova Scotia fauna:

McCorquodale, D.B. 2010. Longhorn Beetles (Cerambycidae: Coleoptera) of the Atlantic Maritime Ecozone. *In*: McAlpine, D.F., Smith, I.M. (editors). Assessment of species diversity in the Atlantic Maritime Ecozone. NRC Press, Ottawa, Ontario, pp. 465–476.

10) Cerylonidae: Minute bark beetles

Cerylon castaneum Say

Bionomics: Adults and larvae are found under bark and in leaf litter where they apparently feed on fungi (Thomas 2002d).

Number of saproxylic species in Nova Scotia: 2

References on the Nova Scotia fauna:

Majka, C.G., and Langor, D. 2011. The Cerylonidae (Coleoptera) of Atlantic Canada. Journal of the Acadian Entomological Society 7: 44–49.

11) Ciidae: Minute tree-fungus beetles

Cis pistoria Casey

Bionomics: Adults and larvae of ciids inhabit and feed on the fruiting bodies of basidiomycete fungi, primarily polypore or bracket fungi. Most ciids are restricted to a relatively small number of host species of fungi. These limitations are partly related to the hyphal structure of the fungi and/or the types of wood rot they produce, which in turn is related to their metabolic capabilities (Thayer and Lawrence 2002).

Number of saproxylic species in Nova Scotia: 13

References on the Nova Scotia fauna:

Majka, C.G. 2007d. The Ciidae (Coleoptera: Tenebrionoidea) of the Maritime Provinces of Canada: new records, distribution, zoogeography, and observations on beetle-fungi relationships in saproxylic environments. Zootaxa 1654: 1–20.

12) Clambidae: Minute beetles

Clambus howdeni Endrödy-Younga

Bionomics: Clambids live in decaying plant matter; they appear to by mycophagous, feeding particularly on spores of Myxomycetes and Ascomycetes (Young 2002b).

Number of saproxylic species in Nova Scotia: 1

References on the Nova Scotia fauna:

Majka, C.G., and Langor, D. 2009. Clambidae (Coleoptera) of Atlantic Canada. Journal of the Acadian Entomological Society 5: 32–40.

13) Cleridae: Checkered beetles

Thanasimus dubius (Fabricius)

Bionomics: The checkered beetles (Cleridae) are predators on various wood and bark-boring insects (particularly Scolytinae). Most of the saproxylic species are associated with coniferous trees (Opitz 2002).

Number of saproxylic species in Nova Scotia: 6
References on the Nova Scotia fauna:

Majka, C.G. 2006b. The Checkered Beetles (Coleoptera: Cleridae) of the Maritime Provinces of Canada. Zootaxa 1385: 31–46.

Majka, C.G. 2006c. A guide to the Cleridae of Atlantic Canada. http://www.chebucto.ns.ca/Environment/NHR/Cleridae.html [accessed 11.IV.2013]

14) Corylophidae: Minute fungus beetles

Clypastrea lunata (LeConte)

Bionomics: Adults and larvae feed on fungal spores and are present in a diversity of habitats. Some species feed on Hyphomycetes and Zygomycetes (e.g., *Orthoperus* and *Sericoderus* spp.) while others have associations with Ascomycetes or Basidomycetes (e.g., *Arthrolips* and *Holopsis* spp.) (Bowstead and Leschen 2002).

Number of saproxylic species in Nova Scotia: 5

References on the Nova Scotia fauna:

Majka, C.G., and Cline, A. R. 2006b. New Records of Corylophidae (Coleoptera) from the Maritime Provinces of Canada. The Coleopterists Bulletin 60(2): 105–111.

15) Cryptophagidae: Silken fungus beetles

Atomaria ephippiata Zimmerman

Bionomics: Cryptophagids are microphagous and occur in decaying habitats that promote fungal growth. They are found in leaf litter and rotting wood or on fungi. Most species feed on fungal hyphae, spores, and conidia, while others are saprophagous (Leshen and Skelley 2002).

Number of saproxylic species in Nova Scotia: 18

References on the Nova Scotia fauna:

There have been no published studies, however, two papers, currently in preparation, will investigate the two subfamilies of cryptophagids found in Atlantic Canada.

Majka, C.G., Johnson, C. and Langor D. 2010. Contributions towards an understanding of the Atomariinae of Atlantic Canada. ZooKeys 35: 37–63.

Majka, C.G., and Langor D. 2010. Contributions towards an understanding of the Cryptophaginae of Atlantic Canada. ZooKeys 35: 13–35

The following website also provides considerable information on the Atomariinae:

Majka, C.G. 2009b. Atomariinae of Atlantic Canada. http://www.chebucto.ns.ca/Environment/NHR/Atomaria.html [accessed 11.IV.2013]

16) Cucujidae: Flat bark beetles

Cucujus clavipes clavipes Fabricius

Bionomics: Adults and larvae of *Cucujus clavipes clavipes* Fabricius are found under the bark of dead trees. Larvae are apparently predaceous (Thomas 2002b).

Number of saproxylic species in Nova Scotia: 1

References on the Nova Scotia fauna:

Majka, C.G. 2008b. The Flat Bark Beetles (Coleoptera: Silvanidae, Cucujidae, Laemophloeidae) of Atlantic Canada. *In*: Majka C.G., Klimaszewski J. (editors), Biodiversity, Biosystematics, and Ecology of Canadian Coleoptera. ZooKeys 2: 221–238.

17) Curculionidae: Weevils and bark beetles

Rhyncolus brunneus Mannerheim

Bionomics: Sixty-one of the species included in this grouping are in the subfamily Scolytinae (bark beetles). The majority of these are phloeophagus species that feed on the cambium of a wide variety of coniferous and deciduous trees. Species in the genera *Trypodendron* and *Xyloterinus* (5 species) are ambrosia beetles that feed on fungal mycelia that they introduce to subcortical environments on mycangial pits located on their heads (Rabaglia 2002). Other species include *Dryophthorus americanus* Bedel (Dryophthorinae), found under bark in association with old rotten logs or in forest litter; and eight species in the Cossoninae which are found under the bark of various tree species, mostly conifers (Anderson 2002).

Number of saproxylic species in Nova Scotia: 69

References on the Nova Scotia fauna:

Majka, C.G., Anderson, R.S., and McCorquodale, D.B. 2007. The weevils (Coleoptera: Curculionoidea) of the Maritime Provinces of Canada, II: new records from Nova Scotia and Prince Edward Island and regional zoogeography. The Canadian Entomologist 139: 397–442.

McCorquodale, D.B., Musgrave, B.L., Atkins, S., Majka, C., and Anderson, R.S. 2005. New records of native and introduced weevils (Coleoptera: Curculionidae) for Nova Scotia from Cape Breton Island. The Coleopterists Bulletin 59: 27–34.

18) Dryophthoridae: Dryophthorid Weevils

Dryophthorus americanus Bedel

Bionomics: Adults are found under bark , in association withnold rotten logs or in forest litter.

Number of saproxylic species in Nova Scotia: 1

References on the Nova Scotia fauna:

Majka, C.G., Anderson, R.S., and McCorquodale, D.B. 2007. The weevils (Coleoptera: Curculionoidea) of the Maritime Provinces of Canada, II: new records from Nova Scotia and Prince Edward Island and regional zoogeography. The Canadian Entomologist 139: 397–442.

19) Elateridae: Click beetles

Ampedus collaris (Say)

Bionomics: The saproxylic elaterids included in this study have larvae that either feed on saprophytic wood decaying organisms such as myxomycetes, or are opportunistic predators in woodland environments (Johnson 2002b).

Number of saproxylic species in Nova Scotia: 77

References on the Nova Scotia fauna:

Majka, C.G. and Johnson, P.J. 2008. The Elateridae (Coleoptera) of the Maritime Provinces of Canada: taxonomic changes, new records, faunal composition, collecting history, and zoogeography. Zootaxa 1811: 1–33.

20) Endomychidae: Handsome fungus beetles

Phymaphora pulchella Newman

Bionomics: Some endomychids feed on spores and hyphae of microfungi; others are specialists on puffballs; some are found in subcortical fungi and soft polypores, others are found on fleshy basidiomycetes, while still others are found on Zygomycete molds and mildews associated with the decomposition of vegetative matter (Skelley and Leschen 2002).

Number of saproxylic species in Nova Scotia: 6

References on the Nova Scotia fauna:

Majka, C.G. 2007a. The Erotylidae and Endomychidae (Coleoptera: Cucujoidea) of the Maritime Provinces of Canada: new records, zoogeography, and observations on beetle-fungi relationships and forest health. Zootaxa 1546: 39–50.

21) Erotylidae: pleasing fungus beetles

Triplax thoracica Say

Bionomics: Erotylids in the Dacninae and Megalodacninae burrow in hard bracket fungi (Polyporaceae), while those in the Tritominae feed on soft polypores or other basidomycetes (Skelley and McHugh 2002).

Number of saproxylic species in Nova Scotia: 7

References on the Nova Scotia fauna:

Majka, C.G. 2007a. The Erotylidae and Endomychidae (Coleoptera: Cucujoidea) of the Maritime Provinces of Canada: new records, zoogeography, and observations on beetle-fungi relationships and forest health. Zootaxa 1546: 39–50.

22) Eucinetidae: Plate-thigh beetles

Nycteus punctulatus (LeConte)

Bionomics: Eucinetids live in detritus or under fungus-covered bark of trees. Larvae are mycophagous on a variety of fungi including spores of slime molds and fruiting bodies of Basidiomycetes (Agaricaceae, Boletaceae, and Coniophoraceae) (Young 2002a).

Number of saproxylic species in Nova Scotia: 3

References on the Nova Scotia fauna:

Majka, C.G. 2010. Eucinetidae of the Maritime Provinces of Canada. Journal of the Acadian Entomological Society 6: 16–21.

23) Eucnemidae: False click beetles

Deltometopus amoenicornis (Say)

Bionomics: Despite their common name, eucnemids are able to "click" just as well as the nominal click beetles (Elateridae). The larvae of almost all species develop in decaying wood, principally that colonized by white rot fungi (Ascomycota and Basidiomycota), and feed on the hyphae using extraoral digestion. Adults can fly and disperse very well (Muona 2000, 2002). Muona (2000) suggested that eucnemids play an important role in the interactions between trees, fungi, and forest regeneration and that they are good indicators of diverse forest structure. Almost all the eucnemids found in Nova Scotia are exclusively associated with deciduous trees, although *Deltometopus amoenicornis* (Say) may be associated with both deciduous and coniferous trees. The only commonly collected species in the region, *Epiphanis cornutus* (Eschscholtz), is the only species associated with conifers (Majka 2007c).

Number of saproxylic species in Nova Scotia: 10

References on the Nova Scotia fauna:

Majka, C.G. 2007c. The Eucnemidae (Coleoptera) of the Maritime Provinces of Canada: new records, observations on composition and zoogeography, and comments on the rarity of saproxylic beetles. Zootaxa 1636: 33–46.

Aeletes politus (LeConte)

24) Histeridae: Hister beetles

Bionomics: The saproxylic species of Histeridae found in Nova Scotia include eight species; the six species in genera *Plegaderus, Paromalus,* and *Platysoma* are subcortical predators typically found in scolytine galleries or tunnels of other bark boring insects. Some species are associated with conifers, whereas others are found in deciduous trees. *Aeletes politus* (LeConte) is found in litter, on fungi, and in tree holes, as is the adventive *Dendrophilus punctatus* (Herbst), although this latter species is found in synanthropic environments in Europe (Bousquet and Laplante 2006; Majka 2008a).

Number of saproxylic species in Nova Scotia: 8

References on the Nova Scotia fauna:

Bousquet, Y., and Laplante, S. 2006. Coleoptera Histeridae: The Insects and Arachnids of Canada, part 24. Ottawa, Ontario: NRC Research Press, 485 pp.

Majka, C.G. 2008a. Contributions to the knowledge of Atlantic Canadian Histeridae (Coleoptera). *In*: Majka C.G., Klimaszewski J. (editors), Biodiversity, Biosystematics, and Ecology of Canadian Coleoptera. ZooKeys 2: 189–202.

25) Laemophloeidae: Lined flat bark beetles

Leptophloeus angustulus (LeConte)

Bionomics: Saproxylic Laemophloeidae feed on ascomycete fungi and are found under the bark of various coniferous and deciduous trees (Thomas 2002b).

Number of saproxylic species in Nova Scotia: 6

References on the Nova Scotia fauna:

Majka, C.G. 2008b. The Flat Bark Beetles (Coleoptera: Silvanidae, Cucujidae, Laemophloeidae) of Atlantic Canada. *In*: Majka C.G., Klimaszewski J. (editors), Biodiversity, Biosystematics, and Ecology of Canadian Coleoptera. ZooKeys 2: 221–238.

Majka, C.G. and Chandler, D.S. 2009. *Leptophloeus angustulus* (LeConte) (Coleoptera: Laemophloeidae): a new flat bark beetle in Canada and New England. Journal of the Acadian Entomological Society 5: 20–23. http://www.acadianes.org/journal/papers/majka_laemophloeidae_0905.pdf [accessed 11.IV.2013]

26) Latridiidae: Minute brown scavenger beetles

Enicmus tenuicornis LeConte

Bionomics: Most latridiids are associated with fungi in the classes Phycomycetes, Deuteromycetes, and Ascomycetes although species of some genera including *Enicmus* feed on the spores of Myxomycetyes (Andrews 2002). Although a number of latridiids are associated with dried stored products, and others are associated with a variety of open habitats, or are found in coastal environments, there are also a suite of saproxylic species associated with coniferous or deciduous forests (Majka *et al.* 2009).

Number of saproxylic species in Nova Scotia: 9

References on the Nova Scotia fauna:

Majka, C.G., Langor, D., and Rücker, W. 2009. The Latridiidae of Atlantic Canada: new records, keys to identification, new synonyms, distribution, and zoogeography. The Canadian Entomologist 141: 317–370.

27) Leiodidae: Round fungus beetles

Colenis impunctata LeConte

Bionomics: The Leiodidae is ecologically diverse family of beetles that includes genera such as *Agathidium, Anisotoma,* and *Gelae* that feed on the plasmodia and fruiting bodies of slime molds (and to a lesser degree on certain fungi); *Colon, Hydnobius, Leiodes,* and *Liocyrtusa* that are known or believed to be associated with subterranean fungi; and *Colenis* which is associated with decaying soft fungi (Majka and Langor 2008).

Number of saproxylic species in Nova Scotia: 39

References on the Nova Scotia fauna:

Majka, C.G., and Langor, D. 2008. The Leiodidae (Coleoptera) of Atlantic Canada: new records, faunal composition and zoogeography. In: Majka C.G., Klimaszewski J. (editors), Biodiversity, Biosystematics, and Ecology of Canadian Coleoptera. ZooKeys, 2: 357–402.

28) Lucanidae: Stag beetles

Ceruchus piceus (Weber)

Bionomics: Adult lucanids lay eggs in crevices in bark or logs and the larvae develop in such habitats, feeding on decaying wood. Adults are also customarily found in saproxylic environments (Ratcliffe 2002).

Number of saproxylic species in Nova Scotia: 3

References on the Nova Scotia fauna:

Majka, C.G. 2008. The Stag Beetles of the Maritime Provinces of Canada (Coleoptera: Lucanidae). Journal of the Acadian Entomological Society 4: 25–31.

29) Lycidae: Net-winged beetles

Bionomics: Most, if not all, of the species in the Lyciidae feed on myxomycetes or metabolic products of fungi. Larvae are found in rotten timber, but also on occasion in leaf litter, or under bark. Adults are found on leaves and flowers and eat nectar and honeydew (Miller 2002).

Dictyoptera aurora (Herbst)

Number of saproxylic species in Nova Scotia: 12

References on the Nova Scotia fauna:

No published studies to date.

30) Lymexilidae: Ship-timber beetles

Elateroides lugubris (Say)

Bionomics: Adults are found in decaying wood, running about on tree trunks, or under bark. They are short lived and are therefore not frequently encountered. The larvae are wood borers in the heart and sapwood of poplar and birch (Young 2002c).

Number of saproxylic species in Nova Scotia: 1

References on the Nova Scotia fauna:

Majka, C.G. 2005. *Elateroides lugubris* (Say). http://www.chebucto.ns.ca/Environment/NHR/Elateroides_lugubris.html [accessed 11.IV.2013]

31) Melandryidae: False darkling beetles

Orchesia ovata Laliberté

Bionomics: Species of Melandryidae can be divided into two groups: fungivorous species in the Orchesiini and xylophagous species in the Serropalpini and Melandryini. It is likely, however, that fungi comprise a significant portion of the diet of species in the xylophagous group as well. Adult Melandryids are primarily nocturnal and can often be seen crawling on dead logs at night (Pollock 2002).

Number of saproxylic species in Nova Scotia: 24

References on the Nova Scotia fauna:

Majka, C.G., and Pollock, D.A. 2006. Understanding saproxylic beetles: new records of Tetratomidae, Melandryidae, Synchroidae, and Scraptiidae from the Maritime Provinces of Canada (Coleoptera: Tenebrionoidea). Zootaxa 1248: 45–68.

Majka, C.G. and Pollock, D.A. 2010. False Darkling Beetles (Coleoptera: Melandryidae) and Allies of the Atlantic Maritime Ecozone. In: Assessment of Species Diversity in the Atlantic Maritime Ecozone. Edited by: McAlpine, D.F., and Smith, I.M. NRC Research Press. Ottawa, Ontario. pp. 453–463.

32) Monotomidae: Root-eating beetles

Rhizophagus b. brunneus Horn

Bionomics: The larvae and adults of *Rhizophagus* spp. have been considered as predators of xylophagous and phloeophagous insects such as scolytine larvae, although there are also indications that they may feed on fungi or fungal by-products (Bousquet 2002).

Number of saproxylic species in Nova Scotia: 4

References on the Nova Scotia fauna:

Majka, C.G., and Bousquet, Y. 2010. Monotomidae (Coleoptera) of the Maritime Provinces of Canada. Journal of the Acadian Entomological Society 6: 1–8.

33) Mordellidae: Tumbling flower beetles

Tomoxia lineella LeConte

Bionomics: The larvae of species in the tribe Mordellini (members of the genera *Tomoxia*, *Mordellaria*, and *Mordella*) are saproxylic, feeding on decaying wood and fungi. Adults are floricolous and are found on many species of plants, especially in the Apiaceae and Asteracae (Jackman and Lu 2002).

Number of saproxylic species in Nova Scotia: 5

References on the Nova Scotia fauna:

Majka, C.G. and Jackman, J.A. 2006. The Mordellidae (Coleoptera) of the Maritime Provinces of Canada. The Canadian Entomologist 138: 292–304.

34) Mycteridae: Palm and flower beetles

Lacconotus punctatus LeConte

Bionomics: Very little is known about *Lacconotus punctatus* LeConte. A specimen of a western species of *Lacconotus* was collected under the bark of a dead poplar; specific habits of adult *Lacconotus* remain unknown. Most larvae in the Eurypinae, the subfamily in which *Lacconotus* is placed, live under dead tree bark and are saproxylic (Pollock 2002b).

Number of saproxylic species in Nova Scotia: 1

References on the Nova Scotia fauna:

Majka, C.G., and Selig, G. 2006. *Lacconotus punctatus* and the family Mycteridae (Coleoptera) newly recorded in Atlantic Canada. The Canadian Entomologist 138(4): 636–637.

Majka, C.G. 2006d. *Lacconotus punctatus* LeConte http://www.chebucto.ns.ca/Environment/NHR/Lacconotus_punctatus.html [accessed 11.IV.2013]

35) Nitidulidae: Sap beetles

Glischrochilus confluentus (Say)

Bionomics: Adults and larvae of Nitidulidae feed on sap, fruit juices, liquids associated with decomposing carrion, etc. They can be found under the bark of freshly fallen trees, at sap flows, on broken limbs and stumps, on ploypore fungi, associated with wilt fungus mats, on decaying fruit and in other similar situations in a variety of forested habitats (Majka and Cline 2006a).

Number of saproxylic species in Nova Scotia: 30

References on the Nova Scotia fauna:

Majka, C.G., and Cline, A. R. 2006a. Nitidulidae and Kateretidae of the Maritime Provinces of Canada 1: New records from Nova Scotia and Prince Edward Island (Coleoptera: Cucujoidea). The Canadian Entomologist 138: 314–332.

36) Oedemeridae: False blister beetles

Asclera ruficollis (Say)

Bionomics: Oedemerid larvae occur in moist, decaying wood. Inland species are associated with coniferous wood, whereas coastal species use various kinds of driftwood. Adults are found on flowers and foliage, under driftwood, or in moist to wet rotten logs (Kriska 2002).

Number of saproxylic species in Nova Scotia: 5

References on the Nova Scotia fauna:

Majka, C.G., and Langor, D. 2011. The Oedemeridae (Coleoptera) of Atlantic Canada. Journal of the Acadian Entomological Society 7: 1–6.

37) Ptiliidae: Featherwing beetles

Acrotrichis castanea (Matthews)

Bionomics: The Ptilidae are a species-rich family found worldwide, primarily in leaf litter and in various kinds of decaying organic materials. In Nova Scotia they have been found in a wide variety of coniferous, deciduous, and mixed forests associated with decomposing fungi, leaf litter, compost, carrion, and other decomposing environments (Majka and Sörensson 2007). *Cylindroselloides dybasi* Hall is an unusual species, being adapted to feed on the spores of polypore fungi (Majka 2002).

Number of saproxylic species in Nova Scotia: 25

References on the Nova Scotia fauna:

Majka, C.G. 2002. *Cylindroselloides dybasi* in the Maritime Provinces. http://www.chebucto.ns.ca/Environment/NHR/Cylindroselloides_dybasi.html [accessed 11.IV.2013]

Majka, C.G., and Sörensson, M. 2007. The Ptiliidae of the Maritime Provinces of Canada (Coleoptera): new records and bionomic notes. Zootaxa 1423: 27–38.

Majka, C.G. and Sörensson, M. 2010. Featherwing Beetles (Coleoptera: Ptiliidae) of the Atlantic Maritime Ecozone. In: Assessment of Species Diversity in the Atlantic Maritime Ecozone. Edited by: McAlpine, D.F., and Smith, I.M. NRC Research Press. Ottawa, Ontario. pp. 433–438.

38) Pyrochroidae: Fire-coloured beetles

Schizotus cervicalis Newman

Bionomics: Larvae of pyrochroids are associated with somewhat cool, moist subcortical conditions beneath slightly loosened bark and decaying wood of dead deciduous and coniferous trees. Adults are found on foliage, vegetation, and trees in associated forested habitats (Young 2002f).

Number of saproxylic species in Nova Scotia: 5

References on the Nova Scotia fauna:

Majka, C.G. 2006a. The Mycteridae, Boridae, Pythidae, Pyrochroidae, and Salpingidae (Coleoptera: Tenebrionoidea) of the Maritime Provinces of Canada. Zootaxa 1250: 37–51.

39) Pythidae: Dead log beetles

Pytho niger Kirby

Bionomics: Larvae of pythids live in the subcortical region of dead conifers (*Pytho* spp.) or in the sapwood of red rotten conifer logs [*Priognathus monilicornis* (Randall)]. They are apparently xylophagous. Adults are found under logs or bark in coniferous forests (Pollock 2002d; Majka 2006a).

Number of saproxylic species in Nova Scotia: 4

References on the Nova Scotia fauna:

Majka, C.G. 2006a. The Mycteridae, Boridae, Pythidae, Pyrochroidae, and Salpingidae (Coleoptera: Tenebrionoidea) of the Maritime Provinces of Canada. Zootaxa 1250: 37–51.

40) Salpingidae: Narrow-waisted bark beetles

Salpingus viridiaeneus (Randall)

Bionomics: The bionomics of salpingids are poorly understood. *Salpingus viridiaeneus* (Randall) is associated with species of Pine (*Pinus* spp.). In Nova Scotia it has sometimes been found on birch (*Betula* sp.) (Majka 2006a). *Sphaeriestes virescens* (LeConte) has been observed to feed on the inner bark of deciduous trees such as linden (*Tilia* spp.) and alder (*Alnus* spp.) (Pollock 2002e).

Number of saproxylic species in Nova Scotia: 2

References on the Nova Scotia fauna:

Majka, C.G. 2006a. The Mycteridae, Boridae, Pythidae, Pyrochroidae, and Salpingidae (Coleoptera: Tenebrionoidea) of the Maritime Provinces of Canada. Zootaxa 1250: 37–51.

Gnorimella maculosa (Knoch)

41) Scarabaeidae: Scarab beetles

Bionomics: Only a small number of the 45 species of scarab beetles found in Nova Scotia are members of the saproxylic fauna, comprising those in the subfamilies Dynastinae and Cetoniinae. Larvae of these species feed on decomposing wood. Adults are found in forested habitats where they feed on leaves or fruits. Some species are also attracted to sap flows (Ratcliffe e*t al.* 2002).

Number of saproxylic species in Nova Scotia: 5

References on the Nova Scotia fauna:

Majka, C.G. 2002. *Gnorimella maculosa* (Knoch). http://www.chebucto.ns.ca/Environment/NHR/Gnorimella_maculosa.html [accessed 11.IV.2013]

42) Scraptidae: False flower beetles

Anaspis rufa Say

Bionomics: Adults (especially in the subfamily Anaspidinae) are floricolous and are found in large numbers on plants in the Apiaceae and Rosaceae. Larvae of *Canifa* spp. have been found under the bark of dead *Populus* sp. trees and larvae of *Anaspis* spp. are associated with dead logs (Pollock 2002f).

Number of saproxylic species in Nova Scotia: 5

References on the Nova Scotia fauna:

Majka, C.G., and Pollock, D.A. 2006 Understanding saproxylic beetles: new records of Tetratomidae, Melandryidae, Synchroidae, and Scraptiidae from the Maritime Provinces of Canada (Coleoptera: Tenebrionoidea). Zootaxa 1248: 45–68.

Majka, C.G. and Pollock, D.A. 2010. False Darkling Beetles (Coleoptera: Melandryidae) and Allies of the Atlantic Maritime Ecozone. In: Assessment of Species Diversity in the Atlantic Maritime Ecozone. Edited by: McAlpine, D.F., and Smith, I.M. NRC Research Press. Ottawa, Ontario. pp. 453–463.

Cephennium gallicum Gangelbauer

43) Scydmaeninae: Ant-like stone beetles

Bionomics: Adult scydmaenids are moderately common in forest floor leaf litter, moss, rotting logs, tree hollow, under bark, and in other moist habitats. They are specialist predators on orabatid mites (O'Keefe 2000). Note: The Scydmaeninae are now classed as a subfamily of the rove beetles, the Staphylinidae.

Number of saproxylic species in Nova Scotia: 16

References on the Nova Scotia fauna:

Majka C.G. and Klimaszewski J. 2004. *Phloeocharis subtilissima* Mannerheim (Staphylinidae: Phloeocharinae) and *Cephennium gallicum* Ganglbauer (Scydmaenidae) new to North America: a case study in the introduction of exotic Coleoptera to the port of Halifax, with new records of other species. Zootaxa, 781: 1–15.

44) Silvanidae: Silvanid flat bark beetles

Uleiota debilis (LeConte)

Bionomics: Flat bark beetles in the Brontinae (Brontini) are found primarily under bark where both adults and larvae probably feed on both ascomycete and other fungi. Species in the Silvaninae are also found under bark where they appear to feed on fungi (Thomas 2002a).

Number of saproxylic species in Nova Scotia: 4

References on the Nova Scotia fauna:

Majka, C.G. 2008b. The Flat Bark Beetles (Coleoptera: Silvanidae, Cucujidae, Laemophloeidae) of Atlantic Canada. *In*: Majka C.G., Klimaszewski J. (editors), Biodiversity, Biosystematics, and Ecology of Canadian Coleoptera. ZooKeys 2: 221–238.

Sphindus americanus LeConte

45) Sphindidae: Cryptic slime mold beetles

Bionomics: Sphindids are myxomycophagous; adults and larvae occur on or inside slime mold sporocarps, where they feed on the spores and supporting structures (McHugh 2002).

Number of saproxylic species in Nova Scotia: 3

References on the Nova Scotia fauna:

Majka, C.G. 2010. The Sphindidae (Coleoptera) of Nova Scotia. Journal of theAcadian Entomological Society 6: 30–33.

46) Staphylinidae: Rove beetles

Phloeocharis subtilissima Mannerheim

Bionomics: The bionomics of the 121 saproxylic staphylinids found in Nova Scotia are very diverse. Included are species in the subfamilies Omaliinae, Proteininae, Micropeplinae, Pselaphinae, Phloeocharinae, Tachyporinae, Habrocerinae, Aleocharinae, Scaphidinae, Piestinae, Oxporinae, and Staphylininae. A summary of the bionomics of the saproxylic species found in Nova Scotia (Newton *et al.* 2000):

subfamily	trophic group	habitat/host
Omaliinae	sap feeding	coniferous forests
Proteininae	saprophagous & mycophagous	fungi and plant debris
Micropeplinae	saprophagous & mycophagous	fungi and leaf litter
Pselaphinae	predaceous	leaf litter
Phloeocharinae	predaceous	subcortical
Tachyporinae	mycophagous	fleshy fungi
Habrocerinae	probably predaceous	on fungi in wood debris and leaf litter
Aleocharinae	predaceous & mycophagous	forested habitats
Scaphidiinae	mycophagous	fungi & slime molds in forested habitats
Piestinae	predaceous	subcortical in forested habitats

Oxyporinae	mycophagous	fleshy fungi in forested habitats
Scaphidinae	predaceous	forested habitats
Staphylininae	predaceous	forested habitats

Number of saproxylic species in Nova Scotia: 120

References on the Nova Scotia fauna:

Brunke, A., Newton, A., Klimaszewski, J., Majka, C.G., and Marshall, S. 2011. Staphylinidae of Eastern Canada and the adjacent United States. Keys to Subfamilies; Staphylininae: Tribes and Subtribes, and species of Staphylinina. Canadian Journal of Arthropod Identification 12: 1–110.

Klimaszewski, J., and Majka, C.G. 2007. *Euvira micmac*, a new species (Coleoptera, Staphylinidae, Aleocharinae), and first record of the genus in Canada. The Canadian Entomologist 139(2): 147–153.

Klimaszewski, J., Pelletier, G., and Majka, C.G. 2004. A revision of Canadian *Leptusa* Kraatz (Col., Staphylinidae, Aleocharinae): new species, new distribution records, key and taxonomic considerations. Belgian Journal of Entomology 6: 3–42.

Majka, C.G. 2004a. A guide to the Scaphidiinae (Shining Fungus Beetles) of Atlantic Canada. http://www.chebucto.ns.ca/Environment/NHR/Scaphidinae.html [accessed 11.IV.2013]

Majka, C.G. 2004b. *Leptusa jucunda* Majka & Klimaszewski. http://www.chebucto.ns.ca/Environment/NHR/Leptusa_jucunda.html [accessed 24.IX.2009]

Majka, C.G. 2007e. Staphylinidae: Proteininae. http://www.chebucto.ns.ca/Environment/NHR/Proteininae.html [accessed 24.IX.2009]

Majka C.G. and Klimaszewski J. 2004. *Phloeocharis subtilissima* Mannerheim (Staphylinidae: Phloeocharinae) and *Cephennium gallicum* Ganglbauer (Scydmaenidae) new to North America: a case study in the introduction of exotic Coleoptera to the port of Halifax, with new records of other species. Zootax*a* 781: 1–15.

Majka, C.G. and Klimaszewski, J. 2008. Introduced Staphylinidae (Coleoptera) in the Maritime Provinces of Canada. The Canadian Entomologist 140(1): 48–72.

Majka, C.G. and Klimaszewski, J. 2008. Adventive Staphylinidae (Coleoptera) in the Maritime Provinces of Canada: further contributions. *In*: Majka C.G., Klimaszewski J. (editors), Biodiversity, Biosystematics, and Ecology of Canadian Coleoptera. ZooKeys 2: 151–174.

Majka, C.G., and Klimaszewski, J. 2010. Contributions to the knowledge of the Aleocharinae (Coleoptera: Staphylinidae) in the Maritime Provinces of Canada. ZooKeys 46: 15–39.

Majka, C.G., Klimaszewski, J., and Lauff, R.F. 2006. New Coleoptera records from owl nests in Nova Scotia, Canada. Zootaxa 1194: 33–47.

47) Stenotrachelidae: False longhorn beetles

Cephaloon ungulare LeConte

Bionomics: Very little is known about the bionomics of stenotrachelids. Larvae feed and develop in decaying wood (Young 2002e).

Number of saproxylic species in Nova Scotia: 2

References on the Nova Scotia fauna:

Majka, C.G. 2011. The Stenotrachelidae (Coleoptera) of Atlantic Canada. Journal of the Acadian Entomological Society 7: 7–13.

48) Synchroidae: Synchroa bark beetles

Synchroa punctata Newman

Bionomics: Synchroids feed largely upon fungal material and decaying wood, commonly beneath the bark of dead deciduous trees (Young 2002d).

Number of saproxylic species in Nova Scotia: 1

References on the Nova Scotia fauna:

Majka, C.G., and Pollock, D.A. 2006. Understanding saproxylic beetles: new records

of Tetratomidae, Melandryidae, Synchroidae, and Scraptiidae from the Maritime Provinces of Canada (Coleoptera: Tenebrionoidea). Zootaxa 1248: 45–68.
Majka, C.G. and Pollock, D.A. 2010. False Darkling Beetles (Coleoptera: Melandryidae) and Allies of the Atlantic Maritime Ecozone. In: Assessment of Species Diversity in the Atlantic Maritime Ecozone. Edited by: McAlpine, D.F., and Smith, I.M. NRC Research Press. Ottawa, Ontario. pp. 453–463.

49) Tenebrionidae: Darkling beetles

Diaperis maculata Olivier

Bionomics: Saproxylic tenebrionids can be classified in several trophic groups (Aalbu *et al.* 2002):
1) Those associated with dead, rotten wood often softened and chemically altered by the action of various fungi. These include species in genera such as *Arthromacra, Centronopus, Androchirus, Capnochroa, Hymenorus, Isomira, Mycetochara, Alobates, Haplandrus, Iphthiminus, Upis,* and *Xylopinus*.
2) Those found under bark and in subcortical spaces such as scolytine galleries. These include species in genera such as *Corticeus*.
3) Those associated with the fruiting bodies of Basidiomycetes (polypore fungi). These include *Bolitophagus, Bolitotherus, Diaperis, Gnatocerus, Neomida, Platydema,* and *Scaphidema*.
4) Those associated with decomposing vegetation. These include genera such as *Paratenetus*.

Number of saproxylic species in Nova Scotia: 30

References on the Nova Scotia fauna:

Majka, C.G., Bouchard, P., and Bousquet, Y. 2008. The Tenebrionidae (Coleoptera) of the Maritime Provinces of Canada. The Canadian Entomologist 140: 690–713.

50) Tetratomidae: Polypore fungus beetles

Tetratoma tessellata Melsheimer

Bionomics: Tetratomids feed largely upon the fruiting bodies of hymenomycete fungi, especially Polyporaceae and Trichlomataceae. They are most commonly found under fungus-grown bark and in softer shelf-fungi where adults tend to browse primarily on the surface, while larvae bore into the tissues. Adults are commonly encountered at night on fungi. (Young and Pollock 2002).

Number of saproxylic species in Nova Scotia: 8

References on the Nova Scotia fauna:

Majka, C.G., and Pollock, D.A. 2006 Understanding saproxylic beetles: new records of Tetratomidae, Melandryidae, Synchroidae, and Scraptiidae from the Maritime Provinces of Canada (Coleoptera: Tenebrionoidea). Zootaxa 1248: 45–68.
Majka, C.G. and Pollock, D.A. 2010. False Darkling Beetles (Coleoptera: Melandryidae) and Allies of the Atlantic Maritime Ecozone. In: Assessment of Species Diversity in the Atlantic Maritime Ecozone. Edited by: McAlpine, D.F., and Smith, I.M. NRC Research Press. Ottawa, Ontario. pp. 453–463.
Majka, C.G. 2007f. Hallomeninae Mulsant, 1856. http://www.chebucto.ns.ca/Environment/NHR/Hallomeninae.html [accessed 11.IV.2013]

51) Throscidae: Throscid beetles

Trixagus carinicollis (Schaeffer)

Bionomics: Adults are usually recovered from duff and litter samples, in rotted wood, and on foliage. They may be generalist pollen and mold feeders. Larvae have been found in red-rotten portions of oak logs, in fungusy soil samples, and in grass tussocks (Johnson 2002a).

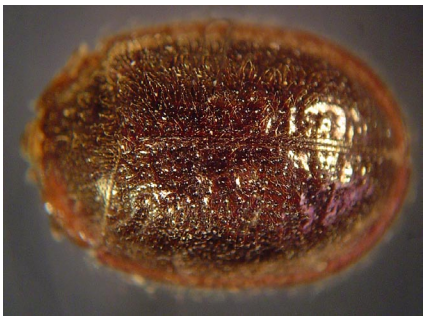
Number of saproxylic species in Nova Scotia: 3

References on the Nova Scotia fauna:

Majka, C.G. 2011. The Throscidae (Coleoptera) of Atlantic Canada. Journal of the Acadian Entomological Society 7: 20–24.

52) Trogossitidae: Bark-gnawing beetles

Thymalus marginicollis Chevrolat



Bionomics: Species in the genera *Airora* and *Tenebroides* are predatory and are found under bark and in galleries of wood-boring beetles. Species in the genera *Calitys* and *Ostoma,* and *Thymalus marginicollis* Chevrolat feed on fungi and are found under bark or are associated with polypore fungi. Species in the genus *Grynocharis* have predaceous larvae; adults and larvae are found under bark (Leschen 2002).

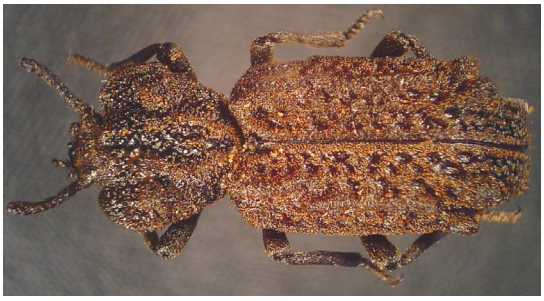
Number of saproxylic species in Nova Scotia: 6

References on the Nova Scotia fauna:

Majka, C.G. 2011. The Trogossitidae (Coleoptera) of Atlantic Canada. Journal of the Acadian Entomological Society 7: 25–31.

53) Zopheridae: Zopherid beetles

Phellopsis obcordata (Kirby)



Bionomics: Most zopherids live in dead and rotten wood or other rotting plant material. Adults of *Phellopsis obcordata* (Kirby) feed on the fruiting bodies of polypores. Larvae bore through soft wood where they feed on white sheet fungi between the laminae of wood (Ivie 2002c). Note: the Zopheridae are now considered to include the Colydiinae, formerly considered a distinct family.

Number of saproxylic species in Nova Scotia: 3

References on the Nova Scotia fauna:

Majka, C.G., Cook, J., and Ogden, J. 2006. Colydiidae (Coleoptera) in the Maritime Provinces of Canada. The Coleopterists Bulletin 60: 225–229.

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