

INVERTEBRATE BIODIVERSITY IN NORTH TEMPERATE PEATLANDS

Albert T. Finnamore

Curator, Invertebrate Zoology, Provincial Museum of Alberta, Edmonton

The Invertebrate Program at the Provincial Museum of Alberta has for the past two years been involved in the "Arthropods of Peatlands" project coordinated through the Biological Survey of Canada. As part of the peatlands project museum field crews conducted a sampling program for terrestrial invertebrates during the summer of 1985 at the Wagner Natural Area, a peatland west of Edmonton. The following submission is an update on this project, presenting some of the results and indicating project direction for future years.

Peatlands are areas where plant remains have accumulated over time owing to slow decomposition, with the remaining plant structures forming a substance called peat. Peatlands form in areas of imperfect drainage where both mineral soil and lower peat layers are in a constant waterlogged condition. They may be divided into two basic types, fens and bogs, based on vegetation and pH. A fen can be described as a peat-covered area influenced by mineral-rich waters in which sedges and brown mosses usually dominate the vegetation and the pH is alkaline. Bogs can be described as peat-covered areas unaffected by mineral-rich ground waters in which heaths, sphagnum and feather mosses dominate the vegetation and the pH is acidic.

In areas of high rainfall such as coastal situations sphagnum growth can be very rapid and accumulation of peat extensive over a short period of time. In these situations the accumulation of peat serves to isolate the mineral soil from the vegetation so that nutrients are available only from rainfall and airborne drift; in addition, sphagnum moss has the ability to acidify the surrounding conditions. These conditions result in the formation of bogs. In Alberta, with its continental climate, sphagnum does not develop as quickly and is not as abundant; decomposition of plant material is more rapid and peat buildup slower. The vegetation is in contact with mineral soil or with water relatively rich in mineral content; these conditions result in the formation of fens where the peat is largely composed of brown mosses in alkaline conditions. As peat layers slowly accumulate, sphagnum hummocks with their acid conditions eventually begin to dominate the fen and a gradual succession to bog conditions begins.

The Wagner Natural Area, located 9 km west of Edmonton, is a peatland formed as a result of Pleistocene glaciation which altered the course of a river comparable in size to the North Saskatchewan. The melting of glacial ice left the valley and surrounding uplands covered with a layer of glacial outwash sand and gravel. A large lake covering much of the Edmonton area at that time further deposited thick layers of silt and clay over the gravels in the Wagner vicinity before the present drainage system developed. It is the underlying deposits of glacial sand and gravel which form the main aquifer in the area, allowing ground water to flow from several kilometers away downhill to the Wagner Natural Area.

The Wagner Natural Area lies below the piezometric surface and is characterized by numerous springs with a year-round water temperature of about 4 degrees Celsius. A major component of water in these springs is calcium carbonate, typical of water from glacial gravels in the area. When the water reaches the surface through these springs the

calcium carbonate precipitates as a white paste or ooze called marl, forming over time the large marl flats characteristic of the Wagner Natural Area.

Peat cores taken from Wagner show accumulations of 157 cm in black spruce areas and 236 cm in areas near open water. Based on these core samples, the age of the peatland has been estimated at 4700 years. Further analysis of the core samples has indicated that both wetter and drier periods occurred over the history of the Peatland.

The peatland complex in the Wagner Natural Area is mixed, with pools, marl flats and carpets of brown moss as well as plants characteristic of alkaline fens giving way to hummocks of sphagnum and other acid-tolerant plants, especially shrubs and black spruce that are characteristic of nutrient-poor bogs. The resulting mosaic of habitats gives the Wagner Natural Area one of the more uniquely complex floras and probably faunas in the province. In addition, the Wagner peatland represents the beginning of a successional process that will eventually result in sphagnum bog formation with acidic conditions. Because of this, any fauna collected at Wagner may have considerable value in the understanding of faunal succession, if any, that follows the aging of these peatlands.

Once permission to sample the fauna was obtained from the Wagner Natural Area Society, field crews from the Provincial Museum set up a terrestrial invertebrate sampling program. The aim of the sampling program was first of all to provide a terrestrial faunal inventory of a rich calcareous, mixed peatland. Secondly, the sampling had to provide data that would allow comparisons of diversity among habitats within the peatland, and eventually allow comparisons of diversity among different peatlands.

The traps selected for sampling were pan-type traps, because such traps are able to collect samples heavily weighted with those species more likely to be permanent peatland residents. A single Malaise trap was also used to provide an indication of those species more likely to be transients. Eight habitats in the peatland were selected, each of which received a triple replicate of pan traps. The first set of habitats was a linear transect of about 90 m consisting of the following: 1. overhanging shore adjacent to a permanent pool; 2. wet sedge area; 3. drier sedge area with some bushes; 4. outer hedgerow; 5. inner hedgerow; 6. black spruce forest. Sites 8 and 9 consisted of relatively vegetation-free marl flats subject to periodical flooding after rains and the area (9) at high water mark adjacent to the marl flats. Periodic sampling was conducted from the first week in May to the last week in September.

Specimens were removed from the pan traps by means of a micro-mesh aquarium dip net, causing minimum disturbance of the trap placement. Specimens were then transferred to and stored in alcohol until they could be sorted to Order. Lab crews then processed the material by pinning, labelling and further sorting to smaller taxa. Once this point was reached specialists were consulted and the specimens sent for identification. At present about half of the specimens (35,000) have been processed to the point where specialists can be consulted for determinations.

Results are available for a number of small groups, but for only one large group, the Coleoptera (except for Staphylinidae). By way of comparison, botanists have identified 278 species of vascular plants including 15 species of Orchidaceae, 46 mosses, 3 liverworts and 50 lichens from Wagner Natural Area. The number of terrestrial invertebrate species identified so far is as follows:

Terrestrial invertebrates

Hirudinea	1	Chilopoda	2
Gastropoda	13	Thysanoptera	14 (incomplete)
Pseudoscorpiones	1	Neuroptera	3
Opiliones	2	Coleoptera	247 (incomplete)
Diplopoda	1	Hymenoptera	30-38 (incomplete)
TOTAL 314-322 species			

The Hymenoptera are second in biomass only to the Diptera in the Wagner peatland. At present about 30,000 specimens are ready for identification. Determinations for one chalcidoid family, Mymaridae, are available. The mymarid sample size was 2,725 specimens, representing the third largest collection of this family in North America after those in the United States National Museum and the Biosystematics Research Centre. The number of species recorded was 30-38. Previous to this collection only 4 genera of mymarid wasps were known from Alberta; samples from Wagner revealed 13 genera, amounting to half of the genera recorded from the continent.

The species of Coleoptera are based on determinations of 4,262 specimens (a further 970 Staphylinidae have yet to be included). The 247 species identified are distributed among the 40 families as follows:

Coleoptera

Cicindelidae	1	Scarabaeidae	4	Melandryidae	1
Carabidae	59	Helodidae	2	Anthicidae	2
Haliplidae	1	Byrrhidae	4	Nitidulidae	3
Dytiscidae	11	Heteroceridae	1	Rhizophagidae	2
Hydrophilidae	15	Buprestidae	4	Cryptophagidae	2
Staphylinidae	?	Elateridae	10	Coccinellidae	20
Hydraenidae	2	Cantharidae	4	Orthoperidae	1
Pselaphidae	3	Lycidae	1	Lathridiidae	6
Silphidae	2	Lampyridae	4	Cerambycidae	7
Leiodidae	9	Cleridae	1	Chrysomelidae	25
Ptiliidae	3	Mordellidae	4	Anthribidae	1
Scydmaenidae	2	Salpingidae	1	Apionidae	1
Histeridae	1	Pyrochroidae	1	Curculionidae	22
				Scolytidae	4

Once species have been identified the data can be used to demonstrate a number of phenomena, for instance the distribution of species with respect to sampling period (Fig. 1). The data can also be used to assess both degree of similarity between sampling sites and level of diversity within sampling sites. Of the 247 species of Coleoptera collected, only 5 species occurred in all 9 sample sites (8 pan sites and 1 Malaise site) while only 7 species were common to all 8 pan trap sites. This implies a low degree of

similarity between sample sites: in other words any two sample sites are likely to have only a few species in common but a relatively large number of different species. The Index of Similarity, with species pooled over sampling period, illustrates this, although the Staphylinidae are not included. Low index values (less than 0.5) indicate relatively fewer common species, or low similarity between two sites, while high index values (site 4 compared with 5 = .702) indicate a larger proportion of species common to both sites.

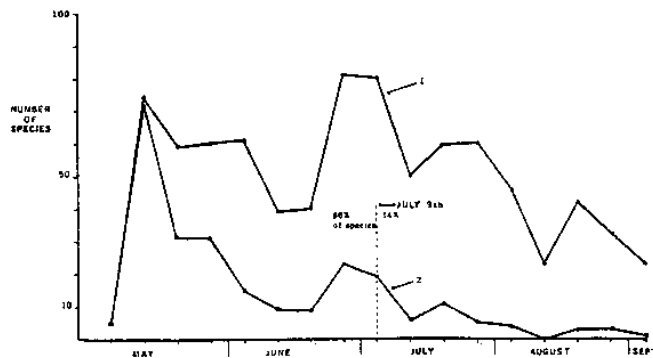


Fig. 1 COLEOPTERA SPECIES COLLECTION AT WAGNER PEATLAND
 1. Total species collected per sampling period
 2. New species records per sampling period

Index of Similarity

$$S = \frac{2C}{A + B}$$

S = similarity
 C = number of common species
 A, B = number of species per sample per site

Trap sites	2	3	4	5	6	8	9	Malaise
1	.578	.491	.397	.426	.312	.448	.273	.253
2		.580	.472	.459	.384	.526	.543	.338
3			.549	.537	.379	.481	.449	.306
4				.702	.535	.296	.418	.333
5					.542	.340	.478	.321
6						.305	.343	.252
8							.566	.271
9								.359

With species pooled over the sampling period the Index of Similarity between all pan trap sites is .111 and between all sites (pan and Malaise) is .067, indicating that the peatland has very few ubiquitous species. Higher index values might possibly be obtained if sample sites were compared for a single sample period (e.g. June 3-9). Spot checks using this index for sites over a single sample period can be compared with the temporally pooled index; this will be done once the staphylinid data are available. Such time-limited comparisons would provide an indication of the relative number of species common to two sample sites should a short-term collection be conducted.

Another measure of diversity is Simpson's Index of Diversity based on the proportion of individuals of a species in a community. Simpson's Index gives little weight to rare species and relatively more weight to abundant species. Low diversity is indicated by low values.

Simpson's Index of Diversity

$$D = \frac{1}{\sum_{i=1}^s (P_i)^2}$$

D = Simpson's Index of Diversity
 P_i = Proportion of individuals of species i in the community

<u>Trap</u>	<u>Diversity</u>	<u>species/site</u>
1	0.890	62
2	0.956	52
3	0.928	48
4	0.968	54
5	0.963	60
6	0.927	47
8	0.952	81
9	0.899	99
Malaise	0.754	96
TOTAL	0.952	246

Results, over a season, indicate a species-rich peatland with high evenness of abundance of many species rather than dominance by a few. As with the Index of Similarity the samples are pooled temporally for each site. Much lower values might be obtained if sites were compared for a single sample period, perhaps indicating dominance by a few species at a few sample sites.

It is already obvious from our data that peatlands contain a highly diverse community. When the data for Hymenoptera and Diptera are available, more rigorous comparison of habitats in the peatland can be contemplated. The Hymenoptera sample, for instance, is dominated by micro egg-parasitic proctotrupoid wasps occurring predominantly at a few sites in the peatland.

Over the next year 30,000 Hymenoptera will be identified and compared with the Coleoptera data; eventually the Araneae, Acari, Collembola, Orthoptera, Grylloptera, Hemiptera, Homoptera and Diptera from the Wagner peatland will be mounted and identified; the resulting data will be used to assess the diversity of this peatland. The next major step in this already massive project will be the sampling of a boreal peatland, Bistcho Lake in northwestern Alberta, during June, 1987. Samples obtained from this peatland will be used to assess the degree of similarity between peatlands in slightly different zones and to compare levels of diversity within these peatlands.

Anyone wishing to partake in identification of groups collected in these studies is urged to contact the author.

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