

STUDIES TO EVALUATE THE INFLUENCE OF FOREST
COVER TYPE AND OTHER FACTORS ON THE PRESENCE AND
POPULATIONS OF ORIBATID MITES

BY

John Richard Hill, B.Sc.

A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfilment of the requirements for the degree of Doctor
of Philosophy

Department of Entomology
Macdonald College of McGill University
Montreal, Quebec

August, 1976

Suggested Short Title:

"Ecology of Oribatid Mites in
the Morgan Arboretum."

HILL

"Mites and springtails represent for mesofauna the essential frame of soil communities, since they are present in almost every natural and man-influenced ecosystem in the world"

(Castri, et al 1966)

"Classification is a fundamental prerequisite of all conceptual thought"

(Gilmour 1951)

ABSTRACT

Ph.D.

Entomology

JOHN RICHARD HILL, B.Sc.

STUDIES TO EVALUATE THE INFLUENCE OF FOREST COVER TYPES AND OTHER FACTORS ON THE PRESENCE AND POPULATIONS OF ORIBATID MITES

In the Morgan Arboretum paired 3.3 cm-diameter soil cores were taken at twelve sites under six replicated or similar forest cover types. The stands occurred in both the beech-hemlock catena in sandy soil and in the sugar maple-basswood catena in clay soil.

Various environmental variables were measured or assessed including moisture, organic matter, pore space, pH, leaf litter, and vegetation.

Populations ranged from the equivalent of 11,400/m² to 1,329,000/m². The most critical resource appeared to be pore space, followed by quantity of organic matter. Soil water appeared to be limiting only in excess.

Sites were compared by Sørensen's quotient of similarity and ordinated by principal components analysis. Similar oribatid species compositions occurred under similar forest stands. The faunas of pure stands were most similar to their replicates. From observations and correlation analysis, leaf litter composition seemed to be the most operative variable determining oribatid diversity.

RÉSUMÉ

Ph.D.

entomologie

JOHN RICHARD HILL, B.Sc.

Études sur l'influence du couvert forestier et
d'autres facteurs sur la présence et la population
des acariens oribatides

Des échantillons jumelés de sol 3.3 cm en diamètre sont prélevés dans l'arboretum Morgan au Collège Macdonald, à douze sites sous six types repliqués ou semblables de couvert forestier. Les peuplements sont situés dans la caténa hêtre-pruche dans un sol sableux, et dans la caténa érable-tilleul d'amérique dans un sol argileux.

Plusieurs variables du milieu sont déterminées, y compris l'humidité du sol, la matière organique, l'espace porifère, le pH, les espèces de feuilles composant la litière, et la végétation.

Le nombre d'acariens varie entre 11,400/m² et 1,329,000/m². L'espace porifère apparaît comme étant la ressource la plus critique, suivi de l'accumulation de matière organique. L'eau du sol ne semble pas limiter les populations à moins d'être présente en excès.

Les populations des sites sont comparées selon le quotient de similarité de Sørensen, et ordonnées par l'analyse des composantes principales. Les couverts forestiers semblables donnent des ensembles d'espèces d'acariens oribatides similaires. Les faunes sous les peuplements purs sont plus caractéristiques du peuplement que ne le sont les faunes des peuplements mixtes. D'après les observations et l'analyse de corrélation, la litière de feuilles apparaît la variable la plus importante déterminant la diversité des espèces d'acariens.

ACKNOWLEDGEMENTS

The work was made possible by grants from the Quebec Agricultural Research Council and the National Research Council.

I am especially indebted to my Research Director Dr. D.K.McE. Kevan for his advice and encouragement. I am also grateful to numerous members of the staff of Macdonald College for assistance in many different matters. I should particularly like to thank Prof. Jones for permission to use the Morgan Arboretum, and other staff members of the Dep't. of Woodlot Management.

Logistical help was provided by the Dep't. of Buildings and Grounds in their construction of the extractor and the machining of soil corers and liners.

Needed assistance on taxonomic problems was provided by Dr. D.E. Johnston at the Acarology Institute in Columbus, Ohio.

For technical assistance in mounting many thousands of specimens I am particularly grateful to Miss Ann Katarak and also to Miss Rafia Hosein.

In the statistical analysis, I am deeply indebted to Mr. Allen Graves for running the principal components analyses and cluster analyses. I should also like to thank Miss Diane Yamaguchi at the Macdonald Computer Centre for her help.

Many other people have rendered assistance in diverse ways for which I am grateful. Among these are Dr. T. Perenyi for help with figures, Mr. A.J. Leder for printing photographs, and Mr. D. Peebles for translating the abstract.

Finally I should like to thank Miss Mary Alexander at the Field Museum, Chicago and Mrs. Toni Bird at Macdonald for doing a lot of typing on very short notice.

TABLE OF CONTENTS

Chapter	Page
ACKNOWLEDGEMENTS	i
LIST OF FIGURES	vii
LIST OF TABLES	viii
INTRODUCTION	1
LITERATURE REVIEW	3
1. Importance of Oribatei	3
a. Nutrition	3
b. Role in the Community	4
2. Ecological Investigations of Oribatid Fauna	6
a. Single Forest Community Studies	6
b. General Faunal Surveys	6
3. Biotic and Abiotic Environmental Variables	7
a. Soil Type	7
b. Humus Formation	8
c. Litter Depth	9
d. Soil Water	9
e. Pore Space	11
f. pH	12
g. Temperature	12
h. Population Potential	13
4.. Vertical Distribution and Migration	13
5. Vegetation	14
a. General	14
b. Macrovegetation	15
c. Ground Vegetation	16
d. Microflora	16
6. Comparison of Faunal Composition	16
a. Spatial Distribution	16
b. Transformation of Data	18
c. Methods of Comparing Samples	18
i. Coefficients of Similarity and Diversity	18
ii. Ordination Methods	19
iii. Other Methods	21
MATERIALS AND METHODS	22
1. Site Description	22
a. Geophysical Background	22
b. Vegetation	22
c. Sampling Sites	23
A. Beech-Hemlock Catena	23
Site 1. Gray Birch-Red Maple Association	25

	Page
Site 10. Grey Birch-Red Maple Association	25
Site 7. Beech-Red Maple Association	26
Site 9. Beech-Red Maple-Red Oak Association	26
Site 2. Beech	26
Site 4. Beech	27
Site 5. Hemlock	27
Site 6. Hemlock	27
B. Sugar Maple-Basswood Catena	28
Site 8. Large-toothed Aspen	28
Site 11. Trembling Aspen	28
Site 3. White Ash	29
Site 12. White Ash	29
2. Sampling Procedure	29
a. Experimental Design	29
b. Sampling Equipment	30
c. Sampling Technique	32
d. Physical Data Measured in the Field	32
3. Extraction	32
a. Description of Extractor	32
b. Preparation of Samples	35
c. Preservation Medium	35
d. Extraction Procedure	35
e. Physical Data Measured in the Laboratory	37
4. Preparation and Identification of Oribatida	37
a. Sorting	37
b. Mounting	38
c. Identification	39
d. Biomass	40
5. Measurement of Biotic and Abiotic Variables	40
a. Moisture	40
i. In Samples	40
ii. Precipitation	40
iii. Water Table	41
b. pH	41
c. Organic Matter	41
i. Depth of Soil Horizons	41
d. Pore Space	41
e. Temperature	43
i. Soil Temperature	43
ii. Day/Degrees	43
f. Ground Cover Estimation	43
g. Leaf Litter Composition	44
h. Distance Between Plots	44
6. Statistical Analyses	44
a. Sørensen's Quotient of Similarity	44
b. Ordination of Samples	45
i. Preparation of Data	46
ii. Computation of Principal Components	46

	Page
(a) Factor Analysis by Principal Components ...	46
iii. Cluster Analysis	47
c. Influence of Environmental Variables on Individual Species and Total Population, ...	47
i. Total Population	47
ii. Individual Species	48
RESULTS	52
1. General Description of Fauna	52
a. Number of Species	52
b. Annotated Species List	52
2. Total Populations of Sites	53
a. General	53
b. Seasonal Changes in Total Populations	53
3. Species Distribution	56
a. Tolerance of Species	56
b. Species Diversity of Sites	60
4. Comparison of Sites	60
a. Sørensen's Quotient of Similarity	60
b. Ordination of Sites	67
i. Factor Analysis by Principal Component	67
(a) Using Raw Data for 100 Variables (Species)	67
(b) Data Transformed to Percent of Total Number for 100 Variables	67
(c) Log N (x + 1) Transformation with 100 Variables	67
(d) Log N (x + 1) Transformation with 72 Variables	70
(e) Log N (x + 1) Transformation with 90 Variables	70
ii. Cluster Analysis	74
(a) Comparison of 9 Factor and 8 Factor Cluster Analysis	75
c. Influence of Biotic and Abiotic Environmental or X Variables	76
i. Introduction	76
ii. Descriptive	76
(a) Presumed Pathways of Some Major Environmental Variables	76
(b) Total Numbers and Biomass Compared to Basic Resources	76
(c) Ecological Valence of Individual Species	82
d. Correlation Studies	82
i. Environmental Variables Influencing Total Populations and Biomass	82
1. Water	84
2. Weight of Organic Matter	84
3. Pore Space	88
4. Mineral Soil	88

	Page
5. pH	88
6. Summary	89
ii. Influence of Some Soil Biotic and Abiotic Variables Compared to Vegetation on Individual Species	89
iii. Estimations of Components Comprising Factors of Principal Components Analyses	91
DISCUSSION	95
1. Taxonomy	95
2. Extraction Efficiency	95
3. Seasonal Changes	97
4. Species Diversity of Sites	97
5. Comparison of Sites	98
a. Measures of Similarity	98
b. Principal Components Analysis	98
6. Correlation Analysis	100
7. Influence of Environmental Variables	101
a. Soil and Humus Formation	101
b. Litter Depth	105
c. Soil Water	105
d. Pore Space	106
e. pH	106
f. Temperature	106
g. Distance Between Sites	107
h. Vegetation	107
i. Macrovegetation and Litter Composition	107
ii. Ground Vegetation	108
SUMMARY AND CONCLUSIONS	110
LITERATURE CITED	111
APPENDIX	129
A. Annotated Species List	129
B. Raw Data Matrix	155
C. Q-mode Varimax Factor Matrix, 100 Variables; λ trans- formation, 10 Factor Extraction	156
D. Q-mode Varimax Factor Matrix, 100 Variables Log N (x + 1) transformation, 10 Factor Extraction	157
E. Q-mode Varimax Factor Score Matrix, 100 Variables Log N (x + 1) transformation, 10 Factor Extraction	158
F. Q-mode Varimax Factor Matrix, 100 Variables Log N (x + 1) transformation, 5 Factor Extraction	159
G. Q-mode Varimax Factor Matrix, 72 Variables Log N (x + 1) transformation, 10 Factor Extraction	160

H.	Q-mode Varimax Factor Matrix, 90 Variables, Log N ($x + 1$) transformation, 10 Factor Extraction	161
I.	Q-mode Varimax Factor Score Matrix, 90 Variables, Log N ($x + 1$) transformation, 10 Factor Extraction	162
J.	Q-mode Varimax Factor Matrix, 90 Variables, Log N ($x + 1$) transformation, 5 Factor Extraction	163
K.	Q-mode Varimax Factor Score Matrix, 90 Variables, log N ($x + 1$) transformation, 5 Factor Extraction	164

LIST OF FIGURES

Figure		Page
1	Map of Morgan Arboretum showing Sampling Locations	24
2	Soil Corer	31
3	Extractor with Cover and Heating Strips in Place	33
4	Extractor without cover, Showing Soil Cores	34
5	Collecting Vessel with Soil Core in Place	36
6	Temporary Mount for Identification	39
7	Oribatid Populations in Paired Cores Collected Seasonally .	55
8a	Distribution of Species Across Sites, Including "Accidental" Occurrences	58
8b	Distribution of Species Across Sites, Excluding "Accidental" Occurrences	59
9a	Sites Ranked According to Number of Species	61
9b	Sites Ranked According to Population of Combined 8 Cores ..	62
10b	Sørensen's Q/S using All Species	64
11	Sørensen's Q/S using Species Accounting for >1% of Total Population	65
12	Sørensen's Q/S using Dominant Species (>2% of Population) .	66
13	Cluster Diagram based on Q-mode Principal Components Analysis with 9 Factor Extraction	74a
14	Cluster Diagram based on Q-mode Principal Components Analysis with 8 Factor Extraction	74b
15	Presumed Influence of Some Environmental Variables on Populations and Diversity of Oribatei	77
16	Volumes of Resources (cont.)	78
16	Volumes of Resources (cont.)	79
16	Volumes of Resources	80
17	Ecological Valence of 20 Species of Oribatids	83

LIST OF TABLES

Table		Page
1	Calculated Populations/m ²	54
2	Total Populations in Individual Cores	57
3	Correlations of Total Populations and Biomass with Soil Variables	85
4	Correlations of Total Populations with Soil Variables	85
5	Correlations of Total Biomass with Soil Variables	87
6	Summary of Correlation Analyses of Core Data	90
7	Intercorrelations of X Variables (Untransformed Subcore Data).....	102
8	Intercorrelations of X Variables (Transformed Core Data)...	103
9	Comparative Correlations Using Transformed and Untransformed X Variables	104
10	Leaf Litter Composition (in % of volume)	109

INTRODUCTION

There have been a comparatively small number of comprehensive studies comparing the oribatid fauna in several forest types. Among these few are Forsslund (1943), Maldague (1961), Marshall (1964) and Reeves (1965). This situation obtains probably because forest stands with a deep humus buildup are the richest habitats in terms of both populations and diversity, thereby discouraging the would-be investigator.

In a non-forest biome-type the influence of different species of plants has been explored by Macfadyen (1952) in a *Molinia* fen.

A few studies have been conducted on the effect of change of vegetation on oribatid fauna. Davis (1963) studied the influence of ecological succession on oribatids in reclaimed land. The changes in oribatid fauna induced by reforestation have been investigated by Pschorn-Walcher (1952) and Gretschy (1952, cited by Kühnelt 1963b). However, relative influence of components of the soil compared to influence of the vegetation remains inconclusive. While Murphy (1953) found definite feeding preferences for different kinds of leaves, Krivolutsky (1965) found moisture to be the most operative variable.

The present study seeks to differentiate the influence of vegetation from that of soil characteristics. Hence pore space, soil water, organic matter, mineral matter, and pH are classed as soil-based variables; while the forest cover type (macrovegetation), ground vegetation, and leaf litter composition are regarded as vegetational variables. The rationale for considering the composition of the leaf litter as a vegetational variable (while the quantity of organic matter is considered a soil variable) is that while the leaf is intact in the litter layer it retains the character of the parent tree in terms of palatability to microarthropods

and bacterial growth enhancing or inhibiting substances, but when it has been broken down in the deeper humus layers its characteristic components have been largely metabolized or leached away. In this state as an amorphous material serving as food for a high density of microflora and microfauna it is considered a soil variable.

The few investigations which have attempted to define oribatids in "synusia" (Strenzke 1952) or communities (Hammer 1937) have been able to define the co-occurrences of species mainly on the basis of what are here called soil variables rather than by vegetation (though a number of studies have shown differing faunal composition in adjacent microhabitats, eg., Travé 1963, Aoki 1967, Hammer 1972).

The present study is, first, an investigation to determine whether the oribatid fauna is recognizably more similar between stands with the same macrovegetation than between dissimilar stands. Secondly, and more tenuously, it attempts to determine whether the macrovegetation, or soil variables to which the macrovegetation itself also responds, is more directly influencing the species composition, i.e., diversity and populations. Thirdly, it is an application of an ordination technique, principal component analysis to soil ecology.

Though this technique was suggested by Blackith (1962) as a promising method for the investigation of soil organisms, it has apparently not been previously attempted before publication of preliminary results (see Hill 1973). It was nevertheless employed by Sinha et al (1969) to explore interrelationships of biotic and abiotic variables in stored grain bulks, where relatively few species were involved. However, neither factor analysis nor principal components analysis has been used for evaluating arthropod distribution in a natural ecosystem.

LITERATURE REVIEW

1. Importance of Oribatei

Though this aspect is not directly involved in the present study, it would seem to be appropriate to first review the previous work done on the nutrition and role in the ecosystem of Oribatei in order to justify their investigation.

a. Nutrition

The earliest systematic attempt to establish the diet of oribatids was Forslund's (1938) investigation of the gut content of five species using squash slides, leading to his conclusion that they feed essentially on fungus mycelia. Later Schuster (1956) examined gut contents of 31 species, which he summarized into three general groups: "macrophytophages" or higher plant feeders, "microphytophages" or microflora feeders, and "non-specialized feeders".

A very limited number of direct observations have been made of feeding behaviour under more or less field conditions. Phthiracarid larvae and nymphs have been observed mining conifer needles first infected by fungi (Jacot, 1936, 1939; Murphy, 1952). Graves (1960) observed a Galumna sp. feeding on dead collembola and a living dipterous larva but it is not known if this is typical behaviour. Rockett and Woodring (1966) also observed a Pergalumna sp. feeding on live nematodes.

Many other investigators have done rearing studies. Among these are Hartenstein (1962a-g), Woodring and Cook (1962), Sengbush (1954, 1959), Woodring (1963), Hayes (1963) and others. This kind of study

may be criticized as determining what the species will survive on rather than its preferred diet in nature. However, the findings of Littlewood (1969) that to rear oribatids on algae, there must first be contamination with microorganisms is probably significant. Führer (1961) also found that a bacterium (Pseudomonas sp.) associated with Artemisia campestris root was strongly attractive to Rhysotritia ardua.

In a recent paper Luxton (1972) has analysed the carbohydrase enzyme content in the gut of 14 species, including macrophytophages, microphytophages and "panphytophages" (feeding on both food types). A wide range of carbohydrase enzymes was found with much interspecific variation. The macrophytophages and panphytophages tested contained a cellulase accompanied by a xylanase and a pectinase indicating that these species may be able to decompose intact plant remains.

It was not determined by Luxton (1972) whether the enzymes were produced by the animals themselves or by symbiotic gut microflora. However Rohde (1955) found symbiotic bacteria in some xylophagous phthiracaroids while Woodring (1963) found yeast-like organisms in the midgut and lateral caeca of Galumna confusa.

b. Role in the Community

Oribatei are more numerous in moor soils where earthworms are largely absent, there is a large accumulation of organic matter, and the high acidity favours fungal growth. One of the main functions of oribatids has been considered to be the maceration of plant material causing reduction in particle size, exposing new material to bacterial action (Engelmann, 1961). A second function is the inoculation of

exposed surfaces with fungal spores, from previous feeding, which pass unchanged through the gut (Jacot, 1930a; Dobbs and Hinson, 1960 [cited by Macfadyen, 1961]; Engelmann, 1961; Talbot, 1952). The new fungal colonies resulting have a higher metabolism with a consequently greater decomposition rate. Thirdly, there may be a reduction of bacterial stasis by browsing on senescent colonies (Macfadyen, 1963; Hinschelwood, 1951). Fourthly, they may produce foci of high nutrient states (Macfadyen, 1961). The results of the above investigators suggest that oribatids are significant principally in facilitating the action of microorganisms.

The above deduction has partly been based on observations of high rates of turnover and low assimilation. Macfadyen (1961) calculated that microbe-feeding arthropods consume up to 10 times their respiratory value of microbes. Engelmann (1961) considered most oribatids incapable of digesting cellulose and related polysaccharides, consequently ingesting up to 40% and egesting 30% of their body weight per day (i.e., only assimilating 25%). In contrast, Luxton (1972) has found the comparatively high assimilation efficiency of 50-65% for Damaeus clavipes, a microphytophage. By comparing estimates of various workers Luxton (1972) tentatively suggests the following efficiencies: 10-15% for macrophytophages, 40-50% for panphytophages, and 50-65% for microphytophages. This clarification does not essentially change the general function stated above.

Different life stages may also vary in their function. In many cases particularly in phthiracaroids and higher oribatids, the nymphs

may have other food sources than the adults. Also Murphy (1955) cites Riha (1951) as considering that the immature stages are probably the more important since the adults spend much of their time in dispersal.

Additional functions have also been observed. Jacot (1936d) found that certain species tunnel out decomposing roots, facilitating water percolation and fertilizing deeper layers. The same has been observed by Ghilarov (1947) and Rogers (1939). However, this applies more to grassland than woodland. Also Crossley and Witkamp (1964) have found some evidence of an influence on mineral recycling.

2. Ecological Investigations of Oribatid Fauna

a. Single Forest Community Studies

Studies of a single community have been done by Drift (1951) in a beech forest, Abbatiello (1966) in an oak woods, Bohnsack (1960) in a pine forest, Price (1967) also under pine trees, Wallwork (1957, 1959) in a hemlock-yellow birch stand, and others. These studies have been concerned largely with vertical distribution, response to abiotic variables, e.g., soil moisture, and the role of oribatids in the biocoenose.

b. General Faunal Surveys

Many faunal surveys have been done in other biome-types. Arctic communities have been studied by Hammer (1937), Haarlov (1942), Tuxen (1943), Krivolutsky (1966), Macfadyen (1954) and others. Antarctic communities have been investigated by Castri, et al. (1966), and Dalenius and Wilson (1958), etc.

Surveys have been done encompassing more than one biome-type. Haarlov (1960) compared pasture, antmounds, hawthorne thickets, pond shore and lakeshore. Strenzke (1952) also compared several biome-types. Karppinen (1955) in a transect survey of nothroids included different forest and peatland types. Covarrubias (1964) in Chile, compared two forest types, savanna, and steppe.

As stated earlier, only a few comparisons of oribatid fauna between several differing adjacent stands have been made. Forsslund (1943) compared the fauna in stands of mature spruce, pine-spruce, spruce-pine-birch, pine-spruce sprinkled with birch, and pine and hardwood mixed with spruce. Marshall (1964) compared the distribution of oribatids under sugar maple with those in hemlock litter. Reeves (1967) compared four cover types: Norway spruce, black walnut, white pine, and mixed hardwood.

3. Biotic and Abiotic Environmental Variables

a. Soil Type

Little attempt has been made to assess the effect of general particle size on oribatids, probably because it is so closely correlated with type of humus formation. Schalk (1968) however, found greater numbers in the sandy soil of a meadow than in the loam soil of a lucerne field, though the population would also be depressed by cultivation.

Ghilarov (1964), treating soil animals as a whole, concluded that while any individual species may occur in different zones and different soil types, the entire community of soil-dwelling invertebrates reflects the peculiarities of the soil regime as a whole, a

certain population composition being related to a certain soil type.

b. Humus Formation

There are three general humus types: mor, on a sandy soil, in which there are discrete organic layers with very little mixing with mineral soil; mull, in clay soil, in which there is incorporation of organic material with the mineral soil; and moder or insect mull in which there is some incorporation of mineral soil with humus by larger arthropods, e.g., diplopoda. The type of humus formation has been shown to have substantial effect on oribatid populations, the mor type with high buildup of organic matter and low pH facilitating fungal growth, and therefore supporting the highest populations. Kühnelt (1963b) stated that a rather good correlation seems to exist between soil fauna and humus types.

Humus formation or forest floor type is, according to Minderman (1960) closely related to soil texture and topography which determines the soil water regime. Nevertheless, he also found that a mull tended to develop where calcium carbonate occurred in an A₁ horizon, even in very coarse sand. Ghilarov (1965) noted this phenomenon in his advocacy of the application of lime to increase the activity of beneficial soil invertebrates which produce a mull with a high rate of turnover, e.g., earthworms, enchytraeids, and diplopods.

Chemical agents released by both the macro- and micro-vegetation also facilitate mor formation. According to Handley (1954, cited by Burges, 1967b) the critical feature is that phenolic material in the leaf tissue tans the protein to form a protective coating over

the cellulose, thus inhibiting rapid decomposition. Also Winter and Bublitz (1953), according to Curtis (1959), consider that beech leaves may have an antibiotic effect which remains for a long time inhibiting bacteria, though if there is high rainfall their dilution may contribute to the formation of a mull (Murphy, 1955). Fungi have been shown to produce acids (Murphy, 1955; Kühnelt, 1963a) which also result in conditions unfavourable to bacteria.

c. Litter Depth

Experimentally the effect of depth of litter has been tested by removal and by burning. Karg (1967) found that removal from an oak woodland, resulted in an impoverished species composition very similar to cultivated soil. Huhta (1967, 1969) and Karppinen (1957) have found that burning over to destroy the litter caused a severe reduction in the oribatid fauna but other side effects, e.g., increase in pH, depressing fungal growth, increased surface drying, and steeper temperature gradients may have been at least partly responsible.

Nosek (1957, 1957a) has found that the organic matter was the most important single factor determining the distribution of the fauna. It has been observed by many other authors that a mor profile with deep litter and abundant fungal growth is conducive to high populations of oribatids, while a mull profile with only a small amount of litter supports much lower populations.

d. Soil Water

The water relations of soil fauna may be considered from several different aspects, e.g., amount of free water, relative humidity

in soil pores, precipitation, and water table, particularly the occurrence of flooding.

Many authors have considered that soil moisture was the dominant factor in the distribution of oribatids, e.g., Willmann (1928), Frenzel (1936), Krivolutsky (1964). Karppinen (1948) observed greater numbers of oribatids in moist forests than in dry ones. Reeves (1969) observed that a moisture level of 10% or less by weight appeared to cause a drastic drop in population. Murphy (1955), however, considered that the relative humidity was rarely a limiting factor in F and H layers (humus layers below the loose litter) since even in a severe drought soil moisture would be approximately 30%, in which case the relative humidity would not be below 90%. Berthet (1964a) found that as long as the percent moisture in the litter was above 20%, the relative humidity in the microcaverns of the soil remained above 95% but, variations in the percent moisture could greatly effect the development of mould and edaphic bacteria which may provide food sources.

Differences in behaviour under different moisture regimes were also found by Berthet (1964b). Steganacarus magnus and Nothrus palustris showed increased mobility when soil moisture was high, and conversely showed an increase in aggregation at moister microhabitats with increasing dryness. Reeves (1969) found some evidence of aestivation by phthiracarids during dry periods.

Resistance to desiccation varies within wide limits among oribatid mites (Kühnelt, 1963b). Hayes (1966) considered that free water might

be necessary for the survival of phthiracarids. In the laboratory Riha (1951) distinguished four groups of oribatids according to their degree of drought resistance. Franz (1950, as cited by Heyer and Ryke, 1966) on comparing a region with hot dry summers with a humid region, found less than 50% of the species of acarines in the dry area occurring commonly in the wet area.

Water as measured in precipitation was found by Huhta et al. (1967) to be the major agent causing fluctuation in animal numbers in the forest floor during the active part of the year.

Flooding may have a detrimental effect on the fauna. Kühnelt (1963b) states that this depends largely on temperature, i.e., resistance of the fauna would be much lower in summer. Wittasek (1947, in Kühnelt, 1963b) concluded that resistance to flooding depended on the ability of the organisms to use air bubbles as physical gills.

e. Pore Space

It has been found that porosity is important both for numbers and for selection of species (Kühnelt, 1960). Many authors have found that larger species tend to be in the L (litter) and F (fermentation) layers where the pore spaces are larger. Krivolutsky (1965), however, found that not all species were dependent on the size of the soil pores for their locomotion, but that some were able to widen pores to accommodate themselves. Under poor conditions Murphy (1955) considered that pore space was probably not a limiting factor.

f. pH

There is little direct evidence of a direct effect on oribatids themselves, the influence being mainly indirectly, in the form of reduction of nutrients. However it has been indicated above that low pH facilitates fungal growth on which many species feed. Russell (1961) considering soil fauna in general stated that H^+ ion may be less important than the associated effects of low nutrients, e.g., calcium, phosphorous, and nitrogen. Low nitrogen limits the maximum biomass and therefore the biological activity.

Kühnelt (1963a) found that H^+ ion concentration in litter had a great influence on collembola but not on acari. Weis-Fogh (1948) found little influence on acarina. Strongly acid substrata are generally avoided but several characteristic oribatids are present in peat bogs (Kühnelt, 1960).

g. Temperature

Temperature was found by Huhta et al. (1967) in Finland to be a critical factor only at onset and termination of winter. The prevailing temperature only had the indirect effect of modifying the effect of precipitation on the environment.

Though Kühnelt (1960) made the general observation that Acarina, Collembola, insect larvae, etc. may be frozen in the soil in winter and on thawing resume their activity, Wallwork (1959) found that in oribatids there was a population decline in winter particularly in adults, followed by a resurgence the following spring. Also Sengbush (1954) found that Galummids survived the winter as nymphs.

Response to temperature varies between different species. Lebrun (1965) was able to group a number of species according to their temperature response into four categories: thermophile species, cold sensitive species, indifferent species, and thermophobe species which resist freezing. Vertical migration in response to temperature will be reviewed under that heading.

h. Population Potential

It is evident that several of the above environmental variables may each be limiting factors under certain conditions. Krivolutsky (1968) was able to assess the favourability of given habitats for oribatid mites with a Coefficient of Suitability (A) in which:

$$A = \frac{F+L}{F} KR,$$

where R is the Index of Radiation balance, K is the Humidity Coefficient, F is the annual amount of litter and L is the litter weight.

4. Vertical Distribution and Migration

In forest soils most of the oribatid fauna occurs in the litter and humus layers. Kühnelt (1961) observed a marked decline in the mineral soil. Wallwork (1967) described the acarine fauna of forest mineral soil as impoverished. Murphy (1955) found that in a forest more acarines were mainly in the surface organic layers.

Different species vary in their depth distribution. It was observed previously that larger species tend to be in the upper layers where pore spaces are larger. Haarløv (1955) observed that Brachychthonius spp. go to deeper layers but other small forms, e.g., Suctobelba spp., remain in the upper 3-4 cm.

Many authors have observed diurnal vertical migration between the hemiedaphic (organic soil layers) and epigeal (vegetation) zones (Wallwork, 1967; Shaldybina, 1956; Stunkard, 1937) apparently as a result of humidity changes in the epigeal zone.

Though a few authors (Haarløv, 1955; Bohnsack, 1954) have not observed vertical migration within the hemiedaphic layers of forest soils most authors have observed its occurrence. Lebrun (1965) observed a downward shift in populations occupying the humus layers compared to the upper litter layer presumably caused by decreased autumn temperatures. Many previous authors (Forsslund, 1943; Tuxen, 1943; Riha, 1951; Drift, 1951; Strenzke 1952) have also noted seasonal vertical migration, finding downward movement during the cold season and in summer due to surface dryness.

That vertical migration varies between species was shown by Tarras-Wahlberg (1961) in a Swedish peat bog. Here it was noted that while Tectocepheus velatus showed downward migration only in response to cold during autumn, Nothrus pratensis, particularly nymphs, also showed daily downward migration as the surface heated up.

5. Vegetation

a. General

In a blanket bog Block (1966) suggested that changes in the acarine fauna were due to biotic factors, e.g., plant cover or soil microflora. On the other hand Krivolutsky (1964a) concluded that moisture is the determining factor with the species which are dominant in drier biotopes rare or absent in moist biotopes. He also considered that the kinds of trees and herbs were less important than the kinds

of soil and litter.

A number of authors (e.g., Dalenius, 1960; Kühnelt, 1960) have found many species which are eurytopic (have a broad ecological valence), and a number of rarer stenobiotic species (have a restricted distribution).

b. Macrovegetation

The climax forest according to Kühnelt (1963b) has in all cases been found the environment richest in species, while other forest types and degradation stages were characterized by impoverishment and almost no characteristic species. This was also indicated by Pschorn-Walcher's (1952) finding of a decrease in the number of species when a mixed deciduous forest was replaced by a spruce monoculture. In a tropical rainforest in Zaire, Maldague (1962) also found that diversity of Acari, especially oribatids, was greatest in the climax forest and decreased with degradation of the primitive vegetation.

Species combination and macrovegetation generally change along parallel lines. Gretschy (1952, in Kühnelt, 1963b) has traced succession of soil animals after clearing and reforestation. Nosek (1957, 1957a) found that succession of plant associations caused a succession of zoocoenoses (animal communities).

Indirectly, the macrovegetation has been shown to influence the soil fauna as a result of toxic substances released from the leaf litter. An antibiotic effect of black walnut (Juglans regia L.) litter was shown on soil bacteria by LaGrange (1956). This has recently been demonstrated by Summers (1975) to be associated with significantly lower populations of soil acarines.

Earlier Franz (1954) discussed the release of substances from decay of roots, leaves, etc. some of which selectively have positive, negative, or neutral effects on different soil organisms. The bio-coenotic effect of these substances would be the promotion of certain bacteria, fungi and perhaps microarthropods with the suppression of others resulting in a particular composite of microflora and microfauna.

c. Ground Vegetation

It was suggested by Murphy (1955) that ground vegetation may have an important influence on the number of species present. Eit-
minavičiūtė (1961) found that in both mixed forests and in coniferous forest the most species of oribatids occurred where there was a ground cover of mosses.

d. Microflora

In rearing studies Hartenstein (1962a) and others showed that many oribatid species are very specific in choice of fungi to feed upon.

6. Comparison of Faunal Composition

a. Spatial Distribution

Populations of species of oribatid mites have been shown to be highly aggregated or contagiously distributed (Hartenstein, 1961; Berthet and Gerard, 1965; Hayes, 1965; Macfadyen, 1962; etc.) The degree of aggregation has been found to vary according to species and microclimatic conditions. Lebrun (1965) found specific divergence between strongly aggregated, and not aggregated. Furthermore a given species might behave differently in the humus than in the litter.

Berthet and Gerard (1965) found that when density falls under less favourable conditions, the heterogeneity of distribution increases, apparently due to increased clumping about the most favourable sites, e.g., Berthet (1964b) found increased clumping by Steganacarus magnus in response to lower soil moisture.

Several possible origins of aggregation have been advanced. Eggs may be laid in patches with the animals remaining near the hatching place (Berthet, 1964b). Fauna would be aggregated at sites where the best microclimatic conditions occur, especially relative humidity (Berthet, 1964a, 1964b). Many animals have marked feeding preferences so that they aggregate about the best food sites (Hartenstein, 1961; Berthet, 1964b). Certain species may be inherently gregarious (Berthet, 1964b). Finally Torne (1967) suggested that the tendency for aggregation of small animals is caused by better conditions for them to compete successfully against their microbial nuclei when the animals attain a high density of population.

Many authors have found that the negative binomial distribution was the most applicable model for the population of oribatids. When comparing the fit of Steganacarus diaphanum, total oribatuloid mites, and total Oribatei to several distribution models Hartenstein (1961) found that the negative binomial fitted the data best. Berthet and Gerard (1965) using 13 species of oribatids in forest communities also found it to be the most frequent distribution.

The negative binomial distribution is defined by two parameters, the arithmetic mean (m) and a positive exponent (k). Berthet and Gerard (1965) present two models leading to a negative binomial distribution. The first of these postulates randomly distributed colonies which follow a poisson (random) distribution, in which the number of individuals per colony follows a logarithmic distribution with the resulting distribution of number of individuals per sample conforming to a negative binomial distribution. The second model which led to a negative binomial distribution was a heterogeneous poisson sampling. This model made greater allowance for variation in habitat factors.

Berthet and Gerard (1965) found that k was inversely density dependent and also that it varied from species to species. Also Hairston (1959) found that the more abundant species were more randomly distributed while rare species were more contagiously distributed because they must select favourable enclaves in a hostile environment.

b. Transformation of Data

The type of transformation generally used to stabilize data fitting a negative binomial distribution is, $y = \log_{10} (x+1)$ (Debauche, 1962; Gerard and Berthet, 1966), though Anscombe (1949) suggested $y = \log_{10} (x + \frac{k}{2})$. However Buzas (1967) used a $\log_{10} (x+1)$ transformation for marine Foraminifera bottom samples.

c. Methods of Comparing Samples

i. Coefficients of Similarity and Diversity

Quite a number of indices or coefficients of similarity have been devised to compare species composition between communities. Coefficients of similarity are all combinations of three qualities: a- the number of species at the first site; b- the number of species at the second site, and j- the number of species common to both. One of the earliest was Jaccard's (1902) coefficient of (floral) community, which is, $C = j/(a+b-j)$. A more widely used coefficient attributed to Sørensen (1948) but considered by Curtis (1959) to have been first used by Czekanowski (1913) is Sørensen's Quotient of similarity which is, $Q/S = 2j/(a+b)$. Mountford (1962) found that all existing measures of similarity increased with increase in sample size. The Mountford index, $I = 2j/2ab-(a+b)j$ does not have this disadvantage. The most widely used measure of similarity used for soil acarines is Sørensen's. It has been employed by Franz (1963), Moritz (1963), Davis (1963), Haarlov (1960) and many others.

A number of indices of diversity have been proposed, e.g., Fisher, Corbet, and Williams' (1943) index based on a logarithmic series distribution; Preston's (1948) log-normal analysis. Other indices of dispersion have been proposed by Numata (1950), Margalef (1951, 1956), and Simpson (1949). These also increase with increasing sample size according to Hairston (1959).

11. Ordination Methods

Factor, and principal components analysis which may be regarded as a branch of factor analysis, were both developed by

psychologists for analysing data from batteries of psychological tests. They provide methods of arranging individuals on the basis of a large number of variables. Factor analysis was first developed by Spearman (1927). Principal components analysis is based on the method of "principal axes" of Hotelling (1933).

From its beginning in psychology, factor analysis has been adapted to sociology, economics, and more recently into the biological sciences.

It was first used in entomological systematics by Stroud (1953). Subsequently it has been used in what is called numerical taxonomy by Sokal and Michener (1958), Rohlf and Sokal (1962), Sokal and Sneath (1963), and in many more recent papers.

The use of principal components analysis in ecology has been developed largely by plant sociologists. It was first used in ecology by Goodall (1954) who erroneously referred to his method as factor analysis.

The term "ordination" was coined by Goodall (1954) who defined it as "an arrangement of units in a uni- or multi-dimensional order". It denotes a mathematical construct to simplify a system approaching a continuum. It was contrasted with classification which presupposes underlying discontinuities or classes. In other words, ordination purports to be unbiased, making no preconceptions of an underlying order.

Within recent years a large number of ordinations using principal component analysis have been done on plant communities, e.g., Orłóci (1966); Williams, et al. (1969); Greig-Smith and Austin (1967); etc.

Ordinations using factor analysis have been used in agriculture by Ferrari, Pijl, and Venekamp (1957); Liberg and Mol (1961); and Ferrari (1965), to analyse crop yields.

Factor analysis has also been utilized in the ordination of geological strata.

These techniques have been very little used in animal ecology. Recently Miracle (1974) showed that principal component analysis could be used in elucidating niche structure in freshwater zooplankton. The only studies known to the writer in which principal component analysis has been employed in arthropod ecology before a preliminary report of the present work (Hill, 1971), is the work of Sinha, Wallace and Chebib (1969); and Sinha and Bronswijk (1970) on the interrelations of fungi, mites, and insects in stored grain bulks.

Cluster analysis is closely related to factor analysis. It has the advantage of providing a printed dendrogram, thus giving a graphical representation, but contains no causal implications. It was also developed by psychologists. It has been applied to geological data (Parks, 1966) and in many other areas.

iii. Other Methods

A number of other multivariate methods have been applied to the same sort of data. Discriminant function analysis has been applied to plant distribution by Norris (1971) and to geological strata by Klován and Billings (1967). Canonical analysis has been used by Buzas (1967) to distribution of Foraminifera. These other methods will not be considered further.

MATERIALS AND METHODS

1. Site Description

a. Geophysical Background

The Morgan Arboretum is situated in the St. Lawrence lowland at $45^{\circ}26'$ N latitude and $73^{\circ}57'$ W longitude. Altitude is 125 to 150 feet above mean sea level. The climate is cool and moist, with the precipitation distributed throughout the year. The underlying bedrock, of Precambrian or Paleozoic origin, is overlaid by deposits of Pleistocene and Recent periods.

The arboretum itself is underlain by Beekmantown calciferous dolomite (Paleozoic) which is covered by an uneven layer of boulder clay. The boulder clay is overlain in some parts by Leda clay which in turn is capped by Saxicava sand (Long, 1955). The greater part of the area is covered by sand with clays making up the remainder.

b. Vegetation

In the Montreal area the forest zone is referred to as lake forest, which is a transitional region between the eastern deciduous and northern coniferous forest zones. It is characterized by the presence of floristic elements of the boreal coniferous forest to the north, elements of the deciduous forest to the south, and some endemic species (Long, 1955).

The Morgan Arboretum has two edaphic seres: sandy soil, supporting the Beech-Hemlock catena, and clay loam supporting the Sugar Maple-Basswood catena. The beech-hemlock catena has beech (Fagus grandifolia Ehrh.) as the climax vegetation in the dry phase of the sere, and eastern hemlock (Tsuga canadensis (L) Carr.) as the climax

in the moist phase. Other species included in the catena are grey birch, red maple, and yellow birch. The sugar maple-basswood catena has climaxes of pure sugar maple (Acer saccharum Marsh.) in the dry phase, and mixed sugar maple and basswood (Tilia americana L.) in the moist phase. Other species include trembling aspen, large-toothed aspen, white ash and shagbark hickory. The majority of species show preference for one catena or the other.

The sandy soil, supporting the beech-hemlock catena, tends to be acidic producing a mor type of soil profile, i.e., one in which there are clearly defined horizons consisting of an upper L (litter) layer, an F (fermentation) layer of partially decomposed leaves, twigs, etc., an H (humus) layer in which the organic matter is decomposed to an amorphous mass, followed by the underlying mineral soil usually consisting of an A₁ layer containing some organic matter, a leached A₂ layer of white sand, and finally a usually yellowish B layer of pure sand (soil horizons designated after Kevan, 1962).

The clay soil supporting the sugar maple-basswood catena, is weakly acidic (pH 5-6), producing a mull type of humus formation in which no clear stratification occurs, due to the mixing of organic matter with mineral soil by earthworms. The L and F layers are very scant, followed by a deep A layer composed of clay mixed with organic matter.

c. Sampling Sites

Six forest cover or macrovegetation types were chosen according to the ease with which they could be replicated. These tree or

Fig. 1: Map of Morgan Arboretum Showing Sampling Locations

1. GBRM - Grey Birch-Red Maple Association
2. Be - Beech
3. WA - White Ash
4. Be - Beech
5. He - Hemlock
6. He - Hemlock
7. BeRM - Beech-Red Maple Association
8. LTA - Large-toothed Aspen
9. BeRM - Beech-Red Maple Association
10. GBRM - Grey Birch-Red Maple Association
11. TA - Trembling Aspen
12. WA - White Ash

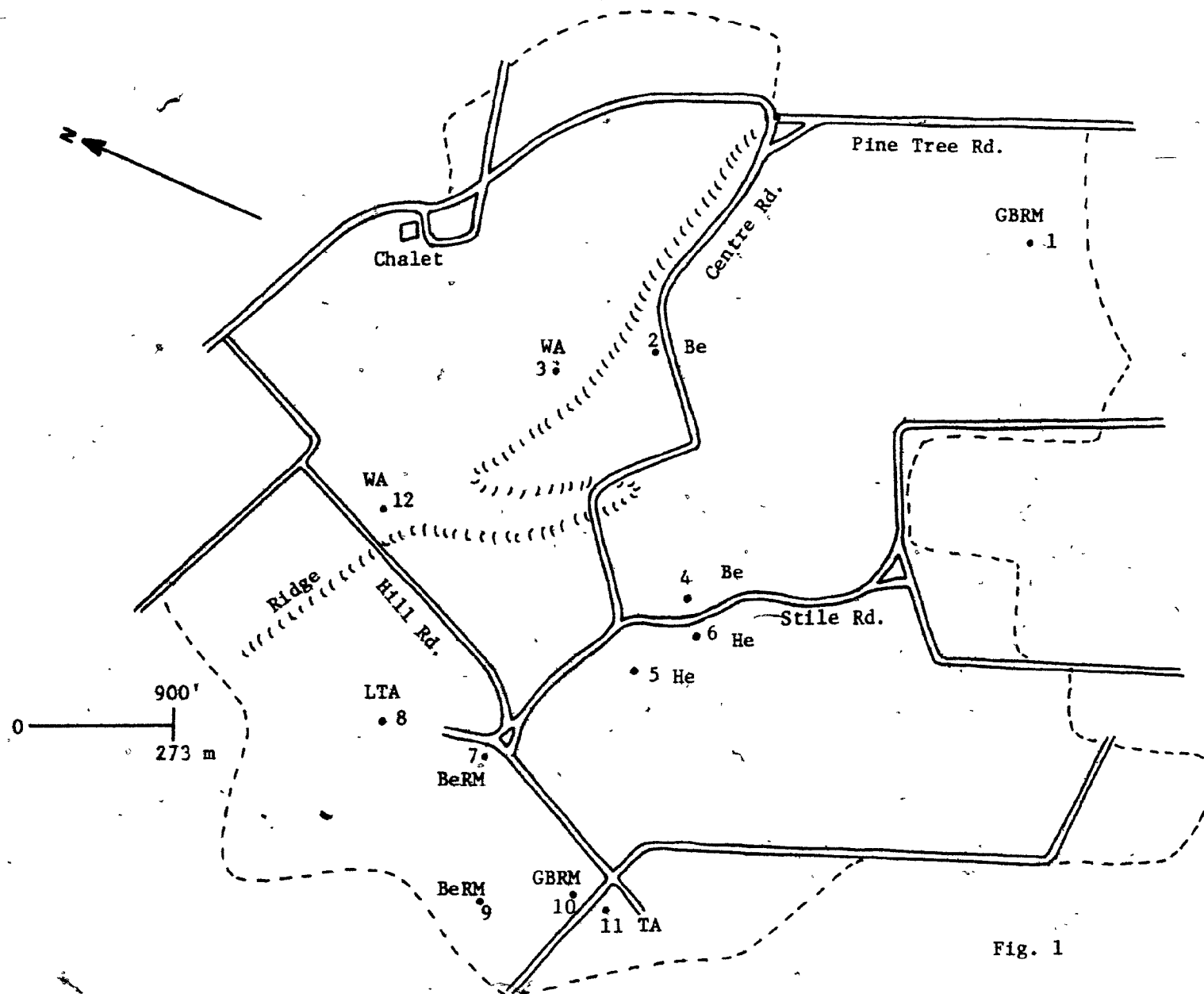


Fig. 1

macrovegetation species which will henceforth be referred to by their common names were: Betula populifolia Marsh (grey birch), Acer rubrum L. (red maple), Fagus grandifolia Ehrh. (beech), Quercus rubra L. (red oak), Tsuga canadensis (L.) Carr. (hemlock), Populus tremuloides Michx. (trembling aspen), Populus grandidentata Michx. (large-toothed aspen), and Fraxinus americana L. (white ash).

Identifications of macrovegetation were according to Cunningham (1956). Sources for determination of ground vegetation included Cunningham (1958) and Brayshaw (1959). The soil series i.e. Ste. Sophie sand, Ste. Rosalie clay, and Ste. Amable sandy loam were according to Lajoie and Baril (1954).

A. Beech-Hemlock Catena

Within the beech-hemlock catena eight sites were selected. All sites occurred on Ste. Rosalie sand.

Site 1. Grey Birch-Red Maple Association

This is considered to be a subclimax stage occurring in the dry phase of the sere. It was the driest site chosen, soil samples averaging about 16% water by weight. The soil was more characterized as a brown podzol with a pH of about 4.5.

The leaf litter was comparatively shallow averaging less than 2.3 cm. The forest canopy over the sampling quadrat was closed but an adjacent clearing resulted in quite dense ground vegetation. This was composed mainly of Bracken fern (Pteridium aquilinum (L.) Kuhn), false lily-of-the-valley (Maianthemum canadense Desf.) and star flower (Trientalis borealis Raf.).

Site 10. Grey Birch-Red Maple Association

This site, the replicate of site 1, was similar except for a deeper humus buildup (average 3.8 cm.) and higher soil moisture, averaging about 41% by weight. pH was about 4.4. The mor type of humus formation showed some evidence of mixing with mineral soil. The canopy was fairly open resulting in a dense ground cover of bracken fern and some false lily-of-the-valley.

Site 7. Beech-Red Maple Association

This association is also a subclimax in the dry phase of the sere. Soil moisture averaged 29% by weight. Depth of litter layers averaged about 3.7 cm. pH averaged 3.8. Soil characteristics were similar to site 1.

The canopy was closed but there was an adjacent bridle path. Ground vegetation consisted of a dense cover of false lily-of-the-valley.

Site 9. Beech-Red Maple-Red Oak Association

The soil was similar to site 7 except that the humus formation was closer to a moder than a mor with considerable mixing of humus with mineral soil. Litter depth averaged about 2.2 cm. Soil moisture averaged about 26%. pH was less acid averaging 4.8.

The canopy was closed. Ground vegetation was scant with a few false lily-of-the-valley, seedling red maples, and seedling red oaks.

Site 2. Beech

Soil was similar to site 1 (a mor characterized as a brown podzol on Ste. Sophie sand). There was some mixing of humus with A layers. Litter depth averaged 4.9 cm. Soil moisture averaged 39%. pH averaged 3.6.

The canopy was closed. Ground vegetation was very scant consisting only of scattered false lily-of-the-valley. Striped maple (Acer pensylvanicum L.) was also present.

Side 4. Beech

Characteristics of site nearly identical with site 2. Litter depth averaged 3.6 cm. Soil moisture averaged 36%. pH averaged 3.8.

The canopy was closed. Ground cover was absent on sample plot.

Side 5. Hemlock

The soil was a gleyed podzol with leaching of the iron oxides leaving white or mixed white and brown sand beneath the humus layers. Winter flooding occurred adjacent to the stand. Soil moisture averaged 61%. Humus layers, averaging about 10 cm deep, represented a very acid mor with a mean pH of 3.2.

The plot was in a small clearing. Ground vegetation consisted of bracken fern, wintergreen (Gaultheria procumbens L.) painted trillium (Trillium undulatum Willd.), moccasin flower (Cypripedium acaule Ait.), yellow clintonia (Clintonia borealis (Ait.) Raf.) and a layer of moss (Dicranum sp?).

Side 6. Hemlock

The soil was similar to site 5. Winter flooding occurred adjacent to the stand. Soil moisture averaged 64%. The litter was slightly less acid, pH averaging 3.5. Litter depth was slightly shallower averaging 8.6 cm.

Canopy was closed. Ground vegetation was sparser than in site 5, but was composed also of bracken, wintergreen, and moccasin flower. Star-flower occurred in addition.

B. Sugar Maple-Basswood Catena

Within the sugar maple-basswood catena, four sites were chosen, all in the moist phase of the catena. Three sites occurred on Ste. Rosalie clay and one on Ste. Amable loamy sand. All were of the mull type of humus formation.

Site 8. Large-toothed Aspen

The stand was situated in Ste. Rosalie clay. The soil appeared to be a dark grey gleysolic soil. Soil moisture averaged about 40% by weight. The site was moist to wet and subject to winter flooding. Humus form was a mull though the pH ranged from 4 to 5, averaging 4.7. Litter depth was variable, averaging 1.3 cm. Beneath the litter occurred an H + A layer of comminuted humus mixed with mineral soil.

The canopy was closed. The stand was small and was adjacent to beech and red oak trees which contributed to the litter. Moderate ground cover consisted mainly of false lily-of-the-valley and grasses.

Site 11. Trembling Aspen

The stand occurred on Ste. Amable loamy sand. The soil was dark grey and gleysolic with an average pH of 4.9. Soil moisture averaged 21%. Litter was very scant (about .2 cm average) most of it being comminuted to form an H + A layer. Surrounding species, particularly red maple, contributed significantly to the litter.

It was a young stand with closely adjacent small trees (closed canopy). Ground cover consisted of many species of angiosperms and horsetail (Equisetum arvense L.)

Site 3. White Ash

The stand occurred on Ste. Rosalie clay. The soil was a heavy clay with an average pH of 6. The soil was moist averaging 27% and subject to winter flooding. Litter depth only averaged .2 cm. A large proportion of the litter was from surrounding sugar maples (Acer saccharum Marsh.).

Canopy was closed. Scattered ground cover consisted of cinnamon fern (Osmunda cinnamomea L.), and seedlings of sugar maple, blue? beech, and white ash.

Site 12. White Ash

The stand occurred on Ste. Rosalie clay. Soil was similar to site 3, with an average pH of 5.5. The soil was moist, averaging 33% and subject to winter flooding. Litter depth averaged .25 cm. A large portion came from adjacent sugar maples.

Stand fairly open. There was a dense ground cover composed of many species including sword fern (Polystichum munitum (Kaulf) Presl.), yellow violets (Viola pensylvanica Michx), jack-in-the pulpit (Arisaema atrorubens (Ait.) Blume), dogtooth violet (Erythronium americanum Ker.), and Hydrophyllum virginianum L.

2. Sampling Procedure:

a. Experimental Design

At each site a plot of 16 ft.² was marked out, equidistant from the tree trunks, so that each plot contained 16 subplots of 1 ft.² each. Different subplots were randomly allocated for separate sampling dates.

A paired sampling technique was used (Hughes, 1962) in which the first sample was taken in the ~~centre~~ centre of the subplot and the second 4" from the first in a random direction.

Samples were taken monthly (those taken on 15: VI: 1965, 20: VIII: 1965, 6: XI: 1965, and 28: V: 1966 were selected for identification).

Depth of the soil cores taken was according to the depth of the humus layers. Normally they were taken 8 cm. deep but this was extended to 10 cm. if necessary or reduced to 6 cm. if the humus was shallow.

b. Sampling Equipment

The sampling device was a corer of stainless steel, containing 2 cm. deep brass liners which slide out to later facilitate division of the sample into convenient 2 cm. deep subsamples (see Fig. 2). Two corers were machined by the Department of Buildings and Grounds from 1 5/8" stainless steel pipe. At the cutting edge the inside diameter was 1 5/16" (3.33 cm.) while 1/2" above the cutting edge the corers were machined to 1 1/2" to accomodate the brass liners. One of the corers was designed to take samples 6 cm. deep (for shallow humus), while the other was designed for cores 10 cm. in depth.

The brass liners, machined from brass tailpieces designed for kitchen sinks, were 1/16" greater in inside diameter than the cutting edge, to reduce shearing (Macfadyen, 1953). Some of the liners were machined by Buildings and Grounds. However a large number were cut to length and reduced in outside diameter to fit the corers, by the author on the Biology workshop metal lathe.

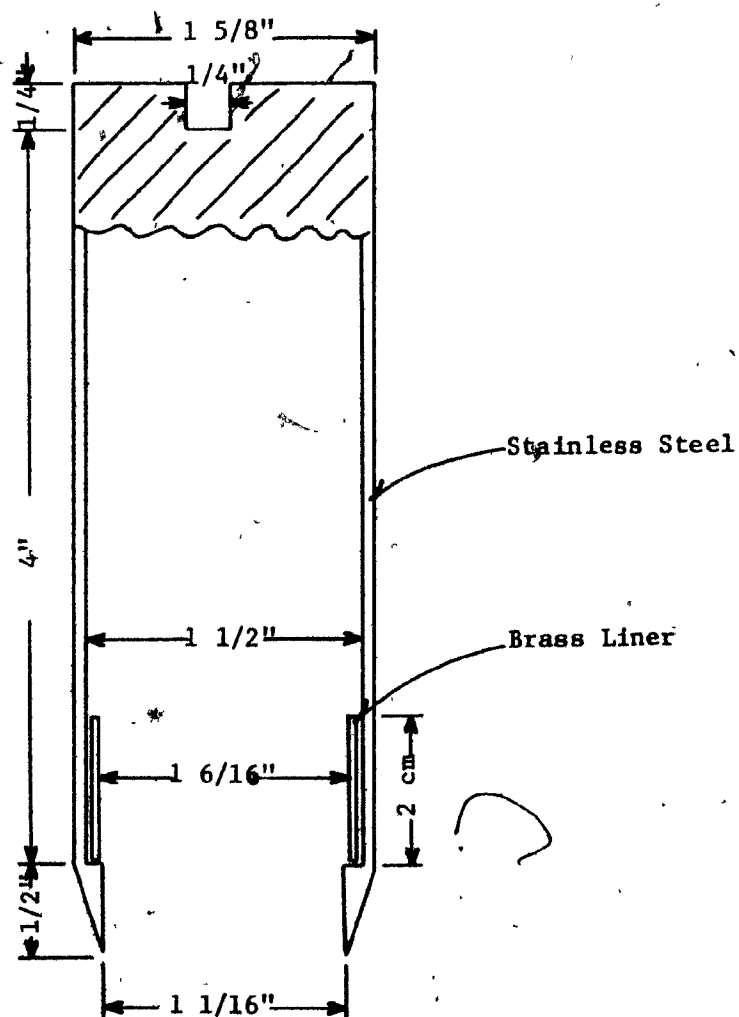


Fig. 2: Soil Corer

c. Sampling Technique

A small U-bolt fitted into slots in the top of the corer was used with a twisting motion to cut through the organic matter and force the corer into the ground. On withdrawal from the ground the soil samples in their brass liners were removed from the corer as carefully as possible to produce the minimum in disturbance of the soil structure. Thereupon, each core was inserted into a plastic bag, which was in turn placed in a labelled cardboard tube which was carried in a box in a rucksack.

d. Physical Data Measured in the Field

At time of sampling both soil temperature, taken with a thermometer demarcated to $.1^{\circ}\text{C}.$, and soil pH, taken with a Beckman Pocket pH Meter, were recorded at depths equivalent to the midpoint of each subsample, i.e., subcores were 0-2 cm., 2-4 cm., 4-6 cm., etc., so that readings were taken at 1 cm., 3 cm., 5 cm., etc.

3. Extraction

a. Description of Extractor (Figs. 3 and 4)

The extractor used was described by Emberson (1968). It combined some features of both Murphy's (1958, 1962) split funnel extractor and Kempson's extractor (Kempson et al., 1963). It measured 4'x2'x18" deep with a water bath, above which was a baffle plate accomodating 105 subsamples. The extractor cover carried heating strips (5 strips of 800 Watts each) which were controlled by a sensor-activated thermostat. When in place the heating strips were 4" above the samples.

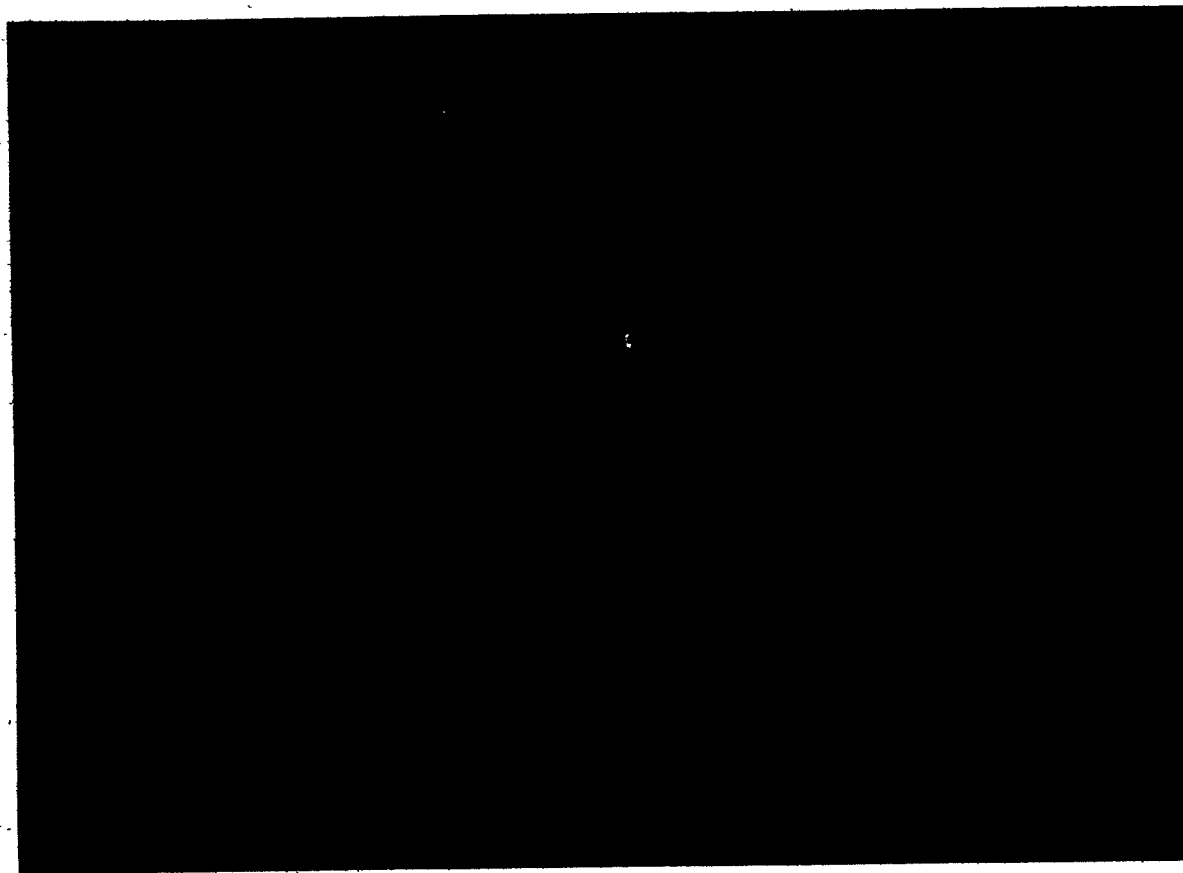


Fig. 3. Extractor with Cover and Heating Strips in Place.

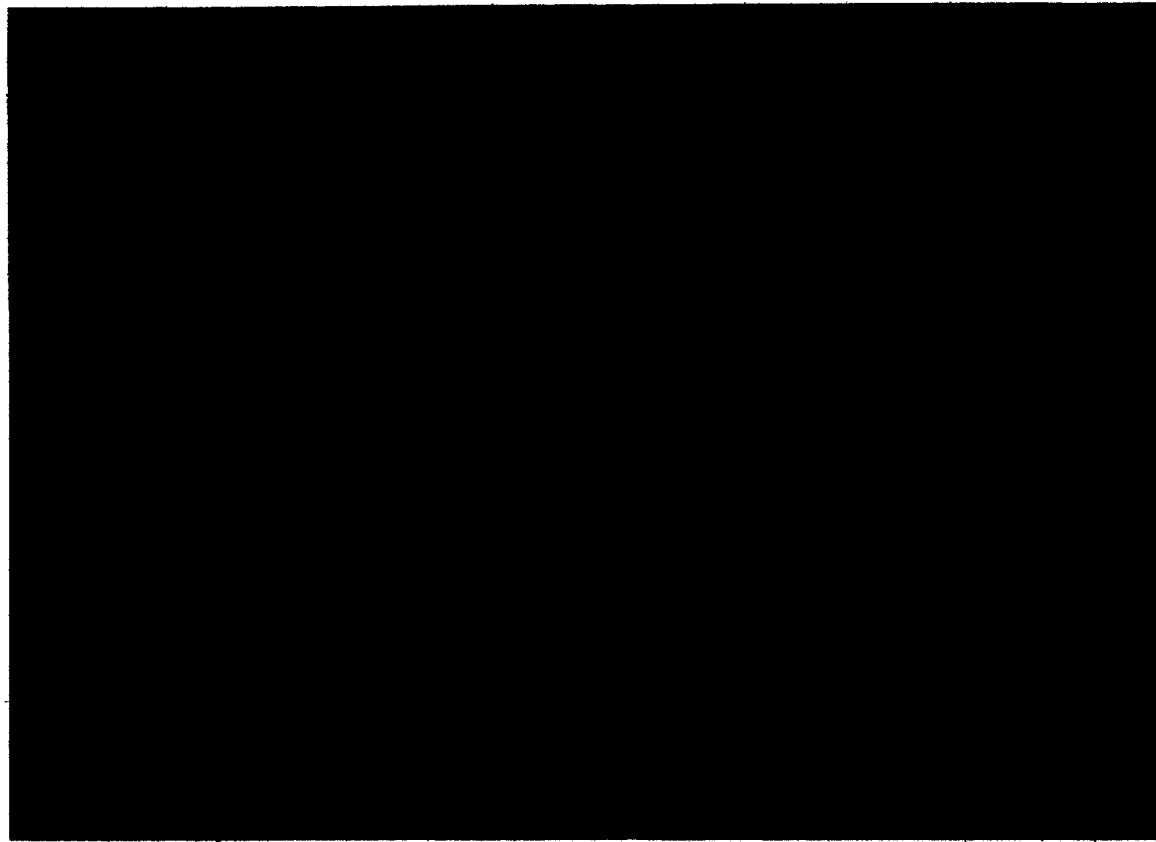


Fig. 4: Extractor without Cover, Showing Soil Cores.

b. Preparation of Samples

On returning to the laboratory, the soil cores were subdivided by carefully cutting through the sample between the 2 cm. deep brass liners with razor blades. First the subcore containing the top humus layers was cut free and weighed for the soil water measurement. Next a 4"x4" piece of cheese-cloth was placed over the top of the subsample. With the razor-blade still under the lower part of the subcore, it was inverted and inserted into the mouth of a 1½ oz. curved-sided tumbler used as the collecting vessel (see Fig. 5), so that the uppermost part of the subsample which would have the largest pore spaces, would be facing downwards, thereby facilitating the escape of the animals. The cheese-cloth was folded downwards and a 1½" diameter neoprene O-ring was placed around the edge of the collecting vessel to prevent it from slipping through the aperture in the baffle-plate. The process was repeated for each subsample.

c. Preservation Medium

The preservation medium was a saturated aqueous solution of picric acid (see Macfadyen, 1962), since this has been found to have very little repelancy, and a lower evaporation rate than alcohol. Also 2 drops of a liquid detergent was added as a wetting agent (to prevent "rafts" of collembola).

d. Extraction Procedure

The subsamples in their collecting vessels were mounted in the baffle-plate of the extractor. For the first 48 hours the samples were air dried to allow the deeper dwelling, smaller, slower moving

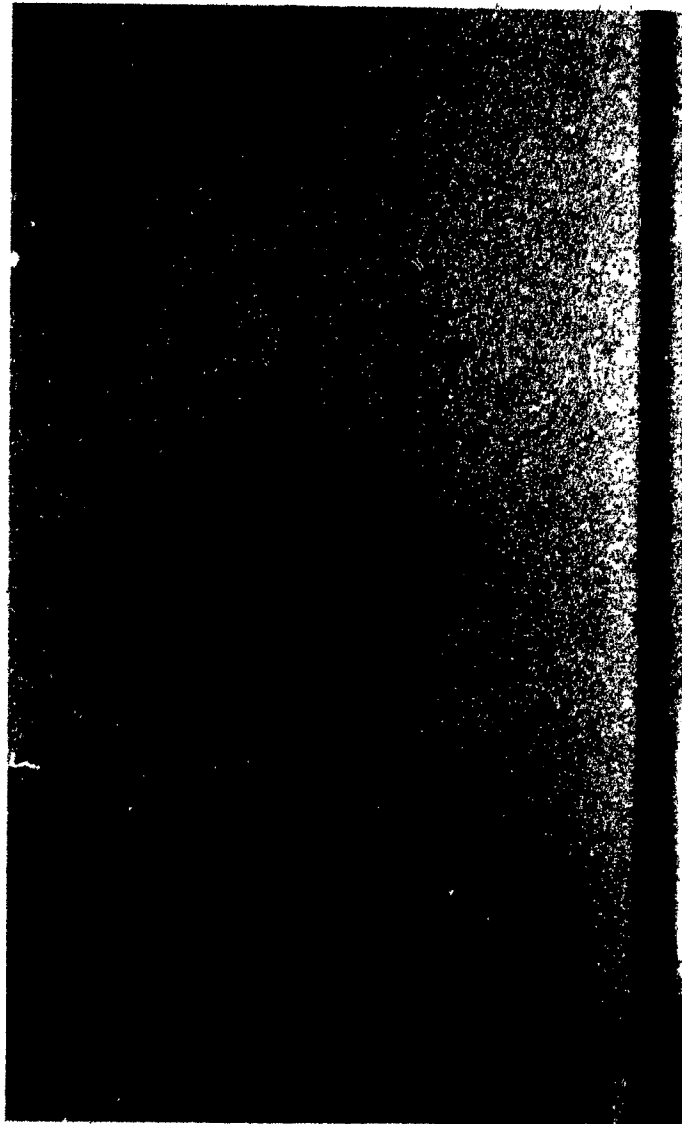


Fig. 5: Collecting Vessel with Soil Core in Place.

species to escape. During this period a light was left on to discourage the escape from the samples of larger species. Subsequently, the cover with the heating strips was put in place, and the sensor set at 25°C, or just high enough above room temperature to allow the thermostat to cut in. (Even a setting of 25°C resulted in a surface temperature in the samples as high as 39°C, hence the necessity of a long air drying period.) The extractor was left in operation for 4 days before removal of the samples. (This was found to be sufficient to remove all but about 2% of the water from the soil, and was adequate to remove virtually all of the animals.)

After removal from the extractor, the contents of the collecting vessels were washed into 4 dram vials with 70% alcohol for storage and later examination.

e. Physical Data Measured in the Laboratory

The remaining dried soil samples were dried further for 24 hours at 105°C in a drying oven (to express the remaining 2% water), weighed, and the brass liners also weighed separately for determining the soil moisture. Also, the depths of each stratum in the soil profile were measured. Subsequently, the dried subsamples were each placed in a porcelain crucible and incinerated at 500°C to remove all organic matter. The ashed samples were again weighed to determine weight of organic matter and of mineral soil.

4. Preparation and Identification of Oribatids

a. Sorting

Each Berlese residue (the fauna extracted from a sample) was

washed into a 5 cm. diameter petri dish and cleared with about 1½ eye droppers full of lactophenol solution (45 gm. phenol: 45 ml. 85% lactic acid). After leaving overnight for clearing, all Oribatids were sorted from the debris in the residues with #3 and #5 jewellers forceps. They were placed in a 1½" square stender dish of distilled water, preparatory to temporary or permanent mounting.

b. Mounting

Permanent mounts were made using the King, Bradley, and McNeil formula for Berlese fluid (as cited by Strandtmann and Wharton, 1958):

- 8 gm. gum arabic
- 8 ml. distilled water
- 5 ml. glycerine
- 70 gm. chloral hydrate
- 3 ml. glacial acetic acid

Small soft-bodied mites were simply placed on a slide in about 2 (small) drops and a #0 cover slip placed directly on top. Larger more globular mites, of which the integument was liable to split when the cover-slip lowered due to shrinkage during drying, were mounted in a larger quantity of medium with splinters of cover-slip placed under the edges of the cover-slip to prevent compression of the specimen.

Slides were dried in drying ovens set at 45°C for one week or more depending upon the humidity. In summer when the humidity approached 60%, drying took several weeks. After drying, cover-slips were ringed (sealed) with Gurr's Glyceel.

The oribatid fauna from three monthly samplings was preserved on permanent mounts. The fourth sample examined was mainly put on temporary mounts, since by this time it was felt that identification for most species was sufficiently accurate that reexamination would not be necessary. Depression slides with a single depression were used. Lactic acid (85%) was placed in the cavity. An 18 mm. square cover-slip was placed half way across the cavity. Up to 10 Oribatids were placed just under the edge of the cover-slip which was then moved over them.

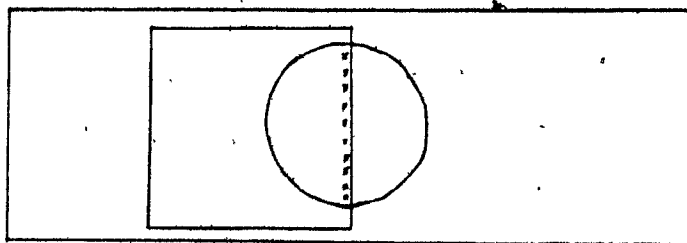


Fig. 6: Temporary Mount for Identification.

All individuals were identified, or at least segregated, to species, except for 22 unidentified nymphs and 144 Suctobelba nymphs unidentifiable to species.

c. Identification

Generic identification was done with the aid of keys by Balogh (1961, 1963, 1965, and 1972). Literature by Jacot, Hammer, Fosslund and many other workers was used to make specific determinations, though in some cases a specimen had to be given a generic name and a number.

d. Biomass

Biomass was calculated for each species in each sample. This was done by taking measurements from slide material (lengths and widths) and using Lebrun's (1971) equations. Where possible lengths and widths of 12 to 20 individuals of each life stage of each species were taken.

The equations used were:

1. General Equation: $\log P = 1.53 \log L + 1.53 \log W - 6.67$
2. Achipteriform Equation: $\log P = 2.09 \log L + 0.92 \log W - 6.67$
3. Carabodiform Equation: $\log P = 1.62 \log L + 1.40 \log W - 6.56$
4. Nothriform Equation: $\log P = 2.09 \log L + 0.84 \log W - 6.44$

5. Measurement of Biotic and Abiotic Variables

a. Moisture

i. In Samples

Moisture content of the samples was determined gravimetrically (by weight). Before being placed in the extractor, each subcore in its brass liner was weighed on a chemical balance. After extraction, it was dried still further in a drying oven for 24 hours at 105°C. Then it was reweighed with the brass liner being weighed separately so that the weight in grams (= volume) could be used as a measure of soil moisture.

ii. Precipitation

The rainfall over the period of sampling was looked up in the meteorological data records taken at the Seed Farm of Macdonald College. Rainfall for the periods, one month and two months before each sampling date, were calculated.

iii. Water Table

Only the roughest of assessments were made. Each site was described as being in the dry, moist, or wet phase of the sere (see Long, 1955). Whether or not winter flooding occurred was recorded.

b. pH

As described earlier, pH was measured in the field at the time samples were taken with a Beckman Pocket pH Meter at depths corresponding to the depth of each subsample.

c. Organic Matter

1. Depth of Soil Horizons

Before incinerating each subsample, when it was removed from the brass liner, the depths of all of the soil horizons that were present, were measured to the nearest millimetre.

d. Pore Space

An attempt was first made to determine the pore space using a manometer system. Using a wire mesh and filter paper, the subsample in its brass liner was fitted to a straight sided funnel which was attached to a manometer system. The system was filled with water so that the sample was thoroughly soaked. The manometer was then lowered to exert a 15 mm. negative pressure on the sample. This will withdraw water from soil pores down to a diameter of 100 μ . However, technical difficulties were encountered in sealing the apparatus, to prevent air bubbles from being sucked into the manometer. Also, this method does not measure total pore space, which is probably a better measure since nymphal Brachycthoniidae may be

only about 50u in diameter.

Consequently, the pore space was estimated volumetrically.

A separate core from each site was collected for this purpose. The approximate density of organic matter and of mineral soil were determined, so that their volume in a given sample could be calculated, which, together with the water (determined by weight when the sample was extracted) were subtracted from the total volume, giving the pore space. The procedure was as follows:

1. Additional cores were subdivided and dried at 105°C overnight.
 2. Each subsample was examined for humus layers and finely ground in a mortar and pestel.
 3. Either 5 or 10 gms. were weighed out from each subsample.
 4. Displacement was measured using a 25 ml. cylinder graduated to .5 ml. or a 100 ml. cylinder graduated to 1.0 ml.
 5. Samples were washed into vessels in which they were dried in an incubator.
 6. Samples were transferred to crucibles and incinerated at 500°C.
 7. The sample was again weighed.
 8. Volume by displacement was again measured, using the 25 ml. graduated cyclinder or a 10 ml. graduated cyclinder (graduated to .2 ml.).
 9. The volume of organic matter was calculated for each subsample.
- From these data the density of organic matter and of mineral soil were calculated. The subsample values for each core were averaged.

The density values obtained for organic matter and for the mineral fraction at each site, were used to calculate the volume of humus and of mineral matter from the weights recorded when the samples were extracted. From these values and the weight (=volume) of soil water recorded, the pore space was extrapolated for each subsample examined.

e. Temperature

i. Soil Temperature

At time of sampling soil temperature was taken with a thermometer demarcated to $.1^{\circ}\text{C}$ at depths equivalent to the midpoint of each subsample, i.e., at 1 cm., 3 cm., 5 cm., 7 cm., and sometimes 9 cm. depths.

ii. Day/Degrees

Meteorological data recorded at the Macdonald College Seed Farm was used to calculate the approximate number of day/degrees that had accumulated that year up to the sampling date. The average air temperature for each day, was used since it was considered that over a period of 24 hours the differences between soil and air temperatures would average out, soil temperatures being lower in the daytime but higher at night.

f. Ground Cover Estimation

Relative proportion of the ground surface covered by ground vegetation was assessed on a scale of 0-4. Presence of particular species, e.g., bracken fern, false lily-of-the-valley, mosses, etc. was also recorded on a scale of 0-4.

g. Leaf Litter Composition

A sample of the leaf litter on a square foot of each site was collected in November 1966 to see if it accurately represented the macrovegetation or if there was significant wind drift from adjacent stands, particularly in the case of small stands. The proportion of the leaf fall from different tree species was estimated volumetrically out of 10.

h. Distance Between Plots

This was estimated by locating sampling sites on a map of the Arboretum (scale 1cm = 108m), then measuring distances between plots with a ruler to determine their relative distances apart.

6. Statistical Analyses

a. Sørensen's Quotient of Similarity

Initially the sites were compared on the basis of species composition using Sorensen's Q/S (Kontkanen, 1957). This method determines the similarity between sites on the basis of presence or absence, using the formula:

$$Q/S = \frac{2j}{a+b}$$

where a = total number of species at one site,

b = total number of species at a second site,

and j = number of species common to both sites.

The Q/S was calculated, first using all species found including accidentals, then using only the species that made up 1% or more of the total population of a site, and finally using only the species

that were considered dominant, i.e., those making up 2% or more of the population.

b. Ordination of Samples

It was decided that it was necessary to use a multivariate statistical method that would incorporate the numbers of each species. Factor analysis by principal components and cluster analysis were used.

Factor analysis techniques are based on data matrices in which M entities or individuals are defined by N attributes or variables. In the matrix each value, represented by X_{ij} is the number of individuals of the i^{th} species in the j^{th} sample. These methods are designed to reduce the dimensionality of a large set of predictor variables to reveal a relatively small number of underlying variables which may be used to estimate criterion variables (Horst, 1965).

Graphically the data may be represented as M points (samples) in N (species) dimensional space. Each sample may be represented as a point with each of the N species being described by a vector passing through the origin. Each vector is a separate dimension, its length according to the number of that species in that sample.

The data may be looked at in two ways: Q-mode analysis compares samples on the basis of species (samples in species space). Its converse, R-mode analysis compares species on the basis of samples (species in sample space). The former was used in this case.

The calculation is based on correlation analysis. To reduce the dimensionality of the variables each must be rendered orthogonal

or uncorrelated to any other variable. The most frequently used method to produce this result is Kaiser's (1958) varimax method of analytical rotation. In the end result each factor may be graphically represented as being a vector composed of segments of the observed variables (species).

i. Preparation of Data

The population data was laid out in a data matrix with samples or cores recorded in columns and species in rows (see Appendix B). It was then key punched on computer cards.

ii. Computation of Principal Components

The data were run on the IBM computer of Gulf Oil in Calgary by Mr. Allen Graves.

(a). Factor Analysis by Principal Components

The analysis required several runs before the most coherent result could be achieved. First the principal component analysis was run on the raw (untransformed) data to look for low information samples using 100 variables. The other 54 species, 17 of which were represented by a single individual, were so sparse and occurred in so few samples of any site that the samples did not adequately represent their distribution. Second, the analysis was run with the data transformed to percent of total number. Thirdly, a $\log n(x+1)$ transformation was used on 100 variables. In an attempt to clarify the result the next run was done using only 72 of the more widely distributed species. The final run used a $\log n(x+1)$ transformation on 90 species. Ten species were eliminated from the

previous 100 variables used by weeding out those species which in the factor score matrix did not have significant loadings on any factors (see Appendix E). Also 4 pairs of samples which had low communalities (i.e., a low proportion of the total information content of the sample accounted for) were lumped so that the final varimax factor matrix was based on 92 entities rather than the original 96. The program was run first extracting 10 factors and then successively fewer factors down to 5, thereby condensing the information on fewer factors to further define similarities between sites.

iii. Cluster Analysis

In the cluster analysis program used a Q-mode (comparison of samples on the basis of species) principal components analysis is first performed. The factor (or principal component) measurements are then normalized and used as the input into a clustering routine based on distance function. In this computation a pair by pair comparison is made between the principal components for each sample, first pairing one sample with the one most highly correlated with it, following which 1 and 2 are averaged and paired with the sample most highly correlated with the averaged value, etc. The end result is a printed dendrogram.

c. Influence of Environmental Variables on Individual Species and Total Population

1. Total Population

In an attempt to assess the limiting gross resources these were plotted graphically against the total populations and total biomass for each core.

ii. Individual Species

Both descriptive and statistical analyses were used. A descriptive method, ecological valence, was used to assess the preference of individual species for levels of basic resources and pH. Only widely distributed species were chosen to eliminate effect of the vegetation. Moisture (%), organic matter (% by vol.), pore space (% by vol.), and pH were used. By comparing the range of these variables across all habitats, a series of ranges over which that variable was considered to be low, medium or high was arrived at. For moisture low was 10-20%, medium was 21-30%, and high was 37-40%. For organic matter low was 3-7%, medium was 10-16%, and high was 17-23%. For pore space low was 20-30%, medium was 32-39%, and high was 47-51%. For pH low was 3.2-3.8, medium was 4.4-4.9, and high was 5.4-5.9.

For the statistical analysis, product-moment correlation analyses (program BMD02D) was used. These were done using the McGill University IBM 360-75 and the University of Chicago IBM-360. In the final version, using cores as the unit, 43 X or environmental variables were correlated with the 90 species (Y variables) used in the factor analysis. These X variables represented all the environmental variables which could be readily measured. Several different measures were sometimes used for the same basic resource where its most operative measure was not known.

X Variables Used:

1. Expressions of Water Relations:

- a. Volume of water in sample
- b. Average % water in sample
- c. Volume of water/Volume of pore space (used as an estimator of relative humidity)
- d. Phase of sere (dry, moist, or wet-used as an estimator of the water table as reflected by the macrovegetation)
- e. Cumulative rainfall over month previous to sampling (to test effect on species with short life cycle)
- f. Cumulative rainfall over two month period previous to sampling (to test effect on species with longer life cycles)
- g. Density of forest canopy (open or closed) (effects amount of precipitation reaching the ground surface evaporation, soil temperature, etc.)

2. Expressions of Quantity of Nutrients:

- a. Weight of organic matter (derived by weighing sample before and after incineration at 500°C)
- b. Depth of L, F, and H layers (measured in mm.); also, total depth of organic matter
- c. The soil pH (an indirect measure of nutrients)
- d. The edaphic sere (sand, loam, or clay); also an indirect indicator

- e. The type of humus formation (mor, moder, or mull),
also an indirect indicator*

3. Expressions of Quantity of Mineral Matter:

- a. Depth of A + B layers (mineral strata) in cores

4. Expressions of Dwelling Space for Soil Animals:

- a. Pore space in c.c.'s - total pore space in core
- b. Water + Pore space - total volume occupied by water and soil pores; since this is a stable value, whereas pore space is inversely related to soil water, it was used to see if it was the more reliable measure.

5. Day/Degrees:

This measure was calculated by adding the average daily temperatures of all days in one season in which the temperature was above freezing. Average daily air temperature was used, since by using data collected by Roland Leger, it was found that plotting air temperature against soil temperature at different depths showed that soil temperature closely paralleled average daily temperatures except that fluctuations were less.

6. Expressions of Quantity and Quality of Ground Vegetation:

- a. Proportion of ground covered (coded in 6 states:
0 = 0%, 1 - 25%, 2 - 50%, 3 - 75%, and 4 - 100%)
- b. Presence of ferns (coded in two states: 0 = absent
and 1 - present)

*c, d, and e are closely intercorrelated

- d. Coverage of second story ground vegetation (as in a)
- e. Coverage with false lily-of-the-valley (coded as in a).

7. Expressions of occurrence and dominance of macrovegetation (coded as follows: 0 = absent, 2 - equal dominance with another species in a forest association, 4 = dominant (pure stand):

- a. occurrence of beech
- b. Occurrence of hemlock
- c. Occurrence of red maple
- d. Occurrence of grey birch
- e. Occurrence of white ash
- f. Occurrence of trembling aspen
- g. Occurrence of large-toothed aspen

8. Expressions of composition of leaf litter (proportion out of 100):

- a. Quantity of beech litter
- b. Quantity of hemlock litter
- c. Quantity of red maple litter
- d. Quantity of red oak litter
- e. Quantity of sugar maple litter
- f. Quantity of grey birch litter
- g. Quantity of white ash litter
- h. Quantity of trembling aspen litter
- i. Quantity of large-toothed aspen litter

RESULTS

1. General Description of Fauna

a. Number of Species

In total 37,194 oribatids, belonging to 154 species, were identified. Numbers of individuals per species ranged from 7,808 for Brachychthonius suecicus to a single representative for 17 species.

Of the 154 species, 66 could not be given a specific name. Most of these 66 species are new, two them belonging to new genera in the families Hermannellidae and Polypterozetidae. However for a few of these existing descriptions of species in their respective genera are not adequate for reliable determination.

b. Annotated Species List (Appendix A)

Higher taxonomic groupings follow those of Balogh (1972). Genera and species are usually arranged alphabetically. Presumably new species which are near to known species are so designated. Usually only the commonest synonym is listed. Size measurements (for adults only) include length, width, and biomass in micrograms, after the formulae of Lebrun (1971) for slide material, with the number of individuals measured in parentheses.

Sites at which the species were found have been listed in descending order of their populations at the respective sites. Geographical distributions have been given usually only by continent since most species distributions are insufficiently known. Soil horizons given are fairly general since the 2 cm. deep sample divisions often included more than one stratum.

References are not exhaustive, including only those that were used in the appropriate identification, which include the particular and/or related species.

2. Total Populations of Sites

a. General

The total populations in each habitat at each sampling were equated with population/metre² to make them comparable with the figures of other workers (see Table 1). The highest population, calculated on the basis of pairs of 3.3 cm. diameter cores was the equivalent of 1,329,000/m², taken at site 5 (hemlock) on 6: XI: 1965. This figure is among the highest ever recorded for a forest soil.

The sites in the beech-hemlock catena contained higher populations than those in the sugar maple-basswood catena with all populations having the equivalent of over 100,000/m². The lowest populations were the samples taken at the two white ash sites, all of which ranged from 11,400 to 51,500/m².

b. Seasonal Changes in Total Populations

On the basis of the four series of samples examined, there appeared to be a general increase in population during the growing season followed by a decline during the winter months. This was true for combined populations collected at all sites on a given date but did not always hold good for individual sites based on lumped pairs of cores at each sampling occasion (see Fig. 7). Sample II (15: VI: 1965), sample IV (20: VIII: 1965), sample VI (6: XI: 1965), and sample VII (28: V: 1966) gave totals of 5,320, 8,458, 13,532 and

SAMPLE DATE SITE	II	IV	VI	VII
	15:VI:1965	20:VIII: 1965	6:XI:1965	28:V:1966
1. Grey-Birch-Red Maple	293,800	387,200	870,000	577,300
10. Grey Birch-Red Maple	254,300	280,100	1,180,000	479,400
7. Beech-Red Maple	573,300	1,183,000	1,084,000	725,100
9. Beech-Red Maple	138,000	478,200	508,600	426,100
2. Beech	358,000	575,000	865,400	861,400
4. Beech	331,000	346,000	655,800	395,200
5. Hemlock	521,200	736,000	1,329,000	1,025,000
6. Hemlock	396,300	398,600	492,000	1,008,000
8. Large-toothed Aspen	45,250	124,300	292,700	88,780
11. Trembling Aspen	92,210	277,200	341,400	218,200
3. White Ash	18,900	51,550	34,360	22,910
12. White Ash	11,460	29,210	37,230	20,620

TABLE 1: Calculated Populations /m²

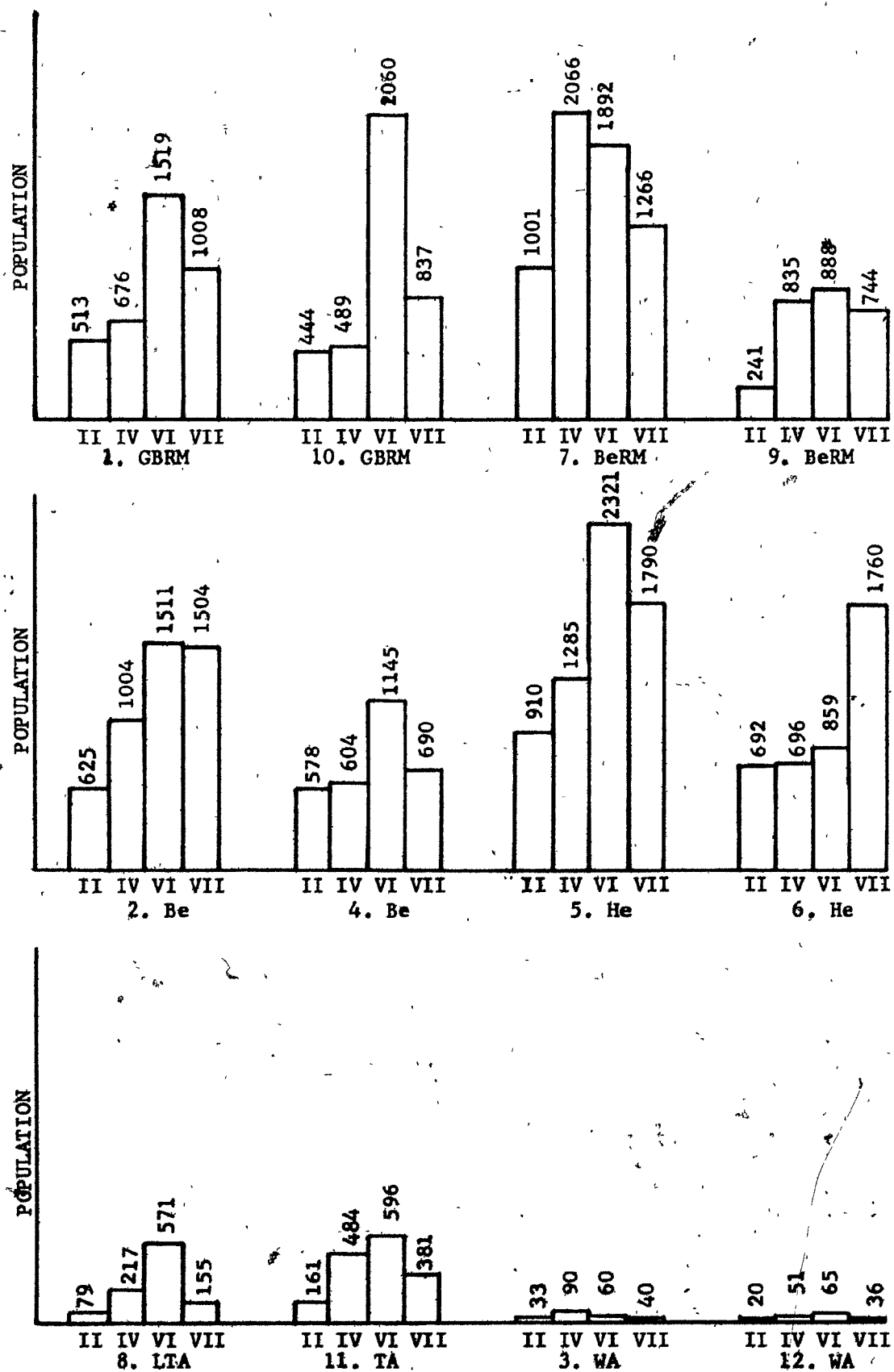


Fig. 7: Oribatid Populations in Paired Cores Collected Seasonally

9,874 individuals respectively. Though 9 out of 12 sites showed their maxima in the November sample, 2 showed an August maximum and one showed a spring maximum.

A Chi-square test on the difference of total populations between members of each pair of cores showed 32 of the 48 pairs to differ at the 5% level and 27 of these to differ at the 1% level (see Table 2). Two of the four pairs taken from hemlock litter (sites 5 and 6) and three of the four pairs from white ash litter (sites 3 and 12) were not significantly different while all pairs in the two beech-red maple sites were significantly different. Hence the seasonal trends illustrated in Fig. 7 must be regarded as indications but are not statistically significant. An examination of all the monthly samples taken would probably have given a clearer picture.

3. Species Distribution

a. Tolerance of Species

As has been observed by other workers, some species are eurytopic, others are more stenotopic, and a few, so-called indicator species, appear to be limited to a very specific habitat. When the species are grouped according to the number of sites in which they occur, as in Figs. 8a and 8b, they appear to group into three general categories: a fairly small number of eurytopic species present in 8 to 12 of the sites, a larger number of species of intermediate tolerance present in 3 to 7 of the sites, and a still larger group of stenotopic species present at only one or two sites often as only a single individual.

SAMPLE CORE SITE	II		IV		VI		VII	
	a	b	a	b	a	b	a	b
1. Grey Birch-Red Maple	** 430	** 83	360	316	** 702	** 817	** 334	** 674
10. Grey Birch-Red Maple	235	209	213	276	** 1157	** 903	** 537	** 300
7. Beech-Red Maple	** 572	** 429	** 912	** 1154	** 1162	** 730	* 674	* 592
9. Beech-Red Maple	** 50	** 191	** 300	** 525	** 494	** 394	** 482	** 262
2. Beech	331	294	** 433	** 531	** 578	** 933	* 800	* 704
4. Beech	* 315	* 263	** 370	** 234	** 665	** 480	370	320
5. Hemlock	454	456	660	625	** 1053	** 1268	* 941	* 849
6. Hemlock	332	360	358	338	** 315	** 544	** 935	** 825
8. Large-toothed Aspen	** 58	** 21	** 133	** 84	** 441	** 70	86	69
11. Trembling Aspen	** 64	** 97	** 196	** 288	** 247	** 349	209	172
3. White Ash	20	13	59	31	28	32	20	20
12. White Ash	12	8	31	20	24	41	22	14

* Significant difference between pairs using chi-square at 5% level

** Significant difference between pairs using chi-square at 1% level

TABLE 2: Total Populations in Individual Cores

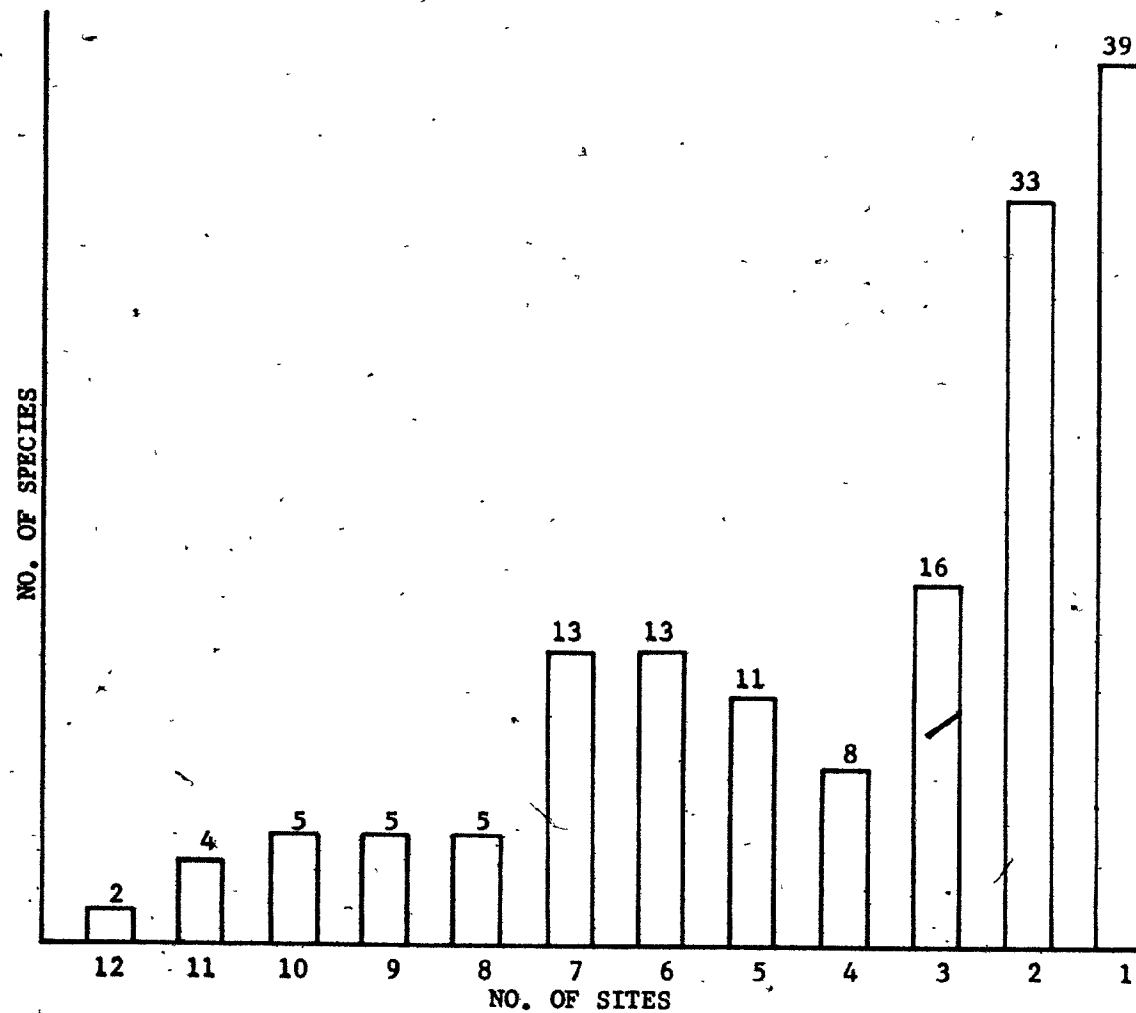


Fig. 8a: Distribution of Species Across Sites, Including "Accidental" Occurrences

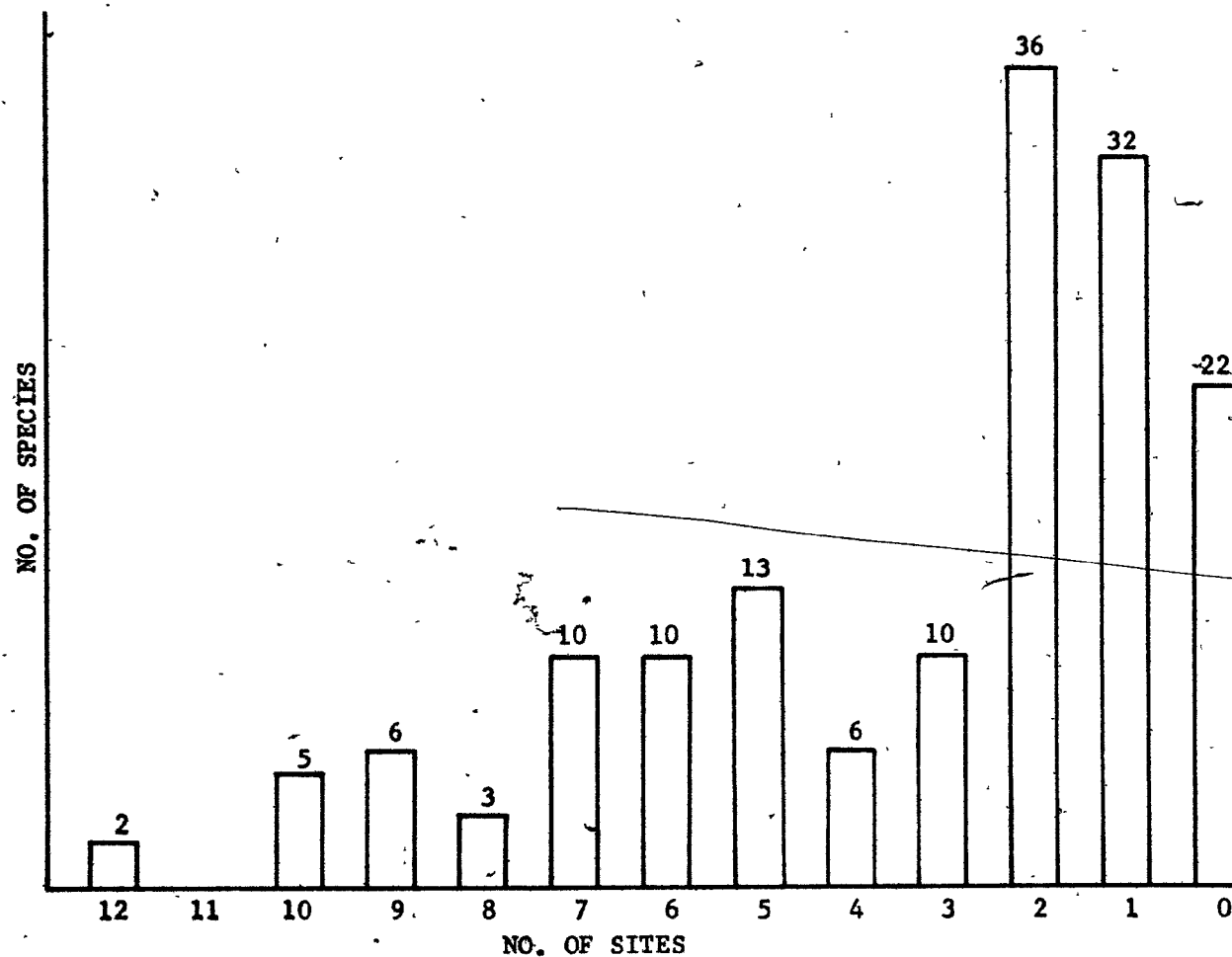


Fig. 8b: Distribution of Species Across Sites, Excluding "Accidental" Occurrences

In Fig. 8a species were included which were present as only a single individual in one of the eight cores, whereas in Fig. 8b these were omitted with a separate category designated 0 added for those rare species present as a single individual at a single site. Nevertheless, the groupings were similar. Including rare species, the eurytopic: intermediate: stenotopic ratio was 21:61:72. Excluding and aggregating rare species, the ratio was 16:49:90.

b. Species Diversity of Sites

The number of species occurring at particular sites varied widely as shown in Fig. 9a with the sites in the beech-hemlock catena, without exception, showing greater species diversity than the sites in the sugar maple-basswood catena. The greatest number of species (74) occurred at site 10 (grey birch-red maple) while the smallest number occurred at site 12 (white ash). The total numbers of individuals collected in the lumped 8 cores for each site, when ranked in descending order, showed a close correspondence with the ranking by species diversity, as shown in Fig. 9b. Sites with high diversity also had high populations.

4. Comparison of Sites

a. Sørensen's Quotient of Similarity

Results from using Sørensen's Q/S on a) all species, b) only those species each accounting for 1% or more of the population of a site, and c) only the dominant species or those accounting for 2% or more of the population, are represented in Figs. 10, 11, and 12 respectively.

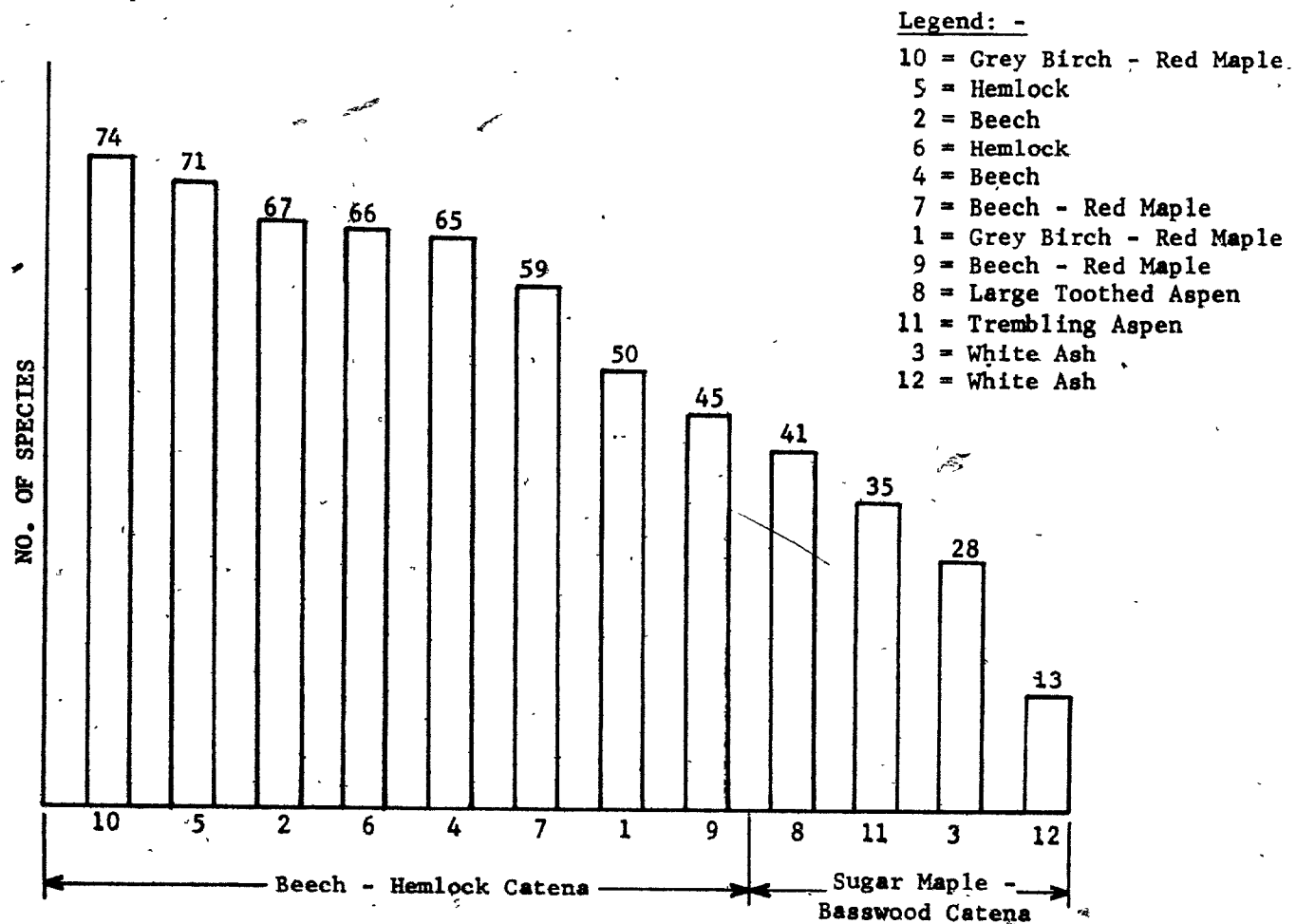


Fig. 9a: Sites Ranked According to Number of Species

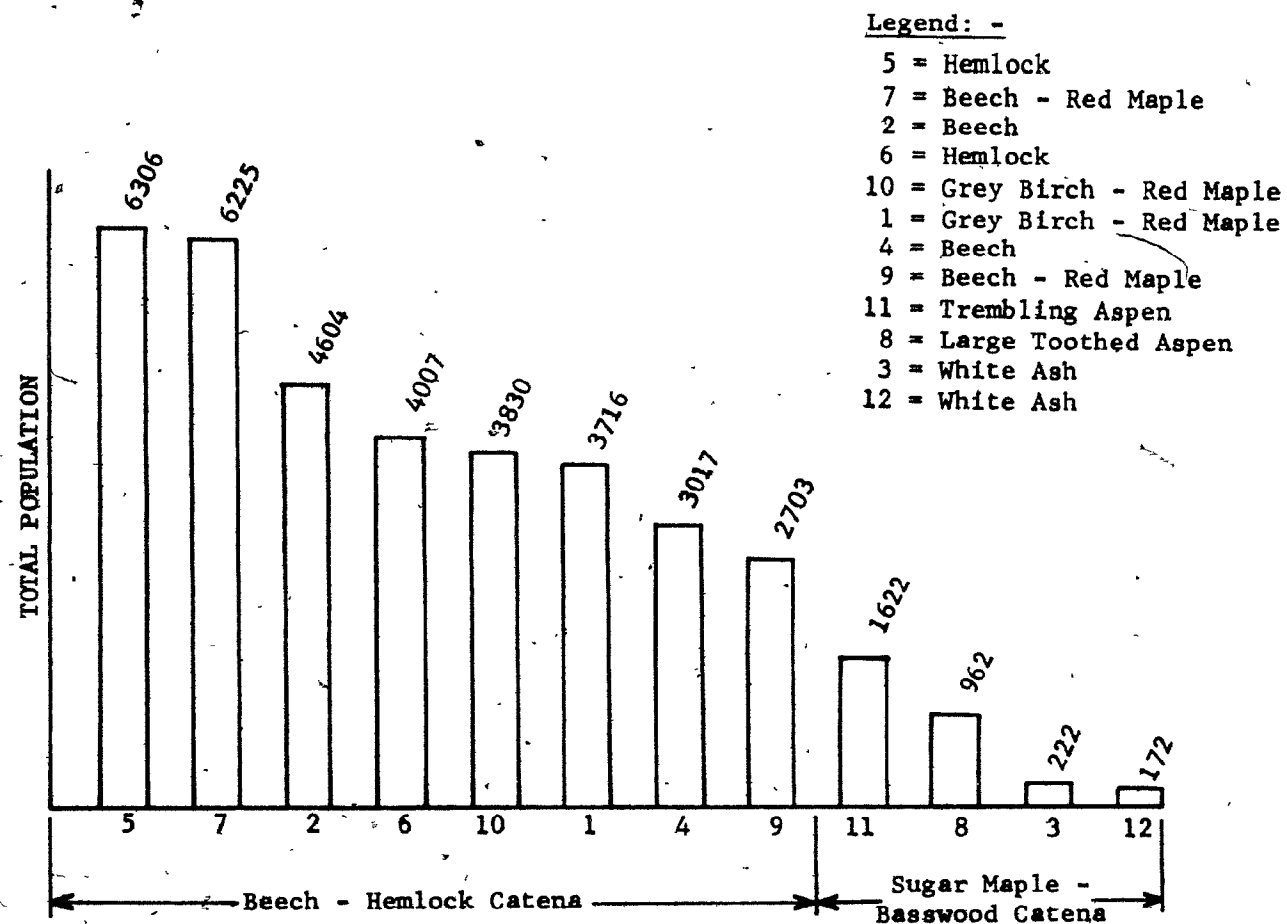


Fig. 9b: Sides Ranked According to Population of Combined 8 Cores

The respective trellis diagrams indicate greater differentiation between sites when the total number of species was used. In addition, lower levels of similarity between sites were revealed. When only the species composing 1% or more of the population were used, greater polarization of the two catenas occurred. This was even more pronounced when only the dominant species were used.

The total species diagram (Fig. 10) clearly shows the two beech (2 and 4), the two hemlock (5 and 6), and the two white ash (3 and 12) sites being more similar to each other than to any other sites. The two grey birch-red maple sites (1 and 10) were not particularly close. Neither were the two beech-red maple sites (7 and 9). However sites 7 and 10, which showed red maple in their stand composition, were most closely related to each other. The remaining two aspen sites were not closely related. Neither site 8 (large-toothed aspen) nor site 11 (trembling aspen) were closely related to any other sites.

The trellis diagram using species comprising more than 1% of the population (Fig. 11) showed poorer definition, e.g., site 5 (hemlock) paired with 6 (hemlock) but 6 paired with 4 (beech).

The diagram of species comprising more than 2% of the population, since it excluded the sparser species, expressed similarity between sites with differing macrovegetation. The sites in the dry phase of the beech-hemlock catena (1, 10, 7, 9, 2, and 4) form a more or less discrete block, the two hemlock sites pair (moist phase of the catena), and the white ash sites (moist phase of sugar maple-basswood

	1	10	7	9	2	4	5	6	8	11	3	12
1		50	50	48	46	49	48	43	37	42	31	22
10	50		72	50	67	65	57	59	50	36	32	16
7	50	72		52	67	71	69	64	48	38	35	19
9	48	50	52		46	51	45	43	51	44	41	24
2	46	67	67	46		71	62	66	46	35	29	18
4	49	65	71	51	71		66	61	53	42	35	18
5	48	57	69	45	62	66		73	45	30	31	14
6	43	59	64	43	66	61	73		43	30	28	14
8	37	50	48	51	46	53	45	43		34	38	37
11	42	36	38	44	35	42	30	30	34		44	31
3	31	32	35	41	29	35	31	28	38	44		50
12	22	16	19	24	18	18	14	14	37	37	50	

Legend: -

- 1 = Grey Birch - Red Maple
- 10 = Grey Birch - Red Maple
- 7 = Beech - Red Maple
- 9 = Beech - Red Maple
- 2 = Beech
- 4 = Beech
- 5 = Hemlock
- 6 = Hemlock
- 8 = Large-Toothed Aspen
- 11 = Trembling Aspen
- 3 = White Ash
- 12 = White Ash

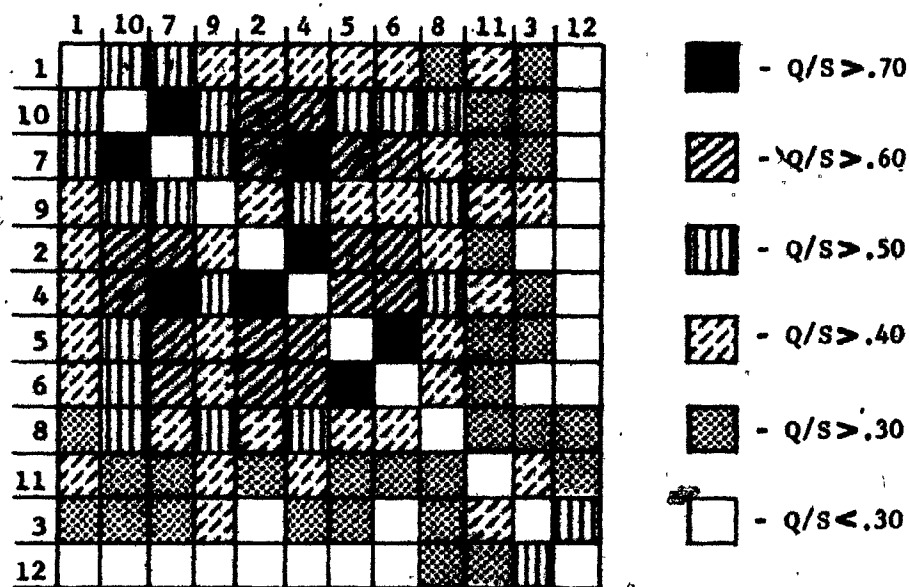


Fig. 10: Sørensen's Q/S using All Species

	1	10	7	9	2	4	5	6	8	11	3	12
1		.62	.70	.62	.44	.38	.24	.29	.34	.29	.15	.18
10	.62		.58	.53	.51	.55	.24	.38	.32	.28	.17	.13
7	.70	.58		.52	.50	.55	.38	.40	.40	.34	.21	.17
9	.62	.53	.52		.39	.44	.28	.37	.48	.38	.32	.23
2	.44	.51	.50	.39		.59	.40	.51	.41	.18	.19	.22
4	.38	.55	.55	.44	.59		.40	.59	.36	.26	.22	.19
5	.24	.24	.38	.28	.40	.40		.54	.31	.13	.20	.16
6	.29	.38	.40	.37	.51	.59	.54		.34	.15	.26	.18
8	.34	.32	.40	.48	.41	.36	.31	.34		.34	.35	.35
11	.29	.28	.34	.38	.18	.26	.13	.15	.34		.36	.36
3	.15	.17	.21	.32	.19	.22	.20	.26	.35	.36		.44
12	.18	.18	.17	.23	.22	.19	.16	.18	.55	.32	.44	

Legend: -

- 1 = Grey Birch - Red Maple
 10 = Grey Birch - Red Maple
 7 = Beech - Red Maple
 9 = Beech - Red Maple
 2 = Beech
 4 = Beech
 5 = Hemlock
 6 = Hemlock
 8 = Large-Toothed Aspen
 11 = Trembling Aspen
 3 = White Ash
 12 = White Ash

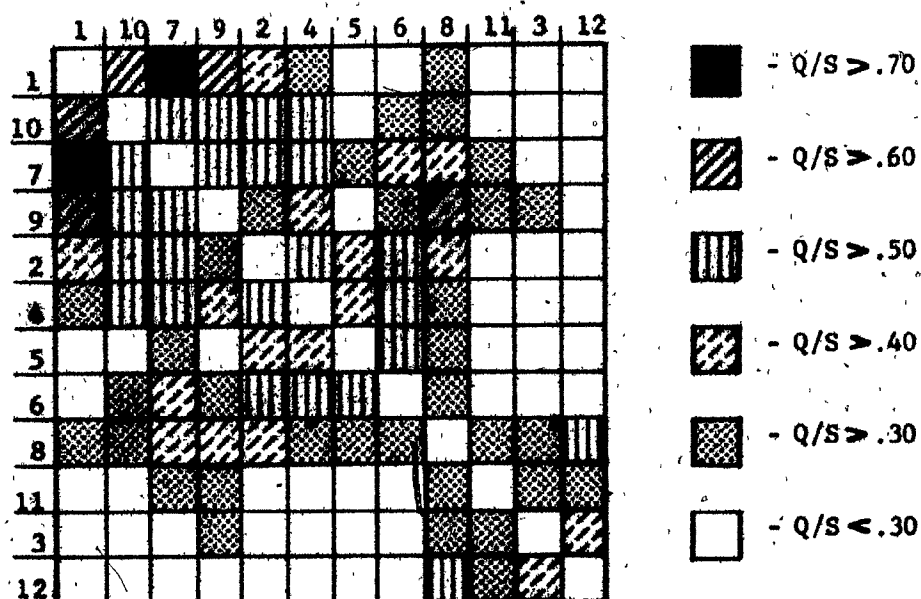
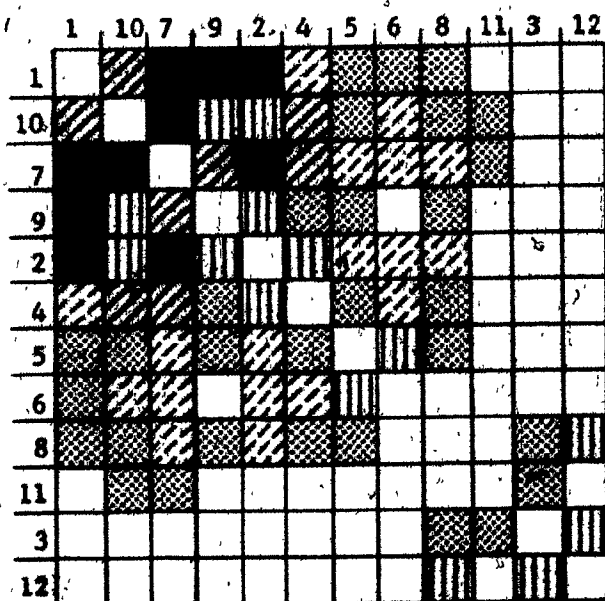


Fig. 11: Sørensen's Q/S using Species accounting for >1% of Total Population

	1	10	7	9	2	4	5	6	8	11	3	12
1		.67	.78	.78	.71	.45	.33	.35	.32	.21	.11	.11
10	.67		.78	.56	.59	.64	.33	.43	.32	.32	.11	.11
7	.78	.78		.67	.71	.64	.44	.43	.42	.32	.11	.21
9	.78	.56	.67		.59	.36	.33	.26	.32	.21	.11	.11
2	.71	.59	.71	.59		.57	.47	.45	.44	.11	.11	.22
4	.45	.64	.64	.36	.57		.36	.44	.35	.26	.09	.17
5	.33	.33	.44	.33	.47	.36		.52	.32	.21	.11	.21
6	.35	.43	.43	.26	.45	.44	.52		.25	.08	.08	.17
8	.32	.32	.42	.32	.44	.35	.32	.25		.10	.30	.50
11	.21	.32	.32	.21	.11	.26	.21	.08	.10		.30	.10
3	.11	.11	.11	.11	.11	.09	.11	.08	.30	.30		.50
12	.11	.11	.21	.11	.22	.17	.21	.17	.50	.10	.50	

Legend: -

- 1 = Grey Birch - Red Maple
- 10 = Grey Birch - Red Maple
- 7 = Beech - Red Maple
- 9 = Beech - Red Maple
- 2 = Beech
- 4 = Beech
- 5 = Hemlock
- 6 = Hemlock
- 8 = Large-Toothed Aspen
- 11 = Trembling Aspen
- 3 = White Ash
- 12 = White Ash



- - Q/S ≥ .70
- ▨ - Q/S ≥ .60
- ▤ - Q/S ≥ .50
- ▥ - Q/S ≥ .40
- ▧ - Q/S ≥ .30
- - Q/S < .30

Fig. 12: Sørensen's Q/S using Dominant Species
(≥ 2% of Population)

catena) pair (though 12 also pairs with the large-toothed aspen site).

b. Ordination of Sites

i. Factor Analysis by Principal Components

(a). Using Raw Data for 100 Variables (Species)

No discernable pattern was revealed indicating the necessity of transforming the data.

(b). Data Transformed to Percent of Total Number for
100 Variables

All variables (species) were transformed to the percentage of the total number of that species in that sample. Here the vari-max factor matrix was exactly the same as that from the raw data (see Appendix C). Ten factors were extracted. Each of these described all or part of the samples at one or more sites in the following order:

Factor 1: all of 5, parts of 7, 2, 6, 10, 4, and 8

Factor 2: parts of 8, 2, 1, 4, 11, 5, and 3

Factor 3: parts of 9, 11, and 1

Factor 4: all of 3, part of 12

Factor 5: parts of 9, 7, 1, and 4

Factor 6: parts of 6, 4, and 8

Factor 7: all of 10, part of 2

Factor 8: part of 12 and 8

Factor 9: part of 11

Factor 10: part of 1

A few factors describe largely the samples from one site or one pair of sites but the majority of them are conglomerations of samples

taken from several or many sites.

(c). $\text{LogN}(x+1)$ Transformation with 100 Variables

Results of this analysis were much more coherent. Ten factors were extracted (see Appendix D) accounting for 82% of the variance but factors 9 and 10 probably are not meaningful.

Factor 1: Site 1: loading of .76-.87 (except one)

Site 9: loading of .81-.85 (except one)

Site 10: loading of .44-.64 (except two)

Site 7: loading of .62-.76

Site 2: two samples with loadings above .50

This analysis shows the GBRM and BeRM sites to be similar, since they all come out on the same factor. Furthermore, sites 1 (GBRM) and 9 (BeRM) are more closely related to each other than to any other sites. Also sites 10 (GBRM) and 7 (BeRM) are most closely related to each other than to either 1 or 9.

Factor 2: Site 3: loading of .72-.84 (except one)

Site 12: loading of .53-.60 for three samples

Sites 3 (WA) and 12 (WA) are more similar to each other than to any other. Similarity of only three of the site 12 samples together with the fact that this site had the lowest populations suggest that the samples from this site were too small to adequately represent the faunal composition.

However, with the five factor extraction (see Appendix F) all samples from sites 3 and 12 (but one) had significant loadings on factor two.

Factor 3: Site 11: loading of .77-.90 (except one of .64).

This indicates that site 11 (TA) is unique among the sites chosen. The samples are closely related, so the sample size appears adequate.

Factor 4: Site 8: loading of .67-.81 (except two)

The large-toothed aspen site also was unique in relation to the other sites.

Factor 5: Site 6: loading of .80-.90

Site 5: loading of .61-.77

Site 4: loading of .50-.59 (for five samples)

Site 2: loading of .52 (on one sample)

Site 5 is most similar to site 6 but is clearly different since the loadings do not overlap. Site 4 (Be) is also similar but less closely so. As is site 2 (Be) to a lesser degree.

Factor 6: Site 5: loading of .37-.46

This factor expresses the unique character of site 5 (He). Since the loadings are at a lower level, the accuracy is lower, but in general this factor is defined by species which are in much higher numbers (see factor score matrix in Appendix E) in site 5 (He) than in 6 (He).

Factor 7: Site 12: loading of .50-.91

This site is unique. The large variability between samples may be because the samples were too small to adequately represent the fauna in this habitat.

Factor 8: Site 2: loading of .59-.68

Site 4: loading of .58-.68

These two sites were very similar, since the differential loadings are extremely close. The faunal composition is therefore virtually identical.

Factor 9: Probably not accurate. It appears to be largely "noise".

Factor 10: as in factor 9.

When 9 factors were extracted, i.e., the information was condensed on 9 factors instead of 10, there was no essential change. However loadings were slightly higher but there was a small amount of clarification lost, i.e., the total variance accounted for was slightly lower and therefore communalities were slightly lower.

(d). $\text{LogN}(x+1)$ Transformation with 72 variables

The variables with smaller numbers were eliminated since the sampling program may not have adequately represented the distribution of these species. Ten factors accounted for 84.068% of the variance (see Appendix G) compared to 82.272% with 100 variables, i.e., clarification was improved by less than 2%. However, there was poorer separation of sites, so that too great a loss of information had occurred.

(e). $\text{LogN}(x+1)$ Transformation with 90 Variables

Ten of the sparser species were deleted from the 100 variable analysis. Also, in 4 cases a simple which had a low information content (communality of .64 or less) was lumped with its pair (see varimax factor matrix in Appendix H):

1) GBRM2B with a communality of .62 was lumped with 1GBRM2A (communality .82) resulting in one sample with .87 (using 90 variables) i.e., situation improved.

2) 9BeRM2A (communality .64) was lumped with its pair 9BeRM2B (communality .87) resulting in communality of .88, also improving the situation.

3) 3W.Ash2A (communality .61) was lumped with its pair 3W.Ash2B (communality .59) giving a communality of only .56, i.e., slightly worsening the situation.

4) 3W.Ash7B (communality .64) was lumped with its pair 3W.Ash7A (communality .87) resulting in communality of only .59, i.e., considerably worsening the situation.

The poor results of lumping low information samples in the aspen and white ash sites argues against the generally poorer loading for these sites being due to inadequate sampling of the fauna due to too small a sample size.

Factor 1: Site 6: loading of .78-.90

Site 5: loading of .54-.65

Site 4: loading of above .50 in 2 samples

This factor (equivalent to F.#5 in 100 variable analysis) shows better separation expressing more disparity between sites 5 and 6, and also more clearly differentiates 5 and 6 from 4 and 2. Sites 5 and 6 are more similar to each other than to any other site but since their loadings do not overlap they represent different habitats.

Factor 2: Site 3: loading of .64-.86

Site 12: loading of .50-.68 (on 4 samples)

Compared to factor 2 in the 100 variable analysis site 12 is more similar to site 3 (4 instead of 3 samples similar).

Factor 3: Site 1: loadings of .77-.89

Site 9: loadings of .77-.86

Site 10: loadings of .51-.65 (except 2)

Site 7: loadings of .64-.79

Site 2: 2 samples above .50

This again showed (as did factor 1 in the 100 variable analysis) site 1 (GBRM) and site 9 (BeRM) are very closely related and sites 10 (GBRM) and 7 (BeRM) are not very closely related. There is also a general increase in the loadings.

Factor 4: Site 11: loadings of .68-.89

This is very similar to factor 3 in the 100 variable analysis, showing site 11 (trembling aspen) to be dissimilar to any other site.

Factor 5: Site 8: loadings of .68-.82 (except 2)

This is the same as factor 4 in the 100 variable analysis, indicating that the large-toothed aspen site is unique. (One of the aberrant samples (6A) was unique, since it contained a root with a local accumulation of decaying organic matter, thus resulting in a different fauna to the other samples.)

Factor 6: Site 12: loading of .81-.93 (4 samples)

loading of .48-.68 (4 samples)

Site 8: loading of .50 (1 sample)

This is the same as factor 7 in the 100 variable analysis. The second set of 4 samples was more similar to the samples from site 3 than to the other samples from site 12. In the 100 variable analysis the spread between these two groups of samples was slightly less.

Factor 7: Site 2: Loadings of .62-.71

Site 4: loadings of .59-.70

This is the same as factor 8 in the 100 variable analysis. The loadings are slightly higher. Both show the two beech sites to be extremely similar. They can be considered the same habitat.

Factor 8: Site 5: loadings of .53-.62

This is similar to factor 6 in the 100 variable analysis, but the loadings are higher. This describes unique characteristics of this hemlock site.

Factor 9: Site 10: loadings of .45-.67

This is similar to factor 9 in the 100 variable analysis, but the loadings are higher and the variance contained in this factor is higher (3.837 cf. 2.828). This factor described unique characteristics of this site (GBRM) compared to the characters in common with sites 1, 7, and 9.

Factor 10: Site 9: loadings of .21-.34

This is similar to factor 10 in the 100 variable analysis except that the loadings are lower and the variance contained in this factor is only 1.779 cf. 2.475. It is therefore probably not meaningful.

In summary, it appears from the foregoing analyses, that the two beech sites are virtually identical; the hemlock sites are more similar to each other than to any other sites; all the beech-red maple and grey birch-red maple sites are similar with one BeRM (9) and one GBRM (1) being the most closely related, while the other two are not very similar, particularly site 10 (GBRM) which has about as much uniqueness as it has similarity; the two white ash sites are similar; the trembling aspen site is unique; and the large-toothed aspen site is unique.

ii. Cluster Analysis

The cluster analysis has the advantage of a graphical representation of similarity between samples, but has no causal implication; whereas the factors or principal components of a principal components analysis have the implication that each factor has an underlying cause.

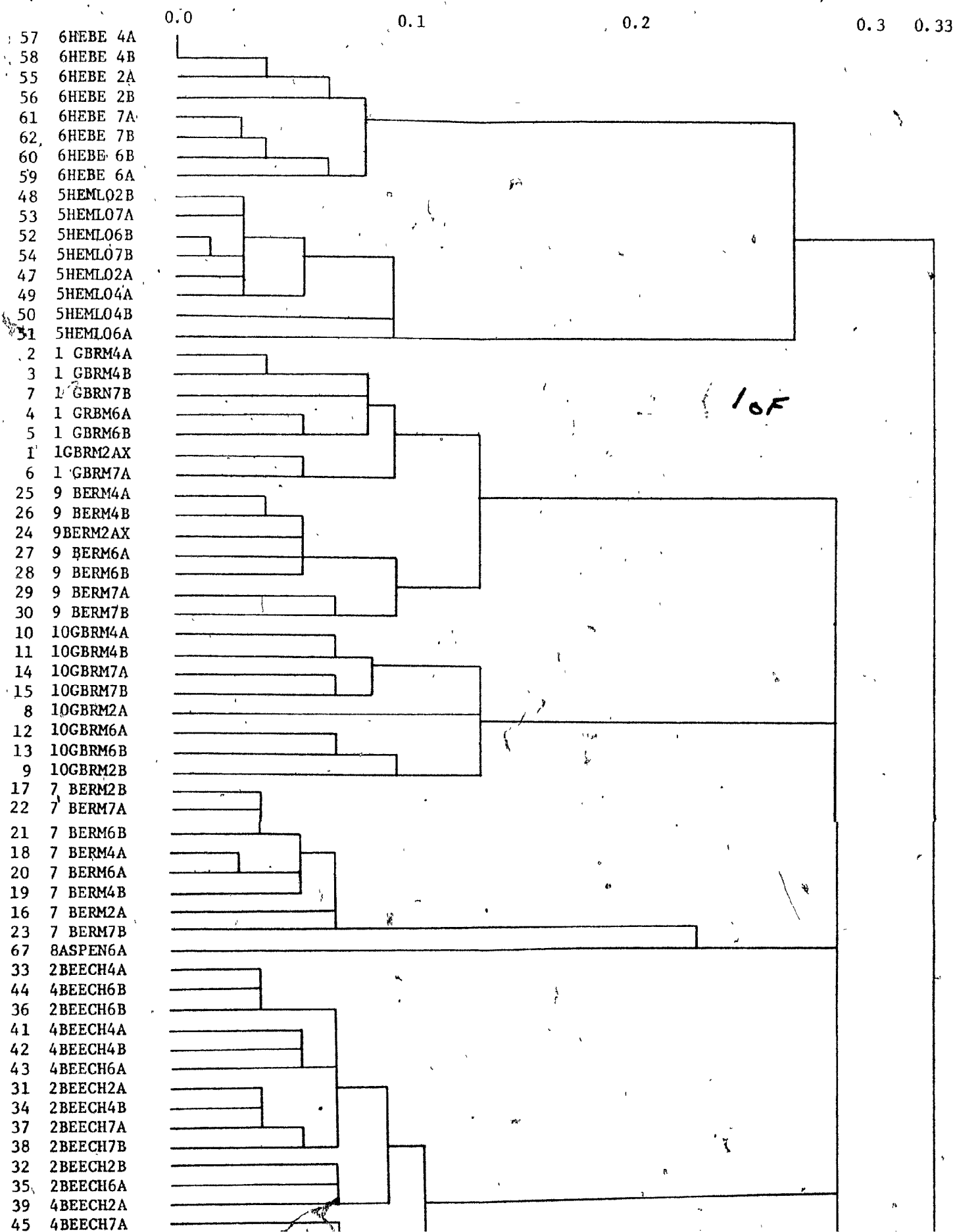
The cluster analyses were computed, using a distance function, from principal components analysis: one in which 9 factors were extracted and another in which 8 factors were extracted. The dendrograms are illustrated in figures 13 & 14. The clustering was very similar, however 9 factors gave slightly better discrimination, probably because they contained nearly 2% more information. Clustering tended to occur at lower levels (indicating greater similarity).

The main difference was that in the 8 factor extraction site 6 (HeBe) clustered with sites 2 and 4 (Be) rather than with site 5 (He), thus disagreeing with the previous principal components analyses.

Figure 13: Cluster Diagram based on Q-mode Principal
Components Analysis with 9 Factor Extraction

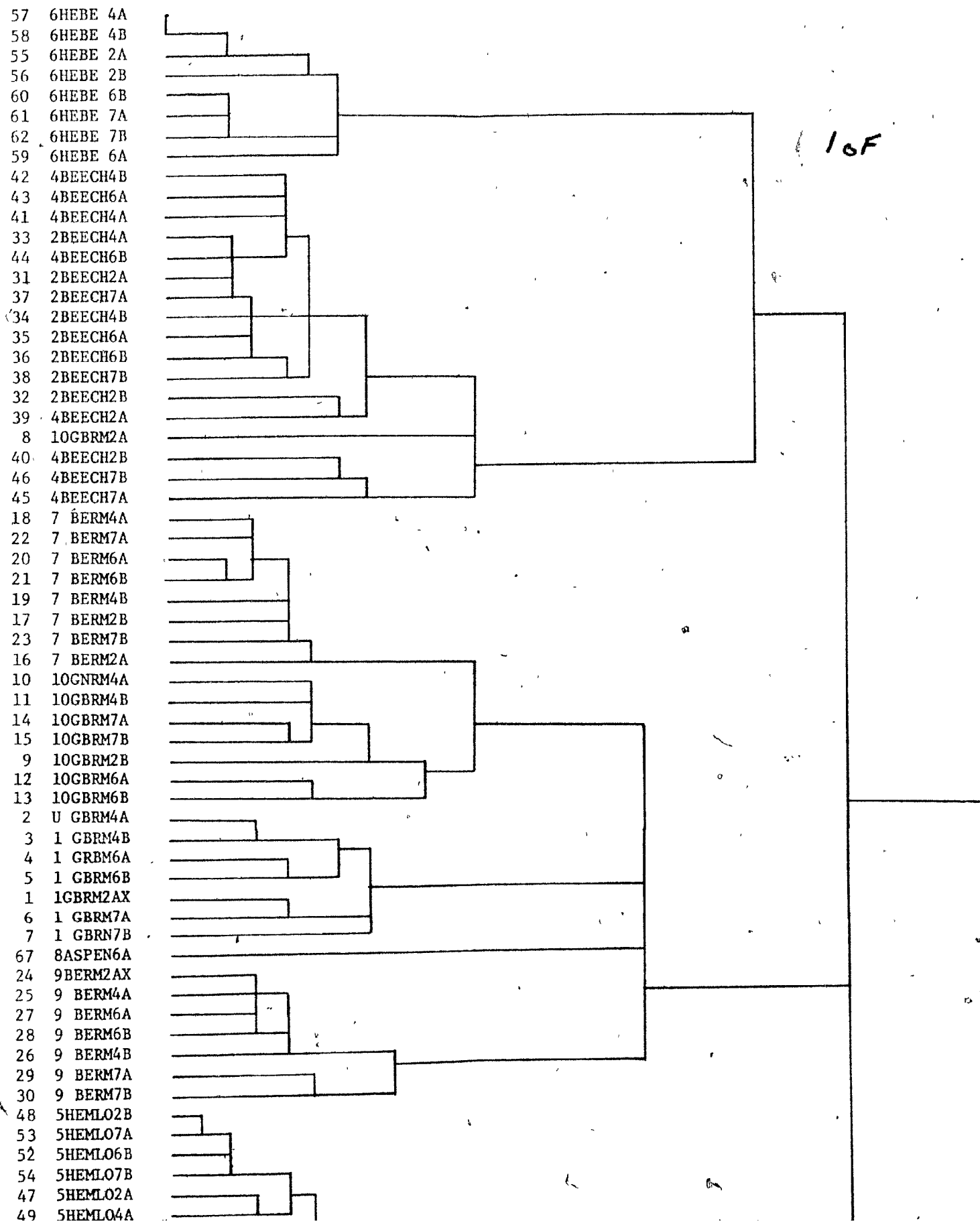
Figure 14: Cluster Diagram based on Q-mode Principal
Components Analysis with 8 Factor Extraction

VALUE OF COEFFICIENT



VALUE OF COEFFICIENT

0.0 0.1 0.2 0.3 0.35



(a). Comparison of 9 Factor and 8 Factor Cluster
Analysis

The two hemlock sites (5 and 6) were shown in the 9 factor cluster analysis to cluster at a fairly high level showing a not very high similarity but that they were closer together than to any other site; but the small amount of information lost in the 8 factor cluster analysis was enough to separate them.

The grey birch-red maple and beech-red maple sites clustered as a discrete group at a moderate level of similarity in the 8 factor, but grouped with the two beech sites and the large-toothed aspen site (8) in the 9 factor cluster analysis at a lower level of similarity.

The two beech sites clustered at low levels, indicating high degrees of similarity in both programs.

The large-toothed aspen (8) grouped with the sites in the beech-hemlock catena (though at quite a low level) rather than the sites in the sugar maple-basswood catena, as also found in previous results.

The trembling aspen site (11) was unique in both programs, not showing similarity to any other site.

For the white ash sites both programs showed only four of the eight samples from site 12 clustering with site 3 at a moderate level of similarity. The other four samples were unique in the 9 factor program but similar at a very low level in the 8 factor program.

Essentially the cluster analyses showed a graphical representation of the relationships found in the principal components analysis.

c. Influence of Biotic and Abiotic Environmental or X Variables

i. Introduction

Environmental variables were considered in relation to total numbers, total biomass, and individual species; first graphically and then statistically.

ii. Descriptive

(a). Presumed Pathways of Some Major Environmental Variables

Some of the presumed pathways by which the major environmental variables are interrelated, and by which they influence the presence of species of soil fauna and their populations, are illustrated in Fig. 15. Only the main interrelationships are indicated.

(b). Total Numbers and Biomass Compared to Basic Resources

The gross total volumes of soil water (designated W), organic matter (designated OM), mineral soil (designated MS) and pore space (designated PS) were compared with total populations and total biomass for each core in Fig. 16.

The fact that only pairs of samples were taken and at different seasons of the year has made it difficult to draw more than very general conclusions. In the first instance, of a pair of samples one might be from a more (or less) favourable microhabitat in which the basic resources were overridden by another variable. In the second instance, seasonal trends may also override general influences.

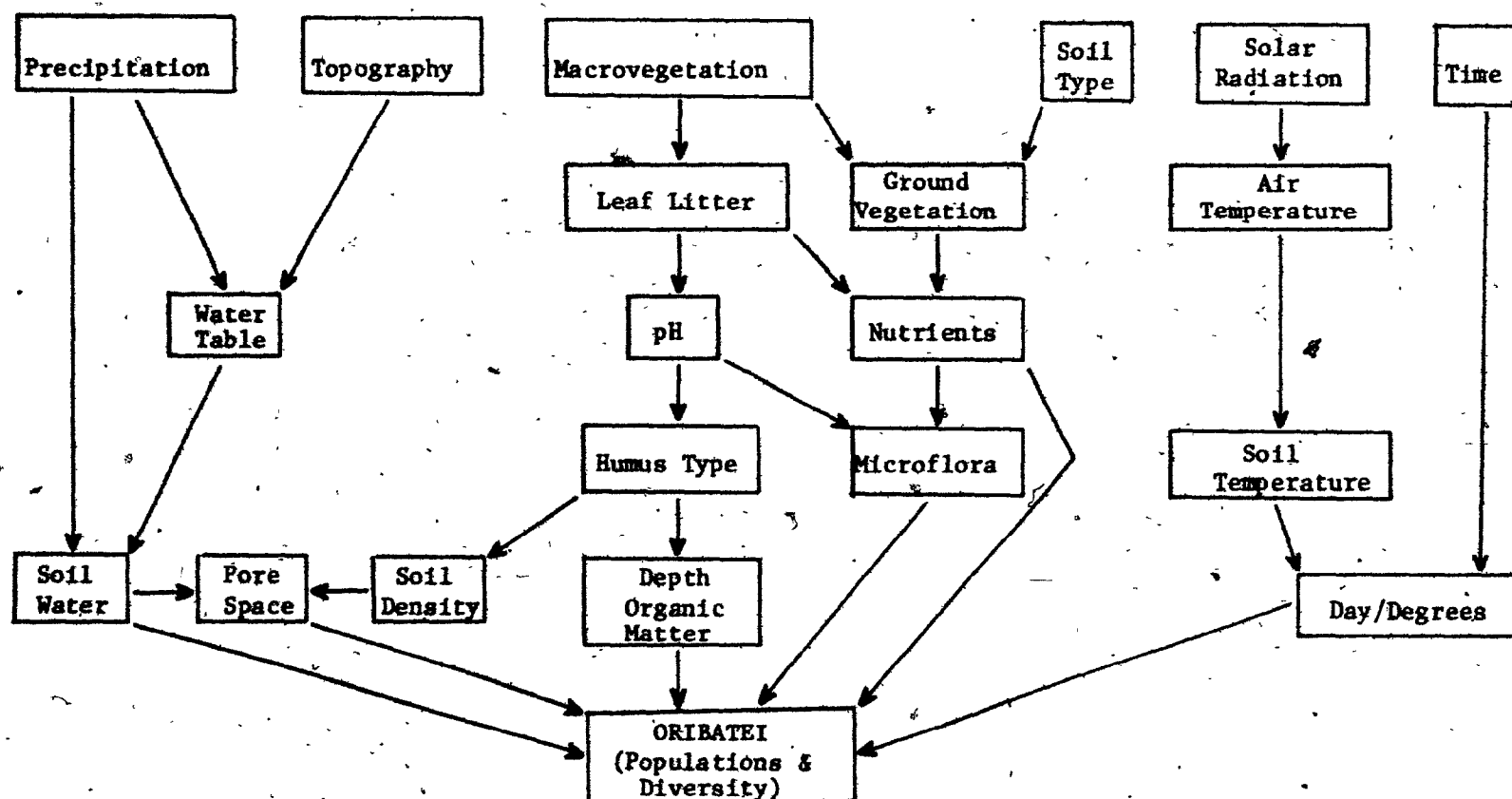


Fig. 15: Presumed Influence of Some Environmental Variables on Oribatei.

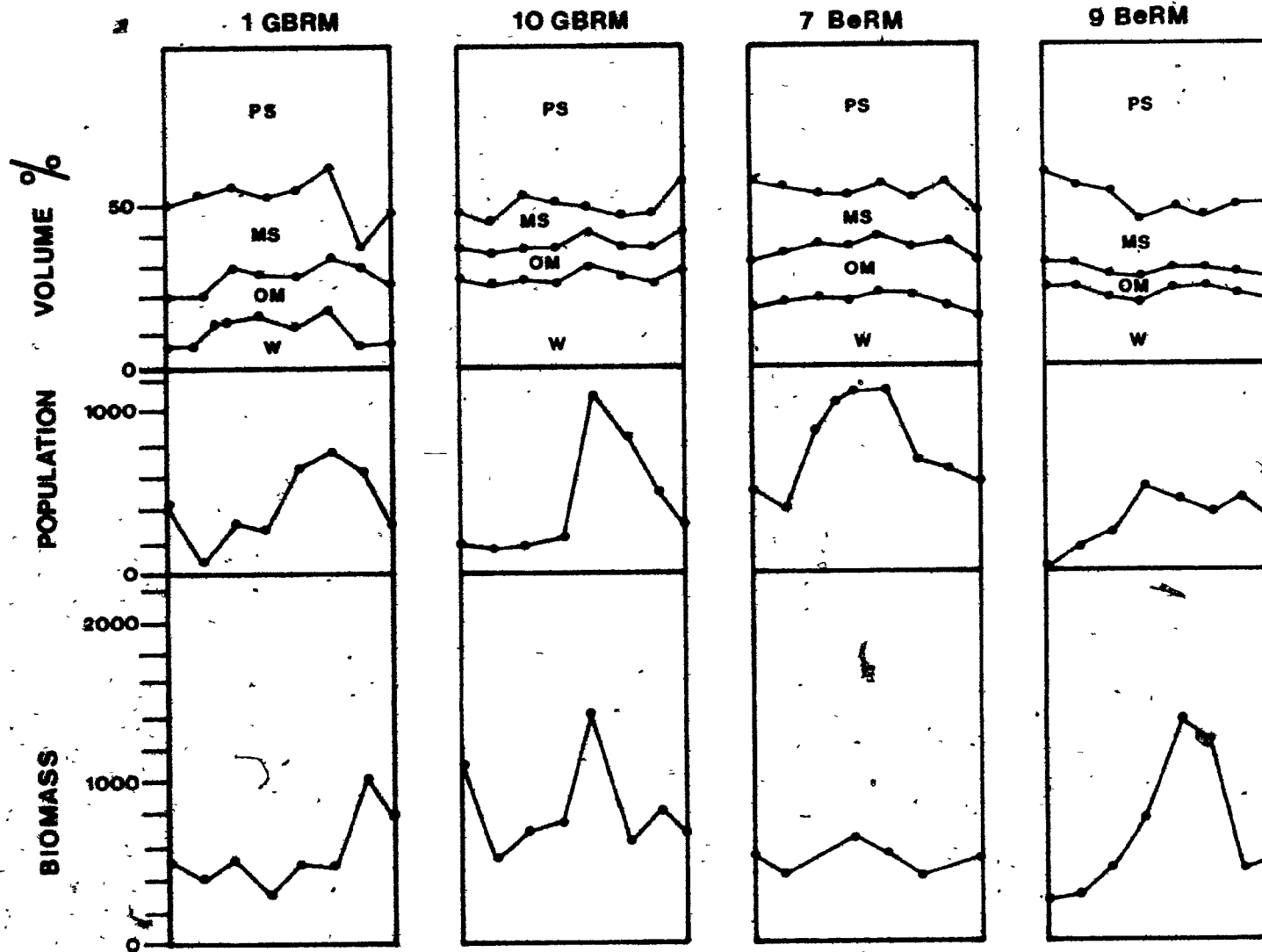


FIG. 16

VOLUMES OF RESOURCES
(cont.)

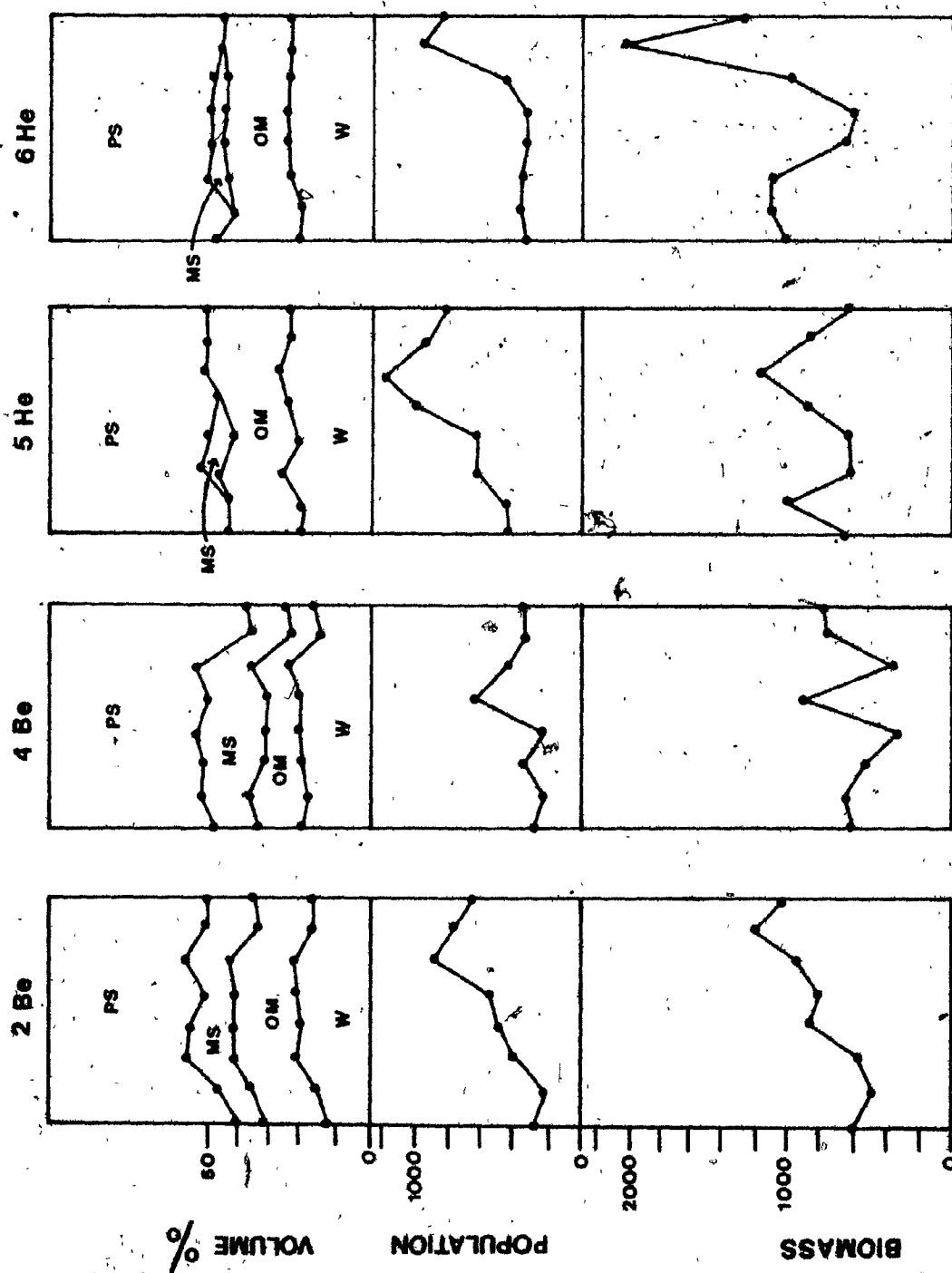


FIG. 16
VOLUMES OF RESOURCES
(cont.)

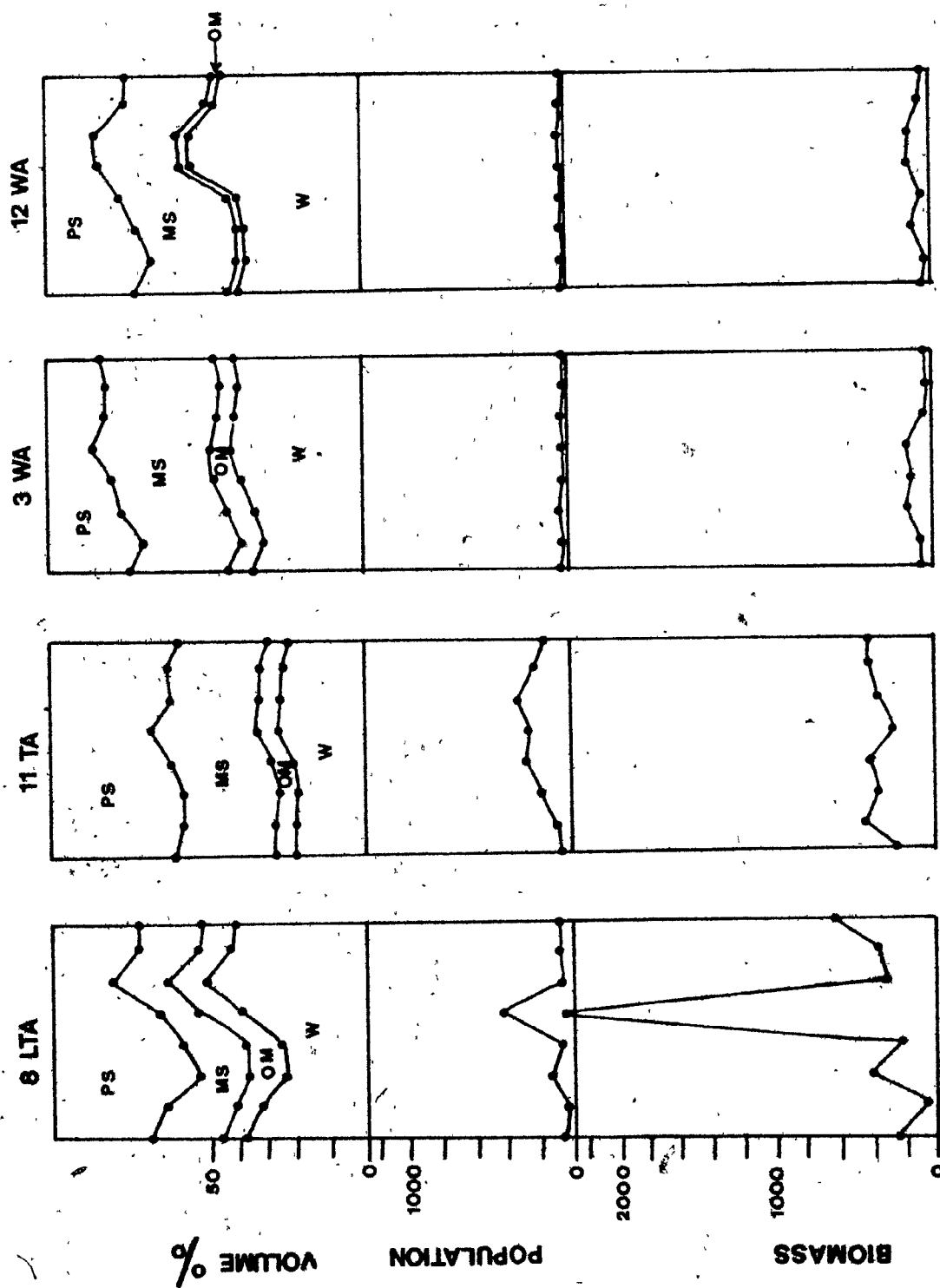


FIG. 16 VOLUMES OF RESOURCES

However, in general the highest populations and biomass occurred where there was a combination of less than 30% soil water, high pore space and high organic matter. Conversely, the lowest populations and the lowest biomass occurred where water was above 30%, pore space was low, and organic matter was low.

Water does not appear to be limiting by its deficiency within the range of moisture regimes in the sites sampled. Even site 1, which was the driest site selected, showed no clear sign of deficiency.

Pore space appears to be the most critical resource, the sites with higher populations having a pore space of approximately 50%. This is suggested by the diagram for site 9 which maintained a relatively high population and biomass on a high pore space and relatively low volume of organic matter (less than 10%). On the other hand, average populations and biomass were much lower on a greater volume of organic matter but much lower pore space. This is also illustrated in site 3 compared to site 11. Both have similar quantities of organic matter but site 3 has a lower pore space with noticeably lower populations and biomass. The sites with the lowest pore space (sites 3 and 12) also have the lowest populations and biomass.

High populations concurrent with high biomass tended to occur where the organic matter was highest (in conjunction with pore space of about 50%), e.g., sites 5 and 6.

From these diagrams it appears that pore space is the most critical resource. High organic matter produces the highest populations and biomass. Soil water does not appear to be critical

in deficiency but the diagrams for sites 3 and 12 suggest that in excess it may have a negative impact, probably by reducing pore space.

(c). Ecological Valence of Individual Species

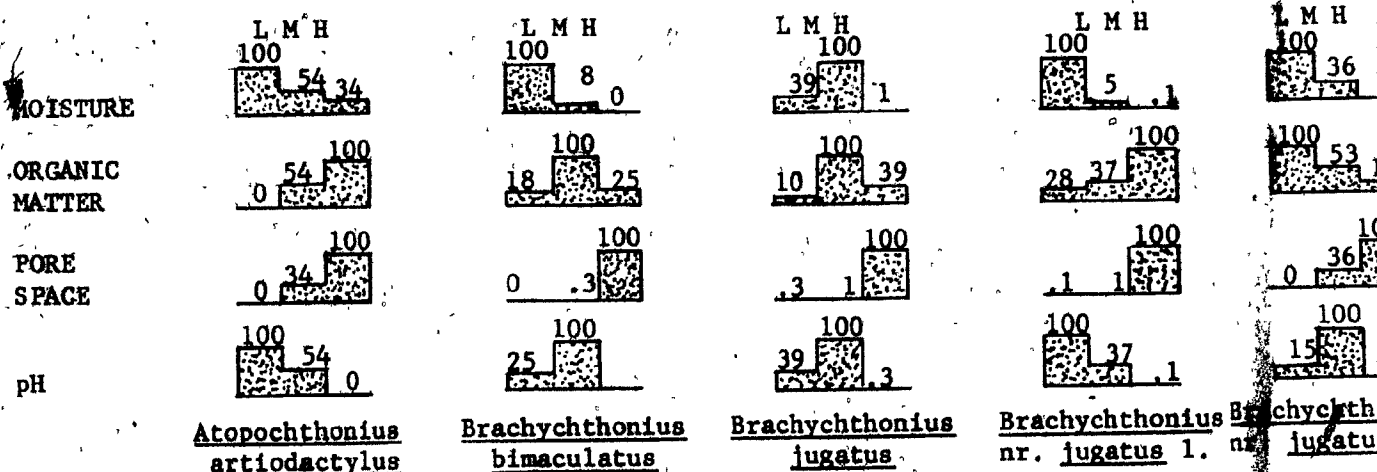
The ecological valence, i.e., the extent to which an environmental component can vary within the tolerance zone of a species (Strenzke, 1952 in Wallwork, 1970) was plotted for the more widely distributed species using moisture, organic matter, pore space, and pH as described in Materials and Methods. Constancy was also included since a widely distributed species would be more accurately defined by the variables chosen. Twenty species with constancies of above 40% are illustrated in Fig. 17.

Of the 20 widely distributed species plotted for their ecological valence, the most favoured conditions were low moisture, high organic matter, high pore space, and low pH. For moisture the ratio of preference for dry, moist and wet conditions was 12:8:0; for organic matter the ratio of preference for low, medium and high concentration was 1:5:14; for pore space the ratio was 0:0:20; and for pH the ratio was 15:5:0.

d. Correlation Studies

1. Environmental Variables Influencing Total Populations and Biomass.

The following information is based on a product-moment correlation analysis of total populations and biomass with data recorded from



CONSTANCY

49%

43%

69%

43%

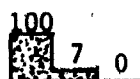
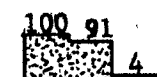
48%

MOISTURE

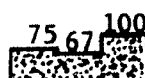
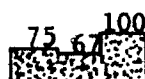
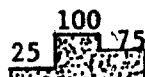
ORGANIC
MATTER

PORE
SPACE

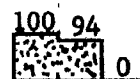
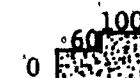
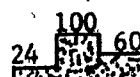
pH



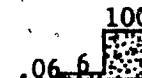
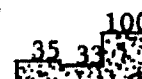
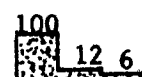
Microtritia
minima



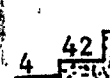
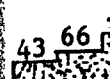
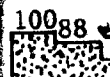
Steganacarus
diaphanus



Nothrus
silvestris



Oppia
minus



Oppia
nova

CONSTANCY

41%

41%

46%

70%

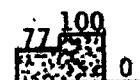
93%

MOISTURE

ORGANIC
MATTER

PORE
SPACE

pH



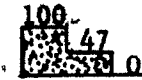
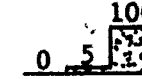
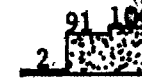
Scheloribates
lanceoliger?



Suctobelbella
laxtoni



Suctobelbella
hurshi?



Suctobelbella
acutidens?

CONSTANCY

43%

75%

74%

53%

105

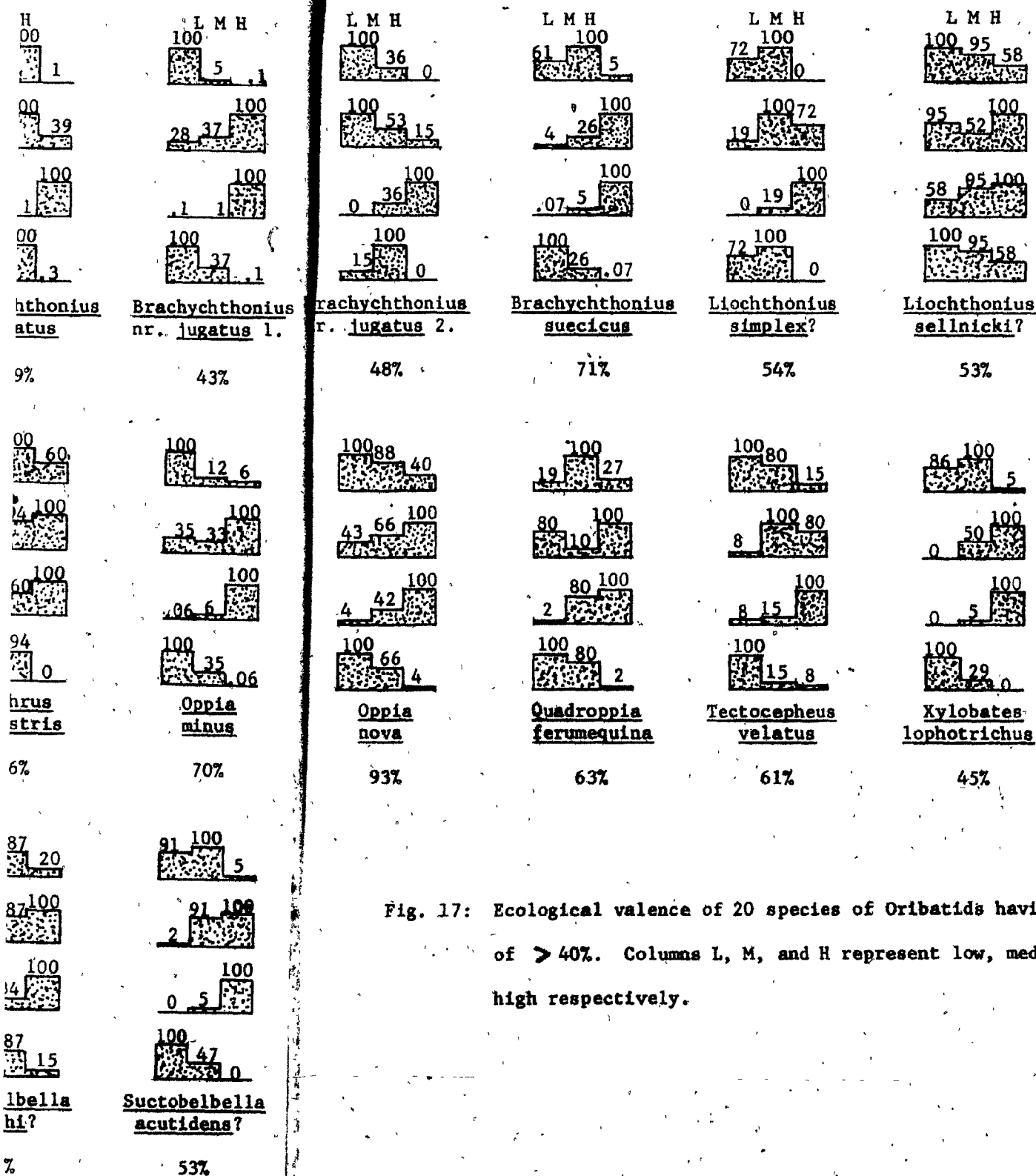


Fig. 17: Ecological valence of 20 species of Oribatids having constancy of $> 40\%$. Columns L, M, and H represent low, medium, and high respectively.

each of the 2 cm subcores which each core sample was divided into. These data are summarized in Tables 3, 4, and 5.

1. Water

For total populations and also for total biomass of oribatids the volume of soil water appears to be a limitation by excess rather than by deficiency. When considered across all sites there was a high negative loading. However, the correlation was insignificant for the combined data from the beech-hemlock catena, and also for the sites considered individually, except for site 6. The biomass correlations in addition were negative for sites 5 and 10. Since sites 5 and 6 were in the moist phase of the catena, this suggests that at least the dry phase of the catena was within the optimal moisture range. On the other hand the combined data for the sugar maple-basswood catena showed significant negative loadings for both population and biomass. The individual sites showed no significant values except site 11 for biomass.

2. Weight of organic matter

For all sites combined, the weight of organic matter was positively correlated with total populations and highly positively correlated with total biomass. For the combined beech-hemlock catena sites it was highly positively correlated with both populations and biomass, though not for all the individual sites, notably 5 and 6 (hemlock). The latter could be due to some of the cores having little or no mineral matter in the bottom subcore to provide the necessary contrast. For the sugar maple-basswood catena, correlations were insignificant except for a strong positive correlation for site 8. The insignificant correlations again could be due to a lack of contrast within the

	Volume of Water	Weight Organic Matter	Pore Space	pH	Depth	Volume Mineral Matter
TOTAL POPULATIONS:						
a. All Sites	-.418**	+.128**	+.654**	-.614**	-.225**	-.567**
b. Beech-Hemlock Catena	n.s.	+.345**	+.344**	-.161**	-.330**	-.437**
c. Sugar Maple-Basswood Catena	-.413**	n.s.	+.548**	-.522**	-.332**	-.303**
TOTAL BIOMASS:						
a. All Sites	-.292**	+.247**	+.661**	-.432**	-.502**	-.663**
b. Beech-Hemlock Catena	n.s.	+.387**	+.650**	+.140**	-.636**	-.670**
c. Sugar Maple-Basswood Catena	-.184*	n.s.	+.440**	-.349**	-.471**	-.476**

* Significant at 5% level

** Significant at 1% level

TABLE 3: Correlations of Total Populations and Biomass With Soil Variables, Using
Subcore Data

SITES	Volume of Water	Weight Organic Matter	Pore Space	Volume Mineral Matter	Depth	pH
All Sites	-.418**	+.128**	+.654**	-.567**	-.225**	-.614**
Beech-Hemlock Catena	n.s.	+.345**	+.344**	-.437**	-.330**	-.161**
1. Grey Birch-Red Maple	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
10. Grey Birch-Red Maple	n.s.	n.s.	+.420*	-.605**	n.s.	n.s.
7. Beech-Red Maple	n.s.	+.633**	+.536**	-.714**	-.617**	n.s.
9. Beech-Red Maple	n.s.	+.387*	+.493**	-.439**	n.s.	n.s.
2. Beech	n.s.	+.357*	n.s.	n.s.	n.s.	-.418**
4. Beech	n.s.	+.579**	+.627**	-.746**	-.692**	n.s.
5. Hemlock	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
6. Hemlock	-.431**	n.s.	+.727**	-.822**	-.611**	+.391*
Sugar Maple-Basswood Catena	-.413**	n.s.	+.548**	-.303**	-.332**	-.522**
8. Large-toothed Aspen	n.s.	+.738**	n.s.	-.688**	-.424*	-.486**
11. Trembling Aspen	n.s.	n.s.	+.384*	-.471**	-.496**	n.s.
3. White Ash	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
12. White Ash	n.s.	n.s.	n.s.	-.439**	-.579**	+.409*

* Significant at 5% level

** Significant at 1% level

TABLE 4: Correlations of Total Populations With Soil Variables, Using Subcore Data

SITES	Volume of Water	Weight Organic Matter	Pore Space	Volume Mineral Matter	Depth	pH
All Sites	-.292**	+.247**	+.661**	-.663**	-.502**	-.432**
Beech-Hemlock Catena	n.s.	+.387**	+.650**	-.670**	-.636*	-.140*
1. Grey Birch-Red Maple	n.s.	+.577**	+.588**	-.713**	-.750**	n.s.
10. Grey Birch-Red Maple	-.481**	n.s.	+.806**	-.902**	-.814**	+.504**
7. Beech-Red Maple	n.s.	+.704**	+.766**	-.859**	-.802**	n.s.
9. Beech-Red Maple	n.s.	+.589**	.632**	-.575**	-.660**	-.517**
2. Beech	n.s.	+.465**	+.575**	-.687**	-.691**	-.553**
4. Beech	n.s.	+.618**	+.812**	-.880**	-.846**	n.s.
5. Hemlock	-.580*	+.324*	+.645**	n.s.	-.667**	+.370
6. Hemlock	-.554**	n.s.	+.673**	-.582**	-.664**	+.386*
Sugar Maple-Basswood Catena	-.184*	n.s.	+.440**	-.476**	-.471**	-.349**
8. Large-toothed Aspen	n.s.	+.622*	n.s.	-.744*	-.564*	n.s.
11. Trampling Aspen	-.475**	n.s.	+.730**	-.800**	-.752**	n.s.
3. White Ash	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
12. White Ash	n.s.	n.s.	n.s.	n.s.	-.495**	n.s.

* Significant at 5% level

** Significant at 1% level

TABLE 5: Correlations of Total Biomass With Soil Variables, Using Subcore Data

soil profile. The organic matter determinations may have been too high in the clay soil, thus distorting the results, since Grim (1962) has shown that hydrated aluminosilicates, which release water of crystallization at high temperatures, can give overestimates of organic matter.

3. Pore space

Pore space was highly correlated with populations across all sites for the beech-hemlock catena combined for 5 out of 8 individual sites in the catena, for the sugar maple-basswood catena and for one of the 4 individual sites in the catena. The values were higher for biomass with all but sites 8, 3, and 12 being highly positively correlated. Again these insignificant values were probably due to lack of contrast across the soil profile.

4. Mineral soil

Combined sites, both catenas, and most individual sites showed high negative correlations with both population and biomass since mineral soil is inversely proportional to organic matter, pore space, and water.

5. pH

High negative correlations with populations and biomass for all sites and for the combined sugar maple-basswood sites, indicates that a low pH is the most favourable to oribatids. The combined data for the beech-hemlock catena with a rather weak negative correlation, and with most individual sites insignificant, suggested that ranges were optimal except for sites 6 and 2 which may reflect preferences of particular species.

6. Summary

Both the pore space and the amount of organic matter would appear to be of close to equal importance with soil water having a negative impact mainly in the sugar maple-basswood catena probably by reducing pore space. This is the same conclusion that was arrived at earlier using space diagrams of the resources.

ii. Influence of Some Soil Biotic and Abiotic Variables Compared to Vegetation on Individual Species

For the purposes of comparison, the gross depth and weight of organic matter, though originating from the vegetation, was considered a soil-based variable, while the composition of that organic matter as measured by the identification of the leaves in the L layer was treated as a vegetational variable.

A reduced and condensed version of the complete correlation matrix is given in Table 6. The species are listed in descending order of their total population. The X variables which were unnecessarily redundant or which did not appear to be meaningful were omitted. However, where it was not apparent which was the most appropriate form in which to express a given variable, both were included.

The species selected, with one exception included all species in which over 25 individuals were collected. They also included species for which 10 to 25 individuals were collected which had a coherent distribution as expressed by the factor score matrix of the principal components analysis. In this listing 98.4% of the individuals identified were included.

	Total Nos.	No. of Sites	Constancy in Cores	Water		Organic Matter	
				%	Phase of sere: Dry - Wet +	Weight	Depth
1 <i>Brachychthonius suecicus</i>	7807	10	71	-.239	-.766	--	+.851
2 <i>Oppia minus</i>	3818	11	70	-.529	-.766	--	+.430
3 <i>Oppia nova</i>	3665	12	93	-.442	-.492	--	+.608
4 <i>Brachychthonius jugatus</i>	2713	10	69	--	-.727	--	+.703
5 <i>Brach. nr. jugatus</i> (2)	2176	7	48	-.523	-.558	-.476	--
6 <i>Brach. nr. jugatus</i> (1)	1388	9	43	-.530	-.574	-.380	+.195
7 <i>Suctobelbella laxtoni</i>	1274	11	75	-.434	-.782	--	+.836
8 <i>Tectocephus velatus</i>	1270	10	61	--	-.275	+.358	+.638
9 <i>Brachychthonius bimaculatus</i>	1112	7	43	-.551	-.668	-.498	+.252
10 <i>Liochthonius sp. 1</i>	715	6	34	--	--	+.469	+.664
11 <i>Suctobelbella sp. 1</i>	552	5	35	--	--	+.402	+.606
12 <i>Liochthonius sp. 2</i>	549	9	54	--	-.440	--	+.538
13 <i>Quadroppia ferumequina</i>	547	11	63	--	--	+.283	+.252
14 <i>Trichthonius majestus</i>	451	2	15	--	--	+.463	+.508
15 <i>Suctobelbella longicuspis</i>	434	8	53	--	-.452	+.359	+.726
16 <i>Suctobelbella sp. 3</i>	417	5	36	--	--	+.397	+.667
17 <i>Nothrus silvestris</i>	380	8	46	--	-.255	+.223	+.477
18 <i>Brachychthonius nr. suecicus</i>	351	1	8	--	+.369	-.235	-.406
19 <i>Eobrachychthonius latior</i>	321	6	36	--	-.414	+.211	+.449
20 <i>Liochthonius sellnicki?</i>	296	11	53	--	+.304	--	-.270
21 <i>Brachychthonius nr. berlesei</i>	284	7	24	--	--	--	+.374
22 <i>Ceratozetes sp. 1</i>	283	8	34	-.280	-.352	--	+.405
23 <i>Suctobelbella hurshi?</i>	276	12	74	--	-.401	--	+.201
24 <i>Brachychthonius nr. bimaculatus</i>	272	2	8	--	-.262	-.625	--
25 <i>Atopochthonius artiodactylus</i>	222	7	49	--	-.332	+.319	+.533
26 <i>Liochthonius perpusillus</i>	217	70	31	--	-.216	+.214	+.364
27 <i>Gehypochthonius rhadamanthus</i>	212	6	30	--	-.243	+.283	+.479
28 <i>Suctobelbella frothinghami?</i>	210	7	36	--	-.244	+.293	+.579
29 <i>Hypochthoniella minutissima</i>	205	8	39	--	-.284	+.227	+.460
30 <i>Nanhermanina elegantula</i>	193	5	21	--	--	--	+.352
31 <i>Microtritia minima</i>	188	9	41	--	-.324	+.390	+.628
32 <i>Oribatula tibialis</i>	179	7	34	--	-.227	--	+.474
33 <i>Scheloribates lanceoliger</i>	175	7	43	--	--	--	+.442
34 <i>Xylobates lophotrichus</i>	173	8	45	-.312	-.391	--	+.596
35 <i>Archoplophora laevis</i>	159	1	8	--	--	+.232	+.358
36 <i>Parhypochthonius aphidinus</i>	150	3	11	--	--	+.393	+.412
37 <i>Steganacarus diaphanum</i>	144	10	41	+.316	+.328	--	--
38 <i>Suctobelbella acutidens?</i>	135	6	26	--	--	+.407	+.518
39 <i>Liochthonius horridus</i>	126	6	29	--	-.392	--	+.407
40 <i>Palaeacarus hystricinus</i>	120	6	29	--	--	+.384	+.551
41 <i>Suctobelbella sp. 14</i>	107	5	25	--	-.350	--	--
42 <i>Brachychthonius zelawaiensis</i>	104	3	16	--	--	+.473	+.388
43 <i>Eremobelba flagellaris</i>	96	7	32	--	--	--	-.222
44 <i>Brachychthonius italicus</i>	93	6	30	-.299	-.271	--	+.369
45 <i>Brachychthonius n.sp.</i>	93	3	14	--	+.408	--	-.438
46 <i>Pergalumna nervosa</i>	90	9	39	--	-.316	--	+.349
47 <i>Suctobelbella sp. 11</i>	90	5	17	--	--	+.422	+.435
48 <i>Liochthonius sp. 3</i>	87	4	15	--	--	+.468	+.433
49 <i>Suctobelbella falcata</i>	84	6	34	--	-.308	+.273	+.576
50 <i>Malaeconothrus sp. 3</i>	82	3	7	--	+.298	--	--
51 <i>Liochthonius nr. pululiferus</i> 6	82	7	16	--	--	--	--
52 <i>Liochthonius nr. sp. 4</i>	80	4	17	--	+.231	--	--
53 <i>Liochthonius hystricinus</i>	79	4	17	--	--	--	--
54 <i>Tectocephus sarekensis</i>	76	3	15	+.262	+.478	--	-.541
55 <i>Brachychthonius arcticus</i>	76	9	27	--	-.305	--	--
56 <i>Brachychthonius berlesei</i>	70	7	28	--	-.260	+.289	+.429
57 <i>Achipteria sp.</i>	68	2	10	--	-.256	--	--
58 <i>Nothrus sp. A.</i>	67	1	7	--	+.334	-.224	-.387
59 <i>Nothrus sp.</i>	62	7	21	--	--	--	--

105

45	Brachychthonius n.sp.	95	3	14	--	+.408	--	-.4
46	Pergalumna nervosa	90	9	39	--	-.316	--	+.3
47	Suctobelbella sp. 11	90	5	17	--	--	+.422	+.4
48	Liochthonius sp. 3	87	4	15	--	--	+.468	+.4
49	Suctobelbella falcata	84	6	34	--	-.308	+.273	+.5
50	Malaconothrus sp. 3	82	3	7	--	+.298	--	--
51	Liochthonius nr. piluliferus 6	82	7	16	--	--	--	--
52	Liochthonius nr. sp. 4	80	4	17	--	+.231	--	--
53	Liochthonius hystericinus	79	4	17	--	--	--	--
54	Tectocephus sarekensis	76	3	15	+.262	+.478	--	-.5
55	Brachychthonius arcticus	76	9	27	--	-.305	--	--
56	Brachychthonius berlesii	70	7	28	--	-.260	+.289	+.4
57	Achipteria sp.	68	2	10	--	-.256	--	--
58	Nothrus sp. A.	67	1	7	--	+.334	-.224	-.3
59	Nothrus sp.	62	7	21	--	--	--	--
60	Pterochthonius angelus	62	3	15	--	--	--	+.2
61	Synchthonius crenulatus	55	5	17	--	--	--	+.3
62	Allodamaeus n.sp.	53	6	26	--	-.508	-.535	--
63	Ceratozetes sp. 2	49	2	11	--	--	--	--
64	Xylobates capucinus	48	2	11	-.405	+.432	--	-.4
65	Liochthonius pilosetosus	45	5	19	--	--	+.281	+.3
66	Trhypochthonius silvestris	45	2	10	--	--	+.420	+.3
67	Allodamaeus n.sp. 2	44	5	19	--	-.249	+.238	+.3
68	Suctobelbella nr. acutidens	44	6	16	--	-.204	--	+.2
69	Oppia carolinae	43	5	10	--	-.203	--	+.2
70	Suctobelbella sp. 10	43	7	22	--	--	--	--
71	Liochthonius N	43	1	2	--	--	-.349	--
72	Liochthonius nr. piluliferus 1	40	2	4	--	--	--	--
73	Brachychthonius lydiae	35	7	18	--	--	+.281	+.3
74	Malaconothrus sp. 2	34	2	13	--	+.298	--	--
75	Eremulus cingulatus	34	2	10	--	-.305	--	--
76	Tectocephus sp. 4	33	5	14	--	-.240	--	+.2
77	Suctobelbella sp. 12	30	1	8	--	--	+.457	+.3
78	Lanceoppia sp. 1	30	3	11	--	--	--	--
79	Hypochthonius rufulus	28	2	9	--	--	--	--
80	Liochthonius piluliferus	27	4	6	--	--	--	--
81	Oppia sp. 2	27	3	2	--	--	--	--
82	Camisia sp.	26	2	7	--	-.240	--	--
83	Liochthonius nr. piluliferus 2	25	1	2	--	--	--	--
84	Cultroribula divergens	25	3	13	--	+.447	--	-.4
85	Galumna emarginatus	25	1	6	--	+.295	-.211	-.3
86	Suctobelbella sarekensis?	24	6	14	--	--	--	--
87	Multioppia splendens	24	3	9	--	--	+.403	+.3
88	Scheloribates nr. confundatus	23	2	6	--	-.236	--	--
89	Lepidozetes sp.	22	2	10	--	-.304	--	--
90	Brachychthonius rostratus	19	2	7	--	--	--	--
91	Eulohmannia ribagai	18	3	7	+.252	+.265	--	-.3
92	Gymnodamaeus n.sp.	17	1	4	--	--	+.251	+.2
93	Suctobelbella sp. 13	17	3	7	--	--	--	--
94	Suctobelbella sp. 14	16	3	10	--	-.281	--	+.2
95	Suctobelbella subtrigona	15	3	10	--	--	--	--
96	Fosseremus americanus	15	2	7	--	-.240	--	--
97	Suctobelbella sp. 8	15	6	5	--	--	--	--
98	Oppia sp. 1	15	1	3	--	--	--	--
99	Suctobelbella sp. 1 & 2	14	4	9	--	--	--	-.2
100	Malaconothrus sp. 1	13	2	3	--	--	--	--
101	Adonistes ammonoosuci	13	2	6	--	--	+.216	+.2
102	Liochthonius nr. piluliferus 3	13	5	8	--	--	--	--
103	Rhysotritia ardua	12	6	9	--	--	--	--
104	Carabodes sp. 2	11	2	3	--	--	--	--
105	Carabodes omo	10	1	6	--	--	+.221	+.3

* Ground Vegetation: fl = false lily-of-the-valley, B = bracken fern, m = moss.

Table 6: Summary of correlation Analyses of core data. Species listed in descending order

+ .408	--	- .438	+ .358	+ .358	+ .356	+ .433	+ .549	TA	+ .549	TA	+ .234	m	*
- .316	--	+ .349	+ .377	- .284	- .346	- .220	+ .277	Be	+ .283	Be	--		*
--	+ .422	+ .435	+ .340	- .555	- .268	- .320	+ .728	He	+ .740	He	+ .714	m	*
--	+ .468	+ .433	+ .342	- .496	- .245	- .294	+ .771	He	+ .778	He	+ .632	m	*
- .308	+ .273	+ .576	+ .515	- .636	- .453	- .542	+ .476	Be	+ .373	He	--		*
+ .298	--	--	--	--	--	--	+ .601	TA	+ .601	TA	+ .263	m	*
--	--	--	--	--	--	--	+ .481	TA	+ .481	TA	+ .455	m	*
+ .231	--	--	--	+ .258	--	+ .268	+ .596	TA	+ .596	TA	+ .244	B	*
--	--	--	--	--	--	--	+ .340	TA	+ .340	TA	--		*
+ .478	--	- .541	- .501	+ .498	+ .545	+ .506	+ .659	WA	+ .664	SM	--		*
- .305	--	--	--	--	- .211	- .256	+ .470	RM	+ .287	RM	+ .408	f1	*
- .260	+ .289	+ .429	+ .368	- .424	- .373	- .447	+ .300	He	+ .302	He	+ .347	B	*
- .256	--	--	--	--	- .214	--	+ .373	RM	+ .298	RO	+ .284	f1	*
+ .334	- .224	- .387	--	--	--	+ .353	+ .880	TA	+ .880	TA	+ .450	m	*
--	--	--	--	--	+ .208	--	+ .398	LTA	+ .361	LTA	--		*
--	--	+ .280	+ .209	--	- .254	- .304	+ .342	GB	+ .271	Be	+ .486	B	*
--	--	+ .373	+ .308	- .307	- .271	- .325	+ .230	He	+ .227	He	+ .370	B	*
- .508	- .535	--	--	--	- .367	- .385	+ .587	GB	+ .666	GB	+ .322	f1	*
--	--	--	--	--	--	+ .300	+ .513	LTA	+ .566	RO	+ .252	f1	*
+ .432	--	- .451	- .563	+ .444	+ .553	+ .456	+ .767	WA	+ .776	WA	--		*
--	+ .281	+ .383	+ .383	- .439	- .306	- .366	+ .330	Be	+ .284	He	--		*
--	+ .420	+ .380	+ .283	- .396	- .225	- .269	+ .539	He	+ .550	He	+ .601	m	*
- .249	+ .238	+ .342	+ .273	- .344	- .305	- .365	+ .279	RM	--		+ .316	B	*
- .204	--	+ .207	+ .250	- .230	--	- .208	+ .363	Be	+ .270	Be	--		*
- .203	--	+ .224	+ .258	- .285	--	- .214	+ .395	Be	+ .264	Be	--		*
--	--	--	+ .212	--	--	--	+ .262	Be	+ .346	Be	--		*
--	- .349	--	--	--	--	--	--	--	--	--	--		*
--	--	--	--	--	--	--	+ .293	GB	+ .416	GB	+ .203	f1	*
--	+ .281	+ .383	+ .383	- .439	- .306	- .366	+ .330	Be	+ .284	He	--		*
+ .298	--	--	--	--	--	--	+ .601	TA	+ .601	TA	+ .263	m	*
- .305	--	--	--	--	- .220	- .263	+ .715	GB	+ .432	GB	+ .626	B	*
- .240	--	+ .273	+ .228	- .213	- .251	- .301	+ .304	RM	+ .264	Be	+ .334	f1	*
--	+ .457	+ .351	+ .270	- .462	--	- .227	+ .671	He	+ .684	He	+ .742	m	*
--	--	--	--	--	--	+ .214	+ .507	LTA	+ .478	LTA	--		*
--	--	--	--	--	--	--	+ .311	RM	+ .412	RO	+ .298	f1	*
--	--	--	--	--	--	--	--	--	--	--	--		*
- .240	--	--	--	--	--	- .208	+ .515	GB	- .307	RM	+ .501	B	*
--	--	--	--	--	--	--	--	--	--	--	--		*
+ .447	--	- .475	- .246	+ .304	+ .337	+ .473	+ .788	TA	+ .788	TA	+ .372	m	*
+ .295	- .211	- .320	--	--	--	+ .312	+ .777	TA	+ .777	TA	+ .397	m	*
--	--	--	--	--	--	--	--	--	--	--	--		*
--	+ .403	+ .362	+ .279	- .470	- .204	- .244	+ .654	He	+ .663	He	+ .642	m	*
- .236	--	--	--	- .214	--	- .204	+ .423	Be	+ .280	Be	--		*
- .304	--	--	--	--	- .219	--	+ .452	RM	+ .373	RO	+ .475	f1	*
--	--	--	--	--	--	--	--	--	--	--	--		*
+ .265	--	- .302	- .305	+ .298	+ .351	+ .284	+ .312	LTA	+ .399	LTA	--		*
--	+ .251	+ .249	--	- .322	--	--	+ .474	He	+ .483	He	+ .525	m	*
--	--	--	--	--	--	--	--	--	--	--	--		*
- .281	--	+ .202	+ .258	- .255	- .226	- .270	+ .500	Be	+ .316	Be	--		*
--	--	--	--	--	--	--	--	--	--	--	--		*
- .240	--	--	--	--	--	- .207	+ .458	GB	+ .256	RM	+ .441	B	*
--	--	--	--	--	--	--	--	--	--	--	--		*
--	--	- .203	--	--	--	--	+ .597	TA	+ .597	TA	+ .275	m	*
--	--	--	--	--	--	--	--	--	--	--	--		*
--	+ .216	+ .298	+ .281	- .253	--	--	+ .503	He	+ .494	He	--		*
--	--	--	--	--	--	--	--	--	--	--	--		*
--	--	--	--	--	--	--	--	--	--	--	--		*
--	+ .221	+ .312	+ .275	- .279	--	- .208	+ .513	He	+ .499	He	--		*

rn, m = moss.

listed in descending order of their total populations.

40F4

As shown in Table 6, many of the species with the highest populations and the widest distribution, as would be expected, appeared to be most closely related to soil variables. Species with lower populations tended to be more influenced by the vegetation. For the sparser species this tendency increased.

Of the 90 species examined 66 were more closely related to the vegetation while only 24 were allied with soil variables.

However, in terms of populations those 24 soil-influenced species accounted for 20,779 individuals while the 66 vegetation-influenced species amounted to only 15,993 individuals.

Consequently it may be concluded that populations are determined by basic resources and soil-based variables while diversity is strongly influenced by the character of the vegetation.

iii. Estimation of Components Comprising Factors of Principal Components Analysis

To estimate the meaning of a factor, the factor score of each species with a significant loading (1.000 or over) was multiplied by its highest correlation value with an X variable in the correlation analysis. This was taken as one weighing of that particular X variable. The same procedure was followed for each species with a significant factor score. The weightings of each of the various X variables were added up. These are shown as a histogram in Fig. 18. Probably only the largest two or three components can be regarded as possibly meaningful.

The 10 factor extraction of the 90 variable analysis was used (Appendix H) with the exception that factor 2 was taken from the 5 factor extraction where it was more coherent (Appendix J).

FIG. 18: Estimates of Principal Components of Factors

Factor: 1	Hemlock Trees and Litter				Low pH	Humus Depth	"Noise"
Stands: 5,6							
2	White Ash Litter	Sugar Maple Litter	"Noise"				
3							
3,12	False Lily-of-the Valley	Mor	Red Maple Litter	Dry Phase	"Noise"		
4,10,7,9							
4	Trembling Aspen Trees and Litter					Moss	"Noise"
11							
5	Low pH	LTA Trees and Litter	False Lily-of-the Valley	Red Oak Litter	"Noise"		
8							
6	White Ash Tree and Litter	"Noise"					
12							
7	Low pH	Beech Trees and Litter			Mor	Humus Depth	"Noise"
2,4							
8	Hemlock Trees and Litter	Low pH	Humus Depth	Moss	"Noise"		
5							
9	Mor	Grey Birch Litter	Humus Depth	"Noise"			
10							

Factor 1 (Sites 5 and 6)

In terms of the oribatid fauna the site is mainly characterized by hemlock trees and litter (which could not be separated), low pH, and deep humus.

Factor 2 (Sites 3 and 12)

Sugar maple litter and white ash litter appear to be the most important influences.

Factor 3 (Sites 1, 10, 7, and 9)

Sites were characterized mainly by false lily-of-the-valley, mor humus formation, red maple litter, and possibly dry soil conditions.

Factor 4 (Site 11)

Site appears to be characterized mainly by trembling aspen trees and litter (which were inseparable). This may or may not be meaningful.

Factor 5 (Site 8)

The site is characterized nearly equally by low pH, large-toothed aspen trees and litter, false lily-of-the-valley and red oak litter. No dominant underlying influence is apparent.

Factor 6 (Site 12)

This factor was not interpretable.

Factor 7 (Sites 2 and 4)

Sites mainly characterized by low pH, beech trees and litter, and mor humus formation.

Factor 8 (part of 5)

This is very similar in content to factor 1.

7

Factor 9 (part of 10)

This appears to be characterized mainly by mor humus formation and grey birch litter, representing the unique character of site 10. However the factor only accounts for 3.8% of the total variance so that it probably is not meaningful.

Factor 10 ("noise")

DISCUSSION

1. Taxonomy

One of the greatest difficulties of the soil acarologist in North America is in identification. He is faced with enormous numbers of species and individuals for which a large portion of the specific descriptions are inadequate for a reliable determination without resource to the author's original material.

The comment of Wallwork (1959) that "the lack of adequate taxonomic descriptions of even the more common soil mites has hampered very greatly the work of the soil zoologist" is still true today. Though determination to the generic level has been greatly eased by the keys of Balogh (1961, 1963, 1965, 1972) the specific determinations often still remain difficult for the North American worker. The European fauna is much better represented in the literature. Many genera and families, e.g., Ceratozetes, Suctobelbidae, Gymnodamaeidae represent trouble areas though recently Moritz (1970a, 1970b, 1971c, 1970c) has helped to clarify the European Suctobelbidae. Also, controversy exists as to the synonymy of early North American descriptions with European species. Often examination of type material remains the only reliable method of determination.

2. Extraction Efficiency

It appears that the overall extraction efficiency of the battery funnels used was relatively high. The only figure higher than the

equivalent of 1,329,000/m² found at site 5, was 1,500,000 recorded by Forsslund (1948) by direct count. Van der Drift (1949) obtained 210,000, Lebrun (1965) 250,000, and most earlier workers less. Nevertheless, the 800 watt heating strips, though controlled by a thermostat, were probably excessive.

High though the overall figures were, extraction efficiency of some groups was very poor. Adult Phthiracaroida were generally in very low numbers, possibly due to aestivation in response to dryness. Reeves (personal communication) has found markedly higher extraction of phthiracaroids when dry samples were wetted before extraction. Nymphal phthiracaroids were not collected since they are internal feeders. Several species have been found to be miners of decaying coniferous needles (Jacot, 1939). These species would not be able to escape. Nymphs of many higher oribatids also were very poorly extracted. Some may be internal feeders, e.g., Adoristes ammonosuci (Jacot, 1939), others, e.g., Oppia nova and O. minus are probably too slow and weakly sclerotized so that many do not escape before being desiccated.

Probably a flotation method would have given better extraction for nymphs. Satchell and Nelson (1962) found better extraction of Steganacarus magnus nymphs using a flotation method, but other species and groups of oribatids showed greater numbers or an insignificant difference in Tullgren funnel extraction. There is probably no method that is equally efficient for all oribatids. However, since the nature of the study is comparative between habitats this is probably not important.

3. Seasonal Changes

In general, North American workers have found an autumn maximum followed by a winter decline (Wallwork 1959, Marshall 1964). This was not so for all of the sites based on lumped pairs of cores for several reasons. First, many workers, e.g., Aoki (1967), Hammer (1972), Travé (1963), have shown great differences in fauna between different microhabitats. Sampling by quadrat, as was done, in many cases may include different microhabitats in different cores, e.g., sample 6a at site 8 included a decaying root and contained 6 times the population with a different species composition than the other 7 cores examined from that site. A second possibility is that optimum moisture conditions at a given site may occur at different seasons in different sites. Also extraction efficiency between cores due to unequal disturbance of soil structure during processing or to more intact leaves in the L layer obstructing escape of smaller species.

Chi-square tests of the data in Table 2 indicate that the hemlock and white ash sites were the most uniform while the two beech-red maple sites were the most discontinuous.

4. Species Diversity of Sites

The species diversity of the different sites did not entirely agree with Kühnelt's (1963b) conclusion that the climax forests had the richest fauna. Site 10 (GBRM) was considered by Long (1955) as a subclimax though the largest number of species (see Fig. 9a) but not the largest total populations (see Fig. 9b) were recorded there. However, the sites with the next four richest faunas were in the hemlock

and beech sites which represent the climaxes of the moist and dry phases respectively of the beech-hemlock catena.

5. Comparison of Sites

a. Measures of Similarity

Sørensen's quotient of similarity was used because notwithstanding the superiority of Mountford's (1962) index in its independence from sample size, as was previously decided by Davis (1963), when all the samples were the same size this advantage was not necessary and therefore the extra calculation did not seem warranted.

b. Principal Components Analysis

An ordination of the data using population figures was decided upon since measures of similarity which are computed from presence and absence data are biased in favour of the more sparsely distributed species since all species are given equal weight. A method in which the species were weighted according to their abundance was considered to form a more adequate description of the sites.

Principal components analysis was considered by Gitting (1969) to be the most successful ordination technique currently used in vegetation studies. Because the vegetational situations in which the technique has been apparently successfully used, have often been close to that of a continuum which it would be expected the soil fauna, being dependent on soil conditions and vegetation, would also simulate, it was considered that it would also be suitable for the present problem.

In fact, it was observed that the distribution of many species of oribatids tends to varying degrees toward a continuum. In a habitat

favourable to a species there will be a high density of favourable microhabitats. Progressively less hospitable habitats will have increasingly more widely distributed niches acceptable to the species.

Species like Trichthonius majestus which were in quite large numbers and are apparently very restricted in their distribution, are the exception. Most species collected at only one site were found in low numbers indicating that the site was probably unfavourable to the species.

Recently, however, considerable criticism of the use of principal components analysis in ecology, has been leveled by Beals (1973), mainly with reference to its use in plant sociology. The inherent concept of each (plant) species being rendered orthogonal (uncorrelated) with any other species was severely criticized, since different species are likely to be responding to the same environmental variables. Nevertheless, Beals (1973) conceded that in animal communities different species were not nearly as likely to be responding to the same environmental variables, though these were often inter-correlated.

In the present case the ordinations gave very similar groupings to those achieved using Sørensen's quotient of similarity, thereby confirming them and also rendering them more meaningful. The Q/S using all species (fig. 10), which gave the best discrimination between sites, gave nearly identical groupings to those achieved by the 9 factor cluster analysis (fig. 13).

The principal components analysis also contains the capacity for interpretation of the factors, through the loadings on the species making up the factors contained in the factor score matrices. While it would be absurd to assume that a given species is controlled by a single X variable, nevertheless a rough approximation of the main component of

the factors was achieved by using correlation data.

Factor analysis techniques must be regarded as still exploratory in terms of describing ecological situations. They may provide a starting point when dealing with a large body of information but the danger lies in assuming that ecology simulates the mathematics. A forewarning of one aspect of this danger was given by Goodall (1954) in his statement that though factors are statistically orthogonal they are not biologically independent. Beals (1973) also observed that most of the tests of effectiveness (of factor analysis) are based on maximum variance accounted for, not on ecological informativeness.

Nevertheless, in view of the fact that the principal components analyses and cluster analyses confirmed and elucidated results achieved by other methods, it would appear to be a reliable method for large scale soil faunal surveys.

Many refinements, which might better define communities, are possible, e.g. elimination of ubiquitous species, such as Oppia nova and O. minus, in this case. Including selected X variables in the analysis, as was done by Ferrari et al (1957), would perhaps give an accurate interpretation.

6. Correlation Analysis

The correlation analyses were also treated cautiously. As has been reiterated many times "correlation is not causation". A strong correlation is not a guarantee of a relationship since misleading spurious correlations occur when two variables are colinear.

Conversely insignificant correlation values do not always assure a lack of relationship. This may occur where that variable is optimal, e.g., for water in the beech-hemlock catena (see Table 4); where there is no basis for comparison, e.g., site 5 where mineral matter was absent (Table 4); or where one variable is in too low numbers

to be coherent, e.g., populations of sites 3 and 12. It could also occur if the environmental variable were overshadowed by another limiting factor.

In the present study there were many intercorrelations between environmental or X variables as shown in Tables 7 and 8.

Stepwise multiple regression analysis was conducted to attempt to elucidate the proportionate influence of X variables on individual species. However, the same problems occurred that are described by Spurr and Bonini (1973, p. 518), namely, that correlation and collinearity of X variables can cause a great increase in standard error rendering the regression coefficient unreliable and also can cause an X variable correlated with a previously extracted X variable to reverse its sign. These eventualities suggested that the method was unsuited to the character of the data.

In the correlation analyses, initially the Y variables (species) were given a $\log_{10} (x+1)$ transformation while the X variables were untransformed. Latterly a $\log_{10} (x+1)$ transformation was applied also to the X variables in the correlations of the core data, to reduce the variance of the vegetation data which had many zero values. However, it was found that as shown in Table 9 the correlation values using transformed X variables did not vary greatly from those using untransformed X variables.

7. Influence of Environmental Variables

a. Soil and Humus Formation

The fauna at the various sites agreed with Kühnelt's (1963b)

	Volume of Water	Weight Organic Matter	Pore Space	Volume Mineral Matter	pH
Volume of Water		+.558**	-.677**	n.s.	+.211**
Weight Organic Matter	+.558**		n.s.	-.555**	-.249**
Pore Space	-.677**	n.s.		-.756**	-.562**
Mineral Matter	n.s.	-.555**	-.756**		+.615**
pH	+.211**	-.249**	-.562**	-.615**	

** Significant at 1% level

TABLE 7: Intercorrelations of X Variables (Untransformed Sub-core Data)

	Water		Phase of Sere	Organic Matter		Pore Space	pH	Sere	Humus Formation
	Volume	%		Weight	Depth				
Volume of Water		+.963**	+.552**	+.787**	n.s.	-.229*	n.s.	+.461**	+.388**
% Water	+.963**		+.647**	+.695**	-.317**	-.401**	n.s.	+.591**	+.500**
Phase of Sere	+.552**	+.647**		+.270**	-.683**	-.603**	+.433**	+.864**	+.803**
Weight Organic Matter	+.787**	+.695**	+.270**		+.251*	n.s.	-.472**	n.s.	n.s.
Depth Organic Matter	n.s.	-.317**	-.683**	+.251*		+.825**	-.860**	-.876**	-.910**
Pore Space	-.229*	-.401**	-.602**	n.s.	+.825**		-.809**	-.832**	-.751**
pH	n.s.	n.s.	+.433**	-.412**	-.860**	-.809**		+.708**	+.755**
Sere	+.461**	+.591**	+.864**	n.s.	-.876**	-.832**	+.708**		+.913**
Humus Formation	+.388**	+.500**	+.803**	n.s.	-.910**	-.751**	+.755**	+.913**	

* Significant at 5% level

** Significant at 1% level

TABLE 8: Intercorrelation of X Variables (Transformed Core Data)

	% Water	Volume Water	Pore Space	pH	Depth Humus
TOTAL POPULATION:					
Transformed X Variables	-.447	-.326	+.803	-.765	+.820
Untransformed X variables	-.548	-.400	+.780	-.788	+.677
TOTAL BIOMASS:					
Transformed X Variables	-.376	-.280	+.759	-.705	.770
Untransformed X Variables	-.446	-.334	+.748	-.732	+.638

TABLE 9: Comparative Correlations Using Transformed and Untransformed X Variables

summarization that there was a fairly good correlation between the soil fauna and humus types except for site 8 which was more closely related to the sites with mor humus formations than to the other mull sites. However, substantial red oak and beech leaf litter apparently made the difference.

b. Litter Depth

In the correlation analysis of total populations and total biomass of cores the depth of humus was the most highly correlated X variable, being +.820 and +.770 respectively. This agrees with Nosek (1957, 1957a) who found the organic matter to be the most important single variable. It also agrees with the experiments of Huhta et al. (1967, 1969), Karppinen (1957) and Karg (1967) in which impoverishment of the fauna was shown when the litter was removed.

c. Soil Water

Within the range of sites chosen water did not appear to be a limiting variable in terms of deficiency but it may have been limiting in terms of excess in the sugar maple-basswood catena, particularly since all four sites were subject to winter flooding.

Many authors, e.g., Karppinen (1948) and Krivolutsky (1964) have observed higher populations in moist than in dry forests; however, this is not apparent within the range of moisture conditions obtaining of the beech-hemlock catena (see Fig. 9b). There appears to be no advantage of the sites in the moist phase (hemlock) over those in the dry phase. The results agree more closely with Murphy (1955) who found relative humidity to be rarely a limiting factor. Even though

Berthet (1964a) observed that low moisture conditions might drastically reduce edaphic mould and bacteria, the fact that precipitation occurs periodically throughout the summer probably would prevent a shortage of food for fungivorous species.

d. Pore Space

Pore space is probably the second most important environmental variable in terms of total populations and total biomass being +.803 and +.759 respectively. However, as it is colinear with depth of humus and as the difference between the correlation values for both variables is insignificant, it is difficult to assess the proportionate influence of each separately. That pore space is one of the most important variables is generally agreed (e.g., Kühnelt, 1961, Davis 1963).

e. pH

Though pH is highly correlated with total population and biomass and is highly correlated with many individual species, it is probably mainly important indirectly by providing favourable conditions for the growth of fungi.

f. Temperature

Temperature measurements taken at the time of sampling were found to have no influence on the fauna. Day/degrees calculated from air temperature figures were found to have no clear relationship with populations. The results appear to agree with Huhta et al. (1967) in which it was stated that in Finland the temperature was only critical at onset and termination of winter.

g. Distance Between Sites

In initial correlation analyses, it appeared that, within the confines of the arboretum, the distance between sites was unimportant.

h. Vegetation

i. Macrovegetation and Litter Composition

It has been shown by both the quotient of similarity and the ordination that the character of the oribatid fauna paralleled the macrovegetation quite closely, particularly in the climax stage of the vegetation.

It appears that the macrovegetation is the main influence through the addition of nutrients and other substances by the leaf litter.

The fact that site 8 (large-toothed aspen), which was a mull in Ste. Rosalie clay, was more similar to the sites of the beech-hemlock catena, as shown in the cluster analyses (Figures 13 and 14) and the trellis diagram of the Q/S (see Fig 10), argues for the deduction that the 60% red oak, 15% beech, and 8% red maple litter (see Table 11) had a greater influence on the fauna than the soil type, soil moisture, etc. The importance of the litter is probably the reason for the dissimilarity of the two hemlock sites. Site 6 in the 8 factor cluster analysis (see Figure 14) groups more closely with site 4 (beech), though in the 9 factor cluster analysis (Figure 13) and the principal components analysis (Appendix H) it is more similar to site 5 than to the beech site. This is probably a result of the 44% beech litter at site 6. The fact that in the estimate of the component of the principal component analysis, the largest component of the beech sites was pH may reflect an influence of the beech litter on the soil acidity

since the pH of site 6 with 44% beech litter was closer to that of the beech sites than to the other hemlock site.

Krivolutsky (1964) found that kinds of soil and litter were more important than the kinds of trees and herbs. These results seem to agree to the extent of the litter probably being more important than the trees, but they appear to give less importance to the soil.

11. Ground Vegetation

The ground vegetation appeared to express an influence in some cases but not in others. The large proportion of the principal component accounting for the grey birch-red maple sites being false Hly-of-the-valley may or may not be meaningful. Bracken which was present at sites 1, 10, and 5 did not express any clear influence. A dense ground cover of moss on site 5 probably influenced the species diversity which was the second highest and also was higher than the other hemlock site. Eitminavičiūtė (1961) found the greatest numbers in coniferous forests to be at those sites with a ground cover of mosses. With this possible exception the ground cover appears to have exerted little direct influence, e.g., site 12 (white ash), with a dense cover of many herbaceous species, was the site with the lowest numbers and the lowest diversity.

Site	LEAF LITTER											
	Beech	Hemlock	Red Maple	Red Oak	Grey Birch	Sugar Maple	White Ash	Trembling Aspen	Larged Toothed Aspen	Bass- Wood	Paper Birch	Eastern Cotton Wood
1 GBRM			33		67							
10 GBRM	46		50		3						1	
7 BeRM	60		25	15								
9 BeRM	60		25	15								
2 Be	95		5									
4 Be	94		5	1								
5 He	1	98			1							
6 He	44	44	10	2								
8 LTA	15		8	60					15		2	
11 TA	5		40	5				40				10
3 WA						60	36		1	3		
12 WA	3			3		50	40			4		

Table 10: Leaf Litter Composition (in % of Volume)

SUMMARY AND CONCLUSIONS

The highest populations and diversity occurred in the beech-hemlock catena where there was a deep acid mor humus formation. Sites with high populations also had high diversity.

There was a general autumn maximum with an overwinter decline giving lower population in the following spring. A higher proportion of nymphs was found in the November sample compared to August and June indicating high fall reproductive activity.

For the sites chosen there was a comparatively small number of eurytopic species occupying 8 to 12 of the sites, a larger not very well defined intermediate group occupying 3 to 7 sites, and the larger group of stenotopic species occupying 1 or 2 sites only or present as only a single individual.

There was usually considerable difference between members of pairs of cores both in numbers and in species composition indicating that frequently samples were taken across differing microhabitats.

In an assessment of population levels in relation to basic resources, the pore space appeared to be the most critical. The quantity of organic matter appeared close to equal in importance. It appeared less critical in a diagrammatic assessment but could not be clearly differentiated from the influence of pore space (a variable colinear with depth of organic matter) in the correlation analysis. Soil water appeared to be limiting only in excess in the clay soil of the sugar maple-basswood catena, probably by a reducing pore space.

The version of Sørensen's Q/S which included all species showed better discrimination between sites than the weighted versions which eliminated the sparser species. The pure stands i.e. beech, hemlock, and white ash

were most similar to their replicates. The associations (grey birch-red maple, and beech-red maple) did not match with their pairs. The trembling aspen and large-toothed aspen sites did not closely match any other site.

The groupings achieved by the ordination using principal components analysis, largely confirmed and elucidated the groupings achieved with the quotient of similarity. Interpretation of the factors by using correlation values of environmental variables with the species defining the factors suggested that the vegetation rather than soil characteristics was the main determiner of the oribatid faunal composition.

General observations and conclusions reached by correlation analysis and cluster analysis pointed to the leaf litter composition as having a greater impact on the fauna than the forest cover. This was particularly evident in site 8 (large-toothed aspen) in which oak and beech leaves from surrounding trees was more influential on the fauna than the forest cover or the soil, so that the fauna was closer to the beech-hemlock catena (sandy soil).

In summary the following points may be made:

1. Populations are determined by quantities of basic resources while diversity is induced by the character of the vegetation, particularly the composition of the leaf litter.
2. The results achieved by principal component and cluster analyses confirmed conclusions reached by other methods confirming the utility of these methods in soil faunal surveys.
3. The oribatid fauna responds to a mosaic of interacting environmental variables any one of which may be limiting by deficiency and sometimes by excess, i.e., results here refer to sets of circumstances which conceivably may differ elsewhere giving somewhat different results.

LITERATURE CITED

- Abbatiello, M.J. 1966. Oribatid Mites of Long Island with Special Reference to Belba johnstoni n.sp. (Acarina:Damaeidae). Unpubl. Ph.D. Thesis, St. John's U. Dissert. Abstr. 27B(10): 3705-6.
- Aoki, J. 1967. Microhabitats of Oribatid Mites on a Forest Floor. Bull. Nat. Sci. Mus., Tokyo, 10(2): 133-8.
- Balogh, J. 1961. Identification Keys of World Oribatid Families and Genera. Acta Zool. Hung. 7: 243-344.
- _____. 1963. Identification Keys of Holarctic Oribatid Mites Families and Genera. Acta Zool. Hung. 9: 1-60.
- _____. 1965. A Synopsis of the World Oribatid Genera. Acta. Zool. Hung. 11: 5-99.
- _____. 1972. The Oribatid Genera of the World. Akadémiai Kiadó, Budapest. 188 pp., 71 pls.
- Banks, N. 1895a. On the Oribatoidea of the United States. Trans. Am. Ent. Soc. 22: 1-16.
- _____. 1896. New North American Spiders and Mites. Trans. Am. Ent. Soc. 23: 57-77.
- _____. 1906. New Oribatidae from the United States. Proc. Acad. Nat. Sci., Philadelphia. 58: 490-500, 5 pl.
- _____. 1947. On Some Acarina from North Carolina. Psyche 54(2): 110-41.
- Beals, E.W. 1973. Ordination: Mathematical Elegance and Ecological Naïveté. J. Ecol. 61(1): 23-35.
- Berlese, A. 1904a. Acari Nuovi Manipulus III. Redia 2: 1-32, 2 pl.
- _____. 1904b. Acari Nuovi Manipulus I. p. 235-52.
- _____. 1908. Elenco di Generi e Specie Nuove di Acari. Redia 5: 1-15.
- _____. 1910. Acari Nuovi Manipulus VI. Redia 6: 215-30, 3 pl.
- _____. 1914. Acari Nuovi Manipulus IX. Redia X: 113-150, 4 pls.
- _____. 1916. Centuria Prima di Acari Nuovi. Redia 12: 19-67.
- Berthet, P. 1964a. L'activité des Oribatides (Acarie) d'une Chenaie. Mém. Inst. Roy. Sci. Nat. Belg. 152: 1-152.
- _____. 1964b. Field Study of the Mobility of Oribatei (Acari) Using Radioactive Tagging. J. Anim. Ecol. 33: 443-9.

- Berthet, P. and G. Gerárd. 1965. A Statistical Study of the Micro-distribution of Oribatei (Acari). Part I. The Distribution Pattern. *Oikos* 16: 214-27.
- Block, W.C. 1966. The Distribution of Soil Acarina on an Eroding Blanket Bog. *Pedobiol.* 6: 27-34.
- Bohnsack, K.K. 1954. A Study of the Forest Floor Arthropods of an Oak-Hickory Woods in Southern Michigan. Unpubl. Ph.D. Thesis. Univ. Michigan, 353 pp. Dissert. Abstr. 14(7): 1114.
- Brayshaw, T.C. 1959. Tree Seedlings of Eastern Canada. Canada Dept. Northern Affairs and Nat. Res., For. Br., Bull. 122, 38 pp.
- Burges, A. 1967. The Decomposition of Organic Matter in the Soil. In Burges, A. and Raw, F. 1967 (eds.), *Soil Biology*. Academic Press, p. 479-92.
- Buzas, M.A. 1967. An Application of Canonical Analysis as a Method for Comparing Faunal Areas. *J. Anim. Ecol.* 36: 563-77.
- Castri, F. di, R. Covarrubias, and E. Hajek. 1966. Soil Ecosystems in Sub-Antarctic Regions. Symposium on Ecology of Sub-arctic Regions. UNESCO. Helsinki 1966.
- Covarrubias, R., and F. di Castri. 1964. Observaciones Ecologico-Cuantitativas sobre la Fauna Edáfica de Zonas Semi-áridas del Norte de Chile. *Monografías sobre Ecología y Biogeografía de Chile* 2.
- Crossley, D.A. Jr., and K.K. Bohnsack. 1960. Long Term Study in the Oak Ridge Area. III. The Oribatid Mite Fauna in Pine Litter. *Ecology* 41: 628-38.
- Crossley, D.A. Jr., and M. Witkamp. 1964. Forest Soil Mites and Mineral Cycling. *Acarologia* 6: 137-46.
- Cunningham, G.C. 1958. Forest Flora of Canada. Canada Dept. N. Affairs and Nat. Res., For. Br., Bull. 121, 144 pp.
- [Cunningham, G.C., and J.W. Summers] 1956. Native Trees of Canada. Canada Dept. N. Affairs and Nat. Res., For. Br., Bull. No. 61, 5th ed., Queens Printer, 293 pp.
- Curtis, J.T. 1959. The Vegetation of Wisconsin. An Ordination of Plant Communities. Univ. Wisconsin Press, Madison.
- Dalenius, P. 1960. Studies on the Oribatei (Acari) of the Torneträsk Territory in Swedish Lapland. I. A list of the habitats, and the composition of their Oribatid fauna. *Oikos* 11(1): 80-124.
- Dalenius, P., and O. Wilson. 1958. On the Soil Fauna of Antarctic and sub-Arctic Islands. The Oribatidae. *Ark. Zool.* 11(23): 393-425.
- Davis, B.N.K. 1963. A Study of Microarthropod Communities in Mineral Soils near Corby, Northants. *J. Anim. Ecol.* 32: 49-71.

- Drift, J. van der, 1951. Analysis of the Animal Community in a Beech Forest Floor. Tijdschr. Ent. 94: 1-168.
- Eitminavičiūtė, I. 1961. Distribution of Oribatei in Coniferous Forests. Forestry Abstracts. No. 2708.
- Emberson, R.E.M. 1968. The Mesostigmata of Certain Coniferous Forest Soils in Western Quebec, with a Preliminary Account of North American Rhodacaridae (Acarina). Unpubl. Ph.D. Thesis, McGill University, 349 pp.
- Englemann, M.D. 1961. The Role of Soil Arthropods in the Energetics of an Old Field Community. Ecol. Monogr. 31: 221-38.
- Evans, G.O. 1952. British Mites of the Genus Brachychthonius Berl., 1910. Ann. and Mag. Nat. Hist. ser. 12, vol.5, p. 228-39.
- Ewing, H.E. 1908. Two New Species of the genus Phthiracarus, Ent. News 19: 449-51, 2 figs.
- _____. 1908a. A New Genus and Species of Oribatidae. Ent. News 19: 243-45, pl. 11.
- _____. 1909. New American Oribatoidea. J. New York Ent. Soc. 17: 116-36.
- Ferrari, Th. J., H. Pijl, and J.T.N. Veneham. 1957. Factor Analysis in Agricultural Research. Neth. J. Agr. Sci. 5: 211-21.
- Ferrari, Th. J. 1965. Models and their testing: Considerations on the Methodology of Agricultural Research. Neth. J. Agric. Sci. 13(4): 366-77.
- Fisher, R.A., A.S. Corbet, and C.B. Williams. 1943. The Relation Between the Number of Species and the Number of Individuals in a Random Sample of an Animal Population. J. Anim. Ecol. 12: 42-58.
- Forsslund K.H. 1938. Über die Ernährungs verhältnisse der Hornmilben (Oribatiden) und ihre Bedeutung für die Prozesse im Waldboden. Verh. VII. Intern. Kongr. Ent. Berlin 1938, III: 1950-57.
- _____. 1941. Schwedische Arten der Gattung Suctobelba Paoli (Acari: Oribatei). Zool. Bidrag fr. Uppsala 20: 381-96.
- _____. 1943. Studier över det Lågre Djurlivet i Nordsvensk Skogsmark. Meddel. Från Statens Skogsförsöksanstalt. 34(1): 1-283.
- _____. 1942. Schwedische Oribatei (Acari) I. Arkiv. for Zoologi 34A (10): 1-11, figs. 1-14.
- _____. 1948. Något om Insamlingsmetodiken Vid Markfaunaundersökningar. Meddn. St. SkogsforsAnst. 37(7): 1-22.
- _____. 1957. Notizen über Oribatei (Acari) I. Ark. Zool. (2) 10: 583-93.

- _____. 1958. Notizen über Oribatei (Acari) II. Ent. Tidskr., Stockholm 79: 75-86, 17 ff.
- Franz, H. 1954. Sur l'importance de l'équilibre des biocénoses terricoles pour la fertilité des sols. 5th Int. Congr. Soil Sci. Leopoldville, III/23: 126-31.
- _____. 1963. Bioönotische und synökologische Untersuchungen über die Boden fauna und ihre Beziehungen zur Mikro- und Makroflora. In Doeksen J. and J. van der Drift (eds.). Soil Organisms p. 345-67.
- Frenzel, G. 1936. Untersuchungen über die Tierwelt des Weisenbodens, Jena 130 pp.
- Ghilarov, M.S. 1947. Distribution of Humus Root Systems and Soil Invertebrates within the Soil of the Walnut Forests of the Ferghana Mountain Range. Comptes Rendus (Doklady) Acad. Sci. U.R.S.S. 55(1): 49-52.
- _____. 1964. Distribution Peculiarities of Soil Dwelling Invertebrates in Different Zonal Soil Types. 8th Int. Congr. Soil Sci., Bucharest. Trans. Comptes Rendus Berichte III(2): 551-60.
- _____. 1965. Some Practical Problems of Soil Zoology Pedobiol. 5(3): 189-204.
- Gilmour, J.S.L. 1951. The Development of Taxonomic Theory since 1851. Nature 168: 400-2.
- Gittins, R. 1969. The Application of Ordination Techniques. In Rorison, I.H. Ecological Aspects of the Mineral Nutrition of Plants. Ecol. Soc. Symposium No. 9, Blackwell Sci. Publ., Oxford & Edinburgh, p. 37-66.
- Goodall, D.W. 1964. Objective Methods for the Classification of Vegetation. III. An Essay in the Use of Factor Analysis. Austr. J. Bot. 2: 304-24.
- Grandjean, F. 1929. Bull Soc. Zool. France. 54: 400-23.
- _____. 1932. Au sujet des Palaeacariformes Trag. Bull. Mus. Hist. nat. Paris, 2^e série, t.4, p. 411-26.
- _____. 1946. Les Enarthronota (Acariens). (1^e série). Ann. Sci. Nat., Zool., (11), 8: 213-48, figs 1-6.
- _____. 1948. Les Enarthronota (Acariens). (2^e série). Ibid. (11), 10: 29-58, figs. 1-7.
- _____. 1948a. L'origine de la pince mandibulaire chez les Acariens actinochéneux Arch. Sci. Phys. Nat. Genève (5), 29: 305-55, fig. 1-4.
- _____. 1950. Les Enarthronota (Acariens). (3^e série). Ann. Sci. Nat.,

- Zool., (11), 12: 85-107, figs. 1-7.
- _____. 1954. Étude Sur Les Palaeacaroides Mem. Mus. Nat. D'Hist. Nat. Paris, série A, t. VII(3): 179-274.
- _____. 1959. Polypterozetes cherubin Berl. 1916 (Oribate) Acarologia 1(1): 147-180.
- _____. 1961. Les Plasmobatidae n. fam. Ibid. 3: 96-129.
- _____. 1962. Au Sujet des Hermannelliidae. Prem. Part. Ibid. 4: 237-73.
- _____. 1962. Au Sujet des Hermannelliidae. Deux Part. Ibid. 4: 632-70.
- _____. 1965. Fosseremus quadripertitus nom. nov. (Oribate) Ibid. 7(2): 343-75.
- Graves, R.C. 1960. Ecological Observations on the Insects and other Inhabitants of Woody Shelf Fungi (Basidiomycetes: Polyporaceae) in the Chicago Area. Ann. Ent. Soc. Amer. 53: 61-78.
- Greig-Smith, P., M.P. Austin, and T.C. Whitmore. 1967. The Application of Quantitative Methods to Vegetation Survey I. Association-Analysis and Principal Component Ordination of Rain Forest. J. Ecol. 55: 483-503.
- Grim, R.E. 1962. Applied Clay Mineralogy. McGraw Hill. New York, Toronto and London. 422 pp.
- Haarlov, N. 1942. A Morphologic-Systematic-Ecological Investigation of Acarina and other representatives of the microfauna of the soil around Morkefjord N.E. Greenland. Medd. om Grønland 128(1): 71 pp., 3 pl.
- _____. 1955. Vertical Distribution of Mites and Collembola in Relation to Soil Structure. In Soil Zoology. Kevan, D.K. McE. (ed.) Butterworths, London, New York, p. 167-79.
- _____. 1960. Microarthropods from Danish Soils. Ecology, Phenology. Oikos suppl. 3: 176 pp.
- Hairston, N.G. 1959. Species Abundance and Community Organization. Ecology 40: 404-16.
- Halašková, V., and M. Kunst. 1960. Über einige Bodenmilbengruppen aus dem Moorgebiet "SOOS" in Böhmen (Acari: Gamasina, Zerconina, Oribatei). Acta Univ. Carolinae, Biol., Praha, Suppl., 11-58.
- Haller, G. 1884. Beschreibung einiger neuen Milben. Arch. f. Naturgesch. 50 Jahrg. 1 Bd: 217-36, Taf. XV & XVI.
- Hammen, L. van der. 1952. The Oribatei (Acari) of the Netherlands. Zool. Verh., No. 17, 139 pp., 12 figs.

- _____. 1956. Notes on the Oribatei (Acari) of Dutch New Guinea IV. Description of Trhypochthonius montanus nov. spec., and preliminary revision of the genus Trhypochthonius. Proc. Kon. Ned. Ak. Wet., Ser. C, 59(3): 398-404.
- _____. 1959. Berlese's Primitive Oribatid Mites. Zool. Verh. No. 40, 93 pp.
- Hammer, M. 1937. A Quantitative and Qualitative Investigation of the Microfauna Communities of the Soil at Angmagssalik and in Mikis Fjord. Medd. om Grønland, 108(2): 1-53.
- _____. 1952. Investigations on the microfauna of northern Canada. Part I. Oribatidae. Acta Arct., København, 4: 1-108, 106 figs.
- _____. 1952a. The Oribatid and Collembola fauna in some soil samples from Søndre Strømfjord. Ent. Medd., København, 26(5): 404-14, 3 figs, 1 t.
- _____. 1955. Alaskan Oribatids. Acta Arct., København, 7: 1-36, 5 pls.
- _____. 1961. Investigations of the Oribatid Fauna of the Andes Mountains. II. Peru. Biol. Skr. Dan. Vid. Selsk. 13(1): 1-157, 43 pls.
- _____. 1962. Idem. III. Chile. Ibid 13(2): 1-96, 30 pls.
- _____. 1967. Some Oribatids from Kodiak Island near Alaska. Acta Arct., København. 14: 1-25.
- _____. 1972. Microhabitats of Oribatid Mites on a Danish Woodland Floor. Pedobiol. 12(6): 412-23.
- Hartenstein, R. 1961. On the Distribution of Forest Soil Microarthropods and their fit to Contagious Distribution Functions. Ecology 42: 190-4.
- _____. 1962a. Soil Oribatei I. Feeding Specificity Among Forest Soil Oribatids. Ann. Ent. Soc. Amer. 55: 202-5.
- _____. 1962b. Soil Oribatei II. Belba kingi n.sp. (Acarina:Belbidae) and a Study of its Life History. Ibid. 55: 357-
- _____. 1962c. Soil Oribatei III. Studies on the Development, Biology, and Ecology of Metabelba montana (Kulcz) (Acarina:Belbidae) and Eremobelba nervosa n.sp. (Acarina:Eremaeidae). Ibid. 55: 361-7.
- _____. 1962d. Soil Oribatei IV. Observations on Ceratozetes gracilis (Acarina:Ceratozetidae) Ibid. 55: 583-6.
- _____. 1962e. Soil Oribatei V. Investigations on Platynothrus peltifer (Acarina:Camisiidae). Ibid. 55: 709-13.
- _____. 1962f. Soil Oribatei VI. Protoribates lophotrichus (Acarina:Haplozetidae) and its Associations with Microorganisms. Ibid.

55: 587-91.

- _____. 1962g. Soil Oribatei VII. Decomposition of Conifer Needles and Deciduous Leaf Petioles by Steganacarus diaphanum (Acarina:Phthiracaridae). Ibid. 55: 713-6.
- Hartman, A.G. 1949. A New Species of Nanhermannia with Notes on the Genus. Proc. Ent. Soc. Wash. 51(4): 169-171, 1 fig.
- Hayes, A.J. 1963. Studies on the Feeding Preferences of Some Phthiracarid Mites (Acar:Oribatidae) Ent. Exp. and Appl. 6: 241-56.
- _____. 1965. Studies on the Distribution of Some Phthiracarid Mites (Acar:Oribatidae) in a Coniferous Forest Soil. Pedobiol. 5(3): 252-61.
- _____. 1966. Studies on the Activity and Survival of Some Phthiracaroid Mites (Acar:Cryptostigmata) at Different Relative Humidities. Pedobiol. 6: 281-7.
- Heyer, J. den, and P.A.J. Ryke. 1966. A Mesofaunal Investigation of the Soil in a Thorn-tree (*Acacia karoo*) Biotope. Revista de Biol. 5(3-4): 309-64.
- Higgins, H.G. 1961. A New Beetle Mite from Utah (Gymnodamaeidae). Gt. Basin Nat. 21(1&2): 27-8.
- Hill, J.R. 1973. An Ordination of Oribatid Mite Fauna under Differing Forest Covers. In Daniel, M. and B. Rosický. Proc. 3rd Int. Congr. Acarology, Prague, 1971, W. Junk Publishers, the Hague, 85-90 pp.
- Hinschelwood, C. 1951. Decline and Death of Bacterial Populations. Nature, London, 167: 666-9.
- Horst, P. 1965. Factor Analysis of Data Matrices. Holt, Rinehart and Winston, New York.
- Hotelling, H. 1933. Analysis of a Complex of Statistical Variables into Principal Components. J. Educ. Psychol. 24: 417-41, 498-520.
- Hughes, R.D. 1962. The Study of Aggregated Populations. In Progress in Soil Zoology. Murphy, P.W. (ed.). Butterworths, London p. 51-5.
- Huhta, V., E. Karppinen, M. Nurminen, and A. Valpas. 1967. Effect of Silvicultural Practices upon Arthropod, Annelid, and Nematode Populations in Coniferous Forest Soil. Ann. Zool. Fenn. 4(2): 87-145.
- Huhta, V., M. Nurminen, and A. Valpas. 1969. Further Notes on the Effect of Silvicultural Practices upon the Fauna of Coniferous Forest Soil. Ann. Zool. Fenn. 6: 327-34.

Hull, J.E. 1916. Terrestrial Acari of the Tyne Province. Trans. Nat. Hist. Soc. Northumberland, Durham, and Newcastle-on-Tyne. New Series 4(2): 381-410, 1 pl.

Jaccard, P. 1902. Lois de distribution florale dans le zone alpine. Bull. Soc. Vaud. Sci. Natur. 38: 69-130.

Jacot, A.P. 1928. Cepheus (Oribatoidea), Especially in the Eastern United States. Trans. Am. Micr. Soc. 47: 262-71, 1 pl.

_____. 1930. Oribatid Mites of the Subfamily Phthiracarinae of the Northeastern United States. Proc. Boston Soc. Nat. Hist. 39: 209-61, pls. 33-42, 1 fig.

_____. 1930a. Moss Mites as Spore-bearers. Mycologia 22: 94-5, 1 fig.

_____. 1934. The Galumnas (Oribatoidea:Acarina) of the Northeastern United States. J. New York Ent. Soc. 42: 87-120, pl. X-XII.

_____. 1935. Fuscozetes (Oribatoidea:Acarina) in the Northeastern United States. J. New York Ent. Soc. 43: 311-318, pl. XXVI.

_____. 1935. The Species of Zetes (Oribatoidea:Acarina) in the Northeastern United States. J. N.Y. Ent. Soc. 43: 51-95, Pl. VII-X.

_____. 1936. Spruce Litter Reduction. Can. Ent. 68: 31.

_____. 1936a. Some Primitive Mossmites of North Carolina. J. Elisha Mitch. Sci. Soc. 52: 20-26.

_____. 1936b. More Primitive Moss-Mites of North Carolina. Ibid. 52(2): 247-54.

_____. 1936c. New Mossmites, Chiefly Midwestern. Amer. Midl. Nat. 17: 546-553, 10 figs.

_____. 1936d. Soil Structure and Soil Biology. Ecology 17: 359-79.

_____. 1937a. New Moss-Mites, Chiefly Midwestern II. Ibid. 18: 237-50, 3 pls.

_____. 1937b. Journal of North-American Moss-Mites. J. N.Y. Ent. Soc. 45: 353-71, 2 pls.

_____. 1938a. More Primitive Moss-Mites of North Carolina III. J. Elisha Mitch. Sci. Soc. 54: 127-37.

_____. 1938b. More Box-Mites of the Northeastern United States. J. N.Y. Ent. Soc. 46(2): 109-144.

_____. 1938d. Some New Western North Carolina Moss-Mites. Proc. Ent. Soc. Wash. 40(1): 10-15.

- _____. 1938e. Four New Arthropods from New England. *Am. Midl. Nat.* 20: 571-74.
- _____. 1938f. The Geenton Mites of Florida. *Fla. Ent.* 21(4): 49-57, 4 figs.
- _____. 1939. Reduction of Spruce and Fir Litter by Minute Animals. *J. Forestry* 37(11): 858-60.
- _____. 1939a. New Mites from the White Mountains. *Occas. Papers Boston Soc. Nat. Hist.* 8: 321-32, 21 figs.
- _____. 1939b. New Mites from Western North Carolina. *J. Elisha Mitch. Sci. Soc.* 55: 197-203, 1 pl.
- Johnston, D.E. 1967a. On the Occurrence of two species of Palaeacarus in the Eastern United States. *Proc. Ent. Soc. Wash.* 69(4): 301-2.
- _____. 1967b. Observations on Oribatei. The Discovery of Haplochthonius simplex (Willmann, 1930) in North America. *Ibid.* 69(4): 365.
- Kaiser, H.F. 1958. The Varimax Criterion for Analytical Rotation in Factor Analysis. *Psychometrika* 23(3): 187-200.
- Karg, W. 1967. Synökologische Untersuchungen von Bodenmilben aus fortwirtschaftlich und landwirtschaftlich genutzten Boden. *Pedobiol.* 7: 198-214.
- Karppinen, E. 1955. Ecological and Transect Studies on Finnish Camisiids. *Ann. Zool. Soc. Vanamö* 17: 1-80.
- _____. 1957. Die Oribatiden Fauna einiger Schlagund Brandflächen. *Ann. Ent. Fenn.* 23: 181-203.
- Kempson, D., M. Lloyd, and R. Gelhardi. 1963. A New Extractor for Woodland Litter. *Pedobiol.* 3(1): 1-21.
- Kevan, D.K.McE. 1962. *Soil Animals*. Witherby Ltd., London, 237 pp.
- Klovan, J.E., and G.K. Billings. 1967. Classification of Geological Samples by Discriminant Function Analysis. *Bull. Canad. Petroleum Geol.* 15(3): 313-30.
- Kontkanen, P. 1957. On the Delimitation of Communities in Research on Animal Biocoenotics. *Cold Spring Harb. Symp. on Quant. Biol.* 22: 373-8.
- Krivolutsky, D.A. 1964. Sellnickochthonius gen.n.—novyj rod pancirnych kleščej iz semejstva Brachychthonidae Balogh, 1943 (Acariformes, Oribatei — *Zool. Zhur.*, Moskva, 18(6): 935-36, 4 figs.
- _____. 1964a. [Chitinous Acarines of Certain Kinds of Forests of the Southern Taiga]. *Ref. Zh. Biol.* 1964. No. 12D161. Transl. in *Biol. Abstr.* 46(22), No. 100620:

- _____. 1965. [Morphological-Ecological types of Oribatid Mites]. (Russian with English Summary) Zool. Zh. 44(8): 1176-89.
- _____. 1966. [Oribatid Mites in Soils of the Tundra Zone]. (Russian with English Summary). Pedobiol. 6: 277-80.
- _____. 1968. [Some Regularities in the Zonal Distribution of Oribatoid Mites]. (Russian with English Summary) Oikos: 19: 339-44.
- Kühnelt, W. 1961. Soil Biology with Special Reference to the Animal Kingdom. Faber & Faber, London, 397 pp.
- _____. 1963a. Functionelle Beziehungen zwischen Bodentieren und Mikroorganismen. In Doeksen J. & J. van der Drift. Soil Organisms. North-Holland Publ. Co., Amsterdam. p. 333-41.
- _____. 1963b. Soil Inhabiting Arthropoda. Ann. Rev. Ent. 8: 115-136.
- Kunst, M. 1956. Nanhermannia komáreki n.sp. eine neue Oribatiden-Art aus Böhmen (Acarina:Oribatei). Acta Soc. Zool. Bohemoslov. 22(3): 267-72.
- La Grange, E. 1956. L'action antibiotique de Juglans regia L. Compt. Rend. Soc. Biol. 150: 613-15.
- Lajoie, P., and R. Baril. 1954. Soil Survey of Montreal, Jesus and Bizard Islands in the Province of Quebec. Can. Dept. Agric. Ottawa: 1-85 and 1 map.
- Lebrun, P. 1965. Contribution à L'étude Écologique des Oribatides. Inst. Roy. des Sci. Nat. de Belg., Mem. 153, 96 pp.
- _____. 1971. Écologie et Biocénotique de Quelques Peuplements d'Arthropodes Édaphique. Ibid. 165: 203 pp.
- Liberg, A.H.J., and J. Mol. 1961. Multiple Factor Analysis as a Method of Agricultural Research. Neth. J. Agric. 9: 269-80.
- Littlewood, C. 1969. A Surface Sterilization Technique in Feeding Algae to Oribatei. In Evans, G.O. (ed.). Proc. 2nd Int. Congr. Acarologie, p. 53-6.
- Long, H.D. 1955. The Plant Communities of Morgan's Woods. Unpubl. M.Sc. Thesis, McGill Univ. 82 pp., 46 tables, 82 maps.
- Luxton, M. 1972. Studies on the Oribatid Mites of a Danish Beech Wood Soil. I. Nutritional Biology. Pedobiol. 12: 434-63.
- Macfadyen, A. 1952. The Small Arthropods of a Molinia Fen at Cothill. J. Anim. Ecol. 21: 87-117.
- _____. 1953. Notes on Methods for the Extraction of Small Soil Arthropods. J. Anim. Ecol. 22: 65-77.

- _____. 1954. The Invertebrate Fauna of Jan Mayen Island (E. Greenland). J. Anim. Ecol. 23: 261-97.
- _____. 1961. Metabolism of Soil Invertebrates in Relation to Soil Fertility, Ann. Appl. Biol. 49: 215-18.
- _____. 1962. Soil Arthropod Sampling. Adv. Ecol. Res. 1: 1-30.
- _____. 1963. The Contribution of the Microfauna to the Total Soil Metabolism. In Doekson, J. & J. van der Drift (eds.) Soil Organisms. North-Holland Publ. Co., Amsterdam. 3-17.
- Maldague, M.E. 1961. Relations entre le couvert végétal et la Microfaune. Leur importance dans la Conservation Biologique des Sols Tropicaux. Publ. Inst. Nat'l Étude Agron., Congo, Belge, sér. sci., No. 90, 1-122.
- Margalef, R. 1951. Diversidad de especies en las comunidades naturales. P. Inst. Biol. Apl. 9: 5-27.
- _____. 1956. Información y Diversidad Específica en las Comunidades de Organismos. Inv. Pesq. 3: 99-106.
- Markel, K. 1964. Die Euphthiracaridae Jacot, 1930, und ihre Gattungen (Acari: Oribatei). Zool. Verhand. No. 67, 78 pp.
- Markel, K., and I. Meyer. 1959. Zur Systematik der Deutschen Euphthiracarini. Zool. Anz. 163: 327-42.
- Marshall, V.G. 1964. Studies on the Microarthropod Fauna of Two Quebec Woodland Humus Forms. Unpubl. Ph.D. Thesis, McGill Univ. 354 pp.
- Marshall, V.G., and R.M. Reeves. 1971. Trichthonius majestus, a new species of Oribatid Mite (Acarina: Cosmochthoniidae) from North America. Acarologia 12(3): 623-32.
- Michael, A.D. 1879. A Contribution to the Knowledge of British Oribatidae. J. Roy. Micr. Soc. 2: 225-51, 3 pls.
- _____. 1880. A Further Contribution to the Knowledge of British Oribatidae. J. Roy. Micr. Soc. 3: 179-201, pl. V-VI.
- _____. 1884. British Oribatidae. vol. 1, Roy Society, London.
- _____. 1885. New British Oribatidae. J. Roy. Micr. Soc. (2), 5: 385-97, 1 pl.
- _____. 1888. British Oribatidae, vol. 2, Roy Society, London.
- Minderman, G. 1960. Mull and Mor (Müller-Hesselman) in Relation to the Soil Water Regime of a Forest. Plant & Soil 13(1): 1-27.
- Miracle, M.R. 1974. Niche Structure in Freshwater Zoo-plankton, a Principal Component Approach. Ecol. 55(6): 1306-16.

- Moritz, M. 1963. Über Oribatiden gemeinschaften (Acari:Oribatei) norddeutscher Laubwaldböden unter besonderer Berücksichtigung der die Verteilung regelnden Milieubedingungen. *Pedobiol.* 3: 142-243.
- _____. 1970a. Beiträge zur Kenntnis der Oribatiden (Acari) Europas II. Abh. u. Berichte des Naturkundemuseums, Görlitz. 45(7): 1-8.
- _____. 1970b. Beiträge zur Kenntnis der Oribatiden (Acari) Europas I. *Ibid.* 45(6): 1-8.
- _____. 1970c. Revision von Suctobelba trigona (Michael, 1888). *Mitt. Zool. Mus. Berlin* 46(1): 135-66.
- _____. 1971. Beiträge zur Kenntnis der Oribatiden (Acari) Europas III. *Ibid.* 47(1): 85-98.
- Mountford, M.D. 1962. An Index of Similarity and its Application to Classificatory Problems. In Murphy, P.W. (ed.). *Progress in Soil Zoology*. Butterworths, London, 43-50 pp.
- Murphy, P.W. 1952. Soil Faunal Investigations. Report on Forest Research, 1951. Forestry Commission H.M.S.O.: p. 130-4.
- _____. 1953. The Biology of Forest Soils with Special Reference to the Mesofauna or Meiofauna. *J. Soil. Sci.* 4: 155-93.
- _____. 1955. Ecology of the Fauna of Forest Soils. In Kevan, D.K. McE., (ed.). *Soil Zoology*. Butterworths, London, 99-124 pp.
- _____. 1958. The Quantitative Study of Soil Meiofauna. I. The effect of sample treatment on extraction efficiency with a modified funnel extractor. *Ent. Exp. and Appl.* 1: 94-108.
- _____. 1962. The Split-funnel Extractor—A Modified Tullgren Funnel. In Murphy, P.W. (ed.). *Progress in Soil Zoology*. Butterworths, London pp. 174-8.
- Niedbala, W. 1968. Mechowce (Acari, Oribatei) nowe dla fauny Polski oraz nowe stanowiska kilku rzadkich gatunków. *Fragm. faun.* Warszawa, 15(1): 1-9, 5 ff.
- Norris, J.M. 1971. Singular Matrices in Multiple Discriminant Analysis and Classification Procedures. *Pedobiol.* 11: 410-16.
- Nosek, J. 1957. Výzkum půdní fauny jako součást výzkumu biocenoty Lesa II (L'exploration de la faune de sol comme une partie de l'exploration de la biocénose de la forêt.) *Biologické Práce. Slovensk. Akad. Vied., Bratislava*, 3(2): 7-96.
- _____. 1957a. Poznámky k ekologii půdní fauny s hlediska biologie pudy (Remarques à la connaissance de la faune terrestre du point de vue de la biologie du sol.) *Ibid.* 97-153.

- Numata, M. 1950. The Homogeneity of Plant Communities — Studies on the Structure of Plant Communities VI. Bot. Mag. (Tokyo) 63: 203-309.
- Orlœci, L. 1966. Geometric Models in Ecology. I. The Theory and Application of Some Ordination Methods. J. Ecol. 54: 193-215.
- Paoli, G. 1908. Monografia del Genere Dameosoma Berl. e generi affini. Redia 5: 31-91, 3 pls.
- Parks, J.M. 1966. Cluster Analysis Applied to Multivariate Geologic Problems. J. Geo. 74: 703-15.
- Preston, F.W. 1948. The Commonness and Rarity of Species. Ecology 29(3): 254-83.
- Price, D.W. 1967. Seasonal Changes in the Abundance and Distribution of the Micro-Arthropod Fauna in a California Pine Forest Soil. Unpubl. Ph.D. Thesis. Univ. Calif., Davis, 144 pp. Dissert Abstr. 28B(5): 2192.
- Pschorn-Walcher, H. 1952. Vergleich der Bodenfauna in Mischwäldern und Fichtenmonoculturen der Nordost-alpen. Mitt. forstl. Versuchsw. Anst. Mariabrunn 48: 44-111.
- Reeves, M. 1969. Seasonal Distribution of Some Forest Soil Oribatei. In Evans, G.O. (ed.). Proc. 2nd Int. Congr. Acarology, 23-30.
- Reeves, R.M., and V.G. Marshall, 1971. Redescription and Chaetotaxy of Brachychthonius lydiae Adults and Nymphs (Acarina:Oribatei). Ann. Ent. Soc. Amer. 64(2): 317-325, 6 ff., 2 tt.
- Rhode, C.J. 1955. Studies on Arthropods from a Moss Habitat with special emphasis on the Life History of three Oribatoid Mites. Unpubl. Ph.D., North Western Univ. Dissert. Abstr. 15(10): 1936.
- Riha, G. 1951. Zur Ökologie der Oribatiden in Kalksteinböden. Zool. Jb. Syst. 80: 407-50.
- Rockett, C.L., and J.P. Woodring. 1966. Oribatid Mites as Predators of Soil Nematodes. Ann. Ent. Soc. Amer. 59(4): 669-71.
- Rogers, W.S. 1939. Root Studies VIII: Apple Root Growth in Relation to Rootstock, Seasonal and Climatic Factors. J. Pomol. 17, 99.
- Rohlf, F.J., and R.R. Sokal. 1962. The Description of Taxonomic Relationships by Factor Analysis. Syst. Zool. 11: 1-16.
- Russell, E.W. 1961. Soil Conditions and Plant Growth. 9th ed.
- Satchell, J.E., and J.M. Nelson. 1962. A Comparison of the Tulgren Funnel and Flotation Methods of Extracting Acarina from Woodland Soil. In Murphy, P.W. (ed.). Progress in Soil Zoology, Butterworths, London, 212-16.

- Schaladybina, E.S. 1956. Vertical Migrations of Oribatid Mites. Zool. Zh. 35(4): 535-45. Abstract in Rev. Appl. Ent. 46B: 17, 1958.
- Schalk, V. 1968. Zur Bodenfauna von Wiesen und Luzerne-beständen unterschiedlicher Standorte unter besonderer Berücksichtigung der Oribatiden. Pedobiol. 8: 424-506.
- Schuster, R. 1956. Der Anteil der Oribatiden an den Zersetzungs-gängen im Boden. Z. Morph. u. Ökol. Tiere 45: 1-33.
- Sellnick, M. 1951. Zwei neue Milbenarten aus dem Marchfelde. Zeit. für Angew. Ent. 32: 275-78, 5 figs.
- . 1960. Hornmilben, Oribatei Nachtrag. Die Tierwelt Mitteleuropas, Leipzig 3(4): 45-136, 2 tt.
- Sellinck M., and K.H. Forsslund. 1953. Die Gattung Carabodes C.L. Koch 1836 in der schwedischen Bodenfauna (Acar. Oribat.). Ark. Zool. (2) 4(22): 367-390, 13 figs.
- . 1955. Die Camisiidae Schwedens (Acari, Oribatei). Ark. Zool. (2) 8(4): 473-530, 47 figs.
- Sengbush, H.G. 1954. Studies on the Life History of Three Oribatoid Mites with observations on other species. Ann. Ent. Soc. Amer. 47: 646-67.
- Simpson, E.H. 1949. Measurement of Diversity, Nature, Lond. 163-688.
- Sinha, R.N., H.A.H. Wallace, and F.S. Chebib. 1969. Principal Component Analysis of Interrelations among Fungi, Mites and Insects in Grain Bulk Ecosystems. Ecology 50(4): 536-47.
- Sinha, R.N., and J.E.M.H. van Bronswijk. 1970. Multivariate Analyses of Canadian and Japanese Populations of Glycyphagus destructor (Schrank) (Acarina Glycyphagidae) Res. Popul. Ecol., Kyoto, 12(2): 205-17.
- Sokal, R.R., and C.D. Michener. 1958. A Statistical Method for Evaluating Systematic Relationships. Univ. Kansas Sci. Bull. 38, p. 1409-38.
- Sokal, R.R., and P.H.A. Sneath. 1963. Principles of Numerical Taxonomy.
- Sørensen, T. 1948. A Method of Establishing Groups of Equal Amplitude in Plant Sociology Based on Similarity of Species Content. Dan. Vid. Selsk. Biol. Skr. 5(4): 1-34.
- Spearman, C. 1927. The Abilities of Man: Their Nature and Measurement. Macmillan, London.
- Spurr, W.A., and C.P. Bonini. 1973. Statistical Analysis for Business Decisions. R.D. Irwin Inc., Illinois.
- Strandtmann, R., and G. Wharton. 1958. Manual of Mesostigmatid Mites. Inst. of Acarology, Contrib No. 4, 330 pp, 96 figs.

- Strenzke, K. 1951. Die norddeutschen Arten der Gattungen Brachychthonius und Brachychochthonius (Acarina, Oribatei). Deutsche Zool. Zeit., Hannover-Berlin 1: 234-49, 13 ff.
- _____. 1952. Untersuchungen über die Tiergemeinschaften des Bodens: Die Oribatiden und ihre Synusien in den Böden Norddeutschlands. Zoologica, Stuttgart 37(104): 1-173.
- _____. 1953. Zwei neue Arten der Oribatiden-Gattung Nanhermannia. Zool. Anz. 150: 69-75, fig. 1-5.
- Stroud, C.P. 1953. An Application of Factor Analysis to the Systematics of Kalotermes. Syst. Zool. 2(2): 76-92.
- Stunkard, H.W. 1937. The Life Cycle of Moniezia expansa. Science 86: 312.
- Summers, D. 1975. The Influence of Black Walnut trees on Soil Microarthropods. Unpubl. M.Sc. Thesis, Univ. of Illinois.
- Talbot, P.H.B. 1952. Dispersal of Fungus Spores by Small Animals Inhabiting Wood and Bark Trans. Brit. Mycol. 35: 123-8.
- Tarras-Wahlberg, N. 1961. The Oribatei in a Central Swedish Bog and their Environment. Oikos Suppl. 4: 56 pp.
- Torne, E. von. 1967. Beispiele für indirekte Einflüsse von Bodentieren auf die Rotte von Zellulose. Pedobiol. 7: 220-7.
- Trägårdh, I. 1910. Acariden aus dem Sarekgebirge. Naturw. Untersuch. des Sarekgebirges. Zool. 4(4): 325-58.
- _____. 1931. Terrestrial Acarina. From Zoology of the Faroes, Copenhagen, 49: 1-69, 122 figs.
- Travé, J. 1963. Ecologie et Biologie des Oribatides Saxicoles et Arboricoles. Vie et Milieu, Suppl. 14: 1-267.
- Tuxen, S.L. 1952. Die Jungendstadien der nordischen Camistiden (Acar. Orib.). I Die Gattungen Nothrus, Platynothrus und Heminothrus. Ent. Medd. 26: 392-403, figs.
- Wallwork, J.A. 1957. The Acarina of a Hemlock-Yellow Birch Forest Floor. Unpubl. Ph.D. Thesis, Univ. of Michigan, 199 pp. Dissert. Abstr. 18(6): 2275-6.
- _____. 1959. The Distribution and Dynamics of Some Forest Soil Mites. Ecology 40(4): 558-63.
- _____. 1967. Acari. In Burges, A., and F. Raw (eds.). Soil Biology, Academic Press, Lond. and N.Y., p. 363-95.
- Weigmann, G. 1969. Zur Taxonomie der europäischen Scheloribatidae mit der Beschreibung von Topobates holsaticus n.sp. Seckenberg. biol. 50(5/6): 421-32, abb. 17.
- Weis-Fogh, T. 1948. Ecological Investigations on Mites and Collembolus in the Soil. Nat. Jutl. 1: 135-270, 31 figs. 21 tables.

- Williams, W.T., G.N. Lance, L.J. Webb, J.G. Tracy, and M.B. Dale. 1969. Numerical Analysis of Complex Rain-Forest Communities. III. The Analysis of Successional Data. *J. Ecol.* 57: 515-35.
- Willmann, C. 1919. Diagnosen einiger neuer Oribatiden aus der Umgebung Bremens. *Abh. Naturw. Ver. Bremen*, 24: 552-4.
- _____. 1928. I. Wissenschaftliche Mitteilungen 1. Neue Oribatiden 1. 76: 1-5, 5 figs.
- _____. 1928a. Die Oribatidenfauna nordwestdeutscher und einiger süddeutscher Moore. *Abh. Naturw. Ver. Bremen*: 27: 143-176, figs. 1-15.
- _____. 1931. Moosmilben oder Oribatiden (Oribatei). *Tiewelts Deutschlands*. 22: 79-200.
- _____. 1935. Faunistisch-ökologische Studien im Anningergebiet IV. Die Milbenfauna 1. Oribatei. *Zool. Jb. Abt. Syst., Oekol u. Geog. Tierre* 66: 331-44, figs. 14-25.
- _____. 1936. Neue Acari aus Schesischen Wiesinböden. *Zool. Anz.* 113: 273-290, figs. 1-22.
- Woodring, J.P. 1963. The Nutrition and Biology of Saprophytic Sarcoptiformes. In Naegle, J.A. (ed.). *Advances in Acarology*, Cornstock Publ. Assoc., N.Y., vol. 1: 89-111.
- Woodring, J.P., and E.F. Cook. 1962. The Biology of Ceratozetes cisalpinus, Scheloribates laevigatus, and Oppia neerlandica, with a description of all stages. *Acarologia* 4: 101-137.
- Woolley, T.A. 1955. A Redescription of Nothrus quadripilis Ewing and its relationships to other species of the genus (Acarina, Oribatei, Camisiaidae). *Proc. Ent. Soc. Wash.* 57(5): 219-222.
- _____. 1958. Redescriptions of Ewing's Oribatid Mites VI Family Liacaridae (Acarina:Oribatei). *Trans. Am. Micr. Soc.* 77(1): 1-10, 13 figs.
- _____. 1959. Redescription of Ewing's Oribatid Mites, VIII-IX. *Ibid.* 78: 258-79.
- _____. 1966. A Review of the Family Oripodidae (Acarina:Oribatei). *Ibid.* 85(1): 2-29, 25 figs.
- _____. 1968. North American Liacaridae, II Liacarus (Acari: Cryptostigmata) *J. Kansas Ent. Soc.* 41(3): 350-66, 21 figs.
- _____. 1967. North American Liacaridae, I, Adoristes and a Related New Genus. *Ibid.* 40(3): 270-6, 12 figs.
- _____. 1972. A New Species of Gymnodamaeus from Colorado. *Gt. Basin Nat.* 32(2): 97-103.

_____. 1973. Two New Species of Gymnodamaeus from Colorado.
(Acarina: Cryptostigmata: Gymnodamaeidae). Ibid. 33(1):
37-42, 4 figs.

Woolley, T.A., and H.G. Higgins. 1963. The Genus Eremulus Berlese,
1908 with a Description of a New Species. (Oribatei,
Eremaeidae). Acarologia 5(1): 97-101, 4 figs.

APPENDIX A:

Annotated Species List

Appendix: A

PALAEACAROIDEA

PALAEACARIDAE

Palaeacarus hystericinus Tragardh, 1932 - 115 ex.

Synonym: Palaeacarus appalachicus Jacot, 1938.

Size: $365\mu \times 197\mu$; $5.75\mu g$ (21 meas.).

Sites: 6(He), 5(He), 10(GBRM), 7(BeRM), 4(Be), & 2(Be).

Horizons: F - H.

Distribution: Europe, Asia, North America.

References: Grandjean (1932, 1954); Jacot (1938a),

Johnston (1967a).

CTENACAROIDEA

APHELACARIDAE

Aphelacarus acarinus (Berlese, 1910) - 1 tritonymph.

Synonym: Parypochthonius acarinus Berlese, 1910.

Size: $391\mu \times 145\mu$; $4.01\mu g$.

Site: 2(Be). Horizon: A + B.

Distribution: Cosmopolitan?

References: Berlese (1910); Grandjean (1954).

MESOPLOPHOROIDEA

MESOPLOPHORIDAE

Archoplophora laevis (Jacot, 1938) - 159 ex.

Synonym: Phtiracarulus laevis Jacot, 1938.

Size: $347\mu \times 221\mu$; $6.40\mu g$ (14 meas.).

Site: 6(He). Horizons: F - H.

Distribution: North America.

References: Hammen (1959), Jacot (1938b).

PHTHIRACAROIDEA

PHTHIRACARIDAE

Phthiracarus boresetosus Jacot, 1930 - 2 ex.

Size: $540\mu \times 360\mu$; $26.4\mu g$ (2 meas.).

Sites: 10(GBRM) & 4(Be). Horizons: L - F.

Distribution: North America.

References: Jacot (1930, 1938b).

Phthiracarus setosellum Jacot, 1930 - 8 ex.

Size: $844\mu \times 483\mu$; $84.6\mu g$ (3 meas.).

Sites: 7(BeRM), 4(Be), 10(GBRM), & 12(WA). Horizons: F.

Distribution: North America.

References: Jacot (1930, 1938b).

Phthiracarus setosus (Banks, 1895) - 2 ex.

Synonym: Hoplophora setosa Banks, 1895.

Size: $778\mu \times 418\mu$; $58.01\mu g$ (1 meas.).

Sites: 8(LTA), & 12(WA). Horizons: L - F.

Distribution: North America.

References: Banks (1895), Jacot (1930, 1938b).

Phthiracarus sphaerulum (Banks, 1895) - 8 ex.Synonym: Hoplophora sphaerula Banks, 1895.Size: $747\mu \times 465\mu$; $64.2\mu g$ (4 meas.).

Sites: 1(GBRM), 11(TA), & 2(Be). Horizons: F.

Distribution: North America.

References: Banks (1895), Jacot (1930, 1938b)

Steganacarus diaphanum Jacot, 1930 - 144 ex.Synonym: Steganacarus striculus diaphanus Jacot, 1930.Size: $509\mu \times 254\mu$; $14.2\mu g$ (20 meas.).Sites: 6(He), 3(WA), 8(LTA), 9(BERMRO), 10(GBRM), 4(Be),
5(He), 12(WA), & 11(TA). Horizons: L - F.

Distribution: North America.

References: Jacot (1930, 1938b).

EUPHTHIRACARIDAE

Euphthiracarus flavus? (Ewing, 1908) - 6 ex.Synonym: Phthiracarus flavus Ewing, 1908.Size: $917\mu \times 523\mu$; $105.3\mu g$ (6 meas.).

Sites: 9(BERMRO), 7(BERM), & 10(GBRM). Horizons: L - F.

Distribution: North America.

References: Ewing (1908), Hammen (1959), Jacot (1930, 1938b).

Note: Specimens significantly larger than type (.78 mm.)
from Urbana, Illinois.Euphthiracarus monodactylus (Willmann, 1919) - 3 ex.Synonym: Pseudotritia monodactyla Willmann, 1919.Size: $519\mu \times 275\mu$; $16.34\mu g$ (3 meas.).

Sites: 9(BERMRO). Horizons: L - F.

Distribution: Europe

References: Markel (1964), Willmann (1919).

Note: Similar to Markel's description except smaller.

Microtritia minima (Berlese, 1904) - 188 ex.Synonyms: Phthiracarus minimus Berlese, 1904,Pseudotritia minima Willmann 1931.Size: $383\mu \times 218\mu$; $7.23\mu g$ (21 meas.).Sites: 2(Be), 5(He), 7(BERM), 4(Be), 6(He), 10(GBRM),
8(LTA), 1(GBRM), & 9(BERMRO). Horizons: L - H.

Distribution: Europe, North America.

References: Berlese (1904), Markel (1964), Markel & Meyer
(1959).Note: Considerable variation in size, eg., length of
notogaster ranged from 218μ to 336μ .

Rhysotritia ardua (C. L. Koch, 1841) - 12 ex.

Synonyms: Hoplophora ardua Koch, 1841; Pseudotritia ardua Jacot, 1930; Oribotritia loricata Willmann, 1931.

Size: $730\mu \times 389\mu$; $47.2\mu g$ (6 meas.).

Sites: 1(GBRM), 11(TA), 10(GBRM), 7(GBRM), 5(He), & 8(LTA). Horizons: F.

Distribution: Europe, North America, Asia.

References: Jacot (1930, 1938b), Markel & Meyer (1959), Markel (1964).

PARHYPOCHTHONOIDEA

PARHYPOCHTHONIIDAE

ParhyPOCHthonius aphidinus Berlese, 1904 - 151 ex.

Size: $451\mu \times 218\mu$; $9.29\mu g$ (11 meas.).

Sites: 5(He), 6(He), & 4(Be). Horizons: F - H.

Distribution: Europe, North America, Asia

References: Berlese (1904), Jacot (1938c).

Note: Compares with P. aphidinus octofilamentis Jacot, 1938.

GEHYPOCHTHONIIDAE

GehyPOCHthonius rhadamanthus Jacot, 1936 - 211 ex.

Size: $265\mu \times 107\mu$; $1.49\mu g$ (25 meas.).

Sites: 7(BeRM), 5(He), 6(He), 9(BeRM), 10(GBRM), & 2(Be). Horizons: F - H.

Distribution: North America, Europe.

References: Jacot (1936a, 1938a).

HYPOCHTHONOIDEA

HYPOCHTHONIIDAE

HypoCHthonius rufulus C. L. Koch, 1836 - 28 ex.

Size: $651\mu \times 363\mu$; $35.6\mu g$ (3 meas.).

Sites: 9(BeRM), & 8(LTA). Horizons: F - H.

Distribution: Europe, North America.

References: Jacot (1936a, 1936b), Willmann (1931).

ENIOCHTHONIIDAE

HypoCHthoniella minutissimus (Berlese, 1904) - 205 ex.

Synonyms: HypoCHthonius minutissimus Berlese, 1904;

HypoCHthonius (HypoCHthoniella) pallidulus Berlese, 1910; EnioCHthonius pallidulus Grandjean, 1933.

Size: $380\mu \times 195\mu$; $6.04\mu g$ (23 meas.).

Sites: 6(He), 9(BeRM), 4(Be), 2(Be), 10(GBRM), 5(He), 3(WA), & 7(BeRM). Horizons: F - H.

Distribution: Europe, North America, S. America, New Zealand.

References: Berlese (1904b, 1910), Hammen (1959), Kunst (1959).

COSMOCHTHONOIDEA

COSMOCHTHONIIDAE

Cosmochthonius lanatus? (Michael, 1885) - 1 ex.

Synonyms: Hypochthonius lanatus Michael, 1885;

Cosmochthonius domesticus Grandjean, 1950.

Size: $264\mu \times 136\mu$; $1.99\mu\text{g}$ (1 meas.).

Site: 10(GBRM). Horizon:

Distribution:

References: Grandjean (1948, 1950b), Hammen (1952), Michael (1885).

Trichthonius majestus Marshall, 1971 - 451 ex.

Size: $220\mu \times 121\mu$; $1.26\mu\text{g}$ (23 meas.).

Sites: 6(He) & 5(He). Horizon: F - H.

Distribution: Quebec.

References: Marshall (1971).

HAPLOCHTHONIIDAE

Haplochthonius simplex? Willmann, 1930 - 1 ex.

Synonym: Cosmochthomius (Haplochthonius) simplex Willmann 1930.

Size: $282\mu \times 146\mu$; $2.5\mu\text{g}$.

Site: 1(GBRM). Horizon: A + B.

Distribution: Cosmopolitan?

References: Grandjean (1946), Johnston (1967b), Willmann (1930).

Note: Johnston suggests that this xerophilous species may occur in Berlese extracts due to contamination in the lab.

BRACHYCHTHONOIDEA

BRACHYCHTHONIIDAE

Brachychthonius arcticus Hammer, 1952 - 76 ex.

Size: $164\mu \times 86\mu$; $.48\mu\text{g}$ (24 meas.).

Sites: 7(BeRM), 10(GBRM), 1(GBRM), 3(WA), 11(TA), 5(He), 4(Be), 2(Be), & 9(BeRM). Horizons: L - H - A?

Distribution: Canada.

References: Hammer (1952).

Brachychthonius berlesei Willmann, 1928 - 70 ex.

Synonym: Brachychochthonius berlesei (Willmann, 1928).

Size: $169\mu \times 88\mu$; $.52\mu\text{g}$ (22 meas.).

Sites: 5(He), 10(GBRM), 4(Be), 6(He), 2(Be), 7(BeRM), & 1(GBRM). Horizons: L - H.

Distribution: Europe, Asia, North America.

References: Evans (1952), Halaskova & Kunst (1960), Jacot (1938a), Willmann (1931).

Brachychthonius nr. berlesei - 284 ex.Size: $168\mu \times 93\mu$; $.56\mu g$ (12 meas.)

Sites: 6(He), 10(GBRM), 7(BeRM), 5(He), 1(GBRM), 2(Be), & 11(TA). Horizons: L - H.

Note: Similar to both B. berlesei and B. jugatus except median divisions between areolations reduced and ridges surrounding areolations regular, not crenulated, compared to B. jugatus.Brachychthonius bimaculatus Willmann, 1936 - 1108 ex.Size: $162\mu \times 68\mu$; $.33\mu g$ (33 meas.)

Sites: 1(GBRM), 2(Be), 9(BeRM), 10(GBRM), 4(Be), 7(BeRM), & 11(TA). Horizons: L - A.

Distribution: Europe, North America.

References: Evans (1952), Niedbala (1968), Willmann (1936)

Brachychthonius nr. bimaculatus - 272 ex.Size: $170\mu \times 70\mu$; $.37\mu g$ (9 meas.)

Sites: 1(GBRM), 2(Be). Horizons: L - A.

Note: Sculpture reduced compared to B. bimaculatus except for "glandular rings" which are very prominent; dorsal notogastral setae (exc. C₃) longer and filiform.Brachychthonius italicus Berlese, 1910 - 94 ex.Synonym: Brachychochthonius italicus (Berlese, 1910)Size: $172\mu \times 95\mu$; $.60\mu g$ (18 meas.)

Sites: 9(GBRM), 6(He), 7(BeRM), 2(Be), 5(He), & 11(TA)

Horizons: L - H.

Distribution: Europe, North America.

References: Berlese (1910), Jacot (1936b).

Note: Species designated B. brevis var. italicus by Berlese (1910). Specimens compare with B. italicus spiciger of Jacot (1936b).Brachychthonius nr. immaculatus - 1 ex.Size: $164\mu \times 91\mu$; $.52\mu g$.

Site: 3(WA). Horizon:

Reference: Forsslund (1942).

Note: Like B. immaculatus except sensillus long and narrow with stiff bristles.Brachychthonius jugatus (Jacot, 1938) - 2711 ex.Synonym: Brachychochthonius jugatus Jacot, 1938.Size: $154\mu \times 83\mu$; $.41\mu g$ (34 meas.)

Sites: 10(GBRM), 7(BeRM), 2(Be), 1(GBRM), 4(He), 9(BeRM), 6(He), 4(Be), 8(LTA), & 3(WA). Horizons: F - A.

Distribution: North America

References: Forsslund (1942); Hammen (1952); Jacot (1938a).

Brachychthonius nr. jugatus #1 - 1388 ex.Size: $150\mu \times 71\mu$; $.31\mu g$ (22 meas.).

Sites: 7(BeRM), 1(GBRM), 9(BeRM), 10(GBRM), 2(Be), 11(TA), 5(He), 6(He), & 3(WA). Horizons: F - A.

Note: Similar to B. jugatus but sculpture weaker; setae la , c_2 and c_3 serrated.Brachychthonius nr. jugatus #2. - 2176 ex.Size: $171\mu \times 62\mu$; $.31\mu g$ (28 meas.).

Sites: 9(BeRM), 1(GBRM), 11(TA), 10(GBRM), 7(BeRM), 2(Be) & 4(Be). Horizons: F - H.

Note: Dorsal setae serrate and sensillus shorter than B. jugatus.Brachychthonius lydiae Jacot, 1938 - 35 ex.Synonym: Brachychochthonius lydiae Jacot, 1938.Size: $152\mu \times 80\mu$; $.38\mu g$ (14 meas.).

Sites: 4(Be), 2(Be), 5(He), 10(GBRM), 7(BeRM), 9(BeRM), & 6(He). Horizons: F - H.

Distribution: North America.

References: Reeves & Marshall (1971), Jacot (1938).

Brachychthonius rostratus Jacot, 1936 - 19 ex.Synonyms: Brachychochthonius rostratus Jacot, 1938a;Sellnickochthonius rostratus Krivolutsky, 1964.Size: $173\mu \times 93\mu$; $.58\mu g$ (14 meas.).

Sites: 6(He), & 10(GBRM). Horizons: F - H.

Distribution: Europe, North America.

References: Evans (1952), Krivolutsky (1964), Jacot (1936b, 1938a).

Brachychthonius suecicus (Forsslund 1942) - 7844 ex.Synonym: Brachychochthonius jugatus var. suecica Forsslund, 1942.Size: $149\mu \times 71\mu$; $.31\mu g$ (30 meas.).

Sites: 5(He), 7(BeRM), 2(Be), 6(He), 10(GBRM), 4(Be), 1(GBRM), 8(LTA), 9(BeRM), & 3(WA). Horizons: F - A.

Distribution: Europe, North America.

References: Forsslund (1942), Hammen (1952), & Niedbala (1968).

Note: Similar to Forsslund's description except sensillus shorter with only 5 or 6 rows of setae. Also, the two dorsal "glandular" areolations more prominent.

Brachychthonius nr. seucicus - 351 ex.Size: $147\mu \times 71\mu$; $.30\mu g$ (7 meas.).

Site: 11(TA). Horizons: F - A.

Note: Similar to B. seucicus but "glandular" rings more prominent.

Brachychthonius zelawaiensis Sellnick, 1929 - 104 ex.

Synonyms: Brachychochthonius zelawaiensis Jacot 1938;
Sellnickochthonius zelawaiensis Krivolutsky, 1964.

Size: $147\mu \times 80\mu$; $.36\mu$ g (16 meas.).

Sites: 5(He), 6(He), & 8(LTA). Horizons: F.

Distribution: Europe, North America

References: Evans (1952), Jacot (1938a), Krivolutsky (1964), Sellnick (1960), Willmann (1931).

Brachychthonius n. sp. - 95 ex.

Size: $155\mu \times 78\mu$; $.38\mu$ g (9 meas.).

Sites: 11(TA), 3(WA), & 4(Be). Horizons: F - H.

Note: Similar to B. jugatus except dorsal setae biserate.

Eobrachychthonius latior Berlese, 1910 - 321 ex.

Synonym: Eobrachychthonius sexnotatus Jacot, 1936

Size: $302\mu \times 180\mu$; 3.75μ g (6 meas.).

Sites: 4(Be), 10(GBRM), 2(Be), 5(He), 8(LTA), & 7(BeRM).

Horizons: F - H.

Distribution: North America.

References: Berlese (1910), Forsslund (1957), Hammer (1952, 1952a), Jacot (1936a).

Liochthonius horridus (Sellnick, 1929) - 126 ex.

Synonym: Brachychthonius horridus Sellnick, 1929.

Size: $167\mu \times 94\mu$; $.56\mu$ g (15 meas.).

Sites: 4(Be), 2(Be), 10(GBRM), 6(He), 9(BeRM), & 7(BeRM). Horizons: F - H.

Distribution: Europe, North America.

References: Evans (1952), Forsslund (1958), Willmann (1931).

Liochthonius hystricinus (Forsslund, 1942) - 79 ex.

Synonym: Brachychthonius hystricinus Forsslund, 1942.

Size: $161\mu \times 89\mu$; $.49\mu$ g (8 meas.).

Sites: 11(TA), 2(Be), 4(Be), & 10(GBRM). Horizons: F - H.

Distribution: Europe, North America.

References: Forsslund (1942, 1957), Strenzke (1951).

Note: Smaller than Forsslund's material. Length 155-164 cf. 182-204. Seta cl (a1 of Forsslund) does not reach dorsosejugal suture.

Liochthonius marginatus? (Forsslund, 1942) - 1 tritonymph

Synonym: Brachychthonius marginatus Forsslund, 1942.

Size: $186\mu \times 109\mu$; $.82\mu$ g.

Site: 1(GBRM). Horizon: F.

Distribution: Europe.

References: Evans (1952), Forsslund (1942), Niedbala (1968).

Liochthonius perpusillus? (Berlese, 1910) - 217 ex.Synonym: Brachychthonius perpusillus Berlese, 1910.Size: $176\mu \times 101\mu$; $.68\mu g$ (20 meas.).

Sites: 4(Be), 5(He), 6(He), 2(Be), 7(BeRM), 10(GBRM), 1(GBRM), 11(TA), 3(WA), & 8(LTA). Horizons: F - H.

Distribution: Europe, North America.

References: Berlese (1910), Evans (1952), Grandjean (1963), Forsslund (1942, 1957), Hammer (1952), Niedbala (1968).

Liochthonius pilosetosus (Forsslund 1942) - 45 ex.Synonym: Brachychthonius pilosetosus Forsslund, 1942.Size: $181\mu \times 87\mu$; $.57\mu g$ (9 meas.).

Sites: 2(Be), 5(He), 4(Be), 6(He), & 10(GBRM).

Horizons: F - H.

Distribution: Europe, North America.

References: Forsslund (1942).

Liochthonius piluliferus? (Forsslund, 1942) - 27 ex.Synonym: Brachychthonius piluliferus Forsslund, 1942.Size: $144\mu \times 63\mu$; $.24\mu g$ (9 meas.).

Sites: 9(BeRM), 4(Be), 5(He), & 1(GBRM). Horizons: F - H.

Distribution: Europe.

References: Forsslund (1942), Evans (1952).

Liochthonius nr. piluliferus #1 - 40 ex.Size: $148\mu \times 58\mu$; $.22\mu g$ (5 meas.).

Sites: 1(GBRM) & 9(BeRMRO). Horizons: F - A.

Liochthonius nr. piluliferus #2 - 25 ex.Size: $156\mu \times 74\mu$; $.35\mu g$ (6 meas.).

Sites: 1(GBRM). Horizons: F - A.

Liochthonius nr. piluliferus #3 - 13 ex.Size: $151\mu \times 72\mu$; $.32\mu g$ (6 meas.).

Sites: 4(Be), 7(BeRM), 5(He), 1(GBRM), & 10(GBRM).

Horizons: F.

Liochthonius nr. piluliferus #4 - 4 ex.Size: $189\mu \times 92\mu$; $.72\mu g$ (3 meas.).

Sites: 1(GBRM), & 2(Be). Horizons: F - H.

Note: Dorsal notogastral setae 24, simple. Similar to L. globuliferus (Strenzke 1951, p. 243), except dorsal notogastral setae appear simple rather than long, lanceolate. Three pairs of median areolations visible on propodosoma.

Liochthonius nr. piluliferus #5 - 1 ex.Size: 111μ X 63μ ; $.16\mu\text{g}$

Site: 4(Be). Horizon: H

Note: Dorsal notogastral setae 7, branched.

Liochthonius nr. piluliferus #6 - 82 ex.Size: 135μ X 67μ ; $.24\mu\text{g}$ (16 meas.)Sites: 11(TA), 5(He), 4(Be), 6(He), 7(BeRM), 9(BeRM)
& 1(GBRM). Horizons: F - H.Note: Dorsal notogastral setae 8, stout serrate;
sensillus strawberry shaped.Liochthonius sp. #1 [possibly L. lapponicus (Trag. 1910)] -
715 ex.Size: 157μ X 88μ ; $.46\mu\text{g}$ (30 meas.).

Sites: 5(He), 6(He), 2(Be), 4(Be), 10(GBRM), & 7(BeRM).

Horizons: F - H.

References: Tragardh (1910).

Notes: Dorsal notogastral setae 10-11 weakly lanceolate;
sensillus broadly fusiform and very finely pilose.
Rostral setae do not reach tip of rostrum. Lamellar
setae directed backwards.Liochthonius sp. #2 ([possible L. simplex (Forsslund 1942)]
- 549 ex.Size: 162μ X 92μ ; $.52\mu\text{g}$ (28 meas.)Sites: 10(GBRM), 7(BeRM), 4(Be), 5(He), 2(Be), 6(He),
11(TA), 1(GBRM), & 9(BeRM). Horizons: F - H.

References: Forsslund (1942), Evans (1952).

Liochthonius sp. #3 - 87 ex.Size: 174μ X 104μ ; $.70\mu\text{g}$ (14 meas.).

Sites: 5(He), 6(He), 1(GBRM), & 7(BeRM). Horizon: F.

Notes: Dorsal notogastral setae very short (5-8);
setae c_1 , ila , and la only 5; setae la bent medially;
ro. setae l_4 , weakly lanceolate; sensillus cleft,
quite finely pilose with about 12 rows.Liochthonius sp. #4, [possibly L. sellnicki (Sigthor, 1930)]
- 296 ex.Synonym: Brachychthonius sellnicki Sigthor, 1930Size: 170μ X 99μ ; $.63\mu\text{g}$ (28 meas.)Sites: 7(BeRM), 11(TA), 5(He), 3(WA), 1(GBRM), 8(LTA),
12(WA), 2(Be), 10(GBRM), 9(BeRM), & 4(Be).

Horizon: F - H.

References: Evans (1952); Hammer (1952a); Forsslund
(1957); Strenzke (1951).Notes: Similar to L. scalaris except posterior segment
of hysterosoma smoother and dorsal notogastral setae
shorter (12-14). Resembles illustration of L.
sellnicki in Evans (1952) in which dorsal notogastral

setae are narrow lanceolate with attenuated tip. Strenzke (1951) considers L. sellnicki synonymous with L. scalaris but Hammer (1952a) considers them separate species. If one accepts the latter L. #4 is probably L. sellnicki.

Liochthonius scalaris? (Forsslund, 1942) - 6 ex.

Synonym: Brachychthonius scalaris Forsslund, 1942.

Size: $197\mu \times 126\mu$; 113μ g (8 meas.).

Sites: 2(Be) & 6(He). Horizons: F.

References: Hammer (1942, 1952a); Strenzke (1951), Forsslund (1942, 1957).

Notes: As in Forsslund (1942) except propodosomal areolations closer together, second and third pair appressed. Also, three areolations lateral to seta Fl Sensillus cleft. Compares with Hammer (1952, p. 17, fig. 6) except propodosomal areolations separated. Dorsal notogastral setae 18-20.

Liochthonius sp. nr. #4 - 80 ex.

Size: $168\mu \times 99\mu$; $.61\mu$ g (28 meas.).

Sites: 11(TA), 10(GBRM), 3(WA), & 4(Be). Horizons: F-H.

Note: Dorsal notogastral setae broad lanceolate, 14 long $\times$ 4 wide.

Liochthonius sp. - 43 ex. (larvae only).

Size: $107\mu \times 60\mu$; $.14\mu$ g (2 meas.).

Site: 6(He). Horizons: L - F.

Note: Large stout simple notogastral setae.

Synchthonius crenulatus (Jacot, 1938) - 55 ex.

Synonyms: Brachychochthonius crenulatus Jacot, 1938;

Braelychthonius crenulatus Hammer, 1952.

Size: $193\mu \times 11\mu$; $.91\mu$ g (18 meas.).

Sites: 10(GBRM), 6(He), 4(Be), 2(Be), & 5(He).

Horizons: H.

Distribution: North America

References: Jacot (1938), Halaskova & Kunst (1960), Hammen (1952), Hammer (1952a), Forsslund (1956).

PHYLLOCHTHONOIDEA

ATOPOCHTHONIIDAE

Atopochthonius artiodactylus Grandjean, 1948 - 222 ex.

Size: $196\mu \times 109\mu$; $.90\mu$ g (22 meas.).

Sites: 2(Be), 10(GBRM), 5(He), 4(Be), 8(LTA), 7(BeRM), 6(He). Horizons: L - H.

Distribution: Europe, North America

References: Grandjean (1948); Forsslund (1956).

PTEROCHTHONIIDAE

Pterochthonius angelus (Berlese, 1910) - 62 ex.

Synonym: Cosmochthonius angelus Berlese, 1910.

Size: $327\mu \times 198\mu$; 4.91μ g (14 meas.)

Sites: 10(GBRM), 6(He), & 2(Be). Horizons: F.

Distribution: Europe, North America

References: Grandjean (1948a, 1950), Berlese (1913)

EULOHMANNOIDEA

EULOHMANNIIDAE

Eulohmannia ribagai (Berlese, 1910) - 18 ex.

Synonym: Lohmannia (Eulohmannia) ribagai Berlese, 1910.

Size: $717\mu \times 243\mu$; 22.4μ g (3 meas.)

Sites: 3(WA), 8(LTA), & 10(GBRM). Horizon: H - A.

Distribution: Cosmopolitan?

References: Berlese (1910), Hammer (1952)

NOTHROIDEA

NOTHRIDAE

Nothrus silvestris Nicolet, 1855 - 380 ex.

Size: $857\mu \times 451\mu$; 75.4μ g (14 meas.)

Sites: 6(He), 10(GBRM), 8(LTA), 4(Be), 2(Be), 9(BeRMRO), 1(GBRM), & 5(He). Horizons: L - H.

Distribution: Europe, North America

References: Hammer (1952), Jacot (1937a, 1937b), Sellnick & Forsslund (1955), Tuxen (1952).

Nothrus sp. - 62 ex.

Size: $720\mu \times 375\mu$; 43.6μ g (5 meas.)

Sites: 8(LTA), 2(Be), 4(Be), 11(TA), 12(TA), 7(BeRM) & 1(GBRM). Horizons: F - H.

Note: Monodactyl posterior notogastral setae clavate fimbriate, lateral and medial pairs nearly equal in length.

Nothrus sp. A - 67 ex.

Size: $847\mu \times 470\mu$; 79.1μ g (5 meas.)

Sites: 11(TA). Horizons: L - H.

Note: Tridactyl, adult resembles N. biciliatus (Koch, 1841)

CAMISSIIDAE

Camisia sp. - 26 ex.

Size: $735\mu \times 423\mu$; 57.13μ g (8 meas.)

Sites: 10(GBRM), & 7(BeRM). Horizons: L - H.

Note: Similar to Camisia lapponica (Tragardh, 1910) except smaller (length 735μ cf. 870μ), propodosoma not punctate, and dorsal notogastral setae larger.

Heminothrus interlamellaris (Jacot, 1939) - 7 ex.

Synonym: Heminothrus longisetosus interlamellaris Jacot, 1939.

Size: $698\mu \times 363\mu$; $45.1\mu g$ (3 meas.)

Sites: 8(LTA), & 10(GBRM). Horizons: L - F.

Distribution: North America

References: Berlese (1913), Hammen (1959), Jacot (1939a), Sellnick & Forsslund (1955), Tuxen (1952), Willmann (1931).

TRHYPOCHTHONIIDAE

Trhypochthonius silvestris Jacot, 1937 - 45 ex.

Size: $532\mu \times 324\mu$; $220\mu g$ (3 meas.)

Sites: 5(He) & 10(GBRM). Horizons: L - F.

Distribution: North America

References: Jacot (1937b), Ewing (1908a), Hammen (1956), Willmann (1928).

MALACONOTHRIDAE

Malaconothrus gracilis? Hammen, 1952 - 13 ex.

Synonym: Malaconothrus molhissetosus Hammer, 1992.

Size: $490\mu \times 266\mu$; $14.3\mu g$ (8 meas.)

Sites: 8(LTA) & 4(Be). Horizons: L - H.

Distribution: Europe, North America

References: Hammen (1952), Hammer (1952), Knulle (1957) Tragardh, 1910.

Malaconothrus sp. #2 - 34 ex.

Size: $365\mu \times 163\mu$; $4.3\mu g$ (10 meas.)

Sites: 6(He) & 11(TA). Horizons: F - H.

Note: Pitted hysterosoma, granular propodosoma, conical posterior.

Malaconothrus sp. #3 - 82 ex.

Size: $457\mu \times 243\mu$; $13.27\mu g$ (14 meas.)

Sites: 5(He), 6(He), & 1(GBRM). Horizons: F - H.

Note: Cerotegument with faint reticular network, similar to M. gracilis.

NANHERMANNOIDEA

NANHERMANNIIDAE

Nanhermannia elegantula Berlese, 1913 (non auct.) - 193 ex.

Synonyms: Nanhermannia dorsalis elegantula Jacot, 1937;

Nanhermannia areolata Strenzke, 1953.

Size: $523\mu \times 256\mu$; $14.9\mu g$ (21 meas.)

Sites: 6(He), 2(Be), 4(Be), 8(LTA), & 10(GBRM).

Horizons: L - H.

Distribution: Europe, North America.

References: Jacot (1937a), Berlese (1913), Banks (1896), Strenzke (1953), Kunst (1956), Hammen (1959),

Hartmann (1949).

Note: Hammen (1959) pointed out that there is considerable confusion within this genus. He does not consider N. dorsalis elegantula Jacot, 1937, to be synonymous with N. elegantula Berlese, 1913.

HERMANNIELLOIDEA

HERMANNIELLIDAE

Hermannobates? sp. - 1 ex.

Size: 535μ X 311μ ; 20.8μ .

Sites: 5 (He). Horizons: L - F.

References: Hammer (1961), Grandjean (1929, 1961, 1962).

Note: Similar to Hermannobates (Hammer, 1961) except seta *ila* about same length as sensillus; notogastral setae stout unilaterally serrated; integument reticular; single claws with basal spur; sensillus capitate, tip narrowing with fine serrations.

GYMNODAMAEOIDEA

GYMNODAMAEIDAE

Allodamaeus n. sp. - 53 ex.

Size: 669μ X 404μ ; 43.6μ (11 meas.)

Sites: 1 (GBRM), 2 (Be), 10 (GBRM), 4 (Be), 9 (BeRMRO), & 7 (BeRM). Horizons: L - H.

References: Banks (1947); Jacot (1937b); Woolley (1972, 1973); Aoki & Fujikawa (1971); Willmann (1935).

Note: The 2 pairs of posterior notogastral setae are not on tubercles.

Allodamaeus n. sp. #2 - 44 ex.

Size: 466μ X 282μ ; 14.5μ (7 meas.)

Sites: 5 (He), 7 (BeRM), 10 (GBRM), 2 (Be), & 4 (Be).

Horizons: L - F.

References: Aoki & Fujikawa (1971); Banks (1947); Balogh (1965); Jacot (1937b).

Note: The 2 pairs of posterior notogastral setae are on tubercles.

Gymnodamaeus n. sp. - 17 ex.

Size: 455μ X 261μ ; 12.4μ (4 meas.)

Sites: 5 (He). Horizons: L - F.

References: Banks (1947); Jacot (1937b), Willmann (1935), Woolley (1972, 1973), Higgins (1961).

Note: 2 pairs posterior notogastral setae not on tubercles. Similar to G. plakosus Woolley (1973).

CEPHEOIDEA

CEPHEIDAE

Cepheus corae Jacot, 1928 - 5 ex.

Size: $710\mu \times 525\mu$; $73.7\mu g$ (2 meas.)

Sites: 6(He), & 1(GBRM). Horizons: L - F

Distribution: North America

References: Jacot (1928), Hammer (1955).

POLYPTEROZETOIDEA

POLYPTEROZETIDAE

Polypterozetidae new genus - 4 ex.

Size: $316\mu \times 190\mu$; $4.38\mu g$ (4 meas.)

Sites: 7(BeRM) & 2(Be). Horizons: L - F.

References: Grandjean (1959), Berlese (1916).

Note: Not Polypterozetes! Has anteriad humeral projections with cavity from each of which emerge two stiff plumose setae.

EREMULOIDEA

EREMULIDAE

Eremulus cingulatus Jacot, 1937 - 34 ex.

Size: $390\mu \times 239\mu$; $8.56\mu g$ (13 meas.)

Sites: 10(GBRM) & 1(GBRM). Horizons: L - H.

Distribution: North America

References: Jacot (1937b), Berlese (1908, 1910);

Woolley (1963), Hammer (1958).

DAMAEOLIDAE

Fosseremus americanus (Jacot, 1938) - 15 ex.

Synonym: Dameolus laciniatus americanus Jacot, 1938

Size: $237\mu \times 129\mu$; $1.56\mu g$ (8 meas.)

Sites: 10(GBRM), & 2(Be). Horizons: L - F.

Distribution: North America

References: Jacot (1938d); Paoli (1908); Grandjean (1963).

EREMOBELBIDAE

Eremobelba flagellaris (Jacot, 1938) - 96 ex.

Synonym: Eremobelba leporosus flagellaris Jacot, 1938

Size: $492\mu \times 312\mu$; $18.4\mu g$ (15 meas.)

Sites: 9(BeRMRO), 11(TA), 8(LTA), 10(GBRM), 2(Be), 12(TA), & 7(BeRM). Horizons: L - H.

Distribution: North America

References: Jacot (1938d), Berlese (1908, 1910), Haller (1884).

EREMAEOIDEA

EREMAEIDAE

Eremaeus sp. - 2 ex. (1 protonymph, 1 larva).

Size: Protonymph: $292\mu \times 156\mu$; $2.87\mu g$.

Site: 10(GBRM). Horizon: L - F.

LIACAROIDEA

LIACARIDAE

Adoristes ammonoosuci (Jacot 1938) - 13 ex.

Synonym: Adoristes ovatus ammonoosuci Jacot, 1938

Size: 537μ X 338μ ; 23.8μ g (6 meas.)

Sites: 6(He) & 5(He). Horizons: L - F.

Distribution: North America

Reference: Jacot (1938e); Woolley (1967); Hull (1916)

Liacarus glaber? Ewing, 1909 - 1 ex.

Size: 759μ X 506μ ; 73.07μ g.

Sites: 9(BERMRO). Horizons: L - F.

Distribution: North America

References: Ewing (1909); Jacot (1937b); Woolley (1958, 1968); Willmann (1931).

Note: Similar to L. glaber except small bent spine between lamellar cusps, no notches on tectopedium I, sensillus long narrow fusiform without tapering apex.

ASTEGISTIDAE

Cultroribula divergens Jacot, 1939 - 25 ex.

Size: 269μ X 180μ ; 3.15μ g (8 meas.)

Sites: 11(TA), 12(TA) & 3(WA). Horizons: L - H.

Distribution: North America

References: Jacot (1939b).

Cultroribula trifurcata Jacot, 1939 - 8 ex.

Size: 227μ X 144μ ; 1.73μ g (10 meas.)

Sites: 4(Be) & 8(LTA). Horizons: L - F.

Distribution: North America

References: Jacot (1939b).

METRIOPIIDAE

Ceratoppia n. sp. - 2 ex.

Size: 778μ X 594μ ; 99.3μ g (2 meas.)

Sites: 1(GBRM), & 5(He). Horizons: L - F.

Note: Similar to species Banks (1906) described as Oppia canadensis.

CARABODOIDEA

CARABODIDAE

Carabodes omo Jacot, 1937 - 10 ex.

Size: 429μ X 236μ ; 9.75μ g (8 meas.)

Sites: 6(He). Horizons: F - H.

Distribution: North America

References: Jacot (1937a), Sellnick & Forsslund (1953).

Note: Jacot slide material examined.

Carabodes labyrinthicus (Michael, 1879) - 1 ex.

Synonym: Tegeocranus labyrinthicus Michael, 1879

Size: $474\mu \times 289\mu$; $15.46\mu g$.

Site: 5(He). Horizons: L - F.

Distribution: Europe, North America

References: Michael (1879, 1884); Willmann (1931);
Sellnick & Forsslund (1953); Berlese (1908, 1910).

Carabodes sp. 2 - 11 ex.

Size: $538\mu \times 330\mu$; $22.96\mu g$ (9 meas.)

Sites: 1(GBRM) & 5(He). Horizons: L - F

TECTOCEPHEIDAE

Tectocepheus velvatus (Michael, 1880) - 1270 ex.

Synonym: Tegeocranus velatus Michael, 1880

Size: $286\mu \times 172\mu$; $3.22\mu g$ (27 meas.)

Sites: 4(Be), 6(He), 7(BeRM), 5(He), 2(Be), 8(LTA),
1(GBRM), 12(WA), 10(GBRM), & 9(BeRMRO).

Horizons: L - H.

Distribution: Cosmopolitan?

References: Michael (1880, 1884); Tragardh (1910);
Knulle (1953); Haarlov (1952); Jacot (1937b);
Berlese (1914)

Tectocepheus sarekensis Tragardh, 1910 - 76 ex.

Size: $335\mu \times 188\mu$; $4.70\mu g$ (4 meas.)

Sites: 3(WA), 12(WA) & 11(TA). Horizons: L - A

Distribution: Europe

References: Machael (1880, 1884); Tragardh (1910);
Knulle (1953); Haarlov (1952); Jacot (1937b);
Berlese (1914).

Tectocepheus sp. 2 - 4 ex.

Size: $292\mu \times 182\mu$; $3.63\mu g$ (3 meas.)

Sites: 1(GBRM). Horizons: L - F.

Note: Sensillus filiform; without cerotegument.

Tectocepheus sp. 4 - 33 ex.

Size: $317\mu \times 189\mu$; $4.37\mu g$ (13 meas.)

Sites: 7(BeRM), 10(GBRM), 6(He), 5(He), & 2(Be).

Horizons: L - F.

Note: Coarser granular cerotegument than T. velatus.
Lamella reaches to end of rostrum where it narrows
and is directed medially.

OPPIOIDEA

OPPIIDAE

Lanceoppia sp. 1 - 30 ex.

Size: 571μ X 338μ ; 26.14μ g (16 meas.)

Sites: 8(LTA), 9(BeRMRO) & 10(GBRM). Horizons: L - H.

References: Hammer (1962)

Lanceoppia sp. 2 - 3 ex.

Size: 384μ X 199μ ; 6.33μ g (2 meas.)

Site: 6(He). Horizons: L - F

References: Hammer (1962)

Oppia carolinae Jacot, 1938 - 43 ex.

Size: 304μ X 169μ ; 3.45μ g (15 meas.)

Sites: 2(Be), 4(Be), 5(Be), 6(He), & 8(LTA).

Horizons: L - H.

Distribution: North America

References: Jacot (1938c).

Oppia minus (Paoli, 1908) - 3818 ex.

Synonym: Dameosoma minus Paoli, 1908; Oppia minor auctt.

Size: 173μ X 75μ ; $.42\mu$ g (29 meas.)

Sites: 7(BeRM), 9(BeRMRO), 1(GBRM), 2(Be), 4(Be),
10(GBRM), 8(LTA), 5(He), 11(TA), 6(He) & 3(WA).

Horizons: L - A.

References: Paoli (1908); Jacot (1938c, 1938d); Sellnick (1951).

Note: Does not agree with cotype slide of O. minus
simplissimus Jacot, 1938. Appears identical to
O. minutissima Sellnick 1951, which is probably a
synonym.

Oppia nova (Oudemans, 1902) - 3665 ex.

Synonyms: Eremaeus neerlandica Oudemans, 1900;

Opniella corrugata Jacot, 1937; Dameosoma corrugatum
Berlese, 1904. Oppia neerlandica auctt.

Size: 239μ X 132μ ; 1.63μ g (41 meas.)

Sites: 2(Be), 5(He), 1(GBRM), 4(Be), 7(BeRM), 11(TA),
10(GBRM), 8(LTA), 6(He), 9(BeRMRO), 12(WA), & 3(WA).

Horizons: L - A.

Distribution: Cosmopolitan.

References: Hammen (1952); Hammer (1952); Paoli (1908);
Forsslund (1942); Jacot (1937b); Woodring & Cook, 1962.

Note: A very variable species..

Oppia nr. nova - 6 ex.

Site: 2(Be). Horizons: L - F.

Oppia sp. 1 - 15 ex.

Size: 251μ X 144μ ; 2.02μ g (10 meas.)

Site: 7(BeRM). Horizons: L - F.

Oppia sp. 2 - 27 ex.Size: 242μ X 122μ ; 1.48μ g (12 meas.)

Site: 8(LTA), 12(WA), & 1(GBRM). Horizons: H - A.

Multioppia spendens? (Paoli, 1908) - 24 ex.Synonym: Dameosoma splendens Paoli, 1908.Size: 300μ X 163μ ; 3.20μ g (13 meas.)

Sites: 5(He), 6(He), & 2(Be). Horizons: L - F.

Distribution: Europe, North America, South America.

References: Hammer (1961); Paoli (1908); Jacot (1939a);

Michael (19879, 1888).

Quadroppia ferumequina Jacot, 1939 - 547 ex.Synonyms: Oppia quadricarinata ferumequina Jacot, 1938.Size: 155μ X 82μ ; $.41\mu$ g (22 meas.)Sites: 5(He), 11(TA), 9(BeRM), 6(He), 7(BeRM), 4(Be),
8(LTA), 2(Be), 10(GBRM), 3(WA), & 12(WA).

Horizons: L - H.

Distribution: North America, South America

References: Jacot (1938c, 1938d, 1939a); Michael

(1885); Hammer (1961)

Note: Probably synonymous with Oppia circumita

Hammer, 1961.

SUCTOBELBIDAE

Suctobelba sp. 1 - 4 ex.Size: 370μ X 185μ ; 5.34μ g (1 meas.)

Sites: 10(GBRM), 9(BeRMRO), & 1(GBRM). Horizons: F - H.

References: Jacot (1937a, 1938c).

Suctobelba sp. 2 - 10 ex.Size: 189μ X 106μ ; $.82\mu$ g (10 meas.)

Site: 11(TA). Horizons: F - H.

References: Jacot (1937a, 1938c)

Allosuctobelba grandis (Paoli, 1908) - 5 ex.Synonym: Suctobelba grandis auctt.Size: 456μ X 248μ ; 33.16μ g (5 meas.)

Sites: 2(Be), & 10(GBRM). Horizons: L - H.

Distribution:

References: Paoli (1908); Jacot (1938d); Forsslund

(1941); Moritz (1970)

Allosuctobelba nr. grandis - 1 ex.Size: 350μ X 185μ ; 4.90μ g.

Site: 6(He). Horizons: L - F.

Suctobelbella laxtoni Jacot, 1937 - 1274 ex.Synonym: Suctobelba laxtoni auct.Size: $163\mu \times 85\mu$; $.46\mu g$ (22 meas.)Sites: 2(Be), 4(Be), 6(He), 7(BeRM), 10(GBRM),
1(GBRM), 5(He), 9(BeRMRO), 8(LTA), 11(TA),
& 3(WA).

Horizons: L - H.

Distribution: North America

References: Jacot (1937b, 1938c); Moritz (1970);
Strenzke (1951); Forsslund (1941); Paoli (1908).Suctobelbella hurshi? Jacot, 1937 - 276 ex.Synonym: Suctobelba hurshi auctt.Size: $192\mu \times 103\mu$; $.80\mu g$ (24 meas.)Sites: 2(Be), 10(GBRM), 9(BeRMRO), 4(Be), 7(BeRM),
11(TA), 6(He), 8(LTA), 3(WA), 1(GBRM), 12(WA),
& 5(He).

Horizons: L - H.

Distribution: North America

References: Jacot (1937b, 1938c); Moritz (1970c);
Strenzke (1951); Forsslund (1941); Paoli (1908).Suctobelbella serratirostrum Jacot, 1937 - 9 ex.Synonym: Suctobelba serratirostrum auctt.Size: $193\mu \times 100\mu$; $1.30\mu g$ (6 meas.)

Sites: 19(GBRM), & 10(GBRM).

Horizons: L - H.

Distribution: North America

References: Jacot (1937b, 1938c); Moritz (1970c);
Strenzke (1957); Forsslund (1941); Paoli (1908).Suctobelbella falcata (Forsslund, 1941) - 84 ex.Synonym: Suctobelba falcata Forsslund, 1941.Size: $230\mu \times 129\mu$; $1.49\mu g$ (17 meas.)Sites: 4(Be), 5(He), 2(Be), 6(He), 7(BeRM),
& 10(GBRM).

Horizons: L - H.

Distribution: Europe

References: Forsslund (1941); Strenzke (1957).

Suctobelbella longicuspis Jacot, 1937 - 434 ex.Synonym: Suctobelba longicuspis auctt.Size: $205\mu \times 107\mu$; .91 μ g (26 meas.)Sites: 5(He), 4(Be), 2(Be), 7(BeRM), 10(GBRM),
6(He), 8(LTA) & 9(BeRMRO). Horizons: L - H.

Distribution: North America

References: Jacot (1937b, 1939a).

Suctobelbella n. sp. - 552 ex.Size: $167\mu \times 87\mu$; .50 μ g (33 meas.)

Sites: 6(He), 4(Be), 5(He), 2(Be), & 7(BeRM).

Horizons: L - H.

Suctobelbella sp. - 5 ex.Size: $202\mu \times 107\mu$; .92 μ g (3 meas.)

Sites: 1(GBRM), 2(Be), & 4(Be). Horizons: L - H.

Suctobelbella frothinghami? Jacot, 1937 - 210 ex.Synonym: Suctobelba frothinghami auctt.Size: $200\mu \times 106\mu$; .89 μ g (27 meas.)Sites: 4(Be), 6(He), 2(Be), 5(He), 7(BeRM), 8(LTA),
& 10(GBRM). Horizons: L - H.

Distribution: North America

References: Jacot (1937b); Strenzke (1951)

Suctobelbella n. sp. - 417 ex.Size: $167\mu \times 87\mu$; .50 μ g (26 meas.)

Sites: 6(He), 5(He), 4(Be), 2(Be), & 7(BeRM).

Horizons: L - H.

Note: Raised area around each short dorsal notogastral seta.

Suctobelbella sp. - 16 ex.Size: $165\mu \times 88\mu$; .50 μ g (6 meas.)

Sites: 4(Be), 2(Be), & 5(He). Horizons: L - F.

Suctobelbella sp. - 2 ex.Size: $161\mu \times 78\mu$; .40 μ g (2 meas.)

Sites: 4(Be). Horizons: H.

Suctobelbella nr. longirostris - 1 ex.Size: $204\mu \times 107\mu$; .93 μ g.

Site: 2(Be). Horizons: H.

Reference: Forsslund (1941).

Suctobelbella acutidens? Forsslund 1941Synonym: Suctobelba acutidens auctt.Size: $183\mu \times 93\mu$; 64 μ g (29 meas.)

Sites: 5(He), 4(Be), 6(He), 2(Be), 7(BeRM), & 10(GBRM).

Horizons: F - H.

Distribution: Europe.

References: Strenzke (1957b); Forsslund (1941)

Note: Swedish form slightly larger (ave. length 204).

Suctobelbella subtrigona (Oudemans, 1916) - 15 ex.

Synonyms: Suctobelba intermedia Willmann, 1939;

Suctobelba subtrigona auct.

Size: $275\mu \times 164\mu$; 2.82μ (11 meas.)

Sites: 10(GBRM), 1(GBRM), & 4(Be). Horizons: L - H.

Distribution: Europe

References: Strenzke (1951b); Forsslund (1941);

Moritz (1971).

Suctobelbella sarekensis? (Forsslund, 1941) - 24 ex.

Synonym: Suctobelba sarekensis Forsslund, 1941.

Size: $211\mu \times 112\mu$; 1.03μ (13 meas.)

Sites: 2(Be), 7(BeRM), 10(GBRM), 1(GBRM), 4(Be), & 6(He). Horizons: L - F.

Distribution: Europe.

References: Strenzke (1951b); Forsslund (1941); Moritz (1971)

Note: Dorsal notogastral setae very long ($28-40\mu$) and weakly serrate.

Suctobelbella nr. sarekensis - 2 ex.

Size: $211\mu \times 112\mu$; 1.05μ (2 meas.)

Site: 9(BeRMRO). Horizons: L - F.

Suctobelbella sp. - 1 ex.

Size: $201\mu \times 107\mu$; $.93\mu$.

Site: 9(BeRMRO). Horizons: L - F.

Suctobelbella sp. - 3 ex.

Size: $195\mu \times 97\mu$; $.75\mu$ (1 meas.)

Site: 2(Be). Horizons: L - F.

Suctobelbella n. sp. - 15 ex.

Size: $243\mu \times 135\mu$; 1.73μ (11 meas.)

Sites: 6(He), 10(GBRM), 9(BeRMRO), 2(Be), 4(Be), & 5(He). Horizons: L - F.

Note: Tectopedial fields fused; notogastral teeth reduced and approximate.

Suctobelbella n. sp. - 2 ex.

Size: $209\mu \times 109\mu$; $.99\mu$ (2 meas.)

Sites: 10(GBRM), & 2(Be). Horizons: L - F.

Suctobelbella n. sp. - 6 ex.

Size: $204\mu \times 115\mu$; 1.04μ (3 meas.)

Sites: 10(GBRM) & 3(WA). Horizons: H - A.

Note: Belongs to the S. nasalis - subtrigona group of Moritz (1971).

Suctobelbella nr. falcata of Forsslund (1941). - 4 ex.Size: $238\mu \times 126\mu$; $1.51\mu g$ (2 meas.)

Sites: 3(WA). Horizons: L - F.

Suctobelbella n. sp. - 43 ex.Size: $212\mu \times 116\mu$; $1.12\mu g$ (12 meas.)

Sites: 9(BeRMRO), 4(Be), 8(LTA), 6(He), 7(BeRM), 10(GBRM), & 11(TA). Horizons: L - A.

References: Strenzke (1951b).

Note: Fits in S. acutidens - sarekensis group.Suctobelbella sp. - 90 ex.Size: $174\mu \times 96\mu$; $.62\mu g$ (16 meas.)

Sites: 5(He), 4(Be), 6(He), 10(GBRM), & 7(BeRM).

Horizons: L - H.

Suctobelbella nr. acutidens - 44 ex.Size: $178\mu \times 90\mu$; $.58\mu g$ (13 meas.)

Sites: 4(Be), 2(Be), 8(LTA), 5(He), 7(BeRM), & 10(BeRM). Horizons: F - H.

Suctobelbella n. sp. - 30 ex.Size: $164\mu \times 82\mu$; $.44\mu g$ (16 meas.)

Sites: 5(He). Horizons: F - H.

Suctobelbella n. sp. 17 ex.Size: $197\mu \times 97\mu$; $.76\mu g$ (15 meas.)

Sites: 10(GBRM), 7(BeRM), & 4(Be). Horizons: F - H.

Note: Similar to S. longicuspis and S. falcata.Suctobelbella n. sp. - 107 ex.Size: $194\mu \times 99\mu$; $.77\mu g$ (19 meas.)

Sites: 2(Be), 4(Be), 9(BeRMRO), 11(TA), & 1(GBRM).

Horizons: L - H.

Note: Related to S. acutidens.Suctobelbella n. sp. - 9 ex.Size: $173\mu \times 90\mu$; $.55\mu g$ (6 meas.)

Site: 6(He). Horizons: H.

ORIBATULOIDEA

ORIPODIDAE

Oripoda sp. - 4 ex.Size: $370\mu \times 224\mu$; $7.15\mu g$ (2 meas.)

Sites: 10(GBRM), 7(BeRM), 9(BeRMRO) & 5(He).

Horizons: L - H.

References: Woolley (1966); Banks (1904).

ORIBATULIDAE

Dometorina sp. - 1 ex.Size: 399 μ X 234 μ ; 8.60 μ g.

Site: 5(He). Horizons: L - F.

Reference: Grandjean (1951).

Incabates sp. - 1 ex.Size: 477 μ X 292 μ ; 15.86 μ g.

Site: 8(LTA). Horizon: L - H.

Reference: Hammer (1961).

Oribatula tibialis (Nicolet, 1855) - 179 ex.Synonyms: Notaspis tibialis Nicolet, 1855; Oribatula tibialis pallida Jacot, 1938.Size: 485 μ X 318 μ ; 18.5 μ g (21 meas.)

Sites: 5(He), 6(He), 9(BeRMRO), 1(GBRM), 10(GBRM), 4(Be), & 7(BeRM). Horizons: L - F.

Distribution: Europe, North America

References: Hammer (1952); Willmann (1931); Tragardh (1910, 1931); Jacot (1938c).

Note: According to Jacot (1938c), Oribatula pallida Banks, 1906 is the North American subspecies of O. tibialis, though Banks gives a length of only .38 mm., and his description is not adequate for precise diagnosis. Liacarus minutus Ewing, 1909 (Oribatula minuta (Ewing)) is also considered a synonym by Jacot (1938c). Size given is .50 mm. X .32 mm. It would seem unlikely that O. pallida is the same species.

Scheloribates lanceoliger? Berlese, 1908 - 175 ex.Synonym: Protoribates (Scheloribates) lanceoliger Berlese, 1908.Size: 426 μ X 253 μ ; 10.7 μ g (27 meas.)

Sites: 1(GBRM), 6(He), 10(GBRM), 5(He), 7(BeRM), 8(LTA), & 11(TA). Horizons: L - F.

Distribution: North America.

References: Woolley (1916), Hammer (1952); Hammen (1952); Berlese (1908); Jacot (1938c).

Note: Material compares with slide identified by Jacot as S. lanceoliger.

Scheloribates sp. 2 - 23 ex.Size: 378 μ X 259 μ ; 9.26 μ g (9 meas.)

Sites: 4(Be), & 2(Be). Horizons: L - F.

Note: Lamella twisted mesad, appearing almost triangular in plane view.

HAPLOZETIDAE

Xylobates capucinus (Berlese, 1908) - 48 ex.

Synonyms: Protoribates capucinus Berlese, 1908;

Oribata oblonga Ewing 1909.

Size: $379\mu \times 211\mu$; 6.79μ g (12 meas.)

Sites: 12(WA), & 3(WA). Horizons: L - A.

Distribution: Europe, North America.

References: Jacot (1937a); Hammer (1961); Willmann (1931); Berlese (1908).

Note: Specimens appear to be Jacot's (1937a) smaller form, X. capucinus angustior.

Xylobates lophotrichus (Berlese, 1904) - 173 ex.

Synonyms: Oribates lophotrichus Berlese 1904;

Protoribates lophotrichus Willmann 1931.

Size: $533\mu \times 347\mu$; 24.4μ g (33 meas.)

Sites: 6(He), 2(Be), 4(Be), 1(GBRM), 7(BeRM), 5(He), 8(LTA), & 10(GBRM). Horizons: L - H.

Distribution: Europe, North America.

References: Jacot (1937a); Berlese (1904); Willmann (1931).

CERATOZETOIDEA

CHAMOBATIDAE

Chamobates pusillus? (Berlese 1895) - 5 ex.

Synonym:

Size: $442\mu \times 334\mu$; 17.36μ g (5 meas.)

Sites: 3(WA), & 8(LTA). Horizons: L - H.

Distribution:

References: Willmann (1931); Hull (1916); Hammen (1952).

CERATOZETIDAE

Boreozetes sp. - 1 ex.

Site: 3 (WA).

Reference: Hammer (1955).

Ceratozetes sp. 1 - 283 ex.

Size: $359\mu \times 209\mu$; 6.15μ g (19 meas.)

Sites: 2(Be), 4(Be), 6(He), 1(GBRM), 8(LTA), 7(BeRM), 5(He), & 11(TA). Horizons: L - H.

Ceratozetes sp. 2 - 49 ex.

Size: $606\mu \times 389\mu$; 35.4μ g (3 meas.)

Sites: 8(LTA), & 9(BeRMRO). Horizons: L - H.

Ceratozetes sp. 3 - 8 ex.

Size: $387\mu \times 234\mu$; 8.2μ g (5 meas.)

Sites: 9(BeRMRO) & 8(LTA). Horizons: L - F.

Fuscozetes setosus? (Koch, 1840) - 4 ex.

Synonym: Fuscozetes fuscipes auct. (according to Jacot 1938f).

Size: $620\mu \times 418\mu$; $40.9\mu g$ (3 meas.)

Site: 5(He). Horizons: L - F.

Distribution: Europe, North America

References: Jacot (1935); Willmann (1931); Jacot (1938f).

ORIBATELLOIDEA

ORIBATELLIDAE

Oribatella sp., ? quadricornuta (Michael, 1880) - 1 ex.

Synonym: Oribata quadricornuta Michael, 1880.

Size: $438\mu \times 302\mu$; $14.7\mu g$.

Site: 11(TA). Horizon: F - H.

Distribution: Europe.

References: Hammer (1955); Michael (1880, 1884); Hammen (1952); Willmann (1931); Tragardh (1931)

Oribatella sp. possibly O. meridionalis Berlese, 1908 - 1 ex.

Size: $302\mu \times 224\mu$; $8.99\mu g$.

Site: 10(GBRM). Horizon: F - H.

Distribution: Europe.

References: Willmann (1931); Berlese (1908).

TEGORIBATIDAE

Lenidozetes sp. - 22 ex.

Size: $362\mu \times 274\mu$; $9.44\mu g$ (16 meas.)

Sites: 9(BERMRO) & 7(BERM). Horizons: L - F.

ACHIPTERIIDAE

Achipteria sp. - 68 ex.

Size: $595\mu \times 418\mu$; $38.5\mu g$ (12 meas.)

Sites: 9(BERMRO), & 5(He). Horizons: L - F.

GALUMNOIDEA

GALUMNIDAE

Acrogalumna? sp. - 4 ex.

Size: $681\mu \times 608\mu$; $84.0\mu g$ (2 meas.)

Site: 9(BERMRO). Horizons: L - F.

Galumna emarginatus (Banks 1895) - 25 ex.

Synonyms: Zetes emarginatus Jacot, 1935; Oribata emarginatus Banks, 1895.

Size: $575\mu \times 441\mu$; $39.63\mu g$ (4 meas.)

Sites: 11(TA). Horizons: L - H.

Distribution: Europe, North America

References: Jacot (1935); Berlese (1914).

Pergalumna nervosa (Berlese, 1915) - 90 ex.

Synonym: Oribates nervosus Berlese, 1915; Zetes nervosus Jacot, 1935.

Size: $618\mu \times 489\mu$; 51.8μ (25 meas.)

Sites: 9(BERMRO), 5(He), 8(LTA), 10(GBRM), 2(Be), 6(He), 7(BERM), & 1(GBRM). Horizons: L - F.

Distribution: Europe, North America.

References: Berlese (1915); Jacot (1935); Hammen (1952).

APPENDIX B:

Raw Data Matrix

(Counts in columns 2 and 3 refer to variable
number designations in factor score
matrices of principal components
analyses).

APPENDIX

10F

RAW COUNT	100 VAR. P.C.A.	90 VAR. P.C.A.	MACROVEGETA
			SITE #
			SAMPLING
			CORE
1	1	1	Palaeacarus hystericinus
2	2	2	Gehypochthonius rhadamanthus
3	3	3	Parhypochthonius aphidinus
4	4	4	Hypochthonius rufulus
5	5	5	Brachychthonius arcticus
6	6	6	Brachychthonius berlessei
7	7	7	Brachychthonius nr. berlessei
8	8	8	Brachychthonius bimaculatus
9	9	9	Brachychthonius nr. bimaculatus
10	10	10	Brachychthonius italicus spid.
11	11	11	Brachychthonius jugatus
12	12	12	Brachychthonius nr. jugatus 1.
13	13	13	Brachychthonius nr. jugatus 2.
14	14	14	Brachychthonius sp. sp.
15	15	15	Brachychthonius lydiae
16	16	--	Brachychthonius rostratus
17	17	16	Brachychthonius sueticus
18	18	17	Brachychthonius nr. sueticus
19	19	18	Brachychthonius zelawiensis
20	20	19	Eobrachychthonius latior
21	21	20	Liochthonius horridus
22	22	21	Liochthonius hystericinus
23	23	22	Liochthonius perpusillus (Ber)
24	24	23	Liochthonius pilosetosus
25	25	24	Liochthonius piluliferus (?)
26	--	--	Liochthonius nr. piluliferus
27	--	--	Liochthonius nr. piluliferus
28	--	--	Liochthonius nr. piluliferus
29	--	--	Liochthonius nr. piluliferus
30	26	25	Liochthonius nr. piluliferus
31	27	26	Liochthonius sp. 1. (lapponico)
32	28	27	Liochthonius sp. 2. (simplex?)
33	29	28	Liochthonius sp. 3.
34	30	29	Liochthonius sp. 4. = sellnicki
35	--	--	Liochthonius scalaris?
36	31	30	Liochthonius sp. nr. 4.
37	--	--	Liochthonius sp. (H.)
38	32	31	Synhthonius crenulatus
39	33	32	Hypochthonia minuta

BEECH - RE

[illegible]

				9							
VI		VII		II		IV		VI		VII	
a	b	a	b	a	b	a	b	a	b	a	b
-	1	-	5	-	-	-	-	-	-	-	-
19	11	11	18	-	-	1	-	-	-	-	410
-	-	-	-	2	-	7	2	5	5	2	1
5	18	2	1	-	-	-	-	-	1	-	-
1	-	2	-	-	-	-	-	-	-	-	-
3	4	-	-	-	-	-	-	-	-	-	-
-	-	2	-	3	22	10	51	9	20	6	8
-	-	-	-	-	-	-	-	-	-	-	-
3	3	5	1	-	-	-	-	-	-	-	-
79	46	97	32	1	4	3	17	10	52	23	5
29	166	43	36	7	4	12	49	47	53	42	13
11	40	7	32	-	36	101	178	210	115	197	67
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	1
-	-	-	-	-	-	-	-	-	-	-	-
95	227	202	134	1	7	18	44	4	5	22	12
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	1	-	1	-	-	-	-	-	-	-	-
-	-	-	-	-	-	2	1	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	20	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	7	13
-	-	-	-	-	-	1	-	2	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	2	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	1	-	-
-	-	1	-	-	-	-	-	-	-	-	-
2	17	16	9	-	-	2	1	-	-	-	-
-	-	1	-	-	-	-	-	-	-	-	-
12	11	4	7	-	-	-	-	1	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	1	4	7	2	16	8	1	-

Euler																	
2								4									
II		IV		VI		VII		II		IV		VI		VII		II	
a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
-	-	1	-	2	-	-	-	-	-	1	-	-	-	-	4	-	2
-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	7	4
-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	12	15
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	1	-	-	-	-	-	-	-	2	-	-	1	1
-	2	-	1	-	2	-	-	1	1	-	1	7	4	2	7	-	-
-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	3	3
4	2	21	32	5	58	19	33	-	-	11	3	40	10	-	1	-	-
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	1	4	-	3	1	-	-	-	-	-	-	-	-	-	-	1
46	25	4	9	46	24	161	66	7	2	3	-	2	12	3	3	6	16
8	-	1	4	1	4	-	-	-	-	-	-	-	-	-	-	-	-
7	-	1	-	-	1	65	14	1	-	10	6	32	21	5	1	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
3	-	1	1	1	3	1	-	-	-	3	2	2	-	5	4	2	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	31	70	117	237	390	132	74	15	2	8	4	72	109	19	22	149	102
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	5
1	4	3	3	4	5	11	12	4	9	21	6	25	40	20	8	1	1
1	3	2	11	1	6	1	6	3	-	2	-	12	4	8	3	-	-
1	-	4	4	1	15	-	1	-	5	-	-	2	11	4	-	-	-
-	-	6	5	6	8	6	3	1	-	2	-	37	18	-	3	-	1
4	2	1	-	3	6	-	2	-	-	-	-	4	4	-	-	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	1	3	-	-	-	-	-	-
-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	15
-	-	-	-	-	-	-	-	-	-	-	-	11	-	-	-	-	-
8	7	5	4	6	24	2	22	4	6	9	-	19	17	12	7	23	25
-	2	2	4	3	1	-	38	1	3	9	25	-	-	12	7	3	7
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	4
-	-	2	6	-	-	-	-	-	-	-	-	1	-	-	-	-	-
-	-	1	1	1	2	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	5	1	-	-	-	1	-	-	7	-	-	-
-	-	5	2														

[illegible]

405

50A5

(105)

RAW COUNT			MACROVEGETA
	100 VAR. P.C.A.	90 VAR. P.C.A.	SITE #
			SAMPLIN
			CORE
40	34	33	Pterochthonius angelus
41	35	34	Trichthonius magestus
42	36	35	Archoplophora laevis
43	37	36	Atopochthonius artiodactylus
44	--	--	Euphthiracarus monodactylus
45	--	--	Euphthiracarus flavus
46	38	37	Microtritia minema
47	39	--	Rhysotritia ardua
48	40	--	Phthiracarus setosellum
49	--	--	Phthiracarus boresetosum
50	41	--	Phthiracarus sphaerulum
51	--	--	Phthiracarus setosum
52	42	38	Steganaeacarus diaphanum
52	43	39	Eulohmannia ribagai
54	44	40	Camisia sp.
55	--	--	Heminothrus interlamellaris
56	--	--	Malaconothrus gracilis?
57	45	41	Malaconothrus sp. 2.
58	46	42	Malaconothrus sp. 3.
59	47	43	Nothrus silvestris
60	48	44	Nothrus sp.
61	49	45	Nothrus sp. A.
62	50	46	Nannhermannia elegantula
63	51	47	Trhypochthonius silvestris
64	52	48	Cultroribula divergens
65	--	--	Cultroribula trifuncata
66	53	49	Carabodes omo.
67	--	--	Carabodes sp. 2.
68	--	--	Cepheus corae
69	54	50	Eremobella flagellaria
70	55	51	Eremulus cingulatus
71	56	52	Fossaremus americanus
72	--	--	Polypetrozetidae n.g.
73	57	53	Allodamasus n.sp.
74	--	--	Gymnodamasus n.sp.
75	58	54	Allodamasus n.sp. 2.
76	59	55	Adoristes ammonodaei
77	--	--	Ceratoppia n.sp.
78	60	56	Lanceoppia sp. 1

155a

GETATION

E #	GREY BIRCH - RED MAPLE																BEECH							
	1								10								7							
	II		IV		VI		VII		II		IV		VI		VII		II		IV		VI		VII	
PLING	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
DRE	-	-	-	-	-	-	-	-	16	-	9	5	1	-	7	1	-	-	-	-	-	-	-	-
us	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
s	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
dactylus	-	-	-	-	-	-	-	-	3	2	2	6	10	3	9	2	-	1	-	-	10	2	2	2
actylus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-
s	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	1	-	-	-	-	1	-	3	1	-	-	-	1	3	2	3	3	-	-	-
	1	2	-	-	-	-	1	2	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-
lum	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	1	1	-	-	-	-
osum	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
lum	1	1	-	1	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
am	-	-	-	-	-	-	1	-	1	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	10	5	5	3	-	-	1	1	-	-	-	-	1	-	-	-
ellaris	-	-	-	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-
us?	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1	-	-	-	1	-	-	-	15	5	18	18	35	5	20	3	-	-	-	-	-	-	-	-
	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	1	-	-	1	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ula	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
estris	-	-	-	-	-	-	-	-	-	-	-	-	3	4	3	-	-	-	-	-	-	-	-	-
ns	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	9	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ia	-	-	-	-	-	-	-	-	-	1	-	-	-	6	1	-	-	1	-	-	-	-	-	-
	-	1	-	1	2	-	2	-	8	2	5	4	-	-	4	5	-	-	-	-	-	-	-	-
s	-	-	-	-	-	-	-	-	7	1	1	-	-	1	2	1	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
	-	5	8	2	5	2	4	3	2	1	1	-	-	-	1	1	1	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	1	1	2	-	1	2	3	-	4	3	3	2	1	2	-	-
i	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	5	-	-	-	-	-	-	-	-

ASPEN			TREMBLING ASPEN								WHITE ASH															
			11								3								12							
VII			II		IV		VI		VII		II		IV		VI		VII		II		IV		VI		VII	
b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	1	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
-	6	7	-	-	-	-	-	-	1	-	3	1	10	6	10	1	2	3	1	-	-	-	-	1	-	-
1	-	6	-	-	-	-	-	-	-	-	6	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	4	1	4	2	3	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	4	4	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	1
-	-	-	4	11	18	14	9	10	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	1	-	3	2	2	3	3	5	1	-	-	-	-	-	-	1	-	2	-	1	1	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	3	6	1	2	-	2	-	11	4	4	-	-	-	-	-	-	-	-	-	-	-	1	1	1	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

50F5

10F

RAW COUNT	100 VAR. P.C.A.	90 VAR. P.C.A.	MACROVEGETA	
			SITE #	
			SAMPLING	
			CORE	
79	--	--	Lanceoppia sp. 2.	
80	61	57	Oppia carolinae	
81	62	58	Oppia minus	
82	63	59	Oppia nova	
83	--	--	Oppia like nova	
84	--	--	Oppia sp. 1.	
85	--	--	Oppia sp. 2.	
86	--	--	Eremaeus? N.	
87	64	60	Multioppia splendens	
88	65	61	Quadroppia ferumequina	
89	66	62	Suctobelba sp. 1 and 2.	
90	67	63	Tectocephus velatus	
91	--	--	Tectocephus sp. 2.	
92	68	64	Tectocephus sarekensis	
93	69	65	Tectocephus sp. 4.	
94	70	66	Achipteria sp.	
95	71	67	Lepidozetes sp.	
96	72	68	Ceratozetes sp. 1.	
97	73	69	Ceratozetes sp. 2.	
98	--	--	Ceratozetes sp. 3.	
99	--	--	Fuscozetes setosus?	
100	--	--	Chamobates pusillus?	
101	74	70	Galumna emarginatus	
102	75	71	Fergalumna nervosa	
103	--	--	Acrogalumna? sp.	
104	76	72	Kylobates lophotrichus	
105	77	73	Kylobates capucinus	
106	78	74	Oribatula tibialis	
107	79	75	Scheloribates lanceoliger	
108	80	76	Scheloribates nr. confundatus	
109	--	--	Oripoda sp.	
110	81	77	Suctobelbella laxtoni	
111	82	78	Suctobelbella hurshi?	
112	83	--	Suctobelbella serratirostrum	
113	84	79	Suctobelbella falcata	
114	85	80	Suctobelbella longicuspis	
115	86	81	Suctobelbella sp. 1 (n.sp.)	
116	87	--	Suctobelbella sp. 2.	
117	88	82	Suctobelbella frothinghami?	

GETATION

E #

P L I N G
O R E

ORE

na

2.

198

US

liger

Infundatus

?

irostrum

38

cuspi8

(п.вр.)

chem1?

BEECH - RED MAPLE

7						9							
IV		VI		VII		II		IV		VI		VII	
a	b	a	b	a	b	a	b	a	b	a	b	a	b
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
284	445	207	89	174	179	9	73	84	126	69	33	120	64
78	87	40	15	34	32	-	5	16	18	29	16	31	16
-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	3	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	2	5	5	7	8	-	2	1	6	11	12	8	13
-	-	-	-	-	-	-	-	-	-	1	-	-	-
45	23	60	34	11	32	-	-	-	-	-	1	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	5	7	2	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	7	5	2	3	16	23	4	5
1	-	-	1	2	-	-	3	1	5	4	2	-	-
-	1	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	1	-	6	4	3	5	-	2
-	-	-	-	-	-	-	-	-	-	4	-	-	2
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	1	-	1	-	2	2	4	4	6	1	7	1
-	-	-	-	-	-	-	-	-	-	1	3	-	-
1	1	-	3	1	2	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	1	-	-	-	-	8	11	5	1	-	1	-	11
1	3	3	1	4	2	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
31	11	38	14	12	14	4	1	3	4	6	1	3	4
1	10	2	1	3	1	-	6	2	4	6	10	-	6
-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	1	-	-	2	4	-	-	-	-	-	-	-	-
4	1	5	7	18	8	-	-	-	1	-	-	-	1
1	2	1	-	3	6	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	1	5	-	-	-	-	-	-	-	-

BEECH

2								4							
I		IV		VI		VII		II		IV		VI		VII	
a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	6	-	13	-	-	11	13	-	-	-	-	1	-	-	1
21	10	30	45	19	99	136	109	55	26	50	8	33	29	-	9
86	80	77	141	59	69	72	85	42	24	58	38	91	44	50	56
-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
1	-	2	-	2	3	2	-	-	1	5	8	2	-	2	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	18	-	3	31	13	34	39	93	59	20	6	129	7	10	8
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	9	3	25	21	36	6	18	2	3	19	19	12	-	8	6
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	2	3	-	-	-	-	2	-	3	2	4	-	2	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	1	11	12	5	7	5	4	1	5	3	1	1	1	8	8
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	1	1	-	6	-	-	-	2
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	7	-	-	-	-	-	-	5	3	1	-	4	-	-	3
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26	57	77	30	34	54	35	42	28	34	35	30	33	26	47	65
15	10	2	6	5	2	8	13	2	1	-	6	10	4	3	5
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	6	-	4	2	2	2	1	3	4	1	1	8	2	4
10	2	26	7	9	8	4	6	6	10	15	14	22	-	15	1
3	-	7	5	1	2	1	1	5	19	11	-	1	6	23	1
2	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
15	3	3	-	4	12	4	6	6	14	6	9	6	8	10	5

[illegible]

[illegible]

(10F)

MACROVEGETA			
RAW COUNT	100 VAR. P.C.A.	90 VAR. P.C.A.	SITE #
			SAMPLIN
			CORE
118	89	83	Suctobelbella 3. (n.sp.)
119	90	84	Suctobelbella sp. 4
120	--	--	Suctobelbella sp. 5
121	91	85	Suctobelbella acutidens?
122	92	--	Suctobelbella subtrigona
123	93	--	Suctobelbella sarekensis
124	--	--	Suctobelbella nr. sarekensis
125	--	--	Suctobelbella sp. 6.
126	94	--	Suctobelbella 7 (n.sp.)
127	--	--	Suctobelbella 8 (n.sp.)
128	--	--	Suctobelbella 9 (n.sp.)
129	--	--	Suctobelbella nr. falcata
130	95	86	Suctobelbella 10 (n.sp.)
131	96	87	Suctobelbella sp. 11
132	97	88	Suctobelbella nr. acutidens
133	98	89	Suctobelbella 12 (n.sp.)
134	99	--	Suctobelbella 13 (n.sp.)
135	100	90	Suctobelbella 14 (n.sp.)
136	--	--	Suctobelbella 15 (n.sp.)
137	--	--	Allosuctobelba grandis
---	---	---	SPECIES WITH ONLY ONE REPRESENTATIVE
138	--	--	Allosuctobelba nr. grandis
139	--	--	Aphelacarus acarinus
140	--	--	Brachychthonius inaculatus
141	--	--	Liochthonius marginatus?
142	--	--	Liochthonius nr. piluliferus
143	--	--	Haplochthonius simplex
144	--	--	Cosmochthonius lanatus?
145	--	--	Liacarus glaber?
146	--	--	Carabodes labyrinthicus *
147	--	--	Hermannobates?
148	--	--	Oribatella quadricornuta?
149	--	--	Oribatella meridionalis?
150	--	--	Incabates sp.
151	--	--	Domatorina sp.
152	--	--	Boreozetes sp.
153	--	--	Suctobelba sp. 16
154	--	--	Suctobelba nr. longirostris
---	---	---	NOT USED IN ANALYSIS: Undetermined
---	---	---	Suctob

[illegible][illegible]

34

50f5

APPENDICES C - K

C. Q-mode Varimax Factor Matrix, 100 Variables; % transformation, 10 Factor Extraction	156
D. Q-mode Varimax Factor Matrix, 100 Variables Log N (x + 1) transformation, 10 Factor Extraction	157
E. Q-mode Varimax Factor Score Matrix, 100 Variables Log N (x + 1) transformation, 10 Factor Extraction	158
F. Q-mode Varimax Factor Matrix, 100 Variables Log N (x + 1) transformation, 5 Factor Extraction	159
G. Q-mode Varimax Factor Matrix, 72 Variables Log N (x + 1) transformation, 10 Factor Extraction	160
H. Q-mode Varimax Factor Matrix, 90 Variables, Log N (x + 1) transformation, 10 Factor Extraction	161
I. Q-mode Varimax Factor Score Matrix, 90 Variables, Log N (x + 1) transformation, 10 Factor Extraction	162
J. Q-mode Varimax Factor Matrix, 90 Variables, Log N (x + 1) transformation, 5 Factor Extraction	163
K. Q-mode Varimax Factor Score Matrix 90 Variables, Log N (x + 1) transformation, 5 Factor Extraction	164

APPENDIX: C

J.R.H. Q-MODE FACTOR ANALYSIS 100 VARIABLES

VARIMAX FACTOR MATRIX

VAR		COMM.	1	2	3	4	5	6	7	8		
1	1	GBRM2A	0.9125	0.0676	-0.2532	0.2610	0.0355	*0.8589	-0.0172	0.1889	0.0171	-0.
2	1	GBRM2B	0.9562	0.0848	*-0.9313	0.0675	0.0009	-0.0141	0.1485	0.1139	0.1102	0.
3	U	GBRM4A	0.9454	0.1689	-0.4474	0.2831	-0.0065	*0.5865	0.0482	0.0745	0.0526	0.
4	1	GBRM4B	0.9640	0.0960	*-0.6250	0.3618	-0.0077	0.4456	0.0783	0.0586	0.0720	0.
5	1	GBRM6A	0.8444	0.0119	-0.0883	0.3121	-0.0110	0.2821	-0.0185	0.1000	0.0402	-0.
6	1	GBRM6B	0.9031	0.0552	-0.0283	*0.6891	-0.0100	0.1513	0.0299	0.2264	0.0878	-0.
7	1	GBRM7A	0.9617	0.2976	*-0.7763	0.2084	0.0170	0.1356	0.0903	0.4170	*0.1043	0.
8	1	GBRM7B	0.9411	0.3198	-0.1574	*0.6079	-0.0020	0.3748	-0.0171	0.4299	0.0285	-0.
9		LOGBRM2A	0.7600	0.0630	-0.3293	0.0355	0.0422	0.0686	0.3129	*0.7266	-0.0324	0.
10		LOGBRM2B	0.9617	*0.6656	-0.2517	0.0756	0.0306	0.2488	0.0446	*0.6195	0.0221	0.
11		LOGNRM4A	0.8975	0.2535	-0.2448	0.3356	0.0568	0.2590	0.1416	*0.7488	0.0261	0.
12		LOGBRM4B	0.7487	0.2094	-0.1066	0.2346	0.0881	0.1207	0.1737	*0.7378	0.0166	Q
13		LOGBRM6A	0.9751	*0.8271	-0.0123	0.0073	0.0309	0.1833	-0.0032	*0.5047	-0.0134	-0.
14		LOGBRM6B	0.9158	0.2633	-0.0721	-0.0032	0.0262	0.1622	0.0003	*0.8961	0.0130	-0.
15		LOGBRM7A	0.9774	0.2829	-0.0935	0.3099	0.0170	0.0851	0.0653	*0.8830	0.0071	-0.
16		LOGBRM7B	0.9061	0.2249	-0.4710	0.4212	0.0056	0.1643	0.1067	*0.6268	0.0512	C
17	7	BERM2A	0.9685	*0.7273	-0.1292	0.0952	0.0249	*0.6050	-0.0228	0.2158	0.0007	-0.
18	7	BERM2B	0.9417	0.3007	-0.1291	0.1382	0.0499	*0.8069	0.0699	0.3936	0.0109	0.
19	7	BERM4A	0.9494	*0.5395	-0.1886	0.1492	0.0198	*0.7686	0.0407	0.0530	0.0555	0.
20	7	BERM4B	0.9690	0.4226	-0.1851	0.1836	0.0210	*0.8466	-0.0133	0.0714	0.0092	-0.
21	7	BERM6A	0.9785	*0.8697	-0.0119	0.0785	0.0232	0.4455	0.0173	0.1186	0.0443	-0.
22	7	BERM6B	0.8179	*0.7395	0.0498	0.1986	0.0318	0.4328	0.0229	0.1652	0.0526	C
23	7	BERM7A	0.9893	*0.6895	-0.1046	0.1058	0.0296	*0.6339	-0.0073	0.2960	0.0011	-0.
24	7	BERM7B	0.9858	*0.5606	-0.1380	0.2370	0.0200	*0.7588	0.0742	0.0993	0.0529	-0.
25	9	BERM2A	0.5835	0.0405	-0.0446	0.0963	0.0495	*0.6645	0.1217	0.0562	-0.0782	-0.
26	9	BERM2B	0.9241	0.0579	-0.1189	*0.5368	0.0194	*0.7713	0.0040	0.0233	-0.0272	-0.
27	9	BERM4A	0.9635	0.1160	-0.1138	*0.8149	0.0039	*0.5187	0.0287	0.0427	-0.0143	-0.
28	9	BERM4B	0.9892	0.1704	-0.0454	*0.8344	-0.0016	0.4740	0.0034	0.0974	-0.0063	-0.
29	9	BERM6A	0.9621	0.0112	-0.0615	*0.9458	0.0022	0.2209	0.0535	0.0949	0.0016	C
30	9	BERM6B	0.9126	0.0349	-0.0185	*0.8315	0.0102	0.2329	0.0277	0.3829	0.0178	C
31	9	BERM7A	0.9772	0.0839	-0.0917	*0.8799	-0.0055	0.4150	0.0203	0.1218	-0.0015	-0.
32	9	BERM7B	0.9504	0.1151	-0.1616	0.7704	0.0239	*0.5566	0.0423	0.0593	*0.0179	
33		2BEECH2A	0.9180	0.1845	*-0.7517	0.1125	0.0165	0.1655	0.2376	0.4415	0.1286	
34		2BEECH2B	0.8751	0.3573	*-0.7080	0.0080	0.0024	0.0816	0.3459	0.2863	0.1388	
35		2BEECH4A	0.8552	*0.5544	*-0.5676	0.0330	0.0232	0.1861	0.3095	0.1000	-0.0118	
36		2BEECH4B	0.9704	*0.6457	*-0.6704	0.0774	0.0264	0.1845	0.1157	0.0887	0.0781	
37		2BEECH6A	0.9727	*0.9409	-0.1507	0.0091	0.0117	0.1167	0.1081	0.1852	0.0665	-
38		2BEECH6B	0.9751	*0.9330	-0.1247	0.0418	0.0146	0.2536	0.0459	0.0575	0.0019	-
39		2BEECH7A	0.9445	0.4958	-0.2292	0.2835	0.0089	0.4932	0.1173	*0.5496	0.0698	-
40		2BEECH7B	0.9111	0.4188	-0.4372	0.1399	-0.0031	*0.5506	0.2405	0.3681	0.1292	
41		4BEECH2A	0.8897	0.1618	-0.3022	0.0574	-0.0631	*0.5122	*0.5433	0.0114	0.4414	
42		4BEECH2B	0.8794	0.0719	-0.2559	0.0102	-0.0595	0.3721	*0.7315	0.0143	0.3616	
43		4BEECH4A	0.8708	0.1510	*-0.6201	0.1712	-0.0056	0.4302	0.4563	0.0796	0.0952	
44		4BEECH4B	0.6843	0.1190	*-0.6185	0.0945	0.0094	0.0854	0.4205	0.1736	0.0432	
45		4BEECH6A	0.8379	0.4317	-0.3633	0.2163	-0.0569	0.2026	0.4982	0.0127	0.4216	
46		4BEECH6B	0.8728	*0.8223	-0.2637	0.1790	-0.0175	0.1840	0.1899	0.1175	0.0151	-
47		4BEECH7A	0.7842	0.2934	*-0.5280	0.0339	0.0209	-0.0446	*0.5970	0.1420	0.0090	
48		4BEECH7B	0.8044	0.3026	*-0.6016	-0.0031	0.0221	0.0604	*0.5251	0.1445	0.0091	
49		5HEMLO2A	0.9338	*0.9288	-0.2225	0.0327	0.0144	0.0281	0.1182	0.0320	0.0591	
50		5HEMLO2B	0.8490	*0.8430	-0.1700	0.0156	0.0257	0.0189	0.2933	0.1236	0.0713	
51		5HEMLO4A	0.9063	*0.8909	-0.2797	0.0686	0.0276	0.0723	0.1112	0.0476	0.0343	
						0.0640	0.0185	0.0867	0.0936	0.1088	0.1067	

1-206

APPENDIX: C

FACTOR ANALYSIS 100 VARIABLES

TPIY

	1	2	3	4	5	6	7	8	9	10
5	0.0676	-0.2532	0.2610	0.0355	*0.8589	-0.0172	0.1889	0.0171	-0.0119	0.0193
62	0.0848	*-0.9313	0.0675	0.0009	-0.0141	0.1485	0.1139	0.1102	0.1157	0.1278
4	0.1689	-0.4474	0.2831	-0.0065	*0.5865	0.0482	0.0745	0.0526	0.0116	*0.5308
0	0.0960	*-0.6250	0.3618	-0.0077	0.4456	0.0783	0.0586	0.0720	0.0459	0.4668
4	0.0119	-0.0883	0.3121	-0.0110	0.2821	-0.0185	-0.1000	0.0402	-0.0146	*0.8045
21	0.0552	-0.0283	*0.6891	-0.0100	0.1513	0.0299	0.2264	0.0878	-0.0033	*0.5843
7	0.2976	*-0.7763	0.2084	0.0170	0.1356	0.0903	0.4170	0.1043	0.0887	0.0874
1	0.3198	-0.1574	*0.6079	-0.0020	0.3748	-0.0171	0.4299	0.0285	-0.0194	0.3430
0	0.0630	-0.3293	-0.0355	0.0422	0.0686	0.3129	*0.7266	-0.0324	0.0411	0.1063
7	*0.6656	-0.2517	0.0756	0.0306	0.2488	0.0446	*0.6195	0.0221	0.0048	-0.0222
25	0.2535	-0.2448	0.3356	0.0568	0.2590	0.1416	*0.7488	0.0261	0.0437	0.0834
27	0.2094	-0.1066	0.2346	0.0881	0.1207	0.1737	*0.7378	0.0166	0.1084	0.1723
51	*0.8271	-0.0123	0.0073	0.0309	0.1833	-0.0032	*0.5047	-0.0134	-0.0242	-0.0261
8	0.2633	-0.0721	-0.0032	0.0262	0.1622	0.0003	*0.8961	0.0130	-0.0120	-0.1048
74	0.2829	-0.0935	0.3099	0.0170	0.0851	0.0653	*0.8830	0.0071	-0.0007	-0.0318
61	0.2249	-0.4710	0.4212	0.0056	0.1643	0.1067	*0.6268	0.0512	0.0746	0.1293
5	*0.7273	-0.1292	0.0952	0.0249	*0.6050	-0.0228	0.2158	0.0007	-0.0042	0.0039
17	0.3007	-0.1291	0.3382	0.0499	*0.8069	0.0699	0.3936	0.0109	0.0255	0.0382
94	*0.5395	-0.1886	0.1492	0.0198	*0.7686	0.0407	0.0530	0.0555	0.0100	0.0404
90	0.4226	-0.1851	0.1836	0.0210	*0.8466	-0.0133	0.0714	0.0092	-0.0010	0.0062
25	*0.8697	-0.0119	0.0785	0.0232	0.4455	0.0173	0.1186	0.0443	-0.0117	0.0161
79	*0.7395	0.0498	0.1986	0.0318	0.4328	0.0229	0.1652	0.0526	0.0154	0.1004
73	*0.6895	-0.1046	0.1058	0.0296	*0.6339	-0.0073	0.2960	0.0011	-0.0112	-0.0342
58	*0.5606	-0.1380	0.2370	0.0200	*0.7588	0.0742	0.0993	0.0529	-0.0071	-0.0437
35	0.0405	-0.0446	0.0963	0.0495	*0.6645	0.1217	0.0562	-0.0782	-0.0231	0.3193
1	0.0579	-0.1189	*0.5368	0.0194	*0.7713	0.0040	0.0233	-0.0272	-0.0342	0.1442
25	0.1160	-0.1138	*0.8149	0.0039	*0.5187	0.0287	0.0427	-0.0143	-0.0197	0.0284
2	0.1704	-0.0454	*0.8344	-0.0016	0.4740	0.0034	0.0974	-0.0063	-0.0184	0.1653
21	0.0112	-0.0615	*0.9458	0.0022	0.2209	0.0535	0.0949	0.0016	0.0114	0.0536
26	0.0349	-0.0185	*0.8315	0.0102	0.2329	0.0277	0.3829	0.0178	0.0245	0.1305
72	0.0839	-0.0917	*0.8799	-0.0055	0.4150	0.0203	0.1218	-0.0015	-0.0030	0.0038
4	0.1151	-0.1616	0.7704	0.0234	*0.5566	0.0423	0.0593	-0.0179	0.0210	0.0328
0	0.1845	*-0.7517	0.1125	0.0165	0.1655	0.2376	0.4415	0.1286	0.0789	0.0675
51	0.3573	*-0.7080	0.0080	0.0024	0.0816	0.3459	0.2863	0.1388	0.0607	0.1219
2	*0.5544	*-0.5676	0.0330	0.0232	0.1861	0.3095	0.1000	-0.0118	0.0263	0.2878
7	*0.6457	*-0.6704	0.0774	0.0264	0.1845	0.1157	0.0887	0.0781	0.0694	0.1761
27	*0.9409	-0.1507	0.0091	0.0117	0.1167	0.1081	0.1852	0.0665	-0.0000	0.0212
51	*0.9330	-0.1247	0.0418	0.0146	0.2536	0.0459	0.0575	0.0019	-0.0161	0.1308
45	0.4958	-0.2292	0.2835	0.0089	0.4932	0.1173	*0.5496	0.0698	-0.0207	-0.0374
11	0.4188	-0.4372	0.1399	-0.0031	*0.5506	0.2405	0.3681	0.1292	0.0251	0.1053
97	0.1618	-0.3022	0.0574	-0.0631	*0.5122	*0.5433	0.0114	0.4414	0.0149	-0.1103
94	0.0719	-0.2559	0.0102	-0.0595	0.3721	*0.7315	0.0143	0.3616	0.0096	-0.0200
08	0.1510	*-0.6201	0.1712	-0.0056	0.4302	0.4563	0.0796	0.0952	0.0434	0.1534
43	0.1190	*-0.6185	0.0945	0.0094	0.0854	0.4205	0.1736	0.0432	0.1189	0.2200
79	0.4317	-0.3633	0.2163	-0.0569	0.2026	0.4982	0.0127	0.4216	0.0403	-0.0277
28	*0.8223	-0.2637	0.1790	0.0175	0.1840	0.1899	0.1175	0.0151	-0.0013	0.1037
42	0.2934	*-0.5280	0.0339	0.0209	-0.0446	*0.5970	0.1420	0.0090	0.0506	0.1912
44	0.3026	*-0.6016	-0.0031	0.0221	0.0604	*0.5251	0.1445	0.0091	0.0369	0.2208
38	*0.9288	-0.2225	0.0327	0.0144	0.0281	0.1182	0.0320	0.0591	0.0329	-0.0083
90	*0.8430	-0.1700	0.0156	0.0257	0.0189	0.2933	0.1236	0.0713	0.0416	0.0105
63	*0.8909	-0.2797	0.0686	0.0276	0.0723	0.1112	0.0476	0.0343	0.0803	-0.0306

35	2BEECH4A	0.8552	*0.5544	-0.5676	0.0330	0.0232	0.1881	0.1079	0.12
36	2BEECH4B	0.9704	*0.6457	*-0.6704	0.0774	0.0264	0.1845	0.1157	0.08
37	2BEECH6A	0.9727	*0.9409	-0.1507	0.0091	0.0117	0.1167	0.1081	0.18
38	2BEECH6B	0.9751	*0.9330	-0.1247	0.0418	0.0146	0.2536	0.0459	0.09
39	2BEECH7A	0.9445	0.4958	-0.2292	0.2835	0.0089	0.4932	0.1173	*0.51
40	2BEECH7B	0.9111	0.4188	-0.4372	0.1399	-0.0031	*0.5506	0.2405	0.30
41	4BEECH2A	0.8897	0.1618	-0.3022	0.0574	-0.0631	*0.5122	*0.5433	0.02
42	4BEECH2B	0.8794	0.0719	-0.2559	0.0102	-0.0595	0.3721	*0.7315	0.02
43	4BEECH4A	0.8708	0.1510	*-0.6201	0.1712	-0.0056	0.4302	0.4563	0.07
44	4BEECH4B	0.6843	0.1190	*-0.6185	0.0945	0.0094	0.0854	0.4205	0.17
45	4BEECH5A	0.8379	0.4317	-0.3633	0.2163	-0.0569	0.2026	0.4982	0.02
46	4BEECH6B	0.8728	*0.8223	-0.2637	0.1790	0.0175	0.1840	0.1899	0.11
47	4BEECH7A	0.7842	0.2934	*-0.5280	0.0339	0.0209	-0.0446	*0.5970	0.11
48	4BEECH7B	0.8044	0.3026	*-0.6016	-0.0031	0.0221	0.0604	*0.5251	0.11
49	5HEMLO2A	0.9338	*0.9288	-0.2225	0.0327	0.0144	0.0281	0.1182	0.02
50	5HEMLO2B	0.8490	*0.8430	-0.1700	0.0156	0.0257	0.0189	0.2933	0.11
51	5HEMLO4A	0.9063	*0.8909	-0.2797	0.0686	0.0276	0.0723	0.1112	0.02
52	5HEMLO4B	0.9580	*0.7606	*-0.5746	0.0640	0.0185	0.0867	0.0936	0.10
53	5HEMLO6A	0.9847	*0.9855	0.0528	0.0085	0.0353	0.0409	0.0444	0.02
54	5HEMLO6B	0.9907	*0.9899	-0.0539	0.0224	0.0208	0.0327	0.0493	0.02
55	5HEMLO7A	0.9834	*0.9902	0.0012	0.0121	0.0228	0.0308	0.0325	0.02
56	5HEMLO7B	0.9864	*0.9879	0.0551	0.0231	0.0354	0.0272	0.0416	0.02
57	6HEBE 2A	0.6565	0.1283	-0.2739	0.0258	0.0959	-0.0492	*0.7160	0.11
58	6HEBE 2B	0.8347	0.1170	-0.0290	0.0124	0.1102	0.0142	*0.8894	0.11
59	6HEBE 4A	0.7497	0.1651	-0.1491	0.0130	0.0193	0.0025	*0.8196	0.02
60	6HEBE 4B	0.6677	0.2403	-0.2766	0.0314	0.0455	-0.0358	*0.7193	0.02
61	6HEBE 6A	0.8600	*0.7617	0.0263	-0.0002	0.0075	0.0276	*0.5122	0.02
62	6HEBE 6B	0.3838	0.3494	-0.1608	-0.0001	0.0364	-0.0317	0.4598	0.11
63	6HEBE 7A	0.9796	*0.9555	0.0427	0.0042	0.0214	0.0433	0.2361	0.02
64	6HEBE 7B	0.9118	*0.8963	-0.0116	0.0080	0.0383	0.0214	0.3191	0.02
65	8ASPEN2A	0.8949	0.0671	*-0.8828	0.1123	0.0698	0.2353	0.0707	0.02
66	8ASPEN2B	0.9558	0.0788	*-0.9427	0.0976	0.0395	0.1022	0.0781	0.02
67	8ASPEN4A	0.9543	0.0598	*-0.8710	0.1293	0.0295	0.3910	0.0445	0.02
68	*ASPEN4B	0.9500	0.1304	*-0.8521	0.1275	0.0013	0.3893	0.0768	0.02
69	8ASPEN6A	0.7888	*0.8328	-0.2161	0.0273	0.0926	0.0629	0.1093	0.11
70	8ASPEN6B	0.7544	0.0639	-0.2033	0.0235	-0.0515	0.2170	*0.5085	-0.02
71	8ASPEN7A	0.9087	0.0797	*-0.9196	0.0845	0.0797	-0.0371	0.0850	0.02
72	8ASPEN7B	0.9004	0.0740	*-0.9011	0.0974	0.1207	-0.0011	0.1232	0.02
73	11ASPEN2A	0.8383	0.0453	-0.1278	0.0968	0.1112	0.0264	0.0103	-0.02
74	11ASPEN2B	0.8829	0.0769	*-0.6343	0.1334	0.1129	0.0560	0.0471	0.02
75	11ASPEN4A	0.9491	0.0223	-0.1847	*0.9221	0.0614	-0.1412	0.0627	0.02
76	11ASPEN4B	0.9684	0.0590	-0.4763	*0.7363	0.0317	-0.1414	0.0815	0.02
77	11ASPEN6A	0.9844	0.0229	-0.1879	*0.9047	0.0117	-0.1144	0.0662	0.02
78	11ASPEN6B	0.9020	0.0376	-0.2599	0.3221	0.0287	-0.0494	0.0385	0.02
79	11ASPEN7A	0.8054	0.0171	-0.2141	-0.0240	0.1864	0.0375	0.0675	0.02
80	11ASPEN7B	0.9601	0.0383	-0.2141	0.0387	0.1128	-0.0019	0.0406	0.02
81	3W. ASH2A	0.4371	-0.0185	-0.0328	0.0201	*0.6417	0.0137	0.0218	0.02
82	3W. ASH2B	0.5859	0.0510	-0.4995	0.1389	*0.5202	-0.0837	0.0723	-0.02
83	3W. ASH4A	0.7500	-0.0057	-0.0802	0.0370	*0.8564	-0.0010	0.0192	-0.02
84	3W. ASH4B	0.8240	-0.0110	-0.1743	0.0285	*0.8848	-0.0035	0.0881	-0.02
85	3W. ASH6A	0.5983	-0.0335	-0.0034	-0.0290	*0.7195	0.1340	0.1454	-0.02
86	3W. ASH6B	0.7805	0.0765	-0.1586	0.0264	*0.8503	-0.0150	-0.0247	-0.02
87	3W. ASH7A	0.9077	0.1227	0.0747	-0.0210	*0.8737	0.0356	-0.0523	0.02
88	3W. ASH7B	0.4157	-0.0247	0.0687	-0.0687	*0.5558	0.0748	0.0635	0.02
89	12WASH2A	0.6949	0.0088	-0.0784	0.0028	0.4127	-0.0626	-0.1289	0.02
90	12WASH2B	0.6339	-0.0023	0.0519	-0.0085	*0.5694	-0.0233	-0.1180	0.02
91	12WASH4A	0.6277	0.0020	0.0080	0.0518	*0.7014	-0.0572	-0.0942	-0.02
92	12WASH4B	0.6216	0.0097	-0.0427	0.0488	*0.6437	-0.0220	0.0468	-0.02
93	12WASH6A	0.9423	0.0356	-0.2012	0.0093	0.0391	0.0373	0.2776	-0.02
94	12WASH6B	0.7905	0.0538	-0.4510	0.0214	0.2933	-0.0073	0.1467	0.02
95	12WASH7A	0.9442	0.0480	-0.3767	0.0228	0.1343	-0.0033	0.1947	0.02
96	12WASH7B	0.9032	0.0315	-0.1849	0.0041	0.1159	-0.0011	0.1383	0.02

VARIANCE	20.085	14.532	9.619	6.483	9.937	6.847	6
CUM. VAR.	20.085	34.617	44.235	50.719	60.655	67.502	74

0.1151	-0.1616	0.7704	0.0237	*0.5566	0.0423	0.0593	-0.0179	0.0210	0.0328
0.1845	*-0.7517	0.1125	0.0165	0.1655	0.2376	0.4415	0.1286	0.0789	0.0675
0.3573	*-0.7080	0.0080	0.0024	0.0816	0.3459	0.2863	0.1388	0.0607	0.1219
*0.5544	*-0.5676	0.0330	0.0232	0.1861	0.3095	0.1000	-0.0118	0.0263	0.2878
*0.6457	*-0.6704	0.0774	0.0264	0.1845	0.1157	0.0887	0.0781	0.0694	0.1761
*0.9409	-0.1507	0.0091	0.0117	0.1167	0.1081	0.1852	0.0665	-0.0000	0.0212
*0.9330	-0.1247	0.0418	0.0146	0.2536	0.0459	0.0575	0.0019	-0.0161	0.1308
0.4958	-0.2292	0.2835	0.0089	0.4932	0.1173	*0.5496	0.0698	-0.0207	-0.0374
0.4188	-0.4372	0.1399	-0.0031	*0.5506	0.2405	0.3681	0.1292	0.0251	0.1053
0.1618	-0.3022	0.0574	-0.0631	*0.5122	*0.5433	0.0114	0.4414	0.0149	-0.1103
0.0719	-0.2559	0.0102	-0.0595	0.3721	*0.7315	0.0143	0.3616	0.0096	-0.0200
0.1510	*-0.6201	0.1712	-0.0056	0.4302	0.4563	0.0796	0.0952	0.0434	0.1534
0.1190	*-0.6185	0.0945	0.0094	0.0854	0.4205	0.1736	0.0432	0.1189	0.2200
0.4317	-0.3633	0.2163	-0.0569	0.2026	0.4982	0.0127	0.4216	0.0403	-0.0277
*0.8223	-0.2637	0.1790	0.0175	0.1840	0.1899	0.1175	0.0151	-0.0013	0.1037
0.2934	*-0.5280	0.0339	0.0209	-0.0446	*0.5970	0.1420	0.0090	0.0506	0.1912
0.3026	*-0.6016	-0.0031	0.0221	0.0604	*0.5251	0.1445	0.0091	0.0369	0.2208
*0.9288	-0.2225	0.0327	0.0144	0.0281	0.1182	0.0320	0.0591	0.0329	-0.0083
*0.8430	-0.1700	0.0156	0.0257	0.0189	0.2933	0.1236	0.0713	0.0416	0.0105
*0.8909	-0.2797	0.0686	0.0276	0.0723	0.1112	0.0476	0.0343	0.0803	-0.0306
*0.7606	*-0.5746	0.0640	0.0185	0.0867	0.0936	0.1088	0.1067	0.0712	-0.0149
*0.9855	0.0528	0.0085	0.0353	0.0409	0.0444	0.0634	0.0366	-0.0024	-0.0174
*0.9899	-0.0539	0.0224	0.0208	0.0327	0.0493	0.0420	0.0340	0.0145	-0.0163
*0.9902	0.0012	0.0121	0.0228	0.0308	0.0325	0.0048	-0.0124	0.0002	0.0081
*0.9879	0.0551	0.0231	0.0354	0.0272	0.0416	0.0478	0.0063	0.0285	0.0046
0.1283	-0.2739	0.0258	0.0959	-0.0492	*0.7160	0.1919	-0.0444	0.0332	0.0138
0.1170	-0.0290	0.0124	0.1102	0.0142	*0.8894	0.1188	0.0450	0.0206	-0.0099
0.1651	-0.1491	0.0130	0.0193	0.0025	*0.8196	0.0484	0.1561	0.0299	-0.0143
0.2403	-0.2766	0.0314	0.0455	-0.0358	*0.7193	0.0273	0.0917	0.0500	-0.0060
*0.7617	0.0263	-0.0002	0.0075	0.0276	*0.5122	0.0134	0.1249	-0.0068	0.0111
0.3494	-0.1608	-0.0001	0.0364	-0.0317	0.4598	0.1209	-0.0146	0.0086	0.0852
*0.9555	0.0427	0.0042	0.0214	0.0433	0.2361	0.0590	0.0541	-0.0083	-0.0113
*0.8963	-0.0116	0.0080	0.0383	0.0214	0.3191	0.0662	0.0010	-0.0128	0.0062
0.0671	*-0.8828	0.1123	0.0698	0.2353	0.0707	0.0894	0.0978	0.1161	-0.0465
0.0788	*-0.9427	0.0976	0.0395	0.1022	0.0781	0.0405	0.1230	0.1278	-0.0140
0.0598	*-0.8710	0.1293	0.0295	0.3910	0.0445	0.0057	0.0891	0.0953	-0.0514
0.1304	*-0.8521	0.1275	0.0013	0.3893	0.0768	0.0030	0.1384	0.1025	-0.0596
*0.8328	-0.2161	0.0273	0.0925	0.0629	0.1093	0.1308	0.0617	0.0490	-0.0041
0.0639	-0.2033	0.0235	-0.0515	0.2170	*0.5085	-0.0417	*0.6064	0.0579	-0.1656
0.0797	*-0.9196	0.0845	0.0797	-0.0371	0.0850	0.0396	0.1148	0.1395	-0.0205
0.0740	*-0.9011	0.0974	0.1207	-0.0011	0.1232	0.0303	0.1267	0.1533	-0.0575
0.0453	-0.1278	0.0968	0.1112	0.0264	0.0103	-0.0136	0.0580	*0.8907	-0.0223
0.0769	*-0.6343	0.1334	0.1120	0.0560	0.0471	0.0084	0.0996	*0.6535	-0.0418
0.0223	-0.1847	*0.9221	0.0614	-0.1412	0.0627	0.0617	0.0542	0.1716	-0.0207
0.0590	-0.4763	*0.7363	0.0317	-0.1414	0.0815	0.0571	0.0796	0.3997	-0.0381
0.0229	-0.1879	*0.9047	0.0117	-0.1144	0.0662	0.0615	0.0350	0.3273	-0.0202
0.0376	-0.2599	0.3221	0.0287	-0.0494	0.0385	0.0402	0.0690	*0.8474	0.0044
0.0171	-0.2141	-0.0240	0.1864	0.0375	0.0675	0.0929	0.0238	*0.8364	0.0966
0.0383	-0.2141	*0.0387	0.1128	-0.0019	0.0406	0.0213	0.0334	*0.9462	0.0124
-0.0185	-0.0328	0.0201	*0.6417	0.0137	0.0218	0.1006	-0.0359	-0.0125	-0.1064
0.0510	-0.4995	0.1389	*0.5202	-0.0837	0.0723	-0.0267	-0.0314	0.0900	-0.1480
-0.0057	-0.0802	0.0370	*0.8564	-0.0010	0.0192	-0.0015	0.0827	0.0390	-0.0009
-0.0110	-0.1743	0.0285	*0.8848	-0.0035	0.0881	-0.0070	-0.0027	0.0423	-0.0105
-0.0335	-0.0034	-0.0290	*0.7195	0.1340	0.1454	-0.0276	-0.1567	0.1174	0.0215
0.0765	-0.1586	*0.0264	*0.8503	-0.0150	-0.0247	-0.0017	0.1428	0.0588	0.0348
0.1227	0.0747	-0.0210	*0.8737	0.0356	-0.0523	0.2410	0.2350	0.0655	0.0399
-0.0247	0.0687	-0.0687	*0.5558	0.0748	0.0635	0.0048	-0.0513	0.2744	0.0958
0.0088	-0.0784	0.0028	0.4127	-0.0626	-0.1289	0.0404	*0.6936	-0.0015	0.1230
-0.0023	0.0519	-0.0085	*0.5694	-0.0233	-0.1180	0.0458	*0.5218	0.0559	0.1221
0.0020	0.0080	0.0518	*0.7014	-0.0572	-0.0942	-0.0196	0.3238	-0.1250	0.0070
0.0097	-0.0427	0.0488	*0.6437	-0.0220	0.0468	-0.0356	0.4229	-0.1346	-0.0448
0.0356	-0.2012	0.0093	0.0391	0.0373	0.2776	-0.0037	*0.9033	0.0459	-0.0497
0.0538	-0.4510	0.0214	0.2933	-0.0073	0.1467	0.0315	*0.6695	0.1625	0.0222
0.0480	-0.3767	0.0228	0.1343	-0.0033	0.1947	0.0294	*0.8574	0.0863	0.0039
0.0315	-0.1849	0.0041	0.1159	-0.0011	0.1383	0.0191	*0.9129	0.0353	0.0224
20.085	14.532	9.619	6.483	9.937	6.847	6.634	5.408	4.397	2.486
20.085	34.617	44.235	50.719	60.655	67.502	74.136	79.544	83.941	86.426

APPENDIX: D

J. R. H. Q-MODE 100 VAR. LN(X+1)

VARIMAX FACTOR MATRIX

	COMM.	1	2	3	4	5	6	7	8	9
1 1 GBRM2A	0.8187	*0.8078	0.0856	-0.0933	0.1312	-0.1208	-0.0646	-0.1844	-0.2293	0.1284
2 1 GRBM2B	0.6202	0.4886	-0.0542	-0.1125	0.3659	-0.1905	0.1546	-0.1718	-0.2370	0.2730
3 U GBRM4A	0.8132	*0.8237	-0.0425	-0.0401	0.1210	-0.1765	0.0711	-0.1289	-0.2417	0.0640
4 1 GBRM4B	0.8232	*0.8265	-0.0449	-0.1306	0.1561	-0.1334	0.0572	-0.1165	-0.2140	0.1120
5 1 GRBM6A	0.7938	*0.8426	0.0292	-0.0883	0.0139	-0.1227	0.0748	-0.1249	-0.1017	0.1500
6 1 GBRM6B	0.8217	*0.8462	0.0377	-0.0979	-0.0169	-0.1761	0.0420	-0.2149	-0.0725	0.0920
7 1 GBRM7A	0.8445	*0.7642	0.0551	-0.0993	0.1774	-0.2656	0.0181	-0.1063	-0.2525	0.2640
8 1 GBRM7B	0.8566	*0.8712	-0.0069	-0.0792	0.0463	-0.1496	0.0163	-0.0488	-0.1560	0.1980
9 10GBRM2A	0.7107	0.4400	0.0974	-0.0633	0.0976	-0.3640	0.1190	0.0444	-0.2189	*0.544
10 10GBRM2B	0.8149	*0.6662	0.0452	-0.0505	0.1620	-0.3727	-0.9060	-0.0320	-0.2335	0.330
11 10GNRM4A	0.8470	*0.6515	0.1239	-0.1283	0.0468	-0.3085	0.0981	-0.0346	-0.1794	0.477
12 10GBRM4B	0.8164	*0.5871	0.1860	-0.2116	-0.0342	-0.3590	0.0577	-0.0302	-0.2046	0.408
13 10GBRM6A	0.8177	*0.5373	0.0795	-0.0052	0.0822	-0.3548	-0.1187	0.0371	-0.3714	0.452
14 10GBRM6B	0.7988	0.4833	0.0686	-0.1026	0.1360	-0.4241	-0.1645	-0.0094	-0.3123	0.405
15 10GBRM7A	0.8401	*0.5893	0.0365	-0.1208	0.0284	-0.3350	-0.0550	0.0246	-0.2871	*0.522
16 10GBRM7B	0.8117	*0.6471	0.0243	-0.1211	0.1025	-0.2535	-0.0914	-0.0216	-0.2908	0.457
17 7 BERM2A	0.8432	*0.6396	0.0257	0.0167	0.1401	-0.3394	-0.1509	-0.0615	-0.2117	0.161
18 7 BERM2B	0.8841	*0.6852	0.1035	-0.1387	0.0630	-0.3063	-0.1562	-0.1036	-0.2577	0.166
19 7 BERM4A	0.9207	*0.7077	0.0585	-0.0984	0.1171	-0.3491	-0.1477	-0.1675	-0.2205	0.074
20 7 BERM4B	0.9135	*0.7578	0.0633	-0.1050	0.1118	-0.3217	-0.1088	-0.1426	-0.2037	0.136
21 7 BERM6A	0.9149	*0.6594	0.0924	-0.0802	0.0589	-0.3554	-0.1429	-0.1452	-0.2265	0.087
22 7 BERM6B	0.9116	*0.6896	0.0881	-0.1198	-0.0171	-0.3418	-0.1138	-0.1209	-0.1784	0.113
23 7 BERM7A	0.9098	*0.6839	0.0742	-0.0977	0.0900	-0.3974	-0.1679	-0.0866	-0.2435	0.135
24 7 BERM7B	0.8833	*0.6186	0.0569	-0.1305	0.0532	-0.4299	-0.1688	-0.1146	-0.3119	0.036
25 9 BERM2A	0.6360	*0.6832	0.1184	0.1538	0.1279	-0.1345	-0.0517	0.1383	-0.1160	-0.223
26 9 BERM2B	0.8733	*0.8509	0.1066	-0.1074	0.1780	-0.1114	-0.0619	0.0676	-0.1742	-0.127
27 9 BERM4A	0.8840	*0.8559	0.0678	-0.1277	0.2346	-0.1429	-0.0521	0.0505	-0.1754	-0.087
28 9 BERM4B	0.9157	*0.8946	0.0671	-0.1488	0.1770	-0.1352	-0.0524	0.0529	-0.1745	-0.052
29 9 BERM6A	0.8435	*0.8129	0.1055	-0.2384	0.2008	-0.1045	0.0215	0.0326	-0.1645	-0.169
30 9 BERM6B	0.7940	*0.8250	0.0403	-0.2136	0.1524	-0.1359	0.0418	0.0050	-0.1070	-0.104
31 9 BERM7A	0.8759	*0.8698	-0.0044	-0.1993	0.1436	-0.1337	-0.0950	0.0222	-0.1075	-0.096
32 9 BERM7B	0.8340	*0.8131	0.0830	-0.1903	0.2343	-0.1850	-0.1118	0.0540	-0.0923	-0.128
33 2BEECH2A	0.8193	*0.5297	0.0107	-0.0967	0.1625	-0.3616	-0.0346	-0.1230	*-0.5888	0.035
34 2BEECH2B	0.8231	0.3702	0.0099	-0.0191	0.2166	-0.3922	-0.1010	-0.1840	*-0.6237	0.181
35 2BEECH4A	0.8255	0.4330	0.0770	-0.0935	0.1040	-0.4233	-0.1033	0.0144	*-0.6491	0.026
36 2BEECH4B	0.8033	0.4747	0.0898	-0.0659	0.1514	-0.3455	-0.0490	-0.1023	*-0.6332	0.091
37 2BEECH6A	0.9109	0.3890	0.0367	-0.0138	0.0915	*-0.5155	-0.0549	-0.0862	*-0.6592	0.104
38 2BEECH6B	0.8848	0.4772	0.0140	-0.0355	0.0660	-0.4571	-0.0541	-0.0426	*-0.6501	0.042
39 2BEECH7A	0.8457	*0.5477	0.0042	-0.0655	0.0764	-0.3735	-0.0253	-0.0920	*-0.6026	0.110
40 2BEECH7B	0.8844	0.4592	0.0003	-0.0479	0.1001	-0.3766	-0.0664	-0.1164	*-0.6841	0.170
41 4BEECH2A	0.8585	0.3404	0.0197	0.0215	0.2630	*-0.5256	-0.0649	-0.1883	*-0.5774	0.040
42 4BEECH2B	0.8072	0.1966	-0.0350	-0.0360	0.1834	*-0.5380	0.0324	-0.1507	*-0.6358	-0.010
43 4BEECH4A	0.8552	0.3931	-0.0140	-0.1184	0.1235	*-0.5012	0.0099	-0.0620	*-0.6443	0.000
44 4BEECH4B	0.7321	0.3749	-0.0074	-0.1096	0.1461	-0.3812	-0.0431	-0.0731	*-0.6051	0.050
45 4BEECH6A	0.8386	0.3759	-0.0071	-0.1506	0.0983	-0.4186	-0.0466	-0.1712	*-0.6763	-0.000
46 4BEECH6B	0.7879	0.4189	0.0252	-0.0138	0.0372	-0.4318	-0.0783	-0.0402	*-0.6398	0.030
47 4BEECH7A	0.8325	0.1727	0.0345	-0.1590	0.0138	*-0.5648	0.0348	-0.0348	*-0.6605	0.120
48 4BEECH7B	0.8845	0.2886	0.0498	-0.0562	0.1317	*-0.5867	0.0018	-0.0411	*-0.6503	0.090
49 5HEMLO2A	0.8472	0.2213	-0.0203	-0.0697	0.1279	*-0.6993	-0.4774	-0.0698	-0.2072	-0.030
50 5HEMLO2B	0.8475	0.2122	0.0482	-0.0730	0.0772	*-0.7768	-0.3815	-0.0492	-0.1733	0.040
51 5HEMLO4A	0.8832	0.2713	0.0079	-0.1234	0.1467	*-0.6935	-0.4573	-0.0573	-0.2325	0.000
52 5HEMLO4B	0.8529	0.3022	0.0347	-0.0639	0.1849	*-0.6087	-0.4504	-0.1394	-0.3086	0.060

APPENDIX: D

100 VAR. LN(X+1)

TRIX

OMM.	1	2	3	4	5	6	7	8	9	10
8187	*0.8078	0.0856	-0.0933	0.1312	-0.1208	-0.0646	-0.1844	-0.2293	0.1284	0.1054
6202	0.4886	-0.0542	-0.1125	0.3659	-0.1905	0.1546	-0.1718	-0.2370	0.2730	-0.1075
8132	*0.8237	-0.0425	-0.0401	0.1210	-0.1765	0.0711	-0.1289	-0.2417	0.0646	-0.0339
8232	*0.8265	-0.0449	-0.1306	0.1561	-0.1334	0.0572	-0.1165	-0.2140	0.1126	-0.0588
7938	*0.8426	0.0292	-0.0883	0.0139	-0.1227	0.0748	-0.1249	-0.1017	0.1500	-0.0766
8217	*0.8462	0.0377	-0.0979	-0.0169	-0.1761	0.0420	-0.2149	-0.0725	0.0929	0.0398
8445	*0.7642	0.0551	-0.0993	0.1774	-0.2656	0.0181	-0.1063	-0.2525	0.2648	-0.0091
8566	*0.8712	-0.0069	-0.0792	0.0463	-0.1496	0.0163	-0.0488	-0.1560	0.1986	0.0171
7107	0.4400	0.0974	-0.0633	0.0976	-0.3640	0.1190	0.0444	-0.2189	*0.5445	-0.0320
8149	*0.6662	0.0452	-0.0505	0.1620	-0.3727	-0.9060	-0.0320	-0.2335	0.3301	0.1661
8470	*0.6515	0.1239	-0.1283	0.0468	-0.3085	0.0981	-0.0346	-0.1794	0.4777	0.1490
8164	*0.5871	0.1860	-0.2116	-0.0342	-0.3590	0.0577	-0.0302	-0.2046	0.4089	0.2214
8177	*0.5373	0.0795	-0.0052	0.0822	-0.3548	-0.1187	0.0371	-0.3714	0.4524	0.1790
7988	0.4833	0.0686	-0.1026	0.1360	-0.4241	-0.1645	-0.0094	-0.3123	0.4056	0.2497
8401	*0.5893	0.0365	-0.1208	0.0284	-0.3350	-0.0550	0.0246	-0.2871	*0.5229	0.0667
8117	*0.6471	0.0243	-0.1211	0.1025	-0.2535	-0.0914	-0.0216	-0.2908	0.4578	-0.0053
8432	*0.6396	0.0257	0.0167	0.1401	-0.3394	-0.1509	-0.0615	-0.2117	0.1618	0.4481
8841	*0.6852	0.1035	-0.1387	0.0630	-0.3063	-0.1562	-0.1036	-0.2577	0.1662	0.3972
9207	*0.7077	0.0585	-0.0984	0.1171	-0.3491	-0.1477	-0.1675	-0.2205	0.0745	0.4088
9135	*0.7578	0.0633	-0.1050	0.1118	-0.3217	-0.1088	-0.1426	-0.2037	0.1362	0.3405
9149	*0.6594	0.0924	-0.0802	0.0589	-0.3554	-0.1429	-0.1452	-0.2265	0.0875	0.4847
9116	*0.6896	0.0881	-0.1198	-0.0171	-0.3418	-0.1138	-0.1209	-0.1784	0.1136	0.4739
9098	*0.6839	0.0742	-0.0977	0.0900	*0.3974	-0.1679	-0.0866	-0.2435	0.1351	0.3845
8833	*0.6186	0.0569	-0.1305	0.0532	-0.4299	-0.1688	-0.1146	-0.3119	0.0364	0.3905
6360	*0.6832	0.1184	0.1538	0.1279	-0.1315	-0.0517	0.1383	-0.1160	-0.2237	-0.1125
8733	*0.8509	0.1066	-0.1074	0.1780	-0.1114	-0.0619	0.0676	-0.1742	-0.1274	-0.1655
8840	*0.8559	0.0678	-0.1277	0.2346	-0.1429	-0.0521	0.0505	-0.1754	-0.0872	-0.1067
9157	*0.8946	0.0671	-0.1488	0.1770	-0.1352	-0.0524	0.0529	-0.1745	-0.0522	-0.0201
8435	*0.8129	0.1055	-0.2384	0.2008	-0.1045	0.0215	-0.0326	-0.1645	-0.1691	-0.0864
7940	*0.8250	0.0403	-0.2136	0.1524	-0.1359	0.0418	0.0050	-0.1070	-0.1041	-0.0194
8759	*0.8698	-0.0044	-0.1993	0.1436	-0.1337	-0.0950	0.0222	-0.1075	-0.0963	0.1032
8340	*0.8131	0.0830	-0.1903	0.2343	-0.1850	-0.1118	0.0540	-0.0923	-0.1288	0.0094
8193	*0.5297	0.0107	-0.0967	0.1625	-0.3616	-0.0346	-0.1230	*-0.5888	0.0353	0.0882
8231	0.3702	0.0099	-0.0191	0.2166	-0.3922	-0.1010	-0.1840	*-0.6237	0.1810	0.1378
8255	0.4330	0.0770	-0.0935	0.1040	-0.4233	-0.1033	0.0144	*-0.6491	0.0267	-0.0164
8033	0.4747	0.0898	-0.0659	0.1514	-0.3455	-0.0490	-0.1023	*-0.6332	0.0932	0.0274
9109	0.3890	0.0367	-0.0138	0.0915	*-0.5155	-0.0549	-0.0862	*-0.6592	0.1040	0.1676
8848	0.4772	0.0140	-0.0355	0.0660	-0.4571	-0.0541	-0.0426	*-0.6501	0.0424	0.1147
8457	*0.5477	0.0042	-0.0655	0.0764	-0.3735	-0.0253	-0.0920	*-0.6026	0.1108	0.1073
8844	0.4592	0.0003	-0.0479	0.1001	-0.3766	-0.0664	-0.1164	*-0.6841	0.1709	0.0662
8585	0.3404	0.0197	0.0215	0.2630	*-0.5256	-0.0649	-0.1883	*-0.5774	0.0402	0.1468
8072	0.1966	-0.0350	-0.0360	0.1834	*-0.5380	0.0324	-0.1507	*-0.6358	-0.0102	0.1220
8552	0.3931	-0.0140	-0.1184	0.1235	*-0.5012	0.0099	-0.0620	*-0.6443	0.0082	-0.0301
7321	0.3743	-0.0074	-0.2036	0.1461	-0.3812	-0.0431	-0.0731	*-0.6051	0.0568	-0.0847
8386	0.3759	-0.0071	-0.1506	0.0983	-0.4186	-0.0466	-0.1712	*-0.6763	-0.0047	0.0282
7879	0.4189	0.0252	-0.0738	0.0372	-0.4318	-0.0783	-0.0402	*-0.6398	0.0358	-0.0083
8325	0.1727	0.0345	-0.1590	0.0138	*-0.5648	0.0348	-0.0348	*-0.6605	0.1233	-0.0549
8845	0.2886	0.0498	-0.0562	0.1317	*-0.5867	0.0018	-0.0411	*-0.6503	0.0964	-0.0110
8472	0.2213	-0.0203	-0.0697	0.1279	*-0.6993	-0.4774	-0.0698	-0.2072	-0.0325	0.1038
8475	0.2122	0.0482	-0.0730	0.0772	*-0.7768	-0.3815	-0.0492	-0.1733	0.0413	0.0755
8832	0.2713	0.0079	-0.1234	0.1467	*-0.6935	-0.4573	-0.0573	-0.2325	0.0076	0.1591
8529	0.3022	0.0347	-0.0639	0.1849	*-0.6087	-0.4504	-0.1394	-0.3086	0.0654	0.1726
8181	0.1987	0.0793	-0.1262	0.0256	*-0.7065	-0.4078	-0.1463	-0.1628	0.0105	0.2053

32	2BEECH2A	0.8193	*0.5297	0.0107	-0.0967	0.1625	-0.3616	-0.0346	-0.1230	*-0.5888	0.03
33	2BEECH2B	0.8231	0.3702	0.0099	-0.0191	0.2166	-0.3922	-0.1010	-0.1840	*-0.6237	0.18
34	2BEECH4A	0.8255	0.4330	0.0770	-0.0935	0.1040	-0.4233	-0.1033	0.0144	*-0.6491	0.02
35	2BEECH4B	0.8033	0.4747	0.0898	-0.0659	0.1514	-0.3455	-0.0490	-0.1023	*-0.6332	0.09
36	2BEECH6A	0.9109	0.3890	0.0367	-0.0138	0.0915	*-0.5155	-0.0549	-0.0862	*-0.6592	0.10
37	2BEECH6B	0.8848	0.4772	0.0140	-0.0355	0.0660	-0.4571	-0.0541	-0.0426	*-0.6501	0.04
38	2BEECH7A	0.8457	*0.5477	0.0042	-0.0655	0.0764	-0.3735	-0.0253	-0.0920	*-0.6026	0.11
39	2BEECH7B	0.8844	0.4592	0.0003	-0.0479	0.1001	-0.3766	-0.0664	-0.1164	*-0.6841	0.17
40	4BEECH2A	0.8585	0.3404	0.0197	0.0215	0.2630	*-0.5256	-0.0649	-0.1883	*-0.5774	0.04
41	4BEECH2B	0.8072	0.1966	-0.0350	-0.0360	0.1834	*-0.5380	0.0324	-0.1507	*-0.6358	-0.01
42	4BEECH4A	0.8552	0.3931	-0.0140	-0.1184	0.1235	*-0.5012	0.0099	-0.0620	*-0.6443	0.00
43	4BEECH4B	0.7321	0.3743	-0.0074	-0.2036	0.1461	-0.3812	-0.0431	-0.0731	*-0.6051	0.05
44	4BEECH6A	0.8386	0.3759	-0.0071	-0.1506	0.0983	-0.4186	-0.0466	-0.1712	*-0.6763	-0.00
45	4BEECH6B	0.7879	0.4189	0.0252	-0.0738	0.0372	-0.4318	-0.0783	-0.0402	*-0.6398	0.03
46	4BEECH7A	0.8325	0.1727	0.0345	-0.1590	0.0138	*-0.5648	0.0348	-0.0348	*-0.6605	0.12
47	4BEECH7B	0.8845	0.2886	0.0498	-0.0562	0.1317	*-0.5867	0.0018	-0.0411	*-0.6503	0.09
48	5HEMLO2A	0.8472	0.2213	-0.0203	-0.0697	0.1279	*-0.6993	-0.4774	-0.0698	-0.2072	-0.03
49	5HEMLO2B	0.8475	0.2122	0.0482	-0.0730	0.0772	*-0.7768	-0.3815	-0.0492	-0.1733	0.04
50	5HEMLO4A	0.8832	0.2713	0.0079	-0.1234	0.1467	*-0.6935	-0.4573	-0.0573	-0.2325	0.00
51	5HEMLO4B	0.8529	0.3022	0.0347	-0.0639	0.1849	*-0.6087	-0.4504	-0.1394	-0.3086	0.06
52	5HEMLO6A	0.8181	0.1987	0.0793	-0.1262	-0.0256	*-0.7065	-0.4079	-0.1463	-0.1629	-0.01
53	5HEMLO6B	0.8627	0.2560	0.0426	-0.1214	0.0555	*-0.7440	-0.3679	-0.0884	-0.2444	-0.01
54	5HEMLO7A	0.8693	0.2022	-0.0060	-0.0955	0.0659	*-0.7651	-0.4362	-0.0368	-0.1893	0.00
55	5HEMLO7B	0.8937	0.2526	0.0734	-0.1363	0.0671	*-0.7398	-0.4473	-0.0810	-0.1979	0.01
56	6HEBE 2A	0.8611	0.1337	0.0851	-0.0477	0.1264	*-0.8664	0.1584	-0.0248	-0.1878	0.06
57	6HEBE 2B	0.8773	0.1431	0.0854	-0.0447	0.0738	*-0.9032	0.1196	-0.0219	-0.0973	0.03
58	6HEBE 4A	0.8437	0.1527	0.0472	-0.0762	0.1057	*-0.8415	0.1640	-0.1182	-0.1965	0.10
59	6HEBE 4B	0.8232	0.1317	0.0497	-0.0686	0.1260	*-0.8314	0.1462	-0.1252	-0.1735	0.13
60	6HEBE 6A	0.7739	0.1379	0.0010	-0.0453	-0.0056	*-0.8444	0.0610	-0.0965	-0.1510	0.04
61	6HEBE 6B	0.7843	0.1916	0.0579	-0.0596	0.0401	*-0.7983	0.1193	-0.0495	-0.2670	0.09
62	6HEBE 7A	0.8423	0.1734	0.0614	-0.0427	0.0002	*-0.8456	0.0580	-0.0441	-0.2836	0.06
63	6HEBE 7B	0.8466	0.1828	0.0769	0.0041	0.0515	*-0.8219	0.0804	-0.0434	-0.3408	0.05
64	8ASPEN2A	0.7216	0.3687	0.1993	-0.1612	*0.6713	-0.1430	-0.0622	-0.0777	-0.1961	0.00
65	8ASPEN2B	0.7950	0.2871	0.0680	-0.2001	*0.7385	-0.1110	-0.0615	-0.2020	-0.2224	0.12
66	8ASPEN4A	0.8192	0.3472	0.0718	-0.1130	*0.8069	-0.0461	-0.0564	-0.0894	-0.1270	-0.00
67	8ASPEN4B	0.8555	0.3925	-0.0580	-0.1522	*0.7093	-0.1502	-0.1208	-0.2319	-0.2364	-0.04
68	8ASPEN6A	0.6853	0.3048	0.2008	-0.1030	0.2832	-0.4200	-0.0780	-0.1611	-0.3850	0.23
69	8ASPEN6B	0.7624	0.2087	0.0330	-0.1132	0.4398	-0.2287	0.0620	*-0.4775	-0.4032	0.01
70	8ASPEN7A	0.8144	0.1963	0.1235	-0.2352	*0.7895	-0.1897	-0.0636	-0.1628	-0.0226	0.08
71	8ASPEN7B	0.8353	0.2105	0.1708	-0.2462	*0.7761	-0.2169	0.0740	-0.1896	-0.0586	-0.00
72	11ASPEN2A	0.8033	0.1566	0.1768	*-0.8149	0.1551	-0.0804	-0.0241	-0.1127	-0.0241	-0.09
73	11ASPEN2B	0.8208	0.1864	0.1963	*-0.7710	0.3087	-0.0684	-0.0339	-0.0997	-0.1120	-0.06
74	11ASPEN4A	0.8165	0.3221	0.1314	*-0.8056	-0.0270	-0.1110	0.0761	-0.1435	-0.0207	-0.07
75	11ASPEN4B	0.9401	0.3030	0.0641	*-0.8972	0.1068	-0.1047	0.0188	-0.1174	-0.0433	-0.00
76	11ASPEN6A	0.8886	0.3486	0.0723	*-0.8575	0.0714	-0.0591	0.0020	-0.0478	-0.0862	-0.01
77	11ASPEN6B	0.9045	0.2063	0.1565	*-0.8859	0.0880	-0.0684	0.0026	-0.0993	-0.1426	0.09
78	11ASPEN7A	0.6306	0.0492	0.2170	*-0.6413	0.1656	0.0063	-0.1197	-0.1163	-0.1599	0.29
79	11ASPEN7B	0.8170	0.0084	0.2264	*-0.8270	0.1820	-0.0965	-0.1091	-0.0535	-0.0741	0.11
80	3W.ASH2A	0.6075	0.0346	*0.7165	-0.0993	0.0910	-0.0697	0.1601	-0.0172	0.0598	-0.00
81	3W.ASH2B	0.5942	0.0860	0.4376	-0.3064	0.3759	-0.2200	0.2089	-0.0335	0.0468	-0.11
82	3W.ASH4A	0.7819	0.0914	*0.7932	-0.2631	0.0987	-0.0712	0.0864	-0.2104	0.0038	-0.01
83	3W.ASH4B	0.8341	0.0466	*0.8350	-0.2048	0.2005	-0.0917	0.1060	-0.1386	-0.0581	0.04
84	3W.ASH6A	0.7724	0.0744	*0.8384	-0.0276	0.2041	-0.0684	0.0226	0.0910	-0.0644	0.00
85	3W.ASH6B	0.7858	0.0878	*0.7895	-0.2309	0.1296	-0.0395	-0.1218	-0.2192	-0.1285	0.00
86	3W.ASH7A	0.8730	0.1363	*0.8551	-0.0224	-0.1092	-0.0716	-0.1628	-0.2629	-0.0061	0.00
87	3W.ASH7B	0.6366	-0.0203	*0.7189	-0.1505	0.1147	0.0319	-0.1687	0.0162	-0.0595	0.11
88	12WASH2A	0.8013	0.0624	*0.5336	-0.1101	0.0352	-0.0346	-0.0561	*-0.6878	0.0495	-0.00
89	12WASH2B	0.7239	0.0523	*0.6014	-0.1129	-0.1378	0.0725	-0.1119	*-0.5513	-0.0581	0.00
90	12WASH4A	0.6983	0.0342	*0.6030	-0.1345	-0.1915	0.0057	0.0094	-0.4951	0.0051	-0.11
91	12WASH4B	0.7656	0.0369	0.4664	-0.0377	-0.0556	-0.1037	0.0849	*-0.6919	-0.0648	-0.11
92	12WASH6A	0.9077	0.0552	0.0214	-0.1310	0.2365	-0.1655	-0.0002	*-0.8898	-0.0978	0.00
93	12WASH6B	0.8867	0.0739	0.2423	-0.2172	0.2979	-0.1482	-0.0589	*-0.8060	-0.0736	0.00
94	12WASH7A	0.8809	0.1003	0.1451	-0.1796	0.2527	-0.1461	-0.0339	*-0.8428	-0.1357	0.00
95	12WASH7B	0.9156	0.0581	0.0847	-0.0866	0.1659	-0.1495	-0.0279	*-0.9162	-0.0818	0.00

VARIANCE	22.287	6.814	7.068	5.748	16.833	2.344	6.071	9.804	2.
CUM. VAR	22.287	29.101	36.169	41.917	58.749	61.094	67.165	76.968	79.

34

3	*0.5297	0.0107	-0.0967	0.1625	-0.3616	-0.0346	-0.1230	*-0.5888	0.0353	0.0882
1	0.3702	0.0099	-0.0191	0.2166	-0.3922	-0.1010	-0.1840	*-0.6237	0.1810	0.1378
5	0.4330	0.0770	-0.0935	0.1040	-0.4233	-0.1033	0.0144	*-0.6491	0.0267	-0.0164
3	0.4747	0.0898	-0.0659	0.1514	-0.3455	-0.0490	-0.1023	*-0.6332	0.0932	0.0274
9	0.3890	0.0367	-0.0138	0.0915	*-0.5155	-0.0549	-0.0862	*-0.6592	0.1040	0.1676
8	0.4772	0.0140	-0.0355	0.0660	-0.4571	-0.0541	-0.0426	*-0.6501	0.0424	0.1147
7	*0.5477	0.0042	-0.0655	0.0764	-0.3735	-0.0253	-0.0920	*-0.6026	0.1108	0.1073
4	0.4592	0.0003	-0.0479	0.1001	-0.3766	-0.0664	-0.1164	*-0.6841	0.1709	0.0662
5	0.3404	0.0197	0.0215	0.2630	*-0.5256	-0.0649	-0.1883	*-0.5774	0.0402	0.1468
2	0.1966	-0.0350	-0.0360	0.1834	*-0.5380	0.0324	-0.1507	*-0.6358	-0.0102	0.1220
2	0.3931	-0.0140	-0.1184	0.1235	*-0.5012	0.0099	-0.0620	*-0.6443	0.0082	-0.0301
1	0.3743	-0.0074	-0.2036	0.1461	-0.3812	-0.0431	-0.0731	*-0.6051	0.0568	-0.0847
6	0.3759	-0.0071	-0.1506	0.0983	-0.4186	-0.0466	-0.1712	*-0.6763	-0.0047	0.0282
9	0.4189	0.0252	-0.0738	0.0372	-0.4318	-0.0783	-0.0402	*-0.6398	0.0358	-0.0083
5	0.1727	0.0345	-0.1590	0.0138	*-0.5648	0.0348	-0.0348	*-0.6605	0.1233	-0.0549
5	0.2886	0.0498	-0.0562	0.1317	*-0.5867	0.0018	-0.0411	*-0.6503	0.0964	-0.0110
2	0.2213	-0.0203	-0.0697	0.1279	*-0.6993	-0.4774	-0.0698	-0.2072	-0.0325	0.1038
5	0.2122	0.0482	-0.0730	0.0772	*-0.7768	-0.3815	-0.0492	-0.1733	0.0413	0.0755
2	0.2713	0.0079	-0.1234	0.1467	*-0.6935	-0.4573	-0.0573	-0.2325	0.0076	0.1591
9	0.3022	0.0347	-0.0639	0.1849	*-0.6087	-0.4504	-0.1394	-0.3086	0.0654	0.1726
1	0.1987	0.0793	-0.1262	-0.0256	*-0.7065	-0.4079	-0.1463	-0.1629	-0.0105	0.2053
7	0.2560	0.0426	-0.1214	0.0555	*-0.7440	-0.3679	-0.0884	-0.2444	-0.0123	0.1447
3	0.2022	-0.0060	-0.0955	0.0659	*-0.7651	-0.4362	-0.0368	-0.1893	0.0073	0.0442
7	0.2526	0.0734	-0.1363	0.0671	*-0.7398	-0.4473	-0.0810	-0.1979	0.0156	0.0892
1	0.1337	0.0851	-0.0477	0.1264	*-0.8664	0.1584	-0.0248	-0.1878	0.0668	-0.0410
3	0.1431	0.0854	-0.0447	0.0738	*-0.9032	0.1196	-0.0219	-0.0973	0.0355	-0.0296
7	0.1527	0.0472	-0.0762	0.1057	*-0.8415	0.1640	-0.1182	-0.1965	0.1071	-0.0461
12	0.1317	0.0497	-0.0686	0.1260	*-0.8314	0.1462	-0.1252	-0.1735	0.1348	-0.0794
9	0.1379	0.0010	-0.0453	-0.0056	*-0.8444	0.0610	-0.0965	-0.1510	0.0454	0.0429
13	0.1916	0.0579	-0.0596	0.0401	*-0.7983	0.1193	-0.0495	-0.2670	0.0965	0.0663
23	0.1734	0.0614	-0.0427	0.0002	*-0.8456	0.0580	-0.0441	-0.2836	0.0609	0.0455
56	0.1828	0.0769	0.0041	0.0515	*-0.8219	0.0804	-0.0434	-0.3408	0.0552	0.0376
16	0.3687	0.1993	-0.1612	*0.6713	-0.1430	-0.0622	-0.0777	-0.1961	0.0023	0.0212
50	0.2871	0.0680	-0.2001	*0.7385	-0.1110	-0.0615	-0.2020	-0.2224	0.1275	0.0025
92	0.3472	0.0718	-0.1130	*0.8069	-0.0461	-0.0564	-0.0894	-0.1270	-0.0054	-0.0153
55	0.3925	-0.0580	-0.1522	*0.7093	-0.1502	-0.1208	-0.2319	-0.2364	-0.0405	0.1529
53	0.3048	0.2008	-0.1030	0.2832	-0.4200	-0.0780	-0.1611	*-0.3850	0.2328	0.2244
24	0.2087	0.0330	-0.1132	0.4398	-0.2287	0.0620	*-0.4775	-0.4032	0.0175	0.2539
44	0.1963	0.1235	-0.2352	*0.7895	-0.1897	-0.0636	-0.1628	-0.0226	0.0872	-0.0858
53	0.2105	0.1708	-0.2462	*0.7761	-0.2169	0.0740	-0.1896	-0.0586	-0.0048	0.0832
33	0.1566	0.1768	*-0.8149	0.1551	-0.0804	-0.0241	-0.1127	-0.0241	-0.0988	0.1712
08	0.1864	0.1963	*-0.7710	0.3087	-0.0684	-0.0339	-0.0997	-0.1120	-0.0620	0.1603
65	0.3221	0.1314	*-0.8056	-0.0270	-0.1110	0.0761	-0.1435	-0.0207	-0.0756	-0.0318
01	0.3030	0.0641	*-0.8972	0.1068	-0.1047	0.0188	-0.1174	-0.0433	-0.0034	-0.0292
86	0.3486	0.0723	*-0.8575	0.0714	-0.0591	0.0020	-0.0478	-0.0862	-0.0192	-0.0884
45	0.2063	0.1565	*-0.8859	0.0880	-0.0684	0.0026	-0.0993	-0.1426	0.0920	-0.0399
06	0.0492	0.2170	*-0.6413	*0.1656	0.0063	-0.1197	-0.1163	-0.1599	0.2979	-0.0142
70	0.0084	0.2264	*-0.8270	0.1820	-0.0965	-0.1091	-0.0535	-0.0741	0.1374	0.0129
75	0.0346	*0.7165	-0.0993	0.0910	-0.0697	0.1601	-0.0172	0.0598	-0.0000	0.2011
42	0.0860	0.4376	-0.3064	0.3759	-0.2200	0.2089	-0.0335	0.0468	-0.1776	0.1821
19	0.0914	*0.7932	-0.2631	0.0987	-0.0712	0.0864	-0.2104	0.0038	-0.0213	0.0909
41	0.0466	*0.8350	-0.2048	0.2005	-0.0917	0.1060	-0.1386	-0.0581	0.0413	-0.0926
24	0.0744	*0.8384	-0.0276	0.2041	-0.0684	0.0226	0.0910	-0.0644	0.0018	-0.0619
158	0.0878	*0.7895	-0.2309	0.1296	-0.0395	-0.1218	-0.2192	-0.1285	0.0600	0.0111
30	0.1363	*0.8551	-0.0224	-0.1092	-0.0716	-0.1628	-0.2629	-0.0061	0.0952	0.0294
166	-0.0203	*0.7189	-0.1505	0.1147	0.0319	-0.1687	0.0162	-0.0595	0.1733	-0.1421
113	0.0624	*0.5336	-0.1101	0.0352	-0.0346	-0.0561	*-0.6878	0.0495	-0.0008	-0.1395
139	0.0523	*0.6014	-0.1129	-0.1378	0.0725	-0.1119	*-0.5513	-0.0581	0.0069	-0.0512
183	0.0342	*0.6030	-0.1345	-0.1915	0.0057	0.0094	-0.4951	0.0051	-0.1831	0.0045
156	0.0369	0.4664	-0.0377	-0.0556	-0.1037	0.0849	*-0.6919	-0.0648	-0.1765	0.1009
177	0.0552	0.0214	-0.1310	0.2365	-0.1655	-0.0002	*-0.8898	-0.0978	0.0091	-0.0497
167	0.0739	0.2423	-0.2172	0.2979	-0.1482	-0.0589	*-0.8060	-0.0736	0.0678	0.0386
309	0.1003	0.1451	-0.1796	0.2527	-0.1461	-0.0339	*-0.8428	-0.1357	0.0493	0.0034
156	0.0581	0.0847	-0.0866	0.1659	-0.1495	-0.0279	*-0.9162	-0.0818	0.0192	0.0170

NCE	22.287	6.814	7.068	5.748	16.833	2.344	6.071	9.804	2.828	2.475
VAR	22.287	29.101	36.169	41.917	58.749	61.094	67.165	76.968	79.797	82.272

40F4

APPENDIX: E

J. R. H. Q-MODE 100 VAR. LN(X+1)

VARIMAX FACTOR SCORE MATRIX

VAR.	1	2	3	4	5	6	7	8	9	10
1	0.022	-0.050	0.076	-0.117	*-1.390	-0.411	0.102	0.753	0.705	0.437
2	0.623	0.026	0.070	-0.313	*-1.079	*-1.153	0.259	1.180	-0.375	*2.279
3	-0.159	-0.063	-0.022	-0.058	*-1.137	*-1.994	0.058	0.620	-0.326	0.455
4	0.694	0.062	0.216	0.528	0.082	0.033	0.156	0.136	-1.090	-0.440
5	0.586	0.754	-0.274	-0.302	-0.184	1.122	0.235	0.522	0.237	*1.614
6	-0.014	-0.004	-0.028	-0.301	-0.517	-0.274	0.079	-0.266	0.852	-0.266
7	0.308	-0.053	0.082	-0.207	*-1.353	0.613	0.096	1.082	0.922	0.870
8	*3.513	-0.161	0.387	-1.100	0.778	0.578	-0.173	*-1.117	-0.052	-3.181
9	*1.376	-0.354	0.262	-0.433	0.138	0.555	-0.708	0.562	0.389	-1.196
10	0.618	-0.134	0.050	-0.436	-0.731	0.658	-0.222	0.557	0.023	0.511
11	*2.933	0.891	1.039	-0.988	*-1.192	-0.485	0.466	0.016	*2.975	1.887
12	*4.001	0.124	-0.037	-0.984	0.298	0.969	0.077	1.565	-1.296	*2.315
13	*4.538	-0.758	*-2.793	-2.342	0.631	0.931	0.093	0.170	-0.459	-1.909
14	-0.600	*3.617	*-1.174	0.105	0.631	*-1.846	1.367	-0.756	*1.595	-1.612
15	-0.094	0.007	-0.059	-0.190	0.025	-0.121	0.136	*-1.063	-0.245	-0.273
** 16	0.053	0.035	-0.001	-0.086	-0.155	0.207	0.057	0.150	0.724	-0.118
17	*2.385	0.506	0.964	-1.205	*-2.498	*-3.237	0.511	*-1.227	0.554	2.222
18	-0.637	-0.608	*-5.001	-0.643	0.354	-0.116	0.471	-0.249	0.269	0.340
19	-0.226	-0.086	0.048	0.987	*1.330	*-1.998	0.113	1.137	-0.037	-0.807
20	-0.495	0.050	0.019	-0.293	0.165	-0.958	0.288	*-2.945	*-1.568	-0.220
21	-0.134	0.158	0.138	-0.283	-0.222	0.692	0.312	*-1.603	0.621	-0.179
22	-0.399	-0.048	*-1.163	-0.370	0.393	-0.149	0.220	*-1.575	0.301	-0.400
23	-0.124	0.221	-0.275	-0.581	-0.480	0.127	0.079	*-1.300	-0.644	0.681
** 24	0.316	0.008	-0.037	-0.029	-0.077	-0.244	0.127	0.079	-0.428	-0.256
** 25	0.500	-0.050	0.059	-0.198	-0.033	0.160	-0.171	0.308	-0.062	-0.461
26	0.012	-0.352	*-1.801	-0.691	-0.377	-0.139	-0.017	0.108	-0.278	-0.339
27	-0.730	-0.109	0.045	-0.498	*-2.684	*-1.539	0.228	*-1.271	-1.131	-1.143
28	0.304	-0.049	-0.939	-0.828	*-1.054	-0.545	0.389	-0.412	*3.502	0.670
29	-0.047	-0.059	-0.034	-0.128	*-1.125	*-1.844	0.015	0.778	-0.281	-0.428
30	0.149	*4.430	*-1.792	-1.121	0.611	*-1.954	*-2.830	0.093	0.673	0.827
31	-0.380	*1.412	*-2.109	-0.251	0.081	1.026	0.754	-0.146	0.829	0.898
32	-0.081	-0.042	-0.039	-0.121	-0.481	-0.089	0.075	-0.064	0.953	-0.424
33	0.497	0.921	0.269	-0.146	*-1.628	1.769	0.793	-0.680	-1.031	-1.847
34	0.077	0.082	0.014	-0.130	-0.843	1.116	0.132	0.592	*1.676	-0.410
35	-0.248	-0.108	-0.018	-0.190	*-3.285	-0.437	0.028	1.933	-0.374	-1.287
36	-0.144	-0.018	0.061	-0.073	*-1.911	1.497	0.045	0.936	-0.149	-0.369
37	-0.174	0.082	0.116	-0.341	-0.273	-0.480	0.158	*-1.410	*1.187	*1.130
38	-0.150	0.098	0.172	-0.354	-0.574	*-1.522	0.246	*-1.660	-0.679	0.501
** 39	0.098	-0.082	-0.089	0.254	0.029	0.046	-0.069	0.133	0.541	-0.155
** 40	0.045	0.135	0.019	-0.177	0.036	0.049	-0.119	-0.141	-0.169	0.359
** 41	0.113	-0.079	-0.167	0.021	0.069	0.008	-0.071	0.014	0.329	-0.273
42	-0.065	*4.739	1.036	*3.193	*-1.379	1.352	1.552	1.126	-0.004	-1.072
43	-0.271	*1.467	-0.187	*1.456	-0.317	1.947	0.889	0.313	-0.760	*1.930
44	0.155	0.051	0.021	-0.067	-0.074	0.248	0.072	0.315	*1.414	0.036
45	-0.150	-0.245	*-1.605	-0.325	-0.525	-0.593	0.118	0.297	-0.281	0.104
46	-0.004	-0.033	0.011	*0.010	-0.611	*-1.445	0.030	0.488	-0.121	-0.570
47	-0.116	0.161	0.139	-0.221	*-1.849	2.638	0.279	-0.183	*2.596	-0.210
48	-0.428	-0.567	-0.004	*1.823	0.350	-0.090	*-1.608	-0.428	0.643	0.293
49	-0.148	-0.437	*-2.841	-0.529	0.066	0.371	0.203	-0.017	-0.557	0.340
50	-0.366	0.107	0.155	0.107	-0.793	1.544	0.214	*-1.459	-0.645	-0.031
51	-0.053	-0.027	-0.034	-0.058	-0.489	*-1.525	0.085	0.400	0.391	-0.293
52	-0.102	0.298	*-1.412	-0.578	0.058	0.055	-0.926	0.144	-0.020	-0.221
53	-0.044	-0.021	0.019	-0.027	-0.506	0.476	-0.017	0.236	-0.021	-0.151
54	0.225	-0.496	*-1.200	*2.098	0.390	-0.187	-0.553	0.095	-0.185	-0.046
55	0.355	-0.042	0.033	-0.068	-0.057	0.336	-0.043	0.412	*1.892	-0.505
56	0.061	0.044	0.019	-0.017	-0.012	0.045	0.004	0.041	0.955	-0.197

34	0.077	-0.082	0.014	-0.130	-0.843	1.116	0.132	0.392	0.132	0.072
35	-0.248	-0.108	-0.018	-0.190	*-3.285	-0.237	0.028	1.933	-0.374	-1.287
36	-0.144	-0.018	0.061	-0.073	*-1.911	1.897	0.045	0.936	-0.149	-0.369
37	-0.174	0.082	0.116	-0.341	-0.273	-0.380	0.158	*-1.410	*1.187	*1.130
38	-0.150	0.098	0.172	-0.354	-0.574	*-1.522	0.246	*-1.660	-0.679	0.501
** 39	0.098	-0.082	-0.089	0.254	0.029	0.046	-0.069	0.133	0.541	-0.155
** 40	0.045	0.135	0.019	-0.177	0.036	0.049	-0.119	-0.141	-0.169	0.359
** 41	0.113	-0.079	-0.167	0.021	0.069	0.008	-0.071	0.014	0.329	-0.273
42	-0.065	*4.739	1.036	*3.193	*-1.379	1.352	1.552	1.126	-0.004	-1.072
43	-0.271	*1.467	0.187	*1.456	-0.317	1.947	0.889	0.313	*0.760	*1.930
44	0.155	0.051	0.021	-0.067	-0.074	0.248	0.072	0.315	*1.414	0.036
45	-0.150	-0.245	*-1.003	-0.335	-0.525	-0.693	0.118	0.297	-0.281	0.104
46	-0.002	-0.053	0.011	-0.010	-0.611	*-1.445	0.030	0.488	-0.121	-0.570
47	-0.116	0.161	0.139	-0.221	*-1.849	2.638	0.279	-0.183	*2.596	-0.210
48	-0.428	-0.567	-0.004	*1.823	0.350	-0.090	*-1.608	-0.428	0.643	0.293
49	-0.148	-0.437	*-2.841	-0.529	0.066	0.371	0.203	-0.017	-0.557	0.340
50	-0.366	0.107	0.155	0.107	-0.793	1.544	0.214	*-1.459	-0.645	-0.031
51	-0.053	-0.027	-0.034	-0.058	-0.489	*-1.525	0.085	0.400	0.391	-0.293
52	-0.102	0.298	*-1.412	-0.578	0.058	0.055	-0.926	0.144	-0.020	-0.221
53	-0.044	-0.021	0.019	-0.027	-0.506	0.476	-0.017	0.236	-0.021	-0.151
54	0.225	-0.496	*-1.200	*2.098	0.390	-0.187	-0.553	0.095	-0.185	-0.046
55	0.355	-0.042	0.033	-0.068	-0.057	0.336	-0.043	0.412	*1.892	-0.505
56	0.061	0.044	0.019	-0.017	-0.012	0.045	0.094	0.041	0.955	-0.197
57	0.733	-0.216	0.164	-0.069	0.127	0.547	-0.241	-0.257	0.884	-1.092
58	0.148	-0.009	0.093	-0.046	-0.153	-0.769	0.057	0.288	0.720	0.872
59	-0.045	-0.021	-0.003	-0.071	-0.487	0.319	-0.021	0.244	-0.057	-0.032
60	0.198	-0.056	0.266	*1.787	0.170	-0.110	0.158	0.199	-0.168	-0.059
61	-0.118	0.018	0.068	-0.059	0.204	-0.014	-0.000	*-1.011	-0.078	0.044
62	*4.182	0.035	1.095	*3.371	1.293	*-1.422	0.754	*-1.988	-1.435	*1.870
63	*1.446	-0.719	*-3.128	*5.910	*-1.546	-0.059	*-2.919	*-1.024	*1.709	-0.764
64	-0.063	-0.031	0.004	0.016	-0.437	*-0.999	0.020	0.257	-0.070	-0.290
65	0.367	0.068	*-4.218	0.247	*-2.029	-0.262	1.116	0.937	-2.795	*1.468
66	-0.062	-0.054	-0.781	-0.081	0.089	-0.049	0.109	-0.052	0.410	-0.136
67	-0.261	-1.369	0.678	0.135	*-2.411	1.338	*-4.868	*-1.411	-1.364	*2.937
68	0.013	*5.303	-0.031	-1.204	0.061	1.389	-0.947	-0.241	-2.190	1.012
69	0.132	0.057	0.063	-0.139	-0.177	0.266	0.089	0.219	0.414	*1.144
70	*1.299	0.240	0.266	0.083	-0.124	-0.401	0.415	0.471	-1.789	-1.293
71	0.563	0.072	0.043	-0.032	0.050	-0.036	0.150	0.175	-0.604	0.087
72	-0.158	-0.177	0.110	-0.148	-0.201	1.659	-0.159	*-2.994	-0.263	-0.632
73	0.504	0.001	0.398	*2.572	0.100	-0.250	0.388	0.513	-0.945	-0.516
74	-0.288	-0.133	*-1.533	-0.046	0.140	-0.135	0.209	-0.091	0.197	0.234
75	0.779	0.260	0.294	0.645	-0.339	-0.843	0.538	-0.277	-0.778	-1.311
76	0.061	-0.048	0.224	-0.251	-0.896	1.239	0.032	*-1.418	-0.134	-0.089
77	0.299	*1.282	0.784	-1.499	0.188	-0.629	*-6.543	0.615	-0.211	-1.981
78	*1.307	0.103	0.524	0.046	*-1.799	-0.621	0.266	1.316	-0.557	-2.636
79	0.790	-0.289	-0.086	0.434	*-1.624	1.004	-0.163	1.864	*2.280	-0.476
80	-0.188	-0.028	0.074	0.051	0.107	0.157	-0.026	-0.870	-0.214	0.097
81	*1.475	0.106	0.473	-0.439	*-1.626	1.534	0.358	*-2.690	0.684	-0.143
82	0.549	*1.797	-0.759	0.920	0.452	-0.017	-0.300	*-1.740	0.881	-0.724
** 83	0.175	-0.070	0.055	0.032	-0.028	0.249	-0.083	0.128	0.585	-0.363
84	-0.211	0.013	0.030	-0.274	-0.641	-0.362	0.238	*-1.035	-0.482	0.253
85	-0.218	0.051	0.111	-0.149	*-1.321	*-1.139	0.512	*-1.705	0.820	0.863
86	-0.503	-0.044	0.046	-0.414	*-2.941	1.493	0.228	-0.494	-1.066	-0.449
** 87	0.090	-0.026	0.014	-0.051	0.044	0.038	-0.039	-0.119	-0.042	-0.120
88	-0.543	0.013	0.045	-0.164	*-1.109	-0.180	0.309	*-2.076	-1.063	-0.314
89	-0.583	-0.040	-0.030	-0.572	*-2.342	-0.548	0.279	*-1.369	-1.219	-0.910
90	-0.106	0.033	-0.028	-0.127	0.113	-0.069	0.060	-0.816	-0.158	-0.251
91	-0.302	-0.144	0.063	-0.073	*-1.429	-0.919	0.020	-0.135	-0.573	-0.500
92	0.111	-0.064	0.037	0.031	0.037	0.087	-0.046	-0.108	0.802	-0.420
** 93	0.113	-0.060	0.050	-0.026	0.069	0.142	-0.012	-0.356	0.385	-0.039
** 94	0.014	0.015	-0.007	-0.068	-0.209	0.107	0.057	-0.032	0.059	-0.139
95	0.073	-0.048	-0.198	0.493	-0.234	0.833	0.129	-0.241	-0.391	0.464
96	-0.143	-0.115	-0.005	0.004	-0.951	*-2.066	0.029	0.423	-0.215	-0.507
97	-0.161	0.084	0.035	0.189	0.108	-0.236	0.194	*-1.017	-0.170	-0.149
98	-0.060	-0.047	-0.034	-0.006	-0.429	*-1.428	0.027	0.314	-0.115	-0.322
** 99	0.121	0.066	-0.030	-0.140	-0.019	0.243	0.058	0.137	0.732	0.368
100	0.309	0.085	-0.578	-0.405	0.455	-0.091	0.391	*-2.080	-1.008	-1.383

** Low information species which can be eliminated from the analysis.

20F2

APPENDIX: F

J. R. H) Q-MODE 100 Var. LN(X+1)

VARIMAX FACTOR MATRIX

		COMM.	1	2	3	4	5	
1	1	GBRM2A	0.8112	0.2350	0.1770	-0.1402	0.0114	*0.8396
2	1	GRBM2B	0.4705	0.2939	0.0212	-0.2186	0.2445	*0.5255
3	U	GBRM4A	0.7583	0.2542	0.0260	-0.0920	0.0443	*0.8262
4	1	GBRM4B	0.7753	0.2075	0.0147	-0.1821	0.0679	*0.8332
5	1	GRBM5A	0.7234	0.1341	0.0915	-0.0928	-0.0118	*0.8297
6	1	GBRM6B	0.7729	0.1834	0.1675	-0.1154	-0.1150	*0.8274
7	1	GBRM7A	0.8029	0.3590	0.0912	-0.1303	0.1188	*0.7966
8	1	GBRN7B	0.8285	0.1990	0.0227	-0.0806	-0.0039	*0.8842
9		10GBRM2A	0.4687	0.4248	0.0374	-0.0065	0.1859	*0.5023
10		10GBRM2B	0.7595	0.4765	0.0596	-0.0664	0.0609	*0.7217
11		10GNRM4A	0.6701	0.3687	0.1286	-0.0727	0.0335	*0.7138
12		10GBRM4B	0.6460	0.4201	0.1842	-0.1203	-0.0031	*0.6489
13		10GBRM6A	0.6912	*0.5278	0.0444	0.0332	0.0775	*0.6353
14		10GBRM6B	0.6770	*0.5781	0.0710	-0.0902	0.0438	*0.5724
15		10GBRM7A	0.6576	0.4559	0.0165	-0.0601	0.0401	*0.6665
16		10GBRM7B	0.6794	0.3882	0.0238	-0.1026	0.0779	*0.7152
17	7	BERM2A	0.7230	0.4621	0.0887	-0.0230	-0.0690	*0.7045
18	7	BERM2B	0.8134	0.4398	0.1734	-0.1388	-0.0935	*0.7496
19	7	BERM4A	0.8463	0.4650	0.1755	-0.1453	-0.1115	*0.7522
20	7	BERM4B	0.8702	0.4229	0.1594	-0.1388	-0.0788	*0.8003
21	7	BERM6A	0.8054	0.4743	0.1984	-0.0994	-0.1440	*0.7144
22	7	BERM6B	0.8093	0.4293	0.1864	-0.1071	-0.1908	*0.7364
23	7	BERM7A	0.8421	*0.5127	0.1379	-0.1128	-0.0826	*0.7353
24	7	BERM7B	0.8167	*0.5657	0.1387	-0.1438	-0.1172	*0.6656
25	9	BERM2A	0.4820	0.1159	-0.0162	0.1234	0.2086	*0.6399
26	9	BERM2B	0.7535	0.1300	0.0097	-0.1390	0.2139	*0.8194
27	9	BERM4A	0.8054	0.1729	-0.0077	-0.1791	0.2140	*0.8352
28	9	BERM4B	0.8661	0.1714	0.0027	-0.1778	0.1482	*0.8849
29	9	BERM6A	0.7434	0.1161	0.0296	-0.2723	0.2012	*0.7838
30	9	BERM6B	0.7224	0.1299	0.0128	-0.2439	0.1069	*0.7965
31	9	BERM7A	0.8162	0.1580	-0.0170	-0.2375	0.0218	*0.8568
32	9	BERM7B	0.7371	0.1859	0.0178	-0.2423	0.1560	*0.7869
33		2BEECH2A	0.7455	*0.5987	0.0539	-0.1365	0.1118	*0.5942
34		2BEECH2B	0.7142	*0.6826	0.0935	-0.0825	0.1153	0.4684
35		2BEECH4A	0.7197	*0.6587	0.0134	-0.0804	0.1842	0.4952
36		2BEECH4B	0.7108	*0.6006	0.0966	-0.0843	0.1746	*0.5506
37		2BEECH6A	0.8355	*0.7749	0.0608	-0.0174	0.0842	0.4732
38		2BEECH6B	0.8012	*0.7023	0.0128	-0.0309	0.0829	*0.5477
39		2BEECH7A	0.7733	*0.6138	0.0375	-0.0692	0.0637	*0.6215
40		2BEECH7B	0.7628	*0.6667	0.0413	-0.0589	0.0926	*0.5518
41		4BEECH2A	0.7878	*0.7659	0.1009	-0.0685	0.1443	0.4069
42		4BEECH2B	0.7011	*0.7798	0.0305	-0.0917	0.1234	0.2616
43		4BEECH4A	0.7558	*0.7207	-0.0162	-0.1309	0.1547	0.4418
44		4BEECH4B	0.6260	*0.6063	-0.0065	-0.2191	0.1641	0.4283
45		4BEECH6A	0.6999	*0.6836	0.0623	-0.1767	0.0733	0.4383
46		4BEECH6B	0.6813	*0.6646	0.0115	-0.0579	0.0970	0.4762
47		4BEECH7A	0.6920	*0.7791	0.0091	-0.1087	0.1351	0.2339
48		4BEECH7B	0.8163	*0.8068	0.0231	-0.0547	0.1981	0.3500
49		5HEMLO2A	0.6716	*0.7760	0.0315	-0.1341	-0.0760	0.2116
50		5HEMLO2B	0.7109	*0.8095	0.0737	-0.0976	-0.0498	0.1955
51		5HEMLO4A	0.7232	*0.7811	0.0186	-0.0386	0.0562	0.2577

32	2BEECH2A	0.7371	0.1859	0.0178	0.1560	0.7860
33	2BEECH2B	0.7455	*0.5987	0.0539	-0.1365	*0.5942
34	2BEECH2B	0.7142	*0.6826	0.0935	-0.0825	0.4684
35	2BEECH4A	0.7197	*0.6587	0.0134	-0.0804	0.4952
36	2BEECH4B	0.7108	*0.6006	0.0966	-0.0843	*0.5506
37	2BEECH6A	0.8355	*0.7749	0.0608	-0.0174	0.4732
38	2BEECH6B	0.8012	*0.7023	0.0128	-0.0309	*0.5477
39	2BEECH7A	0.7733	*0.6138	0.0375	-0.0692	*0.6215
40	2BEECH7B	0.7628	*0.6667	0.0413	-0.0589	*0.5518
41	4BEECH2A	0.7878	*0.7659	0.1009	-0.0685	0.4069
42	4BEECH2B	0.7011	*0.7798	0.0305	-0.0917	0.2616
43	4BEECH4A	0.7558	*0.7207	-0.0162	-0.1309	0.4418
44	4BEECH4B	0.6260	*0.6063	-0.0065	-0.2191	0.4283
45	4BEECH6A	0.6999	*0.6836	0.0623	-0.1767	0.4383
46	4BEECH6B	0.6813	*0.6646	0.0115	-0.0579	0.4762
47	4BEECH7A	0.6920	*0.7791	0.0091	-0.1087	0.2339
48	4BEECH7B	0.8163	*0.8068	0.0231	-0.0547	0.3500
49	5HEMLO2A	0.6716	*0.7760	0.0315	-0.1341	0.2116
50	5HEMLO2B	0.7109	*0.8095	0.0737	-0.0976	0.1955
51	5HEMLO4A	0.7289	*0.7844	0.0486	-0.1775	0.2767
52	5HEMLO4B	0.7231	*0.7602	0.1153	-0.1402	0.3332
53	5HEMLO6A	0.6923	*0.7549	0.1759	-0.1362	0.1881
54	5HEMLO6B	0.7629	*0.8136	0.0959	-0.1449	0.2501
55	5HEMLO7A	0.7090	*0.8087	0.0216	-0.1249	0.1814
56	5HEMLO7B	0.7341	*0.7947	0.1148	-0.1609	0.2397
57	6HEBE 2A	0.7101	*0.8155	0.0592	-0.0460	0.0993
58	6HEBE 2B	0.6743	*0.8060	0.0677	-0.0347	0.0877
59	6HEBE 4A	0.6955	*0.8088	0.0880	-0.0860	0.1216
60	6HEBE 4B	0.6711	*0.7940	0.0921	-0.0861	0.0993
61	6HEBE 6A	0.6583	*0.8014	0.0579	-0.0378	0.0993
62	6HEBE 6B	0.6940	*0.8063	0.0656	-0.0365	0.1845
63	6HEBE 7A	0.7617	*0.8549	0.0657	-0.0123	0.1585
64	6HEBE 7B	0.7854	*0.8593	0.0695	0.0199	0.1785
65	8ASPEN2A	0.6254	0.2516	0.1556	-0.3375	*0.5069
66	8ASPEN2B	0.6025	0.2704	0.1239	-0.4243	0.4615
67	8ASPEN4A	0.5981	0.1518	0.0548	-0.3583	*0.5447
68	8ASPEN4B	0.5724	0.3245	0.0579	-0.4108	0.3154
69	8ASPEN6A	0.6294	*0.6006	0.2452	-0.1523	0.1859
70	8ASPEN6B	0.4878	0.4632	0.2919	-0.3047	0.1239
71	8ASPEN7A	0.6115	0.2352	0.1421	-0.4672	*0.5221
72	8ASPEN7B	0.6454	0.2636	0.2044	-0.4695	*0.5090
73	11ASPN2A	0.7186	0.0806	0.2114	*-0.8000	0.0323
74	11ASPN2B	0.7658	0.1217	0.2041	*-0.7957	0.1719
75	11ASPN4A	0.6779	0.0634	0.1871	*-0.7433	-0.0526
76	11ASPN4B	0.8588	0.0914	0.1119	*-0.8680	0.0093
77	11ASPN6A	0.7752	0.0563	0.0702	*-0.8076	0.0388
78	11ASPN6B	0.7761	0.1084	0.1689	*-0.8244	0.0695
79	11ASPN7A	0.4645	0.1011	0.2287	*-0.6079	0.1367
80	11ASPN7B	0.6929	0.1303	0.2007	*-0.7834	0.1417
81	3W.ASH2A	0.4446	-0.0050	*0.5808	-0.0178	0.3230
82	3W.ASH2B	0.4193	0.1390	0.3494	-0.3450	0.3916
83	3W.ASH4A	0.6976	0.0282	*0.7474	-0.2026	0.2962
84	3W.ASH4B	0.7716	0.0594	*0.7099	-0.1518	0.4879
85	3W.ASH6A	0.6638	0.0335	*0.5753	0.0475	*0.5668
86	3W.ASH6B	0.7059	0.0909	*0.7402	-0.1849	0.3174
87	3W.ASH7A	0.7599	0.0607	*0.8437	0.0743	0.1344
88	3W.ASH7B	0.4539	-0.0155	*0.5341	-0.0662	0.4048
89	12WASH2A	0.7205	0.0353	*0.8277	-0.1824	-0.0177
90	12WASH2B	0.6738	-0.0217	*0.8109	-0.0947	-0.0668
91	12WASH4A	0.6309	-0.0285	*0.7831	-0.0969	-0.0864
92	12WASH4B	0.6712	0.1358	*0.7921	-0.0979	-0.1248
93	12WASH6A	0.5538	0.2892	*0.5477	-0.3597	-0.1962
94	12WASH6B	0.6885	0.2562	*0.6677	-0.4107	-0.0443
95	12WASH7A	0.6172	0.2802	*0.6099	-0.3809	-0.1039
96	12WASH7B	0.5910	0.2646	*0.6166	-0.2959	-0.2261
VARIANCE		24.627	8.857	8.212	3.926	24.604
CUM. VAR		24.627	33.484	41.695	45.621	70.225

20F2

105

APPENDIX: G

J. R. H. Q-MODE 72 VAR. LN(X+1)

VARIMAX FACTOR MATRIX

		COMM.	1	2	3	4	5	6	7	8	9
1	1 GBRM2A	0.8554	0.1653	0.0942	*0.8268	-0.0910	-0.1867	0.1231	0.1786	-0.1026	-0.1155
2	1 GBRM2B	0.6576	0.2258	-0.0463	*0.5113	-0.1082	-0.1831	0.3686	0.1961	0.2196	-0.2037
3	U GBRM4A	0.8596	0.2177	-0.0374	*0.8479	-0.0395	-0.1344	0.1102	0.1824	0.0967	-0.0360
4	1 GBRM4B	0.8553	0.1684	-0.0396	*0.8452	-0.1305	-0.1197	0.1542	0.1624	0.1027	-0.0930
5	1 GBRM6A	0.8337	0.1428	0.0389	*0.8575	-0.0909	0.1251	0.0032	0.0503	0.1284	-0.1075
6	1 GBRM6B	0.8668	0.1984	0.0459	*0.8607	-0.0997	-0.2203	-0.0302	0.0036	0.0258	-0.0814
7	1 GBRM7A	0.8537	0.3078	0.0591	*0.7703	-0.0915	-0.1037	0.1823	0.1849	0.0373	-0.2494
8	1 GBRM7B	0.8692	0.1775	-0.0043	*0.8764	-0.0767	-0.0489	0.0490	0.0995	0.0140	-0.2080
9	10GBRM2A	0.7669	0.3703	0.0917	0.4028	-0.0505	0.0563	0.1328	0.1709	0.1359	*-0.6228
10	10GBRM2B	0.8414	0.4052	0.0360	*0.6403	-0.0413	-0.0268	0.1876	0.1544	-0.1635	-0.4210
11	10GNRM4A	0.8781	0.3190	0.1191	*0.6314	-0.1226	-0.0384	0.0720	0.1116	0.0142	*-0.5708
12	10GBRM4B	0.8373	0.3807	0.1790	*0.5634	-0.2019	-0.0327	-0.0112	0.1155	-0.0875	*-0.5280
13	10GBRM6A	0.8573	0.4012	0.0706	*0.5107	0.0076	0.0484	0.1181	0.3101	-0.1848	*-0.5328
14	10GBRM6B	0.8488	0.4680	0.0577	0.4539	-0.0943	-0.0021	0.1739	0.2415	-0.2540	*-0.5081
15	10GBRM7A	0.9260	0.3571	0.0284	*0.5550	-0.1135	0.0380	0.0722	0.2360	-0.0645	*-0.6363
16	10GBRM7B	0.8431	0.2800	0.0200	*0.6219	-0.1184	-0.0061	0.1417	0.2477	-0.0519	*-0.5276
17	7 BERM2A	0.8522	0.4063	0.0215	*0.6588	0.0203	-0.0797	0.1420	0.0949	-0.3892	-0.2030
18	7 BERM2B	0.8925	0.3756	0.1028	*0.6965	-0.1400	-0.1175	0.0670	0.1569	-0.3597	-0.2243
19	7 BERM4A	0.9335	0.4109	0.0589	*0.7283	-0.0952	-0.1862	0.1066	0.1103	-0.3567	-0.1230
20	7 BERM4B	0.9245	0.3776	0.0624	*0.7694	-0.1029	-0.1542	0.1087	0.0973	-0.2838	-0.1752
21	7 BERM6A	0.8922	0.4208	0.0881	*0.6731	-0.0755	-0.1634	0.0589	0.1137	-0.4111	-0.1634
22	7 BERM6B	0.8916	0.4001	0.0847	*0.7030	-0.1185	-0.1410	-0.0163	0.0692	-0.3784	-0.1950
23	7 BERM7A	0.9149	0.4584	0.0690	*0.6864	-0.0936	-0.0964	0.0970	0.1394	-0.3639	-0.2080
24	7 BERM7B	0.8800	*0.5053	0.0492	*0.6279	-0.1253	-0.1240	0.0577	0.1890	-0.3750	-0.1231
25	9 BERM2A	0.6519	0.1679	0.1143	*0.7034	0.1477	0.1475	0.1190	0.0801	0.0345	0.2232
26	9 BERM2B	0.8745	0.1403	0.0978	*0.8494	-0.1095	0.0813	0.2064	0.1572	0.0630	0.0682
27	9 BERM4A	0.8875	0.1769	0.0585	*0.8543	-0.1351	0.0566	0.2524	0.1468	0.0283	0.0060
28	9 BERM4B	0.9266	0.1678	0.0564	*0.8882	-0.1510	0.0556	0.2014	0.1375	-0.0300	-0.0516
29	9 BERM6A	0.8593	0.1301	0.0932	*0.8211	-0.2400	0.0301	0.2169	0.1388	0.0644	0.0625
30	9 BERM6B	0.8231	0.1500	0.0309	*0.8308	-0.2173	-0.0015	0.1652	0.0676	0.0309	-0.0362
31	9 BERM7A	0.9068	0.1616	-0.0155	*0.8726	-0.2012	0.0160	0.1638	0.0600	-0.1549	-0.0329
32	9 BERM7B	0.8881	0.2144	0.0729	*0.8235	-0.1948	0.0555	0.2714	0.0404	-0.1002	0.0220
33	2BEECH2A	0.8349	0.4627	0.0059	*0.5602	-0.0908	-0.1278	0.1743	0.4885	-0.0690	-0.0833
34	2BEECH2B	0.8633	*0.5080	0.0081	0.3953	-0.0133	-0.1848	0.2302	*0.5323	-0.1513	-0.2135
35	2BEECH4A	0.8415	*0.5348	0.0706	0.4590	-0.0904	0.0241	0.1155	*0.5602	-0.0456	-0.0421
36	2BEECH4B	0.8377	0.4594	0.0921	*0.5158	-0.0640	-0.1011	0.1532	*0.5362	-0.0313	-0.0782
37	2BEECH6A	0.9140	*0.6183	0.0277	0.4045	-0.0032	-0.0883	0.0984	*0.5489	-0.1331	-0.1691
38	2BEECH6B	0.8950	*0.5611	0.0071	0.4991	-0.0272	-0.0424	0.0736	*0.5538	-0.0899	-0.0775
39	2BEECH7A	0.8676	0.4644	-0.0054	*0.5585	-0.0560	-0.0902	0.0993	*0.5151	-0.0806	-0.2125
40	2BEECH7B	0.9029	0.4782	-0.0033	0.4703	-0.0415	-0.1089	0.1132	*0.6107	-0.0762	-0.2135
41	4BEECH2A	0.8806	*0.6214	0.0149	0.3621	0.0295	-0.1937	0.2666	0.4808	-0.1107	-0.0756
42	4BEECH2B	0.8099	*0.6332	-0.0407	0.2239	-0.0251	-0.1601	0.1759	*0.5393	-0.0222	-0.0338
43	4BEECH4A	0.8699	*0.5854	-0.0227	0.4070	-0.1084	-0.0592	0.1367	*0.5619	0.0556	-0.0788
44	4BEECH4B	0.7482	0.4081	-0.0143	0.3789	-0.1993	-0.0618	0.1718	*0.5452	0.0400	-0.0971
45	4BEECH6A	0.8485	*0.5247	-0.0124	0.3968	-0.1456	-0.1724	0.1087	*0.5888	-0.0451	-0.0540
46	4BEECH6B	0.8052	*0.5253	0.0152	0.4256	-0.0667	-0.0290	0.0534	*0.5681	-0.0407	-0.1021
47	4BEECH7A	0.8687	*0.6722	0.0265	0.1830	-0.1558	-0.0335	0.0237	*0.5600	0.0938	-0.1841
48	4BEECH7B	0.9111	*0.6895	0.0422	0.3101	-0.0474	-0.0419	0.1447	*0.5324	0.0480	-0.1630
49	5HEMLO2A	0.8186	*0.7546	-0.0309	0.2096	-0.0722	-0.0541	0.1559	0.1197	-0.3788	0.0190
50	5HEMLO2B	0.8200	*0.8169	0.0417	0.2024	-0.0738	-0.0341	0.1026	0.0915	-0.2707	-0.0680
51	5HEMLO4A	0.8795	*0.7544	0.0002	0.2714	-0.1283	-0.0471	0.1802	0.1722	-0.3798	-0.0450
52	5HEMLO4B	0.8105	*0.6822	0.0330	0.3072	-0.0656	-0.1316	0.2109	0.2491	-0.3927	-0.0760

APPENDIX: G

2 VAR. LN(X+1)

RIX

MM.	1	2	3	4	5	6	7	8	9	10
554	0.1653	0.0942	*0.8268	-0.0910	-0.1867	0.1231	0.1786	-0.1026	-0.1155	-0.1469
576	0.2258	-0.0463	*0.5113	-0.1082	-0.1831	0.3686	0.1961	0.2196	-0.2037	-0.1838
596	0.2177	-0.0374	*0.8479	-0.0395	-0.1344	0.1102	0.1824	0.0967	-0.0360	-0.1274
553	0.1684	-0.0396	*0.8452	-0.1305	-0.1197	0.1542	0.1624	0.1027	-0.0930	-0.1017
337	0.1428	0.0389	*0.8575	-0.0909	0.1251	0.0032	0.0503	0.1284	-0.1075	-0.1484
668	0.1984	0.0459	*0.8607	-0.0997	-0.2203	-0.0302	0.0036	0.0258	-0.0814	-0.1339
537	0.3078	0.0591	*0.7703	-0.0915	0.1037	0.1823	0.1849	0.0373	-0.2494	-0.1094
692	0.1775	-0.0043	*0.8764	-0.0767	-0.0489	0.0490	0.0995	0.0140	-0.2080	-0.0750
669	0.3703	0.0917	0.4028	-0.0505	0.0563	0.1328	0.1709	0.1359	*-0.6228	0.0115
414	0.4052	0.0360	*0.6403	-0.0413	-0.0268	0.1876	0.1544	-0.1635	-0.4210	0.0225
781	0.3190	0.1191	*0.6314	-0.1226	-0.0384	0.0720	0.1116	0.0142	*-0.5708	-0.0575
373	0.3807	0.1790	*0.5634	-0.2019	-0.0327	-0.0112	0.1155	-0.0875	*-0.5280	-0.0344
573	0.4012	0.0706	*0.5107	0.0076	0.0484	0.1181	0.3101	-0.1848	*-0.5328	0.0005
488	0.4680	0.0577	0.4539	-0.0943	-0.0021	0.1739	0.2415	-0.2540	*-0.5081	0.0158
260	0.3571	0.0284	*0.5550	-0.1135	0.0380	0.0722	0.2360	-0.0645	*-0.6363	0.0729
431	0.2800	0.0200	*0.6219	-0.1184	-0.0061	0.1417	0.2477	-0.0519	*-0.5276	0.0336
522	0.4063	0.0215	*0.6588	0.0203	-0.0797	0.1420	0.0949	-0.3892	-0.2030	-0.1549
925	0.3756	0.1028	*0.6965	-0.1400	-0.1175	0.0670	0.1569	-0.3597	-0.2243	-0.1159
335	0.4109	0.0589	*0.7283	-0.0952	-0.1862	0.1066	0.1103	-0.3567	-0.1230	-0.1455
245	0.3776	0.0624	*0.7694	-0.1029	-0.1542	0.1087	0.0973	-0.2838	-0.1752	-0.1384
922	0.4208	0.0881	*0.6731	-0.0755	-0.1634	0.0589	0.1137	-0.4111	-0.1634	-0.0997
916	0.4001	0.0847	*0.7030	-0.1185	-0.1410	-0.0163	0.0692	-0.3784	-0.1950	-0.1000
949	0.4584	0.0690	*0.6864	-0.0936	-0.0964	0.0970	0.1394	-0.3639	-0.2080	-0.0795
800	*0.5053	0.0492	*0.6279	-0.1253	-0.1240	0.0577	0.1890	-0.3750	-0.1231	-0.0445
519	0.1679	0.1143	*0.7034	0.1477	0.1475	0.1190	0.0801	0.0345	0.2232	0.0262
745	0.1403	0.0978	*0.8494	-0.1095	0.0813	0.2064	0.1572	0.0630	0.0682	0.1710
875	0.1769	0.0585	*0.8543	-0.1351	0.0566	0.2524	0.1468	0.0283	0.0060	0.1240
266	0.1678	0.0564	*0.8882	-0.1510	0.0556	0.2014	0.1375	-0.0300	-0.0516	0.1323
593	0.1301	0.0932	*0.8211	-0.2400	0.0301	0.2169	0.1388	0.0644	0.0625	0.1634
3231	0.1500	0.0309	*0.8308	-0.2173	-0.0015	0.1652	0.0676	0.0309	-0.0362	0.1678
9068	0.1616	-0.0155	*0.8726	-0.2012	0.0160	0.1638	0.0600	-0.1549	-0.0329	0.1506
8881	0.2144	0.0729	*0.8235	-0.1948	0.0555	0.2714	0.0404	-0.1002	0.0220	0.1784
3349	0.4627	0.0059	*0.5602	-0.0908	-0.1278	0.1743	0.4885	-0.0690	-0.0833	-0.0404
8633	*0.5080	0.0081	0.3953	-0.0133	-0.1848	0.2302	*0.5323	-0.1513	-0.2135	-0.0986
8415	*0.5348	0.0706	0.4590	-0.0904	0.0241	0.1155	*0.5602	-0.0456	-0.0421	-0.0069
8377	0.4594	0.0921	*0.5158	-0.0640	-0.1011	0.1532	*0.5362	-0.0313	-0.0782	-0.1404
9140	*0.6183	0.0277	0.4045	-0.0032	-0.0883	0.0984	*0.5489	-0.1331	-0.1691	-0.0476
8950	*0.5611	0.0071	0.4991	-0.0272	-0.0424	0.0736	*0.5538	-0.0899	-0.0775	-0.0480
8676	0.4644	-0.0054	*0.5585	-0.0560	-0.0902	0.0993	*0.5151	-0.0806	-0.2123	0.0435
9029	0.4782	-0.0033	0.4703	-0.0415	-0.1089	0.1132	*0.6107	-0.0762	-0.2135	-0.0483
8806	*0.6214	0.0149	0.3621	0.0295	-0.1937	0.2666	0.4808	-0.1107	-0.0756	-0.0671
8099	*0.6332	-0.0407	0.2239	-0.0251	-0.1601	0.1759	*0.5393	-0.0222	-0.0338	-0.0861
8699	*0.5854	-0.0227	0.4070	-0.1084	-0.0592	0.1367	*0.5619	0.0556	-0.0788	0.0449
7482	0.4681	-0.0143	0.3789	-0.1993	-0.0618	0.1718	*0.5452	0.0400	-0.0971	0.0628
8485	*0.5247	-0.0124	0.3968	-0.1456	-0.1724	0.1087	*0.5888	-0.0451	-0.0540	0.0348
8052	*0.5253	0.0152	0.4256	-0.0667	-0.0290	0.0534	*0.5681	-0.0407	-0.1025	0.0697
8687	*0.6722	0.0265	0.1830	-0.1558	-0.0335	0.0237	*0.5600	0.0938	-0.1847	-0.0120
9111	*0.6895	0.0422	0.3101	-0.0474	-0.0419	0.1447	*0.5324	0.0480	-0.1636	-0.0175
8186	*0.7546	-0.0309	0.2096	-0.0722	-0.0541	0.1559	0.1197	-0.3788	0.0196	0.1168
8200	*0.8169	0.0417	0.2024	-0.0738	-0.0341	0.1026	0.0915	-0.2707	-0.0680	0.0802
8795	*0.7544	0.0002	0.2714	-0.1283	-0.0471	0.1802	0.1722	-0.3798	-0.0455	0.0978
8496	*0.6823	0.0330	0.3072	-0.0656	-0.1316	0.2109	0.2491	-0.3927	-0.0761	0.0213
8181	*0.7556	0.0789	0.2009	-0.1305	-0.1427	-0.0195	0.0698	-0.3969	-0.0059	0.0177

20A

32	9BERM7B	0.8881	0.2144	0.0729	*0.8235	-0.1948	0.0555	0.2714	0.0484	-0.1002	0.002
33	2BEECH2A	0.8349	0.4627	0.0059	*0.5602	-0.0908	-0.1278	0.1743	0.4885	-0.0690	-0.08
34	2BEECH2B	0.8633	*0.5080	0.0081	*0.3953	-0.0133	-0.1848	0.2302	*0.5323	-0.1513	-0.21
35	2BEECH4A	0.8415	*0.5348	0.0706	0.4590	-0.0904	0.0241	0.1155	*0.5602	-0.0456	-0.04
36	2BEECH4B	0.8377	0.4594	0.0921	*0.5158	-0.0640	-0.1011	0.1532	*0.5362	-0.0313	-0.07
37	2BEECH6A	0.9140	*0.6183	0.0277	0.4045	-0.0032	-0.0883	0.0984	*0.5489	-0.1331	-0.16
38	2BEECH6B	0.8950	*0.5611	0.0071	0.4991	-0.0272	-0.0424	0.0736	*0.5538	-0.0899	-0.07
39	2BEECH7A	0.8676	0.4644	-0.0054	*0.5585	-0.0560	-0.0902	0.0993	*0.5151	-0.0806	-0.21
40	2BEECH7B	0.9029	0.4782	-0.0033	0.4703	-0.0415	-0.1089	0.1132	*0.6107	-0.0762	-0.21
41	4BEECH2A	0.8806	*0.6214	0.0149	0.3621	0.0295	-0.1937	0.2666	0.4808	-0.1107	-0.07
42	4BEECH2B	0.8099	*0.6332	-0.0407	0.2239	-0.0251	-0.1601	0.1759	*0.5393	-0.0222	-0.03
43	4BEECH4A	0.8699	*0.5854	-0.0227	0.4070	-0.1084	-0.0592	0.1367	*0.5619	0.0556	-0.07
44	4BEECH4B	0.7482	0.4681	-0.0143	0.3789	-0.1993	-0.0618	0.1218	*0.5452	0.0400	-0.09
45	4BEECH6A	0.8485	*0.5247	-0.0124	0.3968	-0.1456	-0.1724	0.1087	*0.5888	-0.0451	-0.05
46	4BEECH6B	0.8052	*0.5253	0.0152	0.4256	-0.0667	-0.0290	0.0534	*0.5681	-0.0407	-0.10
47	4BEECH7A	0.8687	*0.6722	0.0265	0.1830	-0.1558	-0.0335	0.0237	*0.5600	0.0938	-0.18
48	4BEECH7B	0.9111	*0.6895	0.0422	0.3101	-0.0474	-0.0419	0.1447	*0.5324	0.0480	-0.16
49	5HEMLO2A	0.8186	*0.7546	-0.0309	0.2096	-0.0722	-0.0541	0.1559	0.1197	-0.3788	0.01
50	5HEMLO2B	0.8200	*0.8169	0.0417	0.2024	-0.0738	-0.0341	0.1026	0.0915	-0.2707	-0.06
51	5HEMLO4A	0.8795	*0.7544	0.0002	0.2714	-0.1283	-0.0471	0.1802	0.1722	-0.3798	-0.04
52	5HEMLO4B	0.8496	*0.6823	0.0330	0.3072	-0.0656	-0.1316	0.2109	0.2491	-0.3927	-0.07
53	5HEMLO6A	0.8181	*0.7556	0.0789	0.2009	-0.1305	-0.1427	-0.0195	0.0698	-0.3969	-0.00
54	5HEMLO6B	0.8616	*0.7977	0.0362	0.2585	-0.1233	-0.0833	0.0780	0.1515	-0.3143	-0.03
55	5HEMLO7A	0.8363	*0.8246	-0.0119	0.2043	-0.1047	-0.0228	0.0900	0.1352	-0.2695	0.00
56	5HEMLO7B	0.8652	*0.7955	0.0729	0.2498	-0.1438	-0.0684	0.0919	0.1359	-0.3268	-0.03
57	6HEBE 2A	0.8713	*0.8816	0.0754	0.1313	-0.0393	-0.0291	0.1216	0.0507	0.1980	-0.10
58	6HEBE 2B	0.8880	*0.9037	0.0754	0.1402	-0.0397	-0.0258	0.0737	-0.0414	0.1746	-0.07
59	6HEBE 4A	0.8559	*0.8600	0.0395	0.1485	-0.0711	-0.1211	0.1000	0.0584	0.1968	-0.12
60	6HEBE 4B	0.8444	*0.8482	0.0452	0.1288	-0.0661	-0.1262	0.1177	0.0425	0.2071	-0.12
61	6HEBE 6A	0.7927	*0.8596	-0.0032	0.1459	-0.0422	-0.1063	-0.0176	0.0291	0.0767	-0.07
62	6HEBE 6B	0.7939	*0.8373	0.0484	0.1911	-0.0533	-0.0551	0.0387	0.1329	0.0884	-0.13
63	6HEBE 7A	0.8704	*0.8927	0.0521	0.1781	-0.0376	-0.0478	0.0039	0.1525	0.0487	-0.08
64	6HEBE 7B	0.8695	*0.8777	0.0677	0.1883	0.0088	-0.0442	0.0515	0.2008	0.0726	-0.07
65	8ASPEN2A	0.7419	0.1722	0.1885	0.3607	-0.1493	-0.1778	*0.6928	0.1693	-0.0527	-0.04
66	8ASPEN2B	0.7973	0.1439	0.0662	0.2821	-0.1910	-0.2050	*0.7459	0.2027	-0.0274	-0.10
67	8ASPEN4A	0.8570	0.0691	0.0647	0.3463	-0.1125	-0.1049	*0.8333	0.0950	-0.0248	-0.01
68	8ASPEN4B	0.8638	0.1955	-0.0636	0.3948	-0.1433	-0.2444	*0.7162	0.1945	-0.1849	0.00
69	8ASPEN6A	0.6951	0.4826	0.1960	0.2978	-0.0914	-0.1640	0.2903	0.2894	-0.1951	-0.29
70	8ASPEN6B	0.7739	0.3005	0.0400	0.2251	-0.1065	*-0.5186	0.4101	0.3459	-0.1163	-0.05
71	8ASPEN7A	0.8067	0.1938	0.1195	0.1810	-0.2302	-0.1625	*0.7987	-0.0028	0.0308	-0.05
72	8ASPEN7B	0.8534	0.2251	0.1692	0.2089	-0.2350	-0.2143	*0.7921	0.0063	0.0113	-0.03
73	11ASPEN2A	0.7867	0.0986	0.1791	0.1613	*-0.8099	-0.1280	0.1633	-0.0019	-0.1279	0.04
74	11ASPEN2B	0.8158	0.0965	0.2025	0.1943	*-0.7668	-0.1179	0.3163	0.0877	-0.1324	0.01
75	11ASPEN4A	0.8435	0.1058	0.1286	0.3067	*-0.7928	-0.1498	0.0061	0.0131	0.0818	-0.05
76	11ASPEN4B	0.9481	0.1105	0.0670	0.2938	*-0.8952	-0.1232	0.1244	0.0289	0.0417	-0.05
77	11ASPEN6A	0.8941	0.0711	0.0756	0.3435	*-0.8681	-0.0484	0.0885	0.0832	0.0681	-0.01
78	11ASPEN6B	0.9143	0.0936	0.1683	0.2080	*-0.8856	-0.1027	0.0999	0.1358	0.0399	-0.09
79	11ASPEN7A	0.7507	0.0444	0.2501	0.0710	*-0.6553	-0.1131	0.1299	0.1511	-0.1594	-0.09
80	11ASPEN7B	0.8581	0.1306	0.2448	0.0173	*-0.8325	-0.0535	0.1698	0.0540	-0.0728	-0.03
81	3W.ASH2A	0.5489	0.0596	*0.7070	0.0325	-0.0810	-0.0262	0.1059	-0.0912	-0.0072	-0.11
82	3W.ASH2B	0.6173	0.1949	0.4107	0.0638	-0.2763	-0.0538	0.4226	-0.0828	0.0386	-0.06
83	3W.ASH4A	0.7672	0.0761	*0.7921	0.0904	-0.2475	-0.1067	0.1125	-0.0220	0.0109	-0.04
84	3W.ASH4B	0.8368	0.0990	*0.8363	0.0467	-0.1937	-0.1239	0.2098	0.0498	0.1549	-0.04
85	3W.ASH6A	0.8527	0.0991	*0.8446	0.1043	-0.0291	0.0031	0.1819	0.0339	0.0782	0.11
86	3W.ASH6B	0.7838	0.0782	*0.7970	0.0899	-0.2245	-0.1969	0.1362	0.1280	-0.0949	-0.02
87	3W.ASH7A	0.8640	0.0973	*0.8649	0.1314	-0.0185	-0.1311	-0.1029	-0.0044	-0.1437	-0.06
88	3W.ASH7B	0.7898	0.0144	*0.7429	0.0117	-0.1679	0.0430	0.0727	0.0515	-0.0138	0.08
89	12WASH2A	0.7901	0.0284	*0.5455	0.0390	-0.0982	*-0.599	0.0553	-0.0213	0.0473	-0.03
90	12WASH2B	0.7138	-0.0552	*0.6146	0.0391	-0.1048	*-0.213	-0.1209	0.0947	-0.0656	-0.03
91	12WASH4A	0.8502	-0.0152	*0.6054	0.0034	-0.1138	-0.0787	-0.1409	0.0311	-0.0174	-0.00
92	12WASH4B	0.8099	0.1056	0.4663	0.0225	-0.0133	*-0.871	-0.0293	0.0688	-0.0136	0.00
93	12WASH6A	0.9104	0.1843	0.0403	0.0559	-0.1234	*-0.939	0.2185	0.0770	-0.0213	-0.00
94	12WASH6B	0.9024	0.1745	0.2643	0.0792	-0.2128	*-0.046	0.2747	0.0500	-0.0527	-0.00
95	12WASH7A	0.8745	0.1711	0.1635	0.0968	-0.1714	*-0.380	0.2433	0.1223	-0.0189	-0.04
96	12WASH7B	0.9113	0.1672	0.1049	0.0558	-0.0793	*-0.131	0.1507	0.0692	-0.0238	-0.01

VARIANCE 20.524 6.903 22.670 6.961 6.062 6.045 6.520 2.939 3.6
 CUM. VAR 20.524 27.427 50.097 57.058 63.119 69.165 75.684 78.623 82.2

8349	0.4627	0.0059	*0.5602	-0.0908	-0.1278	0.1743	0.4885	-0.0690	-0.0833	-0.0404
8633	*0.5080	0.0081	0.3953	-0.0133	-0.1848	0.2302	*0.5323	-0.1513	-0.2135	-0.0986
8415	*0.5348	0.0706	0.4590	-0.0904	0.0241	0.1155	*0.5602	-0.0456	-0.0421	-0.0069
8377	0.4594	0.0921	*0.5158	-0.0640	-0.1011	0.1532	*0.5362	-0.0313	-0.0782	-0.1404
9140	*0.6183	0.0277	0.4045	-0.0032	-0.0883	0.0984	*0.5489	-0.1331	-0.1691	-0.0476
8950	*0.5611	0.0071	0.4991	-0.0272	-0.0424	0.0736	*0.5538	-0.0899	-0.0775	-0.0480
8676	0.4644	-0.0054	*0.5585	-0.0560	-0.0902	0.0993	*0.5151	-0.0806	-0.2123	0.0435
9029	0.4782	-0.0033	0.4703	-0.0415	-0.1089	0.1132	*0.6107	-0.0762	-0.2135	-0.0483
8806	*0.6214	0.0149	0.3621	0.0295	-0.1937	0.2666	0.4808	-0.1107	-0.0756	-0.0671
8099	*0.6332	-0.0407	0.2239	-0.0251	-0.1601	0.1759	*0.5393	-0.0222	-0.0338	-0.0861
8699	*0.5854	-0.0227	0.4070	-0.1084	-0.0592	0.1367	*0.5619	0.0556	-0.0788	0.0449
7482	0.4681	-0.0143	0.3789	-0.1993	-0.0618	0.1718	*0.5452	0.0400	-0.0971	0.0628
8485	*0.5247	-0.0124	0.3968	-0.1456	-0.1724	0.1087	*0.5888	-0.0451	-0.0540	0.0348
8052	*0.5253	0.0152	0.4256	-0.0667	-0.0290	0.0534	*0.5681	-0.0407	-0.1025	0.0697
8687	*0.6722	0.0265	0.1830	-0.1558	-0.0335	0.0237	*0.5600	0.0938	-0.1847	-0.0120
9111	*0.6895	0.0422	0.3101	-0.0474	-0.0410	0.1447	*0.5324	0.0480	-0.1636	-0.0175
8186	*0.7546	-0.0309	0.2096	-0.0722	-0.0541	0.1559	0.1197	-0.3788	0.0196	0.1168
8200	*0.8169	0.0417	0.2024	-0.0738	-0.0341	0.1026	0.0915	-0.2707	-0.0680	0.0802
8795	*0.7544	0.0002	0.2714	-0.1283	-0.0471	0.1802	0.1722	-0.3798	-0.0455	0.0978
8496	*0.6823	0.0330	0.3072	-0.0656	-0.1316	0.2109	0.2491	-0.3927	-0.0761	0.0213
8181	*0.7556	0.0789	0.2009	-0.1305	-0.1427	-0.0195	0.0698	-0.3969	-0.0059	0.0177
8616	*0.7977	0.0362	0.2585	-0.1233	-0.0833	0.0780	0.1515	-0.3143	-0.0392	0.0750
8363	*0.8246	-0.0119	0.2043	-0.1047	-0.0228	0.0900	0.1352	-0.2695	0.0007	0.0620
8652	*0.7955	0.0729	0.2498	-0.1438	-0.0684	0.0919	0.1359	-0.3268	-0.0349	0.0659
8713	*0.8816	0.0754	0.1313	-0.0393	-0.0291	0.1216	0.0507	0.1980	-0.1022	-0.0406
8880	*0.9037	0.0754	0.1402	-0.0397	-0.0258	0.0737	-0.0414	0.1746	-0.0731	-0.0273
8559	*0.8600	0.0395	0.1485	-0.0711	-0.1211	0.1000	0.0584	0.1968	-0.1238	-0.0739
8444	*0.8482	0.0452	0.1288	-0.0661	-0.1262	0.1177	0.0425	0.2071	-0.1201	-0.1138
7927	*0.8596	-0.0032	0.1459	-0.0422	-0.1063	-0.0176	0.0291	0.0767	-0.0722	-0.0848
7939	*0.8373	0.0484	0.1911	-0.0533	-0.0551	0.0387	0.1329	0.0884	-0.1360	-0.0509
8704	*0.8927	0.0521	0.1781	-0.0376	-0.0478	0.0039	0.1525	0.0487	-0.0896	-0.0402
8695	*0.8777	0.0677	0.1883	0.0088	-0.0442	0.0515	0.2008	0.0726	-0.0709	-0.0612
7419	0.1722	0.1885	0.3607	-0.1493	-0.1778	*0.6928	0.1693	-0.0527	-0.0452	0.0696
7973	0.1439	0.0662	0.2821	-0.1910	-0.2050	*0.7459	0.2027	-0.0274	-0.1097	-0.0623
8570	0.0691	0.0647	0.3463	-0.1125	-0.1049	*0.8333	0.0950	-0.0248	-0.0145	-0.0158
8638	0.1955	-0.0636	0.3948	-0.1433	-0.2444	*0.7162	0.1945	-0.1849	0.0096	-0.0178
6951	0.4826	0.1960	0.2978	-0.0914	-0.1640	0.2903	0.2894	-0.1951	-0.2980	-0.0701
7739	0.3005	0.0400	0.2251	-0.1065	*0.5186	0.4101	0.3459	-0.1163	-0.0596	-0.2149
8067	0.1938	0.1195	0.1810	-0.2302	-0.1625	*0.7987	-0.0028	0.0308	-0.0548	-0.0264
8534	0.2251	0.1692	0.2089	-0.2350	-0.2143	*0.7921	0.0063	0.0113	-0.0377	-0.0174
7867	0.0986	0.1791	0.1613	*0.8099	-0.1280	0.1633	-0.0019	-0.1279	0.0429	0.0415
8158	0.0965	0.2025	0.1943	*0.7668	-0.1179	0.3163	0.0877	-0.1324	0.0180	0.0167
8435	0.1058	0.1286	0.3067	*0.7928	-0.1498	0.0061	0.0131	0.0818	-0.0516	0.2475
9481	0.1105	0.0670	0.2938	*0.8952	-0.1232	0.1244	0.0289	0.0417	-0.0523	0.0879
8941	0.0711	0.0756	0.3435	*0.8681	-0.0484	0.0885	0.0832	0.0681	-0.0163	0.0833
9143	0.0936	0.1683	0.2080	*0.8856	-0.1027	0.0999	0.1358	0.0399	-0.0926	-0.0232
7507	0.0444	0.2501	0.0710	*0.6553	-0.1131	0.1299	0.1511	-0.1594	-0.0960	-0.4319
8581	0.1306	0.2448	0.0173	*0.8325	-0.0535	0.1698	0.0540	-0.0728	-0.0303	-0.2167
5489	0.0596	*0.7070	0.0325	-0.0810	-0.0262	0.1059	-0.0912	-0.0072	-0.1120	0.0707
6173	0.1949	0.4107	0.0638	-0.2763	-0.0538	0.4226	-0.0828	0.0386	-0.0610	0.3697
7672	0.0761	*0.7921	0.0904	-0.2475	-0.0267	0.1125	-0.0220	0.0109	-0.0471	0.0794
8368	0.0990	*0.8363	0.0467	-0.1937	-0.0239	0.2098	0.0498	0.1549	-0.0429	0.0134
8527	0.0991	*0.8446	0.1043	-0.0291	0.0031	0.1819	0.0339	0.0782	0.1183	-0.2299
7838	0.0782	*0.7970	0.0899	-0.2245	-0.0969	0.1362	0.1280	-0.0949	-0.0228	-0.0281
8640	0.0973	*0.8649	0.1314	-0.0185	-0.0311	-0.1029	-0.0044	-0.1437	-0.0638	-0.0097
7898	0.0144	*0.7429	0.0117	-0.1679	0.0430	0.0727	0.0515	-0.0138	0.0895	-0.4376
7901	0.0284	*0.5455	0.0390	-0.0982	*0.599	0.0553	-0.0213	0.0473	-0.0301	0.1962
7138	-0.0552	*0.6146	0.0391	-0.1048	*0.5213	-0.1209	0.0947	-0.0656	-0.0305	0.1413
8502	-0.0152	*0.6054	0.0034	-0.1138	-0.0787	-0.1409	0.0311	-0.0174	-0.0072	0.4693
8099	0.1056	0.4663	0.0225	-0.0133	*0.871	-0.0293	0.0688	-0.0136	0.0063	0.3203
9104	0.1843	0.0403	0.0559	-0.1234	*0.939	0.2185	0.0770	-0.0213	-0.0060	-0.0576
9024	0.1745	0.2643	0.0792	-0.2128	*0.046	0.2747	0.0500	-0.0527	-0.0087	-0.1494
3745	01.711	0.1635	0.0968	-0.1714	*0.380	0.2433	0.1223	-0.0189	-0.0401	-0.0368
9113	0.1672	0.1049	0.0558	-0.0793	*0.131	0.1507	0.0692	-0.0238	-0.0103	-0.0318
ANCE	20.524	6.903	22.670	6.961	6.062	6.045	6.520	2.939	3.622	1.823
VAR	20.524	27.427	50.097	57.058	63.119	69.165	75.684	78.623	82.245	84.068

APPENDIX: H

J. R. H. Q-MODE 90 VAR. LN(X+1)

VARIMAX FACTOR MATRIX

	COMM.	1	2	3	4	5	6	7	8		
1	1GBRMA2X	0.8727	0.1374	0.0775	*0.8255	0.1127	0.1600	-0.1574	0.2612	0.0362	0
2	U GBRM4A	0.8815	0.1737	-0.0190	*0.8543	0.0599	0.0961	-0.0941	0.2811	-0.0519	-0
3	1 GBRM4B	0.8547	0.1305	-0.0143	*0.8478	0.1442	0.1391	-0.0862	0.2465	-0.0660	0
4	1 GBRM6A	0.8359	0.1379	0.0512	*0.8695	0.1053	-0.0045	-0.0853	0.1335	-0.1007	0
5	1 GBRM6B	0.8783	0.1757	0.0513	*0.8812	0.1091	-0.0311	-0.1851	0.0981	-0.0057	0
6	1 GBRM7A	0.8365	0.2391	0.0767	*0.7731	0.1133	0.1648	-0.0762	0.2874	0.0183	0
7	1 GBRN7B	0.8790	0.1287	0.0139	*0.8932	0.0865	0.0342	-0.0131	0.1905	0.0066	0
8	10GBRM2A	0.8041	0.3387	0.0831	0.3924	0.0731	0.1089	0.0254	0.2312	-0.0627	*0
9	10GBRM2B	0.8423	0.2834	0.0479	*0.6393	0.0521	0.1759	-0.0304	0.2598	0.2253	0
10	10GNRM4A	0.8741	0.2776	0.1223	*0.6455	0.1305	0.0491	-0.0409	0.1873	0.0189	*0
11	10GBRM4B	0.8464	0.3105	0.1838	*0.5874	0.2120	-0.0376	-0.0415	0.2098	0.1127	*0
12	10GBRM6A	0.8627	0.2560	0.0894	*0.5057	0.0022	0.0979	0.0422	0.3871	0.2293	*0
13	10GBRM6B	0.8547	0.3123	0.0644	0.4533	0.1031	0.1519	-0.0148	0.3266	0.3187	*0
14	10GBRM7A	0.9212	0.2564	0.0268	*0.5482	0.1168	0.0451	0.0151	0.3063	0.1267	*0
15	10GBRM7B	0.8227	0.1931	0.0006	*0.6185	0.1331	0.1202	-0.0262	0.3091	0.0943	*0
16	7 BERM2A	0.8472	0.2400	0.0374	*0.6738	-0.0102	0.1360	-0.0486	0.2175	0.3995	0
17	7 BERM2B	0.8833	0.2116	0.1008	*0.7081	0.1476	0.0641	-0.1051	0.2592	0.3686	0
18	7 BERM4A	0.9229	0.2581	0.0606	*0.7483	0.1062	0.1086	-0.1610	0.2283	0.3774	0
19	7 BERM4B	0.9242	0.2414	0.0832	*0.7867	0.1080	0.1061	-0.1276	0.2169	0.2992	0
20	7 BERM6A	0.8841	0.2516	0.0964	*0.6958	0.0813	0.0494	-0.1441	0.2276	0.4213	0
21	7 BERM6B	0.8831	0.2478	0.0871	*0.7284	0.1187	-0.0256	-0.1220	0.1758	0.3834	0
22	7 BERM7A	0.9052	0.2936	0.0800	*0.7061	0.1001	0.0877	-0.0789	0.2587	0.3992	0
23	7 BERM7B	0.8597	0.3253	0.0518	*0.6441	0.1313	0.0552	-0.1163	0.3205	0.4143	0
24	9BERM2AX	0.8806	0.0941	0.1030	*0.8012	0.0750	0.2387	0.0840	0.2015	-0.0012	0
25	9 BERM4A	0.8963	0.1118	0.0548	*0.8103	0.1358	0.2814	0.0447	0.1929	0.0232	0
26	9 BERM4B	0.9343	0.0890	0.0588	*0.8563	0.1507	0.2183	0.0491	0.1918	0.0707	0
27	9 BERM6A	0.8659	0.0796	0.0952	*0.7682	0.2387	0.2446	0.0192	0.1734	-0.0119	0
28	9 BERM6B	0.8269	0.1020	0.0405	*0.7800	0.2082	0.1944	-0.0106	0.1188	0.0118	0
29	9 BERM7A	0.9063	0.0685	-0.0236	*0.8553	0.2052	0.1764	0.0089	0.1261	0.1827	0
30	9 BERM7B	0.8893	0.1233	0.0844	*0.7899	0.1951	0.2804	0.0463	0.1217	0.1694	0
31	2BEECH2A	0.8253	0.2963	0.0484	0.5258	0.0943	0.1588	-0.1028	*0.6235	0.1418	0
32	2BEECH2B	0.8263	0.3088	0.0431	0.3671	0.0215	0.2031	-0.1669	*0.6553	0.2069	0
33	2BEECH4A	0.8298	0.3570	0.0980	0.4199	0.1033	0.1062	0.0382	*0.6823	0.1593	0
34	2BEECH4B	0.8250	0.2970	0.1214	0.4814	0.0771	0.1454	-0.0724	*0.6574	0.0940	0
35	2BEECH6A	0.9062	0.4328	0.0525	0.3880	0.0156	0.0888	-0.0788	*0.6849	0.2176	0
36	2BEECH6B	0.8936	0.3851	0.0315	0.4811	0.0408	0.0573	-0.0257	*0.6817	0.1840	0
37	2BEECH7A	0.8503	0.3010	0.0118	*0.5378	0.0602	0.0893	-0.038	*0.6204	0.1407	0
38	2BEECH7B	0.8914	0.3105	0.0131	0.4472	0.0516	0.1069	-0.1132	*0.7079	0.1290	0
39	4BEECH2A	0.8544	0.4594	0.0187	0.3445	-0.0132	0.2666	-0.1969	0.5946	0.2121	0
40	4BEECH2B	0.7929	0.4897	-0.0285	0.2089	0.0432	0.1759	-0.1595	*0.6510	0.1293	0
41	4BEECH4A	0.8533	0.4518	-0.0233	0.3807	0.1244	0.1285	-0.0728	*0.6677	0.0749	0
42	4BEECH4B	0.7363	0.3221	0.0132	0.3406	0.2066	0.1490	-0.0791	*0.6354	0.0741	0
43	4BEECH6A	0.8466	0.3570	0.0106	0.3657	0.1448	0.1049	-0.1751	*0.7034	0.1335	0
44	4BEECH6B	0.7954	0.3674	0.0340	0.3952	0.0705	0.0556	-0.0352	*0.6704	0.1369	0
45	4BEECH7A	0.8380	*0.5250	0.0417	0.1568	0.1578	0.0191	-0.0378	*0.6840	0.0391	0
46	4BEECH7B	0.8853	*0.5307	0.0652	0.2717	0.0579	0.1365	-0.0392	*0.6779	0.1011	0
47	5HEMLO2A	0.8275	*0.5562	-0.0252	0.2033	0.0770	0.1411	-0.0537	0.2729	*0.6051	0
48	5HEMLO2B	0.8326	*0.6523	0.0416	0.1943	0.0807	0.0827	-0.0337	0.2399	*0.5296	0
49	5HEMLO4A	0.8793	*0.5440	0.0095	0.2567	0.1271	0.1548	-0.0393	0.2974	*0.6163	0
50	5HEMLO4B	0.8383	0.4696	0.0281	0.2952	0.0757	0.1912	-0.1204	0.3607	*0.5779	0
51	5HEMLO6A	0.8193	*0.5858	0.0717	0.2101	0.1289	-0.0191	-0.1244	0.2113	*0.5912	0
52	5HEMLO6B	0.8625	*0.6194	0.0342	0.2488	0.1260	0.0666	-0.0763	0.2961	*0.5432	0
53	5HEMLO7A	0.8326	*0.6392	-0.0078	0.1856	0.1043	0.0737	-0.0145	0.2624	*0.5468	0
54	5HEMLO7B	0.8620	*0.6107	0.0596	0.2289	0.1463	0.0805	-0.0627	0.2660	*0.5667	0

APPENDIX: H

90 VAR. LN(X+1)

MATRIX

MM.	1	2	3	4	5	6	7	8	9	10
727	0.1374	0.0775	*0.8255	0.1127	0.1600	-0.1574	0.2612	0.0362	*0.0864	-0.1624
915	0.1737	-0.0190	*0.8543	0.0599	0.0961	-0.0941	0.2811	-0.0519	-0.0569	-0.1205
547	0.1305	-0.0143	*0.8478	0.1442	0.1391	-0.0862	0.2465	-0.0660	0.0190	-0.0746
359	0.1379	0.0512	*0.8695	0.1053	-0.0045	-0.0853	0.1335	-0.1007	0.0167	-0.1075
783	0.1757	0.0513	*0.8812	0.1091	-0.0311	-0.1851	0.0981	-0.0057	0.0024	-0.1070
365	0.2391	0.0767	*0.7731	0.1133	0.1648	-0.0762	0.2874	0.0183	0.1985	-0.0875
790	0.1287	0.0139	*0.8932	0.0865	0.0342	-0.0131	0.1905	0.0066	0.1135	-0.0801
041	0.3387	0.0831	0.3924	0.0731	0.1089	0.0254	0.2312	-0.0627	*0.6722	0.0363
8423	0.2834	0.0479	*0.6393	0.0521	0.1759	-0.0304	0.2598	0.2253	0.4450	0.0050
741	0.2776	0.1223	*0.6465	0.1305	0.0491	-0.0409	0.1873	0.0189	*0.5482	-0.0843
464	0.3105	0.1838	*0.5874	0.2120	-0.0376	-0.0415	0.2098	0.1127	*0.5098	-0.0806
627	0.2560	0.0894	*0.5057	0.0022	0.0979	0.0422	0.3871	0.2293	*0.5639	-0.0418
547	0.3123	0.0644	0.4533	0.1031	0.1519	-0.0148	0.3266	0.3187	*0.5505	-0.0492
212	0.2564	0.0268	*0.5482	0.1168	0.0451	0.0151	0.3063	0.1267	*0.6505	0.0725
227	0.1931	0.0006	*0.6185	0.1331	0.1202	-0.0262	0.3091	0.0943	*0.5131	0.0476
472	0.2400	0.0374	*0.6738	-0.0102	0.1360	-0.0486	0.2175	0.3995	0.2092	-0.2499
833	0.2116	0.1008	*0.7081	0.1476	0.0641	-0.1051	0.2592	0.3686	0.2386	-0.1734
229	0.2581	0.0606	*0.7483	0.1062	0.1086	-0.1610	0.2283	0.3774	0.1185	-0.2044
242	0.2414	0.0832	*0.7867	0.1080	0.1061	-0.1276	0.2169	0.2992	0.1718	-0.1867
841	0.2516	0.0964	*0.6958	0.0813	0.0494	-0.1441	0.2276	0.4213	0.1644	-0.2030
831	0.2478	0.0871	*0.7284	0.1187	-0.0256	-0.1220	0.1758	0.3834	0.1926	-0.1973
052	0.2936	0.0800	*0.7061	0.1001	0.0877	-0.0789	0.2587	0.3992	0.2012	-0.1528
8597	0.3253	0.0518	*0.6441	0.1313	0.0552	-0.1163	0.3205	0.4143	0.1299	-0.1064
806	0.0941	0.1030	*0.8012	0.0750	0.2387	0.0840	0.2015	-0.0012	0.0019	0.3300
963	0.1118	0.0548	*0.8103	0.1358	0.2814	0.0447	0.1929	0.0232	0.0625	0.2878
343	0.0890	0.0588	*0.8563	0.1507	0.2183	0.0491	0.1918	0.0707	0.1026	0.2541
659	0.0796	0.0952	*0.7682	0.2387	0.2446	0.0192	0.1734	-0.0119	0.0191	0.3356
269	0.1020	0.0405	*0.7800	0.2082	0.1944	-0.0106	0.1188	0.0118	0.1086	0.3148
063	0.0685	-0.0236	*0.8553	0.2052	0.1764	0.0089	0.1261	0.1827	0.0661	0.2064
893	0.1233	0.0844	*0.7899	0.1951	0.2804	0.0463	0.1217	0.1694	0.0608	0.2775
253	0.2963	0.0484	0.5258	0.0943	0.1588	-0.1028	*0.6235	0.1418	0.0699	-0.0186
263	0.3088	0.0431	0.3671	0.0215	0.2031	-0.1669	*0.6553	0.2069	0.1946	-0.1210
298	0.3570	0.0980	0.4199	0.1033	0.1062	0.0382	*0.6823	0.1593	0.0446	0.0125
250	0.2970	0.1214	0.4814	0.0771	0.1454	-0.0724	*0.6574	0.0940	0.0572	-0.1169
062	0.4328	0.0525	0.3880	0.0156	0.0888	-0.0788	*0.6849	0.2176	0.1710	-0.0740
2936	0.3851	0.0315	0.4811	0.0408	0.0573	-0.0257	*0.6817	0.1840	0.0617	-0.0699
8503	0.3010	0.0118	*0.5378	0.0602	0.0893	-0.038	*0.6204	0.1407	0.2063	0.0528
3914	0.3105	0.0131	0.4472	0.0516	0.1069	-0.1132	*0.7079	0.1290	0.2223	-0.0287
3544	0.4594	0.0187	0.3445	-0.0132	0.2666	-0.1969	0.5946	0.2121	0.1070	-0.0651
7929	0.4897	-0.0285	0.2089	0.0432	0.1759	-0.1595	*0.6510	0.1293	0.0452	-0.0883
8533	0.4518	-0.0233	0.3807	0.1244	0.1285	-0.0728	*0.6677	0.0749	0.0879	0.0852
7363	0.3221	0.0132	0.3406	0.2066	0.1490	-0.0791	*0.6354	0.0741	0.1490	0.1174
8466	0.3570	0.0106	0.3657	0.1448	0.1049	-0.1751	*0.7034	0.1335	0.0631	0.0776
7954	0.3674	0.0340	0.3952	0.0705	0.0556	-0.0352	*0.6704	0.1369	0.1155	0.1110
3380	*0.5250	0.0417	0.1568	0.1578	0.0191	-0.0378	*0.6840	0.0391	0.1951	0.0436
8853	*0.5307	0.0652	0.2717	0.0579	0.1365	-0.0392	*0.6779	0.1011	0.1776	0.0263
3275	*0.5562	-0.0252	0.2033	0.0770	0.1411	-0.0537	0.2729	*0.6051	0.0292	0.0775
3326	*0.6523	0.0416	0.1943	0.0807	0.0827	-0.0337	0.2399	*0.5296	0.1034	0.0671
8793	*0.5440	0.0095	0.2567	0.1271	0.1548	-0.0393	0.2974	*0.6163	0.0727	0.0459
8383	0.4696	0.0281	0.2952	0.0757	0.1912	-0.1204	0.3607	*0.5779	0.0898	-0.0288
8193	*0.5858	0.0717	0.2101	0.1289	-0.0191	-0.1244	0.2113	*0.5912	0.0082	-0.0119
8625	*0.6194	0.0342	0.2488	0.1260	0.0666	-0.0763	0.2961	*0.5432	0.0585	0.0584
8326	*0.6392	-0.0078	0.1856	0.1043	0.0737	-0.0145	0.2624	*0.5468	0.0400	0.0593
8620	*0.6107	0.0596	0.2289	0.1463	0.0805	-0.0627	0.2660	*0.5667	0.0765	0.0595
8638	*0.8698	0.0818	0.1454	0.0513	0.1291	-0.0179	0.2182	0.0259	0.1070	0.0071

30	9	BERM7B	0.8893	0.1233	0.0844	*0.7899	0.1951	0.2804	0.0463	0.1217	0.1
31	2	BEECH2A	0.8253	0.2963	0.0484	0.5258	0.0943	0.1588	-0.1028	*0.6235	0.1
32	2	BEECH2B	0.8263	0.3088	0.0431	0.3671	0.0215	0.2031	-0.1669	*0.6553	0.2
33	2	BEECH4A	0.8298	0.3570	0.0980	0.4199	0.1033	0.1062	0.0382	*0.6823	0.1
34	2	BEECH4B	0.8250	0.2970	0.1214	0.4814	0.0771	0.1454	-0.0724	*0.6574	0.0
35	2	BEECH6A	0.9062	0.4328	0.0525	0.3880	0.0156	0.0888	-0.0788	*0.6849	0.2
36	2	BEECH6B	0.8936	0.3851	0.0315	0.4811	0.0408	0.0573	-0.0257	*0.6817	0.1
37	2	BEECH7A	0.8503	0.3010	0.0118	*0.5378	0.0602	0.0893	-0.038	*0.6204	0.1
38	2	BEECH7B	0.8914	0.3105	0.0131	0.4472	0.0516	0.1069	-0.1132	*0.7079	0.1
39	4	BEECH2A	0.8544	0.4594	0.0187	0.3445	-0.0132	0.2666	-0.1969	0.5946	0.2
40	4	BEECH2B	0.7929	0.4897	-0.0285	0.2089	0.0432	0.1759	-0.1595	*0.6510	0.1
41	4	BEECH4A	0.8533	0.4518	-0.0233	0.3807	0.1244	0.1285	-0.0728	*0.6677	0.0
42	4	BEECH4B	0.7363	0.3221	0.0132	0.3406	0.2066	0.1490	-0.0791	*0.6354	0.0
43	4	BEECH6A	0.8466	0.3570	0.0106	0.3657	0.1448	0.1049	-0.1751	*0.7034	0.1
44	4	BEECH6B	0.7954	0.3674	0.0340	0.3952	0.0705	0.0556	-0.0352	*0.6704	0.1
45	4	BEECH7A	0.8380	*0.4250	0.0417	0.1568	0.1578	0.0191	-0.0378	*0.6840	0.0
46	4	BEECH7B	0.8853	*0.5307	0.0652	0.2717	0.0579	0.1365	-0.0392	*0.6779	0.1
47	5	HEMLO2A	0.8275	*0.5562	-0.0252	0.2033	0.0770	0.1411	-0.0537	0.2729	*0.6
48	5	HEMLO2B	0.8326	*0.6523	0.0416	0.1943	0.0807	0.0827	-0.0337	0.2399	*0.5
49	5	HEMLO4A	0.8793	*0.5440	0.0095	0.2567	0.1271	0.1548	-0.0393	0.2974	*0.6
50	5	HEMLO4B	0.8383	0.4696	0.0281	0.2952	0.0757	0.1912	-0.1204	0.3607	*0.5
51	5	HEMLO6A	0.8193	*0.5858	0.0717	0.2101	0.1289	-0.0191	-0.1244	0.2113	*0.5
52	5	HEMLO6B	0.8625	*0.6194	0.0342	0.2488	0.1260	0.0666	-0.0763	0.2961	*0.5
53	5	HEMLO7A	0.8326	*0.6392	-0.0078	0.1856	0.1043	0.0737	-0.0145	0.2624	*0.5
54	5	HEMLO7B	0.8620	*0.6107	0.0596	0.2289	0.1463	0.0805	-0.0627	0.2660	*0.5
55	6	HEBE 2A	0.8638	*0.8698	0.0818	0.1454	0.0513	0.1291	-0.0179	0.2182	0.0
56	6	HEBE 2B	0.8843	*0.9034	0.0683	0.1552	0.0521	0.0751	-0.0196	0.1326	0.0
57	6	HEBE 4A	0.8490	*0.8455	0.0574	0.1608	0.0772	0.1047	-0.1122	0.2307	0.0
58	6	HEBE 4B	0.8351	*0.8442	0.0586	0.1462	0.0731	0.1209	-0.1138	0.2106	-0.0
59	6	HEBE 6A	0.7842	*0.8287	0.0002	0.1644	0.0472	-0.0107	-0.0856	0.1929	0.1
60	6	HEBE 6B	0.7778	*0.7779	0.0748	0.2107	0.0550	0.0387	-0.0373	0.2951	0.0
61	6	HEBE 7A	0.8661	*0.8258	0.0610	0.1908	0.0449	0.0026	-0.0364	0.3299	0.1
62	6	HEBE 7B	0.8596	*0.8049	0.0790	0.2004	-0.0013	0.0560	-0.0306	0.3750	0.1
63	8	ASPEN2A	0.7331	0.0996	0.2078	0.3409	0.1664	*0.6816	-0.0812	0.2054	0.1
64	8	ASPEN2B	0.7741	0.0777	0.1075	0.2785	0.2034	*0.7213	-0.1927	0.2419	0.0
65	8	ASPEN4A	0.8322	0.0263	0.0781	0.3288	0.1233	*0.8202	-0.0931	0.1323	0.0
66	8	ASPEN4B	0.8570	0.0879	-0.0402	0.3878	0.1553	*0.7152	-0.2418	0.2497	0.1
67	8	ASPEN6A	0.6798	0.3515	0.1746	0.3043	0.1110	0.2822	-0.1776	0.3841	0.2
68	8	ASPEN6B	0.7479	0.2045	0.0448	0.2411	0.1133	0.4215	*-0.5024	0.3900	0.0
69	8	ASPEN7A	0.7962	0.1770	0.1421	0.1802	0.2403	*0.7878	-0.1589	0.0442	0.0
70	8	ASPEN7B	0.8212	0.2073	0.1636	0.2131	0.2501	*0.7673	-0.2174	0.0599	0.0
71	11	ASPEN2A	0.7891	0.0374	0.2093	0.1523	*0.8134	0.1381	-0.1156	0.0291	0.1
72	11	ASPEN2B	0.8138	0.0246	0.2244	0.1822	*0.7727	0.2912	-0.1013	0.1152	0.1
73	11	ASPEN4A	0.8240	0.0965	0.1367	0.3086	*0.7927	-0.0339	-0.1555	0.0331	-0.0
74	11	ASPEN4B	0.9369	0.0877	0.0800	0.2865	*0.8870	0.1040	-0.1296	0.0557	0.0
75	11	ASPEN6A	0.8915	0.0524	0.0683	0.3315	*0.8546	0.0731	-0.0608	0.0968	-0.0
76	11	ASPEN6B	0.9026	0.0602	0.1779	0.1911	*0.8822	0.0864	-0.1009	0.1463	-0.0
77	11	ASPEN7A	0.7023	0.0162	0.2075	0.0645	*0.6806	0.1446	-0.1032	0.1493	-0.0
78	11	ASPEN7B	0.8574	0.0969	0.2029	0.0124	*0.8548	0.1631	-0.0566	0.0684	0.0
79	3	WXASH2A	0.5592	0.1410	*0.6371	0.1207	0.2525	0.1692	-0.0768	-0.0894	0.0
80	3	WXASH4A	0.7983	0.0809	*0.8203	0.1041	0.2528	0.0845	-0.1827	-0.0306	0.0
81	3	WXASH4B	0.8561	0.1321	*0.8551	0.0445	0.1987	0.2000	-0.1045	0.0340	-0.1
82	3	WXASH6A	0.7095	0.1336	*0.7647	0.1007	0.0570	0.2065	0.1061	0.0224	-0.0
83	3	WXASH6B	0.8116	0.0237	*0.8242	0.0921	0.2195	0.1263	-0.1662	0.1222	0.1
84	3	WXASH7A	0.5912	-0.0151	*0.7232	0.0673	0.0661	0.0859	-0.0499	0.1451	0.0
85	12	WASH2A	0.7812	0.0415	*0.5406	0.0380	0.1061	0.0387	*-0.6682	-0.0528	0.0
86	12	WASH2B	0.7853	-0.0972	*0.6775	0.0201	0.0803	-0.1179	*-0.5079	0.0529	0.0
87	12	WASH4A	0.8072	-0.0458	*0.6623	-0.0038	0.1026	-0.1843	-0.4754	-0.0065	0.1
88	12	WASH4B	0.7533	0.0792	0.4998	0.0388	0.0131	-0.0722	*-0.6796	0.0642	0.0
89	12	WASH6A	0.9378	0.1676	0.0291	0.0706	0.1301	0.2187	*-0.9078	0.0978	0.0
90	12	WASH6B	0.9025	0.1604	0.2390	0.0975	0.2259	0.2786	*-0.8091	0.0645	0.0
91	12	WASH7A	0.8818	0.1329	0.1992	0.0991	0.1606	0.2431	*-0.8376	0.1439	0.0
92	12	WASH7B	0.9326	0.1494	0.0951	0.0696	0.0837	0.1482	*-0.9251	0.0850	0.0

34
 VARIANCE 13.903 6.289 22.266 7.355 5.766 6.055 11.423 5.
 CUM. VAR 13.903 20.192 42.458 49.812 55.578 61.633 73.056 78.

0.1233	0.0844	*0.7899	0.1951	0.2804	0.0463	0.1217	0.1674	0.1608	0.2775
0.2963	0.0484	0.5258	0.0943	0.1588	-0.1028	*0.6235	0.1418	0.0699	-0.0186
0.3088	0.0431	0.3671	0.0215	0.2031	-0.1669	*0.6553	0.2069	0.1946	-0.1210
0.3570	0.0980	0.4199	0.1033	0.1062	0.0382	*0.6823	0.1593	0.0446	0.0125
0.2970	0.1214	0.4814	0.0771	0.1454	-0.0724	*0.6574	0.0940	0.0572	-0.1169
0.4328	0.0525	0.3880	0.0156	0.0888	-0.0788	*0.6849	0.2176	0.1710	-0.0740
0.3851	0.0315	0.4811	0.0408	0.0573	-0.0257	*0.6817	0.1840	0.0617	-0.0699
0.3010	0.0118	*0.5378	0.0602	0.0893	-0.038	*0.6204	0.1407	0.2063	0.0528
0.3105	0.0131	0.4472	0.0516	0.1069	-0.1132	*0.7079	0.1290	0.2223	-0.0287
0.4594	0.0187	0.3445	-0.0132	0.2666	-0.1969	0.5946	0.2121	0.1070	-0.0651
0.4897	-0.0285	0.2089	0.0432	0.1759	-0.1595	*0.6510	0.1293	0.0452	-0.0883
0.4518	-0.0233	0.3807	0.1244	0.1285	-0.0728	*0.6677	0.0749	0.0879	0.0852
0.3221	0.0132	0.3406	0.2066	0.1490	-0.0791	*0.6354	0.0741	0.1490	0.1174
0.3570	0.0106	0.3657	0.1448	0.1049	-0.1751	*0.7034	0.1335	0.0631	0.0776
0.3674	0.0340	0.3952	0.0705	0.0556	-0.0352	*0.6704	0.1369	0.1155	0.1110
*0.5250	0.0417	0.1568	0.1578	0.0191	-0.0378	*0.6840	0.0391	0.1951	0.0436
*0.5307	0.0652	0.2717	0.0579	0.1365	-0.0392	*0.6779	0.1011	0.1776	0.0263
*0.5562	-0.0252	0.2033	0.0770	0.1411	-0.0537	0.2729	*0.6051	0.0292	0.0775
*0.6523	0.0416	0.1943	0.0807	0.0827	-0.0337	0.2399	*0.5296	0.1034	0.0671
*0.5440	0.0095	0.2567	0.1271	0.1548	-0.0393	0.2974	*0.6163	0.0727	0.0459
0.4696	0.0281	0.2952	0.0757	0.1912	-0.1204	0.3607	*0.5779	0.0898	-0.0288
*0.5858	0.0717	0.2101	0.1289	-0.0191	-0.1244	0.2113	*0.5912	0.0082	-0.0119
*0.6194	0.0342	0.2488	0.1260	0.0666	-0.0763	0.2961	*0.5432	0.0585	0.0584
*0.6392	-0.0078	0.1856	0.1043	0.0737	-0.0145	0.2624	*0.5468	0.0400	0.0593
*0.6107	0.0596	0.2289	0.1463	0.0805	-0.0627	0.2660	*0.5667	0.0765	0.0595
*0.8698	0.0818	0.1454	0.0513	0.1291	-0.0179	0.2182	0.0259	0.1070	0.0071
*0.9034	0.0683	0.1552	0.0521	0.0751	-0.0196	0.1326	0.0767	0.0820	0.0227
*0.8455	0.0574	0.1608	0.0772	0.1047	-0.1122	0.2307	0.0026	0.1482	-0.0172
*0.8442	0.0586	0.1462	0.0731	0.1209	-0.1138	0.2106	-0.0146	0.1290	-0.0590
*0.8287	0.0002	0.1644	0.0472	-0.0107	-0.0856	0.1929	0.1320	0.0503	-0.0594
*0.7779	0.0748	0.2107	0.0550	0.0387	-0.0373	0.2951	0.0947	0.1362	-0.0462
*0.8258	0.0610	0.1908	0.0449	0.0026	-0.0364	0.3299	0.1515	0.0909	-0.0222
*0.8049	0.0790	0.2004	-0.0013	0.0560	-0.0306	0.3750	0.1110	0.0804	-0.0424
0.0996	0.2078	0.3409	0.1664	*0.6816	-0.0812	0.2054	0.1039	0.0833	0.0700
0.0777	0.1075	0.2785	0.2034	*0.7213	-0.1927	0.2419	0.0583	0.0981	-0.0927
0.0263	0.0781	0.3288	0.1233	*0.8202	-0.0931	0.1323	0.0397	0.0238	0.0321
0.0879	-0.0402	0.3878	0.1553	*0.7152	-0.2418	0.2497	0.1991	0.0205	-0.0265
0.3515	0.1746	0.3043	0.1110	0.2822	-0.1776	0.3841	0.2292	0.3118	-0.1113
0.2045	0.0448	0.2411	0.1133	0.4215	*-0.5024	0.3900	0.0828	0.0515	-0.1989
0.1770	0.1421	0.1802	0.2403	*0.7878	-0.1589	0.0442	0.0344	0.0731	0.0063
0.2073	0.1636	0.2131	0.2501	*0.7673	-0.2174	0.0599	0.0313	0.0521	-0.0141
0.0374	0.2093	0.1523	*0.8134	0.1381	-0.1156	0.0291	0.1552	-0.0329	-0.0274
0.0246	0.2244	0.1822	*0.7727	0.2912	-0.1013	0.1152	0.1440	-0.0156	-0.0570
0.0965	0.1367	0.3086	*0.7927	-0.0339	-0.1555	0.0331	-0.0044	0.0019	0.2143
0.0877	0.0800	0.2865	*0.8870	0.1040	-0.1296	0.0557	0.0085	0.0524	0.1418
0.0524	0.0683	0.3315	*0.8546	0.0731	-0.0608	0.0968	-0.0289	0.0147	0.1562
0.0602	0.1779	0.1911	*0.8822	0.0864	-0.1009	0.1463	-0.0258	0.1082	0.0345
0.0162	0.2075	0.0645	*0.6806	0.1446	-0.1032	0.1493	-0.0207	0.1176	-0.3513
0.0969	0.2029	0.0124	*0.8548	0.1631	-0.0566	0.0684	0.0639	0.0522	-0.1864
0.1410	*0.6371	0.1207	0.2525	0.1692	-0.0768	-0.0894	0.0775	0.0570	-0.0580
0.0809	*0.8203	0.1041	0.2528	0.0845	-0.1827	-0.0306	0.0193	0.0008	-0.0488
0.1321	*0.8551	0.0445	0.1987	0.2000	-0.1045	0.0340	-0.1131	0.0311	-0.0087
0.1336	*0.7647	0.1007	0.0570	0.2065	0.1061	0.0224	-0.0890	-0.1012	-0.1448
0.0237	*0.8242	0.0921	0.2195	0.1263	-0.1662	0.1222	0.1081	0.0053	-0.0697
-0.0151	*0.7232	0.0673	0.0661	0.0859	-0.0499	0.1451	0.0253	0.1629	0.0309
0.0415	*0.5406	0.0380	0.1061	0.0387	*-0.6682	-0.0528	0.0180	0.0266	0.1505
-0.0972	*0.6775	0.0201	0.0803	-0.1179	*-0.5079	0.0529	0.0810	0.0794	0.1503
-0.0458	*0.6623	-0.0038	0.1026	-0.1843	-0.4754	-0.0065	0.1014	-0.0073	0.2925
0.0792	0.4998	0.0388	0.0131	-0.0722	*-0.6796	0.0642	0.0831	-0.0673	0.1132
0.1676	0.0291	0.0706	0.1301	0.2187	*-0.9078	0.0978	0.0404	0.0121	-0.0609
0.1604	0.2390	0.0975	0.2259	0.2786	*-0.8091	0.0645	0.0614	0.0018	-0.1376
0.1329	0.1992	0.0991	0.1606	0.2431	*-0.8376	0.1439	0.0517	0.0699	-0.0010
0.1494	0.0951	0.0696	0.0837	0.1482	*-0.9251	0.0850	0.0500	0.0138	-0.0400

E	13.903	6.289	22.266	7.355	5.766	6.055	11.423	5.204	3.837	1.779
R	13.903	20.192	42.458	49.812	55.578	61.633	73.056	78.260	82.097	83.875

APPENDIX: I

J. R. H. Q-MODE 90 VAR. LN(X+1)

VARIMAX FACTOR SCORE MATRIX

VAR.	1	2	3	4	5	6	7	8	9
1	* 1.171	-0.066	0.017	-0.084	-0.106	0.101	-0.659	0.771	0.830
2	0.583	0.034	0.755	-0.134	-0.309	0.229	-1.169	* 2.386	0.053
3	0.754	-0.048	-0.251	0.037	0.003	0.177	-0.363	* 1.691	-0.492
4	-0.059	-0.079	0.478	-0.149	0.651	0.013	-0.162	-0.147	-0.324
5	0.119	0.986	0.806	0.133	-0.584	0.215	-0.603	0.098	0.411
6	0.411	-0.059	-0.119	0.035	-0.271	0.033	0.290	0.125	0.939
7	* 1.311	-0.022	0.444	-0.099	-0.255	0.113	-1.022	0.120	0.826
8	-0.367	-0.052	* 3.206	-0.251	-1.082	0.087	* 1.327	-2.153	-0.972
9	0.305	-0.097	* 1.665	-0.163	-0.624	-0.275	-0.289	-1.339	-1.525
10	0.843	0.056	0.961	-0.041	-0.619	-0.017	-0.468	-0.162	-0.892
11	0.718	0.516	* 2.675	-0.901	-0.767	0.486	-0.057	* 1.347	* 3.382
12	-0.215	0.242	* 4.200	0.130	-1.124	0.140	-1.578	0.329	-1.328
13	-0.385	-0.945	* 4.070	* 2.409	-1.820	-0.125	-0.152	-1.661	0.574
14	-0.122	* 2.841	-0.357	* 1.382	0.131	* 1.509	0.547	-0.507	-0.517
15	-0.086	0.007	-0.144	0.035	-0.146	0.120	* 1.005	0.002	-0.094
16	* 1.449	0.424	* 2.317	-0.938	-0.946	0.690	* 1.397	* 3.869	0.752
17	-0.317	-0.593	-0.591	* 4.912	-0.698	0.427	0.253	-0.067	-0.129
18	* 1.014	-0.089	-0.358	0.006	* 1.047	0.238	-0.842	* 1.462	-0.237
19	-0.589	-0.143	-0.847	-0.021	-1.182	0.061	* 2.748	0.535	* 2.343
20	0.234	0.116	-0.235	-0.159	-0.213	0.213	* 1.448	-0.660	* 1.011
21	-0.294	-0.039	-0.358	* 1.189	-0.385	0.250	* 1.476	-0.458	-0.155
22	0.358	0.318	0.011	0.203	-0.596	0.097	* 1.207	0.393	-0.623
23	0.235	0.044	-0.110	-0.014	-0.223	0.099	0.679	0.142	-0.190
24	0.160	-0.009	0.553	-0.040	-0.206	-0.087	-0.224	-0.412	-0.452
25	0.373	-0.376	-0.016	* 1.725	-0.641	-0.050	-0.051	0.038	-0.288
26	* 2.297	-0.052	-0.759	-0.026	-0.359	0.400	* 1.505	* 1.279	-1.296
27	0.850	-0.155	0.275	0.985	-0.868	0.324	0.338	0.333	* 3.182
28	0.867	-0.041	-0.091	0.055	-0.075	0.135	-0.557	* 1.213	-0.441
29	-0.504	* 4.021	0.386	* 1.840	-1.053	-2.467	-0.374	* 1.350	-0.436
30	0.052	* 1.423	-0.294	* 2.063	-0.299	0.711	-0.079	-0.424	0.784
31	0.425	-0.107	-0.230	0.031	-0.053	0.015	0.074	-0.107	* 1.177
32	* 2.028	0.852	0.288	-0.258	0.099	0.703	0.536	-1.882	-0.263
33	0.988	-0.005	-0.040	-0.010	-0.101	0.033	-0.622	-0.999	* 1.931
34	* 3.276	-0.080	-0.217	0.031	-0.085	0.201	-1.573	0.256	-0.667
35	* 2.256	0.010	0.017	-0.067	-0.077	0.076	-0.875	-1.314	-0.259
36	-0.119	-0.044	-0.298	-0.140	-0.328	-0.042	* 1.251	* 1.016	* 1.815
37	0.110	0.121	-0.168	-0.114	-0.348	0.286	* 1.669	* 1.598	-0.525
38	* 1.987	* 3.941	0.051	-0.808	* 3.115	* 1.423	-1.305	-1.574	-0.339
39	0.250	0.964	-0.055	-0.140	* 1.053	0.431	-0.419	-0.156	0.002
40	0.048	-0.031	0.022	-0.029	-0.051	-0.031	-0.337	-0.241	* 1.679
41	0.602	-0.247	-0.119	* 1.529	-0.327	0.061	-0.253	-0.356	-0.202
42	0.361	-0.052	-0.112	0.016	0.052	0.121	-0.289	* 1.035	-0.240
43	* 2.106	-0.074	-0.268	-0.177	-0.130	-0.035	-0.003	-2.028	* 3.409
44	-0.211	-0.671	-0.319	0.118	* 1.698	-1.667	0.333	-0.312	0.298
45	-0.105	-0.441	-0.195	* 2.698	-0.507	0.087	0.025	0.011	-0.210
46	* 1.005	0.121	-0.230	-0.178	0.128	0.170	* 1.284	-1.071	-0.519
47	0.162	-0.051	-0.210	0.039	-0.012	0.114	-0.242	* 1.197	0.461
48	-0.015	0.318	-0.174	* 1.392	-0.536	-0.932	-0.207	-0.049	0.121
49	0.606	-0.011	0.004	-0.014	-0.020	0.001	-0.234	-0.366	-0.072
50	-0.334	-0.611	0.083	* 1.150	* 2.214	-0.688	-0.184	-0.126	0.321
51	0.074	-0.073	0.237	-0.022	-0.137	-0.077	-0.373	-0.543	* 1.770
52	-0.016	-0.025	-0.066	-0.020	0.009	0.023	-0.054	-0.168	* 1.144
53	0.018	-0.066	0.804	-0.131	-0.294	-0.073	0.358	-0.893	-0.032
54	-0.114	-0.027	0.122	-0.091	-0.054	0.044	-0.272	* 1.023	0.841
55	0.511	-0.008	0.007	0.003	-0.078	0.002	-0.221	-0.175	-0.119

APPENDIX: I

90 VAR. LN(X+1)

SCORE MATRIX

2	3	4	5	6	7	8	9	10
-0.066	0.017	-0.084	-0.106	0.101	-0.659	0.771	0.830	-0.142
0.034	0.755	-0.134	-0.309	0.229	-1.169	* 2.386	0.053	-0.390
-0.048	-0.251	0.037	0.003	0.177	-0.363	* 1.691	-0.492	0.631
-0.079	0.478	-0.149	0.651	0.013	-0.162	-0.147	-0.324	* 1.198
0.986	0.806	0.133	-0.584	0.215	-0.603	0.098	0.411	-1.004
-0.059	-0.119	0.035	-0.271	0.033	0.290	0.125	0.939	0.238
-0.022	0.444	-0.099	-0.255	0.113	-1.022	0.120	0.826	-0.850
-0.052	* 3.206	-0.251	-1.082	0.087	* 1.327	-2.153	-0.972	0.892
-0.097	* 1.665	-0.163	-0.624	-0.275	-0.289	-1.339	-1.525	-1.558
0.056	0.961	-0.041	-0.619	-0.017	-0.468	-0.162	-0.892	-1.372
0.516	* 2.675	-0.901	-0.767	0.486	-0.057	* 1.347	* 3.382	-0.510
0.242	* 4.200	0.130	-1.124	0.140	-1.578	0.329	-1.328	-1.691
-0.945	* 4.070	* 2.409	-1.820	-0.125	-0.152	-1.661	0.574	* 3.765
2.841	-0.357	* 1.382	0.131	* 1.509	0.547	-0.507	-0.517	* 2.025
0.007	-0.144	0.035	-0.146	0.120	* 1.005	0.002	-0.094	0.390
0.424	* 2.317	-0.938	-0.946	0.690	* 1.397	* 3.869	0.752	-0.560
-0.593	-0.591	* 4.912	-0.698	0.427	0.253	-0.067	-0.129	-1.144
-0.089	-0.358	0.006	* 1.047	0.238	-0.842	* 1.462	-0.237	0.684
-0.143	-0.847	-0.021	-1.182	0.061	* 2.748	0.535	* 2.343	0.850
0.116	-0.235	-0.159	-0.213	0.213	* 1.448	-0.660	* 1.011	0.300
-0.039	-0.358	* 1.189	-0.385	0.250	* 1.476	-0.458	-0.155	-0.728
0.318	0.011	0.203	-0.596	0.097	* 1.207	0.393	-0.623	-0.227
0.044	-0.110	-0.014	-0.223	0.099	0.679	0.142	-0.190	0.109
-0.009	0.553	-0.040	-0.206	-0.087	-0.224	-0.412	-0.452	-0.110
-0.376	-0.016	* 1.725	-0.641	-0.050	-0.051	0.038	-0.288	0.426
-0.052	-0.759	-0.026	-0.359	0.400	* 1.505	* 1.279	-1.296	0.866
-0.155	0.275	0.985	-0.868	0.324	0.338	0.333	* 3.182	-1.766
-0.041	-0.091	0.055	-0.075	0.135	-0.557	* 1.213	-0.441	0.405
4.021	0.386	* 1.840	-1.053	-2.467	-0.374	* 1.350	-0.436	-1.638
1.423	-0.294	* 2.063	-0.299	0.711	-0.079	-0.424	0.784	-1.033
-0.107	-0.230	0.031	-0.053	0.015	0.074	-0.107	* 1.177	0.379
0.852	0.288	-0.258	0.099	0.703	0.536	-1.882	-0.263	* 1.592
-0.005	-0.040	-0.010	-0.101	0.033	-0.622	-0.999	* 1.931	0.112
-0.080	-0.217	0.031	-0.085	0.201	-1.573	0.256	-0.667	0.575
0.010	0.017	-0.067	-0.077	0.076	-0.875	-1.314	-0.259	-0.173
-0.044	-0.298	-0.140	-0.328	-0.042	* 1.251	* 1.016	* 1.815	0.053
0.121	-0.168	-0.114	-0.348	0.286	* 1.669	* 1.598	-0.525	0.038
3.941	0.051	-0.808	* 3.115	* 1.423	-1.305	-1.574	-0.339	-0.272
0.964	-0.055	-0.140	* 1.053	0.431	-0.419	-0.156	0.002	-0.495
-0.031	0.022	-0.029	-0.051	-0.031	-0.337	-0.241	* 1.679	0.082
-0.247	-0.119	* 1.529	-0.327	0.061	-0.253	-0.356	-0.202	0.018
-0.052	-0.112	0.016	0.052	0.121	-0.289	* 1.035	-0.240	0.479
-0.074	-0.268	-0.177	-0.130	-0.035	-0.003	-2.028	* 3.409	0.214
-0.671	-0.319	0.118	* 1.698	-1.667	0.333	-0.312	0.298	-1.177
-0.441	-0.195	* 2.698	-0.507	0.087	0.025	0.011	-0.210	0.376
0.121	-0.230	-0.178	0.128	0.170	* 1.284	-1.071	-0.519	-0.060
-0.051	-0.210	0.039	-0.012	0.114	-0.242	* 1.197	0.461	0.521
0.318	-0.174	* 1.392	-0.536	-0.932	-0.207	-0.049	0.121	0.311
-0.011	0.004	-0.014	-0.020	0.001	-0.234	-0.366	-0.072	-0.066
-0.611	0.083	* 1.150	* 2.214	-0.688	-0.184	-0.126	0.321	0.579
-0.073	0.237	-0.022	-0.137	-0.077	-0.373	-0.543	* 1.770	-0.051
-0.025	-0.066	-0.020	0.009	0.023	-0.054	-0.168	* 1.144	0.196
-0.066	0.804	-0.131	-0.294	-0.073	0.358	-0.893	-0.032	-0.354
-0.027	0.122	-0.091	-0.054	0.044	-0.272	* 1.023	0.841	-0.379
-0.008	0.007	0.003	-0.078	0.002	-0.221	-0.175	-0.119	-0.078

26	* 2.297	-0.052	-0.129	-0.129	-0.397	-0.400	0.324	0.338	0.333	* 3.182
27	0.850	-0.155	0.275	0.985	-0.868	0.135	-0.557	* 1.213	-0.441	
28	0.867	-0.041	-0.091	0.055	-0.075	0.135	-0.557	* 1.213	-0.441	
29	-0.504	* 4.021	0.386	* 1.840	-1.053	-2.467	-0.374	* 1.350	-0.436	
30	0.052	* 1.423	-0.294	* 2.063	-0.299	0.711	-0.079	-0.424	0.784	
31	0.425	-0.107	-0.230	0.031	-0.053	0.015	0.074	-0.107	* 1.177	
32	* 2.028	0.852	0.288	-0.258	0.099	0.703	0.536	-1.882	-0.263	
33	0.988	-0.005	-0.040	-0.010	-0.101	0.033	-0.622	-0.999	* 1.931	
34	* 3.276	-0.080	-0.217	0.031	-0.085	0.201	-1.573	0.256	-0.667	
35	* 2.256	0.010	0.017	-0.067	-0.077	0.076	-0.875	-1.314	-0.259	
36	-0.119	-0.044	-0.298	-0.140	-0.328	-0.042	* 1.251	* 1.016	* 1.815	
37	0.110	0.121	-0.168	-0.114	-0.348	0.286	* 1.669	* 1.598	-0.525	
38	* 1.987	* 3.941	0.051	-0.808	* 3.115	* 1.423	-1.305	-1.574	-0.339	
39	0.250	0.964	-0.055	-0.140	* 1.053	0.431	-0.419	-0.156	0.002	
40	0.048	-0.031	0.022	-0.029	-0.051	-0.031	-0.337	-0.241	* 1.679	
41	0.602	-0.247	-0.119	* 1.529	-0.327	0.061	-0.253	-0.356	-0.202	
42	0.361	-0.052	-0.112	0.016	0.052	0.121	-0.289	* 1.035	-0.240	
43	* 2.106	-0.074	-0.268	-0.177	-0.130	-0.035	-0.003	-2.028	* 3.409	
44	-0.211	-0.671	-0.319	0.118	* 1.698	-1.667	0.333	-0.312	0.298	
45	-0.105	-0.441	-0.195	* 2.698	-0.507	0.087	0.025	0.011	-0.210	
46	* 1.005	0.121	-0.230	-0.178	0.128	0.170	* 1.284	-1.071	-0.519	
47	0.162	-0.051	-0.210	0.039	-0.012	0.114	-0.242	* 1.197	0.461	
48	-0.015	0.318	-0.174	* 1.392	-0.536	-0.932	-0.207	-0.049	0.121	
49	0.606	-0.011	0.004	-0.014	-0.020	0.001	-0.234	-0.366	-0.072	
50	-0.334	-0.611	0.083	* 1.150	* 2.214	-0.688	-0.184	-0.126	0.321	
51	0.074	-0.073	0.237	-0.022	-0.137	-0.077	-0.373	-0.543	* 1.770	
52	-0.016	-0.025	-0.066	-0.020	0.009	0.023	-0.054	-0.168	* 1.144	
53	0.018	-0.066	0.804	-0.131	-0.294	-0.073	0.358	-0.893	-0.032	
54	-0.114	-0.027	0.122	-0.091	-0.054	0.044	-0.272	* 1.023	0.841	
55	0.541	-0.008	0.007	0.003	-0.078	0.002	-0.221	-0.175	-0.119	
56	-0.164	-0.138	0.096	-0.270	* 1.882	0.078	-0.252	0.020	0.204	
57	-0.238	0.060	-0.096	-0.077	-0.067	0.020	0.968	-0.044	-0.153	
58	-1.703	-0.020	* 3.930	-0.902	* 3.366	0.669	* 1.784	* 1.702	-0.824	
59	* 1.325	-0.339	* 1.381	* 2.998	* 5.229	-2.659	* 1.290	-0.017	0.746	
60	0.248	-0.027	-0.121	0.017	0.037	0.084	-0.123	0.758	-0.153	
61	* 1.272	-0.011	0.160	* 3.798	0.186	0.720	-0.761	* 2.218	-0.653	
62	-0.058	-0.062	-0.079	0.778	-0.092	0.096	0.050	-0.155	0.282	
63	* 2.364	-1.388	0.351	-0.681	-0.112	-4.964	* 1.175	0.568	-1.136	
64	-0.369	* 5.388	-0.086	-0.235	-1.234	-0.665	0.229	0.469	-0.765	
65	0.096	0.056	0.223	-0.085	-0.186	0.033	-0.292	0.344	0.559	
66	0.050	0.016	0.764	-0.115	0.302	0.220	-0.382	0.032	-0.465	
67	-0.067	0.049	0.502	-0.102	0.062	0.102	-0.211	0.138	-0.205	
68	0.483	-0.003	0.072	-0.080	-0.327	-0.048	* 2.859	-1.633	-1.042	
69	-0.100	-0.129	0.289	-0.353	* 2.731	0.272	-0.509	0.012	-0.265	
70	-0.118	-0.128	-0.235	* 1.529	-0.105	0.201	0.074	0.058	-0.063	
71	0.161	0.079	0.321	-0.204	0.853	0.396	0.336	0.292	0.176	
72	* 1.054	0.118	0.283	-0.190	-0.402	0.194	* 1.379	-0.813	-0.803	
73	-0.227	* 1.346	-0.148	-0.872	-1.250	-6.165	-0.468	-0.115	0.672	
74	* 1.791	-0.080	0.778	-0.257	0.208	0.253	-0.929	-0.333	-0.114	
75	* 1.748	-0.199	0.890	0.114	0.197	-0.036	-1.635	-0.710	* 1.394	
76	-0.114	-0.041	-0.172	-0.069	0.051	-0.057	0.795	-0.098	-0.141	
77	* 1.620	0.169	* 1.457	-0.323	-0.636	0.380	* 2.554	-0.879	0.502	
78	-0.747	* 3.021	0.097	0.219	* 1.123	0.073	* 1.798	-0.349	* 1.863	
79	0.450	0.018	-0.192	-0.050	-0.245	0.217	* 1.004	0.585	-0.314	
80	0.752	-0.008	-0.339	-0.132	-0.090	0.405	* 1.637	* 1.563	* 1.398	
81	* 3.121	0.006	-0.273	-0.064	-0.349	0.289	0.530	-0.802	-0.172	
82	0.935	0.013	-0.546	-0.057	-0.090	0.287	* 2.026	0.306	-0.806	
83	* 2.149	-0.022	-0.563	0.024	-0.446	0.360	* 1.459	0.551	-1.202	
84	-0.128	0.044	-0.126	0.025	-0.110	0.072	0.782	-0.092	-0.166	
85	* 1.214	-0.146	-0.317	-0.046	-0.008	0.089	0.296	0.787	-0.622	
86	0.261	-0.121	0.057	0.144	0.539	-0.026	0.129	-0.305	0.198	
87	0.550	-0.112	-0.255	0.032	0.046	0.129	-0.166	* 1.634	-0.351	
88	-0.163	0.079	-0.194	-0.023	0.215	0.189	0.946	0.074	-0.097	
89	0.167	-0.042	-0.144	0.044	0.039	0.098	-0.161	* 1.102	-0.205	
90	-0.381	0.011	0.074	0.615	-0.265	0.324	* 1.982	-0.690	-0.659	

-0.155	0.275	0.985	-0.868	0.324	0.338	0.333	* 3.182	-1.766
-0.041	-0.091	0.055	-0.075	0.135	-0.557	* 1.213	-0.441	0.405
4.021	0.386	*1.840	-1.053	-2.467	-0.374	* 1.350	-0.436	-1.638
* 1.423	-0.294	*2.063	-0.299	0.711	-0.079	-0.424	0.784	-1.033
-0.107	-0.230	0.031	-0.053	0.015	0.074	-0.107	* 1.177	0.379
0.852	0.288	-0.258	0.099	0.703	0.536	-1.882	-0.263	* 1.592
-0.005	-0.040	-0.010	-0.101	0.033	-0.622	-0.999	* 1.931	0.112
-0.080	-0.217	0.031	-0.085	0.201	-1.573	0.256	-0.667	0.575
0.010	0.017	-0.067	-0.077	0.076	-0.875	-1.314	-0.259	-0.173
-0.044	-0.298	-0.140	-0.328	-0.042	* 1.251	* 1.016	* 1.815	0.053
0.121	-0.168	-0.114	-0.348	0.286	* 1.669	* 1.598	-0.525	0.038
3.941	0.051	-0.808	* 3.115	* 1.423	-1.305	-1.574	-0.339	-0.272
0.964	-0.055	-0.140	* 1.053	0.431	-0.419	-0.156	0.002	-0.495
-0.031	0.022	-0.029	-0.051	-0.031	-0.337	-0.241	* 1.679	0.082
-0.247	-0.119	*1.529	-0.327	0.061	-0.253	-0.356	-0.202	0.018
-0.052	-0.112	0.016	0.052	0.121	-0.289	* 1.035	-0.240	0.479
-0.074	-0.268	-0.177	-0.130	-0.035	-0.003	-2.028	* 3.409	0.214
-0.671	-0.319	0.118	* 1.698	-1.667	0.333	-0.312	0.298	-1.177
-0.441	-0.195	*2.698	-0.507	0.087	0.025	0.011	-0.210	0.376
0.121	-0.230	-0.178	0.128	0.170	* 1.284	-1.071	-0.519	-0.060
-0.051	-0.210	0.039	-0.012	0.114	-0.242	* 1.197	0.461	0.521
0.318	-0.174	*1.392	-0.536	-0.932	-0.207	-0.049	0.121	0.311
-0.011	0.004	-0.014	-0.020	0.001	-0.234	-0.366	-0.072	-0.066
-0.611	0.083	*1.150	* 2.214	-0.688	-0.184	-0.126	0.321	0.579
-0.073	0.237	-0.022	-0.137	-0.077	-0.373	-0.543	* 1.770	-0.051
-0.025	-0.066	-0.020	0.009	0.023	-0.054	-0.168	* 1.144	0.196
-0.066	0.804	-0.131	-0.294	-0.073	0.358	-0.893	-0.032	-0.354
-0.027	0.122	-0.091	-0.054	0.044	-0.272	* 1.023	0.841	-0.379
-0.008	0.007	0.003	-0.078	0.002	-0.221	-0.175	-0.119	-0.078
-0.138	0.096	-0.270	* 1.882	0.078	-0.252	0.020	0.204	0.649
0.060	-0.096	-0.077	-0.067	0.020	0.968	-0.044	-0.153	-0.125
-0.020	*3.930	-0.902	* 3.366	0.669	* 1.784	* 1.702	-0.824	-0.410
-0.339	*1.381	*2.998	* 5.229	-2.659	* 1.290	-0.017	0.746	-0.880
-0.027	-0.121	0.017	0.037	0.084	-0.123	0.758	-0.153	0.274
-0.011	0.160	*3.798	0.186	0.720	-0.761	* 2.218	-0.653	* 2.355
-0.062	-0.079	0.778	-0.092	0.096	0.050	-0.155	0.282	-0.214
-1.388	0.351	-0.681	-0.112	-4.964	* 1.175	0.568	-1.136	-1.973
* 5.388	-0.086	-0.235	-1.234	-0.665	0.229	0.469	-0.765	* 1.605
0.056	0.223	-0.085	-0.186	0.033	-0.292	0.344	0.559	-0.631
0.016	0.764	-0.115	0.302	-0.220	-0.382	0.032	-0.465	* 2.179
0.049	0.502	-0.102	0.062	0.102	-0.211	0.138	-0.205	0.618
-0.003	0.072	-0.080	-0.327	-0.048	* 2.859	-1.633	-1.042	-0.866
-0.129	0.289	-0.353	* 2.731	0.272	-0.509	0.012	-0.265	* 1.428
-0.128	-0.235	*1.529	-0.105	0.201	0.074	0.058	-0.063	-0.726
0.079	0.321	-0.204	0.853	0.396	0.336	0.292	0.176	* 1.926
0.118	0.283	-0.190	-0.402	0.194	* 1.379	-0.813	-0.803	-0.956
* 1.346	-0.148	-0.872	-1.250	-6.165	-0.468	-0.115	0.672	* 2.583
-0.080	0.778	-0.257	0.208	0.253	-0.929	-0.333	-0.114	* 1.533
-0.199	0.890	0.114	0.197	-0.036	-1.635	-0.710	* 1.394	-0.792
-0.041	-0.172	-0.069	0.051	-0.057	0.795	-0.098	-0.141	-0.058
0.169	*1.457	-0.323	-0.636	0.380	* 2.554	-0.879	0.502	-0.651
* 3.021	0.097	0.219	* 1.123	0.073	* 1.798	-0.349	* 1.863	* 1.319
0.018	-0.192	-0.050	-0.245	0.217	* 1.004	0.585	-0.314	-0.141
-0.008	-0.339	-0.132	-0.090	0.405	* 1.637	* 1.563	* 1.398	0.144
0.006	-0.273	-0.064	-0.349	0.289	0.530	-0.802	-0.172	-0.096
0.013	-0.546	-0.057	-0.090	0.287	* 2.026	0.306	-0.806	0.608
-0.022	-0.563	0.024	-0.446	0.360	* 1.459	0.551	-1.202	0.816
0.044	-0.126	0.025	-0.110	0.072	0.782	-0.092	-0.166	0.128
-0.146	-0.317	-0.046	-0.008	0.089	0.296	0.787	-0.622	0.448
-0.121	0.057	0.144	0.539	-0.026	0.129	-0.305	0.198	0.395
-0.112	-0.255	0.032	0.046	0.129	-0.166	* 1.634	-0.351	0.571
0.079	-0.194	-0.023	0.215	0.189	0.946	0.074	-0.097	0.157
-0.042	-0.144	0.044	0.039	0.098	-0.161	* 1.102	-0.205	0.388
0.011	0.074	0.615	-0.265	0.324	* 1.982	-0.690	-0.659	* 1.047

40F4

APPENDIX: J

J. R. H. Q-MODE 90 VAR. LN(X+1)

VARIMAX FACTOR MATRIX

	COMM.	1	2	3	4	5	
1	1GBRMA2X	0.8261	0.2204	0.1245	*0.8351	0.0936	0.2362
2	U GBRMA4	0.7670	0.2080	0.0063	*0.8285	0.0398	0.1892
3	1 GBRMB4	0.7858	0.1606	0.0086	*0.8388	0.1331	0.1964
4	1 GRBMA6	0.7210	0.1073	0.0999	*0.8306	0.0774	0.0595
5	1 GBRMB6	0.7424	0.1529	0.1626	*0.8254	0.0587	0.0888
6	1 GBRMA7	0.8106	0.3219	0.0864	*0.8108	0.1173	0.1683
7	1 GBRNB7	0.8388	0.1694	0.0308	*0.8956	0.0718	0.0434
8	10GBRMA2	0.4802	0.4252	0.0760	*0.5331	0.0942	-0.0235
9	10GBRMB2	0.7664	0.4467	0.0609	*0.7409	0.0695	0.0967
10	10GNRMA4	0.7209	0.3628	0.1625	*0.7406	0.1183	-0.0179
11	10GBRMB4	0.7399	0.4319	0.2318	*0.6778	0.1816	-0.0849
12	10GBRMA6	0.7046	*0.5081	0.0636	*0.6650	0.0059	0.0095
13	10GBRMB6	0.6899	*0.5578	0.0746	*0.5981	0.1045	0.0673
14	10GBRMA7	0.7040	0.4452	0.0485	*0.7010	0.1036	-0.0374
15	10GBRMB7	0.7056	0.3628	0.0231	*0.7435	0.1242	0.0728
16	7 BERM2A	0.7203	0.4295	0.0666	*0.7191	-0.0195	0.1175
17	7 BERM2B	0.8022	0.4184	0.1623	*0.7615	0.1102	0.0935
18	7 BERMA4	0.8138	0.4281	0.1440	*0.7581	0.0712	0.1735
19	7 BERM4B	0.8535	0.3873	0.1489	*0.8092	0.0826	0.1401
20	7 BERM6A	0.7682	0.4462	0.1795	*0.7236	0.0393	0.1080
21	7 BERM6B	0.7660	0.4113	0.1829	*0.7473	0.0642	0.0269
22	7 BERMA7	0.8293	0.4877	0.1257	*0.7486	0.0799	0.0940
23	7 BERM7B	0.7885	*0.5397	0.1147	*0.6794	0.0940	0.1170
24	9BERM2AX	0.7211	0.1073	-0.0009	*0.8170	0.1712	0.1127
25	9 BERM4A	0.7896	0.1356	-0.0194	*0.8337	0.2210	0.1642
26	9 BERM4B	0.8637	0.1387	0.0007	*0.8862	0.2162	0.1117
27	9 BERM6A	0.7382	0.0857	0.0327	*0.7801	0.3144	0.1493
28	9 BERM6B	0.7225	0.1005	0.0243	*0.7937	0.2626	0.1138
29	9 BERM7A	0.8340	0.1292	-0.0282	*0.8644	0.2395	0.1094
30	9 BERM7B	0.7760	0.1632	0.0215	*0.8066	0.2825	0.1357
31	2BEECH2A	0.7545	*0.5535	0.0286	*0.6069	0.0760	0.2707
32	2BEECH2B	0.7458	*0.6269	0.0508	0.4858	-0.0097	0.3377
33	2BEECH4A	0.7025	*0.6355	0.0010	*0.5146	0.1069	0.1493
34	2BEECH4B	0.7038	*0.5584	0.0702	*0.5668	0.0615	0.2489
35	2BEECH6A	0.8348	*0.7405	0.0337	0.4964	-0.0152	0.1970
36	2BEECH6B	0.7963	*0.6706	-0.0105	*0.5653	0.0108	0.1634
37	2BEECH7A	0.7803	*0.5708	0.0142	*0.6441	0.0282	0.1967
38	2BEECH7B	0.7785	*0.6242	0.0113	*0.5733	0.0079	0.2450
39	4BEECH2A	0.8342	*0.7089	0.0340	0.4239	-0.0178	0.3879
40	4BEECH2B	0.7290	*0.7341	-0.0221	0.2812	0.0147	0.3323
41	4BEECH4A	0.7516	*0.6834	-0.0490	0.4643	0.1084	0.2341
42	4BEECH4B	0.6204	*0.5721	-0.0120	0.4466	0.1903	0.2393
43	4BEECH6A	0.7150	*0.6116	0.0300	0.4549	0.0983	0.2928
44	4BEECH6B	0.6788	*0.6388	-0.0054	0.4956	0.0509	0.1500
45	4BEECH7A	0.6894	*0.7683	0.0101	0.2657	0.1253	0.1128
46	4BEECH7B	0.7916	*0.7791	0.0105	0.3792	0.0597	0.1928
47	5HEMLO2A	0.6612	*0.7648	-0.0027	0.2285	0.0951	0.1226
48	5HEMLO2B	0.7270	*0.8151	0.0615	0.2175	0.1018	0.0355
49	5HEMLO4A	0.7233	*0.7745	0.0215	0.2959	0.1457	0.1194
50	5HEMLO4B	0.7155	*0.7331	0.0616	0.3481	0.0784	0.2168
51	5HEMLO6A	0.6586	*0.7633	0.1520	0.2036	0.1034	0.0280
52	5HEMLO6B	0.7581	*0.8118	0.0733	0.2692	0.1264	0.0726
53	5HEMLO7A	0.7175	*0.8133	0.0068	0.2010	0.1186	0.0400
			*0.8018	0.0911	0.2525	0.1551	0.0604

105

31	2BEECH2A	0.7545	*0.5535	0.0286	*0.6069	0.7707	
32	2BEECH2B	0.7458	*0.6269	0.0508	0.4858	-0.0097	0.3377
33	2BEECH4A	0.7025	*0.6355	0.0010	*0.5146	0.1069	0.1493
34	2BEECH4B	0.7038	*0.5584	0.0702	*0.5668	0.0615	0.2489
35	2BEECH6A	0.8348	*0.7405	0.0337	0.4964	-0.0152	0.1970
36	2BEECH6B	0.7963	*0.6706	-0.0105	*0.5653	0.0108	0.1634
37	2BEECH7A	0.7803	*0.5708	0.0142	*0.6441	0.0282	0.1967
38	2BEECH7B	0.7785	*0.6242	0.0113	*0.5733	0.0079	0.2450
39	4BEECH2A	0.8342	*0.7089	0.0340	0.4239	-0.0178	0.3879
40	4BEECH2B	0.7290	*0.7341	-0.0221	0.2812	0.0147	0.3323
41	4BEECH4A	0.7516	*0.6834	-0.0490	0.4643	0.1084	0.2341
42	4BEECH4B	0.6204	*0.5721	-0.0120	0.4466	0.1903	0.2393
43	4BEECH6A	0.7150	*0.6416	0.0300	0.4549	0.0983	0.2928
44	4BEECH6B	0.6788	*0.6388	-0.0054	0.4956	0.0509	0.1500
45	4BEECH7A	0.6894	*0.7683	0.0101	0.2657	0.1253	0.1128
46	4BEECH7B	0.7916	*0.7791	0.0105	0.3792	0.0597	0.1928
47	5HEMLO2A	0.6612	*0.7648	-0.0027	0.2285	0.0951	0.1226
48	5HEMLO2B	0.7270	*0.8151	0.0615	0.2175	0.1018	0.0355
49	5HEMLO4A	0.7233	*0.7745	0.0215	0.2959	0.1457	0.1194
50	5HEMLO4B	0.7155	*0.7331	0.0616	0.3481	0.0784	0.2168
51	5HEMLO6A	0.6586	*0.7633	0.1520	0.2036	0.1034	0.0280
52	5HEMLO6B	0.7581	*0.8118	0.0733	0.2692	0.1264	0.0726
53	5HEMLO7A	0.7175	*0.8133	0.0068	0.2010	0.1186	0.0400
54	5HEMLO7B	0.7427	*0.8018	0.0911	0.2525	0.1551	0.0604
55	6HEBE 2A	0.7066	*0.8196	0.0606	0.1298	0.1077	0.0516
56	6HEBE 2B	0.7044	*0.8219	0.0709	0.1150	0.1030	-0.0059
57	6HEBE 4A	0.6993	*0.8057	0.0931	0.1480	0.1007	0.0971
58	6HEBE 4B	0.6698	*0.7895	0.0922	0.1257	0.0991	0.1110
59	6HEBE 6A	0.6753	*0.8091	0.0560	0.1249	0.0436	0.0118
60	6HEBE 6B	0.7114	*0.8083	0.0789	0.2158	0.0698	0.0216
61	6HEBE 7A	0.8120	*0.8765	0.0687	0.1900	0.0527	0.0048
62	6HEBE 7B	0.7961	*0.8635	0.0618	0.2085	0.0200	0.0532
63	8ASPEN2A	0.5783	0.1847	0.0928	0.4090	0.3134	*0.5197
64	8ASPEN2B	0.6779	0.1817	0.0537	0.3479	0.3078	*0.6528
65	8ASPEN4A	0.6531	0.0612	-0.0374	0.3784	0.2891	*0.6490
66	8ASPEN4B	0.7952	0.2218	-0.0444	0.4368	0.2403	*0.7039
67	8ASPEN6A	0.6221	*0.5634	0.1436	0.4060	0.1236	0.2953
68	8ASPEN6B	0.7170	0.3710	0.1412	0.2798	0.0749	*0.6774
69	8ASPEN7A	0.6155	0.1603	0.0716	0.2124	0.3960	*0.6187
70	8ASPEN7B	0.6699	0.1890	0.1211	0.2344	0.3909	*0.6416
71	11ASPN2A	0.7376	0.0939	0.2470	0.1454	*0.7930	0.1334
72	11ASPN2B	0.7809	0.1161	0.2150	0.2021	*0.7851	0.2527
73	11ASPN4A	0.6922	0.0815	0.2324	0.2824	*0.7423	0.0269
74	11ASPN4B	0.8529	0.0976	0.1530	0.2829	*0.8517	0.1208
75	11ASPN6A	0.8093	0.0667	0.1049	0.3293	*0.8243	0.0766
76	11ASPN6B	0.8292	0.1216	0.2149	0.2215	*0.8421	0.0999
77	11ASPN7A	0.5046	0.1099	0.2251	0.1041	*0.6347	0.1678
78	11ASPN7B	0.7791	0.1546	0.2074	0.0290	*0.8345	0.1227
79	3WXASH2A	0.4704	0.1037	*0.5748	0.1178	0.3388	0.0247
80	3W.ASH4A	0.7233	0.0584	*0.7809	0.0969	0.3160	0.0286
81	3W.ASH4B	0.6548	0.0858	*0.7355	0.0607	0.3134	0.0675
82	3W.ASH6A	0.3546	0.0716	*0.5460	0.0946	0.2052	-0.0192
83	3W.ASH6B	0.6823	0.1108	*0.7535	0.1255	0.2813	0.0859
84	3WXASH7A	0.4247	0.0770	*0.6145	0.1454	0.1408	-0.0139
85	12WASH2A	0.7263	0.0178	*0.7866	0.0042	0.0578	0.3222
86	12WASH2B	0.7249	-0.0167	*0.8419	0.0379	0.0273	0.1169
87	12WASH4A	0.6864	-0.0102	*0.8255	-0.0161	0.0579	0.0364
88	12WASH4B	0.6816	0.1142	*0.7596	-0.0023	-0.0698	0.2945
89	12WASH6A	0.7452	0.2014	0.4348	0.0252	-0.0039	*0.7176
90	12WASH6B	0.8123	0.1868	*0.5606	0.0564	0.1381	*0.6640
91	12WASH7A	0.7841	0.2000	*0.5378	0.0873	0.0614	*0.6659
92	12WASH7B	0.7404	0.1846	*0.5109	0.0221	-0.0581	*0.6645

VARIANCE 23.779 7.876 25.910 7.676 7.260

CUM. VAR 23.779 31.655 57.565 65.241 72.500

120F2

APPENDIX: K

J. R. H. Q-MODE 90 VAR. LN(X+1)

VARIMAX FACTOR SCORE MATRIX

VAR.

1	1.025	0.105	-0.000	-0.035	-0.512
2	0.726	*0.250	0.565	-0.111	-0.763
3	0.925	-0.046	-0.379	0.163	-0.275
4	-0.311	-0.221	0.416	0.122	0.409
5	-0.067	0.976	0.725	0.096	-0.864
6	0.633	0.027	0.097	-0.038	-0.321
7	0.775	0.199	0.280	-0.092	-0.666
8	-0.709	-0.149	*2.991	-0.447	-0.350
9	-0.515	0.102	1.041	-0.389	-0.011
10	0.338	0.216	0.499	-0.190	-0.412
11	1.345	0.704	*3.244	-0.986	-1.512
12	-1.048	0.582	*3.390	-0.089	-1.042
13	-1.144	-0.280	*3.876	*2.029	-1.394
14	0.023	1.570	-0.245	1.752	-0.934
15	0.365	-0.155	0.037	-0.017	0.052
16	*3.109	0.331	*2.648	-1.074	-1.185
17	-0.014	-0.418	-0.598	*4.345	-0.523
18	0.851	-0.243	-0.487	0.429	0.278
19	1.255	-0.278	0.263	-0.290	0.153
20	0.759	-0.101	0.211	-0.226	-0.115
21	0.334	-0.234	-0.133	0.906	0.025
22	0.914	0.188	0.054	0.033	-0.197
23	0.526	-0.054	-0.041	-0.065	-0.072
24	-0.183	0.065	0.340	-0.069	-0.078
25	0.279	-0.115	-0.163	1.484	-0.411
26	*2.805	-0.368	-0.857	0.055	-0.241
27	1.477	0.172	0.861	0.550	-1.144
28	0.783	0.009	-0.292	0.162	-0.338
29	-0.053	*4.955	0.148	1.321	0.179
30	0.060	1.038	-0.122	*2.075	-0.941
31	0.494	-0.020	0.004	0.024	-0.230
32	1.132	0.189	0.157	0.242	-0.533
33	0.445	0.174	0.128	0.038	-0.560
34	1.935	0.035	-0.891	0.368	-0.757
35	0.980	0.046	-0.455	0.120	-0.398
36	1.063	0.066	0.359	-0.375	-0.189
37	1.316	-0.131	0.088	-0.238	-0.046
38	0.357	*2.079	-0.157	0.878	0.388
39	-0.047	0.446	-0.062	0.306	0.255
40	0.024	0.143	0.298	-0.057	-0.327
41	0.267	-0.109	-0.298	1.404	-0.311
42	0.454	-0.054	-0.177	1.111	-0.159
43	1.494	0.151	0.185	-0.151	-0.648
44	-0.038	-0.071	-0.239	-0.029	*2.484
45	-0.055	-0.239	-0.255	*2.414	-0.345
46	0.983	-0.228	-0.218	-0.106	0.304
47	0.464	0.008	-0.091	0.085	-0.279
48	-0.068	0.900	-0.259	1.077	0.049
49	0.260	0.009	-0.125	0.029	-0.090
50	-0.420	-0.511	0.199	1.425	*2.000
51	-0.061	0.153	0.489	-0.089	-0.361
52	0.050	0.040	0.170	-0.024	-0.181
53	-0.138	-0.025	0.753	-0.250	-0.021
54	0.244	0.108	0.292	-0.149	-0.247
55	0.272	0.027	-0.120	0.026	-0.124
56	-0.304	-0.482	0.219	0.236	1.205
57	0.221	-0.075	0.065	-0.162	0.208

10F 3

25	0.279	-0.115	-0.163	1.484	-0.411
26	*2.805	-0.368	-0.857	0.055	-0.241
27	1.477	0.172	0.861	0.550	-1.144
28	0.783	0.009	-0.292	0.162	-0.338
29	-0.053	*4.955	0.148	1.321	0.179
30	0.060	1.038	-0.122	*2.075	-0.941
31	0.494	-0.020	0.004	0.024	-0.230
32	1.132	0.189	0.157	0.242	-0.533
33	0.445	0.174	0.128	0.038	-0.560
34	1.935	0.035	-0.891	0.368	-0.757
35	0.980	0.046	-0.455	0.120	-0.398
36	1.063	0.066	0.359	-0.375	-0.189
37	1.316	-0.131	0.088	-0.238	-0.046
38	0.357	*2.079	-0.157	0.878	0.388
39	-0.047	0.446	-0.062	0.306	0.255
40	0.024	0.143	-0.298	-0.057	-0.327
41	0.267	-0.109	-0.298	1.404	-0.311
42	0.454	-0.054	-0.177	1.111	-0.159
43	1.494	0.151	0.185	-0.151	-0.648
44	-0.038	-0.071	-0.239	-0.029	*2.484
45	-0.055	-0.239	-0.255	*2.414	-0.345
46	0.983	-0.228	-0.218	-0.106	0.304
47	0.464	0.008	-0.091	0.085	-0.279
48	-0.068	0.900	-0.259	1.077	0.049
49	0.260	0.009	-0.125	0.029	-0.090
50	-0.420	-0.511	0.199	1.425	*2.000
51	-0.061	0.153	0.489	-0.089	-0.361
52	0.050	0.040	0.170	-0.024	-0.181
53	-0.138	-0.025	0.753	-0.250	-0.021
54	0.244	0.108	0.292	-0.149	-0.247
55	0.272	0.027	-0.120	0.026	-0.124
56	-0.304	-0.482	0.219	0.236	1.205
57	0.221	-0.075	0.065	-0.162	0.208
58	-0.404	-1.100	*4.320	-0.189	*2.602
59	1.665	0.172	1.631	*3.350	*5.532
60	0.368	-0.035	-0.147	0.072	-0.092
61	1.262	-0.116	-0.056	*4.037	-0.755
62	-0.013	-0.042	-0.018	0.693	-0.124
63	*2.621	1.183	-0.282	-1.888	*3.534
64	-0.182	*4.958	-0.090	0.087	-1.248
65	0.155	0.169	0.265	-0.157	-0.291
66	-0.327	-0.163	0.636	0.227	-0.095
67	-0.189	-0.009	0.434	0.010	-0.089
68	1.057	-0.362	0.202	-0.352	0.683
69	-0.505	-0.743	0.325	0.491	1.642
70	0.016	-0.129	-0.232	1.366	-0.109
71	0.266	-0.330	0.515	0.224	0.263
72	1.145	-0.133	0.189	-0.310	0.010
73	-0.373	*4.398	-0.431	-1.925	*2.349
74	0.790	-0.134	0.437	0.133	-0.432
75	0.622	0.138	0.650	0.231	-0.461
76	0.225	-0.127	-0.049	-0.129	0.303
77	*2.219	-0.147	-1.746	-0.509	-0.262
78	0.238	*2.176	1.019	0.721	0.428
79	0.979	-0.154	-0.081	-0.098	-0.096
80	*2.060	-0.201	0.288	-0.197	-0.248
81	*2.384	-0.201	-0.730	0.067	-0.358
82	1.670	-0.392	-0.375	-0.048	0.224
83	*2.432	-0.323	-0.684	0.078	-0.269
84	0.200	-0.088	-0.006	-0.027	0.084
85	1.294	-0.200	-0.444	0.034	-0.034
86	0.163	-0.197	0.113	0.277	0.386
87	0.850	-0.102	-0.305	0.120	-0.156
88	0.301	-0.187	0.009	0.014	0.263
89	0.388	-0.042	-0.161	0.102	-0.111
90	0.232	-0.399	0.314	0.539	0.151

120E2