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An Ecological Comparison of a Forest and Prairie in East-Central Illinois

Frances Ho-mei Lin

AN ECOLOGICAL COMPARISON OF A FOREST AND PRAIRIE IN EAST-CENTRAL ILLINOIS

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BY

Frances Ho-mei Lin

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DEPARTMENT HEAD

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INTRODUCTION

The examination of Pettypool Farm and Fox Ridge Forest may provide an understanding of the ecology of animals of grassland and forest communities in East-Central Illinois. Such an examination is so fragmental that the living world leaves the impression of overwhelming complexity. Yet through the connection of these fragments of living activity, patterns that help us understand the living world begin to appear. In this view, the complexity covers an essential simplicity.

In both prairie and forest, there are biotic factors such as vegetation (mainly green plants), animals and soil organisms, as well as abiotic factors such as temperature, light, etc. These two types of factors interact to produce the ecosystem. Through photosynthesis, green plants use sunlight as energy to transform carbon dioxide in the air, and water and minerals absorbed from soil into food. Green plants can thus manufacture their own food while animals cannot do it and therefore must obtain food directly from plant or other animals. Plants are thus named producers and animals consumers. Plant-eating animals obtaining their food directly from green plants are called primary consumers. Meat-eating animals feed on plant-eating animals and are called secondary consumers. Meat-eating animals feeding on another meat-eating animal belong to the tertiary consumers Many kinds of animals are omnivorous eating both plants and animals and thus belong to all three consumer groups. Among soil organisms, saprophytes, such as bacteria, molds and fungi decompose the dead tissues and excrement of

plants and animals to produce simple organic materials and eventually inorganic materials--minerals. The processes involved in this decomposition are humification which produces humus and then, mineralization which produces free minerals. Therefore, most living materials eventually return to the soil. Some elements are released as gases, such as carbon and oxygen as carbon dioxide. In this way, materials that make up the bodies of living organisms are put back into the air and soil where green plants can again use these materials to make food. Oxygen is released in the process of photosynthesis and thus conpensates consumption of oxygen during respiration. The food coactions of organisms are important since living organisms can obtain energy only from consumed food. All activities of organisms constitute work and require energy. The energy that makes the living system work comes from the sun. It follows many pathways through ecosystem, but gradually leaks out of the living system in a form that cannot be recaptured. Life is thus dependent on the steady input of energy from the sun. On the other hand, the substances of living things are of the earth and are re-used again and again. The pathways of such materials are circular, bending back on themselves in cycles. Energy is captured by producers through photosynthesis. Beyond this, the interchange of both energy and materials with the living system is, through eating and being eaten. Several sequences of this are formed into a food web. The system viewed as a whole is called community. A community, along with the non-living components of the environments is called an ecosystem. A forest or a prairie area is an example of an ecosystem.

DESCRIPTION OF AREAS

Fox Ridge, Coles County, Illinois, is eight miles south of Charleston, near State Highway 130. It has preserved a rather deeply wooded tract on the slopes of the Embarrass River valley. It is not virgin timber but has not been cut for thirty years. It was selectavely cut previous to 1930 however. The Pettypool Farm is nearby, about one mile above the north hillside of the center of Fox Ridge. An area of the farm has not been cultivated for several years and served as a prairie area in this study. Although the classical prairie plants are absent, the physical biological unit is that of a prairie.

The study is primarily concerned with an ecological comparison of these two different areas, forest and prairie. Some of the biotic and abiotic factors characteristic of such areas will be discussed.

METHODS

From July 1 through July 22, 1965, weekly investigations were made between 7:30 and 8:30 A.M. in the forest at Fox Ridge and 8:40 to 9:40 A.M. in the prairie. These investigations were primarily devoted to the determination of the number and kinds of living organisms (animals) found in the two areas as represented in a sampled area of soil one foot square. In addition forty-eight standard sweeps were used to approximate a cubic yard of vegetation and the organisms therein were counted. Air

temperature, soil temperature, relative humidity, wind velocity and light were abiotic factors that were determined. Instruments used were: (1) 1 ft. square---used to outline a one-foot square area (2) Weston light meter for light reading (3) Psychrometer used for measuring relative humidity (4) thermometer used to measure air and soil temperature (5) standard sweep net.

The survey was made coincidentally with determination of the environmental data. The organisms collected were identified in the field to taxa ranging from phylum to family, as each group's taxonomic characters allowed. The data on the environmental factors are represented below in Table 1. In several instances general observations were made during a specific trip and these will be included later in the section on discussion.

Table 1. Environmental Data

	Forest				Prairie			
Abiotic Factors	July 1	8	15	22	July 1	8	15	22
Air Temp. (F)	71	72	71	77	80	85	81	82
Soil temp. (F)	68	71	72	74	76	79	74	81
Light reading	11	11	10	11	16	16	16	15
Wind velocity (mile/hr.)	calm	0	0	calm	4.5	calm	6	6
Soil condition	moist	over moist	dry	moist	dry	damp	dry	very dry
Sky condition	clear	clear	clear	overcast	clear	clear	clear	overcast
Relative humidity (%)	74	65	64	68	56	47	46	55

Tables 2 and 3 provide the data concerning the organisms encountered in the sampling of the forest and prairie respectively. In each table the letter G denotes organisms sampled in the soil and the letter S those sampled by sweeping. Several different representations of these data will be included in the discussion which follows.

Table 2. Organisms of the forest*

Organisms	July 1		July 8		July 15		July 22	
	G	S	G	S	G	S	G	S
Hymenoptera	18	12	22	5	9	28	34	9
Homoptera	1	2	0	1	0	2	0	4
Araneida	1	1	1	5	3	5	3	2
Diptera	0	3	0	16	0	16	3	11
Hemiptera	1	0	5	1	0	0	4	0
Orthoptera	0	0	1	0	0	0	0	0
Coleoptera	2	0	3	1	6	5	0	0
Lepidoptera	0	1	1	1	0	6	0	0
Collembola	1	0	3	0	0	0	0	0
Unidentified Insects	1	1	0	0	0	0	0	0
Gastropoda	1	1	2	0	0	0	1	0
Annelida	0	0	4	0	0	0	1	0

* G=Soil sample
S=Sweeps

Table 3. Organisms of the prairie

Organisms	July 1		July 8		July 15		July 22	
	G	S	G	S	G	S	G	S
Hymenoptera	5	11	15	2	8	4	27	5
Homoptera	1	69	4	27	0	45	0	61
Araneida	2	11	1	2	0	14	1	33
Diptera	0	33	2	12	0	25	0	25
Hemiptera	0	2	0	2	0	0	0	0
Orthoptera	0	7	0	9	0	6	2	5
Coleoptera	2	2	0	4	0	1	1	7
Lepidoptera	0	5	0	0	0	1	2	5
Scutigeromorpha	2	0	0	0	0	0	0	0
Nematophora	0	0	1	0	0	0	0	0
Unidentified insects	0	3	0	0	0	0	0	0

DISCUSSION

This discussion is derived from data collected during the specified investigation. Owing to the limited time and lack of sufficient repetition of the investigation (each weekly investigation lasts approximately one hour in the forest and prairie respectively) the results should not be interpreted as being strictly representative of the general conditions in these areas. It seems definitely safe to say that these results are merely the products of the author's personal survey and study.

I. Comparison of conditions between forest (Fox Ridge) and prairie (Pettypool):

1. Abiotic conditions:

Weather:

Figures A, B, C, D, and E provide data on the abiotic factors associated as weather. In fig. A the higher soil temperatures of the prairie can be compared with the soil temperatures of the forest. The average temperature of the soil in the prairie, 77.7° F. was 6.4° F. higher than the average soil temperature for the forest area, which was 71.3°F.

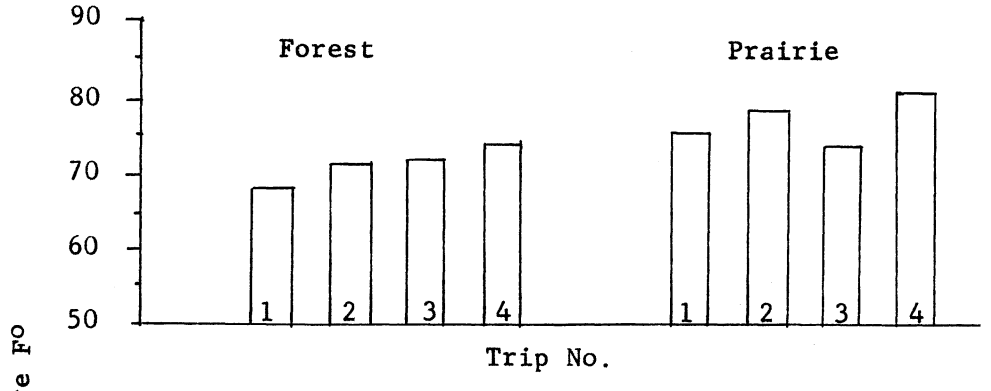

Figure A. Soil Temperature per Trip

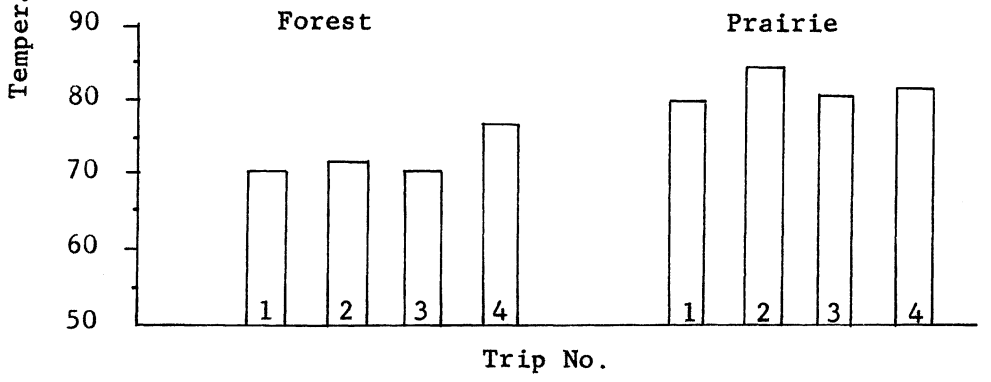

Figure B. Air Temperature per Trip

The air temperature mirrors this condition showing the average air temperature of the prairie of 82° F. as compared to 73° F. for the average air temperature of the forest.

The difference of 9° F. is greater than the difference of 6.4° for the soil temperature and is obviously a factor in the average temperatures found in the soil. In fig. C the data for relative humidity are compared and correlate with the temperature data.

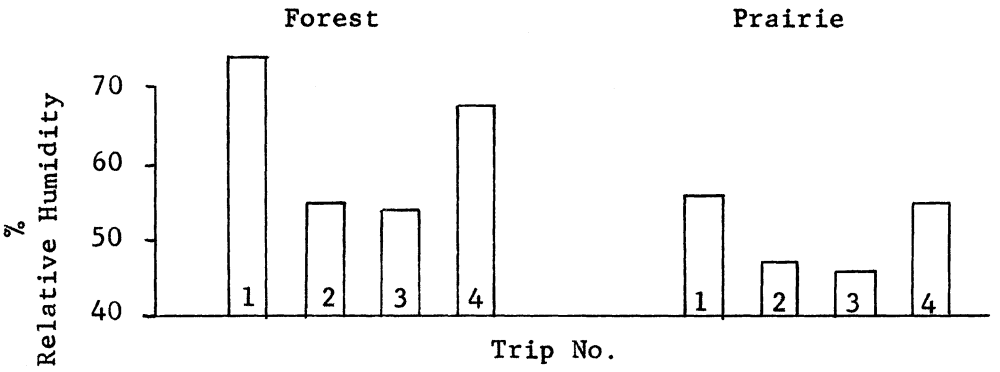

Figure C. Relative Humidity per Trip

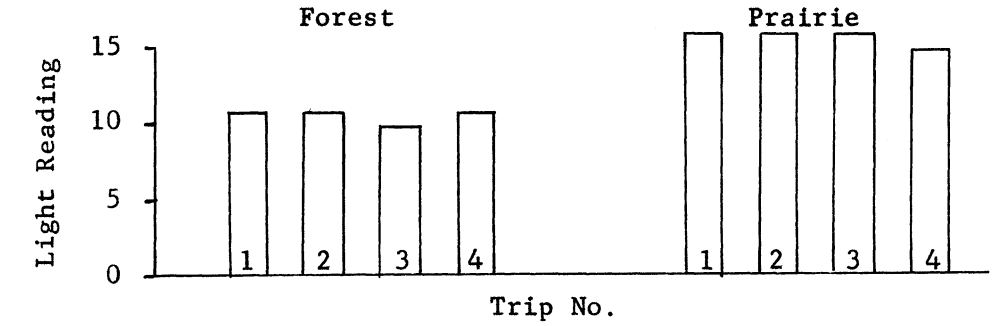

Figure D. Light Readings per Trip

The prairie was drier with an average relative humidity of 51% as compared to the 67% determined as the average value for the forest. This is probably due to the higher temperatures and the drying effect they would produce. The amount of sunlight available on the prairie was consistently higher than the more shaded area of the forest, fig. D.

The values are from a relative scale of a light meter and show only the relative brightness of the two areas. The wind also a factor of considerable effect, did not show a great difference between the two areas in this study. The wind was calm during all four visits to the forest whereas it had an average velocity of 4.1 mph on the prairie, fig. E.

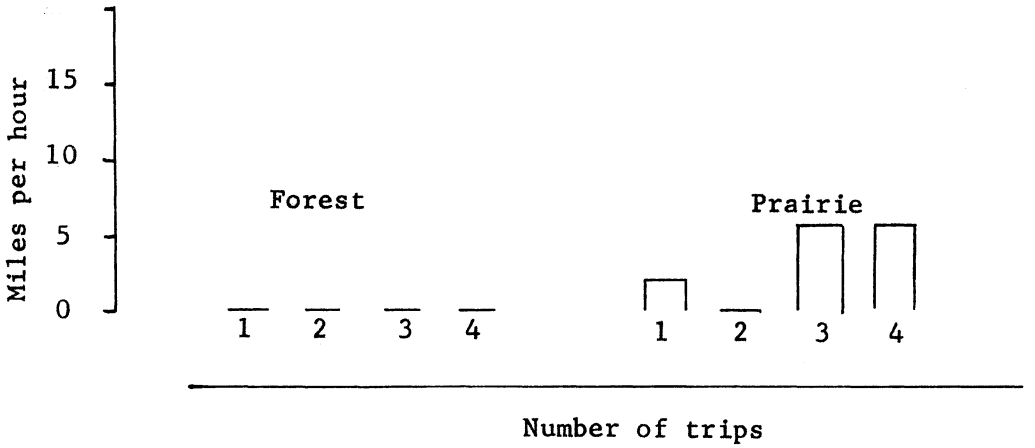

Figure E. Wind Velocity per Trip

The drying effect of this air movement when coupled with the higher temperatures partially explain the lower moisture characteristic of the prairie area.

The soils of the two areas are rather similar but show some differences. Both areas are probably podzolic but the prairie area has been cultivated prior to the past few years and this has changed the upper strata considerably. It has also been fired within the last two years as was evident from fragments of burned grass roots found

during sampling. The forest has been relatively undisturbed during this same period of time and a layer of humus has accumulated in various stages of decay and leaching. Thus the prairie soil appears coarse and hard, without an extensive humus layer whereas the forest is more of a sandy-loam, with a fine, loose nature and an abundance of decaying organic material.

2. Biotic conditions:

Vegetation

The prairie:

The cover of this area is primarily dense but unevenly distributed rye grass (four stalks in one ft. sq. area) blue grass, and clover. Some honey locust, hawthorn and small ash trees were also observed. The area has not been farmed for several years but shows the influence of the adjacent fields.

The forest:

The vegetation is primarily composed of maple and ash, but the cover on the higher elevation is predominantly oak. Other trees identified were hickory, elm, horse chestnut, dogwood and redbud. The understory vegetation is rather typical, including may apple, spring beauty, poison ivy and blood root as well as some scattered raspberry. Most of this vegetation was uniformly distributed. The canopy is incomplete enough as to make light available for a rather dense understory.

Animals

The mean number method was used for investigating the nature of the animal population. The average of four samples taken on July 1, July 8, July 15, and July 22 respectively is assumed to

represent the nature of animal population of the entire area. According to this assumption, Tables 4, 5, 6, and 7 show the nature of an animal population of the one foot square soil sample in the forest, one foot square soil in the prairie, and the nature of the aboveground animal population in the forest and the prairie as determined by sweeping.

In the soil of the prairie, invertebrates average 18 per square foot. The various groups represented and their relative abundance are shown in Table 4.

Table 4. Invertebrate Population of the Prairie Soil

Invertebrates	% of Population
Hymenoptera	75.0
Homoptera	8.5
Araneida	5.5
Lepidoptera	3.0
Orthoptera	3.0
Coleoptera	3.0
Diptera	3.0
Nematoda	1.0

Most of the organisms were insects. The high value for the order Hymenoptera is due to the ant population of the area which was rather high. This was also true of the animals of the samples of forest soil, as shown in Table 5.

Table 5. Invertebrates of the Forest Soil

Invertebrates	% of Population
Hymenoptera	62
Coleoptera	8.5
Hemiptera	8
Araneida	6
Collembola	3
Gastropoda	3
Diptera	3
Annelida	3.5
Centipede	1
Homoptera	0.5
Orthoptera	0.5
Lepidoptera	0.5
Unidentified insects	0.5

In the prairie, invertebrates above the ground average 110 per cubic yard. Of this population the percentage each invertebrate group represents is shown in Table 6.

Table 6. Invertebrate Population of the Prairie as Determined by Sweeping

Invertebrates	% of Population
Homoptera	46
Diptera	22
Araneida	14
Orthoptera	6.5
Hymenoptera	5
Coleoptera	3
Lepidoptera	2.5
Hemiptera	0.5
Unidentified insects	0.5

The predominant form was a leaf hopper found associated with clover in the area.

In the forest, invertebrates above ground average 35 per cubic yard. Of this population, the percent each invertebrate represents is shown in Table 7.

Table 7. Invertebrate Population of the Forest as determined by Sweeping

Invertebrates	% of Population
Hymenoptera	40
Diptera	33
Araneida	9
Homoptera	6.5
Lepidoptera	5.5
Coleoptera	4.5
Gastropoda (snails)	0.5
Hemiptera	0.5
Unidentified insects	0.5

Table 8. The Frequency of Occurrence (percent of each order of invertebrates occurring in one area within the total number of the same order collected from the two areas) of Various Orders of Invertebrates in the Prairie and the Forest Soil.

Invertebrates	Prairie (%)	Forest (%)
Hymenoptera	40	60
Coleoptera	29	71
Hemiptera	0	100
Araneida	34	66
Homoptera	83	17
Collembola	0	100
Gastropoda	0	100
Annelida	0	100
Diptera	40	60

Invertebrates have the habitat preference for the more humid and nutrient forest soil to the dry prairie soil except the predominant clover-eating leaf hoppers in the prairie.

Table 9. The Frequency of Occurrence (percent of each order of invertebrates occurring in one area within the total number of the same order collected from the two areas) of Various Orders of Invertebrates Aboveground in the Forest and Soil.

Invertebrates	Prairie (%)	Forest (%)
Homoptera	96	4
Diptera	67	33
Hymenoptera	28	72
Araneida	82	18
Orthoptera	100	0
Coleoptera	66	34
Lepidoptera	58	42
Hemiptera	80	20
Gastropoda	0	100

With the exception of Homoptera, Diptera, Orthoptera, Hymenoptera and Araneida, the invertebrates in both forest and prairie are very few in number. Therefore, only the differences of the number of Homoptera, Diptera, Araneida, Hymenoptera and Orthoptera between the forest and the prairie seem significant. Leaf-hoppers (Homoptera) eat clover, some insects of the order Orthoptera exclusively eat grasses, spittle bugs (Hemiptera) breed among the grass and clover.

Araneida can be shrub-inhabiting, and thus they all become predominant in the prairie rather than in the forest. However, the forest provides more varieties of habitats for species of Hymenoptera and the number of Hymenoptera in the forest is higher.

II. Interrelation among various conditions:

A. Climate, vegetation and soil

Deciduous forest communities occupy areas with abundant, evenly distributed rainfall (30 to 60 inches) and moderate temperatures which exhibit a distinct seasonal pattern. Grasslands occur where rainfall is too low to support the forest life form but is higher than that which results in desert life forms, generally this means between 10 and 30 inches depending on temperature and seasonal distribution. Therefore, humid soil is more necessary for the forest. Fox Ridge and Pettypool are two nearby areas. The conditions of rainfall should be the same. The difference in the moisture of the soil therefore is probably caused by the following two factors:

1. The evaporation power of air:

The evaporation power of air is again conditioned by light intensity and wind velocity. Summer light intensities are much less under foliage of the forest than out in the open prairie. (Fig. D). Because of the tall tree canopy, the soil in the forest is less exposed to the wind than that in the prairie. The evaporation power of air is inversely correlated with the relative humidity. Thus, the soil in the forest tends to be more humid and favorable to the growth of mature trees.

2. The ability of soil to retain water:

In hilly land such as the forest at Fox Ridge, some water flows along the surface of the ground. Plants, animals, and

microorganisms which maintain the surface of the ground as a "living sponge", are able to hold water and release it gradually without excessive loss of valuable materials. Thus very little erosion results on such a slope.

In flat land, water sinks so quickly, especially through the porous soil like sandy loam in the prairie, that plants find very little water available in the surface layer. Furthermore, in flat land water may reach materials rapidly into the deeper layers, sometimes forming a "hardpan" through which roots of plants, animals and water cannot penetrate. During periods of wet weather it disappears temporarily.

Decomposition of broad leaves is rapid and relatively complete to form a rich humus that mixes gradually with the mineral soil beneath. Humus is organic matter that is partly or entirely decomposed. Because of humus formation (involving oxidation) and the respiration of plant parts and animals underground, soil air contains little oxygen but much carbon dioxide, and it possesses a higher moisture content than does the general atmosphere above ground. This is especially marked in warm summer months when these processes go more rapidly. Humus formed in grasslands is similar to that of deciduous forests since the entire grass plant, including roots, is short-lived. Large amounts of organic material which decays rapidly, leaves little litter or duff, but some humus is added. However, in the Pettypool grassland, the evidence of farming and fire having occurred not long ago (the current history of the area and burned grass stems) provide for less humus accumulation.

Fire and continuous farming remove the humus and prevent its build up. As mentioned above, in soil, organic matter that is partly or entirely decomposed is called humus. Decomposition breaks down complex organic compounds into simpler ones that are washed back into the soil and become available again as nutrients. Therefore, soil becomes more fertile in proportion to the increase in the amount of humus. A dry, sterile type of habitat can only be tolerated by a grassland community, but given a reasonably long period of time, an area undergoing the accumulation of more and more humus will tend to build up a moist fertile soil characteristic of the forest region. If the climate favors a forest community, the Pettypool farm will thus also eventually develop into the forest community.

According to geological analysis, the upper layer of soil is composed of plants and animals which are being reduced to finely divided organic material by the process known as humification. The next layer is composed of mineral soil in which organic compounds have been converted by bacteria into inorganic compounds by the process of mineralization, and thoroughly mixed with finely divided parent material. The soluble materials of this layer are also often formed in the upper layer and deposited, or leached by the downward flow of water. The third layer represents the more or less unmodified parent material. This parent material may represent the original mineral formation which is the result of disintegration and/or decomposition through weathering and/or chemical factors along the surface of the earth crust (rock).

Biotic and abiotic components are especially intimate in soil, which as analyzed above, consists of the weathered layer of the

earth's crust with living organisms and products of their decay intermingled. Without life the earth would have a crust and might have air and water, but the air and water, and especially the "soil", would be entirely different from these components as we know them. Thus, soil not only is a "factor" of the environment of organisms but is produced by them as well. In general we may think of soil as the net result of the action of climate and organisms, especially vegetation, on the parent material of the earth's surface.

B. Climate, animals and vegetation:

Animals and weather:

July is part of the aestival period when the animal reproduction rate is high. During the reproductive period animals are sensitive to the fluctuations of the environment. According to V. E. Shelford (5), the paired factors of humidity and temperature have great influence on such animals, especially those in developmental stages. Thus the population of the animal is affected. This study is too limited to provide data concerning the long-term effect of weather, as for one generation, so the interrelation between animals and weather is difficult to explain. However, in this prairie and forest, the environment seems rather uniform, and those invertebrates abundant in numbers such as Diptera, Hymenoptera and Homoptera are <u>possibly</u> also uniform in distribution. (If the distribution is uniform, the condition in one sampled area could be the representative of the whole.) If this is true, the effect of paired factors upon the animal population shown in Fig. F. and Fig. G. is characteristic.

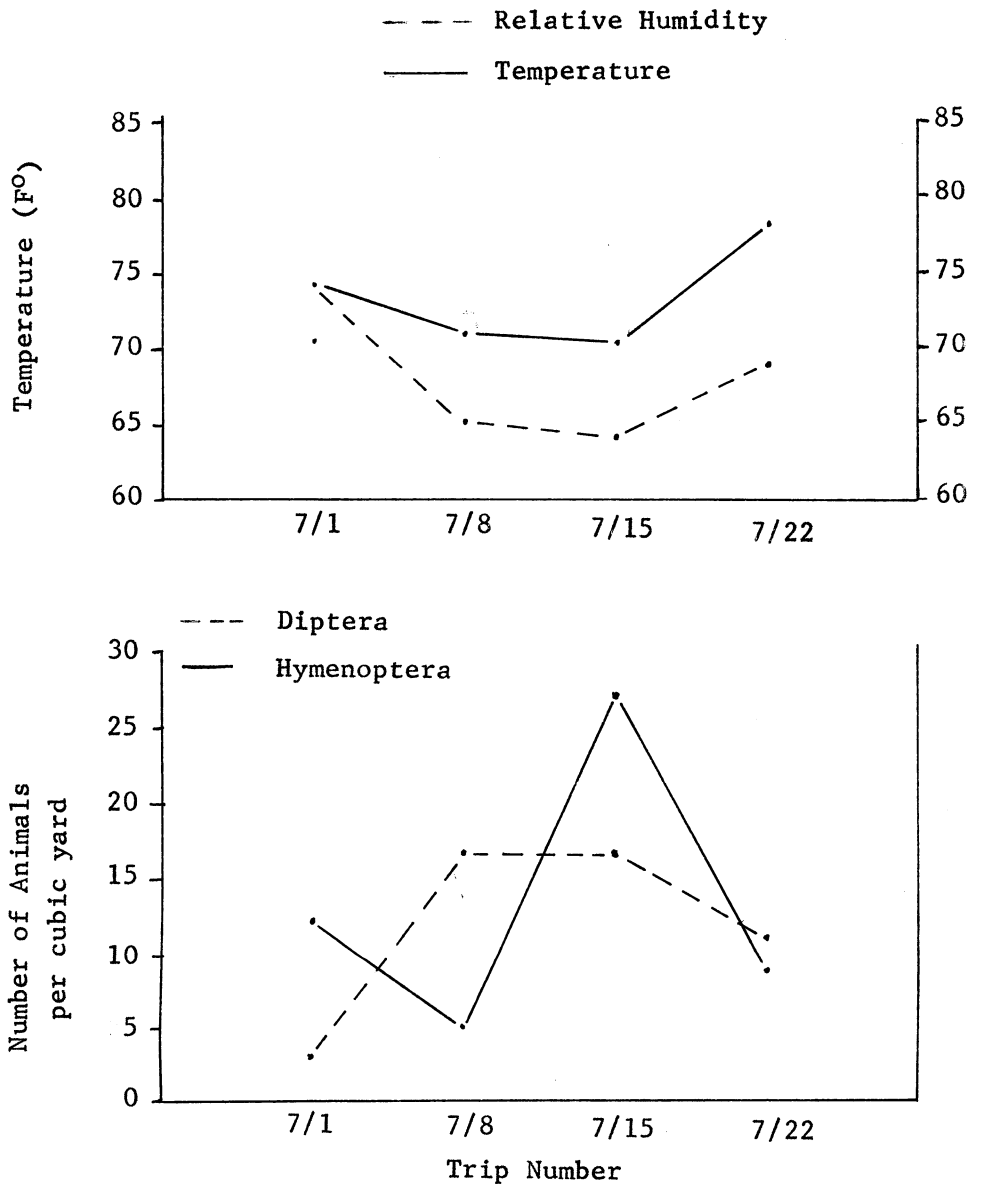

Figure F. The relationship of fluctuations between paired factors (temperature and relative humidity) and the animal (Diptera and Hymenoptera) populations in the swept area of the forest.

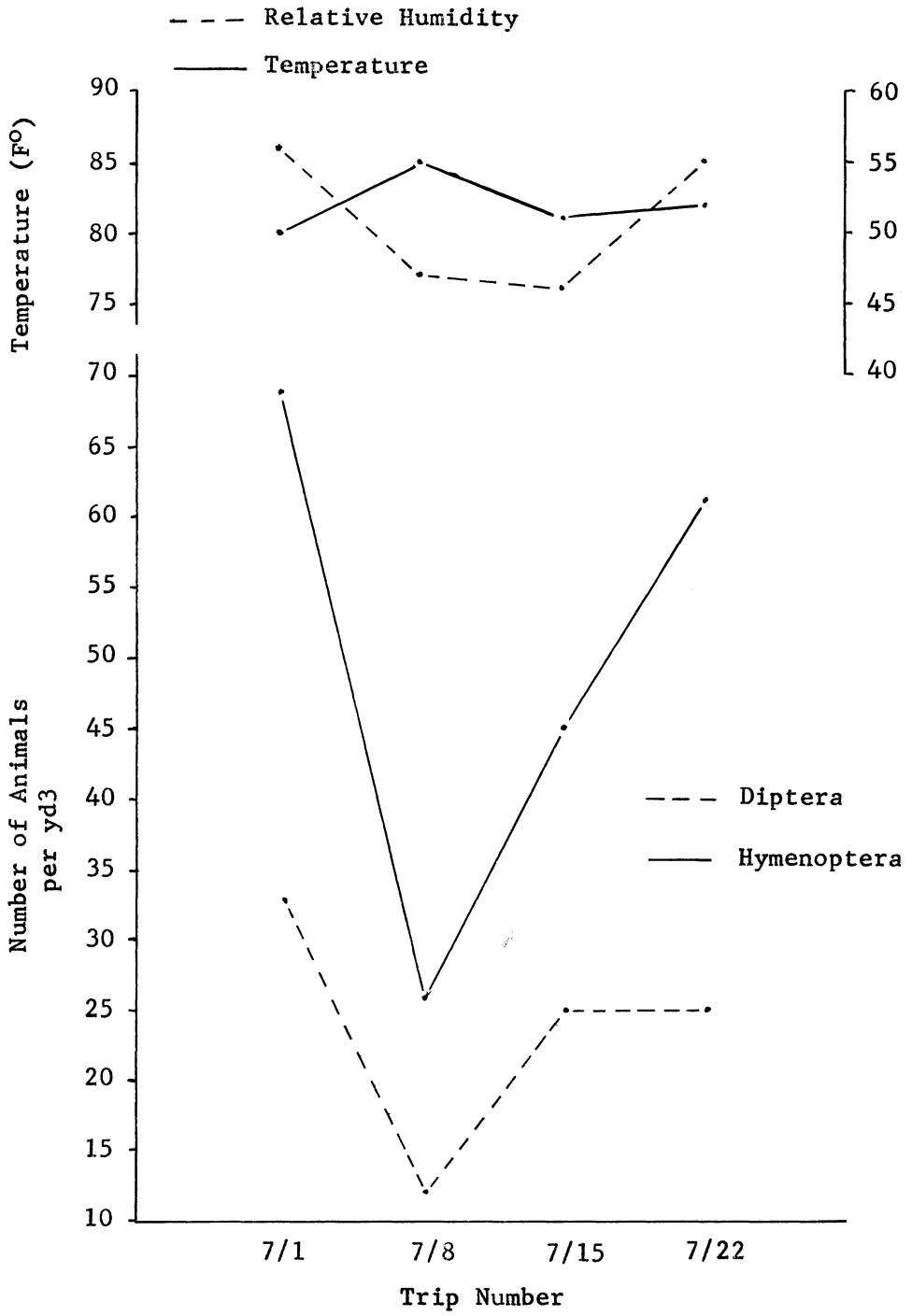

Figure G. Relationship of Fluctuations between paired factors (temperature and relative humidity) and the population of animals (Diptera and Hymenoptera) in the swept area of the prairie.

According to Fig. F., 72° F. temperature with 65% relative humidity and 71° F. temperature with 64% relative humidity are more favorable conditions for Diptera and Hymenoptera in the forest. Yet the population greatly decreases when the relative humidity changes to 74%, although the temperature still remains the same (71° F.). This could be the aspect of the correlation of the paired factors.

Figure G demonstrates that hotter dry weather is less favorable for Diptera and Homoptera in the prairie. But at nearly the same temperature, (85° F. and 82° F.), if the humidity is raised about 10%, they markedly thrive. This could exemplify the importance of the correlation of the temperature and the relative humidity.

Animals and Soil

Some animals spend all their lives in the ground; certain protozoans, flatworms, nematodes, annelids, snails, centipedes, some spiders, mites, wingless insects, some beetles and other winged insects are examples. Other animals live in the ground only as eggs, larvae, or pupae, such as do many flies and beetles; in cocoons, as do some moths; or for hibernation, as do many beetles and bugs. They feed on organic material in the soil, smaller insects, nematodes, protozoans, algae, bacteria or plant roots. The majority of these organisms and their victims are active only in moist soil. The Fig. H shows that the soil animal population in the forest is about twice that of the prairie. Most soil animals must, therefore, live in an environment saturated with moisture, and out of direct sunlight. The soft invertebrate

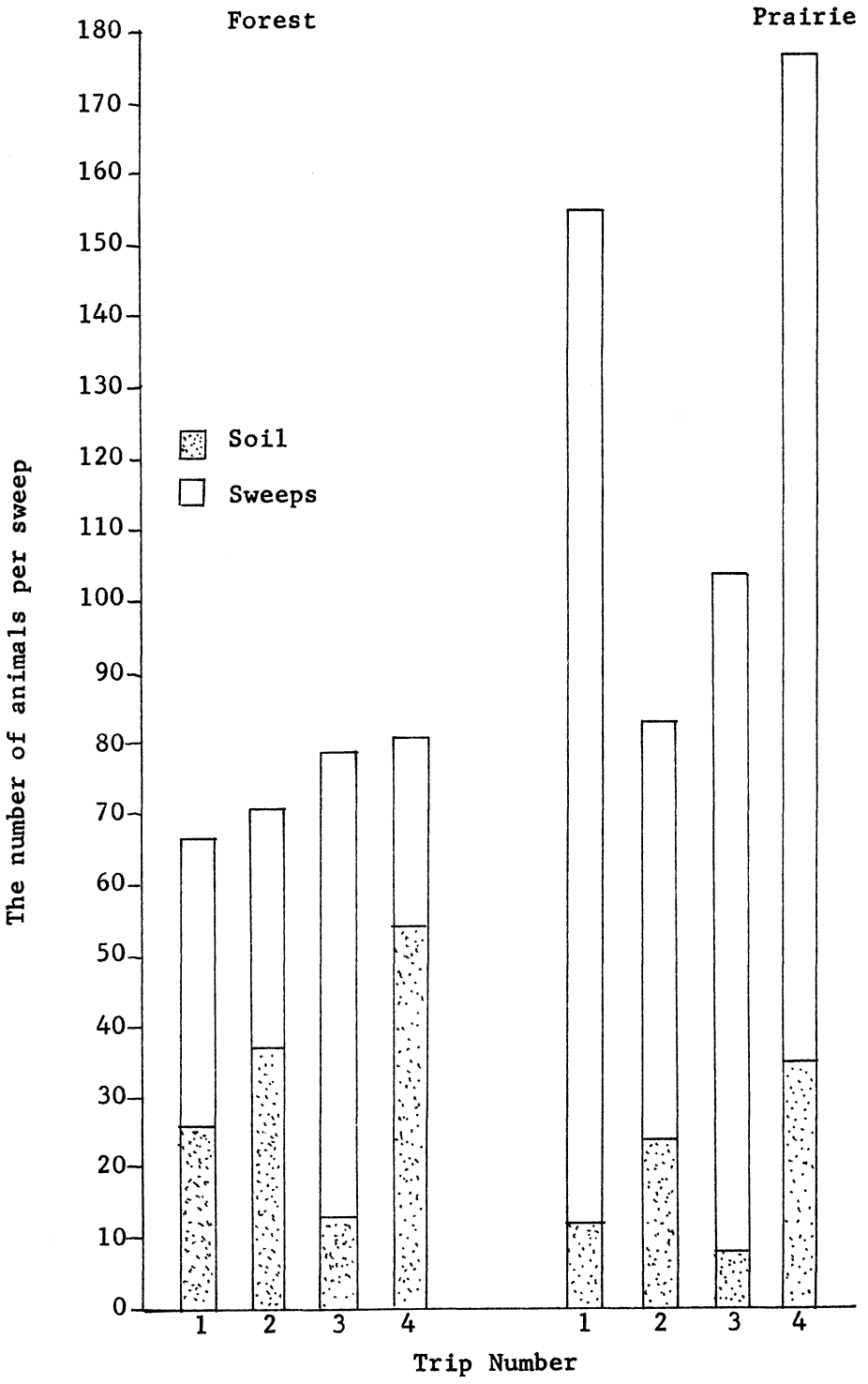

Figure H. Comparison of populations of the soil and vegetation in the forest and prairie.

tissues which are susceptible to drying may play a role in this limitation. Food is also one of the most important factors in limiting their numbers. Differences in the character of soil, whether sand or clay, does not appear to affect the size of populations greatly; however, the amount of decaying humus present is important, since podzolic soil under forest vegetation is not different from clay in the grasslands except that it has more organic material in the form of humus.

Animals and vegetation

As shown in Fig. H, in the grasslands, because of drier soil and high productivity of grasses (unlike trees and shrubs, the terminal bud on grasses lies close to the ground and is not ordinarily injured by feeding of herbivorous animals), the above-ground animal population is about five to eight times greater than the soil animal population exclusive of some minute invisible animals such as protozoans. As Tables 8 and 9 show, snails, earthworms, and other worms are not numerous in grasslands because of the dry habitat. Insects, however, especially those of the orders, Homoptera and Orthoptera feed almost exclusively on grass. This can be proven by their abundant appearance in the herb stratum of the prairie as indicated on table 8 and 9. However, some families of most orders of insects have a variety of food habits or have flexible food habits with wide range of food choice. This probably explains the appearance of most orders of insects on all types of plants including forest and prairie vegetation. Some species and families are herbivorous, some omnivorous and others carnivorous. A forest provides more habitats and thus different kinds of food habits are exhibited by animals. Earthworms ingest particles of mixed humus and mineral soil and absorb the organic matter out of them. Some other worms

feed more on plant and animal detritus, but may ingest some mineral particles. Some of the gastropods are carnivorous, feeding on other snails, but otherwise the gastropods feed chiefly on detritus, algae, lichens, and fungus. Next to Hymenoptera, Coleoptera is a rather significant and abundant order of insect. Their diet varies, some are phloem feeders, some sapwood-feeders, some rotten wood and fungus-feeders, some carnivorous, and others parasitic. Bark beetles require fresh green tissues of the inner bark and cambium. The long-horned beetles and wood borers require green tissues for their younger stages. As they mature, they are able to digest the solid wood. The outer bark is most difficult to digest but it does furnish food for species of Lepidoptera and Diptera. Thus these organisms are more typical of the forest than of the prairie. A forest is a good web and nest building area, so there are more spiders and birds. To some animals the food requirement is not the factor deciding their habitat. If the population of one species is too high, the organisms tend to disperse because of the population pressure. An animal with a large population is not always restricted to one area. For example, insects of the order Hymenoptera can occur in high numbers in both the prairie and forest possibly because of pressure caused by their abundant population and their adaptation to a variety of habitats.

Conclusion and Summary

1. During each weekly investigation in July, data on various abiotic factors--air temperature, soil temperature, relative humidity, light intensity, and wind velocity were taken and numbers of living organisms were counted by sampling and mean-number method in the forest on the hill slope of Fox Ridge and the prairie of Pettypool Farm respectively.

2. Classification, systematization, and comparison of data of abiotic factors and biotic factors (kinds, population and distribution of living organisms) between these two areas led to the discovery of interrelations among various biotic and abiotic conditions:

Temperature, light intensity, and wind velocity are greater in grassland than in the forest, but relative humidity is less.

Soil in the grassland is drier and has less humus than in the forest.

If given a reasonably long period of time, soil in the grassland will accumulate enough humus and becomes moist and fertile soil favorable for the growth of mature trees. Trees will in turn provide shade and humid environment. The Pettypool Farm will thus eventually develop into a forest.

3. The vegetation in the grassland are chiefly rye grass and blue grass. In the forest, maple, ash, oak and hickory are predominant trees.

4. The species composition of animals differs between grassland and forest. Food, shelter, and microclimate are the chief factors. For example, more than 95% of leafhoppers and grasshoppers caught were found in grassland because of their grass-eating habit. More snails, earthworms, mites and spiders were found in the shaded dwelling area of

the forest. More invertebrates dwell in the moist soil with rich humus in the forest. The majority of animals in these two areas are insects.

5. Although detailed composition of vegetation and animals in these two areas are different, the life process to maintain the survival of their own community is the same. In each community, sunlight is the source of energy. Green plants play the role of the food makers --the producers by carrying out the photosynthesis which also transforms the sunlight energy into the food energy. Energy as food passes down from the producers through the primary, secondary, and tertiary consumers, that is, herbivorous, carnivorous and omnivorous. Saprophytes in soil transform the excrements and dead bodies of organisms into minerals available for photosynthesis. Therefore the source of food comes from the earth and can be re-used again and again. Unlike nutrients, energy does not circulate indefinitely. Following the pathways of life activities, bit by bit it leaks out of the living system in a form that cannot be recaptured. Hence energy must continuously enter into the community from the sun. Because of food relation, the interrelation between living things forms a cycle called a biosphere. The biosphere is continuously conditioned by abiotic factors. The interrelation among abiotic and biotic factors produce a system called an ecosystem. Fox Ridge forest, and Pettypool farm grassland are examples of ecosystems.

REFERENCES

1. Allee, W. C. et. al., Principles of Animal Ecology. (Philadelphia and London, W. B. Saunders Company, 1949)

2. Kendeigh, S. C., Animal Ecology. (Englewood Cliffs, N J., Prentice-Hall, Inc., 1961)

3. Knight, Clifford B., Basic Concepts of Ecology. (New York, The Macmillan Company, 1965)

4. Odum, E. P., Fundamentals of Ecology. (Philadelphia and London, W. B. Saunders Company, 1959)

5. Shelford, V. E., Paired Factors and Master Factors in Environmental Relations. V.45, P. 155-160. (Illinois State Academy of Science Tran., 1952)