

STUDIES IN NOCTURNAL ECOLOGY, V.
AN EXPERIMENT IN CONDUCTING FIELD CLASSES AT NIGHT¹

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The chief purpose of this report is to suggest the value of incorporating night field trips into the regular schedule of classes in Animal Ecology. This is predicated upon the belief that instruction should reflect the gains made by research in any given field. Secondly, since the data taken are of interest, a part are given here as they add to our meager store of information upon nocturnal animals, the importance of which has been cited previously by Allee (1927).

METHOD

The locality chosen was a climax beech-sugar maple-wood frog association in northern Indiana. The authors were familiar with the forest in both the nocturnal and diurnal phase, the area having been studied irregularly since 1927. Preliminary details were arranged in the afternoon before regular class work had started. In this work white paint, strips of white cloth or paper squares were used to mark out a series of trails. Following the methods employed earlier (Park, Lockett and Myers, 1931), appropriate observation stations were established, e. g. logs and stumps, usually well decayed and bearing a variety of fungi, Mycetozoa, et cetera. When establishing the trails, any animals which could be observed without destruction of their habitat niches, were marked with paint. For this purpose a fast-drying mixture was made up by dissolving aluminum base in banana oil (Baer's Klondike Paint).

¹It is with pleasure we acknowledge the enthusiasm of the students co-operating in this joint field trip between the classes in Animal Ecology of the two Universities; our indebtedness to Professor W. C. Allee for criticism throughout the conception of the project; and to the many specialists who, by their presence in the field, made subsequent identification of animals possible, e. g., W. J. Gerhard (Hemiptera), Emil Liljeblad (Coleoptera), D. C. Lowrie (Araneida), C. H. Seevers (Coleoptera), Mary Talbot (Formicidae), R. L. Wenzel (Coleoptera) and A. B. Wolcott (Cleridae).

After these preliminaries were completed the group was divided into two observation units of ten to twelve students each and examination of the stations was begun shortly after dusk. The trails were run alternately by each group hourly, until shortly after dawn. Both gasoline lantern and electric torches were used, and full notes taken as to kind of animal, number to be observed at a station, position and activity (feeding, walking, copulating), and time of observation for each station throughout the night. Simultaneously with the running of the trails physical data were also compiled, viz. light intensity, air and soil temperature, rate of evaporation and relative humidity.

RESULTS

Since most of the data taken show at least an apparent correlation with the periodic change in the physical influences measured, the light intensity during dusk and dawn is given in tabular form (Table I). The more commonly measured influences (temperature, relative humidity, evaporation rate)

TABLE I
LIGHT INTENSITY IN FOOT CANDLES
(Weston Illuminometer: May 25-May 26)

		DUSK	
<i>Unobstructed Sky</i>		<i>Under Forest Canopy</i>	
5:15 P. M.	4000	5:10 P. M.	600
5:30 "	3200	5:25 "	450
5:45 "	3000	5:40 "	400
6:00 "	2400	5:55 "	400
6:15 "	2000	6:10 "	300
6:30 "	1800	6:25 "	280
6:45 "	1200	6:40 "	120
7:00 "	400	6:55 "	72
7:15 "	400	7:10 "	54
7:55 "	84	8:00 "	12
8:20 "	6	8:25 "	0
		DAWN	
4:45 A. M.	2	4:55 A. M.	0
5:00 "	4	5:10 "	1
5:02 "	6	5:13 "	2
5:04 "	8	5:23 "	6
5:05 "	10		
5:06 "	12		
5:16 "	34		
5:18 "	40		
5:19 "	46		
5:20 "	50		
5:45 "	400		
6:30 "	620		

(Central Daylight Saving Time)

are intimately associated with the fall and rise in illumination, and as they have been discussed previously (Park, *et al.*, *loc. cit.*) in nocturnal work, need no further elaboration. With respect to these physical measurements, however, it should be kept in mind that in the case of species in which an inherent nocturnal activity has been demonstrated, the releasing stimulus is not a direct consequence of the operative nocturnal influences, or if it is then the elucidation awaits further experimentation.

With respect to the animals observed, little attempt was made to mark or take data upon those forms which could not be determined with precision in the field, or which could not be certainly identified later from collections made for this specific purpose. Despite this necessary limitation of the group's work, the number of species discerned to be active during the night proved surprisingly large. Some few forms were out in relatively great numbers, and these are treated in detail later; however, since lists of nocturnally active animals are so few in comparison with the diurnal fauna, the following table (Table II) gives the species which were positively identified and found to be active during the night, that is, in activity away from their diurnal niches of concealment.

TABLE II
NOCTURNAL CONSTITUENTS OF THE CLIMAX FOREST

ANIMAL OBSERVED	WHERE ACTIVE	BIBLIOGRAPHIC CITATION RELEVANT TO SPECIES NOCTURNALISM
RODENTIA: Peromyscus leucopus noveboracensis	Floor	Johnson, 1926
HYMENOPTERA: Formicidae Lasius niger americanus Aphaenogaster fulva picea Aphaenogaster tenneeseensis Camponotus caryae Camponotus herculeanus pennsylvanicus	Log and Stump	Flint, 1914 McCook, 1877 Park, Lockett and Myers, 1931
COLEOPTERA: Carabidae Pterostichus adoxus Calathus gregarius Galerita janus Pinacodera limbata Chlaenius aestivus	Floor, Log and Stump	Champlain & Kirk, 1910 Chapman, et al, 1926 Floersheim, 1906 Garnett, 1920 Kirchner, 1927 Oertel, 1924 Park, et al, 1931 Scott, 1932 Seeman, 1928

TABLE II—(Continued)
NOCTURNAL CONSTITUENTS OF THE CLIMAX FOREST

ANIMAL OBSERVED	WHERE ACTIVE	BIBLIOGRAPHIC CITATION RELEVANT TO SPECIES NOCTURNALISM
COLEOPTERA—(Continued:)		
Staphylinidae	Cut Stump Surfaces	Park, et al, 1931
<i>Conosoma crassum</i>		
<i>Erchomus ventriculus</i>		
Erotylidae	<i>Fomes applanatus</i> (Feeding and copulating)	Park, et al, 1931 Park and Sejba, 1935
<i>Megalodacne heros</i>		
Nitidulidae	Fungi, Sugaring solu- tion and plasmodia	Park, et al, 1931
<i>Glischrochilus fasciatus</i>		
<i>Glischrochilus</i> <i>sanguinolentus</i>		
Cucujidae	Stump surfaces and plasmodia	
<i>Brontes dubius</i>		
<i>Laemophlaeus fasciatus</i>		
<i>Laemophlaeus testaceus</i>		
Temnochilidae	Logs and Stumps; Fungi and plasmodia	
<i>Tenebroides corticalis</i>		
<i>Tenebroides laticollis</i>		
Cleridae	Stacked Wood	
<i>Enoclerus nigripes</i>		
Cisidae	Fungi	
<i>Cis fuscipes</i>		
Elateridae	Logs and Stumps	
<i>Melanotus communis</i>		
<i>Melanotus decumanus</i>		
Tenebrionidae	Logs and Stumps <i>Fomes applanatus</i> (Feeding and copulating)	Park, et al, 1931 Park and Keller, 1932
<i>Alobates pennsylvanica</i>		
<i>Boletotherus cornutus</i>		
<i>Diaperis maculata</i>	Fungi	
<i>Hoplocephala bicornis</i>	Fungi	
Melandryidae	Cut log surfaces	Park, et al, 1931
<i>Melanodrya striata</i>	Fungi	
<i>Penthe obliquata</i>	Fungi	
<i>Penthe pimelia</i>		
Scarabaeidae	Stacked Wood Feeding on foliage of shrub stratum Feeding on foliage of shrub stratum	Davis, 1916 Forbes, 1907, 1916 Sanders and Fracker, 1916 Schwarz, 1893
<i>Cleotus aphodiodes</i>		
<i>Phyllophaga species</i>		
<i>Serica sericea</i>		
<i>Serica parallela</i>		
Cerambycidae	Stacked Wood	
<i>Leptostylus aculifer</i>		
HETEROPTERA:		
Aradidae	Logs and Stumps, Fungi	
<i>Aradus crenatus</i>		
<i>Aradus implanus</i>		
<i>Aradus quadrilineatus</i>		
Pentatomidae	Foliage and bark of shrub and tree strata	
<i>Menecles insertus</i>		

TABLE II—(Continued)
NOCTURNAL CONSTITUENTS OF THE CLIMAX FOREST

ANIMAL OBSERVED	WHERE ACTIVE	BIBLIOGRAPHIC CITATION RELEVANT TO SPECIES NOCTURNALISM
ORTHOPTERA: Ceuthophilus latens Parcoblatta pennsylvanica	Floor Logs and Stumps	Allard, 1930 Haber, 1920 Lutz, 1932 Park and Keller, 1932 Park, et al, 1931 Rockwood, 1925 Turner, 1915
LEPIDOPTERA: Noctuid larvae and adults	Log and Stump, at sugaring solutions	Balfour-Brown, 1925, 1933 Brower, 1930 Rau and Rau, 1929 Stanley, 1932
DIPLOPODA: Spirobolus marginatus	Log and Stump	Park, 1935 Park, et al, 1931
GASTROPODA: Agriolimax campestris Anguispira alternata	Log and Stump	Allard, 1931 Boycott, 1934, p. 9 Park, et al, 1931 Van Cleave, 1931
ARANEIDA: Dictynidae Amaurobius bennetti Clubionidae Clubiona riparia Clubiona pallens Thomisidae Xysticus ferox Agalenidae Coras medicinalis Pisauridae Dolomedes tenebrosus Lycosidae Schizocosa crassipes Attidae Wala mitrata	In web Logs and Stumps Copulating 1:00 A.M. Logs and Stumps Logs and Stumps Logs and Stumps Logs and Floor Herbaceous Stratum	

The above list of some fifty species represents but a small portion of the animals found active during the night, and does not include the abundant phalangids, centipedes *et cetera* remaining undetermined. It will be noted that these forms found usually under bark and mold during the day are nocturnal constituents of the community. In these species, three phyla (Mollusca, Arthropoda, Chordata) are represented and the greatest number of species are found in the largest group, the arthropods, and particularly in the largest order, the beetles.

Promptly at dusk the majority of the nocturnal forms moved out of their diurnal habitat niches, e. g. log and leaf mold chiefly, and began their nightly activity. The mycetophagous forms (Erotylidae, Nitidulidae, Cucujidae, Temnochilidae, Tenebrionidae, Melandryidae) were to be observed feeding upon the bracket and other fungi, as well as on the plasmodia of Mycetozoa and in some cases on the sap exudates and artificially prepared sugaring solutions smeared on certain stumps and trees; carnivorous forms (Carabidae, Staphylinidae, Araneida) began their nightly hunt for prey, while the herbivores left the leaf mold at the tree bases and in the mold to ascend the tree trunks and feed on foliage of shrub and tree stratum (Pentatomidae, Serica and Phyllophaga, *et al*). The pentatomid, *Meneclis insertus*, proved especially instructive by illustrating the principle of vertical migration. By 9:10 P. M. these bugs were crawling from beneath the leaf mold at the bases of stump and tree and beginning their night ascent into higher strata. They appeared in great numbers throughout the night, and by midnight were from eight to fifteen feet or more up on the tree trunks and foliage. By 3:20 A. M. the pentatomids were moving down the trunks, and this downward movement continued until by 4:23 A. M. they were on the average from six to eight feet above the floor. At 5:00 A. M. the stragglers were two to four feet from the floor, but the majority had crawled once more under the floor mold and debris.

The data with respect to *Meneclis insertus* checks with similar findings of Sanders and Shelford (1922) who showed similar vertical movements up and down of diurnal species during the day, and these results are also perfectly compatible with the fluctuations in numbers of nocturnal constituents as previously demonstrated by Chapman, *et al* (1926), Park *et al* (1931), Park and Keller (1932), Park and Sejba (1935) and Carpenter (1935). To illustrate this general, sustained nocturnal activity, Table III (*see* page 52) has been prepared.

The data shown represents the numbers of active individuals of several typical animals as observed by the unit making the trails at a given time, and consequently represent *indices* of activity rather than a quantitative estimate of such activity as has been demonstrated in work with *Megalodacne heros* under rigid experimental and field conditions (Park and Sejba, 1935). For this reason they understate the activity, since

many individuals undoubtedly escaped observation, or were adversely stimulated by the approaching lights and sought temporary cover.

TABLE III
ACTIVITY OF REPRESENTATIVE NOCTURNAL ANIMALS

TIME	NUMBER OF INDIVIDUALS DISCERNED TO BE ACTIVE FROM THE FIRST EVENING RECORD TO THE LAST OBSERVED RECORD BEFORE RETIRING. MARKED ANIMALS				
	<i>Parcoblatta pennsylvanica</i>	<i>Ceuthophilus latens</i>	<i>Spirobolus marginatus</i>	<i>Polygyra thyroides</i>	<i>Anguispira alternata</i>
(First Trip):					
9:00 P. M.	1				
9:20 "	1				
9:25 "	1	1	2		1
9:35 "			1		
9:40 "	1		1		
9:45 "	1		1		
9:47 "			1		
9:50 "		5	1	1	
(Second Trip):					
10:40 P. M.	1				
10:50 "			1	1	
11:00 "		1			1
11:15 "		1	4		
11:25 "			1	4	1
11:30 "			1	1	
11:35 "	1	1	6		
(Third Trip):					
2:01 A. M.		1			
2:09 "	2				
2:12 "			2	1	
2:17 "				1	
2:19 "	1				
2:21 "					1
2:25 "			2		
2:30 "			1	1	1
2:33 "	1				
2:37 "				2	
2:38 "			1		
2:40 "			1	2	
2:42 "			1		
2:52 "			4	1	
2:54 "	1	1	3		1
3:00 "			1	4	
(Fourth Trip):					
3:25 A. M.			1		
3:30 "			1		
3:45 "			1	1	1
4:05 "			1		
4:35 "			1		
(Fifth Trip):					
(Dawn)					
4:50 A. M.			1	1	1
5:00 "		2			1

The same general activity may be shown for many other forms, for example the pentatomids, *Meneclis insertus*, the spiders, which were active from the first trip (9:00 P. M. to 4:15 A. M.), and for the spotted slug, *Philomycus carolinensis*. The latter gave probably the most abundant and typical picture of nocturnal activity, since the individuals were constantly active in numbers from 9:25 P. M. to 5:05 A. M.; however, the marking of individuals failed as the slugs secreted mucous after being marked and in a few minutes the paint had been swept off of the animal.

Finally, the copulation of many species was observed, in particular in *Boletotherus cornutus*, *Megalodacne heros* and *Clubiona pallens* Hentz.

SUMMARY

Night field work, in courses dealing with the ecology of animals, has been demonstrated to work efficiently, and a provisional plan of operation is given. In night trips emphasis is placed upon certain important features which otherwise would remain unknown, or but vaguely realized, namely, (1) the large and varied number of nocturnal animals, both as to species and individuals, (2) the distinctness or integrity of these nocturnal forms, (3) the phenomenon of vertical movements (inter-, and intra-stratal), (4) the quiescent or sleeping diurnal constituents, and (5) the lack of knowledge concerning the nocturnal fauna, and hence the opportunity for effective research.

The data taken may be summarized as follows: light intensity through dusk and dawn are given in foot-candles; an extensive list of species found active is presented, together with place of activity and relevant bibliographic citations; the abundant and typical forms are dealt with in a table which demonstrates their sustained nocturnal activity, and the vertical migration of the pentatomid bug, *Meneclis insertus*, is described.

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