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Some Factors Affecting the Utilization of Space By Mice of the Genus Peromyscus

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ZOOLOGY

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Each individual within a population of small mammals maintains life by activities confined to an area known as its home range. The size of the home range is usually calculated by setting live-traps in quadrat patterns, trapping over an extended period, and finally drawing a line around all the positions where each animal is trapped (Burt, 1940). Much information has been collected for many different species using such methods. However, such knowledge is vague and often misleading since it does not reveal the true nature of home range. An alternative concept is based on space utilization. Two factors assume importance within this approach: (1) use made of available space within the home range and (2) limitations on the size of home range. Each of these can be investigated in terms of any environmental factors which seem important. To avoid the present dilemma of the lack of field methods which permit direct observations on the nocturnal and secretive animals concerned, laboratory studies can be carried out.

This study was based on such concepts, with the hope that information obtained under artificial conditions would reveal a better approach to field study, where the final solution must rest. The primary objectives were: (1) to determine the relative utilization of four common types of space found in a home range and (2) to analyze possible limitations which the complexity of environment might impose on the size of home range. Two species of mice of the genus *Peromyscus* were used as subjects, each with a different type of natural habitat. *Peromyscus leucopus noveboracensis* lives in forests or brush surroundings and is here assumed to have a somewhat complex habitat. *Peromyscus maniculatus bairdii* is found in

grassland situations and is, comparatively speaking, subjected to a simple environment. Complexity is taken to be related to the number of artifacts, such as trees, logs, stones, etc., which cause changes in direction during ranging movements and which require some learning on the part of the animal.

METHODS AND PROCEDURE

A strip of sheet metal was shaped into an oval pen about five feet long, four feet wide and two feet high. This was placed on the floor and two chalk lines were drawn at right angles to each other dividing the space enclosed by the pen into four equal parts. One of these was left vacant, into another was placed a tray of food and a third was equipped with rows of wood. The last part was used as the point of introduction for each of the subjects, complete with its nest box (see Fig. 1).

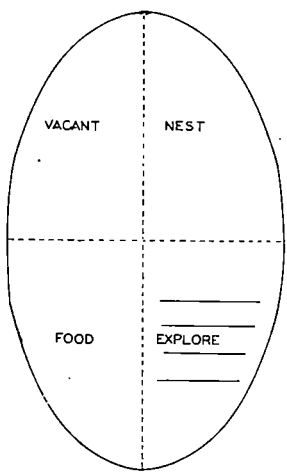

Fig. 1.

Five randomly selected mice of each of the two species were tested. The test for each subject began when it made its first exit from its nest-box. For a period of ten minutes the amount of time spent in each of the four parts was recorded. A dim light provided the only illumination.

The same groups of mice were subjected to a second series of tests. First, each subject was given a ten minute trial period in a

straight, narrow runway 18 feet long. Then the subject was tested the same way a second time, but the runway was altered to force the animal to turn 180 degrees every three feet (see Fig. 2). Data collected in each case were converted to mean distance from the nest box at which activity occurred.

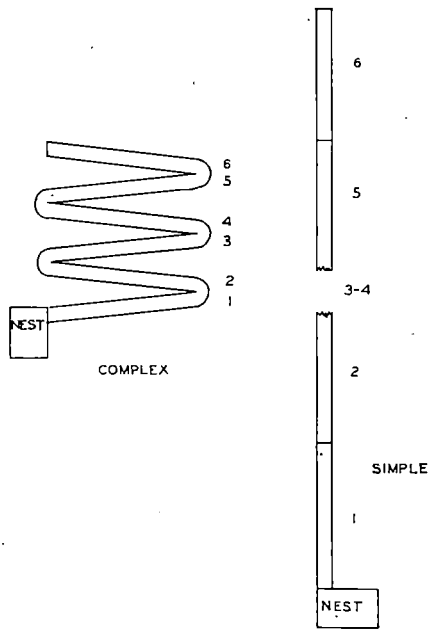

Fig. 2.

All mice studied were kept in the laboratory for at least two weeks before testing. During this time food and water were always abundantly supplied.

RESULTS AND DISCUSSION

The data collected during trials made in pens were grouped into activtity spent in four ways: (1) exploring the rows of wood, (2) taking shelter in the nest box, (3) feeding activity, (4) wandering in areas with no artifacts or rewards. The percent of time spent in each of these activities is shown for both species in Fig. 3. Both species spent more time in exploring and taking shelter than in feeding or in the vacant area. The greatest difference between the

two species was between exploring and seeking shelter. The woodland species spent an average of over 85% of the time running about through the wooden artifacts, while the grassland species devoted only 40% of the time to this activity. The grassland species was in the area of the nest only 40% of the time, while the woodland type took shelter only about 10% of the total time.

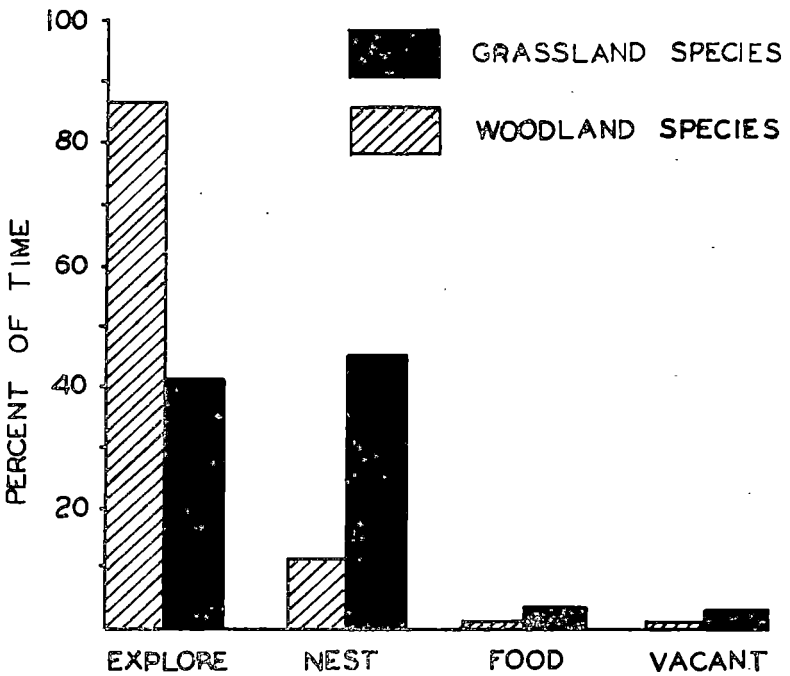

Fig. 3.

These results, although not conclusive because of considerable individual difference, indicated that with food supplies abundant, exploration was an important activity. This occurred in the spite of the presence of a familiar nest box which offered a center of security. It may be that even when home range is constant over a long period of time, space use depends upon a need to renew continually knowledge of the area. Supporting this idea was the fact that the species which did more exploring was the one which lived in the more complex environment under natural conditions. Furthermore, activity

periods (Behney, 1936) are so extended, that feeding alone does not account for all activity, indicating that some time must be spent exploring. It is also interesting that exploring activity prevented the usual amount of escape-directed activity.

Data collected from the runway trials were converted to mean distance of activity from the nest box in terms of yards and grouped under two conditions: (1) complex, meaning the situation requiring a turn every three feet and (2) simple, referring to the straight condition of the runway (see Table I). These data were subjected to a 2 x 2 factorial analysis (Edwards, 1950). A summary of the analysis is given in Table II. Results indicated that while no general species difference occurred, the difference in mean activity distance between the simple and the complex conditions was very highly significant. Further, a significant interaction between species and conditions resulted. It is possible to explain these observations on

MEAN DISTANCE FROM NEST BOX (EXPRESSED IN YARDS) OF ACTIVITY DURING 10-MINUTE TRAIL PERIODS

	Peromyscus leucopus noveboracensis (woodland habitat)		*Peromyscus maniculatus bairdii* (grassland habitat)	
SAMPLE NO.	COMPLEX	SIMPLE	COMPLEX	SIMPLE
1	1.84	2.76	0.70	4.75
2	2.00	3.28	0.72	3.02
3	0.73	3.00	1.19	4.04
4	1.55	2.60	1.46	3.01
5	2.31	2.38	1.25	3.40
Average	1.68	3.40	1.06	3.65

SUMMARY OF 2 X 2 FACTORIAL ANALYSIS TESTING RANGING DISTANCE OF TWO SPECIES OF PEROMYSCUS UNDER SIMPLE AND COMPLEX CONDITIONS

SOURCE OF VARIATION	SUM OF SQUARES	DEGREES OF FREEDOM	MEAN SQUARE	F
Between species	594	1	594	0
Between conditions	170,940	1	170,940	59.00*
Interaction	26,715	1	26,715	9.24*
Within groups	46,218	16	2,888	
TOTAL	244,467	19		

*Significant at the 1% level.

the basis of habitat types. The two species were alike in that both were restricted more by the complex condition and thus the mean distance of activity increased with simplification of habitat. Although the fact that each species reacted this way ruled out overall species differences, the amount of difference between the two species in connection with the two different conditions allowed interaction to be different. That is, the grassland species was more restricted by the complex environment (1.06 yards as opposed to 1.68 yards for the woodland species) and less restricted by the simple environment (3.65 and 4.40 yards). This is the same as saying that the grassland type, living in a relatively uncomplicated environment, will range less into complicated situations but further in simple grassland habitats. The woodland species is apparently less wary of the complicated environment (such as is found in the forest), but is not apt to range far into simple habitats. Complexity of environment appears to be a controlling factor in the home range of these mice, operating through ability to learn and retain knowledge of artifacts.

SUMMARY

Two species of local mice, *Peromyscus leucopus noveboracensis* and *Peromyscus maniculatus bairdii* were given trial periods in an artificial environment. Both types displayed much greater interest in areas containing their home nest-box or simple artifacts than in areas completely vacant or containing food. *P. leucopus,* which normally lives in wooded or brushy areas, devoted twice the amount of time to exploring artifacts than did *P. maniculatus,* which lives in grassland situations. It was concluded that space use within an animal's home range, but away from its nest site, is relative to continued exploration of areas containing artifacts (trees, logs, stones, etc.). Areas with little complexity are used very little. More work is needed to demonstrate relation between feeding activity and exploration.

When the two species of mice were subjected to additional tests comparing the mean distance of activity under simple environmental conditions with that under complex conditions, the complexity was found to limit distance in both types. The grassland species was more limited by complexity and less limited by simplicity than the woodland species. It was concluded that artifacts are important in

determining the amount of space used, and thus the size of home range, because they are related to the learning and memory abilities of the individual. It is apparent that animals in simple environments either have greater range areas or less basic intelligence.

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