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## Microenvironmental Conditions of the Day Resting Places of Cottontail Rabbits

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MICROENVIRONMENTAL CONDITIONS  
OF THE  
DAY RESTING PLACES OF  
COTTONTAIL RABBITS

by  
Orin Gelderloos

A thesis presented to the  
Faculty of the School of Graduate  
Studies in partial fulfillment  
of the  
Degree of Master of Arts

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This investigation was concerned with the micro-environment of the daytime resting places of cottontail rabbits (Sylvilagus floridanus) in southwestern Michigan. Many studies have been made of the habitat (Friley, 1955), cover (Hendrickson, 1938; Leopold, 1942; Linduska, 1947), food (Trippensee, 1938; Dice, 1945), and home ranges (Haugen, 1942) of cottontail rabbits. The purpose of this investigation was to search for possible correlations between various physical factors and the daytime activity and resting places of cottontails.

#### Methods

This investigation was conducted during fall 1961, and winter and spring 1962. The location and number of rabbits observed were as follows: two miles west, one mile south of Bangor, Michigan 8; NW $\frac{1}{4}$ , NE $\frac{1}{4}$ , Sec 31, T2S, R11W, Kalamazoo County, 18; NE $\frac{1}{4}$ , Sec 8, T4S, R12W, Kalamazoo County, 9; Elm St., Kalamazoo, Michigan, 1; 8th St. one mile south of M-43, Kalamazoo County, 2; Fort Custer, Michigan, 2; 12th St. and Oshtemo Avenue, Kalamazoo County, 1; and SW $\frac{1}{4}$ , Sec 1, T5N, R11W, Kent County, Michigan, 6. The total number of rabbits observed is forty seven.

Microenvironmental data were obtained when a rabbit was flushed from its daytime resting place. In finding rabbits the writer worked alone or used trained beagle hounds. Each time a rabbit was found in a resting place

during the daylight hours, the following data were recorded: time of day, date, wind velocity, light intensity, relative humidity, temperature, habitat type, and the place where the rabbit went after it was flushed. Wind velocity, light intensity, temperature, and relative humidity determination were made at a height of 8 - 12 inches. Temperature was measured with a laboratory grade thermometer to the nearest one-half degree Centigrade. Light intensity was measured with a Weston Photometer, Model 741. Relative humidity was calculated from a dry bulb - wet bulb sling psychrometer reading at temperatures of 20°F and above. At lower temperatures a hand-aspirated psychrometer was used. A "Florite" anemometer was used to measure wind velocity.

## Results

### Temperature

As shown in Figure 1, rabbits were found in winter, and in spring and autumn in situations in which the temperatures form a peak for each season. It is possible that more rabbits were found in daytime resting places at colder seasonal temperatures. It is also possible that the seasonal temperature for the general locality followed this pattern.

Studies have been made that correlate temperature with holing-up tendencies of cottontails (Linduska, 1947;

Allen and Shapton, 1942; and Hendrickson, 1947). I found no rabbits when the microenvironmental temperature was below  $-10^{\circ}\text{C}$ . It is possible that the rabbits were in their dens, which were located near to the daytime resting places, when the temperature fell below  $-10^{\circ}\text{C}$ ; this is in agreement with the findings of Linduska (1947), who stated that rabbits were in their dens three times as often between temperatures of  $-22^{\circ}\text{C}$  to  $-11^{\circ}\text{C}$  than between  $-11^{\circ}\text{C}$  to  $0^{\circ}\text{C}$ . Trippensee (1934) also found rabbits tended to go into their burrows at temperatures below  $-7^{\circ}\text{C}$ . I have observed four rabbits going into their dens at a temperature of  $-8^{\circ}\text{C}$ .

#### Wind Velocity

Since rabbits are found in brushy areas (Friley, 1955), one would expect a low wind velocity. According to Figure 2, the majority (63 percent) of the rabbits were found in situations in which there was no measurable wind velocity. All rabbits were located in places with an average wind velocity of two miles per hour or less and a maximum wind velocity of seven miles per hour or less. Average wind velocity was calculated from many measurements taken at each day resting place of the rabbits. Gusts of wind passing through each day resting place were measured as maximum wind velocity.

#### Light

The largest single group (47 percent) of the rabbits were found in situations in which incident light intensity



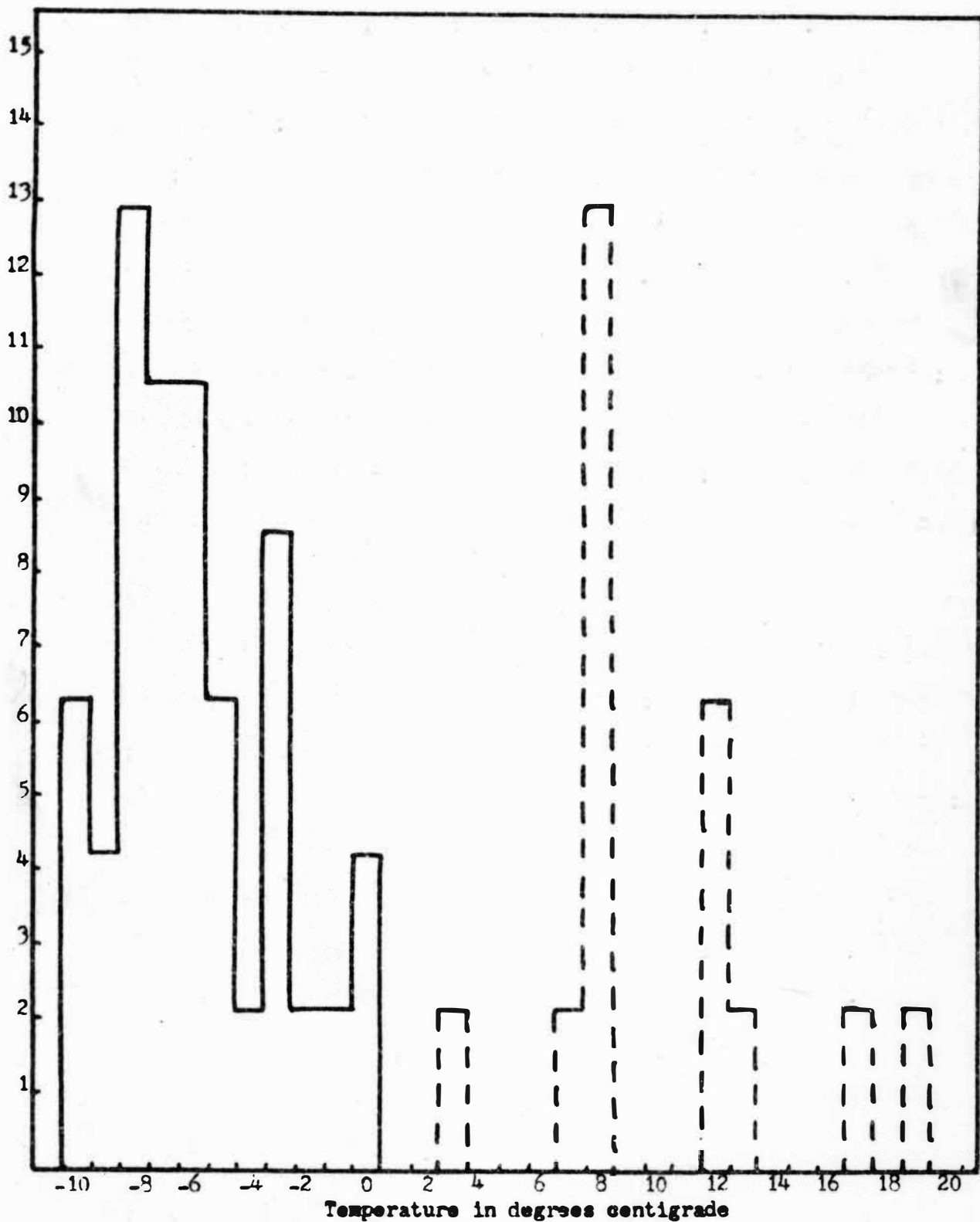


Figure 1. Microenvironmental temperatures of resting sites of cottontail rabbits, autumn, winter, and spring.  
a. Winter temperature  
b. Autumn and spring temperatures

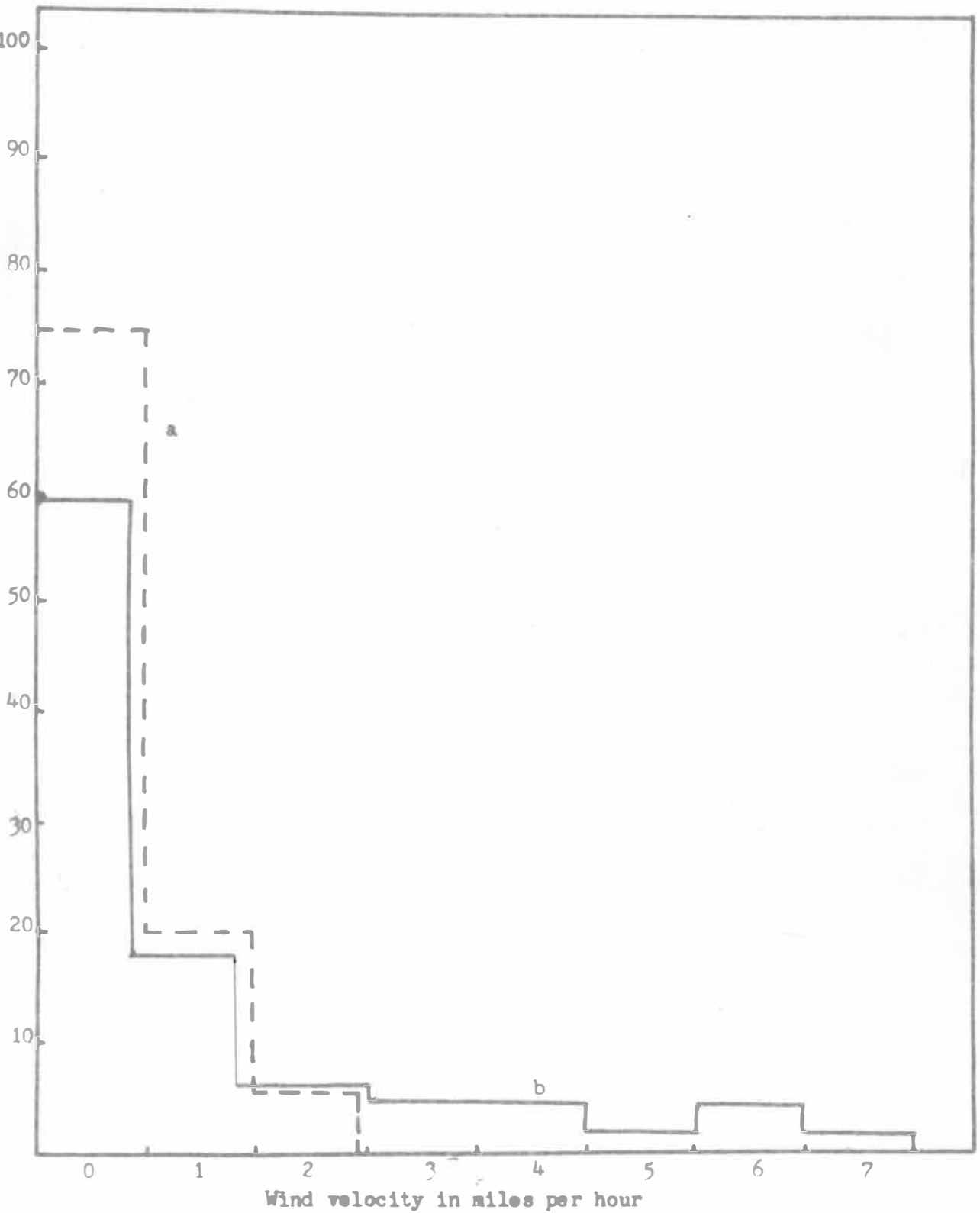


Figure 2. Microenvironmental wind velocity of resting sites of cottontail rabbits, autumn, winter, and spring.  
a. Average velocity  
b. Maximum velocity

was less than 70 foot candles (Figure 3). Of the 47 percent below 70 foot candles, almost one-half were found in situations in which light intensity was less than 10 foot candles.

Figure 4 compares light intensity and temperature. In Figure 4 as in Figure 1 there is a distinction between the data collected for autumn and spring, and for winter. In Figure 4, the data for autumn and spring are found in the upper right. This distinction may be due to the onset of the breeding and nesting season which occurs in early and in mid-March (Hamilton, 1940). During this season the rabbits move from the lowland to the upland (Friley, 1955). Linduska (1947) observed that rabbits moved to heavier cover from an open field situation as fall changed to winter. The decisive increase in light intensity is probably due lack of heavy overhead cover.

In the winter, light intensities of the day resting places were more diversified as temperatures decreased. Conversely, at higher temperatures rabbits were found in a more restricted range of light intensities.

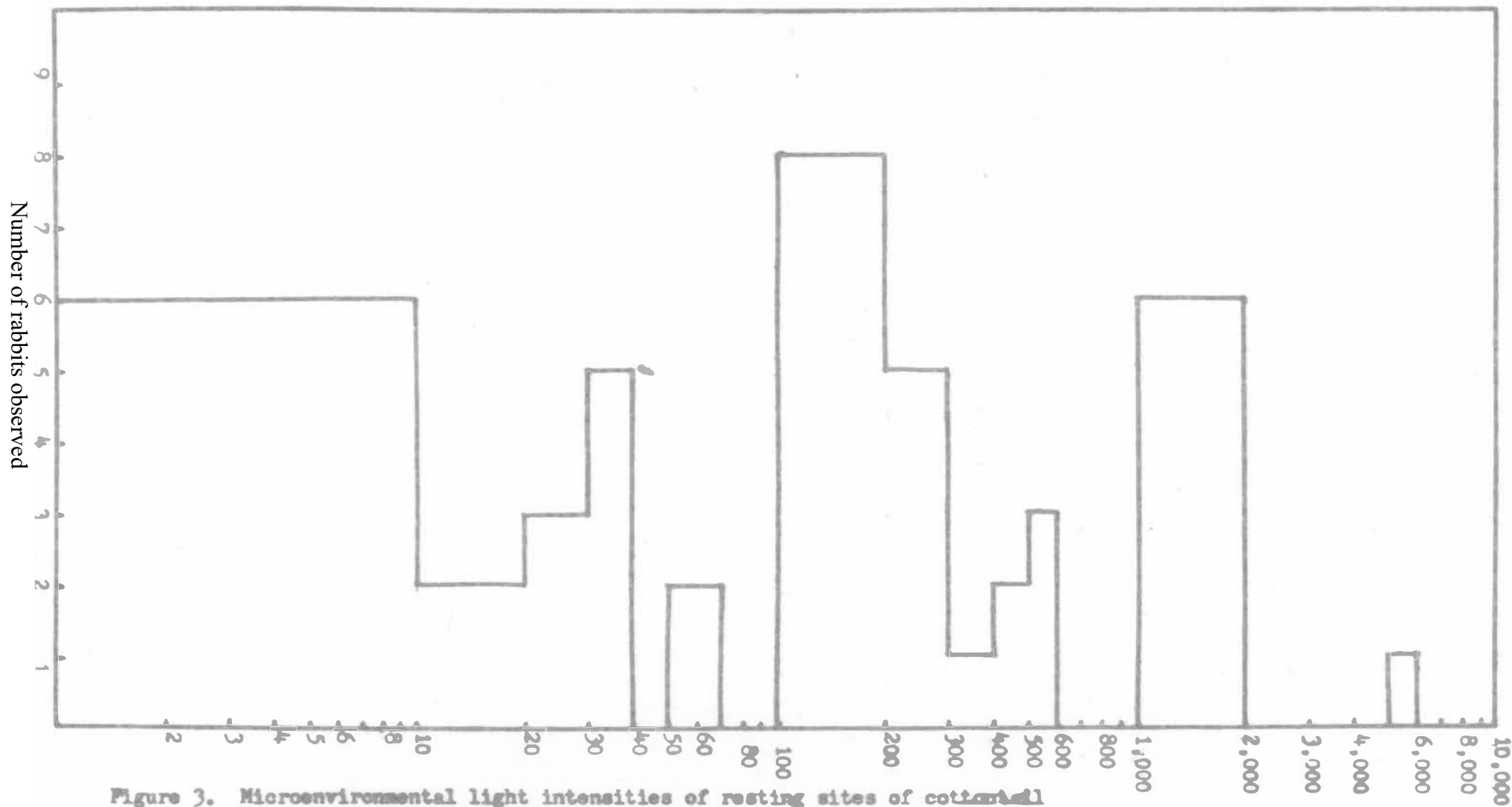


Figure 3. Microenvironmental light intensities of resting sites of cottontail rabbits, autumn to spring.

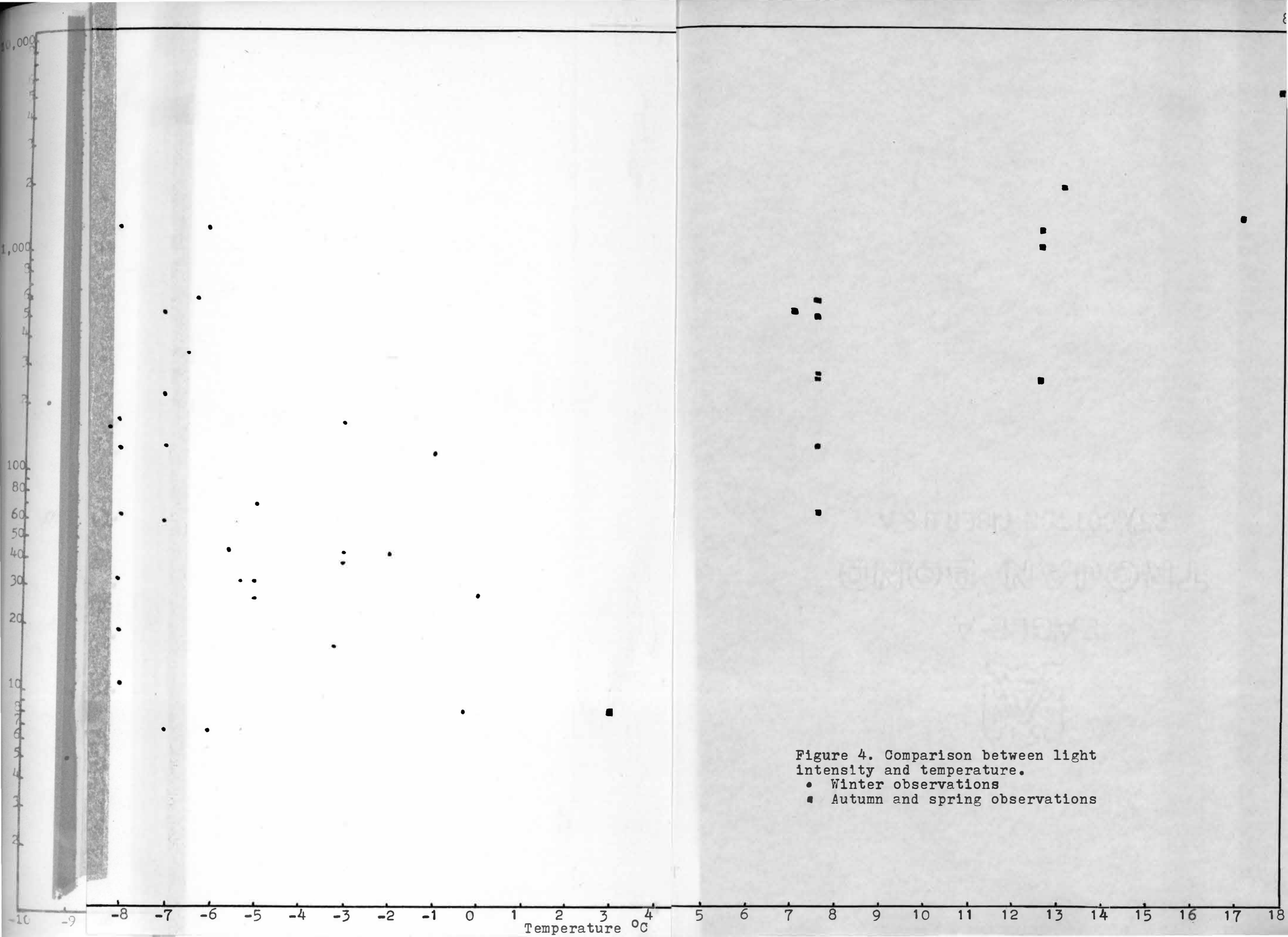


Figure 4. Comparison between light intensity and temperature.  
• Winter observations  
■ Autumn and spring observations

Light Intensity

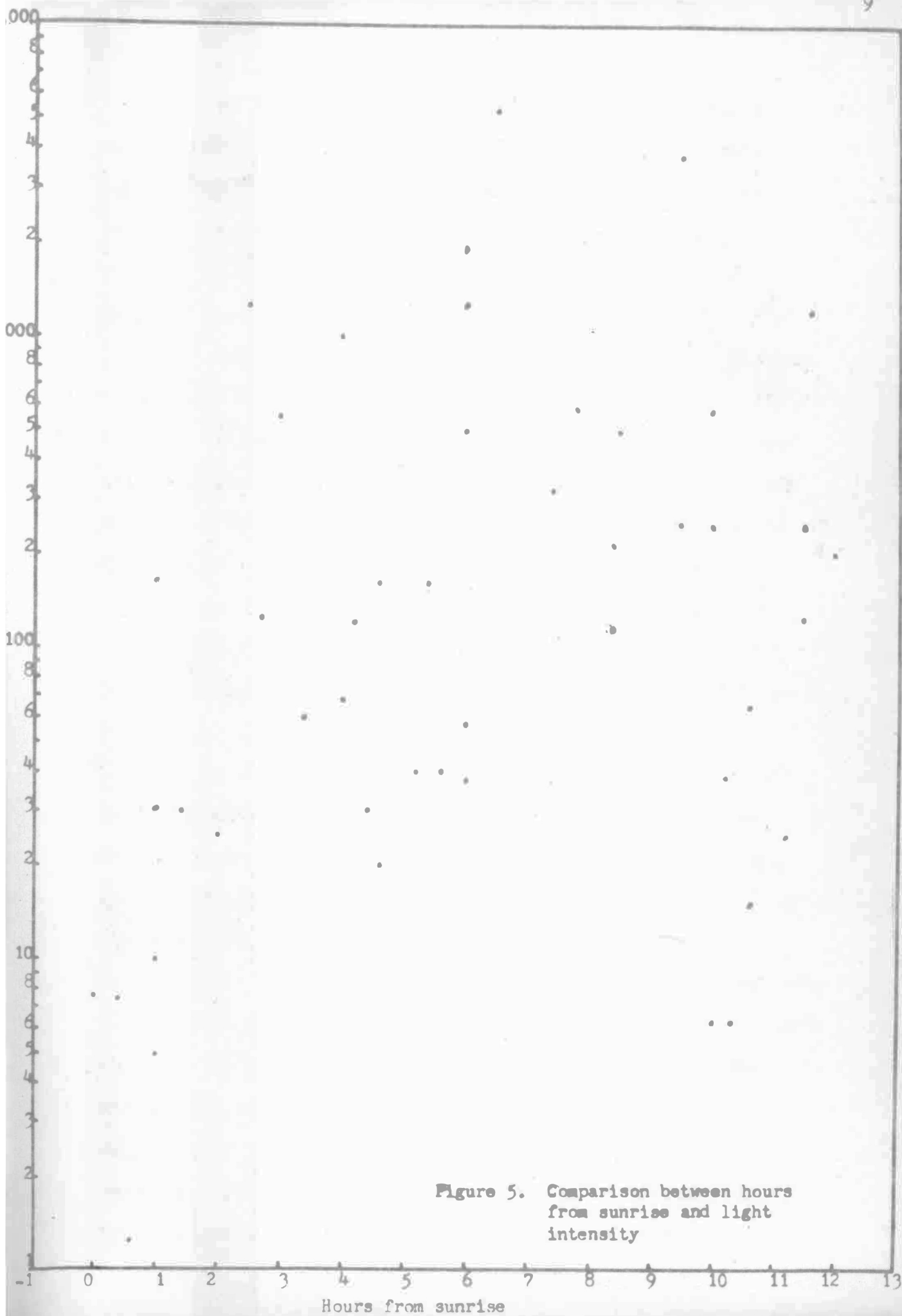


Figure 5. Comparison between hours from sunrise and light intensity

Figure 5 compares light intensity with the length of time from sunrise to the time when the rabbits were found. In the first two hours after sunrise all of the rabbits (except 1) were found at light intensities of less than 30 foot candles. Three to six hours after sunrise most of the rabbits were found at light intensities of 70 - 160 foot candles. Two hours after sunrise no rabbits were found in less than 20 foot candles. The two observations at ten hours after sunrise and 6.25 foot candles were recorded 20 minutes before sunset. In Figure 5, the numbers in parenthesis indicate the number of rabbits of each group excluded from the averages. Some of these rabbits were found in the spring and fall. Others were located in situations in which it was difficult to place the photometer in the exact location in which the rabbit was sitting.

As shown in Table 1, the average light intensity of the day resting places of cottontails is directly proportional to an increase in time from sunrise. From the data of Figure 5 and Table 1, it can be concluded that the rabbits probably find a resting place in the morning and remain in it throughout most or all of the day. If rabbits occupied resting places according to light intensity, there would be no increase in light intensity throughout the day. Therefore, when cottontails occupy a particular resting place, they probably are not limited by light intensity. Perhaps rabbits occupy a resting place for reasons which are not measurable in terms of physical factors.

It seems likely that rabbits occupy a daytime resting place in which the light intensity is the lowest light intensity of any place in the area.

Table 1. Average microenvironmental light intensities for each two hour period after sunrise. The numbers in parenthesis indicate the number of rabbits not included in averages.

Hours from sunrise	Average light intensity	
0 - 2	2.93	(1)
2 - 4	93.1	(3)
4 - 6	117.0	(0)
6 - 8	458.0	(0)
8 - 10	240.0	(1)
10 - 12	97.0	(1)

### Relative humidity

Relative humidity was calculated for only a few resting places because of mechanical difficulties. At the beginning of this investigation, a sling psychrometer was used, for temperatures above 20°F. For temperatures below 20°F, which did not register on the sling psychrometer, a hand aspirated psychrometer was used. When ice was on the wet bulb thermometer, there was no more than one-half degree Centigrade difference between the dry bulb and the wet bulb temperatures.

### Superstrate

The type of cover of each rabbit observed is shown in Table 2. Nearly twice as many rabbits were found in a



shrubby cover as in either of the other two categories.

During the fall, rabbits were found by the writer in a cutover area with uprooted tree stumps, brush and briars, and reverting to natural conditions. These observations are in line with those of Friley (1955).

The majority of the data were collected in the winter in a swamp area with a high wooded ridge on the west side. The brushy environment of the swamp gave the best protection and cover to be found anywhere in the area during the winter. As the brush became covered with snow, it formed an opaque covering for the hollows beneath, which explains the low light intensities.

On the ridge above the swamp there was evidence of much activity in the form of tracks, scats and evidence of feeding. Nevertheless only one rabbit was seen in this ridge area. All others were observed in the swamp during the daytime. It is possible to conclude that the ridge activity was nocturnal as is most of the rabbits' activity (Lord, 1961).

As the winter progressed, there was less evidence of nighttime activity on the ridge. According to Huber (1962), movement of cottontails decreases as snow increases.

Table 2. Superstrate classification of cottontail rabbits, autumn, winter, and spring.

Type of cover	Number of rabbits found		
	Autumn	Winter	Spring
Herbaceous	3	7	2
Shrubby (brush and briars)	4	17	4
Woodpiles and Stumps	1	9	0

## Food

During the winter, the cottontails barked the woody stems of their cover and cut off the stems of the plants on a 45 degree angle (Hendrickson, 1947; Todd, 1927). No rabbits were collected for food habit analysis nor were rabbits actually observed feeding; nevertheless indirect evidence suggests that the canes of Rubus and branches of trees reaching to the snow level were heavily used. This agrees with the findings of Trippensee (1938). No evidence was found that rabbits pawed through the snow for food as Hendrickson (1947) found.

## Predation

I found only two rabbits that had been killed during the winter. Both of these deaths were attributed to red fox (Vulpes fulva) since there were many red fox tracks at the remains. From the data of Hendrickson (1947), the primary predators of rabbits are red fox and horned owls (Bubo virginianus).

### Summary

1. From November 1961, through April 1962, the daytime resting places of 47 cottontail rabbits were observed in southwestern Michigan.
2. Temperature, wind velocity, and light intensity were recorded and compared as possible factors affecting the daytime resting places.
3. In comparing light intensity with temperature, it was found that at higher temperatures rabbits were located in situations of higher light intensity.
4. In comparing light intensity with length of time from sunrise, it was found that the rabbits probably found one of the places of lowest light intensity in the area and remained in this place for most of the day.
5. Nearly one-half of all rabbits were observed in shrubby superstrate.
6. Throughout the winter, rabbits removed the bark from shrubs and trees.
7. Evidence of predation by red fox was found.

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