ADAPTATIONS OF TERRESTRIAL ISOPODS
TO VARYING WAVELENGTHS
OF LIGHT

An abstract of a Thesis by
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The problem. The purpose of this investigation was to determine the response of terrestrial isopods that were subjected to prolonged periods of varying wavelengths of light, and to measure this adaptability by locomotor activity.

Procedure. Terrestrial isopods were randomly collected from their natural environments, placed in study chambers, and subjected to red, blue, green, white, and no light for three days. The isopods were then removed from the study chambers and placed on culture plates containing nutrient agar. The culture plates were exposed to a white beam of light in the center of the plate for five minutes. The distance traveled by each light-adapted sowbug in response to the white light was then measured.

Findings. Terrestrial isopods adapted to the red and blue wavelengths prior to exposure to the white light, showed statistically significant movement when placed on the culture plates. Isopods subjected to the green and white wavelengths, and to the dark, showed less statistically significant movement. The control isopods, those not exposed to the beam of white light, showed more locomotor activity than did the experimental isopods.

Conclusions. Terrestrial isopod behavior appears to be controlled by the environmental conditions of temperature and humidity and not so much by light and dark as previously reported. The isopods adapted to the red and blue wavelengths showed more significant locomotor activity. This is agitation due to the red and blue wavelengths as shown in other crustaceans. With the other isopods, results were very similar as long as the environmental conditions of temperature and humidity remained constant.

Recommendations. Additional studies of terrestrial isopods need to be conducted to determine the importance of temperature, humidity, and photo-negativity. Other research needs to be carried out to further examine the effects of blue and red wavelengths on terrestrial isopods and other crustaceans.

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A Thesis
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The School of Graduate Studies
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by
Sharon Jean Danielson
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INTRODUCTION AND REVIEW OF THE LITERATURE

Light, and its effects upon living things, has long been a source of study and experimentation, for all plants and animals show some form of photosensitivity. According to Wolken (1971) this sensitivity is shown in behavior as phototropism and phototaxis, photosynthesis, and hormonal stimulation, including growth, sexual cycles, flowering of plants, color changes, and any other behavioral phenomena.

It has been proposed by Mast (1938) that there are two different types of photic response in animals and both can be found in almost every animal that responds to light. One is quantitative, which involves an increase or decrease in activity, without orientation. This can be called a kinetic response, or photokinesis (Abbott, 1918). The other is qualitative and consists primarily of change in the direction of movement, either toward or away from the light. This is referred to as a shock-reaction, or phototaxis. Abbott goes on to include a third response even though it is not one shared by all animals, the response to some sort of image made upon photoreceptive cells, vision.

Experimentation by Mast (1938) led him to the conclusion that both photokinesis and phototaxis usually result in bringing the animals involved, especially the lower forms, into and keeping them in regions where the environmental conditions are favorable.

Terrestrial isopods, more commonly called sowbugs, pillbugs, or woodlice, are of special interest as the only Crustacea which have totally adapted to living on land (Abbott, 1918). However, even these isopods exist by avoiding typically terrestrial conditions, and are therefore prevented from fully taking advantage of the opportunities offered (Waterman, 1960).

Waterman (1960) and Green (1961) describe the Crustacea as a group possessing certain features which make terrestrial life at least possible. These include a hard exoskeleton, with the potential for being waterproof and the development of internal fertilization. But even within this class, certain groups are better adapted to terrestrial conditions than others, namely the land isopods. Not only have they developed a body structure convenient for locomotion on land and biting mouth parts for feeding on large particles, but they also have brood pouches within which the eggs develop in their own little private ponds. In this way the terrestrial isopod has truly been emancipated from water whereas others must at least return to the water to spawn.

On the other hand, Waterman (1960) explains that the terrestrial isopod has no satisfactory protection against evaporation from the surface: respiration is carried out by slightly modified gills, and the pseudotracheae are but short branches of tubes which do not extend further than the pleopods; the eggs must be carried by the parent; excretion is ammonotelic; osmotic changes cannot be controlled and must be tolerated; and high temperatures are endured only at the expense of high transpiration. Yet, in spite of their limitations, or possibly even because of them, the land isopod has learned to survive by special behavioral adaptations to become very abundant and readily available. Sowbugs can be found under almost any object that furnishes concealment and a certain amount of moisture and, as they are often found in houses it is not difficult to duplicate their natural surroundings in the laboratory (Abbott, 1918). They therefore, make an excellent experimental animal for behavioral studies.

Woodlice spend the daytime hours under stones, logs, and in other damp places because the majority are nocturnal (Cloudsley-Thompson, 1952). They come out at night from their hiding places and wander in dry areas where they are not usually found during the day. This is generally true of all sowbugs, but there is one exception, *Armadillidium vulgare*, this species is more resistant to desiccation than the others (Edney, 1951), and often appears out in the sunlight, early in the morning (Cloudsley-Thompson, 1951).

It has been suggested by Cloudsley-Thompson (1952) that if an animal shows a tendency to aggregate in certain localities as a result of physiological responses, it is therefore reasonable to expect a reversal or modification of these responses at some other time to account for the wide range of the species.

As early as 1918, Abbott showed that sowbugs react negatively to light by means of both photokinesis and phototaxis and that the response is the same for all light intensities. Cloudsley-Thompson (1952) supports this idea by demonstrating that a "composite diurnal locomotory rhythm" has been established in the woodlouse correlated primarily with alternating light and darkness. But light is not the only factor in determining the habitat of the sowbug, humidity and temperature also play important roles.

Experiments conducted by Waloff (1941) conclude that the danger of desiccation is a very real one to sowbugs, for not only are the respiratory organs affected, but there appears to be no control of loss of water through the cuticle, the loss of weight due to evaporation being proportional both to the time and to the relative humidity.

Porcellio scaber (Gunn, 1937), *Oniscus asellus*, and *Armadillidium vulgare* move about a great deal in dry air but slow down considerably as the atmosphere becomes more saturated (Fraenkel and Gunn, 1961; Carthy, 1962). They can also be seen to turn more frequently in higher humidities. These reactions are most apparent in *Oniscus*, and least obvious in *Armadillidium* which suggests the extent to which the isopods are adapted to land habitation (Carthy, 1962). Carthy proposes that the isopods least well adapted must have a compensatory behavioral mechanism which keeps its members in moist environments.

Just such a mechanism is described by Waloff (1941) as a reversal from negative to positive phototaxis shown in terrestrial isopods associated with water loss from evaporation.

Cloudsley-Thompson (1952) describes a similar mechanism leading him to the conclusion that the intensity of terrestrial isopod humidity responses decreases at night, or at least until the animals become somewhat desiccated, and this allows the sowbugs to be in dryer places than those in which they spend the day. Then, the increased photonegative response in darkness guarantees that the isopods will seek cover at daybreak. If their daytime habitat should dry up they are not kept there until they die from desiccation, they become photo-positive in dry air and are able to move in the open until they find some other damp hiding place when they again become photo-negative.

Similar conclusions have been reached by Fraenkel and Gunn (1961). Photo-positive reactions in terrestrial isopods occur particularly after a sudden rise in the temperature or after a period of starvation or desiccation.

With the decrease of the humidity response, and the increase of the photo-negative response, isopods take cover at daybreak. It is possible that this increase in the light response at night could be thought of as a kind of conditioning to darkness (Cloudsley-Thompson, 1952).

All photobiological phenomena including plant and animal phototropism, phototaxis, photosynthesis, and vision take place in the visible part of the spectrum, a very narrow band from about 3900 A to about 7600 A, with the maximum solar radiation around 5000 A. It is about this position in the spectrum that the photobiological phenomena cluster (Wolken, 1971). In terms of color, this wavelength produces green.

Within the spectrum of white light there are three primary colors; blue, with moderately short wavelengths, less than 5000 A, red, with extremely long wavelengths, about 6500 A, and green, approximately 5000 A (Mueller et al., 1966). It is this property of light, color, that is of primary importance in this paper.

Experimental research conducted by Mast (1917) showed that for fifteen different species of animals, including unicellular and colonial forms, worms and fly larvae, response to light was found to depend upon the wavelength, as certain spectral colors stimulate animal response much better than others. However, there is no evidence to indicate that these responses were not affected to a large extent by brightness, for when the intensity increased so did the animal's response.

Among the invertebrates, not including the arthropods and molluscs, Carthy (1962) has found that there is no positive evidence for clearly defined attraction to any certain wavelength. Yet, Carthy also shows that the effects of the various parts of the spectrum on the life activities of the lower invertebrates do appear to be different. For example, certain protozoans greatly increase their movements when approaching an area of red light while others show an increased activity in the presence of white light (Mast, 1917; Carthy, 1962).

Experiments conducted on certain coelenterates, Hydras, seem to show some evidence of color preference (Carthy, 1962). When colored glass filters were placed against a tank containing hundreds of individuals, the coelenterates would gather on the walls over the area exposed to the blue light. Further investigations by Carthy, with increased efforts to control light intensity, have shown this response to be a true choice of wavelength and not brightness.

The earthworm is an example of an animal that is essentially photo-negative, yet when exposed to the color spectrum the earthworm draws away from the blue colors and tries to leave the light at the red end (Mast, 1917). Light passed through a red filter doesn't seem to bother them, but a blue light will cause them to immediately retreat into their burrows (Carthy, 1962).

Investigations conducted using echinoderms and molluscs were considered inconclusive, again due to the lack of control of brightness. However, in each instance the blue end of the color spectrum was selected for and the red end avoided (Carthy, 1962).

Of the animals considered by Carthy, none appear to distinguish color in their life activities. They do not change their color for camouflage, use color for sex determination or courtship, or seek out highly colored prey. Therefore it is not surprising that there is no definite evidence of color preference among these groups.

An exception occurs in the cephalopod molluscs (Carthy, 1962), for many can change their body color to match the background by using their chromatophores. Octopuses have also been trained to discriminate from among green, yellow, blue, red, and black discs, so that they avoid one or the other. No attempts were made to eliminate the possibility that the animals were reacting to the brightness of the discs, and therefore, this cannot be used as proving the existence of color vision.

There are many descriptions of the phototactic behavior of a great number of crustaceans that have been exposed to the color spectrum (Waterman, 1961). Positively phototactic forms including cladocerans, cirripeds, amphipods, mysids, and decapods typically aggregate in the green and yellow-green wavelengths with less in the blue and violet, and an even greater drop toward the red wavelengths (Mast, 1917).

Wavelength discrimination behavior patterns of some crustaceans, including Daphnia, have been studied by Smith and Baylor (1953) and called "color dances". Daphnia were shown to be phototactically repelled by short wavelengths and attracted by long, while being independent of a considerable intensity range. The ecological significance attributed to this wavelength discrimination is that it provides an adaptive advantage for phytoplankton feeding.

Much of the work carried out by Waterman (1961) on crustacean spectral sensitivities does not meet the criteria of adequacy because of uncontrolled light intensities and poorly defined wavelengths. Thus, the limits of spectral sensitivity in most crustacea are not known.

The animal group having the most to do with plants and particularly the colored flowering plants are the insects (Carthy, 1962). The visits of pollen and nectar collecting insects to brightly colored flowers led to the conclusion that they are capable of perceiving color as such. Also, the larvae of some Lepidoptera show a definite preference for a particular colored background. Some insects have been shown to have preferences for one color during one activity and for another during a different activity. Many butterflies will search out a green, blue-green background on which to lay her eggs, while choosing blue-violets and purples when feeding. Still others show no preference at all for any particular background color. Only a very few insects seem to have no color vision.

According to Mast (1917) the lowest forms in which color vision have been clearly established are the honeybees.

The results obtained from the various investigations show that the reactions in nearly all species studied are dependent on wavelength, certain colors are better stimulating agents than others, but they are not entirely dependent on wavelength, for the stimulating effect on either side of it can be made greater by simply increasing their intensity (Mast, 1917; Carthy, 1962).

Terrestrial isopods are one type of organism that have been ignored by the literature as far as wavelength adaptation is concerned. It would appear that since the terrestrial isopod has been shown to be nocturnal and photo-negative that there has been very little or no interest in determining whether or not there is a wavelength sensitivity.

It was the purpose of this research to determine the response of terrestrial isopods that were subjected to prolonged periods of varying wavelengths of light, and to measure this adaptability by locomotor activity.

METHODS AND MATERIALS

Terrestrial animals which normally seek habitats in areas of reduced light, respond to stimuli which frequently can be measured by behavioral responses. Some arthropods have shown phototropic reactions and isopods are one group which serve as good experimental models for stimulus-response studies.

From mid-June to mid-July, 1974, terrestrial isopods were collected from the West and Central Des Moines area. The major collecting site was near an old run-down garage and the isopods were found beneath boards that had been laying on the ground for several weeks. Other isopods that were collected came from a rotting pile of leaves and grass clippings. The first collection, in June 1974, of approximately 250 isopods, was made to start a laboratory culture that could be used throughout the duration of the investigation. Each of the following four collections, of approximately 100 isopods each, were made not more than one week prior to their use in the experimentation. These later collections were then added to the laboratory cultures to replace those that had already been used or others that had died. At the time of their collection no specific selection was made as to size, color, or classification; any terrestrial isopods that could be found were collected by hand, and placed in white plastic two liter round containers.

Two storage containers were maintained in the laboratory at 26° C. Each container had a white plastic lid with the center section removed to within 2.5 cm of the edge which prevented the isopods from escaping. The containers were filled to approximately three-fourths capacity with the soil and decaying matter that was found in the isopod's original habitat. The isopods were randomly divided between the two cultures as collected.

In its natural habitat the isopod requires a great deal of moisture as it breathes using gills. Every 48 hours, 20 ml of tap water was added to each container. Small amounts of decaying leaves and grasses were also added to each container once each week for food as the isopod is a scavenger, a detritus eater. No other attempts were made to treat the cultures in any special way and the cultures were maintained under normal laboratory conditions.

General observation throughout the investigation did not reveal any unusual behavior and it appeared as though the isopods had adapted to the new artificial habitats. A few days after the cultures were established many broods of young terrestrial isopods were observed. Throughout the entire experiment young isopods could always be seen and very seldom was a dead one ever found; the survival rate was very high. It was also noted that all isopods maintained their normal preference for darkness thus avoiding any areas exposed to the light. From everything that was observed the isopods were reacting as they would be expected to react in their natural environment.

According to Pratt (1935) the isopods, sowbugs used in this study, were identified as belonging to one of three families:

1. Porcellionidae, body flat and oval with the antenna flagellum in two segments, long uropods.
2. Oniscidae, body flat and oval with the antenna flagellum in three segments, long uropods.
3. Armadillidiidae, convex body able to be rolled into a ball; first antennae very small and the second antennae short, short uropods.

Some of these characteristics are obvious on sight while some cannot be identified without detailed observation. As nearly as possible, all collections were randomly made, and representatives of all three families were included in this study.

The ecological habitat of these families is similar, and since all occurred together in the same environment, species identity was not used in the study. The only criteria used in selecting the sowbugs for this study was size. Adult isopods between 1.0 cm and 1.5 cm in length were used for convenience. After the isopods were used for any one experiment they were discarded and for each investigation, new sowbugs were selected to prevent any chance of learned behavior.

The experimental study chambers were made from five commercially available 27 cm x 22 cm x 11 cm rectangular shaped clear plastic disposable mouse cages. The cages were open on the top and a tight fitting 2.5 cm thick white plastic foam was placed at the bottom. The outside of each cage was covered with brown wrapping paper and secured with transparent tape.

For each experiment the foam layer was saturated with tap water, which provided the necessary moisture for the sowbug's respiration. Every 24 hours throughout the experiment 10 ml of tap water was added to the foam layer to maintain the moisture, since the lights used in this study caused a more rapid than normal rate of evaporation.

Food was also added to the study chambers at the beginning of each experiment. It was determined from observations of the laboratory cultures that decaying leaves and grass clippings would need to be added to each group of sowbugs every three days. So that none of the food would be large enough for the sowbugs to hide under it was ground, by hand, with a mortar and pestle and then scattered evenly over the foam bottom.

The study chambers, approximately 1.5 meters apart, were situated on a laboratory table top. There was the chance that the scattering of different lights would interfere with one another, so the chamber sides were covered with paper as previously noted. At the completion of each experiment the study chambers were emptied, rinsed with tap water, dried with standard laboratory brown paper towels, and then used again.

The sowbugs remained in the study chambers for 72 hours and during that time the mortality rate was low. The maximum that died in any one chamber was two specimens. There were no unusual problems, and except for the soil, conditions were very similar to those in the laboratory cultures.

The light sources used in this investigation were General Electric 25 watt transparent glass light bulbs (blue, green, red, and white) placed in standard laboratory gooseneck lamps. Visible white light has a wavelength of from 3900 A to 7600 A (Weber et al., 1959) and within that range are found the three colors that were used in this experiment; blue, green and red. The specific wavelength for the colors used in the study was not determined.

Culture plates, standard 110 x 15 mm disposable clear plastic petri plates containing nutrient agar, were prepared using the standard procedure given for Bacto Nutrient Agar (Difco Laboratories, Detroit, Michigan). The agar was sterilized at 15 pounds pressure for 15 minutes and following transfer, the poured cooled nutrient agar plates were stored in the laboratory refrigerator. When needed, the culture plates were removed from the refrigerator and allowed to warm to room temperature before being used.

Experimental procedure. Fifteen isopods were placed, using a forceps, into five experimental study chambers. Chamber number one was placed in a closet without light.

Chambers two through five were exposed to blue, green, red, and white lights respectively positioned 16 cm above the table. These positions were maintained for 72 hours and during this time the room temperature was recorded every 24 hours using a standard laboratory Celcius thermometer.

On the fourth day after the sowbugs had been conditioned to the various light sources; no light, blue, green, red, or white, 10 isopods were chosen at random from each study chamber. Using a forceps they were placed one at a time in the center of each of 10 culture plates. Each sowbug was exposed for five minutes to a white beam of light, three centimeters in diameter, produced by a Bausch and Lomb stereoscopic microscope light, which was set on number three intensity. This was done to measure the response of the sowbugs after having been exposed to different wavelengths of light and also to observe if there was a change in their behavior. The eleventh isopod from each study chamber was put through the same procedure, but without light. The isopods were then removed, using a forceps, and the culture plates were incubated at room temperature for 48 hours. At the end of this time period each plate was read to determine the distance sowbugs had moved. When all exposed plates were completed, the used sowbugs were discarded, and the study chambers were cleaned.

The distance traveled by each light-adapted sowbug in response to the white light was measured by using a Keuffel and Esser Company map-reader, calibrated in centimeters, by following the path of bacterial colonies that had developed as a result of the isopod movement on the culture plates. From previous observations it was determined that more than six colonies per centimeter indicated that the sowbug had been over the area more than once.

The procedure described was repeated four times for a total of five trials. Measurements were determined for the distance moved by the sowbugs in response to white light stimulus following conditioning in red, blue, green, or white light.

RESULTS

Terrestrial isopods were studied to determine the effects of color upon isopod movement. The isopods which were exposed to varying wavelengths of light showed a variety of locomotor responses. These responses are shown in Table 1 where the mean distance traveled by the isopods which were adapted to each different light source, is given.

Upon examination of the data for each individual trial, the terrestrial isopods adapted to the white light show the least movement; the control isopod of trial five moved 10 cm, while the experimental isopods traveled 20 cm. The greatest locomotor activity, 48 cm, is shown by the control isopods of trials one and four, adapted to blue and green light, and by the experimental isopods of trial one, adapted to the dark, 36 cm.

Further examining the individual trials the greatest range variance occurring in the experimental isopods, 14 cm, occurs with those terrestrial isopods adapted to white light, while the greatest range variance found in the control isopods, 21 cm, occurs with those terrestrial isopods adapted to green light. However, for the blue, green, and red lights, the individual trials for the experimental isopods, do not vary from one another by any more than 8 cm or any fewer than 6 cm.

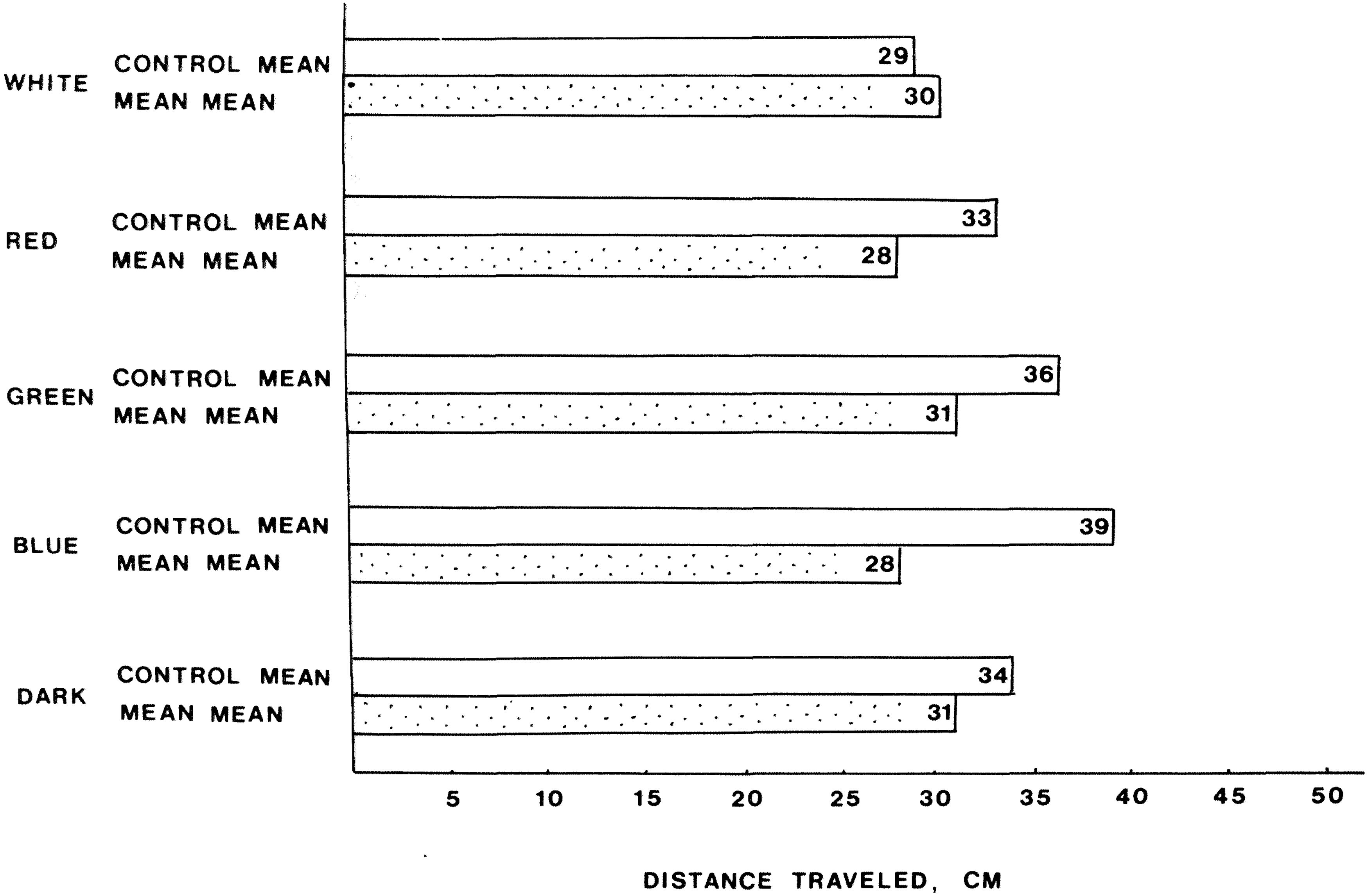
A study of the total trials as shown by the data in Table 1 and in Figure 1 shows that there is 23 cm more distance traveled by the control isopods adapted to the different lights than traveled by the experimental isopods. The greatest movement of the control isopods, 39 cm, comes from adaptation to blue light and the least movement of the control isopods, 29 cm, comes from adaptation to white light.

Considering the means of the total distances moved by each group of terrestrial isopods, the control groups generally show a much greater distance movement than do the experimental groups. In each instance the control group of isopods has either the same or longer mean distances traveled, than does the experimental isopod group. The longest mean distance traveled by the experimental isopods was adapted to green light, 31 cm, while the longest mean

Table 1. Mean distance traveled (cm) by terrestrial isopods following light adaptation and subsequent exposure to white light in a controlled environment.

LIGHT	DARK	BLUE	GREEN	RED	WHITE
TRIAL ONE					
Control	42	48	30	35	30
Experimental Mean	36	27	32	30	25
TRIAL TWO					
Control	38	36	44	27	30
Experimental Mean	30	27	31	27	32
TRIAL THREE					
Control	30	39	29	33	36
Experimental Mean	28	30	34	24	34
TRIAL FOUR					
Control	39	36	48	34	37
Experimental Mean	33	25	32	31	27
TRIAL FIVE					
Control	21	35	27	34	10
Experimental Mean	26	31	26	29	20
TOTAL TRIALS					
Control Mean	34	39	36	33	29
Experimental Mean Mean	31	28	31	28	30

Figure 1. Total mean distance traveled (cm) by terrestrial isopods following light adaptation and subsequent exposure to white light in a controlled environment.


WHITE
CONTROL MEAN
MEAN MEAN
29
30
RED
CONTROL MEAN
MEAN MEAN
33
28
GREEN
CONTROL MEAN
MEAN MEAN
36
31
BLUE
CONTROL MEAN
MEAN MEAN
39
28
DARK
CONTROL MEAN
MEAN MEAN
34
31
5
10
15
20
25
30
35
40
45
50
DISTANCE TRAVELED, CM

distance traveled for the control isopods was adapted to blue light, 39 cm.

Comparing the total trial results obtained from the white light and those obtained from the dark, it appears as though the mean distance moved, both by the control isopods and by the experimental isopods is very much the same, while the total trial results obtained from the different colors, blue, green, and red, differ greatly.

Within the total trial results for each individual light source the white light shows the least amount of difference from the control, one centimeter separates the control isopods from the experimental isopods. The blue light shows the greatest variability with a difference of 11 cm between the control isopods and the experimental isopods.

Table 2. Standard deviations (cm) from the means of the total trials of terrestrial isopods adapted to different wavelengths of light.

	DARK	BLUE	GREEN	RED	WHITE
Control Group	8.54	5.36	9.67	3.24	10.91
Experimental Group	4.00	2.45	3.00	2.78	7.20

Comparing the standard deviations given in Table 2 to the data in Table 1 it is to be noted that all entries are within two standard deviations of the mean. The greatest range variance occurs with green light, the standard deviation for the control group is 9.67 cm, while the standard deviation for the experimental group is 3.00 cm.

Table 3. t-test confidence levels for the means of the total trials of terrestrial isopods adapted to different wavelengths of light.

	DARK	BLUE	GREEN	RED	WHITE
t-test Confidence Level	60%	99%	80%	99%	20%
P	0.941	4.604	1.533	4.604	0.271

From Table 3, both blue light and red light show better than 99% significance, while white light is the lowest with a 20% confidence level.

Referring to Table 1 and Figure 1, the most obvious results appear to be that the overall locomotor activity of the experimental isopods is similar, while there is a definite variance in the activity of the control isopods.

DISCUSSION

Terrestrial isopods have been reported by various authors as being photo-negative, in other words, repelled by light. The authors also suggest that during times of environmental stress the isopods may react in the opposite manner and become photo-positive. These observations have been accepted as accurate, but it is possible that the sowbug may be influenced more by factors other than light.

Temperature and humidity are two major factors in the successful survival of a terrestrial isopod. If the humidity is too low the sowbug cannot carry on respiration and if the temperature changes drastically the sowbug is faced with freezing or desiccation. Darkness, or the shelter of dark places, usually supplies the temperature and humidity conditions necessary for the sowbug to survive and therefore the sowbug is naturally attracted to these areas. Green (1961) observed that some terrestrial isopods will venture out into the sunlight and remain there if they can tolerate the environmental conditions, or possibly, if the environmental conditions are similar to those found in dark places.

Assuming that these observations are correct, it would then appear logical that one of the primary driving forces of the sowbug would be to maintain the proper temperature and humidity necessary for respiration. The terrestrial isopods could be expected to respond to different light wavelengths in much the same manner as other crustaceans considered to be photo-positive. But, even if these observations are not correct, there is nothing in the literature to suggest a difference between photo-negative and photo-positive crustaceans in their responses to different light wavelengths.

Photo-positive crustaceans have been shown by Mast (1917) to be attracted to the green and yellow-green colors of the spectrum while being repelled by the blue and red colors of the spectrum. Since the concept of photo-negative responses and photo-positive responses could be a debatable one, it is possible to conceive that the terrestrial isopods might respond in a similar manner as the photo-positive crustaceans to the spectrum colors of green, red and blue. It would then follow that terrestrial isopods placed in the study chambers and exposed to red and blue lights would be very agitated and therefore exhibit a great deal of locomotor activity, while terrestrial isopods exposed to the green light would be less affected and would not exhibit as much locomotor activity.

When the control isopods were removed from the study chambers and placed on the culture plates it is possible that each was still under the influence of the different light wavelengths, consequently, the control isopods exposed to the red and the blue wavelengths show more significant movement on the culture plates than do the control isopods exposed to the green wavelengths.

Considering the results of the experimental isopods it is logical to conclude that the effects of the colored lights were not lasting. When each animal was subsequently exposed to the white beam of light the results exhibited by the isopods were simply reactions to that white beam of light and to the conditions of each culture plate. It is also logical to assume that the effects of the beam of white light over a five minute time period would create a certain amount of heat which would cause a rise in the humidity on each culture plate. Therefore, once the sowbug had moved out of the beam of white light its locomotor activity would be slowed, possibly even stopped, thus showing the shorter distances traveled by the experimental isopods.

Examining the results of the terrestrial isopods adapted to the light and to the dark, where the temperature and humidity conditions were kept the same for each, it seems likely that the light, or the absence of the light, did not have a significantly different effect upon the sowbugs since the results are very nearly the same. This seems to support the idea that the reaction to the light is secondary and constitutes a response meant to keep the sowbug in an area with the proper humidity.

The conclusions expressed thus far have been substantiated by the t-test, a statistical test of significance. The results of the terrestrial isopods adapted to the red wavelengths and to the blue wavelengths have been shown to be significant at better than the 99% confidence level.

It would appear that different light wavelengths are of little consequence in measurements of sowbug locomotion. Restricted to a humid environment, the terrestrial isopod is forced to seek out conditions where light is most often absent. Still, these experiments show that if and when the opportunity does present itself, the sowbug does react to different light wavelengths showing locomotor activity when exposed to some wavelengths more than when exposed to others.

There was variability in the distances traveled by the isopods throughout the investigation as indicated in Table 1. The reason for this variability is unknown; one may speculate that the temperature or the humidity of the room, the light in the room due to the time of day, the activity in the room, or other factors may have influenced the reactions of the isopods. Further studies should be carried out to identify isopod responses to induced stimuli.

SUMMARY

The purpose of this investigation was to determine the response of terrestrial isopods that were subjected to prolonged periods of varying wavelengths of light, and to measure this adaptability by locomotor activity.

Sowbugs were collected, subjected to varying wavelengths of light, exposed to a beam of white light on a nutrient agar culture plate, and finally, the total distance traveled was measured.

The control isopods showed more locomotor activity than the experimental isopods, and the control isopods exposed to the red and the blue wavelengths showed the most statistically significant movement.

In these experiments it has been shown that terrestrial isopods react differently to varying light wavelengths with the most significant locomotor activity occurring with those isopods adapted to the red and to the blue wavelengths.

This investigation suggests additional research is needed to determine the environmental requirements of terrestrial isopods.

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