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Rearing of Wolf and Lynx Spiders in the Laboratory (Families Lycosidae and Oxyopidae: Araneida)

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THE REARING OF WOLF AND LYNX SPIDERS IN THE LABORATORY (FAMILIES LYCOSIDAE AND OXYOPIDAE: ARANEIDA)[1, 2]

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The only way to obtain accurate information on the duration and number of instars in the life history of a spider species is to rear individuals of that species. In our search for information on the life cycle of wolf and lynx spiders, the rearing of several thousand individuals in the laboratory was necessary. Certain species are much more difficult to rear in captivity than others. However, we have not yet found a species that will not live and mature in the laboratory. Daily individual attention is required, if for no other reason than to keep records complete, but in addition to this, the practiced eye can tell whether a given container is too wet or too dry or whether the spider has other needs.

The literature on methods of rearing cursorial spiders is widely scattered among books and journals. Many of the most informative articles have been published in Europe. The work of Bonnet (1927, 1929, 1930a, 1930b) is particularly well known. Other especially useful articles are those by Berland (1922), Kolosváry (1927), Savory (1926, 1928, 1964), Gerhardt (1924, 1925, 1926, 1927, 1928, 1933), Wiehle (1909), Hull (1938), Potzsch (1964), and others. New techniques are being developed by such investigators as Engelhardt (1964), Holm (1952), Braun (1961, 1963), Papi and Syrjaemaeki (1963), Papi and Tongiorgi (1963), Baccetti et al. (1962), Magni et al. (1962), and others. In the United States, various workers have found the papers of Baerg (1937, 1938, 1958, 1963) very valuable. Techniques described in conjunction with reports of specific experiments are sometimes the most useful of all. In this connection, papers by Petrunkevitch (1911), Kaston (1936), Montgomery (1903), Deevey (1949), and others should be mentioned.

TYPE OF CONTAINER

Wolf spiders must be reared in individual containers. From the time the spiderlings leave the female's back, they are inclined to prey on each other. Mature males and females are kept together only during courtship and mating. We found the type and size of the container relatively unimportant, as long as it is large enough to allow the spider to move about freely and small enough and tight enough to make adjustment of the humidity possible. For small immature spiders, we

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prefer the tops of pint cardboard ice cream containers covered with petri dish lids. For large spiders, we use half-pint and pint ice cream boxes. For those hunting spiders that prefer to live on plants, we use gallon cardboard containers covered with glass plates. Inside each container, a branch of the preferred plant is placed in a small jar of water. Cotton placed in the jar mouth, well above the water level, prevents the spider from drowning.

MOISTURE

Moisture can be a critical factor; it is important for drinking and for maintaining correct air humidity. Ample drinking water is required by all species of wolf spiders with which we have worked. However, some species can live longer without water than others. We use a small piece of wet absorbent cotton in the water to allow the spiders easy access to the moisture without the risk of drowning. The cotton must be changed every three days. Air humidity appears to be very important. As reported by Kaston (1965) for spiders in general, the requirements vary sharply from species to species; too much humidity is as serious a problem for some species as too little is for others. **Pardosa lapidicina** Emerton will survive only a few hours in a dry atmosphere. **Lycosa rabida** Walck. and **L. punctulata** Hentz cannot be reared satisfactorily in a moist atmosphere. The natural habitat can give a clue to humidity requirements. Swamp or shore-dwelling species and spiders that dwell permanently in the ground need more humidity than do other species. In any event, if the air humidity remains under the minimum requirement of the species for a prolonged period, the spider goes into a "nervous dance" and dies.

FOOD

Lack of proper or sufficient food is probably the most crucial item in the rearing of cursorial spiders. The feeding problem is particularly acute with spiderlings that have freshly emerged from the egg sac. The young of some species do not need food at once, but others must be fed immediately to prevent a very high mortality rate. It is often difficult to find small enough prey for the freshly emerged young of some species. We had to resort to the flower thrips, **Frankliniella tritici** (Fitch), as prey for second-instar **Oxyopes salticus** Hentz. Many arachnologists solved this problem by allowing the spiders to feed on their siblings. This was quite successful, but if one is attempting to follow an individual throughout its life history, the method is much too risky, since the wrong spider may be killed. The use of deutova (spiderlings which have not yet emerged from the egg sac) of the same species or closely related species solved the matter nicely. The larger spiderlings invariably feed freely on the deutova, and the deutova, since they are without mouthparts, cannot injure the reared spiderlings. In our rearing, however, deutova are used only when other food is unavailable or unacceptable. Much of the time, small flies, crickets, or lepidopter-

For both spiderlings and mature spiders, a constant food supply is a necessity. This means that prey must be reared. We depend on five cultures; these include two species of **Drosophila, D. hydei** Sturtevant and **D. melanogaster** Meiger; house flies, **Musca domestica L.**; house crickets, **Acheta domesticus** (L.); and the fall armyworm, **Spodoptera frugiperda** (J. E. Smith). We are experimenting with a strain of wingless **Drosophila melanogaster** and with the Mediterranean flour moth, **Anagasta kuehniella** (Zeller). We use moths and beetles from light traps as variants of the diet.

Possibly the most difficult aspect of the feeding problem with older spiderlings and adults is that the effect of less than minimum amounts of food may not be evident for three or four months, when it is too late. Although plenty of food may be offered a week or two before death, apparently many wolf spiders cannot consume more than the tiny amount to which they have become accustomed, even though they are dying of starvation. This is especially serious, since each species has its own critical periods when it must have ample food. This means that preliminary rearing is necessary in some cases to find when these critical times occur. All females, however, must have ample food before the egg sacs are made; otherwise they will fail to construct the egg sacs properly or will destroy them.

SANITATION

Wherever large numbers of animals are handled, disease can be a problem, and spider rearing is no exception. No matter how careful we are about cleanliness, we still lose some spiders from fungi, bacteria, or mites. The first step in reducing these problems is that of ample food and good care; this can be difficult if the natural food and environment are unknown. At the same time, every precaution must be taken to reduce contact with disease-causing organisms. New ice cream boxes are used only once and are then thrown away. Plastic petri dish covers can be thrown away but are generally sterilized and used again. The absorbent cotton is no problem, since it comes from a new roll. However, when there is danger of disease, the cotton cannot be tossed in the bottom of the box. When wet cotton comes into contact with the juices of insects the spider has killed, it forms a very good medium for the growth of many fungi. This can best be avoided by placing the wet cotton in a small sterilized, bakelite dish. For routine situations, we depend on changing containers once or twice a week. In all, eight fungi gave us trouble:

Aspergillus flavus
Aspergillus niger
Aspergillus sp.
Penicillium sp.
Beauveria sp.
Akanthomyces sp.
Hymenostilbe sp.
Rhizopus nigricans

Aspergillus flavus appears to be the most serious problem. Dusting or spraying the spores of this fungus on the food of **L. rabida** was followed by approximately 50% mortality within 30 days. This fungus was then recovered from each of the dead spiders. The two bacteria cultured from diseased spiders have not yet been identified.

Mites of the families Acaridae and Anoetidae give us continual trouble. They enter the spider cultures on insects intended as food. They attack and kill eggs and young spiderlings. Cleanliness must begin in the insect cultures. Often, we must substitute a different method of rearing the insect. For example, we now rear the fall armyworm on culture media instead of on succulent corn. The use of sulfur in the fly and cricket cultures has helped.

TEMPERATURE

Temperature is a critical factor, not because of the danger of spider mortality, but because of the difficulty of duplicating nature. The duration of egg incubation, of instars, and of the preovipositional period may be shorter in the continuous warmth of a heated room than in a pasture with its fluctuations in temperature. A constant temperature chamber makes the situation worse. Fortunately, much spider activity occurs in nature at about 20°C., which is normal room temperature; therefore, the distortion of the life cycle in the laboratory is not as serious as it might be. The greatest deviation from nature occurs during winter rearing. After four months of continued spring-like temperatures, the laboratory spiders may be two or three instars ahead of their siblings outdoors. However, if a spider is exposed in a box outdoors to temperatures much below freezing, it will not survive. The newer types of programmed temperature boxes, in which a history of outdoor temperature fluctuations can be duplicated upon demand, should help solve the problem.

MEASUREMENTS

Without an indicator of body size to compare the different stages of development in a given species, laboratory rearing would lose much of its value. Body weight is useless because of the immediate effect of food intake. Several linear characters were compared by Dondale (1961) for use as indicators. He found carapace width especially satisfactory. Since we found carapace width easier to measure than other factors, and since it is quite constant between individuals in the same stage of development, carapace width measured with an ocular micrometer was consistently used in all our laboratory rearing.

CONCLUSION

In conclusion, it can be stated that spider rearing requires much individual attention if an accurate account of the life history is to be obtained. Variations in food intake and other factors can change the number and length of instars. Care must be taken that all factors are as near optimum for each individual as possible. For this reason, we have obtained much more accurate results by rearing 30 individuals rather than 300 of any given species.

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