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RESEARCH ARTICLE

Collection and Rearing Practices with Spiders and their Maintenance in Laboratory Conditions

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Abstract

The study of distribution and diversity of spiders and preparation of certain eco-safe tactics for their mass-propagation have drawn attention of many field workers in different parts of the world, so that human being can use them at large scale in various fields such as bio-control of pests, silk production, ecological sustainability. Resulting of the degradation or destruction of the species habitats by some human activities, biological species are being threatened continuously at an unprecedented rate. To ensure the effective conservation of biodiversity, the distribution pattern and biological aspects for each species needs to be accurately documented.
Specific documentation for each spider species can be obtained either when collecting the spiders in their natural habitat or from researchers experiencing in laboratory with that species. Our present study provides the necessary information regarding collection and rearing of spiders, obtained during our study on spiders in Shekhawati Aravalian region of Rajasthan, India, which was made from March, 2010 to April, 2013.

Introduction

Spiders occupy virtually every habitat with wide range of life styles, behaviors and morphological and physiological adaptations. Spiders are carnivorous and dominant on invertebrates, predators of insects and other arthropods in every ecosystem in the world. Spiders undoubtedly have a direct impact on human affairs because insects constitute their major source of prey, thus spiders regulate insect pest population in natural and agricultural ecosystems. Diversity of spiders shows certain associations between their population composition and structural complexity of the plant community (Chew, 1961; Riechert and Reeder, 1970). There is great scope for the systematic exploitation and conservation of biodiversity, since human technological capacity can make use of it in various fields such as agricultural -improvement, pest-management and environmental-aspects. But, a number of biological species are unidentified yet and some are disappearing continuously at an unprecedented rate. By the end of this century, the Earth may well lose 1 million species (Myers, 1984). It results from the degradation or destruction of a species habitat by some human activity such as agriculture. To ensure the efficient use and effective conservation of biodiversity, the distribution of species needs to be accurately characterized and areas of high species richness located, this can be achieved only by a complete documentation of species found in definite area (Hopkins and Freckleton, 2002).

Spiders have higher host finding ability and capacity to consume greater number of preys than other field inhabiting predators (Kamal et al., 1990). Silk production, while not unique to this group, is its most characteristic feature (Craig, 1997). Webs built out of silk are used to catch insects, making web building spiders efficient predators and even biological control agents (Riechert, 1999; Symondson et al., 2002). Spiders act as a model system in various scientific fields such as ecology, evolutionary biology, ethology, physiology and chemistry (Zschokke and Herberstein, 2005). Spiders are attractive because of their intriguing biology and they can be easily collected and maintained in laboratory because they are relatively long lived and are resistant to starvation and desiccation. Specific information for each spider species can be obtained either when collecting the spiders in their natural habitat or from researchers experienced with that species. Collection, rearing and caring of spiders in captivity is often a laborious task, especially when large numbers are involved. Three basic problems must be dealt with spider

rearing: providing food and shelter, preventing cannibalism and maintaining for a long time (Jackson,R.R., 1974). The present paper aims to provide the necessary information regarding collection and rearing of spiders, in the hope to foster cross – disciplinary studies on spiders. The methods and recommendations prescribed in this paper are derived from the ideas obtained during our study on spiders in Shekhawati Aravalian region of Rajasthan, India, during March, 2010 to April, 2013.

Collection of Spiders:

The majority of spiders were found on trees, their foliage and flowers, under the caves of rocks, in the cervices of walls, grass and on the ground. A number of methods were applied for collection of spiders according a wide variety of habitats, such as hand collection, sweep netting, beating method and pitfall trap. Here, I will review certain methods and procedures which have been used during my research study from March, 2010 to April, 2013.

(A.) Ground hand collection: One of the best methods to collect spiders was found hand collection, applied from ground to knee level for the spiders visible on (but not hiding in) the leaf litter and on the ground, low buttresses and the lowest plants. This method permits the specimens to be carefully picked by hand. Spider species namely, *Xysticus minutus* Tikader, *Thomisus projectus, Agelena* sp., *Pardosa sumatrana* (Thorell) were collected using this method.

(B.) Aerial hand collection: This method was used to collect the spiders from knee level to as high as one can reach, accessing web building and/or free living spiders on the foliage and stem of living or dead shrubs, high herbs, tree trunks etc. Collection of several species like, *Oxyopes shweta* Tikader, *O*. birmanicus, *Leucauge decorata*, *Neoscona pavida* (Simon), *N. mukerjei* Tikader, *N. nautica* was made by this method.

(C.) Beating method: The beating method was found suitable for spiders living in the shrubs, high herb plants, bushes and small trees and branches, such as *Chiracanthium danieli, Peucetia viridana* (Stoliczka), *Achaeranaea mundula, Evippa praelongipes.* In this method, spiders are collected by beating the plants with heavy stick while holding a collecting tray. After beating spiders are fallen in the tray before they get away.

(D.) Collection by sweep net: This was observed as one of the simplest ways to collect spiders found in the habitat abundant with grasses and flowers. Spider species namely, *Uloborus* sp., *Plexippus paykullii* (Savigny and Audouin), *Lycosa hilaris, Hippasa pisaurina* etc. were collected mainly using sweep net. A sweep net (Fig. 1-a) is made of a circular metallic ring and relatively large sized fabric sac. To use the sweep net, drag the net back and forth across a small group of weeds and brush a number of times with a quick, steady motion. Sweep as many times as necessary to get a high number of specimens.

Fig: 1 (a)

(b)

Fig. 1. (a): Sweep net (b) Pitfall trap

(E) The pitfall trap: Collection by apitfall trap is an ideal method used for collecting the ground dwelling spiders such as *Hasarius adansoni*, *Theridion varians*, *Tetragnatha* sps., *Lycosa hilaris* etc. A pitfall trap (Fig. 1-b) is

consisted of a plastic jar dug in to the ground with the soil surface, with a small plastic cup placed inside the large jar to remove the specimens conveniently without having to displace the entire tip. At the bottom, the jar contains a small quantity of preserving fluid such as ethylene glycol or 0.5 percent formaldehyde solution with a few drops of liquid soap to reduce the surface tension. A lid is placed 2-3 cm above the trap so that the crawling spiders can get by, but small vertebrates, rain water, dust etc., are kept out of the trap.

Since species distribution is correlated with factors such as temperature, humidity and distinctive plant growth of respective habitat (Koponen, 1991), so in order to estimate the synchrony between plant canopy and spider densities, the experimental region can be divided in certain sampling transects according their ecological conditions. In this order, the experimental area during our study was transected as four major habitat types namely woodland, wetland, grassland and caves or rocky areas where survey was conducted. A total of eight sampling transects comprising four habitat types were selected to cover the total spider diversity of the experimental region. Two transects of matching characteristics (vegetation, canopy cover, etc.) were selected for each type of habitat. Woodland habitat selected in two transects –forest area of Udaipurvati (Jhunjhunu) and Patan (Sikar). Marshy habitat selected in two transects – Narsinghpuri pond area (Sikar) and Raipur dam area (Neemkathana). Caves/rocks habitat selected in two transects - Area around Kantali River in Guhala and Khandella while pasture habitat was selected in area of Chala (Sikar) and Guda (Jhunjhunu).

Generally, spiders had two periods of increased population size occurring in early and late summer when ambient temperature ranged from 20 to 25 C (Saini *et al*, 2012), because of this, collections were made during above mentioned time periods and most of collection methods were applied during day from 7 a.m. to 10 a.m. and 5 p. m. to 7 p. m. during summer and 7 a.m. to 10 a. m. and 4 p.m. to 6 p.m. during winter to avoid intense radiations of sunlight.

Keeping of Spiders:

A variety of frames and jars have been used to keep spiders and their webs. In the laboratory of Peter Witt, elaborate metal cages were used (Witt, 1971). The frames should correspond to the web size; initial field measurements may therefore be necessary. To house small to medium sized orb–web spiders eg. *Zilla diodia* (Walckenaer 1802), *Araneus diadematus* Clerck 1757 or *Larinioides sclopetarius* (Clerck 1757), frames consisting of four pieces of transparent Perspex, 5 cm wide, 30 cm long and 3 mm thick, glued together with industrial strength glue at the corners were used by Zschokke and Herberstein (2005). To separate the frames, a thin (0.5 mm) and large (longer than the frames), transparent and somewhat flexible PVC sheet was placed between them.

For short term storage of smaller spiders we used upturned plastic jars (Fig. 2-a) with a small hole on the top corked with a cotton plug. Water was then administered by wetting the cotton plug. Keeping spiders in such small jars can also be an experimental procedure; eg. When studying web building behavior or finding the feeding potential, larger spiders can be maintained in jars to temporarily prevent them from building webs (Reed et al. 1970; Herberstein et al., 2000). The collected spider specimens were preserved in 70 percent ethyl alcohol with a few drops of glycerin (Prasad, 1985).

Fig. 2 (a) (b)

Fig.: 2. (a) Keeping of spiders in plastic jars (b) Preservation of spiders in glass vials

Preservation of spiders:

The specimens collected from the experimental areas were subjected to be treated with 10% KOH for 1-3 hours. Depending upon the size, the specimens were soaked in potassium hydroxide (KOH), in order to bring them to as much natural shape as possible by stretching the legs and palpi. Then the specimens were thoroughly washed with warm water. Further with a dropper, glacial acetic acid was poured on the specimen, taking care that the specimen got fully drenched but not floated in the Petridis. The specimens were left in this condition for 1 to 2 hours till they became stiff. After this they were washed again with water and preserved in glass vials (Fig. 2-b) properly. Each glass vial was filled up to its half volume by 70% ethyl alcohol working as preserving agent.

Feeding and Watering:

All the developing stages and adults of spiders feed only on live and motile insect preys like *Musca domestica*, *Drosophila melanogaster*, *Tribolium castaneum* and *Corcyra cephalonica*. To provide and maintain the proper feeding for spiders, collected specimens were kept in separate glass cages, each of which was marked and numbered. Each glass cage (Fig. 3-a) consisted of a lantern chimney fixed over a petridis containing sterilized and moist sand. The chimney was covered by a piece of muslin cloth and the sand was to be kept moist by putting a few drops of distilled water over it daily in order to provide humidity as the spiders do not thrive under dry conditions. Then ten larvae of *C. cephalonica* or *T. castaneum* were introduced in to each cage as food. Observations were made 24 hours after experimentations to record the number of insects consumed by the spiders. The remaining food was taken out and the spiders were fed continually by providing fixed number of same insects as food. The newly hatched spider lings were separated in small containers, the lid of which had a few small holes for aeration and one moderately big hole for feeding. A small strip of paper was inserted into the container to provide additional support to the spider lings.

Fig.: 3 (a) (b)

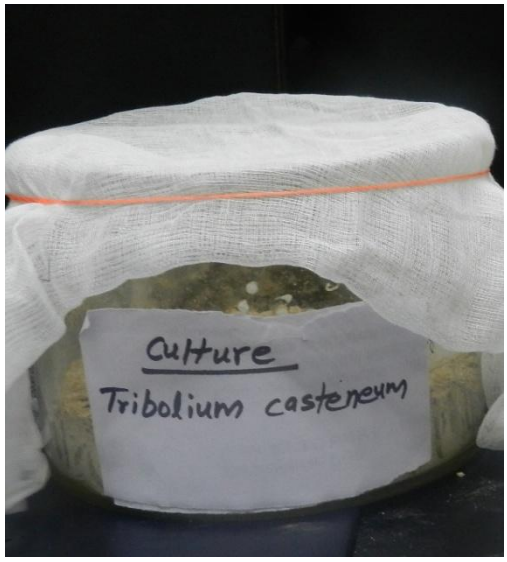
Fig.: 3. (a) Glass cage for feeding and watering of spiders.
(b) B.O.D. Incubator maintaining relative humidity (RH) and temperature during rearing of spiders

Rearing of spiders:

All spiders are carnivores and they feed almost exclusively on living prey. This makes the rearing and maintenance of spider in the laboratory very laborious. Moreover, it appears that most spiders must feed on a variety of insect prey species to obtain the optimum nutrition for survival and reproduction (Greenston, 1979; Uetz, et al., 1991). The need to rear different insects prey species makes it especially difficult to culture spiders in the laboratory. In this order, we practiced with rearing of two types of prey insects in the laboratory namely, *Tribolium castaneum* and *Corcyra cephalonica*.

Laboratory rearing of *Tribolium castaneum*

The rust-red flour beetle *T. castaneum* belongs to order Coleoptera and family Tenebrionidae. It is a serious stored product pest mainly of wheat flour. It was reared in laboratory at 30±2ºC and 70±5% RH in jars placed in B.O.D. Incubator (Fig. 3-b). The jars were sterilized earlier by exposing them to a temperature of 60ºC for two days. The desired humidity was maintained by providing suitable concentrate of sodium chloride solution. The jars were ¾ filled with wheat flour (Fig. 4-a) and 5% Brewer's yeast. 100 adults were released in each jar and larvae for experiments were removed in separate petridishes time to time according to need.



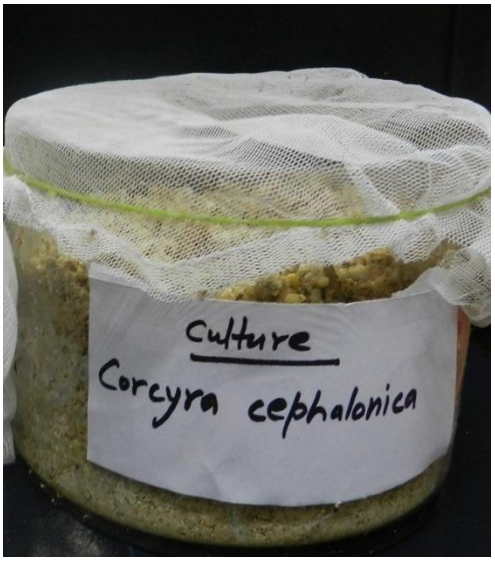


Fig.: 4 (a) (b)

Fig.: 4 (a) Culture of *Tribolium castaneum* maintained in laboratory
(b) Culture of *Corcyra cephalonica* maintained in laboratory

Laboratory rearing of *Corcyra cephalonica*

A least amount of culture of *C. cephalonica* was obtained from Agricultural Research Station, Durgapura, Jaipur and then culture was maintained and propagated in the laboratory in transparent glass jars. The jars were covered with muslin cloth (Fig. 4-b) and tied with a rubber band and at 27±2ºC and 70±5% Relative Humidity (RH). Newly emerged adults were shifted to separate clean jars to maintain the culture. A single female moth laid 150 to 250 eggs, singly or in clusters. Eggs were laid on muslin cloth as well as on the wall of jars. Eggs hatched in 4 to 5 days. Larvae were fed on sorghum grains. There were seven larval instars in its life cycle each lasting for 3 to 5 days. Life cycle was completed in 30 to 45 days.

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