



Research Article

A STUDY ON THE DIVERSITY OF GRASSHOPPER (CAELIFERA) IN TIRUCHIRAPPALLI DISTRICT, TAMIL NADU, INDIA

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ABSTRACT

In the past century, grasshoppers were the reasons for famine and drought due to over population and their voracious feeding practices on crops and plants. For the past few years, major advances have been made in the field of grasshopper studies to study the different species and their impact on agriculture to sustain the yield of agriculture. Many breakthroughs have pushed in the study of grasshopper during the past few decades. In recent years, due to urbanization and reduction in forest areas and agriculture, the grass population is fast reducing. The grasshoppers are also important in the ecosystem to balance the environment and support the pollination of plants. The Tiruchirappalli District is undergoing rapid urbanization as it is considered under city zone, which is a major threat for the agriculture as many villagers surrounding Tiruchirappalli city depends on agriculture for their livelihoods. In this study, a general overview of the field area of Tiruchirappalli surroundings and the different varieties of grasshoppers that are identified in the selected area is being documented. The study helps to gain knowledge of existing grasshopper varieties that are still surviving that helps the eco system and also environment.

Keywords: Grasshopper, Insects, Caelifera, Anthropod, Exoskeleton, Species.

INTRODUCTION

Insects or Insecta (from Latin insecure, a claque of Greek ("cut into sections")) are by far the largest group of hexapod invertebrates within the arthropod phylum. Definitions and circumscriptions vary; in one approach insects comprise a class within the Phylum Arthropods. As the term is used here, it is synonymous with Entognath. Insects have a chitinous exoskeleton, a three-part body (head, thorax and abdomen), three pairs of jointed legs, compound eyes and one pair of antennae. They are the most diverse group of insects on the planet, including more than a million described species and representing more than half of all known living organisms. The number of extent of species is estimated between six and ten million and potentially represents over 90% of the differing animal life forms on Earth. Insects may be found in nearly all environments, although only a small number of species reside in the oceans, a habitat dominated by another arthropod group, crustaceans. The life cycles of insects vary but most

hatches from eggs. Insect growth is constrained by the inelastic exoskeleton and development involves a series of molts. The immature stages can differ from the adults in structure, and can include a passive pupa stage in those groups that undergo 4-stage metamorphosis. Insects that undergo 3-stage metamorphosis lack a pupa stage and adults develop through a series of nymph stages. The higher-level relationship of the Hexapoda is unclear. Fossilized insects of enormous size have been found from the Paleozoic Era, including giant dragonflies with wingspans of 55 to 70 cm (22- 28 in). The most diverse insect groups appear to have co-evolved with flowering plants.

Adult insects typically move about by walking, flying or sometimes swimming (Locomotion). As it allows for rapid yet stable movement, many insects adopt a tripodal gait in which they walk with their legs touching the ground in alternating triangles. Insects are the only invertebrates to have evolved flight. Many insects spend at least part of

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their lives under water, with larval adaptations that include gills, and some adult insects are aquatic and have adaptations for swimming. Some species, such as water striders, are capable of walking on the surface of water. Insects are mostly solitary, but some, such as certain bees, ants and termites, are social and live in large, well-organized colonies. Some insects, such as earwigs, show maternal care, guarding their eggs and young. Insects can communicate with each other in a variety of ways. Male moths can sense the hormones of female moths over great distances. Other species communicate with sounds: crickets stridulate, or rub their wings together, to attract a mate and repel other males. Humans regard certain insects as pests, and attempt to control those using insecticides and a host of other techniques. Some insects damage crops by feeding on sap, leaves or fruits. A few parasitic species are pathogenic. Some insects perform complex ecological roles; blow-flies, for example, help consume carrion but also spread diseases. Insect pollinators are essential to the life cycle of many flowering plant species on which most organisms, including humans, are at least partly dependent; without them, the terrestrial portion of the biosphere (including humans) would be devastated. Many other insects are considered ecologically beneficial as predators and a few provide direct economic benefit. Silkworms and bees have been used extensively by humans for the production of silk and honey, respectively. In some cultures, people eat the larvae or adults of certain insects for protein supplementation to the human body. Although pest insects attract the most attention, many insects are beneficial to the environment and to humans. Some insects like wasps, bees, butterflies and ants, pollinate flowering plants. Pollination is a mutualistic relationship between plants and insects. As insects gather nectar from different plants of the same species they also spread pollen from plants on which they have previously fed. This greatly increases plants ability to cross-pollinate which maintains and possibly even improves their evolutionary fitness. This ultimately affects humans since ensuring healthy crops is critical to agriculture. As well as pollination ants help with seed distribution of plants. This help to spread the plants which increases plant diversity. This leads to an overall better environment.

A serious environmental problem is the decline of populations of pollinator insects, and a number of species of insects are now cultured primarily for pollination management. Lady bugs: lady beetles, or ladybird beetles, whatever they are called in your area of the world, are highly beneficial. Not only are they pretty, but they are the natural predators of aphids, mealy-bugs, mites, and larvae of a wide variety of harmful insects. Because of their voracious appetite for bugs that can destroy your garden. Lady birds are attracted to marigolds and dill. Praying mantis: the praying mantis is a distinctive insect, with its wide head, and long, green-to-brown body. Mantises eat other insects, including moths, mosquitoes, and flies. However, if a mantis is hungry, it could eat other beneficial insects in your garden, including other mantises. Mantises are also attracted to marigolds and dill. Bees, Butterflies, are 'pollinators' while a bee sting can be harmful to humans

and pests, many species of bees help pollinate flowers, allowing them to reproduce and make more beautiful flowers. Butterflies also help pollinate, while feeding the nectar of plants. Insects also produce useful substances such as honey, wax, lacquer and silk. Insects are also used in medicine. For example fly larvae (maggots) were formerly used to treat wounds to prevent or stop gangrene, as they would only consume dead flesh. This treatment is finding its usage in some hospitals. Recently insects have also gained attention as potential sources of drugs and other medicinal substances. It is not hard to imagine that harmful insects destroy the plants, eat the fruits, ruin the flowers, and can turn beautiful yard into a living nightmare. Aphids: aphids are like lice they move into a garden, spread throughout all the plants, and can be hard to get rid of. They are small, usually less than 1/8" in size, and cause stunted plant growth and spread stunted plant growth and spread diseases among plants. Grasshopper: grasshoppers chew on vegetation, and the majority of grasshopper species will eat any type of vegetation they can. Mealy bugs: feed on the juices of greenhouse plants and thrive in warm, moist environments. Caterpillars: not all caterpillars are harmful. Some may be beneficial and many turn into butterflies, which will be beneficial. But in this stage of life, caterpillars are leaf-eating, plant destroying nuisances. They are functionally very important ground invertebrates in grassland ecosystem (Risser, 1995; Stanton, 1983). They are often the main invertebrate in grassland ecosystem for consumers (Curry, 1993) and are an important food source for many groups of predator e.g. birds (Joern, 1986). There almost 20,000 species of orthoptera from the world among them 1,750 species known from India (Joern, 1986). Maximum species are tropical but are also well recorded in temperate areas. Major work on Orthoptera in India which is published in Orthoptera fauna of India but so far, less literature and data are available. Orthoptera of Maharashtra state is available only this catered information on Faunal diversity of Orthoptera of this state has been published by some workers, and number worker (Bhowmik, 1985; Chandra *et al.*, 2007; Chandra *et al.*, 2010) have also worked on the fauna of other state and including the distribution of some species in Maharashtra. There is no published worker report from Koraiyaar river bed of Tiruchirappalli district till date. Therefore, for the first time an attempt was made to study fauna of insects of Koraiyaar river bed, Tiruchirappalli district.

Grasshoppers are insects that found very commonly and therefore grasshopper's habitat can be varied, ranging from moist rain forests to hot deserts. These insects are funnily shaped and are distinguishable by their longlegs and the surprisingly loud noise they make. Grasshoppers are herbivorous insects, which can leap, walk and fly. Grasshoppers have a typical 3 part insect body, which includes the head, thorax and abdomen. They also have 2 antennae, 2 pairs of wings and 6 legs. These insects belong to the order Orthoptera and suborder Caelifera. There are around 10,000 types of grasshoppers. Some species have toxic bodies which are brightly colored, which is supposed to be a warning (of their poisonous nature) to their predators. Some species are unable to make sounds by

rubbing their legs. This sound is a mating call and therefore, some species are brightly colored to attract their mate. A wealth of knowledge concerning grasshopper biology and ecology, damage potential and control practices is available to anyone with the interest and the ability to search through entomological literature. The researcher will quickly note however, that grasshoppers differ significantly in their biological attributes, damage potential crops and susceptibility to management practices. Hence, field workers must be able to identify grasshoppers, or the abundance of specific information on grasshoppers is practically useless. Believing that the grasshopper identification is the key to knowledge concerning. Researchers provide a dichotomous key to the adult grasshoppers known or thought to occur in Colorado. The illustrated key presented here is adapted from (Colorado & Alexander, 1941) it is revised extensively although the original format is retained.

Metamorphosis gradual (Paurometabolous), nymphs resemble adults, typically develop external wing buds, and live in the same habitat as adults, taking the same food. In most crickets and katydids, the female mounts them are for mating, apparently the primitive (original) behavior in Orthoptera. Short-horned grasshoppers (Acridities) have a contorted mating posture with the male mounting the female, but the abdomen twisted eccentrically. The given project is selected to understand the diversity of Grasshopper in local area so it may contribute in conservation of biodiversity of Grasshoppers. In certain cases the data may be utilized for Integrated Pest Management (IPM). The prime objective of the study is to document the diversity of grasshoppers in Koraiyyar river bed, Tiruchirappalli District, Tamil Nadu, India; to monitor and classify the grasshopper's populations; to identify host plant selection behavior of butterfly and to provide a suitable environment for grasshoppers for breeding. The conservatory is being established to foster in-situ and ex-situ conservation of grasshoppers' species and create awareness of the role of grasshoppers in maintaining the ecological equilibrium among people.

MATERIALS AND METHODS

The day from 9.00 am to 4.00 pm provided best results. In study area of Koraiyaar Riverbed is situated just 2 km from Bishop Heber College, Tiruchirappalli. It is a river bed region run through the middle of the city and the temperature varies from 14 to 30°C and altitude ranges from 100 to 1200 meters msl in Koraiyaar river bed. The study area was analyzed to select plenty of wild flora regions to document survey and collect active grasshoppers for the study of their diversity among the size, shape and coloration. Grasshoppers are found in the spring and summer, but are most noticeable in the autumn. Areas with many wild varieties of grasses and bushes and thorny trees were good places to start searching for grasshoppers. Field observation was used during the middle of the night flashlight to find grasshoppers resting on the leaves. In the summer and autumn some grasshoppers fly onto the torch lights and therefore it was easy to identify them. To catch grasshoppers requires patience and determination. The grasshoppers have wings; many species can fly faster than we can run. Those without wings are easier to chase. Grasshoppers are perceptive and can sense humans when we are several feet away. An insect net can be place dove the plant to catch grasshoppers. While holding, up the bottom of the net with hands grasshoppers are gently coax into the net. They can walk or jump out of the net. Hence once inside the net, they are gently picked up and placed in a container. It is also possible to collect hand picking method of grasshoppers by very slowly moving a glass or plastic vial towards the grasshopper's head and they will jump into it.

Equipment's Used for Collection

Before proceeding to collecting the grasshoppers the equipment's used for collection was assembled. The equipment's used were simple and inexpensive. The collecting kit includes collecting net, plastic bottle, forceps, thermocol sheet, pins, notebook, pencils, camera, adhesive solution, etc.

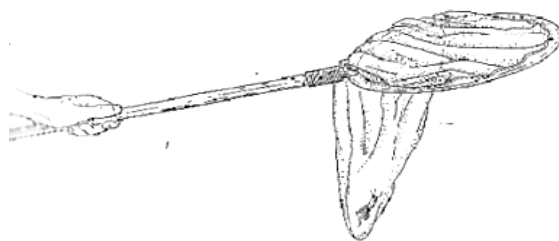


Figure 1. Insect net.

Methodology for Collection

The grasshoppers were collected with the help of collecting nets (Figure 1) in two sites of the Koraiyaar River in Tiruchirappalli city. The net was made-up of nylon wire,

which have loop of about 60 cm diameter. Over the nylon net, the muslin cloth bags were hanging. The loops of net were attached to the stick of one-meter length. Once a grasshopper was seen, it was caught with the help of net and stored in the plastic bottle immediately. The

grasshoppers were collected and put into a plastic bottle with phenolphthalein balls (Figure 2). Once the grasshopper enters into the bottle, the lid is closed and grasshopper gets anesthesia due to phenolphthalein ball. After few hours it will die. The phenolphthalein ball also helps to make the bottle pest proof.

Preservation, Pasting and Photography

Grasshoppers are insects of the order Orthoptera, and having suborder Caelifera and Ensifera. They are sometimes referred to as short-horned grasshoppers (Caelifera), to distinguish them from the kinds which have much longer antennae (Ensifera). They are hemimetabolous insects. The life cycle is completed with three stages viz, egg, nymph and adult. Nymph develops five times, becoming more similar to the adult insect at each developmental stage. At high population densities and under certain environmental conditions, some grasshopper species can change colour and behavior and form swarms. Under these circumstances they are known as locusts. Grasshoppers are plant-eaters, sometimes becoming serious

pests of cereals, vegetables and pasture, especially when they swarm in their millions as locusts and destroy crops over wide areas. Hence, they are included in Oligophagous and mixed feeders (Hugo, 2000). The collected grasshopper is now picked up with the help of forceps and Pasted over the thermocol sheet. The pasting of the insects is done immediately after the death: otherwise the body will become rigid and will break. The pasting of grasshopper is done with the help of adhesive solution. Sometime the pins were also used. Phenolphthalein ball and camphor etc. were also used to make the sheath pest proof. The grasshoppers were pasted over the sheath within the boxes sketched by marker Pen. The distance between two specimens should be 03-04 inches; which were essential for the separate photography of insects for their morphological identification and separate from bulk species of Orthoptera or simply differentiate from cricket and its kinds. Grasshopper's external manifestation is on the basis of their color, size, shape and arrangement of hind limb and fore limb. Adigital camera was used for photography and to analyze the external appearance of grasshoppers and similar species



Figure 2. Grasshoppers collection bottle.

RESULTS AND DISCUSSION

In the site 1, totally 9 plant species belong to 8 families includes shrubs, herbs, small trees, flowering plants and some ornamental, and wild plants were identified. Most of the permanent trees include the rubber bush, wild variety net of grasses and so on. Apart from this there are number of shrubs and herbs are also present in this habitat. Here most of the plants observed are herbs, flowering

plants and very few are shrubs and trees. The members of the family and the dominated plants in this site are *Propsis julifera*, *Aervalanata*, *Acyranthe saspara*, *Azadirac taindica*, *Chloris barbata*, *Malvace aeare*, *Abutilon indicum* and *Asclepedia ceaeare* also very commonly present here. These are all the host plants for many of the larvae and adult insect observed in this location (Table 1).

Table 1. Plant species in the site 1.

S.No	Vernacular Name	Scientific Name	Family	Total
1	Thuthi	<i>Abutilon indicum</i>	Malvaceae	Shrub
2	Vellieruku	<i>Colotro pisprocera</i>	Asclepediaceae	Shrub
3	Veppilai	<i>Azadiracta indica</i>	Meliacear	Tree
4	Karuvelam	<i>Propsis julifera</i>	Fabaceae	Shrub
5	Ottupul	<i>Chlori sbarbatapoaceae</i>	Poacear	Herb
6	Nayurul	<i>Acyranthe saspara</i>	Amaranthaceae	Herb
7	Thumbai	<i>Leucas aspera</i>	Lamiaceae	Herb
8	Koolaipoo	<i>Aerva lantana</i>	Amaranthaceae	Herb
9	Kolinji	<i>Tephrosia purpurea</i>	Fabaceae	Herb

Table 2. Plant species in the site 2.

S.No	Vernacular name	Scientific name	Family	Total
1	Ottupul	<i>Chloris barbatapoa</i>	Poaceae	Herb
2	Veppilai	<i>Azadiracta indica</i>	Meliaceae	Tree
3	Podutali	<i>Phla nodiflora</i>	verbenaceae	Herb
4	Amiranappaci	<i>Hydrilla vertieillata</i>	Lamiaceae	Herb
5	Neetilingam	<i>Polyalthia longiflora</i>	Fabaceae	Tree
6	Thumbai	<i>Leucas aspera</i>	Lamiaceae	Herb
7	Nayurul	<i>Acyranthes aspera</i>	Amaranthaceae	Herb
8	Rubber bush	<i>Vellaierubu</i>	Moraceae	Shrub
9	Koolaipoo	<i>Aria lantana</i>	Amaranthaceae	Herb
10	Neem	<i>Azadirata indica</i>	Meliaceae	Tree

Plant Phenology of the site-2

In the site 2, totally 10 plant species belongs to 7 families were present (Table 1). The most of the plants observed are herbs, flowering plants and very few are shrubs and trees. The members of the family and the dominant species are *Prospis julifera*, *Aervalanata*, *Acyranthesaspera*, *Azadiracta indica*, *Malvaceae*, *Abutilonindicum* and *Asclepediaceae* are also very commonly present here. These are all the host plants for many of the larvae and adult insect observed in this location.

Insects are now being included in biodiversity studies. The present study was started with a view to document the grasshopper insects across seasons in two chosen habitats in Koraiyaar river bed, Tiruchirappalli district, Tamil Nadu. Different micro habitats were identified and insect communities were examined within these natural landscapes to identify factors that influence the diversity and composition of insect assemblages. With qualitative data gathered on grasshopper diversity, the present study analyzed the biodiversity and different species of grasshopper life cycle populations and host plant interactions. The two landscapes were chosen on the basis of their contrasting vegetation types and levels of disturbance. This study is the first of its kind of investigation on species diversity, richness and relative abundances of grasshopper species in Koraiyaar river bed, Tiruchirappalli district of Tamil Nadu.

The field work was done between July 2017 and September 2017. Transect walk method was used for identification the insects during morning 9.00 am to evening 4.00 pm with sampling schedule in an area of 1000 sq.km each. For assessing population fluctuations across seasons and sites, species were arranged in a definite order and then a simple matrix with species in rows and months in columns was made for each site. Grasshoppers in all habitats showed a highly seasonal trend. The populations were low during summer, probably due to heat, scarcity of water and dry ground coverings. In most of the landscapes studied in India, two factors, caused by human beings such as grazing and urbanization alter species diversity of plants and animals. In the present study, the relationships between insects and climate were complex. Insects started appearing

commonly from August and reached their peak in November, synchronizing with the food plant availability. It was observed as an interesting behavior, that when an insect finds a good-source already occupied by another insect, it flutters and hover over the feeder and drives it away. Generally, the grasshopper families such as Caeall compete for the same flowers. A great deal remains to be discovered to complete our understanding of the behavior of insect fauna, host plant interactions and not only in documentation of the species diversity, but also their ecology, evolution and population dynamics. The study yielded about 18 species of grasshopper species from the study area. The project work indicated that among overall order abundance, the Orthoptera was predominant during certain seasons. However, in terms of richness, Orthoptera was the dominant order (18 species) in the study area.

Insects contribute one of the best studied groups of animals among the invertebrate fauna. Adult insects are popular with people because of their bright colored wings and their observable daily activities that include feeding on nectar as they visit garden (Buchmann & Nabhan, 2012). Although there is clearly a need to assess the bio-diversity in selected areas its value would be enhanced if they were combined with consideration of an ecosystems or ecologically sensitive areas, which interact considerably upon which, humans have a major influence. The present study was started with a view to document the diversity of grasshoppers across seasons and ecosystem with qualitative data on grasshopper population gathered from three different types of habitats, the ecosystem. The present analysis is intended to reveal the seasonal patterns in grasshopper species and their populations, the plants which are predominant in that ecosystem and the eco climate and the interaction between the plantations and grasshoppers (Sword & Chapman, 1994).

CONCLUSION

Overall, the study result revealed that the bio-diversity of grasshopper in the ecosystem. During three months of field work. The total number of species counted was 18 and they belong to Orthoptera order. More specifically, the findings indicate that the ecosystem have 9 plant species belonging

to 8 families are observed which are mostly huge and small sized trees. Herbs and shrubs are also thinly represented. Fruiting trees, flowering plants and other leafy crops served to attract many orders of insects (Ashton *et al.*, 1997).

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