

Diversity of orthopteran insects in Rajasthan: A review

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Abstract

Orthoptera constitute a dominant and important group of terrestrial insects, including katydids, crickets, locusts and grasshoppers. They are mostly herbivorous occur in grassland, semi-aquatic, desert and tropical forest ecosystem. Locusts and grasshoppers are important group of acridid pests of agriculture and forest vegetation in seedling stage. Long horned grasshoppers and crickets may herbivore, carnivore, predator and omnivore in nature. The review presented the knowledge of diversity and distribution of orthopteran insect species in the Rajasthan. The family Acrididae, Pyrgomorphidae and Tetrigidae belonging to the suborder Caelifera and the family Tettigoniidae, Gryllidae, Gryllotalpidae, Schizodactylidae representing the suborder Ensifera recorded from different areas of Rajasthan. Maximum species diversity has been recorded of the family Acrididae followed by Tettigoniidae from different regions, particularly from southern part. Richness of orthopteran diversity reflects functional ecology and provide the source of manifold utility of the abundant species for the future aspect.

Keywords: orthoptera, herbivorous, diversity, acrididae

Introduction

Orthoptera is an order of medium to large sized insects, comprising more than 25,000 species worldwide with the presence of 1,750 species (almost 10% of the total world insect species) from India [14]. The order Orthoptera includes locusts, crickets, grasshoppers, katydids and their relatives. They are predominate terrestrial insects inhabit mostly in tropical regions and play a significant role as consumer and prey in the ecosystem. These insects are hemimetabolous in which immature stages (nymphs) resembling adult forms in their morphology but not having well developed wings and reproductive organs. Orthopterans have mandibulate mouthparts for chewing and biting the food. The head condition is hypognathous, seldom prognathous. The antennae are filliform, generally elongated and threadlike, consisting of fewer than ten to several hundred similar segments. The prothorax is enveloped by large and shield-like pronotum curving downward laterally. In most katydids pronotum covers a large part of the body where extended over the abdomen in pygmy grasshoppers. The 2nd and 3rd pairs of legs are cursorial or used for walking, however the first pair of legs is modified for digging in mole crickets, pygmy mole crickets and false mole crickets. In predatory katydids the first and middle pair of legs may be modified for grasping. In most orthopterans the hind legs are saltatorial or modified for leaping, with large, muscular femora and long, slender tibiae. Auditory or tympanum organs (hearing organs) are present at first abdominal segment in caeliferans, while in Ensifera at first tibial tarsus of frontal leg. Stridulation is important feature of the male Ensiferan insects whereas Caelifera devoid of sound producing organ. The forewings of orthopterans are to some extent narrow, thickened, structuring leathery tegmina. Some orthopteran species are found to be apterous and brachypterous. The tegmina in mostly katydids and crickets are modified for stridulation (alary-alary). The hindwings are membranous and broad with rich longitudinal and cross-veins. A well-developed ovipositor present in

females of most orthopterans at the last abdominal segment, derived from the eighth and ninth abdominal appendages. Ovipositor is long, sword or needle like in katydids and crickets, whereas in acridid grasshoppers and their relatives have robust ovipositor or devoid of it [6, 9, 15].

The widespread abundance and availability of Orthoptera and their great species diversity, life-history and body mass has made them an ideal insect group [19]. Orthopteran insects also display behaviors related to defense, temperature control and camouflage and to a lesser extent, swarming. Variation in behaviour is determined by both the genetic and the environmental factors. The order Orthoptera grouped into two suborders, Caelifera and Ensifera. Caelifera comprises eight super families and out of them Acridoidea and Pyrgomorpoidea are commonly found in India. Out of eleven families of Acridoidea, Pyrgomorpoidea, Tetrigidae are commonly distributed in Rajasthan. These are predominantly day-active, fast-moving, visually acute, terrestrial herbivores. Members belonging to Caelifera have short antennae (less than 30 segment) and abdominal tympanal organs (ears). Acrididae consists of about 10,000 among 11,000 species of Caeliferans all over the world comprising locusts and grasshoppers. In India about 285 acridid species are reported which belong to 135 genera [6, 15]. Grasshoppers are of great economic significance and cause significant damage to forest plant seedlings and agricultural crops [8]. The acridid grasshoppers have solitary and gregarious (swarm) phases. Seasonal massive outbreak of some species of locusts and grasshoppers (less frequent in katydids and crickets) can cause great losses for the agriculture and forestry in many parts of the world. Locusts exhibit swarms and during migration in huge groups these can be highly destructive to vegetation and crops. In recent days many areas of Rajasthan are affected by locust outbreak. The locust *Schistocerca gregaria* affect crops with a heavy loss. The poultry farming in many areas of Rajasthan grasshoppers are fed the chickens as they are a good source of protein and other nutrition. The family

Tetrigidae includes pygmy grasshoppers or grouse locusts. They possess pronotum extending backward over the abdomen becoming narrow posteriorly. Sound production and hearing organs (tympana) are absent [11, 18].

The members of suborder Ensifera (long horned grasshoppers, katydids and crickets) are often night-active, phytophages, predators, some omnivores and show camouflage. In suborder Ensifera, the superfamilies Gryllacridoidea, Grylloidea, Tettigonioidea are recognized [9].

The family Tettigoniidae includes long-horned grasshoppers and katydids. They possess long antennae (more than 30 segments), four-segmented tarsi, tympanum at base of front tibia, alary-alary stridulation and laterally flattened blade-like ovipositor. The family Gryllacrididae includes wingless long-horned grasshoppers, humpbacked in appearance, rust and brown colored, caves dwelling, resides

in hollow trees, under logs and stones and in other dark moist places. The family Gryllidae comprising crickets with tapering antennae, three tarsal segments, laterally bended front wings at sides of body. Stridulating organs are located at forewings of male and hearing organs on front tibia. Ovipositor is usually needle-like or cylindrical rather than flattened [15].

Considering the economic importance of Orthopteran pests in the ecosystem, an extensive study and survey of taxonomy and distribution of the long horned grasshoppers, locusts and short horned grasshoppers was carried out by several researchers in different areas of the Rajasthan state (Chandra *et al.*, [2, 3, 4], Pareek *et al.*, [12, 13], Kumar and Usmani [8], Shishodia [14], Shishodia *et al.*, [15], Dhakad *et al.*, [5]). Keeping in view economical significance of the order Orthoptera, a review is prepared to emphasize the diversity and distribution of orthopteran species.

Table 1: Diversity of Orthopteran species in Rajasthan

Suborder	Family	Sub family	Genus	Place	References
Caelifera	Acrididae	Acridinae Catantopinae Hemiacridinae Oedopodinae Oxyinae Spathosterninae	<i>Acrida</i> sp. <i>Aiolopus tumulus</i> (F.) <i>Aulocobotrus</i> sp. <i>Cataloipus</i> sp. <i>Catantops</i> sp. <i>Gastrimargus</i> sp. <i>Gonista</i> sp. <i>Heteracris</i> sp. <i>Hieroglyphus</i> sp. <i>Oxya</i> sp. <i>Parahieroglyphus</i> sp. <i>Phlaeoba</i> sp. <i>Spathosternum</i> sp. <i>Trilophidia</i> sp. <i>Acorypha</i> Krauss <i>Acrida gigantean</i> <i>Acrida</i> Linnaeus <i>Acrida</i> sp. <i>Acrida exaltata</i> (Walker) <i>Acrotylus bertianus</i> Saussure, <i>Aiolopus thalassinus</i> Fabricius <i>Aulacobotrus taeniatus</i> Bolivar <i>Aulacobotrus strictus</i> Bolivar, <i>Bryodemanda</i> Saussure <i>Bryodemaluctuosainda</i> Saussure, 1884 <i>Catantops pinguis</i> Stål <i>Chondronotulu sbengalensis</i> <i>Chondronotulus</i> Uvarov <i>Epacromia replete</i> <i>Gryllus annulatus</i> <i>Gryllus abruptus</i> <i>Hieroglyphus banian</i> Fabricius <i>Hieroglyphus nigrorepletus</i> Bolivar <i>Locusta migratoria</i> <i>Ochrilidia gracilis gracilis</i> <i>Oedaleus abruptus</i> <i>Oedipoda</i> (<i>Oedaleus</i>) Fieber <i>Oedipodacristella</i> Stal <i>Opomalatenebrosa</i> <i>Oxya fuscovittata</i> (Marschall) <i>Oxya hyla</i> Serville <i>Oxya</i> sp. <i>Phlaeoba antennata antennata</i> <i>Phlaeobain fumata</i> Brunner <i>Phlaeoba infumata</i> Brunner <i>Phlaeoba tenebrosa latypterna gracilis</i> Krauss <i>Schistocerca gregaria</i> <i>Spathosternum nigrotaeniatus</i> <i>Spathosternum prasiniferum</i> Walker <i>Sphingonotus benghalensis</i> <i>Sphingonotus savignyi</i> <i>Savignyi</i> <i>Stenohippus mundus</i> <i>Stenohippus</i> Uvarov <i>Trilophidia annulata</i> <i>Trilophidia replete</i> <i>Truxalis</i> sp. <i>Truxalis nasuta</i> (Linnaeus) <i>Acrida</i> sp. <i>Aiolopus thalassinus</i> <i>Catantops pinguis</i> <i>Gastrimargus africanus</i> <i>Hieroglyphus nigrorepletus</i> <i>Oxya</i> sp. <i>Phlaeoba infumatapatho</i> <i>Sternum prasiniferum</i> <i>Trilophidia annulata</i> <i>Truxalis</i> spp.	Udaipur Western Rajasthan Western desert Rajasthan Different districts (Banswara, Chittorgarh, Dungarpur, Pratapgarh and Udaipur) of Southern Rajasthan	Dhakad <i>et al.</i> , 2016 [5] Pareek <i>et al.</i> , 2014 [12] Bhatia <i>et al.</i> , 1965, [1] Kumar and Usmani, 2014 [8] Chandra <i>et al.</i> , 1985, 1988 Chandra, 1990 [2, 3, 4] Sinha and Chandra (1987) [16] Pareek <i>et al.</i> , 2017 [13]
	Pyrgomorphidae		<i>Atractomorpha</i> sp. <i>Pyrgomorpha</i> sp. <i>Chrotogonus</i> sp.	South-western Rajasthan	Dhakad <i>et al.</i> , 2016 [5] Jat <i>et al.</i> , 2010 [7]
	Tetrigidae		<i>Acrydium</i> sp. <i>Criotettix</i> <i>Ergatettix</i> <i>Scelimen</i> a		Dhakad <i>et al.</i> , 2016 [5]
Ensifera	Gryllidae	Gryllinae Trigonidiidae Oecanthinae	<i>Acheta</i> <i>Gryllus</i> <i>Oecanthus</i> <i>Trigonidium</i> <i>Tarbinskiellus orientalis</i> <i>Brachytrypes orientalis</i> <i>Gryllodessigillatus</i> <i>Gryllopsisra jasthanensis</i> <i>Modicogryllus clarellus</i>		Dhakad <i>et al.</i> , 2016 [5] Meena <i>et al.</i> , 2020 [10] Shishodia <i>et al.</i> , 2010 [15]

			<i>Modicogryllus confirmatus</i> , <i>Pteronemobiuscsikii Pteronemobiusjascipes</i> <i>Dianemobiuscsikii</i> <i>Polionemobiustaprobansensis</i> <i>Pteronemobiusconcolor</i> , <i>Paranemobiuspictus</i> <i>Trigonidiumcicindeloides</i> <i>TrigonidiumkundiBhowmik</i> <i>Oecanthusbilineatus</i>		
	Tettigonidae	Pseudophyllinae (Phaneropterinae: Holochlorini) Phaneropterinae	<i>Conocephalus Euconocephalus Elimaea</i> <i>Phaneroptera Trigonocorypha unifcolor</i> <i>Ruspolia interruptus exacentrus mundus</i> <i>Himertula kinneari Himertula pallisignata</i> <i>Parasanaa donovani Holochlora Himertula</i> <i>kinneari Ducetia japonica Trigonocorypha</i> <i>unicolor Isopsera pedunculata</i> <i>Letanaatomifera Letanabilobata ingrisch</i> <i>Letanapyrifera Elimaea (Elimaea)</i> <i>securigera</i>	Southern-western, Rajasthan Rajasthan	Dhakad <i>et al.</i> , 2016 ^[5] Shishodia <i>et al.</i> , 2010 ^[15] Swaminathan and Nagar, 2019 ^[17] Shishodia <i>et al.</i> , 2010 ^[15]
	Gryllotalpidae		<i>Gryllotalpa africana</i>		Shishodia <i>et al.</i> , 2010 ^[15]
	Schizodactylidae		<i>Schizodactylus monstrosus</i>		Shishodia <i>et al.</i> , 2010 ^[15]

Conclusions

Rajasthan state is broadly divided into western desert and eastern semiarid region. Orthopteran species particularly acridids and tettigonids are found abundantly in western and southern part of the Rajasthan. The present study elucidates the diversity and distribution of Orthopteran species on the basis of earlier studies and systematic surveys in various regions of Rajasthan. Hence, the review gives comprehensive knowledge of Orthoptera fauna which would be utilize for future aspects of the development of insect resources and their industrialization. Orthopteran biodiversity can also be assessed for the insect farming to explore nutritional value and therapeutic uses in sustainable manner.

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