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Biodiversity of insects in the tropical moist deciduous forestlands of Kanha National Park, Madhya Pradesh

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Abstract
The present study describes the incidence and diversity of insects in naturally occurring moist deciduous forests of Kanha National Park, Madhya Pradesh based on sampling from 150 sites for one year in 2016. This is the first ever systematic study on the insect diversity of this deciduous forest area recording the occurrence of a total of 52 insect species belonging to order Orthoptera found to be the most dominant represented by 28 species, followed by Isoptera with 16 species and least found Neuroptera with 8 species.

Keywords: insect biodiversity, insect species, orthoptera, isoptera, neuroptera

1. Introduction
Insects are the largest and most diverse group of organisms comprising nearly 80% of all the animal species on Earth, found on land, water, air, almost all habitats and continents including Antarctica. They provide a large number of services to living world acting as pollinators, undertakers, leaf litter sweepers, garbage collectors, soil conditioners and natural fertilizer producers of nature.

Our study is based in the forest patches of Kanha National Park, deriving its name from the old Kanha village, embraced by vast stretches of scrublands. It is nestled in the Maikal range of Satpura hills, being popularized as the Tiger reserve, spreading across the districts of Mandala and Kalaghat in Madhya Pradesh covering an area of 940 sq. km, with terrains marked by a series of plateaus. Halon, Banjar and Surpan comprises the major rivers draining into the Narmada Catchment dividing the forest into two ecological units- the Halon Valley in the east and Banjar Valley in the west. There are three distinct seasons in Kanha, January being the coldest month of winter and the hottest period being from late April to first week of June. Maximum temperature raises up to 41°C and minimum temperature decreasing up to 2 ºC. The wettest months are July and August with average rainfall of about 1800 m.m. The region comprises of moist deciduous forests, with lowland forest cover of Sal trees and other mixed forest trees, interspersed with meadows and highland forests with tropical moist dry deciduous trees with bamboo on slopes.

The reserve offers an ideal habitat for a variety of mammals, birds, reptiles, amphibians, fishes and diversified variety of insects with dominance of insect orders Orthoptera, Neuroptera and Isoptera. An itinerant account of Orthoptera fauna of Madhya Pradesh is available [1-12]. The orthopteran insects are mostly terrestrial in habitat, found in trees, bushes, burrows, caves to tree tops. Orthopterans are scavengers, voracious herbivores, sometimes omnivores, or polyphagous. Most of the species are active, diurnal or nocturnal insects, camouflaged by coloration that resemble the background or foliage. They feed on crops and trees forming biotic constituents of the grazing food chain, servings as food for mammals, many birds, reptiles, amphibians and other predators.

Neuroptera comprises small to large soft bodied insects having variable wing patterns. Being carnivorous, this group serves as biological agent to destroy the harmful pests. There are approximately with 33 species of from Madhya Pradesh usually found in herbages, bushes, trees and also in crop lands due to its pest feeding habits [13].

Termites are the most ecologically important group acting as mediators of ecosystem processes such as soil turnover [14] and nutrient cycling [15]. They gain economic importance, being the most destructive insect pests of wood and other cellulose products [16]. In man dominated

ecosystems, such as agricultural and forest plantations as well as in urban and rural areas, a number of termite species can be important pests, feeding primarily on wood [17].

Few studies have been made during the last two decades by different researchers on insect bio-diversity of moist deciduous forest areas in India, mostly from the deciduous forest belts of Western Ghats [18, 19], Madhya Pradesh [20-21] and Dehradun [22]. But detailed and long term study about insect diversity in the forestlands of Kanha National Park, Madhya Pradesh are very less. Our study was therefore first ever systematic survey on the insect diversity of this region.

2. Materials and Methods

A systematic survey was conducted for one year from January 2016 to December 2016. 1431 samples of insect fauna were collected from 30 sites by cutting infested and abandoned wooden logs or termite mounds into small pieces and insect sweeping nets of the deciduous forest region of KNP extending from $80^0$20′E-81^0E to $22^0$21′N-$22^0$10′30"N at an altitude of about 463-895m (Figure 1). Each of these sites were georeferenced by GPS handset GARMIN Oregon 550. Thematic maps of the study site, insect order, families and species distribution based on altitudinal gradient and map on percentage bar graph of KNP were created using ArcGIS 10.5 (ESRI, Redlands, CA, USA). Investigations regarding insect capture and collection were conducted once in a month for 10 days for the period of one year. The collected insects were brought to laboratory, sorted and identified by using the standard keys [21, 23-28].

3. Results

During the entire survey period, a total of 52 species of insects belonging to 3 orders, 9 families and 32 genera were recorded from the 1437 samples (Figure 2, 3, 4 & 5). The collected insect species including their order, family and zoological names are shown in the (Table 1) given.

In Orthoptera family Acrididae is highly dominant with species *Hieroglypus banian* (Fabricius), a major pest of paddy causing serious damage to crops and vegetable plants, while family Myrmeleontidae or ‘antlions’ of Neuroptera with species *Palpares pardus* Rambur and family Termitidae of Isoptera with species *Odontotermes microdentatus* Roonwal and Sen Sharma are commonly recorded from the sampling sites.

Table 1: Different insect species recorded from Kanha National Park in 2016

Order	Family	Species
Isoptera	Kalotermitidae	*Cryptotermes bengalensis* Snyder
Isoptera	Rhinotermitidae	*Coptotermes heimi* (Wasmann)
Isoptera	Rhinotermitidae	*C. kishori* Roonwal and Chhotani
Isoptera	Termitidae	*Speculitermes chadaensis* Chatterjee and Thapa
Isoptera	Termitidae	*S. cyclops* Wasmann
Isoptera	Termitidae	*S. goesswaldi* Roonwal. and Chhotani
Isoptera	Termitidae	*S. sinhalensis* Roonwal and Sen-Sharma
Isoptera	Termitidae	*Microcerotermes beesoni* Snyder
Isoptera	Termitidae	*M. cameroni* Snyder
Isoptera	Termitidae	*M. sakesarensis* Ahmad
Isoptera	Termitidae	*Odontotermes assmuthi* Holmgren
Isoptera	Termitidae	*O. gurdaspurensis* Holmgren and Holmgren
Isoptera	Termitidae	*O. horai* Roonwal and Chhotani
Isoptera	Termitidae	*O. microdentatus* Roonwal and Sen Sharma
Isoptera	Termitidae	*Trinervitermes biformis* (Wasmann)
Isoptera	Termitidae	*T. nigrirostris* Mathur & Sensarma
Orthoptera	Acrididae	*Acrida exaltata* (Walker)
Orthoptera	Acrididae	*Ceracris nigricornis* Walker
Orthoptera	Acrididae	*Phlaeoba panteli* Bolivar
Orthoptera	Acrididae	*Diabolocatantops innotabilis* (Walker)
Orthoptera	Acrididae	*D. pulchellus* (Walker)
Orthoptera	Acrididae	*Schistocerca gregaria* (Forskal)
Orthoptera	Acrididae	*Choroedocus illustris* (Walker)
Orthoptera	Acrididae	*Hieroglyphus annulicorllis* (Shiraki)
Orthoptera	Acrididae	*H. banian* (Fabricius)
Orthoptera	Acrididae	*Heteropternis respondens* (Walker)
Orthoptera	Acrididae	*Oedaleus senegalensis* (Krauss)
Orthoptera	Acrididae	*Oxya nitidula* (Walker)
Orthoptera	Acrididae	*O. velox* (Fabricius)
Orthoptera	Acrididae	*Chrotogonus (Chrotogonus) trachypterus trachypterus* (Blanchard)
Orthoptera	Tetrigidae	*Criotettix bispinosus* (Dalman)
Orthoptera	Tetrigidae	*C. latifrons* Hebard
Orthoptera	Tetrigidae	*C. orientalis* Hancock
Orthoptera	Tetrigidae	*Thoradonta nodulosa* (Stal)
Orthoptera	Tetrigidae	*T. spiculoba* Hancock
Orthoptera	Tetrigidae	*Hedotettix affenuatus* Hancock
Orthoptera	Tetrigidae	*H. cristitergus* Hancock
Orthoptera	Tetrigidae	*H. punctatus* Hancock
Orthoptera	Tettigoniidae	*Euconocephalus.incertus* (Walker)
Orthoptera	Tettigoniidae	*Xiphidiopsis citrina* Redtenbacher
Orthoptera	Tettigoniidae	*Himertula kinneari* (Uvarov)
Orthoptera	Tettigoniidae	*Letana megastridula* Ingrisch
Orthoptera	Tettigoniidae	*L. pyrifera* Bey-Beinko

Orthoptera	Tettigoniidae	*Sathrophyllia rugosa* (Linnaeus)
Neuroptera	Chrysopidae	*Chrysopa septumpunctata* Wesmael
Neuroptera	Chrysopidae	*Chrysopidia nigrata* Navas
Neuroptera	Chrysopidae	*Italochrysa flavobrunnea* Ghosh
Neuroptera	Nemopteridae	*Croce filipennis* Westwood
Neuroptera	Myrmeleontidae	*Palpares pardus* Rambur
Neuroptera	Myrmeleontidae	*P. contrarius* (Walker)
Neuroptera	Myrmeleontidae	*Tomatares pardalis* Fabricius
Neuroptera	Myrmeleontidae	*Acanthaclisis edax* (Walker)

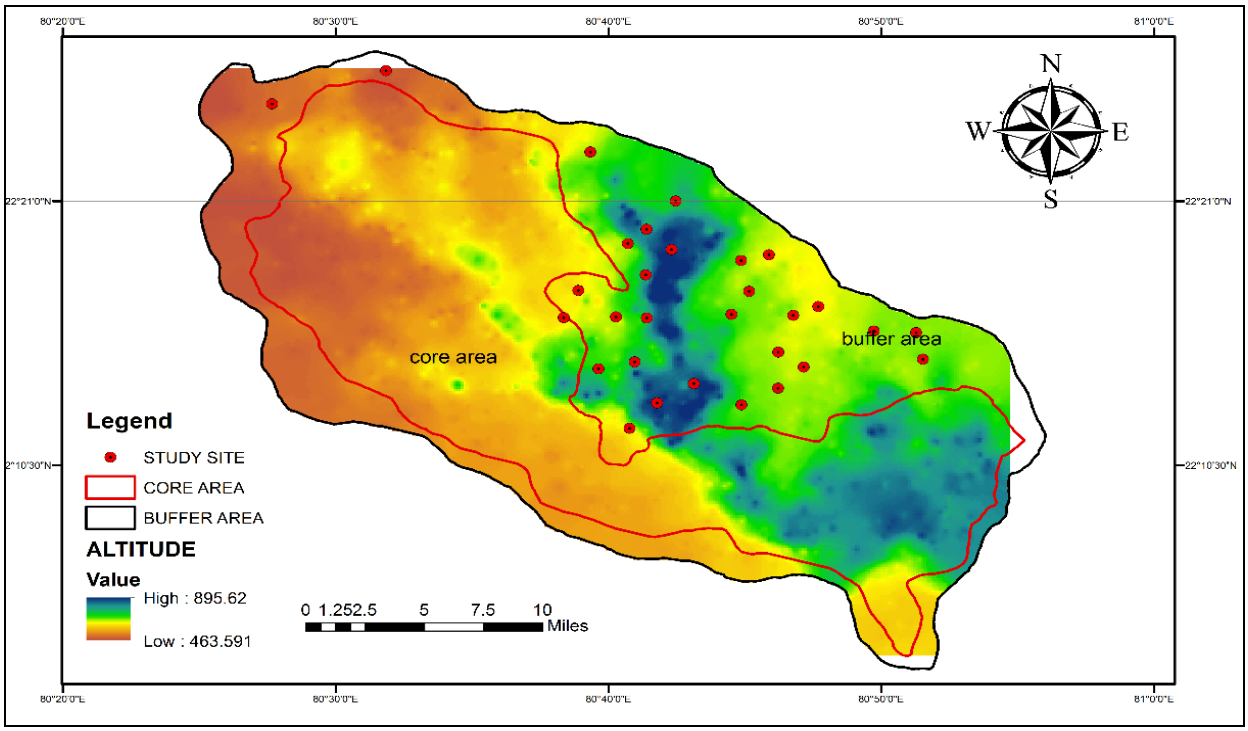

Fig 1: Map showing sampling sites based on altitude in Kanha National Park

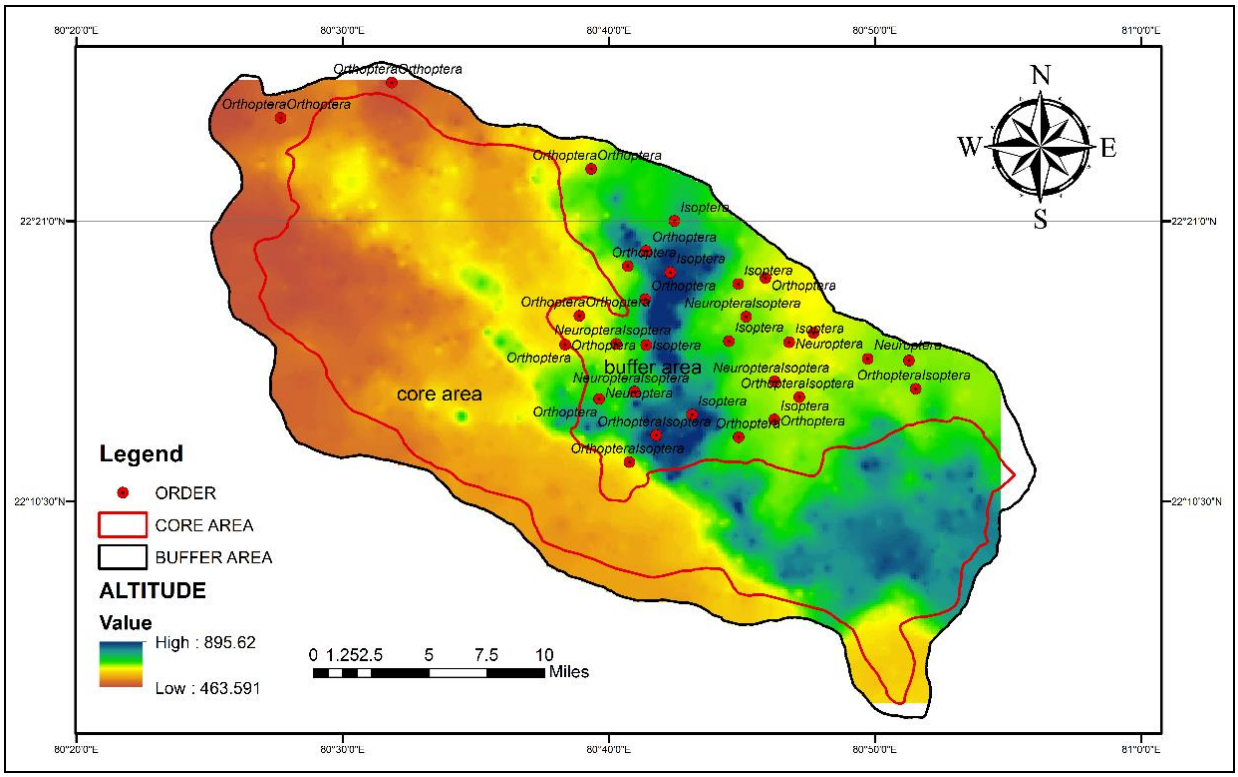

Fig 2: Map showing distribution of orders-Orthoptera, Neuroptera & Isoptera from the study sites

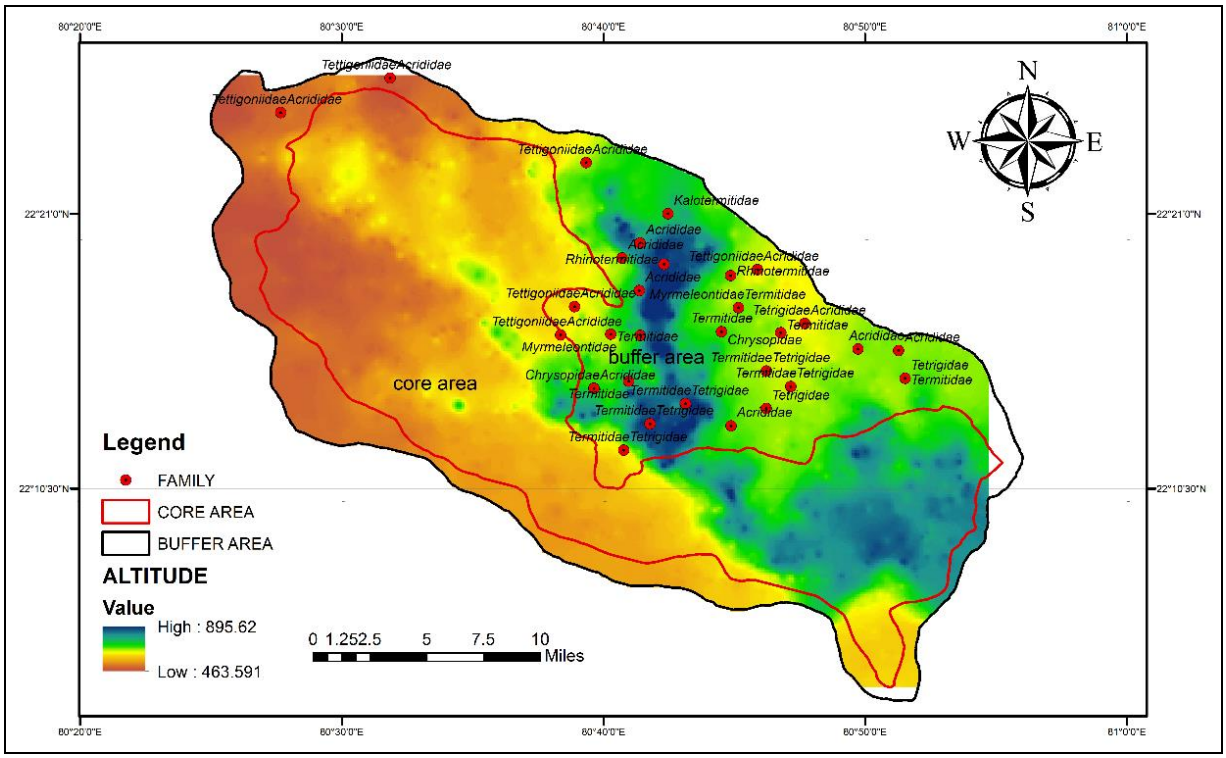

Fig 3: Map showing distribution of different families of orders-Orthoptera, Neuroptera & Isoptera from the study sites

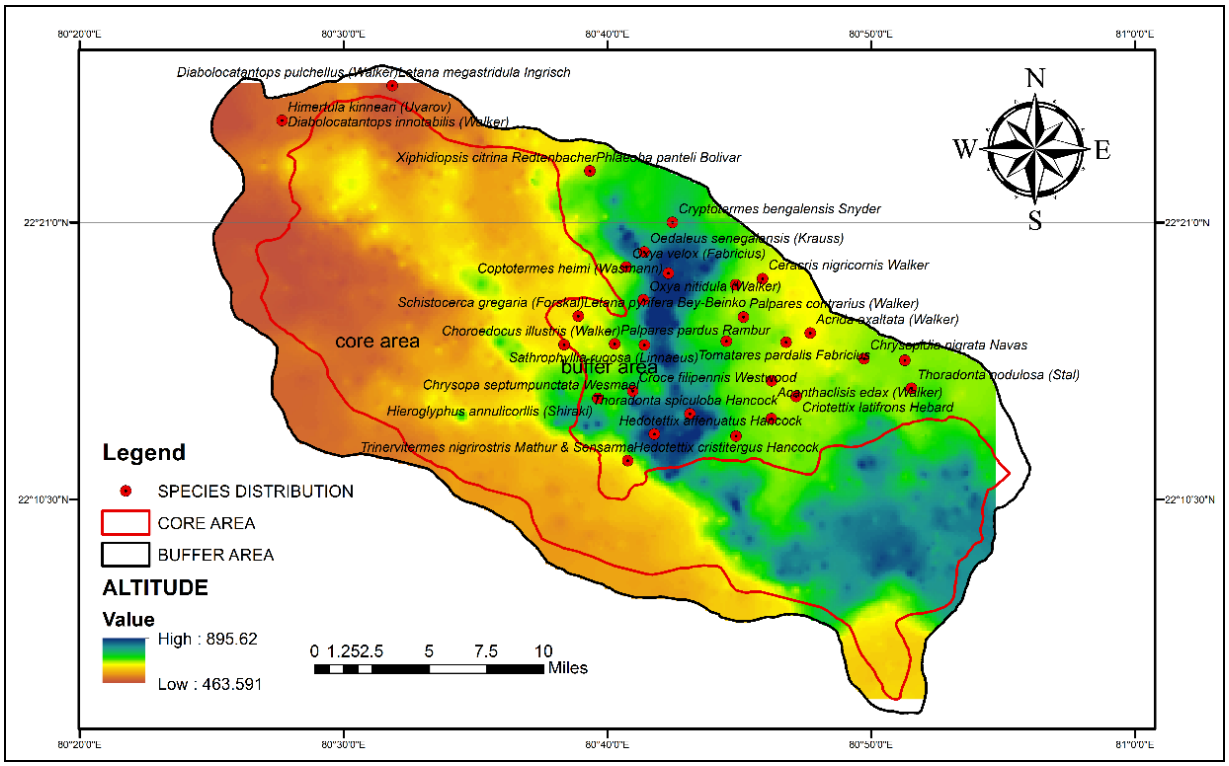

Fig 4: Map showing distribution of different species of orders- Orthoptera, Neuroptera & Isoptera from the study sites

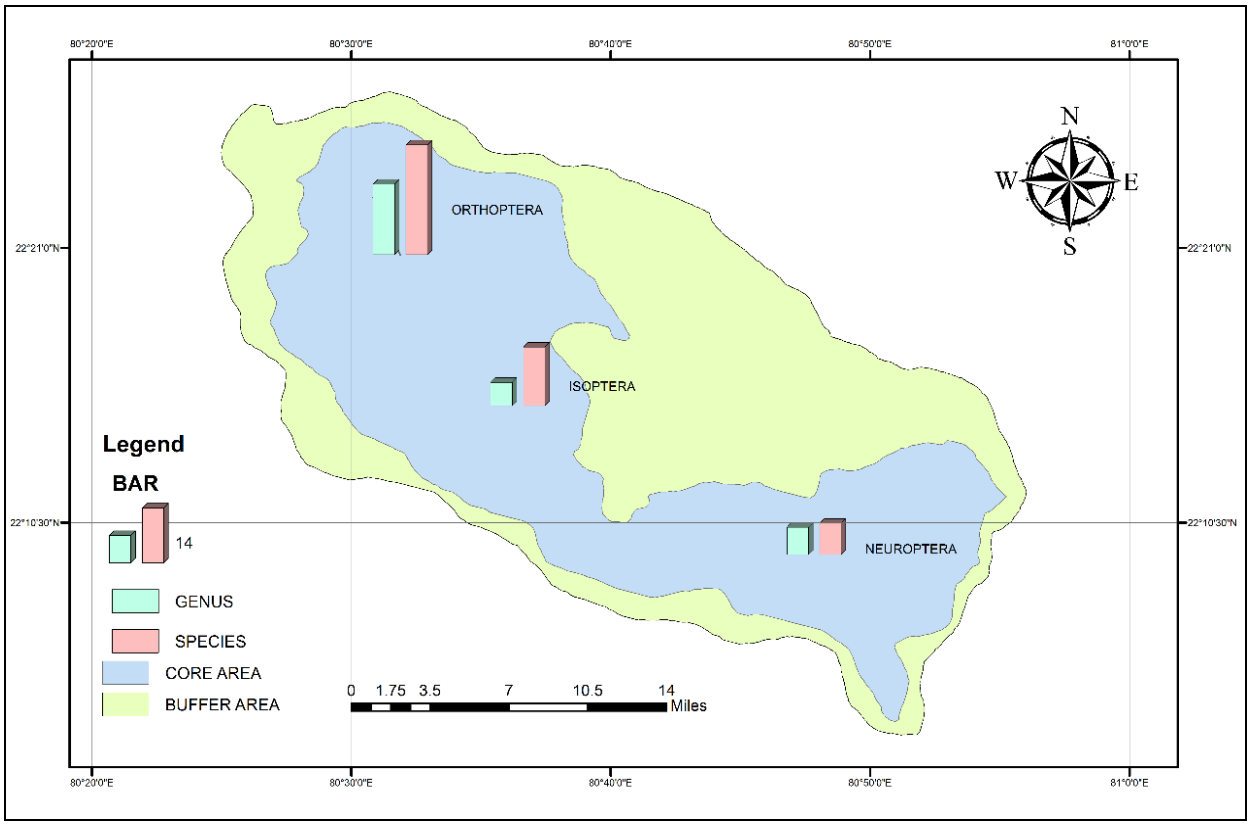

Fig 5: Map showing the percentage contribution of three orders- Orthoptera, Neuroptera & Isoptera depending on the species collected from study sites

4. Discussion

The present researches establishes that Orthoptera order is the most dominant group representing 28 species under 9 genera of 2 families followed by Isoptera order representing 16 species under 6 genera of 2 families and Neuroptera with 8 species under 7 genera of 3 families.

The insect diversity is very unique in Kanha National Park. Order Orthoptera is widely distributed in India. Acrididae, commonly known as the 'shorthorned grasshopper' is a family of grasshoppers including locusts in the order Orthoptera. They change colour and behaviour at high population densities, highly destructive and showing migration. These grasshoppers have both solitary and gregarious (swarm) phases. Locust swarms cause massive damage to crops. Stal was the first to initiate the study of Indian Acrididae [29-31]. A remarkable taxonomical work on Acrididae was made by Kirby in the series 'Fauna of British India' [1]. Usmani *et al*. [32] and Uvarov [33, 34] studied in detail Indian Acrididae.

Termites play a vital role as decomposers in forest growth, therefore acting as excellent indicators of soil and forest health. They are predominantly distributed in the tropical and sub-tropical regions. India is rich in termite diversity; comprises 286 species belonging to 52 genera under six families, almost 10% of the world's termite fauna [35]. The termite fauna of central India is insufficiently documented. Termite fauna of Kanha National Park was premeditated by Chhotani [21]. Verma [36] & Thakur [37] studied termite fauna of Madhya Pradesh and documented 18 species under six genera of which six species were recorded for the first time [38].

Majority of the families of Neuroptera are confusing and difficult to study due to inadequate information on its taxa leading to impossibilty in identifying the species. Lacewings or netwinged insects belong to Super-order Neuropterida and order Neuroptera. Adults are soft-bodied, green or yellow green in colour, having large lateral compound eyes. They feed on honey dew of homopterous insects and on pollen. The larvae of lacewings are predators, having elongated mandibles, adapted for piercing and sucking, voracious eaters of eggs and immature stages of many soft-bodied insects. Lacewings therefore play an important role in biological control of insect pests in the fields.

5. Conclusion

The present article is therefore a short scenario on the first ever systematic study of unique insect diversity of the moist deciduous forestlands of Kanha National Park located in Madhya Pradesh with dominance of insect orders Orthoptera, Neuroptera and Isoptera. Central India being the region with the highest forest cover of India, these kind of studies would help in knowing the species diversity and distribution patterns of insect fauna of this region.

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