DISTRIBUTION AND BIOLOGY OF ARTHROPODS IN GIR PROTECTED AREA AND ITS SURROUNDING ECOSYSTEM

WITH SPECIAL REFERENCE TO INSECTS: COLEOPTERA

[CONCISE SUMMARY]

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CONCISE SUMMARY

Biodiversity is something that arises from the total range of native creatures present. The greatest and smallest species count more or less equally towards a sum. While biodiversity in the broad sense regulates the cycling of carbon and other ecosystem processes, the total number of species involved in these processes has relatively little effects on the processes themselves (Hooper and Vitousek, 1997, Huston, 1997; Huston *et al.*, 2000 and Loreau *et al.*, 2001).

Biodiversity has immeasurable, intrinsic value for the humankind and thus need to be protected. It is essential for supporting human life and maintaining relation between man and nature. Every aspects of our life are sustained by the earth's biodiversity. Therefore, there is need to conserve the biological resources to continue supporting life on earth. The earth is relatively unexplored planet in terms of its biospheres. Inequality in the global distribution of biodiversity is the mirror image of the global distribution of wealth, as estimated by per capita Gross Net Productivity (Huston, 1993). Within region, either tropical or temperate, there is variation in the distribution of biodiversity, and this variation tends to correlate with conditions that influence human activities such as agriculture and forestry. These goods represent important and familiar parts of the economy. These biological resources are freely available for exploitation and development (McNeely, 1982).

Gujarat contributes significantly to the richness of India's biodiversity and is sixth largest state rich in diversity of natural ecosystems. The state has very rich wildlife heritage and enjoys a unique place in the country supporting some of the rare and endangered wildlife. Gujarat is the only state in the country, probably in the world, which protects top three big cats – Asiatic Lion, Tiger and Leopard. Out of eight endangered mammalian species each having only one habitat in the entire country, two of them Asiatic Lion and Indian Wild Ass are endemic to Gujarat representing over 27% diversity of Indian vertebrates (Gujarat Forest Department 1999).

Gir is one of the seven identified protected areas by the Global Environment Fund and World Bank and being the last abode of Asiatic Lion, the Gir forest has earned

an international acclaim and thus, Gir sanctuary and National Park enjoys protection status of the highest order (Chellam, 1993).

Gir forests are studied for its fauna and flora. Studies conducted so far include some compilation of the floral component (Santapau and Raizada, 1956; Habibullah, 1983; Rao, 1983 and Senan, 2002). Several workers carried out research on fauna. Ungulates were studied by Hodd (1970), Berwick (1974) and Khan *et al.,* (1990); where as the endangered big cat – lion drew attention of several naturalists and wildlife enthusiasts as well as scientists like Dharmkumarsinhji and Wynter-Blyth (1951), Dharmakumarsinhji (1968), Joslin (1973), Soni (1992), Chalem (1993), Saberwal *et al.*, (1994). Important parameters in habitat selection by peafowl *Pavo cristatus* was studied by, Trivedi (1993). Nevertheless systematic studies on invertebrates in general and Arthropods in particular are very scanty (Parikh, 2001). **The first objective of the present study therefore, was to identify Arthropods from this area and enlist them** (Chapter 1). Identifying Arthropods is necessary for knowing what is present today and later, a similar list will make it possible to evaluate the nature and extent of changes that have taken place

Insects among arthropods are distributed all over the world in all habitats and constitute about three-quarters of all the living species in the universe. Extremely few species are distributed on all the continents and have worldwide distribution. However, insect distribution on earth is not uniform, insect diversity increases from poles to the equator (Brown, 1981; McCoy, 1990). The distribution of insects in particular area may be regular, occasional, seasonal, persistent or sporadic.

Very few serious and systematic attempts have been made to study forest insects due to the role played by them in maintaining the equilibrium of the forested ecosystem (Stebbing, 1914, Beeson, 1941). Nevertheless, there is a great dearth of expertise for vast majority groups of insects in India (Narendran and Cherian, 2002), and all the more in Gujarat. However, scanty information is available regarding insect diversity of Indian forests. An assumption has been made that Gir forests harbor at least 2000 species of Insects (Singh and Kamboj, 1996). During mid to late nineties attempts were made to collect and identify animals of class insecta (Sing *et al.*, 1998). Therefore, as a prime goal of the present study an extensive entomological survey in the Gir PA was undertaken. **A thorough study on insect diversity, and the temporal variation in abundance and relative density of different orders of insects was under taken in Gir PA** (Chapter 2). One of the major benefits of such

studies in forested habitat and estimation of abundance of insect is that the studies when repeated after several years could help in knowing the status of insect themselves and their habitat.

Beetles make up more than 40% of all the known species of insects, and thus comprise the largest insect order. However, many beetles have yet to be described, and estimates for the total number of species range from one to twelve million (Booth *et al.*, 1990; Pearse *et al.*, 1987). This group includes more species than the entire plant kingdom does, and scientists agree that many thousands or even millions, more beetles have yet to be discovered. In fact, about one of every four animal species known on earth is a beetle (Chadwich, 1998). **Hence, in the current study an attempt was also made to learn the systematics of coleoptera – the dominant insect group – along with their abundance and distribution in space and time at Gir PA** (Chapter 3).

The study area, the Gir National Park and the Sanctuary, is one of the better protected and hence, wooded land mass of Gujarat. Together the Gir Sanctuary and the National Park form the Gir Protected Area (Gir P.A.). Gir P.A. is located in southern region of the Saurashtra peninsula of Gujarat state in the Western India. Geographically the Gir P.A. is situated between 20° 40' N to 21° 50'N and 70° 50'E to 71° 15'E longitude respectively

Gir P.A forms a part of Semi-Arid-Gujarat Rajputana (4B) biogeographic province (Rodger, 1989). Gir P.A has diverse and rich vegetation. The major forest types of Gir P.A. are teak forest, non-teak forest and riverine forest. The vegetation in Gir P.A. has been systematically studied and documented (Chavan, 1993). Champion and Seth (1968) have classified Gir P.A under the type 5A/Cia i.e. very dry teak forest. However, geographical variation in vegetation type is very vivid. The Gir west, Gir N.P and Gir east in particular exhibit characteristic vegetation type.

Based on ecological characteristics three main study sites were selected. Gir West was considered as site – I with six sub sites, Gir N.P was considered as site – II with five sub sites and Gir East as site-III with five sub sites. In order to have precise repeatability geographical position of each sub sites were located using a Geographical Positioning System (Garmin, GPS 12XL). GPS reading for each site is presented in the form of a table.

Regular visits were made twice in a month to each of the sub sites. Samples were sighted and representatives of each group were collected and narcotized and well preserved, and were brought to the working station for further identification. Identification was done by using standard reference books and published articles. The specimens identified were confirmed by comparing with the authentic specimens of Zoological Survey of India, Kolkotta, Jodhpur and at BNHS. Standard quantitative techniques were used to quantify various groups of insects and the data were analysed using statistical programmes *viz.* Excel, SPSS, Species Diversity and Richness Index.

Arthropods of Gir PA are evenly distributed forming an integral part of the forest ecosystem. Arthropods comprise of 80 – 90% of the total species of most of the forest ecosystems (Asquith *et al.*, 1990). Arthropods in general are basic consumers in the forest (Schowalter, 1989, 1995) and play a major role in natural ecosystems (Schultz and Mooney, 1993; Lerdau, 1997).

Arthropod fauna was represented by comparatively sparse number of representatives of Crustacea, Chilopoda, and Diplopoda. This could be because these groups were not intensively studied. However, Chilopoda and Diplopoda were sighted more during monsoon season, which suggests that increased humidity and more detritus condition facilitated their occurrence. Similar observations were also made by other workers (Rathinasabapathy and Yadav, 1999; Finnamore, 1992). It was observed that millipedes were feeding on leaves that were not broken down by other organisms, but preferred weathered leaves. These organisms also eat decaying wood, though they may be digested with the help of microbial flora in their gut. It appears that the actions of millipedes serve in the chemical breakdown and humification of litter, but their most important role in decomposition and nutrient cycling is the fragmentation of vast amounts of litter. Similar opinion made by, Finnamore, (1992) further augments the present notion.

It was observed during the current study that the Arachnids were the most paramount group of Arthropods. However spiders, with fifty-five representative species, formed the dominant group of organisms amongst arachnids. Studies carried out by Sabnis and Amin (1992), Patel and Vyas (2001), Patel (2003) have recorded rich spider diversity in the National Parks and sanctuaries of Gujarat. Number of spiders was more during monsoon season than in winter and summer. Their dominance during monsoon at the study area can be attributed to more

humidity and density of vegetation. Similar observations were also been made by De Bakker and coworkers (2000).

The richness of spiders in the forest ecosystem suggests their tight coupling with a large number of ecological processes. Spiders are among the dominant invertebrate predators of the terrestrial ecosystem (Turnbull, 1973; Wise, 1993; Patric *et al.,* 1999) and play a major role in invertebrate community dynamics (Moulder and Reichle 1972; Riechert, 1974; Wise, 1993). Most of the spiders are generalist predators (Nyffeler, 1999), feeding primarily on insects and secondarily on other spiders but have strict habitat requirements (Gertsch, 1979). Because of their high abundance and predominantly insectivorous feeding habit, spiders play an important role in controlling insect pest (Mason *et al.,* 1997). There are also evidences that the density behavior and population dynamics of spiders act to stabilize terrestrial arthropod population (Breymer, 1966; Turnbull, 1973, Riechert, 1974; Enders, 1975).

The data collected thus form baseline information to understand the temporal changes in the study area. However, it is necessary to acquire more information on community structure, abundance and distribution to determine appropriate levels of protection for ecosystem processes and functions.

The current study also showed the presence of a good diversity of insect species. The entire study area showed a fairly even distribution of different insect orders both in terms of number of species and individuals. However, there was a significant seasonal variation caused due to climatic change, which potentially affected insects both directly and indirectly through plant associations. Similar observations made by Dennis, (1993) and New, (1995) consolidate the present notion.

The insects' orders of apterygotans *viz.* thysanura, diplura and collembola were found dominant during monsoon season. Their dominance may be due to availability of good decaying materials. Gir PA being a deciduous forest leaf litter formation starts by late December till the end of summer which, in turn provides organic substance for these organisms. Ananthakrishnan, (1989) also observed similar relationship existing between apterygots diversity and humus in forest floor.

Pterygotans are represented by 16 orders of which Dermaptera, Embioptera, Neuroptera and Mecoptera were monsoon dominant. Terrestrial ecosystems are sensitive to climatic change when key processes such as primary production are tightly coupled to rainfall. In turn, vegetation structure is closely linked to temperature

and rainfall seasonality (Scholes, 1990). Climatic variations may be the reason for fluctuation in resource availability on which insect population is directly dependent (Demster and Pollurd, 1986; White, 1993). Ant lion larvae prefer dry situation for making conical traps (Borror, 1992) which is facilitated by dry weather prevailing during the months of April and May in the study area.

A single member of ephemeroptera was encountered in huge swarm during winter in 2001, which happens sometimes without any apparent reason (Borror, 1992).

Odonata was represented by good number of 16 species and were monsoon dominant. Prasad and Varshney (1995) have reported about 48 species and subspecies of odonata from different parts of Gujarat. Odonates spend major part of their life cycle in fresh water ecosystem. Being voracious predators during both immature and adult stages they are important component of fresh water ecosystem and occupy an apex position in the food chain of invertebrates (Tyagi, 1985, 1997). Study area is bestowed with seven perennial rivers and four water reservoirs (Singh and Kamboj, 1996), which serve as refugia for these insects.

A Good diversity of orthopteran species was recorded at the study site. Their presence was more prevalent during monsoon and post-monsoon seasons, which coincides with the optimum growth of all types of vegetation. Studies done by Hazara and co-workers (1993) and Tandon and Hazara also made same type of observations during 1998. Mantoidea and Phasmida orders were co-dominant during monsoon and winter. This increasing trend in population is due to an apparent increase in herbivorous insects during monsoon and post monsoon. These insect groups persist from monsoon till winter. Due to the onset of leaf litter formation, number of animals belonging to order Blattaria increases. Members of this group are omnivores and feed on every thing and any thing they get. Annathakrishnan, (2000) noticed that insects of leaf litter community, being one of the food source for Blattarians, provides them with good opportunity to proliferate.

Bugs and hoppers belonging to hemiptera and homoptera respectively showed a good number of species diversity with distinct seasonal preferences. Being semiarid ecosystem, study area showed poor representation of homopterans like aphids. Diversity of these groups depends not only on vegetational diversity alone but also on temperature and humidity, which are favourable during monsoon. Similar observations have been made by Ghosh (1993) from arid and semiarid zones of Rajasthan.

Lepidoptera showed highest diversity among insects excluding coleoptera. Seventy nine species are recorded from this order. Their predominance reflects high diversity of the group. Due to their large size and catchy colour they become conspicuous species compared to other groups, which may be reflected as their relatively greater numbers. Lepidopterans are dependent on various complementary resources suits their dominance, thereby, suggests the availability of these sources such as topography for mating, nectar for food and host plants for oviposition and subsequent larval growth (Dennis, 1993 and Venkata Ramana *et.al.*,2001). Therefore, appearance related aspects of butterfly biology have led their use as models for understanding the direct impacts of atmospheric pollutants and for predicting the indirect effects of climate change. For the same reasons, butterflies are promoted as monitors of climate change (Dennis, 1993).

Diptera is one of the important orders of insecta. Their occurrence was persistent on dead remains, left over preys of carnivores, in vicinity of excreta of vertebrates thereby suggesting their saprophagous mode of feeding habit. Fifteen species of dipterans were recorded during the current study.

As far as the number of species and family are concerned the second dominant order is hymenoptera. The reason for more common occurrence of hymenopterans may be attributed to the good availability of the host insects, which in turn may be due to increased floristic diversity. They have fascinating diversity in biology exhibiting both, entomophagy and phytophagy. According to studies carried out by Sureshan (1996) they are found to attack a wide range of hosts that include twelve orders of insects and two of arachnids. Ants contributed about 50% of total hymenopteran species at the study site. Ninety percentage of the dead remains of all insects are scavenged by ants and they may play a major role in turn over of soil (Wilson, 1991). This order stands out for its greater diversity, utilizing the environment fully and at the same time controlling other insects as noted down by Wagner *et al.,* (1989). Any increase or decrease in their population is an indication of the population of noxious species or pests belonging to other insect orders (Chhotani and Ray, 1975). Hymenopterans also play a critical role of pollinators in forest ecosystem (Buchmann and Nabhan, 1996).

Thus from the present study it can be concluded that the insect fauna of Gir PA is vast and the availability of a wide range of ecological niches and climatic variations enhance distribution of insects. Moreover, the heterogeneous plant architecture

might have supported an appreciable variety of insects' species. The more complex the plant architecture, the more herbivorous insects are supported (Lawton, 1983). In the apparent changelessness of the tropical forests there are however subtle diurnal or temporal variations in weather, which affects insect community structure. Insect population variability is as evident in the tropics as in temperate zones, making monitoring of insect species for presence/absence or abundance important at all latitudes (Samways, 1994). Population of insect species is found attaining maximum level during monsoon season throwing open a plethora of various forms of insects. Availability of humid microhabitats, plentiful of food – in the form of foliage as well as different stages of life forms – may lead to proliferation of these insects during rainy days. Another apparent reason could be the least anthropogenic pressure during rainy season when human interference is at its low ebb. During winter season the environmental scenario changes leading to change in the insect population, which show decreasing trend. Apart from temperature level of humidity was also found decreasing during this period and that might be affecting the insect population negatively. It is evident by slight decline in the insect abundance during winter. Totally foliated trees that are abundant during monsoon starts weathering during winter and that accounts for the lower number of phytophagous insects. Falling of leaves enhances leaf litter formation, which is favourable to insects preferring this stratum of habitat to flourish. Nevertheless, forest fires – a regular forest management practice – play a major role in keeping check on the leaf litter. This state of affairs may be favourable for some groups of insects whereas unfavourable for other group of insects. Moreover, human interference poses major concern during the rest of the year. Seasonal changes leading to summer were remarkably noticeable by a general decrease in insect species richness and abundance. Due to dry condition and defoliated trees during hot season, insect population starts dwindling during summer months. These observations therefore prove beyond doubt that temporal changes affects the composition and abundance of insect community either directly or through altered phenological and edaphic characters at Gir PA a tropical dry deciduous forest.

Few coleopteran families are commonly encountered in the entire study area. These families are Carabidae, Scarabaedae, Staphylinidae, Tenebrionidae, Curculionidae, Crysomelidae, Cerambycidae. However, Carabidae and Scarabaeidae were the most divers and found all over Gir P A. The dominance of these families may be due to the availability of their preferential habitats. Moreover, these are the major families

of Coleopteran fauna of India (ZSI, 1991).Nevertheless for precise conclusion more intense studies on niche preference are needed.

Dominance of carabidae could be due to their broad geographic ranges and ability to occupy all the major habitats except the drier part of deserts (Lövei and Sunderland 1996). Due to this dominance they are well known both taxonomically and ecologically (Lövei and Sunderland 1996, Niemelä 1996) and are also widely used for different kinds of indicator studies because of their sensitivity to slightest habitat alteration (Rainio and Niemelä, 2003). This sensitivity of theirs is been studied in most of the surveys focusing on the response of the species to changing environmental conditions, e.g. forest fragmentation (Niemelä *et al.* 1988) or management practices (Rushton *et al.*, 1990). In addition to this ground beetles have been used in studies for the effect of insecticides (Basedow 1990), effects of military tanks (Mossakowski *et al.*, 1990), classification of habitat type (Eyre and Luff, 1990), assessment of site quality (Eyre *et al.*, 1996) and studies on urban ecology (Vernn, 2000). Their ubiquitous presence was very prominent all over the study area irrespective of any microhabitat during the entire span of study. This supports the observation that they are abundantly found in deciduous forest (Turin and den Boer, 1988). Their ability to survive on a varied range of insects makes them successful in any habitat type they are found in. They being predatory may help in keeping the noxious insect species under control. Their role as predators of pest species is exploited in India (Beeson, 1941). The larva of *Calosoma* and *Chlaenius* are active above ground and are known to feed on caterpillars. It feeds on caterpillars and pupae, Grasshopper and cockroaches and on beetles of Bostrichidae. The species was introduced to some of the irrigated plantation of Punjab in 1938 and 1935 to control the Shisham defoliators. Artificial distribution of *Anthia sexguttata* and *Calosoma maderae* and other species attacking caterpillars of *Plecoptera reflex* a (Noctuidae) has been tried as a control measure in the Shisham plantation of the Punjab species of *Calosoma* have been used in other parts of the world for biological control (Beeson, 1941).

Scarabaeidae (Dung Beetles) are essential component of forest ecosystem, several recent studies have emphasized the potential role these insects play in dispersal, seed burial and germination (Howard and Zanoni, 1989; Estrada and Coates-Estrada, 1991; Shepherd and Chapman, 1998; Andresen, 1999; Feer, 1999; Vulinec, 2000). They do valuable work in quickly mixing raw manure with the soil before the termites gain access to it. This makes them very important part of the ecosystem in

which they are found. By burying the dung and carrion as food for their offspring, dung beetles may increase the rate of soil nutrient cycling (Halffter and Mathews, 1996; Bornemissa and Williams, 1970; Nealis, 1977). Large number and diversity of scarabids in the study area can be coupled with the presence of larger wild mammalian species. Scarabids play a major role in pastures and grassland biomes removing vertebrate feces of many domestic and wild ungulates, which in turn help in forest regeneration. By carrying out this activity they become significant component of the forest ecosystem (Fincher, 1981; Rougan *et al.*, 1988; Halffter *et al.* 1992; Vulinec, 2000). Rensburg (1999) is of the opinion that dung beetles assemblage can match the floral and vertebrate diversity of any habitat. Since the study area is already known for its floristic as well as amazing vertebrate diversity (Singh, 2001), these beetles are found proliferating and sustaining themselves. They exert important control over the egg and larva population of parasitic flies present in fresh dung of mammals (Bergstrom *et al.*, 1976). Because of essential role, loss of this beetle fauna can directly affect not only biodiversity, but also soil structure, nutrient cycling and even the population dynamics of hitchhiking organisms (such as predatory mites and nematodes).

Recently dung beetles have been suggested good indicators for measuring biodiversity as indicators of disturbance in the tropics (Halffter and Favila, 1993; Davis *et al.*, 2001). As occurs in all order of insects (Samways, 1993; 1994; Martín-Piera, 1997) concern has been increasing over dung beetle conservation in the last decade (Klein, 1989; Lumaret, 1994; Martín-Piera and Lobo, 1995; Barbero *et al.*1999; Van Rensburg *et al.*, 1999).

Staphylinidae was one of the leading families of the study area. They have a preference for moist atmosphere, dung, decaying matter, etc. White (1993) has also studied that rove beetles are often abundant in habitats with large numbers of fly larvae -- especially decaying fruit, decaying matter, carrion, and dung, where some are important predators of maggots and others prey upon mites or nematodes. Among leaf litter inhabiting beetles, the family staphylinidae is the most species rich and among numerically dominant taxa in the leaf litter community (Olson, 1993). Gir being a deciduous forest, formation of leaf litter is prominent feature of this ecosystem, which supports in formation of rich organic material in turn supports large number of decomposers organisms, staphilinids are one of them.

Tenebrionid beetles were one of the beetle families, which occurred throughout the study area irrespective of seasons. Adults of this family are generally herbivores and/ or detritivorous feeding on stems, leaves or buds of plants, although decaying or dead plant matter has been recorded as food for some species by Rogers and co workers (1978) and Allsopp (1980). They are considered as ideal study organisms for exploring environmental scaling because they are abundant, conspicuous, and easy to identify. They have been used as model organisms for many other studies on the short grass steppe by Crist *et al.*, (1992); Crist and Wiens (1995); Mc Intyre (1997); Wiens *et al.* (1997).

Buprestidae, metallic beetle are easily recognized by their striking colouration. At the study site adults of this family were commonly observed on *Acacia spp.* Adults of this family don't damage forest trees because on emerging the adults feed, mate and then die in a relatively short time. Ecowatch project (2002) has found that the life span of buprestid beetle is short and depending on the species, adult beetles may live for just one or two days upto about two weeks, their larvae are considered as pest (Ecowatch project, 2002). They are considered as pest of *Acacia spp, Albizzia spp, Bauhinia spp, Shorea robusta, Butea spp. Zizyphus spp, Terminalia spp, Ficus spp.* (Beeson, 1941; Holm, 1979; Hutacharern, 1989; Balu *et al.*, 2001; Jamal, 1994) all this plant variety are profoundly dominant at study site which attracts this beetles to thrive at study area.

Cerambycidae beetles are known pest for forest plants. They are known pest of *Acacia spp. Cassia spp., Casurina equisetifolia* and *Prosopis juliflora, Tectona grandis, Zizypus Spp., Albizzia spp.* (Stebbing, 1914; Beeson, 1941; Ralph, 1985; 1990, Jain *et al.*, 1993, Wylie *et al.*, 1998), a dominant floral component at the study site, which helps to sustain this group of beetles. It is studied by Beeson91941) that one of the species of this family, *C. Scabrator* is practically immune from parasitism and predator control in the larval and pupal stages, bacterial disease is infrequent, and the extensive babul plantation offers a very favourable food supply however, he has also stated that the pest has not multiplied to a permanent epidemic characterized by 100% attack.

From the forestry aspect chrysomelidae are ubiquitous and abundant, but don't cause appreciable damage except in pure plantations or in stands of gregarious spices (Stebbing, 1914; Beeson, 1941; Verma, 1985; Pillai and Gopi, 1990; Lee and

Morimoto, 1991; Yadav *et al.*, 1992). Grass and herb cover was the main factor influencing the composition of the chrysomelidae family (Řehounek, 2002).

Meloidae beetles moreover feed on cucurbitaceae, leguminousease and malvaceae (Beeson, 1941). *Mylabris pustulata* species of family was observed in huge number, a common phenomenon observed in this species (Beeson, 1941). Larvae of this species help in controlling grasshopper population by feeding on its eggs (Borror, 1998).

Curculionidae are purely herbivorous family and show different mode of feeding habit the species recorded from this family at study site are defoliators, shoot and stem borers, soil dwellers. Studies by Ahmad and co-workers (1997) have observed that wide variety of food plant Mango, Citrus, *Zizyphus spp., Acacia spp., Terminalia spp.,* majority of food material listed by eminent entomologist like Stebbing (1914) Beeson (1941) is easily available, which help them to thrive at study area.

Concluding the observations, the variation in species diversity among the beetles noted at study site, could be due to different species having different ecological requirements, some species are generalist and some other are specialized demanding certain habitat characteristics (Dufrene and Lengendre, 1997). Insect species differ considerably in the constancy of their population levels. Some are relatively constant from one generation or year to the next; others are frequently varying, while others remain at fairly consistently low levels only to out break very occasionally (Whittaker, 1975). Increase or decrease of species number or abundance might be directly caused by change in abiotic and/ or biotic factors (Blake *et al.*, 1996) or indirectly by change of species assemblage of other species (Haila *et al.*, 1994). As stated by Eyre and Luff (1990) Change in species number and abundance are predominately affected by soil water content, fragmentation and vegetation (Halme and Niemela, 1993). Seasonal changes in the occurrence of beetle were profoundly noted during the study. Vegetation changes affect the resource availability of members of this group. This is represented by their low diversity as well as species number during summer. Both plant-mediated effects and direct effects of physical contact under crowded conditions have been demonstrated to induce dispersal in other insect groups (Harrison,1980). Therefore, dispersal in coleopteran species too could be triggered by either a reduction in the amount of host material, changes in host quality due to herbivory, or increased contact among adults.

In one of the earlier studies in Gir PA on lions, the blood parasites were investigated and along with that there is a report of several species of insects given as a supplementary data (Majumdar, 1975). Other than this no major attempts have been made to study systematics of arthropods in general and insect in particular. All these years lion has been the focus of all the conservation and management practices in Gir. Nevertheless, it has been realized recently that conservation of any species is possible by faithful conservation and management only if knowledge of all the components of that ecosystem is known and then the management of that ecosystem is planned as a whole (Meffe and Carrol, 1997). Therefore, the present study was undertaken as an attempt to discover the arthropod diversity in general and insect distribution pattern in particular with a special reference to the coleopteran diversity in Gir P A.

The goal is to develop management guidelines that will preserve arthropod fauna within this special forest. Current list contains a total of 81 species of arthropods other than insects, 238 species of insects excluding coleopterans, and 114 species of Coleopterans. The gathered data about some of these groups will be very useful when adequate work is carried out to further explore the area in detail. Availability of species catalogue is invaluable but they provide rather limited information about various aspects of insect life processes. The present species list should be viewed as a work in progress rather than a comprehensive list in the focal region. Although the species diversity of coleoptera has been well documented in the present work, other groups of insects require further taxonomic attention. The present work highlighting detailed ecological requirements provides an insight into the important role played by this group of animals in maintaining delicate balance of the ecosystem. Such work can provide substantial baseline information presently and future work can be planned and executed on this solid foundation.

Empirical and theoretical contributions by entomologists (insect biologists) are needed to improve existing species-focused conservation efforts, to better develop larger scale approaches and to help build conservation policies that better reflect the unique conservation needs of insects.