

WHAT MUSEUMS CAN DO TO SAFEGUARD AND INTERPRET INTANGIBLE NATURAL HERITAGE ?

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Museums, historically been involved in collecting, documenting, preserving, presenting and interpreting Material Evidence of man and the environment. The Article II of International Council of Museums (ICOM) till 2001 defined Museum as, “ a non-profit making, permanent institution in the service of society and of its development, and open to the public, which acquires, conserves, researches, communicates and exhibits, for purposes of study, education and enjoyment, material evidence of people and their environment.” (a). The definition of a museum shall be applied without any limitation arising from the nature of the governing body, the territorial character, the functional structure or the orientation of the collections of the institution concerned. (b). In addition to institutions designated as "museums" the following qualify as museums for the purposes of this definition: natural, archaeological and ethnographic monuments and sites and historical monuments and sites of a museum nature that acquire, conserve and communicate material evidence of people and their environment; institutions holding collections of and displaying live specimens of plants and animals, such as botanical and zoological gardens, aquaria and vivaria; science centres and planetaria; non-profit art exhibition galleries; nature reserves; conservation institutes and exhibition galleries permanently maintained by libraries and archives centres; natural parks; international or national or regional or local museum organisations, ministries or departments or public agencies responsible for museums as per the definition given under this article; non-profit institutions or organisations undertaking conservation research, education, training, documentation and other activities relating to museums and museology; cultural centres and other entities that facilitate the preservation, continuation and management of tangible or intangible heritage resources (living heritage and digital creative activity); such other institutions as the Executive Council, after seeking the advice of the Advisory Committee, considers as having some or all of the characteristics of a museum, or as supporting museums and professional museum personnel through museological research, education or training.

ICOM Statutes, amended by the 18th General Assembly (Barcelona, Spain, 6 July 2001. Now, as per the ICOM Statutes, adopted during the 21st General Conference in Vienna, Austria, in 2007: “A museum is a non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment. The phrase *Material Evidence of Man and the environment* has been replaced with the phrase *tangible and intangible heritage of humanity and its environment*. This, indeed is a major paradigm shift which has revolutionized the very concept , scope , function and role of museums. The other revolutionary development in museological context and philosophy is the

concept of *Ecomuseum*. The other major issue is that of defining *intangible heritage*, while there has been many discussions, efforts by museologists, ethnologists, ethnographers and experts of cultural studies as well as organizations including ICOM and UNESCO to define *Intangible Cultural Heritage*. There is still confusion about the definition of Intangible Natural Heritage. Both UNESCO and ICOM have come out with guide lines about museum's role and action plan for safeguarding and interpreting the Intangible Cultural heritage, but there is hardly any such effort in case of intangible natural heritage, specially for intangible aspect of Geo-diversity and Biodiversity.

CLIMATE CHANGE AND INDIAN AGRICULTURE: IMPACTS, ADAPTATION AND MITIGATION STRATEGIES

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Agriculture is the mainstay of the Indian economy where about 65-70 percent of the population is dependent on it for their livelihood. Therefore, the climate change has direct effect on India. There is a strong evidence to suggest that change in climate has been occurring during the past 100 years. The mean global temperatures increased by 0.6°C during last 100 years and warmest summers were observed in the last decade of the 20th century and first decade of 21st century. This is mainly attributed to the increased concentration levels of GHGs, viz. CO₂, CH₄, N₂O and CFCs. If the emissions of GHGs are continued at the current rate, the average global surface temperature would rise from 0.6 to 2.5°C in the next fifty years and between 1.4 to 5.8°C by the end of the 21st century.

A slight warming trend of 0.4°C over the last 100 years has been noticed over the Indian sub-continent and the changes were found to be more significant during winter. The spatial variability of air temperatures over the country indicated warming in peninsular region while north-west India has exhibited cooling trend. On the rainfall variability over the country, the data did not show any significant trend. However, increase in frequency and intensity of extreme weather events such as droughts, floods or unseasonal rainfall is noticed. Sub-divisional rainfall trends during the recent decades indicated decreasing rainfall trends in north-east-region while increasing trends are noticed in north-west and north India.

Projected scenarios for the Indian sub-continent indicated a warming to the extent of 3.5 to 5.5°C by 2080s and more warming is expected in winter than in summer season. Similarly, a marginal increase in rainfall of 7 to 10 percent is predicted over the sub-continent by 2080. The climate change can influence crop yields. Higher temperatures are likely to alter the fertility status

of soils significantly. Additional application of fertilizers may be needed to counteract the adverse processes. Conditions will be more favourable for the proliferation of weeds, insect-pests and diseases in the warmer climates and crop damages are likely to increase. The expected rise in sea level may range from 10 to 50 cm by 2050 and may pose a serious threat to agriculture in low lying coastal areas.

Climate change is expected to increase evapotranspiration and thus water requirement in crop production. There are several approaches that can assist in reducing GHGs emissions. Improved water and fertilizer management in rice fields could reduce emissions of GHGs. Use of nitrification inhibitors, such as neem-coated urea, and fertilizer placement practices can reduce GHGs emissions. Approaches to increase soil carbon such as organic manures, minimal tillage, and crop residue management should be encouraged. Improving the efficiency of energy use in agriculture by using better designs of machinery and by conservation practices could also lead to mitigation. There are possibilities for crop diversification and changing land use by increasing area under bio-fuels, agro-forestry which will help in mitigation of GHGs emissions. Improved management of livestock population and its diet could also assist in mitigation of GHGs.

Cultivars with a better use of N can reduce surplus N-fertilizer inputs thus protecting the environment by reducing N₂O emissions and thus mitigating climate change. Biological nitrification inhibition or suppressing nitrification by such genes, which are available in some tropical grasses, may pave the way for genetically engineered development of cultivars. Integrated farming systems, intercropping, INM and IPM practices as well as integrated watershed management practices are required to be adopted to manage the adverse effects of climate change in India.

SPECIES DIVERSITY OF COCCINELLIDS (COLEOPTERA: COCCINELLIDAE) IN SOME PROVENANCES OF SANDAL (*Santalum album* Linn.) AND THEIR ROLE IN PEST CONTROL

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Entomophagous coccinellids are perhaps the most familiar of all the predaceous beetle groups. This charismatic group includes many beneficial species that are voracious predators of pestiferous aphids, whiteflies, psyllids, scale insects etc., Research on these coccinellids has advanced mankind's concept of biological pest management which is emerging as an important component of integrated pest management (IPM) programs. The role of coccinellids in biological control of sandal insect pests is less studied. Insect pests particularly scale and mealybugs cause serious damage to the growth of sandal in plantations and they are 'hard to kill pests'. The damage

is caused by sap sucking resulting in die-back symptoms and secreting copious amount of honeydew on which black sooty mould fungus develops. Eggs of the mealybugs, protected by waxy filamentous secretions of ovisacs are almost impossible to reach with insecticides. Late instar nymphs and adult female mealybugs are not affected by foliar application of insecticides since they are covered with waxy coating. However, mealybugs, being sessile, are quite amenable to biological control. In the present study, surveys were conducted to identify the species spectrum coccinellids in six sandal provenances of south India. It revealed the presence of 25 species of coccinellids in the sandal provenances. In the light of these findings, the importance of exploiting these coccinellids for developing ecologically and environmentally sound insect pest management strategies in sandal plantations is discussed.

THE MOSQUITO DIVERSITY IN WESTERN GHATS, WITH SPECIAL REFERENCE TO PHYTOTELMATAN FAUNA

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Of the nearly 360 species recorded in India, almost two-thirds belonging to 33 genera and 30 subgenera have been collected/preserved in the museum of Centre for Research in Medical Entomology. These are represented by over 71,000 specimens under all the main genera, particularly *Culex* (52 species), *Anopheles* (44), *Uroanotaena* (17), *Ochlerotatus* (16), *Stegomyia* (16), *Aedes* (11), *Armigers* (11) and *Verrallina* (9), including new country or regional records of several species and five *species nova*, i.e., *Rhinoskusea portonovoensis*, *Tewarius agastyai*, *Te. reubenae*, *Verrallina (Neomacleaya) assamensis* and *Anopheles (Cellia) pseudosundaicus*. The Western Ghat region provides a rich haven for a variety of mosquitoes, which also facilitate in removing many a dark point in the taxonomy of several intriguing taxa, such as *Ades aegypti* and *Ae. albopictus* which breed in a range of habitats, both natural and manmade. Many a species, like, *Heizmania (Heizmania) chandi*, remain incompletely described (pupa, in case of *Heizmania chandi*) and lack documentation of one or another stage's full taxonomic description. One of the most quaint and less explored breeding sites of certain phytotelmata mosquito species is the pitcher plant, generally the *Nepentus* species. Over a dozen species, including two prospective new species, one belonging to *Armigeres* and another to *Toxorhynchites*, have been sampled from an array of pitcher plants from the Western Ghats. The pitcher plant mosquitoes, such as *Wyeomyia smithii* in western countries, are said to have the potential to interpret correlation with climate change by exhibiting their behavioural changes in resting, breeding and overwintering. It is interesting to trace co-relationship of a pitcher plant species with that of a mosquito species in India. A new method of identifying a mosquito species based on the genomic DNA extraction from pupal exuvium of *Aedes* and *Culex* species has provided a new insight into the hierarchical status of taxa.

DISTRIBUTION AND DIVERSITY OF NOCTUID FAUNA OF VEERANGANA DURGAVATI WILDLIFE SANCTUARY, DAMOH DISTRICT, MADHYA PRADESH

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The Noctuidae is one of the largest family of the insect order Lepidoptera, which includes more than 1300 species of moths from India. The family includes mostly economically important moths, the larvae of which feed voraciously on a wide range of plants (polyphagous) in different agro ecosystem and forests and cause considerable economic loss. Due to intense anthropogenic activities in and around the agriculture and the forest habitats, the distribution and diversity of noctuid fauna is changing in these habitats.

During the present study, attempts has been made during the year 2009-2011 to document the noctuids of one of the conservation area of Madhya Pradesh i.e. Veerangana Durgavati Wildlife Sanctuary, District Damoh. The preliminary studies shows that a good number and the diversity of noctuid moths consists of 21 species and 18 genera under 7 subfamilies were documented, which help immensely in the conservation and management of this habitat.

RODENT SPECIES DIVERSITY IN SANDY BIOMES OF WESTERN RAJASTHAN

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Rodents belong to Order Rodentia of Class Mammalia and constitute one of the largest mammalian groups in the Rajasthan desert. They are represented by 18 species under three families viz., Sciuridae, Hystricidae and Muridae. Of these, former two families are monotypic i.e., represented by one species only. The group consists of porcupines, squirrels, gerbils, rats, mole rats, mice etc. They exhibit a great plasticity in respect of their choice of a wide spectrum of desert habitats. The present study was undertaken through live trapping in sandy biomes consisting of sand dunes and inters dunal plains in Ramgarh and Mohangarh areas of Jaisalmer District. The species composition of the habitat on sand dunes was dominated by two species of *Gerbillus* (Sub Family Gerbillinae, Family Muridae) i.e, hairy footed gerbils, *G. gleadowi* and Baluchistan gerbil, *G. nanus*. Externally, both the gerbil species are of smaller in size (62-70 mm HB) but differs in the size of hind foot which is exceptionally larger in *G. nanus*. Secondly the hind foot (sole) in case of *G. gleadowi* is hairy and that in *G. nanus* is naked. Other two relatively larger gerbils, viz., Indian

desert gerbil, *Meriones hurricane* and Indian gerbil, *Tatera indica* were mainly trapped from interdunal plains. Besides these four gerbil species, a murid fauna viz, Indian field mice, *Mus booduga* was also trapped from the sandy plains. The overall trap index in the study area was 0.15 rodents /trap/day. Five striped squirrel, *Funambulus pennanti* was the other rodent species (Family sciuridae) frequenting in the area near trees and human habitations. In The pucca houses were mainly inhabited by two most common commensal rodents viz., house rats (*Rattus rattus*) and house mouse (*Mus musculus*). Thus the sandy biomes in the study area represent 44.4% share in the over all rodent species diversity of Thar Desert.

BIOMONITORING APPROACH OF AQUATIC ENTOMOFAUNAL DIVERSITY, HUSSAIN SAGAR LAKE, HYDERABAD

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The present study is based on Insect collections made from various surveys to the Hussain Sagar lake, Hyderabad, during April, 2008-March, 2010 as a part of the project entitled “Taxonomic and ecological studies of Aquatic insects of lakes in and around Hyderabad” (FBRC/ZSI/Hyderabad). The Hussain Sagar Lake in Hyderabad is an enchanting lake and is the largest man-made Lake in Asia. The Lake has been developed as a major tourist attraction in the Hyderabad city by the AP Tourism Department. During the course of local surveys, three seasonal surveys in a year were made, and aquatic insects were collected from water bodies of the park. Collections were made with the help of hand operated nets of varying sizes by randomly netting different areas of wetland. Insects collected for study were preserved in 70% alcohol. The collections were identified with the aid of standard literature on the groups. This study is significant due to its maiden effort to study the entomofaunal diversity of lakes of Hyderabad, Andhra Pradesh and their role in biomonitoring of lakes. This paper is dealt with a study on the 28 species of Aquatic insects belonging to, 6 families and 18 genera, comparison of EPT index and chemical analysis of water which forms the first report from the lake.

Aquatic insects are the most widely used organisms in freshwater biomonitoring. Because of the high monetary investment in freshwater management, decisions are often based on biomonitoring results, and a comparative review of different approaches is required. In addition to taking direct samples of water and testing for various metals, organic matters, dissolved oxygen etc, aquatic insects also aid as site monitors of water quality. Few species belonging to family Ephemeroptera (nymphs) beetles of Family Elmidae (adults), Trichoptera (larvae), Plecoptera (nymphs), Psephenidae (water pennies) are highly sensitive to pollution and serve as bioindicators of water quality. These organisms require high dissolved oxygen levels. Generally when present in less numbers, these insects suggest it as eutrophic lake. Some insects of order Megaloptera (larvae), Odonates viz. Dragonflies and damselflies (nymphs), family Gyrinidae (whirligig beetles larvae) tends to tolerate some degradation of water quality. The EPT Index is calculated. The less number

of insects belonging to these three was noted which constitute the EPT Index of a lake. Since these orders of insects are highly sensitive to pollution, they are used as water quality indicators. Their presence and relatively average number suggests the Hussain Sagar Lake to be a eutrophic one, and the results are confirmed by chemical analysis of water. Aquatic entomofauna of Hussain Sagar Lake play a vital role in assessing the health of a lake and are proved to be efficient biodiversity indicators. Further studies aiming to improve our knowledge on water insects and their biomonitoring role should focus on diversity of aquatic insects and its approach in assessing water quality in specific habitats, collecting in little known areas, and revision of the still unstudied material from additional families.

DIVERSITY OF HELMINTH PARASITES IN JHILMIL JHEEL CONSERVATION RESERVE IN DISTRICT HARIDWAR (UTTARAKHAND)

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Studies on the diversity of Helminth parasites in the common skittering frog *Euphlyctis cyanophlyctis* (Anura: Amphibia) in Jhilmil Jheel Conservation Reserve in district Haridwar (Uttarakhand) was carried out under the approved departmental project. *E. cyanophlyctis* were found to harbour 7 genera of helminth parasites. Among nematode parasites, the genus *Camallanus* was most prevalent followed by *Oxysomatium*, whereas, *Rhabdias* and *Cosmocercoides* were the least prevalent genera. Among trematode parasites, *Ganeo* was the most prevalent genus and least was *Pleurogenoides*. No cestode infection was found in the hosts examined. The helminth parasite community in *E. cyanophlyctis* of Jhilmil Jheel comprised 57.1 % of nematodes and 42.8% of trematodes. The present study forms the first report on the diversity of Helminths in Jhilmil Jheel Conservation Reserve.

DIVERSITY, DISTRIBUTION, ENDEMISM AND CONSERVATION OF FISHES OF NORTHERN WESTERN GHATS

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The Western Ghats, one among the 25 biodiversity hotspots of the world, is a chain of mountains, stretching north-south along western Peninsular India for about 1600 km, harbouring rich flora and fauna. The Western Ghats is the catchment for 3 large, 13 medium and 17 minor rivers of the Peninsular India (Rao, 1975). These 33 rivers and associated wetlands harbor high

diversity of freshwater organisms. Of these, part of Gujarat, Maharashtra and Goa represents the Northern Western Ghats. During the present study, 147 species belonging to 9 orders, 24 families and 69 genera have been reported from the northern Western Ghats. Out of 135 endemic species of Western Ghats, 25 endemics inhabit the water bodies of Northern Western Ghats. Seven exotic species are also encountered during the study.

Implementation of river-valley projects, Overexploitation of fish resources, poisoning and dynamiting, pollution, industrialization, introduction of exotic fishes into the reservoir to boost commercial fish production is expected to impact the local fish fauna. Occurrence of endangered, endemic species reaffirms the “hotspot” status of the Western Ghats, a repository of biological wealth (aquatic and terrestrial). The present study is an outcome of the several attempts made by the Western Regional Centre, Zoological Survey of India, Pune to study the diversity profile of fishes of Northern Western Ghats.

ECOLOGY OF BUTTERFLIES IN NORTHWESTERN HIMALAYAS OF INDIA WITH SPECIAL REFERENCE TO HIGH ALTITUDE

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Butterflies (order Lepidoptera) are increasingly being recognized as a flagship species group to monitor global warming and effects of habitat loss. The importance of butterflies is many folds. Apart from being aesthetically attractive, they act as indicators to depict the health of a habitat. The larvae of butterflies are associated with plants but cause only little damage to the hosts. The adults act as incidental, wild pollinators and help in pollination of many native plants. The larvae as well as adults are food for many predators like lizards and birds. The butterfly diversity in an ecosystem tells how much healthy it is, as butterflies are very sensitive to any change in the environment. But in the present day scenario, many butterfly species are under a real threat due to depletion of the natural cover for various developmental activities. This is further exploited due to their use in insect trade. The Northwestern Himalayan Ecosystem has also undergone many upheavals during past two decades. During the course of present studies 280 species of butterflies have been assessed from various habitats of Northwest Himalayas. This also includes various rare high altitude butterflies including Apollo butterflies. Some rich butterfly spots especially at Bhilaru, Mussoorie have found to be totally devastated due to developmental activities whereas some rich species spots particularly of Apollo butterflies have been discovered. The thermoregulation postures of adult at various altitudes have been recorded and compared. The mudpuddling behavior near brackish water lakes of Ladakh in rare butterflies has been observed.

BIODIVERSITY OF INSECT FAUNA IN HENNA CROP IN THE INDIAN ARID ZONE

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Henna (*Lawsonia inermis*) is a popular perennial crop of Sojat region in Pali district of Rajasthan and it earns a sizeable amount of foreign currency in exports. The powder of leaves of this plant yields a natural dye lawsone and is used for cosmetic and medicinal purposes. Henna plants attract a great diversity of both beneficial and harmful insects. Studies were conducted in Jodhpur and Pali districts of Rajasthan to understand the entomo fauna of this crop.

During these studies, the major pest insects observed on henna were the defoliators (*Achaea janata*), whiteflies (*Acaudaleyrodes rachipora*) blister beetles (*Mylabris* species), termites (*Odontotermes* sp.), membracid bugs (*Oxyrachis tarandus*) aphids and spittlebugs. Older plantations, which were not being regularly pruned, had infestations of mealy bug *Ferrisea variegata*. During our studies on entomofauna of this crop significant variation was observed in the types and number of insects during different years. Castor semilooper *Achaea janata* is an important defoliator of henna. Its occurrence is sporadic and when weather conditions are favorable for its multiplication its population sometimes reaches very high levels. Henna inflorescence was found to be infested with blister beetle *Mylabris pustulata* as blister beetle adults are largely pollen feeders. The larvae of the blister beetles are beneficial, since they destroy grasshopper egg pods.

During these studies, abundant diversity of many beneficial insects was observed on henna. The prominent ones among these were; lady bird beetles *Cheilomenes sexmaculata* (Fab) and *Coccinella septempunctata* Linn., yellow jacket wasps, honey bees *Apis* sp., and syrphid flies. Ladybird beetles prey on aphids, scale insects, thrips, mealybugs, and mites. Similarly wasps are important predatory insects of caterpillars. Henna plant have appreciable nectar and pollen resources for the survival of natural enemies of insect pests and its presence in crop field can be utilised for improved pest management by attracting natural predators of insect pests.

ANTIFUNGAL PROPERTIES OF *Citrullus colocynthis* AGAINST ECONOMIC IMPORTANT PATHOGENS

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Continual treatment of plants with chemical fungicides leads to the formation of stable residues containing high concentration of metals which remain in the soil for long periods and adversely affect soil fauna and flora. They may also drain off into ditches and rivers and kill algae

and fish. Plants are known to produce a wide array of constitutive and induced antifungal compounds to fight infection. Plants particularly from arid region would be good candidates to explore for novel broad spectrum antifungal compounds to reduce or eliminate our reliance on synthetic chemicals which would be toxic to animals and beneficial insects and harmful to environment.

In this respect, an attempt was made in this experiment to investigate the antifungal potential of *Citrullus colocynthis* L. (*Tumba*) an important species of Indian arid region. Dried and powdered roots of *Citrullus colocynthis* extracted with ethanol and water using soxhlet extraction apparatus and dried in rotary evaporator. This extract was tested against four fungus pathogen includes *Rhizoctonia solani*, *R. bataicola*, *Fusarium solani* and *Alternaria alternata* using well diffusion method while bevisatin was used as standard fungicide. The extract exhibited mild to moderate antifungal activity against *Rhizoctonia solani*, *R. bataicola*, *Fusarium solani* and *Alternaria alternata*. Thus, the current investigation leads to source of new antifungal compound in future.

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**STATUS OF DAMSELFLIES AND DRAGONFLIES (ODONATA:
INSECTA) IN NORTH INDIA WITH A NOTE ON THE SWARMS
OF *Pantala flavescens* (FABRICIUS) IN RAJASTHAN, INDIA**

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So far 164 species and subspecies of Odonata under 70 genera are recorded from North India (Jammu & Kashmir, Himachal Pradesh, Punjab, Haryana, Delhi, Uttarakhand, Uttar Pradesh and Rajasthan). The swarms of dragonfly, *Pantala flavescens* (Fabricius) a migratory species in India, was recorded in the months of May to August, 2008. The swarms in the agricultural fields are many a times mistaken by farmers in Rajasthan as those of desert locust, *Schistocerca gregaria* (Forsk.). Every year the “Locust Warning Organisation” established by Ministry of Agriculture, Government of India receives complaints from farmers regarding outbreak of desert locust, but at many a times these are swarms of *Pantala flavescens*. There is therefore, an urgent need to publish monographs to create awareness among farmers on the biology and behaviour of dragonfly and desert locust, so that they can differentiate between the two and register correct recordings to the government.

DIVERSITY OF BARNACLES (CIRRIPEDIA) OF MAHARASHTRA

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ABSTRACT

Barnacles are the marine sessile arthropods belonging to infraclass Cirripedia under the class Maxillopoda in the subphylum Crustacea. Being an important constituent in fouling composition, they incur huge monetary loss and as an invasive species sometimes pose serious ecological threats to marine biota in addition to increasing economical burden. Their settlement is of gregarious nature, which is a key factor in recruitment dynamics. Various studies have been carried out on these benthic animals, but estimation of their diversity along Indian coast, particularly in the state of Maharashtra was hardly attempted. Thus, diversity of barnacles of Maharashtra was estimated, which brought into 17 species under 11 genera in 8 families.

LAW TO PROTECT ENTOMOFAUNA IN INDIA

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India is very rich in biodiversity due to its unique biogeographic location, diversified climatic conditions and enormous ecodiversity and geodiversity. With the change of time and with growing human population exerting pressure on wildlife and its habitats considerable depletion of wildlife took place in various parts of India, the first codified law in India which heralded the era of laws for protection of wildlife/entomofauna is the Wildlife (Protection) Act, 1972 implemented by the Government of India. The policy and objects of the wildlife laws have a long history and are the result of an increasing awareness of the compelling need to restore the serious ecological imbalances introduced by the degradations inflicted on nature by man. This Wildlife (Protection) Act, 1972 had amended seven times, the last amendment being in the year 2006, categorised fauna species in six Schedules according to threat status. Beside other groups, 493 species of insects/entomofauna are included in WL (P) Act, in that 454 species of order Lepidoptera, 38 species of Coleoptera and 1 species of Odonata are listed in Schedule I-Part IV; Schedule II-Part II and Schedule IV (Secs. 2,8,9,11 and 61). Still there is need to update the existed fauna species list, to add species facing threat and protection of habitats to save biodiversity in India. It reflects both the despair and the urgency that we feel for stopping the ongoing ecological devastation of the country. It is hoped that a greater public awareness and scrutiny of this Act will help in getting deeper insight for further amendments to deal with the issues and problems.

ASSOCIATION OF ANTS AND HONEYDEW PRODUCING SUCKING PESTS IN BANGALORE PROVENANCE OF SANDAL (*Santalum album* Linn.)

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Mutualism between individuals of two species is increasingly recognized as a common and important ecological interaction. Interactions between ants and honeydew-producing hemipteran insects are abundant and widespread in arthropod food webs, though their ecological consequences are not well understood. Ant-hemipteran interactions have potentially broad ecological effects, because the presence of honeydew-producing hemipterans dramatically alters the abundance and predatory behaviour of ants on plants. In this paper we present an account of the ants and Hemiptera that were observed in association in Bangalore provenance of sandal. Different ants were found associated with five species of coccids viz., *Cardiococcus bivalvata* Green (Coccidae), *Ceroplastes actiniformis* Green (Coccidae), *Nipaecoccus viridis* (Newstead) (Pseudococcidae), *Parasaissetia nigra* (Nietner) (Coccidae) and *Saissetia coffeae* Targioni-Tozzetti (Coccidae) and two species of membracids viz., *Leptocentrus longispinus* Dist. and *Oxyrachis tarandus* Fabr. Ants were known for protecting hemipterans from predators and parasitoids, their association may accelerate the growth and impact of honeydew-producing hemipterans on sandal plants and these findings were discussed in this paper.

FLORISTIC DIVERSITY OF JESSORE SLOTH BEAR WILDLIFE SANCTUARY, GUJARAT STATE, INDIA

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India, owing to its tropical geographical location and diverse topography, has rich and varied floral and faunal diversity. Biodiversity encompasses the variety of the life on the earth at gene, species and ecosystem levels. Protected areas are one of the most widely accepted and practical approaches to biodiversity conservation the World over. Today, almost every country in the World has designated protected areas for a range of conservation objectives, such as maintenance of the integrity and diversity of ecosystem, protection of flora and fauna and cultural heritage. In addition to the conservation objectives, the protected areas also have significant scientific, educational, cultural, recreational and spiritual values apart from the direct and indirect benefits they provided to local as well as national economics. India is the one of the 12 mega

diversity/diverse countries and one of the 12 megadiverse centres of the World. The objectives of *in situ* conservation of rich biodiversity can be achieved only through establishment of network of protected areas in the form of Wildlife Sanctuaries, National Parks and Biosphere Reserves.

Jessore Sloth Bear Wildlife Sanctuary is a unique phytodiversity hotspot of Banaskantha dist. in North Gujarat. It falls under the semiarid climatic zone. Hence, floristically vegetation of the Jessore Sloth Bear Wildlife Sanctuary is characterized into the dry deciduous forest and scrub forest. Jessore hills are the part of Aravalli hills adjoining to Mt. Abu, and separate the desert ecosystem from dry deciduous forest types. The present paper deals with 481 indigenous and naturalized plant species belonging to 277 genera and 80 families of Vascular plants. Among them, 415 species of Dicotyledons and 66 species of Monocotyledons are encountered. Jessore Sloth Bear Wildlife Sanctuary is a paradise for medicinal plants wealth. Ecosystem complexity of the Sanctuary is being changed now a days because of human interference. Heavy grazing activities, exotic weeds and severe drought are the main factors for the loss of phytodiversity of the Sanctuary. Consequently, Sanctuary is facing a lot of threat, particularly the rare and threatened plant species. So, there is urgent need of conservation to preserve such types of hotspot of the States.

BIODIVERSITY OF FUNGI IN DIFFERENT SOIL ECOSYSTEM

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The term 'biodiversity' is a simple contraction of 'biological diversity'. Biodiversity is the sum total of all biotic variation from the level of genes to ecosystems. Biodiversity in all its forms and abundance provides for the sustenance of mankind, but, this is not possible when the environment suffers from various kinds of pollution and degradation. The challenge comes in measuring a broad concept in ways that are useful. Although biodiversity can never be fully captured by a single number, study of particular facets has led to rapid, exciting and sometimes alarming discoveries. Greater biodiversity makes species and systems more resilient, while loss of Biodiversity weakens them, making them more vulnerable to extinction. Phylogenetic and temporal analyses are shedding light on the ecological and evolutionary processes that have shaped current biodiversity. Humans are now destroying this diversity at an alarming rate and its loss is going to affect ecosystem functioning. Although current research efforts are impressive, but much is to be known about the unknown diversity that still exists. Species loss has a decidedly negative impact on ecosystems.

The Kingdom Fungi contains heterotrophic organisms that digest their food before ingesting it by excreting enzymes. Since they possess this kind of feeding they are important in causing decay and decomposition, thus cycling nutrients through the food chain. Fungi are still not completely understood, but their importance to both ecosystems and humans are well known. Hence an attempt was made to study the fungi in different soil. The fungal reproductive structure are studied to

estimate the biodiversity in different soil. This study will give an idea of host-pathogen virulence mechanisms.

PRELIMINARY STUDY OF SOIL ARTHROPOD FAUNA IN RAINFED FORAGE PRODUCTION SYSTEMS OF BUNDELKHAND

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Soil fauna comprises of thousand of species with a wide range of ecological strategies. They may be classified either on the basis of functional groups *viz.*, mycophagus/herbivores, omnivores and predators or on the basis of body width *viz.*, micro (<0.2 mm), meso (0.2-2 mm) and macro (>2 mm). The present investigation has revealed rich soil biodiversity in this region. During this study 148 species were encountered. They belonged to four classes *viz.*, Insecta (12 orders), Arachnida (3 orders), Crustacea (1 order) and Myriapoda (4 orders). The species that more frequently occurred constituted 28 per cent of the total soil diversity while 18 per cent were in the rare category. Remaining 54 per cent were medium order. The absolute species occurring in all the seasons in all the ecosystems were four *Formica* and two cryptostigmata species.

A REPORT ON FAMILY GELECHIIDAE (LEPIDOPTERA) FROM SHIVALIKS OF NORTH-WEST HIMALAYA

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The order Lepidoptera of scaly-winged insects (moths, butterflies and skippers) is one of the most dominant group after Coleoptera and Hymenoptera in the class Insecta. Under order Lepidoptera, one of the micro moths family Gelechiidae known as twirler moths or gelechiid moths. It is under microlepidoptera by having more than 4,600 described species belonging to about 500 genera in the world. These are characterized by scaled proboscis and strongly recurved labial palpus, hindwing subrectangular, trapezoidal with sinuous or concave termen, prominent apex, forewing lanceolate or elongate, the retinaculum of the wing-coupling mechanism on the radial vein of the female forewing, labial palpus long, second segment often with ventral brush, third segment long, acute, rarely with short dorsal brush of rough scales; male genitalia with gnathos forming a pair of lateral, articulated, symmetrical sclerites with an articulated, mesial hook.

The present research work was carried under Fast track project being funded by Department of Science and Technology, New Delhi from year January, 2008 to December, 2010. Twenty-four survey-cum-collection tours from 52 localities of shivaliks of North-West Himalaya were undertaken during different seasons/period within an altitudinal range of 700m MSL to 1600m MSL. In all, thirty-eight species has been collected and identified belonging to the genera such as *Anarsia* Zeller, *Dichomeris* Hubner, *Helcystogramma* Zeller, *Hygroplasta* Meyrick, *Hypatima* Hubner, *Hypelictis* Meyrick, *Pectinophora* Saunder, *Philoptila* Meyrick, *Sitotroga* Oliver and *Stegasta* Meyrick. Although, for their identification various morphological parts (labial palpi, maxillary palpi, antenna, chaetosemata, legs, wing maculation and venation) have been examined but for authentic identification of these species due emphasis were given to external male and female genitalia. The detail aspects on their geographical distribution, collection sites alongwith significance of external male and female genitalia will be highlighted in the National Seminar on Biodiversity and Intangible Natural Heritage.

DIVERSITY AND COMMUNITY STRUCTURE OF BUTTERFLIES IN RITCHIE'S ARCHIPELAGO, ANDAMAN & NICOBAR ISLANDS

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The wide distribution of butterflies in the Andaman & Nicobar Islands is an important element in the dynamics of this ecosystem. Butterflies are recognized by the scientific community as bio-indicators. The Richie's Archipelago is a cluster of smaller islands which lie some 25-30 km east of Andaman. This study was conducted during 2008-2011. Line transect methods was used to assess the population of butterflies. A total of 72 species belongs to 5 families and 48 genera were recorded during the study. The family Nymphalidae followed by Pieridae and Papilionidae were found to be the dominant in Richie's archipelago. Out of seventy two species of butterflies 68 species were recorded from Havelock Island, followed by Neil Island (47), Outram Island (34), Inglis Island (32), and Hendry Lawrence Island (32). Of the recorded species of butterflies, the Pecoek Pansy (5.71 per cent) was highest in dominance followed by Common Mormon (5.48 per cent) and Stripped Tiger (4.13 per cent). Highest number of species richness and abundance was recorded from Havelock Island followed by Neil Island and Outram Island. Diversity Index (H') was 3.97 and (λ) 0.02 and Species Richness Index R1 was 9.95 and R2 was 2.03. The survey indicated the presence of a rich butterfly fauna, which should be systematically collected for further research and study in order to build a good taxonomic database for Richie's Archipelago.

DIVERSITY OF MOTHS IN GREAT NICOBAR BIOSPHERE RESERVE, ANDAMAN & NICOBAR ISLANDS

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The study was conducted in Great Nicobar Biosphere Reserve (GNBR) during 2008-2011. The aim of this study was to describe the species abundance, diversity and distribution pattern of moths of Great Nicobar Biosphere Reserve. The tropical rain forests in Great Nicobar Biosphere Reserve represent high level of biological diversity. Moths are among the taxonomic group in these forests with unique species diversity, increased Pre-tsunami conversion of forest land into agricultural land by native tribes and settlers and conversion of forests for alternative land use for resettlement after 2004 tsunami have posed habitat loss in these forests. This change in land use pattern highlights the importance of assessing diversity of moths and their conservation. We sampled 1840 moths from 80 species belongs to 9 families. Sampling was conducted during all seasons using light traps at 10 different sites within the biosphere reserve. Of the recorded species, 11 were new addition to the moth fauna of GNBR.

DIVERSITY OF MOTHS IN NEIL ISLAND, ANDAMAN & NICOBAR ISLANDS

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The study was conducted in Neil island during 2009-2011 and the aim of this study was to describe the species abundance, diversity and distribution pattern of moths of this island. The information on the faunal diversity and its island wise distribution of the insects are very meager. Neil Island is one of the undocumented islands in South Andaman. It occupies an area of 18.9 km². The most of the area of this island has been converted into crop lands. Despite moth diversity of this island is has not been explored and documented. In this paper, an attempt has been made to assess the species distribution and diversity of fauna of this island. During the period of study, a total of 270 specimens, belongs to 46 species and 8 families were collected using light traps at dusk from 1730 - 2300 hours. The family Pyralidae was dominated with 15 species followed by Noctuidae (10 species) and Geometridae (8 species).

SPECIES DIVERSITY AND ABUNDANCE OF ODONATA IN RICHIE'S ARCHIPELAGO, ANDAMAN & NICOBAR ISLANDS

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The Richie's Archipelago is a cluster of smaller islands which lie some 25-30 km east of Andaman. This study was conducted during 2008-2011. Line transect methods was used to assess the population of butterflies. Different islands in the Richie's archipelago were surveyed to assess the species diversity and distribution of Odonates. Total of thirty one species belong to 8 families were recorded during the study period. Highest number of species was observed from the family Libellulidae. The diversity index was varied in different islands. The distribution patterns and diversity of dragonflies are discussed in this paper. An extensive Odonatological survey needs to be carried out to explore the rich diversity of these graceful insects and come up with a representative checklist of Odonates for Richie's Archipelago.

**DIVERSITY ANALYSIS STUDIES OF ODONATA (INSECTA:
ARTHROPODA) FAUNA OF SELECTED FOUR LAKES OF
UDAIPUR, RAJASTHAN**

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Odonata (Damsel & Dragonflies) includes some of the most ancient and beautiful insects ever roamed the earth, as well as some of the largest flying invertebrates ever to have lived. For some 270 million years, odonates with their four long independent membranous wings and long bodies have remained unchanged in their essential form and are dominant invertebrate predators in ecosystem. They were the first creatures to truly command the air of this earth. They are amphibious hemi-metabolous insects having the aquatic egg and larval (nymphal) stages, while the adults are terrestrial, both larvae and adults are predator. Their powerful acrobatic flight enables them to catch many small organisms. Now a days they are extensively used in controlling causative agents of malaria and filaria, and of insect pests in different ecosystems on the global basis. Approximately 6,000 species and subspecies belonging to 630 genera in 28 families of order Odonata are known from all over the world, out of which 499 species and subspecies of Odonata under 139 genera belonging to 17 families are recorded from India.

The diversity analysis studies on Odonata fauna of four selected lakes of Udaipur, Rajasthan i.e. Pichhola Lake; Fateh Sagar Lake, Uday Sagar Lake and Roop Sagar Lake conducted during Sept., 2008 to March, 2011. About 27 species belongs to 5 families of order Odonata recorded from the study site i.e. 24 species from Pichhola Lake; 18 from Fateh Sagar Lake, 14 from Uday Sagar Lake and 15 from Roop Sagar Lake. The family Libellulidae is the most dominant family in all the selected four lakes of Udaipur. The study reveals that *Ceriagrion coromandelianum* (Fabricius), *Ischnura a. aurora* (Brauer), *Orthetrum pruinatum neglectum* (Rambur), *Orthetrum s. sabina*

(Drury), *Brachythemis contaminata* (Fabricius), *Bradinopyga geminata* (Rambur), *Crocothemis s. servilia* (Drury), *Trithemis aurora* (Burmeister) and *Pantala flavescens* (Fabricius) were the dominant species in the study area. The diversity analysis study indicates that the study sites are rich in Odonata fauna and provided a suitable natural habitat for their existence.

FISH DIVERSITY OF KALESAR WILD LIFE SANCTUARY, HARYANA

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Fishes are the valuable sources of the food worldwide and used for commercial and recreational purposes. 2,513 species of fishes have been recorded from India and it constitutes 11.1% of the world fish diversity, of which 1,580 are marine and 933 species are inhabitant of freshwater ecosystems (Jayaram, 1999). The Haryana state ranks second in fish productivity in India. There are 14 rivers and rivulets in Haryana, which are the source of the capture fishery. However, the Yamuna and Ghaggar are the only potential source of the fisheries in the state. The major streams are Saraswati, Markanda and Sahibi Stream. Various water bodies of Haryana support 60 fish species under 19 families. Out of these, 11 are commercial and 6 exotic species (Johal and Rawal, 2004). Kalesar Wild life Sanctuary is situated along the Yamuna River. The fish fauna of the sanctuary has been worked out for the first time. The sanctuary is contiguous with Simbalbara Wildlife sanctuary in Himachal-Pradesh. As a result, similarities in species composition have been observed with Simbalbara Wildlife Sanctuary. Overall, 15 species comprising of 11 genera, 6 families and 2 orders have been recorded from the Kalesar WLS. Out of which, 9 are used for aquarium purpose and 5 have commercial importance. The conservation status of the fishes has discussed. Two fish species *Tor putitora* (Hamilton-Buchanan) and *Schistura montanus* (McClelland) is under endangered category as per CAMP (1998).

FOUR NEW RECORDS OF COLEOPTERA: SCARABAEIDAE: SCARABAEINAE FROM GILGIT-BALTISTAN

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Himalayan mountains ranging 1000 ft to 16000 ft. The area is diverse and virgin for its flora and fauna. Little work is being done to explore insect community. To record some data, an extensive survey of Himalayan region of Pakistan was conducted during 2006-2008 and recorded nine new records of Scarabaeoidea (Scarabaeidae: Scarabaeinae) two new records of genus *Onitis*, one species of genus *Onthophagus* and one species of genus *Heliocopris*.

STUDIES ON THE REPRODUCTIVE BEHAVIOUR OF *Ischnura senegalensis* (Rambur) (ODONATA: ARTHROPODA) AT RAJSAMAND LAKE, RAJASTHAN, INDIA

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The reproductive behaviour of *Ischnura senegalensis* (Rambur) was studied four times at Rajsamand Lake, Rajasthan during September, 2008 to March, 2011. Courtship is well marked and male demonstrate a circular territory with a radius of about 1-3 meters and defended it from the intruding intra or some inter specific male by chasing it away or by warning signals like wing vibration or abdomen raising. As female entered into the territory, the male starts following her and forms a tandem link, catching hold of her prothorax by his anal appendages. The before wheel tandem lasted for 7-11 minutes and during this period intramale sperm translocation from the gonopore to the vesicular spermalis took place 2-4 times of 15-30 seconds duration. The courtship wheel lasts for about 6-10 minutes and is performed of perching on vegetation near the border of the lake. After wheel tandem lasted for 5-9 minutes. Oviposition is endophytic among the aquatic vegetation and lasts for 7-12 minutes. The female in tandem climbs down underwater and uses her ovipositor to deposit eggs in the submerged vegetation. During oviposition the male in tandem and after release of grip hovers around the female, to defend her from intruding intra or inter specific males. The duration of reproductive behaviour lasts for 24-46 minutes.

COW- THE PANACEA IN AYURVEDA

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Cow has been worshipped in India as '*Kamdhenu*' who fulfils all the desires. Cows have symbiotic relationship with human beings. Cow is said to have divine influence which makes the cow's milk, butter and ghee auspicious.

In Ayurveda the importance of cow and its products are described in great detail. The five basic products of cow are known as Panchagavya. They are the Milk, the Curd, the Ghee, the Dung and the Urine of the Cow. These elements have the power to cure many diseases. Ayurveda mentions 8 types of urines and their medicinal properties. Amongst the 8 urines, cow urine is best. In Ayurveda where ever urine is mentioned, it is to be understood as cow urine. Cow's urine has slightly sweet in taste and capable of balancing 3 body humors i.e., *vata*, *pitta*, *kapha*. Impurities of

the body are destroyed by the cow's urine just as fire burns fuel. Cow urine is antifungal, antibacterial, antibiotic, antiallergic, antimicrobial, etc. It can be used for the treatment of worm infestation, skin diseases and abdominal disorders (Caraka sutra sthana, 1: 102-103). It is reported to contain various vitamins (A, B, C, D and E), enzymes and minerals like iron, copper, sodium, phosphate, manganese, potassium, nitrogen and urea, uric acid. Along with the minerals it also contains hippuric acid (removes toxins through urine) and Aurum hydroxide, which acts as a germicidal, antibiotic, anti-toxic and immuno modulator. It is also used as plant growth stimulator and in bio-gas reactors. Now-a-days to make it palatable for oral intake, go-ark (Cow Urine Distillate) is prepared by distillation process or it can also be taken as Ghanavati (tablet form). The *Gomutra Ark may be used in fever, eye disorders, nasal congestion, cough, asthma, diabetes, jaundice and to reduce body weight and cholesterol.*

STATUS OF FAUNAL BIODIVERSITY- INDICATOR TAXA IN SELECTED SACRED GROVES OF SOUTH-WESTERN MAHARASHTRA

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Various faunal taxa have been explored for their potential value to indicate biodiversity. Their value is immense in terms of optimizing cost of biodiversity monitoring programmes. In an ATREE, Bangalore sponsored study, we surveyed 7 sacred groves from South-Western Maharashtra to rapidly document birds, butterflies and spiders. A 100 m line transect was a basic sampling site at each sacred grove. For birds, two point counts one each at the starting point and end point of the line transect were conducted. Each point count lasted 15 minutes. For butterflies and spiders, a walking strip of 4 m width along this line transect was conducted. All adult butterflies and spiders were counted. This strip was carefully searched for spiders from ground to accessible foliage. For birds, butterflies and spiders, the sampling was repeated on 3 consecutive days. Sampling was carried out during morning hours to capture maximum activity of these creatures. However, because of this policy, some of the species that were active at other times of day could have been missed.

From the seven sacred groves, a total of 53 (range = 10 to 26) species of birds belonging to 24 families, 55 (range = 14 to 31) species of butterflies from five families were recorded from sacred groves. In case of spiders, 59 (range = 15 to 29) species including morphospecies from 15 families were recorded. Different taxonomic groups differed in various diversity indices across sacred groves. But there were no clear trends between conservation status (as interpreted by a subjective threat index) and diversity of these taxa. Among them, the taxa showed little correlation to indicate each other. Indicator value of species at the typology of sacred grove was worked out. Diagnostic species for each sacred grove were also identified.

PARTICIPATION OF LOCAL COMMUNITIES FOR BIODIVERSITY CONSERVATION IN THE THAR DESERT OF INDIA

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The Great Indian Thar Desert constitutes nearly 9% of geographical area of India. It is one of the smallest Desert but most populated in the world, however its biodiversity is very high as have several type of physical environments and their specific Thar antelope (Blackbuck and Chinkara) and secondly local people (*Bishnoies*) have been very generous to wildlife providing full protection to these. The arid region of Rajasthan has two wildlife sanctuary Desert National Park and Tal Chhapar Wildlife Sanctuary with 19 Wildlife Protected Areas. As an endangered species, populations of Blackbuck and Chinkara have been declining within the arid part of India over the last few decades. The decrease in population of these ungulate may be also due to destruction of habitats, increase feral dog population & human population, live stock numbers in their habitats and simultaneously illegal poaching. The Rajasthan Desert presents a unique socio-ecological situation in the sense that here certain communities, particularly the *Bishnoi* people are aggressively protective of all wildlife. But traditionally, *Bheel*, *Bawari*, *Jogi*, *Banjaras* and *Nat* communities are associated with poaching. Some of the people from *Rajput* and *Muslim* communities are also involved in poaching and at present there is no control overgrazing in closed areas of Thar Desert. While some other local communities (*Bishnois*, *Jats*, *Jains*, *Mali* & *Rajpurohit*) are working for the conservation Thar antelope. The field survey which was conducted between August 2009 and July 2010. During study period 233 different aged chinkara & 193 blackbucks were reported dead from entire study area. The killings by feral dogs are very high (62%) especially of chinkara fawns during breeding season (November -December). Another hazard is the over speeding vehicles on national and state highways. The road accidents mortality was about 22% and poachers were responsible for 01% killings or deaths of Blackbuck in arid region.

DIVERSITY AND MONTHLY ABUNDANCE OF BUTTERFLIES (LEPIDOPTERA: INSECTA) IN ZSI, DRC CAMPUS, RAJASTHAN

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A study was undertaken to document the diversity and the monthly abundance of selected butterfly species in the Zoological Survey of India, Desert Regional Centre, Jodhpur for a period of three years from March, 2008 to May, 2011. For the diversity studies the butterfly's species were

collected by using a sweep net and for monthly abundance of butterfly species, 8 dominant species were selected on the basis of their easy identification in the field. The study indicated the presence of 21 species of butterflies belong to 4 families viz., Lycaenidae, Nymphalidae, Papilionidae and Pieridae. The family Nymphalidae (12 species) is the dominant family in the study area. Among the selected species for the monthly abundance studies *Junonia lemonnias* and *Papilio demoleus* were found active throughout the year. During July month all the selected species were found active and more or less same trend was observed in both the years. Maximum numbers of individuals were recorded in monsoon and summer seasons, which coincided with the peak flowering seasons of campus trees viz., August to October and February to April. The visiting butterflies might be playing a major role in pollination along with other pollinating insects.

EGGSHELL ULTRASTRUCTURE OF THE DAMSELFLY *CERIAGRION COROMANDELIANUM* (ZYGOPTERA: COENAGRIONIDAE)

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Scanning electron microscopic examination of the egg of *C. coromandelianum* reveals that it is elongate and cylindrical with a pointed anterior and rounded posterior end. The egg chorion is composed of an outer, thin, lightly corrugated exochorion and an inner, thick, smooth, non-porous endochorion. The anterior end is circumcised by five micropylar orifices. Each orifice is semicircular and continues as a long horizontal streak on the endochorion and concludes at a bifid terminal point. This forms the entry point of the micropylar chute which penetrated the endochorion. The vitelline envelope lodged below the endochorion is thin and smooth.

THE GENITAL DUCTS OF THE MALE DRAGONFLY *ANAX GUTTATUS* (ANISOPTERA: AESHNIDAE)

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Light and transmission electron microscopic (TEM) studies reveal marked variations in the ultra structure of the male genital duct as it terminates into the sperm sac. TEM studies show two types of cells, the brush border cells with short motile irregular microvilli and the smooth border cells in the wall of vasa deferentia. Moreover, the seminal vesicles contain only the cells with brush border. Large number of electron dense granules and cell-coat particles accumulate in the lumen of

vasa deferentia. A dense layer of globules mostly mucoproteins aggregate around the hyaline cap of the sperm bundles in the vasa deferentia.

The chemical composition varies in the seminal fluid of vasa deferentia, seminal vesicles and sperm sac. Changes occur in the seminal fluid as it moves down successively through the vas deferens, seminal vesicle and ultimately in the sperm sac. The seminal fluid is stored and condensed in the sperm sac. Histochemical studies demonstrate chemical composition of the seminal fluid as a mixture of protein, carbohydrate and lipid. Presence of dense quantity of DNA and RNA in the nuclei and cytoplasm of the epithelial cells and mercury bromophenol blue stained granular material suggests that the central canal, vasa deferentia and seminal vesicles are well-equipped with the cellular machinery required for protein synthesis. Histochemical tests demonstrate, in addition, large amount of mucopolysaccharides and lipids. SDS-PAGE of seminal fluid reveals 7 and 12 protein bands in the vasa deferentia and seminal vesicles, respectively.

THE MECHANISM OF VITELLOGENESIS IN THE TASAR SILKMOTH, *Antheraea mylitta* (D.) (LEPIDOPTERA: SATURNIIDAE)

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In the tasar silkmoth, *Antheraea mylitta*, a pair of well developed large polytropic ovaries occupies the whole abdominal cavity. The process of vitellogenesis commences with gradual cytomorphological changes in the nurse and follicular epithelial cells associated with the developing oocytes. Transport of yolk material across the follicular epithelium into the developing oocyte occurs through various changes in the nurse and follicular cells. With absorption and accumulation of yolk granules during vitellogenesis, the oocytes show gradual increase while the trophocytes undergo reduction in their size. The micropinocytosis facilitating yolk transport from follicular epithelial cells to oocyte and formation of the multi-layered chorion is well evident under the electron microscopy.

DIVERSITY IN THE EGG SHELL ULTRASTRUCTURE OF DRAGONFLIES (INSECTA : ODONATA)

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The present report describes the ultrastructural diversity of the egg shell of five odonates exhibiting different mode of oviposition and fertilization. The dragonflies lay eggs in and around water bodies because of their amphibiotic nature. The type of water body and substrate used for

oviposition has a profound influence on the ultrastructural modifications of the eggshell. The eggshell is divided into an external chorion and an inner vitelline envelope. The chorion is further differentiated into an outer exochorion and an inner endochorion. Both the layers of the chorion exhibit ultrastructural radial and regional complexities. Scanning electron microscopic investigations reveal that the radial complexity is customized in accordance with the mode of oviposition whereas the regional complexity is modified for effective fertilization and complements the fertilization pore of the vagina. The functional significance of the egg chorion is described, classified and discussed in the light of recent literature.

ARBUSCULAR MYCORRHIZAL (AM) DIVERSITY IN *Acacia nilotica* WILLD. EX DEL. UNDER ARID AGRO-ECOSYSTEMS

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A. nilotica Willd. ex Del. (Mimosaceae) commonly called as “babul” is one of the most useful tree species occurring throughout arid and semi-arid regions of the country. In Rajasthan, the species occurs in most part of the state but it avoids extreme arid conditions. The species is abundant in northern Rajasthan, particularly in the districts of Jaipur, Bharatpur, Alwar, Sawai Madhopur, Dausa, Kota & Bundi and adjoining areas, where rainfall is comparatively better. The species starts diminishing towards western direction and is almost absent in desert districts of Rajasthan such as Barmer, Jaisalmer, Jalore, Jodhpur, Bikaner, Sikar, etc. The species, however, has grown very well in the command area of Indira Gandhi Nahar Pariyojana. In its native ranges, *A. nilotica* is widely used in agroforestry, social forestry, reclamation of wastelands, and rehabilitation of degraded forests. In traditional agroforestry systems, *A. nilotica* provides fuel, fodder, gum, tannin, and timber. Root nodulations in this species help in biological nitrogen fixation and enhance soil fertility.

Arbuscular Mycorrhizal (AM) fungi associated with *A. nilotica* were assessed for their qualitative and quantitative distribution from eight districts of western Rajasthan. Rhizosphere soil and root samples of *Acacia nilotica* were collected from various forest nurseries viz., AFRI model nursery, Bhuteshwer nursery, Jodhpur; Navalgarh forest nursery, Jhunjhun and high tech nursery of Forest Department, Sojat Road (Pali). In plantations, rhizosphere soil samples of *Acacia nilotica* var. *indica* were collected from various sites viz., Nagaur (4), Bikaner (2), Barmer (5), Pali (5), Sirohi (5), Ganganagar (5), Hanumangarh (5) and Sikar (5) district. For *Acacia nilotica* var. *cupressiformis* samples were collected from Nagaur (1), Pali (5), Sirohi (5) and Ganganagar (2) district. Soil samples were analyzed for pH, EC, (%) organic carbon (% OC), phosphorous (P) and carried out isolation of AM fungi. A high diversity of AM fungi was observed and it varied at

different study sites. The important genera were identified as *Acaulospora*, *Gigaspora*, *Glomus* and *Sclerocystis*. Among these four genera, *Glomus* occurred most frequently. The different species of *Glomus* were recorded as *G. aggregatum*, *G. fasciculatum*, *G. mosseae*, *G. macrocarpum*, *G. microcarpum* and *G. constrictum*. Out of which, *G. fasciculatum* was dominant species in all the sites of nurseries as well as in all the fields studied. The spore population was varied from site to site and ranged between 163 to 480 propagules per 100 gm soil.

DIVERSITY IN COLONY MORPHOLOGY, NODULATION AND 16S rDNA PCR PRODUCT PROFILE IN RHIZOBIA OF *Acacia senegal* AND *Prosopis cineraria*

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In hot arid zone of India (approx. 31.7 million ha area), nitrogen-fixing bacteria have to face the challenges of high soil temperature, salt and osmotic stress, soil acidity, alkalinity and heavy metals in soils. The nitrogen-fixing bacteria must cope with above abiotic stresses and must also survive as saprophyte and persist in such marginal soils in the absence of host plants. The knowledge about diversity in natural populations of such bacteria pertaining to above stresses is necessary before the selection and application of the tolerant rhizobial strains for biological nitrogen fixation. Therefore a study was undertaken to study natural variation in nodules, nodulation pattern, rhizobial colony morphology and molecular diversity in two important arid zone trees viz. *Acacia senegal* and *Prosopis cineraria*. The nodules of *A. senegal* were found to be of different sizes (small, medium and large), shapes (round, oblong and fan-shaped) found singly or in clusters of 4-6 small nodules. The *Rhizobium* colonies on Yeast Extract Mannitol Agar medium (YEMA) supplemented with congo red were small, medium and large in size. The slime production (polysaccharide) also varied from low to medium to high. 16S rDNA PCR product profile also exhibited diversity in rhizobial cultures isolated from *A. senegal* and *P. cineraria*. The presence of diversity in rhizobia isolated from *A. senegal* and *P. cineraria* will facilitate the selection of rhizobial strains tolerant to high temperature and other stresses of hot desert conditions.

STUDIES ON THE REPRODUCTIVE BEHAVIOUR OF *Trithemis festiva* (Rambur) AT FATEH SAGAR LAKE, UDAIPUR, RAJASTHAN

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The reproductive behaviour of *Trithemis festiva* (Rambur) was studied five times at Fateh Sagar Lake, Udaipur during October, 2008 to March, 2011. Courtship is well marked and male demonstrate a circular territory with a radius of about 3-5 meters. Before Wheel tandem lasted for a 30-50 seconds. The courtship wheel lasts for about 6-10 minutes and is performed of perching on vegetation, rocks or on the border of the water body. Oviposition is exophytic and the eggs are laid by dripping the tip of the abdomen several times in water. After laying the first batch of the eggs, the female along with male took rest of 1-2 minutes on vegetation, before going for the next batch. The male guarded the female during oviposition.

COMPARATIVE STUDIES ON DESERT LOCUST (*Schistocerca gregaria*) AND MIGRATORY LOCUST (*Locusta migratoria*)

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The Desert Locust is a large and highly feared acridian that invades many countries worldwide. In invasion period, swarms sometimes reach Southern Europe, Africa North of the Equator, the Arabian Peninsula and the Indo-Pakistan region. In recession periods, solitary locusts take refuge in the following outbreak zones *i.e.* the Indo-Pakistani border, coastal regions along the Red Sea and the Gulf of Aden and near some mountain massifs *i.e.* Central and Southern massifs, Southern edge of the Atlas mountains, Western side of the Oman mountains, valleys of the Mekran in Pakistan and in Iran. Yearly rainfall in all of these zones ranges from 50 to 300mm. Solitarious Desert Locusts are harmless to crops whereas in the gregarious phase their voracity, massive population movements, vast invasion area and swarm densities can be redoubtable. Solitarious locusts only breed in desert zones, whereas gregarious forms are more flexible in their ecological requirements and able to colonize less xeric habitats thus covering a much greater surface area. Since the desert locust gregarises and dissociates very readily in response to population density and as crop damage is done by gregarious phase, it is essential to be aware of difference between phases and to watch the signs of phase transformation.

The Migratory locust is widely distributed throughout the Old World, in Africa, South of the Sahara, in the Arabian and Indo-Pakistani peninsulas, Europe and Mediterranean borders, Eastern

Asia and Australia. However it is not recorded from America. There are at least a dozen migratoria sub-species and each is bio-ecologically adapted to the specific ecoclimatic characteristics of their environments. It is quite a strict graminivore that is able of causing considerable damage to grain crops and even plantations during outbreak periods. In temperate regions, the Migratory locust undergo embryonic diapauses in response to the harsh winters. In such conditions there are 1 or 2 generations per year. This obligatory developmental arrest does not occur in Subtropical & Tropical subspecies such as *Locusta migratoria migratorioides*, which is able to breed continuously by migrating hundreds of kilometers to encounter ecological conditions that will enable them to survive. This locust can produce 3-5 generations per year by utilizing seasonally complementary ecological areas. Hence, their life cycle is rapid, when the weather is hot and wet. The migratory locust is highly sensitive and able of switching from solitarious to gregarious phase once the critical density threshold is surpassed (estimated at 2,000 adults/hectare in subtropical zones). Gregarious migratory locusts are excellent flyers. Swarms migrate diurnally and are able to reach further and fly longer than solitary locusts, which migrate late night using different wind systems. Phase transformation takes place in outbreak centres, which often have more suitable and longer-lasting breeding and densation conditions than elsewhere. Construction of a Dam to control rising and falling floodwaters of the river, development of farming with animal traction and sedentarisation of livestock herds have destroyed many locusta biotopes. Only temporary regional upsurges have occurred, which were easily controlled by the National Crop Protection services. The Directorate of Plant Protection, Quarantine & Storage, Ministry of Agriculture, Government of India by opening Locust Warning Organization in the different parts of country is monitoring the movement of locust and operating control measures immediately in the field to protect the valuable crops of farmers in the country and providing time to time information by means of media and press, if there is any outbreak of locusts in the country and damage to crops.

IMPACT OF POINT AND NON-POINT POLLUTION SOURCES ON LIMNOLOGY OF BHOPAL LAKES

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“City of Lakes” Bhopal has large number of water bodies in and around. Upper and Lower lake that is jointly known as Bhoj wetland (Ramsar site) is very important for the citizens of Bhopal. The Upper Lake (Catchment area: 361 sq. km.) is the main source of drinking water to urban population (16 Lac) and Lower Lake (Catchment area: 9.60 sq. km.) for miscellaneous purposes. Third lake, Shahpura (Catchment area: 8.29 Sq.km.) of Bhopal is an important lake for new township. Unfortunately, the last half of the 20th century has witnessed large-scale degradation

of environment in general and water resources in particular due to multiple anthropogenic factors. Therefore, water quality of these lakes has been deteriorated day by day. This creates misbalance in limnology. During the period under study (March'08 to February'10), limnobiological parameters (Temp., pH, DO, Free CO₂, Alkalinity, Hardness, Cl⁻, BOD, Nutrients, Phytoplankton and Zooplankton), On the basis of study, status of these lakes was found eutrophic in nature. Hence, the conservation and management of these aquatic resources is prerequisite for long-term sustainability.

TERMITES PROBLEM TO MULBERRY TREES IN FOREST, SOCIAL FORESTRY AS WELL AS FOR SERICULTURE IN INDIA

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Mulberry trees are grown as forest tree as well as planted under social forestry programme. Especially mulberry is planted in country by farmers for rearing of silkworm, harvesting of fruits, as fodder and preparation of basket from the shoots. India is second largest silk producing country next to China account for about 15,500 MT of raw silk covering about 34,20,000 ha. of mulberry plantations. The mulberry (*Morus alba*) is sole food for silkworm (*Bombyx mori*) and success of silkworm crops depends on the quality of mulberry leaf. Thus, the quality of mulberry leaf is major contributory factors which influence the growth of silkworm and has a direct impact on the production of cocoon productivity in terms of quality with quantity.

The mulberry is prone to attack of various insect pests which damage the mulberry leaves. So far, about 300 insects and non insect pests damaging mulberry foliage of plants have already been identified from all over India and elsewhere and documented with its integrated pest management. It is observed that most of the insect pests on mulberry plants/trees are season specific, migratory or sporadic in nature and generally appear with leaf sprouting to meet out their biological activities with completion of their life cycle. These all are mostly leaves damaging in nature except stem borer (beetles), whereas termites are soil dweller insect, always remain in hidden condition, and do not feed on leaves and green branches. Termites are only cellulose feeder and damage roots and tree trunk with the result plant turn in to unproductive biomass alongwith loss to ecosystem. Once the termites attack on mulberry tree/plant it intact with till the end of the life of the tree/plant. These either damage roots in the ground or the tree trunk internally/externally more or

less round the year. So far, 20 termite species recorded from mulberry against the record of 10 termite species from all over India. Among the other insect and non-insects pests in forest flora, the termite is a “*Silent Killer*” of different trees including mulberry as most preferred tree/plant in India. The role of termites on mulberry is discussed in detail in this paper.

SUSTAINABLE OF BIODIVERSITY: THE ROLE OF MAGRA ECOSYSTEM IN THE THAR DESERT, RAJASTHAN, INDIA

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Magra ecosystem in the Thar desert is a unique and entirely different than the almost all the desert occur in the world. The “Magra ecosystem” is an admixture of outcrops of hillocks, small rocky gravel forms, oran (pasture and scarred), sand dunes, grassland and wasteland is highly rich in fauna and flora. It is also being called the rocky habitat. The word magra is especially represented to the existence of different races of Goat and Sheep in this region by some of the local inhabitant. In this ecosystem many of the wild animals are survive in associated form viz. Birds: Indian sand goose (*Pterocles exustus*), Grey Quail (*Coturnix coturnix*), Spotted owl (*Athene brama*), Spotted dove (*Streptopelia decocto*), Common babbler (*Turdoides caudatus*), Red turtle dove (*Streptopelia tranquebarica*), Redveted bulbul (*Picnonotus cafer*), Grey shrike (*Lanius exubitor*), Grey partridge (*Francolinus pondicerianus*), White vulture (*Gyps bengalensis*), Pea fowl (*Pavo cristatus*) and King vulture (*Sarcogyps calvus*); Mammals: *Gazella gazelle* (Chinkara), *Boselaphus tragocamelus* (Nilgai), *Vulpes vulpes pusilla* (Desert Fox), *Vulpes bengalehsis* (Indian Fox), *Herpestes edwardsi* (Mongoose), *Canis aureus auveus* (Jackal), *Felis silvetri oranata* (Desert Cat), *Hemiechinus auritus callaris* (Hedghog), *Hystrix indica indica* (Porcupine), *Funambulus pennati* (Five-striped), *Meriones hurrianae* (Indian desert gerbil), *Tetera indica* (Indian gerbil), *Bandicoota bengalensis* (Mole), *Lepus nigri collis* (Desert hare) and *Pteropus giganteus* (Fruit bat) and Reptiles: *Hemidactylus flarviviridis* (House gecko), *Agma agilis* (Agma), *Echis carinatus* (Viper), *Eryx johnii*, (Earth snake), *Varanus bengalensis* (Varanus-pada goh), *Ophiomorus tridactylus* (Sand fish), *Varanus griseus* (Varanus-chandan goh) and Indian spiny-tailed (*Uromastix hardwickii*). These species are the habitat of magra ecosystem whereas Indian spiny-tailed (*Uromastix hardwickii*) is only occurring permanently in and it does not exist in sand dunes and in other part of the Thar desert except for a few time to forge purpose only. Similarly many of the grasses, trees, herbs and shrub are also naturally found which are supporting to the animal's life. The paper discussed in detail on exiting of fauna and flora in Magra ecosystem.

BEE BIODIVERSITY OF THE PUNJAB

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Phylum arthropoda (jointed legged animals with body discernible externally and many internal organs repeated segmentally) is the richest in its diversity among all the other phyla under Animal Kingdom. Amongst its five classes (crustacea, arachnida, chilopoda, diplopoda and insecta), the class insect includes 1.5 million of the 2.0 million known species under the animal kingdom i.e. it constitutes 75 per cent of the animal diversity in the world. The insects are known to evolve on the earth 400 million years ago in comparison with man's evolution belonging only to one million years ago. Phylum arthropoda includes 29 orders (including ametabolous, hemimetabolous and holometabolous insects) with one order as Hymenoptera (includes holometabolous insects) which comprises symphytids, parasitoids, bees, wasps and ants). Hymenopterans are characterized by two pairs of membranous wings with venation greatly reduced / wingless, smaller hind wings, antennae with 10 or more segments, first segment fused with metathorax, ovipositor always present and tarsi usually five segmented. Between the two of its suborders, one Apocrita (excludes symphytids) to include only parasitoids, bees, wasps and ants, which are characterized by petiolated abdomen, presence of propodeum and apodous larva. Further between the two divisions under Apocrita, viz. Parasitica (to which parasitoids belong) and aculeata (to which bees, wasps and ants belong), the latter is characterized by ovipositor issuing at the apex of abdomen and modified as sting. Among the various superfamilies under aculeate (Apoidea, Vespoidea, Formicoidea), apoidea includes exclusively the bees. Apoidea members are characterized by the presence of plumose hair on head & thorax, hind tarsi broadened and often densely pubescent and are morphologically near to sphecoid wasps. Taxonomically, earlier, Apoidea was divided into nine families, viz. andrenidae, anthophoridae, colletidae, fidiidae, halictidae, megachilidae, melittidae, oxaeidae and apidae. however, lately, two more families viz. stenotritidae (derived from colletidae) and ctenoplectridae (derived from melittidae) have been included to make a total of 11 under apoidea. All the bees are known as efficient pollinators of crops due the presence of structural adaptations including the presence of scopae, tomentosa, hairy legs, hair and thorax, and also to many other several characteristic features, while members of apidae (particularly members of meliponinae and apinae) in addition also provide various hive products including honey.

The review of the surveillance of bee diversity from the Punjab has revealed the occurrence of 35 bee species from six bee families (Andrenidae, Anthophoridae, Apidae, Colletidae, Halictidae and Megachilidae) from a total of 11 under super-family Apoidea and these have been identified as important pollinators of various crops. The important non *Apis* bee species reported in the Punjab included *Andrena iderda*, *Andrena leaena*, *Andrena levilebris* (Andrenidae), *Allodapes* sp., *Allodapula* spp., *Ceratina* sp., *Ceratina binghami*, *Xylocopa fenestrata*, *Xylocopa pubescens* (Anthophoridae), *Bombus* spp., *Trigona irridipenis* (Apidae), *Colletes nursei* (Colletidae), *Halictus* spp., *Nomia oxybeloides*, *Nomioides divisus*, *Nomioides minutissima*, *Nomioides pusilla*, *Nomioides variegata* (Halictidae), *Coelioxys apicata*, *Megachile bicolor*, *Megachile disjuncta*, *Megachile fasciculate*, *Megachile femorata*, *Megachile flavipes*, *Megachile lanata*, *Megachile vera*, etc.

(Megachilidae). Besides, the various honey bee species under family apidae found in the State included *Apis dorsata*, *Apis florea*, *Apis cerana* and *Apis mellifera*. The exploitation of diverse bee fauna with diverse niche specialization by their augmentation and/ or conservation would enhance crop production and quality towards food security and sustainability.

WILDLIFE HABITAT DESTRUCTION IN ANANTAPUR DISTRICT, ANDHRA PRADESH, INDIA

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Anantapur District lies between 13'-40' and 15'-15' Northern Latitude and 76'-50' and 78'-30' Eastern Longitude. Geographically it falls in rain shadow region of peninsular India and failure of the rains during the south west monsoon of June to September leads the district to drought and it is having the second lowest rain fall in the country but it is a great repository of minerals like gold, diamonds, asbestos barites and iron ore. At Ramagiri village in Ramagiri mandal, Gold is found to occur in the Cholite Schist's and phyllite along with western part of Dharwar Schist's Belt in the district. The place extends over a length of 14 kms Exploratory mining in the area is pruned about 467 meters of ore shoots with an average width of 100 CMS Tonne. Mining operations are expected to be conducted by Bharat Gold Mines Limited destroying huge area of wildlife habitat Diamonds are known to be available near Vajrakarur. They mainly occur in pipe rocks. Asbestos is Chrysolite variety Cross fibre type and Barytes High Grade Line Stones, Iron ore and steatite are the minerals occurring in the district. Obulapuram Mining Company also known as OMC or OMCPL is an iron ore mining company located in Karnataka and Andhra Pradesh in India. The company has been fighting charges of illegal mining in forest lands on the Karnataka-Andhra Pradesh border OMCPL holds iron ore mining leases in 134 hectares in Anantapur District of Andhra Pradesh and iron ore reserves in these leases are estimated to be around 100 million tonnes There are 2 large scale Cement Factories (Ms. Ultratech Ltd., and Ms. Penna Cement Ltd.,) in Tadipatri Mandal and producing lakhs tonnes of cement in private sector by polluting environment and water bodies and detriminting wildlife habitat. Thousands of Stone crushing and quarrying units located in the district are also causing irrevocable harm to the wildlife habitats. Laying of express high way road from Hyderabad to Bangalore destroyed the unbroken area of wildlife habitat into pieces and is well exemplified by Habitat fragmentation. Town ships, multi-product SEZ, Science City and construction activities over remote areas also contributed to the habitat fragmentation. Over exploitation of natural resources, biotic stress and spread of diseases by invasive species are the other factors that contribute for the loss of both wildlife and its habitats.

***Parthenium hysterophorus*: A SERIOUS THREAT TO PLANT BIODIVERSITY**

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Parthenium hysterophorus L., an annual herb native to the subtropics of north and south America has achieved major weed status in India in last few years. It has been seen to grow luxuriantly in forests, grasslands, wastelands, around the agricultural fields and sometimes in less competitive field crops, and is rapidly replacing the local flora. A phyto sociological analysis of weeds was conducted at three different sites of Agra district in monsoon season, especially their population dynamics in relation to *Parthenium hysterophorus*. Weeds like *Withania somnifera*, *Cassia occidentalis*, *Croton bonplandianum*, *Calotropis procera*, *Datura somnifera* and *Tephrosia purpurea* etc. were commonly found in close vicinity of *Parthenium*. In laboratory, effect of shoot and root leachates of *P. hysterophorus* was assessed on seed germination of some selected plants to evaluate its allelopathic potential in nature. Shoot leachates of *Parthenium* were found most inhibitory on seed germination of most of the plants species. From field and laboratory studies it can be concluded that *P. hysterophorus* has strong allelopathic potential to inhibit seed germination of neighbouring plants and is becoming a serious threat to plant biodiversity in varied ecosystems.

DIVERSITY OF DUNG BEETLES (COPRINAE: SCARABAEIDAE: COLEOPTERA: INSECTA) OF SOUTH- EAST RAJASTHAN

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The present study is based on the dung beetles of South-East Rajasthan, covering eighteen districts *i.e.* Sirohi, Rajsamand, Udaipur, Dungarpur, Banswara Chittorgarh, Pratapgarh, Bhilwara, Bundi, Kota, Jhalawar, Baran, Tonk, Sawaimadhopur, Karauli, Dausa, Alwar, Bharatpur and Dhaulpur. The members belonging to subfamily Coprinae (Scarabaeidae) commonly known as “dung beetles or dung rollers” which are very interesting insects. They are economically important because they play very important role in pasture ecosystem, environment and national economy. They break down tons of animal dung every day into several nodules or balls, roll them into subterranean chambers or tunnels of the soil to buried and degraded into the soil to increase the fertility of the soil, at the same time they also destroy the habitat for the larvae of many pest flies of domestic and wild animals, which they lay eggs in the dung. Some of them are the intermediate hosts for the parasites of domestic and wild animals. The identification keys of tribes, genera and species of subfamily coprinae is followed by systematic account, synonym and locality of all 14 genera and 76 species supported with their complete distribution. The genera recorded with their number of species in descending order include of the genus 1 species of *Scarabaeus*, 3 species of *Gymnopleurus*, 4 species of *Heliocorpus*, 5 species of *Catharsius*, 10 species of *Copris*, 2 species of

Phalops, 1 species of *Disphysema*, 5 species of *Caccobius*, 31 species of *Onthophagus*, 1 species of *Liatongus*, 3 species of *Oniticellus*, 1 species of *Drepanocerus*, 8 species of *Onitis* and 1 species of *Chironitis* were recorded from South-East Rajasthan. The database will be useful as a baseline work for the taxonomists and biodiversity workers of the Nation.

DIVERSITY OF FRESHWATER CRABS AND PRAWNS (DECAPODA) OF MAHARASHTRA

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Maharashtra with 4 river basins i.e. Narmada, Tapti, Godavari and Krishna and several natural as well as manmade lentic water bodies constitute nearly 377905 ha. of water spread area. These freshwater resources provide habitat for various aquatic organisms including crabs and prawns which belong to order Decapoda in the class Malacostraca of phylum Arthropoda. Though their diversity is not very high in freshwater environments, they provide an important fishery resource for economically poor people and play a significant role in nutrient cycle. Many of the freshwater habitats of Maharashtra remain unexplored for these resources and estimation of crab and prawn diversity is of prime importance. Hence, an attempt was made to inventorise the diversity of crabs and prawns resulting in the enumeration of 11 species under 7 genera of crabs and 11 species under 2 genera of prawns from Maharashtra.

VILLAGE INSTITUTIONS: AN EXCELLENT REPOSITORY OF BIODIVERSITY IN THE THAR DESERT

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The Indian desert covers an area of about 0.32 million sq. km., which is nearly 12% of the total geographical area of India. It spreads over the four states of Rajasthan (62%), Gujarat (20%), Haryana and Punjab (9%), and in the west it merges with the fertile plains of the Indus, in Pakistan. It is essentially a sand desert, most of whose area consists of dry undulating plains of hardened sand. The remaining region is largely a mass of loose sand, formed from shifting sand dunes. The desert environment is inhospitable for plants, wild animals and human populations. Yet, the Thar Desert is the most populated desert in the world. Population density here is 84 persons per sq. km. A variety of village institutions like Gauchar, Oran, Nadi, Gravel Lands, Wastelands, Fallow Lands,

Plough Fields, Sand dunes and Forest Enclosures are available in the Thar. The Thar Desert is sustaining itself in spite of vagaries of climate with over 32 million livestock and 41 million human populations. Over 900 plant species, 86 species of grasses, nearly 2,000 animal species have been recorded from the Thar Desert and 80% of taxa reported in these village institutions. A variety of threatened animals such as Hyaena (*Hyena hyaena*), Indian Wolf (*Canis lupus*), Golden Jackal (*Canis aureus*), Fox (*Vulpes bengalensis*), Jungle Cat (*Felis chaus*), Blackbuck (*Antelope cervicapra*), Chinkara (*Gazella bennetti*), Blue Bull (*Boselaphus tragocamelus*), Hanuman Langur (*Presbittis entellus*), small Indian Mongoose (*Herpestes javanicus*), Indian Grey Mongoose (*H. edwardsii*) Monitor Lizard (*Varanus griseus*), Indian Cobra (*Naja naja*), Long-billed vulture (*Gyps indicus*), White-backed vulture (*Gyps bengalensis*) and Indian peafowl (*Pavo cristatus*) and plants like Khejari (*Prosopis cineraria*), Ker (*Capparis decidua*), Kumbhat (*Acacia Senegal*), and Thor (*Euphorbia granulate*), besides a variety of grasses are quite common in the village institutions. Before the turn of this century, large predators such as Asiatic Lion (*Panthera leo*), Cheetah (*Acinonyx jubatus*) and Caracal (*Caracal caracal*) were fairly common in the southern part of the desert. Up till now, no attempt has been made to study the biodiversity of village institutions which are protected and managed by village communities. Each village institution area is an excellent repository of biodiversity. These are common pool resources which support rural population for their needs of firewood, fodder, grain, thatching, fencing, herbal, resin, gum, bones, skin, hides, meat, wool and fur. Once social and institutional dynamics of village institutions are understood, in the present context we may design the programmes to prevent arrest and reverse degradation of these important life support systems so as to provide livelihood opportunities in a sustainable and equitable manner through people's participation.

VULTURE DYNAMICS IN RAJASTHAN

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Vulture studies are carried out in wide areas of Rajasthan in which two national parks viz. Kaoladev National Park and Ranthambhore National Park with nine other wildlife sanctuaries were surveyed which includes Desert National Park, Kumbhalgarh Wildlife Sanctuary, Sitamata Wildlife Sanctuary, Sawai Mansingh Sanctuary, Jawahar Sagar Sanctuary, National Chambal Sanctuary, Raoli Tadgarh Sanctuary, Sajangarh Sanctuary and Tal Chhapar Sanctuary. It is to be remembered that Rajasthan has traditionally been the holder of good livestock population since the rural economy largely depends on livestock after agriculture. Culturally, traditionally and climatically Rajasthan has been supporting high population of cattle of which 2.12 lakh is cross breed cattle and 1.9 crore are indigenous. This is directly related to the presence variety of village institutions like Gauchar, Oran, Nadi, Gravel Lands, Wastelands, Fallow Lands, Plough Fields, Sand dunes and Forest Enclosures, governed by the community. With the above domestic animal population the

study area is also rich in wild faunal diversity like Tiger (*Panthera tigris*), Leopard (*Panthera pardus*), Hyaena (*Hyena hyaena*), Indian Wolf (*Canis lupus*), Jackal (*Canis aureus*), Sloth Bear (*Melursus ursinus*), Wild Boar (*Sus scrofa*), Blue Bull (*Boselaphus tragocamelus*), Sambar (*Cervus unicolor*), Chittal (*Axis axis*), Chinkara (*Gazella gazella*), Black Buck (*Antelope cervicapra*), Four-Horned Antelope (*Tetracerus quadricornis*), etc. in many protected and unprotected areas. In total of 5735 vultures of 7 different species which includes Long-billed vulture (*Gyps indicus*), White-backed vulture (*Gyps bengalensis*), Red-headed vulture (*Sarcogyps calvus*), Egyptian vulture (*Neophron percnopterus*), Himalayan griffon (*Gyps himalayensis*), Eurasian griffon (*Gyps fulvus*) and Cinereous vulture (*Aegypius monachus*) were observed in 24 districts of Rajasthan. A total 1210 long-billed vultures, 381 white-backed vultures, 108 Red-headed vultures and 2715 Egyptian vultures were recorded. Out of seven vulture species the Long-billed vulture, White-backed vulture, Red-headed vulture and Egyptian vulture are resident and three migratory vulture species viz. Himalayan griffon, Eurasian griffon and Cinereous vulture who are nonresident were also observed in the study area. The population of migratory vultures buildup gradually in the study area from October onwards and reaches to its peak during January and February. A total of 1321 migratory vultures were observed in the study area. This includes 283 Himalayan griffon (*Gyps himalayensis*), 787 Eurasian griffon (*Gyps fulvus*) and 251 Cinereous vulture (*Aegypius monachus*). Most of the migratory vulture populations were observed near municipal large dead animal dumping grounds of Jodhpur, Bikaner, Kota, Udaipur, etc. besides this they were also observed at smaller *Panchayat's* dead animal dumping grounds throughout the state. Each large dumping site receives around 10-20 carcasses of dead cows, buffalos, camels, etc. every day and are skinned by the contractors authorized by the Municipal Corporation.

LIVING WITH NATURE: A TRADITIONAL WAY FOR CONSERVATION OF BIODIVERSITY

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The diverse cultures of indigenous people living in nature have developed close association and interaction with their surrounding environment in a long period of time. The diversity of plants and animal species, habitats, and there ecosystems found in the planet are linked with the diverse human culture over long period of time. These cultural and spiritual practices of the Indigenous communities are linked with the forest; flora and fauna have played an important role in the sustenance of biodiversity.

Chhotanagpur plateau is one of the biotic provinces out of 25 biotic provinces of India, and a land of diverse kind of indigenous communities. Thus, documentation of the various cultural and sacred practices of the indigenous communities of this region is essential to protect the culture and

biodiversity of this region. To fulfill the above goal, field visits were conducted in sacred places and attended in the various cultural festival and ceremonies of this region.

Chhotanagpur plateau is a land of different indigenous communities, having rich cultural heritage expressed through the ceremonies, dance, festival, music and rituals. Their cultural and sacred practices are closely linked with the natural environment, forests, animals and croplands. The five festival culture like Karam (seedling), Pata (leaf emerging), Baha (flowering), Falhar (Fruit eating) and Sarhul (Crop harvesting) are celebrated in a cyclic way in every year and are inherently connected with the nature. These close association and link to the nature play important role in the conservation of biodiversity in Chhotanagpur plateau from the long periods. In present time, various flora and fauna of this region are in the verge of extinction due to habitat destruction by mining, industrialization and urbanization. In conclusion, the cultural practices of communities played important role in the protection and conservation of biodiversity, and need to conserve the local culture, sacred and spiritual practices for successful conservation of threatened flora and fauna of this region.

SACRED GROVES IN INDIA: A BIO-CULTURAL PERSPECTIVE

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Sacred groves can be described as parts of landscape having vegetation and other life forms and geographical features that are delimited and protected by human societies under the belief that to keep them in a relatively undisturbed state is expressive of an important relationship of humans with the divine or with the nature. India has enormous diversity in cultural, geographic, climatic, living beings and fossil forms. It has a strong spiritual tradition which can be helpful in biodiversity conservation at a time of increasing anthropogenic pressure (according to census survey of India, during the last decennial census in 2001, the country has witnessed a percent change from previous to last census (decadal growth rate) to the magnitude of 21.30% (from 843 m to 1028.70m).

There are over 13,000 sacred groves reported from India though their number is estimated to be around 1 lac to 1.5 lac. A state like Meghalaya having relatively small geographical area has comparatively high area under sacred groves (over 26,000 ha) and some other states with high area of sacred grove such as Karnataka, Maharashtra and Uttaranchal have mean annual rainfall ranging from 400-800 cm in many parts of the respective states. This shows that both abiotic (such as rainfall) and biotic (including anthropogenic e.g. cultural practices) have influence on sacred groves. (although many of the sacred groves may be unreported as yet in various parts of India). Western ghats and north-east (having sacred groves) are biodiversity hotspots (thus areas of high endemism).

Therefore, there can be a merit in conserving sacred groves in terms of both abiotic and biotic factors, in view of anthropogenic pressure.

BEE VISITORS ON *Tegetes patula* L., A COMMERCIALY PRODUCED FLORAL RESOURCE FOR THE CONSERVATION OF APOIDEAN BIODIVERSITY IN THAR DESERTS (WESTERN RAJASTHAN), INDIA

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This study, for the first time investigated and explored the bee species (Apoidea) which are regularly associated with *Tegetes patula* L. (Asteraceae). The collection and identification of bees was made during years 2000 to 2010 from the deserts of western Rajasthan. It is a perennial ornamental plant that is grown for its commercial utility in garland making business. It is mainly used as an edging plant on herbaceous borders. Liquid concentrate from the flower and leaves is used medicinally in eastern Asia to stop nasal bleeding. The whole plant is harvested when in flower and distilled for its essential oil to be used in perfume industry. It is blended with sandalwood oil to produce 'Ittar genda' perfume. The oil is also used for its antifungal activity, including treatment of candidiasis in humans. Its root secretions kill nematodes in the soil and it is said to repel harmful insects, such as white fly amongst tomatoes.

The investigations revealed that flowers of *T. patula* attracted a total of 69 species of bees (Apoidea) in the eight districts namely, Jodhpur, Jaisalmer, Bikaner, Barmer, Churu, Sikar, Jalore and partially Pali districts. They together constitute the Thar Desert in Western Rajasthan. The collected bees have been so far identified belongs to 18 genera incoming five families. These genera and number of their identified species are: *Amegilla* Friese (02 species), *Colletes* Latreille (01 species), *Apis* Linnaeus (02 species), *Braunsapis* Michener (04 species), *Ceratina* Latreille (07 species), *Ceylalictus* Strand (04 species), *Halictus* Latreille (12 species), *Hylaeus* Fabricius (03 species), *Lipotriches* Gerstraecker (03 species), *Megachile* Latreille (03 species), *Nomia* Latreille (03 species), *Nomioides* Schenck (04 species), *Pseudapis* Kirby (03 species), *Pseudoheriades* Peters (05 species), *Tetragonula* Moure (01 species), *Trachusa* Panzer (03 species), and, the 02 cleptoparasitic genera: *Coelioxys* Latreille (06 species) and *Thyreus* Panzer (03 species). A *Tegetes patula* plant fully blooms for a considerable longer period during springs to summers in this acute arid zone of Rajasthan. The commercially produced crops at different pockets of desert provide enough of resources for the survival of these bee species. Usually its blooming is followed by the flowering periodicity of *Capparis decidua* (Forsk.) Edgew. Thus most of bee species usually migrate to *C. decidua* when blooming on *T. patula* reduces considerably. Precisely, this plant is a

very useful resource for a rich bee biodiversity during extremities of climatic scarcity in deserts and both crops together may aid in conservation of bee biodiversity in this area.

**APOIDEAN BIODIVERSITY ON *Verbesina encelioides* (CAV.)
BENTH. & HOOK. F. EX GRAY (ASTERAEAE), A SHORT TERM
RESOURCE FOR THE CONSERVATION OF BEES IN RAJASTHAN**

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This study, for the first time explored and identified the bee species (Apoidea) which are regularly associated with *Verbesina encelioides* (Cav.) Benth. (Asteraceae). The collections and identification of bees were made during years 1990 to 2010 from all over Rajasthan. It is a perennial weed that interferes with the growth and establishment of crop species in semiarid regions of India. The investigations revealed that flowers of *V. encelioides* attracted a total of 70 species of bees (Apoidea) in Rajasthan. These have been identified belongs to 21 genera incoming five families. These genera and number of their identified species are: *Amegilla* Friese (04 species), *Andrena* Fabricius (04 species), *Colletes* Latreille (02 species), *Apis* Linnaeus (03 species), *Braunsapis* Michener (03 species), *Ceratina* Latreille (05 species), *Ceylalicthus* Strand (02 species), *Halictus* Latreille (07 species), *Hylaeus* Fabricius (04 species), *Icteranthidium* Michener (02 species), *Megachile* Latreille (06 species), *Nomia* Latreille (04 species), *Nomioides* Schenck (04 species), *Pseudapis* Kirby (01 species), *Pseudoheriades* Peters (05 species), *Tetragonula* Moure (01 species), *Trachusa* Panzer (01 species), *Xylocopa* Latreille (04 species) and, the 03 cleptoparasitic genera: *Sphecodes* Latreille (02 species), *Coelioxys* Latreille (04 species) and *Thyreus* Panzer (02 species). A *Verbesina encelioides* plant fully blooms for a very short period amidst mid-September to December and during the extremity of cold season, bees exclusively depend upon this flower resource. Precisely, this plant is a very useful resource for a rich bee biodiversity during extremities of winter in Rajasthan and, amidst the storm of expansion of urbanization; attempts should be initiated to conserve wild naturally growing habitats of *V. encelioides*.

***Colletes comberi* COCKERELL, A RARELY KNOWN BUT
EFFICIENT POLLINATOR OF WILD CROPS IN NORTHERN
THAR DESERT OF RAJASTHAN, INDIA**

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There are 13 species of genus *Colletes* Latreille (Family Colletidae, Superfamily Apoidea) known from India. Majority of them are confined to temperate climate of Jammu & Kashmir, Himachal Pradesh or Himalayan range in the extreme north. *Colletes comberi* Cockerell was rarely known earlier with a few representative specimens preserved at American Museum of Natural History, New York, recorded from Karachi. This study made during years 2007 to 2010 for the first time, explored the complete range of the distribution and the aspect of flower relationships for *C. comberi*. Quite good numbers of specimens are collected from northern part of Thar Desert, more particularly from the districts of Churu, Sikar, Jhunjhunoo, Ganganagar and Hanumangarh etc. This is the lone species of genus *Colletes* which has been recorded from sandy deserts of Thar. Intense collections and identification of the referred bee has further revealed that it pollinates quite good number of wild crops in this desert. The territories and crops recorded with huge bee population from different locations are: Basava (Jhunjhunoo) (during October) on *Aerva persica*, *Capsicum annum*, *Calotropis procera*, *Ziziphus mauritiana*; Malari (Churu) on *Calotropis procera*; Ghassu (Sikar) on *Leptadenia reticulata*; Alpura (Gudha Malani (Barmer) on *Leptadenia reticulata*. Its individuals were also collected from Jaipur and Ludhiana on *Farsetia jacquemontii* and, on *Brassica campestris* var. *sarson* from Bharatpur, Alwar and Kota.

The pollination efficiency of a bee species is estimated on the basis of its attractiveness to crops for resources like pollen, nectar, oils, nest construction material etc.; the amount of pollen loads it can carry in ratio to its own body weight; the rate of floral visit; the rate of field trips and their periodicities of activeness on a crop. The investigations and estimations made recently have concluded that in comparison to ventral abdominal scopa bearing female bees of family Megachilidae (genus *Megachile*, *Anthidium*, *Osmia*, *Hoplitis*, *Heriades* etc *Colletes comberi* has considerable equivalent concern and it has quite good efficiency for the referred crops' pollination. The bee species has recently attracted attention and its several aspects of usefulness need to be explored in near future.

PLANTS VISITED BY *Tetragonula iridipennis* (SMITH), A STINGLESS BEE, IN NORTHERN INDIA

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A survey was conducted during years 2000 to 2010 in 10 States of northern India so as to determine the forage plants of *Tetragonula iridipennis* (Smith), a stingless bee (Hymenoptera: Apidae: Meliponini). A total of fifty six species of plants were recorded visited by this bee. The bee was collected from Punjab, Haryana, Himachal Pradesh, Rajasthan, Uttarakhand, Uttar Pradesh,

Bihar, W. Bengal, Madhya Pradesh and Gujrat. This social bee was noted making collection of either pollen or nectar, or both from the flowers of these plants. The study details about the type of forage collected and the blooming periods of different plant species. It will apprehend a complete crop rotation for this tiny bee for throughout the year. Stingless bees world over are known for their important produces: honey and bitumen of quite great medicinal value. Often their nests can be seen in the empty piths of thick timber yielding tree trunks in northern India. The study will further reveal its importance in the cross pollination and towards the direction of conservation of plant biodiversity in this part of India.

HARNESSING ECONOMIC VALUE FROM FLORA AND FAUNA THROUGH INFORMATION TECHNOLOGY (DIGITIZATION) AND PATENT INFORMATICS

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There are large volumes of taxonomic descriptions in different flora and fauna available in print format, have been produced over the century. While descriptions created by trained taxonomists, systematists and chemist are of high quality and provide consistent information to the readers. The traditional users of such type scientific collections are invariably taxonomists – identifying, naming and classifying species and systematists who study the diversity of life on the planets past and present as well as relationships among living things through time. These specialists make it possible for the comparative science of biology to flourish. Without this essential work, a large portion anatomy, physiology, biochemistry and microbiology, and ecology could not be realized. Development of Information Technology enabled to digitize such important flora and fauna with innovative usage. The majority of digital descriptions are in a format, such as DOC, HTML, or PDF, for human readers. These formats do not convey rich semantics in taxonomic descriptions for computer-aided processing. Newer digital formats, such as XML and RDF, accommodate semantic annotations that allow a computer to process the rich semantics on human's behalf, opening up opportunities for a wide range of innovative uses of taxonomic descriptions, including searching in more precise and flexible ways, integrating morphological, genomic, georeference, or other information, automatically generating taxonomic keys, and knowledge mining and visualizing taxonomic data. In addition, there is no well-defined and well-accepted standard to regulate the content of a description. For example, a manual comparison among the descriptions of five plant species, found in six well-known floras will reveal surprisingly large variations in terms of description content and style. The same is true for zoological specimen.

Scientific collections of plant and animal also have potential to assist the isolation and identification of biopharmaceuticals. For example, taxol as treatment for ovarian cancer has been derived from *Taxus brevifolia* (Pacific Yew) and such ethno-botanical sources or 'traditional' medicines have become subject of discussion for recognition and possible compensation under patent regime. Development of genomics, proteomics, metabolomics and combinatorial chemistry enable us to screen, identify and synthesize new molecules from plant and animal and patent it for temporary monopoly and wide disclosure of the latest development i.e. process and product in this field. Though considerable work has been done on conversion of taxonomic descriptions to digital format, however, no work has been done to integrate patent informatics to unearth the full potential of flora and fauna. Therefore, the present paper will discuss potential issues of harnessing economic value through Information Technology (digitization) and Patent Informatics with selected case studies.

STUDY OF THE PESTS OF ONION AND GARLIC IN SHEKHAWATI REGION OF RAJASTHAN

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Shekhawati is located in the north-west area of Rajasthan. It is situated in the Delhi-Bikaner-Jaipur triangle. Jaipur is 100 Km and Bikaner 180 Km from Shekhawati region. The Shekhawati region includes three districts of Rajasthan namely- Sikar, Churu and Jhunjhunu. The climate of Shekhawati region, like other areas of Rajasthan, is semi desert type. Shekhawati weather experiences hot and dry summers. The average temperature remains in the range of 41.2⁰ C (max) to 29.0⁰ C (min). The climatic conditions in the winter season are cooler, but again dry. The average temperature in winter ranges from 20⁰ C to -2.0⁰ C. In Summer average temperature varies from 24.0⁰ C to 48.0⁰ C. Five village of district Sikar, Jhunjhunu and Churu, (Abusar, Harsawa, Ramser, Ranoli and Thelasar). In each village one farm house where Onion & Garlic crops are sown from 1.5 acre to 3.5 acre area. These Farm houses where named as "A" "B" "C", "D" and "E" respectively.

Thrips tabaci Linderman belongs to Order Thysanoptera and Family Thripidae. The Damage is done by adults as well as by nymphs. The insects are just visible to the unaided eye and are seen moving briskly on the flowers and leaves of onion and garlic plants. The pest is active throughout the year and breeds on onion and garlic from November to May when it migrates to other summer host plants and breeds there till September. Female lays 50-60 kidney-shaped eggs which are 1/125 in length. On the epidermis of succulent leaf, flower, stem. The eggs hatch in 4-9 days and the nymphs start feeding on plant juices. The Farm house "A" (in Abusar) shows damage of 14 plants out of 72 plants per 100 Sq. Meter, while the Farm house "B" (in Harsawa) is having damage of 24 plants out of 82 plants. The pest damaged only 16 plants of onion out of 70 plants in

Farm house “C” (in Ramsar). However, the damage in the Farm house “D” (in Ranoli) was of 18 plants out of 76 plants. The damage to onion plants was severe in the Farm house “E” (in Thelasar) where 28 plants were damaged out of 80 plants. It is due to variation in the percentage of measures of control used by the owner of the Farm houses. The damage also depends upon the interaction between the predator and the prey.

CHECKLIST OF FRESHWATER FISHES OF MIZORAM, INDIA WITH A NOTE ON CONSERVATION STRATEGIES OF THREATENED SPECIES

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A check list of the fish fauna of the Mizoram has been prepared base on present collection and those reported by the earlier workers. A total of 160 species of fishes representing 71 genera and 23 families has been recorded. Highest species diversity was observed in the Cyprinidae (46.2%) followed by Sisoridae (15.0%). The fish fauna includes 2 endangered (EN), 6 vulnerable (VU), 12 near threatened (NT), 101 least concern (LC) and 7 data deficient (DD) as per IUCN status. The fauna is a mixture of endemic hill stream, Assamese, Burmese and widely distributed forms. Strategies for conservation of threatened fishes are discussed.

LARGE SCALE DEMONSTRATION OF POND ASH APPLICATION IN FARMERS’ FIELDS IN THE VICINITY OF TPPS OF MAHGenco

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Coal is primary fuel used in thermal power plants (TPPs) and in India, it continues to be one of the most important sources for meeting the domestic energy needs. It accounts for 68% of the country’s total energy supplies. About 75% of the coal produced in the country is consumed in the power sector. The problem of huge quantity of both fly ash and bottom ash (ca. 160 million tonnes per annum during 2009-10) being generated through 85 existing thermal power plants in the country by consuming about 270 million tonnes of coal is of much environmental concerns. However the current utilization of fly ash in the country is about 50% in different sectors including agriculture and forestry sectors, which is relatively lower than the fly ash utilization in overseas countries. It needs sustainable measures for safe disposal and maximum gainful utilization in various areas. Through the expertise developed by CIMFR (erstwhile CFRI) Fly ash soil amendment technology

(FASAT), it has been established that fly ash has a very good potential for its eco-friendly utilization on bulk scale as soil modifier and source of plant nutrients for boosting the growth and yields of variety of crops.

As a follow up of the earlier studies, the large scale demonstration trials of fly ash/pond ash application in the farmers' fields of Koradi, Khaperkheda and Chandrapur TPPs of MAHGENCO have been carried out during 2005-2010). The application of pond ash (@ 100 t/ha) suitably modified the physicochemical properties including texture of field soil. The yields of various cereals and vegetable crops (paddy, wheat, soybean, maize, cotton, gram, sugarcane, brinjal, tomato, lady's finger, bittergourd, etc.) grown in pond ash amended plots substantially increased (15-30%) over control (without pond ash). Considerable improvement in respect of major and secondary nutrients such as N, P, K, S, Ca, and Mg in the crop produce grown in pond ash amended fields has been observed. The carryover of trace elements/heavy metals and radionuclides from pond ash in the crop produce is observed to be insignificant as compared to the corresponding control. Kisan Gosthi was organized periodically at the selected farmers' fields during cultivation of different crop regarding advantageous application of pond ash in agriculture and management of waste degraded lands. The farmers have been benefitted a lot using pond ash in their fields and more and more farmers have shown their keen interest for applying pond ash in the fields.

SOIL MICRO FLORA AND THEIR ACTIVITIES IN LIGNITE MINING AREA

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Besides coal, lignite is one amongst the prominent energy sources in India. Neyveli Lignite Corporation operates the largest open-pit lignite mines in India, presently mining 24 MT of lignite and has an installed capacity of 2490 MW of electricity per year. Mining activities and the subsequent combustion of lignite in power plant have significant long lasting effect on the environment and surrounding soil quality, especially on the soil microbial activity. To study the effect of lignite mining on soil microbial parameters, microbial biomass, soil respiration, and soil enzymes (dehydrogenase, catalase FDA, peroxidase, phenol oxidase) were studied in the soil samples collected from the nearby areas of Neyveli lignite mines, Tamin Nadu. Most of the soils were acidic. Soil organic carbon, microbial biomass, dehydrogenase activity, FDA hydrolases, catalase etc. were significantly higher in the soils nearby the lignite mines, as compared to a control site. The deposition of lignite dust on soils might have enriched the soil organic matter, which inturn enhanced the soil microbial activities.

A REVIEW OF DEPLETING PLANT RESOURCES, THEIR PRESENT STATUS AND CONSERVATION IN RAJASTHAN, INDIA

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A large number of plants and animals have inadequate future, unless immediate steps are taken to arrest the causes for undertaking to biological improvement. Floral and faunal diversities are the two basic components of biodiversity which covers the variety and variability of species. Concern for conservation and sustainable use of plant diversity has been growing in many countries, including India. The population of both human as well as livestock's in Rajasthan being on higher side, coupled with the changing climate adversely affect the delicately balanced ecosystem. This resulted in an over-exploitation of natural plant resources, which possesses a threat to plant diversity in Rajasthan.

There is a great awareness in the recent times to conserve natural plant resources all over the world as several thousand species of plants and animals are threatened, many are critically rare and a few have already extinct. Studies undertaken during last six decades on floras of several parts of the world have shown that, many plant species are in danger of extinction while some have already become extinct recently. According to the reports given by the International Union for Conservation of Nature and Natural Resources(IUCN) it is estimated that about 10% of world's vascular plant species totaling to about 20,000 – 25,000 species are under varying degrees of threat. The flora of India is very rich in plant diversity with an estimated 50,000 species of which about 18,000 are flowering plants out of these, about 5,000 species are endemic to Indian flora, while several hundred species are threatened. The threat various and environmental survival of threatened species is now attracting the attention of many countries. The recent preparation of Red data Books, list of threatened and endemic taxa and symposia organized by various countries in Europe, Africa, North & South America etc on rarity, endemism and threatened plants have recently stimulated the Asian countries, including India, to look in to the fate of their depleting plant resources. In the eleventh technical meeting of IUCN, held at New Delhi in 1969 (IUCN, 1970), the problems of the taxa on the verge of extinction in India were also discussed and need of the preliminary lists of such taxa as realized to achieve the task of conservation. A brief review of work done in India on the threatened plants and habitats has been published by Jain & Sastry (1981). Following this, concrete efforts on the subject were made during the year 1980 – 85 through programme "Project on Study, Survey & Conservation of endangered species of Flora (POSSCEF) supported by the U.S. Fish & Wild – life service (under PL-480 scheme) in the BSI and valuable baseline data on nearly 1000 threatened and endangered plant species have been gathered. Further, a seminar on "Threatened plants of India was organised by the Botanical Survey of India for the first time in India at Dehradun in September, 1981 to evaluate the endemic flora and to assess the status of the threatened taxa in India. Therein, Pandey, *etal.* (1983) and Sharma (1983) respectively reported 41 and 106 taxa as rare and threatened from whole of Rajasthan. J.N.Vyas University also organised a national Symposium on "Evaluation of Environment" in 1983, therein, Pandey & Shetty (1985) presented a paper on Rare and threatened plants of Rajasthan and enlisted the rare and threatened taxa. Singh (1985) also dealt

with the threatened taxa and their scope of conservation. Mondal (1991) has published “Massuria hill – a type locality at Jodhpur in Rajasthan”, Where he has emphasized that this area harbours a number of new species and varieties. Recently Singh & Pandey (1997) have published “Depleting plant resources in the Rajasthan desert” The project like Man & Biosphere (MAB) is also working in this direction. A regional workshop on the same subject was again organized by BSI in collaboration with National Bureau of plant Genetic Resources (NBPGR) at New Delhi in March, 1982. Recently BSI has also published the Indian plants Red data Book-I” (Edited by Jain & Sastry, 1984) and three volumes of the Red data Book of Indian plants (Edited by Nayar & Sastry, 1987, 88 & 89). Pandey (1984), Singh & Pandey (1995) also dealt with the subject. Recently Singh & Pandey (1998) undertook assessment of phytodiversity of Rajasthan in greater details. Very recently Singh & Pandey (in press) dealt with the conservation of plant diversity in Rajasthan. Parmar prepared supplementary list of plants which are addition to the Flora of Rajasthan (in press).

After establishment of Botanical Survey of India, Arid Zone Regional Centre in March 1972, published a comprehensive “Flora of Rajasthan” in three volumes (Edited by Shetty & Singh, 1987, 91 & 93). All the above publications have contributed quite a lot in the preparation of a list of rare and threatened taxa of Rajasthan. Besides above, the authors have also explored the entire Rajasthan state for Botanical exploration work and examined the various listed “RET” species deposited in various herbaria in India.

The present Flora of Rajasthan compressing 2090 species belonging to 819 genera under 159 families of higher plants growing over here. The present study deals with 63 RET taxa from Rajasthan and strategies for their conservation. The study also reflects Flora and Floral composition, phytogeographical analysis. Besides their 45 species of crop and other cultivated plants having 66 species of wild relatives occurring in the area have also been analyzed. The economic potentiality of the area is further enriched by 65 species of food plants. 11 spp., non-edible oil, 10 spp. Tannin yielding plants, 12 spp. Dye, 29 spp. fibre, 34 spp. timber, 26 spp. fire-wood, 63 spp. fodder grass, 68 spp. medicinal plant and 20 spp. of different miscellaneous uses of plant.

The paper also deals with conservation strategies and measures. At the end paper also enlisted invaded species through “Indra Gandhi Canal project (IGNP)” in N.W.Rajasthan due to impact of canal irrigation and listed about 105 species as new introduction from the neighboring states viz. Punjab, Himachal Pradesh and Kashmir.

BIOLOGY OF *Acanthophrus serraticornis* (COLEOPTERA:CERAMBYCIDAE) A ROOT BORER OF KHEJRI

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Khejri the state tree of Rajasthan, is regarded the lifeline of desert dwellers owing to multiple products and services this species renders. Besides providing food (fresh and dried pods), Fodder (fresh and dry leaves), fuel (wood) and fencing material (lopped branches), it enriches the soil and serves as a shelter for the animals during hot summers. The density of Khejri depends on land forms as well as rain fall distribution. The density ranged between 10 trees/ha to 150 trees/ha. The lowest density was found in Jaisalmer (10 trees/ ha) and maximum was found at and around Sikar, Jhunjhunu and Churu (90-150 trees/ha). In the uncultivated areas, Orans or Beers, the plant density sometimes swells upto 200 trees/ha with 4.8 to 17.8% crown cover. Crops under Khejri may be seen thriving in contrast to many other tree species, which exert a negative effect. Adapted as the tree to the warm and dry conditions, it forms the major part of greenery in the semi-arid tracts. It is an essential woody component of most traditional agroforestry systems in the arid zones. However, *P. cineraria* might have stressed due to recurrent drought, continuous and complete lopping, decrease in ground water table, changes in land use pattern and infestation of shoot/root borers, (*i.e.*, *Derolus iranensis*, *Hypoeshrus indicus*, *Aeolesthes holosericea*, *Acanthophorus serraticornis*).. *Acanthophorus serraticornis*, a cerambycid beetle is recorded as important pest. The detailed life history of *Acanthophorus serraticornis* has been studied.

STUDIES ON LIFE HISTORY OF THE OLEANDER HAWK MOTH, *Daphnis nerii* (LEPIDOPTERA: SPHINGIDAE)

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The studies were conducted on the oleander hawk moth, *Daphnis nerii* (Lepidoptera: Sphingidae), in and around Jodhpur, Rajasthan. Its vernacular name refers to the oleander, *Nerium oleander* (family Apocynaceae), on which its larvae feed, among other members in its family of poisonous, laticiferous plants. The adult are also found on the tree of *Terminalia catappa*. The egg is a tiny, round, oval, or cylindrical object, usually with fine ribs and other microscopic structures. The female lays the egg to leaves, stems, or other objects, usually on or near food on which caterpillar feed. The caterpillar (or larva) is the long, worm-like stage of the moth. It often has an interesting pattern of segmentation. It is the feeding and growth stage. As it grows, it sheds its skin four or more times so as to enclose its rapidly growing body. The incubation period is about ten to fifteen days during hot weather. It is a migratory species, and is one of the most beautiful butterfly-like patterned moths on Earth.

PHYTOPHAGOUS NEMATODE DIVERSITY IN RAJASTHAN STATE

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However, Rajasthan state could not feature in Nematology literature till Arya (1957) reported a root-knot species (*Meloidogyne* spp.) from district Jodhpur. Prasad, Mathur and Sehgal (1959) identified a serious nematode pest *Heterodera avenae* which causes 'Molya disease' in Rajasthan. Other important references on survey, distribution and identification of nematodes from Rajasthan include Swarup & Sethi (1968-77); Koshy, Swarup & Sethi (1971); Sethi & Swarup (1971-88); Mulk & Jairajpuri (1986) have provided useful information about host and localities of phytophagous nematodes from Rajasthan. Baqri (1994, 1998, 2001); Bohra & Baqri (2000, 2001, 2005) described many new species new to science and new geographical records from country and state. Bohra (2006-2008); Bohra & Sultana (2008-2010) contribute to the nematode fauna of the state and describe species new to science and new records from state.

The present paper deals with the diversity of phytophagous nematode fauna of the state. The nematological literature confirms the occurrence of about 316 species of nematodes from the state. Bohra (2010 in press). The orders Tylenchida represented by 57 species belonging to 23 genera of 9 families. The orders Aphelenchida (1 sp.); Dorylaimida (7 spp.); Triplonchida (2 spp.); Mononchida (12 species); Isolaimida (1 sp.); Araeolaimida (4 spp.); Rhabditida (10 spp.); Chromadorida (1sp.); Enoplida (3 spp.). Group-wise and area-wise gaps in research will be discussed.

QUALITATIVE AND QUANTITATIVE STUDY OF PHYTOPHAGOUS NEMATODES ASSOCIATED WITH CEREAL CROPS IN DAUSA DISTRICT, RAJASTHAN

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During (2005-06) survey of districts of southern Rajasthan, soil samples were collected from various cereal crops from in and around Dausa district of the state. The Qualitative analysis of the material collected revealed a wide variety of Plant parasitic/Free-living nematodes. In all 30 species belonging to 27 genera and 10 families under the orders Tylenchida, Aphelenchida, Dorylaimida and Mononchida were found associated with the crops.

The result of Quantitative estimation reveals that *Helicotylenchus*; *Tylenchorhynchus*; *Rotylenchoides*; *Hoplolaimus*; *Pratylenchus*; *Hirschmanniella* are the most frequent nematode pests. *Rotylenchulus reniformis*; *Aphelenchoides* sp; *Trichodorids*; *Xiphinema* are also found in significant number. *Pratylenchoides* sp. has been recorded for the first time from the state. Not a single predatory nematode was found in the study.

PREDATORY NEMATODES AS BIOCONTROL AGENTS IN THE MANAGEMENT OF PLANT PARASITIC NEMATODES

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Nematodes are found in almost every kind of habitat and constitute one of the most important groups of micro-organisms. Among the different ecological groups of the Nematodes, the terrestrial nematodes (plant and soil inhabiting nematodes) form a highly diversified group and play an important role either in restricting the crop fields or in maintaining natural balance in soil. The Predatory nematodes are also soil inhabiting and economically important because they feed on bacteria, fungi, micro-arthropods and other nematodes (including phytophagous) in the soil. They generally are considered more important because some of them can be used as agent in the biological control of plant- parasitic nematodes. They reduce populations of plant- parasitic nematodes in virtually all soils because of their constant association with plant parasitic nematodes in the rhizosphere, and also release nutrients in plant-available forms, which may enable plants to better withstand nematode burden on their roots. Predation by nematodes of the orders Mononchida, Diplogasterida, Dorylaimida and Aphelenchida, has been studied but the biocontrol agents of plant parasitic nematodes. However, among the different types of predators, diplogasterids are the most suited for biocontrol of nematodes, because of their short life cycles, easy culture, prey-specificity, chemotaxis sense and resistance to adverse conditions. This article summarizes progress to date and suggests ways to encourage the use of predatory nematodes as biocontrol agents in the management of plant parasitic nematodes.

IMPACT OF CLIMATE CHANGE ON INSECT ASSOCIATED WITH MUGA ECOSYSTEM

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Climate change or global warming, as it popularly known, is a global event required global solution. The event is happening due to greenhouse gas emissions and other industrial pollutants. The climate change is widely felt with respect to increased surface temperature, which is around 0.6°C. This climate change that is affecting every walk of life also has a major impact on insects associated with muga ecosystem in North Eastern India. Muga ecosystem is consists of host plants of Muga Silkworm (*Antheraea assamensis* Helfer) which belongs to order Lepidoptera and family Saturniidae. *A. assamensis* is endemic to North Eastern India, which produce golden unique silk and also known as Most Unique Golden-Silk of Assam (MUGA). It is multivoltine and completes six crop cycles in a year on primary host plants viz., Som (*Persea bombycina* Kost.) and Soalu (*Litsea monopetala*). These host plants and muga silkworm affected by so many pests and predators. In 2010-2011, Hemiptera (15 species), Coleoptera (20 species), Hymenoptera (15 species), Lepidoptera (13 species) insect pests and predators were recorded. One leaf minor belongs to order Lepidoptera and family *Gracillariidae* were found infesting both the host plants of muga silkworm

and causing damage 50 – 70 % in the year 2010, but due to heavy rain fall, high humidity and high temperature it was not observed in 2011. This change measures that the presence of the insect pest directly affected by climate change. This study was conducted at Farm No. 1, 2, 3 of Central Muga Eri Research and Training Institute, Lahdoigarh Assam.

PRIMITIVE SURVEY OF HYAENA (*Hyaena hyaena* (Linn.) NEAR OSIAN, DISTRICT, JODHPUR, RAJASTHAN

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The study area falls near village Osian of Jodhpur district in Rajasthan state. Today, Osian is a developing town of about 30-35 thousands inhabitants, situated about 62 km. north of Jodhpur and lies at 328.8 meters above sea level; 26° 45' N latitude and 73° 02' E longitude. The area encompasses sand dunes, sandy plains, sand hills and together constitute an open scrub forest. Over 30 species of mammals have been recorded from this region of desert. Apart from carnivores likes Asiatic jackal, wolf, hyaena, desert fox, Indian fox and the common mongoose, other wild animals in the area. In our survey of 2010-11 in the study area, we encountered and observed six different sightings of Hyaena. And every time we found solitary animal. Four dens of hyaena were identified with the help of local people. The striped hyaena is one of the largest carnivores in India. No accurate number of the hyaena population are available in this region. This animal is on the list of Red Data Book of IUCN. Hyaena does not only feed on carrion, but it also prey on sheep, goats and calves. It also eats vegetables and fruits. There has been an intense human pressure on the hyaena in recent years.

RECENT OBSERVATION ON POPULATION SURVEY OF FREE-RANGING HANUMAN LANGUR (*SEMNOPIITHECUS ENTELLUS*) IN AND AROUND JODHPUR RAJASTHAN (INDIA)

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The city of Jodhpur (26° 18'N, 73° 08'E and 241m MSL) supports a pocket population of about 2240 Hanuman langurs (*Semnopithecus entellus*) divided into 37 bisexual troops and 15 all male bands in an area of about 150 km². Recent Observation of this langur population during May-

June, 2011 revealed that there are total 2240 animals in the bisexual troops and all male bands there are one rhesus macaque females in Bheembhark langur troop. The bisexual troop size varied from 9 to 165, average 50.2 individuals and the all male band size ranged from 4 to 64, average 20.6 male langurs of different age group (excluding infants). The male-female sex ratio (at adults) found 1:6.2 and the population density is 14.2 langurs per km².

The Jodhpur pocket population of langurs is under investigation for last 4 decades by various Indian and foreign researchers. There is a gradual increase in the number of animals since 1968-1969 census, when there were about 900 animals in this langur population. And with time some demographic changes took place in the group size and age-sex composition. Such changes might have influenced by several complex factors including animal fertility, infant mortality, emigration/death of group members, the social dynamics such as group fission, environment condition such as food resources (natural) and climate changes, habitat destruction/degradation and human interventions.

NTFPS: A GOOD SOURCE OF RURAL INCOME AND BIODIVERSITY CONSERVATION IN CHITTORGARH DISTRICT OF RAJASTHAN

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Gathering of plant material for food, medicine and utilitarian items was the original relationship between human beings and forests and is being continued till today. These activities provides valuable livelihood resources for gatherers as non-timber forest products which are consumed directly or exchanged both inside and outside formal markets. The Chittorgarh District of Rajasthan (24° 54' N and 74° 78' E) provides good example of NTFP collection and utilization by the rural communities. The total geographical area of the district is 7500.65 Km², out of which only 1789.4402 Km² (23.8 % only) has been classified as forest land. The district has a total population of 18, 02,656 as per 2001 census. A noticeable feature is female to male ratio which stands at 966 per 1000 males as per the 2001 census against 921 per 1000 for Rajasthan and 933 per 1000 for India. The total number of villages in the district is 1747. A socio-economic survey of the district depicts that the habitation pattern of tribals is generally scattered, i.e. rather than living in composite villages they prefer to live in scattered houses. A group of such scattered houses constitute a hamlet which is locally known as “Phala”. These phalas has been developed into formal protection and management committees. In this area NTFP’s collected by the people of phalas to augment their income as well as for their own needs include- Honey, Seeds of Ratanjot (*Jatropha curcus*), Seeds of Mahua (*Madhuca indica*), Seeds of Puwad (*Cassia tora*), Seeds of Karanj (*Pongamia pinnata*),

Anwla (*Emblica officinalis*), Ber, Mahua flowers, Flowers and twigs of Tamat (*Nyctanthes arbortristis*), Baheda (fruits of *Terminalia belerica*), Tendu leaves, Khakhra (*Butea monosperma*) leaves, leaves of various species for fodder, lot of medicinal plants for local use, Bamboos and grasses. In 2008-09, in the villages Sangwa, Dudhitalai, Chittoria, Gajpura and Parlai, VFPCs earned about 1.00 lakhs rupees by selling about 10,000 Quintal grass.

On the other hand, the rural people have developed their own mechanism for conservation of biodiversity of the region. These rural communities have traditionally followed approaches of collective protection of Oran and Gochar as religious and cultural mechanisms from centuries. Several Orans or the sacred groves found in this region are good example of collective biodiversity conservation. Many tribal communities use a mechanism of *Kesar Chhanta* in which saffron color is sprinkled around an area to be protected for a certain period and virtually no green felling or even the grass removal is allowed in this area and these norms are rigorously and spiritually followed by the people of all cast and creed.

ROLE OF WILD AND CULTIVATED PLANT SPECIES IN MATERIAL CULTURE OF TRIBALS OF RAJASTHAN

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Tribal people and ethnic races have developed their own culture, tradition and food habits throughout the World. A large no. of wild and cultivated plants are being used by them for medicinal use, consumption as raw or after processing at village level and various other purposes since time immemorial. Tribals of Rajasthan constitute 12% of the total population, nearly double the national average. The main tribes of Rajasthan are the Bhils and the Meenas while smaller tribes include the Sahariyas, Garasias and the Gaduliya lohars. The major concentration of the tribes is found mainly in the foothills of Aravalli Range. Collection and consumption of wild and cultivated plants is deeply rooted in their day to day habits. They generally collect and consume *Ceropegia bulbosa*, *Leptadenia reticulata*, *Cordia rothii* as food, *Azadirachta indica*, *Acacia nilotica*, *Albizia lebeck*, *Butea monosperma*, *Ficus racemosa* as timber, *Dendrocalamus strictus*, *Calotropis procera*, *Tectona grandis*, *Bombax ceiba* as constructive material, *Acacia nilotica*, *A. leucopholea*, *A. catechu*, *Cordia rothii*, *Anogeissus latifoila*, *Boswellia serrata* as agriculture implements, *Phoenix dactylifera*, *Butea monosperma*, *Crotolaria juncea*, *Derris indica*, *Holoptelia integrifolia* as ropes, cords and strings, *Abrus precatorius*, *Aegle marmelose*, *Barleria prinoites*, *Chlorophytum*

tuberosum, *Achyranthes aspera* for treatment of various ailments. The paper herein encapsulates the information on ethno botanical uses of various wild and cultivated species used by the tribals of Rajasthan.

HAIR SNARES: SIMPLEST TECHNIQUE FOR MONITORING FIELD POPULATION

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Hair snares method is one of the non-invasive techniques for collecting mammalian hair samples from fields. This technique employs simple devices to collect samples without manipulating or hurting the animals. Hair samples are collected for analysis of morphological characters for identification of the species. These hair samples are also used for molecular identification of species, individuals, their sex, and their genetic relatedness, thus called as non-invasive genetic sampling (NGS). Hair morphology coupled with DNA identification is helpful in assessing aspects of animal communities such as occurrence and distribution, relative abundance, habitat fragmentation, and human disturbance.

PATHOGENS AND INSECT PESTS OF

Acacia nilotica* spp. *indica

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Acacia nilotica (linn), Willd ex del is known in India as babul, kikar, babur (Hindi). It is a moderate sized tree with a spreading crown. It is indigenous to the Indian Sub-continent as also in Tropical Africa, Burma, Sri Lanka, Saudi Arabia, Egypt and in West and East Sudan. In India, natural babul forests are generally found in Maharashtra, Gujarat, Andhra Pradesh, Rajasthan, Haryana and Karnataka. *A. nilotica* is truly a multipurpose tree, wood is used as timber, leaves and pod are used as fodder and gum has a number of uses. It tolerates extremes of temperature and moisture. The species is well suited to Rajasthan, where rain fall is comparatively high. *Acacia nilotica* has been adopted by State forest department of Rajasthan and Gujarat for afforestation purpose.

Regular and periodic field surveys were conducted in Rajasthan and Gujarat to investigate the disease or insect infestation in *Acacia nilotica* ssp. *indica* and other subspecies. In total 40 sites were surveyed out of which 15 sites were surveyed on regular quarterly basis which included nurseries, plantations and natural grooves. Diverse kind of pathogen as well as insect species on *Acacia nilotica* were collected during the surveys conducted. Till now, 14 species of insects and 11

diseases have been documented. The most damaging pathogen which was found through survey was *Ganoderma* root rot, heart rot and rust fungi i.e. *Ravenelia* Species. Two species of mites (*Tenuipalpus* sp. and *Oligonychus* sp.) and three species of nematodes were also recorded.

ON SOME ASPECTS OF TERRITORIALITY AND REPRODUCTION OF *Pseudagrion microcephalum* (RAMBUR) (ZYGOPTERA: COENAGRIONOIDEA)

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The territoriality and reproductive behaviour of *Pseudagrion microcephalum* (Rambur) has been studied in detail in a temporary monsoon pond, Jagdalpur, Bastar District, Chhattisgarh State, India from Sept., 2007 to Oct., 2010. The territoriality is strongly demonstrated by males towards both conspecific and heterospecific males. Precopulatory courtship display is present and brief, lasted for 08 to 13 seconds (X: 9.5, N=30). Intramale sperm translocation has occurred after the seizure of the female only and lasted for 10 to 20 seconds (X: 14.25, N=10). The copulatory wheel was formed during the perched condition and stage I lasted for 15 to 35 minutes (X: 25.15, N=20) and stage II lasted for 05 to 08 minutes (X: 6.5, N=20). The surface and below water oviposition is performed by both in tandem and female alone in underwater guarded by male on the above water surface. Behavioural comparisons of various stages have been drawn with other members of the genus *Pseudagrion* Selys.

MORPHOLOGICAL MUTATIONS INDUCED BY RADIOMIMETIC AGENTS IN TWO VARIETIES OF *TRIGONELLA FOENUM- GRAECUM* LINNEAUS

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An understanding of nature and magnitude on existing genetic variability to the available germplasm for important yield contributing characters is necessary for successful breeding programme in the changing agriculture pattern. The artificial induction of mutation with the radiomimetic chemical agents has been used from 1900. The induction of similar type of mutations in both varieties provides an excellent example of parallelism regarding genetic variability in the two varieties of *Trigonella foenum-graecum* L.

In present investigation, it was observed that the induced viable mutation spectrum was broader in variety *Desi methi* in comparison of variety *Kasuri methi*. In both varieties mutation affected almost all parts of plants.

RADIOMIMETIC AGENTS INDUCED MUTAGENIC EFFECTIVENESS AND MUTAGENIC EFFICIENCY IN *Trigonella foenun graecum* Linn.

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One of the important steps in the breeding programme is to induce genetic variability which leads to high yielding mutants. A mutagenic programme was carried out by using three radiomimetic agents, EMS (Ethyl methane sulphonate), MMS (Methyl methane sulphonate) and MES (Methyl ethyl sulphonate) on two varieties of (*Trigonella foenun graecum* L. *Desi methi* and *Kasuri methi*). Mutations have been induced successfully in several crops for breeding agronomical important traits. The treatment of three radiomimetic agents with different doses 0.1%, 0.2% and 0.3% in *Desi methi* and *Kasuri methi* shows delayed germination as compared to their respective controls. Mutagenic effectiveness is higher by the use of EMS as compared to MES and MMS in both *Desi* and *Kasuri methi* with different doses. EMS > MES > MMS. The treatment of different doses of EMS, MMS and MES shows that EMS is more efficient than MES and MMS in both the varieties *i.e* *Desi* and *Kasuri methi*. The M₂ progenies of the two varieties were significantly superior to their respective controls for number of pods per plant, number seeds per pod, Robust seed mutant, 1000 seed weight and seed yield per plant .

BIOECOLOGICAL STUDIES OF SOME MEMBRACIDS IN TAMILNADU

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The biology and ecology of three species of membracids from Tamilnadu with special reference to their Habitat, habits, matting behavior, Ovipositing behavior and nymphal characters. Most of the membracids are minor pests, with the exception of *Otinotus oneratus* and *Leptocentrus taurus* which have been noticed to develop in to major pests on certain species of pulses such as *Cajanus cajan* and *Phaseolus mungo*. However, no regular studies have been made on the pest status of many species of South Indian membracids. It was found during the present study that the major harm to the host plants, by ovipositing behavior which involves severe damage made by the egg laying female using her sharp ovipositor on tender foliage and thereby tender twigs very often

get snapped. This is particularly occur in *Oxyrhachis taranda* (Fabricius), *Leptocentrus maringae* Ananthasubramanian and Ananthakrishnan and *Otinotus obliquus* Ananthasubramanian and Ananthakrishnan.

DIVERSITY OF BUTTERFLIES (LEPIDOPTERA: INSECTA) AROUND ROPAR WETLAND (DISTT. ROPAR) IN PUNJAB SHIVALIK, PUNJAB, INDIA

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A detailed study on the butterfly species diversity was carried out at Ropar wetland, in district Ropar, Punjab, India during 2001-04. The study area has a moist deciduous forest surrounding it. A total of 38 butterfly species belongs to 5 families of order Lepidoptera were recorded during the study period. The family Nymphalidae, represented by 16 species was the most dominant followed by Pieridae (11 species), Lycaenidae (6 species), Papilionidae (4 species) and Hesperidae (1 species). *Eurema hecabe* (Linn.) was the most dominant species of Butterfly in terms of number of individuals followed by *Danaus chrysippus* (Linn.), *Euchrysops cnejus* (Fabr.), *Euploea core* (Cramer), *Junonia lemonias* Linn., *Catopsilia pyranthe* Linn. so on and least by *Delias eucharis* Drury. From the conservation point of view, the study area is undisturbed and rich in flora and fauna species.

INSECT BIO-DIVERSITY ON LEGUMINOUS TREES IN THAR DESERT OF INDIA

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This is attempt to the recorded insect bio-diversity on insect species associated with leguminous trees of Thar desert in India. Study also includes the report of survey and surveillance of insect fauna that was undertaken at Central Arid Zone Research Institute, Jodhpur. Whole list covers not only the pest species but also the casual feeders. The coverage of pest faunal bio-diversity of arid region, in particular is poor in most of the reports. The different scarabacid beetles pose a great menace to establishing trees particularly during rainy season. Gall forming cecidomyiids are more important affecting the growth and pod formation in *Prosopis* spp. Host of sap sucking insects find food and shelter on leguminous trees. Termites are the general feeders feeding on leguminous plants and trees. Much damage is also caused by lepidopteran defoliators

and borers to nursery and young plantation. Noctuids are general leaf feeders and seldom cause alarming damage. Orthopteran pests like crickets, surface and other grasshoppers constitute an important group. Thrips are minor pests only. Pollinators visiting flowers of leguminous trees in different seasons and their abundance is also recorded. This bio-diversity has been classified as major, minor pests, casual visitors and the pollinators.

FISH DIVERSITY IN AND AROUND CHEMBARAMPAKKAM LAKE

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Freshwater fish diversity status in Chembarampakkam Lake was carried out for a period of one year from March 2010 to February 2011 by visiting the field twice in a month (Every fortnight collection of samples). It is a manmade large reservoir build across river Adayar at about 25 Km southwest of the Madras Beach, located in Chengalpattu district, about 40 Km from Chennai. Four microhabitats were identified for this study purpose. The first were concrete channels with concrete bottom without vegetation. The second were the large channels coming from the dam shutters with dense vegetation both aquatic and terrestrial. The third were small shallow streams with vegetation. The fourth were slow riffles of clay bottom with abundant aquatic vegetation. Attempts were also made to record the fish species collected by fishermen in the permanent deep waters of the reservoir. The study reveals the occurrence of 36 fish species under 24 genera, 15 families and 7 orders from the four different habitats of the study area and 18 species of fishes belonging to 16 genera, 11 families and 4 orders caught by the fishermen using gill net and hook and line nets were recorded from the permanent deep waters of reservoir. However attempts were not made to count the individuals as the fishermen were always keen on selling the catches. Information about structure of assemblages was extracted by adopting different univariate indices, namely Margalef's species richness index, Shannon diversity index and Shannon evenness index. Of the 36 species recorded from the selected four habitats of Chembarampakkam Lake, it has been found that the order Cypriniformes was dominant with 18 species followed by order Perciformes with 11 species which was followed by order Siluriformes and Cyprinodontiformes with 2 species each and the orders Clupeiformes, Beloniformes and Synbranchiformes each with one species.

Of the 18 species recorded from deep waters of reservoir of the Lake, the order Cypriniformes and Siluriformes were the most dominant with 6 species of fishes each, followed by the order Perciformes with 5 species of fishes and the lowest being the order Osteoglossiformes representing only one species.

Among all the recorded fish species, the high abundance is of the surface feeder, *Rasbora daniconius* representing 660 individuals and the lowest occurring species are *Macrognathus pancalus* and *Badis badis* with 4 individuals each respectively. Among the 51 species recorded, *Neotropius atherinoides* and *Puntius dorsalis* are included in the lists of endangered freshwater

fishes in India and fish species such as *Anabus testudineus*, *Heteropneustes fossilis*, *Mystus bleekeri*, *M. vittatus*, *Puntius chola*, *P. conconius* and *P. vittatus* are included in vulnerable freshwater fishes in India. Exotic and non-native species that were recorded included, *Hemichromis bimaculatus*, *Oreochromis mossambicus*, *O. niloticus*, *Gambusia affinis*, *Cyprinus carpio*, *Colisa lalia*, *Trichogaster trichopterus* and *Lepidocephalus guntea*. Even with the presence of numerous non-native species, the diversity index remains high in the Chembarampakkam Lake. The high diversity in spite of the presence of the invasive fishes could be attributed to the different types of microhabitat that are seen around the lake.

ZSI INPUTS ON FAUNA OF THE RAJASTHAN FOR THE PREPARATION OF DESERT ECOSYSTEM GALLERY AT REGIONAL MUSEUM OF NATURAL HISTORY, SAWAI MADHOPUR, RAJASTHAN

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The Zoological Survey of India established in 1916, explores the faunal resources in the Indian subcontinent and its objectives redefined in 1987 includes exploration and survey of faunal resources, taxonomic studies, status survey of endangered species, publication of results, identification of zoological specimens, maintenance and development of National Zoological Collections, Museums and Environmental Impact Assessment studies. The Desert Regional Centre, Zoological Survey of India, Jodhpur working on fauna of Rajasthan and Gujarat from 1960. The major documents published so far are: Studies on Plant Mites of Rajasthan; A Handbook on Indian Snakes; Fauna of Indian Reptilia; Studies on Carabid Beetles of Gujarat and Rajasthan; Status Survey of Chinkara and Desert Cat in Rajasthan; Studies on Plant and Soil Nematodes associated with Crops of Economic Importance in Rajasthan; Bibliography of Rajasthan Fauna; Studies on Vertebrate and Invertebrate Fauna of Desert National Park; Faunal Survey of Pichhola Lake; Faunal Survey of Sambhar Lake; Termite Fauna of Rajasthan; Ants (Formicidae) of Rajasthan State; Birds of Thar Desert of Rajasthan; Status Survey of Endangered species; Qualitative and Quantitative Studies of Plant and Soil Nematodes associated with Crops of Economic Importance in Rajasthan, Faunal exploration of Ranthambore National Park *etc.* The Great Indian Bustard (*Ardeotis nigriceps* (Vigors)) is state bird and the Indian Gazelle or Chinkara (*Gazella bennetti* (Sykes)) is state animal of Rajasthan.

The major faunal groups identified from Rajasthan so far are 210 species of Lepidoptera (Butterflies and Moths), 42 species of Odonata (Dragonflies and Damselflies), 366 species of Nematodes, 46 species of Isoptera (Termites), 58 species of Coleoptera (Beetles), 41 species of Hymenoptera (Ants), 53 species of Reptilia (Lizards, Turtles, Tortoise, Snakes and Crocodiles), 429 species of Aves (Birds) and 78 species of Mammals. For Desert Ecosystem Gallery, RMNH, Sawai Madhopur on fauna, the display will be on Insect Collection (Butterflies, Dragonflies, Beetles,

Grasshoppers, Locusts, Bees, Wasps *etc.*) in Insect boxes; Termite Mounds; in containers of different sizes with preservatives fishes, amphibians, Reptiles (Lizards, Turtles, Tortoises, Snakes and Crocodiles), stuffed Birds and Mammals; Desert ecosystems exhibit display, publications, photographs and posters of fauna. The time to time maintenance and proper care of Museum collection and display is necessary.

SURVIVAL STRATEGIES OF DESERT FOX (*Vulpes vulpes pusilla*) IN THE THAR DESERT OF RAJASTHAN

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Desert fox (*Vulpes v. pusilla*) is one among the three sub-species of red fox present in India. It is present in Rajasthan, Gujarat and Madhya Pradesh states of India. This paper is a part of field-observations; study was carried out in Barmer region of the western Rajasthan. Desert foxes manage to survive in such a way in harsh environmental conditions of the Thar/Indian desert, as- their dens were found under xerophytes shrubs and in open scrubs forming amiable microclimate, daily-activities and coat-colour change according to seasons to avoid extreme conditions of the weather, they can lose excess body heat by panting. They are also adapted to omnivorous habits to survive in the arid environment of the desert.

PRESERVATION OF FAUNA COLLECTION/ EXHIBITS IN MUSEUM

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In the Museum exhibits of Fauna (Animals) mostly the displays of Sponges (Porifera); Corals and Jelly fishes (Coelenterata); Crabs, Insects, Termite mounds, Scorpion, Spiders (Arthropoda); Starfish, Sea Urchin, Sea Cucumber (Echinodermata); Pisces, Amphibians, Reptiles, Aves and Mammals *etc.* were maintained. In India the major repository of all types of fauna groups is Zoological Survey of India, Kolkata and its Regional Centres then Entomology Division, Indian Agricultural Research Institute, New Delhi; Entomology Division, Forest Research Institute, Dehra Dun; Bombay Natural History Society, Mumbai; Zoology Department, Patiala University, Punjab; Prince of Wales Museum, Mumbai; National Museum of Natural History, New Delhi and Indian

Museum, Kolkata *etc.* maintaining extensive collections from the Indian subcontinent and the Natural History Museum, London maintained the collections of all over the world. The preservation and maintenance technique varies for fauna one group to another. A collection of properly dried, pinned insects will lost indefinitely if protected from the effect of light, heat, humidity, mould and attack by other insects. To protect collection against other insects, a small amount of flake naphthalene or a small block of Paradichlorobenzene should be placed in insect drawers, which must be nearly airtight to keep out museum pests.

To kill pests that are actively damaging a collection, use liquid fumigants as Carbon disulfide, Carbon tetrachloride, Chloroform, Ethyl acetate and Ethylene dichloride. A dry molluscan shell is preserved after removing the soft body parts of the animals. For display Mollusca specimens preserved in 70% alcohol, Crabs and Sponges in 80-90% ethanol solution, Fishes in 10% formalin solution, Amphibian in 70% ethyl alcohol, Snakes in 4-5% formaldehyde solution or 90% ethyl alcohol, Birds in 75-80% ethyl alcohol or formalin solution, Mammals in 10% formaldehyde or 90% ethyl alcohol in glass container according to size of specimen. Birds and Mammals dry exhibits were prepared by taxidermy technique experts. A combination of mechanical control, sanitation and use of inert compounds will help prevent populations of pests from increasing and it is important to keep dust and dirt to a minimum by vacuuming and sweeping of the Museum.

A REVIEW OF LEECH THERAPY (*JALOUKAVACHARANA*), AN AYURVEDIC PARA SURGICAL PROCEDURE

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Rakta Mokshana or therapeutic blood letting is one of the specialties of Ayurveda, which involves various types of procedures described in Ancient texts. Among them, *Jaloukavacharana* or application of leech is a painless way of withdrawal of blood from the body (sushruta Samhita.sutra sthana, Chapter.8). Among many varieties of *Jalouka* (leech), *Hirudo medicinalis* is used for therapeutic purpose. *Jaloukavacharana* is successfully advocated in inflammatory conditions, heart diseases rheumatic diseases, blood related disorders including many types of skin diseases like eczema, psoriasis, urticaria, chronic and non healing ulcers, abscess, tumours etc. This is also used by many institutions and physicians in gout, haemorrhoids, some type of headache, varicose veins, eye diseases and hypertension. Leeches are used by some surgeons in microvascular surgery.

During the process of feeding, leeches secrete a complex mixture of different biologically and pharmacologically active substances into the wound. Hirudin is the best known component of leech saliva. There is scientific evidence that these substances having anti-coagulative, anti-inflammatory, vasodilatation and anesthetic activities (Bapat *et al*, 1998). In a randomized controlled trial in 2003, Michalsen *et al* found that medicinal leech therapy was effective in relieving symptoms in patients with osteoarthritis of the knee.

The site of leech application, number of leeches to be applied, frequency of blood letting, contra indications etc. need to be decided after thorough understanding of the patient and diagnosis of the disease. If not used properly the procedure may lead to infection, allergic reactions and spread of infection from person-to-person. Though the procedure is generally safe, it should be practiced by a qualified healthcare provider only.

MAJOR THREATS TO BIODIVERSITY IN UTTARAKHAND STATE & THE SUGGESTED STRATEGIES & ACTIONS TO COMBAT THEM

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The earth's vast array of biological resources encompasses a range of ecosystems, species, genetic resources. The intertwined ecological processes support human society ecologically, culturally, spiritually and economically. Uttarakhand is covered with rich forests across all the districts. The recorded forest area constitute 64.79 % of the State's geographical area. During 2001-02, Northern Regional Centre, Zoological Survey of India, prepared document on 'Uttarakhand Biodiversity Strategy & Action Plan ' for NBSAP and report was submitted to State Forest Department and NGO Kalpvriksha (Technical implementing agency). However with the constitution of State Biodiversity Board, further updating of information and data was done in addition to information on traditional practices. During this exercise it was realized that the state is facing many threats for conservation of biodiversity, these are : habitat degradation (increases in urbanization, diversion of forest land for non – forestry purposes ,mining ,road construction, natural disaster), overgrazing and illegal NWFP collection, over exploitation of medicinal herbs and *Bugyals* , threats to natural water resources , pollution of water bodies and soil, unscientific agricultural practices, illegal felling of trees , soil degradation, mega dams construction ,uncontrolled forest fire, invasive alien species, introduction of high yielding varieties, poaching and illegal trade ,man-animal conflict, pathogen diseases ,climate change and related diseases, unregulated tourism, impact of climate on tree-line. The paper thus discusses the threats to biodiversity of the newly constituted State and strategies and actions thus required to combat some major threats for conservation of biodiversity.

EFFECT OF HEAVY METAL POLLUTION ON HUMANS

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Some heavy metals have bio-importance as trace elements but the biotoxic effects of many of them in human biochemistry are of great concern. Hence, there is a need for proper understanding of mechanism involved, such as the concentrations and oxidation states, which make them harmful. It is also important to know their sources, leaching processes, chemical conversions and their modes of deposition in polluting the environment, which essentially supports life. Literature sources point to the fact that these metals are released into the environment by both natural and anthropogenic means, especially mining and industrial activities, and automobile exhausts. They leach into the underground waters, moving along water pathways and eventually depositing in the aquifer, or are washed away by run-off into surface waters thereby resulting in water and subsequently soil pollution. Poisoning and toxicity in ecosystem occur frequently through exchange and co-ordination mechanisms. When ingested, they form stable biotoxic compounds, thereby mutilating their structures and hindering bioreactions of their functions. This paper reviews certain heavy metals and their impact and biotoxic effects on man.

ROLE OF SPIDER (ARANEAE: ARACHNIDA) IN ECOSYSTEM

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Spiders are one of the most abundant groups of predators found in agroecosystems. Their distensible abdomens enable them to consume large amounts of food in relatively short periods of time, while their rate of predation may greatly increase during short periods when plentiful supply of food is available. Spiders are carnivorous arthropods, consume a large number of preys and do not damage plants. They have unique habitat and they live in almost all the environments. Spiders serve as buffers that limit the initial exponential growth of prey populations. The predatory spiders are classified into five major groups based on their foraging style. Prey searching ability, wide host range, ease in multiplication and polyphagous in nature make them as a potential predator in biological pest suppression. Species abundance of spider communities in agricultural and horticultural ecosystem can be as high as in undisturbed natural ecosystem. Spiders have special adaptations towards a predatory way of life. They are exceptionally well adapted to survive in nature. Their extensible abdomens enable them to consume large amounts of food in relatively short periods of time, while their rate of predation may greatly increase during short periods when plentiful supply of food is available. They have an exceeding high resistance to starvation, which enables them to survive and maintain normal reproduction during periods of low prey availability. This is accomplished by an ability to decrease their metabolic rate. During their lifespan, which varies from 9 months to 25 years, all instars feed actively as predators. Most spiders are polyphagous and have a diverse prey spectrum. Predation is not limited to adult's stages of the prey

only, but includes the egg and larval or nymphal stages as well. Spiders are able to withstand extremes of climate. They are easily distributed by wind.

Spiders are marketed as the “farmers best friend” especially for the small scale farmer. The use of spiders as biological control agents depends mainly on the conservation and increase in numbers through the use of agricultural practices such as selective spraying rather than on mass rearing and release. The extent to which spiders can contribute to agricultural pest control, is however limited by the disruptive effect of insecticide applications. The selective use of pesticides to prevent elimination of natural enemies; restricting insecticide usage during crucial periods in the life cycle of the pest; limiting spray application to midday when spiders are less active and shelter; application of pesticides as spot treatments to permit spiders to recolonize treated areas immediately are recommended. Species abundance of spider communities in agricultural and horticultural ecosystem can be as high as in undisturbed natural ecosystem. The use of biopesticides, botanicals and organic manure will enhance the spider population in different ecosystems. This contribution deals with mass production, importance in pest management and conservation. Spiders, like many other invertebrates, have traditionally suffered a lack of attention from conservation professionals and the general public. As more information becomes available, however, scientists are gaining a better understanding of spiders' integral role in natural systems and of the need to improve protection efforts. Additionally, spiders are an important food source for birds, lizards, wasps and other animals. In a study of trunk arthropods, spiders provided a relatively constant food source throughout the year for bark-gleaning birds demonstrated that spiders were a primary winter food source for goldcrests (*Regulus regulus*). Also, spider silk is important to bird species for nest building; 24 of 42 families of passerine birds and nearly all species of humming bird depend on silk from spiders and caterpillars for nest construction.

MICROBIAL DIVERSITY IN THE AIR OF INDOOR ENVIRONMENT

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People spend most of their lives in indoor environment whether at home, office or elsewhere, and are exposed to various microbes present in these environments. Hence, knowledge about the range and diversity of these microbes is important for understanding how it impacts on human health and physical condition. Therefore, our awareness of microbial diversity in the air of indoor has increased in recent years. Microbial pollution involves hundreds of species of bacteria and fungi that grow indoors when sufficient moisture is available, which may result in greater numbers of spores, cell fragments, allergens, mycotoxins, endotoxins, β -glucans and volatile organic compounds in indoor air. An excess level of any of these agents in the indoor environment

is a potential health hazard and clinically associated with respiratory symptoms, allergies, asthma and immunological reactions.

Fungal concentrations in the indoor air have been studied in various indoor environments and climates using different methods. The genera *Cladosporium*, *Penicillium*, *Rhizopus* and *Aspergillus* are common in the indoor air in various climates. In addition, genera *Alternaria*, *Chaetomium*, *Trichoderma*, *Stachybotrys* and *Fusarium* are also isolated in different indoor environments. The diversity of bacterial species in indoor is wide, the concentrations of gram-positive bacteria are generally higher than those of gram-negative bacteria in the indoor air e.g., gram-positive cocci from *Staphylococcus* spp. and *Micrococcus* spp., which are abundant on human skin, pleomorphic organisms including diphtheroids, rods including *Bacillus* spp., as well as gram-negative *Pseudomonas* spp. and *Enterobacter* spp. are frequently isolated followed by *Serratia* spp., *Klebsiella* spp. and *Escherichia* spp.

**COMPARATIVE STUDIES ON THE REPRODUCTIVE
BEHAVIOUR OF DAMSELFLY, *Neurobasis chinensis chinensis*
(Linnaeus) AT RAVI RIVER, CHAMBA (H. P.) AND OF
DRAGONFLY, *Orthetrum sabina sabina* (Drury) AT KAILANA
LAKE, JODHPUR (RAJASTHAN)**

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The reproductive behaviour of *Neurobasis chinensis chinensis* (Linnaeus) was studied three times around Ravi river, Chamba, Himachal Pradesh during September-October, 2007. Courtship is well marked and male demonstrate a circular territory with a radius of about 2-4 m, guarded or defended by the resident male from the intruding conspecific males by wing opening or abdomen raising. As female entered into the territory, the male started following her and got success to bind in tandem link, catching hold her prothorax by its anal appendages. The before wheel tandem lasted for 3-5 minutes. After that the female tried to interlock its vulvar region with the secondary copulatory apparatus of male to form the spectacular courtship wheel. The courtship wheel lasts for about 4-6 minutes and is performed of perching on vegetation or stone near water body. After finding suitable oviposition spot, the male releases the grip on female prothorax. The after wheel tandem lasted for 5-7 minutes. Oviposition is endophytic among the aquatic vegetation. The female went down underwater till their thorax wings and head above water using her ovipositor to grip the oviposited vegetation. This underwater oviposition continued for 6-8 minutes.

During oviposition the male hovers in air around female to defend her from intruding intra or inter specific males. The duration of reproductive behaviour of *Neurobasis chinensis chinensis* (Linnaeus) lasts for 18-26 minutes. The reproductive behaviour of *Orthetrum sabina sabina* (Drury) was studied five times in Kailana lake, Jodhpur, Rajasthan, India during January, 2008 to July, 2008. Courtship is well marked and male demonstrate a circular territory with a radius of about 1-3 meters, guarded or defended by the resident male from the intruding conspecific males. As female entered into the territory, the male started following her and got success to bind in tandem link, catching hold her prothorax by its anal appendages. Before wheel tandem lasted for 5-12 seconds. After that the female tried to interlock its vulvar region with the secondary copulatory apparatus of male to form the copulatory wheel. The courtship wheel lasts for about 4-9 minutes and is performed of perching on vegetation or boundary wall of water body. After completion of copulation, the male release the grip on female prothorax, hovers around and guarded female from the intruding conspecific males during oviposition. Oviposition is exophytic, the eggs are laid by dripping the tip of the abdomen several times in water and lasts for 2-4 minutes. The duration of reproductive behaviour lasts for 10-15 minutes. The study reveals that there is variation in reproductive behaviours of both the species in all the stages.

STUDIES ON THE BIODIVERSITY OF GUJARAT AND ITS INTANGIBLE CULTURAL ASSOCIATION WITH SOCIETY

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“Giant snails invade Miami” reads a news heading dated September 17, 2011. Florida state officials confirm that the giant African land snail has taken hold in South Florida and may pose a threat to human health as well as agriculture. Now they are going door to door to try to eradicate the snails.

From the time immemorial to the present, nature around continues to engage, baffle and challenge the humanity from time to time all over the world. It could be a pest like the above or a rare and reclusive animal, plant, insect or germ on land or arboreal or aquatic creature. Flora and fauna, native and exotic, known and unknown, nature’s creation or human introduction had created ripples and at times havoc. Prospect of addition of a new item of economic use either as a food, medicine, fuel or timber; or of destructive nature that might cause loss of resources, disease or harm limb or life had been taken into consideration with due caution and diligence. Understanding, curiosity, imagination and phobias of human to these have led to creation of films such as Jaws and Arachnophobia (on spiders).

The understanding of nature over the last three centuries had advanced, reasonably saturated but not completed. Also it could not lead to a control or mastery over those, as humanity ideally would like to. It manifests in the outbreak of epidemics from time to time, shortage of desired utilitarian items; and identification and addition of new species to the existing list. Thus, the complexity, mystery and abundance of nature gets manifested occasionally. This paper seeks to discuss the biodiversity of Gujarat and its intangible cultural associations with a cross-section of people in the society, with a focus on Vadodara and its neighbouring districts.

ODONATE SPECIES COMMON TO INDIAN, QATAR AND UAE DESERTS

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The odonates, being amphibiotic, depend on fresh water bodies for completing their life cycle and hence the areas where water bodies are in scarce, their diversity is also much less as in desert ecosystems. However, the odonate fauna of these areas, especially the Great Indian Desert, has attracted the attention of various workers during the past. Recently, the author happen to visit Qatar and there, in spite of scarcity of fresh water bodies in the area, came across dragonflies which made him interested in comparing with Indian fauna from same type of ecosystem i.e. Thar Desert. Under suborder Anisoptera (dragonflies), 7 species belonging to same number of genera and 2 families from Qatar and under both suborders Zygoptera (damselflies) and Anisoptera, 9 species belonging again to same number of genera and 3 families from UAE were found to be common with Indian species in Thar Desert and around which is significant from zoogeographical point of views and needed to be recorded. Interestingly, some of these species are common with Madhya Pradesh fauna too.

SPECIES DIVERSITY AND ITS CONSERVATION IN GUJARAT

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India is one of over 174 countries to become signatory of the Convention on Biological Diversity (CBD) in June, 1993 and is committed for biodiversity conservation at state national level. Biodiversity is threatened more by overexploitation of natural resource in India from about five decades or so. Conservation of varieties and variability of lives on earth at three layers i.e. ecosystem, species and within species, are vital not only important from economic and livelihood point of view but also for ethical, cultural values and for maintenance of natural evolutionary process taking places from millions of years. Man is one among millions of species, is outcome of this process and a part of whole ecosystem. Survival of human is intricately related with whole system and maintenance of biodiversity and habitant. Biodiversity of ecosystem and live hood security refers to human communities critically depended on natural resource for it guaranteed assess and sustainable uses.

Nature has bestowed Gujarat with many natural niches and varied climatic and geomorphological conditions from coastline, saline desert of Runns, Kachchh, vast grassland, dry deciduous forest of Saurashtra and North Gujarat; moist to semi moist forests in south Gujarat and wetland, which support vast biodiversity. The paper deals with change in forest cover, nos. of trees in Gujarat, the rare endemism and extinct plant species etc. The paper also deals with various types of problem such as threats to crop diversity, genetically modified organisms and its repercussions. These plants may become weeds or genes may be transferred to other crops it may create imbalanced of natural system. There are other factors of loss of biodiversity, which are discussed in details which have direct or indirect effect on biodiversity such as biotic pressure, faulty land capability classification, land used system, threatening of medicinal plants availability, excessive use of chemical fertilizer pesticides, fungicides, change in cropping pattern etc. The traditional medicinal system like Arurveda, Yunani, Sidha etc. plants are main component of medicine extracted from the forest but due to over exploitation from some of important medicine plant lead them to cultivate on farmer's field. For example Ashvagandha (*Commifera wightii*), safed musali (*Chlorophylun borivilianum*) has suffered losses from forest of south Gujarat. Steps to reduce consumption of natural resource are suggested.

PROSPECTS OF STUDIES IN SPIDER DIVERSITY OF URBANIZED AREAS NEAR DEVELOPING KOLKATA (THAKURPUKUR – JOKA AREA, BEHALA) WITH SPECIAL REFERENCE TO THE SPIDER MICRO HABITATS.

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Spiders are a primitive group of animals evolved for millions of years and occurring almost every where on or near an aquatic environment, over and under the terrestrial environment from the seashore to the high mountain and in various climates from deserts to snow lands with suitable extensions in their morphological and physiological adaptations. Today they are one of the largest members of arthropod family. These creatures are identified from various fields like domestic sciences, agriculture, forestry, medicine, toxicology, biotechnology of economic importance and general environmental studies. They occupy an integral part of the ecosystem as they play a great role both as predators and food source to other predators. Their morphology, intriguing behaviors, predatory strategies show how fascinating creatures they are ! Which caused their aspects for future use.

Although Spiders survive in almost all environment, the natural habitats of spiders are gradually decreasing. Many major development projects are going on through out the extended city area of Mega city Kolkata, on the other hand the popularity of this area also increasing rapidly and civil constructions for building houses and residential complexes are coming up. Behala

Thakurpukur area, the present study site is also an affected zone of the city, Kolkata due to rapid development through the both side landscape of Diamond Barbour Road by human habitations, modern small industrial developing projects, newly executing Joka BBD Bag metro rail project and many other to cope up the settlement of city wards population of the suburb and to adjust the versatile development of Kolkata and its socio-economy. No comprehensive faunal account of the spiders are available from this urbanizing areas and very much required to explore in the light of their studies on biodiversity and conservation.

During last two years the authors surveyed the Joka Thakurpukur area of Southern extended Kolkata between the GPS Co-Ordinates of $88^{\circ}17'49.78''$ - $88^{\circ}19'02.02''$ - E in East –West direction and $22^{\circ}27'31.64''$ - $22^{\circ}28'02.45''$ - N in North to South and found 53 spider species under 28 genera and identified different terrestrial, arboreal and aquatic micro habitats with distinctive attributes for spiders available in and around the study area which will be very much useful to develop the progressive studies on Socio-Economic importance and possibilities as a bio-medicinal resource for exploitation enlighten the importance of conservation and Biodiversity of this group of organism and significant for future data base. The present context is also importance as occurrence of some spiders unrecorded from the same habitat of this geographical area.

SPECIES RICHNESS OF PREDATORS IN SOME ARID PRODUCTION SYSTEMS

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The arid production systems support a vast number of insects. Select species of these insects fall under twin categories of harmful (pests, vectors) and useful (parasites, predators, pollinators) insects while a majority of others are yet to be assigned a definitive role (sundry herbivores, detritivores and others). Among them, predators play an important role in exercising natural biological control of the harmful lots. Through conservation and multiplication these agents could be deployed for suppression of pest populations in cultivated crops. Studies were carried out at CAZRI on relative abundance of predators in mono crops, weeds, at tree-crop interface and weed-crop interface. The predator profile was constituted by tiger beetles, ground beetles, mantids, coccinellids, geocorid, nabid and reduviid bugs, spiders, syrphids, chrysopids, wasps and dragons. The weed plots exhibited the highest incidence of predators, followed by crop-weed and crop-tree interface while the sole crop space harboured comparatively lesser predators. The occurrence of individual predators was inconsistent under different situations all through the kharif (rainy) season. The predator abundance was comparable in plots with varying plant densities in the case of mung bean, clusterbean and moth bean. The presentation will display the predator composition and population variations of the same over weekly passages through the season.

THE LINE TRANSECT METHOD FOR ESTIMATING DENSITIES OF ODONATES IN ANASAGER LAKE

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We have evaluated techniques of estimating insect density through counts using line transects during 2009-2011 in the area of Anasagar lake of Ajmer in Rajasthan, India for two groups of Odonata, namely, damsel fly (suborder-Zygoptera) and dragon fly (suborder-Anisoptera).

Density estimates derived from techniques consistently had the variation in density. For estimation appropriate cut-off widths of analyzing line transect data for the two groups are suggested. Grouping data into various distance classes did not produce any appreciable differences in estimates of mean density or their variances but raining and harvesting are affecting the density. The sampling effort of 10km of transects returned a slight variation on estimate for damsel fly and dragon fly. There was no statistically significant relationship between detect ability of a group and the size of the group for any species. Density estimates near harvest were generally significantly different from other areas near lake.

FAUNAL STUDIES IN THE SITAMATA WILDLIFE SANCTUARY, RAJASTHAN- A SUITABLE HABITAT FOR INDIAN GAINT FLYING SQUIRREL

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The Sita Mata WLS is situated in the South-East region of the Rajasthan in Chittorgarh, Pratapgarh and Udaipur districts of Rajasthan, where three ancient mountain ranges meet together *i.e.* The Aravallis, The Vindhayas and Malva plateau forming the Northwestern limits of Teak forest and covering an area of approximately 423 km². As the name of Sita Mata WLS itself explain its historical and religious importance that people believes that Devi Sita spent her days of exile in this forest, where the ashram of Rishi Valmiki was situated and her temple is situated in the heart of the forest area of the sanctuary. The climate of this region is quite pleasant with subtropical feature and characterized by distinct winter, summer and rainy season. So far around 50 species of mammals, 275 species of Aves, 40 species of Reptiles, 9 species of Amphibians, 30 species of Pisces and around 800 species of flora recorded by Rajasthan Forest Department and during present study

conducted from 2009-11 recorded 34 species of Butterflies, 21 species of Moths and 27 species of Odonata. Indian Giant Flying Squirrel (*Petaurista philippensis*), Four Horned Antelope or Chowsingha (*Tetracerus quadricorins*), tree frog, Jungle Cat (*Felis chaus*), Indian Pangolin (*Manis crassicaudata*) rare fauna sighted here. The more efforts in management, conservation, protection of habitats and balance between human need and awareness among local communities of this Sanctuary, will help in conservation of rich biodiversity.

DISTRIBUTIONAL PATTERN OF GENUS *UROMASTYX* (MERREM, 1820) (REPTILIA: SQUAMATA: AGAMIDAE) IN INDIA AND ELSEWHERE

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The genus *Uromastyx* (Merrem, 1820), the Spiny-tailed Lizards, is widely distributed. It has about 17 species, out of which one i.e. *Uromastyx hardwickii* (Gray, 1827) is found in India (Thar Desert, Kutch and adjoining arid zones, Madhya Pradesh, Uttar Pradesh) and Pakistan and the rest of the species in North African, Middle-Eastern and across south-central Asian countries. They are mostly large lizards, ranging between 25-91 cm. The smallest is *Uromastyx macfadyeni* (Parker, 1932), the Macfadyen's Mastigure, a species of Somalia and the largest the *U. aegyptia* (Forskal, 1775), the Egyptian Mastigure, found in Egypt, Iran, Iraq, Israel, Jordan, Libya, Oman, Saudi Arabia, Syria and UAE. In the present paper the details of *U. hardwickii* and distribution of all the species has been dealt. They occur at elevations from sea level to well over 914 m and tend to establish themselves in hilly, rocky areas with good shelter and accessible vegetation, though may be in arid zones.

BIODIVERSITY IN TROPICAL HABITATS

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Heterogeneity of biological environment: Evidence suggests that biodiversity has been enhanced by the enormous heterogeneity of the internal rainforest environment. The highly varied kinds of habitats available in tropical areas (differing according to altitude, rainfall, seasonality, soil type, swampiness, etc.) have led to the evolution of a myriad of plants and animals specialized for each of them. Even areas of apparently fairly uniform forest may vary in soil type, topography, or

altitude and each area has its own assemblages of plant and animal species and its own ecological webs. Often habitats to which organisms have adapted are very localized, some as small as 5 to 10 km². Therefore it is not surprising that tropical rainforests should have high diversity, since they contain so many of these specialized habitats. Amazonia, in particular, has great habitat heterogeneity because of its many large river systems, which provide seasonally-flooded forest plains with transitional forests (varzea), palm swamps where the forest is perpetually flooded, lake margins, and, between them, terra firme forests (which can themselves be divided into those on clay soils and those on sandy soils, and the latter of which can be either dry, or waterlogged, after rainfall); limestone outcrops; cloud forests; lakes, rivers, and streams. The river margins and intermittently-flooded areas allow for a variety of stages of forest succession. There are also numerous soil types, which very strongly influence the organisms which live on them and which provide great opportunities for specialist organisms.

Tropical rainforests have a number of layers, or strata, which provide habitats. There are the tall emergent canopy, several mid-layers, an understory, and ground-level herbs and shrubs. Canopy trees are relatively few in number because they are so large and have huge crowns. Ground-dwelling plants are also limited in variety and, surprisingly, are not more diverse than those in temperate forests, perhaps because of the very limited light reaching the forest floor. Under these conditions, survival is difficult for ground-level plants. So most of the diversity of plants in tropical forests lies in the middle strata. The great height of the emergent trees allows much vertical space for other trees and plants and in this way may promote diversity. Because the sun lies overhead during the entire year, there is a great deal of light available to support the plants in the lower strata, more than twice as much as is available to a temperate forest and since plants in the tropics don't suffer from (low) temperature stress, they can devote their energies to growth and reproduction at even very low light intensities. Light intensities in tropical forests are also very patchy and heterogeneous. Thus, plants living under the tall canopy can specialize in exploiting particular light regimes, many of which are not available in temperate forests. And with plant diversity comes animal diversity, since all of these plants provide food and shelter for animals.

Many different sources of food and types of shelter are available in tropical forests. Because of this, organisms with varied requirements (or, put another way, species with different niches or total roles in the ecosystem) can be accommodated. Where there are many food resources seeds, fruits, small rodents, reptiles and amphibians, myriads of insects a highly varied set of animal, plant, bacterial, and fungal species will be there to feed on them. Some species depend upon highly specific types of food sources. Certain birds have bills suited to cracking large seeds or nuts; others, with smaller beaks, make use of small seeds. Species divide up the resources and habitats in such a way as to lessen competition and improve survival. Thus, tropical rainforests provide many opportunities for a variety of life styles. The structural complexity of an ecosystem appears to affect the number of species found within it, and is at least part of the biodiversity picture (Nelson, et al., 1991).

The prevalence of specialized habitats: The fact that a great number of tropical plants which are restricted to specialized habitats (and are therefore called “habitat specialists”) has given rise to another explanation for tropical biodiversity. Many specialist plants survive only in areas of unusual habitat, which suggests that much of the speciation in the tropics (at least of plants) might have arisen through adaptation for specialized habitats. For instance, the small neotropical plant genus *Phryganocydia* has only three species, two of which have arisen as apparent offspring of *P. corymbosa*. The parent species has wind-borne seeds, but the two derivative, swamp-dwelling species have wingless seeds which are dispersed by water. Another derivative group (not yet a separate species) lives in varzea forests and has sFairly recently it has been proposed that some of the great diversity of tree species in tropical forests might be (at least in part) the result of the activity of pathogens (van der Putten, 2000). In rainforests (and probably in some temperate forests as well), many insects and some other herbivores are adapted to survive on a single species of tree or plant. When a tree becomes infected or infested, other young trees in the vicinity of infected ones will be attacked more severely by pathogens than those farther away from the source of infestation. But if the pathogen can attack only one species of tree, trees of other species can become established near the infected individual without harm. Thus trees of any one species will not be able to survive in close proximity to each, and will become widely dispersed throughout a forest. Under these circumstances, trees of many different species will be present within a small area (unlike many temperate forests, which may consist mainly of one or a few species). Soil pathogens may play a similar role in stimulating the biodiversity of soil flora and fauna.

Natural disturbances: There is some evidence that natural disturbances can maintain species diversity, at least among forest plants (and, since they depend upon and are adapted to plants, animals as well). Storms and high winds are common in tropical areas, and frequently lead to considerable damage and the formation of fairly large gaps in forests. When the gap in the forest is small (as when one or a few trees fall), pioneer species will normally enter the gap and flourish, eventually being replaced by climax tree species. If the gap is larger, there may not be sufficient seeds and seedlings of pioneer species to populate the gap, and so the seedlings of other species as well can become established. Thus these gap areas will have a high diversity of plant species compared to undisturbed forest. The formation of large gaps may be essential to the maintenance of diversity in rainforests.

Mountains as diversity refuges: Some mountain regions contain clusters of newer species as well as older ones, which has led to the hypothesis that mountains provide stable habitats for species – older species being maintained and new ones forming. There is evidence for tropical bird speciation in mountainous areas of east Africa (greenbuls) and the Andes (spinetails). According to this scenario, mountains act as refuges because they contain many types of habitats in which species can persist by migrating to appropriate altitudes. After organisms move into varied habitats at different altitudes and were thereby separated from each other, speciation occurs.

Tropical regions are large, as well as topographically complex. As mentioned above, the complexity of the rainforest environment allows for considerable specialization of organisms, and the great size of the tropics allows geographic isolation of groups (incipient species) from each other. The stability of tropical areas, in which there are no great fluctuations of temperature or rainfall, allows survival of these separated groups, so that, over time, isolated groups could diverge, eventually becoming new species (speciation by natural selection). Small changes in climate which might provide an impetus for natural selection could be due to natural planetary perturbations, such as “Milankovich cycles,” oscillations in the earth’s orbit. (For further information, see Terborgh, 1992a).

Unfortunately, molecular evidence (as well as almost every other kind of data – taxonomic, pollen analysis) from tropical species is scarce and so it is difficult to choose among hypotheses by which one might explain the exuberant diversity characteristic of the tropical forests. Perhaps all these factors are involved.

The species which surround us now have evolved to their present states during the long history of life on earth, perhaps three billion years or more. These organisms provide services which are essential to survival for humankind and all other occupants of the planet. They maintain the cycles of organic and inorganic substances necessary for life; they regulate climate; they maintain the cycle of rainfall and evaporation, they provide and maintain the nutrients in soils; they are the transformers of the light energy of the sun into chemical energy (sugars), and they provide many other services.

INDIA: A LAND OF RICH BIODIVERSITY

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India is a land of rich biodiversity. The political boundaries of India encompass a wide range of Ecozones—desert, high mountains, highlands, tropical and temperate forests, swamplands, plains, grasslands, areas surrounding rivers, as well as island archipelago. It hosts three biodiversity hotspots: the Western Ghats, the Eastern Himalayas, and the hilly ranges that straddle the India-Myanmar border. These hotspots have numerous endemic species. India displays significant biodiversity. One of eighteen megadiverse countries, it is home to 7.6% of all mammalian, 12.6% of all avian, 6.2% of all reptilian, 4.4% of all amphibian, 11.7% of all fish, and 6.0% of all flowering plant species.

The region is also heavily influenced by summer monsoons that cause major seasonal changes in vegetation and habitat. India forms a large part of the Indo-malayan biogeographical zone and many of the floral and faunal forms show Malayan affinities with only a few taxa being

unique to the Indian region. The flora and fauna of India have been studied and recorded from early times in folk traditions and later by researchers following more formal scientific approaches. Game laws are reported from the third century BC. A little less than 5% of this total area is formally classified under protected areas.

India is home to several well known large mammals including the Asian Elephant, Bengal Tiger, Asiatic Lion, Leopard and Indian Rhinoceros. Some of these animals are engrained in culture, often being associated with deities. These large mammals are important for wildlife tourism in India and several national parks and wildlife sanctuaries cater to these needs. The popularity of these charismatic animals has helped greatly in conservation efforts in India. The tiger has been particularly important and Project Tiger started in 1972 was a major effort to conserve the tiger and its habitats. Project Elephant, though less known, started in 1992 and works for elephant protection. Most of India's rhinos today survive in the Kaziranga National Park. Other well known species of Indian mammals include ungulates such as the Water Buffalo, Nilgai and several species of deer and antelope. Some members of the dog family such as the Indian Wolf, Bengal Fox, Golden Jackal and the Wild Dogs are also widely distributed. It is also home to the Striped Hyaena. Many smaller animals such as the Macaques, Langurs and Mongoose species are especially well known due to their ability to live close to or inside urban areas.

BIO-DIVERSITY OF PHTHIRAPTERA INFESTING DOMESTIC UNGULATES OF GARHWAL REGION

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Phthirapteran ectoparasites are economically important ectoparasitic insects infesting birds and mammals. They do not only affect the productivity and vitality of host but also reservoirs of certain microorganisms. The domestic mammals like buffaloes harbor one species (*Haematopinus tuberculatus*), goats three species (*Bovicola caprae*, *Linognathus africanus* and *L. stenopsis*), sheep three species (*Bovicola ovis*, *Linognathus ovillus* and *L. pedalis*), cattle three species (*Bovicola bovis*, *Linognathus vituli*, and *Haematopinus eurysternus*), pig one species (*Haematopinus suis*) and horses one species (*Bovicola equi*) of Phthiraptera. The detail characteristics of all the phthirapteran species will be discussed during the session.

PRELIMINARY STUDIES ON FAUNA OF DESERT NATIONAL PARK, JAISALMER

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The studies were conducted in Desert National Park, which is situated in Sudhasaree, Jaisalmer, covering 3162 .50 sq km of Thar desert area in 2011. The area is rich in faunal and floral diversity. During preliminary studies recorded 10 species of flora, 8 species of Lepidoptera, 4 species of Odonata, 2 species of Reptiles, 48 species of Birds and 6 species of Mammals. The study area is vast and requires more extensive and intensive field survey to explore the biodiversity of Desert National Park. The Chinkara (*Gazella bennettii*) and Blackbuck (*Antelope cervicapra*) are commonly sighted and Great Indian bustard (*Ardeotis nigriceps*) the State Bird of Rajasthan is the pride of DNP.

**FOREST ECOSYSTEM: DIVERSITY OF TERRESTRIAL
NEMATODES IN UTTARAKHAND, INDIA**

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The biodiversity of forest ecosystem is one of its distinctive features and its characterization serves fundamental and applied purposes. All forests have some biodiversity value, although some forests are much richer than others in communities and species. The loss and degradation of forest affected directly on biodiversity. Uttarakhand is one of the state which has rich diversity of fauna owing for its geographical position, availability of suitable habitats and supporting climatic condition. Nematodes are a major component of faunal communities inhabiting soil, which show a wide trophic and geographical spectrum among animals.

In forest of Uttarakhand (covering 24,495 sq km forest area or 45.80 % area of the state) so far about 163 species of nematodes (61 tylenchid, 5 aphelenchids, 52 dorylaimid, 21 mononchid, 3 triplonchid, 13 rhabditid, 2 araeolaimid, 1 monohysterid, 1 chromadorid, 1 enoplid and 3 alaimid) are being reported from economically important forest tree species. The diversity in comparison to Indian fauna of plant parasitic, free living and predatory nematode are 8.5%, 5.4% and 51% respectively.

In plant parasitic nematodes, *Hoplolaimus indicus*, *Hemicriconemoides cocophillus*, *H. mangiferae*, *Helicotylenchus dihystra*, *Tylenchorhynchus indicus*, *Meloidogyne incognita* and *M. javanica* are commonly occurring species in forest. The incidence of infestation of root-knot

nematodes (*Meloidogyne* spp.) on *Acacia catechu*, *Albizia procera*, *Tectona grandis*, *Pongamia pinnata*, *Dalbergia sissoo*, *Prosopis juliflora*, *Toona ciliate*, *Cassia fistula*, *Holoptelia integrifolia*, etc. was recorded 10-40% in forest nurseries. The root-knot nematode infestation in natural forest was found lesser than nurseries.

The ectoparasitic dorylaimids, including virus vector longidorids have been found frequently in natural undisturbed forest. Though, the present paper furnishes significant information. In view of huge area covered by the forest in the state (45.80 % area of the state). The present information may not be considered sufficient. Therefore, felt that more intensive and extensive surveys should be conducted in forest ecosystem of Uttarakhand.

SEQUENCE DIVERSITY IN CYTOCHROME OXIDASE I REGION DIFFERENTIATES AMONGST GEOGRAPHICALLY DISTINCT POPULATIONS OF AN INSECT SPECIES

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Agriculturally important insect species constitute major biodiversity intimately associated with food and feed needs of man and domesticated animals. Rapid dispersal of these insects to newer areas/ environments for establishment over a period of years is associated with continuous adaptations involving numerous genetic changes. Whereas this results in evolution of new strains and species, human efforts to effectively manage the same through recommended practices are proving failure. Nucleotides sequencing of specific genomic regions that support indispensable functions of mitochondria and ribosomes have been accepted as regions of importance for molecular differentiation, description and identification of both existing as well as emerging species and strains. In this respect, '*mitochondrial cytochrome c oxidase I*' gene (COX-1 or COI) attracted most attention for single gene analysis due to multiple advantages.

In fact, the evolution of the 'COI gene' is rapid enough to allow the discrimination of not only closely allied species, but also phylogeographic groups within a single species. The usefulness of the COI sequence profiles as a single gene phylogenetic signal has been variously established in successfully (near 100%) assigning of a large number of insect individuals to their respective families, orders, genera and species. The effectiveness of the so called 'DNA barcodes' based on this COI region has also been demonstrated in distinguishing 521 species of Lepidoptera with a

resolution of 97.9 %. Based upon their analysis of specimens from diverse families, orders and taxa, Dr Paul Hebert (Biodiversity Institute of Ontario, Canada) put forward the concept of development of COI based species identification system that will provide a reliable, cost-effective and accessible solution to the current problem of species identification, assembly of which will also generate important new insights into the diversification of life and the rules of molecular evolution. Now, COI sequences providing sufficient variability have been globally accepted for barcoding/identification in different genera and species across all the phyla. The methods involve PCR amplification of targeted DNA regions using specie specific primers and determination of sequence of the amplified product and its analysis. World over efforts have now identified short sequences in mitochondrial cytochrome oxidase I (COI) gene region termed as 'DNA barcode' region for identification and description of new species and differentiation amongst existing and emerging species. Use of this approach for molecular differentiates amongst geographically distinct populations of insect species of agriculturally important insect species will be discussed.

MOLLUSCAN (GASTROPODA) FAUNA IN ARAVALI REGION OF SOUTHERN RAJASTHAN

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Southern Rajasthan encompasses a large number of natural and man –made water bodies that harbour a wide variety of aquatic snail fauna. During January 2011 to September 2011, different lotic and lentic freshwater ecosystems were surveyed for the molluscan (Gastropoda) fauna. A total of about 15 species and subspecies of aquatic snails were collected. The following species were identified from different water bodies – *Lymnaea acuminata* f *patula*, *L. acuminata* f *chlamys*, *L. acuminata* f *typical*, *L.luteola* f *australis*, *L. luteola* f *impura*, *L. luteola* f *typical*, *L.luteola* f *rufescens*, *Indoplanorbis exustus*, *Gyraulus (Anisus) convexiusculus*, *Faunus ater*, *Melanoides (Thiara) tuberculatus*, *M. scabra*, *M. lineata*, *Vivipara bengalensis* (gigantia) and *V. bengalensis* (mandiasis). Besides these aquatic species, many terrestrial snails and slugs (*Limax* spp, *Helix* spp, *Achatina* spp) also add to the molluscan biodiversity of southern Rajasthan. These molluscs exhibit a great deal of adaptation to ecological niches, making this group more vulnerable to modifications in the environmental conditions. Consequently molluscan fauna has suffered a severe decline in diversity and abundance due to human induced alterations of habitats, pollution, pesticides, deforestation and invasion by exotic species. Hence, conservation efforts are needed to maintain these unique components of terrestrial and aquatic biodiversity.

DNA BARCODING- A UNIVERSAL TOOL FOR SPECIES IDENTIFICATION AND DESCRIPTION

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With only 11.3 % of estimated 15 million species catalogued during 250 years of binomial system (based upon morphological characterization), taxonomical identification of remaining biodiversity appears uphill task to be accomplished in the near future. 'DNA barcoding' based upon nucleotide sequence of a universally accepted DNA region has emerged into an international movement in the form of '*International Project on Barcode of Life*' (iBOL). Based upon the premise that "*Sequence diversity in 'DNA barcode region' enables both the identification of known species and the discovery of new ones*", this project has been officially launched on September 25th 2010. iBOL is now an established assemble of a formidable array of 26 nations including India to create a DNA barcodes database on 5 million specimens by year 2015. The 'barcode of life database (BOLD) systems has now available as an online workbench for collection, management, and analysis of DNA barcodes. The '*BOLD Identification System*' accepts sequences from the specified barcode region and returns species-level identification for animals (mitochondrial COI gene), plants (*rbcl* & *matK* gene) and fungi (ITS). Internationally, several specialized groups are generating barcode reference libraries on different groups of life forms for enriching BOLD database. It will upgrade understanding of biodiversity; provide important insights into evolution wherein immense horizontal survey will deliver new details into the factors modulating rates of molecular evolution. Because measures of sequence divergence in the barcode region correlate with those in the nucleus, barcode data will provide contextual information that is valuable in selecting species for other genetic investigations and practical exploitation in medicine, agriculture, regulation, education and recreation.

DNA barcoding data has already started proving beneficial e.g., taxonomical revisions of number of families and genera, prevention and/or economic/ effective control of number of insect pests and diseases, identification of new and exotic pest species; rapid, correct identification/ description of new vectors of infectious diseases, early warning of invasive pest species to prevent outbreak of new disease *etc.*

INTESTINAL PARASITIC FAUNA IN TRIBAL REGION OF SOUTHERN RAJASTHAN

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A total of 375 stool samples of tribal individuals (> 10 years age) residing in the rural areas of tribal region of southern Rajasthan were screened by standard technique to determine various intestinal parasitic fauna. Of these 89.14% tribal subjects were found to be infected with intestinal pathogenic parasites; *Entamoeba histolytica* (36%), *Fasciola hepatica* (27.42%), *Hymenolepis nana* (5.14%), *Taenia solium* (8.57%), *Trichuris trichiura* (0.57%), *Ascaris lumbricoides* (9.71%), *Strongyloides stercoralis* (1.14%), and *Ancylostoma duodenale* (0.57%). A correlation of prevalence of these parasitic species in relation to age, sex, education, and habits of tribals has also been studied and found to exhibit statistically significant correlation.

ASPECT EFFECTS ON GROWTH AND DIVERSITY OF TREES AND SHRUBS IN A DEGRADED FORESTS OF PALI FOREST DIVISION, RAJASTHAN

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Forests are mostly confined to the hilly terrain of Aravalli in Rajasthan, which is oriented in south-west to north-east and thus the aspect effects may be an important factor because the solar radiation received on southern face is relatively greater than the other aspects of the hills. To study the effect of aspect on tree and shrub diversity and consequent effect on soil carbon storage was carried out in Borawad Forest block in Pali Forest division, Rajasthan. Twenty five plots of 0.1 ha area were laid at 200 m interval at both east-west (longitude) and north-south (latitude) directions. Based on the slope facing in a particular direction, these plots were categorized into north-east (NE), south-east (SE), south-west (SW) and North-west (NW). The study indicates that the aspect affected the distribution patterns of incoming solar radiation and water balances, resulting in changes in vegetation pattern. Though this forest represents *Anogeisus pendula* type of forest, but there were wide variation the species dominance in different aspects, preferred by different species.

We find that the southeast (SE) and southwest (SW) aspect were more suitable for vegetation growth and diversity leading to highest biomass production. Tree diversity and population were found maximum on southeast aspect, whereas shrub diversity and population were recorded highest on southwest aspect indicating that shrubs species prefers relatively xeric sites. The maximum carbon stock was estimated on southeast followed by southwest aspects showing strong relation with tree and shrub diversity, their population and most importantly the number of species. Conclusively, population and number of shrub species increases with xeric conditions and

soil carbon storage depended upon vegetation diversity, which were highest in SE aspects. Thus, the highest soil organic carbon in SE aspect provides better environment for the growth and productivity of tree species and can be taken care while afforesting such types of area during rehabilitation programmes.