CHAPTER 1

INTRODUCTION

"The worst thing that can happen in the present century is not energy depletion, economic collapse or limited nuclear war. These can be repaired within a few generations. But the one on-going process that will take millions of years to correct is the loss of genetic and species diversity by the destruction of natural habitats. This is the folly for which our descendents are least likely to forgive us."

E.O. Wilson

Sound taxonomy is the foundation of all meaningful research in biology with great relevance in fields like ecology, biodiversity, agriculture and conservation said T. C. Narendran (2001).

Insects have radiated into so many diverse forms that we have been only able to describe a small fraction of them. The evolutionary processes of variation/selection /retention have endowed the earth with a fantastically rich tapestry of form and color, of development and dispersal that has enriched every corner of terrestrial systems with insect character of some sort. Humans are a latter-day arrival who holds in their palms the future of the insect mosaic. This insect variety is losing its spatial and compositional integrity as we enter the new era, the Homogenocene, which is a mere blink of a geological eyelid (Samways,1988). Samways from South Africa emphasized on modern synergistic approach of management which he termed as 'Synthetic Management'.

Studies based on insect diversity are scarce. Little has been done to conserve the above 50 % of all species on earth that the insects and their close relatives represent. Mathews and Benoy (2003) have consolidated the data of various insect groups from Westerm Ghats with a feeling that there is an absence of consolidated information on the fauna. Same is true for many parts of our country and such studies are of utmost importance.

The main focus of conservation research mainly includes biodiversity assessment .Many developing countries are setting up systems of reserves for protection of biodiversity. So far these types of studies have been focused mainly on vertebrates. Terrestrial arthropod assemblages are the most diverse components of terrestrial ecosystems. Their use as indicators of endemism and for early warnings of ecological change, capability to respond to environmental change rapidly has been insufficiently explored.

One of the key approaches to tackle the decline in insect populations is to catalogue the entire data. In the face of rapidly changing landscape scenarios there further arises the need to map and monitor their distribution.

Local environments sustain a high diversity of insects. Unless there is proper documentation there is a chance that the changes occurring within insect populations go unnoticed. Emblidge and Schuster (1995) from Malaysia had put on record that the loss of pollinators would cause the collapse of a system. According to them habitat loss, fragmentation, pesticides and exotic species all jeopardize plant-pollinator relationship, but above all is human ignorance. Therefore determination of status of each and every insect species within highly urbanized areas calls for assessment that combines examination of museum collections, literature and field surveys along with taxonomic studies.

The prime requisite for conservation of faunal diversity is the conservation of natural habitats. This will ensure continuance of the ecological services that insects render to ecosystems, so that ecological integrity and health are maintained. Connor *et al.* (2002) worked on insect biodiversity in San Fransisco bay area. They mentioned that urbanization, agriculture ,interaction with invasive species etc were the main causes of insect population decline. According to Connor management practices, field studies, insect identification and their records are the necessary conservation steps.

The actual potential wealth of insects as well as the extent of threat they are facing currently and in the years to come, can be gauged only if taxonomic studies are given highest priority.

Modern anthropogenic activities have almost completely altered natural patterns added to the synergistic effect of threats like habitat loss, global climate change, invasive alien species and environmental contamination. Urban impact like traffic is particularly devastating for many Lepidopteran species (McKenna DD *et al.*2001). According to Dempster and Pollard (1986) the real threat for Coleopteran and Lepidopterans is limited resource availability.

In Britain, the major threats to butterflies were considered by Hyman and Parson (1992) to be (in decreasing order of importance) agriculture expansion, deforestation, (habitat) management practices, afforestation and urbanization. Same workers concluded that major threats to endangered beetles are: management practices, deforestation, agricultural expansion, natural succession and removal of dead wood.

Of the estimated 1.7 million (Duff, 2007) known living species of animals, approximately 8,98,973 (Gordon, 2008) are insects. In terms of both taxonomic diversity (>50% of all the described species) and ecological function, insects are considered to be dominant group of organisms on the earth. (Wilson 1992).

There are 31 recognized insect orders known globally of which, barring the insect orders Grylloblattodea ,Mantophasmatodea and Zoraptera, the remaining 27 orders of insects occur in India. Given the unique biogeographic location, diversified climatic conditions and eco-geo diversity of the country, India's biological diversity is immensely rich and diverse. According to Alfred, the country's juxtaposition with three major biological realms, Indo-Malayan, Eurasian and Afro-tropical, endowed with 10 biogeographic zones and 26 biotic provinces altogether make the country one of the mega diversity nations in the world. We know only about 6% of the world total of the realized diversity of insects (Alfred, 2003).

Given the estimates of insect diversity realized from the world vis-à-vis from the country, it is clear that a challenging task is ahead of us in order to bring to light the actual richness and diversity occurring in the country below the actual number of endemic species and genera of insects prevalent in India.

Conservationists are also faced with the daunting task of determining how to best minimize the detrimental effects of urbanization so as to preserve the most species possible. Conservation efforts need to be more effective and with a practical approach. Samways (2007) has described the principles of an ideal synthetic conservation management strategy for conservation of insects. They are maintaining reserves, promoting habitat heterogeneity, while softening the disturbed matrix immediately surrounding the reserve and introducing land sparing.

We conceive an urban region as the lands and waters both embedded within and surrounding areas of intense urban land use. These lands include fragments of un-built land within urban districts as well as remnant patches of natural habitats and agricultural lands which are not yet converted to urban land uses, including parks and natural areas within or in the periphery of urban lands. We include this variety of land within our concept of an urban region since these lands and the biota they harbour are likely to be affected by activities associated with the nearby urban lands.

Agricultural systems not only occupy a dominant position in terms of land use but they also have broad ranging effects to ecosystems and society. Intensification of agricultural practices has had major detrimental impacts to biodiversity via deforestation and land degradation.

Conversion of natural habitats for agriculture is one of the most extensive land uses and, according to Robert Pyle (a noted lepidopterist and author), has resulted in the greatest loss of native insect populations. Pesticides and other pollutants are implicated in the decline of many native insects. Lights along streets and highways also have been implicated in losses of nocturnal insects. Climate change has lead to endangerment of endemic insects with specific, narrow habitat requirements. Proximity of buildings might have affected microclimate by altering light levels, which could affect insect species that forage under specific light conditions (Trumbule and Denno 1995).

Species diversity generally increases with habitat area (MacArthur and Wilson 1967, Simberloff and Wilson 1969) suggesting that increasing habitat will preserve more species .In such conditions the detrimental effects on insect diversity can be reduced by increase in green spaces as species diversity increases with habitat area (Matteson, 2006). Because the capacity to increase the number and area of urban parks and green spaces is limited, other options for optimizing biodiversity must be utilized.

Therefore, for a better understanding of ecology, biodiversity and its conservation; the work on the problem of diversity of insects was started from March 2005 with the study of insects of Vadodara. In the previous years, before starting for solution of the problem, I particularly studied the insects of M.S. University campus to get myself acquainted with local insects.

The scope of work was further extended and various localities in different parts of Vadodara were visited in subsequent years It was then decided to expand the area of the work and collect data from places with approx. 15-20 km radius with Vadodara as a centre.

Given the magnitude of insect diversity and the scope of conserving it, the task that I undertook proved to be challenging. It needed hard field-oriented work, several hours spent in identification and finally consulting individual experts for identification of difficult taxa .

The results from this study will help determine the relative importance of ecological variables (sunlight, habitat patch area, habitat diversity, and amount of green space surrounding habitat patches) and insect biodiversity within habitat fragments (e.g. community gardens) to insect diversity. This knowledge may allow more effective management of urban green spaces for ecological processes.

Keeping the above scenario in mind the present study was conducted.

The main objectives of this research were to:

1. Document the faunal diversity before it is too late.
2. Compare our data with that of India and rest of the world.(Table- 1)
3. Suggest the ideal habitat for sustenance of various insect populations of various orders.
4. Compare different types of habitat with reference to their ecological and environmental conditions.
5. List out the bio control agents that could become important component of integrated pest management. Immense use of pesticides pressurized us to do so.

6. Significantly point out the ecological role of insects whether predators, pests, pollinators or units of food chain in the ecosystem as there is no such study till date.

Moreover my effort is to provide such data which can be used by conservationists and future researchers. It is imminent that insect biodiversity research must take cognizance of this material and knowledge aspects, taxonomy, intraspecific population variations and other complexities, taxonomy's changing roles, and insect pest management related requirements and in future the insect biodiversity research will be intertwined with DNA taxonomy and biodiversity informatics enabled by information technology.

Hopefully the lists of species will grow, as our conservation efforts become more effective with greater cooperation between governmental agencies,non governmental organizations, industry, and the scientific community and as we move towards a new understanding of nature's role in the city.

"If you want to live and thrive
let an insect run alive"

Table 1 Insect diversity realized from the world vis-a-vis India

Insect order	No. of insect species		
	Around the world+	In India*	In Vadodara[$]
Thysanura	55	31	2
Diplura	600	16	1
Protura	10	20	0
Collembola	3000	210	1
Ephemeroptera	2000	106	1
Odonata	5000	499	22
Plecoptera	1700	113	0
Grylloblatodea	16	0	0
Orthoptera	20000	1750	17
Phasmida	3000	146	1
Dermaptera	1200	320	2
Embioptera	300	33	1
Dictyoptera	6000	348	8
Zoraptera	22	0	0
Psocoptera	2000	90	1
Pthiraptera	3100	400	2
Hemiptera	1,00,000	6500	58
Thysanoptera	500	693	4
Neuroptera	4700	335	5
Mecoptera	400	15	0
Coleoptera	3,70,000	15500	93
Strepsiptera	370	18	0
Diptera	1,00,000	6093	34
Lepidoptera	1,50,000	15,000	87
Trichoptera	5,000	812	0
Hymenoptera	1,20,000	5,000	45
Total	898973	54048	385

+ Source :Gordon Ramel ,2008 , *Source: ZSI,1998, [$] Source: Naidu Bhumika , *Many more insect species are reported after 1998 but no published records..