ANIMAL SPECIES DIVERSITY IN THE WESTERN GHATS

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to develop appropriate methodology to quantitatively estimate species abundance and diversity level under our conditions. A combination of several different trapping methods for insects and several different criteria for counting birds (criteria such as sighting, hearing, foraging, nesting etc.) promise to yield unbiased and quantitative albeit relative estimates. This report describes our methodlogy in detail and our preliminary results in the light of our plans for future work.

II. INTRODUCTION

A. Diversity of Life on Earth

Life in one form or another has been evolving on earth for the past three and half billion years and today we have a fantastic diversity of living organisms. It is estimated that there exist 5-10 million species of life forms. Less than 2 million of these have been described and named. These include 300,000, species of green plants and fungi, 800,000 species of insects, 23,000 species of fishes, 3000 amphibians, 6300 reptiles, 8,700 birds and 4100 mammals and several thousand species of micro-organisms (Myers, 1979). The comparable figures of described species in India are 15,000 species of flowering plants, 67000 insects, 4000 species of Molluscs, 6500 species of other invertebrates, 2000 fishes, 140 amphibians, 420 reptiles, 1200 birds and 340 mammals adding upto a total of about 80,000 species (ZSI, 1980). 70 to 85 % of the species thus do not even have a name. Even the million and a half that have been described are very poorly known. Most only have a label with a scientific name on it. Only a few thousand species can claim to be studied to any reasonable degree. On the other hand large scale habitat destructions by man appears

to be rendering species extinct at an alarming rate; we are probably losing one species every day (Myers, 1979).

B. Importance of the Tropics

The tropical regions of the world, the area between the tropic of cancer and the tropic of capricorn represent a bundle of contradictions (Solbrig and Golley, 1983). In area the tropics cover 1.5 times that of the temperate regions. Biologically the tropics are exceedingly rich with a disproportimately large number of species. In an estimate of 5 million species thought to exist in the world, 3 million are believed to be in the tropics. The tropics are also rich in the numbers of human beings, housing nearly two-thirds of the world's population. The countries of the tropics however are classified as "poor" or "very poor" compared to those in the temperate zones. Tightly correlated with the low socio economic status of the people of the tropics is their alarmingly high birth rate leading to unattainably high needs of food and energy. Exacerbating the problem is the low productivities of most tropical soils especially under temperate regimes of management. It is not surprising then that the pressure on tropical forests to fulfil the needs of the growing populations

is so great that tropical species face a much greater threat of immediate extinction than many of their temperate counterparts. It goes without saying that the tropical species are very poorly or not at all studied. The net result is that a very substantial proportion of our biological heritage is fast disappearing even before we begin to recognize its use for mankind. It is very unlikely that we will succeed in conserving and managing any of our tropical biological communities unless we gain some reasonable understanding of how they function.

C. The need to conserve biological diversity

That the deleterious impact of the activities of the growing human population is driving to extinction several species especially of the so called wild life has now been realized by many. Passinate appeals to save the tiger, the gorilla or the blue whale have echoed quite often. But it is only in very recent times that the need not only to conserve spectacular wild animals but the overall biological diversity has begun to be understood. The mere saving of 'tigers' is neither practical nor sufficient. It is not practical because the 'tiger' cannot really survive on a long term basis except in its natural habitat and ecological niche. The different components of ecosystems

are so intricately connected that it is often impossible even to guess the consequences of interfering with any one component. The story of spraying DDT leading to collapsing huts and the outbreak of bubonic plague in Borneo has been told often enough. DDT killed not only mosquitoes but also elegant wasps that kept a check on the caterpillar populations and prevented them from devouring the thatched roofs of the huts. DDT also spread from house flies to geckos to cats leading to an outbreak of rat population and bubonic plague. There are hundreds of such examples to show that the only practical way to preserve wild life is to save their entire habitats. Even if it were really possible, to save a few wild animals is hardly sufficient (Ehrlich and Ehrilich, 1981). The survival and well being of a large fraction of today's human population depends crucially on a number of antibiotics and anti-cancer drugs provided by obscure plants and animals. And yet in harnessing their benefits we have only scratched the surface. No more than 2 percent of flowering plants have been screened for useful alkaloids for instance. The obscure but wild plants and animals especially in the tropics are surely a gold mine of myraid chemical compounds that can bring untold benefits to humanity.

Having had a bitter experience with pesticides we may have to turn increasingly to biological control and where else can we look for potential control agents other than among the obscure insect fauna? Most nourishment for mankind comes from domesticated plants and animals, the remaining coming from wild species. It is estimated that human beings have experimented with only about three thousand species of plants for food. Undoubtedly most potential species have not even been tried. Half of all land under cultivation in the world is devoted to wheat, rice and corn. Wild species of plants are not only potential sources of food but will also help replenish the fast depleting genetic diversity of cultivated plants (Frankel and Soule, 1981; Soule and Wilcox, 1980).

D. Community Ecology

Tremendous advances have been made in our understanding of living organisms during the last few decades. Today we have a very detailed knowledge of the building blocks that make up a living organism, its organization at the biochemical and molecular levels, the patterns of transmission of characters from the generation to the next and the physiological mechanisms that keep life going. Indeed, we have cracked the genetic code and chemically synthesized functional genes. One might therefore be

tempted to think that we have already answered the most fundamental questions and it only remains to work out the details. On the contrary, while all these advances tell us a great deal about the level of organization of individual organisms, they reveal precious little about the level of organization beyond that of an individual organism. It is well known that living organism form complex biotic communities that have fairly well defined structure, composition and energy flow patterns. Without an understanding of the complex interactions occurring between organisms and their physical, chemical and biological environments our knowledge of life would be very incomplete indeed.

Community ecology, a discipline that endeavours to study living organisms as biological communities has unfortunately not made the same level of progress. The primary reason for this appears to be the great complexity of the problems being tackled. Even a superficial glance at a patch of undisturbed forest would tell us that a very large number of animals, plants and microorganisms coexist. How many species does this forest support? How many individuals of each species can survive? Do these numbers remain constant or change with time? Why are certain species more common than others? Is the

spatial arrangement of trees in the forest random or has it a definite pattern? What would happen if we removed a particular species from this community? These are some of the important questions that community ecology is concerned with. As one might expect, patterns of biological species diversity have been given a central role in the development of ecological theory (Johnson and Raven, 1970). There have been considerable efforts therefore in assessing (Gentry, 1982) and quantitatively measuring biological diversity (MacArthur 1965; Pielou, 1975).

E. Island biogeography

Islands, by virtue of their small sizes and discreteness provide a unique opportunity to develop ideas on community ecology. Not surprisingly in both theory (MacArthur and Wilson, 1967) and empirical studies (Williamson, 1981) islands have often provided the lead. MacArthur and Wilson's theory of island biogeography has led to a great proliferation of research on community ecology of islands. The essence of the theory is that the number of species on any islands is determined by a balance between immigration and extinction, immigration rates varying with distance of the island from

the mainlands that are the source of immigration and, extinction rates varying with the area of the island. Although several controversies regarding the detailed patterns remain, these predictions of the theory have by and large been verified. Let us consider two well known examples of empirical studies. Jared M.Diamond (1969) conducted a survey of birds breeding on each of the channel islands off the coast of southern California. Comparing his list to the results of a similar survey conducted 50 years earlier by Howell he found that although no island contained as many species as it might have, had it been part of the mainland and that as many as 30 percent of the species had gone extinct, sufficient new immigrations had taken place leading to the presence of nearly the same number of species as in Howell's list. In a unique experimental study Simberloff and Wilson (Wilson and Simberloff, 1969; Simberloff and Wilson, 1969, 1970) completely defaunated small islands of red mangrove off the coast of Florida by pumping methyl bromide. Carefully monitoring the recolonisation process they provided important evidence for equilibrium. While many species different from those present before defaunation appeared, the total number of species was nearly the same as before.

F. Species distributions on Mainland

The role of climate in determining the distribution of plant and animal species is well known. Climate alone satisfactorily explains the distributional limits of many species that can be considered as exteme examples of adaptations to climate - the polar,bear, the water lilly or the desert rodents for example. MacArthur (1972) has considered the following simple scenario to show that neither climate nor chance alone are sufficient to explain other cases. If most plants occur only where their climatic needs are met, flower gardens and arboretums would be impossible. Most plants can however be grown quite successfully, in flower gardens in exotic places where they are never found under natural conditions. The reasons for not finding them in the natural vegetation cannot merely be historical because if that were so then these artificial flower gardens would never need weeding. As a matter of fact gardens need constant weeding.- an act which can be simply said to be a process of eliminating competitions.

F. The role of competition

In an attempt to propose general principles governing community ecology the role of competition and the concept

of niche have been most vigorously applied. Starting with the early experiments of Gause (1934) ecologists have realised that two species would not coexist but one would be eliminated by competition unless there were two different 'niches' in the habitat. The correctness of this principle of competitive exclusion has been repeatedly confirmed. Even species that appear to be remarkably similar in their niche requirements have on closer examination turned out to be different in subtle ways. The classic example is that of MacArthur's (1958) Warblers that used rather subtly different foraging strategies to divide up the insect resources of New England forests. More recently Martin Cody (1974) has made an extensive study of grassland bird communities in North America and Chile. He showed that birds that foraged for similar kinds of food were separated in the vertical height at which they foraged, or horizontally in the type of microhabitat they preferred or in their feeding behaviour. Remarkably enough Cody showed that the sum of the separations along these different axis was constant for different habitats in North or South America. In fact similar habitats in the two continents had counterpart bird species although of completely different ancestries. Such results have led ecologists firstly to believe that biological communistic are highly

structured and secondly to ascribe prime importance to interspecific competition in determining such structure.

G. The case against competition

In recent years however, there has been severe criticism of the alleged indiscriminate use of the concept of competition ignoring/both other possible mechanisms & demonstrations of the absence of competition (Connell, 1980 ; Connor and Simberloff 1979). Others such as Strong et.al (1979) have questioned the very existence of non-random patterns in communities. Although the validity of the null hypotheses that Strong et.al (1979) use to disclaim, the existence of non-random patterns is disputed, the likli-hood of a much more fluid structure and the lack of an important role for inter-specific competition especially in i ect communities has long been recognised (Andrewaetha and Birch, 1954). More recently Connell (1983) has provided a more balanced view. Asking the question "How much does present day interspecific competition affect the distribution, abundance and resource use of species in natural communities?", we compiled the results of 72 published studies of field experiments designed specifically to detect interspecific

competition. The conclusion was that although competition for resources was found in most of the studies, interspecific competition was stronger than intraspecific competition in about one sixth of all experiments done. Clearly many studies with birds such as those of MacArthur and Cody are good candidates for competitively controlled communities but equally clearly there are many communities especially among insects where present day interspecific competition is relatively unimportant. To take an excellent example, Lawton (1984) studied herbivorous insect communities associated with the bracken fern Pteridium aquilinum. Interestingly Lawton found that most of the component populations were well regulated by density dependent processes generating a community that is predictable in structure but he found no evidence of strong present day interspecific competition.

II. Objectives of the present investigation

It is obvious from the foregoing discussion that an understanding of community structure and function is vitally necessary from the points of view of ecological theory as well as rational managements of our fast disappearing habits. It is also obvious that our efforts to develop both good ecological theory as well as

sound practices of conservation and management suffer from the serious handicap of the imbalance between our knowledge of tem erate versus tropical biological communities. The long term objectives of this study are thus to correct this imbalance and create an understanding of at least some tropical biological communities. It is our conviction that such an understanding will have a profound impact on applied ecology in the tropics. The very scientific foundations of our agricultural practices, soil and water management practices and natural habitat conservation practices are bound to be revolutionised by a sound understanding of tropical community ecology. We also believe that basic ecology with its healthy coevolution of theory and empirical base will be made far more fertile and complete with the advent of modern tropical community ecology.

Our short-term goals are then to develop the appropriate methodology to study tropical community ecology. Communities of insects in the wet evergreen rain forests of western ghats are likely to be very different from any community studied so far. In the first instance we are attempting to quantitatively describe some of these communities and collect base line data on the basis of which we can begin to frame

intelligent questions. To make a beginning we have chosen insects and birds to represent important animal communities

and 8 forested habitats in Uttara Kannada district of Karnataka. Our aim here has been to assess the relative number of species and numbers of individual of each species in defined plots of each habitat. This technical report gives the results of the first round of sampling, some preliminary analysis of data and our future plan of work.

III. INSECTS

A. METHODOLOGY

1. Study sites

To start with we have restricted ourselves to the Uttara Kannada district of Karnataka and the study sites were selected so as to reflect wide differences in environmental parameters as well as levels of human disturbance. Two reserve forests and two minor forests each were chosen on both lower elevation(at the coast), the down ghats and a higher elevation(about 600 m altitude), the up ghats. The sites at the coast and up ghats are expected to contrast in environmental conditions while the minor and reserve forests differ in the levels of human disturbance. At each site the sampling was carried out in three one ha plots; the plots serving as replicates for the locality. Thus a total of eight localities comprising of 24 one ha plots were sampled for insect species. Each of these plots was serialy numbered; the details are given below:

		Reserve forest	Minor forest
Down-ghats	1.	Santagal (plot Nos.1-3)	Chandavar (Plot Nos.10-12)
	2.	Nagur (plot Nos.4-6)	Mirjan (plot Nos.7-9)
Up-ghats	1.	Bidrahalli (plot Nos.16-18)	Bengle (plot Nos.7-9)
	2.	Sonda (plot Nos.19-21)	Bhairumbe (plot Nos.22-24)

2. Sampling methods

To assess the insect species diversity collections were made using five different methods which were standardized after extensive field trials. A description of the methods employed follows:

(i) Net Sweeps: Net sweeps were carried out to collect insects off the vegetation. The nets used in systematic sweeping of the ground level vegetation were made of cotton drill cloth. The diameter of the mouth was 12" and the bag length 24". For carrying out net sweeps the plot was divided into 100 quadrates, measuring 10m x 10m each. Six such quadrates were randomly chosen and the entire ground level vegetation was covered during the sweeping. Net sweeps were done between 10.00 - 12.00 am. The insects collected from each quadrat were transferred into polythene bags containing a cotton wad dipped in chloroform. The bags were properly labelled giving the net sweep number. The insects were later separated from the trash and put in vials containing 70% Iso-propyl alcohol. Each vial containing the insects was labelled giving the information on date, place, the plot no. and net sweep no. The insects were carefully preserved for sorting on a later date.

(ii). Light trap: A portable light trap was fabricated using locally available material. The light trap was completely portable and could be easily dismantled. The light trap used had a flourescent light source of 10W (Eveready flouroliter) powered by eight battery cells. The main framework of the trap consisted of four iron legs, an aluminium roof and two baffles, between which the light source was placed. The insects attracted to the light were collected in a cyanide jar, below the light source, through a funnel. One light trap was placed in the centre of the plot. The light was switched on at dusk and allowed to burn itself out, as the batteries drained out, after about six hours. The insects trapped in the jar were collected the next morning and preserved in 70 percent alcohal and labelled.

(iii). Pit-fall trap: One pit-fall trap was placed in each of the five randomly chosen quadrates. A 2.5 litre plastic jar was buried at ground level and protected from rain by a tripod stand carrying a plastic plate of about 12" diameter. Each jar carried a 25 ml solution of 0.05 per cent methyl parathion. The traps were set up between 3.00 and 5.00 pm. The pit-fall traps were collected the next day after about approximately 18h. The insects were brought to the lab, in 70 % alcohol and duly labelled.

(iv). Scented trap: A plastic jar of 2.5 litre capacity was used to fabricate a scented trap. The mouth of the jar was shielded from rain water using a plastic plate allowing a gap of 2.5 inches between the mouth of the jar and the plastic plate so that insects could freely move in to the jar. The trap was baited with 200 ml of saturated jaggery solution with two tablets of baker's yeast and 0.05 percent methyl parathion and 0.5 ml of Pineapple essence. The traps were hung at at about 3 feet from the ground on a wooden peg specially made for the purpose. Five such traps were used, one each in a randomly chosen quadrate. The insects were collected after a period of approximately 18h. The insects were taken out from the solution, washed and preserved in 70 % alcohol. All the traps were set up between 3.00 and 5.00 I

(v). All out search method: This method was used only to collect ants and butterflies. The ants were collected between 12.00 and 1.00 pm and the butterflies between 2.00 and 3.00 pm. Within the allotted time/an attempt was made to collect representative individuals of as many species as possible. Area from ground level to about 6 feet only was sampled. This method was only used to augment our collections and the data from this method were not used in the statistical analysis.

3. Data recording and preservation of specimens

1. Every insect collected was kept stored in 70 % alcohol for sorting. The insects were identified upto the family level (using keys in Borror et al 1981) and then given a serial number within the family. The serial number correspond to a species/so that and a given species collected from any locality was given the same number, and this would be so for the entire period of the study. For each locality, plot/ and sub-plot, information on the order, family, serial number, number of nymphs or larvae and the number of adults was recorded.

The insects are preserved either as dry specimens, if large, or in alcohol, if small. The specimens collected from each locality are being preserved separately. All the collections are being carefully labelled. A directory giving brief description of every species is being developed.

2. Statistical analysis: Shannon-Weiner diversity index was calculated for all localities, as given by

$$\sum_{i=1}^{w} pi \ln pi$$

where pi is the proportion of the i^{th} species in the community (Pielou, 1975)

B. RESULTS

The data on the insects is available for three plots of Bidrahalli and one plot each of Bengle, Sonda, Bhairumbe and Mirjan. The results so far obtained as regards the number of species, families and orders of insects collected in each locality and the diversity index are presented below.

Table 1 gives a taxonomic break-up of the insects collected by all the methods at Bidralli (plot No.16) A total of 287 individuals belonging to 148 species were collected. The species fell under 70 families, spread over 11 orders. The orders Hemiptera, Diptera, Hymenoptera and Coleoptera were represented by 13,14,16 and 13 families respectively. Similarly Table II shows that 391 individuals belonging to 132 species spread over 55 families under 11 orders were recorded from Bidrali plot No.17. Again Hemiptera,Coleoptera, Diptera and Hymenoptera were the orders which were very well represented by 13,11,14 and 8 families respectively. In plot No.18 at Bidralli only 81 species were recorded. However the total no. individuals collected was 504, of which 235 individuals were accounted for, by one species of ant (Table III). Herethe species collected represented only 42 families

under 12 orders. In the all out search method for ants, 13,17 and 7 species were collected respectively from plot nos.16,17 and 18 (Table IV). In the all out search method for butterflies, 15 species belonging to 5 families were collected in plot No.16 (Table V). In plot No. 17 the butterflies were represented by 5 families comprising of 14 species (Table VI). In plot Nos.18,15 of butterfly species belonging to 5 families were collected (Table VII).

In Bengle, a minor forest, 163 species representing 74 families and 12 orders were collected (Table VIII). Among the major orders, Hemiptera, Coleoptera, Diptera and Hymenoptera were represented by 12,16, 24 and 9 families respectively. In the all out search method 18 species of ants (Table IV) and 19 species of butterflies were recorded (Table IX).

Table X shows the number of species collected at Bhairumbe, a minor forest, 166 individuals representing 11 orders, 29 families and 68 species were collected. The major orders Hemiptera, Coleoptera, Diptera and Hymenoptera were well represented by 5,6,7 and 4 families, respectively. Table IV shows that 10 species of ants were collected at Bhairumbe by all out search method.

In the same plot 12 species of butterflies representing 4 families were collected by all out search method (Table X

In Sonda, a reserve forest, 196 individuals represented 9, orders 35 families and 80 species were collected. Table XII shows that Hemiptera, Coleoptera, Diptera & Hymenoptera are represented by 5,8,13 and 4 families respectively. Only 7 species of ants were collected by all out search method (Table IV). Even the number of butterflies collected was very low in comparison with other localities. Only 7 species of butterflies representing 2 families were collected (Table XIII).

Mirjan, a minor forest yielded 918 individuals belonging to 8 orders, 38 families and 91 species. However, unlike in other localities, just two species accounted for more than half of the total individuals. 254 individuals of a Carabid beetle and 380 individuals of a staphylinid beetle made up for 634 individuals out of 918. Table XIV shows that like in other localities Hemiptera, Coleoptera, Diptera and Hymenoptera were most predominant. In the all out search for ants (Table IV), 10 species were collected. However, the all out search for butterflies proved to be very disappointing as only two species, belonging to one family, were collected (Table XV).

Apart from giving the taxonomic break up of the insects collected, an attempt is also made to compare the different localities for their diversity by computing diversity index given by Shanon and Weiner. Table XVI gives the diversity index for the different localities. The index shows a wide range of variation from 2.046 for plot No.18 of Bidralli and 4.160 for plot No.16 of the same locality. It is interesting to note that the diversity index of Bengle, a minor forest is higher than the diversity index of all the reserve forest except plot No.16 of Bidralli.

C. DISCUSSION

A comparison of number of species collected in different localities reveals some interesting points. From Table XVI it can be seen that the highest number of 163 species were recorded from Bengle a minor forest. Similarly, if 74 families were recorded from Bengle, only 35 families were recorded at Sonda, a reserve forest. A similar picture emerges when we look at the diversity index for the different localities. The diversity index (4.160) for plot No.16 of Bidralli is greater than the diversity index (4.089) for Bengle eventhough the number of species collected and the

number of families represented by species is greater than that of Bidralli. Similarly, at Mirjan 91 species representing 38 families were collected as against 80 species, representing 35 families, which were collected at Sonda, but the diversity index of 3.670 for Sonda is higher than the diversity index of 2.159 for Mirjan. It is important to observe here the influence of total number of individuals on the diversity index. The diversity measures change with changes in the number of individuals and the proportion of individuals contributed to the total by each species. This problem has been the concern of ecologists for quite some time. The methods suggested to deal with the problem, however, are not flawless either. Furthermore it is to be noted that there is a great amount of variation between plots within a given locality. The diversity index for the plot Nos.16,17 and 18 of Bidralli are 4.160, 3.232 and 2.046 respectively. Perhaps when the results are available for all the plots of all the localities, the diversity index may become comparable. Due to these reasons it is hard to draw any solid conclusions from the results that are available. These results, however, are important in guiding the planning of future work as far as the sampling methodology and intensity is concerned.

With the available data an attempt has been made to compare the raw data to arrive at some relative estimate of insect species diversity. It is difficult to arrive at absolute numbers of species that might be encountered in a locality for two reasons. First, insects being smaller, in size can occupy a great variety of niches and since they can do that, the numbers of species that constitute an insect community is very large. Secondly, the sampling methods are not totally unbiased since the samples do not represent all the species that occupy the different microhabitats. However an attempt will be made to arrive at a relative estimate of the species diversity by constructing species area curves. The species area curve will be constructed by pooling the data on insects collected by different methods after making necessary corrections for overlapping species. The equation fitted to the curve will help arrive at a relative estimate of the species. When the data for all the plots becomes available more rigorous statistical tests will be applied to compare the results and draw inferences.

7. FUTURE PLAN OF WORK

After completing one round of sampling, in the first year, in all the localities, it is proposed to continue the sampling in the years to come to study the species

diversity patterns, taking into consideration certain specific parameters like season, canopy height, yearly variations etc., A brief description of the work is as follows:

1. Seasonal Variation: One locality each will be selected both on the up ghats and below ghats. It is tentatively proposed to study the seasonal variations in species diversity in Bidralli and Nagur. The same six plots where the sampling was done in the first year will be sampled in four different seasons for two consecutive years. The sampling will be done during winter (December, January & February), summer (March, April, May), Monsoon (June, July and August) and post-monsoon period (September, October and November). The sampling method and sampling intensity will be same as in the first year.

2. Yearly variation: Two localities Bidralli and Bengle have been tentatively selected for studying yearly variation in species composition. The six one ha plots in the two localities will be sampled during the months of December, January and February for four consecutive years. Sampling methodology and sampling intensity will remain same as in the first year.

3. Diversity at different heights in the canopy: A one ha plot will be selected to study the species composition at different heights. Santagal is tentatively selected for this study. Scented traps, and the light trap will be used at different heights in the canopy to collect insects. This will be done in the post monsoon period during September, October and November.

4. Hourly variation: The species composition at different times of the day will be studied by this method. Chandavar (down-ghats) and Bhairumbe (up-ghats) have been selected for the study. Net sweeps will be taken in each of the six one ha plots at different times of the day (3 times). No other method of sampling will be employed. The sampling will be done during September, October and November.

5. Species area curves: Species area curves, will be constructed from field samples of insects, obtained by taking net sweeps over strips of 3 20m, 100m or 10m x 200m each. The sampling will be done during September, October and November.

6. Biological diversity in plantations: The main objective of this study would be to get a definite idea regarding the differences in the biological species diversity between

natural forest cover and monocultures of teak, eucalyptus and areca plantations. The sampling methodology and the sampling intensity would be same as in the first year. All the five sampling methods will be rigorously employed in 3 plots of one ha in each of the three plantations.

IV. BIRDS

A. METHODOLOGY

Sampling for birds was done by walking along fixed transects. During every sampling event, each one hectare (100 x 100m^2) plot was uniformly covered in 5 transects. The time spent in doing this is 100 minutes. While walking along a transect, a range of 10 metres on either side of the observer was the zone of actual counting and thus the entire hectare was covered without any overlap. Birds were identified (Ali and Ripley, 1983) based on sightings, calls and over head flight. For flying birds to avoid including those far above, the criterian used was to include the birds flying at a height at which even a small bird may be recognised without the aid of field glasses. Thus the samplings were done over the 3 hectares of each locality for 5 hours (300 minutes) in the morning on 3 consecutive days, during the months of December 1983, January, February and March 1984.

B. RESULTS

The results have been given in 8 tables (XVII - XXIV) pooling the data from the 3 plots. The diversity index has been calculated using the Shanon-Weiner index.

The diversity indices for the different areas are Bidrahalli 2.79, Bhengle 2.52, Sonda 2.14, Bhairumbe 3.15, Nagur 3.37, Mirjan 2.79, Santegal 2.61 and Chandavar 2.89 (Table XXV). Except in the case of Nagur and Mirjan, in all others it is apparent that the Diversity Index in the minor forest is either equal to or more than that in the reserve forests.

Distribution of some of the species over the different areas is already begining to show some interestin patterns. Some of the species such as the loriquet (L.vernalis) and greenish leaf warbler (P.trochiloides) for example occur in all of the 8 localities. However some of the other birds seen are more selective about habitat and are unevenly distributed. Tables XXVI, XXVII and XXVIII show the distribution of a few groups based on sightings during the sampling in these 8 areas. Let us consider the bulbuls, sunbirds and drongos.

Six species of bulbuls, 3 species of sunbirds and 4 species of drongos have been sighted in these areas during the sampling. Red vented and red whiskered bulbuls seem to prefer to stay in the opened up forests. The ruby throated bulbul, followed by the yellow browed bulbul on the other hand seem to occupy a wider range

of habitats. The black bulbul prefers denser forest with taller trees. The grey headed bulbul's presence in Santegal is expected as it is evident from the Handbook (Ali and Ripley) that it prefers a dense humid habitat. However its presence in Bhairumbe a thin and highly exploited forest is quite surprising. Singhting of several other species of birds during casual observations in and around Bhairumbe suggests that there is something unusual about this habitat. This may be worth investigating further.

Among the sunbirds, the small sunbird seems to have a wider distribution. In at least 2 localities viz., Mirjan and Bhairumbe all the 3 species coexist. Yet in the better forests (i.e., the reserve forests in our case) the small sunbird has totally replaced the other two. This again is something that deserves more detailed study.

Of the drongos the white-bellied drongo has been sighted only in the more exploited drier regions of our study areas. The grey drongo seems to avoid the denser forests. The racket tailed drongo and bronzed drongo generally seem to prefer dense, humid forests avoiding the opened up thinner areas. Bhairumbe however is again an exception.

C. DISCUSSION

It is too preliminary to conclude based on these observations that a particular bird prefers a very specific habitat and to what extent the degradation of the forests has affected the bird diversity in these areas. Furt studie on territory and breeding of these birds would reveal more conclusive facts.

At this stage it must be understood that our estimate of species as well as the number of individuals is relative. To ke it more realistic we can increase the frequency of sampling by repeating our observations during the different times of the day viz., morning, noon and evening. The different seasons, if they play a role in the bird diversity in an area, will give a different picture each season. This can also be found out by repeating the same sampling procedure over the different seasons giving more importance to the breeding seasons where the birds are more resident and the wintering species are no longer around.

Studies on foraging and nesting of individual species or related groups can give a better idea of what their habitat preferences are like and whether the degradation has really affected their existence in a given area.

D. FUTURE PLAN OF WORK

In this preliminary report we have used sightings in one season and at one time of day alone to assess the relative bird species diversities of different habitats. As mentioned earlier these data will be augmented by sampling at different times of the day and during different seasons of the year. After this is done we will be in a better position to seek explanations for observed patterns such as why do we see unexpected birds in Bhairumbe or why do sunbirds coexist in our degraded habitats but not in our relatively less disturbed ones. Pursuing this approach we wish to start finding out what the birds do in each kind of habitat. Our main emphasis will be on feeding and nesting. For example the bird diversity of a given habitat may be quite different if breeding or feeding is the criterion for inclusion of a bird in our list rather than mere sighting. In fact the difference in diversity between these different methods of study (mere sighting versus feeding or breeding) would themselves be quite revealing. Besides we will attempt to make a quantitative estimate of nesting frequency per unit area for different species in different habitats. This data, the first of its kind in the old world tropics would be invaluable in assessing the importance of different habitats in supporting animal life.

V. ACKNOWLEDGEMENTS

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TABLE - I : TAXONOMIC BREAK-UP OF INSECTS COLLECTED BY FOUR DIFFERENT SAMPLING METHODS

Locality: SIDR-LLI Plot No:16 Date:1.12.1983

er	Family	Total No.of species in the family	Sl.No. of species in the family	No.of nymphs or larvae	No.of adults
2		3	4	5	6
embola	Sminthuridae	1	3		1
	Poduridae	1	1		10
	Entomobryiidae	1	2		1
	Isotomidae	2	3		1
			2		1
neroptera	Caenidae	1	1		2
yoptera	Blattidae		999	1	
	Blattellidae	1	1		1
hoptera	Gryllidae		999	3	
		1	5		1
	Acrididae	1	999	3	
			5		2
coptera	Psocidae	1	1		2
	Archipsocidae	1	1		1
ptera	Chelisocidae		999	1	
ptera	Cercopidae	1	999	1	
			10		1
	Cicadellidae	18	20	1	6
			21		1
			3		2
			22		2

Table - 1 (Contd.)

1	2	3	4	5	6
Hemiptera	Cicadellidae		23		2
			24		1
			25		2
			26		1
			27		2
			28		4
			29		1
			30		1
			31		1
			32		1
			33		1
			34		1
			35		1
			36	1	1
	Membracidae	1	3		1
	Delphacidae	2	1		1
			2		2
	Lophophidae	1	1		2
	Mesoveliidae	1	1		3
	Pyrrhcoridae	1	2		2
	Reduvildae		999	1	
	Nabidae	1	1		1
	Lygaeidae		999	1	
	Monophlebidae	1	1		5
	Coreidae	2	5		1
			6		2
Lepidoptera	Microlepidoptera		1		1
	Noctuidae	6	5		1
			6		5

Table - 1 (Contd.)

1	2	3	4	5	6
Lepidoptera	Noctuidae		7		1
			8		1
			9		1
			10		1
	Pyralidae	2	4		1
			5		5
	Calleridae	1	1		1
	Gracillaridae	1	1		2
	Gelechidae	1	1		2
	Lyonetidae	1	1		5
	Tineidae	1	1		2
	Unidentified	1	35		1
Diptera	Chironomidae	2	2		2
			6		7
	Ceratopogonidae	1	1		1
	Culicidae	1	7		1
	Biblonidae	1	1		1
	Phoridae	2	1		1
			5		1
	Cecidomyiidae	6	7		1
			11		15
			13		1
			14		9
			15		1
			16		1
	Mycetoplicidae	1	3		1
	Celyphidae	1	1		1
	Dolichopodidae	1	1		1
	Platystomatidae	1	1		1

Table - 1 (Contd.)

1	2	3	4	5	6
Diptera	Drosophilidae	1	6		4
	Milichidae	1	2		1
	Chloropidae	1	1		1
	Sphaeroceridae	1	3		1
	Unidentified	2	34		2
			35		1
Hymenoptera	Tiphiidae	1	8		1
	Formicidae	20	66		1
			43		23
			67		12
			58		4
			69		1
			61		1
			70		4
			71		1
			72		1
			13		2
			74		1
			75		1
			76		1
			77		1
			78		1
			50		1
			79		1
			26		1
			5		2
			999		48
			73		1
	Evanidae	1	2		1

Table - 1 (Contd.)

1	2	3	4	5	6
Hymenoptera	Cynipidae	1	1		1
	Aphelinidae	1	2		1
	Trichogrammatidae	1	2		1
	Chalcididae	1	9		1
	Ichneumonidae	11	11		1
			12		1
			13		1
			14		1
			15		1
			16		1
			17		1
			18		1
			19		1
			20		1
			21		1
	Braconidae	1	5		2
	Tetrastichidae	3	1		1
			2		1
			3		1
	Mymaridae	1	2		1
	Pteromalidae	2	1		1
			2		1
	Elasmidae	1	1		1
	Vespidae	1	5		1
Coleoptera	Staphylinidae	4	3		1
			4		3
			5		1
			6		1

Table - 1 (Contd.)

1	2	3	4	5	6
Coleoptera	Chrysomelidae	4	2		1
			7		1
			9		1
			10		1
	Curculionidae	1	5		4
	Coccinellidae	1	4		4
	Melolonthidae	1	2		1
	Dynastidae	1	7		1
	Scarabaeidae	2	5		1
			6		4
	Elateridae	1	1		1
	Georyssidae	1	1		1
	Meloidae	1	3		2
	Melandryidae	2	1		1
			2		1
	Alleculidae	1	1		2
	Alticidae	1	3		1
	Unidentified	3	37		1
			38		1
			39		1
TOTAL 11		70	148		287

TABLE - II : TAXONOMIC BREAK-UP OF INSECTS COLLECTED BY FOUR DIFFERENT SAMPLING METHODS

Locality:BIDRALLI Plot No:17 Date:3.12.1983

Order	Family	Total No.of species in the family	Sl.No. of species in the family	No.of nymphs or larvae	No.of adults
1	2	3	4	5	6
Collembola	Entomobryiidae	2	1		1
			2		2
	Poduridae	1			1
Odonata	Coenagrionidae	1	1		1
Phasmida	Phasmatidae	1	3		1
Dermaptera	Forficulidae	1	2		1
Orthoptera	Tettigonidae	3	2		1
			999	2	
			3		1
			4		1
	Tetrigidae	1	999	1	
			2		3
	Gryllidae	1	999	3	
			4		1
	Acrididae		999	3	
	Gryllacridae		999	2	
Psocoptera	Psocidae	1	2		1
Hemiptera	Ceroopidae	1	13		1
	Membracidae	2	2		1
			4		1
	Cicadellidae	15	46		1
			20		2
			37		3

Table - II (Contd.)

1	2	3	4	5	6
Hemiptera	Cicadellidae		22		3
			38		3
			39		5
			28		3
			40		1
			17		1
			29		1
			22		1
			36		1
			41		1
			1		2
	Coreidae	4	5		1
			8		1
			7		1
			6		2
	Pentatomidae	2	3		1
			4		1
	Miridae	2	3		1
			4		1
		1	999		
	Delphacidae	1	999		
	Lygaeidae	1	3		2
	Lophophidae	1	1		4
	Reduviidae	1	6		1
	Monophlebidae	1	1		2
	Mesovelliidae	1	1		1
Coleoptera	Staphylinidae	2	6		3

Table - II (Contd.)

1	2	3	4	5	6
Coleoptera	Staphylinidae		7		1
	Lampyridae		999	1	
	Buprestidae	1	2		1
	Coccinelcidae	3	5		1
			4		2
			3		1
	Chrysomelidae	2	11		1
			12		2
	Byrrhidae	1	1		1
	Alleculidae	2	2		1
			3		1
	Nitidulidae	1	1		6
	Curculionidae	1	5		5
	Anthribidae	1	1		1
	Scolytidae	1	1		1
	Unidentified	1	54		1
Lepidoptera	Pyralidae	2	6		1
			7		1
	Noctuidae	1	11		1
	Satyridae	2	1		1
			4		1
	Limacodidae	1	1		1
	Unidentified	1	48		1
Diptera	Culicidae	1	10		2
	Bibionidae	1	2		3
	Chironomidae	1	7		1
	Conopidae	1	2		1
	Celyphidae	1	1		1
	Otitidae	2	1		8

Table - II (Contd.)

1	2	3	4	5	6
Diptera	Otitidae		2		1
	Dolichopodidae	3	2		1
			3		1
			1		7
	Sphaeroceridae	1	3		1
	Chaememyiidae	1	2		1
	Drosophilidae	4	7		148
			6		9
			8		3
			9		4
	Cecidomyiidae	2	14		1
			2		1
	Phoridae	2	7		1
			8		1
	Anthomyiidae	4	13		2
			14		2
			15		1
			16		2
	Unidentified	3	41		1
			51		1
			53		1
Hymenoptera	Ichneumonidae	6	22		1
			23		1
			24		1
			25		1
			26		1
			21		1
	Braconidae	2	6		1
			7		1

Table - II (Contd.)

1	2	3	4	5	6
Hymenoptera	Pteromalidae	1	3		1
	Eulophidae	1	1		1
	Eupelmidae	1	1		1
	Formicidae	19	44		47
			86		1
			85		1
			43		23
			87		8
			76		5
			70		1
			82		1
			11		1
			88		1
			89		2
			90		8
			81		1
			91		2
			75		2
			92		1
			74		2
			40		1
			93		1
	Vespidae	1	6		1
	Unidentified	8	40		1
			42		1
			43		1
			44		1
			46		1
			47		1
			52		1
			45		1
	11	55	132	12	391

TABLE - III : TAXONOMIC BREAK-UP OF INSECTS COLLECTED BY FOUR DIFFERENT SAMPLING METHODS

Locality:BIDRALLI Plot No:18 Date:3.12.19

Order	Family	Total No.of species in the family	Sl.No. of species in the family	No.of nymphs or larvae	No.o adul
1	2	3	4	5	6
Collembola	Entomobryiidae	3	2		
			1		
			3		
	Isotomidae	2	3		
			4		
Ephemeroptera	Ephemeridae	1	1		
Odonata	Coenagrionidae	1	2		
Orthoptera	Tetrigidae	1	2		
	Gryllidae	2	999	1	
			6		1
			7		
	Gryllacridae		999	2	
Dictyoptera	Blattellidae	1	2		
Psocoptera	Pseudocaecilidae	1	1		
Hemiptera	Cicadellidae	6	45		
			3		
			46		
			47		
			38		
			22		
	Delphacidae	2	3		
			4		

Table - III (Contd.)

1	2	3	4	5	6
Hemiptera	Coreidae	2	6		8
			5		1
	Aradidae	2	1		1
			2		1
	Lygaeidae	1	5		1
	Pyrrhocoridae	1	3		1
	Reduviidae	1	7		1
	Pentatomidae	1	6		1
	Corixidae	1	1		6
	Unidentified	1	62		1
Coleoptera	Carabidae	1	7		1
	Staphylinidae	2	8		3
			5		1
	Elateridae	2	1		1
			2		1
	Dytiscidae	1	1		1
	Hydraeinidae	1	1		1
	Nitidulidae	1	1		1
	Scarabaeidae	1	11		1
	Coccinellidae	1	4		1
	Chrysomelidae	2	15		1
			17		1
	Hispidae	1	1		2
	Curculionidae	1	7		1
	Anobidae	1	1		7
	Tenebrionidae	2	1		1
			2		1
	Rhipiphoridae	1	1		1
	Unidentified	3	58		1

Table - III (Contd.)

1	2	3	4	5	6
Coleoptera	Unidentified		59		1
			63		1
Lepidoptera	Pyralidae	1	8		3
	Satyridae	1	1		1
Diptera	Culicidae	1	7		1
	Cecidomyiidae	3	13		2
			16		1
			15		1
	Dolichopodidae	1	5		2
	Drosophilidae	2	9		4
			10		2
	Anthomyiidae	1	16		2
	Muscidae	1	10		1
	Phoridae	4	5		1
			8		1
			10		1
			3		1
	Unidentified	4	50		1
			60		1
			61		1
			56		1
Hymenoptera	Formicidae		43		235
			88		3
			5		13
			50		1
			59		2
			78		71
			87		1
			77		1
			79		1
			999		37
	Unidentified	1	59		1
TOTAL	12	42	81		504

TABLE - IV : SPECIES OF ANTS COLLECTED BY ALL OUT SEARCH METHOD IN FIVE LOCALITIES

Sl.No. of species of ants	Plot No.16 (Bidra-halli)	Plot No.17 (Bidra-halli)	Plot No.18 (Bidra-halli)	Plot No.13 (Ben-gle)	Plot No.19 (Sonde)	Plot No.22 (Bhai-rumbe)	Plot No.7 (Mir-jan)
1	2	3	4	5	6	7	8
5				+			+
6				+			
8		+				+	
12	+			+			
13		+		+			+
16						+	
31	+		+		+	+	
34		+					
41							+
43	+	+	+	+	+		
44		+		+			
50	+	+					
52							+
53	+	+	+	+			+
58	+			+			+
59	+	+					
61						+	
66				+			
67		+				+	
70				+			
80	+	+					
81	+		+				
82	+						
83	+						

Table - IV (Contd.)

1	2	3	4	5	6	7	8
84	+						
85	+						
87			+				
88				+			
90					+		
94		+					
95		+					
96		+					
97		+					
98		+					
99		+					
100		+					
103				+			
104			+				
105			+				
106						+	
107						+	
109				+			
111				+	+		
112					+		
113					+		+
114					+		
115				+		+	+
119				+			
120				+			
121				+			
123						+	
124							+
125						+	
128							+
TOTAL: 54	13	17	7	18	7	10	10

TABLE - V : NUMBERS OF SPECIES OF BUTTERFLIES COLLECTED BY ALL OUT SEARCH METHOD

Locality:BIDRALLI Plot No:16 Date:1.12.1983

Family	No. of species in the family
Papilionidae	1
Pieriidae	1
Lycaeinidae	1
Satyridae	1
	6
Nymphalidae	5
TOTAL 5	15

TABLE - VI : NUMBER OF SPECIES OF BUTTERFLIES COLLECTED BY ALL OUT SEARCH METHOD

Locality:BIDRALLI Plot No:17 Date:2.12.1983

Family	No. of species in the family
Pieriidae	1
Lycaeinidae	1
Hesperiidae	4
Satyridae	5
Nymphalidae	3
TOTAL 5	14

TABLE - VII : NUMBERS OF SPECIES OF BUTTERFLIES COLLECTED BY ALL OUT SEARCH METHOD

Locality:BIDRALLI Plot No:18 Date:3.12.1983

Family	No. of species in the family
Nymphalidae	6
Satyridae	5
Papilionidae	1
Pieriidae	2
Hesperiidae	1
TOTAL 5	15

TABLE - VIII : TAXONOMIC BREAK-UP OF INSECTS COLLECTED BY FOUR DIFFERENT SAMPLING METHODS

Locality:BENGLE Plot No:13 Date:10.12.1983

Order	Family	Total No.of species in the family	Sl.No. of species in the family	No.of nymphs or larvae	No.of adults
1	2	3	4	5	6
Collembola	Isotomidae	1	3		8
	Poduridae	1	2		2
Ephemeroptera	Caenidae	1	1		43
Odonata	Coenagrionidae	1	3		1
	Libellulidae	1	4		1
Orthoptera	Acrididae	2	999	5	
			5		1
			10		1
	Tettigonidae	1	999	5	
			5		1
	Gryllidae		999	1	
	Tetrigidae		999	2	
	Gryllacrididae		999	2	
Dictyoptera	Mantidae	2	999	1	
			5		1
			6		1
	Blattidae	1	4		1
Psocoptera	Archipsocidae	1	1		1
	Psocidae	1	1		1
Hemiptera	Membracidae	2	6		1
			7		3
	Cercopidae	1	2		4

Table - VIII (Contd.)

1	2	3	4	5	6
Hemiptera	Cicadellidae	17	20		4
			21		1
			30		1
			48		8
			36		7
			54		1
			55		8
			23		5
			57		6
			58		2
			59		2
			60		5
			16		2
			42		6
			5		1
			62		1
			63		1
			999	4	
	Delphacidae	1	2		5
	Pentatomidae	1	10		1
			999	6	
	Coreidae	5	5		2
			6		12
			9		5
			8		1
			11		4
			999	2	
	Lygaeidae	1	999	3	
			8		1
	Miridae	3	6		2
			5		2
			7		2

Table - VIII (Contd.)

1	2	3	4	5	6
Hemiptera	Miridae		999	1	
	Aphididae	1	6		1
	Tingidae	1	2		1
	Hydrometridae	1	1		12
	Corixidae	1	1		2
	Unidentified	1	75		1
Neuroptera	Myrmeleontidae	1	3		1
	Sisyridae	1	1		1
Coleoptera	Carabidae	5	10		1
	Dytiscidae	1	1		1
	Staphylinidae	3	3		10
			6		1
			12		1
	Scarabaeidae	3	6		1
			13		1
			14		1
	Byrrhidae	2	3		3
			4		1
	Nitidulidae	1	1		3
	Coccinellidae	2	7		1
			3		4
	Tenebrionidae	2	2		1
			3		1
	Mycteridae	1	1		1
	Meloidae	1	3		3
	Chrysomelidae	4	23		1
			26		1
			22		1

Table - VIII (Contd.)

1	2	3	4	5	6
Coleoptera	Chrysomelidae		21		2
	Curculionidae	5	8		1
			11		5
			5		4
			10		1
			9		1
	Alleculidae	1	6		1
	Alticidae	1	4		1
	Sylvanidae	1	1		1
	Elateridae	1	2		1
			1		2
Lepidoptera	Pyralidae	1	8		1
	Microcepidoptera	1	1		2
	Unidentified	1	74		1
Diptera	Tipulidae	1	5		2
	Culicidae	2	6		4
			5		1
	Ceratopogonidae	1	2		1
	Chironomidae	2	2		6
			12		2
	Cecidomyiidae	2	2		1
			7		1
	Tabanidae	1	1		1
	Asilidae	2	4		1
			5		1
	Dolichopodidae	2	1		1
			7		1
	Phoridae	1	11		3
	Syrphidae	1	5		1

Table - VIII (Contd.)

1	2	3	4	5	6
Diptera	Otitidae	2	1		3
			3		1
	Tephritidae	1	2		2
	Sepsidae	3	10		3
			11		5
			6		6
	Sphaerocepidae	1	4		1
	Milichiae	2	3		1
			4		1
	Ephydridae	1	5		1
	Drosophilidae	4	1		1
			9		10
			10		1
			7		6
	Agromyzidae	3	6		5
			7		6
			9		1
	Anthomyiidae	1	11		4
	Muscidae	2	10		1
			13		1
	Tachinidae	2	2		1
			3		1
	Itonididae	1	1		1
	Sciaridae	1	2		2
	Pipunculidae	2	2		2
			3		1
	Unidentified	2	68		1
			70		1
Hymenoptera	Ichneumonidae	6	15		1

Table - VIII (Contd.)

1	2	3	4	5	6
Hymenoptera	Ichneumonidae		38		1
			39		2
			40		1
			41		1
			43		1
	Eulophidae	1	3		1
	Encyrtidae	1	3		1
	Chalcididae	1	10		1
	Cynipidae	2	2		1
			3		1
	Pteromalidae	2	4		2
			5		1
	Elasmidae	2	2		1
			3		1
	Eumenidae	1	2		1
	Formicidae	18	6		5
			106		2
			107		2
			44		48
			87		8
			52		1
			5		3
			103		1
			43		22
			115		1
			23		2
			116		1
			51		1

Table - VIII (Contd.)

1	2	3	4	5	6
Hymenoptera	Formicidae		10		1
			40		4
			117		2
			83		1
			118		1
	Unidentified	2	69		1
			71		1
TOTAL: 12		74	163	32	471

TABLE - IX : NUMBERS OF SPECIES OF BUTTERFLIES COLLECTED BY ALL OUT SEARCH METHOD

Locality:BENGLE Plot No:13 Date:10.1.1984

	Family	No.of species in the family
	Lycaeinidae	3
	Nymphalidae	4
	Pieriidae	5
	Satyridae	4
	Hesperiidae	3
TOTAL	5	19

TABLE - X : TAXONOMIC BREAK-UP OF INSECTS COLLECTED BY FOUR DIFFERENT SAMPLING METHODS

Locality:BHAIRUMBE Plot No:22 Date:2.1.1984

Order	Family	Total No.of species in the family	Sl.No. of species in the family	No.of nymphs or larvae	No.of adults
1	2	3	4	5	6
Collembola	Poduridae	1	1		1
			3		4
			4		7
Ephemeroptera	Caeniidae	1	1		3
Orthoptera	Acrididae		999	6	
	Tettigonidae		999	1	
Thysanoptera	Phlaeothripidae	1	1		1
Psocoptera	Psocidae	1	3		1
Dictyoptera	Blattidae	1	999	2	
			3		1
Hemiptera	Cercopidae	2	16		1
			17		1
	Cicadellidae	8	13		16
			16		1
			61		1
			65		2
			27		1
			66		1
			13		1
			5		1
	Delphacidae	2	2		1

Table - X (Contd.)

1	2	3	4	5	6
Hemiptera	Delphacidae		6		1
	Pentatomidae	1	11		1
	Hydrometridae	1	1		1
Coleoptera	Staphylinidae	3	11		2
			12		1
			13		1
	Elateridae	1	4		1
	Psclaphidae	1	1		2
	Cucujidae	1	1		1
	Tenebrionidae	1	4		1
	Nitidulidae	3	2		1
			1		1
			3		3
Lepidoptera	Hesperiidae	1	9		1
	Noctuidae	2	12		1
			13		1
	Unidentified	1	74		1
Diptera	Cecidomyiidae	2	13		1
			8		4
	Sciaridae	1	2		1
	Agromyzidae	1	10		1
	Otitidae	1	4		5
	Chloropidae	1	4		7
	Drosophilidae	5	7		5
			5		1
			9		9
			11		1
			12		1
	Muscidae	1	14		1

Table - X (Contd.)

1	2	3	4	5	6
Diptera	Unidentified	2	72		1
			78		1
Hymenoptera	Braconidae	3	12		1
			13		2
			14		1
	Ichneumonidae	1	31		2
	Eulophidae	1	4		1
	Formicidae	14	87		1
			67		26
			5		1
			7		4
			22		2
			12		2
			23		1
			88		3
			8		1
			1		1
			122		1
			17		2
			999		5
			123		3
			16		4
	Unidentified	1	73		166
11	29	68			581

TABLE - XI : NUMBERS OF SPECIES OF BUTTERFLIES COLLECTED BY ALL OUT SEARCH METHOD

Locality:BHAIRUMBE Plot No:22 Date: 2.1.1984

	Family	No.of species in the family
	Hesperiidae	3
	Nymphalidae	6
	Satyridae	1
	Pieriidae	2
TOTAL	4	12

TABLE - XII : TAXONOMIC BREAK UP OF INSECTS COLLECTED BY FOUR DIFFERENT SAMPLING METHODS

Locality:SCNDA Plot No:19 Date:21.12.84

Order	Family	Total No.of species in the family	Sl.No. of species in the family	No.of nymphs or larvae	No.of adults
1	2	3	4	5	6
Collembola	Isotomidae	1	3		2
	Poduridae	1	1		2
Orthoptera	Tettigonidae	1	999	1	
			3		1
	Gryllidae		999	1	
Dictyoptera	Blattellidae		999	3	
Isoptera	Termitidae	1	2		1
Hemiptera	Cicadellidae	9	20		6
			49		4
			50		1
			51		1
			52		1
			29		3
			53		1
			57		1
			22		1
	Delphacidae	1	5		1
	Lygaeidae	1	7		2
	Reduviidae	1	8		1
	Coreidae	1	10		1
Coleoptera	Carabidae	1	1		1

Table - XII (Contd.)

1	2	3	4	5	6
Coleoptera	Staphylinidae	2	10		1
			6		1
	Elateridae	1	3		1
	Nitidulidae	1	1		3
	Hispidae	1	2		1
Coleoptera	Chrysomelidae	6	18		1
			17		4
			20		1
			21		1
			24		1
			11		1
	Curculionidae	3	5		21
			9		1
			10		1
	Scolytidae	1	1		1
	Unidentified	3	65		1
			66		1
			67		1
Lepidoptera	Noctuidae	1	12		1
	Gelechidae	1	2		2
Diptera	Tipulidae	1	999		1
	Culicidae	3	10		1
			12		1
			9		1
			999		1
	Chironomidae	3	17		1
			9		2
			10		1

Table - XII (Contd.)

1	2	3	4	5	6
Diptera	Otitidae	1	2		5
	Sepsidae	1	2		1
	Dolichopodidae	1	5		13
	Drosophilidae	2	11		3
			9		2
	Chloropidae	1	1		2
	Anthomyiidae	4	17		3
			16		3
			18		1
			19		2
	Muscidae	1	12		2
	Cecidomyiidae	1	13		6
	Celyphidae	1	1		1
	Agromyzidae	1	8		1
Hymenoptera	Braconidae	4	8		1
			9		3
			10		1
			11		1
	Ichneumonidae	10	29		2
			30		1
			31		1
			32		1
			33		1
			34		1
			35		9
			36		5
			37		1
			42		1

Table - XII (Contd.)

1	2	3	4	5	6
Hymenoptera	Formicidae	7	43		34
			108		1
			109		2
			31		1
			110		1
			37		1
			90		1
9	35		80		196

TABLE - XIII : NUMBERS OF SPECIES OF BUTTERFLIES COLLECTED BY ALL OUT SEARCH METHOD

Locality:SONDA Plot No:19 Date:21.12.83

	Family	No.of species in the family
	Satyridae	4
	Hesperiidae	3
TOTAL	2	7

TABLE - XIV : TAXONOMIC BREAK-UP OF INSECTS COLLECTED BY FOUR DIFFERENT SAMPLING METHODS

Locality:MIRJAN Plot No:7 Date:1.2.1984

Order	Family	Total No.of species in the family	Sl.No. of species in the family	No.of nymphs or larvae	No.of adults
1	2	3	4	5	6
Orthoptera	Acrididae	1	11		12
			999	1	
	Gryllidae	1	999	4	
			8		2
	Tettigonidae		999	1	
Dictyoptera	Blattidae	2	999	3	
			5		2
			3		1
Psocoptera	Psocidae	1	4		1
	Archipsocidae		999	1	
Hemiptera	Cercopidae	2	19		1
			20		1
	Cicadellidae	5	999	1	
			67		1
			55		3
			68		2
			69		3
			70		1
	Lygaeidae	1	2		1
	Miridae	2	8		1
			9		2

Table-XIV (Contd.)

1	2	3	4	5	6
Hemiptera	Delphacidae	1	2		9
	Tingidae	1	2		1
	Phymatidae	1	2		1
	Dipsocoridae	2	1		3
			2		1
	Hydrometridae	1	1		3
	Corixidae	1	1		3
Coleoptera	Carabidae	5	11		1
			12		1
			13		7
			14		1
			15		254
	Staphylinidae	5	14		5
			15		1
			16		7
			17		380
			6		12
	Scarabaeidae	2	15		3
			10		10
	Byrrhidae	4	5		1
			6		2
			7		1
			8		15
	Phengodidae	1	1		2
	Nitdulidae	1	1		7
	Tenebrionidae	1	5		2
	Allecllidae	2	7		1
			8		1

Table - XIV (Contd.)

1	2	3	4	5	6
Coleoptera	Cerambycidae	1	7		1
	Bruchidae	1	2		3
	Chrysomelidae	2	28		2
			29		1
	Anthizoidae	1	1		1
	Sylvanidae	2	2		1
			3		2
	Otniidae	1	1		1
	Unidentified	2	78		1
			82		1
Lepidoptera	Noctuidae	2	14		1
			15		1
	Microcepidoptera	2	2		1
			3		1
Diptera	Culicidae	1	13		1
	Sciaridae	1	1		3
	Phoridae	1	12		1
	Drosophilidae	1	1		2
	Unidentified	4	77		1
			79		1
			80		1
			81		1
	Cecidomyiidae	3	7		57
			18		2
			19		15
Hymenoptera	Bethylidae	1	1		1
	Perilampidae	1	1		1
	Colletidae	1	2		3

Table - XIV (Contd.)

1	2	3	4	5	6
Hymenoptera	Formicidae	20	58		8
			103		1
			107		2
			5		1
			70		1
			124		1
			4		1
			115		1
			12		1
			99		2
			39		1
			113		1
			126		14
			41		1
			12		1
			53		3
			5		2
			116		1
			102		1
			37		2
			999		13
TOTAL	8	38	91	11	918

TABLE - XV : NUMBERS OF SPECIES OF BUTTERFLIES COLLECTED BY ALL OUT SEARCH METHOD

Locality:MIRJAN Plot No:7 Date:1.2.1984

Plot No.	Family	No.of species in the family
7	Papilionidae	2
TOTAL	1	2

TABLE - XVI : DIVERSITY INDICES FOR INSECTS COLLECTED BY FOUR SAMPLING METHODS (FIVE LOCALITIES)

Locality	No.of orders	No.of families	No.of species	No.of individuals	Index (Shanon-Weiner)
Bidralli plot No.16	11	70	148	287	4.160
Plot No.17	11	55	132	391	3.232
Plot No.13	12	42	81	504	2.046
Bengle Plot No.13	12	74	163	514	4.089
Bhairumbe Plot No.22	11	29	68	166	3.515
Sonda Plot No.19	9	35	80	196	3.670
Mirjan Plot No.7	8	38	91	918	2.159

TABLE - XVII : TAXONOMIC BREAK-UP OF BIRDS OBSERVED IN BIDARAHALLI

I. 1.12.83 - 3.12.83 (3 days)

Time : Between 8.00 am to 10.00 am

Order	Family	Name of species	No.of individuals
Columbiformes	Columbidae	Grey fronted green pigeon (Treron pompadora)	3
Psittaciformes	Psittacidae	Loriquet (Loriculus vernalis)	5
		Blossom-headed parakeet (Psittacula cyanocephala)	1
Apodiformes	Apodidae	Crested tree swift (Hemiprocne longipennis)	3
		White rumped spine-tailed swift (Chaetura sylvatica)	5
Piciformes	Capitonidae	Large green barbet (Megalaima zeylonica)	1
	Picidae	Golden backed woodpecker (Dinopim benchalensis)	1
		Indian pigmy woodpecker (Picoides nanus)	1
Passeriformes	Pycnonotidae	Ruby throated bulbul (Pycnonotus melanicterus)	2
		Yellow browed bulbul (Hypsipetes indicus)	3
	Dicruridae	Grey drongo (Dicrurus leucophaeus)	3
		Bronzed drongo (Dicrurus aeneus)	7

Table - XVII (Contd.)

Order	Family	Name of species	No. of individuals
Passeriformes	Dicaeidae	Nilgiri flower pecker (Dicaeum concolor)	3
	Muscicapidae	Brown flycatcher (Muscicapa latirostris)	4
		White bellied blue flycatcher (Muscicapa pallipes)	1
		Shama (Copsychus malabaricus)	3
		Blyth's reed warbler (Acrocephalus dumetorum)	8
		Thick billed warbler (Phragmaticola aedon)	2
		Greenish leaf warbler (Phylloscopus trochiloides)	19
	Campephagidae	Orange minivet (Pericrocotus flammeus)	9
	Ploceidae	White backed munia (Lonchura striata)	6
	Sittidae	Velvet fronted nuthatch (Sitta frontalis)	5
	Nectariniidae	Purple rumped sunbird (Nectrarinia zeylonica)	3
5	13	23	97

TABLE XVIII: TAXONOMIC BREAK-UP OF BIRDS OBSERVED IN BENGLE

II. 10.12.83 - 12.12.83 (3 days)

Time : between 8.00 am and 10.00 am

Order	Family	Name of species	No. of individuals
Falconiformes	Accipiteridae	Shikra (*Accipiter badius*)	1
		White backed vulture (*Gyps benghalensis*)	8
Psittaciformes	Psittacidae	Loriquet (*Loriculus vernalis*)	6
		Blossom headed parakeet (*Psittacula cyanocephala*)	9
Coraciformes	Bucerotidae	Malabar grey horn bill (*Tockus griseus*)	7
Apodiformes	Apodidae	Palm swift (*Cypsiurus parvus*)	1
		Crested tree swift (*Hemiprocne longipennis*)	2
		White rumped spine-tailed swift (*Chaetura sylvatica*)	2
Piciformes	Capitonidae	Large green barbet (*Megalaima haemacephala*)	1
	Picidae	Pigmy woodpecker (*Picoides nanus*)	2
Passeriformes	Pycnonotidae	Red whiskered bulbul (*Pycnonotus jacosus*)	9
	Irenidae	Gold fronted chloropsis (*Chloropsis aurifrons*)	2

Table - XVIII : (Contd.)

Order	Family	Name of species	No. of individuals
Passeriformes	Dicruridae	White bellied drongo (Dicrurus caeruleus)	5
	Corvidae	Jungle crow (Corvus macrorhynchos)	1
	Dicaeidae	Nilgiri flower pecker (Dicaeum concolor)	15
	Campephagidae	Small minivet (Pericrocotus cinnamoneus)	6
	Oriolidae	Golden oriole (Oriolus oriolus)	1
	Motacillidae	Tree pipit (Anthus hodgsoni)	2
	Ploceidae	Yellow throated sparrow (Petronia xanthocollus)	15
	Nectariniidae	Purple sunbird (Nectarinia asiatica)	2
	Muscicapidae	Tailor bird (Orthotomus sutorius)	2
		Magpie Robin (Copsychus saularis)	1
		Greenish leaf warbler (Phylloscopus trochiloides)	3
		Blyth's reed warbler (Acrocephalus dumetorum)	3
	Hirundinidae	House martin (Delichon urbanica)	3
7	18	25	109

TABLE - XIX : TAXONOMIC BREAK-UP OF BIRDS OBSERVED IN SONDA

III. 21.12.83 - 23.12.83 (3 days)

Time : between 8.00 am and 10.00 am

Order	Family	Name of species	No.of individuals
Ciconiformes	Adreidae	Pond heron (Adreola grayii)	1
Psittaciformes	Psittacidae	Loriquet (Loriculus vernalis)	10
		Blossom headed parakeet (Psittacula cyanocephala)	2
Apodiformes	Apodidae	Crested tree swift (Hemiprocne longipennis)	4
		House swift (Apus affinis)	1
Piciformes	Capitonidae	Small green barbet (Megalaima viridis)	2
	Picidae	Golden backed woodpecker (Dinopium benghalense)	2
		Heart spotted woodpecker (Hemicircus canente)	2
Passeriformes	Muscicapidae	Nilgiri quaker babbler (Alcippe poioicephala)	2
		Greenish leaf warbler (Phylloscopus trochiloides)	17
		White bellied blue fly catcher (Muscicapa pallipes)	1
		Paradise flycatcher (Terpsiphone paradisi)	2

Table - XIX (Contd.)

Order	Family	Name of species	No.of individuals
Passeriformes	Pycnonotidae	Black bulbul (Hypsipetes madagascariensis)	1
		Ruby throated bulbul (Pycnonotus melanicterus)	1
		Yellow browed bulbul (Hypsipetes indicus)	5
	Irenidae	Fairy blue bird (Irena puella)	4
	Dicruridae	Racket tailed drongo (Dicrurus paradiseus)	3
		Bronzed drongo (Dicrurus aeneus)	8
	Dicaeidae	Nilgiri flower pecker (Dicacum concolor)	26
	Nectariniidae	Purple sunbird (Nectarinia asiatica)	1
		Small sunbird (Nectarinia minima)	17
	Sittidae	Velvet fronted nuthatch (Sitta frontalis)	6
	Campephagidae	Orange minivet (Pericrocotus flammaeus)	5
		Small minivet (P.cinnamoneus)	2
		Malabar wood shrike (Tephrodornis gularis)	1
	Hirundinidae	House martin (Delichon urbica)	3
5	14	26	124

TABLE - XX : TAXONOMIC BREAK-UP OF BIRDS OBSERVED IN BHAIRUMBE

IV. 2.1.84 - 4.1.84 (3 days)
Time : between 8.00 am and 10.00 am

Order	Family	Name of species	No.of individuals
Columbiformes	Columbidae	Spotted dove (Streptopelia chinensis)	5
		Southern green pigeon (Treron phoenicoptera)	9
Cuculiformes	Cuculidae	Crow pheasant (Centropus sinensis)	2
Psittaciformes	Psittacidae	Loriquet (Loriculus vernalis)	21
		Blossom headed parakeet (Psittacula cyanocephala)	7
Apodiformes	Apodidae	Crested tree swift (Hemiprocne longipennis)	8
		House swift (Apus affinis)	3
		Palm swift (Cypsiurus parvus)	5
		White rumped spine tailed swift (Chaetura sylvatica)	1
Coraciformes	Meropidae	Small green bee eater (Merops orientalis)	9
Piciformes	Capitonidae	Crimson breasted barbet (Megalaima haemacephala)	7
		Large green barbet (Megalaima zeylonica)	6

Table - XX (Contd.)

Order	Family	Name of species	No.of individuals
Piciformes	Picidae	Golden backed wood pecker (Dinopium benghalense)	2
		Pigmy woodpecker (Picoides nanus)	2
Passeriformes	Pycnonotidae	Grey headed bulbul (Pycnonotus priocephalus)	1
		Red vented bulbul (P.cafer)	11
		Red whiskered bulbul (P.jacosus)	16
	Irenidae	Fairy blue bird (Irena puella)	2
		Iora (Aegithina tiphia)	2
		Jerdon's chloropsis (Chloropsis cochinchinensis)	5
	Corvidae	Jungle crow (Corvus macrorhynchos)	2
	Dicruridae	Grey drongo (Dicrurus leucophaeus)	1
		White billied drongo (D.caeruleus)	1
		Racket tailed drongo (D.paradiseus)	1
	Sturnidae	Hill myna (Gracula religiosa)	5

Table - XX (Contd.)

Order	Family	Name of species	No. of individuals
sseriformes	Sturnidae	Grey headed myna (Sturnus malabaricus)	6
	Campephagidae	Pied flycatcher shrike (Hemipus picatus)	2
		Black headed cuckoo shrike (Coracina melanoptera)	1
		Indian wood shrike (Tephrodornis pondicerianus)	2
		Large cuckoo shrike (Coracina novaehollandiae)	2
		Small minivet (Pericrocotus cinnamoneus)	2
	Oriolidae	Black headed oriole (Oriolus xanthornus)	4
		Golden oriole (O. oriolus)	3
	Lanidae	Brown shrike (Lanius cristatus)	4
	Muscicapidae	Greenish leaff warbler (Phylloscopus trochiloides)	4
		Magpie robin (Copsychus saularis)	3
	Hirundiaidae	House martin (Delichon urbica)	19
	Dicaeidae	Nilgiri flower pecker (Dicaeum concolor)	27

Table - XX (Contd.)

Order	Family	Name of species	No.of individuals
Passeriformes	Dicaeidae	Thick billed flower pecker (D.agile)	5
	Nectariniidae	Purple sunbird (Nectarinia asiatica)	9
		Purple rumped sunbird (N.zeylonica)	2
		Small sunbird (N.minima)	1
	Ploceidae	Yellow throated sparrow (Petronia xanthocollus)	29
7	21	43	259

TABLE - XXI : TAXONOMIC BREAK-UP OF BIRDS OBSERVED IN CHANDAVAR

V. 19.1.84 - 21.1.84 (3 days)

Time : between 8.00 am and 10.00 am

Order	Family	Name of species	No. of individuals
Psittaciformes	Psittacidae	Loriquet (Loriculus vernalis)	1
		Blossom headed parakeet (Psittacula cyanocephala)	4
Coraciformes	Meropidae	Blue tailed bee eater (Merops philippinus)	4
		Chestnut headed bee eater (M.leschenaulti)	3
Piciformes	Picidae	Heart spotted wood pecker (Hemicircus canente)	1
	Capitonidae	Crimson throated barbet (Megalaima rubricapilla)	3
Passeriformes	Muscicapidae	Black headed babbler (Rhopocicla atriceps)	6
		Verditer fly catcher (Muscicapa thalassia)	1
		Greenish leaf warbler (Phylloscopus trochiloides)	16
		Black naped blue fly catcher (Monarcha azurea)	1
		Blyth's reed warbler (Acrocephalus dumetorum)	9
		Tailor bird (Orthotomus sutorius)	1

Table - XXI (Contd.)

Order	Family	Name of species	No. of individuals
Passeriformes	Muscicapidae	Brown fly catcher (Muscicapa latirostris)	1
	Pycnonotidae	Red whiskered bulbul (Pycnonotus jacosus)	2
		Ruby throated bulbul (P. melanicterus)	9
		Yellow browed bulbul (Hysipetes indica)	7
	Irenidae	Golden fronted chloropsis (Chloropsis aurifrons)	5
		Fairy blue bird (Irena puella)	3
	Dicruridae	Grey drongo (Dicrurus leucophaeus)	2
	Sturnidae	Hill myna (Gracula religiosa)	2
	Oriolidae	Golden oriole (Oriolus oriolus)	9
	Campephagidae	Orange minivet (Pericrocotus flammeus)	4
		Small minivet (P. cimamoneus)	2
		Pied fly catcher shrike (Hemipus picatus)	4
	Corvidae	Jungle crow (Corvus macrorhynchus)	2

Table - XXI (contd.)

Order	Family	Name of species	No.of individuals
Passeriformes	Dicacidae	Nilgiri flower pecker (Dicacum concolor)	22
	Nectariniidae	Purple sunbird (Nectarinia asiatica)	3
		Small sunbird (N.minima)	23
4	17	28	150

TABLE - XXII : TAXONOMIC BREAK-UP OF BIRDS OBSERVED IN MIRJAN

VI. 1.2.84 - 3.2.84 (3 days)

Time : Between 8.00 am and 10.00 am

Order	Family	Name of species	No. of individuals
Ciconiformes	Adreidae	Cattle egret (Bubulcus ibis)	2
Psittaciformes	Psittacidae	Loriquet (Loriculus vernalis)	8
		Blossom headed parakeet (Psittacula cyanocephala)	4
Coraciformes	Meropidae	Small green bee eater (Merops orientalis)	4
Piciformes	Picidae	Rufous wood pecker (Micropternus brachyurus)	2
	Capitonidae	Crimson breasted barbet (Megalaima haemaciphala)	1
Passeriformes	Pycnonotidae	Red vented bulbul (Pycnonotus cafer)	3
		Red whiskered bulbul (P. jacosus)	15
		Ruby throated bulbul (P. melanicterus)	4
	Dicruridae	Grey drongo (Dicrurus leucophaeus)	7
	Sturnidae	Jungle myna (Acridotheres fuscus)	6
		Grey headed myna (Sturnus malabaricus)	1

Table - XXII (Contd.)

Order	Family	Name of species	No. of individuals
Passeriformes	Lanidae	Brown shrike (Lanius cristatus)	3
	Trenidae	Fairy blue bird (Irena puella)	3
		Iora (Aegithina tiphia)	4
	Corvidae	Jungle crow (Corvus macrorhynchus)	6
	Campephagidae	Pied flycatcher shrike (Hemipus picetus)	1
		Small minivet (Pericrocotus cinnamoneus)	6
	Oriolidae	Black headed oriole (Oriolus xanthornus)	5
		Golden oriole (O.oriolus)	2
	Muscicapidae	Brown fly catcher (Muscicapa lafirostris)	2
		Paradise fly catcher (Terpsiphone paradisi)	1
		Greenish leaf warbler (Phylloscopus trochiloides)	3
		Blyth's reed warbler (Acrocephalus dumetorun)	3
	Dicaeidae	Nilgiri flower pecker (Dicacum concolor)	19
		Thick billed flower pecker (Di agile)	5

Table - XXII (Contd.)

Order	Family	Name of species	No. of individuals
Passeriformes	Nectariniidae	Purple sunbird (Nectarinia asiatica)	10
		Purple rumped sunbird (N. zeylonica)	1
		Small sunbird (N. minima)	5
	Ploceidae	Yellow throated sparrow (Petronia xanthocolus)	2
5	17	30	145

TABLE XXIII : TAXONOMIC BREAK-UP OF BIRDS OBSERVED IN NAGUR

VII. 18.2.84 - 20.2.84 (3 days)
Time : Between 8.00 am and 10.00 am

Order	Family	Name of species	No. of individuals
Falconiformes	Accipiteridae	Asiatic sparrow hawk (Accipiter nisus)	1
		Large Indian kite (Milvus lineatus)	1
Columbiformes	Columbidae	Grey fronted green pigeon (Treron pompadora)	2
Psittaciformes	Psittacidae	Loriquet (Loriculus vernalis)	1
		Blossom headed parakeet (Psittacula cyanocephala)	1
		Blue winged parakeet (P.columboides)	3
Coraciformes	Bucerotidae	Malabar grey hornbill (Tokus griseus)	4
Piciformes	Capitonidae	Crimson throated barbet (Megalaima rubricapilla)	2
		Small green barbet (M.viridis)	2
	Picidae	3 toed golden backed woodpecker (Dinopium jaranense)	1
Passeriformes	Muscicapidae	Black headed babbler (Rhopocicla atriceps)	8
		Nilgiri quaker babbler (Alcippe poioicephala)	6

Table - XXIII (Contd.)

Order	Family	Name of species	No. of individuals
Passeriformes	Muscicapidae	Greenish leaf warbler (Phylloscopus trochiloides)	6
		Paradise flycatcher (Terpsiphone paradisi)	1
		Red breasted flycatcher (Muscicapa parva)	1
		White bellied blue flycatcher (M.pallipes)	1
	Pycnonotidae	Yellow browed bulbul (Hypsipetes indicus)	13
		Ruby throated bulbul (Pycnonotus melanicterus)	1
		Black bulbul (Hypsipetes madagascariensis)	1
	Dicruridae	Racket tailed drongo (Dicrurus paradiseus)	2
	Sturnidae	Hill myna Gracula religiosa)	2
	Oriolidae	Black headed oriole (Oriolus xanthornus)	1
		Golden oriole (O.oriolus)	4
	Campephagidae	Orange minivet (Pericrocotus flammeus)	4
	Irenidae	Fairy blue bird (Irena puella)	2

Table - XXIII (Contd.)

Order	Family	Name of species	No. of individuals
Passeriformes	Corvidae	Jungle crow (Corvus macrorhynchus)	1
	Dicaeidae	Nilgiri flower pecker (Dicaeum concolor)	12
	Nectariniidae	Small sunbird (Nectarinia minima)	12
6	16	28	96

TABLE XXIV : TAXONOMIC BREAK-UP OF BIRDS OBSERVED IN SANTAGAL

VIII. 16.3.84 - 18.3.84 (3 days)

Time : between 8.00 - 10.00 am

Order	Family	Name of species	No. of individuals
Columbiformes	Columbidae	Jerdon's imperial pigeon (Ducula badia)	1
Psittaciformes	Psittacidae	Loriquet (Loriculus vernalis)	1
Piciformes	Picidae	3 toed golden backed wood pecker (Dinopium jaranense)	4
	Capitonidae	Small green barbet (Megalaima viridis)	4
		Large green barbet (M. zeylonica)	1
		Crimson throated barbet (M. rubricapilla)	1
Apodiformes	Apodidae	White rumped spinetailed swift (Chaetura sylvatica)	2
Passeriformes	Muscicapidae	Nilgiri quaku babbler (Alcippe poioicephala)	9
		Scimitar babbler (Pomatorrhinus schisticeps)	2
		Greenish leaf warbler (Phylloscopus trochiloides)	1
		Blyth's reed warbler (Acrocephalus dumetorum)	1

Table - XXIV (Contd.)

Order	Family	Name of species	No. of individuals
Passeriformes	Muscicapidae	Malabar whistling thrush (Myiophonus horsfieldii)	1
	Pycnonotidae	Black bulbul (Hypsipetes madagorcariensis)	7
		Yellow browed bulbul (H.indicus)	11
		Grey headed bulbul (Pycnonotus priocephalus)	6
		Ruby throated bulbul (P.melanicterus)	5
	Irenidae	Golden fronted chloropsis (Chloropsis aurifrons)	2
		Fairy blue bird (Irena puella)	3
	Dicruridae	Bronzed drongo (Dicrurus aeneus)	2
	Sturnidae	Hill myna (Gracula religiosa)	2
	Campephagidae	Orangeminivet (Periorocetus flammeus)	2
	Nectariniidae	Small sunbird (Nectarinia minima)	23
5	13	22	91

TABLE - XXV : DIVERSITY INDICES FOR BIRD FAUNA OF EIGHT LOCALITIES

Locality	No.of orders	No.of families	No.of species	No.of individuals	Shanon Weiner's Index
Bidrahalli	5	13	23	97	2.79
Bhangle	7	18	25	109	2.52
Sonda	5	14	26	124	2.14
Bhairumbe	7	21	43	259	3.15
Nagur	6	16	28	96	3.37
Mirjan	5	17	30	145	2.79
Santegal	5	13	22	91	2.61
Chandarur	4	17	28	150	2.89

TABLE - XXVI : DISTRIBUTION OF BULBULS IN DIFFERENT LOCALITIES

Locality/ Species	Red vented Bulbul	Red whisk-ered Bulbul	Ruby throa-ted Bulbul	Grey headed Bulbul	Yellow browed Bulbul	Black Bulbul
Bidrahalli	-	-	✓	-	✓*	-
Bhengle	-	✓	-	-	-	-
Sonda	-	-	✓	-	✓	✓
Bhairumbe	✓	✓	-	✓	-	-
Chandavur	-	✓	✓	-	✓	-
Mirjan	✓	✓	✓	-	-	-
Nagur	-	-	✓	✓*	✓	✓
Santegal	-	-	✓	✓	✓	✓

* Seen outside the sampling time

TABLE - XXVII : DISTRIBUTION OF SUNBIRDS IN DIFFERENT LOCALITIES

Locality/ Species	Purple rumped sunbird	Purple sunbird	Small sunbird
Bidrahalli	✓	-	-
Bhengle	-	✓	-
Sonda	-	✓	✓
Bhairumbe	✓	✓	✓
Chandavur	-	✓	✓
Mirjan	✓	✓	✓
Nagur	-	-	✓
Santegal.	-	-	✓

TABLE - XXVII - DISTRIBUTION OF DRONGOS IN DIFFERENT LOCALITIES

Locality/ species	White bellied drongo	Grey drongo	Bronzed drongo	Racket tailed drongo
Bidrahalli	-	✓	✓	-
Bhengle	✓	-	-	-
Sonda	-	-	✓	✓
Bhairumbe	✓	✓	-	✓
Chandarur	-	✓	-	-
Mirjan	-	✓	-	-
Nagur	-	-	✓*	✓
Santegal	-	-	✓	-

* Seen outside the sampling area.