Rec. zool. Surv. India, 87(4) : 299-316, 1990

ABUNDANCE AND DIVERSITY OF BIRD SPECIES IN IDUKKI HYDROELECTRIC PROJECT AREA, KERALA

N.L.N.S. PRASAD*

Zoological Survey of India, 36/802, Karakkamuri Cross Road, Cochin-682 011

INTRODUCTION

Any developmental strategy aimed at economic progress when interferes with a natural ecosystem will necessarily have positive as well as negative effects. While most oif the benefits acruing from such projects as hydroelectric projects reach else where, the ill-effects embrace the locals more than others. The most serious among these would be the problem of rehabilitation of the local people. Others include disturbance to the components of the ecosystem - the flora and fauna - due to activities at various stages of project implementation. Recent awareness of the impact of such projects on a variety of components has led to the present scientific insight into the effects of hydroelectric project on fauna of Idukki. The paper presents the abundance and diversity indices of bird fauna in the study plots and attempts to evalute the possible effects of the project on them.

STUDY AREA AND METHODS

The study was centered around the area of Idukki hydroelectric project and the places of abutting. It is located at a distance of 130 km southeast of Cochin in the Western Ghats (9° 51'N and 76° 59'E) (Fig. 1). The terrain is deeply undulating and lined with gorges through which small streams find their way into the reservoir down below. The height of these hill ranges vary from 560-850 m avove MSL. The Idukki project consists of 3 dams - the Idukki Arch dam and Cheruthoni dam constructed on the rivers Periyar and Cheruthoni, respectively and the third is Kulamavu dam located about 25 km southwest of Cheruthoni dam. These have resulted in the 60 km^2 reservoir submerging vast expanses of rich forest wealth.

Four vegetation types have been described in this area by Mohanan (1982 'unpublished'). These are : (i) West-Coast tropical evergreen forests, (ii) West-Coast semi-evergreen forests, (iii) Southern moist deciduous forests, and (iv) South Indian subtropical hill savanna (grasslands). Some areas have cardamon and arecanut plantations while others have eucalyptus plantations. In the valleys and in the river bed which has become dry due to the constructioon of dams, paddy is cultivated.

---

* Present address : Department of Zoology, Osmania University, Hyderabad 500 007, A.P.

TABLE 1

Vegetation details in the study plots

Plots	Transect length(km)	Place	Characteristics of terrain	Vegetation details
I.	1.00	Painavu	Slightly undulating terrain. Water passage and man-made paths present.	Thick vegetation. Identified trees include *Careya arboria, Dillinea pentagyna, Brinia rhomboides, Terminalia paniculta, Melotus* sp., *Tectona grandis*. Illegal felling of trees still continues.
II.	0.75	Meenmutty	On the hillock, about 70 m from the road.	Open grassland with *Dillinea pentagyna* trees here and there. *Eucalyptus* sp. plantations and activity related to this disturbed the area greatly.
III.	1.00	Kudamurutty	Undulating terrain. Man-made paths and small streams and high-tension pylons.	Thick tree vegetation. Opened up areas with *Lantana camera, Eupatorium odoratum*. Cardamom plantations over 50% of the area.
IV.	0.90	Uppukunnu	Slightly undulating terrain. Streams and man-made paths present.	Approximately 20% of the area constitutes grassland with *Dillinea pentagyna, Sterculia* sp., *Artacarpus* sp., in the forest. Some part of area difficult to penetrate due to *Ochlandra* sp.
V.	0.80	Kulamavu	Gently undulating terrain. Streams, road and man-made paths present. Transect runs towards reservoir.	Tree as well as bushy vegetation present. *Butea monosperma, Melotus sp., Grewia* sp., and creeper -*Micania cordata* dominate the open area. Tree felling activity low.
VI.	0.80	Thanikkandam	Gently undulating terrain. Roads and water passages present.	Maximum area opened up. *Lantana camera, Eupatorium odoratum, Solanum* sp., *Ochlandra* sp., in cleared areas. Trees : *Macaranga indica, Terminalia paniculata, Erythrina indica*. Heavily disturbed.
VII.	0.80	Karimpan	Present on the road side.	Thick vegetation present. Bushes include *Helecterus* sp., *Ochlandra* sp., and *Mussenda* sp., Trees: *Butea monosperma, Macaranga indica, Ficus* sp., *Artacasrpus* sp., *Cuillenia* sp., *Sterculia* sp., *Erythrina indica* and *Actinodaphne* sp.
VIII.	0.75	Naragakkanam	On the hillock about 200 m height from the road.	Vegetation thick. Ground vegetation dominated by *Lantana camera, Ploygynum* sp., *Micania cordata,* etc. Trees include *Erythrina indica, Melia* sp., *Syzygium* sp., *Salmalia* sp., *Terminalia paniculata*. Tree felling for firewood - main disturbance.

TABLE 2

Distribution of bird species, abundace and diversity indices in the study plots

Plots	No. of obser-vations	Total No. of species	Mean and per visit S.E. Species	Individuals	Diversity Simpson's index	Shannon's index
I	7	50	14.86 ± 1.66	47.71 ± 6.08	13.21	1.63
II	3	11	—	—	—	—
III	8	45	15.25 ± 0.97	43.25 ± 2.99	16.25	4.51
IV	7	33	11.14 ± 1.15	35.42 ± 5.23	15.48	4.08
V	9	51	18.11 ± 1.14	54.11 ± 4.16	14.75	3.61
VI	8	43	17.37 ± 0.90	51.00 ± 91	19.38	4.62
VII	6	54	22.17 ± 1.15	75.67 ± 4.89	42.75	6.09
VIII	8	62	20.50 ± 1.79	68.00 ± 6.61	19.30	4.91
All plots :			17.04 ± 1.51	53.33 ± 5.29		

TABLE 3

Analysis of variance of bird species in 7 plots in different months

Source of variation	Degrees of Freedom	Sum of Squares	Mean Square	F value
Between Plots	6	2649.67	441.61	18.72*
Between Months	5	435.75	87.15	3.69#
Residual	30	707.58	23.59	
Total	41	3793.00		

* Significance at $p < 0.05$ # Significance at $p < 0.01$

TABLE 4

Analysis of variance of number of birds in 7 plots indifferent months.

Source of variation	Degrees of Freedom	Sum of Squares	Mean Square	F value
Between plots	6	10814.66	1802.44	4.93*
Between Months	5	5599.42	1119.89	3.06*
Residual	30	10971.92	365.73	
Total	41	27386.00		

* Significance at $p < 0.05$.

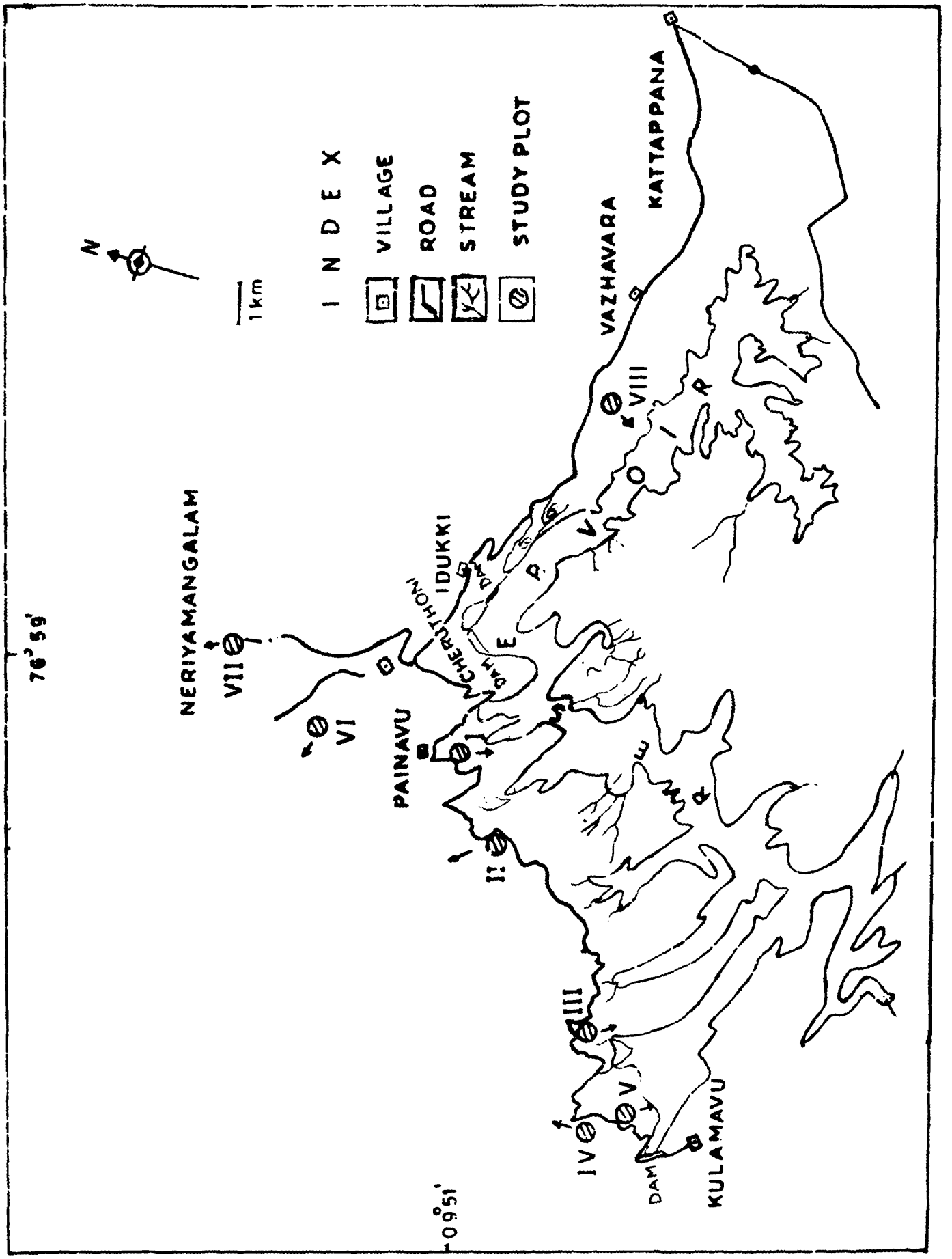

Fig. 1. Distribution of study plots in the study area. Arrow indicates direction of the transect.

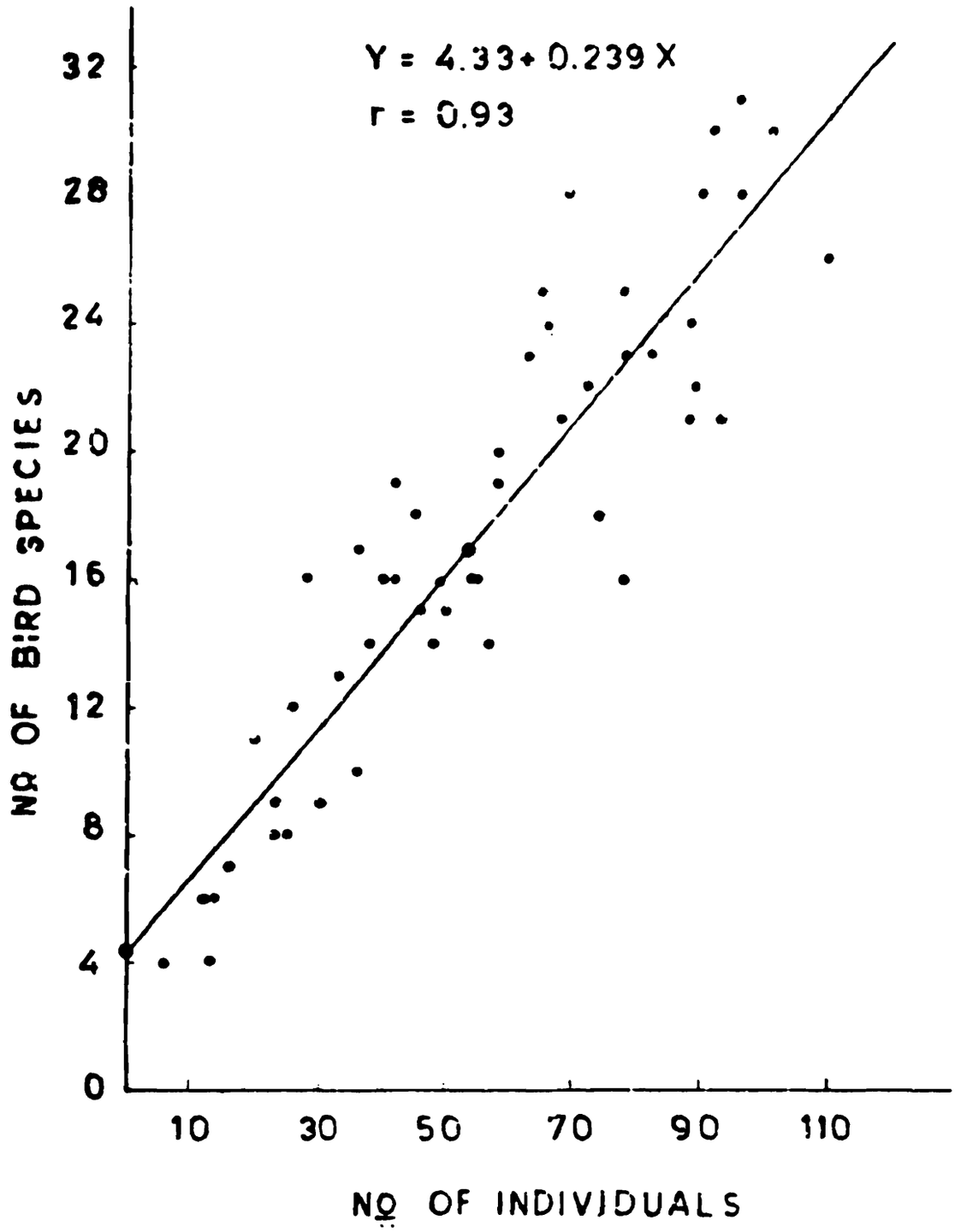

Fig. 2. Regression line showing the relation between the number of individuals against bird species.

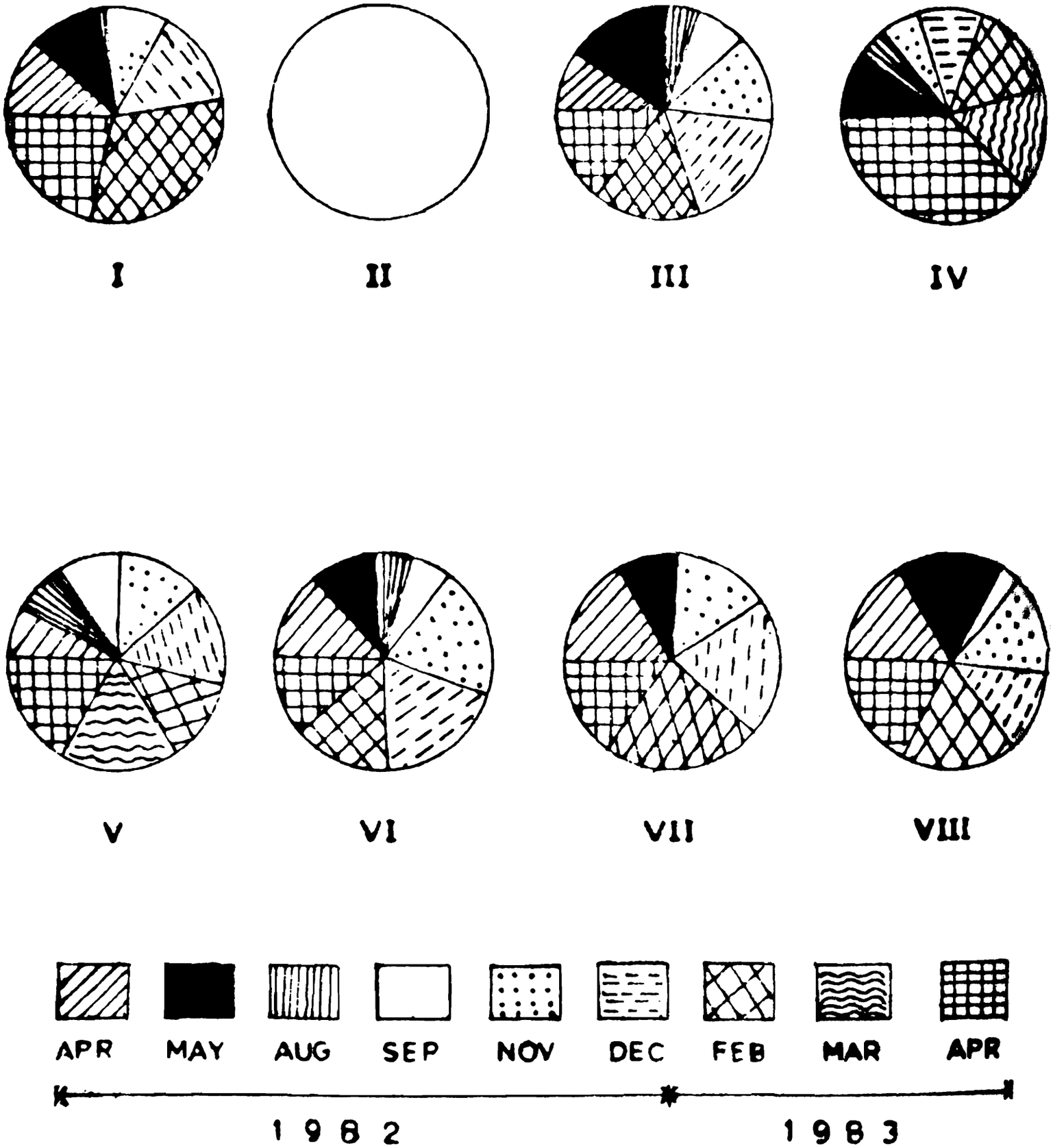

Fig. 3. Monthwise relative abudance of birds. Plot II details are given in the text.

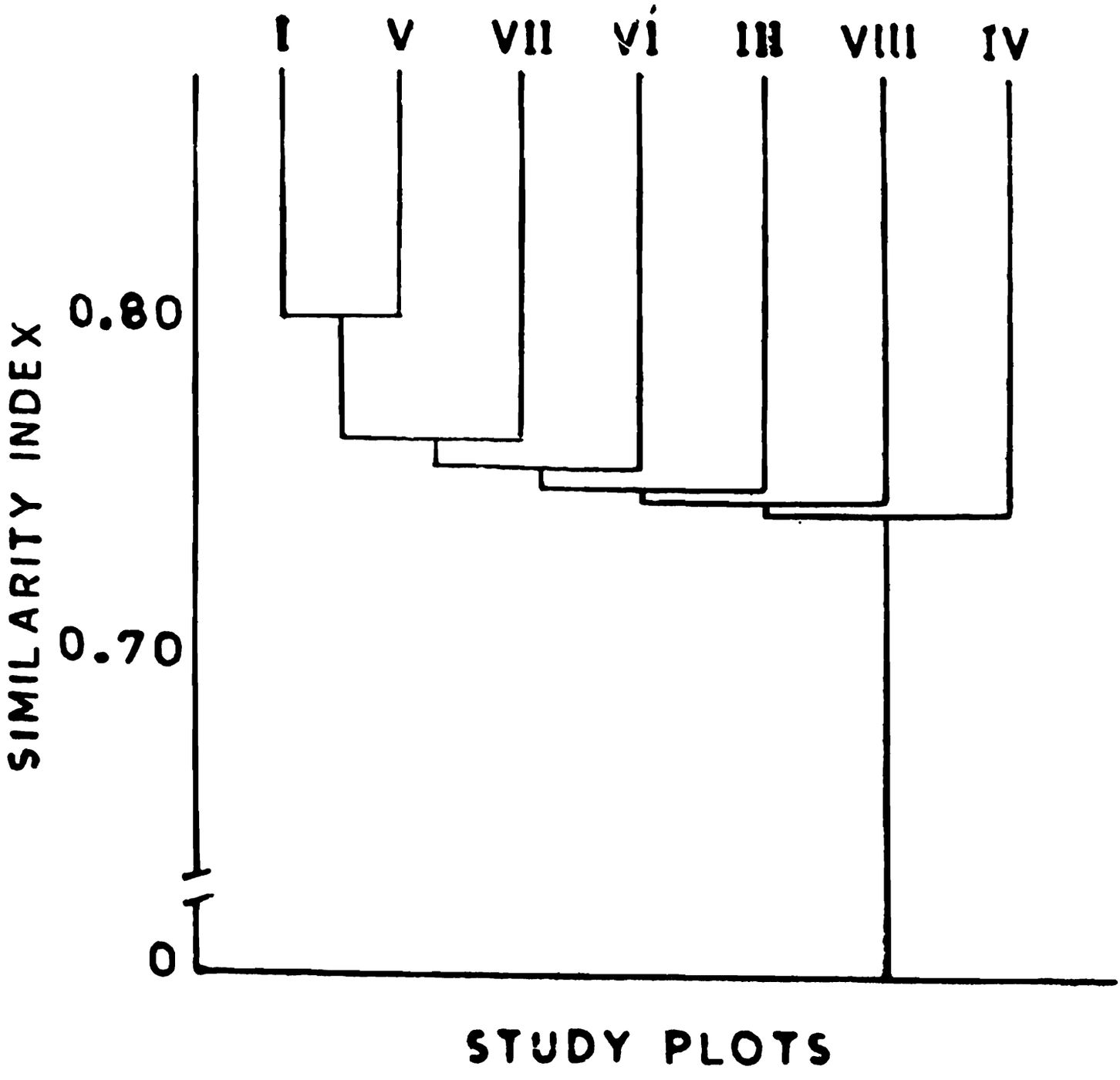

Fig. 4. Dendrogram similarity between plots due to bird species common in between them.

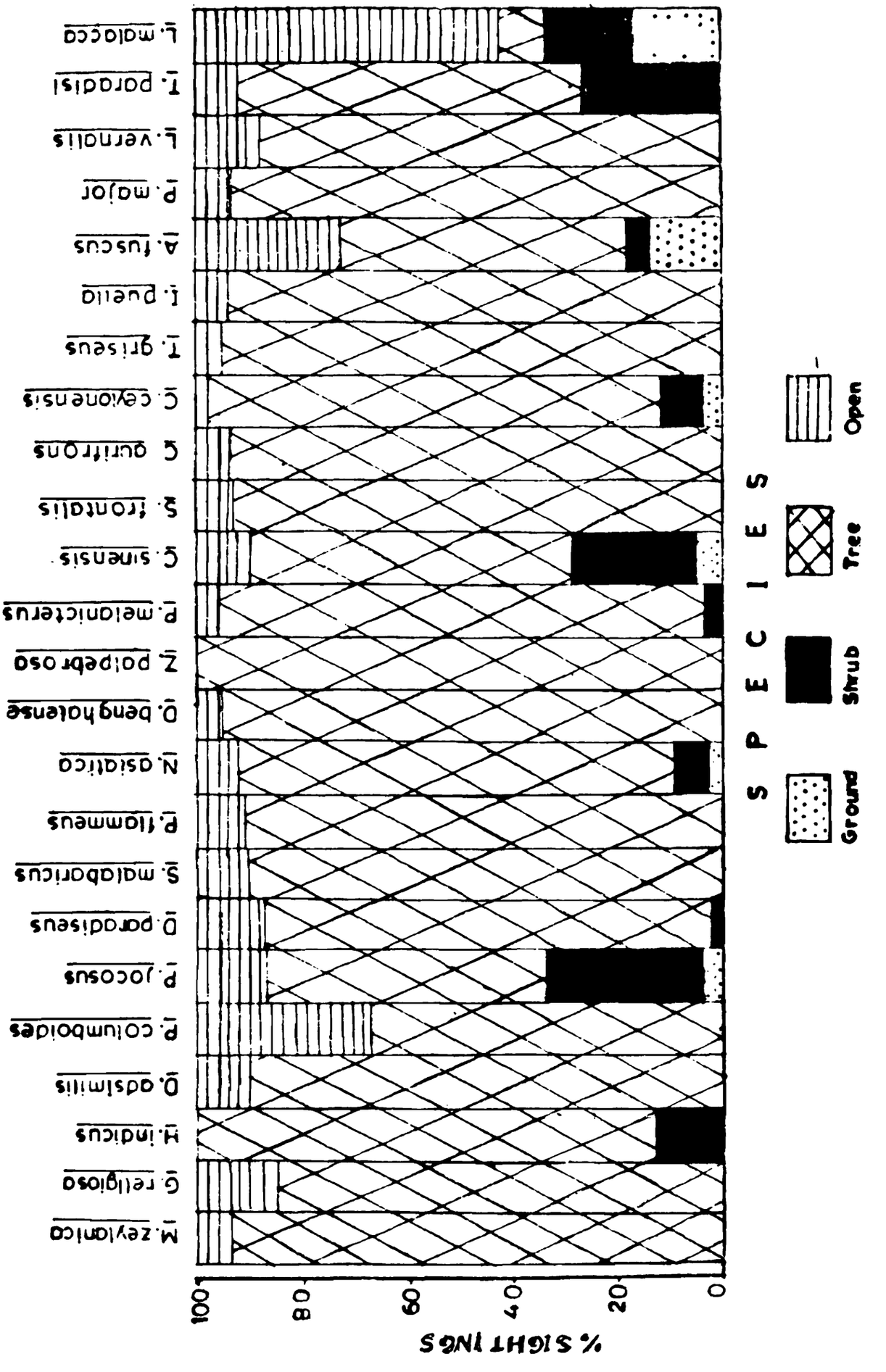

Fig. 5. Occurrence of bird species in different habitats.

Selection of study plots : On the basis of a reconnaisance, a total of 8 study polts were fixed as points of observation in the study area (Fig. 1). The selection of plots was based on the differences in the vegetation structure (Table 1). Each of these plots was a belt transect of approximately 30 m width and with a length varying from 0.75-1.0 km passing through a forest tract. Some transects ran towards the reservoir while the others were away from it. Plot II was abandoned after January, 1983 as the whole area was donned with eucalyptus plantations resulting in total absence of birds due to loss of cover and food in the area. The data analysis hence was confined to only 7 plots.

All observations were made on foot during day time between 0700-1200 h and were aided by a 7 × 50 binoculars. During each observation the name of the bird species and the number of birds sighted were recorded. Ali's (1949, 1969 and 1977) books helped easy identification of birds in the field. Scientific names of birds follow Ali and Reply (1970, 1978 and 1981). Other details such as location of bird - whether on the ground or on shrub or tree and the name of the tree species when known were also noted. Besides, the aquatic birds in the reservoir were as also recorded by survey in a mechanised boat. These, however, were not included in the calculations. A total of over 320 h was spent in data collection from February, 1982 through April, 1983.

The following diversity indices were calculated in each plot and comparisons made.

i) Simpson' index :

$$D = \frac{N\,(N-1)}{\Sigma n\,(n-1)}$$

where, D = the diversity index

N = total no. of individuals of all species

n = number of individuals of a species

ii) Shannon-Weaver index :

$$H' = p_i \log p_i\, H$$

where, $$p_i = \left(\frac{n_i}{N}\right)$$

Where, p_i =

n_i = the number of individuals of a species

N = total number of individuals of all species (Smith, 1980).

RESULTS

Species composition and abudance : A total of 108 bird species were observed in the study area including the birds present in the reservoir (Appendix 1). The total number of species recorded in different plots during the study period varied from11 (plot

II) to 62 (plot VIII). The regression for the number of species versus total number of individuals showed a high positive correlation (r=0.93, fig. 2). 53 observations in all plots showed a mean of 17.04 ± 1.51 species and a mean of 53.33 ± 5.29 individuals. The number of species averaged between 14.86 ± 1.66 (plot I) and 22.17 ± 1.15 (plot VII) while the individuals' average varied from 35.42 ± 5.23 (plot IV) to 75.67 ± 4.89 (plot VII) (Table 2). The variation in the species and number of individuals was significant for different plots and also in different months (Tables 3 & 4). The maximum number of species recorded during a visit was 55 in December,1982 while the minimum was 20 in August, 1982 in all plots. The relative abundance of birds is shown in fig. 3. The maximum number of birds observed during the period of a single visit was 110 (plot VII) in February, 1983 while the minimum was 6 (plot VIII) in August, 1982.

Diversity indices : The values of Simpson' index of diversity varied from 13.21 (plot I) to 42.75 (plot VII), while Shannon' index (H') ranged between 1.63 (plot I) and 6.09 (plot VII) (Table 2). Both indices, however, showed similar tendency in different plots. Plot IV which had only 33 species occupied fourth rank while those having more species occupied subsequent ranks. The diversity indices constitute both the number of species and the total number of individuals and depends upon a variety of combinations of species richness evenness. This makes it difficult to offer a proper explanationas to why it has a higher value of diversity than the plots having greater number of species.

Species composition - similarity between plots : Similarity matrices were obtained by considering the number of species common in between two plots (Odum, 1971; Smith, 1980). These matrices were used to draw dendrogram (Cody, 1974) for comparison. Plots I and V showed the maximum similarity with a value of 0.8 (Fig. 4). These were followed by plots VII, VI, III, VIII, and IV in that order.

Species distribution in the habitat : 92% of the sightings were on the vegetation while 4% were in open areas and 2% on the ground (n=1163). On vegetation, 85% of the sightings were on trees while only 7% were on shrubs. The distribution of sightings of some of the common bird species is shown in fig. 5. Except for the Blackheaded Munia, majority of the sightings of the rest of the birds were on tree vegetation. A few birds such as Redwhiskered Bulbul *(Pycnonotus jocosus)*, Crowpheasant *(Centropus sinensis)*, Paradise Flycatcher *(Terpsiphone paradisi)* were equally sighted on shrub vegetation. Species which dwell on the ground were very few.

DISCUSSION

Each species is adapted to a habitat niche through which the biological needs such as food, cover and water are derived (Thomus, 1979). Any modification, however small in dimension, in a habitat may lead conditions that discourage or encourage a species' existence. Järvinen and Väisänen (1979) have stated that birds constitute a good monitoring tool on account of their ecological diversity despite their limited energetical

role in most habitats. They also vary in their tolerance towards human disturbance, some are jarmed by the impact of man while others respond favourably even to extreme environmental changes. Basically birds of forest and grassland choose their havitats on the basis of density of leaves at different elevations above the ground (Smith, 1980). In the present study, birds such as Hill Myna, Malabar Grey Hornbill, Malabar Trogon, many species of flycatchers, cuckoos, thrushes and pigeons were only a few to mention that were seen only in thick and tall tree vegetation. These presumbaly are more easily effected by changes brought by man. Birds such as Redwhiskered Bulbul, Black Drongo seem to tolerate greater change in the vegetation as shown by their presence in all habitats.

The distribution of bird species depends upon the vegetation characteristics. This is clear by the fact that the study plots which consisted more or less similar vegetation structure showed more bird species in common. Plot II which had the least number of species contained more grassland area with few trees distributed here and there. In plot IV despite thick band of trees there were not as many species as in other plots which may be due to impenetrable shrub and poor light conditions. Although plot VIII recorded the maximum number of species (62), the overall diversity in plot VII was greater. Plot VII, situated by the road side had a thick stand of trees as well as shrubs along the road side thus creating more edge and also had better light penetration. Human disturbance here was comparatively less. Probably due to these factors there was abundant bird fauna resulting in greater values of diversity.

Ferguson and Bourdillon (1903, 1904) reported 332 bird species in different hill ranges of Western Ghats of Kerala. Comparison of this report with the list of birds of Idukki hydroelectric project area could not made, for the present study represents only a small area. An appendix, however, with bird species of the study area is provided showing the common or scientific names of birds that were given by Ferguson and Bourdillon (1903, 1904).

As no scientific data are available on the status of birds of Idukki during the pre-dam period, it became rather difficult to pinpoint the impacts on birds. Since the commencement of our work a number of changes, however, had been witnessed. For example, in plot VI the changes in the bird population were relatively small till January,1983. In this area, which was apparently chosen for rehabilitation of people from other areas of Idukki hydel project, tree felling was started on a large scale resulting in the total loss of cover. Thus due to more openness perching place as well as food for birds was totally lost. With the felling operations still on, one could easily guess what would remain in this area after some time.

Besides this, certain observatrions made outside the study plots in the study area are given below.

1. The birds Darter *(Anhinga rufa)*, Little Cormorant *(Phalacrocorax niger)*, Cattle Egret *(Bubulcus ibis)*, Little Egret *(Egretta garzetta)*, Common Sandpiper *(Tringa*

hypoleucos, and Night Heron *(Nycticorax nycticorax)* were observed in the reservoir. This is considered a favourable impact based on our enquiries with the local people who, apparently, did not see these brids before the reservoir came into being.

2. Large scale deforestation for construction of quarters for the staff of the project and later for the house construction by the immigrants in the area led to the total elimination of birds that preferred tree vegetation. This, however, had favoured birds such as House Crow *(Corvus splendens)* and House Sparrow *(Passer domesticus)* to dominate.

3. Creation of openings in a forest stand, as for example for laying transmission lines through a forest, led to the succession of bushy vegetation mostly dominated by exotic weeds such as *Lantana camera, Eupatorium ordoratum* etc. The dominance of Redwhiskered Bulbul *(Pycnonotus jocosus)*, Tailor Bird *Orthotomus sutorius)* and other warblers, Chestnutheaded Bee-eater *(Merops leschenaulti)* and House Swift *(Apus affinis)* in this vegetation type denote their preference to such a habitat.

4. The obstruction of river waters due to dam construction facilitated cultivation of paddy crop in the river bed of Periyar and Cheruthoni. This attracted birds such as Pond Heron *(Ardeola grayii)* and Whitebreaseted Kingfisher *(Halcyon smyrnensis)*.

SUMMARY

Studies on bird populations of Idukki hydel project area showed a great variation in different plots in different months. The total number of species recorded in 8 study plots varied between 11 and 62. The maximum number of birds observed during a visit was 110 in February, 1983, while the minimum was 6 in August, 1982. The differences in species composition and abundance were mainly due to the differnces in the vegetation structure and the amount of human disturbance in different plots. 85% of the sightings were recorded on the tree vegetation. The diversity indices and similarity with respect to species composition in between various plots were given. The presence of 6 bird species in the reservoir, apparently not noticed during the pre-dam period, was accounted for a positive impact of the reservoir. Based on the present data the other impacts were assessed.

ACKNOWLEDGEMENTS

It gives me great pleasure to acknowledge the facilities extended by Dr. P.T. Cherian, Officer-in-Charge, Idukki Project, ZSI, Cochin. All my colleagues in the project, particularly, Dr. Anil Wason, Dr. P. Gopinath and Dr. T.C. Khatri have been a source of encouragement in the present work. I have greatly benefitted from Sri K. Krishna Rao, Scientist'C', CIFT, Cochin in the statistical calculations and Dr. Vatsavaya S. Raju, BSI, Coimbatore, in the identification of plant species. Tahnks are also due to the Department of Environment, New Delhi, for the financial assistance for the research work.

REFERENCES

Ali, S. 1949. *Indian Hill Birds.* Oxford Univ. press, Delhi. 188 p.

Ali, S. 1969. Birds of Kerala. 2nd Ed. Oxford Univ. Press, London. 444 p.

Ali, S. 1977. *The Book of Indian Birds.* 9th Ed. Bombay nat. Hist. Soc., Bombay. 175 p.

Ali, S. & Ripley, S.D. 1970. *Handbook of the Birds oif India and Pakistan.* Oxford Univ. Press, Delhi. Vol. 4, 265 p.

Ali, S. & S.D. Ripley, 1978. *Handbook of the Birds of India and* Pakistan. Oxford Univ. Press, Delhi. Vol. 1, 384 p.

Ali, S. & Ripley, S.D. 1981. *Handbook of the Birds of india and Pakistan.* Oxford Univ. Press, Delhi. Vol. 3, 327 p.

Cody, M.L. 1974. *Competition and Structure of Bird Communities.* Princeton Univ. Press, Princeton. 218 p.

Ferguson, H.S. & T.F. Bourdillon, 1903. The birds of Travancore with notes on nidification. *J. Bombay nat. Hist. Soc.* **15** (2) : 249-264.

Ferguson, H.S. & T.F. Bourdillon, 1904. The birds of Travancore with notes on nidification. *J. Bombay nat. Hist. Soc.* **15** (3) : 455-474; **15** (4) 654-673; **16** (1) : 1-18.

Järvinen, O. & R.A. Väisänen, 1979. Changes in the bird populations as criteria of environmental changes. *Holarct. Ecol.* **2** : 75-80.

Odum, E.P. 1971. *Fundamentals of Ecology.* 3rd Ed. W.B. Saunders Company, Philadelphia. 574 p.

Smith, R.L. 1980. Ecology and Field Biology. 3rd Ed. Harper and Row Publishers, New York. 835 p.

Thomus, J.W. 1979. *The Blue Mountains of Oregon and Washington.* p.10-22. *In* J.W. (ed.) *Wildlife Habitats in Managed Forests.* Agriculture Hand Book No. 553. U.S. Govt. Printing Office, Washington.

APPENDIX 1

Bird Species of Idukki Hydroelectric Project Area

S.No.	Order	Family	Species	English Name
1.	Podicipitiformes	Podicipedidae	*Podiceps ruficollis* (Pallas)	+ Dabchick[o]
2.	Pelecaniformes	Phalacrocoracidae	*Phalacrocorax niger* (Vieillot)	+ Little Cormorant[o]
			Anhinga rufa (Daudin)	+ Darter[o]
3.	Ciconiiformes	Ardeidae	*Nycticorax nycticorax* (Linn.)	+ Night Heron[o]
			+ *Ardeola grayii* (Sykes)	Pond Heron[o]
			Bulbulcus ibis (Linn.)	+ Cattle Egret[o]
			Egretta garzetta (Linn.)	+ Little Egret[o]
4.	Falconiformes	Accipetridae	+ *Spizaetus girrhatus* (Gmelin)	Crested Hawk-Eagle[b]
			+ *Hieraaetus pennatus* (Gmelin)	Booted Hawk-Eagle[o]
			+ *Haliastur indus* (Boddaert)	Brahminy Kite[o]
			Accipiter badius (Gmelin)	+ Shikra[e]
			+ *Elanus caeruleus* (Desfontaines)	Blackwinged Kite[f]
			+ *Ictinaetus malayensis* (Hodgson)	Black Eagle[f]
5.	Galliformes	Phesianidae	+ *Gallus sonneratii* Temminck	Grey Junglefowl[f]
6.	Charadriformes	Charadridae	*Tringa hypoleucos* Linn.	+ Common Sandpiper[o]
7.	Columbiformes	Columbidae	*Treron pompadora* (Jerdon)	+ Greyfronted Green Pigeon[g]
			Ducula badia (Raffles)	+ Maroonbacked Imperial Pigeon[g]
			+ *Chalcophaps indica* (Linn.)	Emerald Dove[g]
			Streptorpelia chinensis (Scopoli)	+ Spotted Dove[e]

S.No.	Order	Family	Species	English Name
8.	Psittaciformes	Psittacidae	*Psittacula karmeri* (Scopoli)	+ Roseringed Parakeet[g]
			P. columboides (Vigors)	+ Bluewinged Parakeet[a]
			P. cyanocephala (Linn.)	+ Blossomheaded Parakeet[g]
			+ *Loriculus vernalis* (Linn.)	Lorikeet[d]
9.	Cuculiformes	Cuculidae	*Cacomantis merulinus* (Scopoli)	+ Plaintive Cuckoo[f]
			C. Sonneratii (Latham)	+ Baybanded Cuckoo[f]
			+ *Centropus Sinensis* (Stephens)	Crowpheasant[c]
10.	Strigiformes	Strigidae	+ *Glaucidium radiatum* (Tickell)	Barred Jungle Owlet[o]
11.	Apodiformes	Apodidae	*Apus affinis* (J.E. Grey)	+ House Swift[g]
12.	Trogoniformes	Trogonidae	+ *Harpectes fasciatus* (Gould)	Malabar Trogon[f]
13.	Coraciformes	Alcedinidae	+ *Halcyon smyrnensis* (Linn.)	Whitebrasted Kingfisher[o]
			Alcedo atthis (Linn.)	+ Small Blue Kingfisher[f]
			Ceryle rudis (Linn.)	Pied Kingfisher[o]
		Meropidae	*Merops orientalis* Latham	+ Small Green Bee-eater[f]
			M. leschenaulti Vieillot	+ Chestnutheaded Bee-eater[e]
		Coracidae	*Coracias benghalensis* (Linn.)	+ Roller[e]
		Upupidae	*Upua epops* (Linn.)	+ Hoopoe[e]
		Bucerotidae	*Tockus griseus* (Latham)	+ Malabar Grey Hornbill[b]
14.	Piciformes	Capitonidae	*Megalaima viridis* (Boddaert)	+ Small Green Barbet[a]
			M. haemacephala (Muller)	+ Crimsonbreasted Barbet[b]
			M. rubricapilla (Gmelin)	+ Crimsonthroated Barbet[b]

S.No.	Order	Family	Species	English Name
		Picidae	*Dinopium benghalense* (Jerdon)	+ Goldenbacked Woodpecker[a]
			Dryocopus javenensis (Jerdon)	+ The Malabar Great Black Wood-pecker[e]
			Picoides mahrattensis (Latham)	+ Yellowfronted Pied OR Mahratta Woodpecker[g]
			+ *Picumnus innominatus* Hartert	Southern Speckled Piculet[g]
			+ *Hemicircus canente* (Lesson)	Heartspotted Woodpecker[g]
15.	Passeriformes	Pittidae	+ *Pitta brachyura* (Linn.)	Inidan Pitta[f]
		Hirundinidae	*Hirundo concolor* Sykes	Dusky Crag Martin[o]
		Laniidae	*Lanius schach* Linn.	Southern Greybacked Shrike[g]
		Oriolidae	*Oriolus oriolus* (Linn.)	Golden Oriole[c]
		Dicruridae	+ *Dicrurus adsimilis* (Bechstein)	Black Drongo[a]
			+ *D. paradiseus* (Linn.)	Racket-tailed Drongo[a]
		Sturnidae	+ *Acridotheres tristis* (Linn.)	Indian Myna[g]
			+ *A. fuscus* (Wagler)	Jungle Myna[c]
			Gracula religiosa Linn.	Hill Myna[d]
			+ *Sturnus malabaricus* (Gmelin)	Greyheaded Myna[d]
		Corvidae	+ *Corvus splendens* Vieillot	House Crow[o]
			+ *C. macrorhynchos* Wagler	Jungle Crow[f]
			+ *Cendrocitta leucogastra* Gould	Whitebellied Tree Pie[d]
		Campephagidae	*Coracina melanoptera* (Ruppell)	Blackheaded Cuckoo-Shrike[e]
			+ *Hemipus picatus* (Sykes)	Blackbacked Pied Flycatcher Shrike[e]
			+ *Tephrodornis* sp.	Wood Shrike[c]
			+ *Pericrocotus flammeus* (Forster)	Scarlet Minivet[a]
			+ *P. cinnamomeus* (Linn.)	Small Minivet[g]
		Irenidae	*Chloropsis aurifrons* (Temminck)	+ Goldfronted Chloropsis[b]
			+ *Aegithina tiphia* (Linn.)	Iora[f]
			+ *Irena puella* (Latham)	Fairy Bluebird[b]

S.No.	Order	Family	Species	English Name
		Pycnonotidae	*Pycnonotus jocosus*(Linn.)	+ Redwhiskered Bulbul[b]
			P. cafer (Linn.)	+ Redvented Bulbul[f]
			+ *P. melanicterus* (Gould)	Rubythroated Bulbul[b]
			Hypsipetes indicus (Jerdon)	Yellowbrowed Bulbul[a]
			H. medagascariensis (Muller)	+ Black Bulbul[f]
		Musciapidae	*Turdoides striatus* (Dumont)	+ Jungle Babbler [f]
			T. subrufus (Jerdon)	+ Rufous Babbler[f]
			Dumetia hyperythra (Franklin)	Rufousbellied Babbler[g]
			Alcippe poioicephala (Jerdon)	Quaker Babbler[g]
			Pomatorhinus schisticeps Hodgson	+ Slatyheaded Scimitar Babbler[a]
			Terpsiphone paradisi (Linn.)	+ Paradise Flycatcher[d]
			Monarcha azurea (Boddaert)	+ Blacknaped Blue Flycatcher[g]
			Muscicapa thalassina Swainson	+ Verditer Flycatcher[d]
			M. tickelliae (Blyth)	Tickell's Blue Flycatcher[g]
			M. albicaudata Jerdon	Nilgiri Verditer Flycathcher[f]
			+ *Culcicapa ceylonensis* (Swainson)	+ Greyheaded Flycatcher[b]
			+ *Orthotomus sutorius* (Pennant)	Tailor Bird[d]
			+ *Prinia socialis* Sykes	Ashy Wren-Warbler[g]
			Prinia sp.	Wren-Warbler[o]
			Sylvia hortensis (Gmelin)	Orphean Warbler[g]
			Turdus merula Linn.	+ Blackbird[e]
			Saxicola caprata (Linn.)	+ Pied Bushchat[g]
			+ *Myiophoneus horsefieldii* (Vigors)	Malabar Whistling Thrush[f]
			Zoothera citrina (Latham)	+ White-throated Ground Thrush[e]
			Monticola solitarius (Linn.)	+ Blue Rock Thrush[g]
			+ *Copsychus saularis* (Linn.)	Magpie Robin[o]

S.No.	Order	Family	Species	English Name
		Paridae	*Parus major* Linn.	+ Grey Tit[e]
			P. xanthogenys Vigors	+ Yellowcheeked Tit[f]
			Parus sp.	Whitewinged Black Tit ?[g]
		Sittidae	+ *Sitta frontalis* Swainson	Velvetfronted Nuthatch[b]
			S. castanea Lesson	Chestnutbellied Nuthatch[g]
		Matacillidae	*Anthus novaeseelandiae* Gmelin	+ Paddy field Pipit
			+ *Motacilla alba* Linn.	Hodgson's Pied Wagtail[g]
			M. indica Gmelin	+ Forest Wagtail[g]
			+ *M. maderaspatensis* Gmelin	Large Pied Wagtail[g]
			M. capsica (Gmelin)	+ Grey Wagtail[e]
			M. flava Billberg	Greyheaded Wagtail[g]
		Dicaedae	*Dicaeum Agile* (Tickell)	Thickbilled Flowerpecker[g]
			+ *D. erythrorhynchos* (Latham)	+ Tickell's Flowerpecker[f]
		Nectarinidae	*Nectarinia asiatica* (Latham)	+ Purple Sunbird[a]
			N. zeylonica (Linn.)	+ Purplerumped Sunbird[a]
		Zosteropidae	+ *Zosterops palpebrosa* (Temminck)	White-eye[b]
			+ *Passer domesticus* (Linn.)	+ House Sparrow[o]
			Lonchura malacca (Linn)	+ Blackheaded Munia[e]

* Occurrence in Plots : a = all plots; b = 7 plots; c = 6 plots; d = 5 plots; e = 4 plots; f = 3 plots; g = 2 plots and less; o = outside the plots.

+ Reference to the bird listed by Ferguson and Bourdillon (1903 and 1904)