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A SURVEY ON THE HABITAT AND DISTRIBUTION OF STREAM FISHES IN THE KERALA PART OF NILGIRI BIOSPHERE RESERV

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ABSTRACT

A survey of freshwater fishes was conducted in Kerala part of Nilgiri Biosphere Reserve during 1993-'95. The major river systems - Kabani. Vythiripuzha, Chaliyar, Kunthi and Bhavani were visited and fishes collected using conventional and traditional methods. Physical features of the habitat were qualitatively assessed. Water quality parameters were estimated using standard techniques. Dietary analyses of the most common species were made. A questionnaire suruey was conducted among the tribals to understand the traditional fishing methods and to assess their dependence on fish resources.

A total of 91 species were recorded from the rivers in Kerala part of Nilgiri Biosphere Reserve. Kabani and Vythiripuzha harbours 58 species followed by Chaliyar with 50. Twenty four species were recorded from Bhavani and 10 from *Kunthi river. Two new species of fishes,* ***Pangio bashai*** *and* ***Homaloptera menoni*** *were described from Chalikkal and Muthikkulam respectively. New additions to the freshwaters of Kerala and range of extensions were also recorded. Freshwater fishes in the area included 25 species endemic to Western Ghats and five endangered ones. Water quality parameters were within the optimal ranges in most of the areas. The dietary analyses of selected fishes revealed that majority of them were benthic insectivores. The tribals of the area depend heavily on the fish resources for own consumption. Fishing methods employed by the tribals are largely destructive to the aquatic system. Major threats to the aquatic fauna in general and the fishes in particular are the unscientific and non-sustainable methods of fishing and pollution due to biotic factors.*

1. INTRODUCTION

Biodiversity conservation necessitates knowledge on the diversity of animals and plants, their distribution and status. Western Ghats with a variety of vegetation types, climatic zones and remarkable endemism is considered to be one of the hot spot areas for conservation. Kerala part of Western Ghats is the source of forty four rivers of which three are east flowing. Damming the rivers for irrigation and hydro-electric projects, introduction of exotic fishes in reservoirs, pollution of major aquatic systems and recent outbreak of diseases generated greater concern of the native fish fauna among the conservationists.

Study on the freshwater fishes of India dates back to 1822 when Hamilton-Buchanan published his *Account of the fishes found in the river Ganges*. Later, Jerdon (1848) published his work on the fishes of South India especially Cauvary river. But, a comprehensive and authoritative account on the fishes of Indian region was published only during 1875-1878 and 1889 by Francis Day. During the intervening hundred years, there was nothing substantially published to fill the lacuna. Recent publications by Mishra (1976), Jayaram (1981a). Datta Munshi and Srivastava (1988). Menon (1987 & 1992) and Talwar and Jhingran (1991) supplemented information on the freshwater fish fauna of India. In addition, information on the fauna of Western Ghats is also available from the publication by Day (1865). In general. studies on the fish fauna of Western Ghats outside Kerala is very few (Jayaram, 1981b and Jayaram et.al, 1982). Study on fresh water fishes of Kerala starts with Day's monumental classic works, *Fishes of Malabar* (1865) and *Fishes of India* (1889). The Travancore region was comparatively well explored (Pillay, 1929; John, 1936: Hora and Law, 1941: Hora & Nair, 1941; Chacko, 1948 and Silas, 1950 & 1952). Raj (1941a & b) described two new species from Periyar Tiger Reserve. Malabar region, especially the region north of Palghat gap remained underexplored. Hora (1942) described fishes in Wayanad and the adjacent areas. Silas (1951) listed the fishes of Anamalais and Nelliampathis. Mukerji (1931) and Rajan (1955) reported fishes of Bhavani and Remadevi and Indra (1986) described fishes of Silent Valley. Recently, Pethiyagoda and Kottelat (1994) described three new species of fishes from Chalakudy river.

The present study was taken up to document the distribution of fresh water fishes in Kerala part of Nilgiri Biosphere Reserve and to study various aspects of their habitat. It was also envisaged to study different methods of fishing by different communities and assessed major threats to the fauna in the area.

2. STUDY AREA

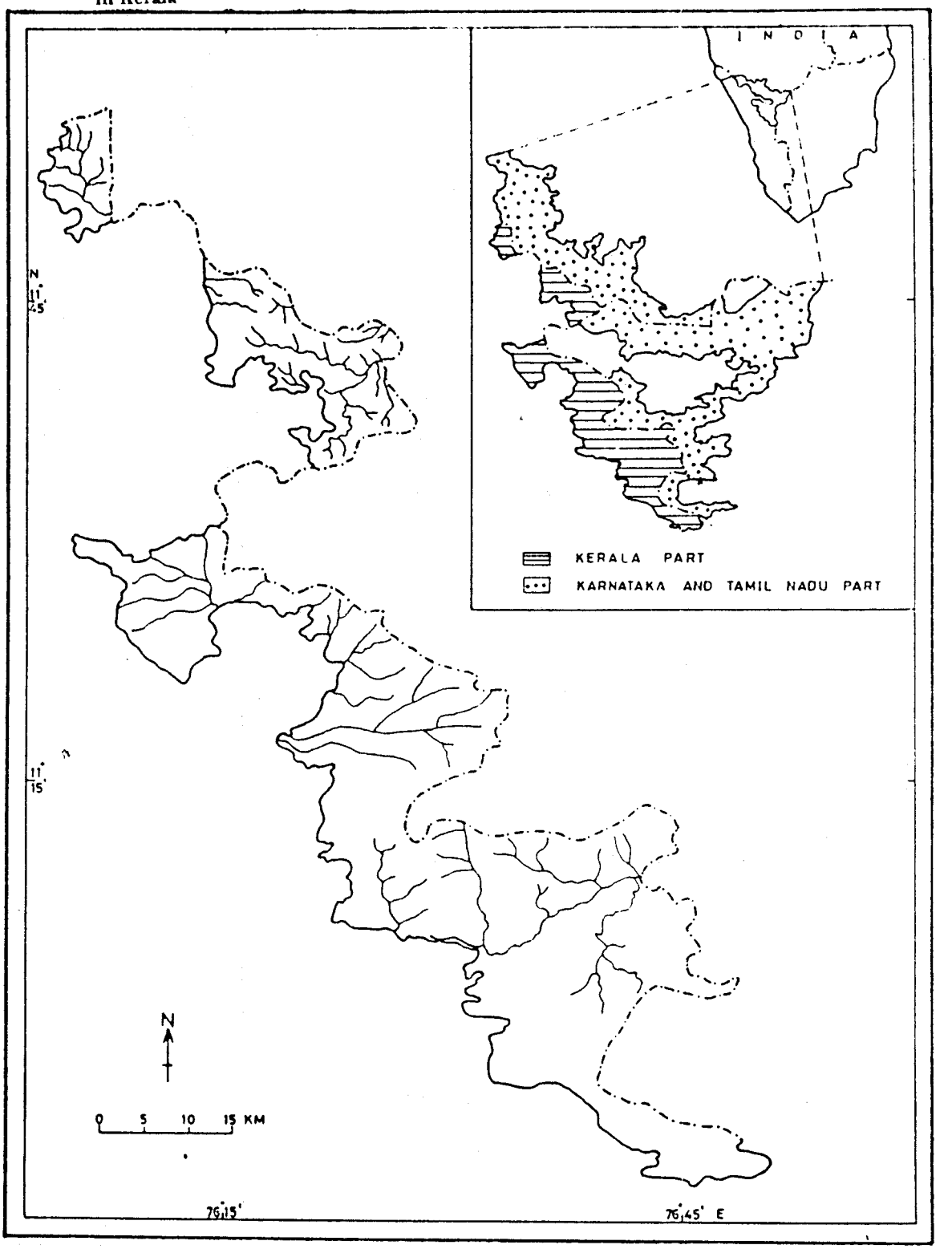
Biosphere Reserves are constituted to conserve representative ecosystems. Areas around the Nilgiri mountain and adjoining hills of Western Ghats, which include two of the biogeographic provinces namely the Malabar rain forests and the Deccan thorn forests were declared as Nilgiri Biosphere Reserve (NBR)in 1986. The Biosphere Reserve is aimed to conserve "Biological and Cultural" heritage of the above regions.

NBR is located in the south - west portion of Western Ghats, (north of Palghat gap between 10 45' and 12 5' N Lat. and between 76 10' and 77 10' E Long.), and is about 5500 Km^2 in extent (Fig.1)The geological evidences suggest that the underlying rocks are two billion years old. Topographic variations ranging from low lying valleys in the west to mountains over 2000 m and flat elevated table land of nearly 800-1000 m above the sea level in the east have resulted in diverse climatic vegetation zones. This leads to diverse type of habitats like tropical wet evergreen forests, tropical semi-evergreen forests, montane sholas with associated grasslands, moist deciduous and dry deciduous forests.

The northern part is formed by the Wayanad, Mysore. Sigur and Talamalai plateau with associated hills at a general elevation of 700-1000 m. On the west, the slopes constituting Nilambur, New Amarambalam and Silent Valley Reserves descend to 250 m in Calicut plains. To the south, the Attapadi plateau, Siruvani and Bolampatti hills show their own diverse topography from 1800 to 150 m in the Palghat gap. On the east, the Nilgiri slopes down to 250 m in the Coimbatore plains.

The Kerala part of Nilgiri Biosphere Reserve extends over an area of 1455 Km^2 encompassing Wayanad Wildlife Division, Silent Valley National Park, Mannarkkad. Nilambur North and South divisions. The Core zone forms about 240 Km^2. the Forestry zone 870 Km^2, the Tourism zone 100 Km^2 and the Restoration zone 246 Km^2. Vegetation types observed in the Nilgiri Biosphere Reserve of Kerala portion are tropical wet evergreen Forests,

Fig. 1 Nilgiri Biosphere Reserve showing the drainage systems in Kerala



tropical montane shola and grasslands, tropical semi-evergreen forests, tropical dry deciduous forests and tropical dry thorn forests.

2.1 WAYANAD

Wayanad is contiguous with Bandipur Tiger Reserve and Rajiv Ghandhi National Park of Karnataka and Mudumalai of Tamil Nadu (Fig.2). The total extent is about 1200 Km^2, of which 344 Km^2 form the Wayanad Wildlife Sanctuary. The eastern and western slopes of Wayanad plateau differ in topography and climate. The Wayanad plateau is at an elevation of 900-1600 m. The northern part, with an elevation of 700-1600 m differs from the south western slope of uneven peaks ranging from 1000-2000 m. The vegetation types include evergreen forests confined to the northern parts and deciduous forests in the areas bordering adjacent states. The natural forests are intervened with bamboo thickets and plantations of teak and eucalyptus.

The east flowing Kabani is the major river in the area. A number of rivulets and streams drain the area joining Kabani. The Western slope is drained by the west flowing Vythiripuzha joining Kuttiadi river.

2.2 NILAMBUR

Nilambur Reserve Forest is located in Malapuram district of Kerala (between 11 16' and 11 34' N Lat. and between 76 31' and 76 31' E Long.). The Reserve consists of evergreen and moist deciduous forests with intervening bamboo thickets. Teak plantations are seen in the areas nearer to habitations. It is drained by west flowing Chaliyar river with a number of tributaries (Fig.3).

2.3 SILENT VALLEY NATIONAL PARK

Silent Valley National Park, with an extent of about 89 Km^2. is located in the Palghat district of Kerala between 11 4' and between 11 13' N Lat. and between 76 24' and 76 29' E Long.). It is bounded by the Nilgiris and forests of Nilambur along the north and Attapadi Reserve forests along the south (Fig.4). Forests of Nilambur and Attapadi form the western and the eastern boundaries respectively. Major vegetation types consist of wet evergreen forests and montane grasslands and shola forests.

The drainage system is formed by the river Kunthi and its tributaries. Kunthi river is one of the major tributaries of the river Bharathapuzha. The stream, Ambalaparathodu, Thodu after Thondathodu and Thondakulam are not

Fig. 2 Drainage system in Wayanad

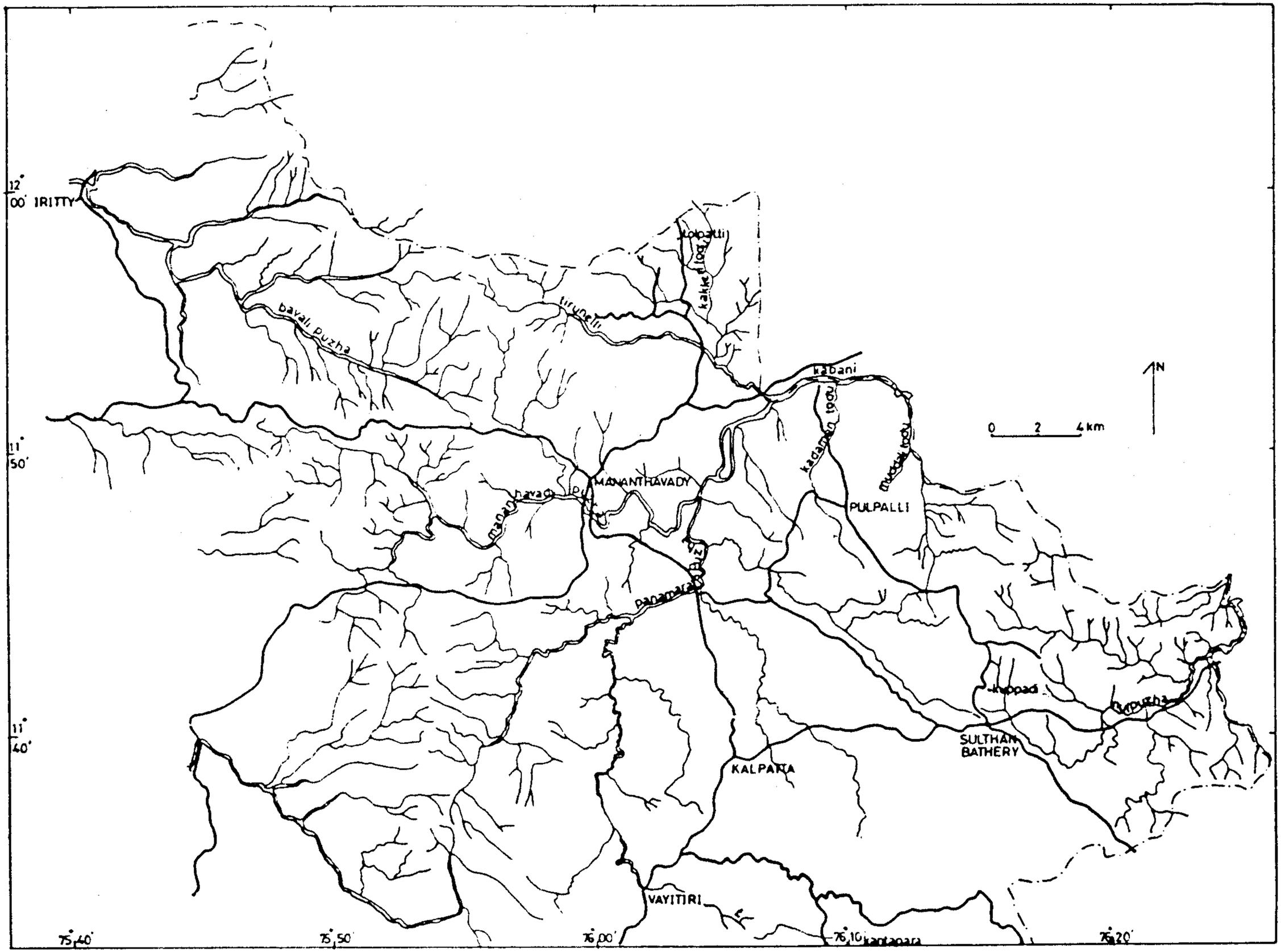


Fig. 3 Drainage system in Nilambur

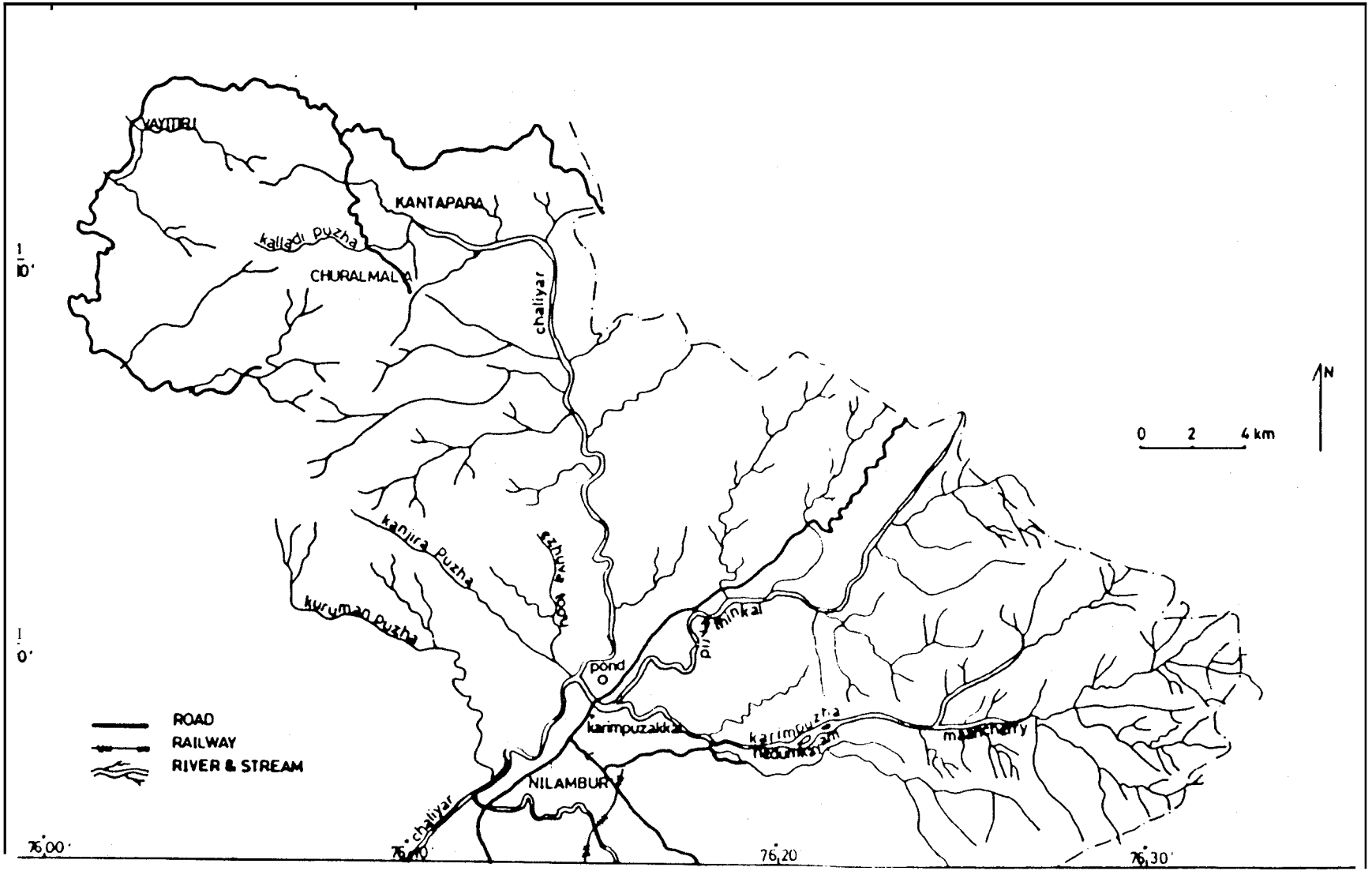
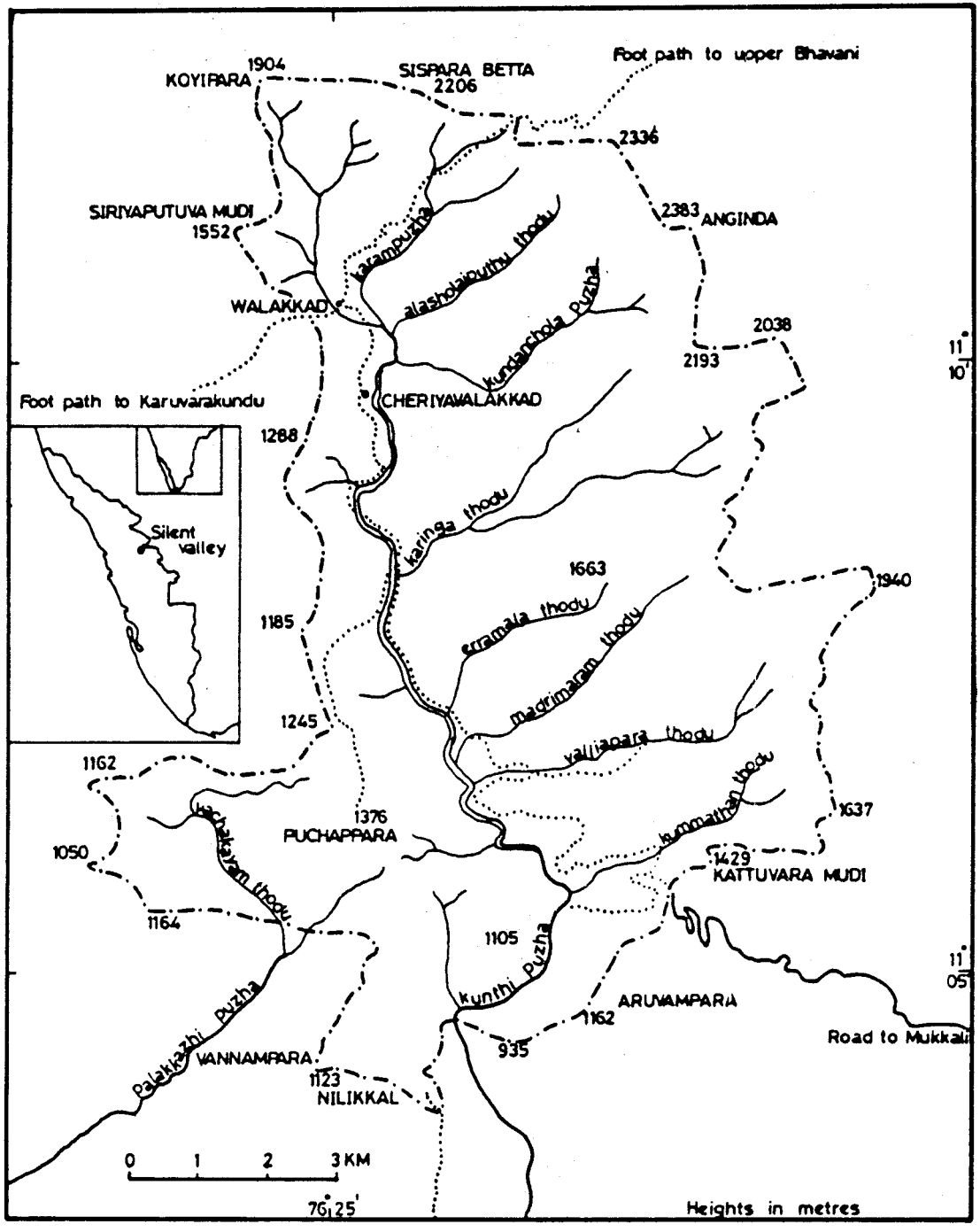


Fig. 4 Drainage system in Silent Valley



draining to Kunthi river. But the area falls under the Park and hence these are treated under Kunthi river system for the present study.

2.4 ATTAPAD1

Attapadi valley is situated in Palghat district between 10 55' and between 11 14' N lat. and between 76 27' and 76 48' E Long.). The area is bordered in the north by Nilgiri district of Tamil Nadu, in the west by Malapuram district, in the south by Palghat district, and in the east by Coimbatore district (TN) (Fig.5). The area is about 765 Km^2. The three major regions of the valley are the Valley proper, Nilgiri Range along the northern side of the valley and Vellingiri Range (Muthikkulam Reserve) on the southern side. The entire valley is rugged with a range of elevation from about 250-1700 m except for the eastern side where it is comparatively less undulating and gently sloping. Malleswaramalai (1664 m) is considered as the highest peak in the valley region. Nilgiri Range region has steep slopes and cliffs with the elevation ranging from 1600 m to 2300 m. The altitude varies from 750 m to 2100 m in the Vellingiri Range consisting largely broken hills.

The area is drained by two major rivers viz., Bhavani, originating from the Nilgiri Range and Siruvani, originating from Vellingiri Range. The river Bhavani flows southward upto Mukkali and then turns northward to Coimbatore district, while the river Siruvani joins Bhavani at Koodappatty (Menon, 1988).

2.5 MUTHIKKULAM-SIRUVANI

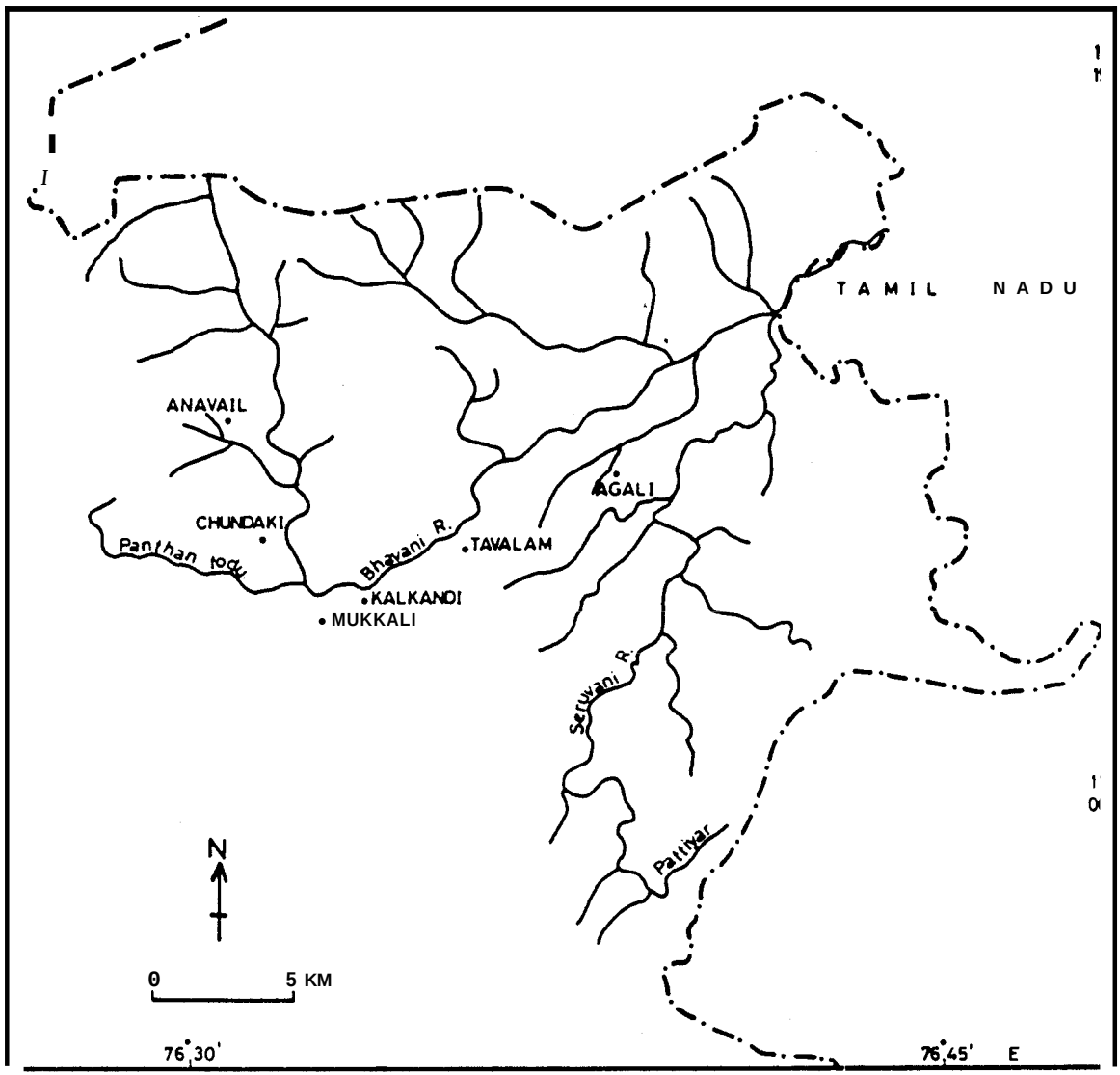
Muthikkulam Reserve (between 10 55' N to 11 03' N Lat. and between 76 35' to 76 41' E Long.) is situated on the Siruvani plateau of Palghat district and covers an area of about 64 Km^2. This Reserve is almost cut-off from north, east and west. Siruvani river forms the drainage system (Fig.5). Elevation ranges from about 600 m to 2065 m (Basha, 1987).

3. METHODS

3.1 SPECIES INVENTORY

Major rivers and streams were visited in different seasons during the year 1993-1995. Collection of fishes were made from different places along the

Fig. 5 Drainage system in Attappadi and Muthikulam



streams using scoop net, cast net and gill nets of varying mesh size. Conventional methods like bund making and sieving by clothes, practised by tribals were also employed in suitable areas. The fishes were preserved in 10% Formaldehyde with maximum care to avoid disgorgement or defecation of fishes due to stress during immediate transfer to Formaldehyde. Sufficient number of specimens of common and abundant fishes were taken for dietary analyses. The works of Day (1865 & 1878), Jayaram (1981a), Datta Munshi & Srivastava (1988) and Talwar and Jhingran (1991) were referred for identification. The Homalopterids and loaches were dealt under family Homalopteridae and Cobitidae instead of Balitoridae. In most cases, the current names are preferred. The *Gonoproktopterus* and *Neolissocheilus* (Talwar & Jhingran 1991) were treated under the genus *Puntius*.

3.2 HABITAT ANALYSES

Physical features of the habitat viz, width, depth, substrate distribution, canopy cover, land use pattern, nature of water, flow rate and disturbance were qualitatively assessed at the locations of collection . The flow rate was noted as 0 when the water was stagnant and 5 when it was fast flowing. Disturbances were noted in scales with 0 as no disturbance and 5 as very high. The chemical parameters of water such as the Dissolved Oxygen (DO) (Winkler's method), conductivity and temperature (Electronic conductivity - temperature meter WTH 0931) were measured in the field. Water samples were collected and analysed in the laboratory for alkalinity, total hardness, chloride and phosphate (APHA, 1985).

3.3 DIETARY ANALYSES

Nineteen species of fishes, which were most common and abundant were selected for dietary analyses. All specimens of each species were pooled and about twenty numbers of each ( ) if the specimens were limited in number) were selected representing all size classes. Each fish was treated individually for dietary analysis, cut open and gut removed. For each gut, the contents of the stomach or intenstine up to the first bend (if no stomach present) was removed to a glass slide and examined under a stereo dissection microscope. The entire food items were then immediately identified and estimated to the percentage volumes through biovolume method (Hynes, 1950).

The gut contents were classified into the following:

(1) Littoral vegetation and macrophytes (LITV), (2) higher terrestrial plant leaves and their remains such as seeds, flowers, etc. (TERP), (3) small algae including diatoms (SALG), (4) filamentous algae (FALG), (5)watermites (WMIT), (6)Chironomid larvae (CHIR). (7) Ephemeropteran larvae (EPHE). (8) Trichopteran larvae (TRIC),(9)insects of terrestrial origin like red ants, bIack ants etc. (ITEO),(10)adult aquatic insects (AAQI),(11) benthic microinvertebrates like Cladocerans (BEMI), (12) others including all other categories like Dipteran larvae other than Chironomids, Lepidopteran larvae (OTDI) and (13) Detritus (DETR).The presence of sand grains, clay particles,if any, in the diet was recorded.

3.4 FISHERY ACTMTIES OF TRIBALS

Kattunaikkans, Pathinaikkans. Cholanaikkans, Mullakurumar, Kurichiyar, Paniyar, Urali and Adiyans are the tribals residing near the streams in Kerala part of Nilgiri Biosphere Reserve. A questionnaire survey was conducted among the tribals residing in Maancherry, (Karulai), Nulpuzha, Kuruva, Mananthavady and Thirunelli. The questionnaire was scheduled to collect information on the involvement of the tribals on fishing, the species and the fishing method employed.

4. RESULTS

4.1 DESCRIPTION OF RIVER SYSTEMS

4.1.1 Kabani and Vythiripuzha

The east flowing Kabani and its tributaries form the major drainage system in Wayanad. Collections were made from fifteen locations in Kabani and tributaries. Of these, Kakkanthodu at Tholpetty and the streams near Vandikkadavu and Kuppadi were seasonal. All the streams pass mostly through forest areas for a long distance and the riparian vegetation was thick except for the sites at Panamaram, Kurichiat, Mananthavady and Kalloorthodu (Table 1). The riparian vegetation was mainly trees of higher

Table 1. Physical features in collection locations in Kabani and Vythiripuzha

SL No.	Location	Flow pattern	Width (Max.) m	Depth (Max.) cm	Vegetation	Substrate distribution in %							canopy %	Land use	distur-bance	Nature of water
						sand	mud	bed-rock	gravel	boulders	pebbles	cobbles				
1.	Nulpuzha	3	7.5	25	Trees	10	-	75	5	10	-	-	80	MDF	1	bnv
2.	Nalloorthodu	1	3.5	100	Trees	-	30	40	-	30	-	-	90	Agri. (Paddy, Ginger)	0	bnv
3.	Kurichiat	2	2.5	100	Herbs, shrubs, trees	25	75	-	-	-	-	-	-	MDF	0	bnv
4.	Vandikkadavu	1	4.0	50	Trees, Bamboo, Shrubs	20	20	-	30	30	-	-	60	MDF	1	bav
5.	Panamaram	4	10.5	70	Herbs, Shrubs, trees	80	20	-	-	-	-	-	-	Agri. (Paddy)	3	bnv
6.	Mananthavady	4	10.5	70	Shrubs, trees	30	30	-	40	-	-	-	-	Agri. (Paddy, Plantain)	2	bnv
7.	Chertyanaikatty	3	3.5	200	Trees, Bamboos	-	-	100	-	-	-	-	80	MDF	2	bnv
8.	Thirunelli	4	7.0	200	Trees, Shrubs	10	-	10	10	20	25	25	30	MDF, Agri. (Paddy)	2	c
9.	Naduthana	1	1.5	50	Trees, Shrubs, Bamboos	-	15	-	35	50	-	-	70	MDF	0	bnv
10.	Perikkallur	3	12.5	70	Trees, Bamboos	10	10	50	-	30	-	-	10	Agri. (Paddy, Banana)	2	bnv
11.	Vythiri	3	6.5	40	Trees, Shrubs	30	-	-	50	20	-	-	20	Agri. (PLN)	2	c/bv
12.	Kabani-Kuruva	4	12.5	60	Mango trees	60	5	20	5	-	10		20	MDF	2	bnv
13.	Kakeri	1	2.5	50	MDF, Shrubs, Trees	80	10		10				40	MDF	0	bnv
14.	Naikatty	1	2.5	50	Trees, Bamboos	-		95	-	5	-		60	MDF	0	bnv
15.	Kalloorthodu	1	2.5	50	Bamboos	80			20	-	-		-	Agri. (Paddy, Ginger)	3	bnv

Flow pattern : 0-Stagnant; 1-Very slow; 2-Slow; 3-Moderate; 4-Fast; 5-Turbulent
Disturbance : 0-No disturbance; 1-Very less; 2-Low; 3-Moderate; 4-High; 5-Very high
Land use : H-Habitation; A-Agriculture (mixed); F-Reserve Forest
Nature of water : C-Clear; bv-Bottom visible; bnv-Bottom not visible

taxonomic level. Land use pattern at collection locations were more or less uniform with either moist deciduous forests (MDF) or agricultural lands (Table 1). In most of the locations, MDF was associated with habitation or human settlements. The stream sections with less or no canopy had high water temperatures due to exposure to sunlight. whereas shading reduced the water temperature in sections with high percentage of canopy.

Sand, mud, gravel and boulders were the most abundant and common substrates in the east flowing streams (Table 1).The flow pattern at study locations were low to high with neither stagnant water nor high flow regimes. The major substrates in the west flowing streams in Vythiripuzhavaried from bed rocks to boulders (Table.l). The streams were with moderate riparian vegetation.

Most of the areas were disturbed due to unscientific fishing. retting of palm leaves and the drainage from agricultural fields. The streams were possibly polluted by the pesticides and herbicides from the nearby estates.

The results of estimation of the water quality parameters showed high conductivity in all the east flowing streams indicating high amount of dissolved solids (Table 2). High conductivity, alkalinity and total hardness were influenced by upland activities. Dissolved Oxygen was never found to be a limiting factor except at the stream at Naikatty (3.50mg/l).

4.1.2 Chaliyar river system

Chaliyar and its tributaries are perennial streams flowing through different types of vegetation (Table 3).Water was clear and visible in most of the sites. The riparian vegetation at most of the locations was highly degraded with little or no overhanging vegetation (Canopy 0-10%). The most dominant substrates in the study sites of Nilambur were sand and gravel. Highest disturbance was noted at chaliyar with fishing, sand excavation, laundering, bathing and washing of vehicles. The disturbance was least at Maancherry and Karimpuzha. The land use around the streams varied from forests to mixed agricultural land and settlements.

Conductivity, chloride, alkalinity, total hardness. dissolved oxygen and phosphate values were within optimal ranges except for some locations (Table 4). The high values at Poovathumkallu and Chalikkal may be due to increased disturbance and changes in the land use pattern. Among the sites in Nilambur, a relatively pristine condition prevailed at Maancherry and

Table 2. Water quality parameters at study sites in Kabani and Vythiripuzha

Sl. No.	Location	Dissolved oxygen (mg/l)	Conductivity (µS/cm)	Alkalinity (mg/1)	Total hardness (mg/1)	Chloride (mg/1)	Temperature (°C)	Phosphate (mg/1)
1.	Nulpuzha	6.50	980	24	34	10	23.9	7.4
2.	Nalloorthodu	6.70	1398	58	50	08	23.0	2.5
3.	Kurichiyat	5.70	1802	62	62	16	25.4	5.0
4.	Vandikkadavu	6.15	2600	96	98	18	27.6	7.4
5.	Panamaram	5.00	978	30	30	14	27.3	7.4
6.	Mananthavady	7.10	554	16	18	18	28.4	0.0
7.	Cheriyanaikatty	4.60	2660	90	92	26	25.6	0.0
8.	Thirunelli	6.50	351	14	10	08	26.3	0.0
9.	Naduthana	6.20	2210	86	76	18	23.6	10.0
10.	Perikkallur	5.60	1405	52	48	14	26.0	0.0
11.	Vythiri	6.50	411	14	14	12	30.0	3.4
12.	Kabani-Kuruva	5.80	1215	44	52	12	27.4	4.4
13.	Kakeri	8.10	2720	76	96	30	26.2	6.9
14.	Naikatly	3.50	1995	72	68	16	26.8	5.5
15.	Kalloorthodu	5.85	1625	50	50	16	30.5	7.4

Table 3. Physical features in collection locations in Chaliyar

Sl. No.	Location	Flow pattern	Width (Max.) m	Depth (Max.) cm	Vegetation	Substrate distribution in %							canopy %	Land use	distur-bance	Nature of water
						sand	mud	bed-rock	gravel	bould-ers	peb-bles	cob-bles				
1.	Chaliyar	1	150	100	Rubber, bamboo, trees, shrubs	100	0	0	0	0	0	0	10	H A	5	c/bnv
2.	Maancherry	4	30	110	MDF, bamboo, shrubs	0	0	45	5	30	10	10	10	F	1	c/bv
3.	Nedumkayam	3	40	80	shrubs, trees	15	0	15	5	45	10	10	0	F	2	c/bv
4.	Poovathumkallu	3	75	90	shrubs, trees	30	0	0	40	0	0	30	0	A	4	c/bv
5.	Kurumanpuzha	2	50	80	MDF, Agri. lands	15	0	0	30	20	0	35	0	F A	3	c/bv
6.	Chalikkal	3	90	50	shrubs, trees	10	0	0	20	30	20	20	10	H A F	3	c/bv
7.	Kanjirapuzha	3	35	20	trees, shrubs	0	0	90	0	10	0	0	0	F A	2	c/bv
8.	Karimpuzha	1	90	45	shrubs, trees	30	0	10	60	0	0	0	0	F A	1	c/bn
9.	Kanthampara	4	7	150	Trees, shrubs	-	-	5	10	85	-	-	30	E	2	c/bv
10.	Chooralmala	4	5	100	Trees, shrubs	5	-	50	10	35	-	-	40	E	2	c/bv

Flow pattern : 0-Stagnant; 1-Very slow; 2-Slow; 3-Moderate; 4-Fast; 5-Turbulent
Disturbance : 0-No disturbance; 1-Very less; 2-Low; 3-Moderate; 4-High; 5-Very high
Land use : H-Habitation; A-Agriculture (mixed); F-Reserve Forest
Nature of water : C-Clear; bv-Bottom visible; bnv-Bottom not visible

Table 4. Water quality parameters in collection locations in Chaliyar

Sl. No.	Location	Dissolved oxygen (mg/l)	Conductivity (µS/cm)	Alkalinity (mg/1)	Total hardness (mg/1)	Chloride (mg/1)	Tempe-rature (°C)	Phosphate (mg/1)
1.	Chalikkal	5.70	893	34	30	10	28.4	0.0
2.	Kurumanpuzha	6.45	516	18	16	10	31.3	3.0
3.	Maancherry	8.05	456	16	16	06	26.8	7.0
4.	Nedumkayam	6.95	606	22	20	10	32.5	6.0
5.	Karimpuzha	7.85	901	36	32	12	33.3	7.4
6.	Poovathumkallu	7.25	820	30	30	08	32.6	5.0
7.	Kanjirapuzha	7.80	428	18	14	10	29.0	3.0
8.	Chaliyar	6.25	910	34	32	14	29.2	6.2
9.	Kanthampara	7.90	827	28	30	12	28.3	0.0
10.	Chooralmala	6.70	330	12	14	08	26.2	0.0

Nedumkayam and also to some extent at Kanjirapuzha. In general, the water quality parameters were within safer limits without affecting much by point and/or nonpoint sources of pollution.

4.1.3 Kunthi river system

The Kunthi river system had unpolluted waters with undisturbed riparian vegetation having high canopy value (20-95%)except at Pathrakadavu (10%) and Kunthi at Sirendhri (10%). The river is passing through evergreen vegetation throughout its course(Tab1e 5). Bedrock, gravel, boulders and pebbles were the most dominant substrates in most of the study sites. The flow pattern varied from very slow to turbulent (Pathrakadavu). Water was never stagnant at any location.

The results of estimation of water quality parameters show low values of conductivity except in Neelikkal (402 S/cm) indicating the least amount of dissolved solids (Table 6). Phosphates in the streams varied from traces to high value at most of the study sites. All the other parameters like total hardness, temperature, chloride, alkalinity and dissolved oxygen were within the optimum range indicating least disturbance (Table 6).

4.1.4 Bhavani river system

Study sites in Bhavani river system were selecred from Anawai to Thavalam along the Bhavani nver and five sites along Siruvani river area. The land use pattern along the river varied from evergreen and moist deciduous forests to agricultural fields and wastelands (Table *7)*. Disturbance was moderate at most of the sites except at Anawai (nodisturbance). Bedrock, gravel, boulders, pebbles and cobbles formed the most abundant substrates in most of the study sites. Sand and mud were poorly represented. Canopy cover along the streams varied from 0 (Kalkandi and Thavalam) to 95% (Damsite and Sinkaparathodu).

The results of estimation of water quality parameters showed high conductivity (447-903 S/cm) indicating high amount of dissolved solids except at Sinkaparathodu where it was minimum (Table 8). The values of phosphates (0.00-5.00 mg/l), chloride (6-10 mg/l), alkalinity (10-18 mg/l), dissolved oxygen (5.4-7.5 mg/l) were within the safer levels. Total hardness observed at Kalkandi and Thavalam was high (52 mg/l each). This may be due to the proximity of stream to the habitation. The values were within safer levels at all other sites (Table 8).

Table 5. Physical features in collection locations in Kunthi river

Sl. No.	Location	Flow pattern	Width (Max.) m	Depth (Max.) cm	Vegetation	Substrate distribution in %							canopy %	distur-bance	Nature of water
						sand	mud	bed-rock	gra-vel	boul-ders	peb-bles	cob-bles			
1.	Neelikkal	1	1	50	Evergreen	-	-	10	-	-	90	-	90	0	c/bv
2.	Panchalithodu	4	5	100	Evergreen	-	-	5	5	20	70	-	50	0	c/bv
3.	Valiyaparathodu	4	3	100	Evergreen	-	-	5	10	10	75	-	50	0	c/bv
4.	Poochiparathodu	3	2	50	Evergreen	-	10	-	10	-	-	80	90	0	c/bv
5.	Thondakkulam	1	1	50	Evergreen	-	-	75	5	10	10	-	5	0	c/bv
6.	Thodu after Thondathodu	1	1	25	Evergreen	-	-	-	5	95	-	-	70	0	c/bv
7.	Ambalaparathodu	2	1	25	Evergreen	-	-	5	-	80	15	-	70	0	c/bv
8.	Poonchola	4	9	150	Evergreen	-	-	-	10	-	90	-	30	0	c/bv
9.	Cheriyawalakadu	4	3	75	Evergreen	-	-	3	2	80	15	-	20	0	c/bv
10.	Walakadu	4	3	100	Evergreen	-	-	60	5	25	10	-	65	0	c/bv
11.	Kunthi at Sirendhri	4	8	150	Evergreen	-	-	35	10	25	20	-	10	0	c/bv
12.	Kummathanthodu	3	5	50	Evergreen	-	-	15	5	80	-	-	25	0	c/bv
13.	Pathrakadavu	5	9	150	Evergreen	-	-	35	-	65	-	-	10	1	c/bv

Flow pattern : 0-Stagnant; 1-Very slow; 2-Slow; 3-Moderate; 4-Fast; 5-Turbulent
Disturbance : 0-No disturbance; 1-Very less; 2-Low; 3-Moderate; 4-High; 5-Very high
Land use : H-Habitation; A-Agriculture (mixed); F-Reserve Forest
Nature of water : C-Clear; bv-Bottom visible; bnv-Bottom not visible

Table 6. Water quality parameters in collection locations in Kunthi river

Sl. No.	Location	Dissolved oxygen	Conductivity	Alkalinity	Total hardness	Chloride	Temperature	Phosphate
		(mg/l)	(μS/cm)	(mg/1)	(mg/1)	(mg/1)	(^{o}C)	(mg/1)
1.	Neelikkal	5.1	402	14	12	10	21.6	0.00
2.	Panchalithodu	7.2	284	10	10	08	24.1	0.00
3.	Valiyaparathodu	7.3	316	12	10	08	23.8	5.00
4.	Poochiparathodu	7.0	263	10	08	06	22.8	0.00
5.	Thondakkulam	5.8	278	10	06	08	22.5	0.00
6.	Thodu after Thondathodu	6.1	329	12	10	08	21.9	2.40
7.	Ambalaparathodu	7.4	307	12	10	08	23.1	0.00
8.	Poonchola	6.4	272	10	08	08	25.4	7.40
9.	Cheriyawalakkadu	7.4	235	08	08	06	23.5	5.00
10.	Walakkad	7.5	207	12	08	06	24.3	0.00
11.	Kunthi at Sirendhri	7.0	279	12	08	06	26.2	0.00
12.	Kummathanthodu	7.1	398	16	14	10	23.5	0.00
13.	Pathrakadavu	7.9	252	10	08	06	24.3	2.40

Table 7. Physical features in collection locations in Bhavani river

Sl. No.	Location	Flow pattern	Width (Max.)	Depth (Max.)	Vegetation	sand	mud	bedrock	boulders	Gravel	pebbles	cobbles	Can-opy %	distur-bance	Nature of water
1.	Anaval	1	3.5	100	Evergreen	-	-	25	70	5	-	-	10	0	c/bv
2.	Chindakki	5	4.0	200	MDF	-	-	85	15	-	-	-	5	1	c/bv
3.	Kizhechindakki	1	4.0	150	MDF	-	-	-	20	5	75	-	10	3	c/bv
4.	Panthamthodu	3	6.0	25	Evergreen	15	-	-	10	-	75	-	30	0	c/bv
5.	Kalkandi	5	8.0	150	Agri. fields	10	-	-	-	5	85	-	0	3	c/bv
6.	Thavalam	2	9.0	150	Wasteland	-	5	-	-	-	95	-	0	3	c/bv
7.	Meppathur	1	8.0	200	Evergreen	-	-	-	80	20	-	-	50	3	c/bv
8.	Bhavani Mukkali	3	6.0	100	MDF	-	-	60	10	30	-	-	10	3	c/bv
9.	Pattiyar	1	2.0	50	MDF	-	-	5	-	-	95	-	10	2	c/bv
10.	Dam Site	2	1.0	50	MDF	-	-	-	20	-	80	-	95	3	c/bv

Flow pattern : 0-Stagnant; 1-Very slow; 2-Slow; 3-Moderate; 4-Fast; 5-Turbulent
Disturbance : 0-No disturbance; 1-Very less; 2-Low; 3-Moderate; 4-High; 5-Very high
Land use : H-Habitation; A-Agriculture (mixed); F-Reserve Forest
Nature of water : C-Clear; bv-Bottom visible; bnv-Bottom not visible

Table 8. Water quality parameters in collection locations in Bhavani river

Sl. No.	Location	Dissolved oxygen	Conductivity	Alkalinity	Total hardness	Chloride	Tempe-rature	Phosphate
		(mg/l)	(µS/cm)	(mg/1)	(mg/1)	(mg/1)	(°C)	(mg/1)
1.	Anavai	5.6	490	10	12	6	23.7	0.00
2.	Chundakki	7.6	565	10	30	6	23.7	5.00
3.	Kizhechundakki	7.4	552	12	30	6	24.1	5.00
4.	Panthamthodu	5.5	447	18	14	8	24.7	2.40
5.	Kalkandi	6.9	557	18	52	8	25.3	5.00
6.	Thavalam	5.4	685	18	52	10	26.8	5.00
7.	Meppathur	6.9	903	12	30	6	25.2	5.00
8.	Bhavani at Mukkali	7.2	567	16	36	8	26.2	4.00
9.	Pattiyar	6.9	667	08	06	6	25.3	5.00
10.	Dam Site	5.6	490	10	08	6	23.7	0.00
11.	Sinkaparathodu	7.5	247	10	06	6	23.3	0.00

4.2 SPECIES INVENTORY

4.2.1 Kabani and Vythiripuzha

A total of 58 species belonging to 17 families and 31 genera were collected from 15 locations from Kabani river and Vythiripuzha in Wayanad (Table 9). The streams in Wayanad support twenty five species endemic to Western Ghats. Most of the species like *Puntius melanampyx, Barilius gatensis, Danio malabaricus, Rasbora daniconius, Garra mullya* and *Lepidocephalus thermalis* were uniformly distributed and haw a wide distributional range extending throughout India and adjacent countries (Jayaram, 1981a, Talwar & Jhingran, 1991). *Osteochilus brevidorsalis, Labeo potail, poecilia reticulata, Noemacheilus nilgiriensis,* and *N. petrubanarescui* are new additions to Kerala. *Danio (brachydanio) rerio* is a new record for Kerala (Shaji and Easa, 1995). *Noemacheilus nilgiriensis* and *N. petrubanarescui are* new species described by Menon (1987) from Netravathi river at Dharmasthala. The present observation in Wayanad is the second report of their occurrence from a different locality.

Tilapia mossambica, Lubeo rohita, Cyprinus carpio communis and *Poecilia reticulata* are alien species and the exact time of mtroduction of these are not available from any source. All these species, except *Poecilia reticulata* thrive well in these streams and probably than the name ones.

Some of the species were observed only from the west flowing rivers. *Noemacheilus sinuatus,* a rare loach was observed only in Vythiri. The endemic, *Puntius wynaadensis* was also from the same locality.

Silurus wynaadensis, Noernacheilus striatus and *Clarias dayii* which were reported earlier from Wayanad could not be located during the present survey. The common and widely distributed species like *Channa marulius, C. striatus* and *Wallago attu* were very less in number. It might be due to the fish disease (Epizootic Ulcerative Syndrome) which was prevalent in the area recently.

The present survey indicates the richness of Wayanad in terms of fish diversity. The area supports two endangered ones and twenty five species endemic to Western Ghats. However, even the more widely distributed fishes were not abundant in most of the areas. Pollution due to retting of palm leaves, application of pesticides and insecticides could be the most important threats to the freshwater ecosystem of Wayanad. Further, the unscientific and destructive methods of collection using dynamite and poisonous plants may completely wipe out the fish communities in the long run.

Table 9. Distribution of fishes in different locations in Kabani and Vythiripuzha

Species	Nulpuzha	Thirunelli	Kakkari-thodu	Kabani	Vythiri	Kuppadi	Vandikadav	Perikkallur Pulpally	Manan-thavady	Pana-maram	Nalloor-thodu	Kurichiat	Cheriya-naikatty	Nadu-thana	Naikatty	Kalloorthodu
Family CYPRINIDAE																
Sub Family CYPRININAE																
1. *Cyprinus carpio communis*	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-	-
2. *Puntium amphibius*	-	-	-	+	-	-	-	-	+	+	-	+	-	-	-	-
3. *P. arulius arulius*	-	-	-	+	-	-	-	-	+	+	-	-	-	-	-	-
4. *P. carnaticus*	+	+	+	+	-	-	-	+	+	+	+	-	+	+	-	-
5. *P. chola*	-	-	-	+	+	-	-	-	+	+	-	-	-	-	-	-
6. *P. conchonius*	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
7. *P. melanampyx melanampyx*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
8. *P. melanostigma*	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
9. *P. micropogon*	+	-	-	+	-	-	-	-	+	-	-	-	-	-	-	-
10. *P. sarana subnasutus*	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11. *P. ticto ticto*	+	+	+	+	+	+	+	+	+	+	+	+	-	+	+	-
12. *P. ticto punctatus*	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13. *P. wynaadensis*	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
14. *Osteochilus brevidorsalis*	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15. *O. nashii*	+	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-
16. *Labeo potail*	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17. *L. rohita*	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
18. *L. ariza*	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub Family : RASBORINAE																
19. *Esomus danricus*	+	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
20. *Barilius gatensis*	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-

Species	Nulpuzha	Thirunelli	Kakkari-thodu	Kabani	Vythiri	Kuppadi	Vandikadav	Perikkallur Pulpally	Manan-thavady	Pana-maram	Nalloor-thodu	Kurichiat	Cheriya-naikatty	Nadu-thana	Naikatty	Kalloorthodu
21. *Danio malabaricus*	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-
22. *Danio rerio*	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
23. *Rasbora daniconius daniconius*	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
24. *Amblypharyngodon melettina*	+	-	-	+	-	-	+	-	-	-	-	-	-	-	-	-
Sub Family : CULTRINAE																
25. *Chela laubuca*	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26. *Salmostoma acinaces*	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
27. *S. boopsis*	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-
Sub Family : GARRINAE																
28. *Garra mullya*	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-
29. *G. gotyla stenorhynchus*	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
Family : CHANIDAE																
30. *Channa marulius Ham.*	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
31. *C. orientalis*	+	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-
32. *C. striatus*	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
Family : CYPRINODONTIDAE																
33. *Aplocheilus lineatus*	+	-	-	+	-	-	-	-	-	-	+	+	-	-	-	-
Family : POECILIDAE																
34. *Poecilia reticulata Peters*	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Family : HETEROPNEUSTIDAE																
35. *Heteropneustes fossilis*	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	Species	Nulpuzha	Thirunelli	Kakkari-thodu	Kabani	Vythiri	Kuppadi	Vandikadav	Perikkallur Pulpally	Manan-thavady	Pana-maram	Nalloor-thodu	Kurichiat	Cheriya-naikatty	Nadu-thana	Naikatty	Kalloorthodu
	Family : CLARIIDAE																
36.	*Clarias dussumieri*	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Family : SISSORIDAE																
37.	*Glyptothorax madraspatanum*	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Family : SILURIDAE																
38.	*Wallago attu*	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
39.	*Ompok bimaculatus*	+	-	+	+	-	-	+	-	-	-	-	-	-	-	-	+
	Family : BAGRIDAE																
40.	*Mystus armatus*	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	+
41.	*M. punctatus*	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
42.	*M. montanus*	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-
43.	*M. malabaricus*	+	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-
44.	*M. cavasius*	+	-	-	+	+	-	+	+	+	+	-	-	-	-	-	-
	Family : HOMALOPTERIDAE																
45.	*Bhavania australis*	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-
46.	*Balitora mysorensis*	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
	Family COBITIDAE																
	Sub Family : NOEMACHEILINAE																
47.	*Noemacheilus nilgiriensis*	-	-	+	-	-	-	-	-	-	-	-	-	+	+	+	-
48.	*N. semiarmatus*	+	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-
49.	*N. sinuatus*	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-
50.	*N. guentheri*	-	+	-	-	+	+	-	-	-	-	-	-	+	-	+	-
51.	*N. petrubanarescui*	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	Species	Nulpuzha	Thirunelli	Kakkari-thodu	Kabani	Vythiri	Kuppadi	Vandikadav	Perikkallur Pulpally	Manan-thavady	Pana-maram	Nalloor-thodu	Kurichiat	Cheriya-naikatty	Nadu-thana	Naikatty	Kalloorthodu
	Sub Family : COBITINAE																
52.	*Lepidocephalus thermalis*	+	+	+	+	+	+	+	+	+	+	-	-	+	+	+	-
	Family : CHANDIDAE																
53.	*Chanda ranga*	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
	Family : GOBIIDAE																
	Sub Family : GOBIINAE																
54.	*Glossogobius giuris giuris*	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-
	Family : NANDIDAE																
55.	*Pristolepis marginata*	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
	Family : MASTACEMBELIDAE																
56.	*Mastacembelus armatus*	+	-	-	+	+	-	-	-	+	+	-	-	-	+	+	-
	Family : NOTOPTERIDAE																
57.	*Notopterus notopterus*	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
	Family : CICHLIDAE																
58.	*Tilapia mossambica*	-	-	-	+	-	-	-	+	+	+	-	+	-	-	-	-

4.2.2 Chaliyar river system

A total of 50 species of 34 genera belonging to 21 families were recorded during the present study (Table 10).Most of these have already been reported from other parts of Kerala. However, the streams of Nilambur harbours four species endemic to Western Ghats (*Puntius denisonii, Osteobrama bakeri Batasio travancoria* and *Tetraodon travancoricus)* and a new species, Pangio bashai (Easa& Shaji, in Press).The earlier reports of Batasio travancoria and *Tetraodon travancoricus* were from Pamba river (Hora & Nair, 1941). *Osteobrama bakeri* was reported only from Kottayam of Travancore (Jayaram, 1981a). *Tetraodon travancoricus* has been recently reported from Trichur of central Kerala (Inasu, 1993). *Puntius denisonii* had been reported only from the High Ranges (John, 1936).The last report of occurrence of the endangered *Batasio travancoria* was from Anamalai. and Nelliampathy hill ranges (Silas,195l,Menon, 1993).Hence, the present record of these species from Nilambur extends its range further to the north of Palghat gap in Western Ghats. *Puntius ticto ticto, P. melanampyx, P.filamentosus, P. curmuca Garra mullya, Rasbora daniconius* and *Lepidocephalus thermalis* were more or less uniformly distributed in Nilambur.

Doryichthys cuncalus and *Euryglossa orientalis* were considered to be esturine species (Talwar & Jhingran, 1991).The former was recorded from Chaliyar and Chalikkal and, the latter from Chaliyar alone during the present survey. The occurrence of these species, especially *D.cuncalus* from Chalikkal, which is a tributary of Chaliyar river indicates that hill stream could also be a good habitat for the species. However, a detailed investigation is required to confirm their presence in the hill stream areas throughout the year.

Osteochilus nashii which has been reported only from the east flowing Cauvary river system (Talwar & Jhingran.1991) was collected from two entirely different locations in Nilambur. Occurrence of this species in the western slope of Western Ghats is zoogeographically significant. *Puntius filamentosus* and *Barilius bakeri* were the most abundant species in the area. These were followed by *Puntius ticto ticto* and *Rasbora daniconius*. The endemic and endangered were the least abundant. The major problems of conservation of the fish fauna in the area are pollution and unscientific method of fishing by poisoning and dynamiting. for local consumption This could be a reason for the rarity of even the common species. Controlling these factors would ensure conservation of the diverse fish fauna of Nilambur.

4.2.3 Kunthi river system

Eleven species were collected from Silent Valley National park (Table) during the present survey. Remadevi and Indra (1986) also reported eleven species from the area. These included two new species *Homaloptera pillai* and *Garra menoni*. Menon (1987) synonymised *Homaloptera pillai* with *Homaloptera montana* without any discussion. But from the morphometric and meristic characters, it is clear that the *Homaloptera pillai* is different from *H. montana* The type locality of *Garra menoni* is recorded as Walakkad. in the upper reaches of Kunthi river (Remadevi and Indra, 1986). However, it was collected from Panthamthodu during the present survey which is a tributary of Bhavani river. The present survey added Puntius *melanampyx* to the fauna of Silent Valley which is present only in Neelikkal tributary of river Kunthi. The loach *Noemacheilus triangularis* from Kunthi river system showed much variation from the same species collected from other locations. Eventhough the meristic and metric characters are same, the morphological characters like colour of the body and fin show marked variation from the type species.

4.2.4 Bhavani river system

The fishes of Bhavani river system have been reported by Mukerji (1931) and Rajan (1955). Rajan (1955) recorded forty five species from the head waters of Bhavani river. The present survey is limited to Kerala part and recorded nineteen species from Bhavani river and sixteen species from Muthikkulam Siruvani area. A total of twenty four species were recorded from Bhavani river system during the present survey (Table 12). *Homaloptera menoni* Shaji & Easa is a new addition from the Siruvani area (Shaji&Easa, 1995) and *Tilapia mossambica* and *Balitora mysorensis* are new additions to Bhavani river.

4.3 DIVERSITY OF FRESH WATER FISHES

4.3.1 Kabani and Vythiripuzha

In Wayanad, both east and west flowing river systems are present. Among the fifteen locations selected for the study, Nulpuzha was the richest in terms of diversity with 32 species(Fig 6). The Kabani stood second and harbours 28 species including the endangered *Pristolepis marginatus, Channa marulius, Wallago attu* and *Lubeo ariza* The introduced species like *Cyprinus carpio* communis and *Tilapia mossambica* thrive well in Kabani than the native ones. Mananthavady and Panamaram, major drainage of Kabani harbours 19 and 18 species respectively. Thirunelli stream with clear water and rocky sub-stratum supports 13 diverse species including the endemic

Table 10. Distribution of fishes in different locations in Chaliyar

	Species	Kanjira-puzha	Chalikkal	Kuruman-puzha	Maancherry	Nedum-kayam	Poovath-umkallu	Karimpuzha	Chaliyar-Edavanna	Pond at Nilambur	Chooral-malai	Kantham-para
	Family CYPRINIDAE											
	Sub Family CYPRININAE											
1.	*Osteobrama bakeri*	-	+	-	-	-	-	-	-	-	-	-
2.	*Osteochilus nashii*	-	-	-	+	-	+	-	-	-	-	-
3.	*Puntius melanampyx melanampyx*	+	-	+	-	-	-	+	-	-	+	+
4.	*P. denisonii*	-	-	-	-	-	+	-	-	-	-	-
5.	*P. filamentosus*	+	+	-	+	-	+	+	-	+	-	-
6.	*P. amphibius*	-	-	-	+	-	-	-	+	+	-	-
7.	*P. sarana subnasutus*	-	+	-	-	-	-	-	-	-	-	-
8.	*P. vittatus*	-	+	-	-	-	-	-	-	-	-	-
9.	*P. ticto ticto*	-	+	+	-	+	+	-	-	+	-	-
10.	*P. curmuca*	+	+	+	+	+	-	+	-	-	-	-
11.	*Tor khudree*	+	-	-	+	-	-	-	-	-	-	-
	Sub Family - CULTRINAE											
12.	*Salmostoma boopsis*	-	+	-	+	-	-	-	-	-	-	-
	Sub Family - GARRINAE											
13.	*Gara mullya*	+	+	+	+	+	-	-	+	-	+	+
14.	*G. gotyla stenorhynchus*	-	-	-	+	-	-	-	-	-	-	-
15.	*G. mcClellandi*	-	-	-	-	-	-	-	-	-	+	+

Table 10 Contd...

	Species	Kanjira-puzha	Chalikkal	Kuruman-puzha	Maancherry	Nedum-kayam	Poovath-umkallu	Karimpuzha	Chaliyar-Edavanna	Pond at Nilambur	Chooral-malai	Kantham-para
	Sub Family : RASBORINAE											
16.	*Esomus danricus*	-	+	-	-	-	+	-	-	-	-	-
17.	*Rasbora daniconius daniconius*	+	-	+	-	-	+	+	+	+	+	+
18.	*Barilius bakeri*	+	-	-	+	+	-	+	-	+	-	-
19.	*B. gattensis*	-	-	-	-	-	-	-	-	-	+	+
20.	*Amblypharyngodon melettina*	-	+	-	-	-	-	-	-	-	-	-
21.	*Danio malabaricus*	+	-	-	+	-	+	-	-	+	+	+
	Family : HOMALOPTERIDAE											
22.	*Bhavania australis*	+	-	-	+	-	-	-	-	-	-	-
	Sub Family : NOEMACHEILINAE											
23.	*Noemacheilus guentheri*	+	-	+	+	-	-	-	-	-	-	+
24.	*N. triangularis*	+	+	-	+	-	-	+	-	-	-	-
	Family : COBITIDAE											
25.	*Lepidocephalus thermalis*	+	+	+	+	-	-	+	-	-	+	+
26.	*Pangio bashai*	-	+	-	-	-	-	-	-	-	-	-
	Family : BAGRIDAE											
27.	*Mystus oculatus*	-	-	-	-	-	-	-	-	+	-	-
28.	*Batasio travancoria*	-	+	-	-	-	-	-	-	-	-	-
	Family : CLARIIDAE											
29.	*Clarias dussumieri dussumieri*	-	-	-	-	-	-	+	-	-	-	-

Table 10 Contd...

	Species	Kanjira-puzha	Chalikkal	Kuruman-puzha	Maancherry	Nedum-kayam	Poovath-umkallu	Karimpuzha	Chaliyar-Edavanna	Pond at Nilambur	Chooral-malai	Kantham-para
	Family : HETEROPNEUSTIDAE											
30.	*Heteropneustes fossilis*	-	-	-	-	-	-	+	-	-	-	-
	Family : SILURIDAE											
31.	*Ompok bimaculatus*	-	-	-	-	-	-	+	-	-	-	-
32.	*Wallago attu*	-	-	-	-	-	-	+	-	-	-	-
	Family : CICHLIDAE											
33.	*Etroplus suratensis*	-	+	-	-	-	-	-	-	-	-	-
34.	*E. maculatus*	-	+	-	-	-	+	+	+	-	-	-
	Family : GOBIIDAE											
	Sub Family : GOBIINAE											
35.	*Glossogobius giuris giuris*	+	-	-	-	+	+	-	+	-	-	-
36.	*Schismatogobius deranyagalai*	-	-	-	-	+	-	+	-	-	-	-
	Family : BELONTIDAE											
	Sub Family : MACROPODINAE											
37.	*Macropodus cupanus*	-	+	-	-	-	-	-	-	-	-	-
	Family : HEMIRAMPHIDAE											
38.	*Hyporhamphus limbatus*	-	+	-	-	-	-	-	-	-	-	-
	Family : BELONIDAE											
39.	*Xenetodon Cancila*	-	+	-	-	-	-	-	-	-	-	-

Table 10 Contd...

Species	Kanjira-puzha	Chalikkal	Kuruman-puzha	Maancherry	Nedum-kayam	Poovath-umkallu	Karimpuzha	Chaliyar-Edavanna	Pond at Nilambur	Chooral-malai	Kantham-para
Family : MASTACEMBELIDAE											
40. *Mastacembelus armatus armatus*	-	+	-	-	-	-	-	+	-	-	-
Family : CHANNIDAE											
41. *Channa striatus*	-	-	-	-	-	-	+	-	-	-	-
42. *C. marulius Ham.*	-	+	-	-	-	-	-	-	-	-	-
43. *C. orientalis*	+	+	-	-	+	-	-	-	-	-	-
Family : CHANDIDAE											
44. *Chanda thomassi*	+	+	-	-	-	+	-	-	-	-	-
Family : TETRAODONTIDAE											
45. *Tetraodon travancoricus*	-	+	-	-	-	-	-	-	-	-	-
Family CYPRINODONTIDAE											
46. *Aplocheilus lineatus*	-	+	-	-	+	-	+	-	-	-	-
Family : NANDIDAE											
47. *Pristolepis marginata*	+	+	+	+	+	-	-	-	-	-	-
Family : SOLEIDAE											
48. *Euryglossa orientalis*	-	-	-	-	-	-	-	+	-	-	-
Family : SYNGNATHIDAE											
49. *Dorichthys cuncalus*	-	+	-	-	-	-	-	+	-	-	-
Family : ANGUILLIDAE											
50. *Anguilla bengalensis bengalensis*	-	-	-	-	-	-	+	-	-	-	-

* *Danio malabaricus* considered as a valid species (Jayaram, 1991) instead of synonymising it with *D. aequeipinnatus* (Hora and Law, 1941)

Table 11. Distribution of fishes in different locations in streams of Silent Valley National Park

	Species	Poonchola	Thonda-kulam	Thodu after Thonda-thodu	Valiya para-thodu	Panchali thodu	Poochi-para-thodu	Kumma-than-thodu	Neelikkal	Pathra-kadavu	Ambala-para-thodu	Kunthi at Sirendri	Walakadu	Cheriya walakadu
	Family CYPRINIDAE													
	Sub Family CYPRININAE													
1.	*Puntius melanampyx*	-	-	-	-	-	-	-	+	-	-	-	-	-
2.	*Barilius gatensis*	+	+	-	-	+	-	-	-	-	-	-	+	-
	Sub Family : GARRINAE													
3.	*Garra mullya*	-	-	-	-	-	+	-	-	-	-	+	-	-
	Family : HOMALOPTERIDAE													
	Sub Family : HOMALOPTERINAE													
4.	*Homaloptera montana*	-	+	-	-	-	-	+	+	+	-	-	-	+
5.	*Homaloptera pillai*	-	-	-	-	-	-	-	+	-	-	-	-	-
	Sub Family : NOEMACHELINAE													
6.	*Noemacheilus triangularis*	-	-	-	-	+	-	-	-	-	-	+	-	+
7.	*N. Guentheri*	-	+	+	+	+	-	-	-	-	-	+	-	-
	Family : CHANNIDAE													
8.	*Channa gachua*	-	-	-	-	-	-	-	-	-	-	+	-	-
	Family : SISSORIDAE													
9.	*Glyptothorax annandalei*	-	-	-	-	-	-	-	-	+	-	-	-	-
	Family : ANGUILLIDAE													
10.	*Anguilla bengalensis*	-	-	-	-	-	-	-	-	-	-	+	-	-

Table 12. Distribution of fishes in different locations in Bhavani river

	Species	Bhavani at Mukkali	Anawai	Meppathur	Kalkandi	Thavalam	Chin-dakki	Kizhe-Chindakki	Pattiyar	Dam site	Siru-vani	Sinkapara thodu	Kerala-medu	Panthan-thodu
	Family CYPRINIDAE													
	Sub Family CYPRININAE													
1.	*Osteochilus nashii*	+	-	-	-	-	-	-	-	-	-	-	-	-
2.	*Puntius melanampyx*	+	-	-	-	-	+	+	+	+	+	-	+	-
3.	*P. filamentosus*	-	-	-	-	+	+	+	-	-	-	-	-	-
4.	*P. dorsalis*	-	-	-	-	-	-	-	-	-	-	-	+	-
	Sub Family : GARRINAE													
5.	*Garra mullya*	-	-	-	+	-	+	+	-	+	-	+	-	+
6.	*G. gotyla stenorhynchus*	+	+	-	-	-	+	+	-	+	-	-	-	-
7.	*G. menoni*	-	-	-	-	-	-	-	-	-	-	+	-	+
	Sub Family : RASBORINAE													
8.	*Barilius gatensis*	+	+	+	-	+	-	+	-	+	-	+	+	+
9.	*Danio aequeipinnatus*	+	-	-	-	+	-	-	-	-	-	-	-	-
10.	*Rasbora daniconius*	+	-	-	+	+	+	+	-	-	-	-	+	-
	Sub Family : CULTRINAE													
11.	*Salmostoma acinaces*	-	-	-	-	+	+	-	-	-	-	-	-	-
	Family : HOMALOPTERIDAE													
	Sub Family : HOMALOPTERINAE													
12.	*Bhavania australis*	+	-	-	-	-	+	-	-	-	+	-	-	-
13.	*Balitora mysorensis*	-	-	-	-	-	-	-	-	-	-	+	+	-

Table 12 Contd.....

Species	Bhavani at Mukkali	Anawai	Meppathur	Kalkandi	Thavalam	Chin-dakki	Kizhe-Chindakki	Pattiyar	Dam site	Siru-vani	Sinkapara thodu	Kerala-medu	Panthan-thodu
14. *Homaloptera menoni*	-	-	-	-	-	-	-	+	-	-	-	-	-
Sub Family : NOEMACHELINAE													
15. *Noemacheilus guentheri*	+	-	+	-	-	-	-	+	+	+	+	+	+
16. *N. denisoni*	+	-	-	+	-	-	-	-	+	+	+	-	-
17. *N. semiarmatus*	+	-	-	+	-	+	+	+	-	+	-	-	-
18. *N. monilis*	+	-	-	+	-	-	-	+	-	-	-	+	-
Family : COBITIDAE													
Sub Family : COBITIDAE													
19. *Lepidocephalus thermalis*	-	-	-	-	+	+	+	-	-	-	-	+	+
Family : GOBIIDAE													
Sub Family : GOBIINAE													
20. *Glossogobius giuris*	-	-	-	-	+	-	-	-	-	-	-	-	-
Family : MASTACEMBELIDAE													
21. *Mastacembelus armatus*	+	-	-	-	+	-	-	-	-	-	-	-	-
Family : CYPRINIDONTIDAE													
22. *Aplocheilus lineatus*	+	-	-	-	+	+	+	-	-	-	-	-	-
Family : CICHLIDAE													
23. *Tilapia mossambica*	-	-	-	+	-	+	+	-	-	-	-	-	-
Family : BAGRIDAE													
24. *Mystus armatus*	-	-	-	-	-	-	-	-	-	-	-	+	-

Fig.6 Fish diversity in collection locations in Kabani and Vythiripuzha

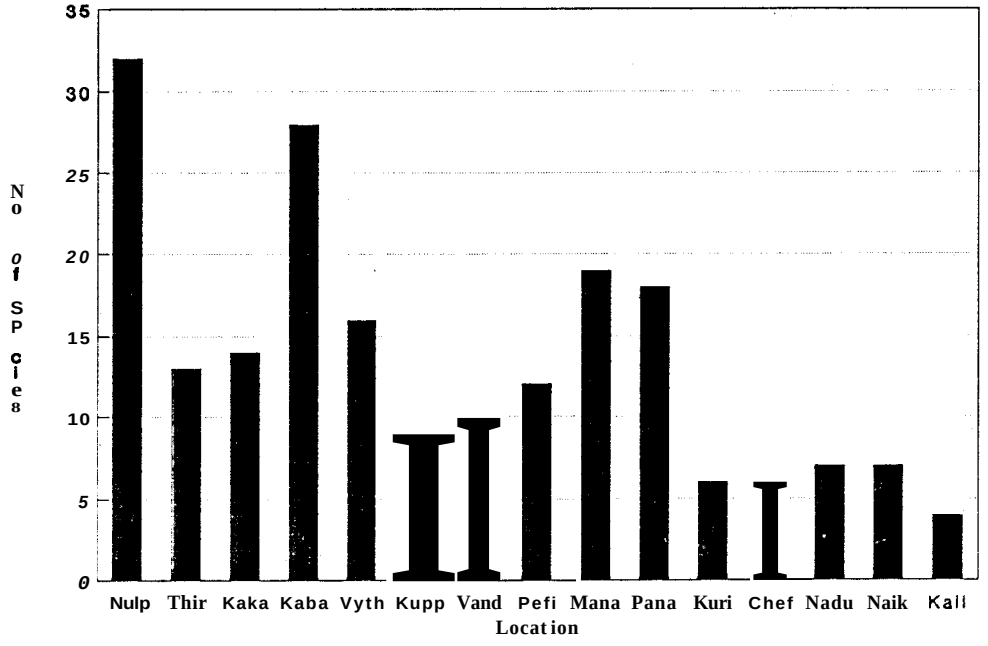
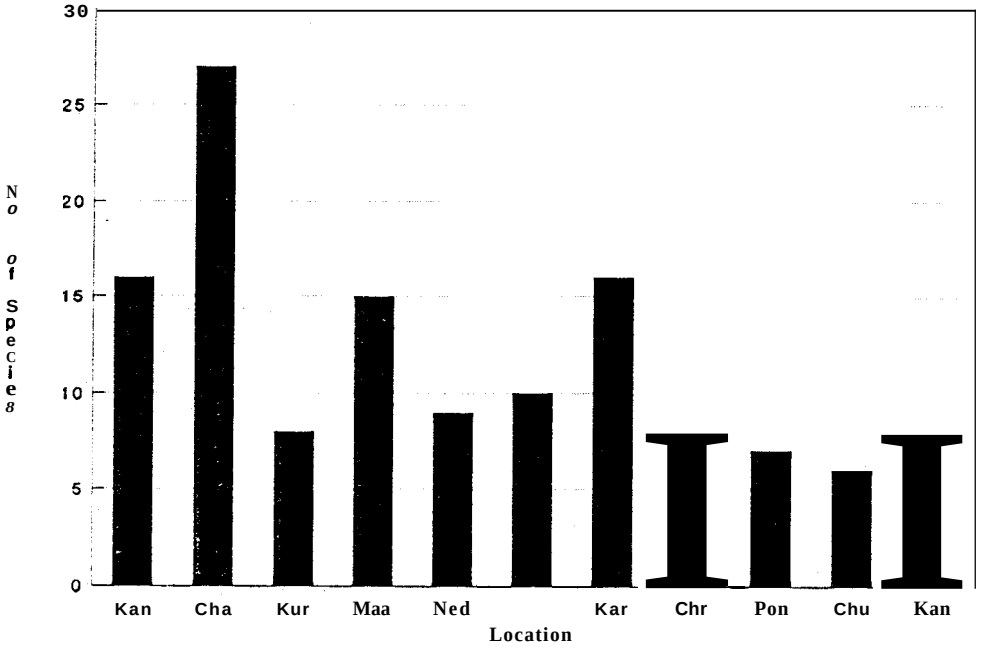


Fig.7 Fish diversity in collection locations in Chaliyar river



Puntius ticto punctatus. Eventhough Kakkarithodu is a small stream, 14 species were recorded during the study. These include *Noemacheilus nilgiriensis*, a new addition to the fish fauna of Kerala.

The diversity of fish fauna in the west flowing stream in Wayanad was low compared to the east flowing Kabani and its tributaries (16 species). Vythiripuzha supports endemics like *Noemacheilus sinuatus* and *Puntius wynaadensis*, and the endangered *Balitora mysorensis*.

Diversity of fishes in Nulpuzha, only a tributary of Kabani, could be attributed to the diverse habitat, high canopy value and least disturbance. Moreover, there is no habitation along the river Nulpuzha unlike the other tributaries.

4.3.2 Chaliyar river system

The number of species collected from the ten locations in Chaliyar and its tributaries is given in Figure 7. Of these, Chalikkal tributary is richest with 26 species. These include four endemics recorded from Kerala *(Tetraodon travancoricus, Batasio travancoria, Osteobrama bakeri* and the new species *Pangio bashai)*. Kanjirapuzha with 16 species stood second. Karimpuzha and Maancheny had 15 species each. Maancherry harbours the *Osteochilus nashii* which was reported earlier only from the east flowing river system. Eventhough the fish fauna in the upper reaches of Maancherry is diverse, it was comparatively less in the lower reaches at Nedumkayam. Mystus *oculatus* was recorded only from the pond near Karimpuzha.

The Chaliyar river supports only seven species including the esturine *Euryglossa orientalis* and *Dorichthys cuncalus*. Perhaps the presence of esturine species may be due to the proximity to sea. The high rate of disturbance and the absence of diverse habitat may be the reason for poor diversity in Chaliyar river. Chalikkal with clear water, diverse habitat and with comparatively less disturbance rich and diverse.

4.3.3 Kunthi river system

The Kunthi river system in Silent Valley National park is the only area with least number of fishes. Among the sites studied, the stream at Sirendhri (5species) harbours maximum number of species (Fig. 8). All the streams are undisturbed with diverse habitats. The water quality parameters were within the optimal ranges. High altitude, rapid water falls and high flow rate (3-5) may be the reason for the poor representation of fish fauna in this region.

Fig. 8 Fish diversity in collection locations in Kunthi river

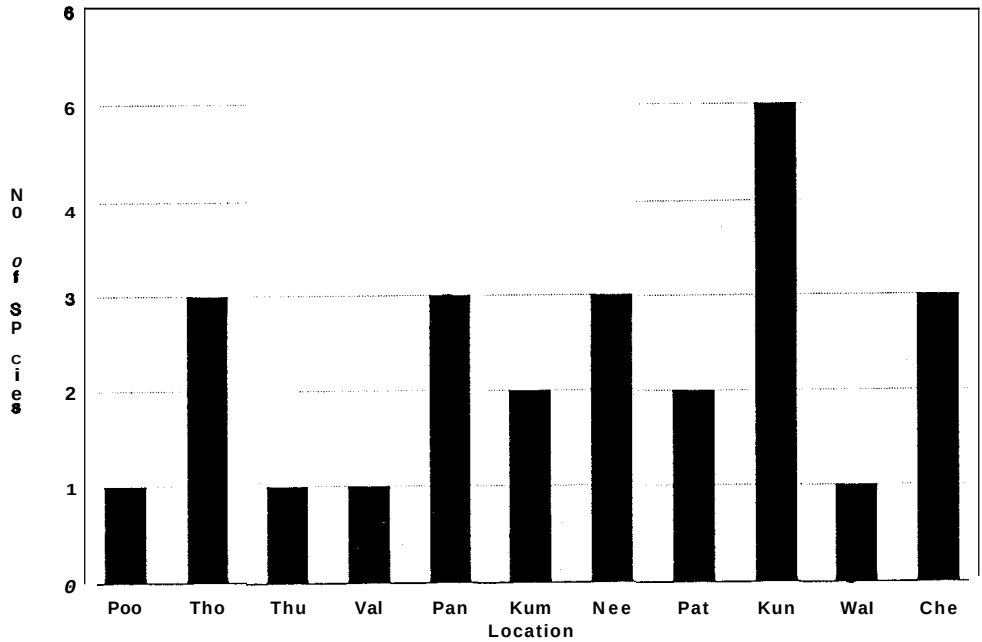
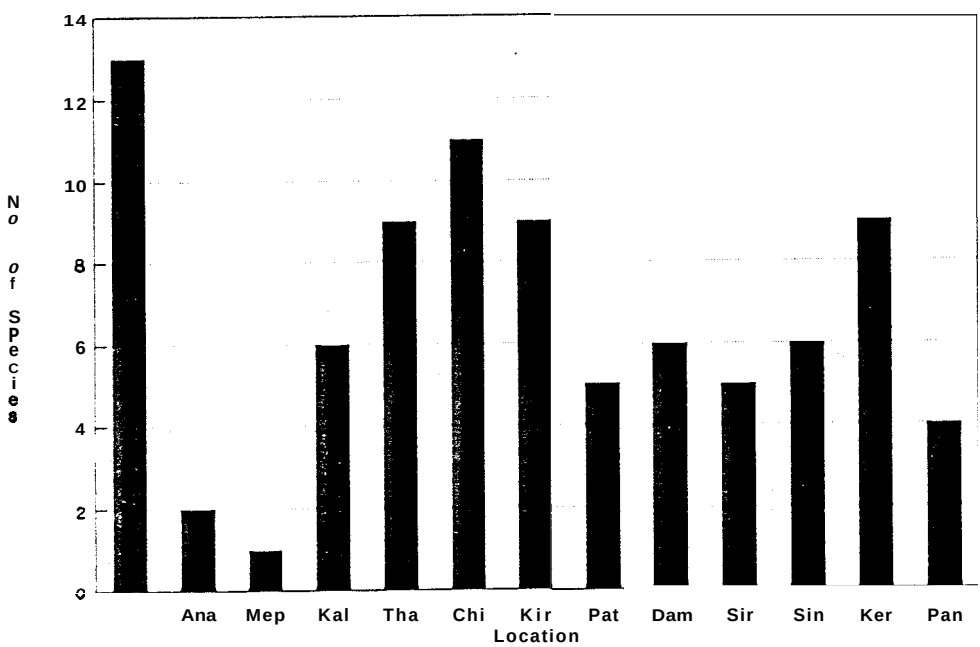


Fig.9 Fish diversity in collection locations in Bhavani river



The tributaries, Poochiparathodu and Ambalaparathodu are seasonal. The low fish diversity in Kunthi river may be due to high gradient, high altitudinal variation and high flow rates in part of the tributaries and the absence of diverse and preferred habitat.

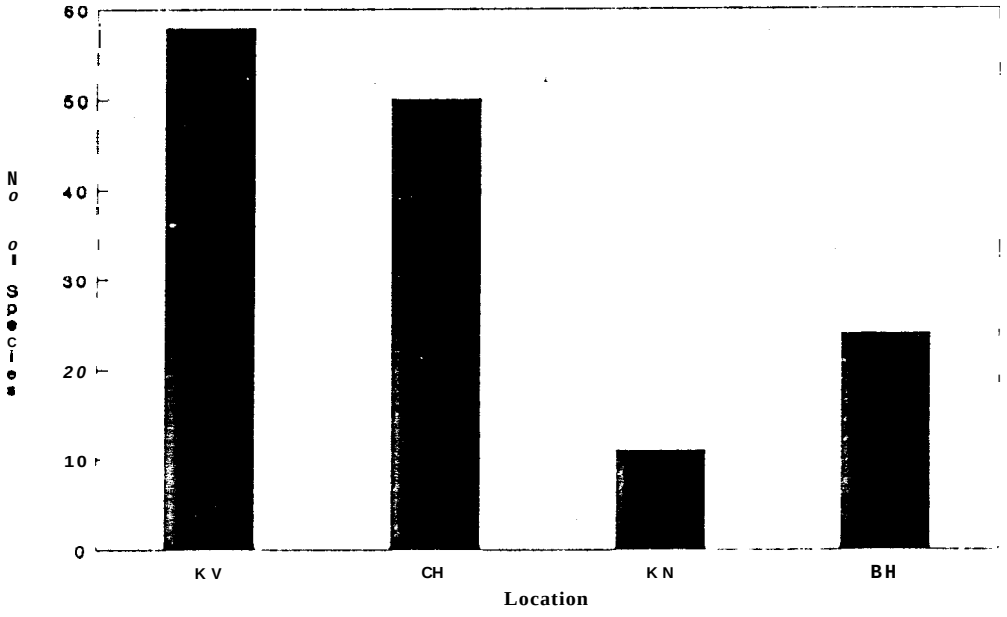
4.3.4 Bhavani river system

Bhavani river near habitations had only thirteen species (Fig. 9). Thavalam area harbours nine species. The diversity in habitat, least disturbance and basin width may be the reason for the diversity in Bhavani. In Muthikkulam - Siruvani area, Keralameduthodu is richer than other streams and (9species) had *Noemacheilus monilis,* which is found only in Bhavani river system, and the endangered *Balitora mysorensis.*

4.4 FISHES OF THE NILGIRI BIOSPHERE RESERV - AN OVERVIEW

The number of species collected from different drainage systems is shown in Figure 10. A total of 91 species belonging to 24 families and 46 genera were collected during the survey (Table 13). Most of them are widely distributed throughout its range and occur evenly in all streams in the study area. *Rasbora daniconius, Channa striatus, C. orientalis, Esomus danricus, Barilius gatensis, Danio aequeipinnatus, Puntius amphibius, P. chola, P. conchonius, Chela laubuca, Crossocheilus latius latius, Garra mullya Lepidocephalus thermalis, Mystus cavasius, Ompok bimaculatus, Wallago attu, Heteropnuestes fossilis, Hyporhamphus limbatus, Xenentodon cancila, Poecilia reticulata, Chanda ranga. Etroplus suratensis, E. maculatus, Glossogobius giuris giuris, Mastacernbelus armatus armatus, Macropodus cupanus, Notopterus notopterus. Euryglossa orientalis, Anguilla bengalensis bengalensis* and *Doryichthys cuncalus* have wide distribution extending upto North India, Pakistan, Bangladesh, Myanmar, Sri Lanka and Andaman and Nicobar islands (Jayaram 1981a and Talwar & Jhingran 1991). *Labeo potail, Danio (Brachydanio) rerio, Noernacheilus petrubanarescui, Osteochilus brevidorsalis* and *Schismatogobius deraniyagalai* are new additions to the fresh waters of Kerala. *Cyprinus carpio communis, Poecilia reticulata, Tilapia mossambica* are exotic species introduced to Kerala and are thriving well than the native ones. *Labeo rohita,* the native of North Indian rivers and introduced to South India, thrives well and supports the fisheries of Wayanad along with *Cyprinus carpio communis.* The members under the family *Homalopteridae*

Fig.10 Fish diversity in different river systems in NBR - Kerala part



KV - Kabani & Vythiripuzha CH - Chaliyar
KN - Kunthi BH - Bhavani

Table 13. List of Freshwater Fishes in Kerala Part of Nilgiri Biosphere Reserve

	Family: **ANGUILLIDAE**
1.	*Anguilla bengalensis bengalensis* (Gray)
	Family: **NOTOPTERIDAE**
2.	*Notopterus notopterus* (Pallas.)
	Family **CYPRINIDAE** Sub Family: **CYPRININAE**
3.	*Cyprinus carpio communis* (Linnaeus)
4.	*Puntius amphibius* (Valenciennes)
5.	*P. arulius arulius* (Jerdon)
6.	*P. carnaticus* (Jerdon)
7.	*P. chola* (Hamilton-buchanan)
8.	*P. curmuca* (Hamilton-Buchanan)
9.	*P. conchonius* (Hamilton-Buchanan)
10.	*P. denisonii* (Day)
11.	*P. dorsalis* (Jerdon)
12.	*P. filamentosus* (Valenciennes)
13.	*P. melanampyx melanampyx* (Day)
14.	*P. melanostigma* (Day)
15.	*P. micropogon* (Valenciennes)
16.	*P. sarana subnasutus* (Valenciennes)
17.	*P. ticto ticto* (Hamilton-Buchanan)
18.	*P. ticto punctatus* (Day)
19.	*P. wynaadensis* (Day)
20.	*Osteobrama bakeri* Day
21.	*Osteochilus (Kantaka) brevidorsalis* (Day)
22.	*O. (Osteocheilichthys) nashii* (Day)
23.	*Tor khudree* (Sykes)
24.	*Labeo ariza* (Hamilton-Buchanan)
25.	*L. potail* (Sykes)
26.	*L. rohita* (Hamilton-Buchanan)

Table 13 contd.

Sub Family: **RASBORINAE**	
27.	*Esomus danricus* (Hamilton-Buchanan)
28.	*Barilus gatensis* (Valenciennes)
29.	*Barilius bakeri* Day
30.	*Danio aequipinatus* (McClelland)
31.	*Danio malabaricus* (Jerdon)
32.	*Danio (Brachydanio) rerio* (Hamilton-Buchanan)
33.	*Rasbora daniconius daniconius* (Hamilton-Buchanan)
34.	*Amblypharyngodon melettinus* (Valenciennes)
Sub Family: **CULTRINAE**	
35.	*Chela laubuca* (Hamilton-Buchanan)
36.	*Salmostoma acinaces* (Valenciennes)
37.	*S. boopis* (Day)
Sub Family: **GARRINAE**	
38.	*Crossocheilus latius latius* (Hamilton-Buchanan)
39.	*Garra mullya* (Sykes)
40.	*G. mcClellandi* (Jerdon)
41.	*G. gotyla stenorhynchus* (Jerdon)
42.	*G. menoni* Remadevi and Indra
Family: **HOMALOPTERIDAE**	
43.	*Bhavania australis* (Jerdon)
44.	*Balitora mysorensis* (Hora)
45.	*Homaloptera pillai* Indra and Remadevi
46.	*H. menoni* shaji and Easa
47.	*H. montana* Herre
Sub Family: **NOEMACHEILINAE**	
48.	*Noemacheilus denisoni denisoni* Day
49.	*N. monilis* Hora
50.	*N. petrubanarescui* Menon
51.	*N. triangularis triangularis* (Day)
52.	*N. nilgiriensis* (Menon)
53.	*N. semiarmatus* Day
54.	*N. sinuatus* Day

Table 13 contd.

55.	*N. guentheri* Day
	Family : **Cobitidae** Sub Family: **Cobitinae**
56.	*Pangio bashai* (Easa and shaji)
57.	Lepidocephalus thermalis (Valenciennes)
	Family: **BAGRIDAE**
58.	*Batasio travancoria* Hora and Law
59.	*Mystus occulatus* (Valenciennes)
60.	*Mystus armatus* (Day)
61.	*M. punctatus* (Jerdon)
62.	*M. montanus* (Jerdon)
63.	*M. malabaricus* (Jerdon)
64.	*M. cavasius* (Hamilton-Buchanan)
	Family: **SILURIDAE**
65.	*Ompok bimaculatus* (Bloch)
66.	*Wallago attu* (Schneider)
	Family: **SISORIDAE**
67.	*Glyptothorax anamalaiensis* Silas
68.	*G. madraspatanum* (Day)
69.	*G. annadalei* Hora
	Family: **HETEROPNEUSTIDAE**
70.	*Heteropneustes fossilis* (Bloch)
	Family: **CLARIIDAE**
71.	*Clarias dussumieri* Valenciennes
	Family: **HEMPHIRAMPHIDAE**
72.	*Hyporhamphus limbatus* (Valenciennes)
	Family: **BELONIDAE**
73.	*Xenentodon cancila* (Hamilton-Buchanan)
	Family: **CYPRINODONTIDAE**
74.	*Aplocheilus lineatus* (Valenciennes)
	Family: **POECILIDAE**
75.	*Poecilia (Lebistes) reticulata* (Peters)

Table 13 contd.

	Family: **SYNGNATHIDAE**
76.	*Doryicthys cunalus* (Hamilton-Buchanan)
	Family: **CHANDIDAE**
77.	*Chanda thomassi* (Day)
78.	*C. ranga* (Hamilton-Buchanan)
	Family: **NANDIDAE**
79.	*Pristolepis marginata* (Jerdon)
	Family: **CICHLIDAE**
80.	*Tilapia mossambica* Peters.
81.	*Etroplus suratensis* (Bloch)
82.	*E. maculatus* (Bloch)
	Family: **GOBIIDAE** Sub Family: **GOBIINAE**
83.	*Glossogobius giuris giuris* (Hamilton-Buchanan)
84.	*Schismatogobius deranyagalai* Pethiyagoda and Kottelat
	Family: **BELONTIDAE**
85.	*Macropodus cupanus* (Valenciennes)
	Family: **CHANNIDAE**
86.	*Channa marulius* (Hamilton-Buchanan)
87.	*C. orientalis* (Bloch and Schneider)
88.	*C. striatus* (Bloch)
	Family: **MASTACEMBELIDAE**
89.	*Mastacembelus armatus armatus* (Lacepede)
	Family: **SOLEIDAE**
90.	*Euryglossa orientalis* (Bloch and Schneider)
	Family: **TETRADONTIDAE**
91.	*Tetraodon travancoricus* Hora and Nair

and *Cobitidae* and other species like *Mystus armatus, M. montana, Puntius carnaticus, P. wynaadensis, P. ticto puricta tus, P. meianostigma, P. denisonii, P. curmuca P. sarana subnasutus. P. melanampyx melanampyx, P. arulius arulius, P. filamentosus, Batasio travancoria Tetraodon travancoricus. Glyptothorax annandaelei Garra mcClellandi, G. menoni Barilius bakeri Osteochilus nashii, 0. brevidorsalis and Osteobrama bakeri* are endemic to the freshwaters of Western Ghats. Among these, *Batasio travancoria Tetraodon travancoricus, Osteobrama bakeri* and *Puntius denisonii* were reported to be endemic to Travancore region of Kerala (Day, 1878).Recently, Inasu (1993) reported *Tetraodon travancoricus* from Trichur of Central Kerala. *Batasio travancoria* has been reported from Anamalai and Nelliampathy hill ranges (Silas 1952). The present survey indicates the occurrence of these species in the streams of Nilambur Reserve Forests indicating its range of extension to north of Palghat gap.

Silurus wynaadensis. Oryzias melanostigma Clarias dissumieri dayii, Noemacheilus striatus were earlier reported from Wayanad (Day, 1878). However, these could not be located during the present survey. Since the type locality of these could not be traced, it is possible that these are confined to a small part of the river or are very few in number. *Euryglossa orientalis, Doryichthys cuncalus* and *Schismatogobius deraniyagalai* are primarily esturine. But their occurrence in the upper reaches of Chaliyar river system prove that the hill streams are also a good habitat for these fishes. The genus *Schismato gobius* is recently reported from Sri Lanka (Kottelat and Pethiyagoda, 1989)and this is new genus to India.

The list includes four endangered species viz. *Balitora mysorensis, Pristolepis marginatus, Batasio travancoria* and *Tetraodon travancoricus* (Menon. 1993). *Pangio bashai* Easa and Shaji (in Press) and *Homaloptera menoni* Shaji and Easa 1995. are new description from the study area.

4.5 NEW DESCRIPTIONS

During the present survey. two new species were also collected. *Pangio bashai* Easa & Shaji was obtained from Chalikkal tributary of river Chaliyar in Nilambur. *Homaloptera menoni* Shaji & Easa was collected from Indekkuthodu of Siruvani in Muthikkulam. The two species are described in detail.

4.5.1 *PANGIO BASHAI* Easa & Shaji

Introduction

Loaches of the genus *Pangio* (Family: Cobitidae) are considered to be good aquarium fishes due to their small size and colour patterns. Menon (1984) treated these under the genus *Acanthophthalmus*. He described the distribution of *Cobitoidea* and discussed their evolutionary changes. The range of distribution of the genus *Pangio* is from Indonesia through Vietnam to India (Talwarand Jhingran, 1991). It is distributed in Bangladesh, Burma and in North East Bengal and Manipur in India (Jayaram, 1981a). Recently, Kottelat and Lim (1993) reviewed the eel Ioaches from Malay Peninsula.

In India, the genus is represented by three species viz., *Pangio pangia* (Ham.), *P. longipinnis* Menon and *P. goaensis* Tilak (Menon, 1992). A new species was obtained from Chalikkal river, a tributary of Chaliyar in Nilambur. The specimen was collected in February 1994.

Diagnostic Characters

This is a small Cobitid fish with dorsal fin inserted in the posterior half of the body and its position is in between pelvic and anal fins. Paired fins are short. Lateral line is entirely absent (Fig.11).

Holotype

Kerala Forest Research institute, Peechi. Thrissur Reg. No. FF/KFRI/56.33.5 mm standard length. Locality: Chalikkal river. Nilambur, Kerala State, South India.

Paratypes

Nine specimens, 30-37.5 standard length. Same locality. All are in well preserved condition in the Kerala Forest Research Institute, Peechi, Thrissur. Reg. No. FF/KFRI/57.

Etymology

Named after Dr. S. Chand Basha, former Director, Kerala Forest Research Institute, who had been a constant source of encouragement throughout the study.

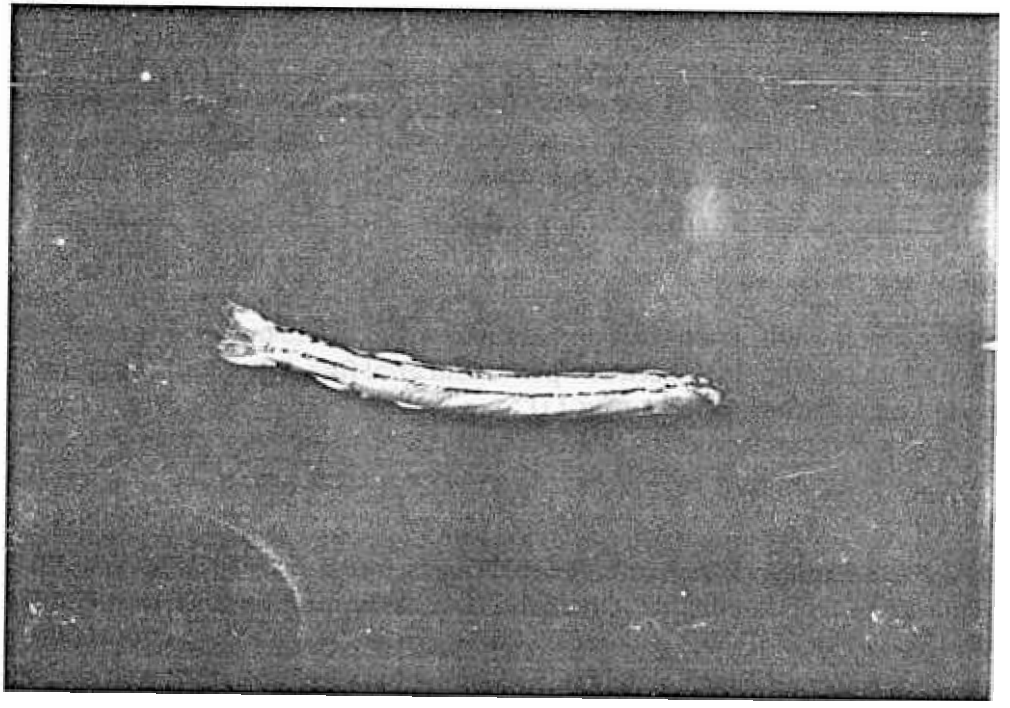


Fig. 11 ***Pangio bashai*** **- the new species described from**

Description

D=2/6: P=1/6. V=1/4: A=2/5: C=18-20 - lateral line is entirely absent. The measurements are made in percentages.

Body: Body is elongated and slightly compressed. Its depth is 11.735 (11.02-12.45) in standard length.

Head: Head is small, its length is 16.665 (16.17-17.16) in SL. Snout is pointed and its length is 36.6(36.36-36.86) in head length. Eyes are small and its diameter 14.45(14.01-14.08) and inter orbital width is 18.18 (17.90-18.46) in SL. Nostrils are close to each other and situated immediately before the eye. There is a bifid sub-orbital spine present below the eye. Barbels three small pairs, rostral, maxillary, and maxillo- mandibular. Their length is less than or equal to eye diameter. Lips are fleshy and the mental lobes are devoid of flap like structures.

Scales: Scales small, imbricate, with small, slightly eccentric focal area, prominent on the caudal region, but absent on head.

Fins: Dorsal fin is inserted in between ventral and anal fins. It is close to ventral fin than anal fin. The length of Dorsal fin is 7.78 (7.70-7.851, ventral fin 6.66 (6.62-7.14) anal fin 2.85 (2.71-2.88) in standard length. Base of the dorsal fin is 7.35(7.31-7.41), base of anal fin 3.67(3.52--1.06) and base of ventral fin is 2.85 (2.6-3.12) % in standard length. Re-dorsal distance is 70.35 (69.176-71.875). pre-ventral distance 60.85 (60.29-61.42) and pre-anal distance is 78.99 (78.57-79.41) in standard length. Caudal fin is cut square. The least width of the caudal peduncle is 50.54 (50.46-50.49) in its length. A carina is present between caudal fin and anal fin.

Colouration

The ground colour is yellowish white with three dark bands running from the tip of the snout to the base of the caudal fin. One band is on mid dorsal line and the other two on the sides of the body. The upper lateral band ends in a blotch at the base of the upper angle of caudal fin. The median band is wider and darker than the others. The fins are yellowish without any markings.

Distribution

It is distributed in the Chalikkal River, a tributary of Chaliyar.

Key for identification

Body elongate, anguilliform, head small, mouth with three barbels. Mental lobes well developed with or without posterior flap like portion. Dorsal fin inserted between anal and ventral fins. Lateral line absent - *Pangio.*

1. Dorsal fin not situated far backwards. Its origin in vertical from root of inner ventral ray. - *P. longipinnis*

   Dorsal fin situated far backwards - 2

2. Mental lobes with flap like portion - *P. goaensis*

   Depth of the body is 10.3 times in SL. Mental lobes without flap like portion - 3

3. Body without any bands and colouration - *P. pangia*

   Body with longitudinal bands. Depth of the body is 11.7 times in SL - *P. bashai* sp. nov.

Remarks

The species closely resembles *Pangio goaensis* Tilak from Goa. But it can be distinguished from *P. goaensis* by mental lobes without flaps, lobulous parts and body measurements. It can be differentiated from *P. pangia* (Ham.)by its colour pattern and from *P. longipinnis* Menon by position of the dorsal fin. The beautiful black bands on yellowish background and the small size make it suitable for rearing in aquaria.

4.5.2 *HOMALOPTERA MEN0Nl* Shaji & Easa

Introduction

The genus *Homdopteravan* Hasselt is represented by four species in the Indian subcontinent, *Homaloptera bilineata* Blyth. *H. modesta* (Vinciguerra), and *Homaloptera* rupicola (Prashad and Mukerji) are distributed in Burma. The genus is represented in India by a single species *Homaloptera montana* Herre is distributed in Silent Valley and New Amarambalam area of Western Ghats. (Menon. 1987). Recently, Indra and Remadevi (1981) added a new species *H. pillaii,* but Menon (1987)considered it as a synonym of *H. montana* Later, Pethyagoda &Kottelat (1994)treated *H. pillaii* as a distinct species.

Diagnostic characters

Body is subcylindrical and covered with scales except the head and ventral surface. Head is pointed with four rostral barbels and two maxillary barbels. The gill opening is extended to the ventral surface for a short distance. The lips are thick, continuous at an angle of mouth and are non papillated. The rostral groove is absent. It can be distinguished from other genera of homalopteridae like *Bhavania* by the extent of gill opening, *Balitora* by the nature of lips and from *Travancoria* by the lesser number of rostral barbels and absence of rostral groove.

Description

D=2/8; P=5/9; V=2/6; k=2/5: C=19: L=59-62; Ltr=7.5/6.5-7

Body: Body is subcylindrical and covered with scales except the ventral parts. Its depth is 13.935 (13.414-14.457) percent in standard length (Fig.12).

Head: Head is pointed and its length is 20.605 (20.48-20.73)percent in SL. Eyes are moderately large, dorso-laterally placed and its diameter is 30.33 percent in head length and not visible from the ventral side. The length of snout is 8.948 (8.536-9.63) percent in SL, and the inter-orbital width is 34.166 percent in Head length. The two pairs of nostrils are closer to the eye than the tip of the snout and the anterior nostrils are with a flap. Mouth small. semicircular with fleshy lips. Three pairs of barbels are present of which two rostral and one maxillary. All are equal in length and are equal to the eye diameter. The lips are non papillated (Fig.13).

Fins: Dorsal fin is situated just behind the origin of pelvic fins and its origin is closer to the tip of the snout than the base of the caudal fin. Its length is 19.394 (19.277-19.512)percent in SL. The pectoral hardly reaches the base of ventral and its length is 21.81 (21.68-21.95)percent in SL. The ventral reaches the anal fin and overlap the vent. Length of ventral fin is 19.277 and length of anal 17.57 (17.07-18.07)percent in SL. The vent is situated very close to origin of anal fin. Distance from vent to anal fin is 11.764 percent in the inter distance between origin of pelvic and anal fins. Pre-dorsal distance is 46.664 (46.341-46.987)and preventral distance is 44.24 (43.902-44.578) percent in SL.

Caudal peduncle is long and narrow. Its least width is 30 percent in its length. Caudal fin is slightly emarginate.

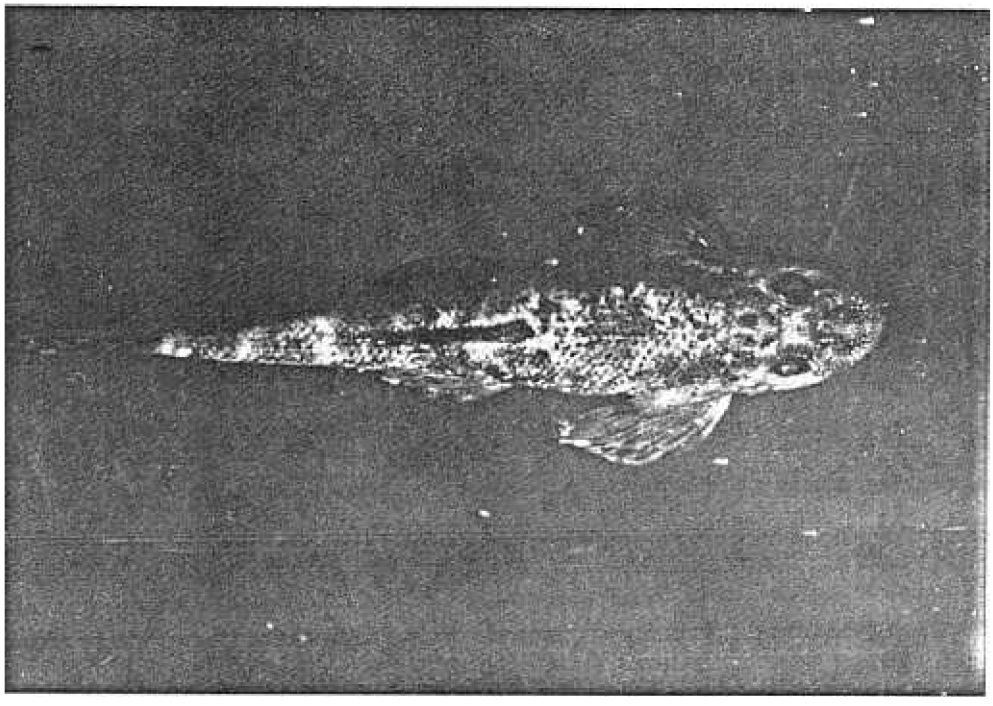


Fig. 12 ***Homaloptera menoni*** **- the new species described from Muthikkulam**

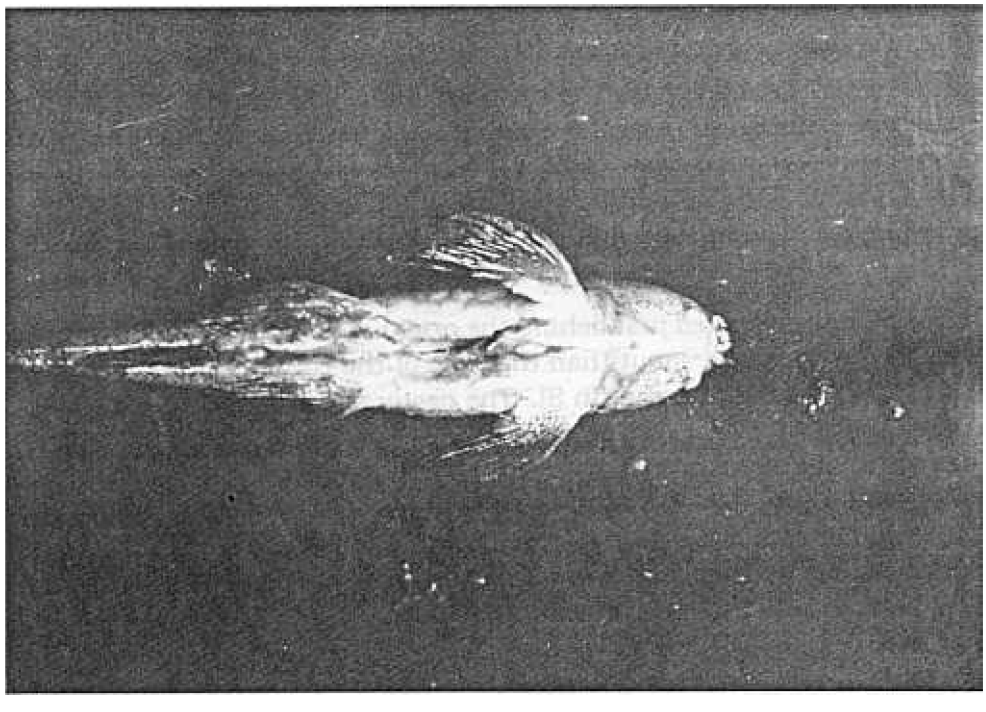


Fig. 13 ***H. menoni*** **- Ventral**

Holotype

FF/KFRI/85. 41 mm standard length from Indekkuthodu in Siruvani, a tributary of Bhavani, Muthikkulam forest, Palghat district. Kerala collected by C.P.Shaji and P.S. Easa on 04-04-1995.

Paratype

One specimen FF/KFRI/86,42 mm standard length collected from the same locality on the same day by the authors. All are in wel1preserved conditions in Kerala Forest Research Institute, Peechi, Trichur.

Etymology

Named after Dr. A.G.K. Menon. Emeritus Scientist, Zoological Survey of India, who has given outstanding contribution to the taxonomy of *Homalopteridae* and *Cobitidae*.

Colouration

Body is greenish yellow in ground colour with a few irregular blotches on the back of the body. The head and anterior parts of the body is mottled with black dots. Head and body is with many tubercles, which are absent on the ventral surface. The tubercles are also present on the anterior simple rays of pectoral fin and ventral fin. The dorsal, ventral and anal fins are with two rows of black dots.

Key for identification

1. Origin of the dorsal opposite or in front of the pelvic fin. - *H. bilineata*

   Origin of the dorsal behind the origin of pelvic fin - 2

2. A. Origin of the dorsal equidistant between tip of the snout and base of caudal.
   a) Lateral line scales 40-45 - *Homaloptera rupicola*

   Lateral line scales more than 45 - b

b) Lateral line scales 70-72 - *H. montana*

Lateral line scales 83-93 - *H. pillaii*

B. Origin of the dorsal nearer to the tip of the snout than the base of the caudal.

a) Lateral line scales 47. Least width of the caudal peduncle 42.86-50.00 percent in its length - *H. modesta*

b) Lateral line scales 59-62. Least width of the caudal peduncle is 30.00 percent in its length - *H. menoni*

4.6 DIET OF FISHES

The dietary analyses of fishes indicate the trophic segregation pattern among the members of the fish community in the area (Table 14, Figs.14-32). It shows that the most frequently utilized food bases in the aquatic habitat were terrestrial insects, small and filamentous algae and aquatic insects. Based on the diet, five trophic classes algivores. terrestrial insectivores, detritivores, aquatic insectivores/benthic insectivores and omnivores (Table 15) were identified among the fishes studied.

Three fishes (*Puntius filamentosus, Puntius ticto, Garra mullya*) were algivores and small and/or filamentous algae formed about 75% of their primary diet.

Barilius gatensis, Barilius bakeri. Danio aequeipinnatus and *Rasbora daniconius* were terrestrial insectivores which fed predominantly on terrestrial insects (about 83%) along with little algae and insect larvae.

Among the detritivores, *Crossocheilus latius* and *Amblypharyngodon melettina* fed almost completely on detritus. But others (*Puntius amphibius* and *Chanda ranga*), had insects also in their food items. Majority of the fishes studied were benthic insectivores and include consisting *Channa gachua, Mystus cavasius, Tor khudree, Noemacheilus guentheri, Puntius melanampyx* and *Salmostoma acinaces*. They consumed mainly adult aquatic insects and/or benthic macroinvertebrates.

Puntius arulius was the only omnivore among the fishes examined. The diet included terrestrial matter, littoral vegetation and detritus.

Table 14. Percentage volume of food categories of fishes

Food categories	Fish species*																		
	AM	BB	BG	CG	CL	CR	DA	GM	MC	NG	PA	PC	PF	PL	PM	PT	RD	SA	TK
LITV	0.00	0.00	0.43	0.00	0.00	0.00	2.50	3.00	1.11	0.00	0.00	0.00	1.00	8.86	0.48	0.00	0.00	0.00	1.67
TERP	0.00	3.82	1.74	0.00	0.00	0.00	0.50	2.00	0.00	0.00	0.00	1.25	1.75	30.00	11.19	0.00	0.00	0.00	0.00
SLAG	0.00	2.35	0.00	0.00	0.00	0.00	1.50	76.50	0.00	0.00	0.00	0.00	0.00	0.00	7.38	0.00	7.65	0.00	1.67
FALG	0.00	20.00	0.22	0.00	0.00	0.00	10.00	7.00	0.00	0.00	0.00	0.00	79.50	0.00	11.19	77.50	3.53	4.17	3.33
WMIT	0.00	0.00	0.00	6.67	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CHIR	0.00	0.86	0.00	6.67	0.00	0.00	0.00	0.00	1.11	3.33	1.50	22.50	0.00	0.00	10.00	0.00	0.00	7.08	11.67
EPHE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.67	4.44	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TRIC	0.00	1.18	0.00	0.00	0.00	0.00	0.00	0.00	8.33	0.00	0.50	1.25	0.00	0.00	0.48	0.00	0.00	1.75	0.00
ITEO	0.00	66.18	88.91	6.67	0.00	28.00	85.50	0.00	6.67	0.00	0.00	6.25	17.75	47.95	1.19	0.00	74.71	0.00	1.67
AAQI	0.00	5.59	8.70	56.67	0.00	0.00	0.00	0.00	68.33	0.00	1.00	6.25	0.00	0.45	0.00	0.00	5.88	0.00	46.67
BEMI	0.00	0.00	0.00	23.33	0.50	0.00	0.00	0.00	0.00	66.67	29.25	51.25	0.00	0.00	58.10	0.00	5.88	64.17	33.33
OTDI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.78	12.22	3.00	11.25	0.00	0.00	0.00	0.00	0.00	18.33	0.00
DETR	100.00	0.00	0.00	0.00	99.50	70.00	0.00	11.50	0.00	13.33	63.75	0.00	0.00	12.73	0.00	22.50	2.25	5.00	0.00

*See the Table 15 for abbreviations.

Table 15. Trophic classification of fishes

Species		Trophic class
Puntius melanampyx	(PM)	Benthic Insectivore
Puntius filamentosus	(PF)	Algivore
Puntius arulius	(PL)	Omnivore
Puntius amphibius	(PA)	Detritivore
Puntius ticto	(PT)	Algivore
Puntius curmuca	(PC)	Benthic Insectivore
Barilius gatensis	(BG)	Terrestrial Insectivore
Barilius bakeri	(BB)	Terrestrial Insectivore
Danio aequipinnatus	(DA)	Terrestrial Insectivore
Crossocheilus latius	(CL)	Detritivore
Arnblypharyngodon melettina	(AM1	Detritivore
Garra mullya	(GM)	Algivore
Channa gachua	(CG)	Benthic Insectivore
Mystus cavasius	(MC)	Benthic Insectivore
Salmostoma acinaces	(SA)	Benthic Insectivore
Tor khudree	(TK)	Benthic Insectivore
Chanda ranga	(CR)	Detritivore
Noemacheilus guentheri	(NG)	Benthic Insectivore
Rasbora daniconius	(RD)	Terrestrial Insectivore

Fig.14 Diet of *Puntius melanampyx*

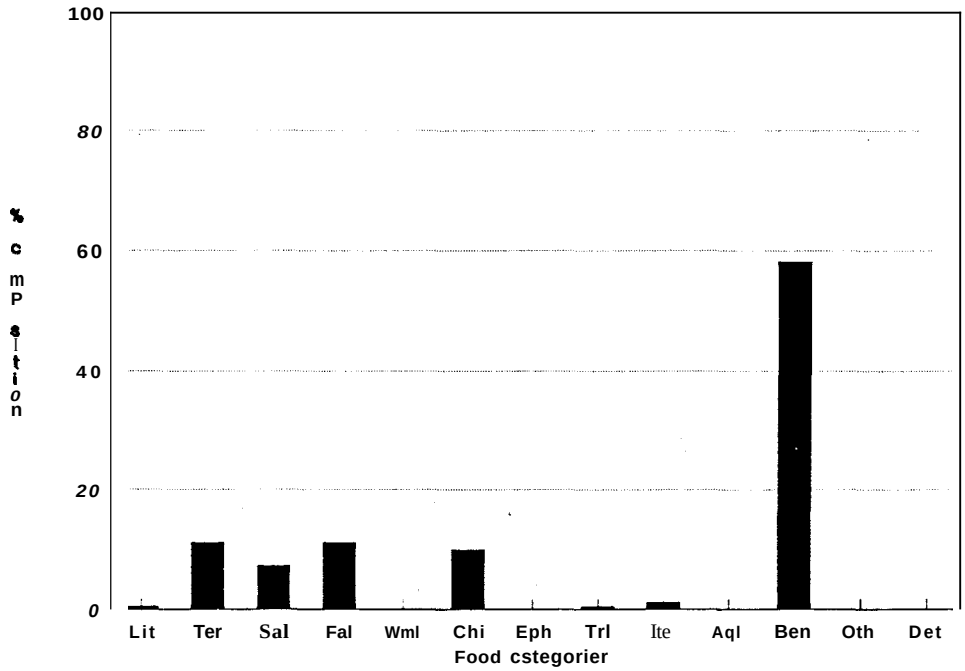


Fig.15 Diet of *Puntius filamentosus*

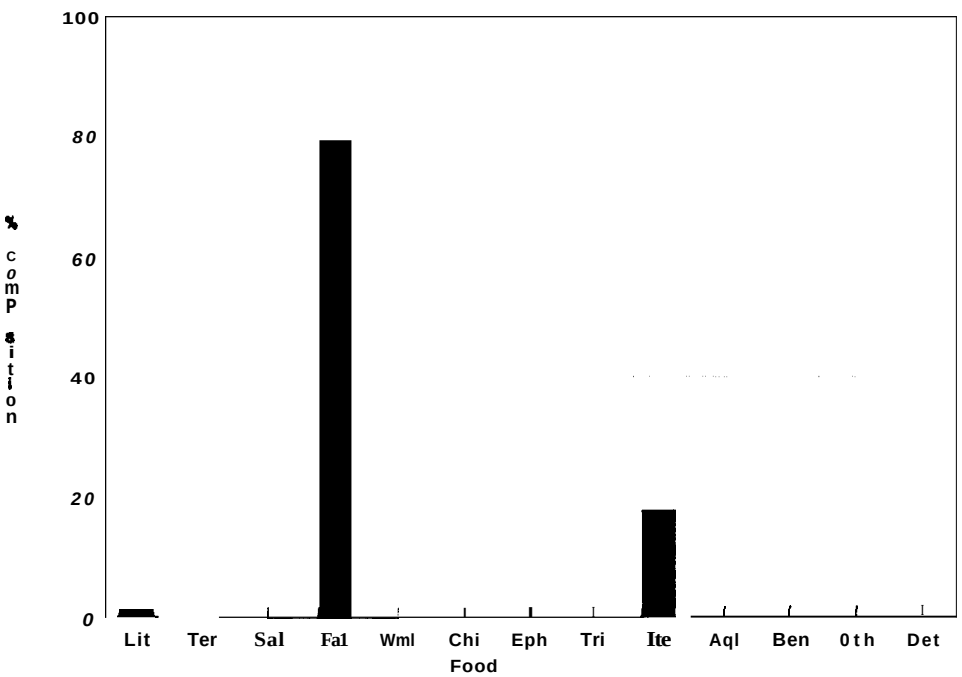


Fig.16 Diet of *Puntius arulius*

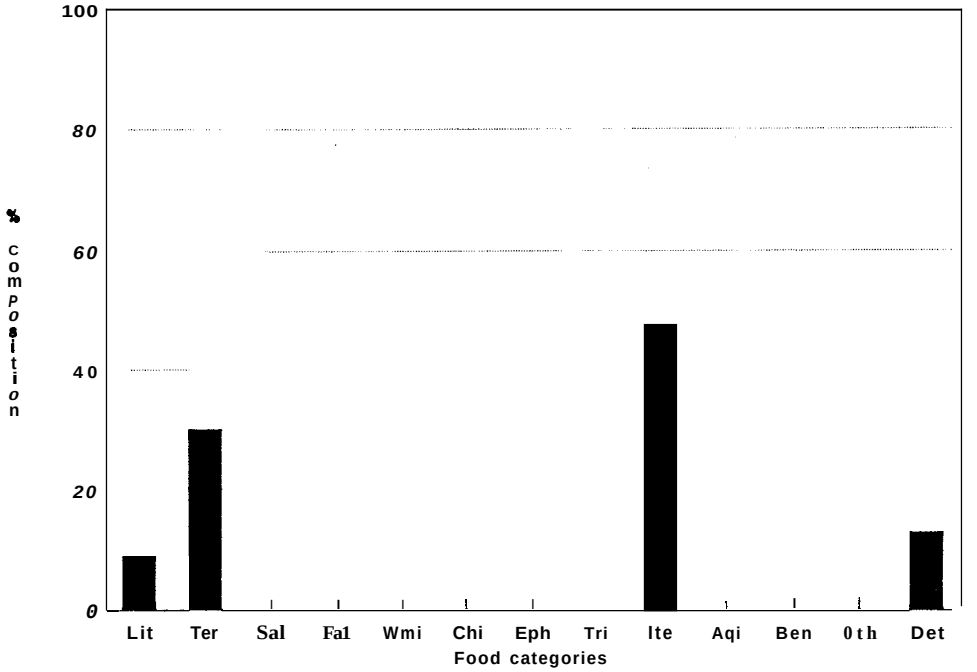


Fig.17 Diet of *Puntius amphibius*

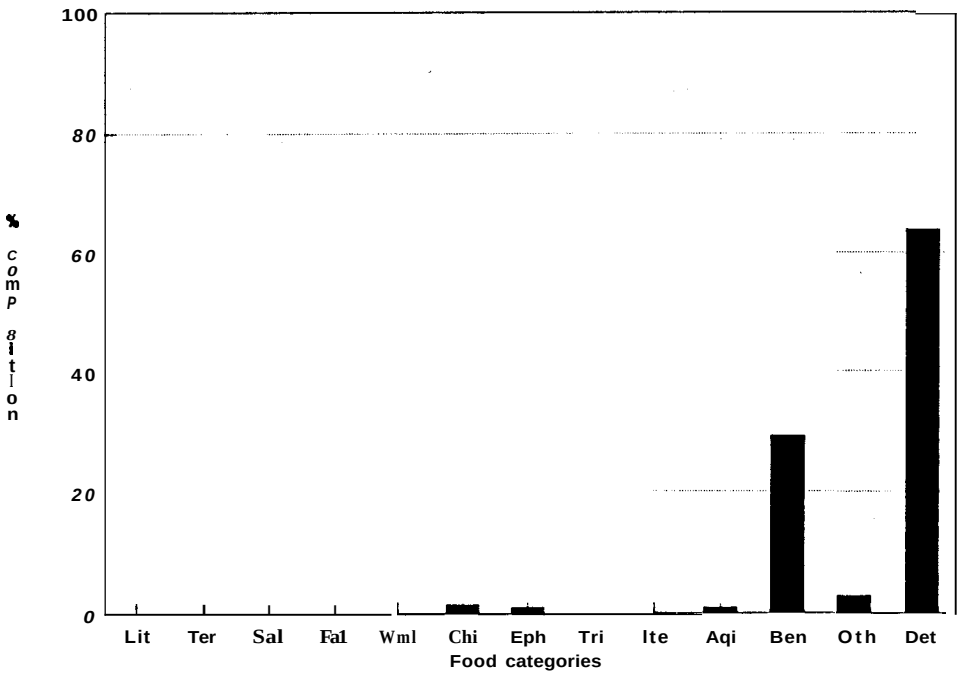


Fig.18 Diet of *Puntius ticto*

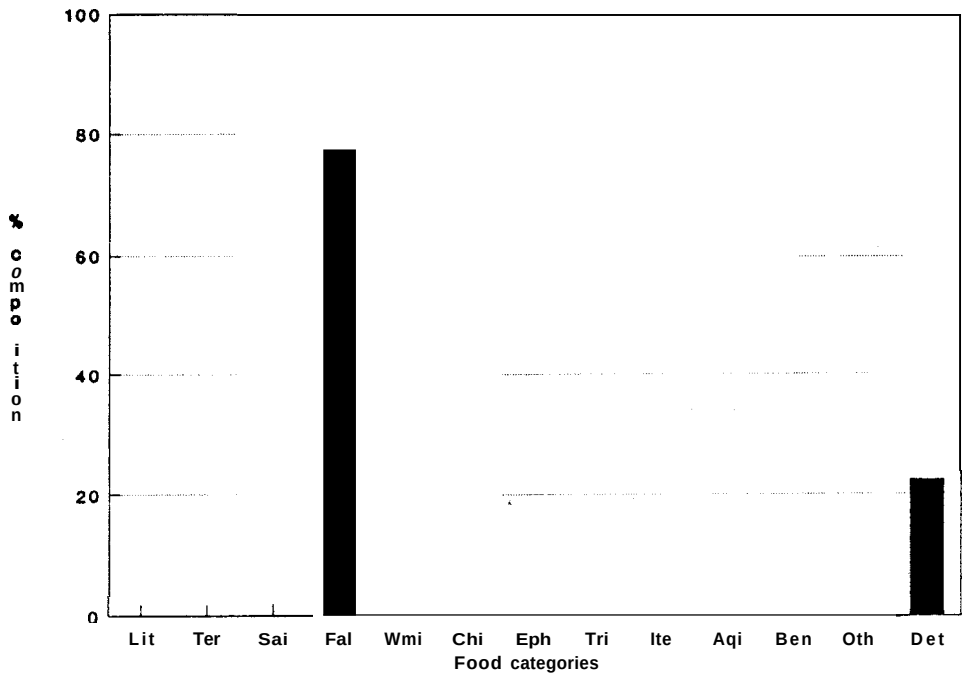


Fig.19 Diet of *Puntius crumuca*

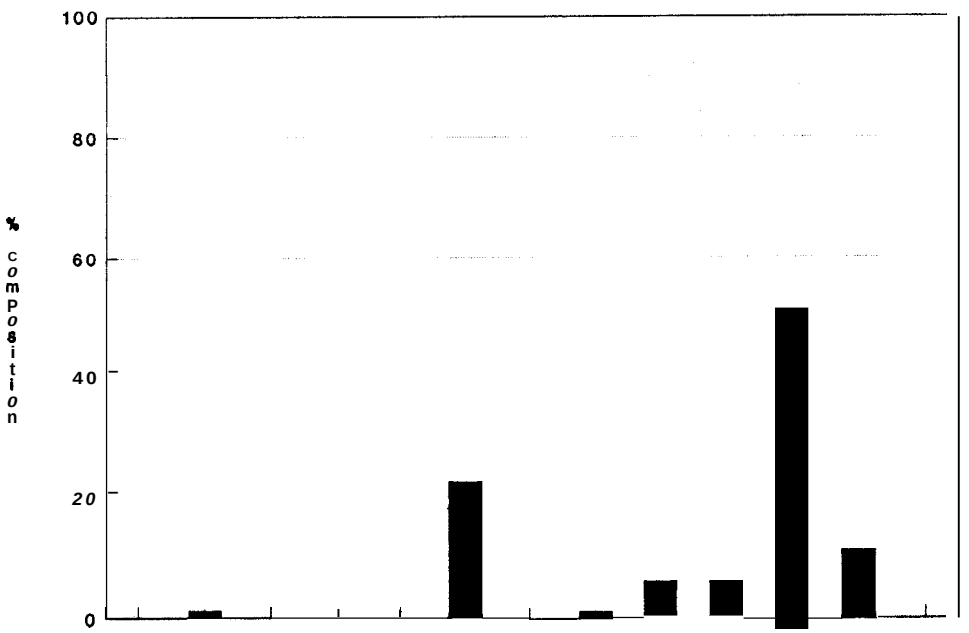


Fig.20 Diet of *Barilius gatensis*

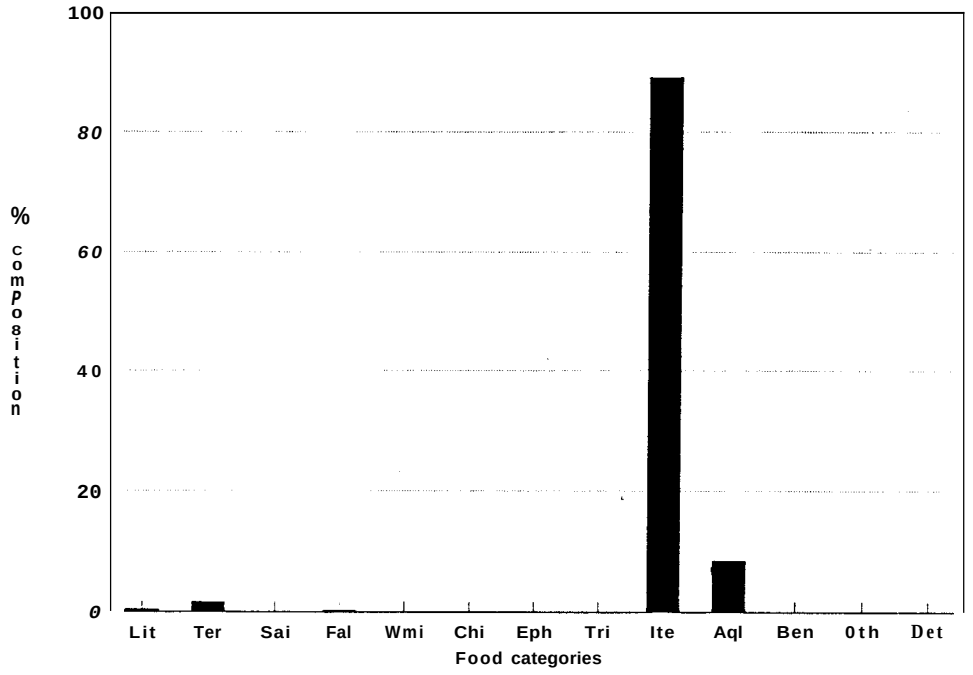


Fig.21 Diet of *Barilius bakeri*

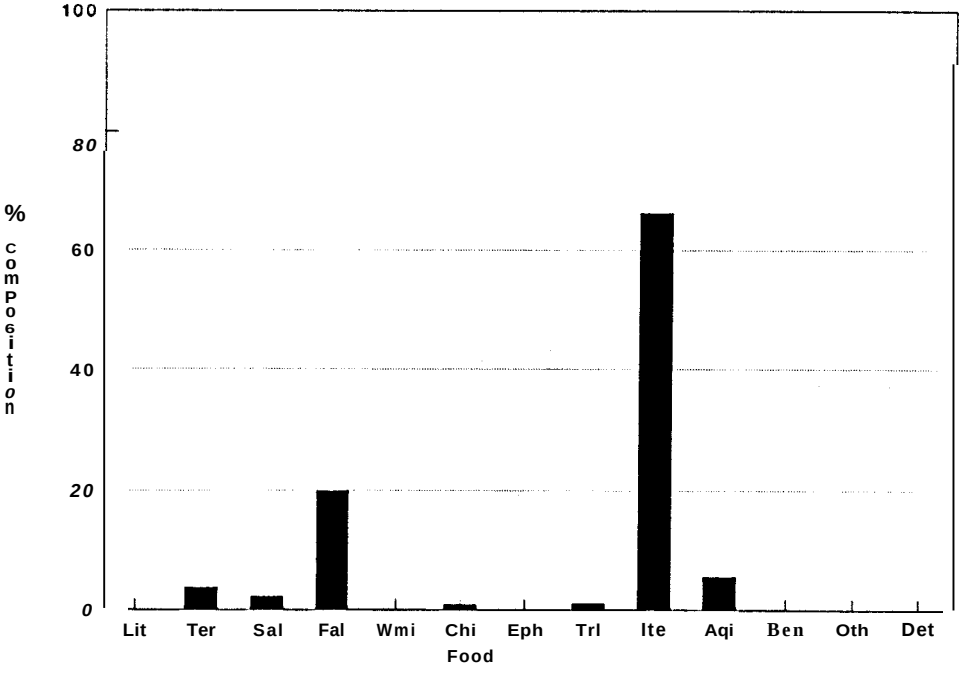


Fig.22 Diet of *Channa gachua*

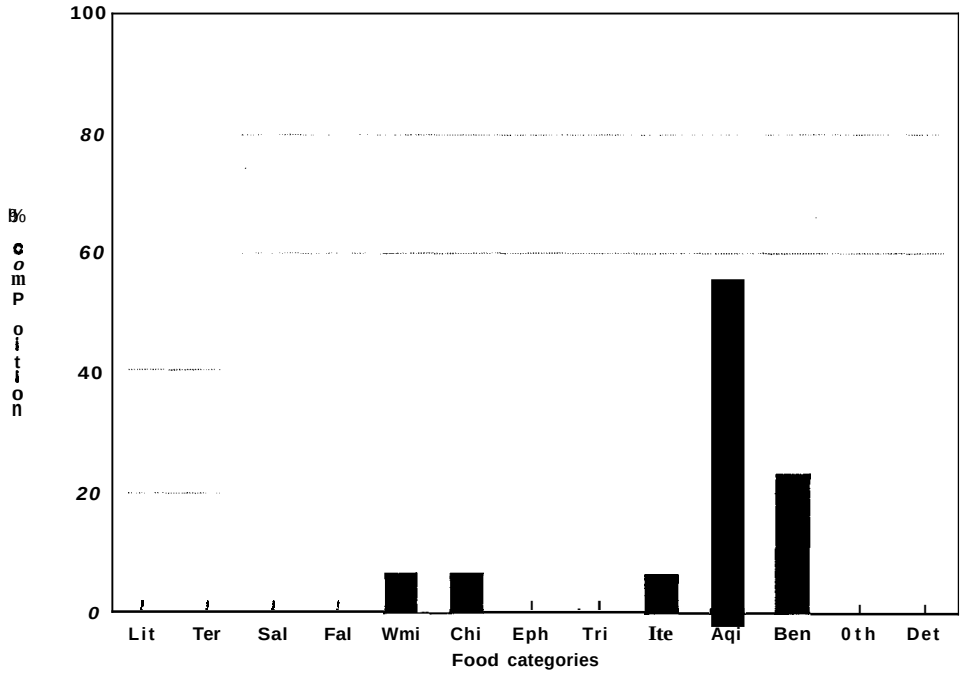


Fig.23 Diet of *Mystus cavasius*

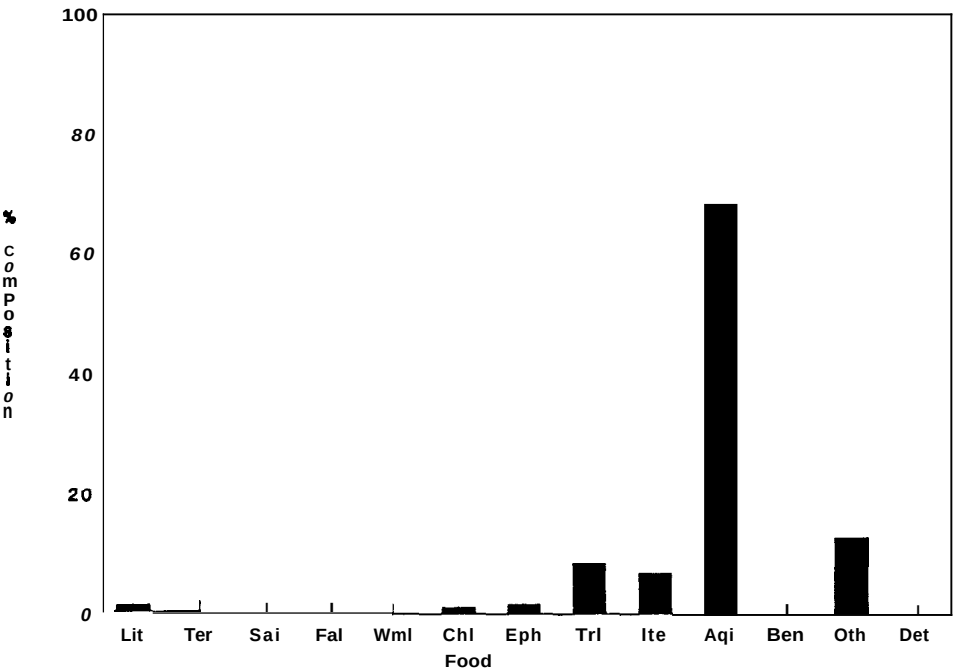


Fig.24 Diet of *Salmostoma acinaces*

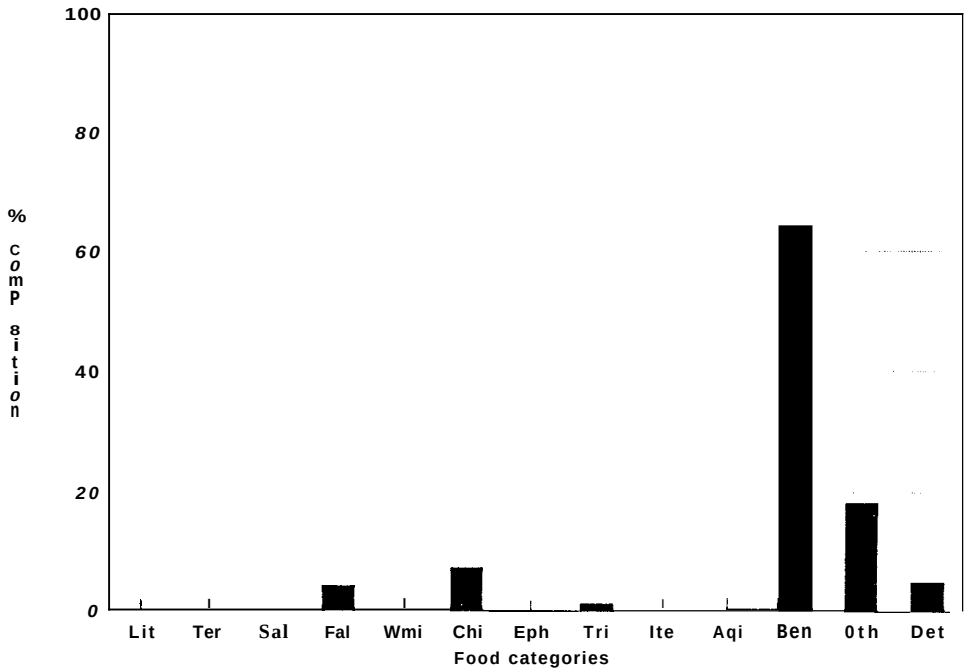


Fig.25 Diet of *Tor khudree*

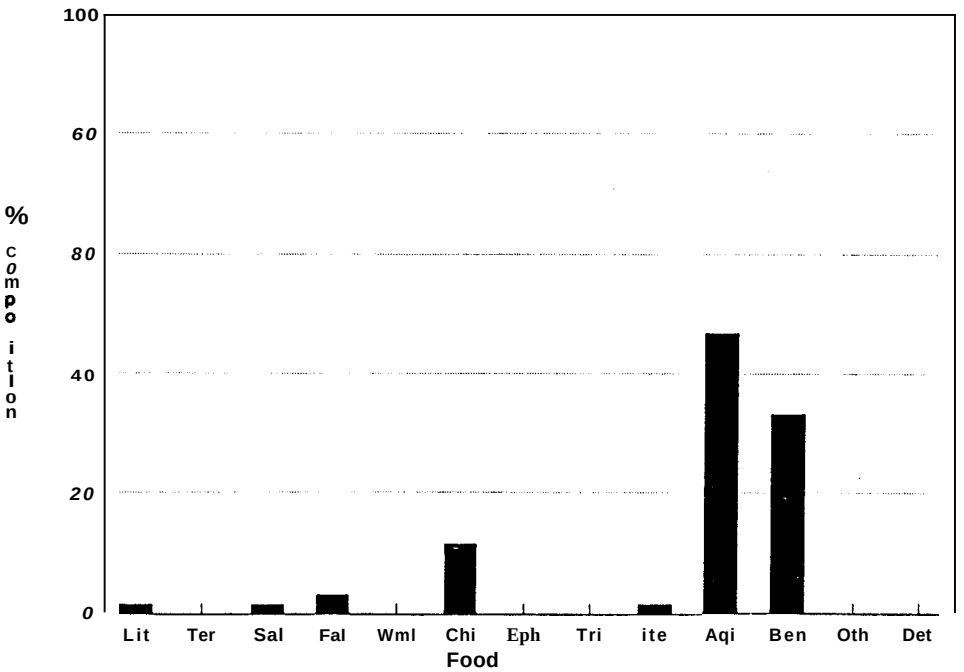


Fig.26 Diet of *Danio aquepinnatus*

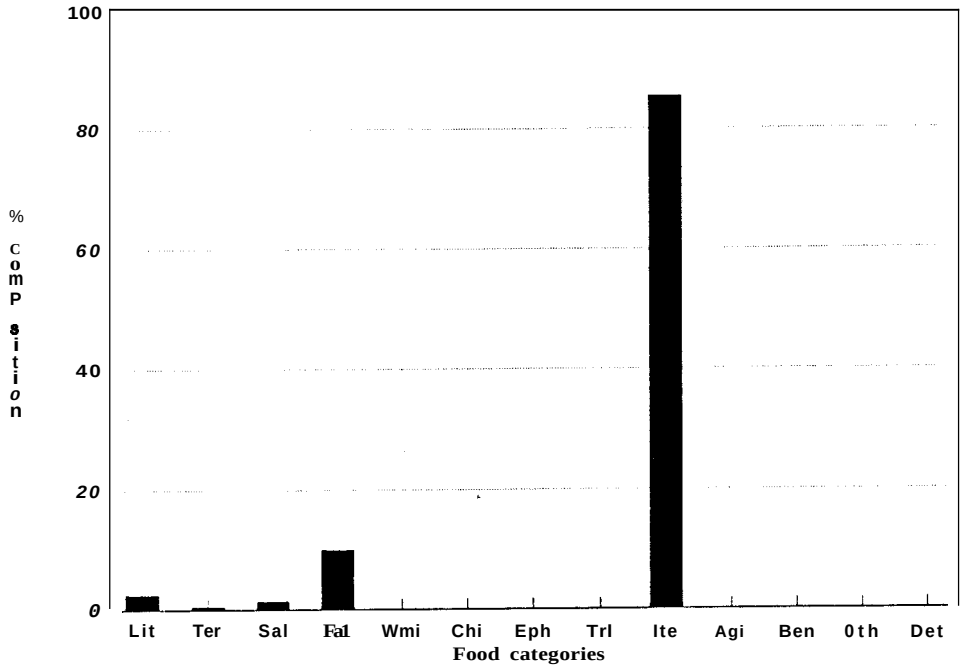


Fig.27 Diet of *Crossochielus latius*

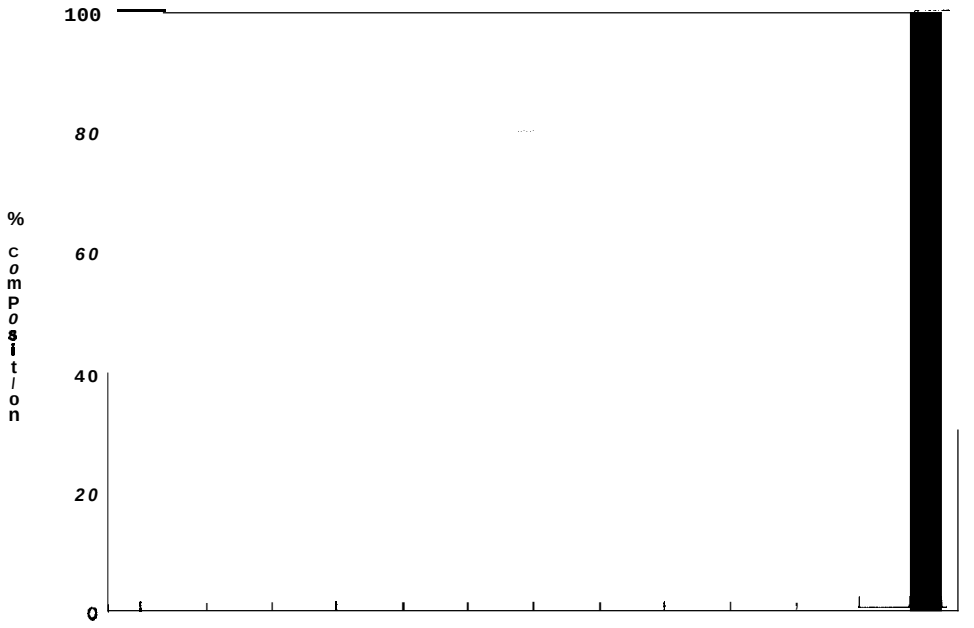


Fig.28 Diet of *Amplypharygodon melatina*

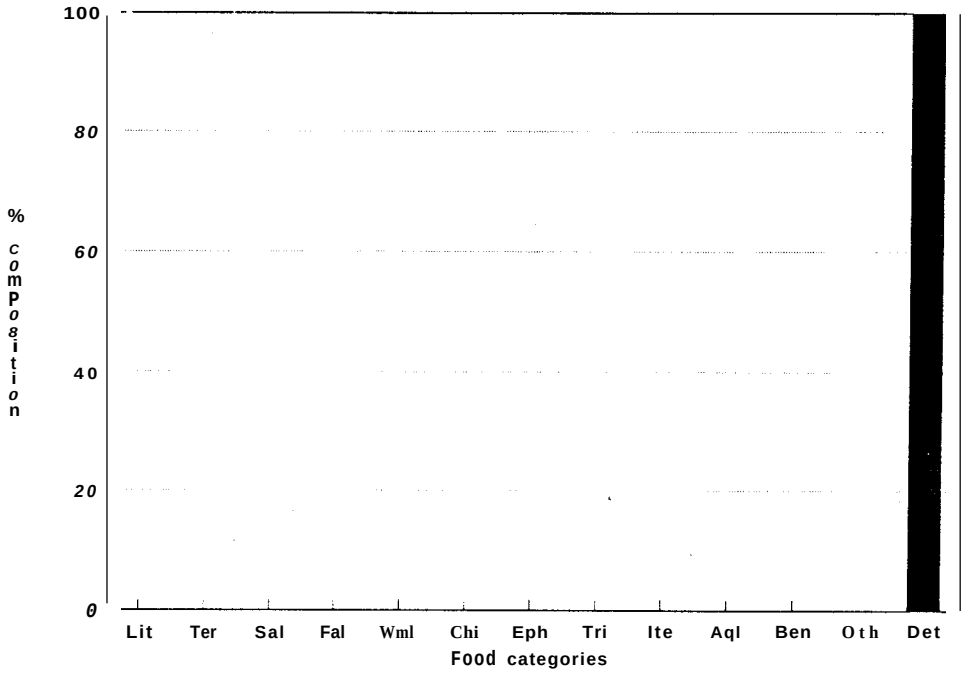


Fig.29 Diet of *Garra mullya*

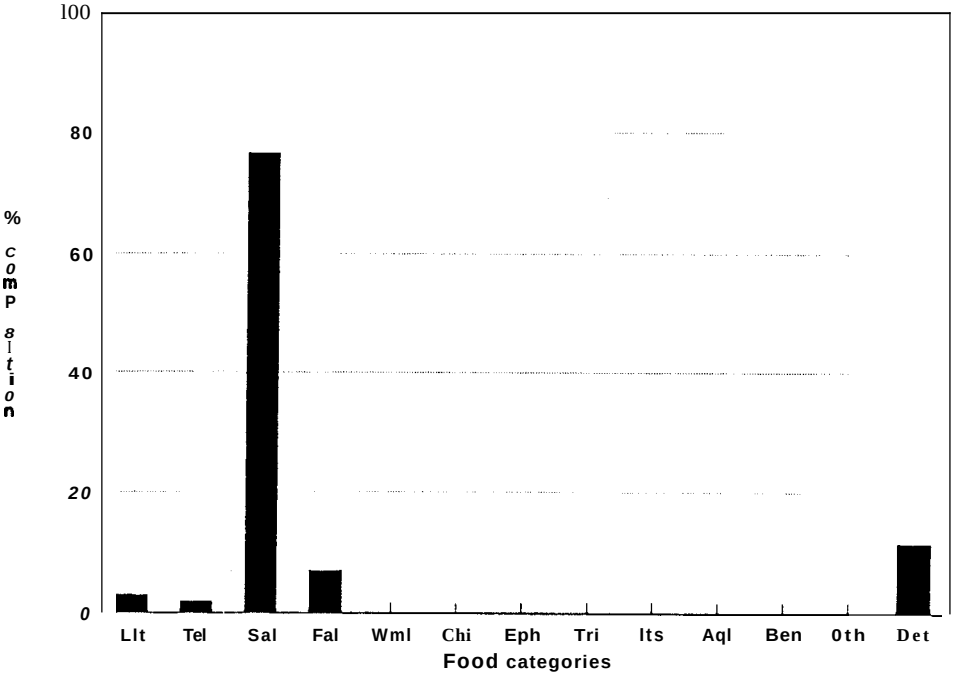


Fig.30 Diet of *Chanda renga*

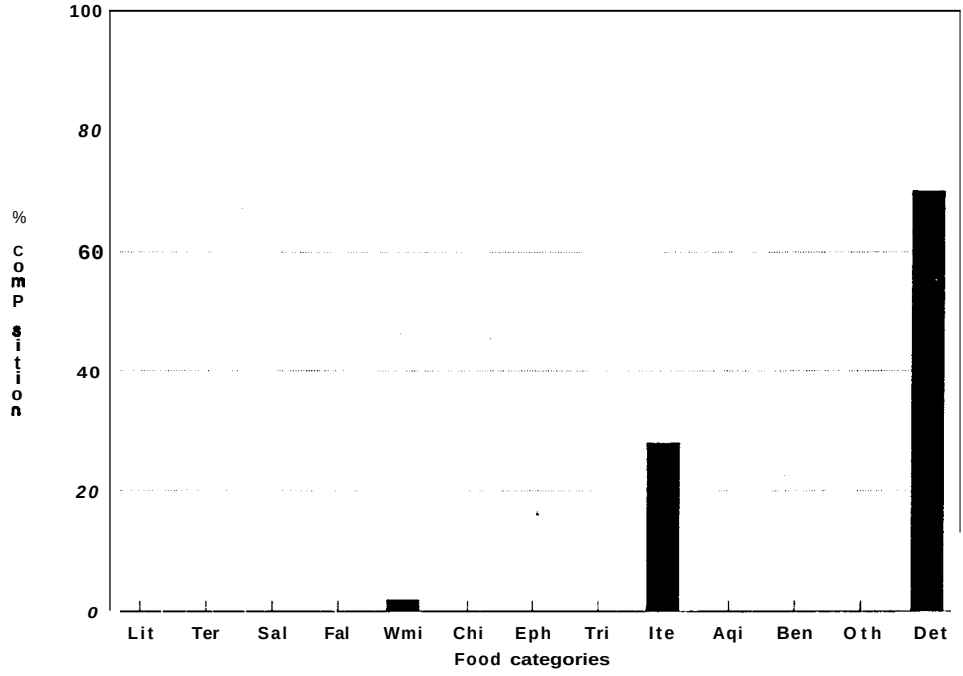


Fig.31 Diet of *Noemacheilus guentheri*

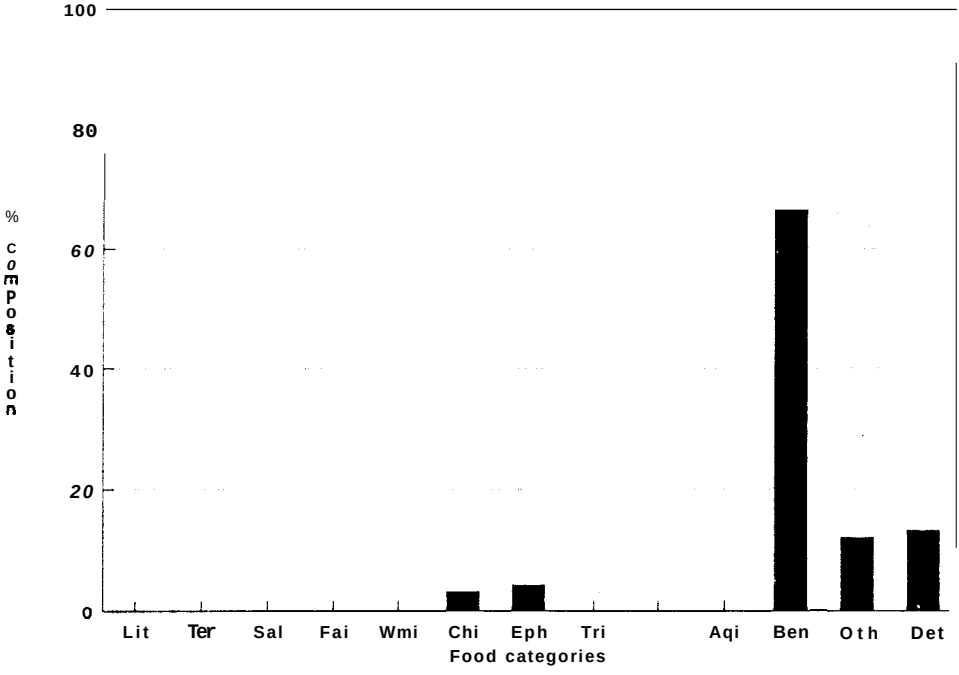
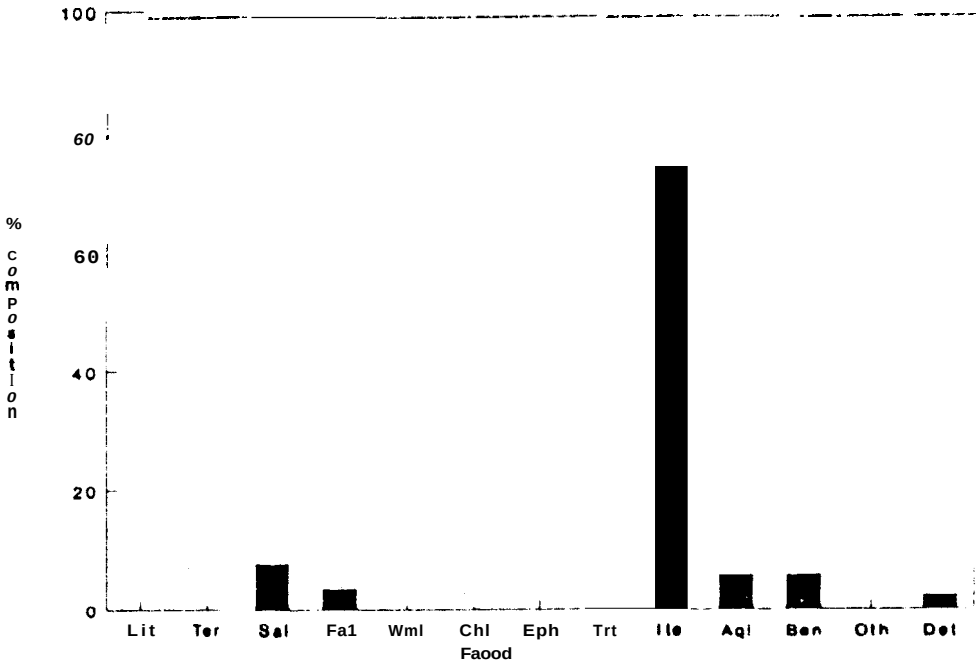


Fig.32 Diet of *Rasbora daniconius*



The present study on the diet of fishes of the area indicate that majority of the species belonged the trophic class benthic insectivore (37%). The terrestrial insectivores (21%) and detritivores (21%) were equal in number. The algivores were a minor group (16%) and omnivore was represented by only one species.

The trophic characteristics of fishes of the area is comparable with other forest stream fishes studied elsewhere, where the insects food base was the mainstay of fish communities (De Silva et al., 1980: Moyle and Senanayake. 1984; Wikramanayake and Moyle, 1989; Arun, 1992).

4.7 FISHERY ACTIVITIES OF TRIBALS

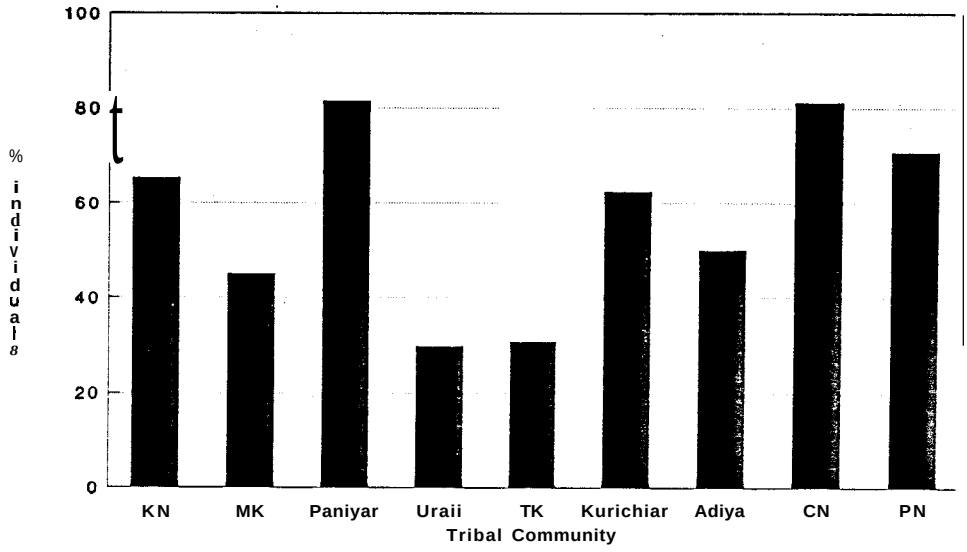
The tribals of Nilgiri Biosphere Reserve include "Kurumar", "Naikan", "Paniyar" and "Kurichiyar". Paniyar and Cholanaikkans were the tribals mostly engaged in fishing (80%). Seventy percent of the Pathinaikkas and about 65% of the Kattunaikkans and Kurichiyar were engaged in fishing. Urali and Thenkurumar engaged in fishng were very few (Fig. 33). Analyses of the data for genderwise involvement in fishing show that all the men among Paniyar, majority among the Cholanaikkans, Kattunaikkans, Pathinaikkans. Kurichiyar and Mullakurumar engaged in fishing (Fig. 34). More number of tribal women were involved in fishing among the Cholanaikkans, Pathinaikkans and Paniyar. Interestingly, the number of Urali women engaged in fishing outnumbered the men.

More than 70% of the tribals in Karulai, Nulpuzha and Mananthavady engaged in fishing. This was about 50% in Pulpally and less than 40% in Thirunelli (Fig. 35). Genderwise analyses in different areas followed the same pattern (Fig. 36).

About 38 species of both fin and shell fishes were collected by the tribals in different areas (Table 16). The type of fishes collected by the tribals obviously varied from region to region. However, *Mastacembelus armatus* (Aral) dominated in all the areas. Eight species formed more than 50% of the fishes exploited in Pulpally (Fig. 37). In Nulpuzha, three species were commonest among the exploited (Fig. 38). Four species contributed to the fishes exploited by the tribals in Thirunelli, Karulai and Manthavady area (Fig. 39-4i).

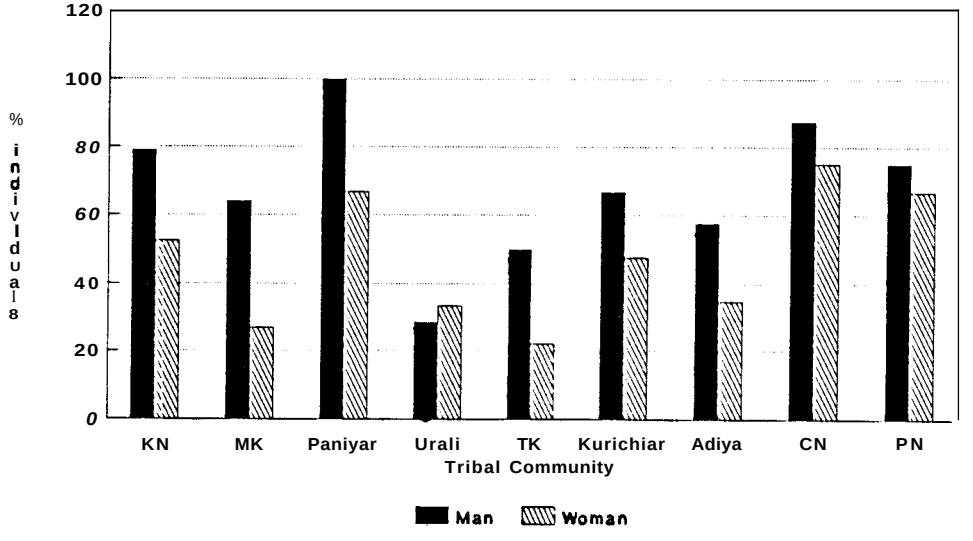
The percentage frequency distribution of fishes collected by different tribes are given in the Figures 42-47. The type of fishes collected by different tribes

Fig.33 Percentage distribution of individuals engaged in fishing in different tribal communities in NBR



KN-Kattunaikkar MK-Mulla Kurumar
TK-Then Kurumar CN-Chola Naikkar
PN-Pathi Naikkar

Fig34 Percentage genderwise distribution of individuals engaged in fishing among different tribal communities



KN-Kattu Naikkan MK-Mulla Kururnar
TK-Then Kururnar CN-Chola Naikkan
PN-Pathi Naikkan

Fig.35 Areawise distribution of tribal individuals engaged in fishing in NBR, Kerala part

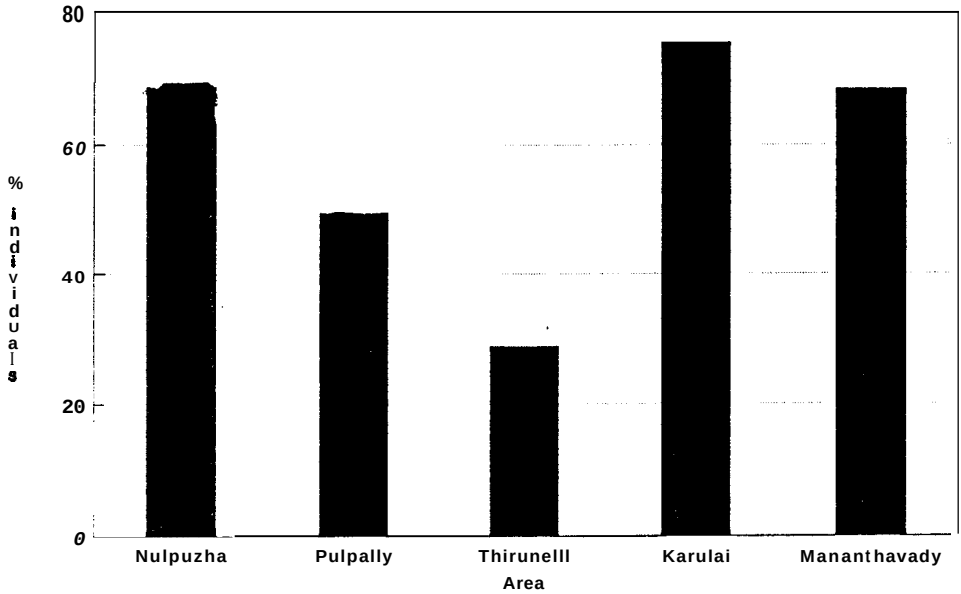


Fig.36 Area wise distribution of Tribals engaged in fishing in NBR

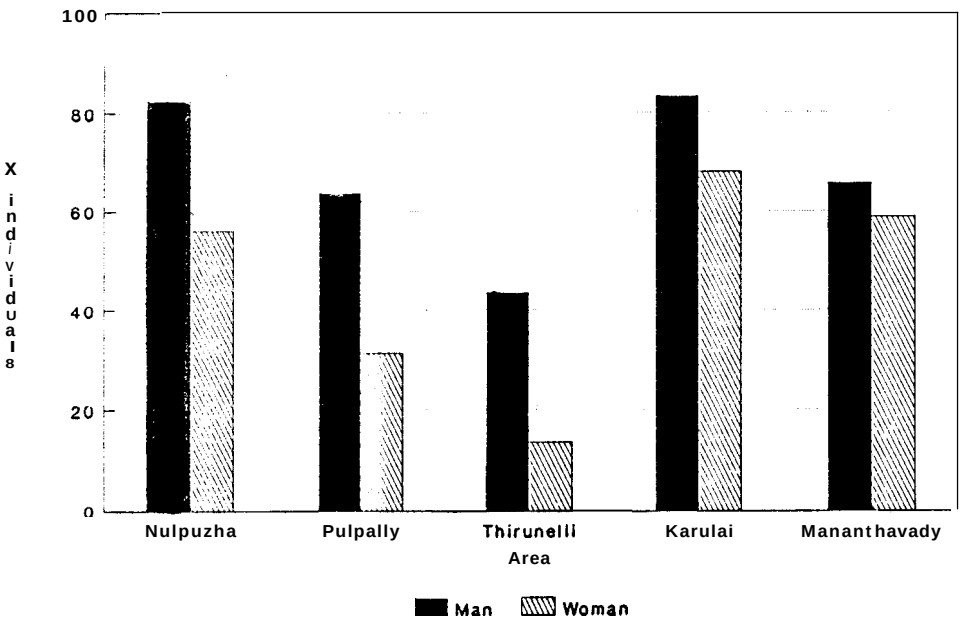


Table 16. The fin and shell fishes exploited by the tribals in NBR of Kerala zone

Sl. No.	Common name	Scientific name
1.	Aral	*Mastacembalus armatus armatus*
2.	Mushi	*Clarias dussumieri*
3.	Mullan	*Mystus* sp.
4.	Vala	*Wallago attu*
5.	Kadanna	*Puntius carnaticus*
6.	Etta	*Mystus punctatus*
7.	Cheran	*Channa gachua*
8.	Varal	*Channa striatus*
9.	Koima	*Noemacheilus* sp. and *Lepidocephalus thermalis*
10.	Pottuvala	*Ompok bimaculatus*
11.	Cherumeen	*Channa* sp.
12.	Mammalu	*Osteochilus* sp.
13.	Paral	*Barilius* sp.
14.	Kallemkari	*Garra* sp.
15.	Vannal	*Puntius* sp.
16.	Rogu	*Labeo* sp.
17.	Kallemutti	*Garra mullya*
18.	Kaduka	*Puntius* sp.
19.	Kallotty	*Garra gotyla stenorhynchus*
20.	Konju	Shrimp
21.	Njandu	Crab
22.	Kuva meen	*Puntius* sp.
23.	Karuva	*Puntius* sp.
24.	Velumeen	*Puntius* sp.
25.	Machan	*Osteochilus* sp.
26.	Kodali	*Garra* sp.
27.	Chethal	*Puntius* sp.
28.	Velimeen	*Cyprinus carpio communis*
29.	Silopi	*Tilapia mossambica*
30.	Kadukka	*Puntius* sp.
31.	Thodan	*Channa orientalis*
32.	Kotti	*Mystus* sp.
33.	Kaverikanni	*Crossocheilus latius latius*
34.	Chembolli	*Labeo rohita*
35.	Kari	*Heteropneustes fossilis*
36.	Kalveli	*Bhavania* and *Homaloptera*
37.	Mananjeel	*Anguilla bengalensis*
38.	Aranjeen	*Ambassis* sp.
39.	Kakka	Gastropodes and Bivalves (Mollusca)

were related to the abundance and the season of fishing. Only five species viz. Aral *(M.armatus).* Paral (*Barilius* sp.), Kallemutti *(Garra mullya*). Kuvameen *(Puntiussp.)* and Karuva *(Puntiussp.)* contributed to the fishery activities of Thenkurumar.

The results of the survey indicate that the tribal community in different parts of the study area depend heavily on the fishery. It is also evident that the fishes caught were mostly used for own consumption. Obviously the tribal women take an active role in the fishery activities.

4.7.1 Methods of fishing - An evaluation

Much has been said since the middle of the last century describing the destructive method of fishing in the fresh waters of India (John, 1936). Majority of the streams in Nilgiri Biosphere Reserve are perennial, though some are small. The fish resource is said to be depleted mostly due to the use of various destructive methods practised by both the tribals and others.

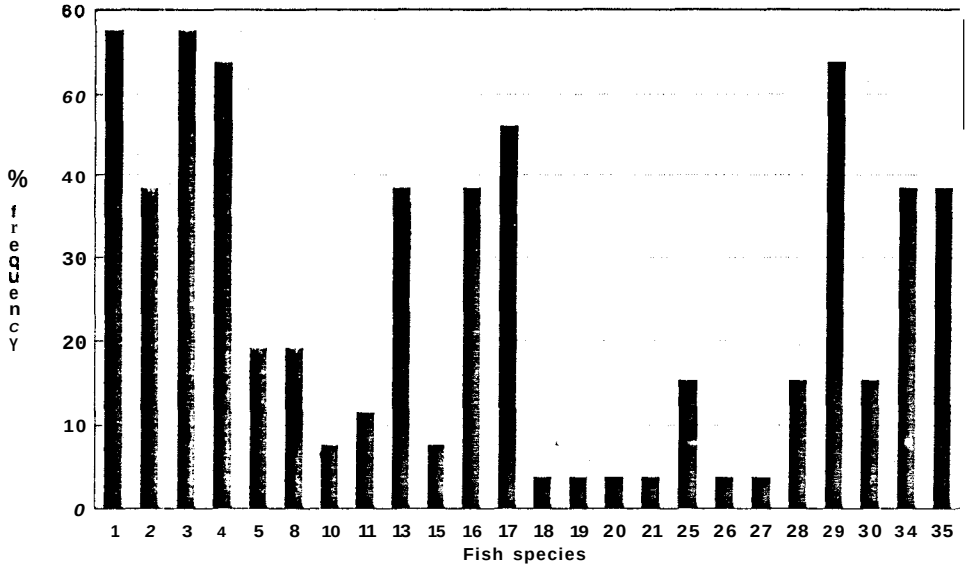
Traditionally the tribals in NBR used to live very near to the streams, especially in summer seasons and depended on the stream fishes for their livelihood. Different fishing methods are employed by the tribals depending on the season. The fishing methods employed include both destructive and non-destructive types.

4.7.1.1 *Non destructive methods of fishing*

1. **Rod and line:** Rod and line method is usually employed in larger streams and stagnant water holes. The species collected by the rod and line include, *Puntius carnaticus,* Mystus *punctatus,* Mystus *cavasius, Puntius micropogan* and *Ompok himaculatus.* Earthworm, grasshopper, small frogs. the larvae of *Oryctes rhinoceros* from cowdung, and fruits and seeds of plants are used as baits.

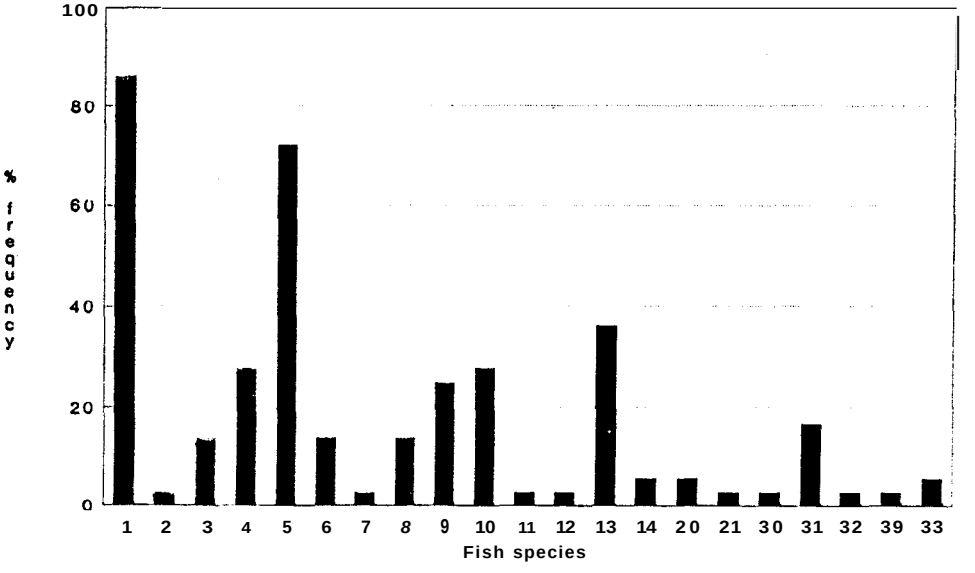
2. **Koortha:** This is a trap made of bamboo (Fig. 48). This device used to collect the fishes from running waters during the flood season when water enters paddy fields. The fishes migrating to paddy fields remain in the fields till September. During this time, people make a channel to drain the water and these "Koortha" are placed in this channel. The fishes coming along with the water are trapped in the Koortha.

Fig.37 Percentage frequency distribution of fishes collected by tribals in Pulpally



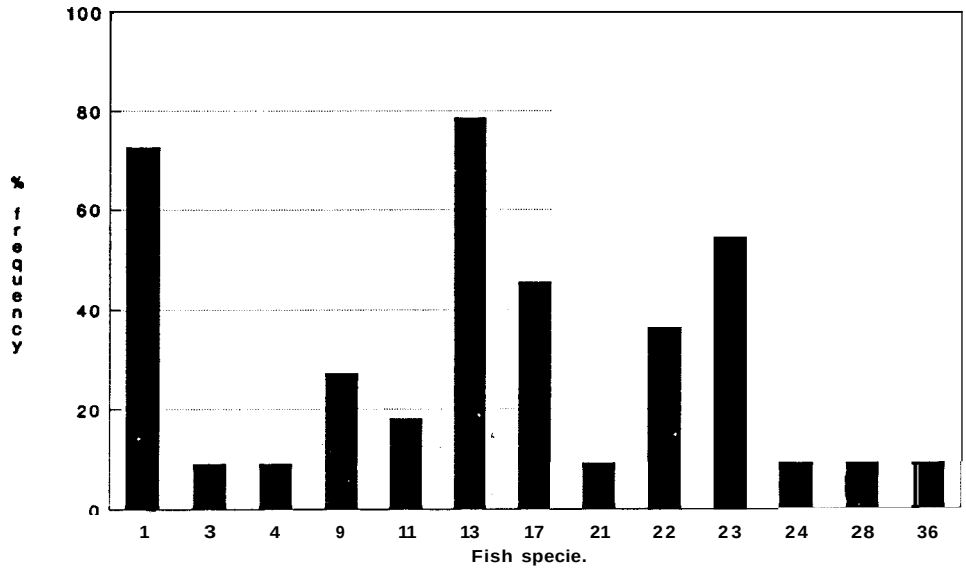
Fish species number corresponds to **the species in Table 17**

Fig.38 Percentage frequency distribution of fishes collected by tribals in Nulpuzha



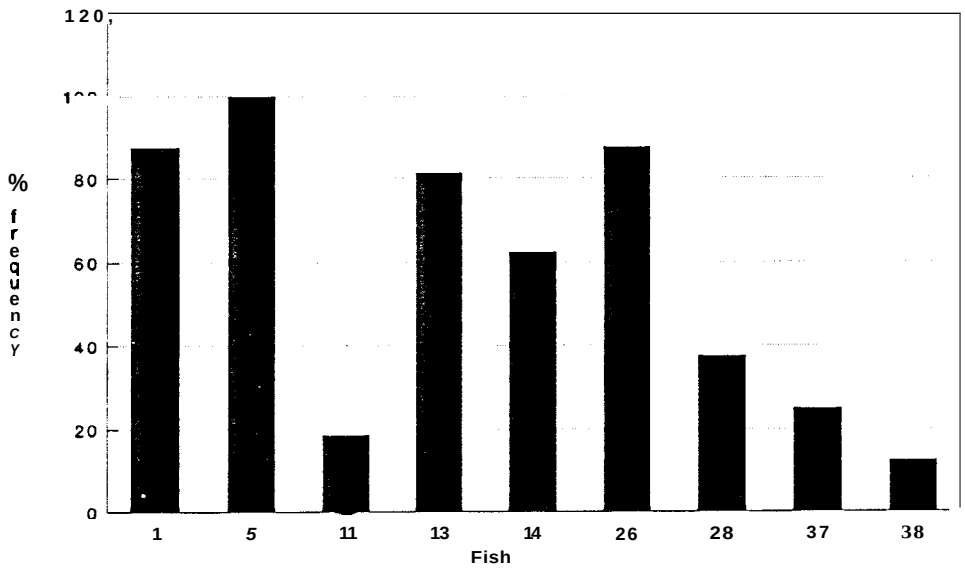
species number corresponds to the species in Table 17

Fig.39 Percentage frequency distribution of fishes collected by tribals in Tirunelli



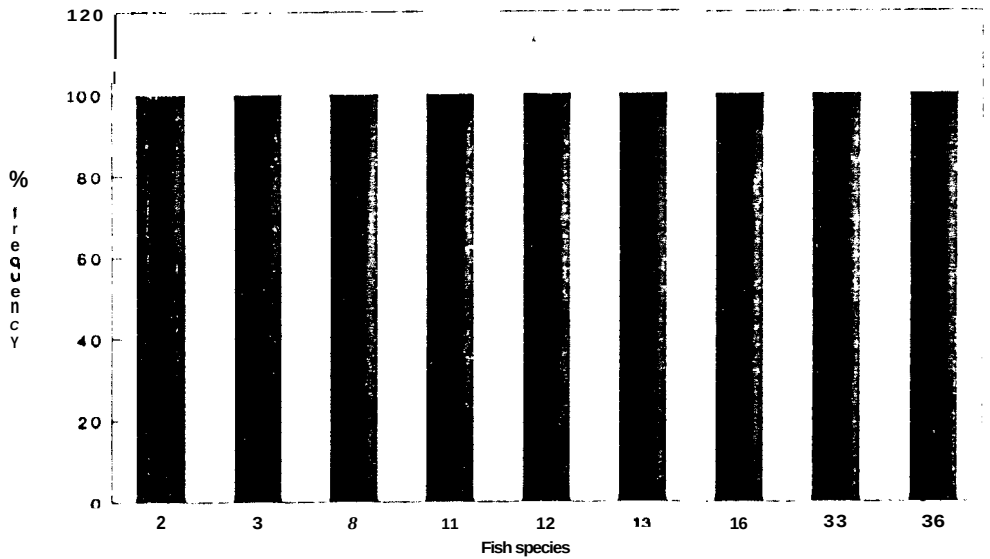
The fish species number corresponds to the name in Table 17

Fig.40 Percentage frequency distribution of fishes collected by tribals in Karulai



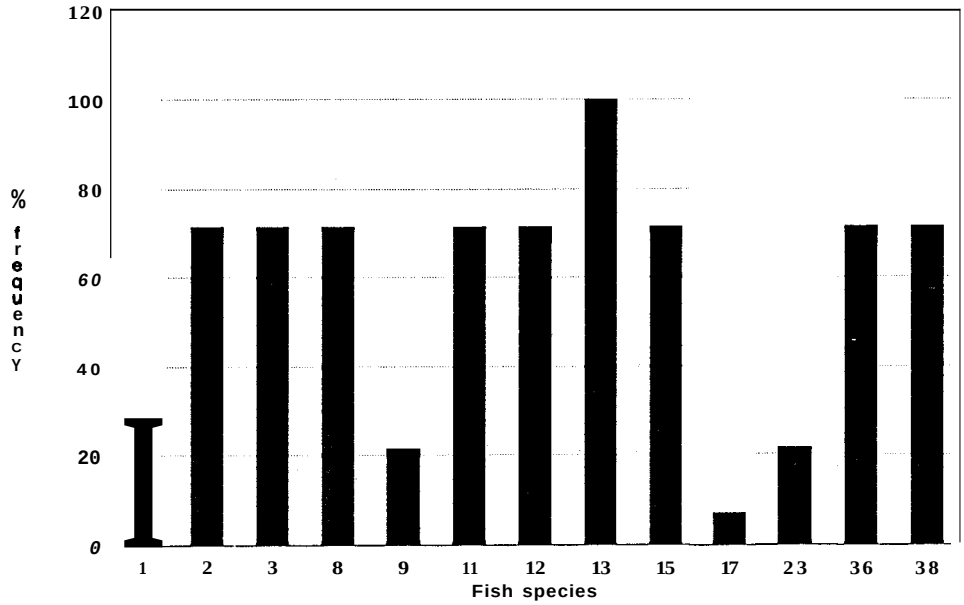
The fish species number corresponds to the name in Table 17

Fig.41 Percentage frequency distribution of fishes collected by tribals in Mananthavady



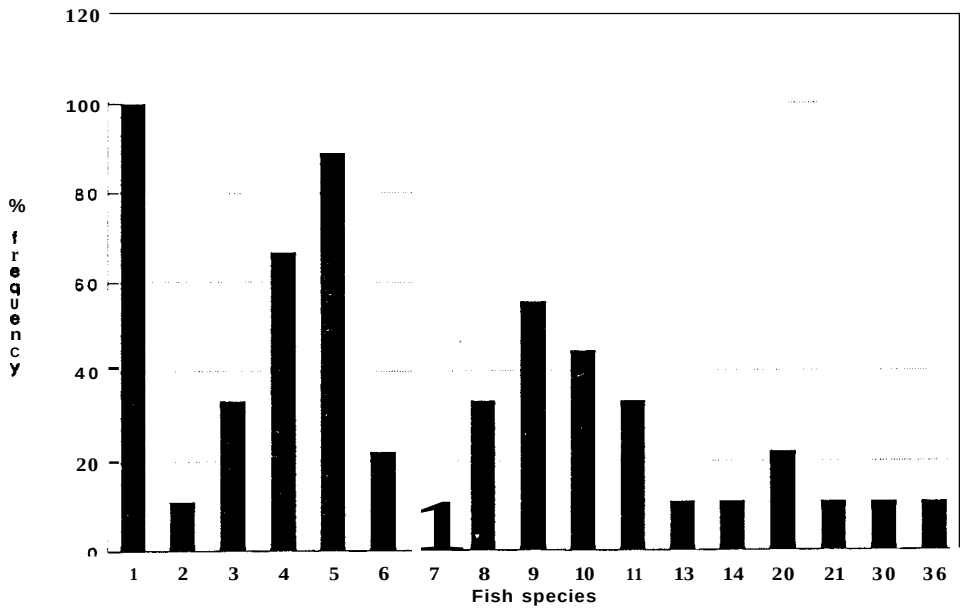
The fish species number corresponds lo the name In Table 17

Fig.42 Percentage frequency distribution of fishes collected by Kurichiar



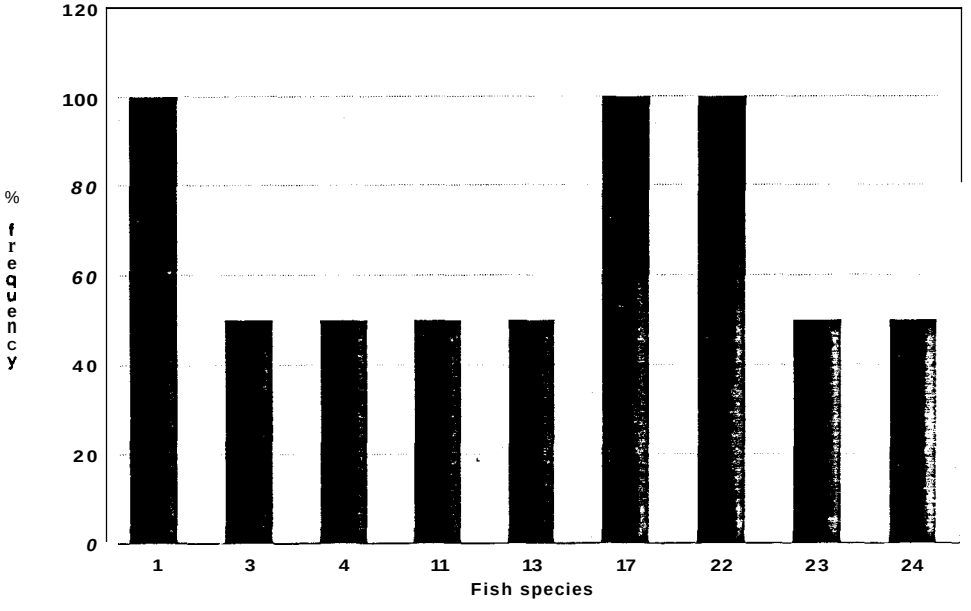
Fish species number corresponds to the species in Table 17

Fig.43 Percentage frequency distribution of fishes collected by Paniyar



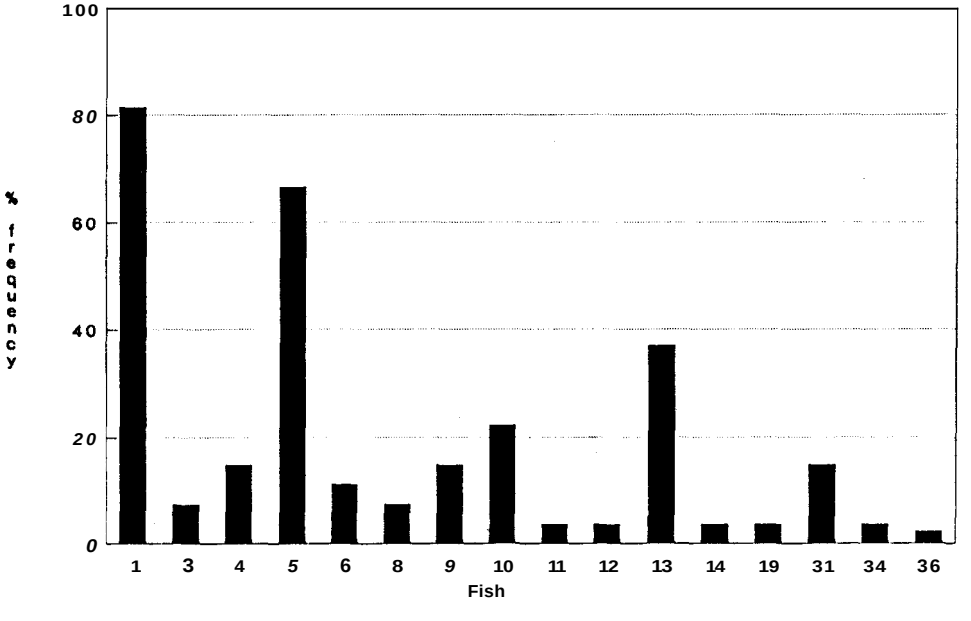
species number corresponds to the species in Table 17

Fig.44 Percentage frequency distribution of fishes collected by Urali



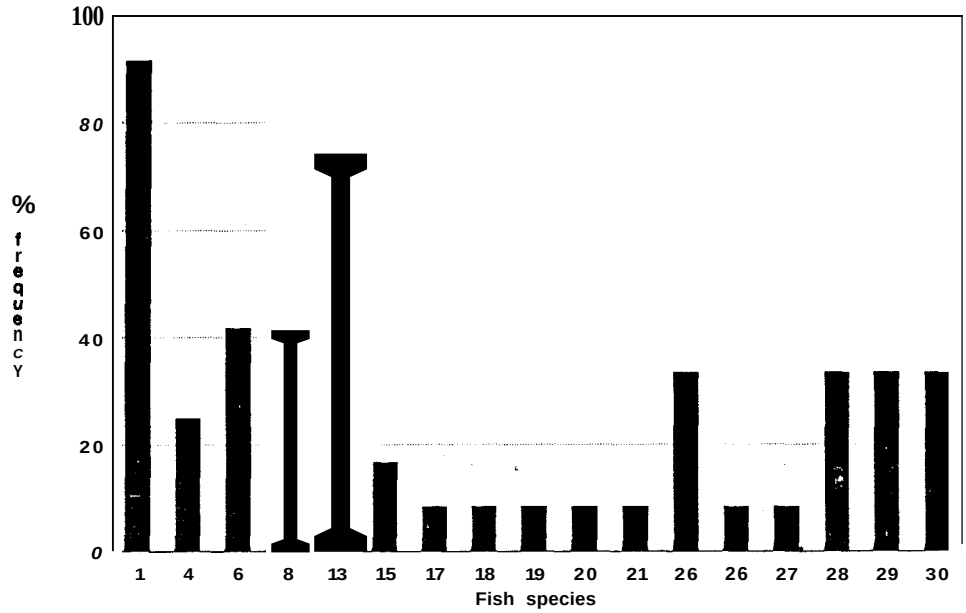
Fish species number corresponds to the species in Table 17

Fig.45 Percentage frequency distribution of fishes collected by Kattunaikar



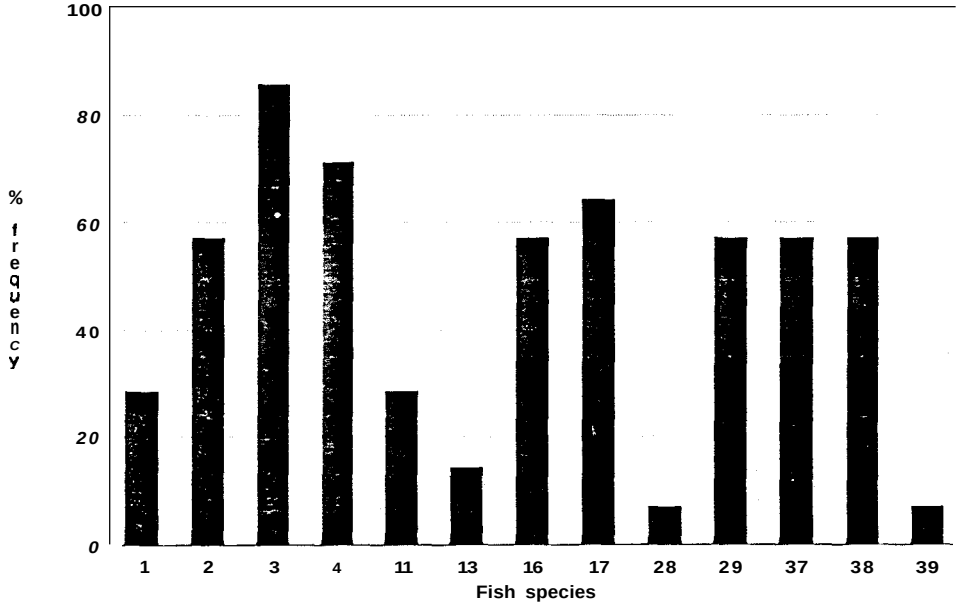
Fish species number corresponds to the species in Table 17

Fig.46 Percentage frequency distribution of fishes collected by Mulla Kurumar



Fish species number corresponds to the species in Table 17

Fig.47 Percentage frequency distribution of fishes cotlected by Adiyar



FIsh species number corresponds to the species in Table 17

3. **Koodu:** Koodu is made of bamboo and reeds [Fig. 49). This is applied mainly in the monsoon. During this season, the fishes have a tendency to migrate upland in search of breeding grounds. The 'Koodu' is applied in the channel through which the fishes could possibly migrate. All other channels will be bunded or closed with mud, bamboo and leaf or twigs. This method is common in Travancore also where mass migration of fishes occur in the monsoon season and is called "Oothayilakkam" in Malayalam. In summer, the tribes use this Koodu to collect the fishes. They make bunds across the rivers and make a single channel to drain the water. The koodu is placed in the channel and the fishes are frightened to trap them. Sometimes, they apply poisons like copper sulphate for a massive movement.

4. **Bow and arrow:** This is mainly used by the Kurichiyar and Kurumas. The bow is made of bamboo and the arrow of iron. They use this to hunt the big sized fishes Like freshwater shark and the snakeheads (Fig. 50).

4.7.1.2 Destructive methods

1. **Thotta-Fish dynamite:** This method is mostly employed by the non- tribals and applied in stagnant rocky pools in rivers and streams. After applying this, 2-3 persons will dive to collect the fishes. Medium sized to big sized fishes will be collected and juveniles are normally discarded. Sometimes **thotta** is specifically used in selected spots where species like *Channa marulius* and *Wallago attu* are abundant. This method is highly detrimental to juveniles of fishes and other aquatic fauna.

2. **Karrakai, *Randia brandisii*** (Fig. 51): The fruits of Randia brandisii are collected from the forest and crushed. Nearly 5-6 kg is normally used. Usually medium sized fishes are collected by this method. The method is commonly employed in summer season when the water level is low.

3. **Thodan Valli, *Acacia torta*** (Fig. 52) : This climber is crushed in water till a surf develops. About 5-6 kg is used for poisoning. The extract is applied in the water with the help of 5-10 persons. After half an hour, fishes lose their balance and are collected using common traps like the Koortha.

Fig. 50 Bow and arrow - a traditional gear used by the tribals

Fig. 51 *Randia brandisii* - the plant used for poisoning the fishes

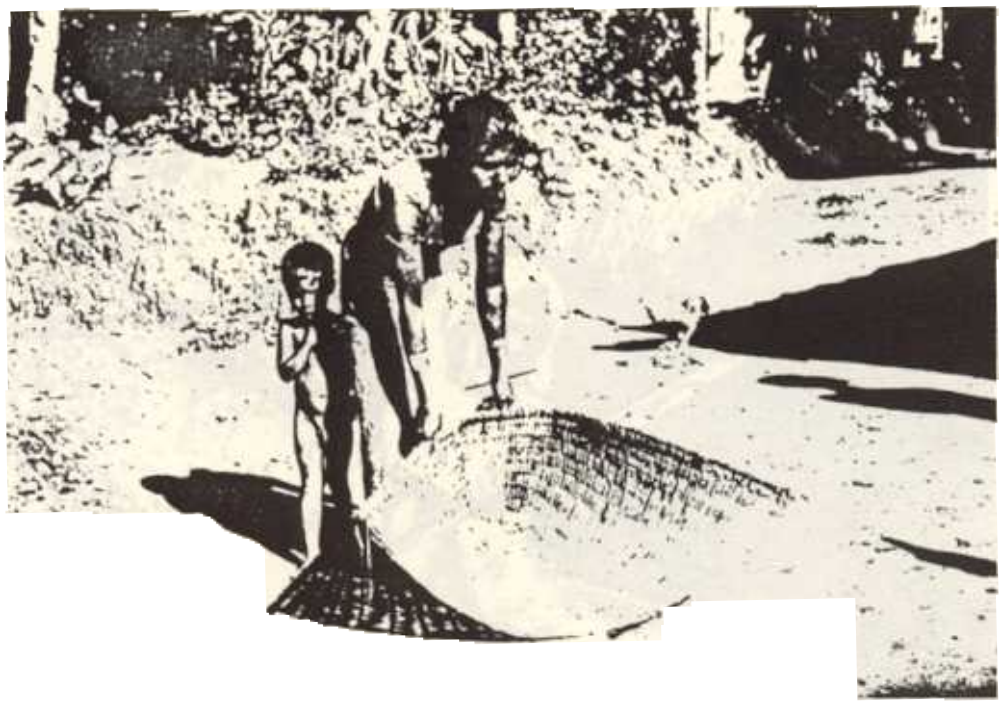


Fig. 48 Koortha - a traditional trap used by the tribals

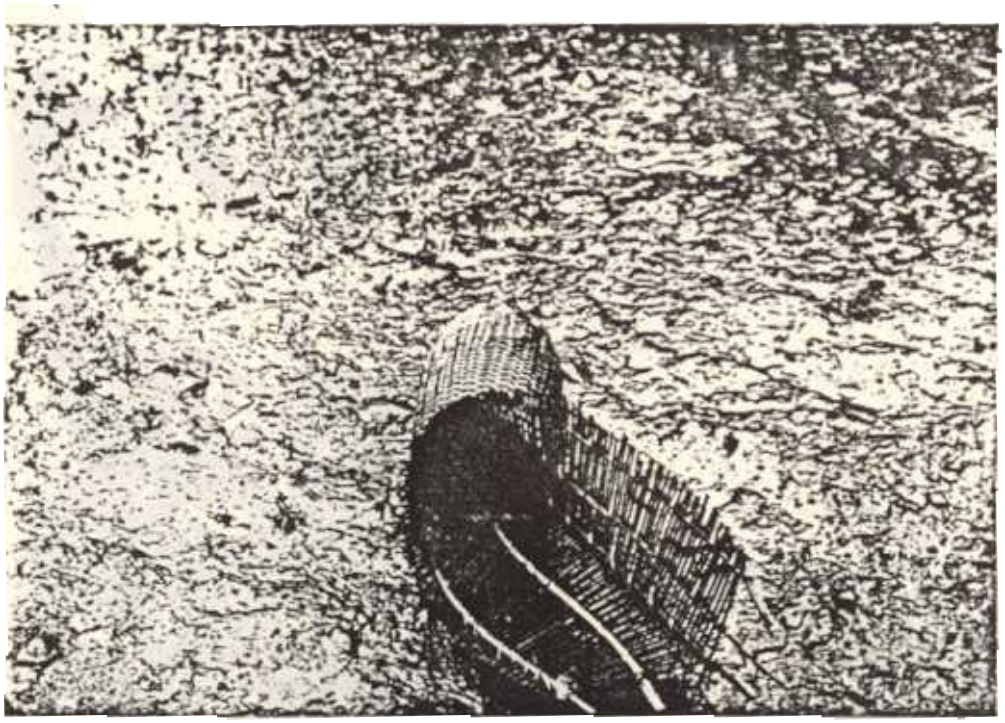


Fig. 49 Koodu - a traditional trap used by the tribals

4. **Mula or Illy (Bamboo):** The tender shoots of bamboo are collected, crushed and mixed with water. Nearly 50-70 tender shoots are used for a single operation and is normally employed during the months of January- March. Sometimes, copper sulphate is also added to this for quick action and prolong the sedation time of fishes.

5. **Njaval, *Zyzigium caryophyllaeum*** (Fig. ***53):*** The bark of the tree, *Z. caryophyllaeum* is collected from the forests, squeezed and mixed in the stream. After half an hour, the fishes become unconscious and are collected using traditional traps like Koortha. Nearly 5 kg of bark is required for a single operation.

6. **Thirukalli, *Euphorbia* sp.** (Fig. 54): The plant is collected and put on the surface of stagnant water. The sap oozed out from the plant is detrimental to fishes. About 5-10 kg of plants are used for a single operation.

7. **Tobacco, *Nicotiana*** The tobacco is cut into pieces and applied. Six kilogram would be required for a single operation. The method is employed by Kurumar during summer season.

8. **Ash-Kalkothi-Njaval:** The bark of Njaval and leaves of Kalkothi is mixed with ash and applied into the water. The sedated fishes are collected using traditional traps and gears.

9. **Sopum-kay *(Sapindus* sp.):** The fruits are crushed to powder form in fresh condition and mixed water. Nearly 4-5 kg is enough for a single operation. This method is normally employed in summer.

10. **Cheenikkay:** The bark of this staggler is collected and crushed and thrown into water. This is applied in February-March season. Nearly 2 bundles (10 kg) are used for a single operation.

11. **Nanjukuru - Green Chilly - Copper Sulphate:** Nanju kuru and green chilly is crushed along with copper sulphate (Thurissu) and the mixture is thrown into the stream. After half an hour, the fishes die or become unconscious and are collected using common traps or hand

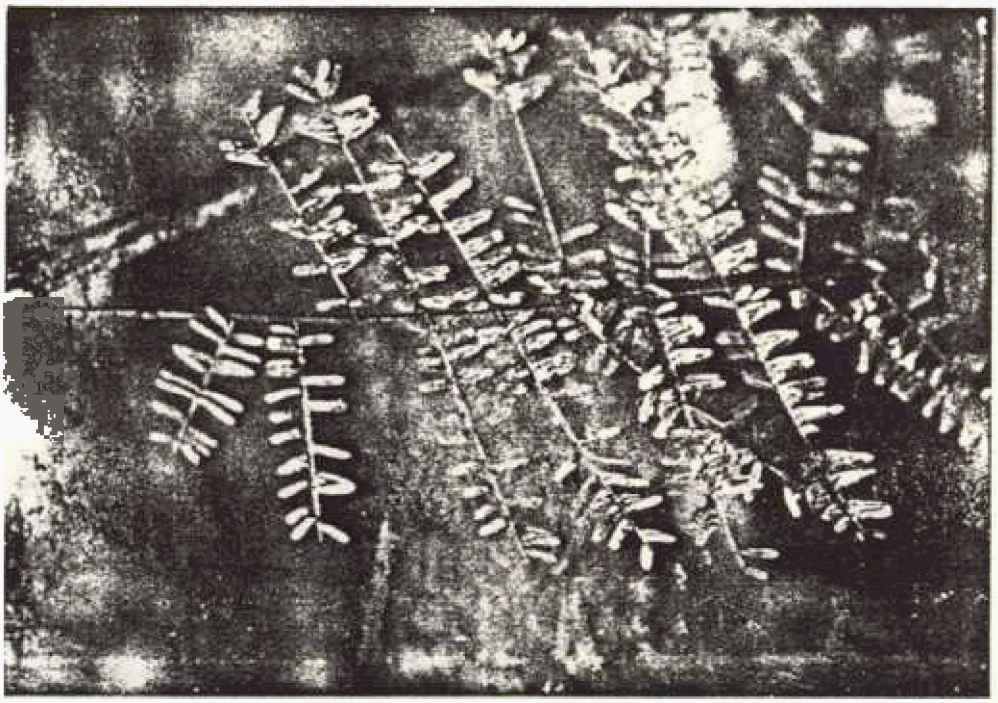


Fig. 52 *Acacia torta* - the plant used for poisoning the fishes

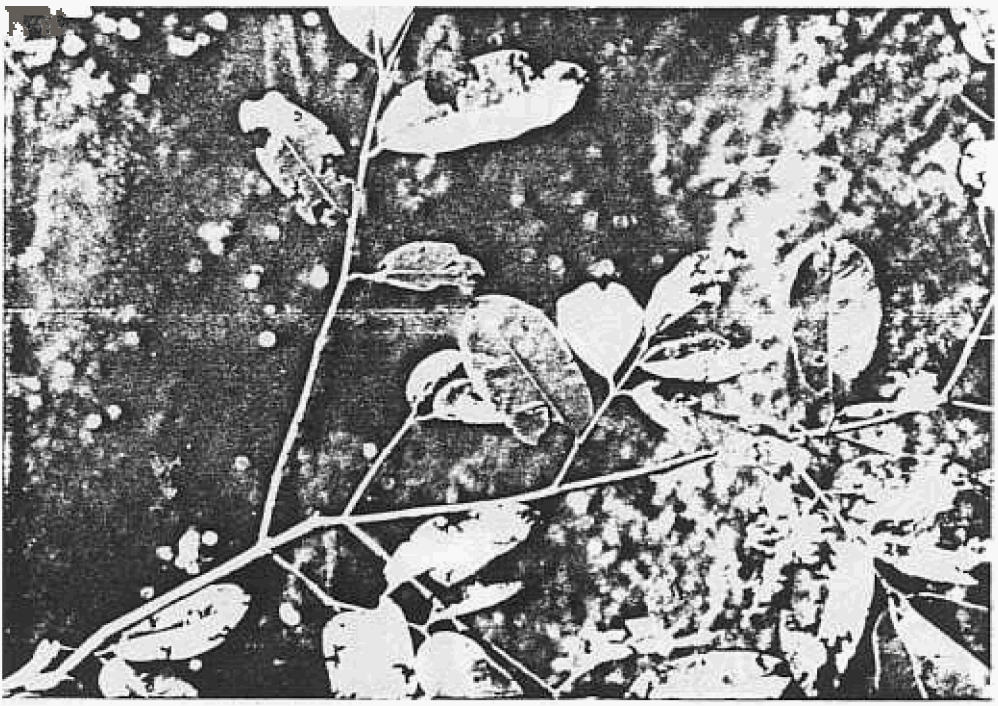


Fig. 53 *Zyzigium caryophyllaeum* - the plant used for poisoning the fishes

Fig. 54 *Euphorbia* sp. - the plant used for poisoning the fishes

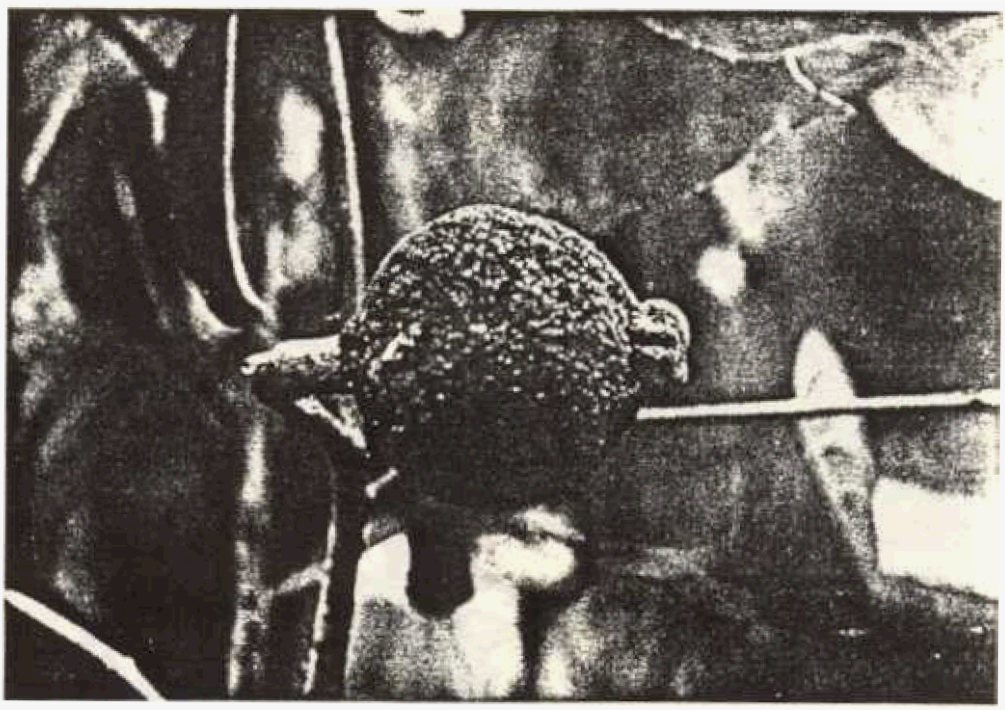


Fig. 55 *Hydnocarpus pentandra* - the plant used for poisoning the fishes

12. **Green chilly (Cheera paranki):** The green chilly is collected from the market and nearly 1-2 kg is needed for the operation. The chilly is crushed along with the Nanjumkay and applied in the water. This is a highly detrimental method and the whole area is destroyed. Copper sulphate may also be added to reduce the time to sedate.

13. **Marrotti, *Hydnocarpus pentandra*** The leaf and the fruit of the plant is crushed and mixed together and is applied in the stream. Fruit alone is sufficient for the operation (Fig. 55) Nearly 5-10 kg of fruit is used for an operation. This technique is usually practised during summer season.

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