

Occasional Paper No. 244

**Fish Fauna of Kozhikode District, Kerala
South India**

K.C. Gopi

Zoological Survey of India

Occasional Paper No. 244

**RECORDS
OF THE
ZOOLOGICAL SURVEY OF INDIA**

Fish Fauna of Kozhikode District, Kerala, South India

K.C. GOPI

Zoological Survey of India, Western Ghats Field Research Station, Calicut - 673002

Edited by the Director, Zoological Survey of India, Kolkata



**Zoological Survey of India
Kolkata**

CITATION

Gopi, K.C. 2006. Fish Fauna of Kozhikode District, Kerala, South India. *Rec. zool. Surv. India, Occ. Paper No. 244* : 1-39. (Published by the Director, *Zool. Surv. India*, Kolkata)

Published : January, 2006

ISBN 81-8171-090-8

© *Government of India*, 2006

ALL RIGHTS RESERVED

- No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without the prior permission of the publisher.
- This book is sold subject to the condition that it shall not, by way of trade, be lent, resold hired out or otherwise disposed of without the publisher's consent, in any form of binding or cover other than that in which it is published.
- The correct price of this publication is the price printed on this page. Any revised price indicated by a rubber stamp or by a sticker or by any other means is incorrect and should be unacceptable.

PRICE

India : Rs. 150.00

Foreign : \$ (U.S.) 9, £ 5

Published at the Publication Division by the Director, Zoological Survey of India, 234/4, A.J.C. Bose Road, 2nd MSO Building (13th Floor), Nizam Palace, Kolkata-700020 and printed at Power Printers New Delhi - 1100 002.

**RECORDS
OF THE
ZOOLOGICAL SURVEY OF INDIA
OCCASIONAL PAPER**

No. 244

2006

1-39

CONTANTS

INTRODUCTION.....	1
STUDY AREA : KOZHIKODE DISTRICT.....	1
RIVER DRAINAGE SYSTEMS.....	2
MATERIALS AND METHODS.....	3
RESULT AND DISCUSSION.....	4
FISH FAUNAL COMPOSITION.....	5
ECOLOGICAL OBSERVATIONS.....	6
ZOOGEOGRAPHIC SIGNIFICANCE AND FISH DIVERSITY.....	8
FISHERY RESOURCES.....	9
AQUATIC ENVIRONMENT AND THE ECOLOGICAL PROBLEMS.....	10
SUMMARY.....	11
ACKNOWLEDGEMENTS.....	11
REFERENCES.....	11
SYSTEMATIC LIST	
TABLES : 1-7.....	15
FIGURES : 1-5.....	31
MAPS : 1-2.....	33
PLATES 1-IV.....	35

INTRODUCTION

Inventorying and monitoring of biodiversity of a biogeographically significant territory is a prerequisite for biodiversity conservation. It becomes all the more imperative once the biodiversity perspectives are related to a biodiversity threatened hot spot like Western Ghats. In the biogeography of Western Ghats, the geographic territory occupied by Kerala has a prime importance. It is well exemplified in the diversity of the aquatic environment available in the state and the fish faunal diversity and richness associated with it.

The State of Kerala is geographically small in size, but its zoogeographic significance in perspective of fish faunal diversity is much greater. It has comparatively more diversity of native fishes, including a preponderance of species endemic to it, as is evident in the documented works of Menon (1999) and Jayaram (1999). Since the monumental works of Day (1865, 1878) : *Fishes of Malabar* and *Fishes of India*, many ichthyologists have contributed to the knowledge on the fish diversity and richness of Kerala, with the studies mainly focused on region/sector-based. The freshwater fishes of southern and central Kerala are rather well studied and documented than the ichthyofauna of northern Kerala (Pillay, 1929; John, 1936; Hora & Law, 1941; Silas, 1950, 1951).

Hora (1942) made studies on the fishes in Wynad and adjacent areas of the Malabar Region falling north of Palakkad Gap. In the more recent period appeared further works on the fish faunal diversity related to certain river systems of the state (Rema Devi and Indra, 1986; Raghunathan, 1995; Ajithkumar, *et al.*, 1999; Biju, *et al.*, 1999; Raju Thomas, *et al.*, 2002, etc.). Cherian, *et al.* (2001) have recently documented the ichthyofauna of Trivandrum District, Kerala. No attempt has hitherto been made to make a detailed study on the ichthyofauna of the Kozhikode District, based on the faunistic exploration of the varied habitats associated with the major river systems of the district. The present study conducted and completed during the period from 2003 to 2005 was aimed to achieve that objective.

STUDY AREA : KOZHIKODE DISTRICT

Kozhikode District (formerly known as Calicut) is one of the 14 districts of Kerala, located in the northern part of the State (Map 1). The district is bound on the west by the Arabian Sea, and on the north, east and south by the other districts of the state, namely Kannur, Wynad and Malappuram, respectively. It extends from north latitude 11° 08' to 11° 52' and east longitude from 75° 26' to 76° 31'. The physiography of the district has much resemblance to that of the whole state, which is characteristically identified into the natural divisions *viz.*, the Highlands, the Midlands and the Lowlands including coastal plains, spanning a short distance from the Western Ghats to the West Coast.

The Highland zone is very characteristic, integrally aligned with the Western Ghats, the most prominent orographic feature of Peninsular India. Midland zone overlapping from the main range of the ghat section almost extends to a short distance from the seashore. The altitudinal range spanning these three divisions is asymmetric owing to the occurrence of isolated hillocks, even found in Lowlands. The mountains fringing the east generate numerous streams, forming the tributaries of rivers that flow westward, forming valleys. The midland region is only moderately elevated, with more areas of it overlapping the lowland zone. Based on the moderate elevation of the physiography and nature of geological relief, the Public Works Department of Kerala, has identified three physiographic zones, viz., the Highland above 76 m M.S.L, the Midland, 7.6 to 76 m and the Lowland below 7.6 m, including the Coastal Plains (Ramachandran Nair, 1986). The Lowland, however, is a section of differential relief dissected by streams, rivers and cultivable plains, and lateritic hill mounts and terraces. The coastal plain of the district at some places (Vadakara to Kolavipalam areas) have the characteristic beach dune ridges lying somewhat parallel to the shoreline. The strand plains here exhibit marshy areas and lagoons (Agalapuzha backwaters and Kottapuzha estuary).

RIVER DRAINAGE SYSTEMS

The Kozhikode District of Kerala falls in the watersheds of three main river basins, namely Chaliyar, Korapuzha and Kuttiadi Rivers (Map 2). As is the feature, in general, of the river-drainage-systems of the state, the rivers in the district are dimensionally small or minor systems with only short-distance courses from the mountains/hills of their origin in the Western Ghats to the shoreline on the West Coast. The drainage of the district is patterned in conformity with the physiographic gradient. The district is drained by 4 of the 41 west flowing rivers of the state. They are the rivers, from the south to north, Chaliyar (or Beypur) River, Kallai River, Korapuzha (or Elathur) River and Kuttiadi (or Murat) River, respectively.

The longer rivers among the four, viz., Chaliyar and Kuttiadi characteristically bear two nick points corresponding to the two breaks in the slopes, marking the delineation between the Midlands and the Lowlands (it is very evident in the river turn of Kuttiadi system, vide, Map 2: Site No. 36). The Chaliyar Drainage System is one of the major rivers in the state, and in fact not just an inter-district (flowing through Wynad, Malappuram and Kozhikode Districts), but an inter-state (between Kerala and Tamil Nadu) drainage system as well. The river originating at an elevation of 2066 m. above M.S.L. in Tamil Nadu, commands a drainage area of 2923 Sq. Km. Out of about ten tributaries of this river, only two tributaries (Thiruvanchipuzha and Cherupuzha) drain down the uplands of the Kozhikode District, and both of them join with the main river course that enters the district (from the Malappuram District), flowing almost apposed to the district's boundary and emptying into the sea at Beypore. The Kuttiadi River (also called Murat River) is about 74 Km long, originating from the western slopes of the Wynad Hills, at an elevation of 1220 M.S.L., and emptying into the sea at Kottakkal, near Vadakara. The Korapuzha River is formed by the confluence of the Agalapuzha with the Punnurpuzha that originates at about 610 m. above M.S.L., and empties into the sea at Elathur. The Kallai River, originating at an elevation of 45 m. above sea level,

is only a very small or minor drainage system, attaining a length of about 22 Km. A moderately large backwater body of it is looped on to the Beypore River by a narrow creek. In this documentation work, Kallai River is dealt with only in association with the Chaliyar R. System of the district.

The rivers with fewer meanderings, following structural trend of rocks, flow in the lowland-coastal plain sector with low gradients towards the sea. The Kuttiadi and Korapuzha Rivers discharge into large lagoon or backwater-like-body, namely, Agalapuzha, literally meaning 'broad river', extending to a north-south distance of 25.6 km., almost in a parallel alignment to the coast, before emptying into the sea through the Korapuzha Estuary at Elathur. An artificial watercourse namely Conolly Canal interconnects the rivers Korapuzha, Kallai and Chaliyar in the coastal plains. A man-made 'Payyoli' canal of about 1.6 km long connects Agalapuzha to Kottapuzha of the Kuttiadi River. Kuttiadi River at its upper reaches opens to two man-made reservoirs namely Kuttiadi (or Kakkayam) and Peruvannamuzhi.

The climate over the district is of a tropical monsoon type with seasonally excessive rainfall and hot summer. The period from March to the end of May is the hot season. It is followed with the southwest monsoon that continues till the middle of October. Then begins the northeast monsoon that lasts up to the end of February, with rains usually ceasing by December.

Kozhikode District, with the elevation of land gradually increasing from the sea level and reaching the average height of 916 m in the east, is virtually fortified by the Wynad plateau, and receives maximum amount of rainfall in the state. The southwest monsoon sets over the district by about 1st week of June. June and July are the rainiest months.

When the rivers are in spate during the monsoon (from June to September), the inflows from the uplands reaching the lagoon discharges sizeable sediment load into the sea. During the dry season, the very same lagoon intakes the tides for considerable distance upriver in the coastal plains. The result is the seasonal fluctuations in salinity, rate of sedimentation and organic transport.

MATERIALS AND METHODS

As part of the ichthyofaunal exploration of the Kozhikode District, in pursuance of a proposed study initiated from the year 2003 and completed by 2005 (April 2003–March 2005), the water bodies at various sites/localities in the watersheds of the river systems falling in the geographical limits of the district were surveyed and the collections of fish-faunal samples made. Besides, the fish samples that had been collected from diverse aquatic habitat systems of the district, over the past years, and deposited in the faunal repository of the Station, were also amply made use for this study. Standard methods were adopted while conducting faunistic surveys and collecting fish samples from varied aquatic habitat systems of the district, using cast nets, gill nets and scoop nets of varying mesh size. The sample collections of specimens were predominantly made during the post-monsoon season when the

water bodies, like streams, were in much depleted condition with less turbidity and flow of waters. Additional fish samples, particularly from estuarine/brackish water areas, were also made available for study from the fishery catches of the local fisher folks, who enabled the study team to gather certain vital information on the fishery potential of some of the species.

The fish collections were made from the following collection-sites/localities falling in the watersheds of the three river systems of the district. The collection-sites as shown below reflect in the same sequencing numbers in the Map 2 of the river basins in the district, as well as in the Table, 1.

Chaliyar River Basin : Collection-sites :

1. Kozhikode; 2. Kuthiravattom; 3. Kottuli; 4. Chevarambalam; 5. Beypore; 6. Farook; 7. Kodampuzha; 8. Mavoor; 9. Pallikadavu; 10. Koolimadu; 11. Mukkam; 12. Thamarasserry; 13. Eengapuzha; 14. Puthuppadi; 15. Pulikayam; 16. Kodancherry; 17. Thiruvambadi; 18. Anakkampoil; 19. Thusharagiri;

Korapuzha River Basin : Collection-sites :

20. Elathur; 21. Annasseri; 22. Chelannur; 23. Koduvalli; 24. Punnur; 25. Kinalur; 26. Kallanode; 27. Thengilakadavu; 28. Kanayangode; 29. Theruvathukadavu; 30. Mooliyangal; 31. Kootalida; and

Kuttiadi River Basin : Collection-sites :

32. Kottapuzha; 33. Murad; 34. Cheruvannur; 35. Chaliyamkadavu; 36. Kuttiadi; 37. Janakikadu; 38. Perambra; 39. Chakkittapara; 40. Peruvannamuzhi; 41. Vattapuzha; 42. Kakkayam.

The fish-collections from various water bodies altogether comprised 1356 specimens. The works of Day (1865, 1878), Talwar and Kacker (1984), Talwar and Jhingran (1991), Jayaram (1999) and Menon (1987, 1999) were referred for fixing the identity of species. The enumeration of the details of the fish collections has been exempted in the presentation of this work. Instead, more thrust has been given on analyses related to the status, diversity and ecological aspects of the ichthyofauna of the Kozhikode District. The ichthyofaunal collections from the district, after the systematic study and identification of the specimens, are categorized and listed in separate tables. Nomenclatural changes followed are based on Jayaram (1999). The diagnostic characters of the species identified and listed are easily accessible from the systematic works of Talwar and Kacker (1984), Talwar and Jhingran (1991) and Jayaram (1999), hence not provided in the text. However, *Monopterus digressus* Gopi, being a later described species (Gopi, 2002), its diagnostic characters have been provided in the text at the appropriate place.

RESULT AND DISCUSSION

The ichthyofaunal diversity recorded from the Kozhikode District, Kerala, is presented in Tables 1 to 7, and Fig. 1-5, supplemented with photoplates I-IV : 1-28. Altogether 142 fish

species belonging to 86 genera under 45 families of 16 orders are dealt with in the present study. They have been arranged in three categories *viz.*, 1. Primary freshwater fishes, 2. Estuarine/Brackish water fishes, and 3. Exotic fishes. The systematic studies on the ichthyofaunal collections from the various water bodies of the district yielded 64 primary freshwater fishes. 8 species, included among the fishes listed and reported earlier (Raghunathan, 1995; Lal Mohan & Rema Devi, 2000), but not represented in the present sample collections, have also been incorporated in the list of the primary freshwater fishes, thus making the diversity of 72 species of primary freshwater fishes represented by the district (*vide*, Fig. 1). The fish samples from the estuarine/brackish waters of the district have revealed a diversity of about 65 species. Exotic fishes comprising 5 species were also observed to occur in a number of water bodies in the district.

FISH FAUNAL COMPOSITION

The ichthyofaunal diversity of the primary freshwater fishes from the Kozhikode District contained 72 species belonging to 41 genera, under 21 families of 9 orders (Table 1 & 2). Earlier reports on the freshwater fishes from the Kozhikode District include 43 primary freshwater species. Estuarine/brackish water zone of the district indicated a fish diversity of about 65 species belonging to 49 genera of 27 families under 12 orders (Table, 3 & 4). The exotic species comprised 5 species under 5 genera of 4 families and 3 orders (Table, 5).

Among the primary freshwater fishes, the group Cypriniformes dominated (*vide*, Fig. 4) with 41 species, accounting for 60 %, followed by Siluriformes with 12 species, having a share of 17%. Perciformes with 9 species formed about 12.5 % of the recorded species among the freshwater fishes. As regard the fish diversity richness related to the respective drainage systems of the district, the recorded species diversity of primary freshwater fishes, based on the collections, Chaliyar River System was observed to have the highest fish-diversity with as many as 66 species, constituting about 92 % of the primary freshwater fish diversity of the district (*vide*, Fig. 2). An earlier study on the ichthyofauna of the River Chaliyar, within the limits of the district, had revealed about 41 species (Raghunathan, 1995), including 21 species of estuarine/brackish water fishes, belonging to 27 genera. A small fish collection made from Chaliyar by Lal Mohan and Rema Devi (2000) comprised about 9 species. 27 species of the primary freshwater fishes reported earlier from the district were exclusively from the Chaliyar River system of the District. Given other data source on inland fishes of the district (Ramachandran Nair, 1986; Anon, 2004), it is revealed that the primary freshwater fishes reported earlier from the district include 43 species. Thus, 29 species of primary freshwater fishes are new records for the Kozhikode District. No scientific data on the fish diversity of the Kuttiady and Korapuzha Rivers within the geographical limits of the Kozhikode District are available. In the present study, the Kuttiadi River system was found to have a diversity of 49 species of primary freshwater fishes, holding 68 % of the fish diversity (primary freshwater species) of the district. The Korapuzha River, the smallest of the three drainage systems of the district, has the least diversity of freshwater fishes, with 24 species (33 %) of the fish diversity of the district.

The composition of the primary freshwater fishes from within the area limits of the district indicates a diversity lower than that of the overall fish diversity of the drainage systems in their entire watershed limits. It is primarily owing to the fact that considerable stretch of the Chaliyar drainage system, particularly its upper reaches and a few major tributaries, are falling outside the geographic territory of the district (vide, Map 1 & 2). More over, in the upland areas of the district, the riparian river stretches, except in the case of the Chaliyar R. system, remain considerably denuded, as a result of which a good number of clean-water species inhabiting the upper/highland reaches of the rivers within the district limits are not represented in the collections. However, as the rivers are continuous fluvial systems, a sharp separation in the distribution and feature of fish diversity exclusive to the river stretches confined to the district's geographic limits, cannot be perceived.

Variation in the species diversity is partly related to species occurrence along the altitudinal gradient, and the characteristic feature of zonation of species, sometimes, determined by habitat limitation also. *Silurus wynaadensis* Day, for example, is known to occur in the highland streams of the Kuttiadi River from the western slopes of the Wynad Hills (Gopi & Radhakrishnan, 2001), but not yet reported from the upper reaches of the same river in the Kozhikode District. Similarly, a number of species that are known from the upper reaches or tributaries of the Chaliyar R. system in Wynad (Shaji & Easa, 1995) and Malappuram (Easa and Shaji, 1997) Districts, are yet to be collected and recorded from the river stretch coursing through the Kozhikode District. Easa and Shaji (1997) have reported a fish diversity of about 50 species from the upland stretches of the Chaliyar River system (excluding the tributaries of Chaliyar river in the Kozhikode District) draining the Kerala part of the Nilgiri Biosphere Reserve. Out of the species diversity documented by them, the species such as *Gonoproktopterus curmuca* (Hamilton-Buchanan), *G. micropogon micropogon* (Val.), *Osteochilichthys nashii* (Day), *Garra mcClellandi* Jerdon, *Mesonemacheilus petrubanarescui* (Menon), *Clarias dussumieri dayi* Hora, etc., as reported to occur in the Chaliyar Drainage System of Wynad and Malappuram Districts have not been obtained from the part of the same drainage system flowing through Kozhikode District. *Glyptothorax davisinghi* described by Manimekalan and Das (1998) from the Karimpuzha (type locality: Manchery, near Nilambur) of Chaliyar River basin was also not represented in our collection from the upland stretches of the same river (Chaliyar) in the Kozhikode district. While the occurrence of these fish species in their allied habitats in the respective river stretches of the Kozhikode District cannot be out-rightly ruled out, they have not, however, been incorporated in this documentation work not having been collected and reported from the district's geographical limits.

ECOLOGICAL OBSERVATIONS

Ichthyofaunal wealth and diversity of the district was observed to be associated with various aquatic habitats of the district. In the study areas, the water bodies, according to their nature as habitats of fish, can be categorized into mountain streams, midland rivers, reservoirs, lowland rivers and still-waters of tanks, ponds and wells in lowland and midland areas, and backwaters in the coastal plains.

Among the freshwater species, the synbranchid eel *Monopterus digressus* Gopi was detected and described from the subterranean waters of a deep well on an isolated laterite hill (locality : Kuthiravattom) in the district (Gopi, 2002). *M. digressus* is a small blind, eel-like species (Plate-III : 20). It can be distinguished by its characteristics : body slim, naked, eel-like elongated; head conspicuous with a muscular occiput; upper jaw with jowl-like lip; gill aperture ventral, wide, lunate without lateral folds; branchiostegal membranes internally fused with isthmus; paired suprpharyngeal pouches present; lateralis system distinct with prominent cephalic pores, and tail tapering with rudimentary dorsal and anal fin ridges confluent at the caudal tip. It is a rare fish species, currently found restricted to the district in its distribution.

Notopterus notopterus (Pallas) was observed to have its presence only in the reservoir waters in the district, unlike its wide distribution in various types of waters in its distributional ranges elsewhere. *Puntius melanostigma* (Day) and *Puntius bovanicus* (Day) were found in the district only from the Kuttiadi reservoir. *P. bovanicus* is a species of Cauvery Drainage System (Bowany River) and its access to the reservoir waters seems to have been elicited through the feeder-canal waters to the reservoir from the watershed of Wynad Plateau. Man-made transplantation of this species in the reservoir waters also cannot be ruled out. *P. denisoni* (Day) (Plate II : 8) and *P. aurilius aurilius* (Jerdon) (Plate II : 7) were obtained from the river streams of Chaliyar along the slopes bordering Kozhikode and Wynad Districts. The rest of the *Puntius* species from the district were observed to thrive in good numbers in the river systems, especially in Chaliyar and Kuttiadi systems. As many as 8 species, viz., *Barilius bakeri* Day (Plate II : 1), *Chela fasciata* Day, *Esomus malabaricus* Day, *Osteobrama bakeri* Day, *Puntius denisoni* (Day), *Puntius parrah* Day, *Batasio travancoria* Hora (Plate III : 13) and *Puntius denisonii* Day that are endemic to Kerala are represented from the river systems within the district.

Horadandia atukorali Deraniyagala (Plate II : 4) was observed to occur in an isolated tank habitat system (Mananchira Tank, Kozhikode) located in the coastal plains of the district (Gopi *et al.*, 2004). This species was not detected from any other freshwater body, either in the wet coastal plains or in the uplands, of the district. Rema Devi (1996) reported this species from the west coastal plains in southern Kerala, from a freshwater pond in the wet plains, near Kalpakkam, Chennai, Tamil Nadu, and also from the freshwater bodies of coastal wet plains of the Pondichery State, bringing to light the extension of range of distribution of *H. atukorali* from the wet plains of the West Coast to that of the East Coast of the country. The species has thus at present a characteristic discontinuity in its distribution in the freshwater wet plains of the West and East Coasts of the Indian Peninsula, besides its distribution in the freshwater wet plains of Sri Lanka, where it was thought to be endemic (Menon, 1999).

Species like *Channa orientalis* (Schneider) (Plate IV : 26) and *Anabas testudineus* (Bloch) (Plate IV : 25) are found in various types of habitats from lowland swamps and rivers to upland rivers, brooks and lakes. These species, with their accessory respiratory system for aerial breathing, are able to thrive even in oxygen deficient, stagnant water bodies found in varying altitudinal ranges from the coastal plains to the highland areas. To some extent this feature of species occurrence, across a wider gradient, in the habitats from the lowland

riverine areas to the upland rivers and lakes, are exhibited by siluriformes like *Ompok bimaculatus* (Bloch) and *Heteropneustes fossilis* (Bloch) also.

The estuarine/brackishwater fishes do not exemplify marked segregation in their distribution, river-wise, possibly due to the inter connectivity of the systems in their lower reaches through networks of canal and backwater systems, besides prevalence of the apparently allied features or similarities in the coastal plain environment of the district. The lagoon-like large backwaters (Agalapuzha) linking the estuarine waters of the Korapuzha and the Kuttiadi Rivers are seemingly rich habitat haunts for a good number of migrant and vagrant fish forms from the coastal marine waters.

The fish diversity of estuarine/brackish water species (65 species) reported based on the collections from the coastal plains and lowland river reaches of the district, is not claimed to be exhaustive, given the opinion of the community fisher folks, and the Agency authority of the river-fish landing center at Elathur (Korapuzha River-site); the listed fish diversity is only indicative of the fishery resource of the district. Among the estuarine/brackish water fishes, a good many species (as indicated by asterisk in the list of species, Table 3) are observed to use freshwaters, their presence often being noticed in the freshwater zones. Some of them, like anguillid species, are diadromous, and others simply entering in freshwaters, in high numbers, indicating their wider range of habitat occupancy (Nelson, 1994).

ZOOGEOGRAPHIC SIGNIFICANCE AND FISH DIVERSITY

The ichthyofaunal diversity associated with the river systems draining the district exhibit considerable similarity with those of the drainage systems of the other districts of the state. The collection of *H. atukorali* from the lentic waters of an isolated tank (protected water supply source) in the district is quite intriguing. Rema Devi and Menon (1992) initially recognized this taxon from India as a subspecies *H. atukorali brittani* of the Sri Lankan endemic species *H. atukorali* Deraniyagala, which was, later, treated as a synonym of it.

As regards the status and distribution of the inland fish fauna of the district (vide, Table 6; Fig. 5), particularly the Primary freshwater fishes, the Kozhikode District has the representation of about 53% (38 species) of the primary freshwater fishes having wider distribution in India/ and beyond, and the remaining 47% (34 species) have the distribution within the Indian Peninsula. Among these 34 species, as many as 27 species are endemic to the Western Ghats itself, holding 37.5 % of the primary freshwater fishes (72 species) of the district. 8 species of these Western Ghats endemics, constituting about 11 % of the freshwater fishes of the district, are exclusively endemic to Kerala itself.

Referring to the zoogeographic relationship of the fish fauna of southern Western Ghats and Sri Lanka, Rema Devi *et al.*, (2000) have shown about 24 species (46%) of the 52 primary freshwater fishes of the southernmost district Trivandrum District of Kerala as being common to Sri Lanka also. The same sort of inference may also be drawn out in the case of the primary freshwater fishes reported from Kozhikode District, Kerala. It is observed that

about 29 species (40 %) out of 72 primary freshwater fishes of the district have their distributional occurrence in Sri Lanka also (vide, Fig. 5), thereby exemplifying the close zoogeographic relationship of Sri Lanka with the southern Western Ghats. Given the distributional peculiarities of freshwater fishes in the Malabar tract and the zoogeographic significance of this tract, Bhimachar (1945) and Menon (1993) proposed the subdivision of the Western Ghats into a northern section of Deccan-Trap area from the River Tapti to about 16° NL about the level of Goa, a middle section upto Nilgiri Hills demarcated by Palakkad Gap at about 11° NL, and a southern section of Anamalai, Palani and Cardamom Hills. As credence to this notion, the fish fauna of Kozhikode District of Kerala, a territory that falls in the middle section of the Western Ghats, north of Palakkad Gap, reflect more similarity in their characteristic diversity and distribution with the ichthyofauna of the southern section of the Western Ghats, than that found in the fish diversity of the northern section (Deccan Trap Area) of the Western Ghats.

FISHERY RESOURCES

The district has rich fishery resources. The district's significance in fish diversity richness and, in turn, its fishery potential is not inseparable from the zoogeographic significance of the State as such. As already cited as a unique feature, Kerala is a state having fourteen districts with forty-four river drainage systems (41 west flowing and 3 east flowing), with a total length of 3,200 km and a water-spread of 85,000 hectares. Associated with them are 30 reservoirs with an area of 30,000 hectares and a large number of tanks and ponds, totaling to an additional 4,000 hectares. The river systems in the coastal plains have links with 30 extensive, interconnected backwaters and estuaries with a water spread of 2,43,000 hectares. And, to cap it all, the 590 km long stretch of coastline of the state has the total area of the continental shelf of about 40,000 sq. km. These facts justify that the water resources of Kerala are among the most productive natural systems known in the country (Dileep, 2000).

The fishery potential of the state is truly reflected in the water resources constituted by the river systems and the associated backwaters of the Kozhikode district as well, and the district has an available brackish water area of about 4162 hectares. The Beypore estuary of the Chaliyar River system and the Elathur estuary of the Korapuzha River are two well-known fish landing centers in the district. Also located in the upland hilly areas of the district are two reservoir systems, namely Peruvannamuzhy and Kakkayam (Kuttiadi) Reservoirs. According to the statistical data of the Department of Fisheries, Govt. of Kerala (Anon, 2004), the native fishes, *viz.*, *Etroplus* spp., *Channa* spp. and common *Puntius* spp. together fetched a total of about 391 tonnes of yield from the inland water bodies of the district during the year 2002-2003. Commercial fishery production, through fish-seed stocking and harvesting in Peruvannamuzhy Reservoir system, having an area expanse of 1052 hectares, is reported to have an average annual harvest of 2,665 kg. of fish (Source : State Planning Board, 1998). The fishery wealth and production to a great extent combine the economy as well as the subsistence of the people of the district. The rural life of the area greatly depends on daily works associated with the fishing activities.

AQUATIC ENVIRONMENT AND THE ECOLOGICAL PROBLEMS

The aquatic environment of the district, in general, reflects the scenario of impacts of environmental degradation and habitat manipulations. The river systems of the Kozhikode District are also not free from this menace. The degradation of riparian areas of the river systems, particularly, in their upstream areas has been observed during the ichthyological surveys. The impoverished diversity and abundance of fishes in the upstream areas at many places are indicative of the degree of deterioration of habitat quality, with the conspicuous absence of 'clean water species'. Cattle grazing and ecotourism that are being perpetrated in these areas have already marked the telltale effects of fragmentation of the rich riparian habitats of the Chaliyar R. system in the upland areas of the district.

Deterioration of water quality of the river systems in the district has been at hazardous level, often upsetting the river system environment, due to the ever-increasing effluents or wastes like pesticides/chemicals from the agricultural, plantation and industrial sectors. The impact of the dreadful water pollution caused by the effluents of the Rayon factory, at Mavoor, close to the Chaliyar System, once upon a time, in the last quarter of the past century, are well known. The lethal level of contamination of the water stretch of Chaliyar System by the toxic chemicals and heavy metals, like mercury, near around the factory environs had made the river stretch almost lifeless, exterminating or impoverishing its biodiversity, particularly ichthyofauna, thus, almost crippling the livelihood of the local community people. The impact of the river water pollution in Chaliyar revealed that the changes in the water quality could unleash a change in the composition of the fish resources of a healthy river system. The same stretch of the Chaliyar, since after the closure of the rayon factory by the turn of the 20th century, is yet to regain its vigour and vitality of the biodiversity component. Hopefully, the area has shown gradually regaining its biodiversity potential, though slowly. Rubber plantations have extensively replaced the upland, riparian stretch of the Korapuzha River system. The Kuttiadi river basin has been largely converted to an agrarian zone, with the commissioning of the irrigation systems of Kakkayam (Kuttiadi) and Peruvannamuzhi Reservoirs.

Another major environmental problem is that of indiscrete sand mining of the river systems, especially in the lower river reaches in the district. The lowering of the river bed profile in consequence of sand mining has often posed percolation problems affecting intrusion of salinity to far inland areas in the coastal plains, substantially influencing the water table of nearby wells and ponds and, in turn, affecting the healthy habitat attributes of these freshwater bodies, impoverishing their characteristic faunal composition and diversity. The local community fisher folks express their deep concern about the sand-mined riverbed being replaced with considerable deposits of silt imperiling the demersal eggs of several fishes as well as chocking up the just-hatched-out larvae in the river bottom.

Another menace to the native fish diversity in the river systems of the district, as found in other parts of the state as well, is the ever-increasing presence of the exotic fishes, like Tilapia (*Oreochromis mossambica* (Peters)) and African catfish *Clarias gariepinus* (Burchell),

and their ever increasing naturalization of populations in the inland water bodies. While *Tilapia* fish has almost become a pseudo-native in the country, fully naturalized to inhabit the natural water bodies from the coastal plains to the upland systems, the banned African catfish is on its move to attain the status of another invasive species (Biju Kumar, 2000), primarily because of the clandestine practices of aqua culturing of this fast growing exotic species.

SUMMARY

Studies on the collections of ichthyofauna from three river systems in the Kozhikode District of Kerala, South India, revealed the presence of 142 species comprising of 72 primary freshwater fishes, 65 estuarine/brackish water fishes and 5 exotic fishes. Out of 72 primary freshwater fishes, 43 species are already reported from the district and 29 species, new records for the district. Of the three river systems in the district, Chaliyar River is most diverse for its fish fauna with 66 species of primary freshwater fishes, followed by Kuttiady River with 49 species, and Korapuzha River least diverse with only 24 species of primary freshwater fishes. Distributional status of some of the species and other ichthyological aspects related to the district are discussed.

ACKNOWLEDGEMENTS

The author is grateful to the Director, Zoological Survey of India, Kolkata, for facilities and encouragement. I am indebted to Sri, C. Radhakrishnan, Officer-in-Charge of Western Ghats Field Research Station, Kozhikode, for his help and guidance, with constructive suggestions, to improve the quality of this research document.

REFERENCES

- Ajithkumar, C. R., Rema Devi, K., Raju Thomas, K. & Biju, C. R. 1999. Fishfauna, abundance and distribution in Chalakudy River system, Kerala. *J. Bombay Nat. Hist. Soc.*, **96** (2) : 244–254.
- Anon, 2004. Inland fisheries statistics of Kerala, 2004. Department of Fisheries Govt. of Kerala, p. 1-45 + i-x.
- Bhimachar, B. S. 1945. Zoogeographical divisions of the Western Ghats, as evidenced by the distribution of hill-stream fishes. *Curr., Sci.* **14** (1) : 12–16, fig. 1.
- Biju, C. R., Raju Thomas, K. & Ajithkumar, C. R. 1999. Distribution of fish in the Manjeswaram River, Kasaaragod (Kerala). *J. Bombay Nat. Hist. Soc.*, **96** (1) : 159–160.
- Biju Kumar, A. 2000. Exotic fishes and freshwater fish diversity. *Zoos' Print*, **15** (11) : 363–367.

- Cherian, P. T., Indra, T. J., Rema Devi, K. Raghunathan, M. B. & Sathishkumar, V. M. 2001. On the ichthyofauna of Trivandrum District, Kerala, India. *Rec. zool. Surv. India*, **99** (1-4) : 95–110.
- Day, F. 1865. *The fishes of Malabar*. Bernard Quaritch, London.
- Day, F. 1878. *The fishes of India; being a natural history of fishes known to inhabit the seas and freshwaters of India, Burma and Ceylon*. Today and tomorrow's Book Agency, New Delhi.
- Dileep, M. P. 2000. Conservation and Management of the fishery resources of Kerala. *Kerala Calling*, **20** (12) : 34–37.
- Easa, P. S. & Shaji, C. P. 1997. Freshwater fish diversity in Kerala part of the Nilgiri Biosphere Reserve. *Current Science*, **72** (2) : 180–182.
- Gopi, K. C. 2002. A new synbranchid fish, *Monopterus digressus* from Kerala, Peninsular India. *Rec. zool. Surv. India*, **100** (1-2) : 137-143.
- Gopi, K.C., Jyothi, R. & Jafer Palot, M. 2004. New locality-record of distribution of *Horadandia atukorali* Deraniyagala (Pisces: Cyprinidae: Rasborinae) along the West Coast in Kerala, India. *Rec. zool. Surv. India*, **102** (3-4) : 29–31.
- Gopi, K. C. & Radhakrishnan, C. 2001. The status of *Silurus wynaadensis* Day (Siluridae: Pisces) with a note on its bionomics. *Zoos' Print*, **16** (9) : 580-582.
- Hora, S. L. 1942. A list of fishes of the Mysore state and of the neighbouring hill ranges of the Nilgiris, Wynad and Coorg. *Rec. Indian Mus.*, **44** (2) : 193–200.
- Hora, S. L. & Law, N. C. 1941. The freshwater fishes of Travancore. *Rec. Ind. Mus.*, **43** : 233–256.
- Jayaram, K. C. 1999. *The freshwater fishes of the Indian Region*. Narendra Publishing House, Delhi. xxvii + 551, pls. XVIII.
- John, C. C. 1936. Freshwater fishes of Travancore. *J. Bombay Nat. Hist. Soc.*, **38** : 702 –733.
- Lal Mohan, R. S. & Rema Devi, K. 2000. Fish fauna of Chaliyar River, North Kerala. In : *Endemic Fish Diversity of Western Ghats* (Ponnaiah, A.G & A. Gopalakrishnan, A., eds.), NBFGR – NATP Publication – 1, 347 p. NBFGR, Lucknow, U.P., India.
- Manimekalan, A. & Das, H. S. 1998. *Glyptothorax davissinghi* (Pisces : Sisoridae), a new catfish from Nilambur in the Nilgiri Biosphere Reserve, South India. *J. Bombay Nat. Hist. Soc.*, **95** : 87-91.

- Menon, A. G. K. 1987. The Fauna of India and the adjacent countries, Pisces 4. Teleostei-Cobitoidea, Part 1, Homalopteridae. Zoological Survey of India, Calcutta : x + 259.
- Menon, A. G. K. 1993. Rare and endangered fishes of Malabar. In : Abstracts of Papers presented in the seminar on the conservation of the endangered fauna of Malabar, Conservation of Nature Trust, Calicut, September 11.
- Menon, A. G. K. 1999. Checklist – Freshwater fishes of India. *Rec. zool. Surv. India, Occ. Paper No.*, 175 : xxix + 366 pp.
- Nelson, J. S. 1994. *Fishes of the World*. John Wiley and Sons, New York, : xvii + 599.
- Pillay, R. S. N. 1929. A list of fishes from Travancore. *J. Bombay Nat. Hist. Soc.*, **33** : 347–379.
- Raghunathan, M. B. 1995. Ichthyological investigation in River Chaliyar, Kerala. *Fishery Technology*, **32** (1) : 53–55.
- Raju Thomas, K., John George, M. & Biju, C. R. 2002. Freshwater fishes of Southern Kerala with notes on the distribution of endemic and endangered species. *J. Bombay Nat. Hist. Soc.*, **99** (1) : 47–53.
- Ramachandran Nair, K. K. 1986. *Kerala State Gazetteer*, vol. I : 401 pp.
- Rema Devi, K. 1996. Extension of range of distribution of *Horadandia atukorali* Deraniyagala (Pisces : Cyprinidae: Rasborinae) to Pondicherry and Tamil Nadu. *J. Bomb. Nat. Hist. Soc. India*, **93** : 303–304.
- Rema Devi, K. & Indra, T.J. 1986. Fishes of Silent Valley. *Rec. zool. Surv. India*, **84** (1-4) : 243–257.
- Rema Devi, K. G. Emiliyamma, K. G. & Lal Mohan, R. S. 2000. Range extension of *Pangio goensis* (Cypriniformes: Cobitidae) to the Chaliyar drainage of Kerala. *J. Bombay Nat. Hist. Soc.*, **97** (1) : 150–152.
- Rema Devi, K. & Menon, A. G. K. 1992. *Horadandia atukorali brittani*, a new subspecies of *Rasborinae* (Pisces : Cyprinidae) from Kerala, South India. *Tropical Fish Hobbyist*, **40** (10) : 175–176.
- Shaji, C. P. & Easa, P. S. 1995. Freshwater fish diversity in Wynad, Kerala, South India. *J. Zool. Soc. Kerala*, **5** (1&2) : 30–36.
- Silas, E. G. 1950. On a collection of Fish from Travancore. *J. Bombay Nat. Hist. Soc.*, **48** (4) : 792 – 797.

- Silas, E. G. 1951. On a collection of fishes from Anamalai and Nelliampathy hill ranges (Western Ghats) with notes on its zoogeographical significances. *J. Bombay Nat. Hist. Soc.*, **49** (4) : 670 – 681.
- Talwar, P. K. & Jhingran, A. 1991. *Inland Fishes of India and adjacent countries*-Oxford and IBH Publishing Co. Pvt. Ltd., N. Delhi, 2 volumes, : xix + 1158.
- Talwar, P. K. & Kacker, R. K. 1984. *Commercial Sea Fishes of India*, Zoological Survey of India, Calcutta, lii + 997.

SYSTEMATIC LIST

Table 1 : Primary Freshwater Fishes Recorded from Kozhikode District-Kerala, South India

No.	Classification/Species	R. Systems			Collection Sites (1 – 41)
		I	II	III	
	Order : OSTEOGLOSSIFORMES				
	Family : NOTOPTERIDAE				
1.	<i>Notopterus notopterus</i> (Pallas)	—	—	+	41
	Order : ANGUILLIFORMES				
	Family : ANGUILLIDAE				
2.	<i>Anguilla bengalensis bengalensis</i> (Gray)	+	—	+	10, 36
3.	<i>Anguilla bicolor bicolor</i> McClelland *	+	—	—	—
	Order : CYPRINIFORMES				
	Family : CYPRINIDAE				
4.	<i>Salmostoma boopis</i> (Day)	+	—	+	14, 42
5.	<i>Barilius bakeri</i> Day	+	—	—	17, 36
6.	<i>Barilius gatensis</i> (Valenciennes)	+	—	+	19, 41
7.	<i>Chela dadyburjori</i> (Menon)	+	—	+	10, 34
8.	<i>Chela fasciata</i> (Silas) *	+	—	—	—
9.	<i>Chela laubuca</i> (Hamilton)	+	—	+	11, 38
10.	<i>Esomus malabaricus</i> Day	+	+	+	11, 24, 34
11.	<i>Danio malabaricus</i> Jerdon	+	+	+	11
12.	<i>Brachydanio rerio</i> (Hamilton)	+	—	—	1
13.	<i>Horadandia atukorali</i> Deraniyagala	+	—	—	1
14.	<i>Rasbora daniconius</i> (Hamilton)	+	+	+	3, 4, 24, 32, 42
15.	<i>Amblypharyngodon melettinus</i> (Val.)	—	—	+	40, 42
16.	<i>Tor khudree</i> (Sykes)	+	—	+	18, 41
17.	<i>Osteobrama bakeri</i> (Day) *	+	—	—	—
18.	<i>Puntius amphibius</i> Valenciennes	+	+	+	3, 11, 22, 25, 36
19.	<i>Puntius arulius arulius</i> (Jerdon)	+	—	—	14, 15
20.	<i>Puntius bovanicus</i> (Day)	—	—	+	42
21.	<i>Puntius chola</i> (Hamilton)	+	—	+	10, 11, 36
22.	<i>Puntius conchoni</i> (Hamilton)	+	—	+	13, 37

No.	Classification/Species	R. Systems			Collection Sites (1 - 41)
		I	II	III	
23.	<i>Puntius denisoni</i> (Day)	+	—	—	19
24.	<i>Puntius dorsalis</i> (Jerdon) *	+	—	—	—
25.	<i>Puntius fasciatus</i> (Jerdon)	+	+	+	16, 17, 18, 27, 36, 42
26.	<i>Puntius filamentosus</i> (Val.)	+	—	+	11, 15, 37, 40
27.	<i>Puntius melanostigma</i> (Day)	—	—	+	37
28.	<i>Puntius parrah</i> Day	+	—	+	13, 35
29.	<i>Puntius punctatus</i> (Day)	+	—	—	16
30.	<i>Puntius sarana subnasutus</i> (Val.)	+	—	+	16, 40
31.	<i>Puntius sophore</i> (Hamilton) *	+	—	—	—
32.	<i>Puntius ticto</i> (Hamilton)	+	+	+	3, 4, 13, 22, 25, 36, 37
33.	<i>Puntius vittatus</i> Day	+	+	+	3, 4, 9, 11, 21, 23, 37
34.	<i>Catla catla</i> (Hamilton)	—	—	+	36, 40
35.	<i>Labeo rohita</i> (Hamilton)	+	+	+	10, 24, 40
36.	<i>Garra gotyla stenorhynchus</i> (Jerdon) *	+	—	—	—
37.	<i>Garra mullya</i> (Sykes)	+	+	+	13, 19, 27, 39, 41, 42
Family : BALITORIDAE					
38.	<i>Bhavana australis</i> (Jerdon)	+	—	+	19,42
39.	<i>Acanthocobitis moreh</i> (Sykes)	+	—	—	14
40.	<i>Schistura semiarmatus</i> (Day)	+	—	+	17,41
41.	<i>Mesonemacheilus guentheri</i> (Day)	+	—	—	17
42.	<i>Mesonemacheilus triangularis</i> (Day)	+	+	+	13, 25, 27, 39, 41
Family : COBITIDAE					
43.	<i>Acantophthalmus goaensis</i> (Tilak) *	+	—	—	—
44.	<i>Lepidocephalus thermalis</i> (Val.)	+	+	+	3, 4, 12, 22, 36
Order : SILURIFORMES					
Family : BAGRIDAE					
45.	<i>Batasio travancoria</i> Hora & Law	+	—	—	19
46.	<i>Mystus armatus</i> (Day)	+	—	+	15, 42
47.	<i>Mystus cavasius</i> (Hamilton-Buchanan)	+	—	+	10, 35
48.	<i>Mystus malabaricus</i> (Jerdon)	+	—	—	13
49.	<i>Mystus montanus</i> (Jerdon)	+	—	—	16

No.	Classification/Species	R. Systems			Collection Sites (1 – 41)
		I	II	III	
50.	<i>Mystus oculatus</i> (Valenciennes)	+	—	+	10, 35
51.	<i>Mystus vittatus</i> (Bloch)	+	+	+	7, 20, 32, 35
	Family : SILURIDAE				
52.	<i>Ompok bimaculatus</i> (Bloch)	+	+	+	11, 27, 38
53.	<i>Ompok malabaricus</i> (Valenciennes)	+	—	+	13, 35
	Family : SISORIDAE				
54.	<i>Glyptothorax annandalei</i> Hora	+	—	—	19
	Family : CLARIIDAE				
55.	<i>Clarias batrachus</i> (Linnaeus)	+	—	+	9, 36
	Family : HETEROPNEUSTIDAE				
56.	<i>Heteropneustes fossilis</i> (Bloch)	+	+	+	6, 10, 23, 36
	Order : BELONIFORMES				
	Family : BELONIDAE				
57.	<i>Xenentodon cancila</i> (Hamilton)	+	+	+	8, 11, 29, 40
	Order : CYPRINODONTIFORMES				
	Family : APLOCHEILIDAE				
58.	<i>Aplocheilus blocki</i> (Arnold)	+	+	+	3, 8, 22, 34
59.	<i>Aplocheilus lineatus</i> (Valenciennes)	+	+	+	4, 16, 18, 25, 40
	Order : SYNBRANCHIFORMES				
	Family : SYNBRANCHIDAE				
60.	<i>Monopterus digressus</i> Gopi	+	—	—	2
	Family : MASTACEMBELIDAE				
61.	<i>Macrognaathus guentheri</i> (Day) *	+	—	—	—
62.	<i>Mastacembelus armatus</i> (Lacepede)	+	—	+	16, 39
	Order : PERCIFORMES				
	Family : CHANDIDAE(=AMBASSIDAE)				
63.	<i>Parambassis thomassi</i> (Day)	+	—	+	13, 41
	Family : NANDIDAE				
64.	<i>Nandus nandus</i> (Hamilton)	+	+	+	6, 22, 35

No.	Classification/Species	R. Systems			Collection Sites (1 – 41)
		I	II	III	
	Family : CICHLIDAE				
65.	<i>Etroplus maculatus</i> (Bloch)	+	+	+	10, 11, 25, 34, 36
66.	<i>Etroplus suratensis</i> (Bloch)	+	+	+	6, 10, 20, 30, 35
	Family : ANABANTIDAE				
67.	<i>Anabas testudineus</i> (Bloch)	+	+	+	3,11,17,24,38
	Family : BELONTIIDAE				
68.	<i>Pseudosphromenes cupanus</i> (Val.)	+	+	+	3,4,11,21,24,36,38
	Family : CHANNIDAE				
69.	<i>Channa marulius</i> (Hamilton)	—	+	+	27, 38
70.	<i>Channa orientalis</i> (Schneider)	+	+	+	3,11,16,22,26,38
71.	<i>Channa striatus</i> (Bloch)	+	—	—	11
	Order : TETRAODONTIFORMES				
	Family : TETRAODONTIDAE				
72.	<i>Tetraodon travancoricus</i> Hora & Nair	+	—	—	11,13

* Earlier records, not represented in the collections

River Systems : I : Chaliyar River; II : Korapuzha River; III : Kuttiadi River
(Collection sites : As referred in Fig, 2 : Map)

Table 2 : Primary Freshwater Fishes
Systematic groups and species (in numbers) at a glance

No.	Orders	Family (No.)	Genera (No.)	Species (No.)
1.	Osteoglossiformes	1	1	1
2.	Anguilliformes	1	1	2
3.	Cypriniformes	3	21	41
4.	Siluriformes	5	6	12
5.	Beloniformes	1	1	1
6.	Cyprinodontiformes	1	1	2
7.	Synbranchiformes	2	3	3
8.	Perciformes	6	6	9
9.	Tetraodontiformes	1	1	1
	Orders : 9	Families : 21	Genera : 41	Species : 72

Table 3 : Estuarine/ Brackish-water Fishes Recorded from Kozhikode District—Kerala, South India

No.	Classification/Species	R. Systems			R. Zones		
		I	II	III	C	U	F
	Order : ELOPIFORMES						
	Family: MEGALOPIDAE						
1.	<i>Megalops cyprinoids</i> (Brusonet) *	+	+	—	+	+	—
	Order : ANGUILLIFORMES						
	Family : MURAENIDAE						
2.	<i>Lycodontis tile</i> (Hamilton-Buchanan)	—	+	—	+	—	—
3.	<i>Thyrsoidea macrura</i> (Bleeker)	+	—	—	+		
	Family : OPHICHTHIDAE						
4.	<i>Lamnostoma orientalis</i> (McClelland)	—	+	—	+	—	—
5.	<i>Pisodonophis boro</i> (Ham.-Buch.) *	—	+	—	—	+	—
	Order : CLUPEIFORMES						
	Family : CLUPEIDAE						
6.	<i>Nematalosa nasus</i> (Bloch)	+	+	—	+	—	—
7.	<i>Dayella Malabarica</i> (Day) *	+	—	—	+	+	+
8.	<i>Ethirava fluviatilis</i> Deraniyagala	+	+	—	+	+	
	Family : ENGRAULIDAE						
9.	<i>Stolephorus commersonii</i> Lacepede	+	+	—	+	—	—
10.	<i>Stolephorus indicus</i> (van Hasselt)	+	+	—	+	—	—
11.	<i>Thryssa malabarica</i> (Bloch)	+	+	—	+	—	—
	Order : GONORHYNCHIFORMES						
	Family : CHANIDAE						
12.	<i>Chanos chanos</i> (Forsskal)	+	+	—	+	+	—
	Order : SILURIFORMES						
	Family : BAGRIDAE						
13	<i>Horabagrus brachysoma</i> (Gunther) *	—	+	—	+	+	—
14	<i>Mystus gulio</i> (Hamilton-Buchanan) *	+	+	+	+	+	—
	Family : ARIIDAE						
15.	<i>Arius arius</i> (Hamilton-Buchanan)	+	+	+	+	—	—

No.	Classification/Species	R. Systems			R. Zones		
		I	II	III	C	U	F
16.	<i>Arius caelatus</i> Valenciennes Order : MUGILIFORMES Family : MUGILIDAE	—	+	—	+	—	—
17.	<i>Liza macrolepis</i> (Smith)	—	+	—	+	—	—
18.	<i>Liza parsia</i> (Hamilton-Buchanan)	+	+	—	+	+	—
19.	<i>Liza subviridis</i> (Valenciennes)	—	+	+	+	—	—
20.	<i>Liza vaigiensis</i> (Quoy & Gaimard)	—	+	—	+	—	—
21.	<i>Mugil cephalus</i> Linnaeus *	+	+	+	+	+	—
22.	<i>Valamugil cunnesius</i> (Valenciennes) Order : BELONIFORMES Family : BELONIDAE	—	+	—	+	—	—
23.	<i>Strongylura strongylura</i> (van Hasselt) Family : HEMIRAMPHIDAE	+	+	—	+	+	—
24.	<i>Hyporhamphus limbatus</i> (Val.) *	+	+	—	+	+	—
25.	<i>Hyporhamphus xanthopterus</i> (Val.) * Order : GASTEROSTEIFORMES Family : SYNGNATHIDAE	—	+	—	+	+	—
26.	<i>Ichthyocampus carce</i> (Hamilton) *	+	+	—	+	+	—
27.	<i>Microphis brachyurus</i> (Bleeker)	+	—	—	+	—	—
28.	<i>Microphis cuncalus</i> (Hamilton) * Order : SYNBRANCHIFORMES Family : SYNBRANCHIDAE	—	+	—	+	+	+
29.	<i>Ophisternon bengalense</i> McClelland Order : SCORPAENIFORMES Family : PLATYCEPHALIDAE	+	+	+	+	+	—
30.	<i>Platycephalus cantori</i> Bleeker	+	+	+	+	+	—
31.	<i>Platycephalus indicus</i> (Linnaeus) Order : PERCIFORMES Family : CHANDIDAE	—	+	—	+	—	—
32.	<i>Ambassis commersoni</i> Cuvier	—	+	+	+	—	—

No.	Classification/Species	R. Systems			R. Zones		
		I	II	III	C	U	F
33.	<i>Ambassis dussumieri</i> Cuvier	—	+	+	+	—	—
34.	<i>Ambassis gymnocephalus</i> (Lacepede)	+	+	—	+	—	—
35.	<i>Ambassis nalua</i> (Hamilton-Buchanan)	—	+	+	+	—	—
36.	<i>Parambassis ranga</i> (Hamilton) *	+	+	+	+	+	+
	Family : SILLAGINIDAE						
37.	<i>Sillago sihama</i> (Forsskal)	+	+	+	+	+	—
38.	<i>Sillago vincenti</i> McKay	—	+	—	+	—	—
	Family : CARANGIDAE						
39.	<i>Caranx carangus</i> (Bloch)	+	+	+	+	+	—
40.	<i>Caranx ignobilis</i> (Forsskal)	—	+	—	+	—	—
41.	<i>Caranx melampygus</i> Cuvier	—	+	—	+	—	—
42.	<i>Caranx sexfasciatus</i> Quoy & Gaimard	—	—	+	+	—	—
	Family : LEIOGNATHIDAE						
43.	<i>Leiognathus bindus</i> (Valenciennes)	—	+	+	+	—	—
44.	<i>Leiognathus splendens</i> (Cuvier)	—	+	+	+	—	—
45.	<i>Secutor insidiator</i> (Bloch)	—	+	+	+	—	—
46.	<i>Secutor ruconius</i> (Hamilton)	—	+	—	+	—	—
	Family : GERREIDAE						
47.	<i>Gerreomorpha setifer</i> (Ham.-Buch)	+	+	—	+	—	—
48.	<i>Gerres abbreviatus</i> Bleeker		+		+	—	—
49.	<i>Gerres filamentosus</i> Cuvier	+	+	+	+	+	—
	Family : POMACENTRIDAE						
50.	<i>Abudefduf sordidus</i> (Forsskal)	—	—	+	+	—	—
51.	<i>Abudefduf saxatilis</i> (Linnaeus)	—	+	+	+	—	—
52.	<i>Abudefduf septemfasciatus</i> C & Val.	—	—	+	+	—	—
	Family : TERAPONIDAE						
53.	<i>Terapon jarbua</i> (Forsskal)	+	+	+	+	+	—
54.	<i>Terapon puta</i> Cuvier	—	+	—	+	—	—
55.	<i>Terapon theraps</i> (Cuvier)	—	+	+	+	—	—

No.	Classification/Species	R. Systems			R. Zones		
		I	II	III	C	U	F
56.	Family : SPHYRAENIDAE <i>Sphyraena jello</i> Cuvier	—	+	—	+	—	—
57.	Family GOBIIDAE <i>Glossogobius giuris</i> (Hamilton) *	+	+	+	+	+	+
58.	<i>Awaous gutum</i> (Hamilton) *	+	+	—	+	+	+
59.	<i>Oligolepis acutipennis</i> (Valenciennes)	—	+	—	+	—	—
60.	<i>Stenogobius gymnopomus</i> (Bleeker)	—	+	—	+	—	—
61.	Family : ELEOTRIDIDAE <i>Butis butis</i> (Hamilton-Buchanan)	—	+	+	+	—	—
62.	<i>Eleotris fusca</i> (Schneider)	—	+	+	+	—	—
63.	Family : GOBIOIDIDAE <i>Taenioides angullaris</i> (Linnaeus)	—	+	—	+	—	—
64.	Family : SCATOPHAGIDAE <i>Scatophagus argus</i> (Linnaeus) *	+	+	+	+	+	—
65.	Order : PLEURONECTIFORMES Family : SOLEIDAE <i>Euryglossa orientalis</i> (Bloch) *	+	+	—	+	+	—

* Species entering freshwaters

R. Systems : I : Chaliyar; II : Korapuzha; III : Kuttiadi

R. Zones : C : Coastal Plain estuarine zones; U : Upper brackish water zones;

F : Freshwater zones (above U)

**Table 4 : Estuarine/Brackish-water Fishes
Systematic groups and species (in numbers) at a glance**

No.	Orders	Family (No.)	Genera (No.)	Species (No.)
1.	Elopiformes	1	1	1
2.	Anguilliformes	2	4	4
3.	Clupeiformes	2	5	6
4.	Gonorhynchiformes	1	1	1
5.	Siluriformes	2	3	4
6.	Mugiliformes	1	3	6
7.	Beloniformes	2	2	3
8.	Gasterosteiformes	1	2	3
9.	Synbranchiformes	1	1	1
10.	Scorpaeniformes	1	1	2
11.	Perciformes	12	25	33
12.	Pleuronectiformes	1	1	1
Orders : 12		Families : 27	Genera : 49	Species : 65

Table 5 : Exotic Fishes Recorded from Kozhikode District-Kerala, South India

No.	Classification/Species	C	L	M	H
1.	Order : CYPRINIFORMES Family : CYPRINIDAE <i>Cyprinus carpio communis</i> Linnaeus *	+	+	—	—
2.	Order : SILURIFORMES Family : CLARIIDAE <i>Clarias gariepinus</i> (Burchell) *	+	+	+	—
3.	Order : CYPRINODONTIFORMES Family : POECILIDAE <i>Gambusia affinis</i> (Baird & Girard) **	+	+	—	—
4.	<i>Poecilia (Lebistes) reticulata</i> Peters **	—	+	+	—
5.	Order : PERCIFORMES Family : CICHLIDAE <i>Oreochromis mossambica</i> (Peters) ***	+	+	+	+

* Aquaculture species in tanks and ponds

** Larvicidal fishes in ditch-waters and small streams

*** Almost naturalised into a pseudo-native species

C : Coastal Plains; L : Lowland Areas; M : Midland Areas; H : Highland Areas

Table 6 : Status and Distribution of Primary Freshwater Fishes recorded from Kozhikode District, Kerala, South India

No.	Classification/Species	E/R	Rel. Ab. (S)	Remarks	
				NR	OSL
	Order : OSTEOGLOSSIFORMES				
	Family : NOTOPTERIDAE				
1.	<i>Notopterus notopterus</i> (Pallas)	WD	R (VU)	+	—
	Order : ANGUILLIFORMES				
	Family : ANGUILLIDAE				
2.	<i>Anguilla bengalensis bengalensis</i> (Gray)	WD	R	—	+
3.	<i>Anguilla bicolor bicolor</i> McClelland *	WD	R (VU)		+
	Order : CYPRINIFORMES				
	Family : CYPRINIDAE				
4.	<i>Salmostoma boopis</i> (Day)	EWG	R	—	—
5.	<i>Barilius bakeri</i> Day	EK	R	+	—
6.	<i>Barilius gatensis</i> (Valenciennes)	EWG	C	+	—
7.	<i>Chela dadyburjori</i> (Menon)	EWC	R	+	—
8.	<i>Chela fasciata</i> (Silas) *	EK	VR (VU)	—	—
9.	<i>Chela laubuca</i> (Hamilton)	WD	R	+	—
10.	<i>Esomus malabaricus</i> Day	EK	R (VU)	+	—
11.	<i>Danio malabaricus</i> Jerdon	PI	C	—	+
12.	<i>Brachydanio rerio</i> (Hamilton)	WD	VR	+	+
13.	<i>Horadandia atukorali</i> Deraniyagala	PI	R (VU)	+	+
14.	<i>Rasbora daniconius</i> (Hamilton)	WD	C	—	+
15.	<i>Amblypharyngodon melettinus</i> (Val.)	WG	R	+	+
16.	<i>Tor khudree</i> (Sykes)	PI	VR (VU)	+	+
17.	<i>Osteobrama bakeri</i> (Day) *	EK	R (VU)	—	—
18.	<i>Puntius amphibius</i> Valenciennes	PI	C	—	+
19.	<i>Puntius arulius arulius</i> (Jerdon)	EWG	R (VU)	+	—
20.	<i>Puntius bovanicus</i> (Day)	EPI	VR	+	—
21.	<i>Puntius chola</i> (Hamilton)	WD	C	—	+
22.	<i>Puntius conchoni</i> (Hamilton)	EI	R	—	—
23.	<i>Puntius denisoni</i> (Day)	EK	VR (VU)	+	—

No.	Classification/Species	E/R	Rel. Ab. (S)	Remarks	
				NR	OSL
24.	<i>Puntius dorsalis</i> (Jerdon) *	PI	R (VU)	—	+
25.	<i>Puntius fasciatus</i> (Jerdon)	EPI	C	—	—
26.	<i>Puntius filamentosus</i> (Val.)	PI	C	—	+
27.	<i>Puntius melanostigma</i> (Day)	EPI	VR (EN)	+	—
28.	<i>Puntius parrah</i> Day *	EK	R	—	—
29.	<i>Puntius punctatus</i> (Day)	PI	R	+	+
30.	<i>Puntius sarana subnasutus</i> (Val.)	E PI	R	—	—
31.	<i>Puntius sophore</i> (Hamilton) *	WD	R	—	—
32.	<i>Puntius ticto</i> (Hamilton)	WD	C	—	—
33.	<i>Puntius vittatus</i> Day	PI	C	—	+
34.	<i>Catla catla</i> (Hamilton)	WD	R (TR)	—	+
35.	<i>Labeo rohita</i> (Hamilton)	WD	R (TR)	—	+
36.	<i>Garra gotyla stenorhynchus</i> (Jerdon) *	EWG	R (VU)	—	—
37.	<i>Garra mullya</i> (Sykes)	EPI	C	—	—
	Family : BALITORIDAE				
38.	<i>Bhavana australis</i> (Jerdon)	EWG	VR (VU)	+	—
39.	<i>Acanthocobitis moreh</i> (Sykes)	EWG	VR	+	—
40.	<i>Schistura semiarmatus</i> (Day)	EWG	R (VU)	+	—
41.	<i>Mesonemacheilus guentheri</i> (Day)	EWG	VR	+	—
42.	<i>Mesonemacheilus triangularis</i> (Day)	EWG	C	+	—
	Family : COBITIDAE				
43.	<i>Acantophthalmus goaensis</i> (Tilak) *	EWG	R (VU)	—	—
44.	<i>Lepidocephalus thermalis</i> (Val.)	PI	C	—	+
	Order : SILURIFORMES				
	Family : BAGRIDAE				
45.	<i>Batasio travancoria</i> Hora & Law	EK	VR (EN)	+	—
46.	<i>Mystus armatus</i> (Day)	EWG	R	—	—
47.	<i>Mystus cavasius</i> (Hamilton-Buchanan)	WD	R	—	—
48.	<i>Mystus malabaricus</i> (Jerdon)	EWG	VR (VU)	+	—
49.	<i>Mystus montanus</i> (Jerdon)	EWG	VR (VU)	+	—

No.	Classification/Species	E/R	Rel. Ab. (S)	Remarks	
				NR	OSL
50.	<i>Mystus oculatus</i> (Valenciennes)	PI	R	—	—
51.	<i>Mystus vittatus</i> (Bloch)	WD	R (VU)	—	+
	Family : SILURIDAE				
52.	<i>Ompok bimaculatus</i> (Bloch)	WD	R	—	+
53.	<i>Ompok malabaricus</i> (Valenciennes)	EWG	VR (VU)	+	—
	Family : SISORIDAE				
54.	<i>Glyptothorax annandalei</i> Hora	EWG	VR (VU)	+	—
	Family : CLARIIDAE				
55.	<i>Clarias batrachus</i> (Linnaeus)	WD	C	—	—
	Family : HETEROPNEUSTIDAE				
56.	<i>Heteropneustes fossilis</i> (Bloch)	WD	C	—	+
	Order : BELONIFORMES				
	Family : BELONIDAE				
57.	<i>Xenentodon cancila</i> (Hamilton)	WD	C	—	+
	Order : CYPRINODONTIFORMES				
	Family : APLOCHEILIDAE				
58.	<i>Aplocheilus blocki</i> (Arnold)	EPI	C	—	—
59.	<i>Aplocheilus lineatus</i> (Valenciennes)	EPI	C	—	—
	Order : SYNBRANCHIFORMES				
	Family : SYNBRANCHIDAE				
60.	<i>Monopterus digressus</i> Gopi	EK	VR	+	—
	Family : MASTACEMBELIDAE				
61.	<i>Macrognaathus guentheri</i> (Day) *	EWG	R	—	—
62.	<i>Mastacembelus armatus</i> (Lacepede)	WD	R	—	+
	Order : PERCIFORMES				
	Family : CHANDIDAE				
63.	<i>Parambassis thomassi</i> (Day)	EWG	R	+	—
	Family : NANDIDAE				
64.	<i>Nandus nandus</i> (Hamilton)	WD	C	—	—

No.	Classification/Species	E/R	Rel. Ab. (S)	Remarks	
				NR	OSL
	Family : CICHLIDAE				
65.	<i>Etroplus maculatus</i> (Bloch)	PI	C	—	+
66.	<i>Etroplus suratensis</i> (Bloch)	PI	C	—	+
	Family : ANABANTIDAE				
67.	<i>Anabas testudineus</i> (Bloch)	WD	R	—	+
	Family : BELONTIIDAE				
68.	<i>Pseudosphromenes cupanus</i> (Val.)	PI	C	+	+
	Family : CHANNIDAE				
69.	<i>Channa marulius</i> (Hamilton)	WD	R	—	+
70.	<i>Channa orientalis</i> (Schneider)	WD	C	—	+
71.	<i>Channa striatus</i> (Bloch)	WD	R	—	+
	Order : TETRAODONTIFORMES				
	Family : TETRAODONTIDAE				
72.	<i>Tetraodon travancoricus</i> Hora & Nair	EWG	R (VU)	+	—

*Earlier records, not represented in the collections.

E/R : Endemic/Range of Distribution (Based on Menon, 1999):

EI : Endemic to India; EPI : Endemic to Peninsular India;

EWG : Endemic to Western Ghats; EWC : Endemic to West Coast

EK : Endemic to Kerala.

WD : Wider Distribution (India/and beyond);

PI : Peninsular India; WG : Western Ghats.

Rel. Ab. : Relative abundance:

VR : Very Rare; R : Rare; C : Common

S : Status; VU : Vulnerable; EN : Endangered.

Remarks : NR : New Record for the District; OSL : Occurrence in Sri Lanka.

**Table 7 : Fishes Recorded from Kozhikode District
Systematic groups and species (in numbers) at a glance**

No.	Orders	Family (No.)	Genera (No.)	Species (No.)
1	Osteoglossiformes	1	1	1
2	Elopiformes	1	1	1
3	Anguilliformes	3	5	6
4	Clupeiformes	2	5	6
5	Gonorhynchiformes	1	1	1
6	Cypriniformes	3	22	42
7	Siluriformes	6	8	17
8	Mugiliformes	1	3	6
9	Beloniformes	2	3	4
10	Cyprinodontiformes	2	3	4
11	Gasterosteiformes	1	2	3
12	Synbranchiformes	2	4	4
13	Scorpaeniformes	1	1	2
14	Perciformes	17	25	43
15	Pleuronectiformes	1	1	1
16	Tetraodontiformes	1	1	1
	Orders : 16	Families : 45	Genera : 86	Species : 142

Fig. 1 : Ichthyofaunal diversity recorded from Kozhikode District, Kerala

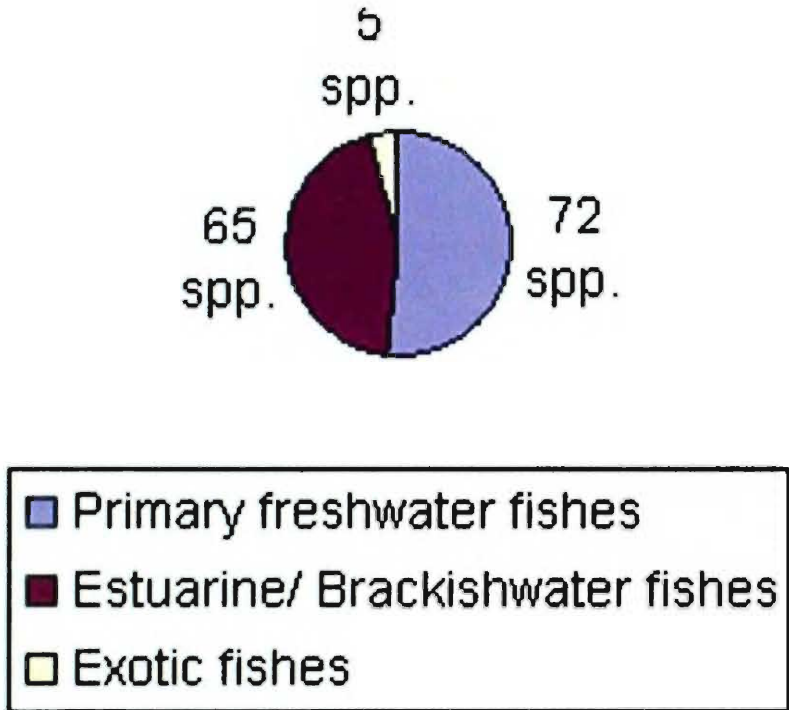
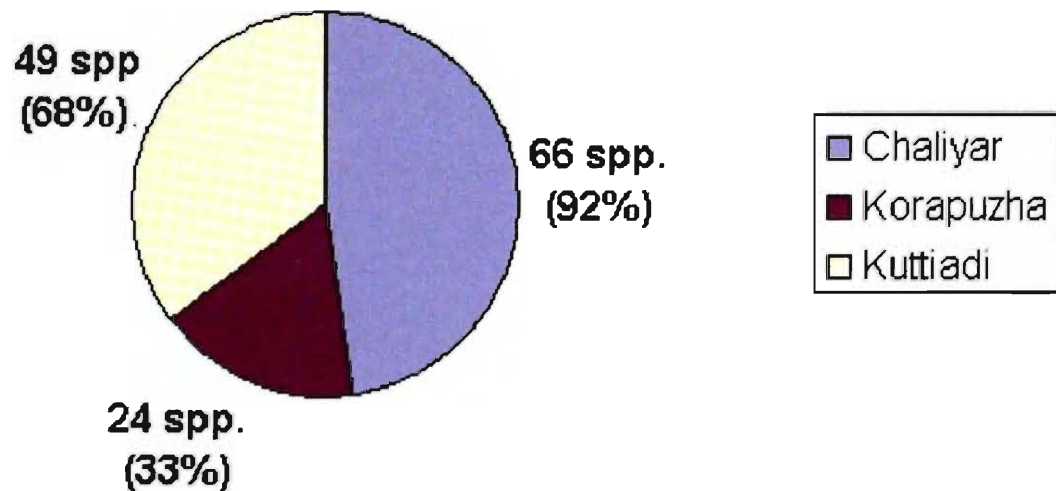
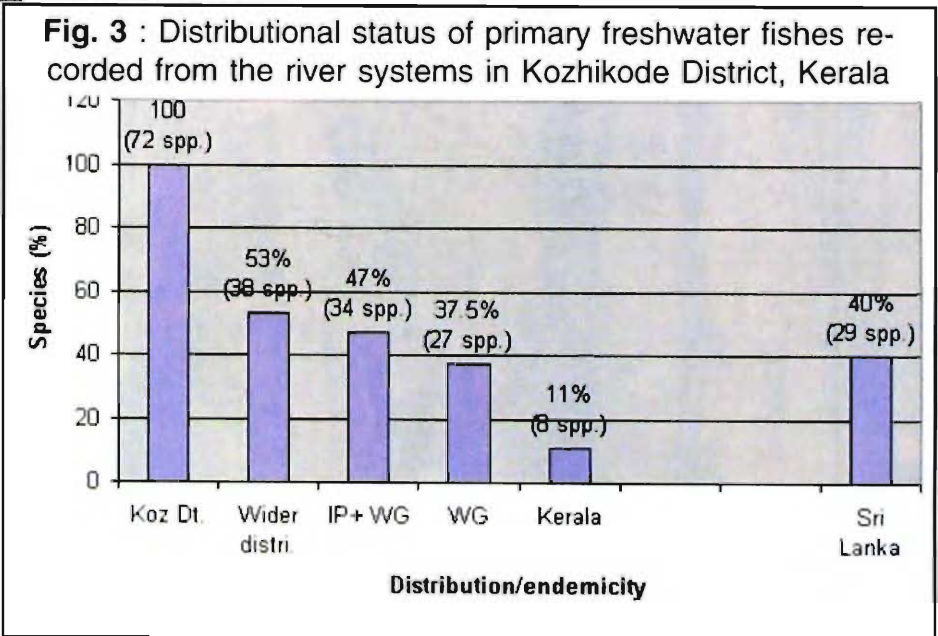
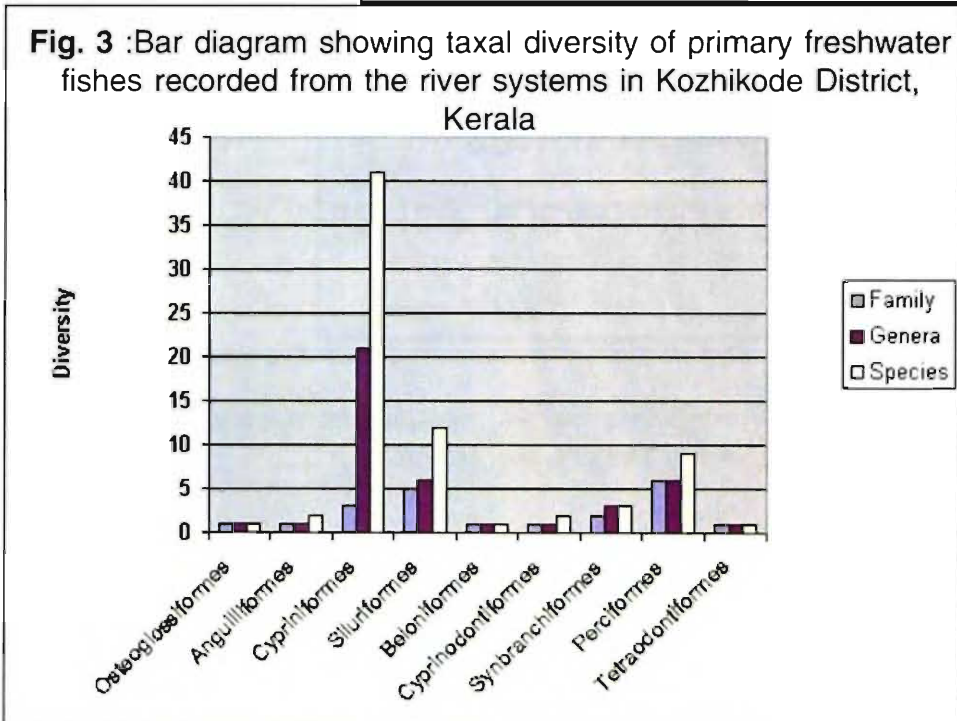
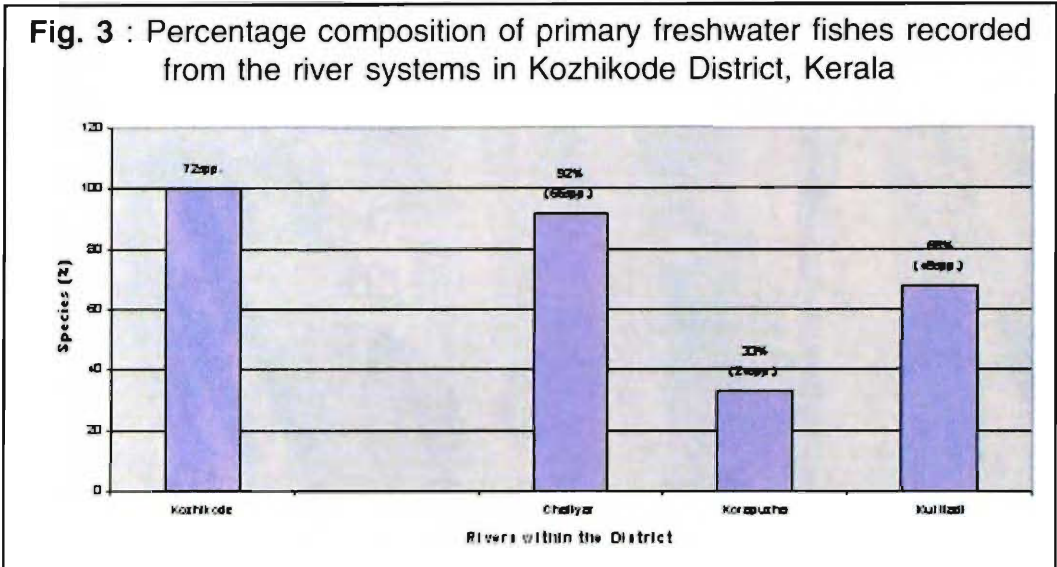
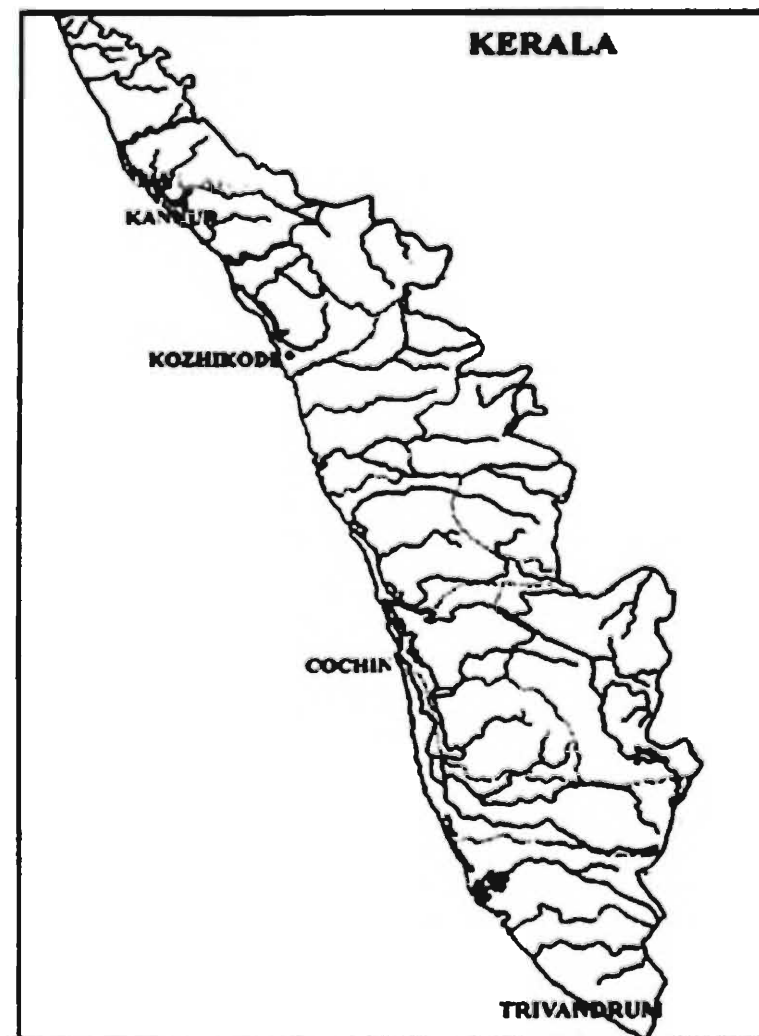
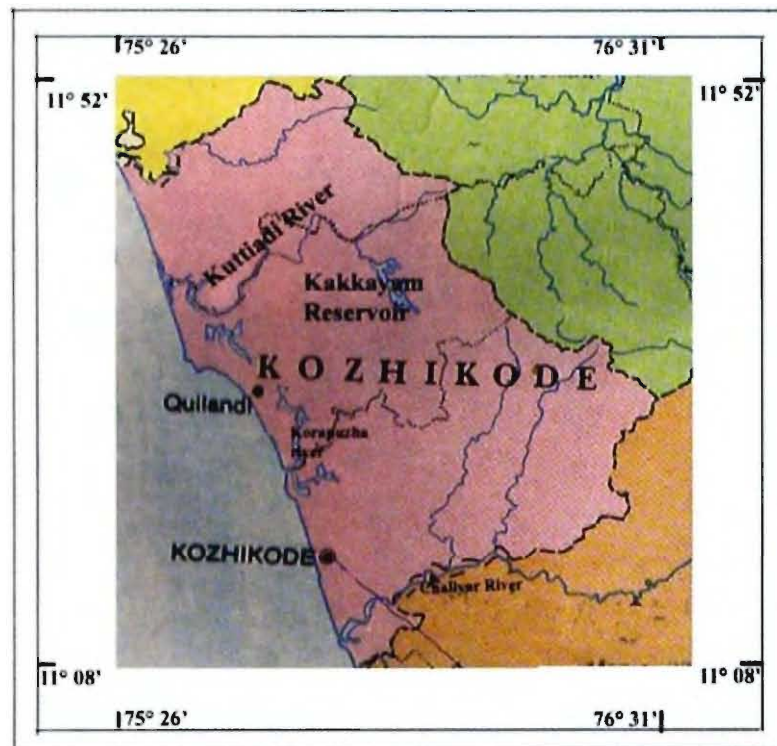


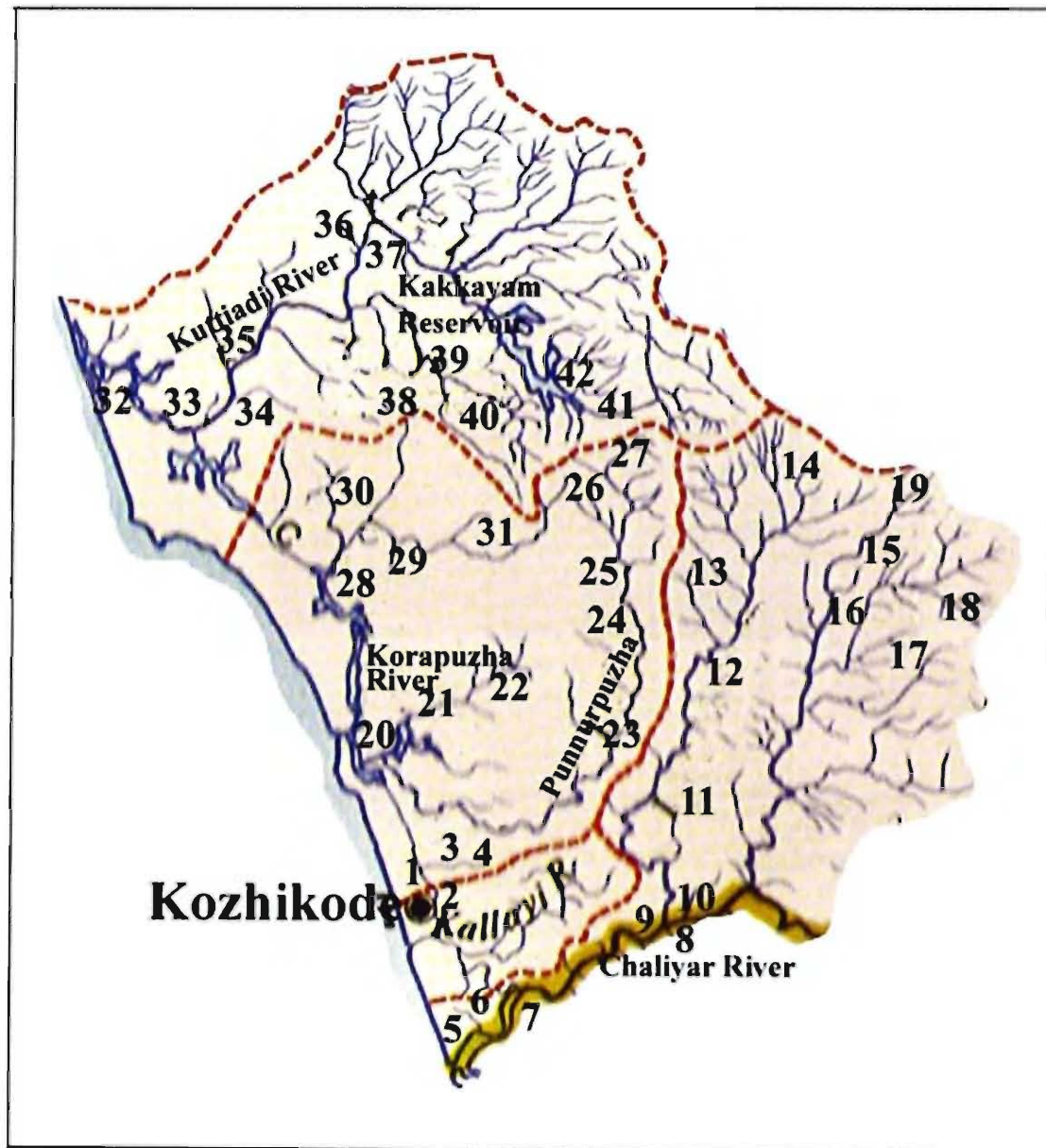
Fig. 2 : Species diversity of primary freshwater fishes recorded from the river systems in Kozhikode District, Kerala





Map 1. Kozhikode District, Kerala, India



Map 2. River Basins in Kozhikode District**Collection sites****I. Chaliyar River**

1. Kozhikode, 2. Kuthiravatam, 3. Kottuli, 4. Chevarambalam, 5. Beypore, 6. Feroke, 7. Kodampuzha, 8. Mavoor, 9. Pallikadavu, 10. Koolimadu, 11. Mukkam, 12. Tamarasserry, 13. Eenagapuzha, 14. Puthuppadi, 15. Pulikayam, 16. Kodancherry, 17. Thiruvambadi, 18. Anakampoyil, 19. Thusharagiri.

II. Korapuzha River

20. Elathur, 21. Annasserry, 22. Chelannur, 23. Koduvally, 24. Punnur, 25. Kinalur, 26. Kallanode, 27. Thenjilakadavu, 28. Kanayangode, 29. Theruvathukadava, 30. Mooliyangal, 31. Koottalida.

III. Kuttiadi River

32. Kottapuzha, 33. Murad, 34. Cheruvannur, 35. Chaliyamkadavu, 36. Kuttiadi, 37. Janakikadu, 38. Perambra, 39. Chakkittapara, 40. Peruvannamuzhi, 41. Vattapuzha, 42. Kakkayam.

Plate – I

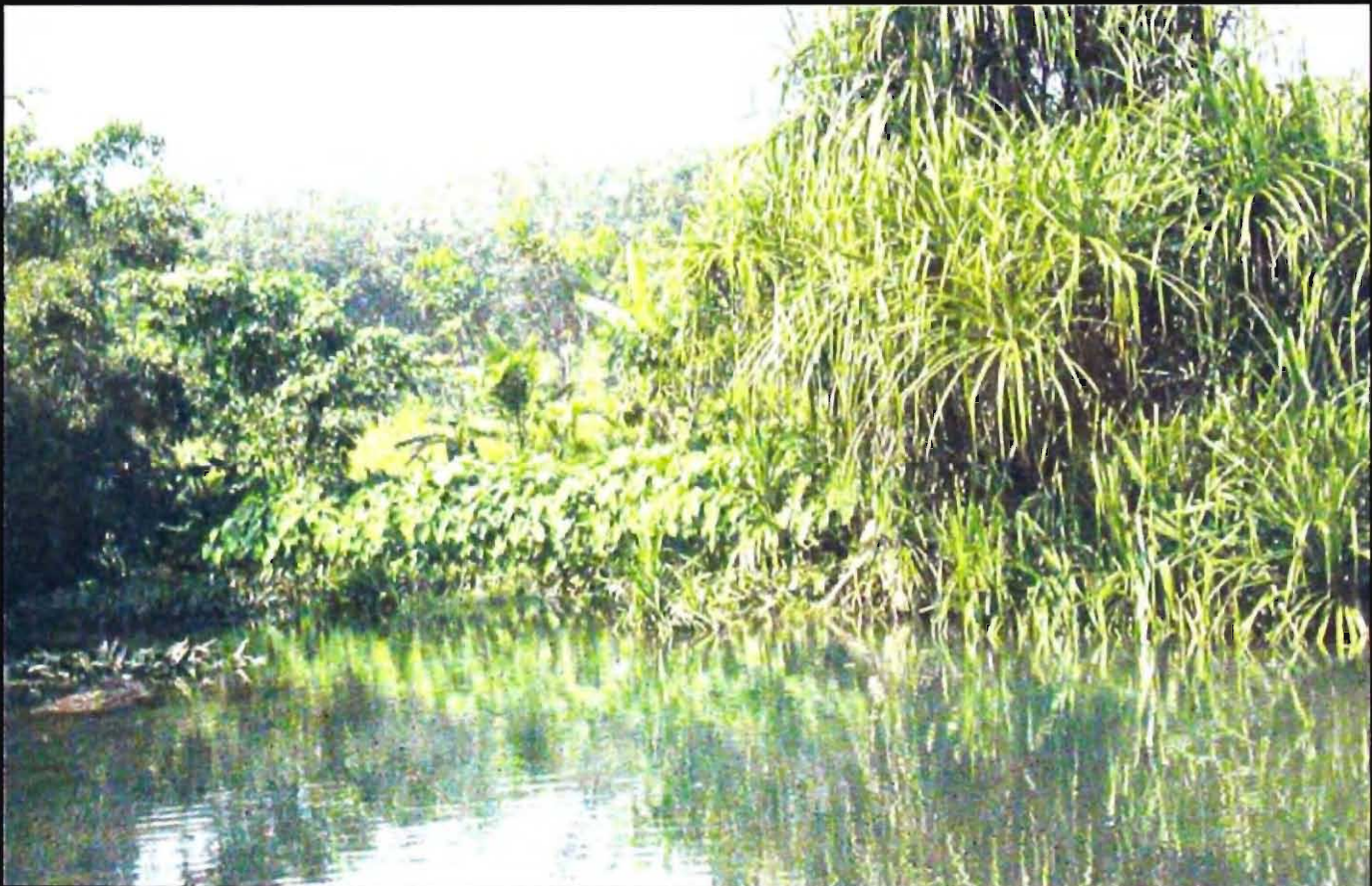


Upstream habitats of Chaliyar River in Kozhikode District



Upstream habitat of Kuttiadi River

Plate – I Contd.



Punnurpuzha, a tributary of Korapuzha River

Plate – II



1. *Barilius bakeri* Day



2. *Barilius gatensis* (Valenciennes)



3. *Danio malabaricus* Jerdon



4. *Horadandia atukorali* Deraniyagala



5. *Amblypharyngodon melettinus* (Val.)



6. *Tor khudree* (Sykes)



7. *Puntius arulius arulius* (Jerdon)



8. *Puntius denisoni* (Day)



9. *Puntius filamentosus* (Val.)



10. *Puntius sarana subnasutus* (Val.)

Plate – III

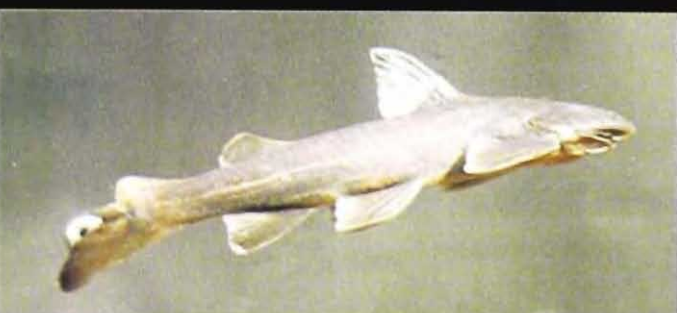
11. *Bhavania australis* (Jerdon)12. *Acanthocobitis moreh* (Sykes)13. *Batasio travancoria* Hora & Law14. *Horabagrus brachysoma* (Gunther)15. *Mystus gulio* (Hamilton-Buchanan)16. *Mystus malabaricus* (Jerdon)17. *Mystus oculatus* (Val.)18. *Ompok malabaricus* (Val.)19. *Glyptothorax annandalei* Hora20. *Monopterus digressus* Gopi

Plate – IV



21. *Parambassis thomassi* (Day)



22. *Etroplus maculatus* (Bloch)



23. *Etroplus suratensis* (Bloch)



24. *Scatophagus argus* (Linnaeus)



25. *Channa orientalis* (Schneider)



26. *Anabas testudineus* (Bloch)



27. *Tetraodon travancoricus* Hora & Nair



28. Exotic catfish : *Clarias gariepinus* (Burchell)