Chapter 5

SUMMARY AND CONCLUSION

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5.1 Summary

Studies on the indigenous ornamental fishes of Keecheri-Puzhakkal river system was conducted from the viewpoint to generate information on the ichthyofaunal diversity that supports the aquarium industry and database was prepared.

Extensive surveys were conducted all along the length of the rivers to record the fish diversity of indigenous ornamental fishes of Keecheri-Puzhakkal river systems. 140 fish species were identified in the present survey. 92 fishes were collected from the Keecheri river and 90 from the Puzhakkal river. Sixty nine riverine ornamental fishes were identified.

The rivers are a rich source of small indigenous ornamental fishes. These possess high value in the international market and therefore could be collected from the wild and used for improving ornamental fish exports from India. It was identified that the estuary, backwaters and Kol wetland zones were also rich in estuarine and marine ornamentals.

The spatial and temporal distribution of fishes was studied to aid the process of wild collections. The distribution pattern through seasons and places identify the sites and availability of various fish species.

The availability of fishes in various sites, their abundance at each site, the variation in species diversity along the longitudinal gradient, the evenness distribution of species were studied as these data will provide basis for the development and rational management of indigenous ornamental fishery.

The down reaches of the rivers had freshwater and secondary fresh water fishes migrating from estuaries. The abundance distribution of individuals shows a typical left skew indicating that most of the fish species are relatively rare and a few species was dominant. The species diversity and richness that increased from upstream to downstream were high in the post monsoon and pre monsoon season.

The length weight relationship of Amblypharyngodon mellelinus muriyadensis and Mystus oculatus were elucidated so that this will yield information on weight from length. Health status is a primary criterion of the ornamental fish.

The condition factor that decides the fitness of a species was studied for it provides an index of wellbeing of the fish. The sex ratio was calculated however females were found to predominate males in both species. The study included computation of length –weight relationship equation and distribution of maturity stages on a length group and month basis.
This enables judicious collection of the species.

It was identified that the total length of the *Amblypharyngodon melettinus muriyadensis* ranged from, 43mm to 110mm and that of *Mystus oculatus* ranged from, 45mm to 110mm. The length group 71-75mm predominate the catches in both *Amblypharyngodon melettinus muriyadensis* and *Mystus oculatus* and the sex ratio shows that females predominates the catch in both species.

In the case of male and female the regression coefficient was found to be significant this shows that there exists significant relation between length and weight in both species and therefore weight can be deduced from length.

The distribution of different life history stages of *Amblypharyngodon melettinus muriyadensis* shows that ripe female were present in the river system from the month of February and spent fish were observed from March. The monthly distribution of *Mystus oculatus* shows that mature and ripe females were observed in the catches from the month of April and spent female were collected for the first time in the month of May.

Current trends in indigenous ornamental fish trade were evaluated to estimate prospects of Keecheri-Puzhakkal river system in context of world trade. The fishes that could be accessed from Keecheri –Puzhakkal river system were listed and their international markets identified. The Commercial fitness of fish species of Keecheri- Puzhakkal river system enables identification and popularization of suitable species for trade.

According to the data on the indigenous fish exports from India during the period September 2012 to August 2013, members of the family Channids recorded highest export price. One hundred and twenty nine native species were traded with proper scientific names from India. It was identified that of this, twenty eight species are sourceable from Keecheri- Puzhakkal river system. The ornamental decisive index of *Aplocheilus lineatus, Etroplus maculatus, Horadandia atukorali, Pethia punctata, Pseudosphromenus cupanus, Channa gachua, Channa marulius, Garra mullya, Etroplus suratensis, Parluciosma daniconius, Dawkinsia filamentosa, Carinotetraodon travancoricus* were high and therefore they could be popularised as fish possessing all aquarium potentials.

Surgery, induced breeding, handling, packing and transportation causes severe stress in fish. Methods to combat the same with anaesthetics were studied. To identify the maximum loading density of *Etroplus maculatus* for transport after packing the fish in polythene bags with one litre water, survival tests were conducted for 48 hours.
To estimate the appropriate anesthesia dosage of 2-Phenoxyethanol, Clove oil and Lemon grass oil for short exposure and long term transportation the fishes were observed in different anaesthetic concentrations for a period of ten minutes and 48 hours respectively. Haematological indicators and water quality parameters were assessed to determine the efficiency of 2-Phenoxyethanol, Clove oil and Lemon grass oil in combating stress in handling and packing.

The maximum loading density for transportation of juveniles of *Etroplus maculatus* weighing 2 ±1g in one litre water and for 48 hours without anaesthesia was 50g while it increased to 80g/l, 90g/l and 120g/l for 4 ±1g, 7 ±1g and 10±1g size fish respectively. A concentration of 60mg/l, 12mg/l and 8mg/l were ideal for transportation with 2-Phenoxy ethanol, Clove oil and Lemon grass oil as anesthetic for the 48 hour transportation.

All stress indicators evaluated indicated an alteration in all experiments during the 48 hour study period. The plasma cortisol value increased during the first six hours of transportation but it decreased after unpacking after 48 hours of transportation. The plasma glucose also followed the trend of cortisol. In the case of Haemoglobin, Erythrocytes and Haematocrit the values remained high even after 48 hours after unpacking. However, stress was identified to be adaptive in the fish as the cortisol and glucose returned to basal values after 48 hours of the experiment.

The water quality changed during transportation with accumulation of carbon dioxide and ammonia and reduction in oxygen. The water quality changes in all three anaesthetic treatments was lesser compared to control. This is indicative of reduced stress. Therefore they were identified to be efficient in combating handling and packing stress in *Etroplus maculatus*. 
5.2 Conclusion

The ornamental fish industry is a striving business endeavor relying on fish biodiversity, population dynamics, fish transportation and export statistics. The present work studied the components of the hierarchical chain from the niche of the species to the export destinations. As far as the Thrissur district is concerned it is a gold mine outfitted with all the potencies required for the industry. Still the stakeholders have to travel a long way.

The present findings reveal that the Keecheri- Pузhakkal river system possesses 140 fish species. Sixty nine are riverine ornamental fish. The estuarine and marine species obtained in the collection that were unfit for human consumption are presently discarded as waste. But these fish are highly valued ornamental fish that if properly utilized could earn dollars.

Of the sixty nine riverine ornamental fish, six species were identified as critically endangered according to the regional conservation status. Ten percent of the fish were identified to be endemic to Kerala necessitating the importance of their regional conservation.

It is understood from the results that the zone which were previously affected by pollution, clay mining, waste disposal is today under severe stress from the developmental activities. Chetuva and Puzhakkal were the sites most affected.

The fish distribution studies revealed that both rivers followed a strong longitudinal pattern of distribution and therefore collection of different species has to be done from different sites as indicated by the database generated in the present study. Seasonal distribution of fish indicates that premonsoon and post monsoon season were rich in diversity and richness. Still the appropriate time to collect the fish is during the pre monsoon season when the rivers start to dry up. Strong similarity existed between sites having similar habitat and therefore between the two rivers at similar stream order. High diversity was observed in the downstream.

The length group studies on *Amblypharyngodon melletinus muriyadensis* and *Mystus oculatus* reveal that 71-75mm length group was the predominant length group in both fish species captured. The b value was 3.420 and 3.480 for male and female indicating a positive allometric growth in *Amblypharyngodon melletinus muriyadensis* and it was 2.939 and 3.026 for male and female of *Mystus oculatus* indicating an isometric growth pattern.

The studies on distribution of maturity stages indicate that the best time to collect the brooders is the premonsoon season for both fishes. The juveniles are abundant in the months from June onwards. The present study proves that both the fish species studied are available throughout the year and they could be collected for the aquarium industry prudentially. However it is ideal to collect the fish during growing phase or collapse phase.
The decennial exports indicated that South East Asia was the biggest market of Indian fishes. 380 indigenous fish species are currently exported from India.

The present study also derived efficient loading density for different sized *Etroplus maculatus*. The lowest effective concentration of anaesthetic for induction for short and long exposure has been identified and therefore these were the ideal concentration for handling and transportation of *Etroplus maculatus*. The finding of the present study has great significance with considerable application in stress management, induced breeding, survival and transport of *Etroplus maculatus*.

This study is the first of its kind for the Thrissur district. The distance between the different components and the stakeholders need to be minimized and the present study has brought together all these components into a single unit.

While the local fishermen strive for a meal of a day and the stakeholders suffer difficulties in fish transportation and threats from the globally leading entrepreneurs of the ornamental export, this study gives a distinct direction to the fish exporters. It equips them with the information on availability of different species in different sites of the rivers. It provides life history trends of 2 important endemic ornamental fishes, that assists for collection at the appropriate time and the transportation studies introduces a green anaesthetic to the wide array of existing anaesthetics compounds. Further research with regard to the pharmaceutical property of lemon grass is however essential. Breeding operations need to be started along with wild collections, for the rich resource provide ample genes for manipulation and development of more different strains of ornamental fish which is an essential requirement of the industry.