SUMMARY
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1. The first chapter has covered some of the ecological aspects of the Sharavati estuary study area.

2. A brief description of different types of estuaries is given as a prerequisite information.

3. A description of estuaries along the coast of Karnataka state (West coast of India) is given with particular reference to Sharavati estuary, the present study area.

4. A brief description of Sharavati river, its course, geomorphology and surrounding vegetation and climatic conditions, from the river's origin to its confluence with the Arabian sea is given.

5. Location of each of the three sampling stations, station 1, station 2 and station 3, in the river estuary is described.

6. Fortyfour species of teleosts belonging to twentyeight families are recorded.

7. The second chapter includes studies on some hydrological features of Sharavati estuary over a period of twelve consecutive months, February 1988 to January 1989.

8. The period includes the premonsoon period February to May, the South-West monsoon period, June to September and the postmonsoon period, October to January.

9. Water samples were collected from the surface as well as the bottom at station 1, 2 and 3, once every month. The water samples were collected on the day of the highest tide period of every month, during the high tide and the low tide on the same day to keep uniformity, throughout the year.
10. The total rainfall during the study period (February 1988 to January 1989) was 4361.5 mm, out of which the major part, 3992.4 mm occurred from mid June to September 1988, the South West monsoon period.

11. The water temperature of the study area ranged from 25°C to 33°C and there was not much fluctuation between the surface and bottom temperature since the estuary is a shallow estuary. Generally the water temperature was higher during the premonsoon period compared to that of monsoon period.

12. The pH value of surface and bottom waters generally remained on the alkaline side (pH 7.3 to 8.5) except for a single acidic phase (pH 6.8) at station 2. The alkaline pH range of Sharavati estuary suggests that the estuary water is not polluted during the period of the present work.

13. The Sharavati estuary showed clear water during pre and postmonsoon periods whereas the estuary became more turbid recording higher extinction coefficient values during the monsoon period. In general there was positive correlation between extinction coefficient and turbidity values.

14. The monthly as well as the seasonal conductivity values showed a decreasing trend from station 1 to station 3 during both the tides in the Sharavati estuary. There was a positive correlation between conductivity and salinity at all the three stations.

15. In Sharavati estuary, the surface and bottom water salinity diminished progressively from the lower reaches (mouth) of the estuary (station 1) towards the upper reaches (stations 2 and 3) and reached the lowest value at upper reaches (station 3). Further, the study period could be demarcated into a period of high salinity during the hot weather months (March to May), a period of low salinity during the South West monsoon months (July to August) and a period gradual increase in salinity during the postmonsoon months (October to November).
16. The Sharavati estuary is well oxygenated since the DO ranged from 4.3 to 9.1 ml l⁻¹. The general trend of the DO showed a steady increase in concentration with increasing distance from the mouth of the river to the upper freshwater dominated reaches. The DO was very high during the monsoon period whereas an increase in temperature and salinity resulted in a decrease in the dissolved oxygen in the Sharavati estuary.

17. The phosphate-phosphorus concentration of the estuary was higher during the monsoon months than that of premonsoon and postmonsoon months. The high concentration of phosphate-phosphorus observed during the monsoon months, particularly June to July 1988, may be due to the heavy rain fall and consequent discharge of freshwater from the upper reaches of the river, leading to a massive transportation of sediments and release of phosphates from the sediments.

18. The concentration of nitrite-nitrogen in Sharavati estuary was low when compared to phosphate-phosphorus or silicates. The average nitrite-nitrogen values showed a decreasing trend from the lower reaches (station 1) to the upper reaches (station 3).

19. Silicate-silicon concentration showed high values throughout the Sharavati estuary and the average value showed an increasing trend from station 1 to station 3 during both the tides. Further, silicate-silicon concentration showed an inverse relationship with salinity.

20. In conclusion, the Sharavati estuary, during the present study showed to be an unpolluted estuary having optimum pH and DO for aquatic life.

21. The third chapter includes some investigations on the zooplankton of Sharavati estuary, as a part of the ecophysiological studies on the estuary, since the zooplankton functions as an "intermediate link" between the primary producers the
22. The zooplankton samples were collected at monthly intervals during the high tide from the three sampling stations, spread over a period of one year, from February 1988 to January 1989.

23. The zooplankton in the Sharavati is constituted by copepods, cladocerans, chaetognaths, sergestids, appendicularians, hydromedusae, ctenophores, different larval forms and the miscellaneous group including mysids, ostracods, herpactacoids, ephasids, chaetopterus larvae, some protozoans, polychaete worms and some unidentified forms.

24. The copepods were found throughout the year at station 1 and 2 whereas they were found for most of the year at station 3 indicating their presence almost throughout the year, thus constituting an important zooplankton group in Sharavati estuary.

25. Cladocerans constituted another important group of zooplankton. They were present throughout the year at station 1 (marine dominated lower reaches near the mouth of the estuary), but they were not found for a few months at station 2 and for some months at station 3 (freshwater dominated upper reaches of the estuary) whereas copepods occurred almost throughout the year in Sharavati estuary. However, numerically cladocerans constituted the first major group among the total annual zooplankton since they were found in very large numbers from September to November 1988. Incidentally, the second numerically major group was formed by copepods.

26. The crustacean larvae formed the third major group among the total zooplankton in the Sharavati estuary and they were found almost throughout the year at all the three stations. This may be due the presence of considerable population of...
carridean and penaeid prawns, crabs in addition to copepods and cladocerans in
the estuary.

27. The sergestids, represented by *Lucifer* sp. occurred at station 1 and 2 for some
months and they were not found at station 3.

28. The carnivorous zooplankton forms, such as the hydromedusae, ctenophores and
chaetognaths are ecologically dominant though they are found in relatively small
numbers in Sharavati estuary. Among the carnivorous zooplankton forms,
chaetognaths represented by *Sagitta* sp. was the major group. They were
prominently found in station 1 and 2 during the premonsoon months. Ctenophora,
represented by *Pleurobrachia* sp. was found at the marine water dominated station
1 during only one month, December 1988 whereas it was not found any time at
station 2 and 3. Hydromedusae were found for a few months at station 1 and 2 and
were not found in the freshwater dominated station 3.

29. The zooplanktonic polychaetes and their larvae were confined to the marine water
dominated station 1 only, for five months of the year under study. They were not
found at station 2 (marine dominated region during the high tides and freshwater
dominated region during low tides) and at station 3 (freshwater dominated upper
reaches). This observation confirms that polychaetes are exclusively marine in their
habitat and get drifted at the confluence of Sharavati river mouth and the sea

30. The fish eggs and larvae were found during most of the months at station 1 and 2
and for some months at station 3. They were rather found in large numbers
immediately after the monsoons in the latter half of September 1988

31. The molluscan larvae were very sparse and were found for a few months at station
1 and for a single month at station 2 and 3.
32. The appendicularians represented by *Oikopleura* sp. were found for a few months in station 1 and for a single month at station 2 and were absent at station 3.

33. The other miscellaneous group which included mysids, ostracods, herpactacoids, euphasids, chaetopterus larvae, some protozoans and some unidentified forms also contributed considerably to the total zooplankton population in the estuary.

34. The total zooplankton per meter$^3$ for the year under investigation was maximum at station 2, followed by station 1, whereas it was remarkably low in the freshwater dominated station 3 in the upper reaches of the Sharavati estuary. The present work supports the concept that zooplankton population is more abundant in an estuary, particularly in the high salinity region, than in a low salinity region.

35. The total zooplankton production showed a major peak in September to November 1988, during the postmonsoon period, immediately after the cessation of monsoon rains. There was a minor peak in the zooplankton production during the premonsoon months, March, April and May 1988.

36. The present study shows that the Sharavati estuary, particularly the middle reaches at station 2, has abundant zooplankton population that can support a good estuarine fishery.

37. The fourth chapter includes studies on the annual reproductive cycle of the female fish *Strongylura strongylura* and its relation to some environmental factors.

38. The samples of the fish were collected over a period of one year, for twelve consecutive months from February 1988 to January 1989. A monthly sample of a minimum of five sexually mature female fish of comparable size and weight were used for the study.
39. The ovaries are of cystoovarian type and oviduct opens to the exterior by the urinary opening independent from the urinary pore. The right ovary is better developed than the left ovary.

40. Basing evidence on the gross morphological changes in a) the size of the ovary, b) the gonosomatic index and c) the presence of different types of ovarian follicles, the reproductive cycle of *S. strongylura* can be divided into five periods, as mentioned below:

i) Repopulation period – September to November
ii) Preparatory period – December to February
iii) Prespawning period – March to mid June
iv) Spawning period – Mid June to July, and
v) Postspawning period – August

41. The present study shows that the fish *S. strongylura* spawns once in its annual reproductive cycle, during a short duration (Mid June to July)

42. The monthly variation in the relative weight of the liver of *S. strongylura*, expressed as the H.S.I., is found to be statistically significant. It is suggested that vitellogenin might be synthesized and stored in the liver during the repopulation and preparatory periods. During the prespawning period a steep rise in the G.S.I parallel with a steep fall in the H.S.I. suggested that vitellogenin is transported to the active developing ovary to form large vitellogenic follicles.

43. The condition factor K showed a rapid increase from February to May, that is, during the prespawning period parallel with the rapid increase in the G.S.I, suggesting a general well being of the fish during the prespawning period.

44. The decrease in the K value during the spawning period and the postspawning period indicated that the body reserves are utilised when the fish probably does not feed.
45. The progressive growth of the ovary in *S. strongylura* is parallel with the increasing water temperature, particularly during the prespawning period suggesting a positive correlation between the increasing temperature and development of the ovary.

46. Spawning in *S. strongylura* occurs with the onset of the South West monsoons when there is a fall in the water temperature and salinity and a relative rise in the dissolved oxygen concentration in the Sharavati estuary.

47. The photoperiod does not vary almost throughout the year in Sharavati estuary region and it seems that natural photoperiod does not play any important role in the development of the ovary in *S. strongylura*.

48. It is suggested that there is a need to carry out a detailed study on the histological/cytological stages of the ovarian follicles to arrive at a definite conclusion on the reproductive cycle of the fish *S. strongylura*. However, it is pointed out that the present work has provided some basic and useful information on the annual gonadal cycle of the tropical estuarine fish *S. strongylura*, for the first time, to the best of the author’s knowledge.

49. The fifth chapter includes investigations on the interrenal tissue of the female *S. strongylura* in relation to annual breeding cycle and changes in the salinity of the Sharavati estuary.

50. The interrenal tissue of *S. strongylura* consists of a large number of lobules of columnar epithelial cells associated with venous sinuses within the haemopoetic tissue of the head kidney. The chromaffin cells are found in groups around the venous sinusoidal spaces and interspersed among interrenal lobules.

51. In the present work, the measurement of the interrenal cell activity is based on histometric studies, that is changes in the diameter of the nucleus and the cell are taken as parameters showing the changes in the cell activity
52. The interrenal cells showed a low activity during July to August 1988 parallel with the low salinity of the estuary, on account of South West monsoon rain.

53. During the postmonsoon months, there was a gradual increase in the interrenal activity parallel with the increase in salinity.

54. There was an increase in the nuclear as well as the cell diameter of the interrenal cells, suggesting an increase in activity, during the premonsoon months (March to May) which was parallel with the increased salinity of Sharavati estuary during the premonsoon period.

55. The present study shows that there is a positive correlation between the salinity and interrenal activity, since whenever there was an increase in estuarine salinity there was a parallel increase in the activity of interrenal tissue in *S. strongylura*. The observation supports the concept that adrenocortical activity in teleosts is greater in salt water than in freshwater.

56. The interrenal activity also showed some positive correlation with the development of the ovary in *S. strongylura*.

57. There was a gradual increase in the interrenal tissue activity parallel to the development of the ovary during the repopulation, preparatory and particularly the prespawning period. These observations suggest an increased interrenal activity during maturing and mature phases of the reproductive cycle in *S. strongylura*.

58. The significant reduction in interrenal cell diameter in July and a significant reduction of nuclear diameter of interrenal cells in August suggests a low interrenal activity parallel with late spawning period (July) and postspawning period (August).

59. The conclusion drawn in the present work is more suggestive than definitive, since it is based on histometric data. Hence, further investigations like quantitative measurements of corticosteroids are quite essential for confirming the observations.