

Table of Contents

Chapter 1	Introduction	1
1.1	Characteristics of a lagoon	1
1.2	Koggala lagoon	4
1.2.1	Climate of the region	6
1.2.2	Hydrodynamics	7
1.2.3	Formation of the sand bar	8
1.2.4	Anthropogenic impacts of the Lagoon	8
1.2.5	Water quality of the Koggala lagoon	12
1.2.6	Biological assemblages	17
1.2.7	Fishing in the Koggala lagoon	21
1.2.7.1	Cast net	21
1.2.7.2	Drift net / Gill net	22
1.2.7.3	Crab net	23
1.2.7.4	Baited crab trap	23
1.2.7.5	Angling (Rod & line)	24
1.2.7.6	Stake net	24
1.2.7.7	Cage trap	26
1.2.7.8	Cover pot	27
1.2.8	Fishing vessels used in the Koggala lagoon	28
1.2.9	Fish and shrimp species found in the Koggala lagoon	28
1.2.10	Ornamental fish collection	32
1.2.11	Aquatic plants in the Koggala lagoon	32
1.2.12	Mangroves in the Koggala lagoon	35

1.3 Objectives of the study	38
1.3.1 The research need	38
1.3.2 Objectives	39
Chapter 2 Bathymetry and salinography of the lagoon	40
2.1 Introduction	40
2.2 Materials and methods	42
2.2.1 Study site description	42
2.2.2 Bathymetric study	43
2.2.3 Determination of salinity stratification	43
2.3 Results	44
2.3.1 Bathymetry	44
2.3.1.1 Sediments of the Koggala lagoon	47
2.3.2 Salinity stratification	47
2.4 Discussion	53
Chapter 3 Effects on habitat segregation of <i>Etroplus suratensis</i>	56
3.1 Introduction	56
3.1.1 Anthropogenic impacts on coastal environments	56
3.1.2 Groyne system in the Koggala lagoon	57
3.1.3 Fish and their environment	58
3.1.4 Brackish water species	60
3.1.5 <i>Etroplus suratensis</i>	60
3.1.6 Null and alternative hypothesis for the current study	62
3.2 Material and methods	63
3.2.1 Study sites	63
3.2.2 Analysis of fish size, catch and stomach content of <i>E. suratensis</i>	63
3.2.3 Analysis of effects of salinity on growth of <i>E. suratensis</i>	66

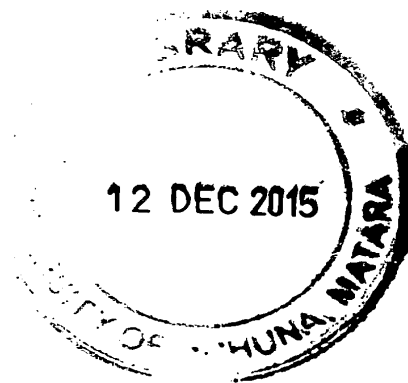
3.2.4	Statistic analysis	68
3.2.4.1	Analysis of the catch and stomach content	68
3.2.4.2	Analysis of effects of salinity on growth	68
3.3	Results	69
3.3.1	Differences of the two regions	69
3.3.2	Analysis of catch and stomach content of <i>E. suratensis</i>	70
3.3.3	Analysis of effects of salinity on growth of <i>E. suratensis</i>	74
3.4	Discussion	77
3.4.1	Environmental factors affecting food availability and food preference of fish	77
3.4.2	Factors affecting availability of refuges and predation due to opening of the lagoon mouth	78
3.4.3	Salinity and fish	80
3.4.4	Reason for untimely death of <i>E. suratensis</i>	81
Chapter 4	Declining of mud crab (<i>Scylla serrata</i>) population and its relevance to fishing gear efficiency	85
4.1	Introduction	85
4.1.1	Biology of mud crabs	86
4.1.2	Crab gears	89
4.1.3	Salinity and <i>Scylla serrata</i>	91
4.1.4	Rationale for current study	91
4.2.	Materials and methods	92
4.2.1	Crab taxonomic status, morphometrics, sexes and Comparison of harvest of crab pots and crab nets	92
4.2.2	Size at maturity	95

4.3 Results	97
4.3.1 Water quality and crab harvest data	97
4.3.2 The carapace width (CW) - body weight (BW) relationship	98
4.3.3 Catch of crab pot and net	101
4.3.4 Size at maturity	101
4.4 Discussion	102
Chapter 5 Conclusions and recommendations	108
5.1 Bathymetry and salinography of the Koggala lagoon	108
5.2 Anthropogenic impacts on green chromid fish, <i>Etroplus suratensis</i> , population in the Koggala lagoon	108
5.3 The mud crab population, <i>Scylla serrata</i> , in the Koggala lagoon	109
5.4 Restoration of the Koggala lagoon	110
References	115

List of Tables

Table 1.1	Area of the islands in the Koggala lagoon	6
Table 1.2	Annual ranges of salinity, temperature, dissolved oxygen and secchi depth at four sites of the Koggala lagoon from April 1981 to March 1982	12
Table 1.3	Physico-chemical parameters reported by Pemadasa and Senaratne in 1992	13
Table 1.4.	Physico-chemical parameters at the middle of the lagoon on 3 rd of March, 1994	14
Table 1.5	Physico-chemical parameters of 10 selected stations from November, 1992 to April, 1993	15
Table 1.6	Physico-chemical parameters of 5 selected stations from June, 2004 to November, 2004	15
Table 1.7	Physico-chemical parameters of 6 selected stations on 26 th of December, 2009	16
Table 1.8	List of fish species encountered in the Koggala lagoon	29
Table 1.9	Composition of shrimp catch of the Koggala lagoon	32
Table 1.10	Aquatic plant species in Koggala lagoon reported in 2011	33
Table 1.11	Mangrove species in Koggala lagoon reported in 2011	35
Table 1.12	Mangrove associate species in Koggala lagoon reported in 2011	36
Table 2.1	Field survey conditions and dates	44
Table 2.2	Summary of lagoon bathymetric statistics	45
Table 2.3	Distribution of different particle sizes of sand by weight	47
Table 3.1	Classification of <i>Etroplus suratensis</i>	61

Table 3.2	Comparison of physical characteristics of the lagoon proper (A) and the upper region (B) of the Koggala Lagoon in 2011	69
Table 3.3	Catch data of the lagoon proper (A) and the upper region (B) which is separated by an anicut	72
Table 3.4	Habitat difference with respect to food availability and selectivity (Chesson's α) variation of <i>E. suratensis</i> in the two parts of the lagoon	72
Table 4.1	Morphological characteristics used in determining species identity of genus <i>Scylla</i> (Keenan et al., 1998)	85
Table 4.2	Classification of <i>Scylla serrata</i>	86
Table 4.3	Percentage of composition and sex ratio of mud crabs of the Koggala lagoon	98
Table 4.4	Carapace widths of mud crabs caught by crab pots and crab nets from the Koggala lagoon	99
Table 4.5	Details of the t-test	101
Table 4.6	Comparison of <i>Scylla serrata</i> populations in different countries	103



List of Figures

Figure 1.1	Types of coastal lagoons	3
Figure 1.2	Map of the Koggala lagoon, Sri Lanka	5
Figure 1.3	Distribution of mangroves and mangrove associate species in the Koggala lagoon	36
Figure 1.4	Distribution of mangrove species in the Koggala lagoon	37
Figure 1.5	Distribution of mangrove associate species in the Koggala lagoon	37
Figure 2.1	Bathymetric map of the Koggala lagoon, Sri Lanka (2012)	46
Figure 2.2	Distribution of monthly rainfall of Koggala area from January, 2009 to December, 2011	48
Figure 2.3	Vertical profiles of salinity in the Koggala lagoon in rainy and dry seasons under spring and neap tidal conditions	49
Figure 2.4	Different mixing characteristics of Koggala lagoon in the dry period	50
Figure 2.5	Different mixing characteristics of Koggala lagoon in the rainy period	51
Figure 2.6	Vertical profiles of temperature in the Koggala lagoon in rainy and dry seasons under spring and neap tidal conditions	52
Figure 3.1	Temporal variations in mean salinity (\pm SE) of the lagoon proper (A) and the upper region (B) which is separated by an anicut	70
Figure 3.2	Total length distribution of caught <i>E. suratensis</i> in the lagoon proper (A) and the upper region which is separated by a dyke (B)	71
Figure 3.3	Composition of the stomach contents of <i>E. suratensis</i> caught from the lagoon proper (A) and the upper region (B)	73
Figure 3.4	Growth of <i>E. suratensis</i> in different salinities	75
Figure 3.5	Box plot of life times of <i>E. suratensis</i> in different salinities	76
Figure 4.1	Life cycle stages of <i>Scylla serrata</i> : Zoea, megalopa, juvenile and adult	89
Figure 4.2	Map of the Koggala Lagoon, Sri Lanka showing sampling stations	95

Figure 4.3	The mean annual spatial variations in salinity and bottom temperature of the Koggala lagoon	97
Figure 4.4	Morphometric relationship between body weight and carapace width of <i>S. serrata</i> in the Koggala lagoon	100
Figure 4.5	Size at maturity for female crab of <i>S. serrata</i> in the Koggala lagoon	102

List of Plates

Plate 1.1	Visual evidence of the destroyed embankment constructed at the outlet of the Koggala lagoon in the Second World War	9
Plate 1.2	Main anicuts at (a) Warabokka and (b) Kerena area that prevent salt water intrusion	9
Plate 1.3	Satellite image of the Koggala lagoon outlet	11
Plate 1.4	Some of the phytoplankton species recorded in the lagoon	18
Plate 1.5	Some of the zooplankton species recorded in the lagoon	19
Plate 1.6	A jelly fish found in the Koggala lagoon	20
Plate 1.7	Cast net at operation	22
Plate 1.8	A fish caught in a gill net at the Koggala lagoon	23
Plate 1.9	Rod and line operation in a canoe at the Koggala lagoon	24
Plate 1.10	Stake nets at the mouth of the Koggala lagoon	25
Plate 1.11	A cage trap with the catch at the Koggala lagoon	26
Plate 1.12	Cover pots of the Koggala lagoon	27
Plate 1.13	The lagoon canoes at the landing site in the Koggala lagoon	28
Plate 1.14	Commercially important prawn species	31
Plate 1.15	Aquatic plants in the Koggala lagoon	34
Plate 3.1	The green chromid, <i>Etroplus suratensis</i>	61
Plate 3.2	Aquatic plants in the Koggala lagoon	79
Plate 3.3	Healthy and diseased fish	83
Plate 4.1	<i>Scylla serrata</i> . Illustration of major body parts	87
Plate 4.2	Crabs in different colours caught in the Koggala lagoon	88
Plate 4.3	A crab pot and crab net used in the Koggala lagoon	90
Plate 4.4	Assessment of sex and maturity of crabs by stage of the abdomen	94
Plate 4.5	The underside of a male mud crab showing mating scars	96
Plate 5.1	A place is undergoing to illegal land fill nearby an inflow	112
Plate 5.2	The temporal sand bar built at the lagoon mouth in August, 2011	114