

## APPENDIX

### Chapter 6 COST STRUCTURE, PROFITABILITY AND ECONOMIC MODELLING OF FISHING

6.1	INTRODUCTION .....	146
6.2	MATERIALS AND METHODS .....	147
	6.2.1 Cost Structure .....	148
	6.2.2 Revenue .....	151
	6.2.3 Sharing System .....	152
	6.2.4 Labour and Employment .....	153
	6.2.5 Repairs and Maintenance .....	153
	6.2.6 Profitability and Efficiency Parameters .....	154
	6.2.7 Pure Economic Profit and Resource Rent .....	156
	6.2.8 Economic Model .....	158
	6.2.8.1 Bio-economic Modelling of Multigear Fisheries on Economically Important Species .....	158
	6.2.8.2 Bio-economic Modelling of Multigear Multispecies Fishery .....	158
6.3	RESULTS .....	162
	6.3.1 Fixed Cost .....	162
	6.3.2 Operational Cost of Fishing .....	162
	6.3.3 Fish Price .....	166
	6.3.4 Revenue .....	168
	6.3.5 Operational Profit, Income and Income Distribution .....	169
	6.3.6 Variable Cost .....	171
	6.3.7 Total Variable Cost .....	174
	6.3.8 Total cost .....	174
	6.3.9 Cost of Production .....	175
	6.3.10 Profitability .....	176
	6.3.11 Efficiency Parameters .....	180
	6.3.12 Return to Capital and Labour .....	182
	6.3.13 Resource Rent .....	185
	6.3.14 Economic Model .....	186
	6.3.14.1 Thompson and Bell Bio-economic Model .....	186
	6.3.14.2 Projections of Performance Under Different Development Fishing Strategies .....	188
	6.3.14.3 Economic Model of Multispecies Fishery .....	194
6.3	DISCUSSION .....	197
	APPENDIX	

### Chapter 7 MARKETING OF FISH CATCH

7.1	INTRODUCTION .....	209
7.2	MATERIALS AND METHODS .....	210
7.3	RESULTS .....	211
	7.3.1 Marketing Systems .....	211
	7.3.2 Categories of Buyers and Market Network .....	214
	7.3.3 Fish Distribution .....	216
	7.3.4 Fish Price .....	217
7.4	DISCUSSION .....	219

### Chapter 8 SOCIO-ECONOMICS OF FISHING HOUSEHOLDS

8.1	INTRODUCTION.....	223
8.2	MATERIALS AND METHODS.....	224
8.3	RESULTS .....	225
	8.3.1 Socio-Demographic Profile .....	225
	8.3.2 Literacy and Education Attainment .....	230
	8.3.3 Career Development of Boat Owners .....	233

3.2.5	Spawning Season.....	62
3.2.6	Length at Maturity .....	63
3.2.7	Fecundity.....	63
3.3	RESULTS .....	63
3.3.1	Sex Ratio .....	63
3.3.1.1	Seasonal Variation of Sex Ratio .....	63
3.3.1.2	Variation of Sex Ratio by Size .....	65
3.3.2	Seasonal Variation of Gonosomatic Indices (GSI) .....	67
3.3.3	Development of Ova to Maturity .....	69
3.3.4	Variation of Gonosomatic Indices (GSIs) in Different Stages .....	69
3.3.5	Maturity Stages of Gonad Development .....	71
3.3.6	Spawning Season .....	74
3.3.7	Size at Sexual Maturity .....	77
3.3.8	Fecundity .....	79
3.4	DISCUSSION .....	80
<b>Chapter 4 LENGTH-WEIGHT RELATIONSHIP AND VITAL STAISTICS</b>		
<b>OF <i>L. nebulosus</i> AND <i>L. lentjan</i></b>		
4.1	INTRODUCTION .....	86
4.1.1	Population/Stock Structure .....	86
4.2	MATERIALS AND METHODS .....	87
4.2.1	Length- Weight Relationship .....	87
4.2.2	Growth Parameters .....	87
4.2.3	Estimation of Total Mortality Coefficients (Rate) (Z) .....	91
4.2.4	Estimation of Natural Coefficient (Rate) (M), Fishing Mortality Coefficient (Rate) (F) and Exploitation Rate (E) .....	94
4.2.5	Determination of Probability of Capture and Mean Length at First Capture .....	94
4.3	RESULTS .....	95
4.3.1	Length-Weight Relationship .....	95
4.3.2	Growth Parameters .....	97
4.3.3	Length at Age .....	98
4.3.4	Natural and Fishing Mortality Coefficients (Rates) and Exploitation Rate .....	99
4.3.5	Probability of Capture .....	100
4.4	DISCUSSION .....	101
APPENDIX		
<b>Chapter 5 STOCK ASSESSMENT AND MODELLING OF FISH STOCKS</b>		
5.1	INTRODCUTION .....	107
5.1.1	Assessment Models .....	108
5.1.1.1	Single Species Models .....	108
5.1.1.2	Multispecies Models .....	110
5.1.1.3	Choice of Stock Assessment Models .....	111
5.2	METHODS AND MATERIALS .....	112
5.2.1	Singlespecies Stock Assessment .....	112
5.2.2	Multispecies Stock Assessment .....	118
5.2.3	Standardisation of Fishing Effort .....	120
5.3	RESULTS .....	121
5.3.1	Jones Length Based Cohort Analysis .....	121
5.3.2	Single Species Stock Assessment – Thompson and Bell Model .....	126
5.3.3	Projections of Performance Under Different Fishing Strategies .....	128
5.3.4	Standardised Fishing Effort .....	134
5.3.5	Total Biomass Production Model .....	134
5.4	DISCUSSION .....	140

# Contents

<b>Chapter 1 INTRODUCTION AND AN OVERVIEW OF FISHERIES IN SRI LANKA</b>		
1.1	INTRODUCTION .....	1
1.2	MARINE ENVIRONMENT .....	1
1.3	MARINE FISHERY RESOURCES .....	3
1.4	MARINE FISHERIES .....	3
1.5	DEMERSAL FISHERIES IN SRI LANKA .....	4
	1. 5. 1 Fishing Crafts .....	5
	1. 5. 2 Fishing Methods .....	6
	1. 5. 3 Species Composition .....	7
	1. 5. 4 Distribution of Resources .....	7
	1. 5. 5 Stock Status .....	7
1.6	FISHERIES MANAGEMENT .....	8
1.7	AIMS AND OBJECTIVES OF THE STUDY .....	12
1.8	ORGANISATION OF THE THESIS .....	12
<b>Chapter 2 ASSESSMENT OF DEMERSAL FISHERIES IN THE WEST COAST OF SRI LANKA</b>		
2.1	INTRODUCTION .....	14
2.2	MATERIALS AND METHODS .....	14
	2. 2. 1 Fishing Grounds .....	16
	2. 2. 2 Fishing Gear .....	16
	2. 2. 3 Fishing Craft .....	17
	2. 2. 4 Unit of Fishing Effort .....	23
	2. 2. 5 Estimation of Fishing Effort .....	23
	2. 2. 6 Estimation of Catch per Unit Effort (CPUE) .....	24
	2. 2. 7 Estimation of Fish Production .....	24
	2. 2. 8 Estimation of Size Frequency Distribution .....	25
2.3	RESULTS .....	25
	2. 3. 1 Fishing Effort .....	25
	2. 3. 1. 1 Seasonal Variation of Fishing Effort .....	27
	2. 3. 1. 2 Fishing Effort in Relation to Fishing Depth .....	30
	2. 3. 2 Inter Annual Variation of Catch per Unit Effort (CPUE).....	31
	2. 3. 2. 1 Seasonal Variation of CPUE .....	32
	2. 3. 2. 2 Variation of CPUE in Relation to Fishing Depth .....	35
	2. 3. 3 Fish Production .....	36
	2. 3. 4 Dynamic of Demersal Fishery .....	37
	2. 3. 5 Catch Composition .....	38
	2. 3. 6 Species Composition .....	38
	2. 3. 6. 1 Variation of Species Composition by Gear .....	40
	2. 3. 6. 2 Variation of Species Composition by Fishing Depth.....	42
	2. 3. 7 Species Composition of Family Carangidae and Lethrinidae .....	44
	2. 3. 8 Production of Family Lathrinidae .....	46
	2. 3. 9 Sequential Exploitation .....	47
	2. 3. 10 Size Distribution by Different Depths .....	49
2.4	DISCUSSION .....	51
<b>Chapter 3 REPRODUCTIVE BIOLOGY OF <i>L. nebulosus</i> AND <i>L. lentjan</i></b>		
3.1	INTRODUCTION .....	59
3.2	MATERIALS AND METHODS .....	60
	3. 2. 1 Gonad Structure .....	60
	3. 2. 2 Sex Determination and Maturity Stage .....	61
	3. 2. 3 Gonosomatic Index .....	61
	3. 2. 4 Development of Ova .....	61



8.3.4	Relationship to the Fishing Area – Negombo .....	233
8.3.5	Selection of Fishing as a Vocation .....	234
8.3.6	Hired Labour Relations .....	235
8.3.7	Household Occupation Structure .....	236
8.3.8	Participation of Women in Economic and House Keeping Activities .....	237
8.3.9	Occupation Structure of Headman .....	237
8.3.10	Ancillary Economic Activities of Headman .....	238
8.3.11	Economic Activities of Other Family Members of Fishing Households .....	238
8.3.12	Total and Disposable Income Distribution of Fishing Households .....	239
8.3.13	Expenditure .....	244
8.3.14	Food Expenditure and Engel’s Coefficient .....	247
8.3.15	Household Savings .....	248
8.3.16	Ownership of Property and Assets .....	252
8.3.17	Debts and Liabilities .....	252
8.4	DISCUSSION .....	253
<b>Chapter 9 GENERAL DISCUSSION, CONCLUSIONS, LIMITATIONS OF THE STUDY AND FUTURE RESEARCH</b>		
9.1	GENERAL DISCUSSION .....	261
9.2	MANAGEMENT OPTIONS .....	268
9.3	ALTERNATIVE MANAGEMENT OPTIONS .....	269
9.4	MANAGEMENT BODIES AND INTERVENTIONS .....	272
9.5	MANAGEMENT STRATEGY AND IMPLEMENTATION .....	274
9.6	CONCLUSIONS .....	275
9.7	LIMITATIONS OF THE STUDY .....	275
9.8	FUTURE RESEARCH NEEDS .....	277
<b>REFERENCES .....</b>		<b>297</b>