

TABLE OF CONTENTS

	Page
ABSTRACT	(i)
ACKNOWLEDGEMENT	(ii)
List of the Tables	(ix-xi)
List of Figures	(xiii-xiii)
CHAPTER 1 GENERAL INTRODUCTION	1
1.1 Importance of diseases and parasites in aquaculture	1
1.2 The monogeneans	5
1.2.1 Monogeneans as pathogens	6
1.2.2 Monogeneans as ecological indicators	8
1.3 Review of monogenean studies in Thailand	9
1.4 Importance of siluriform fish	11
1.5 Objective of study	14
1.6 Descriptions of the different Chapters	15
CHAPTER 2 MATERIALS AND METHODS	16
2.1 Introduction	16
2.2 Fish collection	16
2.2.1 Fish collection sites	16
2.2.2 Methods of fish collection	22
2.3 Monogenean collection	27
2.3.1 Collection, preparation and preservation of monogeneans	27
2.3.2 Identification and descriptions of monogeneans	28
2.4 Analyses of data	28
2.4.1 Distribution data: prevalence and mean intensity	28
2.4.2 Morphological analysis	28

	Page
2.4.2.1 Categorisation (coding) of sclerotised structures	29
(i) Sclerotised haptoral parts	29
(ii) Sclerotised reproductive parts	40
2.4.2.2 Non-sclerotised reproductive parts: seminal vesicle	45
2.4.2.3 Cluster analysis	45
2.5 Limitations and delimitations of study	50
 CHAPTER 3 THE SILURIFORMES OF THAILAND	51
3.1 Introduction	51
3.2 The Siluriformes	51
3.3 The freshwater siluriforms of Thailand	51
3.3.1 Classification	51
3.3.2 Freshwater siluriforms investigated	57
3.3.2.1 Akysidae	57
3.3.2.2 Amblycipitidae	58
3.3.2.3 Ariidae	58
3.3.2.4 Bagridae	59
3.3.2.5 Chacidae	62
3.3.2.6 Clariidae	62
3.3.2.7 Heteropneustidae	63
3.3.2.8 Pangasiidae	63
3.3.2.9 Schilbeidae	64
3.3.2.10 Siluridae	64
3.3.2.11 Sisoridae	65
3.4 Phylogenetic relationships of Thai catfish	68
3.4.1 Familial relationships	68
3.4.2 Generic relationships	72
3.5 Distribution patterns of Thai freshwater catfish	80
3.5.1 Affinity of Southeast Asian fish fauna	80
3.5.2 Affinity with the Ethiopian (African) fish fauna	82

	Page
3.5.3 Affinity with the Palearctic fish fauna	82
3.6 Geological history of Southeast Asia	82
3.7 Centre of the origin of freshwater catfish	83
3.8 Summary	85
 CHAPTER 4 RESULTS AND DISCUSSIONS:	86
DISTRIBUTION PATTERNS OF MONOGENEANS	
4.1 Introduction	86
4.2 Host-monogenean data	86
4.2.1 Ariidae	93
4.2.2 Bagridae	94
4.2.3 Clariidae	98
4.2.4 Heteropneustidae	100
4.2.5 Pangasiidae	101
4.2.6 Schilbeidae	102
4.2.7 Siluridae	103
4.2.8 Sisoridae	106
4.3 Discussion	107
4.3.1 Ancyrocephalidae Bychowsky, 1937	107
(i) Ancylodiscoidinae Gussev, 1961	109
(ii) Ancyrocephalinae Bychowsky, 1937	114
4.3.2 Diversity within monogeneans	118
4.3.3 Diversity of monogeneans on catfish	118
4.3.3.1 On different host families	120
4.3.3.2 On different host genera and species	121
4.3.3.3 Multispecies monogeneans community on the fish host	122
4.3.4 Monogenean-host distribution patterns: Specificity	122
4.3.4.1 At familial and generic levels	123
4.3.4.2 At specific level	124
4.3.5 Biogeographical distribution of monogeneans	125

	Page
4.4 Summary	132
CHAPTER 5 RESULTS AND DISCUSSION:	134
MORPHOLOGICAL DIVERSITY OF MONOGENEANS	
5.1 Introduction	134
5.2 Results characterisation of monogeneans	135
5.2.1 Hard sclerotised parts	136
5.2.1.1 Ancylodiscoidinae	136
5.2.1.2 Ancyrocephalinae	149
5.2.2 Non-sclerotised reproductive parts: seminal vesicles	153
5.3 Results of cluster analysis	153
5.3.1 All the aencylodiscoidin species	157
5.3.2 All the <i>Thaparocleidus</i> species	163
5.3.3 The <i>Thaparocleidus</i> species from Pangasiidae	169
5.3.4 The <i>Thaparocleidus</i> species from Siluridae	171
5.3.5 The <i>Thaparocleidus</i> species from Bagridae	174
5.3.6 All the <i>Cornudiscoides</i> species	176
5.3.7 All the aencyrocephalin species	179
5.4 Discussion	181
5.4.1 Interrelationships of monogeneans	181
5.4.2 Correlation with host species	182
5.4.3 Importance of morphological diversity	182
5.5 Evaluation of analysis	183
5.6 Conclusion	184
CHAPTER 6 GENERAL DISCUSSION	185
6.1 Introduction	185
6.2 Taxonomic status of Ancyrocephalidae Bychowsky, 1937	185
6.2.1 Monogenea van Beneden, 1858	186
6.2.2 Validity of Ancyrocephalidae Bychowsky, 1937	186

6.3 Characteristics of monogeneans on siluriforms in Thailand	189
6.3.1 Expected diversity of species on Siluriformes of Thailand	190
6.3.2 Monogenean species diversification	194
6.3.2.1 Significance of morphological diversity and rates of change	194
6.3.2.2 Significance of morphological diversity and co-existing species	195
6.3.3 Association between host and monogenean	196
6.3.3.1 Significance of faunistic links	198
6.3.3.2 Endemicity of monogenean and transition zone	199
6.3.3.3 Centre of origin of the monogeneans	199
6.4 Evolution and phylogeny of monogenean fauna of Thai catfish	200
6.4.1 The primitive of monogeneans	201
6.4.2 Evolutionary pathways of the ancyrocephalins and aencylodiscoidins	203
6.4.3 Evolution of the aencylodiscoidins	205
6.4.4 Phylogeny of monogeneans versus phylogeny of hosts	206
6.5 Disease causing potentials of monogeneans	210
6.6 Concluding remarks	212
 SUMMARY	214
REFERENCES	216
APPENDICES	247
Appendix 1: List of monogenean species from the Old World siluriforms	247
Appendix 2: Siluriform fishes examined: photographs	259
Appendix 3: Monogeneans of Thai freshwater siluriforms	267
Appendix 3.1: Monogeneans of Ariidae	271
Appendix 3.2: Monogeneans of Bagridae	275
Appendix 3.3: Monogeneans of Clariidae and Heteropneustidae	337
Appendix 3.4: Monogeneans of Pangasiidae	360
Appendix 3.5: Monogeneans of Schilbeidae	401

	Page
Appendix 3.6: Monogeneans of Siluridae	408
Appendix 3.7: Monogeneans of Sisoridae	446
Appendix 3.8: Monogeneans from <i>Wallago attu</i> (Bloch & Schneider, 1802) of Thailand	451
Appendix 3.9: Monogeneans of clariid fishes of Thailand	465