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ICHTHYOFAUNA OF THE GIANH RIVER BASIN FROM VIETNAM

SPECIALTY: 165.03. ICHTHYOLOGY

Doctoral thesis in Biological Sciences

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CONTENTS

ADNOTARE

Ho Anh Tuan "Ihtiofauna bazinul fluviului Gianh din Vietnam" Teza de doctor în științe biologice, Chişinău, 2015. **Structura tezei**. Introducere, 4 capitole, concluzii şi recomandări, bibliografia 326 surse, 150 pagini, 20 figuri, 7 tabele, 3 anexe (21 pagini, 193 figuri). Rezultatele obţinute sunt publicate în 15 lucrări ştiinţifice. **Cuvinte cheie.** Ihtiofauna Vietnamului, statut taxonomic, caractere meristice, caractere metrice, specii invazive, specii economic valoroase, valorificare sustenabilă. **Domeniul de studiu**. 165.03 Ihtiologie. **Scopul lucrării.** Evaluarea diversităţii ihtiofaunistice a bazinului fl. Gianh, completarea informaţiei ştiinţifice existente în domeniu şi elaborarea recomandărilor de protecţie şi utilizare durabilă a resurselor piscicole. **Obiective:** Inventarierea diversităţii ihtiofaunistice a bazinului fluviului Gianh din Vietnam; descrierea caracterelor morfometrice şi meristice a speciilor identificate, analiza repartiţiei spaţiale; identificarea speciilor economic valoroase de peşti, alogene invazive şi rare din bazinul fluviului Gianh.

Noutatea şi originalitatea ştiinţifică. Pentru prima dată s-a alcătuit o listă completă a speciilor de peşti din bazinul fluviului Gianh şi descrise caracterele morfologice ale taxonilor identificaţi. Au fost analizate particularităţile de distribuţie spaţială a speciilor de peşti din bazinul fluviului Gianh. Speciile au fost sistematizate conform valorii economice, originii şi statutului de raritate naţional şi internaţional. A fost identificate 3 specii noi pentru ştiinţă: *Schistura kottelati* Tuan ş.a, 2015; *Carassioides phongnhaensis* Tu & Tuan, 2003 şi *Cyprinus hieni* Tu & Tuan, 2003.

Problema științifică importantă soluționată în teză constă în actualizarea diversităţii ihtiofaunei şi a particularităţilor de repartiţiei a speciilor de peşti în bazinului fluviului Gianh, ceea ce a condus la elaborarea recomandărilor ştiinţifico-practice, în vederea conservării şi utilizării raţionale a fondului piscicol.

Semnificaţia teoretică. A fost actualizată informaţia ştiinţifică cu privire la diversitatea ihtiofaunei din bazinul fluviului Gianh, inclusiv Parcului Naţional Phong Nha - Ke Bang. Au fost identificate şi descrise 3 specii de peşti noi pentru ştiinţă. Au fost analizate caracterele metrice şi meristice ale speciilor capturate. Informaţia cu privire la speciile de peşti a fost sistematizată conform particularităţilor de repartiţie spaţială, valorii economice, originii şi statutului de raritate desemnat de Lista Roşie naţională şi internaţională (IUCN).

Valoarea aplicativă a lucrării. Rezultatele generalizate au servit ca bază științifică la elaborarea recomandărilor privind protecţia şi valorificarea durabilă a fondului piscicol din bazinul fluviului Gianh.

Implementarea rezultatelor. Rezultatele obţinute la tema tezei au fost implementate în cadrul instituţiilor de profil din Vietnam: Societatea Vânătorilor şi Pescarilor, Departamentul Protecţia Pădurilor, Departamentul Stiinţă şi Tehnologie, iar în procesul didactic la Universitatea Vinh din Vietnam şi Universitatea de Stat din Moldova.

РЕЗЮМЕ

Хо Ань Туан "Ихтиофауна бассейна реки Гйанх из Вьетнама". Диссертация на соискание ученой степени доктора биологических наук. Кишинэу, 2015

Структура работы: введение, 4 главы, выводы, 326 библиографических источников, 150 основных страниц, 20 таблиц, 7 рисунков, 3 приложения (21 страниц, 193 таблиц). По теме диссертации опубликовано 15 работ.

Ключевые слова: Ихтиофауна Вьетнама, таксономический статус, мерестические и метрические признаки, инвазивные виды, промысловоценные виды, устойчивое использование рыбных ресурсов. **Область исследований:** 165.03 ихтиология

Цель: Оценка разнообразия рыб в бассейне реки Гйанх из Вьетнама и разроботка рекомендаций по сохранению и устойчивому использованию рыбных ресурсов.

Задачи работы: Инвентаризация таксономического разнообразия ихтиофауны бассейна реки Гйанх из Вьетнама; описание метрических и мерестических признаков видов рыб в зоне исследований; анализ пространственного распределения, промысловой ценности, происхождения и редкости видов рыб в бассейне реки Гйанх.

Научная новизна и оригинальность. Впервые составлен полный список таксономического разнообразия ихтиофауны бассейна реки Гйанх, описаны метрические и мерестические признаки видов рыб в зоне исследований; анализировано пространственное распределение, промысловая ценность, идентифицированы чужеродные виды рыб, и составлен список редких видов рыб включённых в Красную книгу Вьетнама (2007) и Международный Красный Список (МСОП). Было идентифицировано 3 новых видов для науки: *Schistura kottelati* Tuan и др., 2015; *Carassioides phongnhaensis* Tu & Tuan, 2003 и *Cyprinus hieni* Tu & Tuan, 2003.

Важная научная задача, решённая в данной работе, состоит в том, что было актуализировано видовое разнообразие и особенности распределения видов рыб в бассейне реки Гйанх из Вьетнама, что позволило разработать научно-практические рекомендаций по сохранению и рациональному использованию рыбных ресурсов.

Теоретическое значение работы. Было актуализировано разнообразие ихтиофауны бассейна реки Гйанх из Вьетнама, включительно Национального Парка Фонгня-Кебанг. Идентифицировано 3 новых для науки видов рыб. Описаны метрические и мерестические признаки всех видов рыб в зоне исследований. Информация о видах рыб была систематизирована в соответствии с особенностями пространственного распределения, экономической ценности, происхождения и статуса редкости согласно Красной Книге Вьетнама и Международным Красным списоком (МСОП).

Практическое значение. Полученные результаты послужили научной основой для разработки рекомендаций по сохранению и устойчивому использованию рыбных ресурсов бассейна реки Гйанх.

Внедрение результатов. Результаты исследований были внедрены: Обществом Охотников и Рыболовов Вьетнама, Департаментом по Охране Лесного Хозяйства, Департаментом Науки и Техники, а также в учебной программе Университета Винь из Вьетнама и Молдавского Государственного Университета.

SUMMARY

Ho Anh Tuan "**Ichthyofauna of the Gianh river basin from Vietnam**". Thesis of a Doctor in Biology, Chisinau, 2015. Thesis structere: introduction, 4 chapters, conclusions and recommendations, 326 cited literature, 150 pages, 20 figures, 7 tables, 3 annexes (21 pages 193 figures). The obtained results have been published in 15 scientific works and 3 projects. **Key words:** Vietnam ichthyofauna, taxonomic status, meristic character, metric character, invasive species, economically valuable species, sustainable valorification. **The domain of study**: 165.03. Ichthyology.

Research purpose. Evaluation of the ichthyofaunistic diversity in the basin of river Gianh, and elaboration of recommendations for protection and durable use of fish resources.

Objectives. Inventory of fish fauna diversity in the basin of river Gianh from Vietnam; description of morphometric and meristic characters of the identified species; analysis of spatial repartition; identification of fish species with high economic value, of the invasive and rare alogens ones in the basin of river Gianh.

Novelty and scientific originality. For the first time there has been composed a complete list of fish species from the basin of river Gianh and there have been described the morphological characters of identified taxons. There have been analyzed peculiarities of spatial distribution of the fish species in the basin of river Gianh. The species have been systematized according to their economic value, origin, and national and international status of rarity. There have been identified 3 new species for research: *Schistura kottelati* Tuan et al., 2015; *Carassioides phongnhaensis* Tu & Tuan, 2003 and *Cyprinus hieni* Tu & Tuan, 2003.

The important scientific problem solved in the thesis consists in the actualization of ichthyofauna diversity and the peculiarities of distribution of fish species in the basin of river Gianh which led to the elaboration of scientific-practical recommendations for the conservation and rational use of fisheries.

Theoretical significance. The scientific information about the diversity of ichthyophauna in the basin of river Gianh and the National Park Phong Nha - Ke Bang was updated. There were identified and described 3 new fish species for science. There were analized the metric and meristic characters of the caught species. The information about the fish species has been systematized according to peculiarities of spatial distribution, economic value, and origin and rarity status designated by national and international Red List (IUCN).

Practical value of the work. The obtained results served as scientific basis for developing recommendations for the protection and sustainable use of fish resources in the basin of river Gianh.

Implementation of the results. The obtained results on the topic of the thesis were implemented in specialized institutions of Vietnam: Society of Hunters and Fishermen, Forestry Protection Department, Department of Science and Technology, and also in the teaching process at University Vinh from Vietnam and Moldova State University.

LIST OF ABBREVIATIONS

Dorsal	D	Head depth at nape	Hdn
first dorsal-fin base	D1	Head depth at eye	Hde
second dorsal-fin base	D2	Body depth at anal	Bda
Height of first dorsal-fin base	Hfd	Body depth at dorsal	BdD
Height of second dorsal-fin base	Hsd	Body depth at anal	BdA
Length of base anal fin	Lba	Depth of caudal peduncle	Dcp
Length of base dorsal fin	Lbd	Length of caudal peduncle	Lcp
Length of first dorsal-fin base	Lbdf	Distance of Pectoral to Pelvic	P→V
Length of second dorsal-fin base	Lbds	Distance of Pelvic to Anal	V→A
Anal	A	Head width at nape	Hwn
Pectoral	P	Head width at eye	Hwe
Ventral (Pelvic)	V	Body width at dorsal	Bwd
Caudal	C	Body width at anal	Bwa
Predorsal scales	PrD	1st dorsal spine length	DSI
Circumpeduncular scales	Csc	2nd dorsal spine length	DS2
Total length	TL	3rd· dorsal spirie length	DS3
Stander length	SL	4th dorsal spine length	DS4
Snout length	SnL	1st dorsal ray length	FDR
Eye diameter	Ed	Last dorsal ray length	LDR
1st Eye diameter	Edf	Ist anal ray length	FAR
2nd Eye diameter	Eds	Last anal ray length	LAR
Interorbital width	Iw	Pectoral fin length	PFL
Lateral head length	HL	Pelvic fin length	PVL
Dorsal head length	Dhl	Head depth at pre-eye	Hdpre
Predorsal length	Prdl	Head depth at post-eye	Hdpoe
Postdorsal length	Podl	Dorsolateral line	DLL
Postanus length	Poul	Midlateral	MLL
Preanal length	Pral	Ventrolateral	VLL
Pre-pectoral	Prpl	Supraorbital commissure	SOC
Pre-pelvic length	Prvl	Preopercular	POL
Pre-anus length	Prul	Cephalodorsl line	CDL
Postorbital	Po	Mandibulo-opercular line	MOL
Body depth	Bd	Supraorbital line	SOL

Transverse scales between lateral line and origin of dorsal fin	TSD
Transverse scales between lateral line and origin of pelvic fin	TSV
Transverse scales between lateral line and origin of anal fin	TSA
Last scale on body and first scale on caudal fin	Sc
Lateral line	Ll

INTRODUCTION

Topicality and importance of research. One of the biggest challenges encountered at present by the mankind is "eroding" and continued reduction of biodiversity at all levels of organization and integration of the living world, from the genetic to the specific one, from the ecosystemic to the biospheric one. From 1960 till 2010 the human population increased from 3 to 7 billions, and in order to insure the great needs in food the surfaces of agrocoenoses expanded almost to the half from the total surface of land. If we add to the above said the fierce exploitation of biological resources strongly fragmented such as fishing and hunting, timber extraction, etc. the results of the estimation made by the International Union for Conservation of Nature and Natural Resources – IUCN do not come as a surprise, when they say that 40% of evaluated species (40 thousand species) already appeared on the list of endangered species [324].

It is believed that the changes in the structure of the environment caused by the human activity have an objective reason that is the maintaining of structure and functionality of the human body in a certain comfort zone, often in defiance of the right to life of other creatures in natural conditions. In terms of interspecific relations the human being looks like an amensal constrictor forming various anthropogenic landscapes and degrading the environment as a rapacious predator, often hunting and fishing not only to meet the necesities in food, but also as an imprudent mutualism, favouring allogenic, rare and resistant species which in their turn affect the existence of aboriginal sensitive and less competitive taxa.

However, at global level, the situation began to change for the better. Some well developed states understood that such a tempo the "boomerang effect" becomes immanent, and if there is a need in changes for the benefit of the human being, then all the activities must focus towards the principle of sustainable development and the establishment of mutually beneficial relations with nature.

Fortunately nowadays still exist "cradles of diversity" which still preserve a huge variety of plants and animals, many of which were not identified at species level. As an eloquent example can serve the oriental zoogeographical area (Vietnam is a part of it) which hosts numerous fish species with a high level of endemism and known everywhere as ornamental fish. Already with 1000 years ago there were grown in China these fish for their beauty and diverse forms and varieties of gold fish (*Carassius auratus*) were used actively in artificial selection. In the fresh water ichthyofauna of this region there are known 4 endemic families (*Homalopteridae*, *Pristoleptidae*, *Luciocephalidae* and *Chaudhuriidae*), and for the representatives of orders *Siluriformes*, *Cypriniformes* and *Perciformes* this region became a center of their philogenetic origin.

It is important to mention that the rich ichthyofaunistic diversity of Vietnam is the result of the complex action of ecological, geographical and climate factors (relatively constant temperature, abundant and constant rainfall, systematic flooding on large areas, landscape diversity and sudden changes of altitude, etc.) which conditioned the appearance of numerous ecological niches, being occupied by stenobionte species (cave species, oxy resistant species characteristics for flooding areas, oxyphile and cryophile species of mountain rivers, estuary species, etc.). In this context, one of the key postulates submitted in the thesis is the one which sustains keeping a close connection between the biological and biotopical diversity and it will lead to achieving a sustainable improvement of conservation and sustainable use of the fish stock in the country.

Nowadays the solving of biodiversity problems has a great importance in the conditions of a rise of anthropic influence at local, regional, and world level. The study of the fish resources in the basin of river Gianh is justified both by the insufficient study of this unique macroecosystem from the point of view of specific and hydrobiotopic diversity and the necessity of elaboration of adequate environmental policies with the purpose of protection and sustainable verification of fish resources which can be achieved only through a deep knowledge of the structural-functional ichthyochenoses from the region and their determining factors. There are especially proposed scientific-practical recommendations for protection of ichthyofauna of the National Park Nha - Ke Bang. On that basis, we develop the topic "**Ichthyofauna of the Gianh river basin from Vietnam**".

Aim of the work: Evaluation of the fish fauna diversity in Gianh river basin, completion of the existing scientific information in the field and elaboration of recommendations for protection and long-term use of fish resources.

Objectives:

- Inventory and updating of ichthyofaunistic diversity of Gianh river basin from Vietnam.
- Analysis of morphometric and meristic characters of identified species.
- Cataloguing of fish species according to types of populated aquatic ecosystems and habitats from Phong Nha - Ke Bang National Park.

- Study of peculiarities of spatial and temporal distribution of fish species from Gianh river basin.
- Identification of fish species with high economic value and of the allogenic ones from Gianh river basin.
- Survey of fish species with different status of rarity from Gianh river basin which are included in the Red Book of Vietnam and International Red List (IUCN).
- Evaluation of the state of fish species populations from Gianh river basin, and of the ecological factors with important influence upon their functioning.
- Elaboration of theoretical and practical recommendations for a sustainable verification and adequate protection of fish resources.

Methodology of scientific research.

Works of Freyhof, J., D.V. Serov (2001); Freyhof, J. F. Herder (2002); Hartel K. E., T. Nakabo (2003); Imamura, H., M. Komada (2006); Knapp, Smith, Heemstra (1986); Kottelat, M. (1990, 2000); Mai Dình Yen (1978, 1992); Nakabo T (1982, 1983); Menon A. G. K. (1977); Nguyen Huu Phung (2001); Nguyen Khac Huong (1991, 2007); Nguyen Nhat Thi (1991, 2001); Nguyen Van Hao (2001, 2005); Prokofiev A. M. (2010); (Rainboth, W.J) 1996; Tetsji Nakabo (2002); William P. D. (1966); Yue Peiqi et al (2000); served as methodological and theoretical scientific basis.

Novelty and scientific originality

For the first time there have been completed a list of fish species from the basin of river Gianh and there have been described the morphological characters of identified taxons. There have been analyzed peculiarities of spatial distribution of the fish species in the basin of river Gianh. The species have been registered (catalogued) according to their economic value, origin, and national and international status of rarity. There have been identified 3 new species for science: *Schistura kottelati* Tuan et all, 2015; *Carassioides phongnhaensis* Tu & Tuan, 2003 and *Cyprinus hieni* Tu & Tuan, 2003. There have been identified and catalogued fish species with a diverse national and international status of rarity (IUCN). There have been identified fish species that represent high economic value. There have been attested 3 alien fish species in the ichthyofauna of river Gianh. There have been underlining anthropic factors with important impact on populations of ichthyofauna from the basin of river Gianh.

The important scientific problem solved in the thesis

Consists in the updating of ichthyofauna diversity and the peculiarities of distribution of fish species in the basin of river Gianh which led to the development of scientific-practical recommendations for the conservational and practical use of fisheries.

Theoretical importance.

The scientific information about the diversity of ichthyofauna in the basin of river Gianh and the National Park Phong Nha - Ke Bang was updated. There were identified and described 3 new fish species for science. There were analized the metric and meristic characters of the caught species. The information about the fish species has been systematized according to peculiarities of spatial distribution, economic value, and origin and rarity status designated by national and international Red List (IUCN).

Applicative value of work.

The obtained results served as fundamental basis for developing recommendations for the protection and sustainable use of fish resources in the basin of river Gianh.

The results are significant part of reports on projects

1. Nguyen Thai Tu, **Ho Anh Tuan** (Taxonomy), Ngo Si Van. Conservation of unique and valuable fish diversity in Phong Nha - Ke Bang limestone mountains "RE - VNM - 008". The program was financed by "Asean Regional Centre for Biodiversity Conservation and the Europian Commission". 2003.
2. **Ho Anh Tuan** (Project leader)**.** Nguyen Thai Tu, Hoang Ngoc Thao, The Investigation, study of freshwater systems have economic value in Quang Binh, conservation and adopted. Science and Technology project. Quang Binh province. 2009 - 2011. 2011.
3. **Ho Anh Tuan** (Project leader), Nguyen Thai Tu, Hoang Ngoc Thao Biodiversity survey of fishes in and around the Phong Nha - Ke Bang National park, Quang Binh, Vietnam. Nature Conservation and Sustainable Natural Resource Management in Phong Nha - Ke Bang National Park Region Project, Vietnam, Kredit Anstalt für Wiederaufbau – German Development Bank component. 2011.

The materials of the thesis can be used in the framework of fundamental and applicative studies in the field of ecology, zoology, hydrobiology, and ichthyology. They also can serve as didactic material for such courses as: “Aquatic ecology”, “Zoology of Vertebrata” and some other adjacent disciplines and for dissemination among local people of knowledge about protection and long-term verification of fish resources through instructive courses.

The main scientific results submitted to support.

1. The diversity of ichthyiofauna is in a positive correlation with the diversity of hydrobiotopes and environment gradients established in the ecosystem.
2. The ichthyofauna of river Gianh is unique as to its number of species, share of stenotopic species, and an impressive number of rare species which are important for community and those which were insufficiently studied (DD and NE according to IUCN).
3. In order to efficiently protect a species and to insure the success of its perpetuation in time and space an integral protection of its habitat is necessary.
4. In present ecological conditions it is impossible to omit totally the anthropic factor on fish resources in the region (as a result of continually industrialization, demographics, etc.), but it is possible to find an optimal formula for a less hostile coexistence, and why not, a friendly one.

Implementation of the results.

The obtained results on the topic of the thesis were implemented in specialized institutions of Vietnam: Society of Hunters and Fishermen, Forestry Protection Department, Department of Science and Technology, and also in the teaching process at University Vinh from Vietnam and Moldova State University.

Approvement of scientific results. The results of the thesis were presented and discussed at the following scientist workshops: The problems of basic research in life sciences at the University of Hue in 2003; A number of scientific studies in Biology at the University of Vinh in 2006; The global scientific values of Phong Nha - Ke Bang National Park in Dong Hoi, Quang Binh Province in 2008; The 4th National conference on Ecology and Biological resources in 2009; The 6th National conference on Ecology and Biological resources in 2013; Report on the results of the investigation of biodiversity in Phong Nha - Ke Bang National Park in Dong Hoi, Quang Binh Province in 2012; Report on Biodiversity of freshwater fish in Quang Binh Province by Department of Science and Technology Quang Binh Province in 2012; The 6th National conference on Ecology and Biological resources in 2013.

Publications. The obtained results have been published in 15 scientific works, including: articles in international scientific journals: 2 (an article (Scopus) publishing); Articles in national scientific journals: 5 (2 articles with mono-author publishing); Participation in international conference: 5; Participation in project realization: 3 (2 projects with status project leader).

Volume and thesis structere. The thesis consists of introduction, 4 chapters, conclusions and recommendations, annotations in Romanian, English and Russian, has a basic volume of 150 pages, 326 cited literatures. The thesis is illustrated with 20 figures, 7 tables, contains 3 annexes (21 pages and 193 figures)

Key words: Vietnam ichthyofauna, taxonomic status, meristic character, metric character, invasive species, economically valuable species, sustainable verification.

Summary of thesis components. The introduction reflects the novelty and importance of the approached problem, the goal and objectives of the thesis, methodology of scientific research, scientific novelty of the obtained results, the theoretical importance and applicative value of the work, the main scientific postulates submitted for defence, approving the results, summary of thesis compartments. The thesis comprises four chapters, the first one presenting an analysis of the situation in the field, and the other three reflect the methodical contributions and the results of the research.

Chapter 1. "**Impact of environment factors on diversity and structure of ichthyofauna in continental aquatic ecosystems**"**.** The chapter comprises a bibliographical synthesis of the results of scientific investigations about the diversity, structure and functioning of ichthyofauna in ecosystems of different types. There are elucidated aspects about natural and anthropic factors which influence the diversity, populational structure and distribution peculiarities of ichthyofauna in continental ecosystems. There is reflected the detailed physics-geographical, hydrologic and climatic characteristics of aquatic ecosystems in the basin of river Gianh from Vietnam. A short history of the investigation of ichthyofauna in the aquatic ecosystems from Vietnam is given. Finally the research problems are formulated and principles of their solving are presented, the goal and objectives of the PhD thesis are defined.

Chapter 2. “”Material and methods”. Base on the location and terrain of basin at research area and comments of researcher who study on ichthyology and aquatic biology. We objectively chose locations of research which were relatively equal in distance as well as represented for the characteristics ecosystems in the research area with aims to generating the best results for the thesis. In this chapter, we introduced the methods of sampling, fixing methods of sample, identity methods of sample and the ways of writing diary at fields. Besides, we also introduced the methods of analysis, methods of identification which were used frequently by ichthyologist researchers around the world.

Chapter 3. "Fish biodiversity, distribution characteristics of fish resources in Gianh river basin". We have established a table of composition of fish at all of study sites in the Gianh River Basin with biological criteria for assessing the status of fish fauna, such as, the species of rare fish recorded in the Red List of Vietnam as well as recorded in the IUCN Red List of Threatened Species, economic fishes, imported fishes and dangerous fishes to human and another fish. We also indicated the fish species to be in characterized ecosystems, such as, the ecosystems of cave, field, lakes, brackish water and saltwater as well as in a variety of water body as upstreams, middle stream, downstream and estuary. Factors that affect the distribution of fish, such as spawning migration, migration of foraging from rivers to the sea and back, were also mentioned. We have conducted to compare biodiversity of species in the study area which compared with other basins in north-central area of Vietnam and have conducted to compare morphology of *Carassius auratus* species which distributed in the Gianh River Basin, with those in downstream of Prut River in the Republic Moldova. Based on these results, we have found out the cause of the decline and affect to the biodiversity of fish stocks and provide for measures to protect fishery resources in the study area.

Chapter 4. "Description of basic characteristics of fish resource in Gianh river basin". In this chapter, we briefly described the basic morphological characteristics of 181 species distributed in the Gianh River with detailed information of each species, such as, number of collected samples, number of analysed sample of each species, Synonym of species, Meristics of species, Morphometric of species and characters of distribution of species in areas of sampling in study areas.

1. IMPACT OF ENVIRONMENT FACTORS ON DIVERSITY AND STRUCTURE OF ICHTHYOFAUNA IN CONTINENTAL AQUATIC ECOSYSTEMS

1.1. Diversity of ichthyophauna and ecological peculiarities of fish species in different types of aquatic ecosystems

The diversity, being the fundamental property of the biological form of the matter circuit in space and time, attracts attention of the researchers and, as an object of study, went beyond the purely biological discipline. Currently solving the problems of biodiversity has an utmost importance because together with the development of human civilization the conservation of the biodiversity on Earth is one of the essential conditions of the further existence of the biosphere and the man as biological species, especially in conditions of increasing anthropogenic influence on biosphere and manifestations of local, regional, and global crisis phenomena [3].

The ichthyofauna, as a component part of aquatic ecosystems, interacts mutually, directly or indirectly with other components. The development and spatial distribution of fish species are influenced by a wide range of ecological abiotic and biotic factors. The influence of environmental factors is complex, varied, that is why a quantitative expression of them is quite difficult. The factors which influence the development of ichthyofauna can be divided into abiotic factors (physical, chemical, climatic) and biotic factors (phytogenic, zoogenic and anthropogenic) or the mutual influence of organisms.

Examining the influence of different factors on qualitative and quantitative structure of ichthyofauna, it must be mentioned that these factors' influence is complex. The intensity and concentration of a certain factor can be favourable for a certain species or population in combination with the intensity of some other factors. The notions of "favourable" and "extreme" factors are real for concrete species only at certain values of the parameters of the other factors. Very often the favourable factors for a species from ichthyofauna are limitative for many others.

The UNO Conference for Environment and Development ECO'92 from Rio de Janeiro defines the biodiversity as being "variability among alive organisms of any origin, including among others the terrestrial, marine and other aquatic systems and the ecological complexes to which they belong". The concept of biodiversity means, first of all, all taxa, however it should be understood that there is little research that led to this attribute for an entire biota. Most often there is appreciated the diversity of a certain ecological or systematic group on a certain delimited ecologically area unit (for example the diversity of fish, plankton, benthos from a lake, river, zone, etc.), what we call **α** (alpha) diversity intrabiotopic diversity). It is used mainly to estimate the richness of species in an ecosystem, to evaluate the ratio between the number of species and that of individuals, the share of populations in biocoenose, distribution heterogeneity of populations and taxa, etc. When we compare the diversity of different ecosystems, underlining the degree of similarity between their communities, we speak about **β** (beta) diversity (interbiotopic diversity), and when we characterize the variety on a bigger geographical area (for example a hydrographic basin) we speak about **γ** diversity (sectorial diversity which integrate both α and β diversities) [2].

Biodiversity measuring, although it is a constant preoccupation in studies of biology, ecology and environment protection, represents one of the biggest challenges in this field. This fact is determined by the necessity to inventory the species but also to process the modifications that happen in time and space. Apparently it seems that the number of species is a simple attribute to highlight, which often include cataloguing studies. But never a powerful computer technique or a quantitative study of high precision will replace the skills of a good systematician, it will only help him.

In spite of numerous studies, discussions and polemics, the criteria for delimitation of species, at least under certain systematic groups, remains today a topic of discussions (for example fish from genera: *Schistura, Cyprinus, Carassioides, Carassius, Opsariichthys, Sewellia Macropodus, Glyptothorax, etc* [24], [25], [26], [29], [44], [112]. Along with classical criteria (the morphological criterion and that of reproductive isolation at animals) the modern science provide the researchers with generic and biochemical criteria of great finesse but more difficult to apply in the current practical research. Some of them even question the classical definition of the concept of species. The importance of these theoretical problems for the practice of biodiversity protection is undoubtful but we consider that it should not be exaggerated but cautiously combined because such an exaggeration could lead to a sterile standstill, to a waste of time in theoretical discussions and hence to a delay of necessary and efficient measures for the protection of populations and taxa [2].

Today increased anthropic interference in aquatic ecosystems from Vietnam (multiple hydrobiotopic fragmentation, persistent pollution, overfishing, etc.) caused the extinction of many stenotopic species vitally dependent on the degree of conservation of characteristic habitats. However, globally (but not nationally) the state of things began to change for the better. Some high-developed countries understood that with such a tempo the “boomerang effect” becomes immanent and if modifications of the environment are required (for human well-being), all activities should focus on the principle of sustainable development and ecosystemic approach.

In the past the strategies of traditional conservation of environment were mainly based on a utilitarian philosophy, anchored in the economic value of components of biodiversity which is considered only as a source of goods and services through some visible components, and it was managed in order to maximize the effective of only some species. Currently, however, it is recognized that all components of biodiversity are important [2].

In this context there have been elaborated and ratified a number of international treaties whose new vision on environment led to a reorientation of conservation strategies focused only on, species, biota, and ecological systems. Among the most important international treaties to which Vietnam also acceded which aim at full protection of species and habitats are: Convention on Wetlands of International Importance as Wlidlife Habitats (Ramsar, 1971); Convention concerning the Protection of the World's Cultural and Natural Heritage, 1972; Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1973; The Bern Convention, 1982; United Nations Convention on Law of the Sea, 1982; Convention on the Conservation of Migratory Species of Wild Animals 1983; Vienna Convention for the Protection of the Ozone Layer, 1985; Convention on Early Notification of a Nuclear Accident, 1986; Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, 1989; United Nations Framework Convention on Climate Change, 1992; Convention on Biological Diversity, 1992; United Nations Convention to Combat Desertification (UNCCD), 1994; Stockholm Convention on Persistent Organic Pollutants, 2001

Next we are going to make an ecological classification of fish species according to environment peculiarities in which they live. This classification is not a static and rigid one as there are several considerations regarding this topic but it is useful to study the biology of fish species [308].

Depending on the characteristic of saline gradient of the living environment, the fish are classified in marine species - which populate saline waters; salmastricole - from mesohaline waters and fresh water fish - which live in oligohaline waters. **In relation to the flow rate of the water**, the fish are grouped into reofili - which live in flowing waters and limnofili - which live in stagnant waters. There are species which prefer stagnant waters but they can be met in slow areas of rivers, they being classified as stagnofili-reofili and, vice versa, prefer slow waters but are met in stagnant waters too - reofili-limnofili.

In relation to the populated area in the ecosystem there distinguished coastal species - which live in shallow waters near the coast, pelagic - live in the bulk water and benthonic - which live at the bottom or near it. This classification also does not have a clear delimitation and there appear the subcategory bento-pelagic because individuals of some species in different ontogenetic periods can occupy different stratification zones both vertically and horizontally.

In relation to migrations which they perform during their life cycle, the fish were classified into holobiotic - which migrate in the same environment and amfibiotic - which migrate in different environments.

Depending on territorial origin of species they can be: indigenous (native, aboriginal) or allogeneous (non-indigenous, exotic).

According to reproductive peculiarities there are species which during their life they reproduce only once and die after leaving sexual products, they belong to the monocyclic category of fish and the species which reproduce more than once are called polycyclic. Depending on **type of reproductive migration** we distinguish anadromous species, which live in the sea but for reproduction they migrate to rivers and catadromous species, which spend their life in fresh waters and for reproduction move to saline waters. The species which migrate only within the limits of the lotic ecosystem are considered potamodromous, and the species which reproduce in the same environment where they live are conventionally called generatively sedentary species.

A particular attention is paid to the **age of sexual maturity**. Usually in the case of species with a short life cycle this age is reached very early (1 - 2 years), but at species with a long life cycle the age of sexual maturity is reached even at the age of 16 - 18 years.

According to the way of reproduction, that is according to the nature of the substrate on which the eggs are deposited, the fish are divided into: pelagofili - which spawn eggs in the bulk of water, fitofili - which spawn eggs on vegetation, litofili - on stones, psamofili - spawn eggs on sand, and ostracofili - which spawn eggs in paleal cavity of bivalve molluscs. There are also species with a flexible way of reproduction which spawn on different substrates and are called polifili.

As to the **type of reproduction**, we distinguish species which spawn only once a year - with a single reproduction, and those which spawn in several installments - portioned reproduction (having a long period of reproduction). As a rule, the portioned reproduction is characteristic to species from the south where the vegetative period is long.

According to **the type of nutrition**, that is food preferences, the fish are divided into macro- phytophagous - consume aquatic macrophytes; phyto-planctono phytophagous - eat planktonic algae; zoo- planctono phytophagous - consume planktonic invertebrates; detrito phytophagous - consume organic detritus and periphyton; zoo-bentho phytophagous - consume invertebrates on the bottom; ichthyophagous - eat fish and omnivores - consuming both plant and animal food. There is not a clear delimitation among these categories too, the trophic status being a variable of the age of organism, gravimetric dimensions, accessibility and preferentiality of trophic resources in the ecosystem, the temperature of water, the period of year, the dimensions of ecosystem, position in the area, etc.

Not all species behave similarly to the changes of abiotic gradients, some of them have a bigger degree of tolerance, others do not. In relation to the **water salinity** we distinguish euryhaline species - which can live in high saline waters; species conventionally stenohaline - to which belong mixohaline with an interval up to ≤ 13 ‰ and ahaline species (S ≤ 0,5‰) - stenohaline species which are strictly adapted to fresh water and very sensitive to the salinity more than 0,5 ‰.

Depending on the **degree of tolerance to temperature ranges** we distinguish euriterme species - tolerate large variations of temperature and stenoterme (thermophilic or cryophylic) - adapted to a more or less constant temperature.

In relation to the **requirements to the concentration of oxygen in water** we distinguish stenooxibionte oxifile species - prefer waters with a high concentration of oxygen and eurioxibionte - which can live in different types of gas regime.

In relation to the **life cycle length** we distinguish long-lived species or those with a long life cycle which can reach the age of 100 years; others have a medium life length of approximately 10-15 years; in the third category we mention fish species with a short life length, up to 4, rarely up to 7 years.

Currently, in the freshwater aquatic ecosystems from Vietnam the majority of the fish species belong to categories: eurytopic according to the type of populated ecosystem, fitofili according to the way of reproduction; phytophagous and ichthyophagous according to the type of nutrition; thermophilic, eurioxibionte and mixohaline in relation to abiotic gradients.

1.2. The brief history of research in ichthyofauna of Vietnam

Vietnam passed under aggression wars by the Japanese, the French and American imperialist. Hence, the sciences had the late starting. Like other sciences, ichthyology in Vietnam began from the second half of the eighteenth century, along with the penetration of Western scientists. According to Mai Dinh Yen may divide the development of Vietnamese Fisheries into 3 periods.

Feudal Period to 1954

This period was mainly sporadic knowledge of fish life, breeding, fishery and fish processing were recorded in the history and economists feudal.

This period is mainly the French fishermen and scientists from UK, USA, China. Typical: Sauvage H. E. [294], [295], [296]; Cuvier G., A. Valenciennes [288]; Vaillant L. [301]; Tirant G. [297], [298], [299]; Chabanaud M. P. [280]; Hora S. L. [43]; Chevey P.

[282], [283], [284], [285]; Chevey P., J. Lemasson [286]; Pellegrin J., Chevey P. [290], [291], [292], [293]; Pellegrin J. [289]; Rendahl H. [302]; Tirant G., P. Chevey [300]; Chevey P., F. Le Poulain [287]; Rendahl H. [303]; Chaux J., P. W. Fang [281].

In conclusion of this period, the ichthyology researches were mainly done by the foreign ichthyologists, without the ichthyologists of Vietnam, they studied a lot of morphological classification and fish fauna of the country. Although that was not much and sufficient, it was the foundation to provide Vietnamese ichthyologists documents, methods and approaches to further study.

Period from 1954 to 1975

In this period, the country was under US occupation in the south. Therefore in these years It mainly had staff training and initial construction of infrastructure in the North, in preparation for the construction of the country latter. So this time only a few studies of small nature were done in some places in North: The study of the ichthyology at this stage is enumerated the following:

Dao Van Tien [14]; Dao Van Tien, Mai Dinh Yen [15], [16]; Vo Quy, Mai Dinh Yen, Nguyen Thanh, Le Hien Hao, Tran Gia Huan [260]; Kuronuma K. A [72]; Pham Huy Thu [211]; Nguyen Duy Nhat [119]; Mai Dinh Yen [79]; [80]; Nguyen Van Hao [173], [174], [175], [176], [177]; Hoang Duy Hiep, Nguyen Van Hao [37]; Smith J. L. B. [236]; Nguyen Van Hao, Doan Le Hoa [185], [186], [187]; Tran D. T. [243]; Tran Thi Thu, Duong Tuan, Le Xanh [247]; Doan Le Hoa, Pham Van Doan [19]; Vu Trung Tang [269]; Huynh Nguyen [43]; Kawamoto, Nguyen Viet Truong and Tran Thi Tuy Hoa [49].

In this phase, the research was primarily conducted by researchers of the Institute of Aquaculture Research I and Hanoi synthetic university.

Period from 1975 to present

This period in Vietnam had ichthyologists as: Nguyen Nhat Thi, Bui Dinh Chung, Le Trong Phan, Nguyen Khac Huong, Nguyen Huu Phung, Pham Thuoc, Chu Tien Vinh... studies of marine fish. Mai Dinh Yen, Vu Trung Tang, Nguyen Thai Tu, Nguyen Huu Duc, Vo Van Phu, Nguyen Van Hao, Hoang Duc Dat, Nguyen Xuan Huan ... studied freshwater fish. The study of the domestic and international ichthyologists are enumerated below:

From the period 1975 to 1996: Nguyen Thai Tu [139], [140], [141], [142], [143], [144], [145], [146], [147], [148], [149], [150], [151], [152], [153], [154], [155], [156], [157], Nguyen Thai Tu, Vu Trung Tang [167]; Nguyen Thai Tu, Nguyen Trong Lu. [166]; Nguyen Thai Tu, Nguyen Thi Theu [163]; Mai Dinh Yen described 13 new species: *Sinogastromyzon chapaensis, Sinogastromyzon minutus, Sinogastromyzon rugocauda, Beaufortia buas, Beaufortia daon, Beaufortia elongata, Beaufortia loos, Liniparhomaloptera monoloba,* *Vanmanenia multiloba, Vanmanenia tetraloba, Vanmanenia ventrosquamata, Schistura caudofurca, Schistura orthocauda* [81]; Mai Dinh Yen [82]; Mai Dinh Yen, Nguyen Huu Duc [85]; Mai Dinh Yen, Nguyen Thai Tu [86]; Mai Dinh Yen, Nguyen Van Thien, Le Hoang Yen, Nguyen Van Trong [87]; Mai Dinh Yen, Nguyen Van Trong [88]; Mai Dinh Yen, Vu Trung Tang, Bui Lai, Tran Mai Thien [89]; Nguyen Van Hao [178], [179]; Nguyen Van Hao, Doan Minh Duc, Tran Thi Thu Huong, Nguyen Thi Lai [188]; Nguyen Van Hao, Nguyen Huu Duc [191]; Nguyen Van Hao, Nguyen Ngoc Hiep, Nguyen Duy Hong [193]; Nguyen Xuan Tan, Nguyen Van Hao [208]; Tran Thi Thu Huong [248]; Roberts T. R. [227]; Roberts T. R. [228], [229]; Roberts T. R. described two news species of genus *Osphronemus* in Southeatst Asian [230]; Roberts T. R., M. Kottelat [232]; Nguyen Van Thuan [204]; Tran Nhat Anh, Kharin V. E. [51]; Kottelat M. [55], [56], [57], [59]. Kottelat described new species *Nemacheilus platiceps* to science in Trang Bom Dong Nai province [58]; Chu X. L., M. Kottelat [10]; Nguyen Nhat Thi [137]; Nguyen Khac Huong [133]. Truong Thu Khoa, Tran Thi Thu Huong [250]; Vo Van Phu [261], [262], [263]; [264]; Vu Trung Tang [270]; Pham Thuoc et all [213]; Nguyen H. P., N. T. Nguyen [130]; Nguyen H. P., P. Le Trong, N. T. Nguyen, P. D. Nguyen, N. Do Thi Nhu, V. L. Nguyen [131]; Vidthayanon C., M. Kottelat [254].

From the period 1997 to 1998: Nguyen Huu Duc [121], [122]; Nguyen Huu Duc, Mai Dinh Yen [123]; Nguyen Huu Duc, Nguyen Van Hao [124]; Nguyen Van Hao [180]; Serov D. V. described new species *Sewellia marmorata* to science in Gia Lai & Kon Tum province [234]; Nguyen H. P., N. T. Nguyen, P. D. Nguyen, T. N. N. Do [132]; Nguyen V. L., H. H. Do [200]; Rainboth Walter J. [225]; Nguyen Thai Tu [159]; Vu Trung Tang [271]; Vu Trung Tang, Nguyen Thi Thu He [273]; Ayyapan S. [5]; Kotlyar A. N. described a new species - *Myripristis astakhovi* of the Holocentridae family from Vietnam [54]; Mai Dinh Yen [83], [84]; Roberts T. R. described four new species of the balitorid loach genus *Sewellia* of Vietnam and Laos, including described new species *Sewellia pterolineata* to science in Tra Khuc river Quang Ngai province[231]; Kottelat M. described twenty-two new species in Laos and Vietnam including two new species *Schistura nudidorsum, Schistura obeini* in Lam river Nghe An & Ha Tinh province [61]; Le N. X., P. T. Liem [75]; Kottelat M., H. H. Ng, P. K. L. Ng [70]; Ng H. H., M. Kottelat described six new species of genus *Akysis* Bleeker in Indochina [114]; Ng H. H., M. Kottelat described a new genus *Hyalobagrus* from Southeast Asia [113].

From the period 1999 to 2000: Nguyen Thai Tu [94]; Nguyen Thai Tu, Nguyen Xuan Khoa [94]; Nguyen Thai Tu, Le Viet Thang, Le Thi Binh, Nguyen Xuan Khoa described a new species *Cyprinus quidatensis* in Phong Nha - Ke Bang National Park [160]; Nguyen Thai Tu, Le Viet Thang, Nguyen Xuan Khoa described a new species of genus *Chela* (Hamilton,

1822) [161], [162]; Nguyen Thai Tu, Nguyen Xuan Khoa, Le Viet Thang [164], [165]; described two new species of the genus *Lissochilus* Weber et de Beaufort, 1916 in Phong Nha - Ke Bang National Park [94]; Vu Trung Tang [272]; Machida Y., W. Hiramatsu [78]; Lourie S. A., J. C. Pritchard, S. P. Casey, S. K. Truong, H. J. Hall, A. C. J. Vincent [77]; Khanh P. V., N. Tuan, N.V. Hao, Z. Jeney, T. Q. Trong, N. M. Thanh [50]; Britz R., M. Kottelat described *Sundasalanx mekongensis*, a new species of clupeiform fish in the Mekong basin [6]; Nguyen Van Hao, Vo Van Binh [198]; Nguyen Van Hao, Nguyen Quang Dieu, Nguyen Trong Dai, Tran Viet Vinh [194]; Kottelat M., H. H. Ng described *Belodontichthys truncatus*, a new species of silurid catfish in Indochina [71] Nguyen Nhat Thi defined species component and economic values of Serranidae of Vietnam sea. There are 74 species, 17 genera belong to the Serranidae have been found in Vietnam sea [94]; Nguyen Quoc Nghi [94]; Freyhof J., D. V. Serov described three new species *Sewellia breviventralis, Sewellia patella* in Kon Tum, Gia Lai province and *Schistura melarancia* in Dien Bien province [25]; Ng H. H., M. Kottelat described three new species of catfishes (Teleostei: Akysidae and Sisoridae) from Laos and Vietnam [145]; Kottelat M. described two new species *Schistura athos* in Dien Bien province and *Schistura finis* in Nghe An province [63]; Kottelat M. [62]; Nguyen Thi Thu He [91]; [172]; Vo Văn Phu [91]; Vo Van Phu, Nguyen Truong Khoa [265]; Tuan L. A., J. Hambrey [251].

From the period 2001 to 2002: Freyhof J., D. V. Serov described fourteen new species *Nemacheilus banar, Schistura kontumensis* in Kon Tum province, *Nemacheilus cleopatra, Schistura sokolovi* in Gia Lai province, *Schistura antennata* in Ha Tinh province, *Schistura bachmaensis, Schistura carbonaria, Schistura huongensis* in Thua Thien Hue province, *Schistura dalatensis, Schistura yersini* in Da Lat, Lam Dong province, *Schistura namboensis* in Dac Lac province, *Schistura psittacula* in Quang Tri province, *Schistura susannae* in Quang Nam province, *Schistura thanho* in Binh Dinh province [26]. Freyhof J., F. Herder described *Tanichthys micagemmae*, a new miniature cyprinid fish from Central Vietnam (Cypriniformes: Cyprinidae) [27] and described two species of the genus *Macropodus* in Vietnam [29] and described a new species of *Hemimyzon* in Vietnam [28]; Ng H. H., J. Freyhof described two new species of the catfish genus *Pterocryptis* (Siluridae) in Vietnam [107] and described *Oreoglanis infulatus*, a new species of glyptosternine catfish (Siluriformes: Sisoridae) from central Vietnam [108]; Nguyen Van Hao [181]; Nguyen Van Hao, Ngo Sy Van [189], [190]; Nguyen Van Hao, Nguyen Huu Duc described a new species and one new genus of the family Balitoridae found in Dien Bien - Lai Chau [192]; Nguyen Huu Duc, Nguyen Van Hao [126]; Describe two new species of genus *Pareuchioglanis* in Vietnam [125]; Le Viet Thang, Nguyen Huu Duc [74]; Nguyen Khac Huong [134]; Nguyen Huu Phung [129]; Kottelat M. [64]; Muda O., M. M. Isa, C. T. Vinh, M. T, Mohd Nasir, A.

Zainal [99]; Nguyen Nhat Thi [138]; Crumlish M., T. T. Dung, J. F. Turnbull, N.T.N. Ngoc, H.W. Ferguson [13].

In 2003: Nguyen Huu Duc, Duong Quang Ngoc, Ta Thi Thuy, Nguyen Van Hao defined 132 fish species belong to 94 genus, 35 families and 9 orders were recorded in Ma river in Thanh Hoa province [95]; Nguyen Xuan Huan, Nguyen Viet Cuong, Thach Mai Hoang identified 78 species and subspecies of fish in total belonging to 55 genera, 16 families in Ba Na national reserves and identified 54 species and subspecies of fishes in total belonging to 42 genera, 17 families and 9 orders in in Van Long national reserves [95]. Nguyen Kim Son, Nguyen Khac Do, Phan Van Mach [95]; Le Thi Nam Thuan, Phan Anh [95]; Nguyen Van Luc [95]; Vo Van Phu, Nguyen Thi Phi Loan, Ho Thi Hong identified 108 species of fish belonged to 67 genera 46 families and 13 orders in O Loan lagoon, Phu Yen province [95]; Cao Xuan Hieu, Nguyen Dinh Cuong, Nguyen Thuy Duong, Nguyen Dang Ton, Le Thi Thu Hien, Le Tran Binh, Nong Van Hai, Bui Dinh Chung, Trinh Dinh Dat [95]; Nguyen Thai Tu, Ho Anh Tuan discovered two more new species of Subfamily Cyprininae at Phong Nha Ke Bang. This event makes Phong Nha Ke Bang not only become the genesis center of genus *Cyprinus* but also the center of whole tribe Cyprinini [95]; Nguyen Thai Tu [158]; Nguyen Thai Tu, Nguyen Thi Huong, Nguyen Thi Hong Ha [92]; Vo Van Binh, Nguyen Quang Dieu, Chu Duy Thinh [92]; Hoang Duc Dat, Thai Ngoc Tri, Nguyen Xuan Thu [92]; Nguyen Van Hao, Do Van Binh [184], [92]; Nguyen Thi Thu He [92]; Nguyen Van Tuong et al [92]; Ngo Sy Van described two new species: *Danio trangi* and *Cobitis ylengensis* the Phong Nha - Ke Bang Quang Binh [117]; Ngo Sy Van, Pham Anh Tuan [92]; J. Freyhof described *Sewellia albisuera*, a new balitorid loach in Central Vietnam [24]; Ng H. H., J. Freyhof described *Akysis clavulus*, a new species of catfish from central Vietnam [109]; Gustiano, Trugels, Pouyaud [31]; Long D. N. [76]; Murdy E. O., K. Shibukawa described *Odontamblyopus rebecca*, a new species of amblyopine goby from Vietnam with a key to known species of the genus *Odontamblyopus* [100]; Van Quan N. [202]; Winterbottom R. described *Feia ranta*, a new species of gobiid fish from Vietnam [276]; Nguyen Van Kiem [92].

In 2004: Kottelat M. described *Schistura spekuli*, a new species of cave fishes in Northern Vietnam [66] and described two new genera and two new species Vietnam [65]; Ng H. H., M. Kottelat described *Amblyrhynchichthys micracanthus*, a new species of cyprinid fish in Indochina [116]; Ng H. H. described two new Glyptosternine catfishes from Vietnam [103]; Prokofiev A. M. described *Amblypomacentrus vietnamicus* a new damselfish from the South China Sea [214]; Vu Thi Phuong Anh, Vo Van Phu finded 71 fish species belonged to 49 genus, 19 families and 9 orders of the ichthyofauna in Phu Ninh lake [96]; Nguyen Huu Duc, Duong Quang Ngoc, Nguyen Thi Nhung defined 94 species belong to 68 genus, 24 families and 9 orders were recorded in Chu river, Thanh Hoa province [96]; Nguyen Van Hao, Nguyen Huu Duc described two new species of Genus *Macropodus* Lacépède, 1802 in Vietnam [96]; Thach Mai Hoang, Nguyen Xuan Huan defined 32 species of freshwater fish, wich belong to 9 families and 5 orders in Thang Hen [96]; Nguyen Xuan Huan, Doan Huong Mai, Hoang Thi Hong Lien finded 117 species belonging to 44 families of 11 diffenrent orders in Quang Ninh province [96]; Le Trong Phan [96]; Vo Van Phu, Ho Thi Hong identified 101 fish species belonged to 74 genus, 45 families and 13 orders of ichthyofauna Sot estuary, Ha Tinh province [96]; Vu Trung Tang, Ngo Quang Du defined 133 fish species of 43 families belonging to 13 fish orders from Thai Thuy district, Thai Binh province [96]; Quyen Dinh Thi, Dao Thi Tuyet, Pham Anh Tuan [96]; Nguyen Nghia Thin, Le Vu Khoi, Nguyen Xuan Huan, Nguyen Xuan Quynh, Nguyen Xuan Quang, Ngo Si Van, Dang Thi Dap defined 118 species, 25 families 9 orders of fishes Phong Nha - Ke Bang National Park [96]; Ho Anh Tuan, Le Van Duc, Hoang Xuan Quang defined 109 fish species in mangroves of Hung Hoa and in Lam estuary, which belong to 78 genera, 46 families and 16 orders [34].

From the period 2005 to 2006: Nguyen Hong Nhung [120]; Tong Xuan Tam [241]; Nguyen Van Hao [182]; Chen I. S., M. Kottelat described four new freshwater gobies of the genus *Rhinogobius* in Northern Vietnam [9]; Ng H. H., J. Freyhof described a new species of *Pseudomystus* from Central Vietnam [110]; Vu Phuong Anh, Vo Van Phu, Nguyen Hoang Ngoc Tan identified 83 species belonged to 59 genus, 34 families and 10 orders of the ichthyofauna in Tam Ky river, Quang Nam province [97]; Nguyen Huu Duc, Duong Quang Ngoc recorded 64 fish species arranged in 48 genera, 19 families and 6 orders in Buoi river of Thanh Hoa province" [97]; Nguyen Thi Hoa, Nguyen Huu Duc recorded 70 fish species arranged in 33 genera, 13 families and 5 orders in Sap (Yen Chau district) and Mu (Muong La district) stream, Son La province [97]; Nguyen Xuan Huan, Thach Mai Hoang found 69 species belonging to 36 families of 11 different orders in the estuarine and coastal area, Tien Lang distric, Hai Phong city [97]; Vo Van Phu, Phan Do Quoc Hung collected 121 species belonged to 85 genus, 43 families and 13 orders of the ichthyofauna in Huong river, Thua Thien Hue province [97]; Nguyen Kim Son, Ho Thanh Hai collected 66 species belonging to 25 families, 9 orders in the National park U Minh Thuong [97]; Nguyen Anh, Do Van Thu, Nguyen Thuan Loi, Do Hoai Chau, Vo Thi Ninh, Le Xan, Pham Van Thin, Vu Dinh Thuy [97]; Nguyen Thi Cam Hoang, Le Thi Nam Thuan [97]; Nguyen Huu Phung, Tran Thi Hoa Hong, Tran Thi Le Van, Dao Tan Ho, Pham Thi Du, Cao Van Nguyen defined species composition of poisonous marine products that can cause a number human deaths with 21 species of fish in family Tetraodontidae in the coastal waters of Southern central Vietnam [97]; Le Thi Nam Thuan, Nguyen Ngoc Sang [97]; Nguyen Thai Tu, Nguyen Thi Thu Huong, Nguyen Thi Thu Ha, Nguyen Le Ai Vinh [97]; Astakhov D. A., A. N. Kotlyar [4]; Motomura

H., S. Tsukawaki described new species of the threadfin genus *Polynemus* from the Mekong River Basin Vietnam, with comments on the Mekong species of *Polynemus* [98]; Ng H. H., H. H. Tan described *Pseudecheneis maurus*, a new species of glyptosternine catfish from Central Vietnam [106]; Nguyen N. T., V. Q. Nguyen [203]; Imamura H., M. Komada, T. Yoshino [45]; Duong Quang Ngoc, Nguyen Huu Duc, Tran Duc Hau, Ta Thi Thuy described two new fish species of the genus *Toxabramis* Gunther, 1873 from Vietnam [21]; Ho Anh Tuan, Le Van Duc, Hoang Xuan Quan defined new data of distribute genus fish *Esomus* Swainson, 1839 in north middle Vietnam; Hoang Xuan Quang, Ho Anh Tuan, Ngo Sy Van, Cao Tien Trung, Hoang Ngoc Thao, Nguyen Le Ai Vinh, Ong Vinh An [40].

From the period 2007 to 2008: Ng H. H., J. Freyhof described *Pseudobagrus nubilosus*, a new species with notes on the validity of *Pelteobagrus* and *Pseudobagrus* from central Vietnam [111]; Dinh T. D., M. A. Ambak, A. Hassan, N.T. Phuong [17]; Nguyen Xuan Khoa, Nguyen Huu Duc described a new species of genus *Schistura* from Pu Mat National Park, Nghe An Province, Vietnam [206]; Nguyen Huu Quyet, Vo Van Phu [259]; Nguyen Xuan Dong, Hoang Duc Dat, Nguyen Xuan Thu [255]; Thai Ngoc Tri, Nguyen Xuan Dong, Nguyen Xuan Thu, Hoang Duc Dat defined 30 fish species belonging to 16 families and 5 order in Nui Chua National Park Ninh Thuan Province [255]; Nguyen Kiem Son [255]; Ho Anh Tuan, Hoang Xuan Quang defined 92 fish species found in Con river basin, which belong to 57 genera, 18 families and 15 orders in Con river, Nghe An province [255]; Ho Anh Tuan, Hoang Xuan Quang, Le Van Duc, Dinh Duy Khang [259]; Nguyen Huu Quyet, Vo Van Phu [255]; Nguyen Kiem Son, Ho Thanh Hai defined 107 species, belonging to 31 families, 9 orders and 9 species of this fauna is in red book of Vietnam in Vu Gia - Thu Bon rivers [259]; Hoang Thi Long Vien, Vo Van Phu defined 145 fish species belong to 102 genera, 49 families and 14 orders in ecosystem of Bo river, Thua Thien Hue province [259]; Duong Quang Ngoc, Nguyen Huu Duc, Tran Duc Hau described new species of fish belonging to of subgenus *Spinibarbichthys* in Vietnam [22]; Do Thi Nhu Nhung [18]; Nguyen Khac Huong [135]; Nguyen Van Luc, Le Thi Thu Thao, Nguyen Phi Uy Vu [201]; Duong Quang Ngoc [20]; Conway K. W., M. Kottelat described *Araiocypris batodes*, a new genus and species of cyprinid fish from Northern Vietnam [12]; Ng H. H., J. Freyhof described two new species of *Glyptothorax* from central Vietnam [112]; Hoang Xuan Quang, Le Van Son, Nguyen Huu Duc identified 85 species belong to 55 genera, 20 families, 9 orders in Thanh Hoa Northeastern [41]; Tran Kim Tan, Hoang Xuan Quang, Ho Anh Tuan, Nguyen Huu Duc, Ngo Si Van identified 107 species belonging to 86 genera, 33 families and 9 orders from Yen river basin in Thanh Hoa province [245]; Nguyen Thi Hoa, Mai Dinh Yen, Nguyen Huu Duc [169]; Nguyen Thai Tu, Ho Anh Tuan; Vo Van Phu, Tran Thuy Cam Ha [266]; Prokofiev A. M. described a new species of *Platygobiopsis* from Vietnam [216]; Prokofiev A. M. [217], [218], Prokofiev A. M. described a new species of eel catfishes of the genus *Plotosus* from Nha Trang Bay South China Sea, central Vietnam [215] and described a new species of genus *Aulopus* from waters of Vietnam [219].

From the period 2009 to 2010: Tong Xuan Tam, Nguyen Huu Duc [242]; Ng H. H. described *Tachysurus spilotus*, a new species of catfish from central Vietnam [104]; Le Thi Thu Thao, Nguyen Phi Uy Vu were 128 species of fishes belonged to 91 genera, 54 families and 16 orders at coastal wetlands of Quang Nam province [256]; Ho Anh Tuan, Hoang Xuan Quang, Nguyen Van Giang, Mai Thi Thanh Phuong, Nguyen Huu Duc identified 6 species of genus *Acheilognathus* Bleeker, 1859 in the north central Vietnam; Nguyen Van Quan [256]; Thai Ngoc Tri, Hoang Duc Dat identified 88 fish speices belonging to 26 families and 10 orders in Lo Go - Sa Mat national park, Tay Ninh province [256]; Le Hung Anh, Nguyen Kim Son, Tran Duc Luong, Do Van Tu, Nguyen Dinh Tao, Duong Ngoc Cuong [256]; Nguyen Xuan Dong [256]; Nguyen Kiem Son recorded 91 species of fish belonging to 23 families and 7 oders in waters of Xuan Son national park and adjacent areas and fish species composition in upstream and mid-stream sections of Dong Nai river under influence of hydropower dams [256]; Ho Anh Tuan, Nguyen Van Giang, Mai Thi Thanh Phuong, Hoang Xuan Quang studied morphological features supplement of species on genus - *Hemiculter* Blekeer, 1859 in northern central Vietnam; Hoang Xuan Quang, Cao Tien Trung, Ho Anh Tuan, Le Nguyen Ngat, Nguyen Huu Duc, Hoang Ngoc Thao, Ong Vinh An [39]; Havird J. C., L. M. Page described two new species of *Lepidocephalichthys* from Thailand, Laos, Vietnam, and Myanmar [33]; Nielsen J. G., A. M. Prokofiev described a new, dwarf species of *Grammonus* found of Vietnam [209]; [221], and described two new species of the genus *Cocotropus,* two new species of fishes from Families Muraenidae and Mugiloididae from the waters of Vietnam [222], [223] and described a new species of *Lubricogobius* from Nha Trang Bay, Vietnam [220]; Nguyen V. H., T. H. Nguyen B. C. Mua described a new fish species of the *Danio* was found in the Ky Son district, the Northern Central province of Nghe An, Vietnam [196]; Bui T. M., L. T. Phan, B. A. Ingram, T. T. T. Nguyen, G. J. Gooley, H. V. Nguyen, P. T. Nguyen, S. S. de Silva [7]; Nguyen Thi Hoa, Nguyen Van Hao, Hoang Thanh Thuong described two new species of *Oreias* discovered in Son La city, Vietnam [170]; Vu Thi Phuong Anh, Vo Van Phu [268]; Nguyen Thi Phi Loan, Vo Van Phu, Vu Trung Tang [171]; Vu Thi Phuong Anh [267]; Nguyen Minh Ty [136].

In 2011: Ng H. H., D. K. Hong, N. V. Tu described *Clarias gracilentus*, a new walking catfish from Vietnam and Cambodia [105]; Karmovskaya E. S. described *Bathycongrus parviporus* a new species from waters of Central Vietnam (Nha Trang and Van Phong bays) [48]; Nguyen Van Hao described two new species belong to genus *Channa* discovered in Ninh Binh province from Vietnam [183]; Nguyen Xuan Huan, Nguyen Lien Huong found 93 species belonging to 43 families of 11 differrent orders in the area of Ha Coi estuary Quang Ninh province [257]; Mai Thi Thanh Phuong, Nguyen Van Giang, Hoang Xuan Quang, Nguyen Huu Duc found 123 species and 94 genera in 49 families and 12 orders in Gianh river, Quang Binh province [257]; Nguyen Dinh Tao identified in this area belonging to 17 families and 7 orders in Huong Son, My Duc, Ha Noi [257]; Le Thi Thu Thao identified 92 species names belonging to 15 genera of family Lutjanidae in different ecological areas of Vietnam sea [257]; Nguyen Vinh Hien identified 100 fish species belonging to 78 genera, 45 families and 12 orders of Ben Hai river system, Quang Tri province [257]; Vo Van Phu, Nguyen Hoang Dieu Minh, Hoang Dinh Trung recorded 81 species belonging to 55 genera, 18 families and 6 orders in Tra Bong area of Quang Ngai province [257]; Dinh Minh Quang, Ly Tuan Cuong, Pham Thi Le Trinh, Huynh Thi Truc Ly, Lam Hung Khanh, Vo Thi Thanh Quyen, Dang Thanh Thao, Nguyen Thi Be Tho, Nguyen Van Tuyen, Nguyen Thi Kieu Tien recorded 55 species belong to 36 genera, 21 families and 12 orders in Hau river basin, Can Tho province [257]; Nguyen Duy Thuan, Vo Van Phu, Vu Thi Phuong Anh recorded 109 species belonging to 76 genera, 31 families and 11 orders species in O Lau river, Thua Thien Hue province [257]; Thai Ngoc Tri, Hoang Duc Dat recorded 78 fish species belong to 20 families and 7 orders in the Yok Don national park [257]; Thai Ngoc Tri, Hoang Duc Dat, Nguyen Van Sang recorded 43 fish species belonging to 17 families and 8 orders in Tra Su cajeput forest landscape protected area, An Giang province [257]; Vo Van Quang, Tran Thi Le Van, Tran Cong Thinh [257]; Tran Van Trong, Tran Van Bang [257]; Ho Anh Tuan, Hoang Xuan Quang, Nguyen Huu Duc recorded 192 fish species of 128 genera, 56 families and 14 orders are in Thach Han basin Quang Tri province [257]; Tran Dac Dinh, Huynh Thao Tran [257]; Nguyen Xuan Dong [257]; Vo Van Quang, Tran Thi Le Van, Doan Nhu Hai [257]; Luong Thi Bich Thuan, N. G. Emel’yanova, D. A. Pavlov [257]; Mai Viet Van [257]; Nguyen Xuan Khoa, Nguyen Huu Duc described new species of genus *Neodontobutis* from Khe Khang stream in Pu Mat national park [207]; Ta Thi Thuy, Do Van Nhuong, Tran Duc Hau, Nguyen Xuan Huan [238]; Ho Anh Tuan, Nguyen Thai Tu, Nguyen Duy Duong, Hoang Quoc Dung, Le Van Đuc identified 172 species of 131 genera, 59 families and 14 orders in Nhat Le river - Quang Binh province [35]; Nguyen Thi Hoa [168]; Tong Xuan Tam [240]; Nguyen Xuan Khoa [205].

From the period 2012 to present: Shibukawa K., D. D. Tran, L. X. Tran described *Phallostethus cuulong*, a new species of priapiumfish from the Vietnamese Mekong [235]; Nguyen Van Hao, Nguyen Thi Hanh Tien, Nguyen Thi Dieu Phuong described a new fish species of the walking snakehead group, the genus *Channa* in Vietnam [197]; Kottelat M. described *Draconectes narinosus*, a new genus and species of cave fish from an Iceland of Halong Bay, Vietnam [67], [68]; Vasil'eva E. D., V. P., Vasil'ev [252]; Nguyen Van Hao, T.

H. T. Nguyen, V. T. Do, T. D. P. Nguyen described three new species in *Opsariichthy* collected from Dakrong district, Quang Tri province, Vietnam [195]; Nguyen Van Hoang, Nguyen Huu Duc [199]; Ho Anh Tuan, Nguyen Thuc Tuan identified 138 species of 99 genena of 49 families of 16 orders in Lam estuary in Nghe An province [36]; Ta Thi Thuy [237]; Vasil'eva E. D., V. P. Vasil'ev described two new species of Cyprinoid fishes from the fauna of Phu Quoc Island, Gulf of Thailand, Vietnam [253]; Huynh T. Q., I. S. Chen described a new species of cyprinid fish of genus *Opsariichthys* from Ky Cung - Bang Giang River basin, Northern Vietnam with notes of the taxonomic status of the genus from Northern Vietnam and Southern China [44]; Karabanov D. P., Y. V. Kodukhova described *Pseudorasbora parva* a new species in the ichthyofauna of Vietnam [47]; Nguyen Xuan Huan, Nguyen Thanh Nam, Nguyen Thi Mai Dung identified 111 fish species representing 45 families and 15 orders in Ba Lat estuary [258]; Tran Thi Hong Hoa described the family Diodontidae is currently represented by 6 species belonging to 3 genera [258]; Ho Anh Tuan, Ludmila Victorovna Cepurnova, Nguyen Thi My Yen, Hoang Xuan Quang, Hoang Ngoc Thao [258]; Nguyen Dinh Tao, Hoang Thi Thanh Nhan identified 122 species belonging to 46 families and 13 orders in Ba Lat estuary and Xuan Thuy national park, Nam Dinh province [258]; Nguyen Van Quan [258]; Vo Van Quan [258]; Dinh Minh Quang, Le Thi My Xuyen, Nguyen Minh Thanh, Tran Thi Lua, Duong Hong Vi [258]; Vo Van Thiep [258]; Le Thi Nam Thuan, Ngo Thi Huong Giang [258]; Le Thi Nam Thuan, Nguyen Thanh [258]; Dang Do Hung Viet [258]; Ngo Thi Mai Huong, Nguyen Huu Duc [118]; Nguyen Huu Duc, Tran Duc Hau, Ta Thi Thuy described a new species of genus *Acheilognathus*, Bleeker, 1895 from the Tien Yen river, Vietnam [128]; Tran Dac Dinh, Shibukawa Koichi, Nguyen Thanh Phuong, Ha Phuoc Hung, Tran Xuan Loi, Mai Van Hieu, Utsugi Kenzo [244]; Hoang Ngoc Thao, Tran Vo Thi Hoai, Nguyen Thi Huyen, Ho Anh Tuan [38]; Nguyen Huu Duc, Pham Thi Hong Ninh, Ngo Thi Mai Huong [127].

It can be said that this period, Vietnamese ichthyology actually achieved certain results, including the quantity and quality. Besides it also trained many researchers such as: Nguyen Thi Thu He (2000); Duong Quang Ngoc (2008); Nguyen Thi Phi Loan, Vu Thi Phuong Anh, Nguyen Minh Ty (2010); Nguyen Xuan Khoa, Nguyen Thi Hoa, Tong Xuan Tam (2011); Ta Thi Thuy (2012).

The remarkable thing about the study of fish in the Gianh river basin, in recent years Nguyen Thai Tu and colleagues 1997 published 72 species of fish distributing in the Phong Nha - Ke Bang, but in which 13 species were not identified [92]. By the years 1998 - 2001, the scientist team of the Institute of Ecology and Biological Resources of Vietnam Academy of Science and Technology studied in the Phong Nha - Ke Bang National Park and announced 75 species of fish distributed here including 8 species were not identified [92]. In 2002 - 2003, Ngo Sy Van, Tran Anh Tuan published 121 fish species distributed in the Phong Nha - Ke Bang National Park, in which there were 23 species still unidentified [92]. At the same period, Nguyen Thai Tu published 162 species and 58 unidentifiable species in this area [158]. By the years 2011 in the mainstream of Gianh river basin, Mai Thị Thanh Phuong, Nguyen Van Giang, Hoan Xuan Quang, Nguyen Huu Duc recorded 123 fish species and 6 unidentifiable species [257]. However in this study there still remains some problems in terms of classification. For examples, fish genus *Schistura* consisted 8 species: *Schistura aramis* Kottelat, 2000; *Schistura carbonaria* Freyhof & Serov, 2001; *Schistura huongensis* Freyhof & Serov, 2001; *Schistura hingi* (Herre, 1934); *Schistura psittacula* Freyhof & Serov, 2001 *Schistura susannae* Freyhof & Serov, 2001; *Schistura fasciolata* (Nichols & Pope, 1927; *Schistura* sp. in the Gianh river basin but 1 species not yet identified. Meanwhile, Freyhof & Dmitri V. Serov reported that genus *Schistura* the Gianh river basin includes 2 species: *Schistura hingi* and *Schistura pervagata* [26]. Comparing to results of Mai Thi Thanh Phuong et al, it is showed that the research on fish species in mainstream of the Gianh river basin still have problems in terms of classification. These studies showed that the nomenclature classification system is not unified between fish composition in the Gianh river basin and other fish fauna in Vietnam, and also national and international ichthyologists studying fish fauna in the Gianh river basin.

1.3. The natural conditions of ichthyofauna in Gianh River Basin

1.3.1. Geographical location

The Gianh river basin is located in Quang Binh Province in Vietnam’s North Central Coast. North Central region ranges from Thua Thien Hue province in the south to Thanh Hoa province in the north, with geographical coordinates from $16^{0}13'$ to $20^{0}40'$ north latitude and $104^{0}25'$ to $108^{0}10'$ east longitude. Whole area is 51500 km^2 wide. The terrain is divided into three regions: the plain, midland and mountainous areas. The Gianh river is 158 km long and the basin area approximately 4680 km^2. It is derived from the coastal area of the Co Pi mountain which is 2.017 m height and belongs to Truong Son range. It flows through the territory of Minh Hoa, Tuyen Hoa, Quang Trach districts [326]. In addition to the main line, there is a tributary river called the Con river (Son river) in the south with many underground rivers and caves originate in Thuong Trach commune, Bo Trach district and flows through the Phong Nha - Ke Bang National Park then confluence with the main stream in Quang Thuan commune, Quang Trach district and reach into the East Sea at Gianh River Estuary.

Particularly, the Con river is located in The Phong Nha - Ke Bang National Park which was officially recognized by UNESCO as a world heritage site on 07/02/2003. It is in the Bo Trach district and Minh Hoa district of central Quang Binh Province, about 50 km northwest of the Dong Hoi city and about 500 km south of Hanoi. The park borders the Hin Namno Nature Reserve in the Khammouane Province, Laos to the west, and 42 km east of the South China Sea from its borderline point [322].

The Phong Nha - Ke Bang National Park is situated in a limestone zone of 200.000 hectare in Vietnamese territory and borders another limestone zone of 200.000 hectare of the Hin Namno in Laotian territory. The core zone of this national park covers 857.54 km^2 and a buffer zone of 1.954 km^2 [322].

In August 2013, the Prime Minister has decided to expand this national park to 1233.26 km^2. The park was created to protect one of the world's two largest karst regions with 300 caves and grottoes and also protects the ecosystem of limestone forest of the Annamite Range region in North Central Coast of Vietnam. The Phong Nha - Ke Bang National Park is noted for 300 caves and grottos underground rivers and rare flora and fauna in the Vietnam Red Book and World Red Book. The length of the cave system is more than 80 km, but British and Vietnamese explorers only discovered about 20 km, in which there is 17 km in Phong Nha and the rest with 3 km in the Ke Bang area [322].

In April 2009, the Son Doong cave was re-discovered by a team of British cave explorers of the British Caving Association as known as the world's largest cave (5 kilometres in length, 200 meters high and 150 meters wide), overtakes Deer Cave in Malaysia and 4 to 5 times larger than the Phong Nha. In this survey, the cave British explorers also discovered other new caves.

In addition, the Son River tributary, where the Phong Nha - Ke Bang National Park locates, is attracted almost tourists, especially foreign tourists. Therefore, demand of high quality of ecosystem and food supply, especially fish resources for tourism services are increasing. People live in the Gianh river sides are mainly ethnic minorities, so that the lives of people here are mostly self-sufficient, rely on forest and river. Their literacy level is low so that their methods of exploiting natural products especially fishing are primitive, mainly using destructive methods.

Quang Binh is a province along Vietnam's North - Central coast. The province has an area of 8,037,6 square kilometres km^2. The province is located at the coordinates: The northernmost point: 18^0 5'12 N; The southernmost point: 17^0 5'02 N; The westernmost point: 106^0 59'37 E; The westernmost point: 105^0 36'55 E. Quang Binh Province's sea area includes continental shelf and special economic area up to 20,000 km^2. There are five islet: Hon La islet, Hon Gio islet, Hon Nom islet, Hon Co islet, Hon Chua islets. It borders Ha Tinh Province on the north with the Ngang mountain pass as the natural frontier, Quang Tri province to the south, Laos to the west with the the border of 201.87 km long, and faces the

Dong Sea to the east with 116.04 km long coast. In terms of administrative organization, Quang Binh has 4 districts and 1 city adjacent to the sea: Quang Trach, Bo Trach, Quang Ninh, Le Thuy, Dong Hoi city and two mountainous districts: Tuyen Hoa and Minh Hoa. Quang Binh Province is in North Central Coast, has small deltas with natural land area is 805,200 ha, mostly mountainous area occupied 150,000 ha and sandy coastal area occupied 58,743 ha [73].

1.3.2. Topographical features

The provincial topography is generally quite complex, lower from west to east. The west is eastern side of the majestic Truong Son range was enhanced over times of orogenic tectonic movement, creating a series of peaks over 1000 m. Towards the east, the terrain is lower, but due to the narrow width, the slope is relatively large. Hills and mountains extend many branches to the sea that narrowed a significant portion of the area of the coastal plain. In terms of the structure, Quang Binh can be divided into 4 varied terrain areas:

Mountains: includes average terrain and low mountains which are mainly distributed in the western territory with an area of about 522,624 hectares, accounting for 65% of the natural area, lower from west to east and from north to south. This mountainous terrain of the eastern side of the Truong Son range from height 250 m to 1500 m, including mountain area mainly 500 - 600m height were composed of slate rocks, metamorphic rocks, sandstone powder with water line forming, the slopes are relatively comfortable. In contrast the mountains with average height above 1000 m are usually composed of intrusive rocks such as Cotarun peak (1624 m), Ba Ren (1137 m), U Bo (1009 m) . The surface of water division is rather complex, peaks are sharp, slopes are downhill. Overall, the average slope of the mountain is 250 and average split depth is 250 - 500m. One of the traits of the mountains in Quang Binh is the wide distribution of topographic cacxto with Ke Bang and Khe Ngang massive limestone blocks which are located close to the border with Vietnam-Laos and have the developed underground river system. Quang Binh cacxto topography lurks in most beautiful and longest caves in the country and has special value for tourism as Phong Nha Cave with 7.729 m length and 83 m average depth. There are also many other caves: Dark Cave (5258 m long), Arch Cave (5050 m), Thung Cave (3351 m), Tien Ong Cave (2500 m) [274].

Midlands: area is 161,775 ha occupied about 20% of the natural area, with height from 50 - 250 m, the average slope is 3-80, distributed mostly in the districts, they run along the major river and valleys (such as Rao Nay, Kien Giang) and lie in a transition between the low mountains to the coastal plain. Because it is composed mainly by the terrigenous sedimentary, metamorphic, strongly affected by the process of denudation so terrain has soft forms, often exist as independent hills or low hills form. This also has the Ho Chi Minh route runs through the area and investors should focus economic development of the province [274].

The coastal plain: an elevation of 15 m or less with about 88.561 ha area accounted for 11% of the natural area in the province. Here is the plain having abrasive and deposition origin mainly distributing in Le Thuy, Quang Ninh, Dong Hoi, Bo Trach, Quang Trach districts. This is also the locality of concentration of population and favorable for the development of food crops, especially rice.

Coastal sand dunes: Stretching along the coast from foot of Deo Ngang (Quang Trach) to Mui Lay (Le Thuy) over 126 km in length, which is most concentrated in two districts of Quang Ninh and Le Thuy. The area of sand about 32.140 ha accounted for 4% natural area in the province. This dune height varies from 2 - 3 meters to 30 - 40 m, the widest place is 7km, larges slopes, strongly affected by the action of wind and water leading to sand blowing and sand filling in the fields, roads make it difficult to manufacture and transportation. This is also the area need to be invested in planting sand shielding forest and developing economic models of sandy area which is considered to be harsh but the has economic potential of the province [274].

1.3.3. Climate features

Quang Binh belongs to Truong Son South East climate, geographical location stretches on a macro level, from 17^0 to 18^0 East latitude and from $105^0$35’ to 107^0 east longitude. North is blocked by Hoanh Son range, west is Truong Son range, east is the Sea, and the south borders with Quang Tri province. Located entirely within Truong Son range but occupied the northernmost position of Eastern climates so Quang Binh has Truong Son climate regime demonstrates how the transition between climatic northern and eastern Truong Son. Despite it has relatively high temperature, but is still affected by the tropical atmosphere, Quang Binh province has slightly cold winter, temperatures differentiation is still pretty big in the year. There is abundant moist, but due to geographical location and terrain conditions, the rainfall is very clear differentiation in year. The rainy season last from late summer to autumn and early winter with huge rainfall due to the influence of the northeast monsoon combined with heavy rain causing disturbances such as hurricanes, tropical depression, tropical convergence ... leading to excess water, even causing flooding and inundation. During the second half of winter, and even from the early to mid-summer, due to the hot dry wind to water shortages, droughts are quite severe. Quang Binh is one of places in our country is quite heavily influenced by the weather such as storms, heavy rain caused flooding; hot dry winds cause drought. Due to its transitional position, the climate Quang Binh strong volatility, expressed most clearly in temperature regime in winter and rainy summer regime [212].

1.3.4. Hydrological characteristics

Quang Binh has thick hydrographic network, with great potential for hydroelectric power, irrigation, fisheries and transport. Quang Binh river density is approximately 0.6 - 1,85 km / km^2. River network is not evenly distributed; river density tends to decrease from west to east. The mountainous region river density reached 1 km/km^2, coastal areas from 0,45 - 0,5 km/km^2. Quang Binh has five major river basins, basin area of 7977 k m^2 and with a total length of 343 km and end up in the East Sea. From north to south, there are: Ron Rivers, Gianh river, Ly Hoa river, Dinh river and Nhat Le river. In which Gianh river is the largest river with length of 158 km and basin area of 4680 km^2. There are about 160 natural and artificial lakes with an estimated capacity of 243.3 million m^3. Based on the findings of rain, flow, evaporation, the geological characteristics of lithology, topography, soil cover, it is showed that Quang Binh water is plentiful. The flow is not evenly distributed throughout the year, rainfall is distributed unevenly over time in the territory. Compared with the rainy season, flooding season has significant deviation. Features of rainfall and flow regimes in Quang Binh is that way of flow distribution in a year has two distinct peaks. The main peak appears in September and Octorber, sub-chronic secondary peaks appear in May and June. Flood flow accounts for about 60 - 81% of annual flow. Maximum flow occurs in September and October and accounts for 24 - 31% of annual flow. Months of sub-chronic occupy 1.72 to 5.75% of the current year. Flood flows are important features in the hydrological regime. Flood flows on the river in Quang Binh account for the bulk of the flow in the year. For small rivers, the entire flow is the flood flow. The flow of flooding appears due to heavy rains and floods born by flooding regime on the river bank. The cause of heavy rains is dominated by the monsoon, strong differentiation terrain elevation and direction of the terrain rain. More importantly, storm or hurricane is associated with weather patterns cause massive floods in Octorber and November. Shallow flow, in addition to groundwater flow, there is rainfall, especially in sub-chronic rain. In months from flooding season into the dry season rainfall is relatively large, approximately 100mm. In months from dry season to flooding season rainfall approximately 100 - 300mm. The length of the dry season of the rivers is in average of 8-9 months, the longest is 10 months, the shortest is 7 months. Dry season flows is accounted for 21 - 39% of the total annual rainfall. The total amount of 3 minimum months for about 4 - 6% of the total annual flow [249]**.**

1.4. Conclusion of chapter 1.

After analyzing the bibliographical sources referring to the investigations of ichthyofauna in the basin of river Gianh and the main factors influencing their development we have reached the following conclusions:

Vietnam passed under aggression wars by the Japanese, the French and American imperialist. Hence, the sciences had the late starting. Like other sciences, ichthyology in Vietnam began from the second half of the eighteenth century, along with the penetration of Western scientists. Although enduring such circumstances. But ichthyologist Vietnam has trained relatively ichthyology studies such as: Nguyen Nhat Thi, Bui Dinh Chung, Le Trong Phan, Nguyen Khac Huong, Nguyen Huu Phung, Pham Thuoc, Chu Tien Vinh... studies of marine fish. Mai Dinh Yen, Vu Trung Tang, Nguyen Thai Tu, Nguyen Huu Duc, Vo Van Phu, Nguyen Van Hao, Hoang Duc Dat, Nguyen Xuan Huan. Nguyen Thi Thu He, Duong Quang Ngoc, Nguyen Thi Phi Loan, Vu Thi Phuong Anh, Nguyen Minh Ty, Nguyen Xuan Khoa, Nguyen Thi Hoa, Tong Xuan Tam, Ta Thi Thuy.

The analysis of specialty bibliographical sources shows the necesity to do a complex, systematic, thorough study of the peculiarities of ichthyofauna in the basin of river Gianh and to identify the economic valuable, invasive allogenic and rare species of fish.

Solved scientific problem, which was formulated as a result of bibliographical analysis consists in a survey of ichthyofaunistic diversity, underlining of peculiarities of spatial and temporal distribution of fish species in Gianh river basin and elaboration of theoretical and practical recommendations for a rational use of fish species.

Aim of the work consists in evaluation of the fish fauna diversity in Gianh river basin, completion of the existing scientific information in the field and elaboration of recommendations for protection and long-term use of fish resources.

Objectives of the work are: Inventory and updating of ichthyofaunistic diversity of Gianh river basin from Vietnam; Analysis of morphometric and meristic characters of identified species; Cataloguing of fish species according to types of populated aquatic ecosystems and habitats from Phong Nha - Ke Bang National Park; Study of peculiarities of spatial and temporal distribution of fish species from Gianh river basin; Identification of fish species with high economic value and of the allogenic ones from Gianh river basin; Survey of fish species with different status of rarity from Gianh river basin which are included in the Red Book of Vietnam and International Red List (IUCN); Evaluation of the state of fish species populations from Gianh river basin, and of the ecological factors with important influence upon their functioning; Elaboration of theoretical and practical recommendations for a sustainable verification and adequate protection of fish resources.

2. MATERIAL AND METHODS

2.1. Location of investigations

We have carried out samplings (1882 specimens) at 36 points in Gianh river basin in Quang Binh Province, North Central of Vietnam, each sampling point is from 0.5 km to 3 km. (Table 2.1.1. and Figure. 2.1.1.)

Table 2.1.1. Geographic coordinates of sampling point conducted in the sutdy field

Positions	**Address**	**Northern latitude**	**Eastern longitude**	**Altitude**
1	Gianh bridge - Quang Phuc	17^{0}42’677”	106^{0}24’072’	14 m
2	Quang Thanh - Quang Trach	17^{0}45’517”	106^{0}22’633”	0 m
3	Trung Thuan - Quang Trach	17^{0}49’157”	106^{0}20’708”	25 m
4	Quang Lien - Quang Trach	17^{0}47’008”	106^{0}18’154”	2 m
5	Quang Son - Quang Trach	17^{0}46’118”	106^{0}13’277”	1m
6	Cao Quang - Tuyen Hoa	17^{0}46’100”	1060 04’ 086”	1m
7	Mai Hoa - Tuyen Hoa	17^{0}49’425”	106^{0}11’593”	7 m
8	Minh Cam - Phong Hoa	17^{0}49’462”	106^{0}10’546”	19 m
9	Cho Gac - Son Hoa	17^{0}50’634”	106^{0}08’702”	89 m
10	Xuan Canh - Đong Hoa	17^{0}52’195”	106^{0}05’130”	13 m
11	Khe Net - Kim Hoa	17^{0}58’735”	105^{0}55’680”	34 m
12	Kim Lu - Kim Hoa	17^{0}54’602”	106^{0}00’040”	29 m
13	Lam Hoa - Tuyen Hoa	17^{0}38’283”	106^{0}31’189”	230 m
14	Ca Tang - Lam Hoa	17^{0}57’548”	105^{0}48’716”	67 m
15	Dan Hoa - Minh Hoa	17^{0}50’634”	106^{0}31’289”	169 m
16	Tan Tien - Hoa Tien	17^{0}52’496”	105^{0}50’747”	113 m
17	Quang Hoa - Hong Hoa	17^{0}51’691”	105^{0}57’41”	76 m
18	Hoa Son - Minh Hoa	17^{0}46’230”	106^{0}31’245”	179 m
19	Tan Sun - Hoa Hop	17^{0}47’966”	105^{0}54’141”	191 m
20	Quy Dat - Minh Hoa	17^{0}48’613”	105^{0}57’097”	180 m
21	Tan Hoa - Minh Hoa	17^{0}46’123”	105^0 58’ 055”	89 m
22	Hung Tre - Thượng Hoa	17^{0}44’ 063’’	105^0 59’ 606”	298 m
23	Hung Sac - Thuong Hoa	17^{0}41’ 070’’	105^0 58’ 055”	320 m
24	Xuan Trach - Bo Trach	17^{0}42’677”	106^{0}10’746	45 m
25	Ha Ca Tot - Phong Nha Ke Bang	17^{0}36’ 780”	106^0 03’ 549”	302 m
26	Lam Trach - Bo Trach	17^{0}41’ 170’’	106^{0}11’597”	15 m
27	Hung Dang - Phong Nha Ke Bang	17^{0}37’ 752”	106^0 04’ 086”	83 m
28	Son Trach - Bo Trach	17^{0}39’003”	106^{0}28’442”	34 m
29	Son Lam - Phuc Trach	17^{0}34’656”	106^{0}15’277”	2 m
30	Ngu Hoa - Tuyen Hoa	17^{0}52’195”	106^{0}11’872”	15 m
31	Hung Trach - Bo Trach	17^{0}39’103”	106^{0}20’908”	13 m
32	Phuc Trach - Bo Trach	17^{0}38’973”	106^{0}18’842”	28 m
33	Lien Trach - Bo Trach	17^{0}40’480”	106^{0}24’700”	6 m
34	Cu Nam - Bo Trach	17^{0}37’328”	106^{0}23’360”	7 m
35	Quang Minh - Quang Trach	17^{0}41’ 070’’	106^{0}23’432”	2 m
36	Tan Duc bridge - Tan Ap	18^{0}03’471”	105^{0}49’923”	29 m

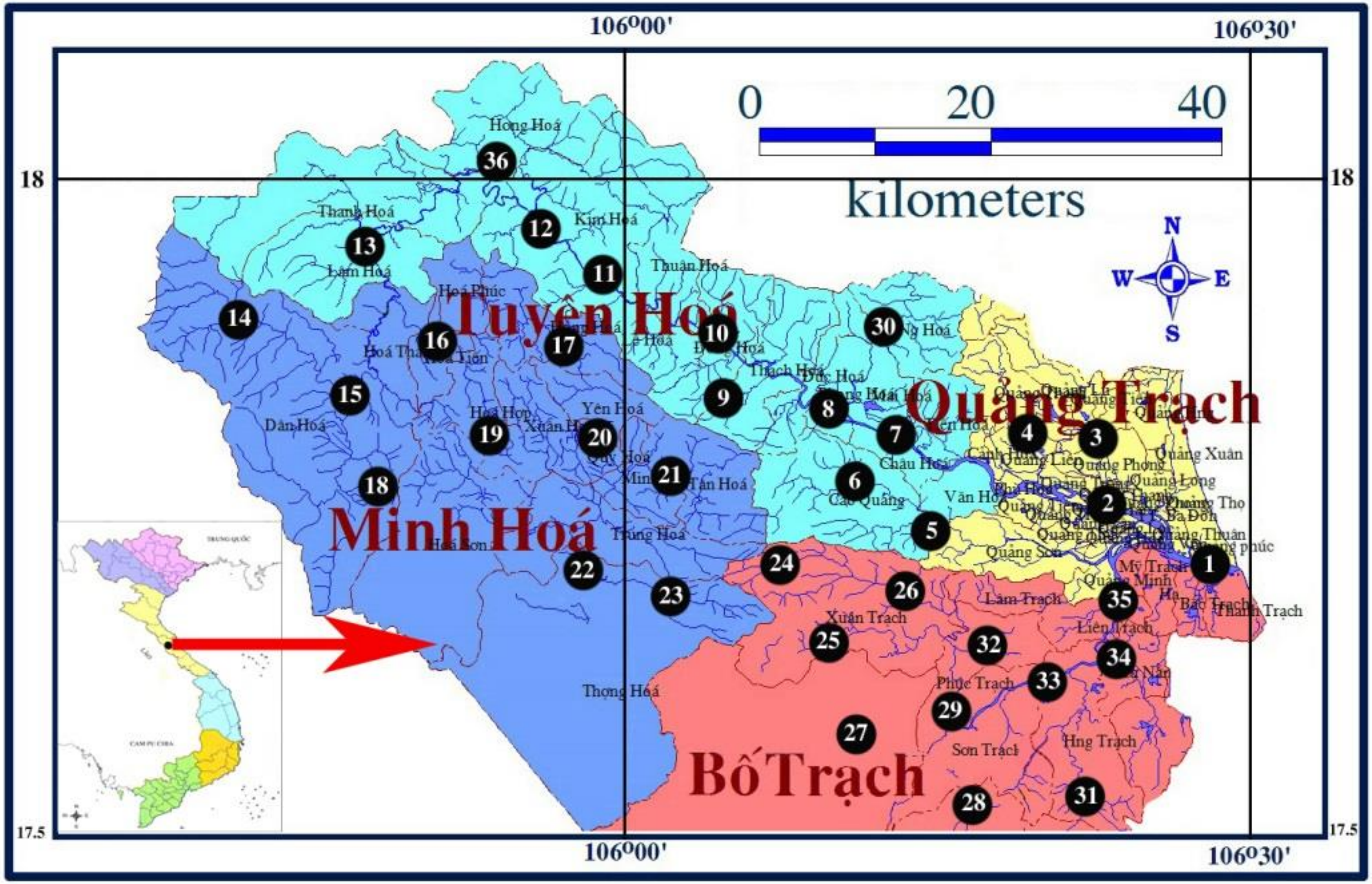

Fig. 2.1.1. Map of fish study in Gianh river basin

2. 2. Study time

We conducted the study in 36 locations, analysed specimens, identified the name of the species in the Laboratory of North Truong Son Biodiversity Center and in the Laboratory of Zoology - Vinh University from 2003 - 2011. Then the specimens were further analyzed and identified the species in the laboratory of Ichthyology and Aquaculture of Institute of Zoology of the Academy of Sciences of Moldova from 2013 to 2015 year.

2.3. Methods of collecting and processing specimens

Fish specimens were mainly directly catched by fishermen in the study sites (Figure 2.1.1.). Fishing equipment included nets, rackets, fishing rods with different sizes and some other tools of fishermen such as coop, trap, etc. Some specimens were bought from fishermen and some asked them to catch. In addition, we also sent chemicals (formaldehyde) to fishermen to ask them to collect the species that we had not obtained during our field visits. Specimens were noted in logs, photographed and fixed by formaldehyde 8 - 10% then were preserved in formaldehyde solution 5% and stored in Laboratory of Animals, Department of Biology, Vinh University.

2.4. Classification morphology methodology

For fish, there are a lot of different morphologies, every morphology has a respective analysis. We just introduced several typical morphologies as following:

a. Measurements taken on Batoidea by Tetsji Nakabo [239]

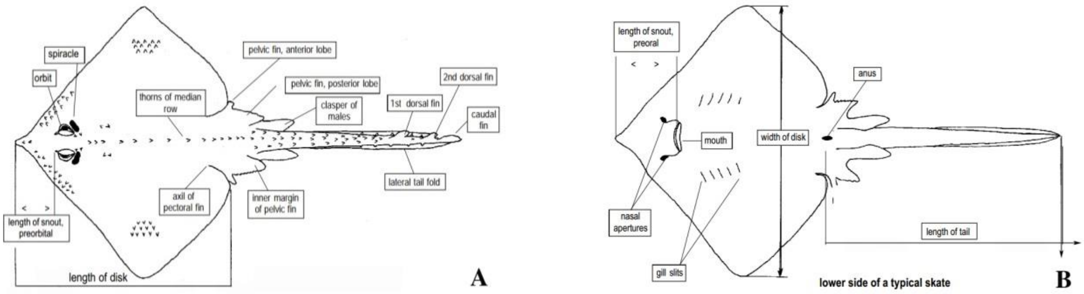

Fig. 2.4.1. Measurements taken on Batoidea

b. Measurements taken on Cyprinidae by Kottelat M. [69]

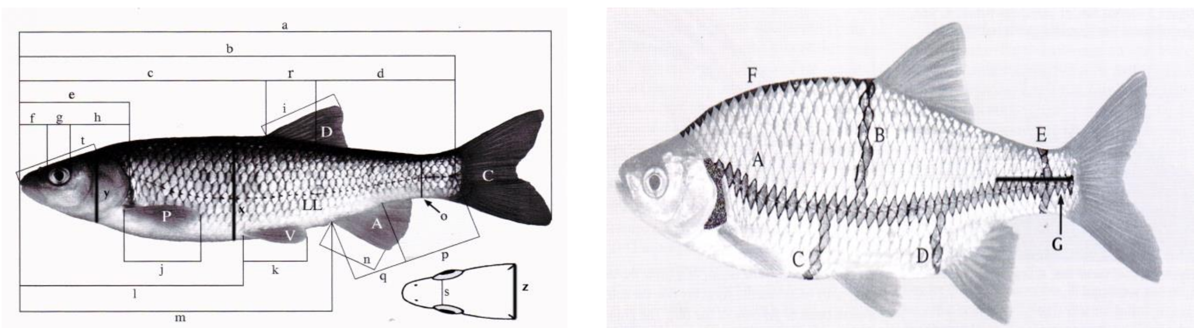

Fig. 2.4.2. Measurements taken on Cyprinidae

c. Measurements taken on Cobitidae by Kottelat M. [57]

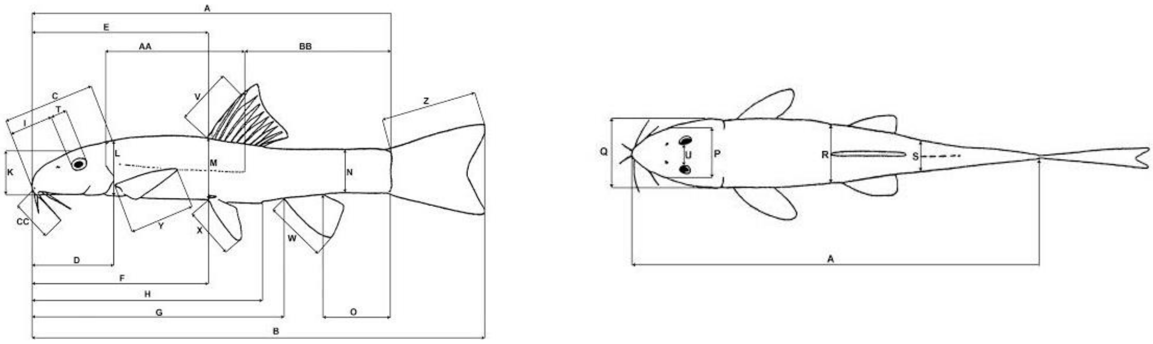

Fig. 2.4.3. Measurements taken on Cobitidae

d. Measurements taken on Platycephalidae by Knapp [52, 53]

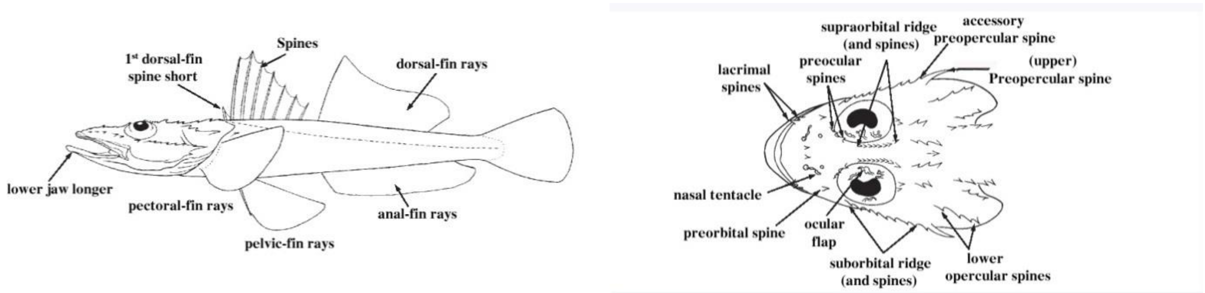

Fig. 2.4.4. Measurements taken on Platycephalidae

e. Measurements taken on Perciformes by Rainboth J. Walter [226]

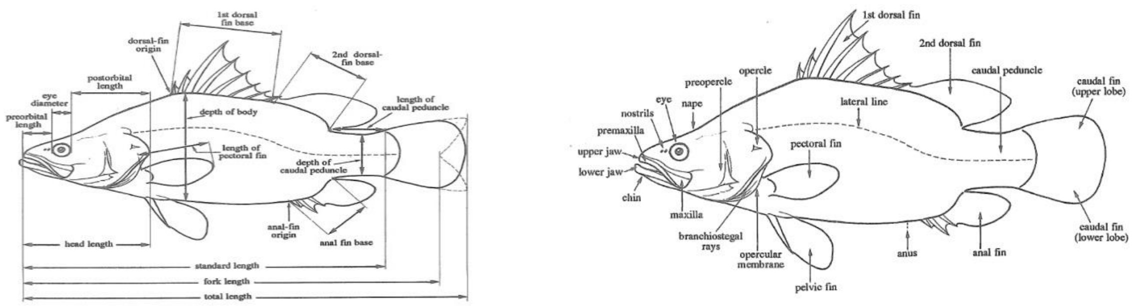

Fig. 2.4.5. Measurements taken on Perciformes

f. Measurements taken on Callionymidae by Hartel K. E., T. Nakabo [32]

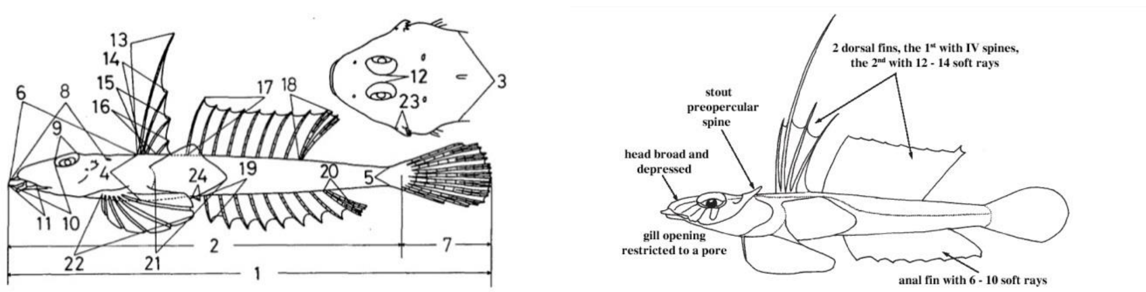

Fig. 2.4.6. Measurements taken on Callionymidae

g. Measurements taken on Osphronemidae by Freyhof J., F. Herder [29]

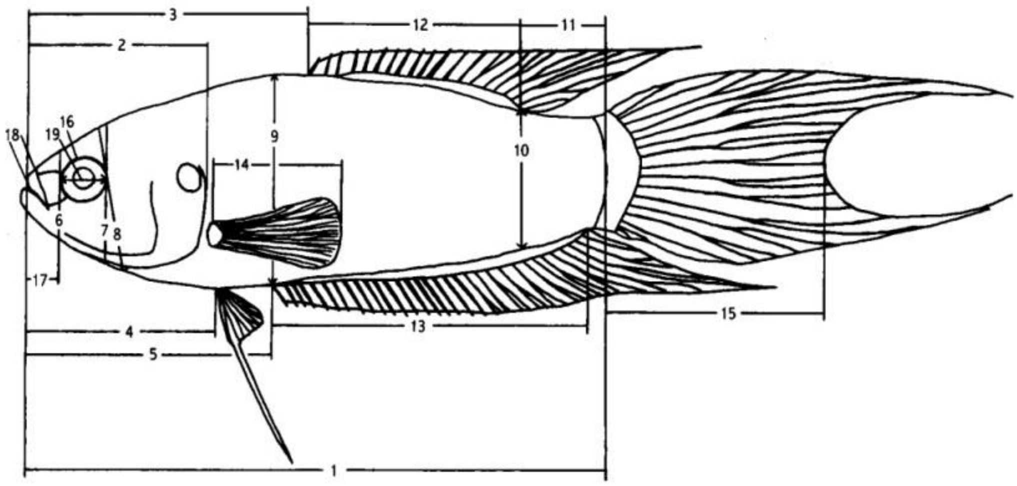

Fig. 2.4.7. Measurements taken on Osphronemidae

h. Measurements taken on Pleuronectiformes byYokogawa K., H. Endo, H. Sakaji [268]

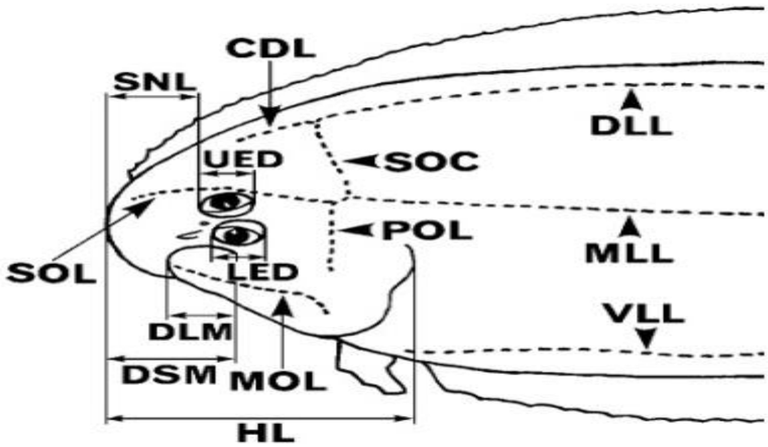

Fig. 2.4.8. Measurements taken on Pleuronectiformes

2.5. Classification method

We use the following materials to identification species: Chen Yiyu et al. (1998); Chu Xinluo et al. (1999); Do Thi Nhu Nhung (2007); Freyhof J., F. Herder (2001); Hartel K. E., T. Nakabo (2003); Knapp L. W (1999); Kottelat M (1990); Kottelat M., Freyhof J. (2007); Mai Dinh Yen (1978); Mai Dinh Yen et al. (1992); Menon A. (1977); Nakabo T (1982, 1983); Nguyen Huu Phung (2001); Nguyen Khac Huong (1991, 2001; 2007); Nguyen Nhat Thi (1991, 2001); Nguyen Van Hao, Ngo Si Van (2001); Nguyen Van Hao (2005); Nguyen Van Luc et al. (2007); Ochiai A. et al. (1955); Prokofiev A. M. (2010); Rainboth J. (1996); Tetsji Nakabo (2002); William P. (1966); Yokogawa K. et al. (2008); Yue Peiqi et al (2000).

Compare and contrast with the reference: [9; 10; 12; 21; 24; 25; 26; 27; 28; 33; 44; 45; 47; 48; 53; 54; 55; 56; 58; 59; 61; 62; 63; 64; 65; 66; 68; 71; 72; 78; 99; 100; 103; 104; 105; 106; 107; 108; 109; 110; 111; 112; 113; 114; 115; 116; 128; 130; 131; 132; 170; 196; 197; 206; 209; 214; 215; 216; 217; 219; 220; 221; 222; 225; 229; 230; 231; 232; 234; 235; 236].

To establish the veracity of data there were used methods of mathematical and statistical analysis through using EXCEL 2007 and the recommendations of ichthyological researchers: [8], [11], [18], [26], [32], [52], [57], [69], [81], [87], [90], [101], [102], [129], [133], [134], [135], [137], [138], [182], [189], [201], [210], [224], [226], [239], [275], [277], [278].

2.6. Conclusion of chapter 2

Methods of collection and investigation of ichthyofauna are very diverse, being determined both by ecological-morphological peculiarities of representatives of different taxis and ecological groups, and by the diversity of aims and ways of approaching the investigations.

We use the following basic materials and method to identification species: Chen Yiyu et al. (1998); Chu Xinluo et al. (1999); Do Thi Nhu Nhung (2007); Freyhof J., F. Herder (2001); Hartel K. E., T. Nakabo (2003); Knapp L. W (1999); Kottelat M (1990); Kottelat M., Freyhof J. (2007); Mai Dinh Yen (1978); Mai Dinh Yen et al. (1992); Menon A. (1977); Nakabo T (1982, 1983); Nguyen Huu Phung (2001); Nguyen Khac Huong (1991, 2001; 2007); Nguyen Nhat Thi (1991, 2001); Nguyen Van Hao, Ngo Si Van (2001); Nguyen Van Hao (2005); Nguyen Van Luc et al. (2007); Ochiai A. et al. (1955); Prokofiev A. M. (2010); Rainboth J. (1996); Tetsji Nakabo (2002); William P. (1966); Yokogawa K. et al. (2008); Yue Peiqi et al (2000).

3. TAXONOMIC DIVERSITY AND ECOLOGICAL PECULIARITIES OF FISH SPECIES IN GIANH RIVER BASIN

3.1. Fish biodiversity in Gianh river basin

As a result of collected ichthyological materials during 2003 - 2015 with the assistance of the international ichthyologists. We have identified 181 fish species belong to 139 genera, 64 families of 16 orders distributed in Gianh river basin in Quang Binh - North Central of Vietnam (Table 3.1.).

In framework of studying of fish fauna in the Gianh river basin, we have also discovered 3 new species for science. In which, 2 species: *Cyprinus hieni* and *Carassioides phongnhaensis* was published in the Basis research programme in Natural science. Problemes of basis research in Biology. Proceedings National conference on Biology conference in Vietnam. The remaining species, *Schistura kottelati* specimens have been sent to somes famous ichiologists such as Kottelat M., Freyhof J, Joerg Bohlen and other experts of genus *Schistura* for comparison and identification to make sure a new species. Specimens and was Kottelat, Freihof, Bohlen expert on the genus *Schistura* worldwide recognized as a new species. We also have already complete the manuscript to submit to the journal Ichthyological Exploration of Freshwaters to publish. We are pleased to present 3 new species discovered in the framework of my thesis as below:

***1. Carassioides phongnhaensis* Tu & Tuan, 2003**

Diagnosis. *Carassioides phongnhaensis* Tu & Tuan, 2003 (Figure 3.1.1.) a new fish species is distinguished from the other species of genus *Carassioides* known from Vietnam and adjacent basins in Laos by the unique combination of the following characters: SL = 2.27 (2.04 - 2.49) Bd = 3.25 (3.06 - 3.36) HL; HL = 3.36 (3.19 - 3.57) Ed = 3.37 (3.10 - 3.53) SnL; Lcp = 0.62 (0.60 - 0.64) Dcp.

Meristics. Dorsal = III.16 - 17; Anal = III.5 - 6; Pectoral = I.14 - 16; Pelvic = 2.8; Predorsal scales = 12 - 13; Lateraline scales = 30 - 31; TSD = 6 - 7; TSV = 6 - 7.

Morphometric. Standard length = 19.67 (13.60 - 30.20) Dorsal head length = 25.77 (16.90 - 40.30) Lateral head length = 44.05 (27.90 - 70.90) Predorsal length = 18.70 (12.10 - 30.70) Post dorsal length = 24.13 (15.00 - 38.50) Pre-pectoral length = 40.83 (25.70 - 65.50) Pre-pelvic length = 58.65 (36.70 - 93.30) Pre-anus length = 62.82 (40.90 - 100.50) Pre-anal length = 10.72 (6.30 - 17.60) Length of caudal peduncle = 7.73 (4.80 - 13.00) Length of snouth = 7.58 (5.30 - 11.60) Diameter of eyes = 36.72 (22.00 - 62.60) Body depth = 17.17

(10.50 - 27.30) Depth of caudal peduncle = 20.85 (14.10 - 33.50) Head depth nape = 13.97 (9.40 - 22.80) Head width at napes = 13.67 (8.40 - 23.50) Body width at dorsal origin = 8.92 (5.20 - 15.30) Body width at anal origin = 21.92 (12.60 - 36.20) Length of dorsal fin = 17.72 (11.70 - 27.30) Length of anal fin = 18.65 (11.50 - 31.60) Length of pectoral fin = 19.97 (11.90 - 33.20) Length of pelvic fin = 30.62 (19.70 - 49.20) Length of upper caudal lope = 29.75 (19.60 - 46.50) Length of lower caudal lope = 12.67 (8.60 - 20.30) Length of median caudal lope.

Fig. 3.1.1. *Carassioides phongnhaensis*

Lateral head length = 41.27 (37.28 - 43.67) Length of caudal peduncle = 29.64 (28.34 - 32.26) Length of snout = 29.77 (28.04 - 31.36) Diameter of eyes = 139.88 (130.18 - 155.33) Body depth = 66.51 (62.13 - 70.59) Depth of caudal peduncle = 80.83 (77.54 - 83.43) Head depth nape = 54.27 (51.55 - 56.58) Head width at napes = 52.03 (45.88 - 58.65) Body width at dorsal origin = 33.50 (28.34 - 37.97) Body width at anal origin = 82.98 (74.56 - 89.83) Length of dorsal fin = 68.45 (62.57 - 72.16) Length of anal fin = 71.28 (66.84 - 79.20) Length of pectoral fin = 75.66 (67.91 - 83.21) Length of pelvic fin = 118.50 (115.38 - 123.31) Length of upper caudal lope = 115.20 (112.30 - 118.56) Length of lower caudal lope = 49.97 (45.86 - 59.17) Length of median caudal lope.

Distribution and habitat. *Carassioides phongnhaensis* Tu & Tuan, 2003 is discovered in Son river of Gianh river basin from Central Vietnam (17^{0}38N – 106^{0}18E). See sampling points (33); (34); (35) of Figure 2.1.1.)

***2. Cyprinus hieni* Tu & Tuan, 2003**

Diagnosis. *Cyprinus hieni* Tu & Tuan, 2003 (Figure 3.1.2.) a new fish species is distinguished from the other species of genus *Cyprinus* known from Vietnam and adjacent basins in Laos by the unique combination of the following characters: Fish body with dark brown, barbels is shorter than diameter of eyes, upper jaw is as long as lower jaw, caudal lope is round, pelvic is not axillary scales.

Meristics. D = III. 20; A = III.5; P = I.6; V = I.8. PrD =12; Ll = 30 (TSD = 5; TSV = 6); Sc = 9.

Fig. 3.1.2. *Cyprinus hieni*

Morphometric. SL = (3.00) Bd = (3.15) HL = (1.84) Prdl = (6.09) Podl = (7.07) Lcp = (6.37) Dcp; HL = (2.24) SnL = (4.70) Ed = (2.25) Lcp = (6.37) Dcp.

Distribution and habitat. *Cyprinus hieni* Tu & Tuan, 2003 is discovered in Cu Nhang Dam, Thuong Hoa commune, Minh Hoa district, Quang Binh province of Gianh river basin from Central Vietnam ($17^0$35N – $105^0$55E). See sampling points (23) of Figure 2.1.1.

***3. Schistura kottelati* Tuan et al., 2015**

Diagnosis. *Schistura kottelati* (Figure 3.1.3.) is distinguished from the other species of genus *Schistura* known from Vietnam and adjacent basins in Laos by the unique combination of the following characters: lateral line incomplete, reaching vertical of dorsal fin. a short caudal peduncle and tapered (length 8.0 - 11.6% SL, depth 1.2 - 1.7 times in its length), a large eye (4.7 - 6.2% SL), a large interorbital width (9.1 - 11.7 % SL).

Description. A small-sized nemacheilid loach with moderately elongated body. Body anteriorly slightly compressed, caudal peduncle compressed. Maximum body depth between pectoral-fin base and dorsal-fin origin. Head depressed, depth at nape 0.8 - 1.0 (mean 0.9) times in its width. Snout round in lateral view, slightly squarish in dorsal view. Width of head increasing from level of mouth backwards to anterior part of opercle, from that point onwards head and body regularly narrowing until caudal-fin origin. Caudal fin emarginate. Low ventral and dorsal adipose crests on caudal peduncle which is 1.2 - 1.7 (mean 1.4) times longer than deep. Distal margin of dorsal fin convex. Largest known size 42.1 mm SL.

Fig. 3.1.3. *Schistura kottelati*

Dorsal fin with 3 simple and 7 ½ branched rays; distal margin of dorsal fin straight or very slightly convex. Anus slightly in front of anal-fin origin. Anal fin with 3 simple and 5½ branched rays, reaching about halfway to caudal fin base. Caudal fin with 9 + 8 branched rays (9 + 9 in one paratype), forked, lobes rounded or slightly pointed. Pelvic fin with 9 rays; origin under last unbranched or first branched dorsal-fin ray; reaching distinctly beyond half of distance to anal-fin origin; usually just reaching anus. Pectoral fin with 10 rays, reaching half of distance between bases of pectoral and pelvic fins. (complete 0.2 - 0.3 times longer than lateral incomplete)

Posterior part of body covered by embedded scales. Scales only sparsely-set at predorsal part os body, being deeply embedded. Lateral line incomplete, with 8 - 14 pores, reaching to pelvic-fin base (mean 10). Cephalic lateral line system with 6 supr**ao**rbital, 6 + 8 infraorbital, 8 - 10 preoperculo-mandibular and 3 supratemporal pores.

Anterior nostril pierced in front side of a flap like tube, with a low anterior rim. Eye 3.5-4.8 times in head length, directed dorsolaterally, diameter 1.5 - 2.2 (mean 1.8) times in interorbital width. Interorbital distance increasing with body size, while relative size of eye slightly decreasing. Processus dentiformis wide, low, broadly rounded. Mouth gape about 1.6 - 1.9 times wider than long. Lips thin; upper lip with a well- marked median incision and no furrows. Lower lip with a narrow median interruption, no furrows, but few small folds towards corners of mouth. Inner rostral barbel reaching vertical of anterior margin of eye; outer one reaching vertical of posterior margin of eye. Maxillary barbel reaching vertical of nape.

Colouration.

Freshly preserved specimens: body sides brownish, darker color on the dorsal side and lighter on belly. The color of specimen become white after a few days preserved in formalin. Dorsal midline covered by a quite thick and yellow stripe from posterior of head, via dorsal-fin base, to caudal-fin base. Head laterally somehow purplish without any kind of pigmentation or patterns. Caudal base with a thin and faint dark bar, thicker at upper and lower extremities, very weak in middle area and not reaching dorsal and ventral midlines. Fins hyaline , without pigments on rays and membranes.

Juveniles: overall coloration as mature individuals but a series of dark blotches on flanks, varying in number (3 - 7) and shape. Particularly, in some juveniles, a chain of tiny black dots along lateral line and dorsal midline.

Sexual dimorphism. None observed.

Distribution and habitat.

Schistura kottelati is presently found only in locally typical pool in an extensive karstic area of Hung Dang valley, Quang Binh province. It located in core area of the Phong Nha - Ke Bang National Park with dimension about 2 x 3 meters, and 70 centimeters at the deepest point. Although locating in the basin of Gianh River, the pool is about 83m high sea level and completely isolated from any adjacent water bodies but water is permanently available and being reckoned that it is fed by rain and underground water. This pool is also found uniquely in this mountain by distance from 5km around hence it becomes very important place that forest management officers protect seriously because local people also need to use water for living activities. (17° 37' 12" N, 106° 04' 01" E). See sampling points (27) of Figure 2.1.1.

Etymology. The species is named for Maurice Kottelat, in appreciation for his research on Eurasian freshwater fishes, among other those of Vietnam.

Remarks. *Schistura kottelati* somewhat resembles *S. pervagata* from which it differs in having a more slender caudal peduncle (depth 8.0 - 11.6% SL, vs. 11.7-13.6% SL; depth 1.2-1.7 times in its length), a greater predorsal distance (55.3 - 59.3% SL, vs. 52.3 - 54.9%SL) (*S. pervagata* data Kottelat, 2000: 68). *S. kottelati* is without bar pattern but *S. pervagata* with 8 – 13 bars. And *S. kottelati* was found in standing water meanwhile *S. pervagata* distributes in flowing water.

List of classes, orders, families and subfamilies is sorted by William N. Eschmeyer and Jon David Fong 2015. Genera of subfamilies and species of genera is sorted by a to z. [323; 326] (Table 3.1).

Table 3.1. Composition of fish species in Gianh river basin

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
N^0	**Scientific name**	**Red Book**	**IUCN**	**EV**	**IS**	**Distribution**							
						PN - KB National Park		**Water bodies**					
								Standing water		**Running water**			
A	**CLASS CHONDRICHTHYES**												
I.	**ORDER RAJIFORMES**												
(1).	**FAMILY RAJIDAE**												
1.	*Dasyatis sinensis* (Steindachner, 1892)		**DD**										+
II.	**ORDER MYLIOBATIFORMES**												
(2).	**FAMILY GYMNURIDAE**												
2.	*Gymnura poecilura* (Shaw, 1804)		**NT**										+
B	**CLASS ACTINOPTERYGII**												
III.	**ORDER OSTEOGLOSSIFORMES**												
(3).	**FAMILY NOTOPTERIDAE**												
3.	*Notopterus notopterus* (Pallas, 1769)		**LC**	*		+			+		+	+	+
IV.	**ORDER ANGUILLIFORMES**												
(4).	**FAMILY ANGUILLIDAE**												
4.	*Anguilla marmorata* Quoy & Gaimard, 1824	**VU**	**LC**	*		+	+		+	+	+	+	+
(5).	**FAMILY OPHICHTHIDAE**												
1	**Subfamily Ophichthinae**												
5.	*Ophichthus celebicus* (Bleeker, 1856) Add		**NE**										+
6.	*Pisodonophis boro* (Hamilton, 1822) Add		**LC**										+
(6).	**FAMILY CONGRIDAE**												
2	**Subfamily Congrinae**												
7.	*Gnathophis nystromi* (Jordan & Snyder, 1901) Add		**NE**										+

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
8.	*Rhynchoconger ectenurus* (Jor. & Ric., 1909) Add		**NE**										+
V.	**ORDER CLUPEIFORMES**												
(7).	**FAMILY CLUPEIDAE**												
9.	*Clupanodon thrissa* (Linnaeus, 1758)	**EN**	**NE**	*		+						+	+
10.	*Konosirus punctatus* (Tem. & Sch., 1846)	**VU**	**NE**	*		+						+	+
11.	*Escualosa thoracata* (Valenciennes, 1847) Add		**NE**										+
12.	*Sardinella albella* (Valenciennes, 1847) Add		**LC**	*									+
(8).	**FAMILY ENGRAULIDAE**												
13.	*Thryssa vitrirostris* (Gil. & Tho., 1908) Add		**NE**										+
VI.	**ORDER CYPRINIFORMES**												
(9).	**FAMILY CYPRINIDAE**												
3	**Subfamily Acheilognathinae**												
14.	*Acheilognathus lamus* Tu, 1983		**NE**			+				+	+		
15.	*Acheilognathus tonkinensis* (Vailant, 1892)		**DD**			+	+			+	+		
16.	*Rhodeus kyphus* (Yen, 1978)		**NE**			+				+			
17.	*Rhodeus ocellatus* (Kener, 1867)		**DD**			+	+			+			
18.	*Rhodeus spinalis* Oshima, 1926		**LC**			+				+			
4	**Subfamily Cultrinae**												
19.	*Cultrichthys erythropterus* (Basilewsky, 1855)		**LC**						+		+		
20.	*Hemiculter leucisculus* (Basilewsky, 1855)		**LC**	*		+		+	+	+	+	+	
21.	*Pseudohemiculter dispar* (Peters, 1881)		**VU**						+		+		
5	**Subfamily Cyprininae**												
22.	*Carassioides acuminatus* (Richardson, 1846)		**LC**	*		+			+	+	+	+	
23.	*Carassioides phongnhaensis* Tu & Tuan, 2003		**DD**			+					+		
24.	*Carassius auratus* (Linnaeus, 1785)		**LC**	*		+		+	+	+	+	+	+
25.	*Cyprinus carpio* Linnaeus, 1758		**VU**	*	+	+		+	+	+	+	+	+

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
26.	*Cyprinus hieni* Tu & Tuan, 2003		**DD**			+			+	+	+		
27.	*Cyprinus quidatensis* Tu, 1999		**DD**			+				+			
6	**Subfamily Barbinae**												
28.	*Puntius brevis* (Bleeker, 1849)		**LC**			+		+	+	+	+	+	+
29.	*Puntius semifasciolatus* (Günther, 1868)		**LC**			+		+	+	+	+	+	+
7	**Subfamily Labeoninae**												
30.	*Cirrhinus molitorella* (Valenciennes, 1844)		**NT**	*		+		+	+	+	+	+	+
31.	*Garra imberba* Garman, 1912		**DD**	*		+	+			+			
32.	*Osteochilus lini* Fowler, 1935		**LC**			+			+	+	+	+	
33.	*Osteochilus salsburyi* Nichols & Pope, 1927		**LC**	*		+			+	+	+	+	
8	**Subfamily Squaliobarbinae**												
34.	*Ctenopharyngodon idella* (Val., 1844)		**NE**	*	+	+		+	+	+	+	+	
35.	*Squaliobarbus curriculus* (Richardson, 1846)		**DD**	*		+			+		+	+	
9	**Subfamily Xenocypridinae (Xenocyprinae)**												
36.	*Hypophthalmichthys molitrix* (Valenciennes, 1844)		**NT**	*	+	**+**			+	+	+	+	
10	**Subfamily Gobioninae**												
37.	*Hemibarbus umbrifer* (Lin, 1931)		**LC**	*		+			+	+	+	+	
38.	*Microphysogobio kachekensis* (Oshima, 1926)		**LC**	*		+				+	+	+	
39.	*Sarcocheilichthys parvus* Nichols, 1930		**LC**			+				+	+		
40.	*Squalidus argentatus* (Sau. & Dab. Thi., 1874)		**DD**			+			+	+	+	+	
11	**Subfamily Danioninae**												
41.	*Devario fangfangae* (Kottelat, 2000) Add		**LC**			+				+			
42.	*Devario gibber* (Kottelat, 2000) Add		**LC**			+				+			
43.	*Esomus metallicus* Ahl, 1923 Add		**LC**			+		+	+	+	+		
44.	*Esomus longimanus* (Lunel, 1881) Add		**DD**			+		+	+		+	+	
45.	*Rasbora steineri* Nichols & Pope, 1927		**LC**			+	+		+	+	+		

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
12	**Incertae sedis Subfamily**												
46.	*Hypsibarbus annamensis* (Pel. & Che., 1936)	**VU**	**DD**	*		+				+			
47.	*Hypsibarbus macrosquamatus* (Mai, 1978)		**DD**	*		+				+			
48.	*Nicholsicypris dorsohorizontalis* Ng. & Do., 1969		**NE**	*		+	+			+	+		
49.	*Neolissochilus benasi* (Pellegrin & Chevey, 1936)		**DD**	*		+	+			+			
50.	*Onychostoma gerlachi* (Peters, 1881)		**NT**	*		+				+	+		
51.	*Opsariichthys bidens* Günther, 1873		**LC**	*		+	+			+	+		
52.	*Paraspinibarbus macracanthus* (Pel. & Che., 1936)		**DD**	*		+			+	+	+		
53.	*Poropuntius solitus* Kottelat, 2000 Add		**EN**	*		+	+			+			
54.	*Spinibarbus denticulatus* (Oshima, 1926)		**LC**	*		+	+		+	+			
55.	*Spinibarbus hollandi* Oshima, 1919		**DD**	*		+			+	+	+		
13	**Subfamily Alburninae**												
56.	*Metzia lineata* (Pellegrin, 1907)		**LC**			+			+		+		
(10).	**FAMILY COBITIDAE**												
14	**Subfamily Cobitinae**												
57.	*Cobitis laoensis* (Sauvage, 1878)		**LC**	*		+	+	+	+	+	+		
58.	*Misgurnus anguillicaulatus* (Cantor, 1842)		**NE**	*		+	+	+	+		+	+	
59.	*Misgurnus mizolepis* Günther, 1888		**NE**	*		+	+	+	+	+			
(11).	**FAMILY BALITORIDAE**												
60.	*Annamia normani* (Hora, 1931)		**LC**			+				+			
61.	*Sewellia lineolata* (Valenciennes, 1836)		**VU**			+				+			
(12).	**FAMILY NEMACHEILIDAE**												
62.	*Schistura finis* Kottelat, 2000 Add		**DD**			+				+			
63.	*Schistura hingi* (Herre, 1934)		**LC**	*		+				+			
64.	*Schistura pervagata* Kottelat, 1998		**LC**	*		+				+			
65.	*Schistura kottelati* Tuan et all Add		**NE**			+				+			

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
66.	*Traccatichthys taeniatus* (Pel. & Che., 1936)		**NE**	*****		+			+	+	+		
VII.	**ORDER SILURIFORMES**												
(13).	**FAMILY BAGRIDAE**												
67.	*Mystus gulio* (Hamilton, 1822)		**LC**			+			+	+	+		
68.	*Hemibagrus centralus* Mai, 1978		**DD**	*****		+			+	+	+		
69.	*Tachysurus virgatus* (Oshima, 1926)		**DD**	*****		+			+	+	+		
(14).	**FAMILY SILURIDAE**												
70.	*Silurus asotus* Linnaeus, 1758		**LC**	*****		+	+			+	+		
71.	*Pterocryptis cochinchinensis* (Val., 1840)		**LC**	*****		+	+		+	+	+		
(15).	**FAMILY SISORIDAE**												
<u>15</u>	**Subfamily Glyptosterninae**												
72.	*Glyptothorax laosensis* Fowler, 1934 Add		**LC**			+			+	+	+		
73.	*Glyptothorax interspinalus* (Mai, 1978) Add		**NT**			+				+	+		
74.	*Glyptothorax quadriocellatus* (Mai, 1978)		**DD**			+				+	+		
75.	*Glyptothorax zanaensis* Wu, He & Chu, 1981 Add		**NE**			+	+			+	+		
(16).	**FAMILY CLARIIDAE**												
76.	*Clarias fuscus* (Linnaeus, 1758)		**LC**	*****		+		+	+		+	+	
(17).	**FAMILY PLOTOSIDAE**												
77.	*Plotosus lineatus* (Thunberg năm 1787)		**NE**	*****								+	+
VIII.	**ORDER AULOPIFORMES**												
(18).	**FAMILY SYNODONTIDAE**												
<u>16</u>	**Subfamily Harpadontinae**												
78.	*Saurida elongata* (Tem. & Sch., 1846)		**NE**	*****		**+**							+
IX.	**ORDER ATHERINIFORMES**												
(19).	**FAMILY ATHERINIDAE**												
<u>17</u>	**Subfamily Atherinomorinae**												

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
79.	*Hypoatherina valenciennei* (Bleeker, 1854) Add		**NE**										+
X.	**ORDER BELONIFORMES**												
(20).	**FAMILY BELONIDAE**												
80.	*Strongylura strongylura* (van Hasselt, 1823)		**NE**	*								+	+
(21).	**FAMILY HEMIRAMPHIDAE**												
81.	*Hyporhamphus sinensis* (Günther 1866)		**LC**			+						+	+
XI.	**ORDER SYNGNATHIFORMES**												
(22).	**FAMILY SYNGNATHIDAE**												
18	**Subfamily Syngnathinae**												
82.	*Microphis cuncalus* (Hamilton, 1822) Add		**LC**									+	+
83.	*Hippichthys spicifer* (Rüppell, 1838) Add		**LC**									+	+
XII.	**ORDER SYNBRANCHIFORMES**												
(23).	**FAMILY SYNBRANCHIDAE**												
84.	*Monopterus albus* (Zuiew, 1793)		**LC**	*		+	+	+	+	+	+	+	
(24).	**FAMILY MASTACEMBELIDAE**												
85.	*Mastacembelus armatus* (Lacepède, 1800)		**LC**	*		+	+		+	+	+	+	
86.	*Sinobdella sinensis* (Bleeker, 1870)		**LC**	*		+	+		+	+	+	+	
XIII.	**ORDER SCORPAENIFORMES**												
(25).	**FAMILY TETRAROGIDAE**												
87.	*Paracentropogon rubripinnis* (Tem. & Sch., 1843)		**NE**										+
(26).	**FAMILY SYNANCEIIDAE**												
19	***Subfamily Minoinae***												
88.	*Minous pusillus* (Tem. & Sch., 1843) Add		**NE**										+
(27).	**FAMILY PLATYCEPHALIDAE**												
89.	*Platycephalus indicus* (Linnaeus, 1758)		**DD**	*		+						+	+
90.	*Rogadius serratus* (Cuvier, 1829) Add		**NE**	*									+

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
91.	*Sorsogona tuberculata* (Cuvier, 1829) Add		**NE**	*									+
XIV.	**ORDER PERCIFORMES**												
(28).	**FAMILY AMBASSIDAE**												
92.	*Ambassis ambassis* (Lacepède, 1802)		**LC**			+				+	+	+	
(29).	**FAMILY PERCICHTHYIDAE**												
93.	*Coreoperca whiteheadi* Boulenger, 1900		**LC**	*		+			+	+	+		
(30).	**FAMILY LATIDAE**												
94.	*Lates calcarifer* (Bloch, 1790)		**NE**	*		+			+			+	+
(31).	**FAMILY SERRANIDAE**												
20	**Subfamily Epinephelinae**												
95.	*Epinephelus awoara* (Tem. & Sch., 1842)		**DD**	*									+
96.	*Epinephelus longispinis* (Kner, 1864)		**LC**	*									+
(32).	**FAMILY TERAPONTIDAE**												
97.	*Terapon jarbua* (Forsskål, 1775)		**LC**	*		+						+	+
98.	*Pelates sexlineatus* (Quoy & Gaimard, 1825)		**LC**	*		+							+
(33).	**FAMILY APOGONIDAE**												
21	**Subfamily Apogoninae**												
99.	*Apogon poecilopterus* Cuvier, 1828		**NE**										+
100.	*Ostorhinchus fasciatus* (White, 1790)		**NE**										+
(34).	**FAMILY SILLAGINIDAE**												
101.	*Sillago maculata* Quoy & Gaimard, 1824 Add		**NE**	*									+
102.	*Sillago sihama* (Forsskål, 1775)		**NE**	*									+
(35).	**FAMILY CARANGIDAE**												
103.	*Carangoides praeustus* (Bennett, 1830) Add		**NE**	*								+	+
104.	*Selaroides leptolepis* (Cuvier, 1833)		**NE**	*									+
105.	*Scomberoides lysan* (Forsskål, 1775) Add		**NE**										+

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(36).	**FAMILY LEIOGNATHIDAE**												
106.	*Eubleekeria splendens* (Cuvier, 1829) Add		**LC**										+
107.	*Leiognathus equulus* (Forsskål, 1775)		**LC**			+							+
108.	*Leiognathus brevirostris* (Valenciennes, 1835) Add		**NE**										+
109.	*Secutor ruconius* (Hamilton, 1822)		**NE**										+
(37).	**FAMILY LUTJANIDAE**												
110.	*Lutjanus fulviflamma* (Forsskål, 1775) Add		**NE**	*									+
111.	*Lutjanus russellii* (Bleeker, 1849)		**NE**	*									+
112.	*Lutjanus fulvus* (Forster, 1801) Add		**NE**										+
(38).	**FAMILY GERREIDAE**												
113.	*Gerres limbatus* Cuvier, 1830		**LC**	*		+						+	+
114.	*Gerres decacanthus* (Bleeker, 1864)		**NE**			+						+	+
115.	*Gerres filamentosus* Cuvier, 1829		**LC**	*		+						+	+
(39).	**FAMILY HAEMULIDAE**												
22	**Subfamily Haemulinae**												
116.	*Pomadasys maculatus* (Bloch, 1793) Add		**LC**	*									+
(40).	**FAMILY SCIAENIDAE**												
117.	*Argyrosomus pawak* Lin, 1940 Add		**NE**	*									+
(41).	**FAMILY MULLIDAE**												
118.	*Upeneus luzonius* Jordan & Seale, 1907 Add		**NE**										+
119.	*Upeneus subvittatus* (Tem. & Sch., 1843) Add		**NE**										+
120.	*Upeneus tragula* Richardson, 1846		**NE**										+
(42).	**FAMILY DREPANEIDAE**												
121.	*Drepane punctata* (Linnaeus, 1758)		**NE**	*									+
(43).	**FAMILY MONODACTYLIDAE**												
122.	*Monodactylus argenteus* (Linnaeus, 1758)		**NE**			+							+

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(44).	**FAMILY MUGILIDAE**												
123.	*Liza affinis* (Günther, 1861)		**NE**	*		+							+
(45).	**FAMILY CICHLIDAE**												
23	**Subfamily Pseudocrenilabrinae**												
124.	*Oreochromis niloticus* (Linnaeus, 1758)		**NE**	*	+	+				+	+	+	+
(46).	**FAMILY POMACENTRIDAE**												
125.	*Pomacentrus nigricans* (Lacepède, 1802) Add		**NE**										+
(47).	**FAMILY BLENNIIDAE**												
24	**Subfamily Blenniinae**												
126.	*Omobranchus fasciolatoceps* (Richardson, 1846) Add		**LC**										+
(48).	**FAMILY CALLIONYMIDAE**												
127.	*Callionymus curvicornis* Valenciennes, 1837 Add		**NE**	*									+
128.	*Callionymus pleurostictus* Fricke, 1982 Add		**NE**										+
(49).	**FAMILY ODONTOBUTIDAE**												
129.	*Sineleotris chalmersi* Nichols & Pope, 1927		**LC**	*		+			+	+	+		
130.	*Sineleotris namxamensis* Chen & Kottelat, 2004		**DD**	*		+			+	+	+		
(50).	**FAMILY ELEOTRIDAE**												
25	**Subfamily Butinae**												
131.	*Bostrychus sinensis* Lacepède, 1801	**CR**	**LC**	*		+						+	+
132.	*Butis butis* (Hamilton, 1822)		**LC**			+						+	+
133.	*Butis koilomatodon* (Bleek, 1849)		**NE**			+						+	+
26	**Subfamily Eleotrinae**												
134.	*Eleotris fusca* (Forster, 1801)		**LC**			+						+	+
135.	*Eleotris melanosoma* Bleeker, 1853		**LC**			+						+	+
(51).	**FAMILY GOBIIDAE**												
27	**Subfamily Gobionellinae**												

(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**
136.	*Chaeturichthys stigmatias* Richardson, 1844		**NE**									+	+
137.	*Oligolepis acutipennis* (Valenciennes, 1837)		**DD**			+					+	+	
138.	*Oxyurichthys microlepis* (Bleek, 1849)		**NE**			+						+	+
139.	*Oxyurichthys tentacularis* (Valenciennes, 1837)		**NE**	*		+						+	+
140.	*Rhinogobius giurinus* (Rutter, 1897)		**LC**			+					+	+	
141.	*Rhinogobius leavelli* (Herre, 1935)		**LC**	*		+			+	+	+		
142.	*Tridentiger trigonocephalus* (Gill, 1859)		**NE**	*		+						+	
143.	*Ctenogobius brevirostris* Günther, 1861		**NE**									+	+
144.	*Papuligobius uniporus* Chen & Kottelat, 2003		**DD**	*		+				+	+		
<u>28</u>	**Subfamily Oxudercinae**												
145.	*Pseudapocryptes elongatus* (Cuvier, 1816)		**LC**	*		+						+	+
<u>29</u>	**Subfamily Gobiinae**												
146.	*Acentrogobius caninus* (Valenciennes, 1837)		**NE**									+	+
147.	*Acentrogobius nebulosus* (Forsskål, 1775)		**NE**			+						+	+
148.	*Arcygobius baliurus* (Valenciennes, 1837)		**NE**									+	+
149.	*Favonigobius aliciae* (Herre, 1936)		**NE**			+						+	+
150.	*Glossogobius giuris* (Hamilton, 1822)		**LC**	*		+	+			+	+		
151.	*Glossogobius olivaceus* (Tem. & Sch. , 1845)		**LC**			+						+	+
152.	*Oplopomus oplopomus* (Valenciennes, 1837)		**NE**									+	+
153.	*Paragobiodon echinocephalus* (Ruppell, 1828)		**NE**			+						+	+
154.	*Parachaeturichthys polynema* (Bleek, 1853)		**NE**									+	+
155.	*Psammogobius biocellatus* (Valenciennes,1837)		**LC**			+						+	+
156.	*Yongeichthys criniger* (Valenciennes, 1837)		**NE**			+						+	+
(52).	**FAMILY SCATOPHAGIDAE**												
157.	*Scatophagus argus* (Linnaeus, 1766)		**LC**	*		+							+
(53).	**FAMILY SIGANIDAE**												

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
158.	*Siganus canaliculatus* (Park, 1797)		**NE**	*									+
159.	*Siganus punctatissimus* Fowler & Bean, 1929		**NE**										+
(54).	**FAMILY SPHYRAENIDAE**												
160.	*Sphyraena pinguis* Günther, 1874		**NE**	*									+
(55).	**FAMILY ANABANTIDAE**												
161.	*Anabas testudineus* (Bloch, 1792)		**DD**	*		+		+	+	+	+	+	+
(56).	**FAMILY OSPHRONEMIDAE**												
30	**Subfamily Macropodusinae**												
162.	*Macropodus opercularis* (Linneaeus, 1758)		**LC**			+		+	+	+	+	+	+
163.	*Macropodus spechti* Schreitmüller, 1936 Add		**DD**			+		+	+		+	+	+
164.	*Macropodus erythropterus* Frey. & Her., 2002 Add		**DD**			+		+	+		+	+	+
165.	*Trichopsis vittata* (Cuvier, 1831) Add		**LC**			+		+	+		+	+	+
31	**Subfamily Luciocephalinae**												
166.	*Trichopodus trichopterus* (Pallas, 1770)		**LC**			+		+	+	+	+	+	+
(57).	**FAMILY CHANNIDAE**												
167.	*Channa striata* (Bloch, 1793)		**LC**	*		+		+	+	+	+	+	+
168.	*Channa gachua* (Hamilton, 1822)		**LC**	*		+	+		+	+			
XV.	**ORDER PLEURONECTIFORMES**												
(58).	**FAMILY PARALICHTHYIDAE**												
169.	*Paralichthys olivaceus* (Tem. & Sch., 1846) Add		**NE**			+							+
170.	*Pseudorhombus cinnamoneus* (T. & Sch., 1846) Add		**NE**										+
171.	*Pseudorhombus malayanus* Bleeker, 1865 Add		**NE**										+
(59).	**FAMILY BOTHIDAE**												
172.	*Engyprosopon longipelvis* Amaoka, 1969 Add		**NE**										+
(60).	**FAMILY SOLEIDAE**												
173.	*Aseraggodes xenicus* (Matsubara & Ochiai, 1963) Add		**NE**	*		+							+

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
174.	*Heteromycteris japonicus* (Tem. & Sch., 1846) Add		**NE**			+							+
175.	*Solea ovata* Richardson, 1846		**NE**	*		+							+
(61).	**FAMILY CYNOGLOSSIDAE**												
32	**Subfamily Cynoglossinae**												
176.	*Cynoglossus cynoglossus* (Hamilton, 1822) Add		**NE**										+
177.	*Cynoglossus lingua* Hammilton, 1822 Add		**NE**										+
178.	*Cynoglossus puncticeps* (Richardson, 1846) Add		**NE**										+
XVI.	**ORDER TETRAODONTIFORMES**												
(62).	**FAMILY TRIACANTHIDAE**												
179.	*Triacanthus biaculeatus* (Bloch, 1786)		**NE**										+
(63).	**FAMILY MONACANTHIDAE**												
180.	*Paramonacanthus japonicus* (Tilesius, 1809) Add		**NE**										+
(64).	**FAMILY TETRAODONTIDAE**												
181.	*Lagocephalus sceleratus* (Gmelin, 1789) Add		**LC**			+							+
Total		**5**	**181**	**84**		**119**	**21**	**20**	**52**	**72**	**66**	**69**	**109**

Notes of table 3.1.: (1) Number the order; (2) Scientific name; (3) Species in the Vietnam Red Book 2007; (4) Species in the IUCN Red List of Threatened Species; (5) EV: Species with precious economic values; (6) IS: Invasive species; (7) Species distribute in the Phong Nha - Ke Bang National Park; (8) Species distribute inside cave habitat; (9) Species in rice farm; (10) Species in ponds, lakes, reservoirs; (11) Species found in upper stream; (12) Species found in middle; (13) Species found in downstream; (14) Species found in estuary; Add: Supplemental species in the Gianh River; Not Evaluated (NE); Data Deficient (DD); Least Concern (LC); Near Threatened (NT); Vulnerable (VU); Endangered (EN); Critically Endangered (CR).

The order Perciformes have most families (30 families occupy 46.9%), next to the order Siluriformes (5 families are accounted for 7.8%), Order Cypriniformes and Pleuronectiformes (4 families: 6.3%), order Anguilliformes; then are order Scorpaeniformes, order Tetraodontiformes (3 families are accounted for 4.7%); and order Clupeidae, order Beloniformes, order Synbranchiformes (2 families occupy 3.1%). The remain orders as: Order Rajiformes; Order Myliobatiformes; Order Osteoglossiformes; Order Aulopiformes; Order Atheriniformes and Order Syngnathiformes each have only 1 family accounts for 1.6% (Figure 3.1.4).

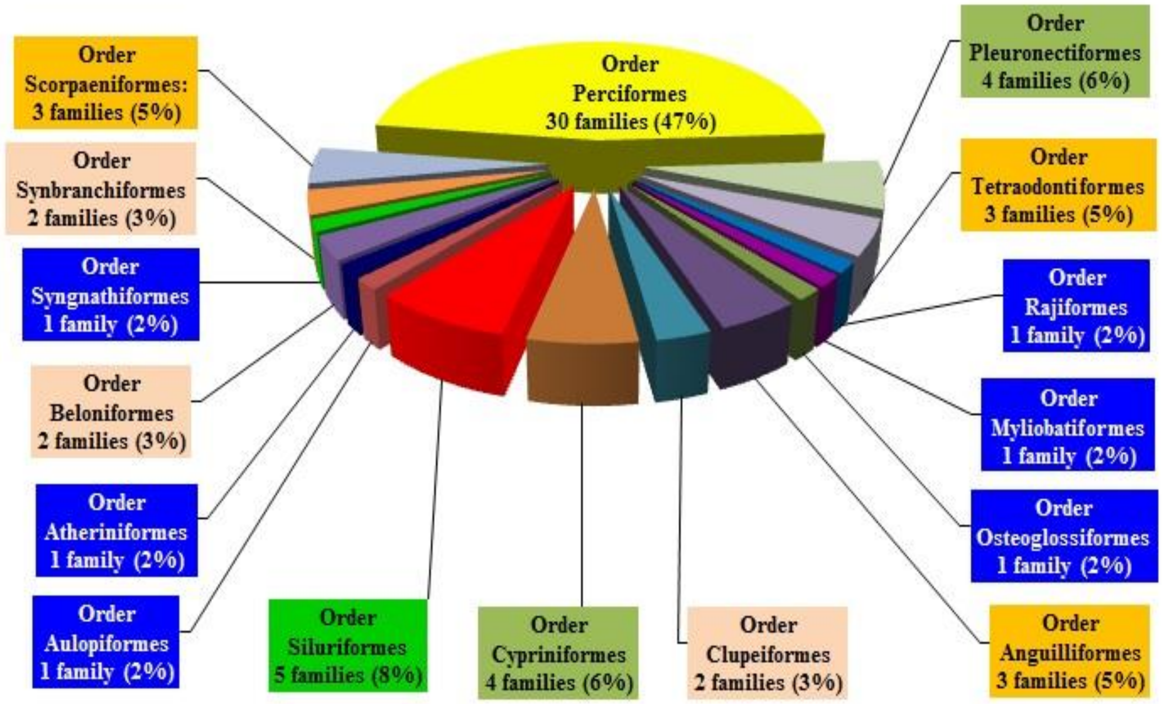

Fig. 3.1.4. Taxon structure - family level

The order Perciformes have the most diverse genera (57 genera is accounted for 42.2% of the total number of genera); Next is the order Cypriniformes (37 genera is accounted for 27.4%); Next is order Siluriformes (8 genera is accounted for 7%); Next is the order Pleuronectiformes (7 genera accounted for 5.2%); then is order Anguilliformes, order Clupeiformes, order Scorpaeniformes (5 genera is accounted for 3.7%); order Synbranchiformes, order Tetraodontiformes (3 genera is accounted for 2.2%); order Beloniformes, Syngnathiformes (2 genera is accounted for 1.5%). The remain orders as: Order Rajiformes; Order Myliobatiformes; Order Osteoglossiformes; Order Aulopiformes; Order Atheriniformes have only 1 genus is accounted for 0.7% (Figure 3.1.5).

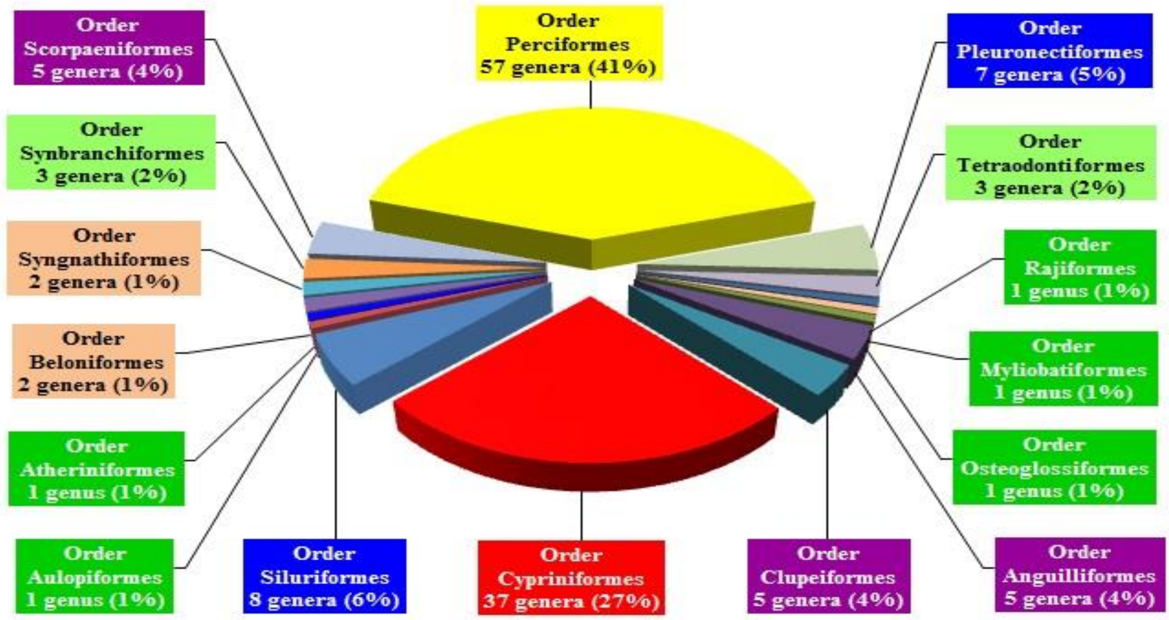

Fig. 3.1.5. Taxon structure - genera level

The order Perciformes have the most diverse number of species (77 Species accounts for 42.5% of total species); Next is the order Cypriniformes (53 species are accounted for 29.3%); then is order Siluriformes (11 species are accounted for 6.1%); order Pleuronectiformes (10 species are accounted for 5.5%); order Anguilliformes, order Clupeidae, order Scorpaeniformes (5 species are accounted for 2.8%); order, Synbranchiformes, order Tetraodontiformes (3 species are accounted for 1.7%); order Beloniformes, order Syngnathiformes (2 species accounted for 1.1%); The remain orders as: Order Rajiformes; Order Myliobatiformes; Order Osteoglossiformes; Order Aulopiformes; Order Atheriniformes have only 1 species is accounted for 0.6 % of the total number of species (Figure 3.1.6.).

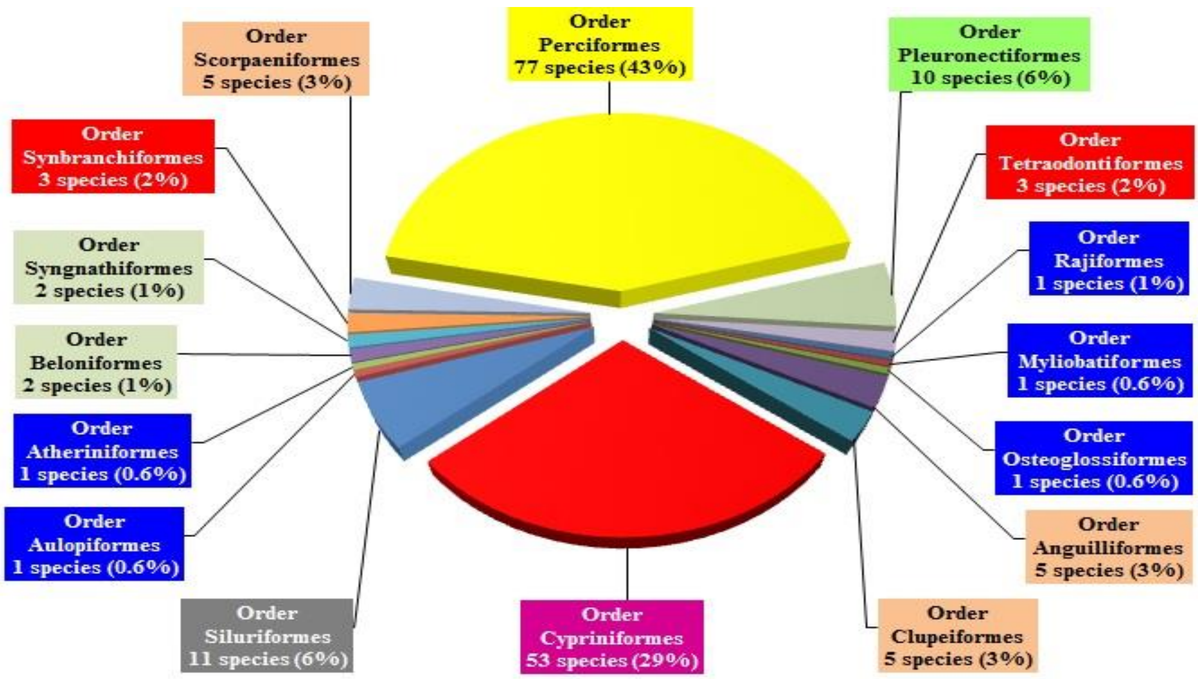

Fig. 3.1.6. Taxon structure - species level

3.2. The distribution of fish species in the Gianh river basin

In the Phong Nha - Ke Bang National Park (Loc. 1) there are 119 species accounted for 65.7 % of this total species throughout the basin; Next to the estuary (Loc. 8) has 109 species accounted for 60.2 %; upstream (Loc. 5) to 72 species accounted for 39.8 %; downstream (Loc. 7) 69 species accounted for 38.1%; the middle (Loc. 6) 66 species accounted for 36.5 %; in ponds, lakes, reservoirs (Loc. 4) there are 52 species accounted for 28.7 %; in caves (Loc. 2) there are 21 species occupied 11.6%; The least diverse is in rice farm (Loc. 3), there are only 20 species, accounted for 11. % (Figure 3.2.)

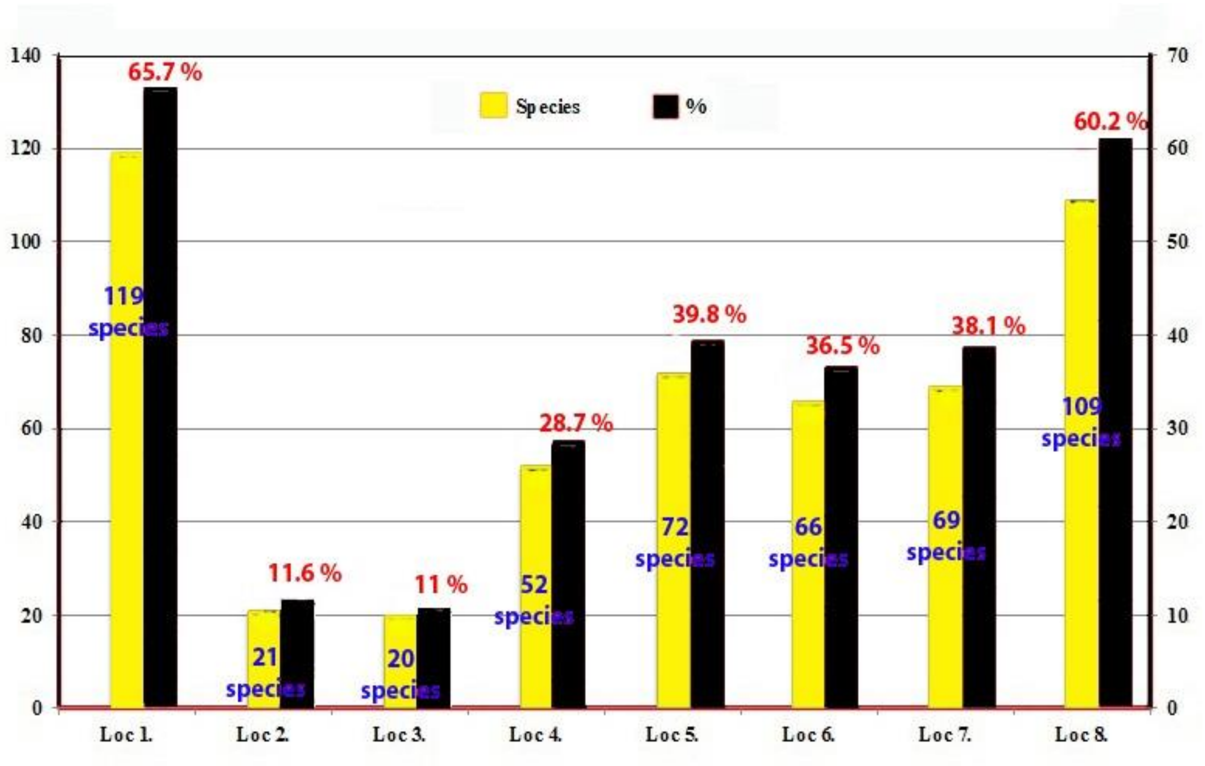

Fig. 3.2. The distribution of species in the in the Gianh river basin

Notes: Species distribute in the Phong Nha - Ke Bang National Park (Loc. 1); Species distribute inside cave habitat (Loc. 2); Species in rice farm (Loc. 3); Species in ponds, lakes, reservoirs (Loc. 4); Species found in upper stream (Loc. 5); Species found in middle (Loc. 6); Species found in downstream (Loc. 7); Species found in estuary (Loc. 8).

Distribution by origin and ecological factors Ecological groups of fish: Ichthyofauna of the Gianh river basin from Vietnam is directly affected by the tides in the downstream, as well as by the impact of the streams on the upstream at the high altitude, which run through some caves and flow into the main river. This has contributed to the characteristics of the water compared to other basins. These are also very important ecological factors of Ichthyofauna of the Gianh river basin from Vietnam; create groups of fish with different adaptability. These differences are not only shown in morphology, physiology, but also in behavioural biology. In terms of ecology and environmental origin, we can divide species of fishes in Gianh river basin into different ecological groups according to origin and nutrition as follows:

Typical freshwater group

This group of fish has numerous species, mainly falls into branch Order Cypriniformes and species: *Hemibagrus centralus* Mai, 1978; *Silurus asotus* Linnaeus, 1758; *Pterocryptis cochinchinensis* (Val., 1840); *Glyptothorax laosensis* Fowler, 1934; *Glyptothorax interspinalus* (Mai, 1978); *Glyptothorax quadriocellatus* (Mai, 1978); *Glyptothorax zanaensis* Wu, He & Chu, 1981; *Clarias fuscus* (Linnaeus, 1758) of Order Siluriformes and some species such as: *Monopterus albus* (Zuiew, 1793); *Mastacembelus armatus* (Lacepède, 1800); *Sinobdella sinensis* (Bleeker, 1870); *Coreoperca whiteheadi* Boulenger, 1900; *Oreochromis niloticus* (Linnaeus, 1758); *Sineleotris chalmersi* Nichols & Pope, 1927; *Sineleotris namxamensis* Chen & Kottelat, 2004; *Rhinogobius leavelli* (Herre, 1935); *Anabas testudineus* (Bloch, 1792); *Channa striata* (Bloch, 1793) .... They are present in different seasons of the year. But they can mostly be seen in rainy season. Based on the origin and ecological character we categorized typical freshwater fish into 2 different sub-group as follows:

Group of fish from streams

They distributed mainly in small streams in the highlands where there are many waterfalls, rapids with steep slope which generate large flows and make flow here always has high concentration of dissolved oxygen in the water. The species distributed here are usually good swimmers, adapt to the environment of high concentration of dissolved oxygen. Their foods are some kinds of plant clinging to the bottom. Characteristics of this species is that they have no auxiliary respiratory organs, but their mouths often become suckers like species: *Rhodeus kyphus* (Yen, 1978); *Rhodeus ocellatus* (Kener, 1867); *Rhodeus spinalis* Oshima, 1926; *Garra imberba* Garman, 1912; *Microphysogobio kachekensis* (Oshima, 1926); *Squalidus argentatus* (Sau. & Dab. Thi., 1874); *Devario fangfangae* (Kottelat, 2000); *Devario gibber* (Kottelat, 2000); *Hypsibarbus annamensis* (Pel. & Che., 1936); *Hypsibarbus macrosquamatus* (Mai, 1978); *Nicholsicypris dorsohorizontalis* Ng. & Do., 1969; *Neolissochilus benasi* (Pellegrin & Chevey, 1936); *Onychostoma gerlachi* (Peters, 1881); *Opsariichthys bidens* Günther, 1873; *Poropuntius solitus* Kottelat, 2000; *Annamia normani* (Hora, 1931); *Sewellia lineolata* (Valenciennes, 1836); *Schistura finis* Kottelat, 2000;

Schistura hingi (Herre, 1934); *Schistura pervagata* Kottelat, 1998; *Schistura kottelati* Tuan et all; …. Characteristics of the species here are their narrow habitat.

Group of fish from farming pond

These fish species are distributed mainly in the plains, where the concentration of dissolved of oxygen is low, the turbidity of water is high and its flow rate is slower than the species distributed in streams. The species residing here usually have auxiliary respiratory organs. Representatives of the species: *Misgurnus anguillicaulatus* (Cantor, 1842); *Clarias fuscus* (Linnaeus, 1758); *Monopterus albus* (Zuiew, 1793); *Anabas testudineus* (Bloch, 1792); *Channa striata* (Bloch, 1793). And fish species swim good such as: *Carassius auratus* (Linnaeus, 1785); *Cyprinus carpio* Linnaeus, 1758…

Group of brackish fish

Gianh river estuary flows into the East sea so it is the intersection of freshwater and saltwater. Habitat always varies in terms of ecological factors especially the fluctuations in salinity of water in dry and rainy season. Group of brackish fish can adapt the large fluctuation of salt concentrations during the rainy season and dry season and has become a major resident of the area. Through research, we found out the following species: *Dasyatis sinensis* (Steindachner, 1892); *Pisodonophis boro* (Hamilton, 1822); *Gnathophis nystromi* (Jordan & Snyder, 1901); *Clupanodon thrissa* (Linnaeus, 1758); *Escualosa thoracata* (Valenciennes, 1847); *Plotosus lineatus* (Thunberg năm 1787); *Hypoatherina valenciennei* (Bleeker, 1854); *Terapon jarbua* (Forsskål, 1775); *Pelates sexlineatus* (Quoy & Gaimard, 1825); *Gerres limbatus* Cuvier, 1830; *Gerres decacanthus* (Bleeker, 1864); *Gerres filamentosus* Cuvier, 1829; *Drepane punctata* (Linnaeus, 1758); *Bostrychus sinensis* Lacepède, 1801; *Butis butis* (Hamilton, 1822); *Butis koilomatodon* (Bleek, 1849); *Eleotris fusca* (Forster, 1801); *Pseudapocryptes elongatus* (Cuvier, 1816). *Favonigobius aliciae* (Herre, 1936); *Yongeichthys criniger* (Valenciennes, 1837); *Aseraggodes xenicus* (Matsubara & Ochiai, 1963); *Heteromycteris japonicus* (Tem. & Sch., 1846); *Solea ovata* Richardson, 1846; *Cynoglossus cynoglossus* (Hamilton, 1822); *Cynoglossus lingua* Hammilton, 1822; *Cynoglossus puncticeps* (Richardson, 1846) …

Group of saltwater fish

This group does not have many species. They are mainly distributed in the estuary where the salt concentration is high. These fishes can adapt to the large fluctuation range of salinity, so they can migrate into brackish estuaries to live and looking for foods. Typical species are the following species: *Gymnura poecilura* (Shaw, 1804); *Ophichthus celebicus* (Bleeker, 1856); *Rhynchoconger ectenurus* (Jor. & Ric., 1909); *Sardinella albella*

(Valenciennes, 1847); *Thryssa vitrirostris* (Gil. & Tho., 1908); *Epinephelus awoara* (Tem. & Sch., 1842); *Epinephelus longispinis* (Kner, 1864); *Apogon poecilopterus* Cuvier, 1828; *Ostorhinchus fasciatus* (White, 1790); *Sillago maculata* Quoy & Gaimard, 1824; *Sillago sihama* (Forsskål, 1775); *Carangoides praeustus* (Bennett, 1830); *Selaroides leptolepis* (Cuvier, 1833); *Scomberoides lysan* (Forsskål, 1775); *Pomadasys maculatus* (Bloch, 1793); *Argyrosomus pawak* Lin, 1940; *Upeneus luzonius* Jordan & Seale, 1907; *Upeneus subvittatus* (Tem. & Sch., 1843); *Upeneus tragula* Richardson, 1846; *Monodactylus argenteus* (Linnaeus, 1758); *Pomacentrus nigricans* (Lacepède, 1802); *Omobranchus fasciolatoceps* (Richardson, 1846); *Callionymus curvicornis* Valenciennes, 1837; *Callionymus pleurostictus* Fricke, 1982; *Scatophagus argus* (Linnaeus, 1766); *Siganus canaliculatus* (Park, 1797); *Siganus punctatissimus* Fowler & Bean, 1929; *Sphyraena pinguis* Günther, 1874…. These species distributed mainly in tropical coastal area. The distribution of these species also varies according to the season. They can be seen more frequently in rainy season than in dry season because salt concentration in the rainy season is lower than that of dry season.

Group of migratory fish

Migration is a common phenomenon and biological significance in the life of the fish, created by the body needs during different periods of the life cycle and seasonal cycle. The migration mainly relates to breeding, nutrition and wintering. The migration phenomenon plays important role in fishing sector, because many fish are caught by local residents in fish migration season.

Migration for Feeding: Some fish are distributed in the basin of the river, they can make two-way movement between fresh water and salt water, which means moving from the rivers and coastal estuaries to feed including species: *Strongylura strongylura* (van Hasselt, 1823); *Hyporhamphus sinensis* (Günther 1866); while the species: *Eubleekeria splendens* (Cuvier, 1829); *Leiognathus equulus* (Forsskål, 1775); *Secutor ruconius* (Hamilton, 1822); *Lutjanus fulviflamma* (Forsskål, 1775); *Lutjanus russellii* (Bleeker, 1849); *Lutjanus fulvus* (Forster, 1801)… move from sea to estuaries to feed.

Migration for breeding: Some species often move from the sea to the estuary and up the river to breed in flowing waters containing aquatic plants, such as species: *Liza affinis* (Günther, 1861); *Konosirus punctatus* (Tem. & Sch., 1846); *Triacanthus biaculeatus* (Bloch, 1786); *Paramonacanthus japonicus* (Tilesius, 1809); *Lagocephalus sceleratus* (Gmelin, 1789)…. On the other side, species of *Anguilla marmorata* Quoy & Gaimard, 1824move from upstream or caves to the sea to breed.

The outstanding feature of fish species in Gianh river basin is that they are the intersection between many species with different origins. The fish fauna of Gianh river basins located on four types of typical terrains including: The mountainous terrain, caves terrain, plain terrain and coastal terrain. Upstream and cave areas live mostly typical freshwater fish groups, while in delta area there are intersection between freshwater and saltwater fish groups. In coastal estuaries, there are fish species from the sea and some fresh water species that have adapted to environment with higher salt concentration.

3.3. The rare and valuable economic fish species in Gianh river basin

3.3.1. The rare fish species in Vietnam Red Animals and in the IUCN Red List

The rare fish species in Vietnam Red Animals

According to Vietnam Red Animals (2007) [93] and based on species composition table (Table 3.1), we determined that in Gianh river basin there are 5 fish species were recorded in the Red Book to be protected. (Table 3.3.1)

Table 3.3.1. The species listed in the Red Book's 2007

TT	Scientific name	Level
1.	*Anguilla marmorata* Quoy & Gaimard, 1824	Vulnerable
2.	*Clupanodon thrissa* (Linnaeus, 1758)	Endangered
3.	*Konosirus punctatus* (Tem. & Sch., 1846)	Vulnerable
4.	*Hypsibarbus annamensis* (Pel. & Che., 1936)	Vulnerable
5.	*Bostrychus sinensis* Lacepède, 1801	Critically Endangered

In five species in the Gianh river basin recorded in the Vietnam Red Book (2007), there are two species: *Anguilla marmorata, Clupanodon thrissa* that were caught in our field studies with large output. Moreover these 2 species are frequently used by people and have high price, so we put them into the list of species having economic value in Gianh River Basin. 3 species: *Hypsibarbus annamensis, Konosirus punctatus, Bostrychus sinensis* we only caught 1 to 2 times during our field study with low output. Therefore, the managers of natural resources should build more closely regulations to protect these species.

The rare fish species in the IUCN Red List of Threaten Species

List of distributive fish species of Gianh river basin in the table 3.1 and is recorded in the IUCN Red List of Threaten Species as below: 78 species is level Not Evaluated (NE); 27 is level species Data Deficient (DD); 67 species is level Least Concern (LC); 5 species is level Near Threatened (NT); 3 species is level Vulnerable (VU); 1 species is level Endangered (EN). the rate of bioconservation level was showed in the Figure. 3.3.1. [324].

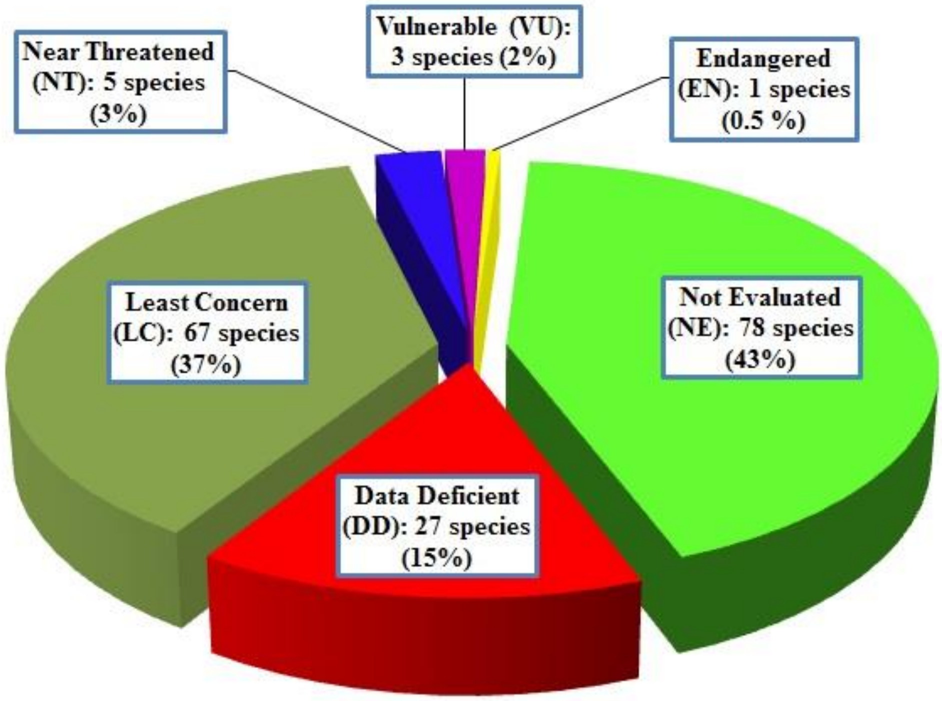

Fig. 3.3.1. The rate of protected level for species is concerned in the IUCN Red Book

Table 3.1 & 3.3.1. and Figure 3.3.1. showed that species for bioconservation in level VU, EN and CR of the Red Book's 2007 is different from the IUCN Red List of Threatened Species. Our results indicate that conservative species in the Red Book's 2007 are suitable to the IUCN Red List of Threatened Species. This can be explained that species in conservation at level VU and EN of the IUCN Red List of Threatened Species distribute with high abundance and they are not really attractive to local people for exploitation

3.3.2. Fish species having economic value

According to the method of determining fish species with economic value of the Mai Dinh Yen, Vo Van Phu, Nguyen Xuan Huan, Hoang Xuan Quang, Ho Anh Tuan fish species having economic value are fish having large output, with high prices and frequently used by people. We identified in the Gianh river basin there are 84 species of economic value. List of economic species are shown in column 4 table 3.1 and Figure 3.3.2.

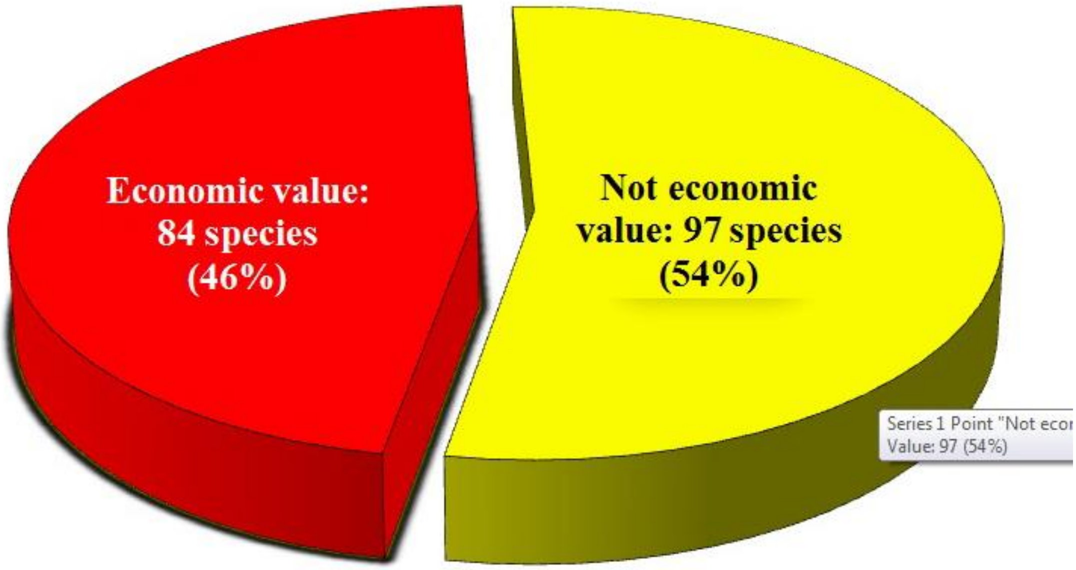

Fig. 3.3.2. Proportion of economic value species and not economic value species

These species we encountered at all times of fieldwork with large output, and are frequently used, sold, exchanged, served food to tourists in Phong Nha - Ke Bang National Park. Thus we consider these 84 species of fish having economic value in Gianh River Basin. Currently, people living on both sides of the basin of Gianh river have successfully raised some fish species, which have high economic value such as *Cyprinus carpio* Linnaeus, 1758; *Cirrhinus molitorella* (Valenciennes, 1844); *Ctenopharyngodon idella* (Val., 1844); *Hypophthalmichthys molitrix* (Valenciennes, 1844); *Clarias fuscus* (Linnaeus, 1758); *Monopterus albus* (Zuiew, 1793); *Oreochromis niloticus* (Linnaeus, 1758).

However, for some species of which, people cannot obtain the breed easily, and they have to catch young fishes in the river to raise them in their lake or pond, such as: *Notopterus notopterus* (Pallas, 1769); *Anguilla marmorata* Quoy & Gaimard, 1824; *Carassioides acuminatus* (Richardson, 1846); *Spinibarbus hollandi* Oshima, 1919; *Misgurnus anguillicaulatus* (Cantor, 1842); *Lates calcarifer* (Bloch, 1790); *Epinephelus awoara* (Tem. & Sch., 1842); *Bostrychus sinensis* Lacepède, 1801; *Channa striata* (Bloch, 1793). Also, the raising scale is also small and individual. The remaining species are mainly exploited in the wild. Therefore, the overexploitation on these high-economic value fish specifies becomes more and more intensive. Facing this situation, local government should have the measures for planning and developing aquaculture sector as well as investing in research of high value species of local, in order to breed these species extensively, to help people obtain breeds and raising technique easier.

3.3.3. Invasive species and species created a danger to humans

Invasive species: According to Nguyen Van Hao [182]. Ichthyofauna of the Gianh river basin from Vietnam have 4 invasive species: *Cyprinus carpio* Linnaeus, 1758; *Ctenopharyngodon idella* (Val., 1844); *Hypophthalmichthys molitrix* (Valenciennes, 1844); *Oreochromis niloticus* (Linnaeus, 1758). But in this 4 species Kottelat said that *Hypophthalmichthys molitrix* (Valenciennes, 1844) is indigenous. According to our research and W. J. Rainboth, 4 species which were collected, *Cyprinus carpio* was the original species in northern Vietnam. Prior to 1954, *Cyprinus carpio* was only on the rivers from Quang Ngai province to the north of Vietnam. From 1954 to 1955, Le Van Dang brought the carp which were supported by Ha Dong (in Ha Noi City) fish breeding farms to Thu Duc (Ho Chi Minh City) fish breeding farms. Start from there, the fish farming of carp have been becoming popular, thus, the carp were released to the rivers in the south of Vietnam. Rainboth (1990) discovered the distribution of species *Cyprinus carpio* in the Mekong river, Cambodia. The way of appearance of *Cyprinus carpio* was due to the aforementioned introduce of Le Van Dang. Today, species *Cyprinus carpio* distributes over around the world as a results of anthropogenic farming. In the nature, only they originally distributed from Quang Ngai province, Vietnam (14^0 N) along the eastern slopes of the Truong Son mountain across the Red River basin as well as the basin of the rivers in south of China to the south China sea and Amua river. Besides, the Basin of Mekong River originally did not contain this species. Now, the small tributaries which belongs to Mekong river on Yunnan Province of China (28^0 N), discover to the subspecies of *Cyprinus carpio chilia.* But, this tributaries which were a main flow of the Red River in the past, merged into the Mekong River because of the change of flow. Today, twenty of species are discovered and classified which belong to genus of carp (*Cyprinus).* All of them are narrowly distributed in the mountain areas, except for *Cyprinus carpio* species which to distribute in both the mountain areas and Delta areas while *Cyprinus melanes* species are discovered in the delta areas. The distribution of this 20 species are enclosed by areas which are discovered the distribution of *Cyprinus carpio* species.

Ctenopharyngodon idella species (Valenciennes, 1844) and *Hypophthalmichthys molitrix* (Valenciennes, 1844) species originated from China and were introduced to Vietnam in 1958. The anthropogenic breeding of two of species which were performed by Researchers of aquaculture in Vietnam, were successful. *Oreochromis niloticus* species (Linnaeus, 1758) originated from Africa and Middle East and in Vietnam; they were introduced from Taiwan in 1973. Four species had the wide of ecological threshold, they well lived in most of the inland basins of Vietnam. Besides, their characters were easy to farm and economic efficiency thus, they were widely farmed in all localities. Because of wide farming, these species were distributed to most of basins of Vietnam

Species created a danger to humans: According to the Nguyen Van Hao [182] and our research shows that. In Gianh river basin have only 1 species *Lagocephalus sceleratus* secrete toxins endanger to humans. Similar to other puffer fishes, the silver-cheeked toadfish is extremely poisonous if eaten because it contains tetrodotoxin in its ovaries and to a lesser extent its skin, muscles and liver, which protects it from voracious predators. It becomes toxic as it eats bacteria that contain the toxin. This deadly substance causes paralysis of voluntary muscles, which may cause its victims to stop breathing or induce heart failure.

These species created a danger of mechanics for humans such as: *Dasyatis sinensis Mystus gulio, Hemibagrus centralus, Tachysurus virgatus, Silurus asotus, Pterocryptis cochinchinensis, Clarias fuscus, Plotosus lineatus, Strongylura strongylura, Mastacembelus armatus, Sinobdella sinensis, Paracentropogon rubripinnis, Minous pusillus, Platycephalus indicus, Rogadius serratus, Sorsogona tuberculata, Terapon jarbua, Pelates sexlineatus, Scomberoides lysan, Callionymus curvicornis, Callionymus pleurostictus, Scatophagus argus, Siganus punctatissimus, Anabas testudineus, Triacanthus biaculeatus.*

3.4. Comparison of the composition of species in North Central of Vietnam basins and other acvatic ecosistems

Comparison of the composition of species in North Central of Vietnam basins

In comparison we can say that the number of species from the basin of river Gianh does not differ relevantly from the other basins with the same area and hydrobiotopic peculiarities in the north-center area of the country. Only the basin of river Ma shows a bigger ichthyophaunistic diversity – 263 species (in comparison with 181 species from the basin of river Gianh), having a 6 times bigger hydrobiotopic area and respectively comprising a bigger diversity of habitats for numerous ecological groups of fish. It is important to be mentioned that although the basin of river Lam has almost the same dimensions as river Ma the number of fish species found here is much smaller. One of the causes might be that the results are old as the last investigations about the taxonomic composition in the basin of river Lam were performed in 1983

In the upstream, the flow of the Gianh river which is shaped "V", with southwest - northeast is as a main direction. From point border of Thanh Thach, Huong Hoa, Kim Hoa village, originally. It flows to northwest-southeast, before flowing to westward when it is in the border of the Kim Hoa and the Le Hoa village due to adding water volume of tributary in the right bank. The 3 km distance from bottom of the Ba Don town, Gianh river is contributed continuously water volume from tributary in the right bank, hence it flows to the Phong Nha - Ke Bang area.

From upstream in the Khe Net to the source, it is approximately length 70 - 80 km with many falls in river-bed. Within 20 km from source, stones are chaotic in the river-bed. In Dong Tam, river-bed is wide from 80 - 90 m to peak at 110-115 m. River-bed of the Gianh river has five dunes, small island in the part of river from the Phu Hoa, Quang Tien village to Ba Don town (17°45′25″N, 106°25′10″E). In which, the longest island is 3.8 km while the widest one is 0.8 km. The river-bed is wide 1 km in the Ba Don.

The Phong Nha - Ke Bang national parks, which is located in the southern of the Gianh river, is one of two largest limestone areas over around the world. Comparing to 41 the World Heritage which had Carxto terrain, Phong Nha - Ke Bang is different about terrain, geomorphology and organism. It had a system of 300 large and/or small cave which is appreciated as the most valuable cave in the world by British Cave Research Association (BCRA) with 4 important characters: the longest underground river, the highest and widest entrance, largest and most beautiful sand banks and the most beautiful stalactites.

Comparing to 3 national parks in ASEAN (Gunung Mulu national parks in Malaysia, Puerto Princesa national parks in Philippines and Lorentz national parks in Indonesia) and some carxto terrain in Thailand, China, Papua New Guinea, which are recognized as the World Heritage by UNESCO, the Phong Nha - Ke Ban national parks is older, more complex geological structure and more diverse in underground river than aforementioned national parks.

Besides, the system of cave, the Phong Nha - Ke Bang natinal parks has the longest underground river. Characteristics of limestone in the Phong Nha - Ke Bang area generated a complex system of river, where had little frequent water-containing streams. There are 3 main rivers which are in this national parks, namely, Chay river, Son river and Troóc river. Water source supported for these rivers, is a system of underground streams, which emerged the ground in the caves such as En, Vom, Toi and Phong Nha cave. The three major rivers in the Phong Nha-Ke Bang national park flowed into Gianh river, before, into the south China sea in the town of the Ba Don town, Quang Trach district.

In the part of upstream of the Chay River, water is green which, according to many experts, is due to contain the amount of $Ca(HCO_3)_2$ and other minerals with high concentrations.

The Phong Nha-Ke Bang area also had ten of beautiful streams and waterfalls such as Gio fall, Me Loan fall, Moc stream, and the Tra Ang stream.

The differences from characteristics of Gianh River caused its biodiversity and unique of fish fauna which comparing with those in North Central, where:

- The underground river of limestone formed separation of water body. That is the condition to form the endemic species and faunas with the diversity of species component.
- The Gianh river flows directly into the South China sea, thus, there are many marine species of migrated fish to this river for feeding as well as reproduction.
- The part of the Gianh rivers, which locates in the North of the Truong Son, had many factors of geography and fauna such as the Hoa Nam, MeKong, migration from ocean and native, specially

The data in table 3.4.1. shows that the Ma river basin (28.400 km^2) has the most diverse species composition (263 species, 167 genera, 58 family, 14 order), because the area of this basin is largest in all river basins in North Central, as well as its ecosystem is very diverse; next are Huong river basin (2830 km^2) (186 species, 129 genera, 60 family, 17 order), Thach Han river basin (2660 km^2) (192 species, 128 genera 56 family, 14 order), Nhat Le river basin (2647 km^2) (172 species, 131 genera, 59 family, 14 order), **Gianh river basin** (**4680 km^2**) (181 species, 139 genera, 64 family, 16 order) and Lam river basin (17.730 km^2) (180 species, 110 genera, 41 family, 12 order), number of species have not differ significantly; It is worth noting that the Lam river basin has the area is as large as Ma river basin but its species composition is less than Ma river basin's. Because the results of the study of fish in Lam river basin was made in 1983, species composition have had many changes. Ben Hai river basin is the poorest, there are only 100 species, because this river basin has the smallest area as well as the ecosystem here is very poor.

Table 3.4.1. Number of genera, families, orders and species of fish in the basins of the North Central.

No	Basin (★)	Basin area	Order	Family	Genus	Species	References
1.	Huong river	2830 km^2	17	60	129	186	259
2.	Thach Han river	2660 km^2	14	56	128	192	257
3.	Ben Hai river	964 km^2	12	45	78	100	257
4.	Nhat Le river	2647 km^2	14	59	131	172	35
5.	**Gianh river**	**4680 km^2**	**16**	**64**	**139**	**181**	**Author**
6.	Lam river	17.730 km^2	12	41	110	180	34, 148
7.	Ma river	28.400 km^2	14	58	167	263	20

Notes: (★) Basins are arranged from South to North; Huong river basin in Thua Thien Hue province; Thach Han river basin in Quang Tri province; Ben Hai river basin in Quang Tri province; Nhat Le river basin in Quang Binh province; Gianh river basin in Quang Binh province; Lam river basin in Nghe Anprovince; Ma river basin in Thanh Hoa.

Comparative morphological aspects of the cosmopolitan taxon *Carassius auratus s. lato* from different points of its distribution area

Despite numerous scientific works dedicated to the biology of silver carp, the taxonomic status of the specimen now remains still not fully explained [312]. There are some approaches in this respect. One of them supports the idea that genus *Carassius* Nilson comprises only two adult taxons rating as species: *Carassius carassius* L. - caracuda and *C. auratus* L. - silver carp. The last one forms 2 subspecies: *C. auratus gibelio* Bloch - Euroasian silver carp and *C. auratus auratus* - Chinese silver carp (Prussian carp) with terra typica south to the basin of Amur which include also a large diversity of decorative forms of "goldfish" known everywhere by aquarists. This classification can be seen in the works of Berg, 1948, 1949; Bănărescu, 1964; Popa, 1977; Dolghii, 1993; Movcian, Smirnov, 1983; Apalicova et. al., 2011; Resetnicov 1998; Vasilieva, 2004, and others [1], [306], [307], [311], [315], [318], [319], [320].

Another classification is proposed and based on the works of Kottelat M. [60, 69], where the taxonomic status of caracuda remains unchanged, but the Euroasian silver carp and the Chinese one are considered species *C. gibelio* Bloch and respectively *C. auratus* L. Now this classification is considered right by many systematicians, ecologists and geneticians [30, 46, 308, 314]. According to the affirmations made by some researchers [304], [305], [309], [313], [321] the poliploid unisexed silver carp (3n = 135 - 165) - *Carassius gibelio* Bloch, 1782, penetrated into the aquatic basins of Europe in the XIX^{th} century and by the beginning of 1960s of the XX^{th} century it was the only identified form here. Subsequently, as a result of massive works of acclimatization the second species, the amphidiploid bisexual Chinese carp (2n = 98 - 100) - *Carassius auratus* Linnaeus, 1758, penetrated here. In populations both sexes are represented about equally and in a short period of time invaded the whole Ponto-Caspian basin [304], [312], [316], [317]. Current researches at cariologic level demonstrated that between triploid and diploid forms a change of genetic material takes place, with a tendency towards an unidirectional transformation of the triploid ginogenetic form into a bisexual diploid one [305], [306]. Recent studies performed on the teritory of Republic of Moldova on silver carp populations confirmed the fact that there is an increase in the sex structure with an increased share of males in lake Beleu and Manta ponds (inferior basin of river Prut) being almost reported as 1:1, and the analyzed mormometric and ecologic characters questioned the identification of the right taxon *Carassius gibelio* Bloch, 1782 [2].

Fig. 3.4.1. *Carassius auratus* (Vietnam)

Fig. 3.4.2. *Carassius auratus* s. lato (lake Beleu, Republic of Moldova)

In this regard we proposed ourselves to perform a comparative morphological analysis of the silver carp from Republic of Moldova (with an uncertain taxonomic status) with a sample from Vietnam which is unanimously recognized as Chinese silver carp *Carassius auratus* Linnaeus, 1758, and to confirm the hypothesis of a double penetration of the taxon in Europe.

Table 3.4.2. Meristics of *Carassius auratus s.lato* and *Carassius auratus*

Meristics	*Carassius auratus s.lato* (Lower Prut, Republic of Moldova)	*Carassius auratus* (Control sp. Vietnam)
D	III.18	III. 16 - 17
A	III.5	II-III.5
P	1.15 - 17	1.13 - 15
V	1.8	1.7 - 8
C	4.17	4.18
Csc	13	14 - 15
PrD	10 - 11	10 - 11
Sc	7	6 - 7
L.l.	29 - 30	30 - 32
TSD	6	6
TSV	4	6

During the comparative analysis of the meristic characters there was highlighted the existence of some differences in the formula of the fins (D, A P, V), in the number of scales in the lateral line (1.1), in the number of cross scales between lateral line and origin of fins, and others, but the obtained results do not permit us to assert with confidence that the taxon from the lake Beleu is undoubtedly *Carassius gibelio* Bloch, 1782 (Table 3.4.2.)

More close to the truth would be to support the affirmations of some cytogenetic studies which demonstrate that triploid females (3n = 150) can reproduce both ameiotic ginogenetically and meiotic sexually [23], [279]. The odd poliploid body can have sexual chromosomes XXX or XXY where Y-heterochromosome is in a repressive state. The strengthening of the anthropic pressing and instability of environmental factors (a state particularly relevant in the lake Beleu where there are draughts very often, alternations of oxigen consentrations and extreme temperatures) cause “a passing” from the ameiotic ginogenetic form of the silver carp into a meiotic bisexual one where can appear triploid males with XXY heterosomes [304].

When analysing the comparative morphometric characters there can be also observed that in the majority of cases there are no significant differences, and those which were attested do not permit the validation or information of the species as *Carassius gibelio* Bloch, 1782 (Table 3.4.3.)

The significant differences of the metric characters are determined by the peculiarities of the ecologic conditions established in the ecosystems from which there were collected samples and by the high adaptive potential of the taxon. Some other comparative morphological studies of bisexual and unisexual populations of silver carp [310], also confirm the fact that there are no sure differences in the majority of characters, and this does not permit to validate the species through classical methods. The distinctive morpho-metric characters sustained by Kottelat M. (2007) also are not determining, as they are based mainly on the colour of the body (the Chinese carp is more yellowish) and on the number of scales from the lateral line (at Chinese carp 26 - 31 and at the Euroasian one 29 - 33) [69]. Mejerin (2009) argues that the separation of these taxons can only be done using genetic markers because of the rapid transgression of the distinctive morpho-metric characters (although there have been observed some tendencies towards special separation of these biotypes) [316]. But the studies performed by using the genetic markers on the teritory of China demonstrate that the Chinese silver carp and the Euroasian one are equally identified as belonging to both species: *Carassius auratus* Linnaeus, 1758 and *Carassius gibelio* Bloch, 1782 [233].

Table 3.4.3. Morphometric of *Carassius auratus s.lato* and *Carassius auratus*

Morphometric	***Carassius auratus s.lato* (Lower Prut, Republic of Moldova) n = 18**				***Carassius auratus* (Vietnam), n = 8**				**t Student**
	Mean	**Min**	**Max**	**SD**	**Mean**	**Min**	**Max**	**SD**	
SL/Bd	2.43±0.01	2.29	2.55	0.066	2.48±0.01	2.34	2.71	0.119	**-2.14806**
SL/HL	3.21±0.02	3.08	3.39	0.083	3.14±0.02	2.97	3.59	0.200	2.009827
SL/Dhl	4.05±0.05	3.59	4.46	0.237	4.18±0.04	3.84	4.68	0.288	-1.83569
SL/Prdl	1.95±0.01	1.86	2.08	0.054	1.97±0.008	1.91	2.09	0.061	-1.265088
SL/Podl	6.06±0.08	5.37	6.61	0.366	6.22±0.04	5.61	6.58	0.309	-1.611576
SL/Lcp	7.62±0.14	6.47	8.53	0.579	7.12±0.108	6.23	8.06	0.760	**2.818163**
SL/Dcp	6.43±0.04	6.05	6.80	0.195	6.42±0.06	5.91	7.30	0.422	0.130484
HL/SnL	3.39±0.04	2.98	3.61	0.181	3.40±0.03	2.94	3.61	0.234	-0.181286
HL/Ed	3.55±0.05	3.14	3.89	0.217	4.07±0.04	3.73	4.64	0.288	**-7.780718**
HL/Iw	2.38±0.01	2.22	2.53	0.070	2.32±0.02	2.10	2.60	0.154	**2.162798**
HL/Po	2.07±0.01	1.96	2.18	0.075	2.05±0.008	1.98	2.16	0.056	1.010655
HL/Lcp	2.38±0.04	2.04	2.68	0.201	2.27±0.02	2.04	2.48	0.171	2.017775
HL/Dcp	2.00±0.06	1.89	2.15	0.067	2.05±0.02	1.87	2.35	0.148	-1.762762
Iw/Ed	1.49±0.02	1.30	1.70	0.107	1.77±0.02	1.52	2.21	0.209	**-7.09179**
Lcp/Dcp	0.85±0.01	0.74	1.00	0.073	0.91±0.01	0.78	1.01	0.090	**-2.729388**
P→V/V→A	0.68±0.007	0.61	0.73	0.032	0.60±0.01	0.43	0.68	0.078	0.96829

Note: $n_{\text{(Republic of Moldova)}}$ = 18 ind.; $n_{\text{(Vietnam)}}$ = 8 ind.; p=95% (0,05); g=24; t_{tabel}=2,064

All these results show, on the one hand, that the biology of the silver carp is still far from being fully studied, and the majority of "current populations" represent a "genetic mixture of predecessors from different regions", in some cases being more correct to mention the taxon as *Carassius auratus s. lato* or as *Carassius auratus* - complex.

3.5. The causes of threats and proposals of conservation of fishery resources in Gianh river basin

3.5.1. The causes of threats to biodiversity of fish in the study area

In recent years, the ban on exploiting, hunting and fcatching wildlife animals has been implemented strictly, closely at the locals. However, for the large animals such as birds and animals, the hunt was almost prevented, fishes are the main object of people because they have large numbers, widely distribute and are easy to catch. We can say that fish fauna in Gianh river basin plays important role in providing food for the local people here. Especially fishes have high economic value are purchased in bulk as the species: ... have become a target catch of the people in any way.

During our study in Gianh river basin, fishing activities that local people use were discovered, along with the service activities of human livelihoods are seen as threats to fish stocks including fishing activities, exploitation of forest products, activities affecting their environments are.

The wild fish species in the Ichthyofauna of the Gianh river basin from Vietnam are significantly decreasing in quantity and number of species. Some species are in danger of extinction and many species are reducing in number, which have adverse impact on the nature richness, diversity and specificity of the fauna. Surveys, interviews to local fishermen and people, through real sampling and number of samples obtained has show that the quantity of fishing sector is decreasing, which is only 10% - 20% compared to the 80s of the last century. There are many factors that negatively affect natural fish resources. These include common factors such as climate change affecting ecosystems or the pressure of the process of urbanization, industrialization, with many industrial parks, factories rising. Population growth quickly, modernization of technique and exploitation of natural resources also increased to serve the increasing demand of people. Besides, the natural fish resources are also be affected by the market economy, the increase of price, daily needs.... All these abovementioned factor have affected directly or indirectly to the exploitation and protection of biodiversity including fish species.

According to a survey of the local fishermen and people, the majority of whom have resided in this area for over 30 years, there are many factors that affect fish source: overfishing, large destruction fishing equipment, management and consciousness of people, water pollution and other causes (deforestation, floods ...)

Overfishing: We can see that this is the main cause, the greatest impact on fish resources in Ichthyofauna of the Gianh river basin from Vietnam particular and the region in general. Population is still increasing and demand for food of fish rises, so large quantity of wild fish is overexploited in many forms to meet these requirements. The use of fishing nets, gill nets, fishing activities have generated big pressure on fish stocks in the estuary. And in the middle and upper areas, despite lower intensity fishing than downstream, due to narrow rivers, streams and the use of electric pulses, fish stocks are declining. Most days of the week there are fishermen in a river or stream segments, which has caused certain pressure on fish resource.

Destructive exploitation: The use of destructive exploiting equipment to fish resources like small mesh fishing nets, which can catch young fish, is very popular. Fishing equipment is outdated in terms of the level of selection of proper fish to catch which resulting in catching young fish. The rate of trash and young fish falling into the nets is high, which decreases the revenue of fishing. The use of chemicals and building dam at the streams not only kills fish in large scale, but also destroys other aquatic features and pollutes the water.

The regular use of electrical impulses in the upper and middle area, or use of explosives ... in the downstream and estuary area have major effect on stocks of fish. In case these forms of fishing take place in estuary areas, it will affect the migration, spread of two-way migrating fish. These activities also limit the penetration fish species from the sea to the brackish water, reducing fish stocks here. Destructive fishing means and high intensity of exploitation also affect the ability to recover of fish stocks. If this process takes place for a long time, the quantity and the number of fish share decrease considerably, especially with high value fish.

The current situation requires the attention of the management at local level, as well as awareness of protection and sustainable development of local resource. In Ichthyofauna of the Gianh river basin from Vietnam, there has not been any research works specializing in evaluating the current resource. There is also a lack of promotion program and good forms of proper fishing and protection of local resources. The management is still loose. The pressure of overfishing continues to rise, causing exhaustion. The fishery has not been properly planned, failing to meet requirements of quantity as well as quality. There are very few educated labors, therefore, exploitation activities depend mainly experience. The management and people’s awareness of the protection of diversity are still incompetent.

In the Gianh river basin from Vietnam, low intellectual level, and the fact that major population are ethnic minorities, plus the lack of management of government make the protection and development of resources very difficult. On the other hand, for fishermen, fishing is their basic needs, especially in estuary Gianh and Phong Nha - Ke Bang National Park, where mostly fishermen and their income depend entirely on fishing activities. If they are restricted in fishing activities, their daily life shall be seriously affected, especially in current economic conditions. It can be seen that this is a dilemma that can hardly be solved in a short time without the basic research on the existing resources and the socio-economic investigation in fishing sector. Based on this analysis, we present the factors that endanger fish biodiversity in the study area as follows:

- ✓ Method of fishing with high intense such as using explosives, poisons and electric shocks. The use of dynamite in fishing has been prohibited, but it still happens in some places. However, using of poisons and electric shocks is more common in the study area.
- ✓ Some exploitation of fishery resources are not properly also cause harm to the fish, such as the use of nets with small mesh sizes, fishing during the breeding season or at breeding sites are also the direct cause of depleting fish stocks.
- ✓ Due to the difficult economic life of local people, mainly ethnic minorities living on both sides of the basin, the lives of the people here are mostly self-sufficient so that their demand for food pressure fishery resources.
- ✓ The exploitation of natural resources affect the environment, such as exploiting minerals, gold, .and building dams, activities altering the flow in the basin are also the indirect cause to affect fish stocks.
- ✓ The problem of environmental pollution such as waste, unscientific construction works to serve tourists visiting the landscape of the Phong Nha - Ke Bang National Park especially the tourist route to caves also affect fish stocks.

3.5.2. The proposals for the protection and conservation of fish biodiversity in the study area

Ichthyofauna of the Gianh river basin from Vietnam plays an important role in daily life and income of local people. Although the fish resources of rivers and streams are naturally renewable resource, it is not unlimited without being used and exploited appropriately. This result is the first step to assess the current conditions of fish resource and the direct and indirect factors that affect it. In particular, due to the characteristics of estuary Gianh and Phong Nha - Ke Bang National Park, it may be considered that the fishing of Anguilla marmorata Quoy & Gaimard, 1824 is a burning issue for the conservation of biological diversity. Data plays an important part in the proposed plan, exploitation program and protection of fish resources in Ichthyofauna of the Gianh river basin from Vietnam.

We prohibit the exploitation of these followings: *Anguilla marmorata, Clupanodon thrissa, Hypsibarbus annamensis, Konosirus punctatus, Bostrychus sinensis*. We prohibit the exploitation of 5 species: Ichthyofauna of the Gianh river basin from Vietnam. These are species listed in the Red Book and are very rare in this study.

The completion of the basic scientific data: Continuing basic research on fish fauna, ecological features and phenomena of all fish species in the area. This is an important database to serve the protection and development of resources. Management and exploitation of resources: building regulations on the exploitation, protection and development of local fish stocks. Strictly and specifically conduct and monitor the implementation of fishing regulations. To reduce excessive exploitation of resource, it is necessary to require local fishermen to exploit under the control of village government. In the upper and middle area of the river, rivers and streams should be divided into sections and area and allocated it to fishermen to manage and exploit. We should manage fishing times during the week, fishing location, time and distance to travel. In the downstream, salt water is usually present, therefore, there are many marine fish species, especially migratory species that move to the river to spawn. The way of management to this issue is similar to the abovementioned methods, which are dividing river into sections and managing fishing intensity. The fishing of migratory fish from the sea to the river to spawn in their spawning season should be banned, ensuring the recovery of resources. In the estuary area, where "the resource is renewable", it not only enriches itself, but also cultivates and maintains stability for neighboring systems. Fishery should gradually shifts to the deep and offshore waters, in order to reduce pressure on estuaries and shallow waters. In addition, there should also be areas where fishing is banned temporarily or permanent. The use of outdated and destructive fishing equipment such as: electric impulses, explosives, toxic chemicals should be prohibited. Environment-friendly and selective fishing methods including offshore long line, mobile and fix fishing gills should be encouraged, while restrict the use of small-sized mesh fishing net and avoid catching small fish. At first we should promote and give instructions to fishermen, if it does not work, strict punishment of violators must be carried out.

Protection Planning: In the Phong Nha - Ke Bang National Park where there are many caves, estuaries where there are unique environments with heterogeneous living conditions increase the variation in species. Furthermore, the estuary is the place where marine species feed and breed ... and it plays an important role in maintaining marine biodiversity. The development of resources to ensure the long term conservation of local resources, and the lives of the native fishermen should be concerned because their income depends on fish stocks of the region. However, conflicts of interests will make it difficult for conservation. It requires: Proper investment for the extension, encouragement of fishery and support the households to contribute to the development of resource. Aquaculture Development, the selection of appropriate species with high economic returns which is suitable with local growing conditions is necessary. We should keep raising: *Notopterus notopterus* (Pallas, 1769); *Cyprinus carpio* Linnaeus, 1758; *Cirrhinus molitorella* (Valenciennes, 1844); *Ctenopharyngodon idella* (Val., 1844); *Hypophthalmichthys molitrix* (Valenciennes, 1844); *Oreochromis niloticus* (Linnaeus, 1758); *Channa striata* (Bloch, 1793); *Clarias fuscus* (Linnaeus, 1758). In addition, we should focus on development of: *Anguilla marmorata* Quoy & Gaimard, 1824; *Carassioides acuminatus* (Richardson, 1846); *Hypsibarbus annamensis* (Pel. & Che., 1936); *Neolissochilus benasi* (Pellegrin & Chevey, 1936); *Onychostoma gerlachi* (Peters, 1881); *Paraspinibarbus macracanthus* (Pel. & Che., 1936); *Spinibarbus denticulatus* (Oshima, 1926); *Spinibarbus hollandi* Oshima, 1919; *Misgurnus anguillicaulatus* (Cantor, 1842); *Hemibagrus centralus* Mai, 1978; *Monopterus albus* (Zuiew, 1793); *Lates calcarifer* (Bloch, 1790); *Epinephelus awoara* (Tem. & Sch., 1842)… to serve tourism and domestic consumption.

However, comprehensive research and thorough investigation must be conducted to ensure the supply for the area or other regions, while ensuring income, living standards of local people. We can increase fish production, and fishing quantity in deep and offshore water, replace fishing by other industries, in turn gradually make people's income less dependent on natural fish stocks. From this, the conservation of fish species in the area shall be far easier, and be supported by local people. Foster and train qualified fishermen: Local policies should focus on professional training for key officials in the fisheries sector. For fishermen, it is necessary to train the captain, skilled labor who are capable of applying science to advanced techniques to perform offshore fishing. Other workers should be trained on fishing equipment to use it effectively. Knowledge of fishermen on conservation value and sustainable development should also be improved.

Environment Protection: Protect and develop the vegetation, increase the area of natural forests in the watershed, mangrove forests in estuaries. Require factories to perform the wastewater treatment before discharging it into the river. Treat seriously and thoroughly units that violates the regulations. The emphasis should be raising awareness of resource protection for the public by propaganda and mobilization, transfer the responsibility to people to join in environmental and fish resources protection in Ichthyofauna of the Gianh river basin from Vietnam. On this basis, we made the recommendations on the protection and conservation of fish biodiversity in the study

The diversity of fish species here have shown the importance of the fish fauna to the biological diversity as well as its role in the livelihood issues and social welfare here. But fishing of local people has destructive nature and is not scientific that caused significant impact on the number of fish species. Therefore, we offer a number of specific measures to protect biodiversity and fish resources in the study area in accordance with the actual situation of local as following:

- ✓ Reconstruction of species habitats with community interest and extinction of protected areas (maintenance of the banks, stabilizing bottom, planting trees along the riverbed, full restoration of natural conditions in caves, extending wetlands, etc.)
- ✓ Reduction of pollution (construction of new wastewater treatment plants and rebuilding of old ones, improving technologies for collection, storage and processing of waste in densely populated areas and those with touristic destination located along the river, springs cleaning, sanitation of banks, etc.)
- ✓ Stopping the issue of individual licenses for the exploitation of mineral resources in rivers and a strict control of enterprises that have this right. Limiting building dams and other hydraulic structures that affect the morphological integrity of riparian territories.
- ✓ Banning the destructive methods of catching fish such as light (as a source of enticement), toxic substances, explosives, small-meshed nets. Compliance to permitted times and places for fishing, the number of species fished, the minimum allowable size, etc.
- ✓ Saving juveniles from overflowing flood, a tighter control over penetration of alien species of fish and invertebrates, and on epidemiologic state, etc.
- ✓ Directed reproduction of indigenous fish species of community and functional importance, and systematic restocking of natural aquatic ecosystems with larvae and juveniles of these species.
- ✓ Improving living conditions of the local population, their active involvement in work and stimulating methods of voluntary ecological compliance (in competition with the restrictive ones) with the aim to protect and restore fish resources in the area.
- ✓ Strict scientific monitoring which provides a systematic assessment of ichthyofaunistic diversity and the structural-functional ichthyocenotic state, permanent perfection of biotechnologies of artificial reproduction of native species of fish (in recirculating systems), overseeing the acclimation works, a genetic control over breeders and over epidemiologic state in fishing communities.
- ✓ Dissemination of knowledge through educational courses on protection and sustainable exploitation of fishing resources among local people.

3.6. Conclusion of chapter 3

- There have been attested 181 fish species that belong to 139 genera, 64 families and 16 ordins in the hydrographic basin of province Gianh Quang Binh.
- There have been identified 119 species in the National Park Phong Nha - Ke Bang from which: 21 specise have been attested in cave ecosystems, 20 species in rice fields (and other flooding zones), 52 species in ponds and dam lakes, 72 species in upper riveran areas, 66 species - in middle sectors, 69 species - in lower riveran areas, and 109 species in estuary zone.
- Fish species *Schistura kottelati* Tuan et all, 2015; *Carassioides phongnhaensis* Tu & Tuan, 2003 and *Cyprinus hieni* Tu & Tuan, 2003 were registered and approved as new specise for science.
- There heve been underlined peculiarities of spatial repatrition of 52 species from the basin of river Gianh.
- There have been identified 84 fish species that have a high economic value and 3 invasive allogenic species. 26 species created a danger to humans.
- The ichthyofauna of river Gianh is unique as to its number of species, share of stenotopic species, and an impressive number of rare species which are important for community and those which were unsufficiently studied (DD and NE according to IUCN).
- According to the International Red List (IUCN) in the basin of river Gianh there were identified 5 species almost threatened with Near Threatened (NT), 3 species is level vulnerable (VU), 1 species is level Endangered (EN), and 67 species is level Least Concern (LC), 78 species is level Not Evaluated (NE), 27 species is level Data Deficient (DD). According to National Red List there have been identified 5 fish species with rarity status.
- In order to protect efficiently a species and insure the success of its perpetuation in time and space the whole habitat should be protected.
- The scientific-practical recommendations for protection and improvement of fish resources in the basin of river Gianh have an undeniable practical importance in the process of ecological reconstruction, bioindication and monitoring of well-being of aquatic ecosystems in the region.

4. DESCRIPTION OF BASIC MORPHOLOGICAL CHARACTERISTICS OF FISH SPECIES IN GIANH RIVER BASIN

In order to study the ichthyofaunistic diversity a special importance has the correct determination of taxis and the highlighting of phenotypic variability within the population or between different populations and in this case the classical metric and meristic method is used. Any determinator uses these measurements.

In case of come regions on the globe where the faunistic and floristic diversity is insufficiently studied, the description of these characters has an utmost importance and serve as pertinent evidence in the validation of species new to science. In determining some problem species in this work such international specialists as M. Kottelat şi J. Freyhof have been involved.

Also the metric and meristic measurements of the caught individuals allow to calculate some corporal indices that help in evaluation of the phisiological state of fish and their living conditions in different ecosystems. The necessity of these investigations appears when characters (or reports of characters) are compared for populations of the same species of fish which habitate in different types of aquatic ecosystems (e.g. lake and river) or in cases od far away points within the distribution area of the taxon (example carp from Vietnam and Moldova).

Determination of variablity of caharacters at collected individuals on the basis of measuring, counting, weighing and processing of obtained data through statistics of variations constitutes the area of competence of biometric studies, and the imposing number of individuals undergoing this analysis (1882 individuals) and identification of new species for science (from 181 identified species 3 are new for science: *Schistura kottelati* Tuan et al., 2015; *Carassioides phongnhaensis* Tu & Tuan, 2003 and *Cyprinus hieni* Tu & Tuan, 2003 show the high prestige of the work and a major impact of the obtained results for the entire scientific national and international community.

Along with the classical criteria (the morphological one and that of reproductive isolation at animals), the modern science provides the researchers with genetic and biochemical criteria of great finesse but moe difficult to apply in the current practical research. Some of them even question the classical definition of the concept of species. The importance of these theoretical problems for the practice of biodiversity protection is undoubted but we consider that it should not be exagerated, but it must be cautionly combined, and in no case should it diminish the importance of the classical methods of taxonomic analysis.

4.1. Description of basic characteristics of fish species

I. ORDER RAJIFORMES

(1). FAMILY RAJIDAE

***1. Dasyatis sinensis* (Steindachner, 1892) desciption of basic characteristics of fish resources in Gianh rive basin**

Total sample. Analyzed: 5 specimens

Synonyms. *Dasybatus sinensis* (Steindachner, 1892); *Trygon sinensis* Steindachner, 1892

Description. In percentages to the disc width, disc length 98.4%, head length 36.6, interspiracle width 17.4, spiracle diameter 7.2, preoral snout length 21.8, preorbital snout length 25.0, eye diameter 3.5, interorbital width 10.4, moth width 10.5, prebranchial length 36.2, first interbanchial with 23.1, 5^{th} interbranchial width 15.7, ventral fold length 44.8, dorsal fold length 14.8, trunk length 82.0.

Disc of body diamond. Disc moderately flat and thick, fairly pointed anteriorly and rounded posteriorly. Disc width and disc length almost equal. Length of preoral snout about two times of mouth width. Snout fairly prominence, and its angle about 100^0. Preorbital snout length short, but longer than preoral length. Dorsal surpace in center of shoulder and front of poison spine of tail with granular tubercle. Midline of snout with many sensory porses. Interorbital width to snouth length about 41.6 percent. Clasper of matured male large and stout. Teeth of upper and lower jaws with round form and with a cusp each. Posterior part of tail rough and asperities. (Figure A 1.1.)

Sampling locations in the study area: (1); (2) (Figure 2.1.1.)

II. ORDER MYLIOBATIFORMES

(2). FAMILY GYMNURIDAE

***2. Gymnura poecilura* (Shaw, 1804)**

Total sample. Analyzed: 3 specimens

Synonyms. *Pastinaca kunsa* Cuvier, 1829; *Pteroplatea annulata* Swainson, 1839; *Raja poecilura* Shaw, 1804.

Description. The pectoral fin disc of the longtail butterfly ray has the lozenge shape characteristics of its family, measuring around twice as wide as long. The leading margin of the disc is gently sinuous, the trailing margin is convex, and the outer corners are mildly angular. The snout is short and broad, with a tiny protruding tip. The medium-sized eyes have larger, smooth-rimmed spiracles behind. The nostrils are positioned close to the mouth; between them is a short and broad curtain of skin with a smooth margin. The large mouth forms a transverse curve and contains over 50 tooth rows in each jaw, increasing in number with age; the teeth are small, narrow, and pointed. There are five pairs of short gill slits on the underside of the disc. The pelvic fins are small and rounded.

The thread-like tail lacks dorsal or caudal fins, though there are low ridges along its length above and below. Its length is about equal to the distance between the snout tip and the vent, distinguishing this species from other butterfly rays that have shorter tails. Sometimes there is a small stinging spine (very rarely two) on the upper surface of the tail near the base. The skin is devoid of dermal denticles. This species is brown to greenish brown to gray above, with many small pale spots and sometimes also a smattering of dark dots. The tail has nine to twelve black bands alternating with white bands, which often have a small, dorsally positioned dark spot within. The underside is white, darkening at the edges of the fins. (Figure A 1.2.).

Sampling locations in the study area: (1) see (Figure 2.1.1.)

III. ORDER OSTEOGLOSSIFORMES

(3). FAMILY NOTOPTERIDAE

3. *Notopterus notopterus* (Pallas, 1769).

Total sample. Analyzed: 7 specimens

Synonyms. *Notopterus primaevus* Günther, 1876; *Gymnotus notopterus* Pallas, 1769; *Notopterus kapirat* Lacepède, 1800.

Meristics. D = 7; A = 96 - 103; P = 1.14; V = 1.5 - 6; C = 14 - 16. PrD = 100 - 120; Ll 142 - 162 (TSD = 27 - 30; TSV = 30 - 36)

Morphometric. SL = 3.49 (3.24 - 3.52) Bd = 5.45 (4.98 - 6.21) HL = 1.72 (1.59 - 1.78) Prdl = 3.14 (3.04 - 3.25) Podl = 3.91 (3.27 - 4.17) BdD = 3.59 (3.44 - 3.72) BdA; HL = 3.45 (3.02 - 4.00) SnL = 4.05 (3.02 - 4.09) Ed = 3.09 (2.78 - 3.49) Iw = 1.16 (1.00 - 1.25) Po = 1.08 (0.97 - 1.29) Hdn = 2.14 (1.99 - 2.42) Hwn = 2.16 (2.00 - 2.57) Hwe; Bd = 1.47(1.22 - 1.56) Hdn = 1.23(1.07 - 1.89) BdD; Iw = 1.37 (1.25 - 1.49) Ed; Po = 2.45 (2.12 - 2.67) SnL. (Figure A 1.3.).

Sampling locations in the study area: Not distributed in (25); (27) see (Figure 2.1.1.)

IV. ORDER ANGUILLIFORMES

(4). FAMILY ANGUILLIDAE

***4. Anguilla marmorata* Quoy & Gaimard, 1824**

Total sample. Analyzed: 6 specimens

Synonyms. *Anguilla mauritiana* Bennett, 1831; *Muraena manillensis* Bleeker, 1864; *Anguilla johannae* Günther, 1867.

Meristics. D = 240; A = 210; P = 21; C = 20.

Morphometric. SL = (13.0 - 16.0) Bd = (6.2 - 6.9) HL; HL = (9.0 - 10.0) Ed = (4.6 - 4.8) Iw = (4.5 - 6.0) SnL; Iw = (2.0 - 2.5) Ed. (Figure A 1.4.)

Sampling locations in the study area: Not distributed in (25); (27) see (Figure 2.1.1.)

(5). FAMILY OPHICHTHIDAE

5. *Ophichthus celebicus* (Bleeker, 1856)

Total sample. Analyzed: 2 specimens

Synonyms. *Ophisurus celebicus* Bleeker, 1856; *Ophichthys celebicus* (Bleeker, 1856); *Ophisurus broekmeyeri* Bleeker, 1856

Morphometric. Bd = (3.5 - 4.1) % SL; HL = (9.4 - 11.1) % SL; Lcp = (1.5 - 1.8) Pral. (Figure A 1.5.).

Sampling locations in the study area: (1) see (Figure 2.1.1.)

***6. Pisodonophis boro* (Hamilton, 1822)**

Total sample. Analyzed: 2 specimens

Synonyms. *Ophisurus boro* Hamilton, 1822; *Ophichthys boro* (Hamilton, 1822); *Ophisurus harancha* Hamilton, 1822

Morphometric. Bd = (2.0 - 3.1) % SL; HL = (8.6 - 10.3) % SL; Lcp = (1.4 - 1.5) Pral. (Figure A 1.6.).

Sampling locations in the study area: (1) see (Figure 2.1.1.)

(6). FAMILY CONGRIDAE

7. *Gnathophis nystromi* (Jordan & Snyder, 1901)

Total sample. Analyzed: 2 specimens

Synonyms. *Leptocephalus nystromi* Jordan & Snyder, 1901; *Rhynchocymba nystromi* (Jordan & Snyder, 1901); *Rhynchocymba nystromi nystromi* (Jordan & Snyder, 1901)

Morphometric. Bd = (5.6 - 7.7) % SL; HL = (16.7 - 20.1) % SL; Lcp = (1.4 - 1.7) Pral. (Figure A 1.7.).

Sampling locations in the study area: (1) see (Figure 2.1.1.)

8. ***Rhynchoconger ectenurus*** **(Jordan & Richardson, 1909)**

Total sample. Analyzed: 2 specimens

Synonyms. *Leptocephalus ectenurus* Jordan & Richardson, 1909; *Rhynchocymba ectenura* (Jordan & Richardson, 1909)

Meristics. V = 11 - 13;

Morphometric. Bd = (3.9 - 5.4) % SL; HL = (11.8 - 15.9) % SL; . Lcp = (1.6 - 2.5) Pral. (Figure A 1.8.).

Sampling locations in the study area: (1) see (Figure 2.1.1.)

V. ORDER CLUPEIFORMES

(7). FAMILY CLUPEIDAE

9. Clupanodon thrissa **(Linnaeus, 1758)**

Total sample. Analyzed: 12 specimens

Synonyms. *Clupea thrissa* Linnaeus, 1758; *Clupea triza* Linnaeus, 1759; *Chatoessus maculatus* Richardson, 1846.

Meristics. D = 15 - 17. A = 20 - 24. P = 16. V = 8. Ll = 52 - 56.

Morphometric. SL = 3.04 (2.98 - 3.11) Bd = 3.20 (3.09 - 3.31) HL = 6.14 (5.95 - 6.33) Lbd = 4.20(4.02 - 4.39) Lba = 9.88(9.86 - 9.91) Lcp = 10.30 (10.12 - 10.47) Dcp; HL = 4.19 (4.13 - 4.26) SnL = 4.02 (3.99 - 4.05) Ed = 4.30 (4.29 - 4.31) Iw = 3.09 (2.98 - 3.21) Lcp = 3.22 (3.16 - 3.28) Dcp; Iw = 0.93 (0.92 - 0.94) Ed; Lcp = 1.04 (1.02 - 1.06) Dcp. (Figure A 1.9.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

10. ***Konosirus punctatus*** **(Temminck & Schlegel, 1846)**

Total sample. Analyzed: 21 specimens

Synonyms. *Chatoessus punctatus* Temminck & Schlegel, 1846; *Clupanodon punctatus* (Temminck & Schlegel, 1846); *Nealosa punctata* (Temminck & Schlegel, 1846).

Meristics. D = 15 - 17; A = 20 - 24; P = 16; V = 8; Sq = 52 - 56.

Morphometric. SL = 3.09 (2.78 - 4.11) Bd = 3.68 (3.63 - 3.76) HL = 6.30 (6.01 - 6.55) Lbd D = 4.58 (4.35 - 4.79) Lba = 10.88 (9.52 - 11.68) Lcp = 9.22 (9.00 - 9.41) Dcp; HL = 4.48 (4.06 - 4.81) SnL = 3.34 (3.10 - 3.62) Iw = 3.71 (3.67 - 3.76) Ed = 2.95 (2.58 - 3.15) Lcp = 2.50 (2.39 - 2.58) Dcp. Iw = 0.90 (0.84 - 0.98) Ed; Lcp = 0.85 (0.80 - 0.99) Dcp. (Figure A 1.10.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

11. *Escualosa thoracata* (Valenciennes, 1847)

Total sample. Analyzed: 7 specimens

Synonyms. *Kowala thoracata* Valenciennes, 1847; *Kowala coval* (Cuvier, 1829); *Meletta lile* Valenciennes, 1847.

Meristics. D = 15; A = 19; P = 13; V = 7; Ll = 40.

Morphometric. SL = 3.82 (3.67 - 4.12) Bd = 3.70 (3.76 - 3.63) HL = 6.46 (6.45 - 6.48) LbD = 4.46 (4.35 - 4.57) Lba = 11.06 (10.86 - 11.27) Lcp = 9.02 (9.00 - 9.03) Dcp; Hl = 4.42 (4.06 - 4.78) SnL = 3.21 (3.10 - 3.32) Iw = 3.72 (3.67 - 3.76) Ed = 3.00 (2.89 - 3.10) Lcp = 2.44 (2.39 - 2.49) Dcp; Iw = 0.86 (0.88 - 0.84) Ed; Lcp = 0.82 (0.80 - 0.83) Dcp. (Figure A 1.11.).

Sampling locations in the study area: (1) see (Figure 2.1.1.)

***12. Sardinella albella* (Valenciennes, 1847)**

Total sample. Analyzed: 12 specimens

Synonyms. *Kowala albella* Valenciennes, 1847; *Clupalosa bulan* Bleeker, 1849; *Clupeonia perforata* Cantor, 1849.

Meristics. D = 18 - 19; A = 20 - 11; P = 16; V = 8; Ll = 49 - 50. Scutes = 32 - 34.

Morphometric. SL = 3.61 (3.55 - 3.67) Bd = 3.92 (3.79 - 4.03) HL = 5.86 (5.22 - 6.39) Lbd = 5.96 (5.75 - 6.40) Lba = 10.97 (10.61 - 11.45) Lcp = 10.16 (9.78 - 10.60) Dcp; HL = 3.56 (3.37 - 3.78) SnL = 3.21 (3.04 - 3.49) Iw = 4.81 (4.47 - 5.09) Ed = 2.80 (2.63 - 2.94) Lcp = 2.60 (2.49 - 2.80) Dcp; Iw = 0.67 (0.61 - 0.71) Ed; Lcp = 0.93 (0.85 - 1.00) Dcp. (Figure A 1.12.).

Sampling locations in the study area: (1) see (Figure 2.1.1.)

(8). FAMILY ENGRAULIDAE

***13. Thryssa vitrirostris* (Gilchrist & Thompson, 1908)**

Total sample. Analyzed: 7 specimens

Synonyms. *Engraulis vitrirostris* Gilchrist & Thompson, 1908; *Thrissa vitirostris* (Gilchrist & Thompson, 1908); *Thrissocles vitirostris* (Gilchrist & Thompson, 1908).

Meristics. D = 15; A = 19. P = 14; V = 7; C = 23. Sq = 39 - 40. Scutes of P → V: 5. Scutes of V → A: 9 - 10.

Morphometric. SL = 4.90 (4.85 - 4.96) Bd = 4.15 (4.09 - 4.22) HL = 6.23 (6.01 - 6.45) Lbd = 5.10 (5.04 - 5.15) Lba = 6.15 (6.06 - 6.25) Lcp = 10.75 (10.66 - 10.85) Dcp; HL = 4.43 (4.32 - 4.54) SnL = 4.01 (3.93 - 4.08) Ed = 3.87 (3.80 - 3.95) Iw = 1.48 Lcp = 2.59 (2.53 - 2.65) Dcp; Iw = 1.03 (1.00 - 1.07) Iw; Lcp = 1.75 (1.71 - 1.79) Dcp. (Figure A 1.13.).

Sampling locations in the study area: (1) see (Figure 2.1.1.)

VI. ORDER CYPRINIFORMES

(9). FAMILY CYPRINIDAE

***14. Acheilognathus lamus* Nguyen, 1983**

Total sample. Analyzed: 15 specimens

Meristics. D = 2.14 - 16; A = 2.11 - 13; P = 1.14 - 15; V = 1.6 - 7; C = 5.17.6; PrD = 12 - 13; Sc = 9 - 10; Csc = 9 - 10; Ll = 35 - 36 (TSD = 5; TSV = 4).

Morphometric. SL = 2.10 (2.05 - 2.14) Bd = 3.92 (3.66 - 4.08) HL = 1.88 (1.71 - 2.41) Prdl = 5.87 (4.90 - 6.68) Podl = 6.84 (6.12 - 7.24) Lcp = 7.40 (6.91 - 7.56) Dcp; HL = 6.30 (5.68 - 6.82) SnL = 2.73 (2.44 - 2.83) Ed = 2.68 (2.55 - 2.88) Iw = 2.45 (2.39 - 2.61) Po = 1.88 (1.78 - 2.02) Hwn = 4.07 (3.60 - 4.71) Hdn = 1.74 (1.53 - 2.30) Lcp = 1.89 (1.78 - 2.02) Dcp; Iw = 1.02 (0.95 - 1.10) Ed; Lcp = 1.10 (1.01 - 1.30) Dcp; P→V = 1.19 (1.08 - 1.25) V→A. (Figure A 1.14.).

Sampling locations in the study area: Not distributed in (1); (2); (3); (4); (7); (8); (14); (25); (27); (28); (32); (33); (34) see (Figure 2.1.1.)

***15. Acheilognathus tonkinensis* (Vaillant, 1892)**

Total sample. Analyzed: 46 specimens

Synonyms. *Acanthorhodeus tonkinensis* Vaillant, 1892; *Acanthorhodeus robustus* Holcík, 1972.

Meristics. D = 2.13 - 15; A = 2.11 - 13; P = 1.13 - 15; V = 1.7; C = 6.17.6; PrD = 13; Sc = 9 - 10; Csc = 8 - 10; Ll = 35 - 37 (TSD = 5; TSV = 4).

Morphometric. SL = 2.15 (2.03 - 2.28) Bd = 3.84 (3.61 - 4.10) HL = 1.78 (1.68 - 1.90) Prdl = 5.56 (5.28 - 6.12) Podl = 7.03 (6.76 - 7.56) Lcp = 7.41 (7.01 - 8.21) Dcp; HL = 5.11 (4.66 - 5.55) SnL = 2.90 (2.67 - 3.20) Ed = 2.68 (2.58 - 2.88) Iw = 2.31(2.04 - 2.57) Po = 1.84 (1.34 - 2.18) Lcp = 1.93 (1.80 - 2.10) Dcp; Iw = 1.08 (0.98 - 1.18) Ed. Lcp = 1.07 (0.90 - 1.21) Dcp. P→V = 1.19 (1.07 - 1.28)V→A. (Figure A 1.15.).

Sampling locations in the study area: Not distributed in (1); (2); (3); (4); (14); (25); (27); (28); (32); (33); (34) see (Figure 2.1.1.)

***16. Rhodeus kyphus* (Yen, 1978)**

Total sample. Analyzed: 13 specimens

Synonyms. *Pararhodeus kyphus* Mai, 1978.

Meristics. D = 3.12; A = 2.15; P = 1.10; V = 1.5; C = 4.19; Ll = 8; Csc = 13; PrD = 13; Sc = 8.

Morphometric. SL = 2.43 (2.29 - 2.55) Db = 4.30 (4.03 - 4.65) HL = 4.96 (4.46 - 5.40) Dhl = 1.93 (1.75 - 2.13) Prdl = 4.85 (4.34 - 5.55) Podl = 6.48 (5.67 - 7.20) Lcp = 7.40 (6.91 - 7.82) Dcp; HL = 3.31 (3.12 - 3.65) SnL = 2.52 (2.29 - 2.86) Ed = 2.31 (2.21 - 2.53) Iw = 2.69 (2.55 - 2.86) Po = 1.51 (1.34 - 1.68) Lcp = 1.72 (1.58 - 1.83) Dcp; Iw = 1.10 (1.01 - 1.25) Ed; Lcp = 1.15 (1.04 - 1.34) Dcp; P→V =1.29 (1.18 - 1.48) V→A. (Figure A 1.16.).

Sampling locations in the study area: Not distributed in (1); (2); (3); (4); (7); (8); (14); (25); (27); (28); (32); (33); (34) see (Figure 2.1.1.)

***17. Rhodeus ocellatus* (Kener, 1867)**

Total sample. Analyzed: 5 specimens

Synonyms. *Pseudoperilampus ocellatus* Kner, 1866; *Rhodeus maculatus* Fowler, 1910; *Rhodeus hwanghoensis* Mori, 1928; *Rhodeus wangkinfui* Wu, 1930.

Meristics. D = 3.12; A = 2.14; P = 1.10; V = 1.5; C = 4.19; Ll = 9; Csc = 11; PrD = 9. Sc = 7.

Morphometric. SL = 2.17 (1.98 - 2.28) Bd = 4.05 (3.83 - 4.63)HL = 4.81 (4.40 - 5.24) Dhl = 1.83 (1.74 - 2.04) Prdl = 4.25 (3.71 - 5.26) Podl = 7.16 (6.49 - 8.32) Lcp = 6.87 (6.44 - 7.15) Dcp; HL = 3.13 (2.98 - 3.45) SnL = 2.52 (2.25 - 2.74) Ed = 2.51 (2.29 - 2.88) Iw = 3.00 (2.43 - 3.71) Po = 1.80 (1.66 - 1.89) Hwn = 1.06 (0.98 - 1.15) Hdn = 1.78 (1.54 - 2.14) Lcp = 1.70 (1.54 - 1.84) Dcp; Iw = 1.01 (0.93 - 1.12) Ed; Lcp = 0.97 (0.82 - 1.08) Dcp; P → V =1.28 (1.13 - 1.51)V → A. (Figure A 1.17.).

Sampling locations in the study area: Not distributed in (1); (2); (3); (4); (14); (25); (27); (28); (32); (33); (34) see (Figure 2.1.1.)

***18. Rhodeus spinalis* Oshima, 1926**

Total sample. Analyzed: 4 specimens

Synonyms. *Pseudoperilampus hainanensis* Nichols & Pope, 1927*; Rhodeus ocellatus vietnamensis* Mai, 1978; *Rhodeus vietnamensis* Mai, 1978.

Meristics. D = II.11 - 16; A = II.13 - 14; P = 1.9 - 10; V = 1.11 - 12; C = 5.18.5; PrD = 12 - 14; Sc = 8 - 10; Csc = 8; Ll = 6 - 7.

Morphometric. SL = 2.18 (1.94 - 2.29) Bd = 3.89 (3.71 - 4.01) HL = 1.79 (1.68 - 1.91)Prdl = 1.83 (1.76 - 1.90) Podl = 5.75 (4.94 - 6.18) Lcp = 7.29 (6.35 - 7.87) Dcp; HL = 3.42 (3.08 - 3.85) SnL = 2.81 (2.64 - 3.17) Ed = 2.82 (2.65 - 3.01) Iw = 2.44 (2.32 - 2.56) Po = 1.48 (1.27 - 1.61) Lcp = 1.88 (1.63 - 2.12) Dcp; Iw = 0.99 (0.94 - 1.12) Ed; Lcp = 1.28 (1.06 - 1.49) Dcp; P→V = 1.21 (1.09 - 1.36)V→A. (Figure A 1.18.).

Sampling locations in the study area: Not distributed in (1); (2); (3); (4); (7); (8); (14); (25); (27); (28); (32); (33); (34) (Figure 2.1.1.)

***19. Cultrichthys erythropterus* (Basilewsky, 1855)**

Total sample. Analyzed: 4 specimens

Synonyms. *Culter erythropterus* Basilewsky, 1855; *Culter brevicauda* Günther, 1868; *Culter ilishaeformis* Bleeker, 1871.

Meristics. D = 3.27; A = 2.7; P = 1.14; V = 1.8; C = 4.19; Csc = 24; PrD = 37; Sc = 10; Ll =.73 - 83 (TSD = 17; TSV = 5)

Morphometric. SL = 3.96 (3.86 - 4.07) Bd = 4.01 (3.76 - 4.16) HL = 6.06 (5.21 - 6.89) Dhl = 1.86 (1.67 - 1.95) Prdl = 2.47 (2.41 - 2.53) Podl = 7.70 (6.77 - 8.47) Lcp = 10.31 (10.00 - 10.82) Dcp; HL = 3.10 (2.89 - 3.54) SnL = 3.59 (3.08 - 3.91) Ed = 4.24 (3.50 - 4.79) Iw = 2.45 (2.38 - 2.50) Po = 2.60 (2.40 - 2.74) Hwn = 1.63 (1.48 - 1.82) Hdn = 1.91 (1.80 - 2.04) Lcp = 2.57 (2.41 - 2.73) Dcp; Iw = 0.85 (0.77 - 0.92) Ed; Lcp = 1.35 (1.18 - 1.51) Dcp; P → V = 0.86 (0.75 - 0.96) V → A. (Figure A 1.19.).

Sampling locations in the study area: (2); (3); (4); (5); (6); (7); (9); (10); (12); (20); (32); (33); (34); (35) see (Figure 2.1.1.)

***20. Hemiculter leucisculus* (Basilewsky, 1853)**

Total sample. Analyzed: 134 specimens

Synonyms. *Culter leucisculus* Basilewsky, 1855; *Squaliobarbus annamiticus* Tirant, 1883; *Hemiculter schrencki* Warpachowski, 1888.

Meristics. D = 2.7; A = 2.14; P = 1.10; V = 1.7; C = 4.19; Csc = 15 - 17; PrD = 17 - 18; Sc = 11 - 12; Ll = 50 - 52 (TSD = 8; TSV = 2).

Morphometric. SL = 4.99 (4.89 - 5.09) Bd = 4.16 (4.01 - 4.31) HL = 5.44 (5.28 - 5.60) Dhl = 1.87 (1.82 - 1.92) Prdl = 2.78 (2.73 - 2.82) Podl = 7.21 (7.15 - 7.27) Lcp = 11.56 (10.47 - 12.66) Dcp; HL = 3.69 (3.56 - 3.83) SnL = 3.51 (3.47 - 3.55) Ed = 3.26 (3.13 - 3.40) Iw = 2.49 (2.39 - 2.58) Po = 1.19 (0.02 - 2.35) Hwn = 1.47 (1.38 - 1.55) Hdn = 1.74 (1.69 - 1.78) Lcp = 2.79 (2.43 - 3.16) Dcp; Iw = 1.08 (1.02 - 1.14) Ed; Lcp = 1.60 (1.44 - 1.77) Dcp; P → V = 0.99 (0.92- 1.06) V → A. (Figure A 1.20.).

Sampling locations in the study area: Not distributed in (1); (13); (23); (25); (27); (28); see (Figure 2.1.1.)

***21. Pseudohemiculter dispar* (Peters, 1881)**

Total sample. Analyzed: 4 specimens

Synonyms. *Hemiculter dispar* Peters, 1881; *Hemiculter dispar dispar* (Peters, 1881).

Meristics. D = 2.8; A =2.14; P = 1.9; V = 1.8; C = 3.18; Csc = 15; PrD = 19 - 20; Sc = 9 - 11; Ll = 48 - 50 (TSD = 6 - 7; TSV = 3).

Morphometric. SL = 4.35 (4.00 - 4.99) Bd = 4.24 (4.03 - 4.64) HL = 5.24 (4.90 - 5.43) Dhl = 1.99 (1.91 - 2.09) Prdl = 2.49 (2.03 - 2.71) Podl = 6.57 (5.84 - 7.23) Lcp = 10.32 (8.93 -

11.26) Dcp; HL = 3.31 (3.11 - 3.65) SnL = 3.13 (3.00 - 3.33) Ed = 3.17(2.83 - 3.78) Iw = 2.71 (2.45 - 3.15) Po = 2.29 (2.09 - 2.44) Hwn = 1.46 (1.25 - 1.74) Hdn = 1.55 (1.36 - 1.80) Lcp = 2.44 (2.07 - 2.66) Dcp; Iw = 0.99 (0.83 - 1.11) Ed; Lcp = 1.58 (1.32 - 1.90) Dcp; P→V = 1.06 (0.85 - 1.34) V→A. (Figure A 1.21.).

Sampling locations in the study area: (2); (3); (4); (5); (6); (7); (9); (10); (12); (20); (32); (33); (34); (35) see (Figure 2.1.1.)

***22. Carassioides acuminatus* (Richardson, 1846)**

Total sample. Analyzed: 6 specimens

Synonyms. *Cyprinus acuminatus* Richardson, 1846; *Carpio cantonensis* Heincke, 1892; *Carassioides cantonensis* (Heincke, 1892); *Carassioides rhombeus* Oshima, 1926.

Meristics. D = III. 16; A = III.5; P = 1.16; V = 1.8; C = 4. 20; Csc = 14; PrD = 12; Sc = 7; Ll = 30 - 31 (TSD = 6; TSV = 6).

Morphometric. SL = 2.30 (2.12 - 2.56) Bd = 3.53 (3.30 - 3.87) HL = 3.99 (3.86 - 4.23) Dhl = 1.89 (1.65 - 2.04) Prdl = 4.50 (4.32 - 4.67) Podl = 7.77 (7.45 - 7.97) Lcp = 6.41 (6.23 - 6.75) Dcp; HL = 3.22 (2.97 - 3.42) SnL = 2.98 (2.64 - 3.14) Ed = 2.49 (2.21 - 2.78) Iw = 2.20 (2.03 - 2.46) Po = 1.60 (1.47 - 1.75) Hwn = 1.08 (0.97 - 1.21) Hdn = 2.20 (2.07 - 2.35) Lcp = 1.82 (1.67 - 1.98) Dcp; Iw = 1.20 (1.09 - 1.37) Ed; Lcp = 0.82 (0.71 - 0.95) Dcp; P→V = 0.60 (0.51 - 0.72) V→A. (Figure A 1.22.).

Sampling locations in the study area: Not distributed in (1); (25); (27) see (Figure 2.1.1.)

***23. Carassioides phongnhaensis* Tu & Tuan, 2003**

Total sample. Analyzed: 5 specimens

Meristics. D = III.16 - 17; A = III.5 - 6; P = I.14 - 16; V = 2.8; PrD = 12 - 13; Ll = 30 - 31.

Morphometric. SL = 2.27 (2.04 - 2.49) Bd = 3.25 (3.06 - 3.36) HL; HL = 3.36 (3.19 - 3.57) Ed = 3.37 (3.10 - 3.53) SnL; Lcp = 0.62 (0.60 - 0.64) Dcp. (Figure A 1.23.).

Sampling locations in the study area: (33); (34); (35) see (Figure 2.1.1.)

***24. Carassius auratus* (Linnaeus, 1785)**

Total sample. Analyzed: 8 specimens

Synonyms. *Cyprinus auratus* Linnaeus, 1758; *Cyprinus mauritianus* Bennett, 1832; *Cyprinus gibelioides* Cantor, 1842.

Meristics. D = III.18; A = III.5; P = 1.15 - 17; V = 1.8; C = 4.17; Csc = 13; PrD = 10 - 11; Sc = 7; Ll = 29 - 30 (TSD = 6; TSV = 4).

Morphometric. SL = 2.48 (2.34 - 2.71) Bd = 3.14 (2.97 - 3.59) HL = 4.18 (3.84 - 4.68) Dhl = 1.97 (1.91 - 2.09) Prdl = 6.22 (5.61 - 6.58) Podl = 7.12 (6.23 - 8.06) Lcp = 6.42 (5.91 - 7.30) Dcp; HL = 3.40 (2.94 - 3.61) SnL = 4.07 (3.73 - 4.64) Ed = 2.32 (2.10 - 2.60) Iw = 2.05 (1.98

- 2.16) Po = 2.27 (2.04 - 2.48) Lcp = 2.05 (1.52 - 2.35) Dcp; Iw = 1.77 (1.52 - 2.21) Ed; Lcp = 0.91 (0.78 - 1.01) Dcp; P → V = 0.60 (0.43 - 0.68) V → A. (Figure A 1.24.).

Sampling locations in the study area: Not distributed in (25); (27) see (Figure 2.1.1.)

***25. Cyprinus carpio* Linnaeus, 1758**

Total sample. Analyzed: 15 specimens

Synonyms. *Cyprinus cirrosus* Schaeffer, 1760; *Cyprinus rexcyprinorum* Bloch, 1782.

Meristics. D = III. 22; A = III.5; P = 1.16; V = 1.8; C = 5.17; Csc = 15; PrD = 13; Sc = 8; Ll = 34 - 35 (TSD = 5; TSV =5)

Morphometric. SL = 2.82 (2.65 - 3.02) Bd = 3.39 (3.13 - 3.60) HL = 3.99 (3.72 - 4.25) Dhl = 1.89 (1.84 - 1.91) Prdl = 5.46 (5.02 - 6.22) Podl = 6.75 (6.36 - 7.27) Lcp = 7.35 (6.87 - 7.64) Dcp; HL = 2.63 (2.44 - 2.81) SnL = 4.15 (3.52 - 4.92) Ed = 2.51 (2.36 - 2.63) Iw = 2.32 (2.21 - 2.62) Po = 2.00 (1.77 - 2.22) Lcp = 2.17 (2.10 - 2.22) Dcp; Iw = 1.66 (1.38 - 2.01) Ed; Lcp = 1.09 (0.99 - 1.19) Dcp; P→V = 0.71 (0.65 - 0.76) V→A. (Figure A1.25.).

Sampling locations in the study area: Not distributed in (25); (27) see (Figure 2.1.1.)

***26. Cyprinus hieni* Tu & Tuan, 2003**

Total sample. Analyzed: 1 specimen

Meristics. D = III. 20; A = III.5; P = I.6; V = I.8. PrD =12; Ll = 30 (TSD = 5; TSV = 6); Sc = 9.

Morphometric. SL = (3.00) Bd = (3.15) HL = (1.84) Prdl = (6.09) Podl = (7.07) Lcp = (6.37) Dcp; HL = (2.24) SnL = (4.70) Ed = (2.25) Lcp = (6.37) Dcp. (Figure A1.26.).

Sampling locations in the study area: (23) see (Figure 2.1.1.)

***27. Cyprinus quidatensis* Tu, 1999**

Total sample. Analyzed: 7 specimens

Meristics. D = 2.15; A = 2.5; P = 18 - 20; V = 9; C = 28; Csc = 16 - 20; PrD = 10 - 17; Sc = 8 - 10; Ll = 36 - 38 (TSD = 16; TSV = 13 - 14).

Morphometric. SL = 6.50 (6.49- 6.51) Bd = 3.48 (3.43- 3.53) HL = 4.21 (4.17- 4.25) Dhl = 1.82 (1.79- 1.85) Prdl = 1.32 (1.31- 1.33) Podl = 6.81 (6.58- 7.04) Lcp = 7.91 (7.63- 8.19) Dcp; HL = 2.52 (2.49- 2.56) SnL = 4.24 (4.21- 4.27) Ed = 2.57 (2.54- 2.60) Iw = 2.51 (2.33- 2.68) Po = 0.95 (0.92- 0.99) Hwn = 3.05 (3.05- 3.05) Hdn = 1.96 (1.92- 1.99) Lcp = 2.27 (2.16 - 2.39) Dcp; Iw = 1.65 (1.65- 1.66) Ed; Lcp = 1.16 (1.08- 1.24) Dcp; P→V = 0.82 (0.81- 0.84) V→A. (Figure A 1.27.).

Sampling locations in the study area: (23) see (Figure 2.1.1.)

***28. Puntius brevis* (Bleeker, 1850)**

Total sample. Analyzed: 12 specimens

Synonyms. *Capoeta brevis* Bleeker, 1849; *Systomus leiacanthus* Bleeker, 1860; *Puntius ocellatus* Mai, 1978.

Meristics. D = II - III. 8; A = 3. 5; P = 1.11 - 12; V = 1.8; C = 5.17.5; PrD = 8 - 9; Sc = 7 - 8; Csc = 8.

Morphometric. SL = 2.58 (2.37 - 2.67) Bd = 3.57 (3.36 - 3.74) HL = 4.57 (4.29 - 4.85) Dhl = 1.96 (1.86 - 2.09) Prdl = 1.79 (1.73 - 1.85) Podl = 5.53 (5.14 - 5.88) Lcp = 6.71 (6.41 - 6.89) Dcp; HL = 3.13 (3.05 - 3.24) SnL = 3.13 (2.93 - 3.21) Ed = 2.48 (2.41 - 2.51) Iw = 2.29 (2.15 - 2.36) Po = 1.55 (1.45 - 1.68) Lcp = 1.88 (1.84 - 1.94) Dcp; Iw = 1.26 (1.17 - 1.31) Ed; Lcp = 1.22 (1.13 - 1.30) Dcp; P→V = 0.91 (0.89 - 0.93) V→A. (Figure A 1.28.).

Sampling locations in the study area: Not distributed in (25); (27) see (Figure 2.1.1.)

***29. Puntius semifasciolatus* (Günther, 1868)**

Total sample. Analyzed: 45 specimens

Synonyms. *Barbus semifasciolatus* Günther, 1868; *Barbus aureus* Tirant, 1883; *Barbus hainani* Lohberger, 1929.

Meristics. D = 3.7 - 8; A = 2.5; P = 1.10 - 11; V = 1.7; C = 5.18; Csc = 10 - 11. PrD = 8 - 10. Sc = 6 - 9; Ll = 22 - 25 (TSD = 3; TSV = 2 - 3).

Morphometric. SL = 2.98 (2.83 - 3.16) Bd = 3.57 (3.31 - 3.97) HL = 4.44 (4.22 - 4.62) Dhl = 1.94 (1.83 - 2.10) Prdl = 2.86 (2.03 - 3.33) Podl = 5.47 (4.87 - 6.43) Lcp = 6.88 (6.35 - 7.28) Dcp; HL = 3.43 (3.12 - 3.79) SnL = 2.93 (2.58 - 3.27) Ed = 2.50 (2.16 - 2.88) Iw = 2.21 (1.93 - 2.47) Po = 1.54 (1.27 - 1.94) Lcp = 1.94 (1.71 - 2.09) Dcp; Iw = 1.18 (0.93 - 1.46) Ed; Lcp = 1.27 (1.03 - 1.47) Dcp; P→V = 0.87 (0.66 - 1.02) V→A. (Figure A 1.29.).

Sampling locations in the study area: Not distributed in (25); (27) see (Figure 2.1.1.)

***30. Cirrhinus molitorella* (Valenciennes, 1844)**

Total sample. Analyzed: 10 specimens

Synonyms. *Leuciscus molitorella* Valenciennes, 1844; *Leuciscus chevanella* Valenciennes, 1844; *Cirrhinus melanostigma* Fowler & Bean, 1922.

Meristics. D = III.13; A = III.6; C = 6.17; P = 1.16; V = 1.8; CSc = 17; PrD = 13; Sc = 8; Ll = 39 - 41 (TSD = 8; TSV = 6)..

Morphometric. SL = 3.49 (3.43 - 3.59) Bd = 4.48 (4.30 - 4.74) HL = 5.06 (4.77 - 5.32) Dhl = 2.15 (2.09 - 2.25) Prdl = 2.94 (2.74 - 3.25) Podl = 7.09 (6.52 - 7.84) Lcp = 7.73 (7.60 - 7.97) Dcp; HL = 2.72 (2.59 - 2.86) SnL = 3.67 (3.56 - 3.88) Ed = 2.01 (1.96 - 2.06) Iw = 2.58 (2.51 - 2.63) Po = 1.59 (1.46 - 1.82) Lcp = 1.73 (1.60 - 1.85) Dcp; Iw = 1.82 (1.73 - 1.92) Ed; Lcp = 1.09 (1.02 - 1.17) Dcp; P→V = 1.12 (1.08 - 1.18) V→A. (Figure A 1.30.).

Sampling locations in the study area: Not distributed in (25); (27) see Figure 2.1.1.)

***31. Garra imberba* Garman, 1912**

Total sample. Analyzed: 18 specimens

Synonyms. *Discognathus pingi* Tchang, 1929; *Garra alticorpora* Chu & Cui, 1987.

Meristics. D = II.8 - 9; A = II. 5 - 6; P = 1.14 - 15; V = 1.8; C = 6.16.6; PrD = 14 - 17; Sc = 10 - 11; Csc = 15 - 16; Ll = 45 - 48 (TSD = 4 - 5; TSV = 2.5 - 4).

Morphometric. SL = 5.26 (5.14 - 5.47) Bd = 4.95 (4.87 - 5.03) HL = 5.18 (4.95 - 5.37) Dhl = 2.37 (2.35 - 2.39) Prdl = 2.31 (2.27 - 2.33) Podl = 5.76 (5.62 - 5.86) Lcp = 9.32 (9.05 - 9.60) Dcp; HL = 1.72 (1.63 - 1.77) SnL = 4.95 (4.63 - 5.40) Ed = 2.10 (2.03 - 2.15) Iw = 3.73 (3.59 - 3.83) Po = 1.16 (1.15 - 1.17) Lcp = 1.88 (1.80 - 1.93) Dcp; Iw = 2.36 (2.15 - 2.66) Ed; Lcp = 1.62 (1.55 - 1.65) Dcp; P→V = 1.00 (0.93 - 1.09) V→A. (Figure A 1.31.).

Sampling locations in the study area: Not distributed in (1); (2); (3); (4); (6); (7); (8); (10); (23); (25); (27); (33); (34); (35) see (Figure 2.1.1.)

***32. Osteochilus lini* Fowler, 1935**

Total sample. Analyzed: 5 specimens

Meristics. D = 3.11 - 12; A = 2.5; P = 13 - 15; V = 1.8; C = 18 -20; Csc = 18 - 19; PrD = 13 - 15; Sc = 9 - 10; Sq = 34 - 36.

Morphometric. SL = 3.19 (3.00 - 3.40) Bd = 4.13 (4.08 - 4.15) HL = 4.82 (4.56 - 5.05) Dhl = 2.18 (2.10 - 2.23) Prdl = 3.16 (2.89 - 3.28) Podl = 6.13 (5.79 - 6.51) Lcp = 7.05 (6.60 - 7.21) Dcp; HL = 2.53 (2.39 - 2.59) SnL = 3.62 (3.48 - 3.89) Ed = 2.15 (2.04 - 2.26) Iw = 1.55 (1.50 - 1.63) Po = 0.82 (0.76 - 0.94) Hwn = 1.93 (1.63 - 2.26) Hdn = 1.48 (1.40 - 1.57) Lcp = 1.71 (1.60 - 1.77) Dcp; Iw = 1.69 (1.54 - 1.87) Ed; Lcp = 1.15 (1.10 - 1.18) Dcp; P→V = 1.07 (0.93 - 1.17) V→A. (Figure A 1.32.).

Sampling locations in the study area: Not distributed in (1); (2); (7); (22); (23); (25); (27); (35); (36) (Figure 2.1.1.)

***33. Osteochilus salsburyi* Nichols & Pope, 1927**

Total sample. Analyzed: 7 specimens

Meristics. D = 2.11; A = 2.5; P = 13 - 15; V = 1.8; C = 19 - 20; Csc = 15 - 16; PrD = 12 - 13; Sc = 9; Sq = 34 - 36.

Morphometric. SL = 3.19 (3.04- 3.34) Bd = 3.96 (3.76- 4.09) HL = 4.49 (4.20- 4.75) Dhl = 2.12 (2.10- 2.16) Prdl = 3.20 (2.89- 3.38) Podl = 5.78 (5.48- 6.12) Lcp = 7.18 (6.79- 7.56) Dcp; HL = 2.30 (2.15- 2.53) SnL = 3.68 (3.58- 3.78) Ed = 2.10 (1.97- 2.20) Iw = 1.49 (1.45- 1.53) Po = 0.85 (0.80- 0.89) Hwn = 1.99 (1.84- 2.10) Hdn = 1.46 (1.37- 1.53) Lcp = 1.81 (1.77- 1.87) Dcp; Iw = 1.75 (1.64- 1.87) Ed; Lcp = 1.24 (1.16- 1.35) Dcp; P→V = 1.11 (1.04- 1.17) V→A. (Figure A 1.33.).

Sampling locations in the study area: Not distributed in (1); (2); (7); (22); (23); (25); (27); (35); (36) see (Figure 2.1.1.)

***34. Ctenopharyngodon idella* (Valenciennes, 1844)**

Total sample. Analyzed: 3 specimens

Synonyms. *Leuciscus idella* Valenciennes, 1844; *Leuciscus tschiliensis* Basilewsky, 1855; *Ctenopharyngodon laticeps* Steindachner, 1866.

Meristics. D = 1-2. 6 - 7; A = 1.7 - 8; P = 1.12; V = 1.8; C = 3.17.2; PrD = 14; Sc = 7 - 8; Sc = 14; Ll = 36 - 39 (TSD = 4 ; TSV = 4).

Morphometric. SL = 3.47 (3.38 - 3.56) Bd = 3.06 (2.95 - 3.17) HL = 3.95 (3.93 - 3.98) Dhl = 1.75 (1.72 - 1.78) Prdl = 2.97 (2.80 - 3.17) Podl = 7.16 (6.72 - 7.56) Lcp = 8.37 (7.64 - 9.05) Dcp = 11.13 (10.42 - 11.65) Hwn; HL = 4.00 (3.71 - 4.31) SnL = 3.37 (3.19 - 3.59) Ed = 2.24 (2.22 - 2.28) Iw = 2.19 (2.11 - 2.30) Po = 1.82 (1.75 - 1.86) Hwn = 1.47 (1.39 - 1.62) Hdn = 2.34 (2.28 - 2.38) Lcp = 2.74 (2.50 - 3.07) Dcp; Iw = 1.50 (1.40 - 1.61) Ed; Lcp = 1.17 (1.06 - 1.35) Dcp; Bd = 3.20 (3.08 - 3.27) Hwn; P→V = 1.26 (1.10 - 1.39)V→A; SnL = 0.55 (0.50 - 0.62) Po. (Figure A 1.34.).

Sampling locations in the study area: Not distributed in (1); (23); (25); (27) see (Figure 2.1.1.)

***35. Squaliobarbus curriculus* (Richardson, 1846)**

Total sample. Analyzed: 13 specimens

Synonyms. *Leuciscus curriculus* Richardson, 1846; *Leuciscus teretiusculus* Basilewsky, 1855; *Squaliobarbus caudalis* Sauvage, 1884.

Meristics. D: III.7 - 8; A: III.7 - 8; P: I.12 - 14; V: II.7 - 8; C: 4.17.4. PrD = 13 - 15; Sc = 8 - 10; Csc = 16; Ll = 41 - 43 (TSD = 5 - 6; TSV = 3 - 4).

Morphometric. SL = 4.07 (3.80 - 4.46) Bd = 3.94 (3.57 - 4.25) HL = 1.99 (1.90 - 2.06) Prdl = 2.01 (1.87 - 2.17) Podl = 6.16 (5.60 - 6.44) Lcp = 8.34 (7.67 - 8.60) Dcp = 7.66 (6.86 - 8.96) Hwn; HL = 3.22 (2.96 - 3.59) SnL = 4.68 (4.15 - 5.20) Ed = 1.99 (1.91 - 2.05) Po = 2.45 (2.31 - 2.54) Iw = 1.61 (1.58 - 1.66) Hdn = 2.34 (2.20 - 2.77) Hde = 1.87 (1.77 - 1.98) Hwn = 4.57 (3.89 - 4.89) Hwe; Iw = 1.92 (1.63 - 2.14) Ed; P→V = 1.06 (0.97 - 1.16) V → A = 2.29 (2.17 - 2.41) Lcp = 1.70 (1.53 - 1.84) Dcp; Lcp = 1.36 (1.21 - 1.54) Dcp. (Figure A 1.35.).

Sampling locations in the study area: Not distributed in (1); (2); (23); (25); (27); (35) see (Figure 2.1.1.)

***36. Hypophthalmichthys molitrix* (Valenciennes, 1844)**

Total sample. Analyzed: 3 specimens

Synonyms. *Leuciscus molitrix* Valenciennes, 1844; *Leuciscus hypophthalmus* Richardson, 1845; *Cephalus mantschuricus* Basilewsky, 1855.

Meristics. D = 3.6 - 7; A = 2.12 - 13; P = 1.16 - 17; V = 1.7; C = 3.17.2; Sc = 26 - 28; Csc = 29 - 34; Ll = 83 - 97 (TSD = 20 - 25; TSV = 11 - 12)

Morphometric. SL = 3.94 (3.68 - 4.25) Bd = 2.60 (2.42 - 2.72) HL = 3.52 (3.28 - 3.86) Dhl = 1.77 (1.71 - 1.86) Prdl = 3.11 (3.01 - 3.20) Podl = 6.39 (5.53 - 6.80) Lcp = 10.29 (9.97 - 10.69) Dcp = 13.71 (12.52 - 15.34) Hwn; HL = 3.45 (3.06 - 3.97) SnL = 4.18 (3.72 - 4.73) Ed = 2.77 (2.64 - 2.93) Iw = 2.01 (1.83 - 2.22) Po = 2.46 (2.05 - 2.69) Hwn = 1.49(1.37 - 1.61) Hdn = 2.30; Lcp = 1.62 (1.52 - 1.93) Dcp; Bd = 3.48 (3.40 - 3.61) Bwd; P → V = 0.70 (0.64 - 0.79) V → A; SnL = 0.59 (0.51 - 0.68) Po. (Figure A 1.36.).

Sampling locations in the study area: Not distributed in (1); (23); (25); (27) see (Figure 2.1.1.)

***37. Hemibarbus umbrifer* (Lin, 1931)**

Total sample. Analyzed: 12 specimens

Synonyms. *Paraleucogobio umbrifer* Lin, 1931; *Paracanthobrama umbrifer* (Lin, 1931).

Meristics. D = III.7; A = 2.5; P = 1.13 - 14; V = 1.8; C = 4.16; Csc = 12 - 14; PrD = 11 - 13; Sc = 12 - 13; Ll = 43 - 48 (TSD = 6; TSV = 4 - 5).

Morphometric. SL = 4.77 (4.38 - 5.17) Bd = 3.34 (3.13 - 3.58) HL = 3.69 (3.40 - 5.00) Dhl = 2.11 (2.00 - 2.24) Prdl = 2.64 (2.49 - 3.23) Podl = 6.00 (5.18 - 8.35) Lcp = 10.53 (9.41 - 11.35) Dcp; HL = 2.76 (2.51 - 3.13) SnL = 2.94 (2.49 - 3.25) Ed = 3.67 (3.17 - 4.73) Iw = 3.40 (2.92 - 3.96) Po = 2.11 (1.78 - 2.32) Hwn = 1.66 (1.54 - 1.80) Hdn = 1.80 (1.47 - 2.55) Lcp = 3.16 (2.92 - 3.47) Dcp; Iw = 0.81 (0.59 - 0.94) Ed; Lcp = 1.77 (1.26 - 2.07) Dcp; P → V = 0.93 (0.67 - 1.15) V → A. (Figure A 1.37.).

Sampling locations in the study area: Not distributed in (1); (2); (23); (25); (27); (35) see (Figure 2.1.1.)

***38. Microphysogobio kachekensis* (Oshima, 1926)**

Total sample. Analyzed: 30 specimens

Synonym. *Pseudogobio kachekensis* Oshima, 1926.

Meristics. D = 3.7; A = 2.6; P = 1.12; V = 1.7; C = 6.17; Csc = 11 -12; PrD = 10 - 11; Sc = 10; Ll = 39 - 40 (TSD = 2 - 4; TSV = 2 - 4).

Morphometric. SL = 5.19 (4.73 - 5.84) Bd = 4.01 (3.66 - 4.25) HL = 4.37 (4.06 - 4.67) Dhl = 2.15 (2.05 - 2.20) Prdl = 4.39 (2.37 - 12.25) Podl = 5.66 (5.16 - 6.28) Lcp = 11.13 (10.49 - 11.71) Dcp; HL = 2.34 (2.28 - 2.43) SnL = 4.02 (3.62 - 4.35) Ed = 3.95 (3.73 - 4.33) Iw = 2.65 (2.50 - 2.77) Po = 1.70 (1.64 - 1.78) Hwn = 2.03 (1.59 - 3.48) Hdn = 1.41 (1.26 - 1.57)

Lcp = 2.78 (2.63 - 2.88) Dcp; Iw = 1.02 (0.92 - 1.16) Ed; Lcp = 1.98 (1.77 - 2.19) Dcp; P → V = 0.99 (0.91 - 1.17) V → A. (Figure A 1.38.).

Sampling locations in the study area: Not distributed in (1); (2); (23); (25); (27); (35) see (Figure 2.1.1.)

***39. Sarcocheilichthys parvus* Nichols, 1930**

Total sample. Analyzed: 4 specimens

Meristics. D = II.7 - 8; A = II.6; P = 1.15 - 16; V = 1.7; C = 6.16.6; PrD = 10 - 13; Sc = 12 - 14; Csc = 10 - 12; Ll = 38 - 42 (TSD = 5.5; TSV = 3.5).

Morphometric. SL = 3.35 (3.15 - 3.57) Bd = 4.04 (3.89 - 4.32) HL = 4.84 (4.34 - 5.12) Dhl = 2.02 (1.78 - 2.34) Prdl = 2.30 (2.10 - 2.67) Podl = 5.27 (5.03 - 5.69) Lcp = 6.97 (6.45 - 7.32) Dcp; HL = 2.97 (2.56 - 3.25) SnL = 4.46 (4.12 - 4.74) Ed = 2.87 (2.65 - 2.98) Iw = 2.35 (2.12 - 2.67) Po = 1.70 (1.46 - 1.92) Hwn = 1.24 (1.01 - 1.45) Hdn = 1.30 (1.15 - 1.52) Lcp = 1.73 (1.56 - 1.89) Dcp; Iw = 1.55 (1.42 - 1.69) Ed; Lcp = 1.32 (1.21 - 1.44) Dcp; P → V = 1.42 (1.23 - 1.57) V → A. (Figure A 1.39.).

Sampling locations in the study area: (11); (12); (13); (14); (15); (16); (17); (18); (19); (20); (21); (22); (24); (26); (29); (36) see (Figure 2.1.1.)

***40. Squalidus argentatus* (Sauvage & Dabry, 1874)**

Total sample. Analyzed: 5 specimens

Synonyms. *Gobio argentatus* Sauvage & Dabry de Thiersant, 1874; *Gobio hsui* Wu & Wang, 1931.

Meristics. D = 2.6; A = 2.5; P = 1.12; V = 1.7; C = 4.16; Csc = 12; Sc = 9 - 10; PrD = 10; Ll = 37 - 38 (TSD = 5; TSV =3).

Morphometric. SL = 4.45 (4.20 - 4.33) Bd = 4.17 (4.03 - 4.71) HL = 4.59 (4.44 - 4.71) Dhl = 2.21 (2.17 - 2.39) Prdl = 2.30 (2.20 - 2.39) Podl = 10.54 (10.16 - 10.86) Lcp = 2.81 (2.75 - 2.93) Dcp; HL = 2.91 (2.68 - 3.40) SnL = 3.82 (3.39 - 4.23) Ed = 2.65 (2.42 - 2.81) Iw = 1.84 (1.74 - 1.90) Po = 1.55 (1.52 - 1.59) Hwn = 1.19 (1.12 - 1.38) Hdn = 2.53 (2.42 - 2.64) Lcp = 0.77 (0.63 - 0.96) Dcp; Iw = 2.13 (1.82 - 2.32) Ed; Lcp = 1.02 (0.83 - 1.22) Dcp; P → V = 10.54 (10.16 - 10.86) V → A. (Figure A 1.40.).

Sampling locations in the study area: Not distributed in (1); (2); (23); (25); (27); (35) see (Figure 2.1.1.)

***41. Devario fangfangae* (Kottelat, 2000)**

Total sample. Analyzed: 4 specimens

Synonym. *Danio fangfangae* Kottelat, 2000.

Meristics. D = 1.9 - 13; A = 12 - 16; P = 1.12; V = 7; C = 20 - 24; Csc = 14 - 16; PrD = 16; Sc = 7 - 9; Ll = 37 - 39 (TSD = 14; TSV =9)

Morphometric. SL = 4.89 (4.54- 5.33) Bd = 2.12 (1.98- 2.18) HL = 11.76 (10.88- 12.71) Dhl = 1.32 (1.28- 1.37) Prdl = 2.74 (2.49- 3.17) Podl = 11.66 (10.74- 12.97) Lcp = 2.10 (2.07- 2.16) Dcp; T = 2.35 (2.26- 2.47) SnL = 7.18 (6.47- 7.50) Ed = 3.62 (3.32- 4.06) Iw = 7.00 (6.03- 7.74) Po = 3.58 (3.01- 5.96) Hwn = 1.99 (1.84- 2.11) Hdn = 5.51 (4.98- 6.56) Lcp = 0.99 (0.95- 1.08) Dcp; Iw = 1.99 (1.70- 2.26) Ed; Lcp = 0.18 (0.16- 0.20) Dcp; P → V = 0.35 (0.26- 0.41) V → A. (Figure A 1.41.).

Sampling locations in the study area: Not distributed in (1); (2); (7); (8); (10); (23); (25); (27); (33); (34); (35) see (Figure 2.1.1.)

***42. Devario gibber* (Kottelat, 2000)**

Total sample. Analyzed: 8 specimens

Synonym. *Danio gigber* Kottelat, 2000

Meristics. D = 12; A = 2.13; P = 12 -13; V = 7; C = 24 - 28; Csc = 14 - 16; PrD = 14 - 16; Sc = 9 - 11 ; Ll = 33 - 35 (TSD = 16 - 17; TSV = 9 - 15).

Morphometric. SL = 4.77 (4.33- 5.21) Bd = 2.18 (2.06 - 2.83) HL = 11.76 (10.91- 12.38) Dhl = 1.31 (1.28- 1.35) Prdl = 2.66 (2.57- 2.80) Podl = 11.58 (6.22- 13.21) Lcp = 2.09 (1.92- 2.20) Dcp; HL = 2.30 (1.76- 2.64) SnL = 7.15 (5.26- 8.46) Ed = 3.55 (3.02- 4.16) Iw = 7.34 (5.81- 8.97) Po = 3.25 (2.28- 4.03) Hwn = 1.94 (1.53- 2.22) Hdn = 5.34 (2.93- 6.15) Lcp = 0.96 (0.76- 1.01) Dcp; Iw = 2.02 (1.63- 2.46) Ed; Lcp = 0.18 (0.15- 0.33) Dcp; P → V = 0.36 (0.29 - 0.41) V → A. (Figure A 1.42.).

Sampling locations in the study area: Not distributed in (1); (2); (7); (8); (10); (23); (25); (27); (33); (34); (35) see (Figure 2.1.1.)

***43. Esomus metallicus* Ahl, 1923**

Total sample. Analyzed: 95 specimens

Meristics. D = 2.6; A = 1.5; P = 1.11; V = 18. C = 2.19; Ll = 20 (TSD = 5; TSV = 2); Csc = 14; PrD = 15; Sc = 10.

Morphometric. SL = 3.96 (3.80 - 4.16) Bd = 4.60 (4.41 - 4.89) HL = 6.25 (6.09 - 6.50) Dhl = 1.48 (1.40 - 1.52) Prdl = 3.96 (3.73 - 4.17) Podl = 5.44 (4.91 - 5.73) Lcp = 8.16 (8.00 - 8.40) Dcp; HL = 3.36 (3.19 - 3.65) SnL = 3.01 (2.78 - 3.17) Ed = 2.27 (2.13 - 2.37) Iw = 2.15 (2.08 - 2.24) Po = 1.68 (1.60 - 1.71) Hwn = 1.33 (1.28 - 1.41) Hdn = 1.19 (1.00 - 1.29) Lcp = 1.78 (1.64 - 1.91) Dcp; Iw = 1.33 (1.29 - 1.38) Ed; Lcp = 1.51 (1.41 - 1.63) Dcp; P → V = 1.57 (1.37 - 1.71) V → A. (Figure A 1.43.).

Sampling locations in the study area: Not distributed in (1); (2); (35) see (Figure 2.1.1.)

***44. Esomus longimanus* (Lunel, 1881)**

Total sample. Analyzed: 46 specimens

Synonyms. *Nuria longimana* Lunel, 1881; *Esomus goddardi* Fowler, 1937.

Meristics. D = 2.6; A = 1.5; P = 1.11; V = 18. C = 2.19; Ll = 20 (TSD = 5; TSV =2); Csc = 14; PrD = 15; Sc = 10.

Morphometric. SL = 3.96 (3.80 - 4.16) Bd = 4.60 (4.41 - 4.89) HL = 6.25 (6.09 - 6.50) Dhl = 1.48 (1.40 - 1.52) Prdl = 3.96 (3.73 - 4.17) Podl = 5.44 (4.91 - 5.73) Lcp = 8.16 (8.00 - 8.40) Dcp; HL = 3.36 (3.19 - 3.65) SnL = 3.01 (2.78 - 3.17) Ed = 2.27 (2.13 - 2.37) Iw = 2.15 (2.08 - 2.24) Po = 1.68 (1.60 - 1.71) Hwn = 1.33 (1.28 - 1.41) Hdn = 1.19 (1.00 - 1.29) Lcp = 1.78 (1.64 - 1.91) Dcp; Iw = 1.33 (1.29 - 1.38) Ed; Lcp = 1.51 (1.41 - 1.63) Dcp; P → V = 1.57 (1.37 - 1.71) V → A. (Figure A 1.44.).

Sampling locations in the study area: Not distributed in (1); (2); (35) see (Figure 2.1.1.)

***45. Rasbora steineri* Nichols & Pope, 1927**

Total sample. Analyzed: 21 specimens

Synonyms. *Rasbora cephalotaenia steineri* Nichols & Pope, 1927; *Rasbora lateristriata allos* Lin, 1931; *Rasbora volzi pallopinna* Lin, 1932.

Meristics. D = 2.8; A = 2.6; P = 1.13; V = 1.8; C = 4.17; PrD = 12; Sc = 28.

Morphometric. SL = 3.17 (2.52 - 3.58) Bd = 3.60 (2.94 - 4.10) HL = 7.23 (2.70 - 9.68) Lbd = 8.73 (6.05 - 10.40) Lba = 5.95 (5.00 - 7.81) Lcp = 7.36 (5.83 - 8.39) Dcp. HL = 3.28 (2.96 - 3.86) SnL = 3.39 (2.86 - 3.85) Iw = 2.46 (2.36 - 2.53) Ed = 1.74 (1.23 - 2.66) Lcp = 2.04 (1.91 - 2.23) Dcp; Iw = 1.38 (1.21 - 1.52) Ed; Lcp = 1.33 (0.75 - 1.68) Dcp. (Figure A 1.45.).

Sampling locations in the study area: Not distributed in (1); (2); (35) see (Figure 2.1.1.)

***46. Hypsibarbus annamensis* (Pellegrin & Chevey, 1936)**

Total sample. Analyzed: 30 specimens

Synonyms. *Barbus annamensis* Pellegrin & Chevey, 1936; *Lissochilus annamensis* (Mai, 1978); *Acrossocheilus annamensis* (Hao & Van, 2001).

Meristics. D = IV. 8; A = 3.5; P = 1.14 - 16; V = 1.8; C = 4.17; Csc = 13 - 14; PrD = 10 - 12; Sc = 9 - 10; Ll = 29 - 31 (TSD = 5.5; TSV = 2 - 3).

Morphometric. SL = 3.12 (2.80 - 3.53) Bd = 3.77 (3.50 - 4.25) HL = 1.89 (1.78 - 2.12) Prdl = 1.96 (1.88 - 2.17) Podl = 3.97 (3.76 - 4.46) Prvl = 6.27 (5.87 - 7.02) Lcp = 8.54 (7.81 - 9.65) Dcp; HL = 3.27 (3.08 - 3.38) SnL = 3.18 (3.02 - 3.37) Ed = 3.12 (2.97 - 3.23) Iw = 1.98 (1.89 - 2.22) Hwn = 1.67 (1.59 - 1.75) Lcp = 2.27 (2.14 - 2.43) Hdn = 1.36 (1.30 - 1.41) Hde; Iw = 1.02 (0.97 - 1.06) Ed; Lcp = 1.36 (1.22 - 1.46) Dcp; Lbd = 1.84 (1.66 - 2.09) Lba. (Figure A 1.46.).

Sampling locations in the study area: (12); (13); (14); (15); (18); (28); (31); (36) see (Figure 2.1.1.)

***47. Hypsibarbus macrosquamatus* (Mai, 1978)**

Total sample. Analyzed: 25 specimens

Synonyms. *Lissochilus macrosquamatus* Mai, 1978; *Acrossocheilus macrosquamatus* Hao & Van, 2001.

Meristics. D = IV. 8; A = II-III. 4 - 5; P = 1.14; V = 1.8; C = 5.17; Csc = 14; PrD = 9 - 12; Sc = 10; Ll = 32 - 34 (TSD = 5 - 6; TSV = 3 - 4).

Morphometric. SL = 3.09 (2.99 - 3.31) Bd = 4.10 (3.79 - 4.83) HL = 4.86 (4.33 - 5.34) Dhl = 1.96 (1.84 - 2.04) Prdl = 2.89 (2.80 - 3.00) Podl = 5.73 (5.19 - 6.11) Lcp = 8.51 (8.31 - 8.76) Dcp; HL = 3.26 (2.85 - 3.57) SnL = 3.17 (2.78 - 3.46) Ed = 2.51 (2.14 - 2.85) Iw = 2.30 (1.92 - 2.59) Po = 1.58 (1.35 - 1.70) Hwn = 1.18 (0.99 - 1.25) Hdn = 1.41 (1.22 - 1.58) Lcp = 2.09 (1.81 - 2.24) Dcp; Iw = 1.27 (1.13 - 1.33) Ed; Lcp = 1.49 (1.36 - 1.64) Dcp; P → V = 1.10 (1.02 - 1.26) V → A. (Figure A 1.47.).

Sampling locations in the study area: (12); (13); (14); (15); (18); (28); (31); (36) see (Figure 2.1.1.)

***48. Nicholsicypris dorsohorizontalis* Nguyen & Doan, 1969**

Total sample. Analyzed: 12 specimens

Synonym. *Yaoshanicus dorsohorizontalis* (Nguyen & Doan, 1969).

Meristics. D = 2-3.7; P = 1.10 - 11; V = 1.7; A = 2 - 3. 7 - 8; C = 5.17; Ll = 36 - 38 (TSD = 5-6; TSV = 2); Csc = 13 - 14; PrD = 13 - 15; Sc = 13 - 14.

Morphometric. SL = 3.57 (3.21 - 4.17) Bd = 3.82 (3.48 - 4.32) HL = 5.47 (4.56 - 6.06) Dhl = 1.80 (1.65 - 1.93) Prdl = 2.92 (2.67 - 3.12) Podl = 4.80 (3.70 - 5.44) Lcp = 7.44 (6.23 - 8.46) Dcp; HL = 3.29 (2.70 - 3.83) SnL = 3.51 (3.04 - 4.07) Ed = 2.28 (1.97 - 2.79) Iw = 2.27 (2.04 - 2.78) Po = 1.82 (1.64 - 1.99) Hwn = 1.39 (1.18 - 1.62) Hdn = 1.26 (0.88 - 1.48) Lcp = 1.95 (1.68 - 2.17) Dcp; Iw = 1.55 (1.32 - 1.78) Ed; Lcp = 1.57 (1.20 - 2.26) Dcp; P → V = 1.07 (0.73 - 1.47) V → A. (Figure A 1.48.).

Sampling locations in the study area: (12); (13); (14); (15); (18); (22); (23); (28); (31); (36) see (Figure 2.1.1.)

***49. Neolissochilus benasi* (Pellegrin & Chevey, 1936)**

Total sample. Analyzed: 4 specimens

Synonyms. *Crossochilus benasi* Pellegrin & Chevey, 1936; *Crossocheilus benasi vuha* Nguyen. Nguyen & Le, 1999; *Neolissochilus benasi* (Hao & Van, 2001).

Meristics. D = III.8; A = III. 5; P = 1.12 - 13; V = 1.8; C = 4.17; Csc = 13; PrD = 15; Sc = 10; Ll = 38 - 39 (TSD = 7; TSV = 4).

Morphometric. SL = 3.53 (3.31 - 3.77) Bd = 3.86 (3.69 - 4.04) HL = 4.65 (4.41 - 4.86) Dhl = 1.89 (1.80 - 2.00) Prdl = 2.71(2.61 - 2.79) Podl = 5.32 (4.90 - 5.81) Lcp = 8.62 (7.95 - 8.97) Dcp; HL = 2.83 (2.71 - 2.90) SnL = 4.07 (3.78 - 4.27) Ed = 2.64 (1.48 - 2.98) Iw = 2.31 (2.22 - 2.49) Po = 1.69 (1.56 - 1.85) Hwn = 1.36 (1.32 - 1.44) Hdn = 1.38 (1.25 - 1.51) Lcp = 2.23 (2.08 - 2.38) Dcp; Iw = 1.62 (1.30 - 2.87) Ed; Lcp = 1.63 (1.44 - 1.80) Dcp; P → V = 1.10 (1.02 - 1.18) V → A. (Figure A 1.49.).

Sampling locations in the study area: (12); (13); (14); (15); (18); (28); (31); (36) see (Figure 2.1.1.)

***50. Onychostoma gerlachi* (Peters, 1881)**

Total sample. Analyzed: 9 specimens

Synonyms. *Barbus gerlachi* Peters, 1881; *Varicorhinus thacbaensis* Nguyen & Ngo, 2001; *Varicorhinus babeensis* Nguyen & Nguyen, 2001.

Meristics. D = III.10; A = III.6; P = 1.14; V = 1.8; C = 4.17; Csc = 14; PrD = 13; Sc = 11; Ll = 40 - 41 (TSD = 8; TSV = 4).

Morphometric. SL = 3.18 (3.03 - 3.29) Bd = 4.12 (3.87 - 4.35) HL = 4.87 (4.78 - 4.95) Dhl = 1.98 (1.96 - 2.02) Prdl = 2.95 (2.81 - 3.04) Podl = 4.83 (4.69 - 5.13) Lcp = 8.37 (7.86 - 8.97) Dcp; HL = 2.60 (2.38 - 3.02) SnL = 3.84 (3.56 - 4.13) Ed = 2.06 (1.96 - 2.18) Iw = 2.77 (2.48 - 2.98) Po = 1.62 (1.54 - 1.76) Hwn = 1.12 (1.05 - 1.18) Hdn = 1.17 (1.10 - 1.21) Lcp = 2.03 (1.94 - 2.22) Dcp; Iw = 1.87 (1.64 - 2.10) Ed; Lcp = 1.74 (1.64 - 1.89) Dcp; P → V = 1.10 (0.96 - 1.16) V → A. (Figure A 1.50.).

Sampling locations in the study area: (12); (13); (14); (15); (18); (28); (31); (36) see (Figure 2.1.1.)

***51. Opsariichthys bidens* Günther, 1873**

Total sample. Analyzed: 10 specimens

Synonyms. *Opsariichthys brevistomatus* Nguyen, Nguyen, Do & Nguyen, 2012; *Opsariichthys longianalis* Nguyen, Nguyen, Do & Nguyen, 2012; *Opsariichthys dorsoarcus* Nguyen, Nguyen, Do & Nguyen, 2012.

Meristics. D = 2 - 3.7; A = 3.10; P = 1.12 - 13; V = 1.8; C = 3.19.4. PrD = 16; Sc = 10; Csc = 16; Ll = 39 - 42 (TSD = 9; TSV = 5).

Morphometric. SL = 3.75 (3.33 - 4.19) Bd = 3.13 (2.92 - 3.24) HL = 4.21 (3.83 - 4.50) Dhl = 1.90 (1.78 - 2.01) Prdl = 2.62 (2.46 - 2.74) Podl = 6.06 (5.25 - 7.34) Lcp = 9.75 (9.11 - 10.69) Dcp; HL = 2.88 (2.67 - 3.24) SnL = 5.13 (4.20 - 5.55) Ed = 3.46 (3.03 - 3.68) Iw = 2.05 (1.99

- 2.20) Po = 2.39 (2.20 - 2.50) Hwn = 1.53 (1.44 - 1.63) Hdn = 1.93 (1.64 - 2.31) Lcp = 3.12 (2.88 - 3.51) Dcp; Iw = 1.48 (1.39 - 1.56) Ed; Lcp = 1.62 (1.24 - 1.82) Dcp; P → V = 1.31 (1.10 - 1.54) V → A. (Figure A 1.51.).

Sampling locations in the study area: Not distributed in (1); (2); (25); (27); (33); (34); (35); see (Figure 2.1.1.)

***52. Paraspinibarbus macracanthus* (Pellegrin & Chevey, 1936)**

Total sample. Analyzed: 4 specimens

Synonyms. *Spinibarbus macracanthus* Pellegrin & Chevey, 1936*; Spinibarbus macracanthus maculatus* Dao & Mai, 1959; *Balantiocheilus hekouensis* Wu, 1977.

Meristics. D = III. 9; A = 3.5; P = 1.16; V = 1.12; C = 4.17; CSc = 17; PrD = 14; Sc = 9; Ll = 36 - 37 (TSD = 7; TSV = 3).

Morphometric. SL = 3.28 (3.19 - 3.37) Bd = 4.28 (4.21 - 4.35) HL = 4.89 (4.83 - 4.95) Dhl = 2.08 (2.08 - 2.08) Prdl = 2.87 (2.87 - 2.87) Podl = 5.28 (5.14 - 5.42) Lcp = 8.70 (8.52 - 8.88) Dcp; HL = 2.40 (2.23 - 2.57) SnL = 3.65 (3.40 - 3.89) Ed = 2.67 (2.67 - 2.68) Iw = 2.77 (2.61 - 2.94) Po = 1.23 (1.18 - 1.29) Lcp = 2.03 (1.96 - 2.11) Dcp; Iw = 1.36 (1.27 - 1.46) Ed; Lcp = 1.65 (1.64 - 1.66) Dcp; P → V = 1.15 (1.14 - 1.16) V → A. (Figure A 1.52.).

Sampling locations in the study area: Not distributed in (1); (2); (3); (4); (6); (7); (8); (10); (23); (25); (27); (33); (34); (35) see (Figure 2.1.1.)

***53. Poropuntius solitus* Kottelat, 2000**

Total sample. Analyzed: 5 specimens

Meristics. D = IV.8; A = 2 - 3.5; P = 1.13; V = 1.8; C = 4.18; Csc = 8 - 13; PrD = 10 - 13; Sc = 8 - 9; Ll = 30 - 32 (TSD = 4 - 5; TSV = 2 - 3).

Morphometric. SL = 3.12 (2.99 - 3.32) Bd = 4.14 (4.02 - 4.22) HL = 5.35 (4.87 - 5.59) Dhl = 2.05 (1.98 - 2.14) Prdl = 2.93 (2.76 - 3.12) Podl = 5.96 (5.45 - 6.34) Lcp = 8.38 (7.75 - 8.60) Dcp; HL = 3.06 (2.93 - 3.25) SnL = 3.28 (3.05 - 3.53) Ed = 2.94 (2.71 - 3.16) Iw = 2.78 (2.66 - 2.97) Po = 2.80 (2.66 - 3.04) Hwn = 1.31 (1.21 - 1.64) Hdn = 1.44 (1.33 - 1.55) Lcp = 2.02 (1.90 - 2.11) Dcp; Iw = 1.12 (1.00 - 1.24) Ed; Lcp = 1.41 (1.27 - 1.57) Dcp; P → V = 1.02 (0.95 - 1.12) V → A. (Figure A 1.53.).

Sampling locations in the study area: (12); (13); (14); (15); (18); (28); (31); (36) see (Figure 2.1.1.)

***54. Spinibarbus denticulatus* (Oshima, 1926)**

Total sample. Analyzed: 7 specimens

Synonyms. *Spinibarbichthys denticulatus* Oshima, 1926; *Spinibarbus denticulatus polylepis* Chu, 1989.

Meristics. D = 3.9; A = 2.6; P = 1.12; V = 1.7; C = 4.16; Csc = 13; PrD = 9; Sc = 9; Ll = 28 - 29 (TSD = 5; TSV = 4).

Morphometric. SL = 3.09 (2.91 - 3.23) Bd = 3.91 (3.70 - 4.04) HL = 4.67 (4.49 - 4.96) Dhl = 1.94 (1.91 - 1.97) Prdl = 2.84(2.67 - 2.92) Podl = 7.28 (6.57 - 7.75) Lcp = 8.41 (8.32 - 8.55) Dcp; HL = 3.06 (2.89 - 3.34) SnL = 3.80 (3.39 - 4.05) Ed = 2.19 (2.09 - 2.43) Iw = 2.35 (2.14 - 2.48) Po = 1.86 (1.67 - 1.94) Lcp = 2.15 (2.06 - 2.28) Dcp; Iw = 1.74 (1.62 - 1.90) Ed; Lcp = 1.16 (1.08 - 1.27) Dcp; P → V = 1.15 (1.08 - 1.19) V → A. (Figure A 1.54.).

Sampling locations in the study area: (12); (13); (14); (15); (18); (28); (31); (36) see (Figure 2.1.1.)

55. *Spinibarbus hollandi* Oshima, 1919

Total sample. Analyzed: 5 specimens

Synonyms. *Spinibarbus elongatus* Oshima, 1920; *Barbodes elongatus* (Oshima, 1920).

Meristics. D = 2.9; A = 2.7; P = 1.15; V = 1.9; C = 4.19; CSc = 8; PrD = 11; Sc = 5; Ll = 22 - 23 (TSD = 3; TSV = 2).

Morphometric. SL = 3.83 (3.58 - 4.24) Bd = 3.68 (3.48 - 3.97) HL = 4.64 (4.32 - 5.07) Dhl = 2.09 (2.03 - 2.15) prdl = 2.55 (2.51 - 2.59) Podl = 6.55 (5.84 - 6.95) Lcp = 8.74 (8.05 - 9.40) Dcp; HL = 2.72 (2.64 - 2.86) SnL = 4.23 (3.81 - 4.91) Ed = 2.44 (2.34 - 2.53) Iw = 2.15 (2.05 - 2.22) Po = 1.79 (1.47 - 2.00) Lcp = 2.37 (2.31 - 2.44) Dcp; Iw = 1.74 (1.56 - 2.10) Ed; Lcp = 1.35 (1.16 - 1.61) Dcp; P → V = 1.22 (1.16 - 1.30) V → A. (Figure A 1.55.).

Sampling locations in the study area: (12); (13); (14); (15); (18); (28); (31); (36) see (Figure 2.1.1.)

***56. Metzia lineata* (Pellegrin, 1907)**

Total sample. Analyzed: 6 specimens

Synonyms. *Ischikauia lineata* Pellegrin, 1907; *Rasborichthys altior* Regan, 1913; *Rasborinus fukiensis* Nichols, 1925.

Meristics. D = 2.6 - 7; A = 2.15; P = 1.12 - 13; V = 1.7; C = 7.18.5; PrD = 19 - 20; Sc = 11 - 13; Csc = 12; Ll = 43 - 44 (TSD = 7 - 8; TSV = 4).

Morphometric. SL = 3.31 (3.16 - 3.43) Bd = 3.87 (3.63 - 4.08) HL = 1.82 (1.77 - 1.88) Prdl = 2.65 (2.12 - 2.93) Podl = 5.53 (5.14 - 6.21) Lcp = 8.96 (8.29 - 9.25) Dcp = 8.72 (8.01 - 9.04) BdD; HL = 3.39 (2.98 - 3.71) SnL = 2.89 (2.72 - 3.07) Ed = 2.29 (2.17 - 2.39) Po = 3.71 (3.69 - 4.00) Iw = 1.46 (1.39 - 1.53) Hdn = 2.46 (2.20 - 2.66) Hwn; Iw = 0.78 (0.71 - 0.87) Ed; P → V = 1.03 (1.02 - 1.04) V → A = 1.92 (1.91 - 1.94) Dcp = 1.19 (1.07 - 1.31) Lcp; Lcp = 1.63 (1.48 - 1.80) Dcp. (Figure A 1.56.).

Sampling locations in the study area: (12); (13); (14); (15); (18); (22); (23); (28); (31); (36) see (Figure 2.1.1.)

(10). FAMILY COBITIDAE

***57. Cobitis laoensis* (Sauvage, 1878)**

Total sample. Analyzed: 37 specimens

Synonym. *Misgurnus laoensis* Sauvage, 1878.

Meristics. D = 1. 6; A = 1 - 2. 5; P = 1.6 - 7; V = 1.5; C = 2.14.2.

Morphometric. SL = 6.15 (5.49 - 6.41) Bd = 4.70 (4.45 - 4.97) HL = 5.87 (5.71 - 6.03) Dhl = 7.46 (6.27 - 8.20) Lcp = 9.53 (8.81 - 10.04) Dcp = 1.84 (1.77 - 1.91) Prdl = 1.80 (1.75 - 1.90) Podl = 1.24 (1.23 - 1.25) Pral; HL = 3.52 (3.31 - 3.65) SnL = 6.07 (5.59 - 6.64) Ed = 8.75 (7.33 - 10.81) Iw = 1.59 (1.26 - 1.84) Lcp = 2.03 (1.87 - 2.20) Dcp; Lcp = 1.29 (1.13 - 1.54) Dcp; Iw = 0.70 (0.61 - 0.78) Ed. (Figure A 1.57.).

Sampling locations in the study area: Not distributed in (1); (2); (3); (7); (8); (10); (34); (35); see (Figure 2.1.1.)

***58. Misgurnus anguillicaulatus* (Cantor, 1842)**

Total sample. Analyzed: 5 specimens

Synonyms. *Cobitis anguillicaudata* Cantor, 1842; *Misgurnus crossochilus* Sauvage, 1878.

Meristics. D = 2.5; A = 2.5; P = 1.10 - 11; V = 1.6; C = 17 - 20.

Morphometric. SL = 7.18 (6.81 - 7.60) Bd = 5.94 (5.45 - 6.21) HL = 7.10 (6.56 - 7.56) Dhl = 5.86 (5.20 - 6.52) Lcp = 8.16 (7.61 - 8.69) Dcp = 1.68 (1.58 - 1.75) Podl = 1.66 (1.59 - 1.75) Prvl = 1.33 (1.25 - 1.38) Pral; HL = 2.73 (2.58 - 2.88) SnL = 7.14 (6.67 - 8.07) Ed = 4.39 (3.70 - 4.76) Iw = 1.95 (1.61 - 2.52) Hwn = 0.99 (0.84 - 1.12) Lcp = 1.38(1.23 - 1.53) Dcp; Lcp = 1.40 (1.23 - 1.52) Dcp; Iw = 1.64 (1.40 - 1.92) Ed. (Figure A 1.58.).

Sampling locations in the study area: Not distributed in (1); (2); (25); (27) see (Figure 2.1.1.)

***59. Misgurnus mizolepis* Günther, 1888**

Total sample. Analyzed: 3 specimens

Synonyms. *Misgurnus mizolepis fukien* Nichols, 1925; *Misgurnus mizolepis hainan* Nichols & Pope, 1927.

Meristics. D = 1.5 - 6; A = 1.5; P = 1.10 - 11; V = 1.6; C = 17 - 20.

Morphometric. SL = 7.46 (6.58 - 8.18) Bd = 6.31 (6.24 - 6.35) HL = 7.35 (7.04 - 7.55) Dhl = 6.11 (5.12 - 7.03) Lcp = 8.73 (7.86 - 9.23) Dcp = 1.75 (1.67 - 1.80) Prdl = 1.66 (1.57 - 1.76) Prvl = 1.32 (1.27 - 1.35) Pral = 10.50 (9.84 - 11.28) Hwn; HL = 2.53 (2.41 - 2.64) SnL = 7.05

(5.86 - 8.61) Ed = 4.15 (3.67 - 4.70) Iw = 1.83 (1.77 - 1.90) Hwn = 2.97 (2.77 - 3.16) Hwe = 1.59 (1.36 - 1.69) Hdn = 1.17 (1.13 - 1.19) Dhl = 2.05 (1.94 - 2.25) Hde = 0.97 (0.81 - 1.13) Lcp = 1.38 (1.24 - 1.48) Dcp; Lcp = 1.45 (1.31 - 1.76) Dcp; Iw = 1.70 (1.53 - 1.96) Ed. (Figure A 1.59.).

Sampling locations in the study area: (11); (12); (13); (14); (15); (16); (17); (18); (19); (20); (21); (22); (23); (24); (26); (28); (31) see (Figure 2.1.1.)

(11). FAMILY BALITORIDAE

***60. Annamia normani* (Hora, 1931)**

Total sample. Analyzed: 12 specimens

Synonym. *Parhomaloptera normani* Hora, 1931.

Meristics. D = II. 8; A = I. 4; P = 1. 16 - 27; V = 1. 10. C = 12; PrD = 29; Sc = 12; Csc = 25; Ll = 100 - 104 (TSD = 16 -18; TSV = 17 - 18).

Morphometric. SL = 6.82 (6.16 - 7.47) Bd = 4.96 (4.85 - 5.04) HL = 1.18 (1.14 - 1.22) Pral = 1.95 (1.88 - 2.06) Prvl = 5.49 (5.20 - 5.70) Prpl = 2.12 (2.04 - 2.23) Prdl = 17.54 (16.58 - 18.91) Lba = 6.62 (6.25 - 7.08) Lbad = 9.13 (8.51 - 9.70) high A = 15.90 (14.49 - 16.70) Lcp = 11.34 (10.91 - 12.05) Dcp; HL = 1.69 (1.66 - 1.74) SnL = 6.55 (6.31 - 6.75) Ed = 2.26 (2.19 - 2.33) Iw = 2.13 (2.10 - 2.18) Hdn = 1.18 (1.14 - 1.23) Hwn = 1.30 (1.25 - 1.36) Hwe = 2.43 (2.29 - 2.53) Hde = 2.29 (2.17 - 2.48) Lcp = 3.21(2.88 - 3.40) Dcp. (Figure A 1.60.).

Sampling locations in the study area: (11); (12); (13); (14); (15); (16); (17); (18); (19); (20); (21); (22); (23); (24); (26); (28); (31) see (Figure 2.1.1.)

***61. Sewellia lineolata* (Valenciennes, 1846)**

Total sample. Analyzed: 10 specimens

Synonym. *Balitora lineolata* Valenciennes, 1846.

Meristics. D = II.8; A = I.3; P = 1.19 - 20; V = 1.17 - 18; C = 13 -1 5; Ll = 49 - 51 (TSD = 9; TSV = 6).

Morphometric. SL = 5.04 (4.72 - 5.21) Bd = 14.32 (11.43 - 16.23) Lcp = 8.54 (8.26 - 8.72) Dcp = 4.22 (4.10 - 4.43) HL; HL = 1.51 (1.48 - 1.56) SnL = 1.74 (1.68 - 1.82) Iw = 5.11 (5.00 - 5.18) Ed = 1.19 (1.15 - 1.26) Bd. (Figure A 1.61.).

Sampling locations in the study area: (11); (12); (13); (14); (15); (16); (17); (18); (19); (20); (21); (22); (23); (24); (26); (28); (31) see (Figure 2.1.1.)

(12). FAMILY NEMACHEILIDAE

***62. Schistura finis* Kottelat, 2000**

Total sample. Analyzed: 86 specimens

Meristics. D = 3.7 ½; A = 3.5½; P = 11; V = 8; C = 9 + 8.

Morphometric. SL = 5.61 (5.29 - 5.94) Bd = 4.58 (4.53 - 4.62) HL = 5.12 (5.00 - 5.24) Dhl = 5.76 (5.64 - 5.89) Lcp = 8.45 (8.12 - 8.87) Dcp = 1.88 (1.84 - 1.92) Pral = 1.95 Prvl = 1.29 (1.29 - 1.30) Pral = 1.47 (1.45 - 1.48) Prul; HL = 2.32 (2.26 - 2.37) SnL = 5.69 (5.21 - 6.16) Ed = 3.54 (3.38 - 3.70) Iw = 1.26 (1.24 - 1.28) Lcp = 1.85 (1.79 - 1.90); Lcp = 1.47 (1.44 - 1.49); Iw = 1.62 (1.41 - 1.82) Ed. (Figure A 1.62.).

Sampling locations in the study area: (11); (12); (13); (14); (15); (16); (17); (18); (19); (20); (21); (22); (23); (24); (26); (28); (31) see (Figure 2.1.1.)

***63. Schistura hingi* (Herre, 1934)**

Total sample. Analyzed: 64 specimens

Synonym. *Homaloptera hingi* Herre, 1934.

Meristics. D = 3.7 ½; A = 3.5½; P = 11; V = 8; C = 9 + 9.

Morphometric. SL = 5.63 (4.79 - 6.59) Bd = 4.11 (4.00 - 4.20) HL = 4.54 (4.22 - 4.75) Dhl = 6.77 (6.33 - 7.41) Lcp = 6.74 (5.83 - 7.84) Dcp = 1.87 (1.80 - 1.95) Pral = 1.83 (1.78 - 1.86) Prvl = 1.27 (1.21 - 1.30) Pral = 1.44 (1.38 - 1.48) Prul; HL = 2.10 (2.01 - 2.15) SnL = 5.91 (4.89 - 6.70) Ed = 3.17 (2.76 - 3.46) Iw = 1.65 (1.52 - 1.85) Lcp = 1.64 (1.43 - 1.87); Lcp = 1.00 (0.82 - 1.20); Iw = 1.88 (1.42 - 2.20) Ed. (Figure A 1.63.).

Sampling locations in the study area: (11); (12); (13); (14); (15); (16); (17); (18); (19); (20); (21); (22); (23); (24); (26); (28); (31) see (Figure 2.1.1.)

***64. Schistura pervagata* Kottelat, 2000**

Total sample. Analyzed: 70 specimens

Meristics. D = 3.7 ½; A = 3.5½; P = 11; V = 8; C = 10 + 8.

Morphometric. SL = 6.11 (5.37 - 7.01) Bd = 4.30 (4.00 - 4.65) HL = 4.75 (4.34 - 5.16) Dhl = 6.53 (5.82 - 7.54) Lcp = 7.45 (6.21 - 8.46) Dcp = 1.90 (1.77 - 2.01) Pral = 1.89 (1.78 - 2.07) Prvl = 1.29 (1.22 - 1.37) Pral = 1.47 (1.40 - 1.56) Prul; HL = 2.23 (2.08 - 2.39) SnL = 5.40 (4.76 - 6.94) Ed = 3.34 (2.83 - 4.14) Iw = 1.52 (1.31 - 1.89) Lcp = 1.73 (1.55 - 2.05); Lcp = 1.15 (0.82 - 1.42); Iw = 1.64 (1.20 - 2.23) Ed. (Figure A 1.64.).

Sampling locations in the study area: (11); (12); (13); (14); (15); (16); (17); (18); (19); (20); (21); (22); (23); (24); (26); (28); (31) see (Figure 2.1.1.)

***65. Schistura kottelati* Tuan et al., 2015**

Total sample. Analyzed: 28 specimens

Meristics. D = 3.7 ½; A = 3.5½; P = 10; V = 9; C = 9 + 8.

Morphometric. SL = 5.75 (4.92 - 6.60) Bd = 3.80 (3.47 - 4.26) HL = 4.38 (3.89 - 4.80) Dhl = 6.80 (5.93 - 7.82) Lcp = 9.55 (8.54 - 12.53) Dcp = 1.75 (1.69 - 1.81) Pral = 1.77 (1.68 - 1.96) Prvl = 1.28 (1.24 - 1.34) Pral = 1.38 (1.33 - 1.44) Prul; HL = 2.84 (2.52 - 3.53) SnL = 4.79 (3.90 - 5.67) Ed = 2.68 (2.42 - 3.16) Iw = 1.80 (1.54 - 2.25) Lcp = 2.52 (2.24 - 3.61); Lcp = 1.41 (1.20 - 1.65); Iw = 1.79 (1.51 - 2.16) Ed. (Figure A 1.65.).

Sampling locations in the study area: (27) see (Figure 2.1.1.)

***66. Traccatichthys taeniatus* (Pellegrin & Chevey, 1936)**

Total sample. Analyzed: 7 specimens

Synonyms. *Nemacheilus pulcher taeniata* Pellegrin & Chevey, 1936; *Micronemacheilus taeniatus* (Pellegrin & Chevey, 1936).

Meristics. D = 2.10 - 12; A = 1.4 - 5; P = 1.11 - 15; V = 1.6 - 7; C = 6.16.6.

Morphometric. SL = 4.46 (3.98 - 5.02) Bd = 3.96 (3.61 - 4.22) HL = 6.48 (5.66 - 7.89) Lcp = 6.60 (6.05 - 7.22) Dcp = 2.05 (1.94 - 2.09) Prdl = 1.30 (1.22 - 1.34) Pral = 1.83 (1.68 - 1.93) Prvl; HL = 2.27 (2.15 - 2.55) SnL = 4.48 (4.01 - 5.05) Ed = 3.33 (3.01 - 3.70) Iw = 1.64 (1.47 - 1.87) Lcp = 1.67 (1.54 - 1.80) Dcp = 2.53 (2.38 - 2.77) Po; Lcp = 1.03 (0.87 - 1.22) Dcp; Iw = 1.35 (1.09 - 1.65) Ed. (Figure A 1.66.).

Sampling locations in the study area: (11); (12); (13); (14); (15); (16); (17); (18); (19); (20); (21); (22); (23); (24); (26); (28); (31) see (Figure 2.1.1.)

VII. ORDER SILURIFORMES

(13). FAMILY BAGRIDAE

***67. Mystus gulio* (Hamilton, 1822)**

Total sample. Analyzed: 4 specimens

Synonyms. *Pimelodus gulio* Hamilton, 1822; *Bagrus albilabris* Valenciennes, 1840.

Meristics. D = I.7; A = 2.15; P = I.7; V = 1.5; C = 4.17.4.

Morphometric. SL = 3.69 (3.36 - 3.95) Bd = 3.74 (3.62 - 3.90) HL = 2.47 (2.36 - 2.67) Prdl = 6.52 (6.04 - 6.92) Lcp = 8.94 (8.21 - 9.69) Dcp = 1.87 (1.79 - 1.97) Prvl = 1.54 (1.49 - 1.62) Pral = 5.24 (4.85 - 6.00) Hwd = 1.64 (1.62 - 1.71) Prul; HL = 5.13 (4.64 - 5.79) Ed = 2.09 (1.88 - 2.25) Iw = 2.49 (2.37 - 2.59) SnL = 2.14 (1.99 - 2.31) Po = 1.16 (1.13 - 1.21) Hwn = 1.25 (1.16 - 1.32) Hwe = 1.74 (1.63 - 1.85) Lcp = 2.39 (2.22 - 2.48) Dcp; Iw = 2.46 (2.26 - 2.58) Ed; Lcp = 1.37 (1.31 - 1.51) Dcp; Lbd = 0.61 (0.52 - 0.67) Lba; Bd = 1.19 (1.17 - 1.20) Bda = 2.42 (2.37 - 2.45) Dcp = 1.27 (1.22 - 1.30) Bdn. Bwd = 1.99 (1.86 - 2.13) Bwa. (Figure A 1.67.).

Sampling locations in the study area: (1); (2); (3); (7); (35) see (Figure 2.1.1.)

***68. Hemibagrus centralus* Mai, 1978**

Total sample. Analyzed: 7 specimens

Meristics. D = I.7; A = 10; P = I.9; V = 6; C = 22.

Morphometric. SL = 5.06 (4.79 - 5.24) Bd = 3.75 (3.68 - 3.85) HL = 62.58 (54.79 - 69.76) Prdl = 1.44 (1.41 - 1.48) Podl = 5.36 (5.14 - 5.61) Lcp = 10.12 (9.63 - 10.82) Dcp = 5.19 (5.04 - 5.36) Hwn = 6.76 (6.37 - 7.12) Hwe; HL = 6.69 (5.92 - 7.13) Ed = 3.20 (3.08 - 3.39) Iw = 2.57 (2.46 - 2.65) SnL = 2.14 (2.10 - 2.20) Po; Lcp = 1.88 (1.72 - 2.01) Dcp; Iw = 2.09 (1.88 - 2.25) Ed. (Figure A 1.68.).

Sampling locations in the study area: Not distributed in (1); (2); (7); (8); (22); (23); (25); (27); (34); (35) see (Figure 2.1.1.)

***69. Tachysurus virgatus* (Oshima, 1926)**

Total sample. Analyzed: 23 specimens

Synonyms. *Aoria virgatus* Oshima, 1926*; Leiocassis virgatus* (Oshima, 1926).

Meristics. D = I.6 - 7; A = 13 - 14; P = I.6; V = 1.5; C = 18 - 20.

Morphometric. SL = 4.61 (3.99 - 5.21) Bd = 4.39 (4.17 - 4.55) HL = 14.49 (12.94 - 15.34) Prdl = 8.39 (8.07 - 8.84) Lcp = 9.39 (8.07 - 10.20) Dcp = 4.79 (4.37 - 5.21) Prvl = 2.77 (2.63 - 2.91) Prsl = 10.18 (10.02 - 11.11) Hwd = 1.98 (1.92 - 2.04) Prul; HL = 1.55 (1.45 - 1.60) Ed = 3.16 (2.61 - 3.75) Iw = 2.58 (2.31 - 3.53) SnL = 2.95 (2.61 - 3.19) Po = 1.05 (0.94 - 1.25) Hwn = 1.40 (1.13 - 1.44) Hwe = 1.91 (1.59 - 2.00) Lcp = 2.14 (1.91 - 2.22) Dcp; Iw = 0.49 (0.43 - 0.55) Ed; Lcp = 1.12 (1.05 - 1.20) Dcp; Lbd = 1.25 (1.14 - 1.36) Lba; Bd = 1.10 (1.07 - 1.17) Bda = 2.04 (1.97 - 2.27) Dcp = 1.33 (1.20 - 1.43) Hdn. Bwd = 0.66 (0.61 - 0.69) Bda. (Figure A 1.69.).

Sampling locations in the study area: Not distributed in (1); (2); (7); (8); (22); (23); (25); (27); (34); (35) see (Figure 2.1.1.)

(14). FAMILY SILURIDAE

***70. Silurus asotus* Linnaeus, 1758**

Total sample. Analyzed: 12 specimens

Synonyms. *Parasilurus asotus* (Linnaeus, 1758); *Silurus japonicus* Temminck & Schlegel, 1846.

Meristics. D = 5; A = 71; P = 10; V = 10; C = 19.

Morphometric. SL = 5.18 (4.49 - 5.87) Bd = 4.40 (4.26 - 4.61) HL = 36.16 (33.16 - 39.52) Prdl = 2.37 (2.21 - 2.51) Pral = 6.19 (5.78 - 6.38) Hwn = 7.22 (6.86 - 7.63) Hwe; HL = 8.20

(7.91 - 8.62) Ed = 1.66 (1.60 - 1.74) Iw = 2.09 (1.90 - 2.17) SnL = 1.96 (1.81 - 2.11) Po = 1.64 (1.58 - 1.73) Hwe = 1.41 (1.36 - 1.45) Hwn; Hwe = 0.86 (0.81 - 0.92) Hwn; Iw = 4.95 (4.53 - 5.40) Ed. (Figure A 1.70.).

Sampling locations in the study area: (1); (2); (3); (7); (35) see (Figure 2.1.1.)

***71. Pterocryptis cochinchinensis* (Valenciennes, 1840)**

Total sample. Analyzed: 12 specimens

Synonyms. *Silurus cochinchinensis* Valenciennes, 1840; *Parasilurus cochinchinensis* (Valenciennes, 1840).

Meristics. D = 5; A = 57 - 61; P = 11 - 13; V = 11 - 13; C = 17 - 19.

Morphometric. SL = 6.09 (5.49 - 7.00) Bd = 5.25 (4.97 - 5.68) HL = 3.32 (3.20 - 3.53) Prdl = 2.92 (2.61 - 3.07) Prvl = 2.51 (2.22 - 2.70) Pral; HL = 9.42 (8.48 - 10.65) Ed = 1.90 (1.82 - 1.97) Iw = 2.51 (2.47 - 2.56) SnL = 1.87 (1.81 - 1.96) Po; Iw = 4.98 (4.44 - 5.86) Ed; Bd = 1.04 (0.95 - 1.16) Hwn. (Figure A 1.71.).

Sampling locations in the study area: Not distributed in (1); (2); (7); (8); (22); (23); (25); (27); (34); (35) see (Figure 2.1.1.)

(15). FAMILY SISORIDAE

***72. Glyptothorax laosensis* Fowler, 1934**

Total sample. Analyzed: 4 specimens

Meristics. D = 2.6; A = 3.9; V = 1.5; P = 1.10; C = 18.

Morphometric. SL = 3.66 (3.21 - 3.95) Bd = 3.71 (3.33 - 4.55) HL = 4.48 (4.08 - 5.18) Hwn = 6.05 (4.99 - 6.58) Lcp = 9.45 (8.74 - 10.31) Dcp = 2.61 (2.44 - 2.85) Prdl; HL = 2.10 (1.86 - 2.28) SnL = 6.45 (6.10 - 7.50) Ed = 3.01 (2.34 - 3.31) Iw = 1.31 (1.15 - 1.59) Hdn = 1.21 (1.11 - 1.28) Hwn; Iw = 2.16 (1.62 - 2.96) Ed; Lcp = 1.58 (1.30 - 1.72) Dcp; Bd = 1.33 (1.07 - 1.55) BdA= 1.32 (1.19 - 1.70) BdD = 2.59 (2.03 - 2.95) Dcp; Lbd = 0.95 (0.73 - 1.06) Lba. (Figure A 1.72.).

Sampling locations in the study area: Not distributed in (1); (2); (7); (8); (22); (23); (25); (27); (34); (35) see (Figure 2.1.1.)

***73. Glyptothorax interspinalum* (Yên, 1978)**

Total sample. Analyzed: 6 specimens

Synonyms. *Glyptosternon interspinalum* Mai, 1978; *Glyptothorax merus* Li, 1984.

Meristics. D = 2.6; A = 2 - 3.9; V = 1.5; P = 1.10 - 11; C = 18.

Morphometric. SL = 5.23 (4.70 - 5.80) Bd = 3.63 (3.21 - 4.32) HL = 4.66 (4.11 - 5.30) Hwn= 6.07 (4.91 - 6.82) Lcp = 9.54 (8.22 - 10.27) Dcp = 2.65 (2.45 - 3.19) Prdl; HL = 2.32

(2.05 - 2.87) SnL = 7.88 (6.10 - 8.48) Ed = 3.26 (2.84 - 3.67) Iw = 1.67 (1.36 - 1.92) Hdn = 1.29 (1.05 - 1.50) Hwn; Iw = 2.44 (2.07 - 3.10) Ed; Lcp = 1.60 (1.13 - 2.05) Dcp; Bd = 1.07 (0.90 - 1.26) BdA = 1.15(1.07 - 1.30) BdD = 1.83 (1.66 - 1.97) Dcp; Lbd = 0.93 (0.88 - 1.17) LbA. (Figure A 1.73.).

Sampling locations in the study area: Not distributed in (1); (2); (7); (8); (22); (23); (25); (27); (34); (35) see (Figure 2.1.1.)

***74. Glyptothorax quadriocellatus* (Yên, 1978)**

Total sample. Analyzed: 4 specimens

Synonyms. *Glyptosternon quadriocellatum* Mai, 1978; *Glyptothorax spectrum* Kottelat, 2001.

Meristics. D = 2.6; A = 1.9; V = 1.5; P = 1.9; C = 19.

Morphometric. SL = 6.16 (5.99 - 6.40) Bd = 3.91 (3.71 - 4.18) HL = 5.51 (5.28 - 5.72) Hwn = 5.06 (4.55 - 5.53) Lcp = 12.59 (11.68 - 13.15) Dcp = 2.82 (2.51 - 3.02) Prdl; HL = 2.10 (1.95 - 2.17) SnL = 8.48 (6.54 - 9.85) Ed = 3.64 (3.12 - 4.13) Iw = 1.80 (1.62 - 1.97) Hdl = 1.41 (1.36 - 1.48) Hwn; Iw = 2.33 (2.05 - 2.81) Ed; Lcp = 2.50 (2.25 - 2.88) Dcp; Bd = 1.19 (1.16 - 1.32) BdA = 1.23 (1.17 - 1.35) BdD = 2.20 (2.04 - 2.39) Dcp; Lbd = 0.85 (0.68 - 0.97) Lba. (Figure A 1.74.).

Sampling locations in the study area: Not distributed in (1); (2); (7); (8); (22); (23); (25); (27); (34); (35) see (Figure 2.1.1.)

***75. Glyptothorax zanaensis* Wu, He & Chu, 1981**

Total sample. Analyzed: 4 specimens

Synonym. *Glyptothorax zainaensis* Wu, He & Chu, 1981.

Meristics. D = 2.6; A = 2.9; V = 1.5; P = 1.9 - 10; C = 18.

Morphometric. SL = 4.57 (4.30 - 4.90) Bd = 3.76 (3.45 - 4.11) HL = 4.64 (4.12 - 5.33) Hwn = 6.13 (5.10 - 7.89) Lcp = 9.36 (7.63 - 10.10) Dcp = 2.65 (2.54 - 2.86) Prdl; HL = 2.06 (1.90 - 2.32) SnL = 7.02 (6.64 - 8.31) Ed = 3.23 (2.95 - 3.53) Iw = 1.50 (1.28 - 1.69) Hdn = 1.23 (1.11 - 1.39) Hwn; Iw = 2.17 (1.51 - 2.78) Ed; Lcp = 1.55 (1.13 - 1.92) Dcp; Bd = 1.15 (1.01 - 1.27) BdA = 1.23 (1.18 - 1.34) BdD = 2.05 (1.75 - 2.37) Dcp; Lbd = 0.99 (0.78 - 1.17) Lba. (Figure A 1.75.).

Sampling locations in the study area: Not distributed in (1); (2); (7); (8); (22); (23); (25); (27); (34); (35) see (Figure 2.1.1.)

(16). FAMILY CLARIIDAE

***76. Clarias fuscus* (Lacepède, 1803)**

Total sample. Analyzed: 5 specimens

Synonyms. *Macropteronotus fuscus* Lacepède, 1803; *Clarias pulicaris* Richardson, 1845.

Meristics. D = 63 - 65; A = 40 - 42; P = I. 7; V = 6; C = 17 - 18.

Morphometric. SL = 6.07 (5.64 - 7.03) Bd = 4.68 (4.20 - 5.04) HL = 3.48 (2.79 - 5.82) Pral = 15.49 (14.38 - 19.71) Dcp = 2.2 4 (2.17 - 2.34) Prvl = 1.87 (1.85 - 1.90) Pral; HL = 8.77 (7.79 - 9.94) Ed = 1.79 (1.69 - 1.95) Iw = 2.59 (2.22 - 2.89) SnL = 1.90 (1.81 - 1.95) Po = 3.32 (2.86 - 4.07) Dcp; Iw = 4.92 (4.18 - 5.71) Ed. (Figure A 1.76.).

Sampling locations in the study area: Not distributed in (25); (27) see (Figure 2.1.1.)

(17). FAMILY PLOTOSIDAE

***77. Plotosus lineatus* (Thunberg, 1787)**

Total sample. Analyzed: 3 specimens)

Synonyms. *Silurus lineatus* Thunberg, 1787; *Silurus arab* Forsskål, 1775; *Plotosus lineatus* Valenciennes, 1840.

Meristics. D1 = I.5; D2 = 80 - 100; A = 85 - 90; P = 1.12 - 13; V = 11 - 13.

Morphometric. SL = 7.54 (7.32 - 7.74) Bd = 4.65 (4.27 - 4.97) HL; HL = 7.57 (7.23 - 7.89) Ed = 3.58 (3.25 - 3.92) Iw. (Figure A 1.77.).

Sampling locations in the study area: (1); (2); (3); (7); (35) see (Figure 2.1.1.)

VIII. ORDER AULOPIFORMES

(18). FAMILY SYNODONTIDAE

***78. Saurida elongata* (Temminck & Schlegel, 1846)**

Total sample. Analyzed: 2 specimens

Synonyms. *Aulopus elongatus* Temminck & Schlegel, 1846; *Saurida elongatus* (Temminck & Schlegel, 1846).

Meristics. D = 12; A = 1.10; P = 1.11. V = 1.8; PrD = 22. Ll = 57.

Morphometric. SL = (7.21 - 7.79) Bd = (4.20 - 4.97) HL = (7.62 - 7.89) Lbd = (10.41 - 11.20) Lba = (5.42 - 6.82) Lcp = (15.27 - 16.11) Dcp; HL = (3.03 - 3.97) SnL = (5.03 - 5.98) Ed = (5.19 - 5.87) Iw = (1.38 - 1.94) Lcp = (3.16 - 3.94) Dcp; Iw = (0.84 - 1.04) Ed; Lcp = (2.53 - 2.91) Dcp. (Figure A 1.78.).

Sampling locations in the study area: (1); (2) see (Figure 2.1.1.)

IX. ORDER ATHERINIFORMES

(19). FAMILY ATHERINIDAE

***79. Hypoatherina valenciennei* (Bleeker, 1854)**

Total sample. Analyzed: 2 specimens

Synonyms. *Atherina valenciennei* Bleeker, 1854; *Allanetta valenciennei* (Bleeker, 1854); *Atherina bleekeri* Günther, 1861; *Haplocheilus argyrotaenia* Tirant, 1883.

Meristics. D = V. II. 9; A = II. 13; P = I.l l-14; V = I. 5; C = 17; Ll = 45.

Morphometric. SL = (5.40 - 5.95) Bd = (4.34 - 4.75) HL; HL = (5.12 - 5.45) SnL = (2.10 - 2.34) Ed = (2.61 - 2.73) Iw = (1.42 - 1.57) SnL. (Figure A 1.79.).

Sampling locations in the study area: (1); (2) see (Figure 2.1.1.)

X. ORDER BELONIFORMES

(20). FAMILY BELONIDAE

***80. Strongylura strongylura* (Hasselt, 1823)**

Total sample. Analyzed: 2 specimens

Synonyms. *Belone strongylura* van Hasselt, 1823; *Strongylura caudimaculata* van Hasselt, 1824; *Belone caudimacula* Cuvier, 1829; *Belone saigonensis* Sauvage, 1879.

Meristics. D = 13 - 15; A = 15 - 17; P = 10 - 12; V = 6; C = 14 - 16; Ll = 140 - 164.

Morphometric. SL = (13.06 - 17.24) Bd = (2.64 - 2.94) HL; HL = (1.30 - 1.59) SnL = (10.40 - 12.0) Ed = (8.75 - 10.80) Iw. (Figure A 1.80.).

Sampling locations in the study area: (1); (2); (3); (7); (35) see (Figure 2.1.1.)

(21). FAMILY HEMIRAMPHIDAE

***81. Hyporhamphus sindensis* (Regan, 1905)**

Total sample. Analyzed: 2 specimens

Synonym. *Hemirhamphus sindensis* Regan, 1905.

Meristics. D = 13 - 15; A = 12 - 16; P = 10 - 12; V = 6; C = 14 - 16; Ll = 40 - 60.

Morphometric. SL = (6.58 - 7.24) Bd = (3.64 - 4.94) HL; HL = (2.30 - 2.59) SnL = (3.40 - 3.80) Ed = (3.00 - 3.80) Iw. (Figure A 1.81.).

Sampling locations in the study area: (1); (2); (3); (7); (35) see (Figure 2.1.1.)

XI. ORDER SYNGNATHIFORMES

(22). FAMILY SYNGNATHIDAE

***82. Microphis cuncalus* (Hamilton, 1822)**

Total sample. Analyzed: 2 specimens

Synonyms. *Syngnathus cuncalus* Hamilton, 1822; *Doryichthys cuncalus* (Hamilton, 1822); *Paramicrophis schmidti* Klausewitz, 1955; *Doryichthys chokderi* Ataur Rahman, 1976.

Meristics. D = 36 - 48; A = 3 - 4; P = 18 - 23.

Morphometric. SL = (8.20 - 8.45) HL; HL = (1.23 - 1.57) SnL = (6.54 - 6.98) Iw. (Figure A 1.82.).

Sampling locations in the study area: (1); (2); (34); (35) see (Figure 2.1.1.)

83. Hippichthys spicifer **(Rüppell, 1838)**

Total sample. Analyzed: 2 specimens

Synonyms. *Syngnathus spicifer* Rüppell, 1838; *Syngnathus gastrotaenia* Bleeker, 1853; *Syngnathus gracilis* Steindachner, 1901; *Micrognathus suvensis* Herre, 1935.

Meristics. D = 27; P = 16; C = 9.

Morphometric. SL = (18.72 - 18.93) Bd = (7.49 - 7.68) HL = (14.94 - 15.20) SnL = (73.31 - 75.84) Ed = (121.59 - 121.98) Iw = (11.17 - 11.75) Lbd; Bd = (0.05 - 0.08) SL = (0.40 - 0.49) HL = (0.80 - 0.87) SnL = (3.92 - 4.21) Ed = (6.50 - 6.82) Iw = (0.60 - 0.72) Lbd; HL = (2.00 - 2.34) SnL = (9.79 - 9.92) Ed = (16.24 - 16.43) Iw = (1.49 - 1.58) Lbd = (0.69 - 0.84) Lba; Iw = (0.60 - 0.73) Ed. (Figure A 1.83.).

Sampling locations in the study area: (1); (2); (34); (35) see (Figure 2.1.1.)

XII. ORDER SYNBRANCHIFORMES

(23). FAMILY SYNBRANCHIDAE

84. Monopterus albus **(Zuiew, 1793)**

Total sample. Analyzed: 6 specimens

Synonyms. *Muraena alba* Zuiew, 1793; *Monopterus javanensis* Lacepède, 1800; *Ophicardia phayriana* McClelland, 1844; *Apterigia immaculata* Basilewsky, 1855.

Morphometric. SL = 25.54 (18.7 - 28.9) Bd = 30.18 (29.05 - 31.05) Bwd = 12.30 (10.5 - 13.10) HL = 39.5 (30.8 - 40.5) Bda = 3.60 (3.4 - 4.3) Poul. HL = 4.5 (4.2 - 6.3) SnL = 13.5 (9.2 - 15.6) Ed = 1.42 (1.35 - 1.47) Po = 6.75 (6.1 - 7.6) Ed = 1.69 (1.63 - 1.75) Hdn = 2.5 (2.2 - 2.9) Hwn; Bd = 1.37 (1.35 - 1.42) Had; Iw = 2.0 (1.85 - 2.16) Ed. (Figure A 1.84.).

Sampling locations in the study area: Not distributed in (25); (27) see (Figure 2.1.1.)

(24). FAMILY MASTACEMBELIDAE

85. Mastacembelus armatus **(Lacepède,1800)**

Total sample. Analyzed: 6 specimens

Synonyms. *Macrognathus armatus* Lacepède, 1800; *Mastacembelus ponticerianus* Cuvier, 1832; *Macrognathus hamiltonii* McClelland, 1844; *Mastacembelus manipurensis* Hora, 1921.

Meristics. D1 = XXXII - XXXVI; D2 = 65 - 67; A = III. 69 - 71; P = 27; C = 18.

Morphometric. SL = 26.66 (23.09 - 28.83) Hfd = 19.45 (18.14 - 21.33) Hsd = 5.63 (5.33 - 5.84) HL = 2.35 (2.27 - 2.52) Lbd1 = 2.97(2.85 - 3.12) Lbd2; HL = 2.98 (2.92 - 3.05) SnL = 11.17 (10.74 - 11.98) Ed = 10.24 (9.53 - 11.07) Iw; Iw = 1.10 (0.98 - 1.23) Ed. (Figure A 1.85.).

Sampling locations in the study area: Not distributed in (1); (25); (27) see (Figure 2.1.1.)

***86. Sinobdella sinensis* (Bleeker, 1870)**

Total sample. Analyzed: 12 specimens

Synonyms. *Rhynchobdella sinensis* Bleeker, 1870; *Mastacembelus sinensis* (Bleeker, 1870); *Ophidium aculeatum* Basilewsky, 1855.

Meristics. D1 = XXXIV - XXXVI; D2 = 65 - 69; A = III. 73 - 77; P = 26; C = 17 - 18.

Morphometric. SL = 28.80 (27.15 - 30.79) Hfd = 19.84 (18.75 - 21.23) Hsd = 5.49 (5.33 - 5.67) HL = 2.31 (2.24 - 2.37) Lbdf = 2.93 (2.88 - 2.97) Lbds; HL = 2.94 (2.76 - 3.11) SnL = 11.27 (10.82 - 11.92) Ed = 10.52 (9.99 - 11.09) Iw; Iw = 1.07 (0.98 - 1.14) Ed. (Figure A 1.86.).

Sampling locations in the study area: Not distributed in (1); (2); (25); (27) see (Figure 2.1.1.)

XIII. ORDER SCORPAENIFORMES

(25). FAMILY TETRAROGIDAE

***87. Paracentropogon rubripinnis* (Temminck & Schlegel, 1843)**

Total sample. Analyzed: 3 specimens

Synonyms. *Apistus rubripinnis* Temminck & Schlegel, 1843; *Hypodytes rubripinnis* (Temminck & Schlegel, 1843).

Meristics. D1 = 3; D2 = 11.5; A = 3.4; P = 13; V = 1.4; C: 14 - 15.

Morphometric. SL = 3.22 (3.01- 3.55) Bd = 2.88 (2.70 - 3.03) HL = 10.81 (10.36 - 11.42) Lcp = 10.34 (9.64 - 11.11) Dcp = 9.38 (8.31 - 9.97) SnL = 20.33 (17.10 - 21.99) Ed = 11.73 (11.42 - 12.03) Iw = 11.94 (11.51 - 12.15) Lbdf = 1.83 (1.80 - 1.87) Lbds = 3.91 (3.54 - 4.18) Lba; Bd = 0.89 (0.85 - 0.93) HT = 3.36 (3.22 - 3.45) Lcp = 3.24 (2.72 - 3.70) Dcp = 2.91 (2.76 - 3.20) SnL = 6.39 (4.82 - 7.31) Ed = 3.66 (3.22 - 3.90) Iw = 3.72 (3.43 - 3.90) Lbdf = 0.57 (0.51 - 0.62) Lbds = 1.23 (1.00 - 1.39) Lba; HL = 3.26 (3.07 - 3.45) SnL = 7.12 (5.64 -

8.13) Ed = 4.09 (3.77 - 4.34) Iw = 3.76 (3.69 - 3.83) Lcp = 3.61 (3.18 - 4.11) Dcp = 4.16 (4.01- 4.26) Lbdf = 0.64 (0.60 - 0.69) Lbds = 1.37 (1.17 - 1.55) Lba; Iw = 1.73 (1.50 - 1.87) Ed; Lcp = 0.96 (0.84 - 1.07) Dcp. (Figure A 1.87.).

Sampling locations in the study area: (1); (2) see (Figure 2.1.1.)

(26). FAMILY SYNANCEIIDAE

***88. Minous pusillus* Temminck & Schlegel, 1843**

Total sample. Analyzed: 7 specimens

Meristics. D = 14.8; A = 3.5; P = 10; V = 1.4; C = 14; Ll = 23 - 25.

Morphometric. SL = 3.23 (3.07- 3.41) Bd = 3.15 (3.08 - 3.20) HL = 6.97 (6.13 - 7.64) Lcp = 10.75 (10.34 - 11.40) Dcp = 9.73 (9.56 - 9.82) SnL = 10.67 (10.00 - 11.40) Ed = 15.56 (14.07 - 16.44) Iw = 1.22 (1.21- 1.23) Lbdf = 3.96 (3.81- 4.19) Lba; Bd = 0.98 (0.94 - 1.04) HL = 2.17 (1.91 - 2.49) Lcp = 3.34 (3.08- 3.56) Dcp = 3.02 (2.88 - 3.12) SnL = 3.31 (3.12 - 3.56) Ed = 4.82 (4.59 - 5.13) Iw = 0.38 (0.36 - 0.39) Lbdf = 1.23 (1.21 - 1.24) Lba; HL = 3.09 (3.01 - 3.18) SnL = 3.39 (3.15 - 3.70) Ed = 4.94 (4.43 - 5.33) Iw = 2.21 (1.99 - 2.41) Lcp = 3.41 (3.25 - 3.70) ccd = 0.39 (0.38 - 0.39) Lbdf = 1.26 (1.20 - 1.31) Lba; Iw = 0.69 (0.66 - 0.71) Ed; Lcp = 1.56 (1.35 - 1.86) Dcp. (Figure A 1.88.).

Sampling locations in the study area: (1); (2) see (Figure 2.1.1.)

(27). FAMILY PLATYCEPHALIDAE

***89. Platycephalus indicus* (Linnaeus, 1758)**

Total sample. Analyzed: 14 specimens

Synonyms. *Callionymus indicus* Linnaeus, 1758; *Cottus insidiator* Forsskål, 1775; *Platycephalus insidiator* (Forsskål, 1775); *Cottus madagascariensis* Lacepède, 1801.

Meristics. D1 = IX; D2 = 13; A = 13; P = 18 - 19; V = I, 5; C: 13 - 15; Ll = 105 - 136; anterior 11 - 15 scales with a spine; oblique body-scale rows slanting downward and backward above lateral line 110 - 140; oblique body-scale rows slanting downward and forward above lateral line 93 - 98.

Morphometric. Proportions as % standard length (SL): head length (HL) 32.49 (31.79 - 33.36); predorsal length 34.04 (33.75 - 34.66); length of first dorsal fin base 15.52 (14.12 - 18.07); length of second dorsal fin base 34.71 (33.36 - 35.42); length of anal fin base 37.32 (36.08 - 39.50); caudal peduncle length 3.51 (3.08 - 3.77); caudal peduncle depth 8.03 (6.24 - 9.11); snout length 9.75 (9.36 - 10.21); orbital diameter 4.85 (4.21 - 5.11); upper jaw 11.89 (10.71 - 12.80); lower jaw 12.08 (11.16 - 12.96); interorbital width 3.92 (3.40 - 4.40);

postorbital length 56.20 (55.17 - 58.32); suborbital width 2.47 (2.09 - 2.73); pectoral fin length 14.70 (13.92 - 16.17); pelvic fin length 19.67 (18.84 - 20.46); caudal fin length 15.31 (14.57 - 16.32); length of first spine of first dorsal fin 1.46 (1.35 - 1.67); length of second spine of first dorsal fin 14.39 (12.67 - 15.49); length of first ray of second dorsal fin 13.31 (11.33 - 15.06); length of first anal fin ray 5.61 (4.88 - 6.17). Proportional measurements (% HL): snout length 30.00 (28.89 - 30.90); orbital diameter 14.94 (12.87 - 15.88); upper jaw 36.59 (33.69 - 39.34); lower jaw 37.19 (34.91 - 40.77); interorbital width 12.08 (10.20 - 13.76); postorbital length 56.20 (55.17 - 58.32); suborbital length 7.61 (6.45 - 8.42). (Figure A 1.89.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

90. *Rogadius serratus* (Cuvier, 1829)

Total sample. Analyzed: 17 specimens

Synonyms. *Platycephalus serratus* Cuvier, 1829; *Platycephalus polyodon* Bleeker, 1853; *Rogadius polijodon* (Bleeker, 1853); *Platycephalus polijodon* Bleeker, 1853.

Meristics. D1 = I+VIII; D2 = 12; A = 12; P = 18 - 21; V = I, 5; C = 13 - 15; Ll = 56 - 60; anterior 6 - 7 scales with a spine; oblique body-scale rows slanting downward and backward above lateral line 64 - 66; oblique body-scale rows slanting downward and forward above lateral line 54 - 59.

Morphometric. Proportions as % standard length (SL): Head length (HL) 36.31 (34.46 - 37.92); predorsal length 36.52 (34.61 - 38.99); length of first dorsal fin base 20.57 (18.17 - 22.77); length of second dorsal fin base 29.90 (28.57 - 31.62); length of anal fin base 31.33 (29.96 - 34.00); caudal peduncle length 4.93 (4.66 - 5.39); caudal peduncle depth 8.34 (7.45 - 8.92); snout length 11.90 (10.51 - 12.43); orbital diameter 8.31 (7.62 - 9.13); upper jaw 14.68 (13.25 - 15.51); lower jaw 13.28 (12.58 - 14.03); interorbital width 2.58 (2.83 - 2.40); postorbital length 44.39 (40.69 - 47.31); suborbital width 3.03 (2.25 - 3.82); pectoral fin length 14.98 (14.32 - 16.44); pelvic fin length 23.13 (20.99 - 24.11); caudal fin length 19.33 (18.47 - 20.28); length of first spine of first dorsal fin 6.13 (5.38 - 6.76); length of second spine of first dorsal fin 14.70 (13.11 - 16.15); length of first ray of second dorsal fin 11.75 (10.26 - 14.53); length of first anal fin ray 7.75 (7.05 - 9.01). Proportions as % HL: snout length 32.78 (30.11 - 34.73); orbital diameter 22.89 (22.11 - 24.07); upper jaw 40.44 (37.94 - 42.34); lower jaw 36.57 (35.68 - 37.67); interorbital width 7.10 (6.35 - 7.74); postorbital length 44.39 (40.69 - 47.31); suborbital length 8.37 (5.97 - 11.09). (Figure A 1.90.).

Sampling locations in the study area: (1); (2) see (Figure 2.1.1.)

91. *Sorsogona tuberculata* (Cuvier, 1829)

Total sample. Analyzed: 4 specimens

Synonyms. *Platycephalus tuberculatus* Cuvier, 1829; *Onigocia tuberculatus* (Cuvier, 1829); *Rogadius tuberculatus* (Cuvier, 1829); *Thysanophrys tuberculatus* (Cuvier, 1829).

Meristics. D1 = I+VIII; D2 = 12; A = 11; P = 20 - 21; V = I, 5; C = 13 - 15; Ll = 61 - 63; anterior 4 scales with a spine; oblique body-scale rows slanting downward and backward above lateral line 65 - 67; oblique body-scale rows slanting downward and forward above lateral line 61 - 63.

Morphometric. Proportions as % standard length (SL): Head length (HL) 37.34 (36.75 - 37.93); predorsal length 36.54 (35.66 - 37.42); length of first dorsal fin base 21.89 (20.79 - 23.00); length of second dorsal fin base 26.39 (25.81 - 26.96); length of anal fin base 28.97 (28.37 - 29.57); caudal peduncle length 5.56 (5.46 - 5.65); caudal peduncle depth 8.89 (8.37 - 9.42); snout length 11.98 (11.69 - 12.28); orbital diameter 9.22 (8.97 - 9.47); upper jaw 15.00 (14.70 - 15.31); lower jaw 13.98 (13.79 - 14.16); interorbital width 2.74 (2.69 - 2.80); postorbital length 43.53 (42.52 - 44.55); suborbital width 2.82 (2.73 - 2.91); pectoral fin length 17.86 (17.54 - 18.19); pelvic fin length 24.73 (24.51 - 24.95); caudal fin length 18.84 (18.16 - 19.51); length of first spine of first dorsal fin 4.85 (4.64 - 5.06); length of second spine of first dorsal fin 12.47 (12.38 - 12.57); length of first ray of second dorsal fin 12.48 (11.84 - 13.13); length of first anal fin ray 9.06 (8.38 - 9.75). Proportions as % HL: snout length 32.09 (31.81 - 32.36); orbital diameter 24.69 (24.41 - 24.97); upper jaw 40.18 (40.01 - 40.35); lower jaw 37.43 (37.33 - 37.54); interorbital width 7.35 (7.10 - 7.61); postorbital length 43.53 (42.52 - 44.55); suborbital length 7.55 (7.43 - 7.66). (Figure A 1.91.).

Sampling locations in the study area: (1); (2) see (Figure 2.1.1.)

XIV. ORDER PERCIFORMES

(28). FAMILY AMBASSIDAE

92. Ambassis ambassis (Lacepède, 1802)

Total sample. Analyzed: 4 specimens

Synonyms. *Centropomus ambassis* Lacepède, 1802; *Ambassis commersonii* Cuvier, 1828.

Meristics. D1 = VIII; D2 = 8; A = III.10; P = I. 13; V = I. 5; C = 6.16; PrD = 8 - 19; Sq = 37 - 39.

Morphometric. SL = 2.62 (2.40 - 2.83) Bd = 3.30 (3.08 - 3.52) HL = 6.07 (5.89 - 6.24) Lcp = 8.27 (7.39 - 9.15) dcp = 9.94 (8.90 - 10.99) SnL = 10.13 (9.25 - 11.02) Ed = 15.27 (14.13 - 16.40) Iw = 6.02 (5.33 - 6.72) Lbdf = 5.32 (5.27 - 5.38) Lbds = 4.59 (4.57 - 4.61) Lba; Bd =

0.38 (0.35 - 0.42) SL = 1.26 (1.24 - 1.28) HL = 2.34 (2.08 - 2.60) Lcp = 3.15 (3.08 - 3.23) Dcp = 3.79 (3.70 - 3.88) SnL = 3.87 (3.85 - 3.89) Ed = 5.83 (5.79 - 5.88) Iw = 2.29 (2.22 - 2.37) Lbdf = 2.05 (1.86 - 2.24) Lbds = 1.76 (1.61 - 1.92) Lba; HL = 3.01 (2.89 - 3.12) SnL = 3.07 (3.01 - 3.13) Ed = 4.63 (4.59 - 4.66) Iw = 1.85 (1.67 - 2.03) Lcp = 2.50 (2.40 - 2.60) Dcp = 1.82 (1.73 - 1.91) Lbdf = 1.62 (1.50 - 1.75) Lbds = 1.40 (1.30 - 1.50) Lba; Iw = 0.66 (0.65 - 0.67) Ed; Lcp = 1.37 (1.18 - 1.55) Dcp; (Figure A 1.92.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(29). FAMILY PERCICHTHYIDAE

***93. Coreoperca whiteheadi* Boulenger, 1900**

Total sample. Analyzed: 7 specimens

Synonym. *Siniperca whiteheadi* (Boulenger, 1900).

Meristics. D1 = 13 - 15; D2 = 12 - 13; A = III.10 - 11; P = I.12 - 14; V = I.5; C = 20 - 24; Ll = 74 - 79 (TSD = 9 - 11; TSV = 15 - 25).

Morphometric. SL = 3.01 (2.83 - 3.15) Bd = 2.44 (2.38 - 2.51) HL = 2.34 (2.31 - 2.38) Prdl = 1.66 (1.58 - 1.72) Podl = 7.11 (6.34 - 8.12) Lcp = 9.05 (8.60 - 9.11) Dcp = 1.47 (1.40 - 1.49) Pral = 2.40 (2.29 - 2.45) Prvl; HL = 4.33 (3.61 - 4.75) Ed = 6.41 (5.80 - 6.94) Iw = 2.17 (2.09 - 2.30) SnL = 2.07 (1.99 - 2.15) Po = 1.74 (1.67 - 1.80) Hdn; Iw = 0.68 (0.52 - 0.73) Ed; Lcp = 1.28 (1.12 - 1.53) Dcp; P→A = 1.08 (1.03 - 1.16) V→A; Bd = 3.01 (2.77 - 3.22) Dcp = 1.41 (1.33 - 1.49) Hdn. (Figure A 1.93.).

Sampling locations in the study area: Not distributed in (1); (2); (22); (23); (25); (27) see (Figure 2.1.1.)

(30). FAMILY LATIDE

***94. Lates calcarifer* (Bloch, 1790)**

Total sample. Analyzed: 2 specimens

Synonyms. *Holocentrus calcarifer* Bloch, 1790*; Pseudolates cavifrons* Alleyne & Macleay, 1877; *Lates darwiniensis* Macleay, 1878.

Meristics. D1 = VII - VIII; D2 = I.10 - 11; A = III.7 - 8; V = I.5; Ll = 52 -60; PrD = 27 - 28.

Morphometric. SL = (3.0 - 3.1) Bd = (2.6 - 2.7) HL; HL = (6.8 - 7.0) Ed = (5.2 - 5.8) SnL. (Figure A 1.94.).

Sampling locations in the study area: (1); (2); (3); (4); (7); (8); (29); (32); (33); (34); (35) see (Figure 2.1.1.)

(31). FAMILY SERRANIDAE

***95. Epinephelus awoara* (Temminck & Schlegel, 1842)**

Total sample. Analyzed: 5 specimens

Synonym. *Serranus awoara* Temminck & Schlegel, 1842.

Meristics. D1 = XI; D2 = 12; A = III.9; P = I.16; V = I.5; C = 4.14; Ll = 90 - 110.

Morphometric. SL = 3.23 (3.11 - 3.34) Bd = 2.58 (2.55 - 2.61) HL = 3.14 (2.92 - 3.36) Lbd = 5.58 (5.25 - 5.92) Lba = 5.87 (5.67 - 6.07) Lcp = 8.53 (8.14 - 8.93) Dcp; HL = 3.46 (3.31 - 3.62) SnL = 4.91 (4.00 - 5.82) Ed = 5.87 (5.61 - 6.13) Iw = 2.28 (2.17 - 2.38) Lcp = 3.31 (3.19 - 3.42) Dcp; Iw = 0.83 (0.71 - 0.95); Lcp = 1.46 (1.34 - 1.57) Dcp. (Figure A 1.95.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***96. Epinephelus longispinis* (Kner, 1864)**

Total sample. Analyzed: 4 specimens

Synonyms. *Serranus longispinis* Kner, 1864; *Epinephelus fario* (Thunberg, 1793).

Meristics. D1 = XI; D2 = 15; A = II. 8; P = I. 17; V = I.5; C = 4.14; Ll = 60 - 64 (TSD = 18; TSV = 36).

Morphometric. SL = 3.25 (3.04 - 3.67) Bd = 2.32 (2.01 - 2.57) HL; HL = 4.43 (4.13 - 4.74) SnL = 6.72 (6.45 - 6.87) Ed = 6.91 (6.50 - 7.23) Iw. (Figure A 1.96.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(32). FAMILY TERAPONTIDAE

***97. Terapon jarbua* (Forsskål, 1775)**

Total sample. Analyzed: 8 specimens

Synonyms. *Sciaena jarbua* Forsskål, 1775; *Holocentrus servus* Bloch, 1790; *Coius trivittatus* Hamilton, 1822; *Terapon timorensis* Quoy & Gaimard, 1824; *Therapon farna* Bleeker, 1879.

Meristics. D1 = XI; D2 = I.9; A = III.8; P = I.13; V = I.5; C = 6.17; PrD = 10 - 12; Ll = 80 - 85.

Morphometric. SL = 3.11 (3.04 - 3.15) Bd = 2.75 (2.66 - 2.86) HL = 3.36 (3.14 - 3.60) Lbd = 5.19 (4.81 - 5.52) Lba = 5.79 (5.10 - 6.53) Lcp = 8.72 (8.40 - 8.95) Dcp; HL = 3.37 (3.19 - 3.46) Iw = 4.40 (4.13 - 4.57) SnL = 3.94 (3.64 - 4.39) Ed = 2.11 (1.78 - 2.45) Lcp = 3.17 (3.01 - 3.32) Dcp; Iw = 1.13 (0.94 - 1.23) Ed; Lcp = 1.52 (1.29 - 1.69) Dcp. (Figure A 1.97.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***98. Pelates sexlineatus* (Quoy & Gaimard, 1825)**

Total sample. Analyzed: 13 specimens

Synonyms. *Terapon timorensis* Quoy & Gaimard, 1824; *Sciaena jarbua* Forsskål, 1775; *Holocentrus servus* Bloch, 1790; *Coius trivittatus* Hamilton, 1822.

Meristics. D1 = XI; D2 = I.10; A = III.10; P = II.13; V = I.5; C = 4.15; PrD = 17; Ll = 78 - 87.

Morphometric. SL = 3.41 (3.18 - 3.79) Bd = 3.48 (3.24 - 3.77) HL = 2.85 (2.78 - 3.00) Lbd = 4.68 (4.36 - 5.36) Lba = 6.74 (6.13 - 7.50) Lcp = 10.97 (10.49 - 11.79) Dcp; HL = 3.20 (2.87 - 3.55) Iw = 3.52 (3.25 - 3.84) SnL = 3.65 (3.08 - 4.12) Ed = 1.94 (1.66 - 2.18) Lcp = 3.15 (3.02 - 3.30) Dcp; Iw = 0.98 (0.81 - 1.12) Ed; Lcp = 1.64 (1.44 - 1.92) Dcp. (Figure A 1.98.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(33). FAMILY APOGONIDAE

***99. Apogon poecilopterus* Cuvier, 1828**

Total sample. Analyzed: 9 specimens

Synonyms. *Amia poecilopterus* (Cuvier, 1828); *Apogon glaga* Bleeker, 1849.

Meristics. D1 = VII; D2 = I.10; A = II.9; P = II.13; V = I.5; C = 5.15; PrD = 6; Ll = 30 - 31.

Morphometric. SL = 2.94 (2.76 - 3.12) Bd = 2.61 (2.60 - 2.62) HL = 6.28 (5.67 - 6.87) Lbd = 6.81 (6.66 - 6.94) Lba = 4.88 (4.54 - 5.38) Lcp = 6.04 (5.59 - 6.45) Dcp; HL = 3.48 (3.42 - 3.53) SnL = 3.85 (3.76 - 3.96) Ed = 3.46 (3.35 - 3.63) Iw = 1.87 (1.75 - 2.06) Lcp = 2.31 (2.15 - 2.47) Dcp; Iw = 1.11 (1.06 - 1.18) Ed; Lcp = 1.24 (1.13 - 1.36) Dcp. (Figure A 1.99.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***100. Ostorhinchus fasciatus* (White, 1790)**

Total sample. Analyzed: 4 specimens

Synonyms. *Mullus fasciatus* White, 1790; *Apogon fasciatus* (White, 1790); *Apogon quadrifasciatus* Cuvier, 1828; *Amia elizabethae* Jordan & Seale, 1905.

Meristics. D1 = VII; D2 = I.9; A = II.9; P = 1.16; V = I.5; C = 5.15; PrD = 7; Ll = 23 - 25.

Morphometric. SL = 2.84 (2.73 - 3.01) Bd = 2.65 (2.55 - 2.78) HL = 7.21 (6.87 - 7.82) Lbd = 6.44 (6.15 - 6.73) Lba = 4.33 (4.21 - 4.46) Lcp = 6.60 (6.34 - 7.04) Dcp; HL = 3.68 (3.35 - 3.89) SnL = 3.20 (3.02 - 3.27) Iw = 4.09 (3.67 - 4.36) Ed = 1.63 (1.54 - 1.69) Lcp = 2.49 (2.29 - 2.67) Dcp; Iw = 0.79 (0.75 - 0.82) Ed; Lcp = 1.53 (1.42 - 1.62) Dcp. (Figure A 1.100.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(34). FAMILY SILLAGINIDAE

***101. Sillago maculata* Quoy & Gaimard, 1824**

Total sample. Analyzed: 5 specimens

Synonyms. *Sillago maculata maculata* Quoy & Gai., 1824; *Sillago gracilis* Alleyne & Mac., 1877.

Meristics. D1 = XI; D2 = I.19; A = II.15; P = I. 14; V = I.6; C = 4.15; Ll = 79 - 81.

Morphometric. SL = 5.49 (5.35 - 5.73) Bd = 3.38 (3.18 - 3.60) HL = 4.94 (4.82 - 5.10) Lbd = 2.69 (2.63 - 2.73) Lba = 11.11 (10.55 - 11.87) Lcp = 12.51 (12.18 - 13.09) Dcp; HL = 2.46 (2.39 - 2.52) SnL = 5.20 (4.67 - 5.91) Iw = 3.78 (3.60 - 4.12) Ed = 3.30 (3.03 - 3.54) Lcp = 3.71 (3.63 - 3.86) Dcp; Iw = 0.73 (0.70 - 0.77) Ed; Lcp = 1.13 (1.03 - 1.20) Dcp. (Figure A 1.101.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***102. Sillago sihama* (Forsskål, 1775)**

Total sample. Analyzed: 4 specimens

Synonyms. *Atherina sihama* Forsskål, 1775; *Sciaena malabarica* Bloch & Schneider, 1801.

Meristics. D1 = XII; D2 = I.19 - 21; A = II.21 - 23; P = I.14 - 17; V = I.6; C = 4.15; Ll = 66 - 76.

Morphometric. SL = 5.49 (5.45 - 5.54) Bd = 3.29 (3.18 - 3.43) HL = 11.48 (9.77 - 12.90) Lcp = 13.46 (12.92 - 13.75) Dcp = 7.83 (7.36 - 8.24) SnL = 13.11 (11.71 - 14.03) Ed = 14.93 (12.93 - 18.03) Iw = 6.12 (5.45 - 6.79) Lbdf = 2.97 (2.85 - 3.03) Lbds = 2.81 (2.64 - 2.89) Lba; Bd = 0.60 (0.58 - 0.62) HL = 2.09 (1.79 - 2.37) Lcp = 2.45 (2.34 - 2.52) Dcp = 1.43 (1.35 - 1.49) SnL = 2.39 (2.12 - 2.55) Ed = 2.72 (2.37 - 3.25) Iw = 1.11 (1.00 - 1.23) Lbdf = 0.54 (0.52 - 0.55) Lbds = 0.51 (0.48 - 0.53) Lba; HL = 2.38 (2.31 - 2.52) SnL = 3.98 (3.58 - 4.37) Ed = 4.53 (3.93 - 5.26) Iw = 3.49 (3.07 - 3.92) Lcp = 4.09 (3.95 - 4.28) Dcp = 1.86 (1.66 - 2.11) Lbdf = 0.90 (0.87 - 0.94) Lbds = 0.86 (0.77 - 0.91) Lba; Iw = 0.89 (0.78 - 0.99) Ed; Lcp = 1.18 (1.07 - 1.40) Dcp. (Figure A1.102.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(35). FAMILY CARANGIDAE

***103. Carangoides praeustus* (Bennett, 1830)**

Total sample. Analyzed: 3 specimens

Synonyms. *Caranx praeustus* Bennett, 1830; *Caranx ire* Cuvier, 1833; *Caranx melanostethos* Day, 1865.

Meristics. D1 = VIII; D2 = I.21; A = III.18; P = I.20; V = I.5; C = 4.17; Ll = 109.

Morphometric. SL = (3.31 - 3.49) Bd = (3.27 - 3.57) HL = (8.83 - 9.20) Lbd = (2.39 - 2.78) Lba = (11.84 - 12.13) Lcp = (20.39 - 21.54) Dcp; HL = (4.86 - 5.08) Iw = (3.44 - 3.98) SnL =

(3.13 -3.56) Ed = (3.62 - 4.12) Lcp = (6.24 - 6.57) Dcp; Iw = (0.64 - 0.79) Ed; Lcp = (1.72 - 1.92) Dcp. (Figure A 1.103.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***104. Selaroides leptolepis* (Cuvier, 1833)**

Total sample. Analyzed: 5 specimens

Synonyms. *Caranx leptolepis* Cuvier, 1833; *Caranx mertensii* Cuvier, 1833; *Selariodes leptolepis* (Cuvier, 1833); *Caranx procaranx* De Vis, 1884.

Meristics. D1 = VII; D2 = I.14; A = II.20; P = I.16; V = II. 4; C = 4.15; Ll = 79 - 81.

Morphometric. SL = 3.02 (3.01 - 3.02) Bd = 3.70 (3.59 - 3.77) HL = 6.48 (6.18 - 7.02) Lbd = 2.14 (2.11 - 2.17) Lba = 9.47 (9.30 - 9.79) Lcp = 20.40 (18.96 - 21.22) Dcp; HL = 3.48 (3.33 - 3.65) Iw = 3.12 (3.01 - 3.18) SnL = 3.34 (3.27 - 3.42) Ed = 2.56 (2.49 - 2.60) Lcp = 5.51 (5.03 - 5.92) Dcp; Iw = 0.94 (0.91 - 0.97) Ed; Lcp = 2.16 (1.94 - 2.28) Dcp. (Figure A 1.104.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***105. Scomberoides lysan* (Forsskål, 1775)**

Total sample. Analyzed: 6 specimens

Synonyms. *Scomber lysan* Forsskål, 1775; *Scomber forsteri* Schneider & Forster, 1801; *Lichia tolooparah* Rüppell, 1829; *Chorinemus mauritianus* Cuvier, 1832.

Meristics. D1 = VII; D2 = I.21; A = III.19; P = I.16; V = I.5; C = 4.15.

Morphometric. SL = 4.02 (3.96 - 4.08) Bd = 4.32 (4.21 - 4.44) HL = 5.33 (4.84 - 5.55) Lbd = 1.99 (1.95 - 2.03) Lba = 11.82 (11.43 - 12.38) Lcp = 19.36 (18.80 - 20.36) Dcp; HL = 3.78 (3.53 - 3.97) Iw = 3.19 (3.13 - 3.32) SnL = 4.20 (3.79 - 4.57) Ed = 2.74 (2.58 - 2.83) Lcp = 4.48 (4.35 - 4.61) Dcp; Iw = 1.11 (0.99 - 1.18) Ed; Lcp = 1.64 (1.59 - 1.69) Dcp. (Figure A 1.105.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(36). FAMILY LEIOGNATHIDAE

***106. Eubleekeria splendens* (Cuvier, 1829)**

Total sample. Analyzed: 8 specimens

Synonyms. *Equula splendens* Cuvier, 1829; *Equula gomorah* Valenciennes, 1835.

Meristics. D = VII.16; A = III.15; P = I.17; V = I.5; C = 21; Sq = 40 - 42.

Morphometric. SL = 2.43 (2.35 - 2.51) Bd = 3.10 (3.10 - 3.11) HL = 15.68 (13.47 - 17.88) Lcp = 18.69 (17.80 - 19.57) Dcp = 10.24 (8.79 - 11.69) SnL = 8.31 (7.75 - 8.86) Ed = 10.81 (10.19 - 11.43) Iw = 1.78 (1.75 - 1.81) Lbd = 2.09 (2.04 - 2.14) Lba; Bd = 1.28 (1.24 - 1.32)

HL = 6.50 (5.37 - 7.62) Lcp = 7.70 (7.59 - 7.81) Dcp = 4.20 (3.74 - 4.66) SnL = 3.43 (3.09 - 3.78) Ed = 4.45 (4.34 - 4.56) Iw = 0.73 (0.72 - 0.75) Lbd = 0.86 (0.85 - 0.87) Lba; HL = 3.30 (2.84 - 3.77) SnL = 2.68 (2.50 - 2.86) Ed = 3.49 (3.29 - 3.68) Iw = 5.06 (4.34 - 5.77) Lcp = 6.03 (5.75 - 6.30) Dcp = 0.57 (0.57 - 0.58) Lbd = 0.67 (0.66 - 0.69) Lba; Iw = 0.77 (0.68 - 0.87) Ed; Lcp = 1.22 (1.00 - 1.45) Dcp. (Figure A 1.106.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***107. Leiognathus equulus* (Forsskål, 1775)**

Total sample. Analyzed: 7 specimens

Synonyms. *Scomber equula* Forsskål, 1775; *Scomber edentulus* Bloch, 1795.

Meristics. D = VIII.16 - 18; A = III.15 - 17; P = 18; V = 1.5; C = 30; Sq = 60 - 63.

Morphometric. HL = 1.89 (1.84 - 1.93) Bd = 3.23 (3.15 - 3.32) HL = 9.04 (8.68 - 9.41) Lcp = 16.00 (14.94 - 17.05) Dcp = 8.09 (7.96 - 8.22) SnL = 8.97 (8.72 - 9.23) Ed = 9.79 (9.20 - 10.39) Iw = 1.74 (1.70 - 1.78) Lbd = 2.14 (2.09 - 2.20) Lba; Bd = 4.80 (4.50 - 5.10) Lcp = 8.50 (7.75 - 9.25) Dcp = 4.29 (4.26 - 4.32) SnL = 4.76 (4.52 - 5.01) Ed = 5.20 (4.77 - 5.64) Iw = 0.92 (0.88 - 0.97) Lbd = 1.14 (1.08 - 1.19) Lba; HL = 2.50 (2.48 - 2.53) SnL = 2.78 (2.63 - 2.93) Ed = 3.04 (2.77 - 3.30) Iw = 2.80 (2.61 - 2.99) Lcp = 4.96 (4.50 - 5.42) Dcp = 0.54 (0.51 - 0.57) Lbd = 0.66 (0.63 - 0.70) Lba; Iw = 0.92 (0.89 - 0.95) Ed; Lcp = 1.77 (1.72 - 1.81) Dcp. (Figure A 1.107.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***108. Leiognathus brevirostris* (Valenciennes, 1835)**

Total sample. Analyzed: 9 specimens

Synonym. *Equula brevirostris* Valenciennes, 1835.

Meristics. D = VII.15; A = III.17; P = 16; V = 1.5; C = 36; Sq = 65 - 67.

Morphometric. SL = 2.39 (2.38 - 2.40) Bd = 3.60 (3.50 - 3.69) HL = 9.18 (8.99 - 9.37) Lcp = 16.50 (16.18 - 16.83) Dcp = 10.07 (8.57 - 11.57) SnL = 11.64 (11.04 - 12.23) Ed = 10.88 (10.41 - 11.34) Iw = 1.81 (1.78 - 1.84) Lbd = 2.18 (2.15 - 2.20) Lba; Bd = 3.84 (3.78 - 3.91) Lcp = 6.91 (6.80 - 7.01) Dcp = 4.22 (3.57 - 4.86) SnL = 4.87 (4.60 - 5.14) Ed = 4.55 (4.34 - 4.77) Iw = 0.76 (0.74 - 0.78) Lbd = 0.91 (0.90 - 0.93) Lba; HL = 2.79 (2.45 - 3.13) SnL = 3.23 (3.15 - 3.31) Ed = 3.02 (2.97 - 3.07) Iw = 2.56 (2.44 - 2.68) Lcp = 4.59 (4.38 - 4.81) Dcp = 0.50 (0.50 - 0.51) Lbd = 0.61 (0.60 - 0.62) Lba; Iw = 1.07 (1.06 - 1.08) Ed; Lcp = 1.80 (1.80 - 1.80) Dcp. (Figure A 1.108.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***109. Secutor ruconius* (Hamilton, 1822)**

Total sample. Analyzed: 10 specimens

Synonyms. *Chanda ruconius* Hamilton, 1822; *Leiognathus ruconius* (Hamilton, 1822).

Meristics. D1 = VIII; D2 = 14 - 15; A = III.14; P = I.14 - 15; V = I.7; C = 25.

Morphometric. SL = 2.40 (2.33 - 2.44) Bd = 3.38 (3.29 - 3.47) HL = 5.41 (5.31 - 5.51) Lbd = 2.21 (2.20 - 2.22) Lba = 11.16 (10.04 - 11.97) Lcp = 16.25 (15.70 - 16.85) Dcp; HL = 2.64 (2.51 - 2.87) Iw = 2.65 (2.59 - 2.72) SnL = 3.43 (3.27 - 3.55) Ed = 3.30 (2.97 - 3.48) Lcp = 4.80 (4.67 - 4.98) Dcp; Iw = 0.77 (0.76 - 0.79) Ed; Lcp = 1.47 (1.35 - 1.68) Dcp. (Figure A 1.109.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(37). FAMILY LUTJANIDAE

***110. Lutjanus russellii* (Bleeker, 1849)**

Total sample. Analyzed: 3 specimens

Synonyms. *Mesoprion russellii* Bleeker, 1849; *Lutianus nishikawae* Smith & Pope, 1906; *Lutianus orientalis* Seale, 1910.

Meristics. D1 = X; D2 = I.13; A = III.8; P = I.15; V = I.5; C = 4.15; PrD = 19; Sq = 50.

Morphometric. SL = (3.13 - 4.05) Bd = (2.77 - 3.12) HL = (3.28 - 3.79) Lbd = (5.49 - 5.98) Lba = (6.82 - 7.07) Lcp = (7.34 - 7.89) Dcp; HL = (2.96 - 3.49) SnL = (3.75 - 4.12) Iw = (4.08 - 4.78) Ed = (2.47 - 2.87) Lcp = (2.65 - 3.06) Dcp; Iw = (0.92 - 1.02) Ed; Lcp = (1.08 - 1.10) Dcp. (Figure A 1.110.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***111. Lutjanus fulviflamma* (Forsskål. 1775)**

Total sample. Analyzed: 3 specimens

Synonyms. *Sciaena fulviflamma* Forsskål, 1775; *Centropomus hober* Lacepède, 1802; *Lutjanus unimaculatus* Quoy & Gaimard, 1824; *Mesoprion aurolineatus* Cuvier, 1829.

Meristics. D1 = X; D2 = I.9; A = III.8; P = I.12; V = I.5; C = 4.14; PrD = 9; Sq = 48.

Morphometric. SL = (2.89) Bd = (2.91) HL = (3.22) Lbd = (5.42) Lba = (5.38) Lcp = (7.94) Dcp; HL = (2.07) SnL = (3.12) Iw = (3.92) Ed = (1.85) Lcp = (2.73) Dcp; Iw = (0.80) Ed; Lcp = (1.47) Dcp. (Figure A 1.111.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***112. Lutjanus fulvus* (Forster, 1801)**

Total sample. Analyzed: 4 specimens

Synonyms. *Holocentrus fulvus* Forster, 1801; *Diacope vaigiensis* Quoy & Gaimard, 1824; *Diacope marginata* Cuvier, 1828; *Diacope aurantiaca* Valenciennes, 1830.

Meristics. D1 = X; D2 = I.9; A = III.8; P = I.12 - 13; V = I.5; C = 4.14; PrD = 9; Sq = 48.

Morphometric. SL = (2.59) Bd = (3.21) HL = (3.27) Lbd = (5.42) Lba = (5.72) Lcp = (8.04) Dcp; HL = (2.08) SnL = (3.02) Iw = (3.72) Ed = (1.95) Lcp = (2.73) Dcp; Iw = (0.84) Ed; Lcp = (1.43) Dcp. (Figure A 1.112.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(38). FAMILY GERREIDAE

***113. Gerres limbatus* Cuvier, 1830**

Total sample. Analyzed: 6 specimens

Synonyms. *Catochaenum limbatum* (Cuvier, 1830); *Gerres lucidus* Cuvier, 1830.

Meristics. D1 = X; D2 = I.9 - 10; A = III.8; P = I.13; V = I.5; C = 6.15; PrD = 18 - 19; Sq = 47 - 48.

Morphometric. SL = 2.59 (2.55 - 2.62) Bd = 3.18 (2.99 - 3.38) HL = 3.93 (3.52 - 4.16) Lbd = 6.60 (6.27 - 7.14) Lba = 6.44 (5.90 - 6.85) Lcp = 9.18 (8.91 - 9.75) Dcp; HL = 2.86 (2.72 - 2.98) Iw = 3.60 (3.09 - 3.88) SnL = 2.32 (2.20 - 2.48) Ed = 2.03 (1.75 - 2.19) Lcp = 2.89 (2.64 - 3.26) Dcp; Iw = 0.81 (0.78 - 0.84) Ed; Lcp = 1.43 (1.32 - 1.56) Dcp. (Figure A 1.113.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***114. Gerres decacanthus* (Bleeker, 1864)**

Total sample. Analyzed: 4 specimens

Synonyms. *Diapterus decacanthus* Bleeker, 1864; *Gerreomorpha decacantha* (Bleeker, 1864).

Meristics. D1 = X; D2 = I.9 - 10; A = III.8; P = II.13; V = I.5; C = 6.15; PrD = 21; Sq = 47 - 49.

Morphometric. SL = 2.48 (2.42 - 2.52) Bd = 3.14 (3.10 - 3.22) HL = 3.86 (3.84 - 3.88) Lbd = 6.48 (6.31 - 6.75) Lba = 6.28 (6.18 - 6.39) Lcp = 8.60 (8.52 - 8.73) Dcp; HL = 2.90 (2.74 - 3.06) Iw = 3.64 (3.45 - 3.81) SnL = 2.54 (2.52 - 2.56 Ed = 2.00 (1.92 - 2.06) Lcp = 2.74 (2.71 - 2.76) Dcp; Iw = 0.88 (0.82 - 0.94) Ed; Lcp = 1.37 (1.34 - 1.41) Dcp. (Figure A 1.114.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***115. Gerres filamentosus* Cuvier, 1829**

Total sample. Analyzed: 7 specimens

Synonyms. *Gerres punctatus* Cuvier, 1830; *Sparus edentulus* Günther, 1859.

Meristics. D1 = IX; D2 = I.9 - 10; A = III.8; P = I.15; V = I.5; C = 4.17; PrD = 19; Sq = 55 - 56.

Morphometric. SL = 2.56 (2.29 - 2.82) Bd = 3.04 (2.88 - 3.21) HL = 4.18 (4.14 - 4.23) Lbd = 5.91 (5.76 - 6.05) Lba = 5.45 (5.24 - 5.66) Lcp = 8.33 (7.93 - 8.72) Dcp; HL = 3.08 (3.04 -

3.12) Iw = 2.93 (2.78 - 3.08) SnL = 3.01 (2.81 - 3.20) Ed = 1.79 (1.77 - 1.82) Lcp = 2.74 (2.72 - 2.75) Dcp; Iw = 0.98 (0.90 - 1.05) Ed; Lcp = 1.53 (1.52 - 1.54) Dcp. (Figure A 1.115.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(39). FAMILY HAEMULIDAE

***116. Pomadasys maculatus* (Bloch, 1793)**

Total sample. Analyzed: 3 specimens

Synonyms. *Anthias maculatus* Bloch, 1793; *Pristipoma caripa* Cuvier, 1829.

Meristics. D1 = VII; D2 = I.14; A = II.20; P = I.16; V = II.4; C = 4.15; Sq = 79 - 81.

Morphometric. SL = 2.57 (2.54 - 2.60) Bd = 2.97 (2.89 - 3.05) HL = 2.94 (2.90 - 2.98) Lbd = 6.21 (5.83 - 6.59) Lba = 5.58 (5.47 - 5.69) Lcp = 8.5 (8.29 - 8.81) Dcp; HL = 2.97 (3.72 - 3.41) Iw = 3.41 (2.77 - 3.18) SnL = 3.57 (3.36 - 3.45) Ed = 1.88 (1.79 - 1.97) Lcp = 2.88 (2.87 - 2.89) Dcp; Iw = 0.96 (0.90 - 1.01) Ed; Lcp = 1.53 (1.46 - 1.61) Dcp. (Figure A 1.116.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(40). FAMILY SCIAENIDAE

***117. Pennahia pawak* (Lin, 1940)**

Total sample. Analyzed: 3 specimens

Synonym. *Argyrosomus pawak* Lin, 1940.

Meristics. D1 = X; D2 = I.26; A = II.8; P = II.14; V = III.4; C = 3.15; Sq = 36 - 48.

Morphometric. SL = (3.62) Bd = (3.52) HL = (5.03) Lbd = (10.99) Lba = (9.14) Lcp = (10.15) Dcp; HL = (3.06) Iw = (3.39) SnL = (3.86) Ed = (2.60) Lcp = (2.88) Dcp; Iw = (0.88) Ed; Lcp = (1.11) Dcp. (Figure A 1.117.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(41). FAMILY MULLIDAE

***118. Upeneus luzonius* Jordan & Seale, 1907**

Total sample. Analyzed: 5 specimens

Meristics. D1 = VII; D2 = II. 9; A = II.7; P = II.12; V = I.6; C = 4.13; PrD = 9; Sq = 36 - 38.

Morphometric. SL = 4.14 (3.97 - 4.27) Bd = 3.74 (3.53 - 3.93) HL = 6.78 (6.64 - 7.04) Lbd = 8.78 (8.63 - 8.95) Lba = 4.14 (3.87 - 4.36) Lcp = 9.40 (9.15 - 9.65) Dcp; HL = 2.47 (2.37 - 2.53) SnL = 3.01 (2.71 - 3.41) Iw = 3.97 (3.74 - 4.26) Ed = 1.11 (1.03 - 1.18) Lcp = 2.51 (2.39 - 2.59) Dcp; Iw = 1.33 (1.15 - 1.47) Ed; Lcp = 2.28 (2.16 - 2.50) Dcp. (Figure A 1.118.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

119. Upeneus subvittatus **(Temminck & Schlegel, 1843)**

Total sample. Analyzed: 3 specimens

Synonym. *Mullus subvittatus* Temminck & Schlegel, 1843.

Meristics. D1 = VII; D2 = II.9; A = II.5; P = I.15; V = I.6; C = 5.13; PrD = 11; Sq = 38.

Morphometric. SL = (3.39) Bd = (3.24) HL = (6.20) Lbd = (8.58) Lba = (4.96) Lcp = (7.98) Dcp; HL = (2.52) SnL = (3.21) Iw = (4.05) Ed = (1.53) Lcp = (2.46) Dcp; Iw = (1.26) Ed; Lcp = (1.61) Dcp. (Figure A 1.119.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

120. Upeneus tragula **Richardson, 1846**

Total sample. Analyzed: 5 specimens

Synonyms. *Upeneoides tragula* (Richardson, 1846); *Upeneus tragua* Richardson, 1846.

Meristics. D1 = VII; D2 = 9; A = II.6; P = I.12 - 13; V = I.6; C = 5.15; PrD = 15 - 19; Sq = 32 - 34.

Morphometric. SL = 4.03 (3.96 - 4.07) Bd = 3.54 (3.37 - 3.68) HL = 4.99 (3.85 - 5.64) Lbd = 8.33 (7.61 - 8.74) Lba = 4.05 (3.81 - 4.29) Lcp = 8.82 (8.16 - 9.26) Dcp; HL = 2.38 (2.02 - 2.65) SnL= 3.51 (3.33 - 3.63) Ed = 3.63 (3.48 - 3.71) Iw = 1.15 (1.07 - 1.20) Lcp = 2.49 (2.28 - 2.68) Dcp; Iw = 0.97 (0.90 - 1.04) Ed; Lcp = 2.17 (2.14 - 2.23) Dcp. (Figure A 1.120.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(42). FAMILY DREPANEIDAE

121. Drepane punctata **(Linnaeus, 1758)**

Total sample. Analyzed: 3 specimens

Synonyms. *Chaetodon punctatus* Linnaeus, 1758; *Drepanichthys punctatus* (Linnaeus, 1758).

Meristics. D1 = VIII - X; D2 = 20 - 22; A = III. 16 - 19; P = 16 - 18; V = I.5; C = 17; Ll = 46 - 50.

Morphometric. SL = (1.23 - 1.45) Bd = (3.13 - 3.4) HL; HL = (3.02 - 3.89) SnL = (2.55 - 3.34) Ed. (Figure A 1.121.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(43). FAMILY MONODACTYLIDAE

122. Monodactylus argenteus **(Linnaeus, 1758)**

Total sample. Analyzed: 1 specimen

Synonyms. *Chaetodon argenteus* Linnaeus, 1758; *Scomber rhombeus* Forsskål, 1775.

Meristics. D = 8.27; A = 3.27; P = 1.17; V = 1.4; C = 2.17; Sq = 89.

Morphometric. SL = 1.40 Bd = 2.97 HL = 12.12 Lcp = 7.90 Dcp = 11.00 SnL = 7.55 Ed = 9.55 Iw = 1.69 Lad = 1.79 Lba; Bd = 2.12 HL = 8.64 Lcp = 5.63 Dcp = 7.85 SnL = 5.39 Ed = 6.81 Iw = 1.21 Lbd = 1.27 Lba; HL = 3.71 SnL = 2.54 Ed = 3.22 Iw = 4.08 Lcp = 2.66 Dcp = 0.57 Lbd = 0.60 Lba; Iw = 0.79 Ed; Lcp = 0.65 Dcp. (Figure A 1.122.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(44). FAMILY MUGILIDAE

***123. Liza affinis* (Günther, 1861)**

Total sample. Analyzed: 7 specimens

Synonyms. *Mugil affinis* Günther, 1861; *Myxus profugus* Mohr, 1927.

Meristics. DI = 4; DII = 8; A = 11; P = 13; V = 6; C = 18; PrD = 21; Sq = 29.

Morphometric. SL = 3.58 Bd = 4.06 HL = 5.90 Lcp = 8.45 Dcp = 16.23 SnL = 14.47 Ed = 10.76 Iw = 16.76 Lbdf = 8.37 Lbds = 6.72 Lba; Bd = 1.13 HL = 1.65 Lcp = 2.36 Dcp = 4.53 SnL = 4.04 Ed = 3.01 Iw = 4.68 Lbdf = 2.34 Lbds = 1.88 Lba; HL = 4.00 SnL = 3.56 Ed = 2.65 Iw = 1.45 Lcp = 2.08 Dcp = 4.13 Lbdf = 2.06 Lbds = 1.65 Lba; Iw = 1.34 Ed; Lcp = 1.43 Dcp. (Figure A 1.123.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(45). FAMILY CICHLIDAE

***124. Oreochromis niloticus* (Linnaeus, 1758)**

Total sample. Analyzed: 12 specimens

Synonyms. *Perca nilotica* Linnaeus, 1758; *Chromis guentheri* Steindachner, 1864.

Meristics. D1 = 14 - 18; D2 = 10 - 14; A = II - III. 8 - 10; P = I.5; V = I.12 - 14; C = 20 - 22; Ll = 35 - 38.

Morphometric. SL = 2.29 (2.21 - 2.36) Bd = 2.64 (2.48 - 2.71) HL = 2.48 (2.44 - 2.56) Prdl = 1.44 (1.40 - 1.49) Podl = 9.03 (7.65 - 10.24) Lcp = 6.71 (6.15 - 7.04) Dcp; HL =3.58 (3.16 - 4.01) Ed = 3.09 (2.77 - 3.42) Iw = 3.83 (3.15 - 4.21) SnL = 2.15 (1.81 - 2.33) Po; Iw = 1.16 (1.09 - 1.40) Ed; Lcp = 0.75 (0.67 - 0.80) Dcp; P → V = 1.09 (1.00 - 1.16) V → A. (Figure A 1.124.).

Sampling locations in the study area: Not distributed in (25); (27) see (Figure 2.1.1.)

(46). FAMILY POMACENTRIDAE

***125. Pomacentrus nigricans* (Lacepède, 1802)**

Total sample. Analyzed: 8 specimens

Synonyms. *Holocentrus nigricans* Lacepède, 1802; *Pomacentrus scolopseus* Quoy & Gaimard, 1825.

Meristics. D1 = XIII; D2 = 11; A = II. 11; P = 16; V = 1.5; C = 14; PrD = 9; Sq = 27.

Morphometric. SL = 2.45 (2.42 - 2.48) Bd = 3.52 (3.41 - 3.63) HL = 6.67 (6.45 - 6.90) Lcp = 6.79 (6.71 - 6.86) Dcp = 11.20 (11.14 - 11.26) SnL = 11.06 (10.67 - 11.45) Ed = 10.88 (10.75 - 11.01) Iw = 1.64 (1.62 - 1.66) Lbd = 4.56 (3.82 - 5.31) Lba; Bd = 1.44 (1.41 - 1.47) HL = 2.73 (2.61 - 2.85) Lcp = 2.77 Dcp = 4.58 (4.50 - 4.66) SnL = 4.52 (4.31 - 4.73) Ed = 4.45 (4.34 - 4.55) Iw = 0.67 Lbd = 1.86 (1.58 - 2.15) Lba; HL = 3.18 (3.07 - 3.30) SnL = 3.15 (2.94 - 3.35) Ed = 3.09 (2.96 - 3.23) Iw = 1.90 (1.78 - 2.02) Lcp = 1.93 (1.89 - 1.97) Dcp = 0.47 (0.46 - 0.47) Lbd = 1.29 (1.12 - 1.46) Lba; Iw = 1.02 (0.99 - 1.04) Ed; Lcp = 1.02 (0.97 - 1.06) Dcp. (Figure A 1.125.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(47). FAMILY BLENNIIDAE

***126. Omobranchus fasciolatoceps* (Richardson, 1846)**

Total sample. Analyzed: 1 specimen

Synonym. *Blennius fasciolatoceps* Richardson, 1846.

Meristics. D = 33; A = 24; P = 13; V = 2; C = 16.

Morphometric. SL = 4.33 Bd = 4.58 HL = 14.87 Lcp = 10.57 Dcp = 14.48 SnL = 17.43 Ed = 29.15 Iw = 1.32 Lbd = 2.02 Lba; Bd = 1.06 HL = 3.44 Lcp = 2.44 Dcp = 3.35 SnL = 4.03 Ed = 6.74 Iw = 0.31 Lbd = 0.47 Lba; HL = 3.16 SnL = 3.81 Ed = 6.37 Iw = 3.25 Lcp = 2.31 Dcp = 0.29 Lbd = 0.44 Lba; Iw = 0.60 Ed; Lcp = 0.71 Dcp. (Figure A 1.126.).

Sampling locations in the study area: (1) (Figure 2.1.1.)

(48). FAMILY CALLIONYMIDAE

***127. Callionymus curvicornis* Valenciennes, 1837**

Total sample. Analyzed: 21 specimens

Synonyms. *Repomucenus curvicornis* (Valenciennes, 1837); *Callionymus punctatus* Richardson, 1837; *Callionymus richardsonii* Bleeker, 1854; *Repomucenus richardsonii* (Bleeker, 1854).

Meristics. D1 = IV; D2 = 8 - 10; A = 8 - 10; P= 17 - 22; C = 10.

Morphometric. SL = 4.49 (4.34 - 4.65) HL = 4.79 (4.53 - 5.08) Bwd = 10.32 (9.63 - 11.20) Bd = 6.20 (6.01 - 6.52) Lcp = 18.50 (16.89 - 19.36) Dcp; HL = 2.56 (2.44 - 2.65) SnL = 3.32 (3.13 - 3.39) Ed = 16.33 (14.46 - 19.30) Iw = 1.69 (1.59 - 1.84) DS1 = 1.85 (1.79 - 1.94) DS2

= 1.86 (1.77 - 1.93) DS3 = 2.98 (2.49 - 3.76) DS4 = 1.33 (1.29 - 1.36) FDR = 1.10 (1.00 - 1.25) LDR = 2.17 (1.96 - 2.38) FAR = 1.68 (1.61 - 1.80) LAR = 1.03 (0.97 - 1.09) PFL = 0.97 (0.89 - 1.04) PVL. (Figure A 1.127.).

Sampling locations in the study area: (1); (2) see (Figure 2.1.1.)

***128. Callionymus pleurostictus* Fricke, 1982**

Total sample. Analyzed: 18 specimens

Synonym. *Pseudocalliurichthys pleurostictus* (Fricke, 1982).

Meristics. D1 = IV; D2 = vii.1; A = vi.1; P = i. 14 - 17; V = I.5; C = iii.7iii.

Morphometric. SL = 4.20 (3.97 - 4.44) HL = 4.57 (4.22 - 4.93) Bwd = 14.15 (13.31 - 15.00) Bd = 6.84 (6.71 - 6.97) Lcp = 21.11 (19.22 - 23.00) Dcp; HL = 2.70 (2.64 - 2.76) SnL = 3.13 (3.10 - 3.16) Ed = 11.22 (10.83 - 11.60) Iw = 1.53 (0.57 - 2.49) DS1 = 1.71 (1.68 - 1.74) DS2 = 3.62 (2.90 - 4.33) DS3 = 1.61 (1.20 - 2.02) FDR = 1.55 (1.03 - 2.07) LDR = 2.86 (2.24 - 3.48) FAR = 2.23 (1.70 - 2.76) LAR = 1.12 (1.09 - 1.15) PFL = 0.96 (0.95 - 0.97) PVL. (Figure A 1.128.).

Sampling locations in the study area: (1); (2) see (Figure 2.1.1.)

(49). FAMILY ODONTOBUTIDAE

***129. Sineleotris chalmersi* (Nichols & Pope, 1927)**

Total sample. Analyzed: 5 specimens

Synonyms. *Philypnus chalmersi* Nichols & Pope, 1927; *Percottus chalmersi* (Nichols & Pope, 1927).

Meristics. D1 = II-VIII; D2 = I.11; P = 15; A = I.8 - 9; V = I.5; C = 19 - 22; Sq = 41 - 42; PrD = 25 - 27.

Morphometric. SL = 2.99 (2.86 - 3.02) HL = 5.01 (4.69 - 5.43) Bd = 3.79 (3.46 - 4.00) Lcp = 9.51 (8.64 - 10.18) Dcp; HL = 3.22 (3.13 - 3.36) SnL = 3.34 (3.2 - 3.57) Ed; Lcd = 2.51 (2.41- 2.61) Dcp. (Figure A 1.129.).

Sampling locations in the study area: Not distributed in (1); (2); (25); (27); see (Figure 2.1.1.)

***130. Sineleotris namxamensis* Chen & Kottelat, 2004**

Total sample. Analyzed: 7 specimens

Meristics. D1 = VIII; D2 = I.10; P = 15; A = I.8; V = I.5; C = 18 - 20; Sq= 44 - 49; Sq = 25.

Morphometric. SL = 2.96 (2.78 - 3.12) HL = 3.73 (3.54 - 3.99) Bd = 3.89 (3.68 - 4.1) Lcp = 4.97 (3.78 -10.14) Dcp; T = 2.98 (2.81 - 3.18) SnL = 3.76 (3.44 - 4.04) Ed; Lcp = 2.55 (2.33- 2.77) Dcp. (Figure A 1.130.).

Sampling locations in the study area: Not distributed in (1); (2); (25); (27); see (Figure 2.1.1.)

(50). FAMILY ELEOTRIDAE

***131. Bostrychus sinensis* Lacepède, 1801**

Total sample. Analyzed: 2 specimens

Synonym. *Bostrichthys sinensis* (Lacepède, 1801).

Meristics. D1 = VI; D2 = I.10; A = I.9; P = 17; V = I.5; C = 26; Sq = 165; PrD = 89.

Morphometric. SL = (3.3 - 3.5) HL = (5.07 - 5.56) Bd = (5.88 - 6.23) Lcp = (6.85 - 7.21) Dcp; HL = (3.36 - 3.55) SnL = (5.91 - 6.20) Ed; Lcp = (1.16 - 1.24) Dcp. (Figure A 1.131.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***132. Butis butis* (Hamilton, 1822)**

Total sample. Analyzed: 6 specimens

Synonyms. *Cheilodipterus butis* Hamilton, 1822; *Eleotris butis* (Hamilton, 1822).

Meristics. D1 = VI; D2 = I.8; A = I.8; P = 19 - 20; V = I.5; C = 18 - 20; Sq = 30; PrD = 22 - 24.

Morphometric. SL = 2.78 (2.62 - 3.02) HL = 3.83 (3.27 - 4.49) Bd = 3.61 (4.04 - 5.25) Lcp = 8.71 (7.72 - 10.1) Dcp; HL = 3.45 (3.38 - 3.58) SnL = 4.26 (3.9 - 4.58) Ed; Lcp = 1.89 (1.7 - 2.21) Dcp. (Figure A 1.132.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***133. Butis koilomatodon* (Bleeker, 1849)**

Total sample. Analyzed: 5 specimens

Synonyms. *Eleotris koilomatodon* Bleeker, 1849; *Eleotris caperatus* Cantor, 1849; *Eleotris delagoensis* Barnard, 1927; *Hypseleotris raji* Herre, 1945.

Meristics. D1 = VI; D2 = I.7 - 8; A = I.7 - 8; V = I.5; C = 23 - 24; Sq = 28 - 30; PrD = 10 - 15.

Morphometric. SL = 2.78 (2.62 - 3.02) HL = 3.83 (3.27 - 4.49) Bd = 4.61 (4.04 - 5.25) Lcp = 8.77 (8.17 - 9.71) Dcp; HL = 3.45 (3.37 - 4.58) SnL = 4.26 (3.9 - 4.58) Ed; Lcp = 1.89 (1.7 - 2.21) Dcp. (Figure A 1.133.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***134. Eleotris fusca* (Forster, 1801)**

Total sample. Analyzed: 2 specimens

Synonyms. *Poecilia fusca* Forster, 1801; *Eleotris niger* Quoy & Gaimard, 1824; *Eleotris fornasini*; Bianconi, 1855; *Eleotris cavifrons* Blyth, 1860; *Eleotris klunzingerii* Pfeffer, 1893.

Meristics. D1 = VI; D2 = I.8; A = I.8; P = 18; V = I.5; C = 30; Sq = 55; PrD = 44.

Morphometric. SL = (2.93 - 3.05) HL = (4.50 - 4.67) Bd = (5.42 - 5.76) Lcp = (7.28 - 7.43) Dcp; HL = (5.12 - 5.54) SnL = (5.42 - 5.76) Ed; Lcp = (1.57 - 1.84) Dcp. (Figure A 1.134.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***135. Eleotris melanosoma* Bleeker, 1853**

Total sample. Analyzed: 3 specimens

Synonym. *Culius melanosoma* (Bleeker, 1853).

Meristics. D1 = VI; D2 = I.8; A = I.8; V = I.5; C = 24 - 25; Sq = 50 - 57; PrD = 40 - 45.

Morphometric. SL = 2.62 (2.56 - 2.77) HL = 4.73 (4.45 - 5.04) Bd = 4.87 (4.48 - 5.10) Lcp = 7.78 (7.25 - 8.08) Dcp; T = 3.43 (3.35 - 3.51) SnL = 5.81 (5.41 - 6.33) Ed; Lcp = 1.6 (1.58 - 1.62) Dcp. (Figure A 1.135.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(51). FAMILY GOBIIDAE

***136. Chaeturichthys stigmatias* Richardson, 1844**

Total sample. Analyzed: 6 specimens

Meristics. D1 = VIII; D2 = I.10; A = I.9; P = 21; V = I.5; C = 20; Sq = 48 - 50; PrD = 15 - 20.

Morphometric. SL = 3.78 (3.74 - 3.83) HL = 6.07 (6.00 - 6.14) Bd = 5.46 (5.18 - 5.75) Lcp = 8.45 (8.09 - 8.8) Dcp; HL = 4.35 (4.31 - 4.38) SnL = 5.41 (5.3 - 5.51) Ed; Lcp = 1.55 (1.53 - 1.56) Dcp. (Figure A 1.136.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***137. Oligolepis acutipennis* (Valenciennes, 1837)**

Total sample. Analyzed: 2 specimens

Synonyms. *Gobius acutipennis* Valenciennes, 1837; *Ctenogobius acutipennis* (Valenciennes, 1837); *Gobius setosus* Valenciennes, 1837; *Gobius melanostigma* Bleeker, 1849.

Meristics. D = VI; D2 = I.10; A = I.9; V = I.5; P = 17; C = 26. Sq = 30.

Morphometric. SL = (3.51 - 3.85) HL = (4.58 - 4.89) Bd = (6.95 - 7.05) Lcp = (7.69 - 8.54) Dcp; HL = (3.69 - 4.05) SnL = (4.32 - 4.54) Ed; Lcp = (1.27 - 1.32) Dcp. (Figure A 1.137.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***138. Oxyurichthys microlepis* (Bleek, 1849)**

Total sample. Analyzed: 5 specimens

Synonyms. *Gobius microlepis* Bleeker, 1849; *Euctenogobius cristatus* Day, 1873; *Gobius longicauda* Steindachner, 1893; *Gobius nuchalis* Barnard, 1927.

Meristics. D1 = VI; D2 = I.12 - 14; A = I.13 - 14; P = 21 - 23; C = 16 - 23; Sq = 46 - 52.

Morphometric. SL = 3.91 (3.65 - 4.24) HL = 5.49 (5.06 - 5.79) Bd = 11.52 (8.9 - 14.6) Lcp = 11.14 (8.71 - 14.07) Dcp; HL = 3.14 (2.95 - 3.45) SnL = 3.91 (3.57 - 4.44) Ed; Lcp = 0.97 (0.96 - 0.98) Dcp. (Figure A 1.138.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***139. Oxyurichthys tentacularis* (Valenciennes, 1837)**

Total sample. Analyzed: 5 specimens

Synonym. *Gobius tentacularis* Valenciennes, 1837.

Meristics. D1 = VI; D2 = I.12; A = I.13; P = 20 - 22; V = I.5; C = 20 - 26; Sq = 45 - 53.

Morphometric. SL = 3.94 (3.66 - 4.15) HL = 4.77 (3.26 - 5.29) Bd = 15.45 (13.24 - 17.48) Lcp = 8.24 (7.1 - 9.29) Dcp; T = 2.61 (2.54 - 2.72) SnL = 3.76 (3.57 - 3.96) Ed; Lcp = 0.53 (0.53 - 0.54) Dcp. (Figure A 1.139.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***140. Rhinogobius giurinus* (Rutter,1897)**

Total sample. Analyzed: 5 specimens

Synonyms. *Gobius giurinus* Rutter, 1897; *Ctenegobius giurinus* (Rutter, 1897); *Ctenogobius hadropterus* Jordan & Snyder, 1901; *Rhinogobius hadropterus* (Jordan & Snyder, 1901).

Meristics. D1 = VI; D2 = I.8 - 9; A = I.7 - 8; P = 18 - 19; V = I.5; C = 25 - 30; Sq = 30 - 31.

Morphometric. SL = 3.4 (3.19 - 3.55) HL = 5.30 (5.11 - 5.59) Bd = 4.41 (3.82 - 4.87) Lcp = 14.43 (12.51 - 15.95) Dcp; HL = 2.34 (2.27 - 3.48) SnL = 3.81 (3.68 - 3.99) Ed; Lcp = 3.27 (3.13 -3.18) Dcp. (Figure A 1.140.).

Sampling locations in the study area: Not distributed in (1); (2); (25); (27); see (Figure 2.1.1.)

***141. Rhinogobius leavelli* (Herre, 1935)**

Total sample. Analyzed: 7 specimens

Synonym. *Ctenogobius leavelli* Herre, 1935.

Meristics. D1 = VI; D2 = I.8; A = I.8; V = I.5; C = 20 - 21; Sq = 30 - 31.

Morphometric. SL = 3.45 (3.38 - 3.49) HL = 5.37 (5.19 - 5.58) Bd = 4.14 (4.01 - 4.2) Lcp = 9.34 (8.68 - 9.65) Dcp; HL = 2.77 (2.72 - 2.81) SnL = 3.28 (3.67 - 4.14) Ed; Lcp = 2.26 (2.20 -2.32) Dcp. (Figure A 1.141.).

Sampling locations in the study area: Not distributed in (1); (2); (25); (27); see (Figure 2.1.1.)

***142. Tridentiger trigonocephalus* (Gill, 1858)**

Total sample. Analyzed: 9 specimens

Synonym. *Triaenophorus trigonocephalus* Gill, 1859.

Meristics. D1 = VI; D2 = I.12; P = 18; A = I.10; V = I.5; C = 27 - 30; Sq = 50 - 53.

Morphometric. SL = 3.63 (3.59 - 3.67) HL = 5.06 (4.97 - 5.27) Bd = 4.97 (4.73 - 5.23) Lcp = 7.96 (7.48 - 8.58) Dcp; HL = 3.73 (3.58 - 3.83) SnL = 4.19 (4.10 - 4.27) Ed; Lcp = 1.61 (1.57 -1.64) Dcp. (Figure A 1.142.).

Sampling locations in the study area: 1, 2 (Figure 2.1.1.)

***143. Ctenogobius brevirostris* Günther, 1861**

Total sample. Analyzed: 2 specimens

Meristics. D1 = VI; D2 = I.10; A = I.9; P = 17; V = I.5; C = 20; Sq = 50.

Morphometric. SL = (3.31 - 3.45) HL= (5.67 - 5.79) Bd = (5.08 - 5.67) Lcp = (7.36 - 7.67) Dcp; HL = (3.60 - 3.87) SnL = (5.11 - 5.56) Ed; Lcp = (1.45 - 1.57) Dcp. (Figure A 1.143.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***144. Papuligobius uniporus* (Chen & Kottelat, 2003)**

Total sample. Analyzed: 2 specimens

Meristics. D1 = VI; D2 = I.9; A = I.11; P = 18; V = I.5; C = 18; Sq = 41.

Morphometric. SL = (3.00 - 3.20) HL = (5.06 - 6.59) Bd = (5.21 - 5.43) Lcp = (7.66 - 7.87) Dcp; HL = (3.46 - 3.76) SnL = (4.15 - 4.34) Ed; Lcp = (1.47 - 1.56) Dcp. (Figure A 1.144.).

Sampling locations in the study area: Not distributed in (1); (2); (25); (27); see (Figure 2.1.1.)

***145. Pseudapocryptes elongatus* (Cuvier, 1816)**

Total sample. Analyzed: 2 specimens

Synonyms. *Gobius elongatus* Cuvier, 1816; *Eleotris lanceolata* Bloch & Schneider, 1801; *Gobius changua* Hamilton, 1822; *Apocryptes dentatus* Valenciennes, 1837; *Boleophthalmus taylori* Fowler, 1934.

Meristics. D1 = VI; D2 = I.25; A = I.26; P = 21; V = I.5; C = 22; Sq = 95; PrD = 41.

Morphometric. SL = (5.25 - 5.45) HL = (7.25 - 7.73) Bd = (42.50 - 42.74) Lcp = (11.96 - 12.05) Dcp; HL = (3.64 - 3.70) SnL = (6.41 - 6.57) Ed; Lcd = (0.28 - 0.34) Lcp. (Figure A 1.145.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***146. Acentrogobius caninus* (Valenciennes, 1837)**

Total sample. Analyzed: 2 specimens

Synonyms. *Gobius caninus* Valenciennes, 1837; *Yongeichthys caninus* (Valenciennes, 1837); *Gobius philipi* Tirant, 1883; *Gobius zanzibarensis* Liénard, 1891.

Meristics. D1 = VI; D2 = I.9; A = I.9; P = 18; V = I.5; C = 20; Sq = 31; PrD = 26.

Morphometric. SL = (3.65 - 3.78) HL = (4.72 - 4.92) Bd = (4.75 - 4.87) Lcp = (7.53 - 7.76) Dcp; HL = (2.78 - 2.92) SnL = (4.38 - 4.54) Ed; Lcp = (1.59 - 1.76) Dcp. (Figure A 1.146.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***147. Acentrogobius nebulosus* (Forsskål, 1775)**

Total sample. Analyzed: 7 specimens

Synonyms. *Gobius nebulosus* Forsskål, 1775; *Gobius brevifilis* Valenciennes, 1837; *Gobius baliuroides* Bleeker, 1849; *Gobius petersii* Steindachner, 1866; *Gobius caninus africanus* Playfair, 1867; *Rhinogobius lungi* Jordan & Seale, 1907; *Gobius criniger decaryi* Pellegrin, 1932.

Meristics. D1 = VI; D2 = I.10 - 11; A = I.11; P = 19 - 21; V = I.5; C = 26; Sq = 29 - 31.

Morphometric. SL = 3.56 (3.07 - 3.67) HL = 4.05 (3.98 - 4.23) Bd = 10.39 (9.29 - 12.04) Lcp = 8.31 (7.48 - 9.59) Dcp; HL = 2.31 (2.25 - 2.38) SnL = 3.73 (3.57 - 3.92) Ed; Lcp = 0.81 Dcp. (Figure A 1.147.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***148. Arcygobius baliurus* (Valenciennes, 1837)**

Total sample. Analyzed: 3 specimens

Synonyms. *Gobius baliurus* Valenciennes, 1837; *Acentrogobius baliurus* (Valenciennes, 1837); *Gobius atherinoides* Peters, 1855; *Gnatholepis calliurus* Jordan & Seale, 1905.

Meristics. D1 = VI; D2 = I.10; A = I.9; V = I.5; C = 15 - 19; Sq = 26 - 28; PrD = 11 - 15.

Morphometric. SL = 3.25 (3.12 - 3.29) HL = 5.39 (5.3 - 5.64) Bd = 4.86 (4.63 - 5.26) Lcp = 7.84 (7.48 - 8.36) Dcp; HL = 3.28 (3.04 - 3.43) SnL = 3.57 (3.41 - 3.74) Ed; Lcp = 1.61 (1.59 - 1.64) Dcp. (Figure A 1.148.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***149. Favonigobius aliciae* (Herre, 1936)**

Total sample. Analyzed: 7 specimens

Synonym. *Aboma aliciae* Herre, 1936.

Meristics. D1 = VI; D2 = I.8; A = I.8; P = 16; V = I.5; C = 23 - 24; Sq = 27 - 28.

Morphometric. SL = 3.50 (3.45 - 3.6) HL = 5.39 (5.16 - 5.61) Bd = 4.72 (4.55 - 4.9) Lcp = 9.24 (9.02 - 9.5) Dcp; HL = 3.45 (3.39 - 3.56) SnL = 3.54 (3.41 - 3.61) Ed; Lcp = 1.96 (1.94 - 1.98) Dcp. (Figure A 1.149.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***150. Glossogobius giuris* (Hamilton, 1822)**

Total sample. Analyzed: 8 specimens

Synonyms. *Gobius giuris* Hamilton, 1822; *Gobius russelii* Cuvier, 1829; *Gobius catebus* Valenciennes, 1837; *Gobius kurpah* Sykes, 1839; *Gobius phaiospilosoma* Bleeker, 1849; *Gobius sublitus* Cantor, 1849; *Gobius spectabilis* Günther, 1861; *Euctenogobius striatus* Day, 1868; *Gobius grandidierii* Playfair, 1868; *Glossogobius tenuiformis* Fowler, 1934.

Meristics. D1 = VI; D2 = I.9; A = I.8 - 9; P = 19 - 21; V = I.5; C = 25 - 29; Sq = 32 - 35; PrD = 25 - 29.

Morphometric. SL = 3.14 (3.05 - 3.22) HL = 5.8 (5.06 - 6.19) Bd = 4.90 (4.77 - 5.10) Lcp = 10.13 (9.93 - 10.26) Dcp; HL = 3.04 (3.00 - 3.15) SnL = 5.02 (4.83 - 5.41) Ed; Lcp = 2.07 (2.02 - 2.10) Dcp. (Figure A 1.150.).

Sampling locations in the study area: Not distributed in (1); (2); (25); (27) see (Figure 2.1.1.)

***151. Glossogobius olivaceus* (Temminck & Schlegel, 1845)**

Total sample. Analyzed: 3 specimens

Synonym. *Gobius olivaceus* Temminck & Schlegel, 1845.

Meristics. D1 = VI; D2 = I.9; A = I.7 - 8; V = I.5; C = 18 - 21; Sq = 31 - 32; PrD = 9 - 11.

Morphometric. SL = 3.12 (3.09 - 3.15) HL = 4.84 (4.59 - 5.11) Bd = 4.2 (4.16 - 4.23) Lcp = 8.68 (8.5 - 8.82) Dcp; HL = 3.69 (3.59 - 3.77) SnL = 5.24 (4.82 - 5.5) SnL; Lcp = 2.07 (2.01 - 2.11) Dcp. (Figure A 1.151.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***152. Oplopomus oplopomus* (Valenciennes, 1837)**

Total sample. Analyzed: 2 specimens

Synonym. *Gobius oplopomus* Valenciennes, 1837.

Meristics. D1 = VI; D2 = I.10; P = 18; A = I.9; V = I.5; C = 22; Sq = 35; PrD = 13.

Morphometric. SL = (3.34 - 3.47) HL = (4.80 - 4.97) Bd = (4.41 - 4.54) Lcp = (8.09 - 8.12) Dcp; HL = (3.55 - 3.76) SnL = (3.76 - 3.84) Ed; Lcp = (1.49 - 1.54) Dcp. (Figure A 1.152.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***153. Paragobiodon echinocephalus* (Rüppell, 1830)**

Total sample. Analyzed: 5 specimens

Synonyms. *Gobius echinocephalus* Rüppell, 1830; *Gobius amiciensis* Valenciennes, 1837.

Meristics. D1 = VI; D2 = I.9 - 10; A = I.9; P = 16; V = I.5; C = 22; Sq = 28 - 29; PrD = 10.

Morphometric. SL = 3.59 (3.49 - 3.62) HL = 3.36 (3.35 - 3.37) Bd = 4.69 (4.28 - 5.10) Lcp = 7.75 (7.13 - 8.36) Dcp; HL = 4.02 (3.98 - 4.07) SnL = 3.93 (3.82 - 4.05) SnL; Lcp = 1.65 (1.64 -1.66) Dcp. (Figure A 1.153.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***154. Parachaeturichthys polynema* (Bleeker, 1853)**

Total sample. Analyzed: 2 specimens

Synonyms. *Chaeturichthys polynema* Bleeker, 1853; *Gobius polynema* (Bleeker, 1853).

Meristics. D1 = VI; D2 = I.10; P = 21; V = I.5; C = 30; Sq = 29; PrD = 14.

Morphometric. SL = (3.95 - 4.12) HL = (5.50 - 5.54) Bd = (5.47 - 5.67) Lcp = (7.86 - 7.99) Dcp; HL = (4.52 - 4.76) SnL = (3.43 - 3.54) Ed; Lcp = (1.44 - 1.47) Dcp. (Figure A 1.154.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***155. Psammogobius biocellatus* (Valenciennes, 1837)**

Total sample. Analyzed: 9 specimens

Synonyms. *Gobius biocellatus* Valenciennes, 1837; *Glossogobius biocellatus* (Valenciennes, 1837); *Gobius sumatranus* Bleeker, 1854.

Meristics. D1 = VI; D2 = I.9; A = I.8; P = 17 - 18; V = I.5; C = 17 - 26; Sq = 31; PrD = 17 - 20.

Morphometric. SL = 3.02 (2.65 - 3.20) HL = 6.62 (5.89 - 7.34) Bd = 4.94 (3.96 - 5.37) Lcp =10.83 (8.72 - 11.72) Dcp; HL = 3.17 (2.81 - 3.48) SnL = 4.85 (4.45 - 5.59) Ed; Lcp = 2.19 (2.11 -2.29) Dcp. (Figure A 1.155.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***156. Yongeichthys criniger* (Valenciennes, 1837)**

Total sample. Analyzed: 3 specimens

Synonyms. *Gobius criniger* Valenciennes, 1837; *Acentrogobius criniger* (Valenciennes, 1837).

Meristics. D1 = VI; D2 = I.10; A = I.9; P = 17 - 18; V = I.5; C = 24 - 25; Sq = 32 - 34; PrD = 23 - 24.

Morphometric. SL = 3.18 (3.06 - 3.27) HL = 5.01 (4.65 - 5.31) Bd = 5.15 (4.94 - 5.27) Lcp = 8.03 (7.73 - 8.22) Dcp; HL = 3.52 (3.45 - 3.57) SnL = 3.98 (3.92 - 4.09) Ed; Lcp = 1.56 (1.55 -1.56) Dcp. (Figure A 1.156.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(52). FAMILY SCATOPHAGIDAE

***157. Scatophagus argus* (Linnaeus, 1766)**

Total sample. Analyzed: 1 specimen

Synonyms. *Chaetodon argus* Linnaeus, 1766; *Chaetodon pairatalis* Hamilton, 1822; *Chaetodon atromaculatus* Bennett, 1830; *Scatophagus bougainvillii* Cuvier, 1831.

Meristics. D1 = XII; D2 = 17; A = IV 15; P = 1.16; V = 1.5; C = 3.15.

Morphometric. SL = (1.45) Bd = (2.75) HL = (2.47) Lbdf = (3.94) Lbds = (2.68) Lba = (13.83) Lcp = (6.45) Dcp = (8.51) Ed = (6.17) Iw; HL = (3.09) Ed = (2.24) Iw = (3.37) SnL = (5.02) Lcp = (2.34) Dcp; Lcp = (0.47) Dcp; Iw = (0.72) Ed. (Figure A 1.157.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(53). FAMILY SIGANIDAE

158. Siganus canaliculatus (Park, 1797)

Total sample. Analyzed: 7 specimens

Synonyms. *Chaetodon canaliculatus* Park, 1797; *Amphacanthus guttatus oramin* Bloch & Schneider, 1801; *Amphacanthus dorsalis* Valenciennes, 1835; *Teuthis dorsalis* (Valenciennes, 1835).

Meristics. D1 = XIII; D2 = 10; A = VII.9; P = 16; V = 4; C = 20; Sq = 40.

Morphometric. SL = 3.05 (3.00 - 3.10) Bd = 3.43 (3.40 - 3.47) HL = 8.45 (7.96 - 8.94) Lcp = 22.33 (22.18 - 22.49) Dcp = 9.79 (9.55 - 10.02) SnL = 9.12 (9.09 - 9.16) Ed = 12.75 (11.93 - 13.56) Iw = 1.48 Lbd = 2.65 (2.61 - 2.68) Lba; Bd = 1.13 (1.12 - 1.13) HL = 2.77 (2.66 - 2.89) Lcp = 7.33 (7.26 - 7.40) Dcp = 3.21 (3.08 - 3.35) SnL = 2.99 (2.96 - 3.03) Ed = 4.18 (3.98 - 4.38) Iw = 0.49 (0.48 - 0.49) Lbd = 0.87 Lba; HL = 2.85 (2.75 - 2.95) SnL = 2.66 (2.64 - 2.67) Ed = 3.71 (3.51 - 3.91) Ed = 2.46 (2.34 - 2.58) Lcp = 6.51 (6.49 - 6.53) Dcp = 0.43 Lbd = 0.77 Lba; Iw = 0.72 (0.68 - 0.76) Ed; Lcp = 2.65 (2.51 - 2.79) Dcp. (Figure A 1.158.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

159. Siganus punctatissimus Fowler & Bean, 1929

Total sample. Analyzed: 5 specimens

Meristics. D = XIII; D2 = 10; A = VII.9; V = 4; C = 20; Sq = 42.

Morphometric. SL = 3.15 (3.00 - 3.10) Bd = 3.33 (3.40 - 3.47) HL = 8.75 (7.96 - 8.94) Lcp = 22.39 (22.18 - 22.49) Dcp = 9.79 (9.55 - 10.02) SnL = 9.12 (9.09 - 9.16) Ed = 12.75 (11.93 - 13.56) Iw = 1.48 Lbd = 2.65 (2.61 - 2.68) Lba; Bd = 1.13 (1.12 - 1.13) HL = 2.77 (2.66 - 2.89) Lcp = 7.33 (7.26 - 7.40) Dcp = 3.21 (3.08 - 3.35) SnL = 2.99 (2.96 - 3.03) Ed = 4.18 (3.98 - 4.38) Iw = 0.49 (0.48 - 0.49) Lbd = 0.87 Lba; HL = 2.85 (2.75 - 2.95) SnL = 2.66 (2.64 - 2.67) Ed = 3.71 (3.51 - 3.91) Iw = 2.46 (2.34 - 2.58) Lcp = 6.51 (6.49 - 6.53) Dcp = 0.43 Lbd = 0.77 Lba; Iw = 0.72 (0.68 - 0.76) Ed; Lcp = 2.65 (2.51 - 2.79) Dcp. (Figure A 1.159.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(54). FAMILY SPHYRAENIDAE

***160. Sphyraena pinguis* Günther, 1874**

Total sample. Analyzed: 5 specimens

Meristics. D1 = V; D = 9; A = I.9; P = I.13; V = I.5; C = 4.13; PrD = 28 - 29; Sq = 86 - 87.

Morphometric. SL = 7.14 (6.73 - 7.78) Bd = 2.93 (2.74 - 3.01) HL = 15.01 (14.83 - 15.16) Lbd = 10.22 (9.51 - 10.71) Lba = 5.32 (5.23 - 5.50) Lcp = 14.16 (13.73 - 14.64) Dcp; HL = 2.16 (2.12 - 2.20) SnL = 5.47 (5.19 - 5.67) Iw = 6.89 (6.55 - 7.18) Ed = 1.82 (1.75 - 1.91) Lcp = 4.84 (4.62 - 5.08) Dcp; Iw = 0.79 (0.76 - 0.82) Ed; Lcp = 2.66 (2.61 - 2.78) Dcp. (Figure A 1.160.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(55). FAMILY ANABANTIDAE

***161. Anabas testudineus* (Bloch, 1792)**

Total sample. Analyzed: 7 specimens

Synonyms. *Anthias testudineus* Bloch, 1792; *Perca scandens* Daldorff, 1797; *Lutjanus testudo* Lacepède, 1802; *Anabas spinosus* Gray, 1834; *Anabas variegatus* Bleeker, 1851.

Meristics. D1 = XV - XVI; D2 = 9; A = IX.10 - 11; P = 1.13 - 14; V = I.5; C = 17 - 18; Ll = 27 - 29 (TSD = 3 - 4; TSA = 8.5 - 9).

Morphometric. SL = 2.80 (2.54 - 2.99) Bd = 2.73 (2.66 - 2.76) HL = 2.55 (2.52 - 2.59) Prdl = 12.30 (11.96 - 12.70) Podl = 24.20 (22.00 - 26.25) Lcp = 6.66 (6.41 - 6.97) Dcp; HL = 3.98 (3.81 - 4.27) Ed = 2.86 (2.78 - 2.99) Iw = 3.60 (3.38 - 3.74) SnL = 1.81 (1.78 - 1.84) Po; Iw = 1.39 (1.35 - 1.44) Ed; Lcp = 0.28 (0.25 - 0.29) Dcp; P → V = 1.44 (1.38 - 1.59) V → A. (Figure A 1.161.).

Sampling locations in the study area: Not distributed in (25); (27) see (Figure 2.1.1.)

(56). FAMILY OSPHRONEMIDAE

***162. Macropodus opercularis* (Linneaeus, 1758)**

Total sample. Analyzed: 6 specimens

Synonyms. *Labrus opercularis* Linnaeus, 1758; *Chaetodon chinensis* Bloch, 1790.

Meristics. D1 = XIV; D2 = 7; A = XIX.11 - 12; P = 11; V = 7; C = 16.

Morphometric. %SL = 34.24 (32.70 - 36.25) HL = 49.62 (47.98 - 52.89) Prdl = 36.22 (34.45 - 37.87) Prvl = 47.65 (46.06 - 48.48) Pral = 16.31 (15.56 - 16.85) Hdpre = 24.78 (23.37 - 25.77) Hdpoe = 31.04 (29.15 - 32.43) Hdn = 37.33 (35.96 - 39.12) BdA = 24.21 (23.49 -

25.11) BdD = 17.17 (16.04 - 19.65) Bwd = 8.30 (7.75 - 8.79) Bwa = 13.97 (13.01 - 14.62) Podl = 41.58 (40.18 - 42.90) Lbd = 53.56 (52.97 - 54.90) Lba = 10.26 (9.54 - 10.67) SnL = 8.90 (8.49 - 9.94) Ed = 11.07 (10.94 - 11.23) Iw; % HL = 25.96 (25.03 - 27.43) Ed = 32.35 (30.99 - 33.47) Iw = 30.00 (28.12 - 31.92). (Figure A 1.162.).

Sampling locations in the study area: Not distributed in (25); (27) see (Figure 2.1.1.)

***163. Macropodus spechti* Schreitmüller, 1936**

Total sample. Analyzed: 10 specimens

Synonyms. *Macropodus opercularis spechti* Schreitmüller, 1936; *Macropodus concolor* Ahl, 1936.

Meristics. D1 = VIII; D2 = 6 - 8; A = XIX.13 - 14; P = 11 - 12; V = 5 - 6; C = 7 - 18.

Morphometric. %SL = 35.30 (32.57 - 37.36) HL = 52.21 (50.81 - 53.92) Prdl = 36.61 (34.53 - 38.74) Prvl = 48.39 (46.60 - 50.31) Pral = 16.32 (14.99 - 17.08) Hdpre = 24.43 (22.87 - 25.67) Hdpoe = 30.55 (28.17 - 32.98) Hdn = 37.63 (35.13 - 40.31) BdA = 23.61 (22.55 - 25.03) BdD = 16.80 (14.78 - 18.20) Bwd = 14.58 (13.28 - 15.71) Podl = 36.10 (34.72 - 37.68) Lbd = 53.25 (50.52 - 55.78) Lba = 10.77 (9.47 - 11.42) SnL = 9.21 (7.90 - 10.82) Ed = 9.64 (8.78 - 9.98) Iw; % HL = 26.02 (23.64 - 29.17) Ed = 27.37 (24.46 - 29.37) Iw = 30.54 (27.91 - 32.70). (Figure A 1.163.).

Sampling locations in the study area: Not distributed in (25); (27) see (Figure 2.1.1.)

***164. Macropodus erythropterus* Freyhof & Herder, 2002**

Total sample. Analyzed: 41 specimens

Meristics. D1 = XII - XV; D2 = 6 - 8; A = XVII.13 - 17; P = 11; V = 6; C = 18.

Morphometric. % SL = 34.66 (32.66 - 36.39) HL = 51.97 (46.40 - 59.85) Prdl = 36.04 (32.14 - 40.98) Prvl = 47.98 (40.22 - 52.05) Pral = 15.85 (13.55 - 19.02) Hdpre = 23.51 (20.78 - 26.18) Hdpoe = 28.04 (22.89 - 33.62) Hdn = 37.24 (34.01 - 40.51) BdA = 23.07 (20.32 - 24.85) BdD = 15.79 (13.88 - 17.43) Bwd = 14.63 (10.63 - 18.56) Podl = 37.40 (29.71 - 46.79) Lbd = 51.42 (43.08 - 55.53) Lba = 10.59 (8.71 - 12.19) SnL = 8.38 (7.30 - 9.64) Ed = 9.79 (8.60 - 14.17) Iw; % HL = 24.17 (20.71 - 27.41) Ed = 28.27 (25.02 - 40.86) Iw = 30.55 (25.27 - 34.63) SnL. (Figure A 1.164.).

Sampling locations in the study area: Not distributed in (25); (27) see (Figure 2.1.1.)

***165. Trichopsis vittata* (Cuvier, 1831)**

Total sample. Analyzed: 35 specimens

Synonyms. *Osphromenus vittatus* Cuvier, 1831; *Ctenops vittatus* (Cuvier, 1831).

Meristics. D = II.7; A = VI.25 - 26; P = 9; V = 6; C = 14.

Morphometric. %SL = 34.99 (33.63 - 36.22) HL = 67.51 (66.58 - 68.58) Prld = 38.08 (37.13 - 39.02) Prvl = 48.94 (47.91 - 50.20) Pral = 14.71 (14.07 - 15.17) Hdpre = 20.99 (20.35 - 21.70) Hdpoe = 24.71 (23.06 - 25.38) Hdn = 33.51 (32.79 - 34.31) BdA = 24.01 (23.18 - 24.90) BdD = 12.57 (11.96 - 13.08) Bwd = 21.20 (19.15 - 22.38) Podl = 14.21 (13.35 - 15.69) Lbd = 51.70 (48.29 - 53.89) Lba = 12.18 (11.37 - 12.90) SnL = 8.74 (8.31 - 9.47) Ed = 10.30 (9.80 - 10.67) Iw; % HL = 24.99 (23.51 - 26.14) Ed = 29.45 (27.74 - 31.27) Iw = 34.84 (32.17 - 38.37) SnL. (Figure A 1.165.).

Sampling locations in the study area: Not distributed in (25); (27) see (Figure 2.1.1.)

***166. Trichopodus trichopterus* (Pallas, 1770)**

Total sample. Analyzed: 54 specimens

Synonyms. *Labrus trichopterus* Pallas, 1770; *Osphromenus siamensis* Günther, 1861.

Meristics. D1 = VI - VIII ; D2 = 6 - 9 ; A = X - XII. 29 - 33; P = 9 - 12; V = 3 - 4; C = 17 - 19

Morphometric. % SL = 31.39 (28.60 - 35.07) HL = 57.55 (52.35 - 63.16) Prdl = 27.21 (22.73 - 30.32) Prvl = 34.83 (29.41 - 42.74) Pral = 15.41 (13.05 - 19.58) Hdpre = 25.21 (22.09 - 28.49) Hdpoe = 32.20 (28.23 - 37.06) Hdn = 40.98 (37.97 - 45.97) BdA = 29.07 (25.86 - 34.18) BdD = 12.83 (8.24 - 16.61) Bwd = 22.20 (18.17 - 26.19) Podl = 24.23 (17.84 - 30.80) Lbd = 65.75 (55.41 - 72.62) Lba = 9.58 (7.85 - 10.74) SnL = 8.33 (7.01 - 9.83) Ed = 12.64 (11.55 - 14.50) Iw; % HL = 26.54 (23.33 - 30.44) Ed = 40.29 (36.17 - 43.48) Iw = 30.52 (25.70 - 35.35) SnL. (Figure A 1.166.).

Sampling locations in the study area: Not distributed in (25); (27) see (Figure 2.1.1.)

(57). FAMILY CHANNIDAE

***167. Channa striata* (Bloch, 1793)**

Total sample. Analyzed: 12 specimens

Synonyms. *Ophicephalus striatus* Bloch, 1793; *Ophiocephalus chena* Hamilton, 1822.

Meristics. D = 40 - 41; A = 25; P = 1.15 - 18; V = 1.6; C = 15 - 16; Ll = 56 - 58 (TSD = 4; TSA = 8 - 10).

Morphometric. SL = 5.74 (5.42 - 6.08) Bd = 2.96 (2.87 - 3.09) HL = 2.70 (2.61 - 2.88) Prdl = 1.52 (1.44 - 1.59) Podl = 10.44 (9.93 - 10.96) Lcp = 10.46 (9.71 - 11.02) Dcp = 1.82 (1.74 - 1.91) Pral = 2.81 (2.66 - 2.97) Prvl; HL = 6.40 (6.02 - 6.73) Ed = 4.31 (4.15 - 4.40) Iw = 4.87 (4.64 - 5.04) SnL = 1.45 (1.42 - 1.48) Po = 2.34 (2.24 - 2.52) Hdn; Iw = 1.49 (1.39 - 1.61) Ed; Lcp = 1.01 (0.89 - 1.11) Dcp; P→V = 1.18 (1.12 - 1.23) V→A; Bd = 1.83 (1.73 - 1.97) Lcp = 1.21 (1.10 - 1.28) Hdn; Lbd = 1.64 (1.57 - 1.77) Lba. (Figure A 1.167.).

Sampling locations in the study area: Not distributed in (1); (25); (27) see (Figure 2.1.1.)

168. *Channa gachua* (Hamilton, 1822)

Total sample. Analyzed: 7 specimens

Synonyms. *Ophicephalus gachua* Hamilton, 1822; *Ophicephalus marginatus* Cuvier, 1829.

Meristics. D = 33 - 34; V = 21 - 22; P = 1.15; V = 1.4; C = 16 - 17; Ll = 42 - 43 (TSD = 3; TSA = 6 - 7).

Morphometric. SL = 5.35 (5.04 - 5.59) Bd = 3.20 (3.14 - 3.37) HL = 2.65 (2.62 - 2.70) Prdl = 1.61 (1.51 - 1.74) Podl = 11.58 (10.90 - 12.13) Lcp = 8.89 (8.52 - 9.06) Dcp = 1.79 (1.75 - 1.82) Prdl = 2.74 (2.56 - 2.83) Prvl; HL = 5.93 (5.75 - 6.14) Ed = 3.18 (3.06 - 3.38) Iw = 4.50 (4.40 - 4.69) SnL = 1.52 (1.46 - 1.61) Po = 1.94 (1.85 - 2.13) Hdn; Iw = 1.87 (1.80 - 1.96) Ed; Lcp = 0.77 (0.74 - 0.83) Dcp; P→V = 1.24 (1.17 - 1.28) V→A; Bd = 1.66 (1.52 - 1.80) Dcp = 1.16 (1.12 - 1.22) Hdn; Lbd = 1.67 (1.55 - 1.78) Lba. (Figure A 1.168.).

Sampling locations in the study area: Not distributed in (1); (2); (7); (8); (25); (27); (34); (35) see (Figure 2.1.1.)

XV. ORDER PLEURONECTIFORMES

(58). FAMILY PARALICHTHYIDAE

***169. Paralichthys olivaceus* (Temminck & Schlegel, 1846)**

Total sample. Analyzed: 1 specimen

Synonym. *Hippoglossus olivaceus* Temminck & Schlegel, 1846.

Meristics. Dorsal = 46; Pectoral = 13; Pelvic = 6; Anal = 37; Caudal = 19; Cephalodorsal line = 10; Scales of DLL to MLL = 31; Scales of MLL to VLL = 33; Lateral line = 83.

Morphometric. Proportions as % standard length (SL): Body depth = (54.09); Dorsal fin length = (12.95); Anal fin length = (14.18); Lateral head length = (31.90).

Proportions as % Lateral head length (HL): Snout length = (22.9); Upper eye diameter = (24.4); Lower eye diameter = (21.7); Interorbital width = (3.8); Distance from tip of fleshy snout to angle of mouth = (34.3); Distance from tip of lower jaw to angle of mouth = (30.7). (Figure A 1.169.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***170. Pseudorhombus cinnamoneus* (Temminck & Schlegel, 1846)**

Total sample. Analyzed: 4 specimens

Synonym. *Rhombus cinnamoneus* Temminck & Schlegel, 1846.

Meristics. Dorsal = 78 - 89; Pectoral = 12 - 13; Anal = 60 - 69; Caudal = 19; Lateral line = 75 - 84

Morphometric. Proportions as % standard length (SL): Body depth = 49.50 (47.91 - 50.28); Dorsal fin length = 10.95 (9.84 - 11.85); Anal fin length = 11.13 (10.45 - 12.15); Caudal fin length = 26.98 (26.72 - 27.18); Lateral head length = 30.95 (29.80 - 32.54).

Proportions as % Lateral head length (HL): Snout length = 23.26 (22.08 - 25.25); Upper eye diameter = 22.80 (22.04 - 23.48); Lower eye diameter = 21.76 (21.09 - 22.91); Interorbital width = 4.86 (3.91 - 7.28); Distance from tip of fleshy snout to angle of mouth = 36.84 (35.55 - 37.44) = Distance from tip of lower jaw to angle of mouth = 35.22 (33.57 - 36.94). (Figure A 1.170.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***171. Pseudorhombus malayanus* Bleeker, 1866**

Total sample. Analyzed: 2 specimens

Meristics. Dorsal = 73 - 74; Pectoral = 11 - 12; Pelvic = 6; Anal = 57 - 59; Caudal = 17; Cephalodorsal line = 12; Mandibulo-opercular line = 18 - 20; Scales of DLL to MLL = 28; Scales of MLL to VLL = 30; Lateral line = 75 - 79.

Morphometric. Proportions as % standard length (SL): Body depth = 48.59 (48.50 - 48.69); Dorsal fin length = 12.95 (11.74 - 14.16); Anal fin length = 12.45 (12.17 - 12.73); Caudal fin length = 25.89 (24.97 - 26.80); Lateral head length = 31.37 (30.76 - 31.98).

Proportions as % Lateral head length (HL): Snout length = 21.44 (21.02 - 21.85); Upper eye diameter = 20.91 (20.28 - 21.55); Lower eye diameter = 23.86 (23.01 - 24.70); Interorbital width = 5.24 (4.47 - 6.01); Distance from tip of fleshy snout to angle of mouth = 34.04 (32.89 - 35.19); Distance from tip of lower jaw to angle of mouth = 30.58 (30.07 - 31.09). (Figure A 1.171.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(59). FAMILY BOTHIDAE

***172. Engyprosopon longipelvis* Amaoka, 1969**

Total sample. Analyzed: 3 specimens

Meristics. Dorsal = 84 - 85; Pectoral = 9 -10; Pelvic = 6; Anal = 64 - 66; Caudal = 18.

Morphometric. Proportions as % standard length (SL): Body depth = 59.09 (57.78 - 61.05); Dorsal fin length = 15.04 (13.59 - 15.97); Anal fin length = 12.60 (12.21 - 13.14); Caudal fin length = 25.61 (24.36 - 27.07); Lateral head length = 25.76 (25.13 - 26.17).

Proportions as % HL: Snout length = 23.90 (23.64 - 24.30); Upper eye diameter = 33.22 (32.05 - 33.83); Lower eye diameter = 33.42 (32.26 - 34.35); Interorbital width = 25.79 (25.46

- 26.21); Distance from tip of fleshy snout to angle of mouth = 32.41 (31.68 - 33.05); Distance from tip of lower jaw to angle of mouth = 28.43 (27.36 - 29.26). (Figure A 1.172.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(60). FAMILY SOLEIDAE

***173. Aseraggodes xenicus* (Matsubara & Ochiai, 1963)**

Total sample. Analyzed: 1 specimen

Synonyms. *Parachirus xenicus* Matsubara & Ochiai, 1963; *Aseraggodes smithi* Woods, 1966.

Meristics. Dorsal = 61; Pelvic = 6; Anal = 39; Caudal = 17; Scales of DLL to MLL = 23; Scales of MLL to VLL = 26; Lateral line = 64.

Morphometric. Proportions as % standard length (SL): Body depth = (43.99); Dorsal fin length = (14.65); Anal fin length = (14.88); Caudal fin length = (30.77); Lateral head length = (20.79).

Proportions as % HL: Snout length = (41.02); Upper eye diameter = (29.74); Lower eye diameter = (30.54); Interorbital width = (16.77); Distance from tip of fleshy snout to angle of mouth = (41.42); Distance from tip of lower jaw to angle of mouth (35.23). (Figure A 1.173.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***174. Heteromycteris japonicus* (Temminck & Schlegel, 1846)**

Total sample. Analyzed: 2 specimens

Synonyms. *Achirus japonicus* Temminck & Schlegel, 1846; *Heteromycteris japonica* (Temminck & Schlegel, 1846).

Meristics. Dorsal = 93; Pelvic = 5; Anal = 63 - 64; Caudal = 19; Scales of DLL to MLL = 25; Scales of MLL to VLL = 33; Scales in longitudinal series beside VLL = 105.

Morphometric. Proportions as % standard length (SL): Body depth = 36.67 (36.14 - 37.19); Dorsal fin length = 8.70 (8.29 - 9.12); Anal fin length = 8.41 (7.97 - 8.86); Caudal fin length = 21.76 (20.94 - 22.59); Lateral head length = 25.24 (24.32 - 26.15).

Proportions as % HL: Snout length = 35.53 (34.86 - 36.19); Upper eye diameter = 15.83 (15.43 - 16.24); Lower eye diameter = 12.89 (12.64 - 13.14); Interorbital width = 9.37 (8.59 - 10.16); Distance from tip of fleshy snout to angle of mouth = 67.11 (66.40 - 67.82); Distance from tip of lower jaw to angle of mouth = 42.65 (42.03 - 43.26). (Figure A 1.174.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***175. Solea ovata* Richardson, 1846**

Total sample. Analyzed: 10 specimens

Synonyms. *Microbuglossus ovatus* (Richardson, 1846); *Solea humilis* Cantor, 1849.

Meristics. Dorsal = 61 - 69; Pectoral = 7 - 8; Pelvic = 5 - 6; Anal = 44 - 51; Caudal = 18.

Morphometric. Proportions as % standard length (SL): Body depth = 51.5 (49.2 - 53.3); Dorsal fin length = 11.6 (10.2 - 12.6); Anal fin length = 11.9 (10.1 - 13.8); Caudal fin length = 23.5 (21.0 - 25.8); Lateral head length = 24.4 (22.4 - 26.1).

Proportions as % HL: Snout length = 31.3 (29.8 - 32.6); Upper eye diameter = 27.2 (24.9 - 28.4); Lower eye diameter = 30.8 (28.7 - 32.7); Interorbital width = 11.1 (9.4 - 14.5); Distance from tip of fleshy snout to angle of mouth = 35.7 (33.1 - 37.8); Distance from tip of lower jaw to angle of mouth = 26.3 (24.8 - 28.2). (Figure A 1.175.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***176. Cynoglossus cynoglossus* (Hamilton, 1822)**

Total sample. Analyzed: 2 specimens

Synonyms. *Achirus cynoglossus* Hamilton, 1822; *Plagusia oxyrhynchos* Bleeker, 1851; *Cynoglossus hamiltonii* Günther, 1862; *Cynoglossus buchanani* Day, 1870; *Cynoglossus deltae* Jenkins, 1910.

Meristics. Dorsal = 93 - 98; Pelvic = 4; Anal = 66 - 69; Caudal = 24; Cephalodorsal line = 18; Mandibulo-opercular line = 25 - 27; Supraorbital line = 12 -13; Preopercular line = 9 -11; Dorsolateral line = 128 - 129; Midlateral line = 92 - 116; Scales of DLL to MLL = 17; Scales of MLL to VLL = 22 - 25; Scales in longitudinal series beside DLL = 98 - 121; Scales in longitudinal series beside VLL = 99 - 105.

Morphometric. Proportions as % standard length (SL): Body depth = 30.95 (30.08 - 31.81); Dorsal fin length = 8.04 (6.95 - 9.13); Anal fin length = 8.48 (7.48 - 9.48); Caudal fin length = 14.08 (13.85 - 14.31); Lateral head length = 20.82 (20.58 - 21.05).

Proportions as % HL: Snout length = 30.06 (29.09 - 31.02); Upper eye diameter = 17.12 (16.72 - 17.52); Lower eye diameter = 16.04 (15.33 - 16.75); Interorbital width = 3.44 (3.39 - 3.50); Distance from tip of fleshy snout to angle of mouth = 22.26 (22.21 - 22.31); Distance from tip of lower jaw to angle of mouth = 17.93 (17.58 - 18.29). (Figure A 1.176.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***177. Cynoglossus lingua* Hammilton, 1822**

Total sample. Analyzed: 3 specimens

Synonyms. *Arelia lingua* (Hamilton, 1822); *Pleuronectes potous* Cuvier, 1829; *Plagusia macrorhynchos* Bleeker, 1851; *Cynoglossus acinaces* Jenkins, 1910.

Meristics. Dorsal = 126 - 138; Anal = 97 - 114; Caudal = 10; MLL = 90 - 101; SOL = 11 -12.

Morphometric. Proportions as % standard length (SL): Body depth = 30.49 (29.68 - 31.77); Dorsal fin length = 10.04 (9.89 - 10.26); Anal fin length = 8.99 (8.60 - 9.57); Caudal fin length = 11.20 (10.33 - 11.65); Lateral head length = 20.95 (20.27 - 21.45).

Proportions as % HL: Snout length = 29.57 (28.03 - 30.74); Upper eye diameter = 11.17 (10.67 - 11.81); Lower eye diameter = 13.83 (13.34 - 14.52); Interorbital width = 4.91 (4.37 - 5.21); Distance from tip of fleshy snout to angle of mouth = 25.03 (24.25 - 25.58); Distance from tip of lower jaw to angle of mouth = 20.78 (18.91 - 22.07). (Figure A 1.177.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

***178. Cynoglossus puncticeps* (Richardson, 1846)**

Total sample. Analyzed: 1 specimen

Synonyms. *Plagusia puncticeps* Richardson, 1846; *Plagusia brachyrhynchos* Bleeker, 1851; *Cynoglossus brevis* Günther, 1862; *Cynoglossus puncticeps immaculata* Pellegrin & Chevey, 1940.

Meristics. Dorsal = 91; Pelvic = 4; Anal = 76; Caudal = 12; Cephalodorsal line = 12; Mandibulo-opercular line = 21; Supraorbital line = 10; Preopercular line = 14; Dorsolateral line = 98; Ventrolateral line = 16; Scales of DLL to MLL = 19.

Morphometric. Proportions as % standard length (SL): Body depth = (32.82); Dorsal fin length = (7.80); Anal fin length = (7.86); Caudal fin length = (12.65); Lateral head length = (20.46).

Proportions as % HL: Snout length = (31.9); Upper eye diameter = (15.3); Lower eye diameter = (15.2); Interorbital width = (4.9); Distance from tip of fleshy snout to angle of mouth = (26.5); Distance from tip of lower jaw to angle of mouth = (20.8). (Figure A 1.178.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

XVI. ORDER TETRAODONTIFORMES

(61). FAMILY TRIACANTHIDAE

***179. Triacanthus biaculeatus* (Bloch, 1786)**

Total sample. Analyzed: 5 specimens

Synonyms. *Balistes biaculeatus* Bloch, 1786; *Triacanthus brevirostris* Temminck & Schlegel, 1850.

Meristics. D1 = IV; D2 = I.23; A = I.16; P = I.13; V = I; C = 3.18.

Morphometric. SL = 2.56 (2.53 - 2.61) Bd = 3.61 (3.49 - 3.69) HL = 8.47 (7.99 - 8.77) Lbd = 5.09 (4.88 - 5.37) Lba = 4.15 (4.04 - 4.24) Lcp = 22.84 (21.27 - 24.35) Dcp; HL = 1.56

(1.55 - 1.57) SnL = 3.40 (3.13 - 3.57) Iw = 2.85 (2.78 - 2.93) Ed = 1.15 (1.15 - 1.16) Lcp = 6.34 (5.77 - 6.97) Dcp; Iw = 1.20 (1.10 - 1.29) Ed; Lcp = 5.50 (5.02 - 6.02) Dcp. (Figure A 1.179.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(62). FAMILY MONACANTHIDAE

***180. Paramonacanthus japonicus* (Tilesius, 1809)**

Total sample. Analyzed: 1 specimen

Synonyms. *Balistes japonicus* Tilesius, 1809; *Monacanthus broekii* Bleeker, 1858.

Meristics. D1 = I; D2 = I.26; A = I.29; P = I.13; V = I; C = 3.11.

Morphometric. SL = (1.75) Bd = (2.83) HL = (17.61) Lbd = (2.76) Lba = (14.39) Lcp = (6.94) Dcp; HL = (1.47) SnL = (2.95) Iw = (3.25) Ed = (5.08) Lcp = (2.45) Dcp; Iw = (0.91) Ed; Lcp = (0.48) Dcp. (Figure A 1.180.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

(63). FAMILY TETRAODONTIDAE

***181. Lagocephalus sceleratus* (Gmelin, 1789)**

Total sample. Analyzed: 2 specimens

Synonyms. *Tetrodon sceleratus* Gmelin, 1789; *Tetraodon bicolor* Brevoort, 1856.

Meristics. D = 2.20; A = 2.9; P = 2.14; C = 3.7.3

Morphometric. SL = (4.61 - 4.95) Bd = (2.53 - 2.93) HL; HL = (3.21 - 3.53) Ed = (3.12 - 3.45) Iw. (Figure A 1.181.).

Sampling locations in the study area: (1); (2); (35) see (Figure 2.1.1.)

4.2. Conclusion of chapter 4

We have described the basic characteristics of 181 fish species, such as: analyzed the basic Meristics, Morphometric of each species. Provide information such as: The number of specimens, Synonyms. And determine the distribution of the species in the sampling point location on map of each species.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

The analysis of the theoretical and practical approaches on the studied topic "**Ichthyofauna of the Gianh river basin from Vietnam**" have lead to the drafting of the following conclusions:

1. There have been attested 181 fish species that belong to 139 genera, 64 families and 16 orders in the hydrographic of Gianh river basin from Quang Binh province. There have been identified peculiarities of spatial distribution of 52 fish species from the basin of river Gianh.
2. Fish species *Schistura kottelati* Tuan et all, 2015; *Carassioides phongnhaensis* Tu & Tuan, 2003 and *Cyprinus hieni* Tu & Tuan, 2003 have been registered and approved as new species for science. There are still 3 unidentified species, the samples of which have already been sent to internationally known ichthyologists to confirm the proposed taxonomic status.
3. According to the IUCN in Gianh river basin there were identified 5 species is level (NT), 3 species is level (VU), 1 species is level (EN), 67 species is level (LC), 78 species is level (NE), 27 species with insufficient data (DD). According to national Red List there have been identified 5 fish species with rarity status.
4. Ichthyofauna of the Gianh river is unique as to its number of species, share of stenotopic species, and an impressive number of rare species which are important for community and those which were insufficiently studied (DD and NE according to IUCN). A major economic value present 84 fish species, and 3 species are allogenic invasive species and 26 species are potentially dangerous for humans.
5. There have been identified 119 species in the Phong Nha - Ke Bang National Park, 21 species have been attested in cave ecosystems, 20 species in rice fields, 52 species in ponds and dam lakes, 72 species in upstream, 66 species in the middle, 69 species in downstream and 109 species in estuary zone.
6. In order to protect efficiently a species and insure the success of its perpetuation in time and space the whole habitat should be protected. The scientific-practical recommendations for protection and improvement of fish resources in the Gianh river basin have an undeniable practical importance in the process of ecological reconstruction, bioindication and monitoring of well-being of aquatic ecosystems in the region.

Solved scientific problem consists in a survey of ichthyofaunistic diversity, underlining of peculiarities of spatial and temporal distribution of fish species in Gianh river basin and elaboration of theoretical and practical recommendations for a rational use of fish species.

Personal contribution: the idea of performing the investigation belongs to the consultant, scientific advisor and the author. The personal contribution of the author consists in the analysis of specialty literature on the topic of the thesis, collection and analysis of fish, identification of species in the ichthyofauna. Besides these, the statistic processing of the data and the analysis of the obtained results, sinthesis and interpretation of these results. Generalization of information and exposure in scientific publications. The approach of the research scientific problem, conclusions and practical recommendations belong to the author.

RECOMMENDATIONS

1. Quang Binh People's Committees, functional departments and the administration of National Park should have coordination and directing the implementation of measures to protect fish resources in Gianh river basins including in the National Park.
2. The Department of Science and Technology, Department of Agriculture and Rural should have plans to invest in raising and taming rare fish recorded in Vietnam Red Book and species of economic value for protection.
3. Prohibit the exploitation of rare fish species recorded in the Vietnam Red Book is recommended with providing policy of sanctions in destructive
4. Research on biology and ecology of high economic value and aquaculture species in order to offer a scientific policy for management is necessary.
5. Government should support funding to investigate fish fauna in these areas. Especially, to those far away from the studied area where was dangerous and difficult to investigate before.
6. Regional economical activities as points of sources pollution in this basin need to be well controlled, strengthening awareness of biodiversity conservation when biodiversity law was approved by National Assembly, especially for fisher communities.
7. Training for local officers of fisheries in the Gianh River basins and forest guard of the Phong Nha - Ke Bang National Park about basic knowledge of fish fauna biodiversity conservation and sustainable exploitation of fish resources.

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ANNEXES

ANNEX 1. Photo of the species in the study area

Fig. A1.1. *Dasyatis sinensis*

Fig. A1.2. *Gymnura poecilura*

Fig. A1.3. *Notopterus notopterus*

Fig. A 1.4. *Anguilla marmorata*

Fig. A 1.5. *Ophichthus celebicus*

Fig. A 1.6. *Pisodonophis boro*

Fig. A 1.7. *Gnathophis nystromi*

Fig. A 1.8. *Rhynchoconger ectenurus*

Fig. A 1.9. *Clupanodon thrissa*

Fig. A 1.10. *Konosirus punctatus*

Fig. A 1.11. *Escualosa thoracata*

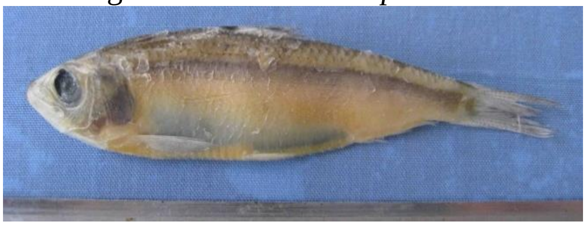

Fig. A 1.12. *Sardinella albella*

Fig. A 1.13 *Thryssa vitrirostris*

Fig. A 1.14. *Acheilognathus lamus*

Fig. A 1.15. *Acheilognathus tonkinensis*

Fig. A 1.16. *Rhodeus kyphus*

Fig. A1.17. *Rhodeus ocellatus*

Fig. A 1.18. *Rhodeus spinalis*

Fig. A 1.19. *Cultrichthys erythropterus*

Fig. A 1.20. *Hemiculter leucisculus*

Fig. A 1.21. *Pseudohemiculter dispar*

Fig. A 1.22. *Carassioides acuminatus*

Fig. A 1.23. *Carassioides phongnhaensis*

Fig. A 1.24. *Carassius auratus*

Fig. A 1.25. *Cyprinus carpio*

Fig. A 1.26. *Cyprinus hieni*

Fig. A 1.27. *Cyprinus quidatensis*

Fig. A 1.28. *Puntius brevis*

Fig. A 1.29. *Puntius semifasciolatus*

Fig. A 1.30. *Cirrhinus molitorella*

Fig. A 1.31. *Garra imberba*

Fig. A 1.32. *Osteochilus lini*

Fig. A 1.33. *Osteochilus salsburyi*

Fig. A 1.34. *Ctenopharyngodon idella*

Fig. A 1.35. *Squaliobarbus curriculus*

Fig. A 1.36. *Hypophthalmichthys molitrix*

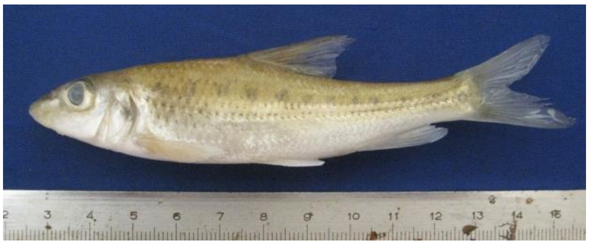

Fig. A 1.37. *Hemibarbus umbrifer*

Fig. A 1.38. *Microphysogobio kachekensis*

Fig. A 1.39. *Sarcocheilichthys parvus*

Fig. A 1.40. *Squalidus argentatus*

Fig. A 1.41. *Devario fangfangae*

Fig. A 1.42. *Devario gibber*

Fig. A 1.43. *Esomus metallicus*

Fig. A 1.44. *Esomus longimanus*

Fig. A 1.45. *Rasbora steineri*

Fig. A 1.46. *Hypsibarbus annamensis*

Fig. A 1.47. *Hypsibarbus macrosquamatus*

Fig. A 1.48. *Nicholsicypris dorsohorizontalis*

Fig. A 1.49. *Neolissochilus benasi*

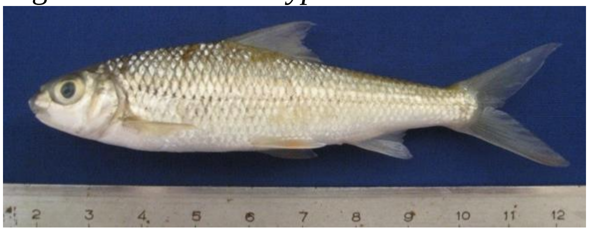

Fig. A 1.50. *Onychostoma gerlachi*

Fig. A 1.51. *Opsariichthys bidens*

Fig. A 1.52. *Paraspinibarbus macracanthus*

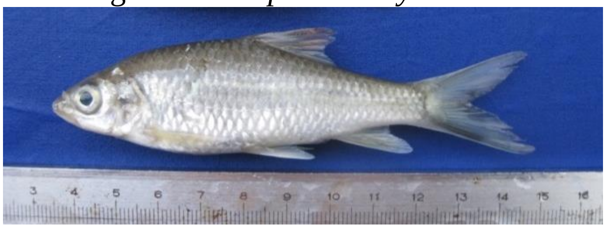

Fig. A 1.53. *Poropuntius solitus*

Fig. A 1.54. *Spinibarbus denticulatus*

Fig. A 1.55. *Spinibarbus hollandi*

Fig. A 1.56. *Metzia lineata*

Fig. A 1.57. *Cobitis laoensis*

Fig. A 1.58. *Misgurnus anguillicaulatus*

Fig. A 1.59. *Misgurnus mizolepis*

Fig. A 1.60. *Annamia normani*

Fig. A 1.61. *Sewellia lineolata*

Fig. A 1.62. *Schistura finis*

Fig. A 1.63. *Schistura hingi*

Fig. A 1.64. *Schistura pervagata*

Fig. A 1.65. *Schistura kottelati*

Fig. A 1.66. *Traccatichthys taeniatus*

Fig. A 1.67. *Mystus gulio*

Fig. A 1.68. *Hemibagrus centralus*

Fig. A 1.69. *Tachysurus virgatus*

Fig. A 1.70. *Silurus asotus*

Fig. A 1.71. *Pterocryptis cochinchinensis*

Fig. A 1.72. *Glyptothorax laosensis*


Fig. A 1.73. *Glyptothorax interspinalus*


Fig. A 1.74. *Glyptothorax quadriocellatus*


Fig. A 1.75. *Glyptothorax zanaensis*


Fig. A 1.76. *Clarias fuscus*

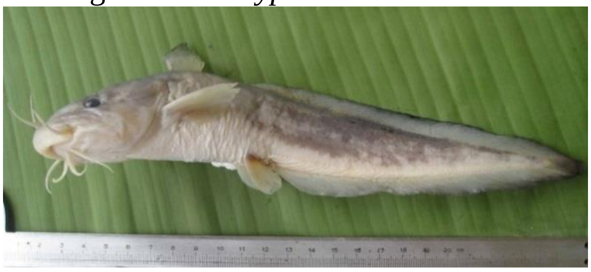
Fig. A 1.77. *Plotosus lineatus*


Fig. A 1.78. *Saurida elongata*


Fig. A 1.79. *Hypoatherina valenciennei*


Fig. A 1.80. *Strongylura strongylura*


Fig. A 1.81. *Hyporhamphus sinensis*


Fig. A 1.82. *Microphis cuncalus*


Fig. A 1.83. *Hippichthys spicifer*


Fig. A 1.84. *Monopterus albus*

Fig. A 1.85. *Mastacembelus armatus*

Fig. A 1.86. *Sinobdella sinensis*

Fig. A 1.87. *Paracentropogon rubripinnis*

Fig. A 1.88. *Minous pusillus*

Fig. A 1.89. *Platycephalus indicus*

Fig. A 1.90. *Rogadius serratus*

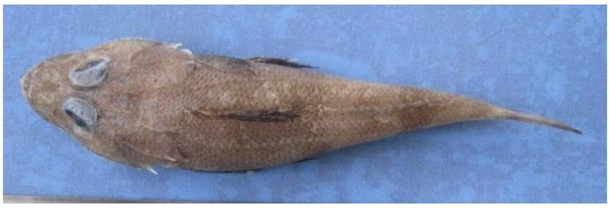

Fig. A 1.91. *Sorsogona tuberculata*

Fig. A 1.92. *Ambassis ambassis*

Fig. A 1.93. *Coreoperca whiteheadi*

Fig. A 1.94. *Lates calcarifer*

Fig. A 1.95. *Epinephelus awoara*

Fig. A 1.96. *Epinephelus longispinis*

Fig. A 1.97. *Terapon jarbua*

Fig. A 1.98. *Pelates sexlineatus*

Fig. A 1.99. *Apogon poecilopterus*

Fig. A 1.100. *Ostorhinchus fasciatus*

Fig. A 1.101. *Sillago maculata*

Fig. A 1.102. *Sillago sihama*

Fig. A 1.103. *Carangoides praeustus*

Fig. A 1.104. *Selaroides leptolepis*

Fig. A 1.105. *Scomberoides lysan*

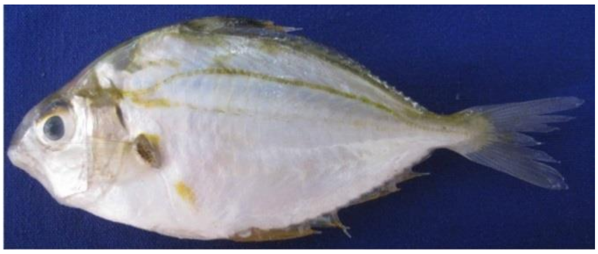

Fig. A 1.106. *Eubleekeria splendens*

Fig. A 1.107. *Leiognathus equulus*

Fig. A 1.108. *Leiognathus brevirostris*

Fig. A 1.109. *Secutor ruconius*

Fig. A 1.110. *Lutjanus fulviflamma*

Fig. A 1.111. *Lutjanus russellii*

Fig. A 1.112. *Lutjanus fulvus*

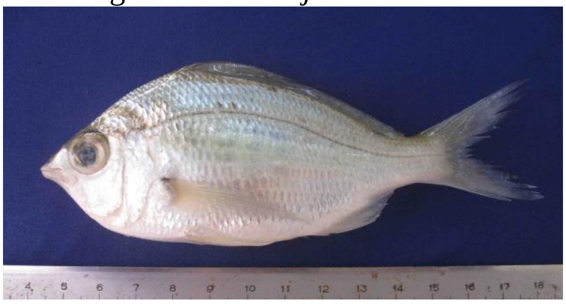

Fig. A 1.113. *Gerres limbatus*

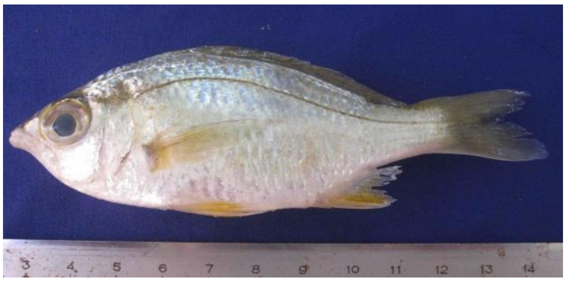

Fig. A 1.114. *Gerres decacanthus*

Fig. A 1.115. *Gerres filamentosus*

Fig. A 1.116. *Pomadasys maculatus*

Fig. A 1.117. *Argyrosomus pawak*

Fig. A 1.118. *Upeneus luzonius*

Fig. A 1.119. *Upeneus subvittatus*

Fig. A 1.120. *Upeneus tragula*


Fig. A 1.121. *Drepane punctata*

Fig. A 1.122. *Monodactylus argenteus*


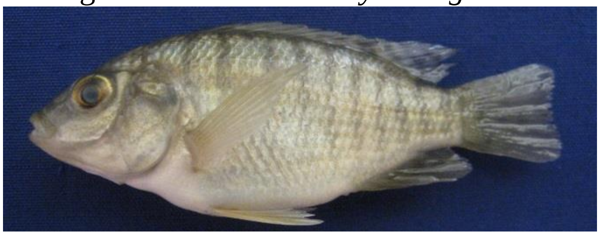

Fig. A 1.123. *Liza affinis*

Fig. A 1.124. *Oreochromis niloticus*


Fig. A 1.125. *Pomacentrus nigricans*

Fig. A 1.126. *Omobranchus fasciolatoceps*


Fig. A 1.127. *Callionymus curvicornis*

Fig. A 1.128. *Callionymus pleurostictus*


Fig. A 1.129. *Sineleotris chalmersi*

Fig. A 1.130. *Sineleotris namxamensis*


Fig. A 1.131. *Bostrychus sinensis*

Fig. A 1.132. *Butis butis*


Fig. A 1.133. *Butis koilomatodon*


Fig. A 1.134. *Eleotris fusca*


Fig. A 1.135. *Eleotris melanosoma*


Fig. A 1.136. *Chaeturichthys stigmatias*


Fig. A 1.137. *Oligolepis acutipennis*


Fig. A 1.138. *Oxyurichthys microlepis*


Fig. A 1.139. *Oxyurichthys tentacularis*


Fig. A 1.140. *Rhinogobius giurinus*


Fig. A 1.141. *Rhinogobius leavelli*


Fig. A 1.142. *Tridentiger trigonocephalus*


Fig. A 1.143. *Ctenogobius brevirostris*


Fig. A 1.144. *Papuligobius uniporus*


Fig. A 1.145. *Pseudapocryptes elongatus*

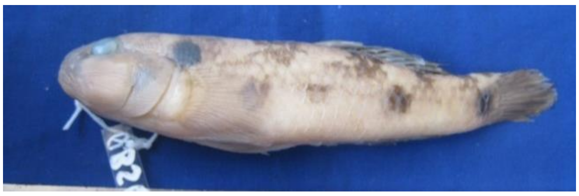
Fig. A 1.146. *Acentrogobius caninus*

Fig. A 1.147. *Acentrogobius nebulosus*

Fig. A 1.148. *Arcygobius baliurus*

Fig. A 1.149. *Favonigobius aliciae*

Fig. A 1.150. *Glossogobius giuris*

Fig. A 1.151. *Glossogobius olivaceus*

Fig. A 1.152. *Oplopomus oplopomus*

Fig. A 1.153. *Paragobiodon echinocephalus*

Fig. A 1.154. *Parachaeturichthys polynema*

Fig. A 1.155. *Psammogobius biocellatus*

Fig. A 1.156. *Yongeichthys criniger*

Fig. A 1.157. *Scatophagus argus*

Fig. A 1.158 *Siganus canaliculatus*

Fig. A 1.159. *Siganus punctatissimus*

Fig. A 1.160. *Sphyraena pinguis*

Fig. A 1.161. *Anabas testudineus*

Fig. A 1.162. *Macropodus opercularis*

Fig. A 1.163. *Macropodus spechti*

Fig. A 1.164. *Macropodus erythropterus*

Fig. A 1.165. *Trichopsis vittata*

Fig. A 1.166. *Trichopodus trichopterus*

Fig. A 1.167. *Channa striata*

Fig. A 1.168. *Channa gachua*

Fig. A 1.169. *Paralichthys olivaceus*

Fig. A 1.170. *Pseudorhombus cinnamoneus*


Fig. A 1.171. *Pseudorhombus malayanus*


Fig. A 1.172. *Engyprosopon longipelvis*


Fig. A 1.173. *Aseraggodes xenicus*

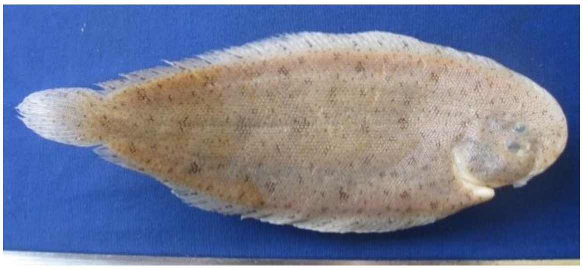
Fig. A 1.174. *Heteromycteris japonicus*


Fig. A 1.175. *Solea ovata*


Fig. A 1.176. *Cynoglossus cynoglossus*

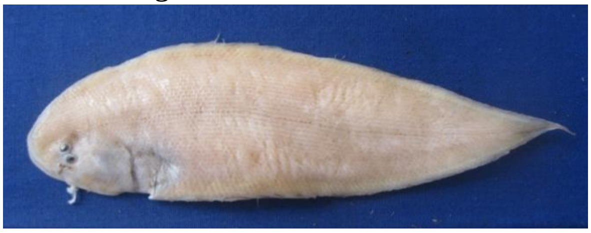
Fig. A 1.177. *Cynoglossus lingua*


Fig. A 1.178. *Cynoglossus puncticeps*


Fig. A 1.179. *Triacanthus biaculeatus*

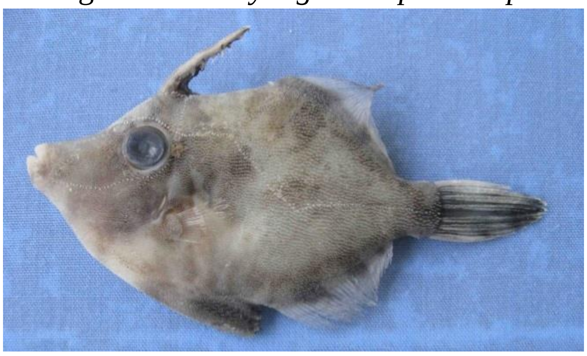
Fig. A 1.180. *Paramonacanthus japonicus*


Fig. A 1.181. *Lagocephalus sceleratus*

ANNEX 2. Image of sampling activities, processing of ichthyologycal materials and determination of species.

Fig. A2.1. Fishermen catch fish in Bo Trach

Fig. A 2.2. Fishermen catch fish in Quang Ninh

Fig. A 2.3. Fishermen catch fish in Quang Trach

Fig. A 2.4. Mineral mining in Bo Trach

Fig. A 2.5. Sampling studies in Hang En cave

Fig. A 2.6. Sampling studies in Khe Lanh Cave


Fig. A 2.7. Sampling studies in Hung Bung

Fig. A 2.8. Sampling studies in Bo Trach

Fig. A 2.9. Sample treatment in Hung Bung

Fig. A 2.10. Sample treatment in Hang En cave

Fig. A 2.11. Determination of species with ichthyologist researcher Jörg Freyhof

Fig. A 2.12. Determination of species with ichthyologists researchers Jörg Freyhof and Jörg Bohlen

ANNEX 3. Implementing acts

Act of implementation A 3.1.

MINISTERUL EDUCAŢIEI
UNIVERSITATEA DE STAT DIN MOLDOVA

MD-2009, Chişinău
Str. A. Mateevici, 60
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МИНИСТЕРСТВО ОБРАЗОВАНИЯ
ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ МОЛДОВЫ

МД-2009, Кишинэу
ул. А. Матеевич, 60
тел. 57-74-01, факс (373-2) 24-06-55

18.12.15 Nr. 01/2622

Act de implementare

Prin prezentul se confirmă, că rezultatele ştiinţifice referitoare la diversitatea ihtiofaunei, particularităţile morfometrice şi meristice ale speciilor de peşti şi recomandările ştiinţifico-practice de protecţie şi ameliorare a fondului piscicol din bazinul fl. Gianh obţinute de Domnul Ho Anh Tuan la tema tezei de docto în ştiinţe biologice "IHTIOFAUNA BAZINULUI FLUVIULUI GIANH DIN VIETNAM" sunt utilizate în cadrul Universităţii de Stat din Moldova în procesul didactic la disciplinele "Ecologie acvatică", "Hidrobiologie" şi "Ihtiologie", la familiarizarea studenţilor cu metodele clasice de analiză a materialului ihtiologic în cadrul tehnicilor speciale de laborator, la realizarea tezelor de licenţă şi de masterat.

Prorector pentru studii,
Doctor habilitat,
Profesor universitar

Otilia Dandara

Decanul Facultăţii
Biologie şi Pedologie,
Doctor conferenţiar

Mihai Leşanu

DECLARATION ON ASSUMING RESPONSIBILITY

I hereby declare that the thesis: "**Ichthyofauna river basin of the Gianh from Vietnam**" is my own work. All of database and information in the thesis is true and never been pubished in any other scientific document. All of references that I cited in the thesis is authentic resouces.

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- PhD in Specialized ichthyologist from the Faculty of Biology and Soil Science, Moldova state University, Republic of Moldova (2013 to present).

Book

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Declaration

I confirm that the information in this CV and any attachments is correct up to date. I understand that any information found to be incorrect may result in termination of any agreements made.

Update: 12 October 2015 Signature: