Gupta

Genetic Improvement of Carp Species in Asia

PROJECT PROGRESS REPORT

July 1998

Financed by the Asian Development Bank
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ICLARM
International Center for Living Aquatic Resources Management

INGA
International Network on Genetics in Aquaculture

Genetic Improvement of Carp Species in Asia

Project Progress Report
(November 1997 to June 1998)

July 1998

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Genetic Improvement of Carp Species in Asia

I. Introduction

The Project consists of two phases, Phase I focusing on determining research priorities leading to the development of high yielding breeds and strains; documentation of carp genetic resources, documentation of carp genetic improvement and initiation of breeding programs; and Phase II concentrating on (i) continued development of improved breeds, (ii) dissemination and evaluation of improved carp species, and (iii) establishment of carp breeding programs. The Asian Development Bank (ADB) provided a Technical Assistance Grant (RETA No. 5711) for implementing Phase I. Six developing member countries (DMCs) of the Bank: Bangladesh, People's Republic of China, India, Indonesia, Thailand and Vietnam are the participants in this Project.

The Phase I of the Project which became operative on 1 June 1997 will be implemented over a period of 36 months. The objective of this Project is to assist the six-participating DMCs, all major carp producing countries, to increase food fish production and to improve the nutrition and income of small-scale fish farmers by developing genetically improved carp breeds with sustainable productivity. Specifically, the project will establish research priorities for carp species, farming systems, and breeding strategies, and will conduct strategic research and training activities on the basis of these priorities.

Specific activities under Phase I will include: (i) establishment of strategic research partnerships and networking arrangement; (ii) assessment of the current status of carp genetic resources in Asia, including their systematic documentation and evaluation; (iii) documentation of existing technologies and experience on carp culture and breeding in Asia; (iv) development of criteria for prioritizing carp genetic research, (v) identification of research priorities and approaches, including species, farming systems, and breeding strategies; and (vi) initiation and implementation of location-specific strategic research and training based on identified research priorities leading to the development of high-yielding carp strains.

ICLARM submitted a Project Inception Report, covering the activities from June to October 1997, to ADB in November 1997. This technical report discusses the activities and accomplishment of the Project from November 1997 to June 1998.

II. Documentation of Carp Genetic Resources and Improvement

Major progress was made in this area. Information were collected from all 6 participating countries, Bangladesh, China, India, Indonesia, Thailand and Vietnam, and also from countries outside the project. The information are being processed and two draft documents have been initiated.

All collaborators are continuing to gather information. The draft documents will be updated, revised and expanded. Translation will be needed for some documents.

1. Documentation of Carp Genetic Resources

Bangladesh

Information are being compiled concerning the documentation of carp genetic resources in Bangladesh based on the guidelines and format given at the planning workshop held at CIFA, Bhubaneswar, India during 26 to 29 July 1997. Several documents have already been forwarded to ICLARM. The draft write up of the documentation is in progress and it may be submitted to ICLARM the latest by end of August 1998.

China

Of more than 2,000 carp species belonging to over 200 genera, there are about 410 species, 110 genera and 10 subfamilies inhabiting the waterbodies of China. About 20-30 carp species are cultured in ponds, lakes, rivers, reservoirs and paddy fields throughout the country. Carps are not only favorite species to culture but also dominate production in natural waters as well. Production of carps account for about 90 percent of the total production of freshwater species. Appendix 1 shows the carp genetic resources available in China. Several resource materials have been forwarded to ICLARM but need translation.

India

Some resource materials have been forwarded.

Indonesia

Preparation of working manuals were completed, concerning methods of data search, system of data collection, inventory of data source, data priority, data format and report format. Based on these manuals, data collection has been started in Jakarta and West Java.

Thailand

A minimal amount of literature exists on carp genetics resources in Thailand. Much of this has been forwarded to ICLARM but needs to be translated. A description of Thai carp genetics resources is found in Appendix 2.

Vietnam

Existing documents on carp genetic resources in Vietnam are being compiled. So far, it is somewhat difficult to collect the relevant information as there were limited research on carp genetic resources undertaken in the country. In addition, research on carps were scattered and not systematically carried out. For this activity, the Project is relying heavily on secondary data on carp species in culture systems and in the wild which were collected last March 1998 through a Network of Aquaculture Centres in Asia-Pacific (NACA) project. Analysis and documentation of the available data would be completed by the end of June 1998.

2. Documentation of Carp Genetic Improvement

Bangladesh

Carp genetics and breeding research are mostly being undertaken at Bangladesh Fisheries Research Institute (BFRI) under its Freshwater Station, Mymensingh since 1986. A few master's theses at Bangladesh Agricultural University, Mymensingh and Dhaka University dealt on genetic of silver barb related to BFRI's carp genetic program. All these works are being compiled into a report entitled "Documentation of carp genetic improvement in Bangladesh". A draft of this report was presented in the Bhubaneswar Workshop of the Project. The report is currently being revised and updated.

China

Relevant information on carp genetic improvement in China have been collected from all possible sources such as research institutions, colleges and libraries throughout the country. The preliminary report on the documentation of carp genetic improvement in China is given in Appendix 3. The report includes presentation and discussion of economically important carp species and various carp genetic improvement research undertaken in China that dealt on carp selective breeding, cross breeding, haploid breeding, polyploid breeding, sexual control, mutation breeding, integration breeding, transplant of karyon and cell culture, cell fusion, gene engineering and basic theory studies. The final report is expected to be completed by the end of October 1998. Several documents still need translation.

India

Some resource materials have been forwarded.

Indonesia

Documentation of carp genetic improvement has been initiated. Synthesis of this information is in progress. Preparation of working manuals were completed, concerning methods of data search, system of data collection, inventory of data source, data priority, data format and report format. Based on these manuals, data collection has been started in Jakarta and West Java.

Thailand

The majority of the information has been forwarded to ICLARM but needs translation.

Vietnam

Documents or information on carp genetic improvement came mainly from genetic selection program of common carp (*Cyprinus carpio*) and silver carp (*Hypophthalmichthys molitrix* [Chinese silver carp] and *H. harmandi* [Vietnamese silver carp]), which were carried out at RIA No. 1 for the last 18 years. A number of reports on carp genetic improvement have been published. All available information are being gathered and assessed.

III. Carp Socioeconomic and Prioritization Research

ICLARM scientists visited collaborating scientists in all 6 participating countries and developed detailed protocols for the socioeconomic surveys. Questionnaires have been formulated and the surveys are underway in all 6 countries. Species prioritization and surveys of farmers, consumers and hatchery operators are being conducted in all countries. Survey of hatchery operators is not being conducted in China because of the nature of distribution of carp fingerlings by the government.

Currently the surveys are in progress. They should be completed by January 1999 or before. Some participants plan to initiate and complete reports during the next 6 months.

1. Species Prioritization

As a limited number of carp species are cultured in Indonesia, Thailand and Vietnam, the choice of species among fish farmers is obvious. Thus, simple qualitative species prioritization analysis is being undertaken in these countries. While in Bangladesh, China and India, various carp species are being cultured. Hence, detailed quantitative analysis for carp species prioritization research is being initiated in these countries. A questionnaire used in Bangladesh for this purpose is shown in Appendix 4. Below is the progress of carp species prioritization research in Bangladesh, China and India.

Bangladesh

Formulation of a questionnaire for the prioritization of carp species in Bangladesh was completed after a thorough pre-testing. Data are being collected from about 30 fisheries scientists working on aquaculture genetic research and 10 senior fisheries extensionists. In addition, secondary information are being collected to supplement the results of the survey. Draft report of this exercise is expected to be available towards the end of August 1998.

China

The species prioritization exercise began in November 1997. Published and unpublished data/information were collected mainly during the first two months. The research team was also organized during this period. The methodology and criteria to be used in the study were discussed. Documentation and data analysis were carried out in early months of 1998.

A draft report of the documentation of species prioritization for carp genetic improvement in China was completed at the end of May. The report is currently being revised. Common carp was identified as the priority species for carp genetic improvement in China. In addition to species prioritization, questionnaires are being developed for trait and culture systems prioritization.

India

Secondary data are being collected. Survey of scientists working on carps will be initiated soon. Report on species prioritization exercise will be completed by the end of 1998.

2. Socioeconomic Survey of Fish Farmers

All countries participating in the Project are conducting a socioeconomic survey of fish farmers. A questionnaire used in Vietnam for this survey is presented in Appendix 5, as sample questionnaire. The following is the progress of this activity in each participating country:

Bangladesh

The sites to be covered in this survey are shown in Table 1. A pilot survey was conducted to obtain the list of fish producers from the pre-selected thanas in the four districts and divisions of Bangladesh. The thanas were stratified into developed and less developed in each stratum, there were four pre-selected thanas, each with a total of 60 pre-determined samples. Fish producers were further stratified into poor, medium and rich groups. An equal number of samples or 20 for each group will be randomly drawn from the list of fish producers in each thana. A total of 480 samples will be covered in this survey. The survey will be completed by end of June 1998, and data entry and analysis by end of September 1998.

Table 1. Sites and number of respondents for the socioeconomic survey, Bangladesh

Division	District	Developed		Less Developed	
		Thana	No. of respondents[1]	Thana	No. of respondents[1]
Dhaka	Mymensingh	Trishal	60	Ishawarganj	60
Chittagong	Comilla	Chandina	60	Burichong	60
Khulna	Jessore	Jhikargacha	60	Bagharpara	60
Rajshahi	Bogra	Sadar	60	Sariakandi	60
Total			240		240

[1]Respondents are further stratified into poor, medium and rich groups with 20 respondents for each stratum.

China

After thorough discussion on the objectives and methodology of the survey, a preliminary draft questionnaire was designed in April 1998 and finalized in May 1998. The survey will cover six provinces representing different types and level of carp culture in China. Social and economic factors will be considered in the selection. For each province, 6 to 10 counties will be covered in the survey. The total sample size will be about 400 to 500. One coordinator will manage the survey in each province. One enumerator will be assigned to carry out the survey in each county. This will ensure the quality of the survey. The survey is expected to commence in July 1998 and will be completed by early next year. A short training on survey instruments and approaches will be given to those who will be involved in the survey.

India

The sampling plan for the socioeconomic survey of fish producers was prepared based on the secondary statistics related to aquaculture development in different states of the country such as production, productivity, resources and consumption levels. Six states, namely: Andhra Pradesh, Punjab combining Haryana (due to similarity in production, productivity and consumption levels), West Bengal, Orissa, Uttar Pradesh and Karnataka were purposively selected to draw representative samples of 672 fish farmers for this survey.

Indonesia

To better understand the socioeconomic environment affecting carp farming, the Project hosted a seminar on status of common carp culture in Indonesia in Bogor on 23 February. This provided the venue for the Project to focus its activities and strengthen collaboration of scientists/geneticists of Indonesian Network for Fish Genetic Research and Development (INFIGRAD) and fishery socioeconomists of Indonesian Fisheries Socio-Economic Research Network (IFSERN) working on carp.

Formulation of questionnaires and collection of selected secondary data were completed. List of sample farmers representing each type of carp farming system in selected locations was finalized. Pre-survey of respondents was undertaken. The purpose was to verify the sampling frame and to check validity of the questionnaire. Based on this exercise, the questionnaire was revised as to meet objectives of the study. Current list of respondents was updated. The survey will cover Sukabumi, Cianjur, Bandung and Subang districts in which representative respondents will be covered by the survey.

Thailand

A preliminary survey questionnaire was pre-tested from 1 to 3 April 1998 and was consequently improved. Secondary data of carp production indicates that carp culture has spread through out the country. Two carp species are popular in Thailand: Thai silver barb and common carp.

The selection of sites to be covered by the survey was based on areas that have a high concentration of carp culture. Provinces selected and the corresponding number of respondents are in Table 2. The socioeconomic survey of fish farmers is expected to be completed by the end of October 1998.

Table 2. Sites and number of respondents for the socioeconomic survey, Thailand.

Province	No. of respondents
Northern	
Chiang Mai	40
Phetchabun	40
North - Eastern	
Khon Kaen	40
Nakhon Ratchasima	40
Central Plain	
Pathum Thani	40
Eastern	
Chachoengsao	40
Western	
Suphan Buri	40
Total	280

Vietnam

In the North, RIA No. 1 is undertaking the socioeconomic survey in collaboration with the Vietnam Agricultural Science Institute (VASI). A working team has been organized consisting of three socioeconomists/statisticians from VASI and three socioeconomists/biologists from RIA No. 1. The survey will cover four provinces, namely: Hanoi, Hai Dung, Vinh Phuc and Thai Nguyen, representing various agroecosystem as shown in Table 3. A total of 160 fish producers will be covered in this survey. The team started collecting data, which will be completed by the end of July 1998.

Table 3. Sites and number of sample respondents for the fish producer surveys, North Vietnam

Province	Agroecosystems	No. of respondents
Hanoi	Urban area	40
Hai Dung	Red river delta	40
Vinh Phuc	Midland area	40
Thai Nguyen	Highland area	40
Total		160

In the South, RIA No. 2 is implementing the socioeconomic survey. The survey covers five inland provinces of Mekong Delta (Tien Giang, Dong Thap, Vinh Long, Can Tho, and An Giang), as shown in Table 4. A total of 240 fish producers representing various production systems will be covered in this survey. The survey is expected to be completed by the end of July 1998.

Table 4. Sites and number of sample respondents for the fish producer surveys, South Vietnam.

Province/district	Production system	No. of respondents
An Giang		
Long Xuyen	Rice-fish/cage	24
Chau Phu	Cage	24
Can Tho		
Thot Not	Pond/rice-fish	24
Chau Thanh	Pond/rice-fish	24
Vinh Long		
Binh Minh	Pond	24
Long Ho	Pond	24
Dong Thap		
Cao Lanh	Pond	24
Thap Muoi	Pond/rice-fish	24
Tien Giang		
Cai Be	Pond	24
Go Cong Dong	Pond	24
Total		240

3. Consumer Survey

As in the socioeconomic survey, all countries participating in the Project are conducting a consumer survey. For this survey, a questionnaire used in Vietnam is presented in Appendix 6, as sample questionnaire. Below is the progress of this activity in each participating country:

Bangladesh

The sites covered for the socioeconomic survey will also be covered by the consumer survey as shown in Table 5. Sample consumers will be first classified into producer-consumer, rural consumer and urban consumer in each thana. Each consumer group will then be classified into three sub-groups, poor, medium and rich. For each of the sub-group, 10 sample respondents will be selected randomly. Total sample for each thana will be 90 and for each district will be 180. A total of 720 sample consumers will be interviewed for this survey. Year round survey from June 1998 to May 1999 will be conducted on a quarterly basis. The first round of the survey will be completed by the end of July 1998.

Table 5. Sites and number of respondents for the socioeconomic survey, Bangladesh.

Division	District	Developed		Less Developed	
		Thana	No. of respondents[1]	Thana	No. of respondents[1]
Dhaka	Mymensingh	Trishal	90	Ishawarganj	90
Chittagong	Comilla	Chandina	90	Burichong	90
Khulna	Jessore	Jhikargacha	90	Bagharpara	90
Rajshahi	Bogra	Sadar	90	Sariakandi	90
Total			360		360

[1]Respondents are further stratified into producer-consumer, rural consumer, and urban consumer and into poor, medium and rich groups with 10 respondents for each stratum.

China

A draft questionnaire was designed and formulated in April 1998. The questionnaire was submitted to ICLARM for review and was finalized in May 1998. The consumer survey will be undertaken by college students, team members and survey staff. The consumer survey will not be limited to six provinces as in the producer survey, but will cover as broad area in China as possible. The consumer survey will begin in July 1998.

India

The sampling plan for the consumer survey is similar to that of socioeconomic survey. Based on the secondary statistics related to aquaculture development in the different states of the country such as production, productivity, resources and consumption levels, six states, namely: Andhra Pradesh, Punjab combining Haryana (due to similarity in production, productivity and consumption levels), West Bengal, Orissa, Uttar Pradesh and Karnataka were purposively selected to draw at random 5,040 sample consumers for this survey.

Indonesia

As in the socioeconomic survey, similar activities were undertaken in the consumer survey. Formulation and pre-testing of questionnaire was completed. Sampling frame was generated and verified. A consumer survey will be conducted in Bandung, Cianjur and Jakarta. Major consumers of carp species produced from West Java are found in these areas. Sample respondents will be randomly drawn from these areas.

Thailand

As in a socioeconomic survey, a preliminary survey questionnaire was pre-tested from 1 to 3 April 1998 and was subsequently improved. In addition to the sites covered in the socioeconomic survey, Bangkok was included to represent the urban sector as well as non-fish producers (Table 6). The consumer survey is expected to be completed by the end of August 1999.

Table 6. Sites and number of respondents for the consumer survey, Thailand.

Province	No. of respondents
Northern	
Chiang Mai	44
Phetchabun	44
North - Eastern	
Khon Kaen	44
Nakhon Ratchasima	44
Central Plain	
Pathum Thani	44
Eastern	
Chachoengsao	44
Western	
Suphah Buri	44
Urban	
Bangkok	120
Total	428

Vietnam

The same sites as for the socioeconomic survey in the North and South Vietnam are covered in the consumer survey. In the North, consumers are stratified into urban and rural areas (Table 7). Consumers in the rural areas are further stratified into fish producers and non-producers. A total of 180 sample respondents will be interviewed in this survey. The first round of the survey will commence in July 1998.

Table 7. Sites and number of respondents for the consumer survey, North Vietnam.

Province	Urban	Rural		Total
		Fish producer	Non-producer	
Hanoi	15	15	15	45
Hai Dung	15	15	15	45
Vinh Phuc	15	15	15	45
Thai Nguyen	15	15	15	45
Total	60	60	60	180

In the South, a similar approach will be used in stratifying consumers. Instead of non-producers, samples will be obtained from semi-urban areas who are also non-producers (Table 8). A total of 320 sample respondents will be interviewed in this survey. The first round of survey will commence in July 1998.

Table 8. Sites and number of respondents for the consumer survey, South Vietnam.

Province/district	Rural producer	Semi-urban (non-producer)	Urban	Total
An Giang				
Long Xuyen	12	12		24
Chau Phu	12	12		24
Can Tho				
Thot Not	12	12		24
Chau Thanh	12	12		24
Vinh Long				
Binh Minh	12	12		24
Long Ho	12	12		24
Dong Thap				
Cao Lanh	12	12		24
Thap Muoi	12	12		24
Tien Giang				
Cai Be	12	12		24
Go Cong Dong	12	12		24
Ho Chi Minh City			80	80
Total	120	120	80	320

4. Carp Hatchery Survey

Except China, collaborating research institutes or agencies of the participating countries in the Project will undertake a hatchery survey or will utilize existing surveys. In China, carp farmers are mainly dependent on government (state owned) and collective (rather large ins scale) hatcheries for their seed requirements. In other participating countries, carp farmers are obtaining their seed either from the government or private hatcheries. Even in Vietnam, their is now emergence of commune-based and private carp hatcheries operating independently from the government.

Research collaborators in India and Thailand will conduct the hatchery survey within this year. In Bangladesh and Vietnam, a hatchery survey will be done on a limited basis (few samples). The timing of the survey in these countries will depend on the progress of their other surveys. In Indonesia, existing surveys on carp hatcheries will be utilized rather than conducting a new survey.

A preliminary survey questionnaire was pre-tested from 1 to 3 April 1998 specifically for Thailand. The sites to be covered in this survey are shown in Table 9. Together with the socioeconomic data, this survey will provide better understanding of the carp industry in Thailand. The hatchery survey is expected to be completed by the end of October 1998. The questionnaire to be used in Thailand is presented in Appendix 7, as a sample questionnaire for this survey.

Table 9. Sites and number of respondents for the hatchery survey, Thailand.

Province	No. of respondents
Northern	
Chiang Mai	5
Phetchabun	5
North - Eastern	
Khon Kaen	5
Nakhon Ratchasima	5
Central Plain	
Pathum Thani	5
Eastern	
Chachoengsao	5
Western	
Suphah Buri	5
Total	35

IV. Carp Genetics Research

ICLARM scientists visited collaborating scientists in all 6 participating countries and formulated detailed research plans. Successful spawning and initiation of genetic improvement experiments were accomplished for silver barb in Bangladesh, Thailand and Vietnam, for common carp in China, Thailand, Indonesia and Vietnam, for blunt snout bream in China and for rohu in India.

All experiments are underway. These experiments will continue. The fish will be periodically sampled during the next 6 months.

Bangladesh

Genetic improvement research has been initiated for two carp species, silver barb (*Puntius gonionotus*) and catla (*Catla catla*). The progress and future plans are summarized below.

Development of a Base Population of Silver Barb

Two wild stocks of silver barb were obtained through ICLARM from Thailand and Indonesia in 1994 and are being maintained. These two unrelated stocks and an existing local stock were mated under normal breeding conditions to produce a F_1 generation. The representative F_1 breeders (Thai, Indonesian and Bangla) were crossed (diallele 3 x 3 pattern) to produce nine genetic groups (Table 10).

Table 10. Mating design for production of the base population of the Silver barb, *Puntius gonionotus* through 3 x 3 diallele crossing, Bangladesh.

Female	Male		
	Thai stock	Indonesian stock	Bangla stock
Thai stock	X	X	X
Indonesian stock	X	X	X
Bangla stock	X	X	X

Growth Performance Evaluation of Diallele Crosses of Silver barb

The three purebred strains and six crossbred groups from diallele crosses were stocked communally using AVID tags at the advanced fingerling stage (with equal number of fish from each of the genetic groups) in the same pond. A total of six ponds were selected on the basis of productivity, depth and other physical features and divided into "good", "medium" and "poor" ponds. Each of the test environments had two replicated ponds. The same stocking density was observed in all test environments and fish were fed twice daily with a standard formulated feed at 2 to 4 percent of their biomass per day. Sampling of fish weight was performed at monthly intervals to adjust feeding rate and to monitor growth performance. Evaluation of the performance of individual genetic groups was done until their maturity and harvesting. Results of this experiment are in Table 11.

Table 11. Performance of 9 genotypes of silver barb, *Puntius gonionotus*.

SI No.	Group Name	Initial Size (Mean weight g)		Final Size (Mean weight g)		Sex Ratio Female : Male	Growth Rate (%)	
		Female	Male	Female	Male		Female	Male
1	BxB	33.99 ±6.37	28.73 ± 7.27	258.13 ± 49.83	138.13 ± 24.06	16 : 23	659.43	381.24
2	TxT	26.73 ±3.66	26.87 ±4.85	253.00 ± 56.18	128.41 ± 27.40	20 : 27	846.50	377.89
3	IxI	37.02 ± 5.24	35.91 ± 6.00	212.33 ± 31.84	133.81 ± 26.97	15.21	473.55	272.63
4	BxT	33.37 ± 6.39	31.99 ± 5.59	238.21 ± 44.88	125.68 ± 24.02	14 : 22	613.84	292.87
5	TxB	18.21 ± 3.69	16.85 ± 5.89	246.88 ± 39.41	130.68 ± 25.51	16 : 22	1255.7	675.55
6	TxI	25.151 6.20	23.19 ± 6.06	248.85 ± 46.55	138.70 ±17.34	26 : 23	889.46	498.10
7	IxT	23.76 ± 4.88	24.11 ± 4.72	224.00 ± 37.40	128.61 ± 29.36	21 : 28	842.76	433.43
8	BxI	30.41 ± 3.87	29.06 ± 3.31	264.74 ± 40.81	134.78 ±19.04	20 : 22	770.57	363.80
9	IxB	30.40 ±5.40	27.63 ± 6.24	262.00 ± 53.03	122.52 ± 18.76	10: ± 31	761.84	343.43

Development of Outbred Broodstock of Silver Barb

For each of the reciprocal crosses, 5 to 8 pairs with female to male ratio of 1:1 were mated separately and best 3 progeny (larvae) groups were selected to make 18 full-sib families (Figure 1). The fertilized eggs were incubated in a series of funnel jars and hatchlings were kept in hapas until feeding stage. Subsequently, the fish were transferred to communal grow-out ponds at a stocking density of 0.75 to 1.0 fish/m^2. Throughout the rearing period, the fish were given protein rich supplementary feed. At the age of 10 months, a large number of breeders were made available for individual (mass) selection.

Growth Performance of Crossbred Purebred (Bangla) Silver Barb

An eight month experiment was initiated in September 1997 to May 1998 at the Freshwater Station, FRI, Mymensingh. The ponds were prepared by draining and liming with CaO at the rate of 250 kg/ha. Three days after liming, ponds were filled with ground water and fertilized with cattle manure at the rate of 1,000 kg/ha. About three to four days after fertilization, the ponds were stocked with communal F_2 crossbreds and existing purebred (Bangla) *Puntius gonionotus* at the rate of 3 fish/m^3 in 4 chambers with replicates of bamboo partitioned ponds. The stocked fish were regularly fed with a mixture of rice bran (30 percent), wheat bran (30 percent), mustard oil cake (25 percent) and fish meal (15 percent) at the rate of 3 percent body weight. All the chambers were regularly fertilized with cattle manure (1,000 kg/ha). All the chambers were sampled at monthly intervals to assess the growth performance and adjust feed ration.

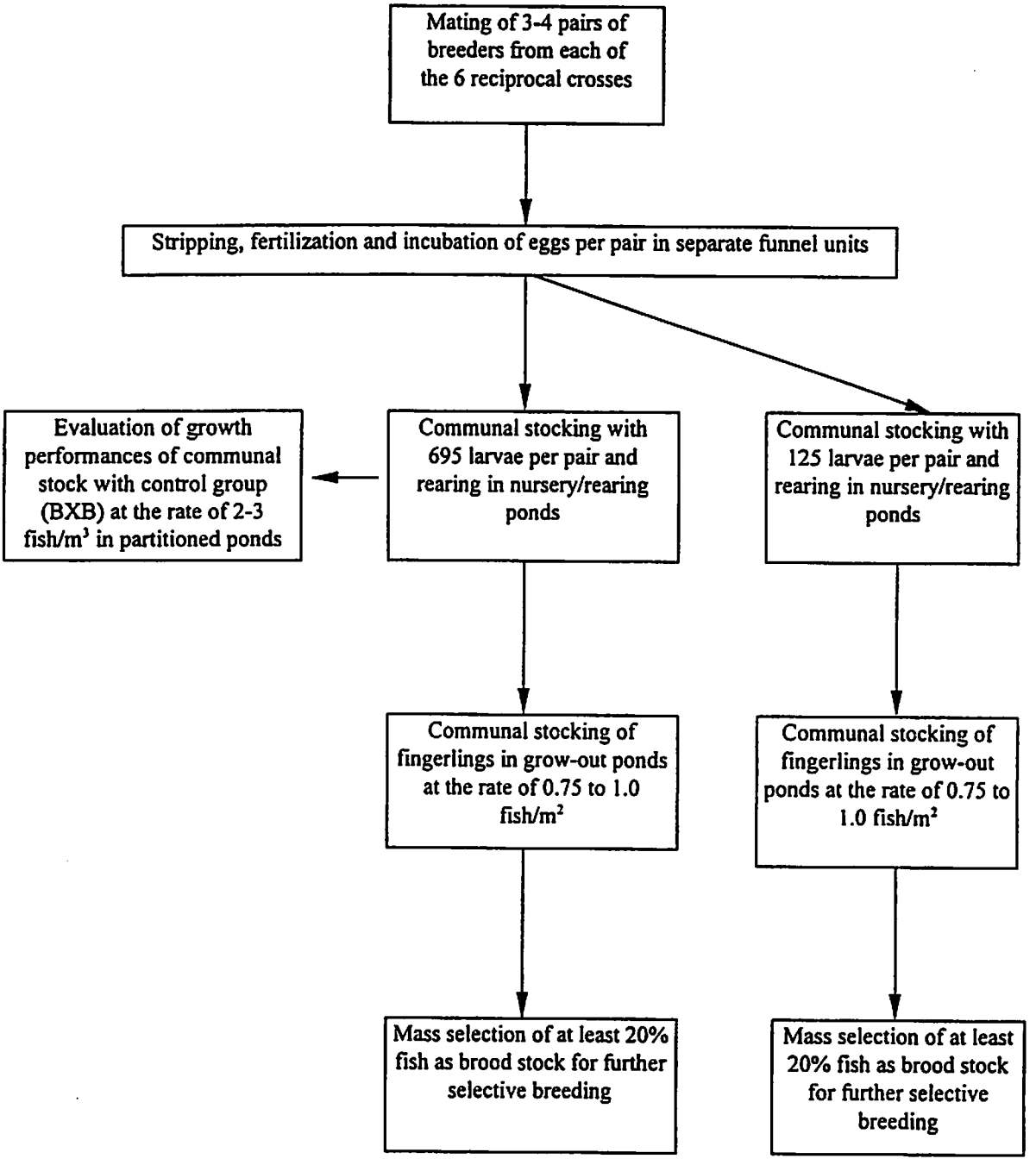

Figure 1. Design for mating and production of F_2 brood stock from F_1 base population derived from reciprocal cross of *P. gonionotus*, evaluation, communal rearing and mass selection of the progeny groups.

At harvest, the maximum and minimum average weight gain of crossbred hybrid groups were 77.26 g and 49.21 g respectively. Whereas the maximum and minimum weight gain attained by control group were 61.47 g and 56.13 g respectively (Table 12). The data of monthly mean weight showed no significances (P>0.05) between crossbred groups and control groups, Physico-chemical parameters such as temperature, DO and pH of water were monitored and recorded at weekly intervals (Table 13).

Table 12. Comparison of performance between the F_2 crossbred group and existing purebred (Bangla) silver barb (*Puntius gonionotus*).

Month	Average weight (g)			
	Communal F2 crossbred		Control group	
	Group 1	Group 2	Group 1	Group 2
Initial	3.86 ± 1.04	3.86 ± 1.04	3.49 ± 0.88	3.49 ± 0.88
October	17.41 ± 3.70	16.58 ± 4.09	20.01 ± 3.938	13.43 ± 4.01
November	25.17 ± 6.40	21.53 ± 4.14	24.02 ± 4.77	17.68 ± 3.33
December	32.50 ± 17.89	23.79 ± 7.60	28.48 ± 5.11	21.92 ± 8.51
January	40.97 ± 10.13	33.42 ± 9.60	36.18 ± 11.00	32.07.9.24
February	43.56 ± 10.06	36.11 ± 8.89	40.23 ± 9.75	35.58 ± 11.22
March	46.25 ± 14.57	39.76 ± 12.10	42.56 ± 13.45	39.37 ± 12.18
April	55.24 ± 12.47	45.40 ± 11.62	45.60 ± 14.49	48.80 ± 11.71
May	77.26 ± 29.49	49.21 ± 13.56	61.47 ± 14.05	56.13 ± 13.96

Table 13. Physico-chemical parameters of pond water.

Parameters	Average value
Water temperature (°C)	21.53
Transparency (cm)	23.77
pH	7.65
DO (mg/l)	3.38

Mass Selection of Silver Barb

During the month of April 1998 (at the age of 10 months) when all the communally stocked fish were mature, 20 percent of largest females and 20 percent of largest males were selected and kept separately in earthen ponds until they were used for induced breeding. Selection was based on size, health and shiny color. Table 14 shows the weight range and the total number of available fish from which 20 percent best breeders were selected from several sub-populations. A total of 195 female and 212 male breeders were mass selected. The average weight of the best females was between 84.0 to 152.4 g. The average weight of the best males was ranged between 68.0 to 107.8 g.

Table 14. Sex wise total number of fish, average weight and weight range of mass selected breeders of *Puntius gonionotus*.

SI No.	Population/ Group	Parameters	Sub-population	Selected Individuals	Total Selected Breeder
01	695 larvae taken from each pair	Female: Total number of fish Average weight (g) Weight range (g) Male: Total number of fish Average weight (g) Weight range (g)	 317 78.96 ± 30.44 35.0 - 209.0 387 68.32 ± 14.03 40.00 - 111.0	 66 124.00 ± 36.99 91.0 - 209.0 80 85.45 ± 9.28 80.0 - 111.0	Female : 193 Male : 212
02	695 larvae taken from each pair	Female : Total number of fish Average weight (g) Weight range (g) Male: Total number of fish Average weight (g) Weight range (g)	 370 68.0 48.0 - 118.0 300 57.0 31.0 - 89.0	 70 84.0 78.0 - 118.0 58 68.0 62.0 - 89.0	
03	125 larvae taken from each pair	Female : Total number of fish Average weight (g) Weight range (g) Male : Total number of fish Average weight (g) Weight range (g)	 131 68.54 ± 17.09 44.0 - 138.0 161 70.15 ± 13.78 46.1 - 118.2	 28 91.25 ± 16.34 80.0 -138.0 36 78.13 ± 23.71 81.0 - 118.2	
04	125 larvae taken from each pair	Female : Total number of fish Average weight (g) Weight range (g) Male : Total number of fish Average weight (g) Weight range (g)	 68 85.48 ± 16.24 53.0 - 134.0 111 72.40 ± 13.96 37.0 - 100.0	 16 106.50 ± 13.08 96.0 - 134.0 23 90.08 ± 4.68 85.0 - 100.00	
05	125 larvae taken from each pair	Female : Total number of fish Average weight (g) Weight average (g) Male : Total number of fish Average weight (g) Weight range (g)	 56 118.26 ± 24.70 76.0 - 177.0 61 89.06 ± 18.85 48.0 - 120.0	 13 152.38 ± 13.62 138.0 - 177.0 15 107.8 ± 8.53 97.0 - 20.0	

Production of the Next Generation of Silver Barb

The production of next generation will be followed separately by pool breeding of at least 150 pairs of mass selected breeders and 50 pairs of non-selected breeders (Bangla). Induced breeding activities will be performed during the mid June to early July 1998. The overall program for the production and evaluation of next generation (F_3) of *Puntious gonionotus* is shown in Figure 2.

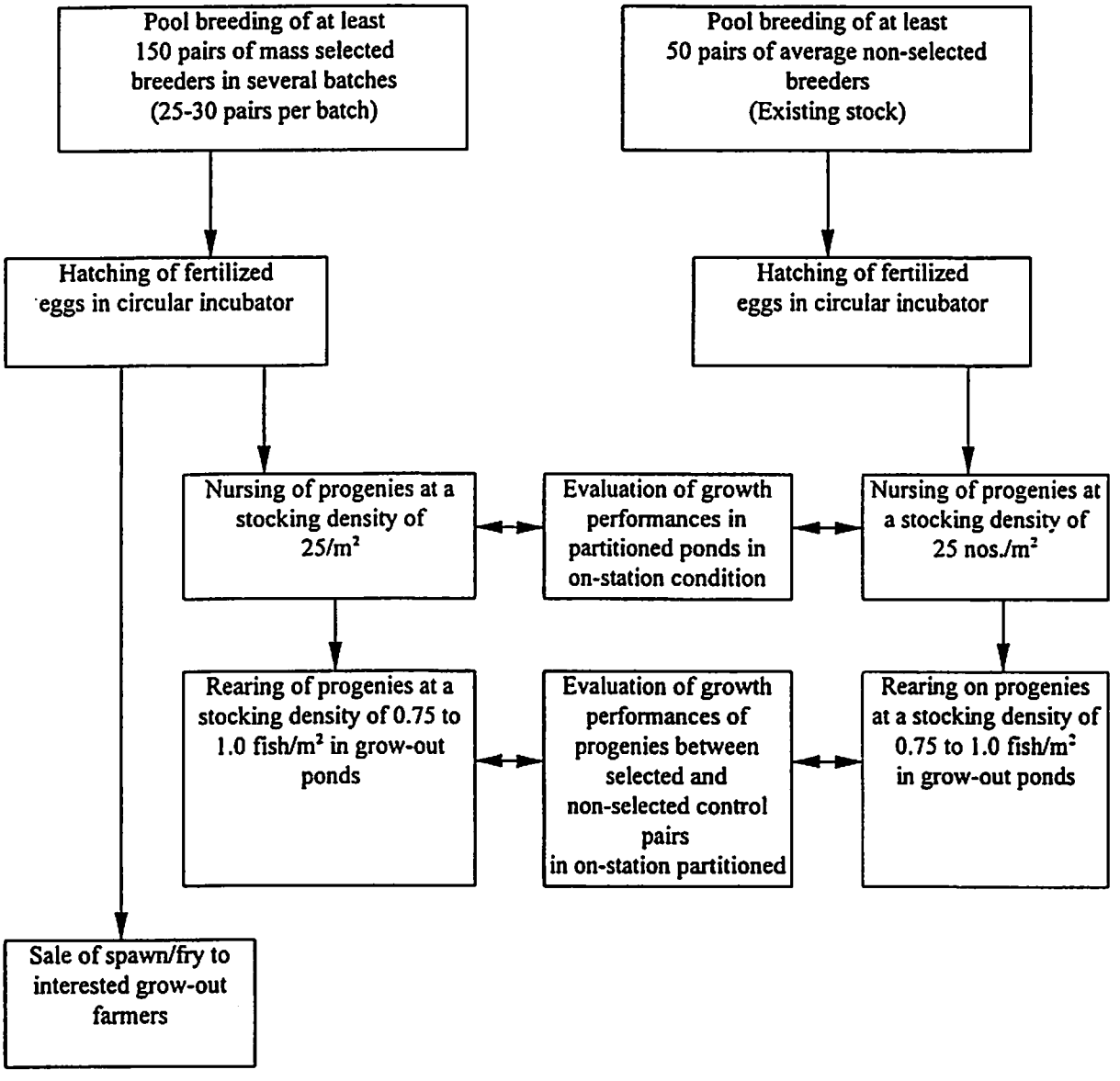

Figure 2. Design for mating of selected brood stock and production of F_3 generation. Evaluation of growth performance of improved stocks with control groups under on-station and on-farm condition and distribution of improved brood stock.

Future plans

- Genetic characterization of 3 different land races of catla, *Catla catla*;
- Evaluation of growth performances of F3 progenies derived from selected and non selected control silver barb breeders under on-station and on-farm conditions;
- Sale and distribution of putative improved stock of silver barb among interested grow-out farmers;
- Evaluation of growth performance of F4 putative improved stock of silver barb under on station and different on-farm conditioned;
- Initiation of selective breeding program for genetic improvement of catla.

China

Freshwater Fisheries Research Center (FFRC)

The experiments for carp genetic improvement at FFRC will focus on the following four areas: 1) Jian carp (*Cyprinus carpio*) selection; 2) carp hybridization trial; 3) carp growth trial; and 4) polyploidy evaluation.

Broodstock Collection and Trial Preparation

The collection of brood stock of six common carp genotypes for selection was completed in October 1997. The following genotypes were collected: a) Hebao red carp (He) *Cyprinus carpio* var. *wuyuanensis*wu, from the broodstock farm of Hebao red carp, Wuyuan county, Jiangxi province; b) Xinguo red carp (Xi) *C. carpio* var. *singuonensis*si, from the broodstock farm of Xinguo red carp, Xinguo county, Jiangxi province; c) Jian carp (Ji) *C. carpio* var. *jian*ji, from Freshwater Fisheries Research Center; d) Scattered mirror carp and Ying carp, from Changjiang Fisheries Research Institute; and e) Huanghe carp, from the superior breed farm of Huanghe carp, Zhenzhou city, Henan province. Hebao red carp, Jian carp and Huanghe carp were identified priority genotypes for research.

Before spawning, the female and male parent fish of three carp lines, Jian carp, Hebao and Huanghe were reared separately. Commercial feed and soybean cake were used as feeds in rearing the parent fish at the rate of 3 to 5 percent body weight per day.

Jian Carp Selection

The components for the selection index of Jian carp include growth, body shape and color. The varieties for evaluation include selected Jian carp, unselected Jian carp and one of its parents, Hebao red carp. About 50 female and 50 male fish were selected from more than 1000 parent fish for the select group and another 50 pairs were randomly chosen as the unselected control. On April 15th, as the water temperature reached 18°C, artificial spawning was induced. Females were injected with 500 IU/kg of HCG and 20ug/kg of LRH-A. Males were injected with 250 IU/kg of HCG and 10 ug/kg of LRH-A intraperitoneally. Parent fish and nests were then placed in spawning ponds. After

fertilized eggs stuck to the palm fibers, palms were moved to fry-rearing ponds. The fry hatched after 4 days on April 20 at a water temperature of 18 to 20 °C. The fish were fed twice a day with soybean milk at 6.0 g/m^2 (dry soybean). Fry were stocked at the density of about 300 fish/m^2 for rearing.

Carp Crossbreeding

Six carp crosses were produced: Jian carp × Huanghe, Jian carp × Hebao red carp, Jian carp selected and unselected, Hebao and Huanghe. The fry are being reared separately in six ponds and are ready for growth trials. On April 15th, the same day as Jian carp spawning, the mature parent fish, the male and female fish which had been reared separately in cages were injected with hormone and were placed in different ponds. When the brood fish were ready to ovulate at 15 hours and began to spawn, they were immediately captured and artificial fertilization was used to make the crosses. First, semen was stripped into a clean basin. Then eggs were stripped. The mixture was stirred gently with a feather for 2 to 3 minutes then the fertilized eggs adhered to on palm nests. Hatching and fry rearing were the same as above.

Growth Trials

After 40 days of fry rearing, the fry that reached 3 to 5 cm, were collected for growth trials, which begin May 28. Six experimental groups will be tested under monoculture and polyculture systems. Each group will have 3 replicates for a total of 18 monoculture ponds and eighteen polyculture ponds. The carp fry were stocked at a density of 150 fish/m2 in monoculture ponds and 0.15 fish/m2 in polyculture ponds together with other fish species.

Polyploid Experiment

Hydrostatic pressure apparatus was used to induce triploidy and tetraploidy, hybrid goldfish-common carp. Resulting fish will be evaluated for rapid growth, meat quality and sterility.

Shanghai Fisheries University

Selection of Blunt Snout Bream (*Megalobrama amblycephala*) for Growth Rate

Introduction

Blunt snout bream is one of the important cultured species in China. Its production reached 434,896 tons in 1997. The culture of blunt snout bream began in the 1960s. The degeneration of commercial stocks characterized by reduction in growth rate, earlier maturity and reduction in body thickness has occurred at many hatcheries and farms.

Selection of blunt snout bream for growth rate was initiated in 1986. The foundation population of bream was transplanted twice from a wild population in Yuli Lake, Hubei Province in 1985 and 1986, respectively (Table 15). Two selective lines were initiated from the two collections and one control line was established. Mass selection for growth rate and deep body shape was initiated. The F4 of line 1 and line 2 produced in 1994 and 1995, respectively had 19 percent increased growth rate compared to the control line, the ratio of body depth/standard length was 0.44, similar to the wild fish.

The study of the mechanism of degeneration of culture performance of blunt snout bream has proven that improper management and breeding method results in decreasing growth rate. For example, the growth rate of blunt snout bream, which was inbred for two consecutive generations, was 16 percent lower than the control group, the heterozygosity estimated from isoenzyme eletropholesis also decreased.

The F5 of line 1 and line 2 were produced in 1996 and 1997, respectively. The normal maturation age of female bream is 3 years. To shorten the generation interval and to speed the selection program, the fish have been cultured in better environment, raised at less density, fed more green food (duck weeds, black wheat etc.) since the F3 generation. Fish can reach maturity at 2 years (24 to 25 months).

Table 15. History of the bream experimental fish.

Year	Line 1	Line 2	Control 1	Control 2
1985	Foundation population		Foundation population	
1986	F1	Foundation population		
1987		F1		
1988				
1989	F2			
1990		F2		
1991				
1992	F3			
1993		F3		
1994	F4			
1995		F4		
1996	F5			
1997		F5		Foundation population
1998	F6			

Progress as of June 1998

On station study

- F6 of Line 1 has been produced by mass spawning from 18 females and 25 males.
- Inbreeding (fullsib, one female and one male) for G3 has been produced.
- Control group (randomized propagation and screening) produced. The foundation fish were from the Yuni Lake, Hubeing Province in 1985 (Control Group 1).
- Twenty wild brooder fish (8 female and 12 male, average weight 1kg) from Liangzhi Lake have been introduced in December 1997, and fry produced in May, 1998. These fish will be used as 1) another control (group 2); and 2) new gene resource for further selection after F6.
- A communal stocking and comparison study will be started in July in nursing tanks for the F6 line, control 1, control 2 and inbred line G3 to evaluate growth performance.
- The genetic gain of F5 of line 2, at age two, is ongoing in grow-out ponds (1300 m^2) in the communal stocking environment.
- Selection procedure : The following selection intensity will be used during the different growth stages:

From fry to summering(about 3 cm)	5 percent
From summering to fingering(about 10 cm)	10 percent
From fingering to brooder(>500 g)	6 percent
Select parents for next generation	

On Farm study

To evaluate the results from the on-station study, and to maximize the benefit from the breeding program, the genetically improved fish will be evaluated on fish farms. Two farms will collaborate.

(1) Gehu Lake Fish Seed Farm

Gehu Lake is a middle-sized lake in the lower stream of the Yangtze River, with surface area of 4,000 ha. The total aquaculture production of Gehu Lake reached 15,000 tons, in which bream consisted of 80% of the volume, and 90% of the value. The surrounding area of the Gehu Lake is the most advanced aquaculture area in China - Taihu area, with 1,210,000 tons of production annually. Bream ranks after silver carp, bighead carp, grass carp and crucian carp in production.

Two-hundred brooders with an average weight 600 g are transferred to the Gehu Fish Seed Farm in January 1998. Sixty females spawned and 4,000,000 fry were produced in May.

(2) Wanxin Fish Seed Farm

This farm is the largest hatchery in Shanghai area with fry production of 1,000,000,000 individuals in which bream is about 30,000,000 individuals.

Since 1994, the brood stock of bream in Wanxin Farm has been gradually changed to the selected bream. About 500 fish (500 g in body weight) per year were transferred to Wanxin farm. Total number of selected breeders is over 2,000 fish.

Wanxin Farm's fry have mostly been transported to the Beijing area in northern China. A survey is planned to see the influence of our genetically improved fish in Northern China.

Educational efforts will be initiated to ensure that collaborating farms are informed and educated with regards to maintenance and use of the genetically improved brood stock. Education will also be provided to surrounding farmers to understand the use of top quality seed from above collaborating farms.

India

Utilization of DNA fingerprinting on rohu breeding programme:

Blood samples were collected from six founder stocks of 1994 year class namely Rivers Ganga, Gomati, Yamuna, Sutlej, Brahmaputra and farm (local) stocks, two selected groups and two central groups from the ongoing Indo-Norwegian project on "Selective breeding of rohu for growth. PMA was processed following the standard protocol, i.e. SDS/Proteinase K lysis followed by phenol-chloroform extraction. Quality and quantity checking of the isolated DNA have been carried out by spectrophotometric readings and agarose (0.8 percent) gel electrophoresis. Procurement of imported chemical/equipments and recruitment of staffs are in the process. Further studies will be continued soon after the arrival of chemicals/equipments.

Indonesia

Formation of a synthetic population base of common carp strains of Rajadanu (RD), Wildan Cianjur (WC), Sutisna Kuningan (SUK) and Majalaya (MM) has been initiated. This will involve complete diallele crossing (4 x 4 cross) with pooling of gametes from 5-7 pairs of each strain. The experiment will be conducted at Cijeruk. Hatchery (ponds), Lido (floating net cages) and Sukamandi (experimental ponds).

The following activities have been undertaken: 1) gonadal maturation of all strains of test fish; 2) provision of 96 hapas (1 mm mesh size) of 2 x 1 x 1 m each, consisting of 48 cages for ponds in Sukamandi and 48 hapas for ponds in Cijeruk; 3) provision of 96 cages (5 mm mesh size) of 2 x 2 x 1 m each, consisting of 48 cages for

ponds in Sukamandi and 48 hapas for ponds in Cijeruk; 4) construction of 48 bamboo frames for the hapas or net cages; 5) rehabilitation of ponds: repairs of water channels, leaks and deepening of pond bottom; 6) pond fertilization using chicken manure, urea and TSP; 7) installation of paddle wheel equipment; 8) provision of 2 sets of blower and air installation for increasing dissolved oxygen content in Sukamandi and Cijeruk ponds; and 9) mass culture of natural fish food (Daphnia spp.) in concrete tanks and ponds.

Thailand

The project will focus on genetic improvement for growth of 2 carp species; silver barb (*Puntius gonionotus*) and common carp (*Cyprinus carpio*).

Experimental plans:

1) Silver barb

- develop Chao Phraya River and Maeklong River neomale silver barb stocks via diploid gynogenesis and sex control,
- develop selected silver barb stocks via selective breeding,
- monitor and evaluate on-station trials of monosex female silver barb culture at NAGRI regional centers,
- monitor and evaluate on-farm trials of monosex female silver barb culture in N and NE provinces,
- distribute neomales and selected silver barb stocks to NAGRI regional centers for multiplication and dissemination,
- disseminate neomales and selected silver barb stocks to public and private hatcheries for commercial monosex production and culture.

2) Common carp

- monitor and evaluate on-station trials of selected Vietnamese common carp and local stocks at Pitsanulok regional center,
- apply selective breeding to produce F_1 offspring from the selected Vietnamese common carp stock, monitor and evaluate on-station trials of these F_1 and the control to determine the response to selection value,
- produce the crossbreeds and the purebreeds between the selected Vietnamese and local common carp stocks, monitor and evaluate on-station trials of the crossbreeds and the purebreeds,
- apply selective breeding to produce F_2 offspring from the F_1 stock, monitor and evaluate on-station trials of these F_2 and the control to determine the response to selection value,
- monitor and evaluate on-farm trials of selected common carp stocks in N and NE provinces,
- distribute selected common carp stocks to NAGRI regional centers for multiplication and dissemination,

- disseminate selected common carp stocks to public and private hatcheries for commercial production and culture.

Vietnam

Genetic Improvement of Common Carp

Family selection of common carp has been initiated. In 1997, nine families were used in selective breeding. Based on the survival and growth rate of their progeny reared under the same environmental condition, the best three families have been selected. The broodfish of the three select families and the progeny of each family are being maintained in controlled conditions. Mass selection will be conducted with these progeny.

In March 1998, 17 families were induced to breed on the same day. The induced breeding was successful for all families. Larvae from each family were nursed in aquaria and hapas up to fry stage. Tables 16 and 17 show the survival and growth of fry from the above nursing systems.

As shown in Table 16, survival rate of fry reared in aquarium was very low. This could be due to the following reasons: 1) swim up fry nursing in aquarium have no live food (Moina) to feed on during the first few days, resulting in high fry mortality; 2) inadequate dissolved oxygen (DO) in water during nursing; and 3) water quality and other environment factors in aquarium were not adequate. Table 17 shows that survival rate of fry reared in hapas (suspended in pond) was much higher compared to the survival of fry reared in aquarium and similar to survival of fry reared in earthen ponds. In both rearing systems, negative correlations between survival and growth were observed. Regression equations (Linear model : $Y= a+bX$) had an r^2 of 0.62 and 0.73 for fry reared in aquarium and hapas, respectively. Regression equations of the multiplicative model ($Y= aX^b$) had an r^2 of 0.87 and 0.94 respectively.

In the early development stage (from larval to fry stage), survival is the most important trait. Families No. 3 and 4 were considered the best families in both rearing system when considering both growth and survival. In the hapa system, progeny of families 1 and 8 have high survival rate comparable with families No. 3 and 4. In terms of growth, fry reared in aquarium and hapas had lower growth rate than those reared in earthen ponds.

Table 16. Survival and growth rates of fry reared in aquariums (three replicates, I, II, III, from 7 March to 14 May 1998) at RIA-1.

Family	Survival Rate (%)				Growth (g)			
	I	II	III	Mean	I	II	III	Mean
1	3.0	7.8	5.5	5.4	0.95 ± 0.34	0.47 ± 0.12	0.56 ± 0.12	0.7
2	6.0	6.5	6.8	6.4	0.49 ± 0.15	0.41 ± 0.20	0.43 ± 0.11	0.4
3	12.8	13.0	11.3	12.3	0.24 ± 0.06	0.22 ± 0.05	0.24 ± 0.04	0.2
4	12.5	9.5	8.3	10.1	0.21 ± 0.05	0.31 ± 0.08	0.36 ± 0.11	0.3
5	9.8	7.8	6.8	8.1	0.32 ± 0.09	0.33 ± 0.08	0.46 ± 0.13	0.4
6	0.8	0.8		0.8	2.02 ± 0.63	3.31 ± 3.79		2.7
7	1.8	2.3	2.8	2.3	1.32 ± 0.63	1.16 ± 0.29	0.93 ± 0.31	1.1
8	0.3	4.3	4.5	3.0	4.15 ±	0.5 ± 0.13	0.58 ± 0.13	1.7
9	1.0	0.5		0.8	1.11 ± 0.81	3.87 ± 0.41		2.5
10	9.3	3.5	6.8	6.5	0.30 ± 0.09	0.69 ± 0.24	0.37 ± 0.10	0.5
11	7.5	6.5	7.3	7.1	0.31 ± 0.09	0.44 ± 0.12	0.36 ± 0.05	0.4
12	10.8	7.5	9.8	9.3	0.23 ± 2.02	0.37 ± 2.04	0.24 ± 2.02	0.3
13	1.8	0.3	1.5	1.2	1.53 ± 0.76	11.14	1.84 ± 0.91	4.8
14	6.8	3.0	1.0	3.6	0.31 ± 0.10	0.82 ± 0.24	2.53 ± 0.80	1.2
15	5.3	9.8	6.8	7.3	0.38 ± 0.09	0.22 ± 0.04	0.29 ± 0.05	0.3
16	10.0	9.3	9.5	9.6	0.23 ± 0.06	0.24 ± 0.05	0.25 ± 0.05	0.2
17	8.8	7.3	6.0	7.3	0.30 ± 0.07	0.31 ± 0.07	0.32 ± 0.12	0.3

Table 17. Survival and growth rates of fry reared in hapas (from 7 March to 14 May 1998) at RIA-1.

Family	Survival Rate (%)				Growth (g)			
	Hapa 1	Hapa 2	Hapa 3	Mean	Hapa 1	Hapa 2	Hapa 3	Mean
1	57.7	59.3	49.1	55.4	0.57 ± 0.00	0.52 ± 0.01	0.64 ± 0.01	0.6
2	25.2	51	35.3	37.2	1.24 ± 0.12	0.70 ± 0.08	0.87 ± 0.08	0.9
3	68	67.9	64.5	66.8	0.43 ± 0.04	0.52 ± 0.07	0.61 ± 0.10	0.5
4	65.5	54.9	58.8	59.7	0.42 ± 0.05	0.48 ± 0.06	0.54 ± 0.06	0.5
5	32.7	36.1		34.4	0.82 ± 0.10	0.77 ± 0.09		0.8
6	34.1			34.1	0.88 ± 0.09			0.9
7	45.9	43.1		44.5	0.67 ± 0.07	0.66 ± 0.06		0.7
8	72.6	54	64.6	63.7	0.33 ± 0.04	0.54 ± 0.06	0.40 ± 0.04	0.4
9	23	28.2	26.8	26.0	0.96 ± 0.10	0.89 ± 0.08	0.93 ± 0.08	0.9
10	40			40.0	0.56 ± 0.05			0.6
11								
12	39.6	34.5		37.1	0.56 ± 0.05	0.77 ± 0.09		0.7
13	11.2	11.5	8.4	10.4	1.88 ± 0.17	2.05 ± 0.15	2.40 ± 0.21	2.1
14	12.8	12.7	13.2	12.9	1.88 ± 0.16	2.00 ± 0.15	2.09 ± 0.17	2.0
15	28.8	47		37.9	0.98 ± 0.09	0.47 ± 0.04		0.7

Date : 2 June 1998

Tran Mai Thien, RIA-1, Dinh Bang, Tien Son, Bac Ninh, Vietnam

Genetic Improvement of Silver Barb

In the first half of 1998, individuals of silver barb strains gathered from different localities in Mekong River Delta were conditioned at the Fish Seed Centre of Mekong River Delta, Cai Be (RIA-2). From these initial collections, evaluations and selections will begin.

V. Project Constraints, Corrective Measures and Fund Status

No major constraints have been encountered. Minor problems have been encountered, but these problems are solvable and we are confident that they will be. There is a large quantity of very valuable information from China for the documentation objective. However, it is almost all in Mandarin and needs to be translated. An economical means of translation needs to be identified and implemented. Research on genetic improvement is essentially ahead of schedule, but some exchange of germplasm was hindered by the crisis in Indonesia, however, the germplasm exchanges are delayed not terminated. Some of the cooperators have overextended their facilities. For development of first class genetic improvement programs some institutions need expansion of their pond facilities. However, we are working on innovative ways to efficiently utilize the existing facilities so that the current research is not compromised. Survey work was slowed in Vietnam and Thailand due to personnel changes, however, Mr. Gaspar B. Bimbao, spent extra time working in these countries to put these programs back on schedule.

Of the US $450,000 representing project funds for the period June 1997 to May 1998 ICLARM received last 16th July 1997 from the Bank, the Project spent US $374,432.82, with a net fund balance of US $75,567.18. The projected fund requirement of the Project will amount to US $349,432.82 for the period June 1998 to November 1998.

APPENDIX 1

Appendix 1

Carp Genetic Resources in China

Freshwater Fisheries Research Centre
of Chinese Academy of Fishery Sciences
Qitang, Wuxi,
China 214081

Carp Genetic Resources in China

1. Indigenous Carp Species

Sub-farmily 1 : Hypophthalmichthyinae Suonly in China, 3 species, 2 genera

- ***Aristichthys nobilis*** Richardson (Bighead carp)
- ***Hypophthalmichthys molitrix*** Cuvie Valenciennes (Silver carp)
- ***H. harmandi*** Sauv.

Sub-family 2 : Cyprininae Suin China, 26 species, 5 genera

Genus Carassius :

- ***C. auratus*** Linnaeus (Crucian carp)
- ***C. auratus cuvieri***
- ***C. auratus gibelio***
- ***C. auratus pengzenensis***

Genus Cyprinus:

- ***Cyprinus carpio*** Linnaeus (common carp)
- ***C. carpio chilia***
- ***C. carpio pellegrini***
- ***C. carpio rubrofuscus***
- ***C. carpio yuankiang*** (Yuanjiang carp)
- ***C. carpio*** var.***crystallos*** (Wan'an transparent red carp)
- ***C. carpio wuyuanensis*** (Hebao red carp)
- ***C. carpio singuoensis*** (Xinguo red carp)
- Huanghe carp
- Germany mirror carp
- Scattered mirror carp
- Songpu mirror carp

New varietires and hybrids :

- Allogynogenetic crucian carp
- Fong carp --- hybrid of *C.c. singuonensis* x Scattered mirror carp
- Jian carp --- new variety, (*C.c. wuyuanensis* x *C. c. yuankiang*, gynogenesis, integration breeding)

- Ying carp --- f_1 (Scattered mirror carp x CyCa f_2)
- Heyuan carp --- (*C. carpio var. wuyuanensis* x *C. carpio var. yuankiang*)
- Yue carp --- (*C. carpio var. wuyuanensis* x *C. carpio*)
- Baiyuan carp --- *C. carpio var. yuankiang* x *C. pellegrini*
- Tri-crossed carp --- [(*C. carpio* var. *wuyuanensis* x *C. carpio* var. *yuankiang*) x mirror carp]
- Backcross carp --- [*C. carpio* var. *yuankiang* x (*C. carpio* var. *wuyuanensis* x *C. carpio* var. *yuankiang*)]

Sub-farmily 3 : Xenocyprininae Suin China, 11 species, 4 generain

- ***Plagiognathops microlepis*** lBleekerBl
- ***Xenocypris davidi*** eBleekerBl

Sub-farmily 4 : Leuciscinae (only in China, 45 species, 22 genera)

- ***Mylopharyngodon piceus*** Richardson (Black carp)
- ***Ctenopharyngodon idellus*** Cuvier et Valenciennes (Grass carp)
- ***Leuciscus waleckii*** (Dybowski)

Sub-farmily 5 : Abramininae uin china, 54 species, 17 generain

- ***Megalobrama amblycephala*** Yih
- ***Parabramis pekinensis*** (Basilewsky)
- ***Culter erythropterus*** Basilewsky
- ***Erythroculter ilishaeformis*** (Bleeker)

Sub-farmily 6 : Barbinae (in China, 105 species, 27 genera)

- ***Cirrhina molitorella*** (Cuvier et Valenciennes)
- ***Spnibarbus calauelli*** (nichols)

Sub-farmily 7 : Acheilognathinae

Sub-farmily 8 : Cobioninae

- ***Hemibarbus maculatus*** Bleeker
- ***Saurogobio dabryi*** Bleeker

Sub-farmily 9 : Schizothoracinae

- ***Gymnocypris pezewalskii*** Kessler
- ***Schizothorax (Schizopyge) yunnanensis*** Norman

Sub-farmily 10 : Gobiobotinae

2. Exotic Carp Species

The exotic carp species have been introduced and cultured in China are as following:

- Russian scale carp,
- Scattered mirror carp,
- Germany mirror carp,
- White crucian carp (*Carassius auratus cuvieri*), 1959 (Taiwan), 1973 (Hong Kong), 1976 (Guangdong)
- *Labeo rohita,* 1978 (Guangdong).

APPENDIX 2

Appendix 2

Carp Genetic Resources in Thailand

National Aquaculture Genetics Research Institute (NAGRI)
Tumbon Klongha, Amphur Klongloung
Pathumthani 12120, Thailand

Carp Genetic Resources in Thailand

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Part I

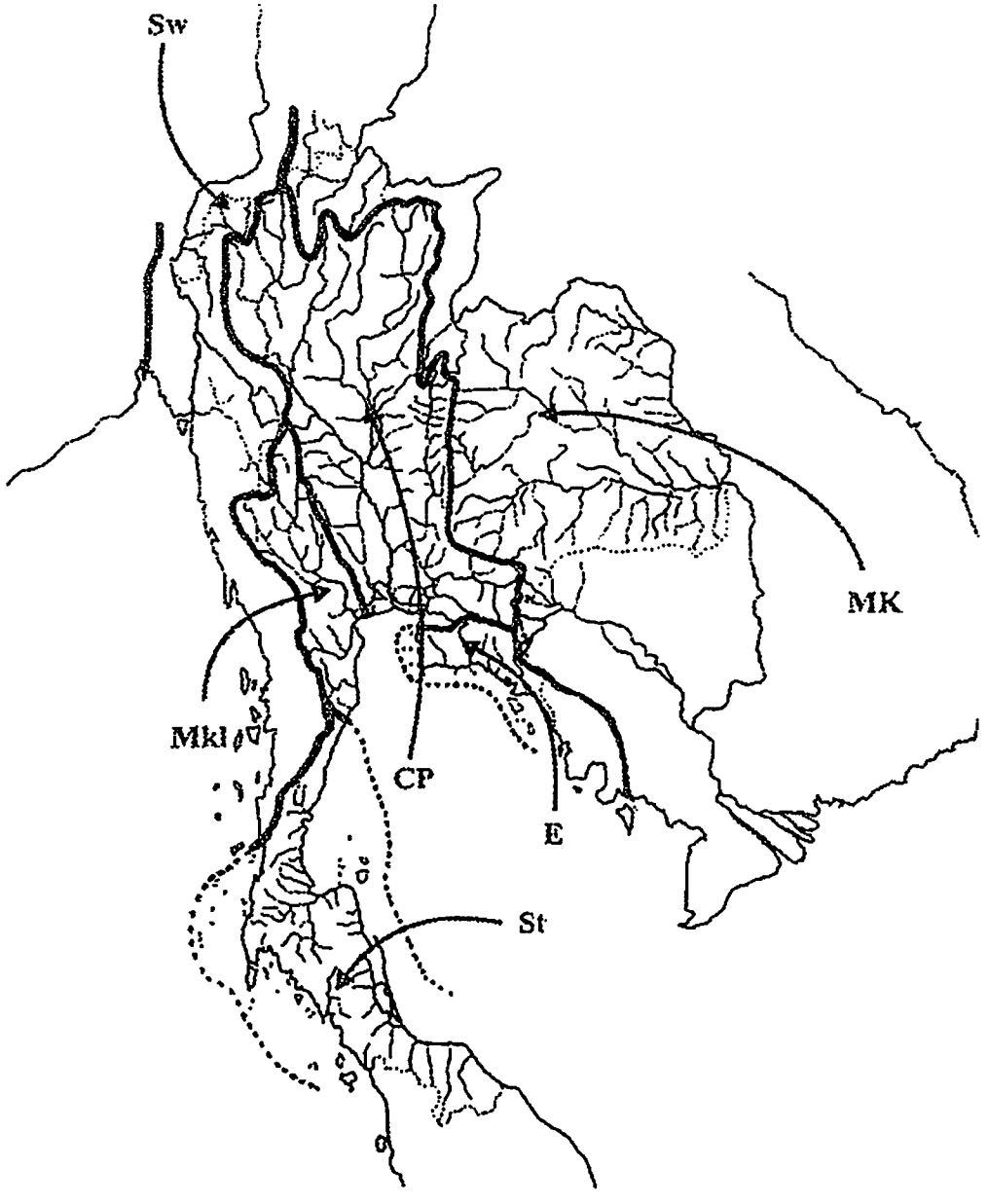
Diversity of Cyprinidae in Thailand

Vidthayanon C., et.al (1997) classified Cyprinidae in Thailand following that of Greenwood et al. (1996) and Nelson (1990), with the generic names and validity based on Eschmeyer (1990). Abbreviations of the river system and others cited below in this checklist are defined as:

Sw=the Salween River and its tributaries;
Mkl=the Meklong River and other rivers southward above Chumporn;
St=the rivers of peninsular Thailand from below Chumporn southward;
E=the rivers of southeast Thailand;
CP=entire the Chao Phraya River basin including Bangpakong River;
MK=the Mekong basin of Thailand;
?= for any uncertain taxonomic identification and/or possible distribution,occuring to that river system.

Part II

Distribution of cyprinidae in Thailand.



Order Cypriniformes

Family Cyprinidae

1. Subfamily Cyprininae

1.1. Tribe Cyprinini

River systems of Thailand.
Sw = Salween; Mkl = Maeklong; St = Peninsular Thailand; E = Southeast; Cp = Chao Phraya; MK = Mekong, ? = taxonomy or occurrence is uncertain.

Species account	Distribution / River system						
	Sw	**Mkl**	**St**	**E**	**CP**	**MK**	**Source,Ref.**
Catlocarpio siamensis (Boulenger, 1898)		X			X	X	Smith, 1945
Neolissochilus blanci (Pellegrin & Fang, 1940)						X	Rainboth, 1996
Neolissochilus dukai (Day, 1878)	X		X		?		Rainboth,1985
Neolissochilus paucisquamatus (Smith, 1945)?			X				Rainboth,1985
Neolissochilus soroides (Duncker, 1904)	X	X	X				Rainboth,1985
Neolissochilus stracheyi (Day, 1871)	X	X	X	X	X	X	Rainboth,1985
Neolissochilus sumatranus (Weber & de Beaufort, 1916)			X				Rainboth,1985
Neolissochilus vittatus (Smith, 1945)	X	X	X	X	X		Rainboth,1985
Probarbus jullieni (Sauvage, 1880)		X			X	X	Roberts, 1992
Probarbus labeamajnor (Roberts, 1992)						X	Robert, 1992
Probarbus labeaminor (Roberts, 1992)						X	Robert,1992
Thynnichthys thynnoides (Bleeker, 1852)		X	X	?	X	X	Smith, 1945
Tor douronensis (Val. In Cuv. & Val., 1842)			X		X	X	Smith, 1945
Tor putitora (Hamilton, 1822)	X						Vid. & collaeques, 1997
Tor sinensis (Wu, 1977)					?	X	Smith, 1945
Tor tambroides (Bleeker, 1854)	X	X	X		X	X	Smith, 1945
Tor sp.					X		Vid. & collaeques, 1997

1.2. Tribe Systomini

Albulichthys albuloides (Bleeker, 1855)		X			X	X	Smith, 1945
Amblyrhynchichthys truncatus (Bleeker, 1851)		X	X		X	X	Smith, 1945
Balantiocheilos melanopterus (Beeker, 1851)		X			X	X	Smith, 1945
Cosmochilus harmandi Sauvage, 1878					X	X	Smith, 1945
Cyclocheilicthys spogon (Val. In Cuv., 1842)		X	X	X	X	X	Sontirat,1976
Cyclocheilicthys armatus (Val. In Cuv., 1842)		X	X	X	X	X	Sontirat,1976
Cyclocheilichtys enoplos Bleeker, 1850		X	X		X	X	Sontirat,1976
Cyclocheilicthys furcatus (Sontirat, 1985)						X	Sontirat,1985
Cyclocheilicthys heteronema (Bleeker, 1853)			X		X	X	Sontirat,1976
Cyclocheilicthys lagleri (Sontirat, 1985)					X		Sontirat,1985
Cyclocheilicthys repasson (Bleeker, 1853)		X	X		X	X	Sontirat,1976
Mystacoleucus argenteus (Day, 1888)	X						Sontirat,1984
Mystacoleucus atridorsalis (Fowler, 1937)						X	Sontirat,1984
Mystacoleucus greenwayi (Pellegrin & Fang, 1940)					X	X	Sontirat,1984
Mystacoleucus marginatus (Val. In Cuv. & Val., 1842)		X	X	X	X	X	Sontirat,1984
Mystacoleucus sp.						X	Vid. & collaeques,1997
Puntioplites bulu (Bleeker, 1851)			X				Smith,1945
Puntioplites fulcifer (Smith, 1929)						X	Smith,1929
Puntioplites waandersii (Bleeker, 1859)						X	Kottelat,1989
Puntioplites proctozysron (Bleeker, 1865)		X	X	X	X	X	Smith,1945
Osteobrama alfrediana (Val. In Cuv. & Val., 1844)	X						Smith,1945
Sikukia gudgeri (Smith, 1934)					X	X	Smith,1934
Sikukia stejnegeri (Smith, 1931)			X		X	X	Imaki & taki,1976

1.3. Tribe Poropunti

Barbodes altus (Gunther, 1868) = *Puntius altus.* (Smith, 1945)		X	X	X	X	X	Smith,1945
Barbodes gonionotus (Bleeker, 1850) = *Puntius gonionotus,* (Smith, 1945)		X	X	X	X	X	Smith,1945
Barbodes schwanenfeldi (Bleeker, 1853) = *Puntius schwanenfeldi,*(Smith, 1945)		X	X	X	X	X	Smith,1945
HyVidthayanon & Collaeques,1997ibarbus lagleri (Rainboth, 1996)						X	Rainboth,1996
HyVidthayanon & Collaeques,1997ibarbus malcolmi (Smith, 1945)		X	X		X	X	Smith,1945
HyVidthayanon & Collaeques,1997ibarbus pierrei (Sauvage, 1878)						X	Kottelat,1989
HyVidthayanon & Collaeques,1997ibarbus salweenensis (Rainboth, 1996)	X						Rainboth,1996
HyVidthayanon & Collaeques,1997ibarbus suvattii (Rainboth, 1996)		X			X	X	Rainboth,1996
HyVidthayanon & Collaeques,1997ibarbus vernayi (Narman, 1925)		X			X	X	Smith,1945
HyVidthayanon & Collaeques,1997ibarbus wetmorei (Smith, 1931) = *Puntius daruphani* ,Smith, 1934		X	X		X	X	Smith,1945

HyVidthayanon & Collaeques,1997ibarbus sp.?	X						Vid. & collaeques,1997
Chagunius baileyi (Rainboth, 1986)	X						Rainboth,1996
Discherodontus ashmeadi (Fowler, 1937)						X	Rainbth,1989
Discherodontus halei (Duncker, 1904)		X	X		X		Rainbth,1989
Discherodontus schroederi (Smith, 1945)		X			X		Rainbth,1989
Folifer brevifilis (Peters, 1880)	X					X	Ukatawewat, 1982
Onychostoma gerlachi (Peters. 1880)					X	X	Taki,1975
Poropuntius bantamensis (Rendahl, 1920)					X	X	Smith,1945
Poropuntius chondrorhynchus (Fowler, 1934)	X	X			X	X	Smith,1945
Poropuntius deauratus (Val., in Cuv. & Val., 1842)?		X	X	X	X	X	Smith,1945
Poropuntius laoensis (Gunther, 1868)						X	Smith,1945
Poropuntius speleoVidthayanon & Collaeques,1997 (Roberts, 1992)						X	Roberts,1992
Poropuntius' hampaloides (Vinciguerra, 1890)	X	X	X				Kottelat,1989
ScaphognathoVidthayanon & Collaeques,1997 bandanensis (Boonyaratpalin & Srirungroj, 1971)					X		Boonyaratpalin & Srirungroj,1971
ScaphognathoVidthayanon & Collaeques,1997 stejegeri (Smith, 1931)					X		Smith,1931

1.4. Tribe Systomi

Hampala dispar (Smith, 1934)					X	X	Smith,1934
Hampala macrolepidota Kuhl & van Hasselt in van Hasselt, 1823		X	X	X	X	X	Smith,1945
Hampala salweenensis (Doi & Taki, 1993)	X						Doi & Taki, 1993
Oreichthys cosuatis (Hamilton, 1822)	X						Smith,1945
Oreichthys parvus (Smith, 1933)				X			Smith,1933
Puntius spilopterus (Fowler, 1934)					X		Fowler,1934
Puntius brevis (Bleeker, 1850)		X	X	X	X	X	Kottelat,1989
Systomus aurotaeniatus (Tirant, 1885)						X	Kottelat,1989
Systomus binotatus (Val. in Cuv. & Val., 1842)	X	X	X	X	X	X	Smith,1945
Systomus johorensis (Duncker, 1904)			X				Kottelat,1989
Systomus lateristriga (Val. in Cuv. & Val., 1842)		X	X	?		X	Smith,1945
Systomus hexazona (Weber & de Beaufort, (1912)			X				Kottelat,1989
Systomus orphoides (Val. in Cuv. & Val., 1842)		X	X	X	X	X	Smith,1945
Systomus partipentozona (Fowler, 1934)		?	X	X	X	X	Smith,1945
Systomus sp.1	X						Vid. & collaeques,1997
Systomus sp.2					X	X	Rainboth, 1996
Systomus stolitczkae (Day, 1869)	X				X	X	Smith,1945

1.5. Tribe Semiplotini

Scaphiodonichthys acanthopterus (Fowler, 1934)					X	X	Fowler,1934
Scaphiodonichthys burmanicus (Vinciguerra, 1890)	X	X					Vinciguerra, 1890

1.6. Tribe Labeonini

Bangana devdevi (Hora, 1936)	X						Jayaram,1981
Bangana behri (Fowler, 1937)		X			X	X	Fowler,1937
Barbichthys laevis (Val. in Cuv. & Val., 1842			X				Smith,1945
Barbichthys nitidus (Sauvage, 1878)		X			X	X	Kottelat,1989
Henicorhynchus caudiguttatus (Fowler, 1934)		X		X	X	X	Rainboth,1994
Henicorhynchus caudimaculatus (Fowler, 1934)		X		X	X	X	Rainboth, 1994
Henicorhynchus simensis (Sauvage, 1881)? = *Cirrhinus jullieni.* (Smith 1945)		X		X	X	X	Rainboth, 1994
Henicorhynchus lineatus (Smith, 1945)					X	X	Rainboth, 1994
Cirrhinus microlepis (Sauvage, 1878)					X	X	Sodsuk,1988
Cirrhinus macrosemion (Fowler, 1935)		X			X	X	Sodsuk,1988
Cirrhinus chinensis Gunther, 1868?		X	X		X	X	Sodsuk,1988
Morulius chysophekadian (Bleeker,1850)	X	X	X	X	X	X	Smith,1945
Labeo dyocheilus (McClelland, 1839) ?	X	X			X	X	Smith,1945
Labeo pierrei (Sauvage, 1880)?	X					X	Smith,1945
Sinilabeo cf. Sinkleri (Fowler, 1934)					X	X	Vid. & collaeques,1997
Sinilabeo sp. 2					X		Vid. & collaeques,1997
Labiobarbus siamensis (Sauvage, 1881)		X		X	X	X	Rainboth, 1993
Labiobarbus leptocheilus (Val. in Cuv. & Val., 1842)	?	X	X		X	X	Rainboth, 1993
Lobocheilus cheveyi (Smith, 1945)?					X	X	Smith,1945
Lobocheilus cryptopogon (Fowler, 1935)?					X	X	Fowler,1935
Lobocheilus delacouei (Pellegrin & Fang, 1940)						X	Taki,1974
Lobocheilus geacilis (Fowler, 1937)?					X		Fowler,1937
Lobocheilus nigrovittatus (Smith, 1945)?					X		Smith,1945
Lobocheilus melanotaenia (Fowler, 1935)?					X	X	Fowler,1935
Lobocheilus quadrilineatus (Fowler, 1935)?			X		X	X	Fowler,1935
Lobocheilus rhabdoura (Fowler, 1934)			X		X	X	Fowler,1934
Osteochilus enneaporus (Bleeker, 1852)			X				Kamasuta,1981
Osteochilus hasselti (Val. in Cuv. & Val., 1842)	X	X	X	X	X	X	Kamasuta,1981

Osteochilus lini Fowler, 1935				X	X	X	Kamasuta, 1981
Osteochilus melanopleura (Bleeker, 1852)		X	X	?	X	X	Kamasuta, 1981
Osteochilus microcephalus (Val. in Cuv., & Val. 1842)	X	X	X	X	X	X	Kamasuta, 1981
Osteochilus schlegeli (Bleeker, 1851)		X	X		X		Kamasuta, 1981
Osteochilus spilurus (Bleeker, 1851)			X				Kamasuta, 1981
Osteochilus waanderii (Bleeker, 1852)		X	X	X	X	X	Kamasuta, 1981

1.7. Tribe Garrae

Crossocheilus burmanicus (Hora, 1936)	X						Sompohn,1982
Crossocheilus coatesi (Fowler, 1937)					X	X	Fowler,1937
Crossocheilus cobitis (Bleeker, 1853)?			X				Smith,1945
Crossocheilus oblongus Kuhl & van Hasselt, 1823			X		X	X	Smith,1945
Crossocheilus reticulatus (Fowler, 1934)				?	X	X	Fowler,1934
Crossocheilus siamensis (Smith, 1931)		X	X	?	X		Smith,1931
Epalzeorhynchos bicolor (Smith, 1931)		X			X		Smith,1931
Epalzeorhynchos frenatus (Fowler, 1934)		X			X	X	Fowler,1934
Epalzeorhynchos kalopterus (Bleeker, 1851)			X				Smith,1945
Epalzeorhynchos munensis (Smith, 1934)		X				X	Smith,1934
Garra cambodgiensis (Tirant, 1884)			X	X	X	X	Kottelat,1989
Garra fasciacauda (Fowler, 1937)		X			X	X	Smith,1945
Garra fuliginosa (Fowler, 1934)		X	X		X	X	Rainboth,1996
Garra fisheri (Fowler, 1937)		X	X		X	X	Rainboth,1996
Garra nasuta (McClelland, 1838)	X						Kottelat,1989
Garra notata (Blyth, 1890)	X						Kottelat,1989
Garra sp. 1	X						Vid. & collaeques,1997
Garra pingi (Tchang, 1929)					X	?	Vid. & collaeques,1997
Mekongina erythrospila (Fowler, 1937)						X	Fowler,1937

2. Subfamily Danioninae
2.1. Tribe Oxygastrini

Howes, 1979

Aspidoparia morar (Hamilton, 1822)	X						Smith, 1945
Luciosoma bleekeri (Steindachner, 1879)				?	X	X	Smith, 1945
Luciosoma setigeru (Valenciennes in Cuv. & Val., 1844)		X	X	?	X	X	Smith, 1945
Macrochirichthys macrochirus (Val. In Cuv. & Val., 1844)		?	X		X	X	Smith, 1945
OVidthayanon & Collaeques,1997ariicthys bidens Gunther, 1873						?	Vid. & collaeques, 1997
Aaptosyax grypus (Rainboth, 1991)						X	Rainboth, 1991
OVidthayanon & Collaeques,1997arius barnoides (Vinciguerra, 1890) ?	X						Vinciguerra, 1980
OVidthayanon & Collaeques,1997arius bernaziki (Koumans, 1937) ?			X				Kottelat, 1989
OVidthayanon & Collaeques,1997arius koratensis (Smith, 1931)				?	X	X	Smith,1931
OVidthayanon & Collaeques,1997arius pulchellus (Smith, 1931)					X	X	Smith,1931
OVidthayanon & Collaeques,1997arius ornatus (Sauvage, 1883)	X				X	X	Smith, 1945
Oxygaster anomalura van (Hasselt, 1823)		X	X	X			Smith, 1945
Oxygaster pointoni (Fowler, 1934)				?	X	X	Smith, 1945
Parachela maculicauda (Smith, 1934)		X	X	X	X	X	Smith,1934
Parachela oxygastroides (Bleeker, 1892)		X	X	?	X	X	Bleeker, 1892
Parachela siamensis (Gunther, 1869)			X	?	X	X	Smith, 1945
Parachela williaminae Fowler, 1934)					X	X	Smith, 1945
Salmostoma sardiniella (Val. In Cuv. & Val., 1844)	X		X				Vid. & collaeques, 1997
Raiamas guttatus (Day, 1869)	X	X	X	?	X	X	Howes, 1980

2.2. Tribe Danionini

Amblypharyngodon chulabhrnae (Vidthayanon & Kottelat, 1990)		X		X	X	X	Vid.&Kot, 1990
Boraras maculatus (Duncker, 1904)		X	X				Pholprasith, 1967
Boraras micros (Kottelat & Vidthyanon, 1993)						X	Kot.&Vid, 1993
Boraras urophthalmoides (Kottelat, 1991)			X		X		Kottlat,1991
Brachydanio kerri (Smith, 1931)			X				Smith,1931
Brachydanio albolineatus (Blyth, 1860)	X	X	X	X	X	X	Smith, 1945
Chela caeruleostigmata (Smith, 1931)		X		?	X	X	Smith,1931
Chela laubuca (Hamilton, 1822)	?		X				Smith, 1945
Danio aequipinnata (McClelland, 1839) ?	X						Smith, 1945
Danio regina(Fowler, 1934)?		X	X		X		Smith, 1945
Danio maetaengensis (Fang , 1997)					X	X	Fang,1997
Danio annandalei (Chaudei, 1908)					X	X	Kottelat, 1989
Esomus metallicus (Ahl, 1924)		X	X	X	X	X	Smith,1945
Esomus longimanus (Lunel, 1881) ?						X	Kottelat, 1989
Leptobarbus hoeveni (Bleeker, 1851)		X	X	X	X	X	Smith, 1945
Microrasbora sp.			X				Kottelat, 1989
Rasbora agilis (Ahl, 1937)			X				Tarn & Colleaques, 1995
Rasbora argyrotaenia (Bleeker, 1850)			X	X	X	X	Lum. & Collaeques, 1986
Rasbora aurotaenia Tirant, 1885 ?		X			X	X	Lum. & Collaeques, 1989
Rasbora bankanensis (Bleeker, 1853)			X				Lum. & Collaeques, 1986
Rasbora borapetensis, Smith,1934		X	X	X	X	X	Lum,& Collaeques, 1986
Rasbora sp					X	X	Vid. & collaeques, 1997
Rasbora caudimaculata Volz, 1903		X	X	X			Lum.& Collaeques, 1986
Rasbora daniconius (Hamilton, 1822)	X	X			X	X	Lum & Collaeques, 1986
Rasbora dorsinotata (Kottelat in Kottelat & Chu, 1988)					X	X	Kottelat in Kottelat & Chu,1988
Rasbora dorsiocellata (Duncker, 1904)			X				Lum. & Colleaques, 1986
Rasbora einthovenii (Bleeker, 1851)			X				Lum & Colleaques, 1986
Rasbora eintovenii(Bleeker, 1851)			X				Tarn. & Collaeques, 1995
Rasbora espei (Meinken, 1967)			X				Meinken, 1967

Rasbora heteromorpha (Duncker, 1904)			X	X			Lum. & Collaeques, 1986
Rasbora hobelmani (Kottelat, 1984)			X				Kottelat, 1984
Rasbora myersi (Brittan, 1954)						X	Kottelar, 1989
Rasbora paviei (Tirant, 1885)			X	X	X		Kottelar, 1989
Rasbora pauciperforata (Weber & de Beaufort, 1916)					X	X	Lum. & Collaeques, 1986
Rasbora paucisqualis (Ahl in Schreitmuller, 1935)			X				Kottelar, 1989
Rasbora retrodorsalis (Smith, 1945)			X	X	X		Smith,1945
Rasbora somphongsi (Meinken, 1958)		X					Meinken,1958
Rasbora sumatrana (Bleeker, 1852)		X	X	X			Kottelar, 1989
Rasbora spilocerca (Rainboth & Kottelat, 1987)						X	Rainboth & Kottlet,1987
Rasbora trilineata (Steindachner, 1870)		X	X	X	X	X	Smith, 1945
Thryssocypris tonlesapensis (Roberts & Kottelat, 1984)?					X		Vid. collaeques, 1997

3. Subfamily Acheilognathinae

Acanthorodeus deignani (Smith, 1995)					?	X	Smith, 1995

4. subfamily Gobioninae

Abbottina rivularis (Basilewsky, 1855)						X	Vid. & Kot., 1995

5. Subfamily Alburninae

Longiculter siahi (Fowler, 1937)						X	Banarescu, 1971
Paralaubuca barroni (Fowler, 1934) ?		X			X	X	Banarescu, 1971
Paralaubuca harmandi (Sauvage, 1883) ?					X	X	Banarescu, 1971
Paralaubuca riveroi (Fowler, 1935)		X	X	?	X	X	Banarescu, 1971
Paralaubuca typus (Bleeker, 1865)		X	X	?	X	X	Banarescu, 1971

Addendum

Mystacoieucus lepturus (Huang, 1979)					X		Chu et al., 1989

Part III

Name of subfamily and numbers of tribe, genus and species
Data based on Nanakhon (1997)

No.	Subfamily	No. of Tribes	No. of genera	No. of Species	No. of don't have Species
1.	Acheilognathinae	-	1	1	
2.	Gobioninae	-	1	1	
3.	Alburninae	-	2	5	
4.	Danioninae	2	20	57	2
5.	Cyprininae	7	38	129	7
	Total	9	62	192	9

Part IV

Economically Important Cyprinidae fish species subject to induced reproduction practices in Thailand

Data based on Tavaratmaneegul, et. al., (1992)

Scientific name	Common name	Thai name
1 *Hypophthalmichthys molitrix*	Silver Carp	Pla Lin
2.*Aristichthys nobilis*	Bighead Carp	Pla Song
3.*Ctenopharyngodon idellus*	Grass Carp	Pla Chow
4.*Labio rohita*	Indian Carp	Pla Yee Sok Ted
5.*Barbodes gonionotus* = *Puntius gonionotus*	Common Silver Carp	Pla Tapien Khao
6.*Probarbus jullieni*	Jullien's Golden-price Carp	Pla Yee Sok
7.*Leptobarbus hoevenii*	Hoeven's Slender Carp	Pla Ba
8.*Catlocarpio siamensis*	Siamese Giant Carp	Pla Kaho
9.*Mekonggina erythrospila*	Thai Carp	Pla wa
10.*Cirrhina microlepis*	Small- scale Mud Carp	Pla Nuan Chan
11.*Osteochillus hasselti*	Osteochilids	Pla Soi Nok Khao
12.*Cyclocheilichthys enoplos*	-	Pla Takok
13.*Polynemus paradiseus*	Paradisc Thread Fin	Pla Nuad Pram
14.*Pantius schwanenfeldi*	Schwanenfeld's Tinfiol Barb	Pla Kahae
15.*Epalzeorhynchos bicolor*	Red-tailed Black Shark	Pla Song Kruang
16.*Balantiocheilus melanopterus*	Silver Shark	Pla Hang Mai
17.*Labeo erythrurus (albino)*	Red- finned Shark	Pla Gar Daeng
18.*Puntius altus*	Red-tail Tinfiol Barb	Pla Tapian Thong
19.*Morulius Chrysophekadion*	Greater Black Shark	Pla Ka Dum
20.*Patnioides microlepis*	Siamese Tiger Fish	Pla Seua Taw

Part V

Cyprinidae (Introduced & commonly found in Thailand)

Specialist list	Years	From	Origin	Reference
Cyprinus carpio Linnaeus, 1785	1912	China	China	Duang. & Pupipat., 1982
Carassius auratus Linnaeus, 1785	1980	Japan	China	Duang. & Pupipat., 1982
Ctenopharyngodon idellus Valenciennes, 1842	1922	China	China	Duang. & Pupipat., 1982
Hypophthalmicthys molirix Valenciennes, 1844	1932	China	China	Duang. & Pupipat., 1982
Hypophthalmicthys nobilis (Richardson, 1844)	1922	China	China	Duang. & Pupipat., 1982
Labeo rohita (Hamilton, 1822)	1968	India	Ganges basin	Duang. & Pupipat., 1982
Cirrhina mrigla (Hamilton, 1829)	1980	Bangladesh	Ganges basin	Duang. & Pupipat., 1982

Part VI

Taxonomic identification of Cyprinidae in Thailand

Berg (1940) classified family Cyprinidae under

Phylum	Vertebrata
Subphylum	Craniata
Superclass	Gnatostomata
Class	Teleostomi
Subclass	Actinopterygii
Superorder	Teleostei
Order	Cypriniformes (Ostariophysi, Plactospodyli)
Suborder	Cyprinoidei (Eventognathi)
Family	Cyprinidae

Smith (1945)

Oder	Eventognathi
Family	Cyprinidae

Nelson (1994)

Subphylum	Vertebrata (Craniata)
Class	Actinopterygii
Order	Cypriniformes
Family	Cyprinidae

Vidthayanon , et., al (1997) classified family Cyprinidae into subfamilies which was similar to Nilson, (1994)

1) Subfamily Acheilognathinae
2) Subfamily Gobioninae
3) Subfamily Alburninae
4) Subfamily Danioninae (Rasborinae)
5) Subfamily Cyprininae

Characteritics of Order Cypriniformes

Kinethmoid present (a median bone between ascending processes of maxillae); palatine articulating in a socket of the endopterygoid; fifth ceratobranchial (the pharyngeal bone) enlarged, with teeth ankylosed to the bone (bound by collagenous fibers to the bone in other ostariophysans with teeth, pharyngeal teeth absent in gyrinocheilieds); pharyngeal teeth opposed to enlarged posterior process of basioccipital bone (which encloses the dorsal aorta) rather than to upper pharyngeal elements, the basioccipital process against which the pharyngeal teeth press usually covered by a pad (tough horny pad in cyprinids, soft pad in catostomids); ascending process to premaxillae; upper jaw usually protractile; mouth (jaws and palate) always toothless; adipose fin absent (exept in some cobitiods); head almost always scaleless; branchiostegal rays three; spinelike rays in dorsal fin of some species.

Characteristic of Family Cyprinidae

Usually more than one row of pharyngeal teeth. 2 or fewer pairs of barbels. No inhalent aperture at gill slit. Many species in several subfamilies.

1. Subfamily Cyprininae

- Magin of belly rounded. Axillary scale only at base of pelvic fin. First dorsal - fin ray spinous or non - spinous. Lateral line at center of caudal peduncle. Often with 1 or 2 pairs of barbels. No notch on upper jaw or a symphyseal knob on lower jaw. Numerous tribes and many species.

1.1. Tribe Cyprinini

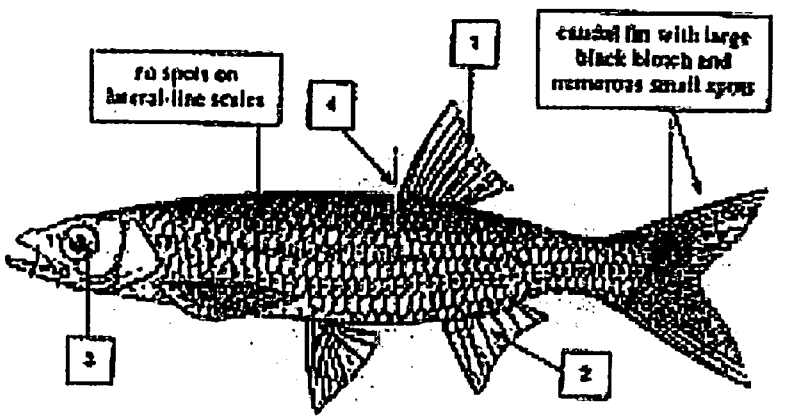
- 2 pairs of barbels. Eye in upper part of head. No epibranchial organ. Dorsal fin either with serrated spine and more than 15 branched rays, or with nonserrated spine and 10 or fewer branched rays.

- Have only 7 genus and 11 species reported by Walter J. Rainboth, 1996.

1.1.1. Genus *Luciosoma.*

(1) DORSAL FIN WITH AN UNBRANCHED, NON - SPINIOS FIRST RAY AND 7 BRANCHED SOFT RAYS;
(2) 6 BRANCHED ANAL-FIN RAYS;
(3) MOUTH LARGE EXTENDING BELOW EYE, WITH 4 LARGE BABELS;
(4) DORSAL-FIN ORIGIN IN POSTERIOR HALF OF BODY.

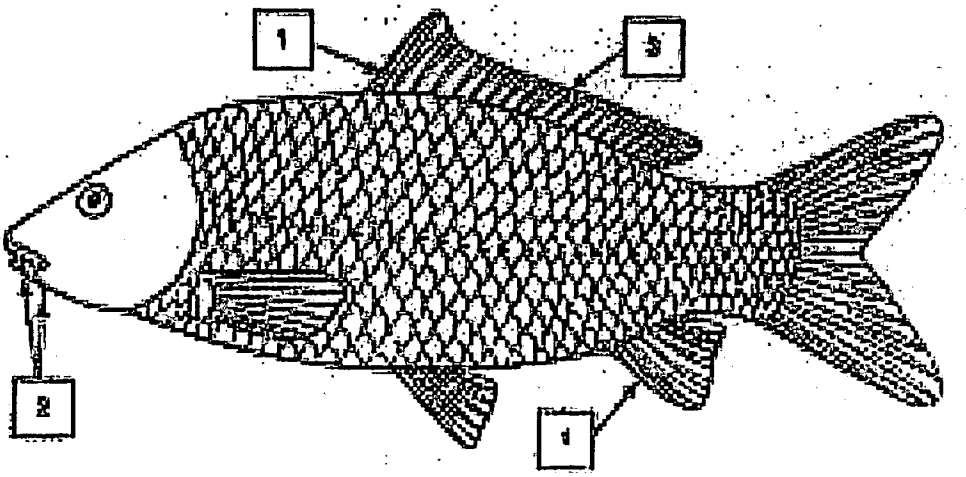
1.1.1.1. ***Luciosoma bleekeri*** (Stendachner, 1879)
Size: To 26 cm.
Habitat, biology, and fisheries: Found at the surface of flowing waters on the Mekong and Chao Phrya basins. Inhabits flooded forests and moves into permanent water in November and December as flood waters rapidly recede. Diet includes mostly exogenous insects as well as some small crustaceans and fish. Taken with seines, cast-nets, set -nets, and traVidthayanon & Collaeques, 1997. Used to make prahoc.



1.1.2. Genus ***Cyprinus***

(1) DOSAL AND ANAL FINS BOTH WITH A SHARP, SERRATED SPINE;
(2) 4 BARBELS;
(3) LONG DORSAL FIN WITH 18 OR MORE RAYS.

1.1.2.1. ***Cyprinus carpio*** (Linnaeus, 1758)
Size : To 120 cm. usually smaller.
Habitat, biology, and fisheries: A widely introduced species native to temperate latitudes, which is now beginning to show up as scattered small individuals in fish markets. They seem to be capable of reproducing in cooler waters within the Mekong basin. In cool waters, these fish are extremely tolerant of turbidity and stream contamination. They are omnivorous. Consuming a wide variety of plant and animal matter, often uprooting aquatic the water transparency. In developed countries of the western hemisphere they ingest all manner of industrial pollutants, making them inedible. Coupled with their destructive feeding activities, the have earned a reputation as a "trash fish" and millions of dollars have been unsuccessfully spent to eradicate or at least control them. Taken with seines, gill-nets, and hook-and-line. Usually marketed fresh.

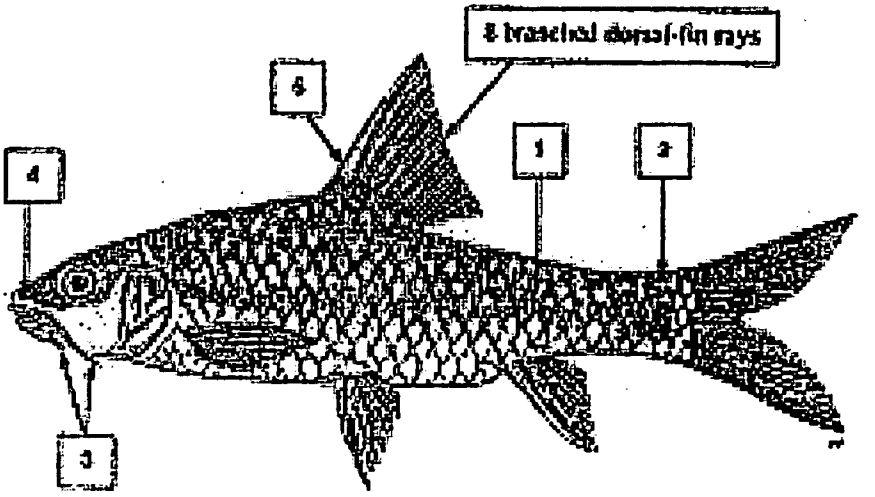


1.1.3. Genus *Neolissochilus.*

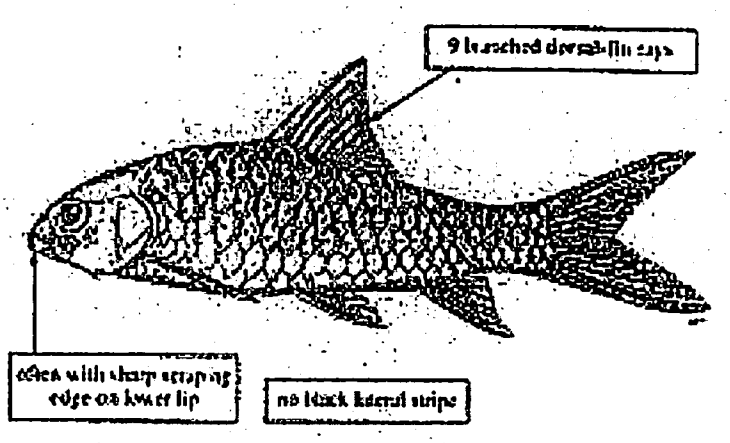
(1) LARGE SCALES, FEWER THAM 30 IN LATERAL LINE;
(2) 12 SCALES AROUND CAUDAL PEDUNCLE;
(3) 4 BARBELS;
(4) FACIAL TUBERCLES,WHEN PRESENT, CONFINED TO SIDES OF SNOUT;
(5) DORSAL FIN WITH NON-SERRATED SPINE.

1.1.3.1. *Neolissochilus blanci* (Pellerin and Fang, 1940)

Synonyms/misidentification: *Tor soro* (non Valenciennes).
Size: To 40 cm.
Habitat, biology, and fisheries: Found in pools of clear forest streams and rivers in the middle Mekong, primarily of Laos, and possibly still in extreme northern Thailand. Disappears when forest canopy is cut and suspended solids in streams increase because of human activities. Primarily a predator, but also feeds on some types of plant matter, particularly fruits. Caught by hook - and -line, cast - nets, and gill-nets. Not yet encountered in Cambodia, but expected from the northern part of the country.



1.1.3.2. ***Neolissochilus soroides*** (Duncker, 1904)
Synonyms/misidentifications: *Acrossocheilus sumatranus* (non Weber and de Beaufort).
Size: To 45 cm.
Habitat, biology, and fisheries: Known from pools of clear forested streams and rivers from Thailand and Cambodia, south to Malaysia. Found in the Cardamom mountains, but not yet seen in northern Cambodia. Disappears when human activities degrade aquatic habitats, as seen in *N. blanci* Often develoVidthayanon & Collaeques, 1997 a sharp edge on the lower jaw, which is used in scraping rocks as it grazes. Taken by seines, hook-and-line and cast-net.

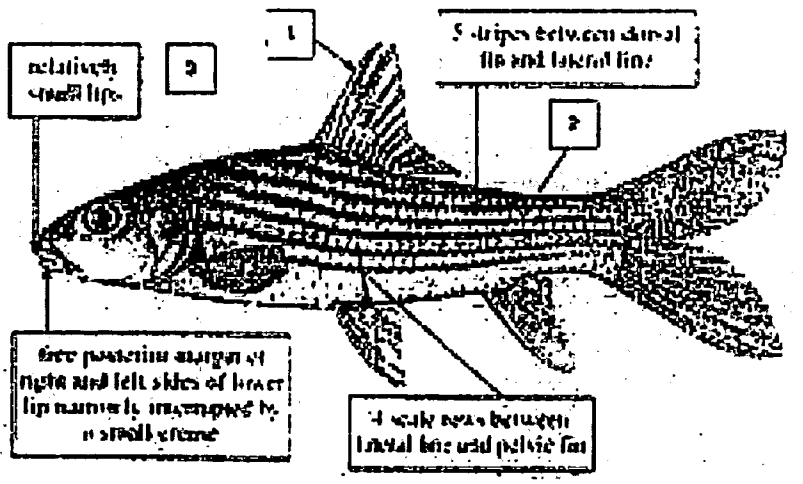


1.1.4 Genus *Probarbus.*

(1) DORSAL FIN WITH AN UNSERRATED SPINE AND 9 BRANCHED RAYS;
(2) A DARK STRIPE FOLLOWING EACH OF THE LONGITUDINAL SCALE ROWS ABOVE THE LATERAL LINE, AND SOME ROWS BELOWS;
(3) LARGE MOLARIFORM PHARYNGEAL TEETH IN A SINGLE ROW.

1.1.4.1. *Probarbus jullieni* (Sauvage, 1880)

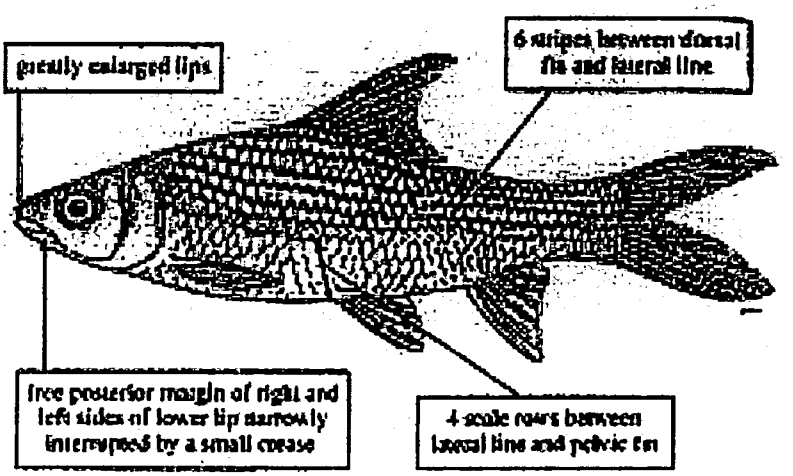
FAO name: Seven-line barb.
Size: To 100 cm.
Habitat, biology, and fisheries: Known from large rivers with sand or gravel substrates and abundant mollusk populations. Originally distributed from Thailand and Cambodia to Malaysia, although it no longer inhabits much of its former range. In Cambodia, it occurs in the Mekong from the Lao border to the Great Lake. Generally intolerant of habitat alterations, it has disappeared from areas affected by impoundments, Natural populations have been extirpated from the Chao Phrya and other the rivers of Thailand and can be expected to disappear as more impoundments are constructed in the Mekong. No longer seen in large numbers it is an extremely desirable food fish. Sold fresh and at high prices in markets. Taken by seines, hook-and-line, drift gill-nets, and occasionally by large mesh cast-nets. Listed as "K" or insufficiently Known in the IUCN Red List (1994).



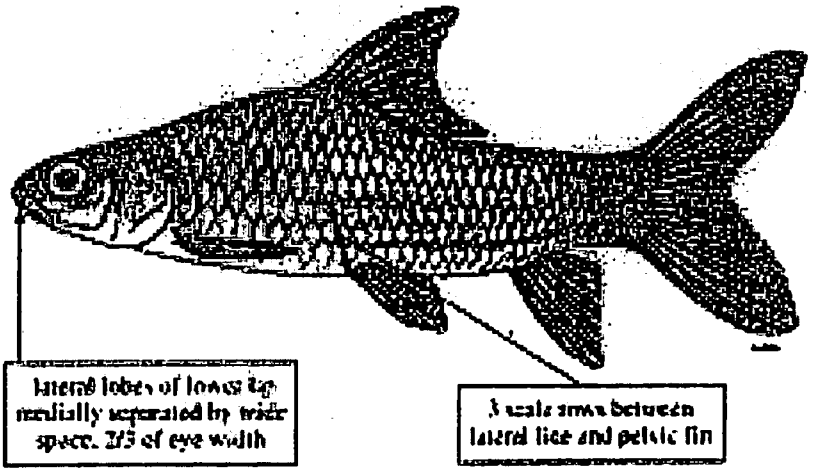
1.1.4.2. *Probabus labeamajor* (Roberts, 1922)

Synonyms/misidentifications: *Probarbus jullieni* (non Sauvage).
FAO name: Thicklip barb.
Size: To 150 cm.
Habitat, biology, and fisheries: Found in large upland rivers of the middle an lower Mekong basin. Apparently endemic to the Mekong . Due to past confusion with *P. jullieni,* little is known about this species. It likely experiences the same problems with

impoundments that are seen with *P. jullieni*. Probably more common than *P. jullieni* in Stung Treng, but apparently not found in The Great Lake. Taken by drift gill-nets, hook-and-line, and towed cast-nets.



1.1.4.3. ***Probarbus labeaminor*** (Roberts, 1992)
Synonyms/misidentifications: *Probarbus jullieni* (no Sauvage).
FAO name: Thinlip barb.
Size: To 70 cm.
Habitat, biology, and fisheries: Found in upland reaches of large and medium sized rivers of the Mekong basin. Apparently endemic to the Mekong. Little is known about this species due to past confusion with *P. jullieni*. It seems to be less common than either *P. jullieni* or *P. labeamajor* in Cambodia. Although commonly encountered at the mouth of the Mun River by the University of Michiga team in 1975, it may already be suffering negative impacts from the Pak Mun dam. Taken by seines, cast-nets, hook-and-line, and drift gill-nets.



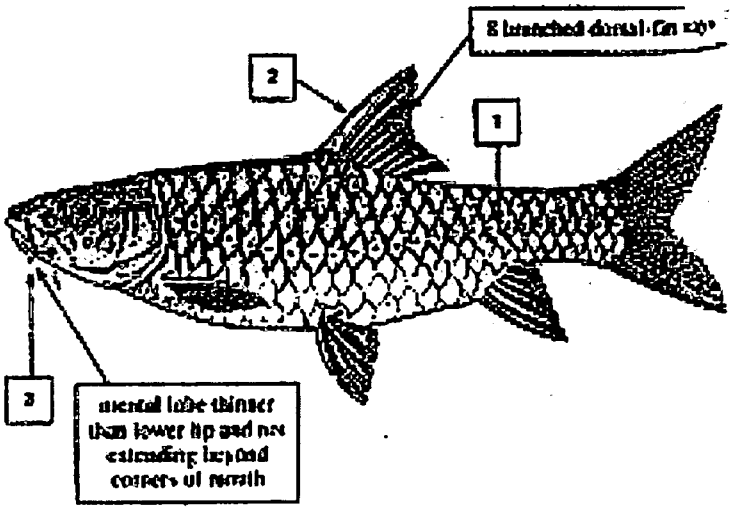
1.1.5. Genus *Tor*

(1) MEDIUM TO LARGE-SIZED FISHED WITH LARGE SCALES. FEWER THAN 30 IN LATERAL LINE;
(2) A NON-SERRATED SPINE IN DORSAL FIN;
(3) MENTAL LOBE IN LOWER AT MANDIBULAR SYM PHYSIS.

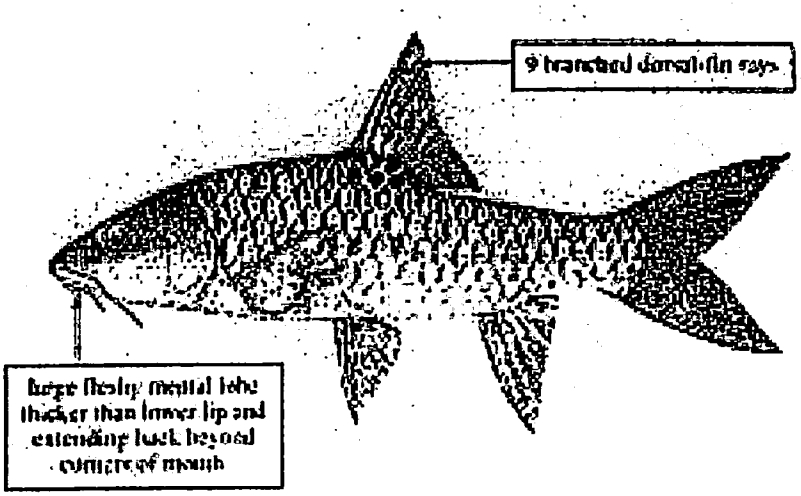
1.1.5.1. *Tor sinensis* (Wu, 1977)

Size: To 35 cm.

Habitat, biology, and fisheries: Known from pools and runs over gravel and cobble in clear rivers in forest areas of the middle and upper Mekong. Not yet been recorded from Cambodia. An omnivorous species, consuming vegetable matter such as fruits, as well as fish, crustaceans, and other invertebrates. Taken by seines, hook -and-line and cast-nets. Occasionally caught, but never in large numbers. Members of this genus are marketed fresh.



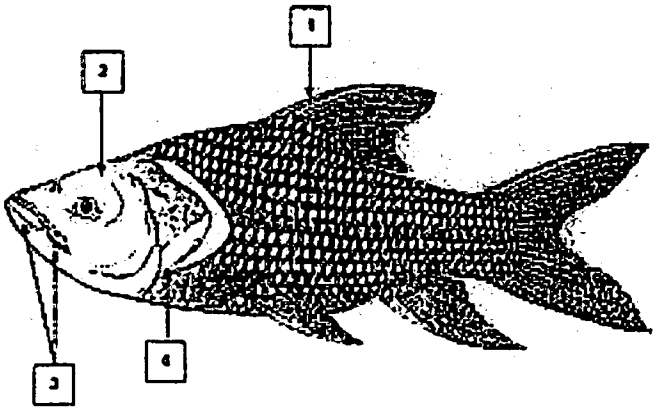
1.1.5.2. ***Tor tambroides*** (Bleeker, 1854)
FAO name: Thai mahseer.
Size: To 70 cm in Indonesia, up to 50 cm in the Mekong.
Habitat, biology, and fisheries: Known from pools and runs over gravel and cobble in rivers flowing through undisturbed forest. Found in small rivers and streams during the dry season. Moves downstream at the onset of the rainy season, but generally avoids turbid waters. Migrates uVidthayanon & Collaeques, 1997 tream after about two mouths and spawns in July near the mouths of small streams that the young subsequently ascend. Although this pattern has been reported for central Thailand only (Smith, 1945), the timing should be similar in Cambodia. These fishes are omnivorous, consuming both animal and vegetable matter, at times consuming toxic fruits in flooded forests, making them temporarily inedible. Taken by seines, hook-and-line, and cast-nets. Taken in Thailand mostly by hooks baited with dough-balls of rice flour mixed with sugar palm fruit (Smith, 1945). With their large rubbery liVidthayanon & Collaeques, 1997 acting to improve suction as they root around in gravel and cobblestones, these fishes are most easily caught when a baited hook is made invisible by burying it under a few small rocks.



1.1.6.Genus *Catlocarpio.*

(1) NO DORSAL-FIN SPINE;
(2) LARGE HEAD COMPRISING OVER ONE THIRD OF STANDARD LENGHT;
(3) NO BARBELS;
(4) GILL RAKERS LONG AND NUMEROUS, 90 TO 110 ON FIRST ARCH.

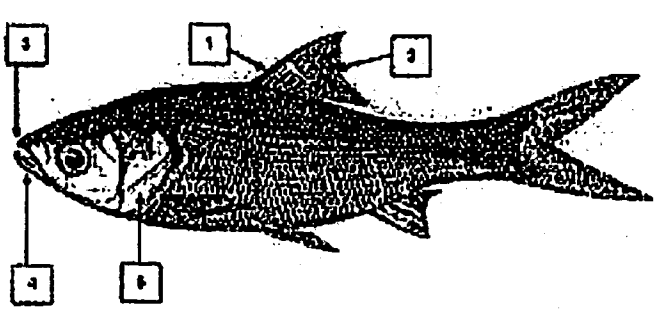
1.1.6.1. *Catlocarpio siamensis* (Boulenger, 1898)
FAO name: Giant barb.
Size : To 300 cm, rarely more than 200 cm in recent times.
Habitat, biology, and fisheries: Known from large rivers and seasonally in canals and floodplains in the Chao Phrya and Mekong. Diet consists of algae, Phytoplankton, and fruits of inundated terrestrial plants. Its numbers have declined seriously during this century, except for a brief period during the Pol pot regime when large-scale fishing operations were curtailed. It is now almost never seen in the great Lake, and has become quite rare throughout Cambodia. Individual fishes rarely survive to reach reprocuctive maturity. Its catch should be strictly regulated by size, taken with seines, traVidthayanon & Collaeques, 1997, gill-nets and by hooks baited with comparcted balls of rice. Avery desirable food fish, sometimes eaten fresh, sometimes pickled.



1.1.7.Genus *Thynnichthys*

(1) NO DORASL-FIN SPINE;
(2) 8 BRANCHED DORSAL-FIN RAYS;
(3) UPPER ABSENT;
(4) BARBELS ABSENT;
(5) GILL RACKERS ABSENT.

1.1.7.1. ***Thynnichthys thynnoides*** (Bleeker, 1852)
Size: To 25 cm, commonly between 10 and 12 cm.
Habitat, biology, and fisheries: Found in large rivers canals, oxbows, and floodplains from Thailand to Indonesia. Microphagos, feeding mostly on phytoplankton and periphyton with lesser amounts of bottom algae and small zooplankton. Migrates for spawning onto floodplains during high water levels. Young of the year are caught as they begin to return to rivers in October. In the Tonl© Sap, large adults make up nearly all of the October catch, with larger and larger proportions of young in subsequent months. Taken with seines, cast-nets, gill-nets, and traVidthayanon & Collaeques, 1997. Used to make prahoc and nuoc mam.



1.2. Tribe Systomini

- 2 or fewer pairs of barbels present. No epibranchchial organ in upper gill arch region. No vomeropalatine organ in the roof of the mouth. Dorsal fin with serrated or smooth spine. Mouth terminal or subterminal.

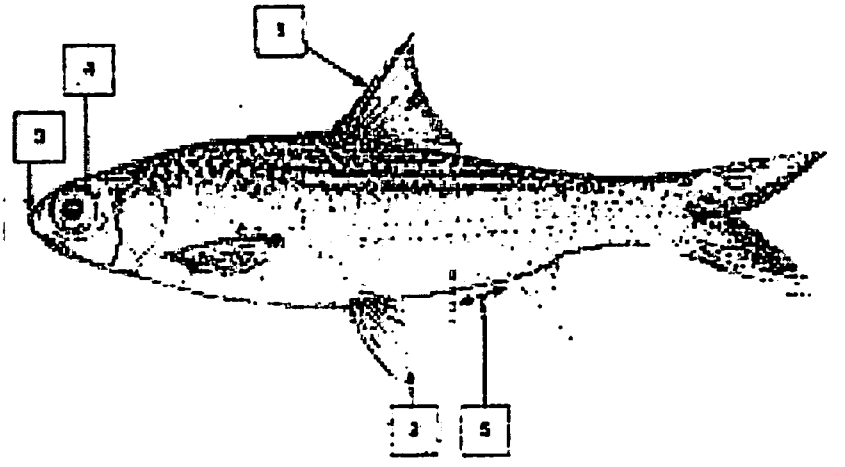
- Have only 8 genus 20 species reported by Walter J. Rainboth, 1996.

1.2.1. Genus *Albulichthys.*

(1) SERRATED DORSAL - FIN SPINE;
(2) 9 BRANCHED PELVIC - FIN RAYS;
(3) SNOUT OBTUSE ;
(4) ACIPOSE EYELID;
(5) 5 SCALE ROWS BETWEEN VENT AND ANAL FIN.

1.2.1.1. *Albulichthy albuloides* (Bleeker, 1855)

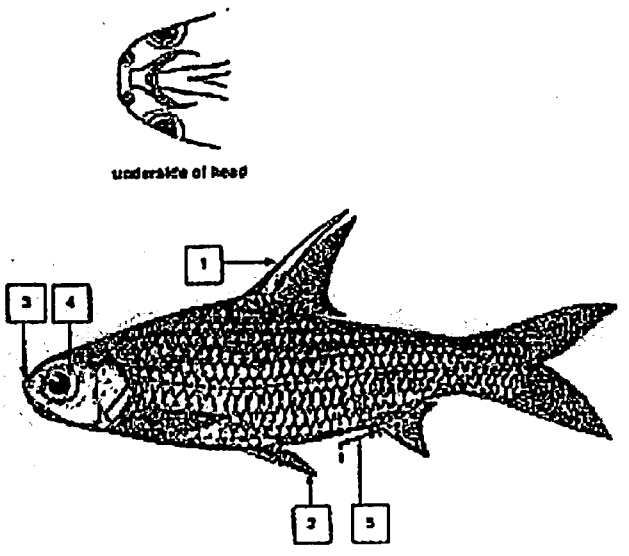
Size: To 36 cm. commonly to about 25 cm.
Habitat, biology, and fisheries: Known from midwater to bottom levels of large rivers from Indonesia to Cambodia and Thailand. Adults are common in the Great Lake and are seen sporadically downstream. Juveniles may be found as far downstream as the upper tidal zone of the Mekong delta in Vietnam. Little is known about its seasonal movements. Like many carVidthayanon & Collaeques, 1997, this species is omnivorous (Levan Dang. 1970) but consumes somewhat more plant than animal matter. Taken with large seines and traVidthayanon & Collaeques, 1997, juveniles taken by set-nets. Adults are sold fresh in markets around the Great Lake, or are cleaned and sliced in half by a single sagittal cut in preparation for salting and dying. They can be quickly recognized in this state by their golden scales and bright red caudal fin.



1.2.2.Genus *Amblyrhynchichthys.*

(1) SERRATED DORSAL-FIN SPINE;
(2) 9 BRANCHED PELVIC-FIN RAYS;
(3) EXTREMELY BLUNT SNOUT;
(4) ADFIPOSE EYELID;
(5) 3 SCALE ROWS BETWEEN VENT AND ANAL FIN.

1.2.2.1. *Amblyrhynchichthys truncatus* (Bleeker, 1850)
Size: To 40 cm, commonly to about 30 cm.
Habitat, biology, and fisheries: Known from midwater to bottom depths in large and medium-sized rivers from Indonesia to Cambodia and Thailand. Moves into inundated forests during the flood season and returns to the rivers in October and November as floodwaters recede. From then on, its numbers decrease in the rivers of the Tonl— Sap until the end of the fishing season. Primarily microphagous, feeding mostly on periphyto, with some phytoplankton, bottom growing algae, and small zooplankton. Taken by seines, set-nets, and traVidthayanon & Collaeques, 1997. Small in dividuals are used for prahoc, larger ones marketed.

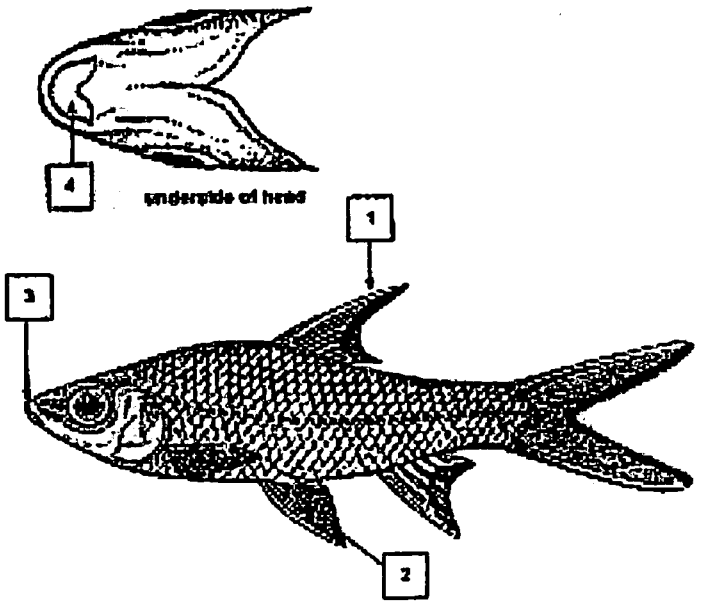


1.2.3. Genus *Banlantiocheilos*

(1) SERRATED DORASL-FIN SPINE;
(2) 8 BRANCHED PELVIC-FIN RAYS;
(3) SNOUT POINTED;
(4) LOWER LIP ABROAD SMOOTH FOLD OF SKIN WITH FREE POSTERIOR BORDER.

1.2.3.1. *Balantiocheilos melanopterus* (Bleeker, 1850)

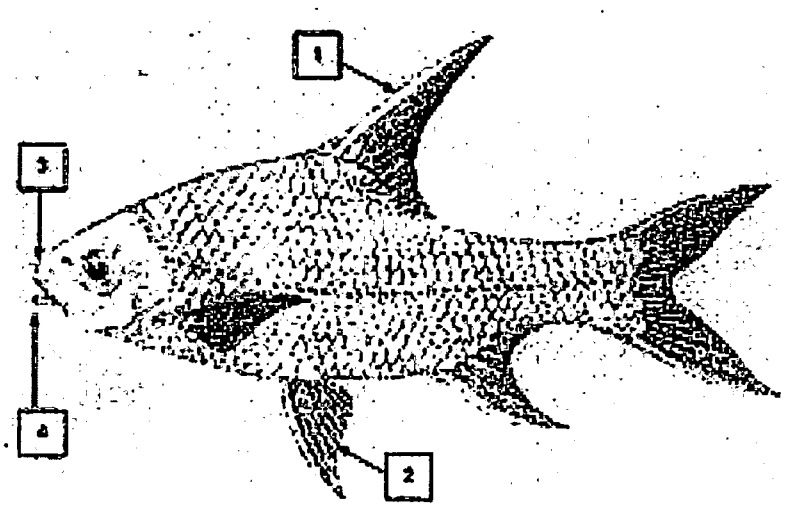
FAO name: Bala sharkninnow.
Size: To 35 cm. in Indonesia, usually 20 cm in Thailand and Cambodia.
Habitat, biology, and fisheries: Known from midwater depths in large and medium-sized rivers and lakes ranging from Indomesia to Cambodia and Thailand. Moves into flooded forests during high water levels. Feeds on some phytoplandton, but mostly on small crustaceans and rotifers as well as insects and their larvae (Vaas, 1953). Returns to the rivers in December and is caught with seines and traVidthayanon & Collaeques, 1997. Although it occured regularly in rivers downsteam from the great Lake in the 1950s, the species has become rare in recent years, perhaVidthayanon & Collaeques,1997 due to human activities. It now iccurs in a few river flowing through relatively pristine inundated. Forest at the eastern end of the Great Lake. Generally intolerant of habitat alterations, it has completely disappeared in Thailand are should receive precial listing by the IUCN.



1.2.4.Genus *Cosmochilus.*

(1) SERRATED DORSAL-FIN SPINE;
(2) 9 BRANCHED PELVIC-FIN RAYS;
(3) SNOUT OBTUSE;
(4) MOUTH SMALL, SUBTERMINAL, WITH THICK LIVIDTHAYANON & COLLAEQUES, 1997 COVERED BY LARGE PAPILLAE.

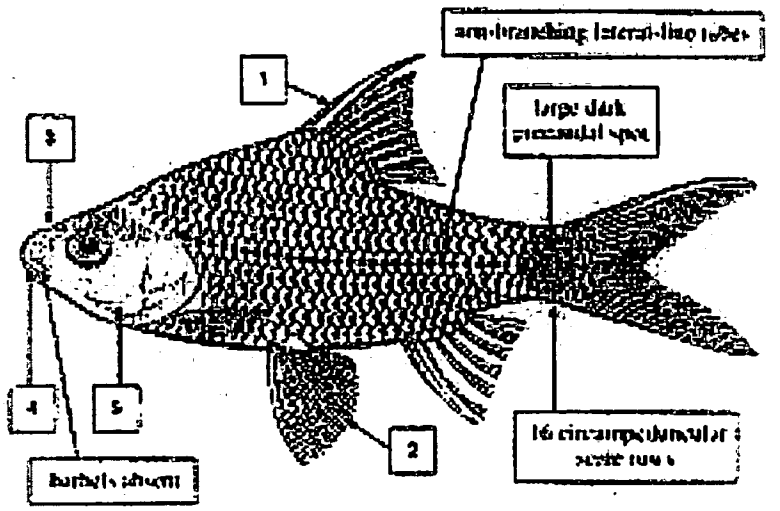
1.2.4.1. ***Cosmochilus harmandi*** (Sauvage, 1878)
Size: To 40 cm. commonly to about 30 cm.
Habitat, biology, and fisheries: Know from midwater to bottom depths in the middle and lower Mekong. Found in the clear waters of the main channels during the dry season and moves to floodplains and riparian forests during the rainy season. Returns to the Tonl— Sap fairly early, usually during October with its numbers decreasing after that. The species is relatively common in the upland river habitat of the middle Mekong until water levels begin to rise. Dietary habits have not yet been studied but the subterminal mouth and papillate liVidthayanon & Collaeques, 1997 indicate the it probably roots around for food in fine-grained sediments. The largest adults are seen in the middle Mekong, with most individuals in the Tonl— Sab being less than half the length of the large adults found at stung Treng. Taken by seines, gill-nets, Set-nets, and traVidthayanon & Collaeques, 1997. Juveniles caught in the dai fishery of the Tonl— Sap are used for prahoc. Adults are sold fresh.



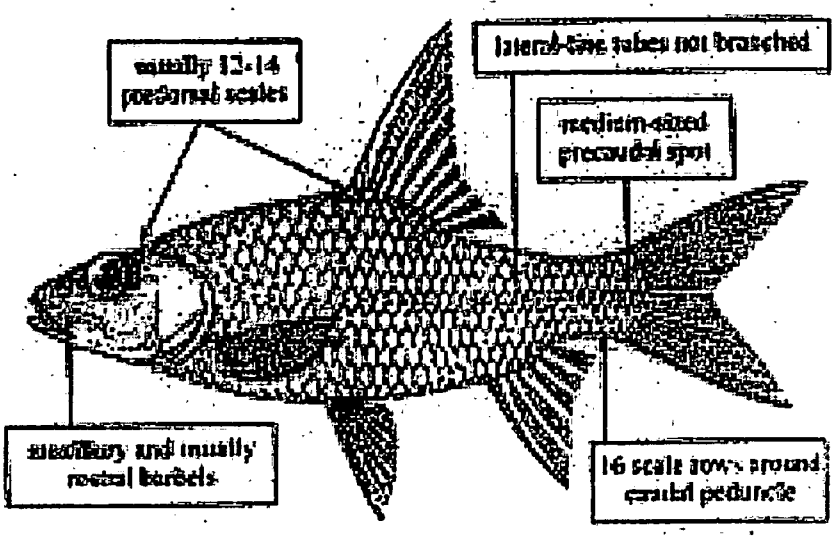
1.2.5. Genus *Cyclocheilichthys.*

(1) SERRATED DORSAL-FIN SPINE;
(2) 9 BRANCHED PELVIC-FIN RAYS;
(3) SNOUT CONICAL;
(4) MOUTH SMALL SUBTERMINAL, HORSESHOE-SHAPED;
(5) NUMEROUS PARALLEL ROWS OF SENSORY FOLDS ON THE SNOUT AND CHEEKS.

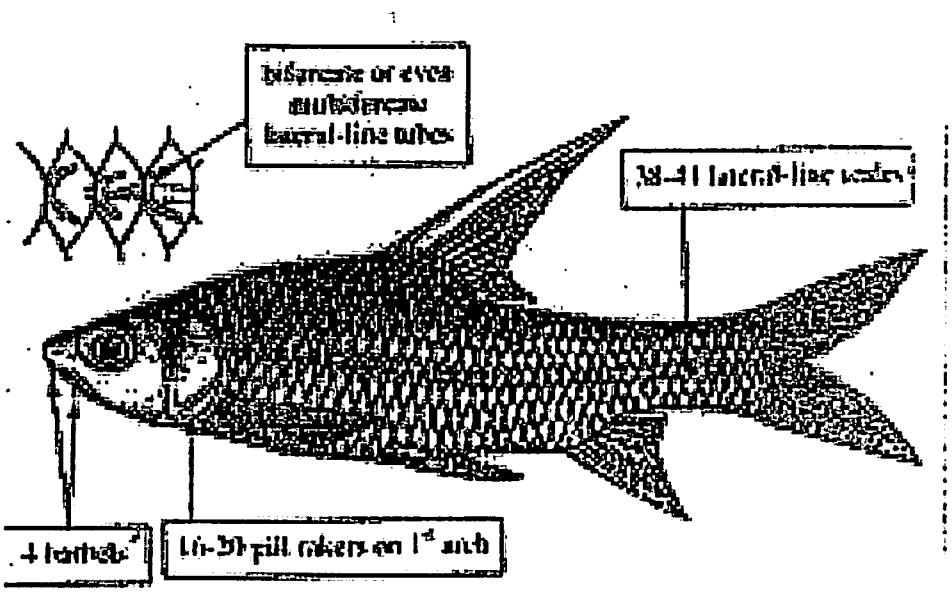
1.2.5.1. ***Cyclocheilichthys apogon*** (Valenciennes, 1842)
FAO name: Beardless barb.
Size: To 15 cm.
Habitat, biology, and fisheries: Widely distributed, known from Indonesia to Burma A common midwater species in the Mekong. Occurs in canals, ditches, and generally in habitats with slowly moving or standing water. Typically found around surfaces, such as plant leaves branches, and tree roots where it browses for small plankton and crustaceans. Moves into flooded forests and non-forested floodplains. Known to breed late in the high water season from September to October as water levels peak and begin to decline. PerhaVidthayanon & Collaeques, 1997 this avoids predation by species that move back to rivers immediately at the onset of falling waters. Often found in impoundments and seems to prosper there. Taken with seines, cast-nets, set-nets, and traVidthayanon & Collaeques, 1997. Sometimes marketed fresh along the Tonl— Sap and used to make prahoc.



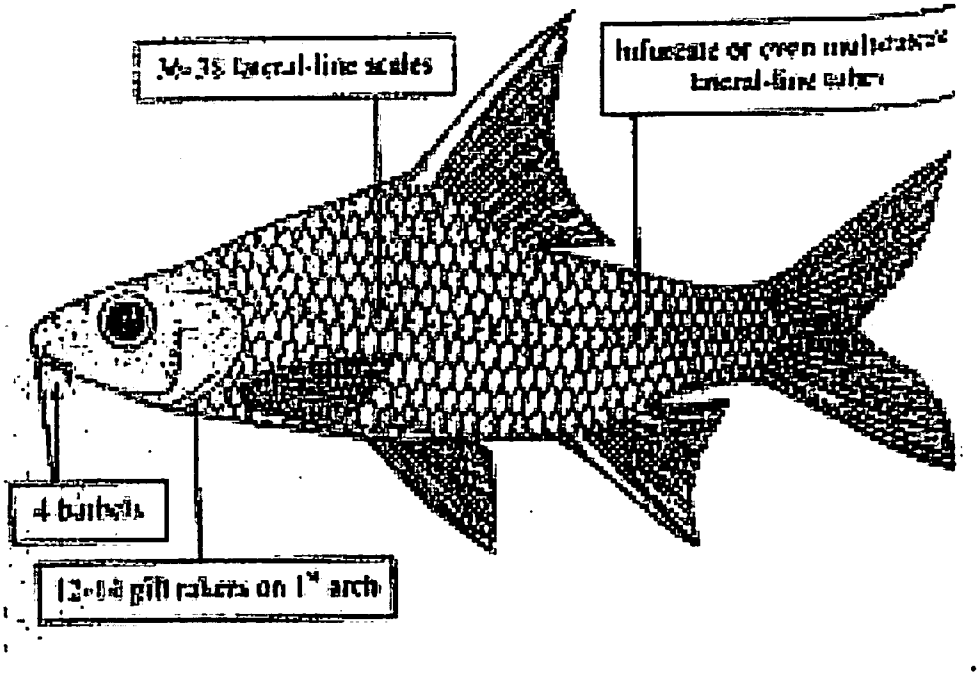
1.2.5.2. ***Cyclocheilichthys armatus*** (Valenciennes, 1842)
Synonyms/misidentifications: *Cyclocheilechthys mekongensis, Cyclocheilichthys mekongensis, Cyclochilichthystapiensis.*
Size: To 23 cm, commonly to about 15 cm.
Habitat, biology, and fisheries: Found at midwater ot bottom levels in rivers andstreams from Indonesia to Thailand and Cambodia. Common in the Mekong. Individuals are sometimes found in reservoirs, but occur much more often in flowing water. Lives in rivers during the dry season and migrates to floodplains to spown in the rainy season, with reproduction taking place relatively late in the high-water season during September and October. Diet consists of zooplankton, small crustaceans, chironomids and other insect larvae. Taken with seines, cast-nets, set-nets and traVidthayanon & Collaeques, 1997. Large individuals between 15 and 20 cm. are marketed fresh, and small ones are used to make prahoc.



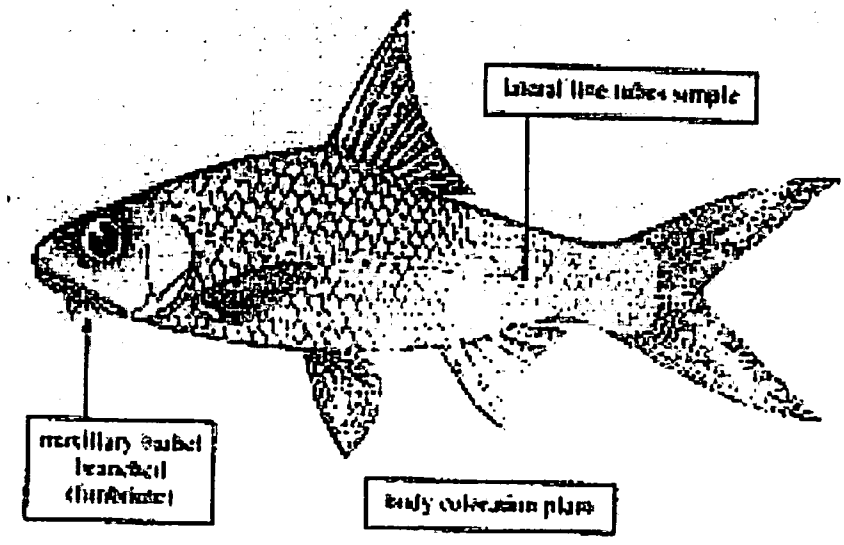
1.2.5.3. *Cyclocheilichthys enoplos* (Bleeker, 1850)
Size: To 74 cm. (in wietnam), commonly to aboout 45 cm.
Habiitat, biology, and fisheries: Found at midwater to bottom levels of rivers from Indonesia to Thailand. Common in the Mekong. Lives in rivers and spawns in the rainy season, probably on floodplains or inundated riparian forests. Returns to the rivers from October to December with the catch decreasing steadily in sixe as the fishing season progresses in the Tonl— Sap (Blache and Goossens, 1954). Not found in impoundments. Young feed on zooplankton and adults on insect larvae, crustaceans, and fish. Taken with seines, cast-nets, gill-nets, set-nets, and traVidthayanon & Collaeques, 1997. A desirable food fish, marketed fresh.



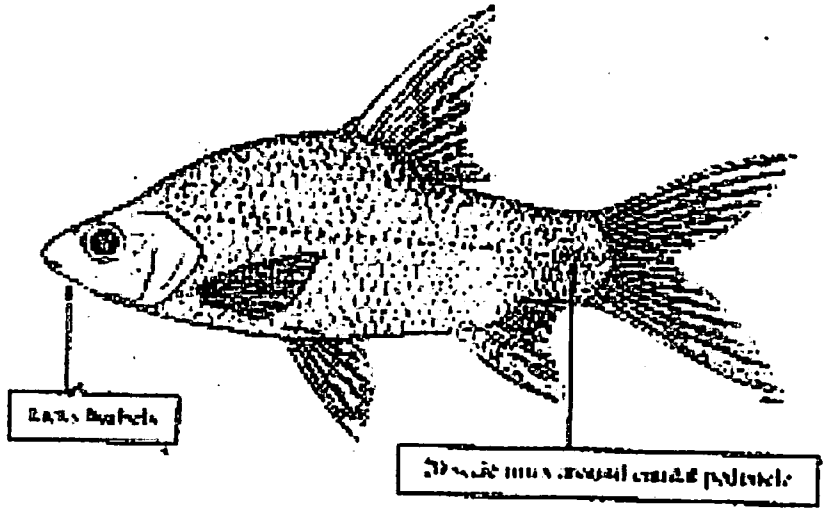
1.2.5.4. *Cyclocheilichthys furcatus* (Somtirat, 1985)
Synonyms/misidentifications: *Cyclocheilechthys enoplos* (non Bleeker).
Size: To 60 cm.
Habitat, biology, and fisheries: Apparently a Mekong endemic, know from the middle Mekong along the Thai-Lao border to the Tonl— Sap. Lives in large rivers and probably migrates in flooded riparian forests and smaller smaller streams during the rainy season. Does not occur in impoundments. Little is known about the biology of this species. Probably habhits similar to *C. enoplos*. For many years individuals were simply thought to be deep-bodied specimens of *C. enoplos* with which it is most easily confused. Taken with seines, cast-nets, gill-nets, and traVidthayanon & Collaeques, 1997. Occasionally seen rarkets but considerbly less common than *C. enoplos.*



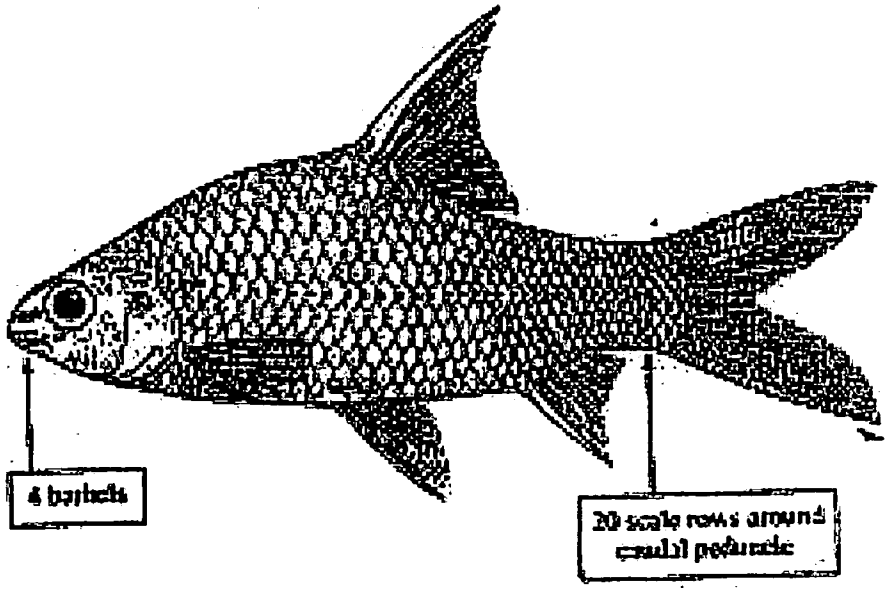
1.2.5.5. *Cyclocheiliehtthys heteronema* (Bleeker, 1853)
Size: To 12 cm.
Habitat, biology, and fisheries: Found near the bottom in large rivers from Thailand to borneo. An uncommon fish in the Mekong Occurs Just uVidthayanon & Collaeques, 1997 tream from Khon— Falls at the mouth of the Mun River. Also recorded from the Great Lake. Typically found in the middle Mekong during the dry season and moves into flooded forests during high water periods. Little is known about its biology. Not seen in markets.



1.2.5.6. *Cyclocheilichthys lagleri* (Sontirut, 1985)
Size: To 15 cm.
Habitat, biology, and fisheries: Known from lowland floodplains in Cambodia and Thailand. Little is known about this recently described species. Expected to have similardietary and migratory habits to *C. apogon*, *C.armartus*, and *C.repasson*, the three species it resembles most closely. Most easily confused with *C. repasson*. With which it shares smilar scale-counts, but lacks barbels entirely,Taken with seines, cast-nets, and traVidthayanon & Collaeques, 1997. Most likely used to make prahoc.



1.2.5.7. *Cyclocheilichthys repasson* (Bliiker, 1853)
Size: To 28 cm in Indonesia, up to 60 cm in the Mekong.
Habitat, biology, and fisheries: Occurs at midwater to bottom levels in small rivers, canals, ponds, and reservoirs form Indonesia to Thailand. This species, like other small members of the genus, moves out into the flooded forest during the high-water season. Little is known about the precese timing of its movements. Diet consists primarily of insects with some aquatic macrophytes. Very similar to C. lagleri, but clearly distinguished by the four barbels. It is 1 of 2 species in the genus that are known to proliferate in impoundments in the Mekong of Thailand. Taken with seines, cast-nets, and set-nets. Not major commercial fish, but used to make prahoc.

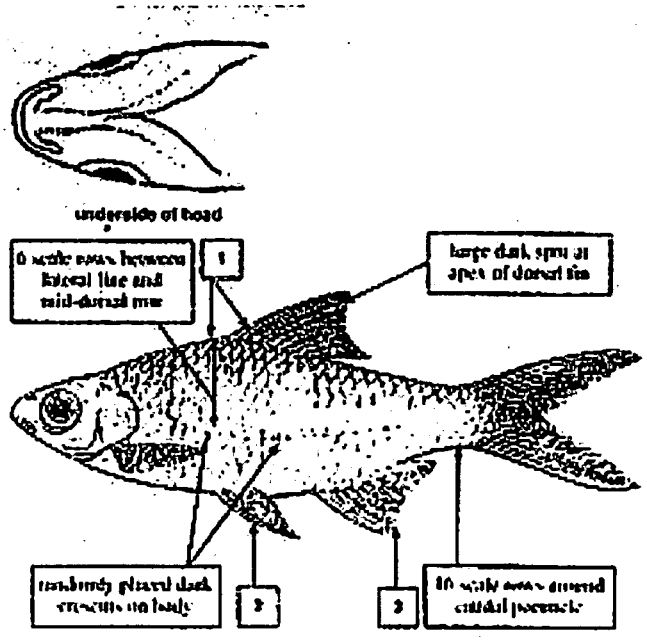


1.2.6. Genus *Mystacoleucus.*

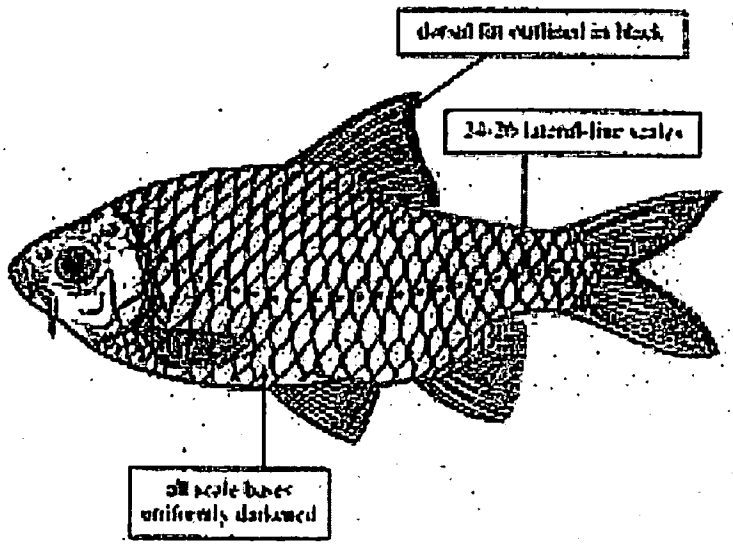
(1) SERRATED DORSAL-FIN SPINE PRECEDED BY A HORIZONTAL SPINE PROJECTING FROM THE SKIN AT THE DORSAL-FIN ORIGIN;
(2) 8 BRANCHED PELVIC-FIN RAYS;
(3) 7 TO 10 BRANCHED ANAL- FIN RAYS.

1.2.6.1. *Mystacoleucus atridorsalis* (Fowler, 1937)
Size: To 7 cm.
Habitat, biology, and fisheries: Apparently a Mekong endemic, occurring at bottom depths over gravel in places with fairly strong currents. Found in the main stream of the middle Mekong with populations in fast flowing forest streams. Feeds on worms, insect larvae, and crustaceans living in bottom sediments, along with algae. Taken with seines, cast-nets, and traVidthayanon & Collaeques, 1997. There is another undescribed species in the middle Mekong that resembles *M.atridorsalis*. The undescribed species has 27 to

29 lateral-line scales, 14 scale rows around the caudal peduncle, and 5 scale rows between the lateral line and the mid-dorsal scale row at the dorsal - fin origin. Fowler's original description of *M. atridosalis* fits one form and his illustration fish the other. Both are provisionally included here as a single species.



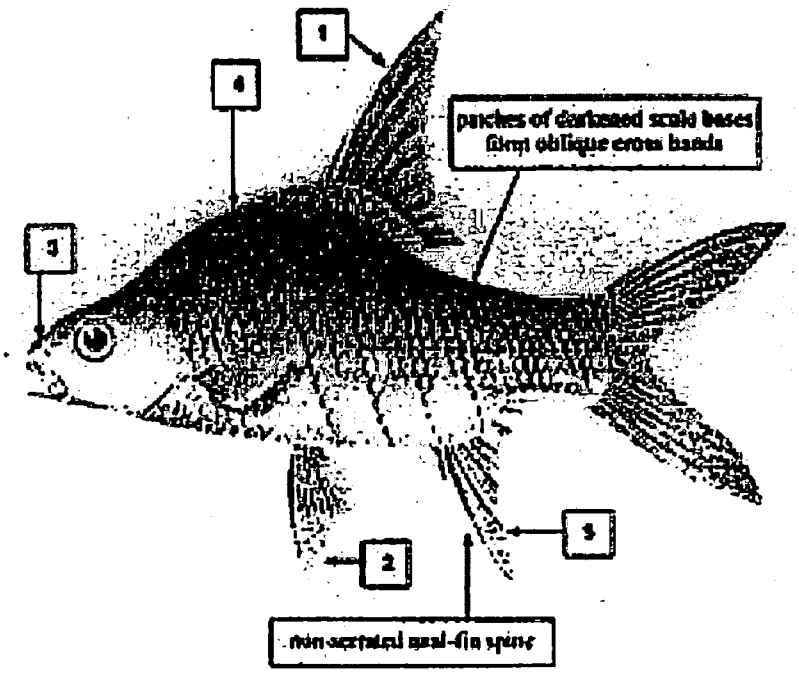
1.2.6.2. ***Mystacoleucus marginatus*** (Valeneiennes, 1842)
Synonyms/misidentifications: ***Mystacoleucus chilopterus.***
Size: To 20 cm, commonly to about 10 cm.
Habitat, biology, and fisheries: Found at bottom depths of rivers and strems from Indonesia to Thailand. Inhabits areas with sand or pea-gravel from small streams to large rivers including the main stream of the Mekong. Apparently, this species breeds when water levels begin to rise (Smith, 1945), but whether it leaves permanent water or not is unknown. Diet is similar to that of *M. atridorsalis.* Taken with seines, cast-nets and traVidthayanon & Collaeques, 1997, and occasionally seen in markets.



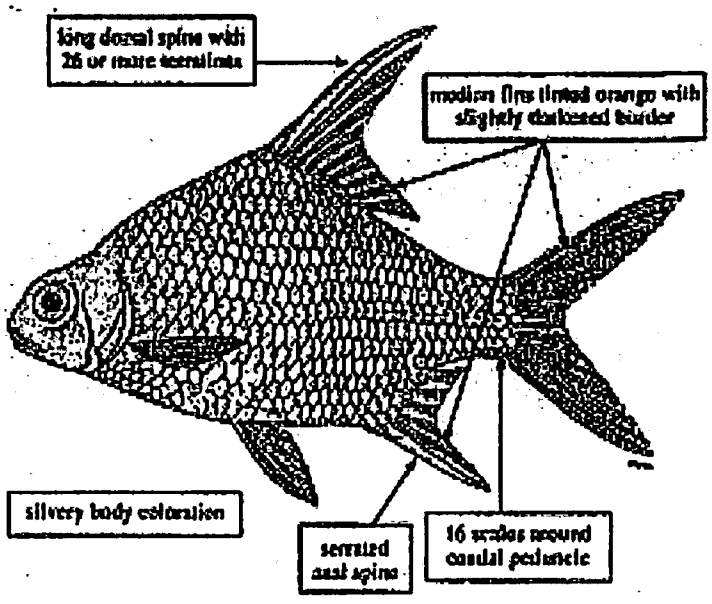
1.2.7. Genus *Puntioplites*.

(1) SERRATED DORSAL - FIN SPINE;
(2) 9 BRANCHED PELVIC-FIN RAYS;
(3) SNOUT BLUNT;
(4) BODY DEEP AND STRONGLY COMPRESSED;
(5) UNBRANCHED ANAL-FIN RAY ENLARGED AND HARDENED INTO A SPINE THAT IS SERRATED IN SOME SPECIES.

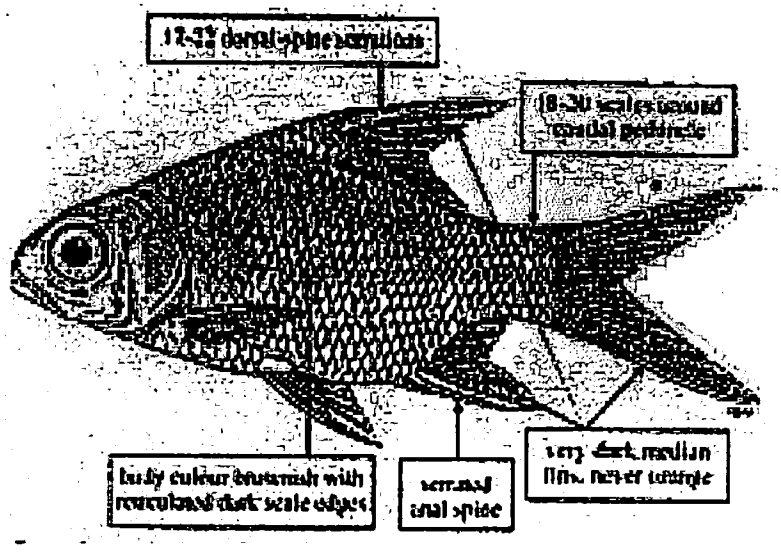
1.2.7.1. *Puntioplites bulu* (Bleeker, 1851)
Synonyms/misidentifications: *Puntius bulu.*
Size: To 35 cm, in Indonesia, to 30 cm. in the Mekong
Habitat, biology, and fisheries: Found at midwater to bottom depths in large lowland rivers and lakes from Indonesia to Cambodia and peninsular Thailand. Formerly common, but very rare in recent years. Moves into flooded forests when water-levels are high, feeding mostly on submerged plants along with some filamentous algae and insects that occur on the plants. Returns to the Tonl— Sap in October where it formerly was taken in the dai fishery (Blache and Goossens, 1954). Previously also common in the Great Lake (Fily and Aubenton, 1966) where it was an important part of the catch by the large traVidthayanon & Collaeques, 1997. Its precipitous decline markes it a candidate for listing by the IUCN.



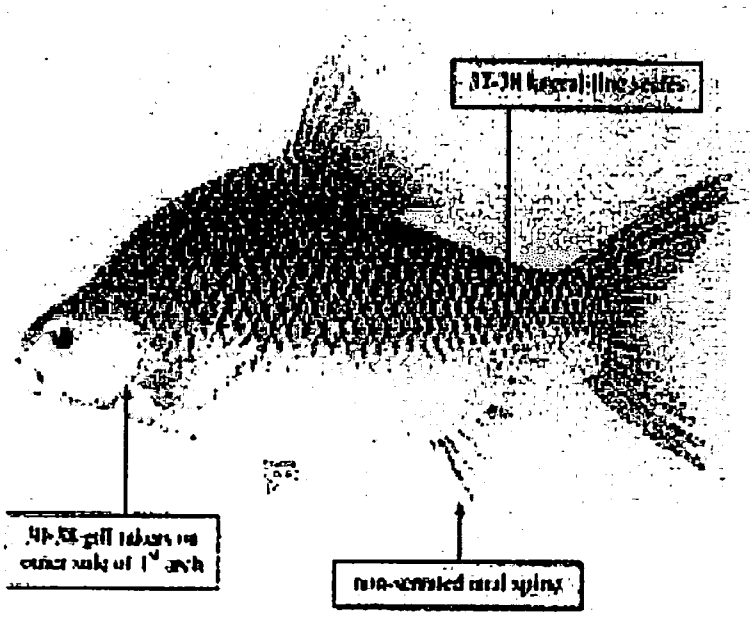
1.2.7.2. *Puntioplites falcifer* (Smith, 1929)
Synonyms/misidentifications: *Puntioplites proctozysron* (non Bleeker).
Sizi: To 35 cm.
Habitat, biology, and fisheries: Described from the Mekong and perhaVidthayanon & Collaeques,1997 endemic to this area where it inhabits large upland rivers. Although common around Stung Treng, it does not seem to occur in the Great Lake, and seems to avoid standing water. Little is known about its biology. Like other members of the genus, it probably feeds mostly on plant matter with occasional insects and insect larvae. Taken with seines and gill-nets, and sold fresh in markets.



1.2.7.3. ***Puntioplites proctozysron*** (Bleeker, 1865)
Size: To 25 cm.
Habitat, biology, and fisheries: A common species in standing and slowly moving water. Found in streams, cannals ditches, and reservoirs from Malaysia to northern Thailand, in cluding Cambodia and Vietnam Moves into flooded forests as well as into marshes during high-water periods. Usually found around submerged aquatic or inundated terrestrial vegetation where it consumes some algae.,but mostly insects and zooplankton. It begins to return to the Tonl— Sap in October and becomes progressively more abundant until January, when its numbers begin to taper off. Caught with seines gill - nets, set-nets, and traVidthayanon & Collaeques, 1997. Larger individuals are marketed fresh, smaller ones are used ones are used to make prahoc along the Tonl— Sap.



1.2.7.4. ***Puntioplites waandersi*** (Bleeker, 1858-59)
Size: To 30 cm in Indonesia, up to 25 cm. in the lower Mekong.
Habitat, Biology, and fisheries: Known in the lower Mekong from large river habitats, but generally rare. Ranges from the Great Lake of Cambodia downstream to Vietnam, and on to Indonesia. The specimens from the lower Mekong have characteristics identical to those from Indonesia, but appear to be distinct from a similar undiscribed species known only from the middle Mekong. Only a few specimens of this species were encountered during the surveys in support of the present field guide. A primarily hervbivorous species, feeding on aquatic macrophytes, inundated terrestrial vegetation, and filamentous algae along with some insects (Vaas, 1953). Nothing is known about its migratory habits or breeding behaviour in the Mekong. Its biology is probably similar to other members of the genus. Unlike *P. bulu* which has declined seriously, there is no information available if this species is experiencing any similar trends in the Mekong. Taken by seines, set-nets, or traVidthayanon & Collaeques, 1997.

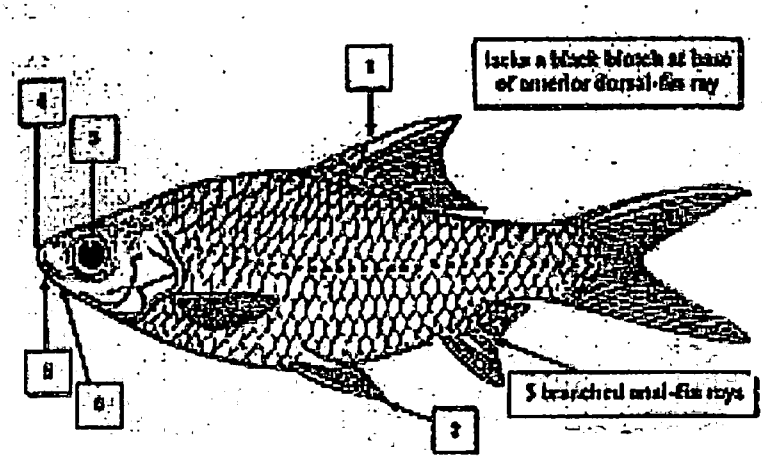


1.2.8. Genus *Sikukia*

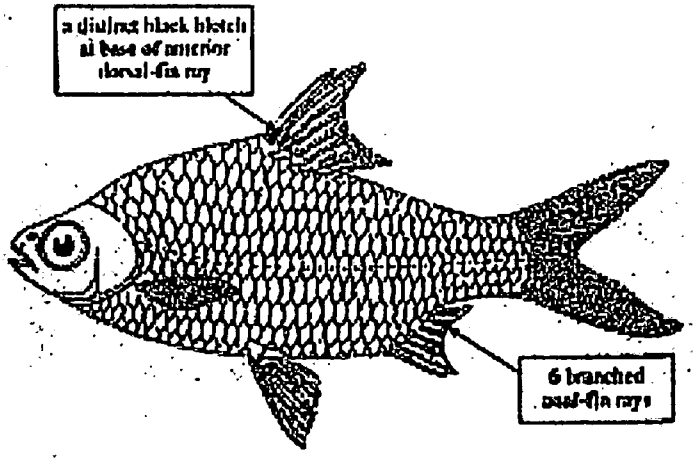
(1) SERRATED DORSAL - FIN SPINE;
(2) 8 BRANCHED PELVIC - FIN RAYS;
(3) ADIPOSE EYELID PRESENT,BUT WEAKLY DEVELOPED;
(4) SHORT BLUNT SNOUT;
(5) MOUTH SMALL AND SUBTERMINAL, WITH A SYMPHYSEAL TUBERCLE ON LOWER JAW;
(6) NO BARBELS.

1.2.8.1. *Sikukia gudgeri* (Smoth, 1934)

Synonyms/misdentification: *Xenocheilichthys gudgeri.*
Size: To 18 cm.
Habitat, biology, and fisheries: Found in large upland rivers of the Mekong and Chao Phraya basins,usually occurring near the bottom of the channel over sand substrate. Although often quite abundant, it is frequently overlooked and rarely recorded because of its rather nondescript appearance and its occurrence along the very bottom of the river over sand substrate. Taken in large numbers by trawls and haulseines in the middle Mekong along the Thai-LAO border. All specimens examined had mouths full of sand which is strained for detritus, diatoms, algae, worms, and other organisms. The gut often contains sand that may be swallowed inadvertantly. This species is always found in flowing water and little is known about its migratory habitats.It is apparently replaced in the lower Mekong by *S.stejnegeri.* Usually sold fresh in the market at Stung Treng.



1.2.8.2. ***Sikukia stejnegeri*** (Smith,1931)
Synonyms/misidentifications: *Xenocheilichthys loppei.*
Size: To 12 cm.
Habitat, biology, and fisheries: Found in lowland rivers of the Mekong and Chao Phraya basins. Rarely occuring in large numbers like *S. gudgeri,* but much easier to recognize. Little is known about the biology of this species. Reported to be herbivorous by Taki (1978). Taken most often in traVidthayanon & Collaeques, 1997 and set-nets. Used to make prahoc along the Tonle Sap.



1.3 Tribe Poro punti.

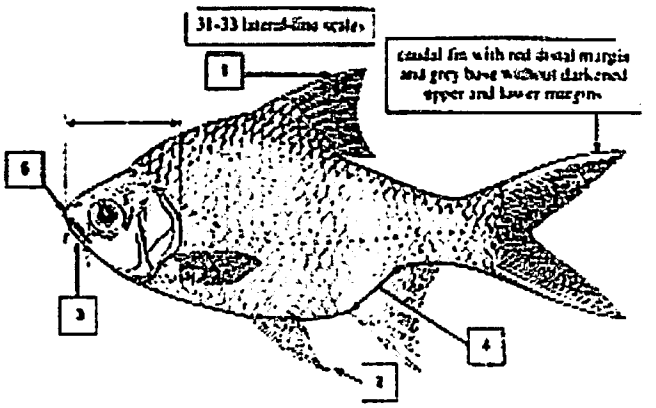
- Scale radii appearing as simple fissures parallel or diverging, but not reaching the scale fucus. Lower lip, when pressent, separrated from lower jaw by wellmarked furrow. Lower lip often reduced or absent medially. Some froms with a sharp, karatinous edge on the lower jaw. Several genera.

- Have only 5 genus and 13 species reported by Walter J. rainboth., 1996.

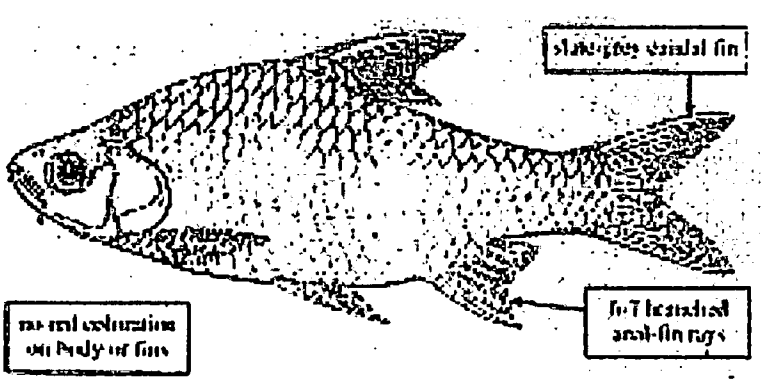
1.3.1.Genus *Barbodes.*

(1) SERATED DORSAL-FIN SPINE;
(2) 8 BRANCHED PELVIC-FIN RAYS;
(3) SKIN OF LOWER LIP SEPARATED FROM LOWER JAW BY A SHALLOW GROOVE;
(4) ANAL-FIN BASE LONG, 90% OF HEAD LENGTH;
(5) NO TURBERCLES ON SNOUT.

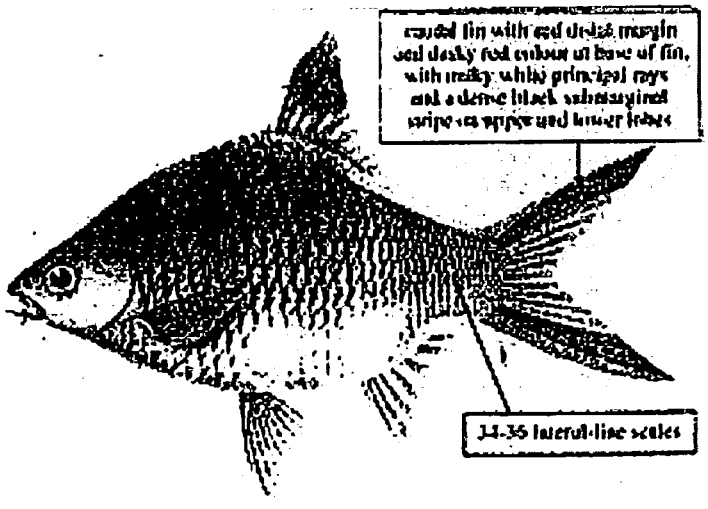
1.3.1.1. ***Barbodes altus*** (Gunther, 1868)
Synonyms/misidentifications: *Puntius altus, Puntius foxi.*
Size: To 20 cm,commonly to about 15 cm.
Habitat, biology, and fisheries: Known only from the Mekong and Chao Phraya. Found at midwater depths in large and medium-sized rivers and floodplains. Feeds on a wide varity of animal and plant matter. Particularly common near villages where it feeds on organic detritus disposed of by humans. Colonizes inundated forest and adults migrate back to the river in October. Young of the year follow in the next few months as water levels recede. Caught with seines, set-nets, and traVidthayanon & Collaeques, 1997. An important food-fish,cultured in floating cages in Vietnam. Large individauls are marketed fresh, smaller ones are used to make prahoc and nuoc mam. Also a popular fish in the aquarium trade where it is sold under the name of "tinfoil barb", the same name that is applied to *B. schwanefeldi.*



1.3.1.2. ***Barbodes gonionotus*** (Bleeker, 1850)
Synonyms/misidentification: *Puntius gonionotus, Puntius javanicus, Puntius jolarmaki, Puntius viehoeveri.*
FAO name: Tawes.
Size: To 33 cm.
Habitat, biology, and fisheries: Commonly occuring from Thailand through Indonesia. Found at midwater to bottom depths in rivers, streams, floodplains, and occasionally in reservoirs. Seems to prefer standing water habitats instead of flowing waters. Not commonly taken in the dai nets of the Tonl— Sap,but much more likely to be caught in the large traVidthayanon & Collaeques, 1997 of the Great Lake. Feeds on both plant and animal matter, and inhabits the flooded forest during periods of high water. Taken with seines, gill-nets, set-nets, and traVidthayanon & Collaeques, 1997. Usually marketed fresh. Occasionally seen in the aquarium trade,but its nondescript coloration and lethargic habits have limited its popularity.



1.3.1.3. ***Barbodes schwanefeldi*** (Bleeker, 1853)
Synonyms/misidentifications: *Puntius schwanefeldi.*
FAO name: Tinfoil barb.
Size: To 35 cm.commonly to about 25 cm.
Habitat, biology, and fisheries: Known from Thailand through Indonesia. Found in rivers streams, canals, and ditches. Seems to be slightly less common than *B. altus,*and is found in the same habitats. Largely herbivorous, consuming aquatic macrophytes and submerged land plants, as well as filamentous algae and occasionally insects. Also feeds on small fishes. Usually marketed fresh. The latin name for this special is sometimes spelled *"schwanefeldi"* based on Bleeker's mis-spelling of Dr. Schwanefeldi's name in the original description, a mistake Bleeker subsequently corrected.

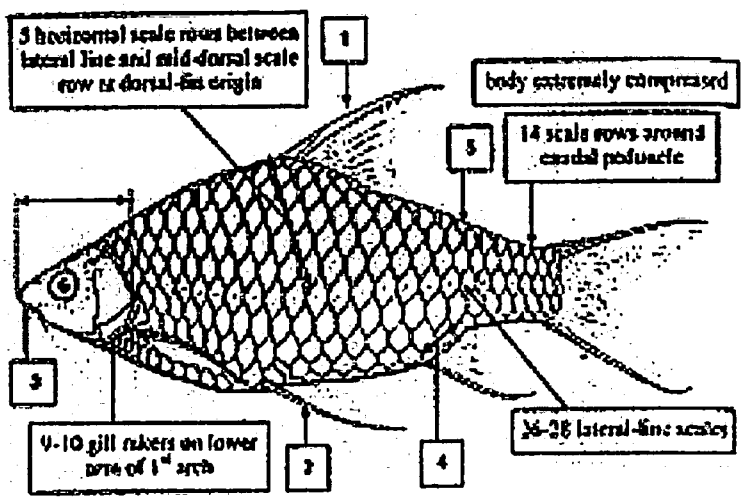


1.3.2. Genus *HyVidthayanon & Collaeques, 1997ibarbus*

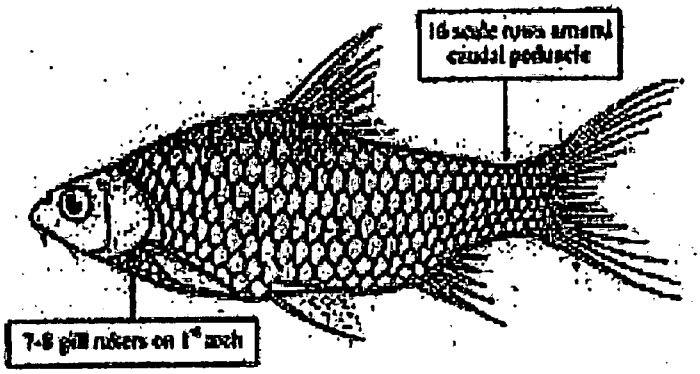
(1) SERATED DORSAL-FIN SPINE;
(2) BRANCHED PELVIC-FIN RAYS;
(3) SKIN OF LOWER LIP DISCONTINUOUS WITH LOWER JAW, SEPARATED BY A SHALLOW GROOVE;
(4) ANAL-FIN BASE 60% OF HEAD LENGTH;
(5) BLACK SCALE MARGINS GIVE A RETICULATED COLLOUR PATTERN

1.3.2.1. ***HyVidthayanon & Collaeques, 1997 ibarbus lagleri*** (Rainboth, 1996)
Synonyms/misidentification: *Puntius plerrei* (non Sauvage), *Puntius huguenini* (non Bleeker).
Size: To 40 cm.

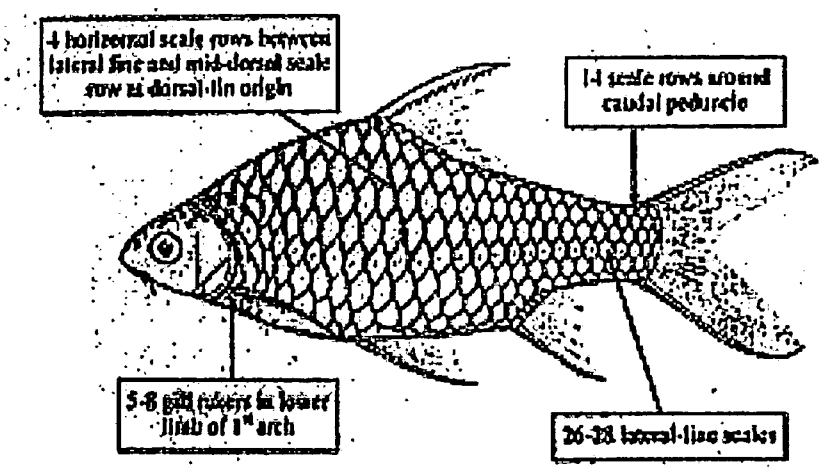
Habitat, biology, and fisheries: Endemic to the middle Mekong, occurring in large rivers in the dry season and moving to medium - sized rivers in the wet season. Found at midwater to bottom depths in clear water. May move into flooded forest habitats immediately adjacent to rivers, but does not occur over fine - grained sediments, priferring rocks intead. Not known to persist in impoundments. Not found in the Tonl© Sap or the Great Lake. Diet consists of zooplankton. Worms, and algae. Caught wit seines, gill-nets, traVidthayanon & Collaeques, 1997, and hook-and-line. Marketed fresh.



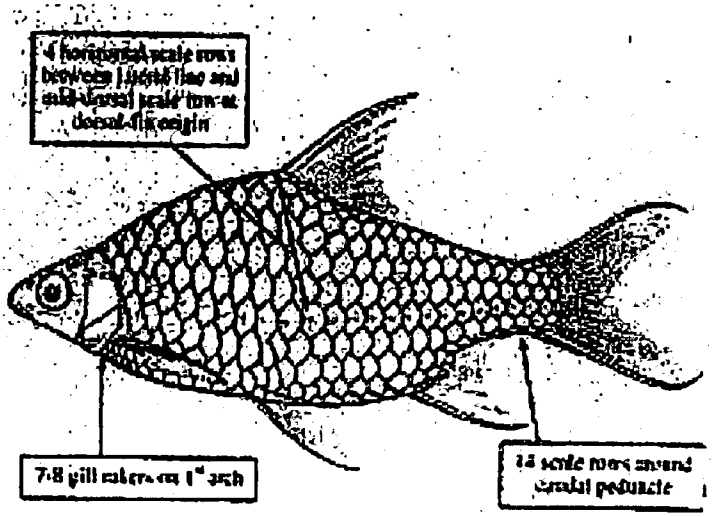
1.3.2.2. *Hysibarbus malcolmi* (Smith, 1945)
Synonym/misidentifications: *Puntius daruphani* (non Smith), *Puntius bramoides* (non Valenciemmes).
FAO name: Goldfin tinfoil barb.
Size: To 50 cm.
Habitat, biology, and fisheries: Known from midwater to bottom depths in large and medium - sized rivers from Cambodia, Thailand, and Malaysia. Found in large rivers in the dry season and moves to medium - sized rivers in the wet season. Breeds at the end of the rainy season, as the water levels fall, young of the year 2 cm length appear in Febuary to March. Usually absent from the lowland parts of the Mekong although it can be found in rapidly flowing tributaries to the lower Mekong. Usually found over coarse substrate. Its guts is usually full of fine matter with occusional insect exoskeleta. Most commom species of the genus. Has not persisted in any impoundments. Taken with seines, gill-nets, and traVidthayanon & Collaeques, 1997. Marketed fresh, ahd also seen in the aquaium trade.



1.3.2.3. *HyVidthayanon & Collaeques, 1997 ibarbus pierei* (Sauvage, 1880)
Size: To at least 30 cm. May grow condiderably larger.
Habitat, biology, and fisheries: Known from the Dong Ngai River (Saigon River) in Vietnam and eastern Cambodia, and the Kelantan River in Malaysia. Possively occurs in the middle Mekong of Cambodia to rivers coming from the Vietnam highlands, but not yet recorded from there. Occurs in medium to large rivers and like other members of the genus it is not likely to persist in impoundments. Taken with seines, gill-nets, and traVidthayanon & Collaeques, 1997.



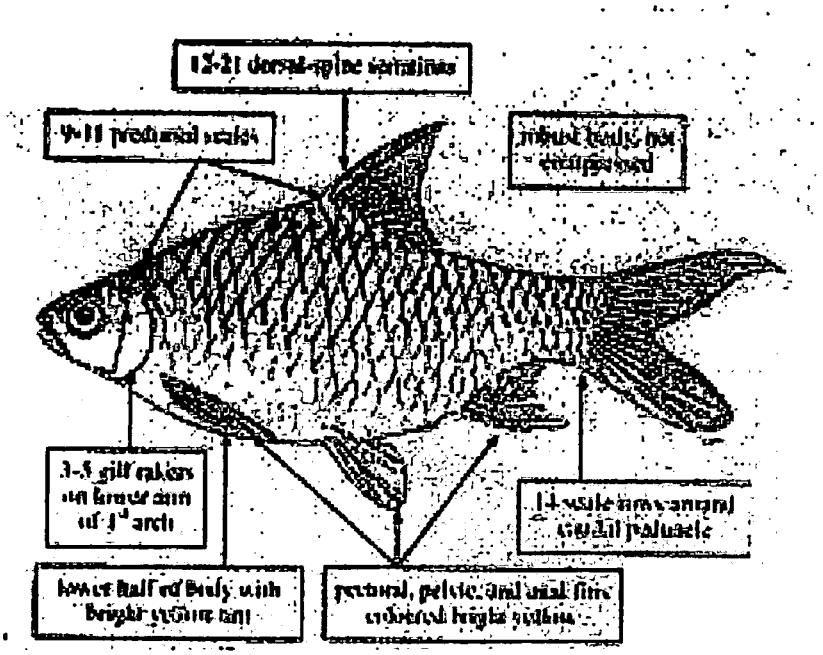
1.3.2.4. *Hysibarbus suvattii* (Rainboth, 1996)
Synonyms/misidentifications: *Puntius daruphani* (non Smith).
Size: To 35 cm.
Habitat, biology, and fisheries: Known from the Mekong of Thailand as well as coastal rivers of the Cardamom moutains in Cambodia and the Dong Ngai River of Vietnam, Possibly occurs in the Mekong but has not yet been recorded from there. Occurs in medium to large upland rivers and does not persist in impoundments. Like other members of the genus, it probably migrates into smaller streams during the rainy season.



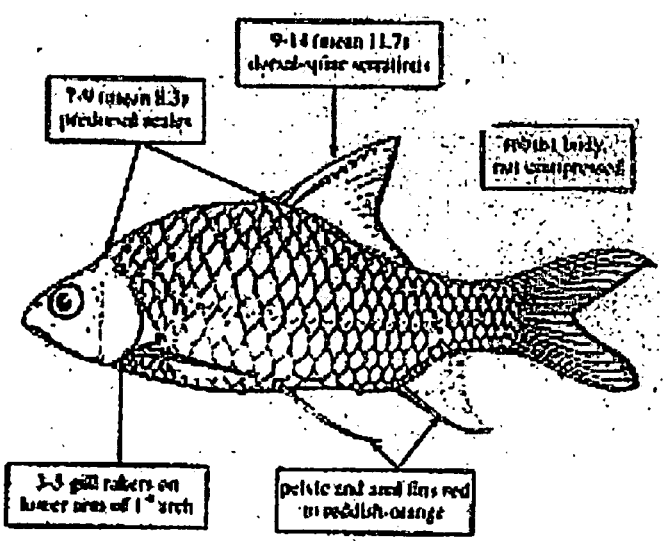
1.3.2.5. *Hysibarbus* sp.cf. *vernayi.*

Size: To 25 cm.

Habitat, biology, and fisheries: Occurs in the upland Mekong of Cambodia and Vietnam in medium-sized rivers. Expected from the Cardamom mountains and may also be found in rivers draining the highlands of Vietnam. Like other members of this genus it probably would not persist in impoundments. This species has characteristics intermediate to *H. vernayi* of the upper Mekong, Chao Phya, and Meklong of Thailand and *H.wetmorei* of the middle Mekong. Chao Phrya, and Meklong and the Pahang of Malaysia. It is not known if this species is found in the middle Mekong with *H. wethmorei.* During a recent revision of this genus (Rainboth, 1996), two small juveniles of thes species were encountered in European museums. It was not possible to identify these specimens as a known species, and assitional material is needed to describe these species. Caught with traVidthayanon & Collaeques, 1997, gill-nets, and by hook - and - line. Marketed fresh in northern Cambodia.



1.3.2.6. ***Hysibarbus wetmorei*** (Smith, 1931)
Synonyms/misidentifications: *Puntius daruphani, Puntius beasleyi.*
Size: to 25 cm.
Habitat, biology, and fisheries: Found at midwater to bottom depths of medium-sized streams in forests and occasionally in the main stream of the Mekong. Not known to migrate, but may move uVidthayanon & Collaeques, 1997 tream during periods of high water levels. Does not tolerate impoundments. Taken by seines gill-nets, and traVidthayanon & Collaeques, 1997. Most likely sold fresh like other members of the genus.

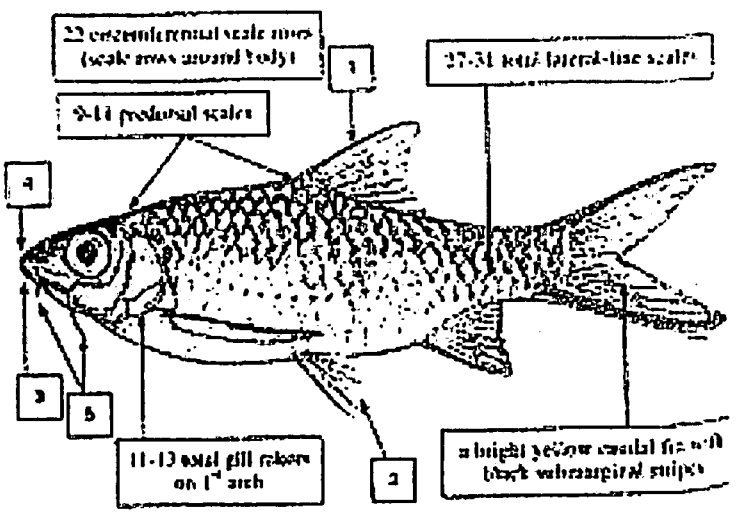


1.3.3.Genus *Poropuntius.*

(1) SERRATED DORSAL-FIN SPINE;
(2) 8 BRANCHED PELVIC-FIN RAYS;
(3) LOWER JAW OCCASIONALLY SHARP AT ITS TIP, BUT LIVIDTHAYANON & COLLAEQUES, 1997 ARE PRESENT AND PRESENT AND JUST SLIGHTLY REDUCED AT THE SYMPHYS;
(4) TIPAND SIDES OF SNOUT USUALLY COVERED WITH TUBERCLES;
(5) 4 WELL DEVELOPED BARBLES PRESENT.

1.3.3.1. *Poropuntius deauratus* (Valenciennes, 1842)

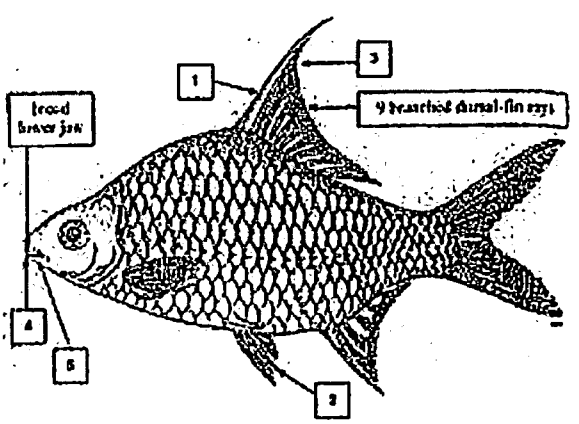
Synonyms/misidentifications: *Poropuntius nomani, Acrossochellus deauratus.*
Size: to 15 cm.
Habitat, biology, and fisheries: Found in clear forest streams, and sometimes large clear rivers from Thailand, Cambodia,and Vietnam. Does not persist in impoundments. Its long gut is usually packed with fine debris, mostly detritus, algae and diatoms, with occasional insect exokeleta, mainly chironomids. Taken with seines, cast-nets, and traVidthayanon & Collaeques, 1997. Occasionally marketed fresh and sometimes seen in the aquarium trade. *P. deauratus* is most similar to an undescribed species that occurs in the coastal drainages of the Cardamom Moutains, and probably also on the Mekong side. The undescribed species has 14 to 18 total gill rakers on the first arch 25 to 28 total lateral-line scales, 20 to 22 circumferential scale row, 10 to 12 predorsal scales, and a dark grey caudal fin with black submarginal stripes, the colour of caudal fin is undocumented in the undescribed species.



1.3.4.Genus *ScaphogenathoVidthayanon & Collaeques, 1997.*

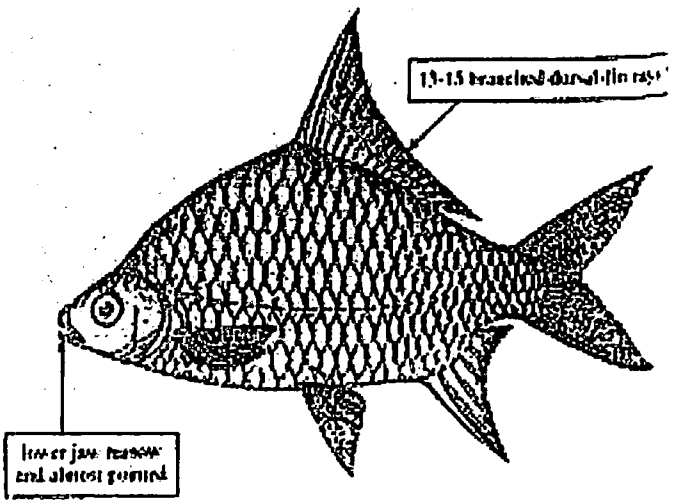
(1) SERRATED DORSAL-FIN SPINE;
(2) 8 BRANCHED PELVIC-FIN RAYS;
(3) 9 TO 15 BRANCHED DORSAL-FIN RAYS;
(4) LOWER JAW SHARP AT TIP, LOWER LIP PRESENT AT CORNERS OF THE MOUTH;
(5) NO BARBELS.

1.3.4.1. *ScaphognatoVidthayanon & Collaeques, 1997 bandunensis* (Boonysratpalin and Srirungroj, 1971)
Synonyms/misidentifications: *Scaphog nathoVidthayanon & Collaeques, 1997 mekongensis.*
Size : To 20 cm.
Habitat, biology, and fisheries: Endemic to the middle Mekong where it lives in the main stream during the dry season. Migrates to smaller streams or floodplanis during the rainy season. It has not been found in any impoundments. Omnivorous, feeding on detritus, periphuton, worms, and insects. Breeds at the end of the rainy season, as water levels fall, young of the yeat reaching about 2 cm by late February. Taken with seines, cast nets, gill-nets and traVidthayanon & Collaeques, 1997. Marketed fresh.



1.3.4.2. *ScaphognathoVidthayanon & Collaeques, 1997 stejnegeri* (Smith, 1931)
Size: To 25 cm.
Habitat, biology, and fisheries: Known only from large river habitats in the middle Mekong where it is much rarer than S. Bandanensis. Apparently breeds a couple of months after *S. bandanensis* (Taki, 1978). Not known to migrate, although it probably leaves the main stream for flooded forests during the periods of high - water. It has not been found in any impoundments. Omnovorous, feeding on detritus and algae along with

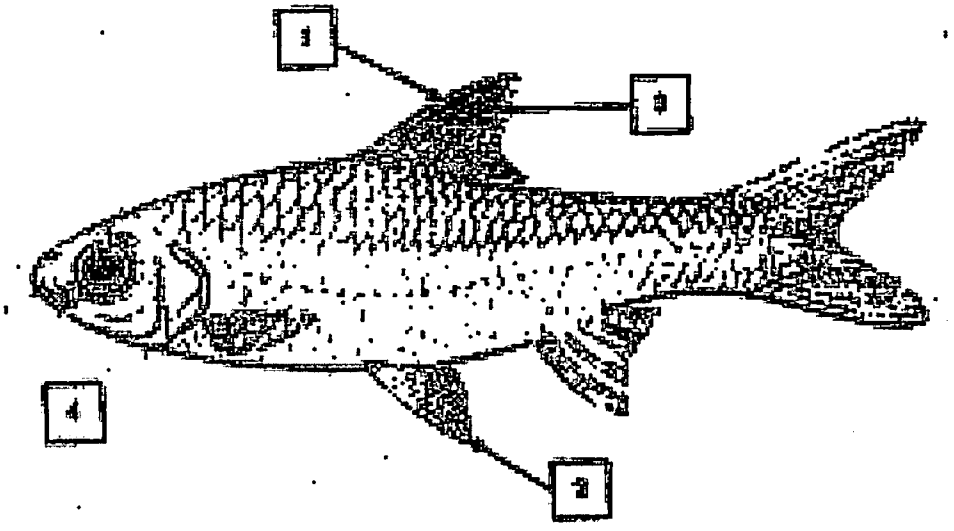
worms, crustaceans, and insects. Taken with seines, cast-nets, and gill-nets. Maketed fresh.



1.3.5. Genus *Dischérodontus.*

(1) SERRATED DORSAL - FIN SPONE;
(2) 8 PRANCHED PELVIC-FIN RAYS;
(3) TIP OF DORSAL FIN DARKENED;
(4) PHARYINGEAL TEETH IN 2 ROW.

1.3.5.1. ***Disherodontus ashmeadi*** (Fowler, 1937)
FAO name : Redtail barb
Size : To 11 cm.
Habitat, biology, and fisheries: Endemic to the middle Mekong. Occurs near the bottom in pools of small to medium-sized rivers. Typically found near decaying plant debris where it feeds on insects and other invertebrates. Possibly moves out into flooded forests during high-water periods. Apparently found in localized population and encountered sporadically. Taken with seines, cast-net, and small-mesh gill-nets. Rarely seen in markets.



1.4. Tribe Systomi

- Scale radii straight, their margins with heavy tissue deposition, diverging spoke - like from the scale focus. Lower lip always complete. Lower jaw never developing a keratinous edge. Several genera.

- Have only 3 genus and 8 species reported by Walter J. Rainboth, 1996.

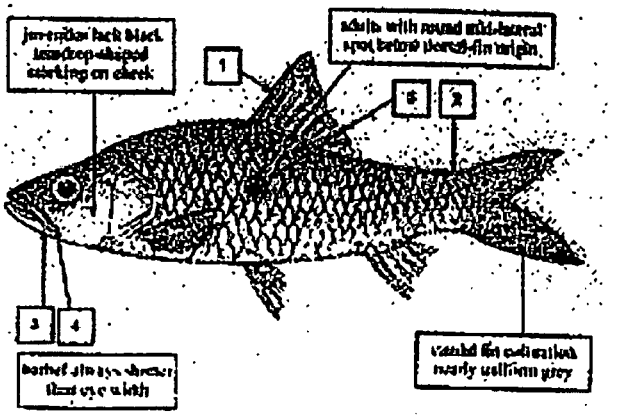
1.4.1. Genus *Hampala.*

(1) SERRATED DORSAL-FIN SPINE;
(2) 12 SCALE ROWS AROUND THE CAUDAL PEDUNCLE;
(3) 2 LARGE MAXILLARY BARBELS (1 PER SIDE);
(4) MOUTH LARGE, EXTENDING BACK PAST THE ANTERIOR MARGIN OF THE EYE;
(5) A SINGLE BLACK BAR OR A LARGTE SPOT BELOW THE DORSAL-FIN ORIGIN.

1.4.1.1. *Hampala dispar* (Smith, 1934)

Size: To 35 cm.

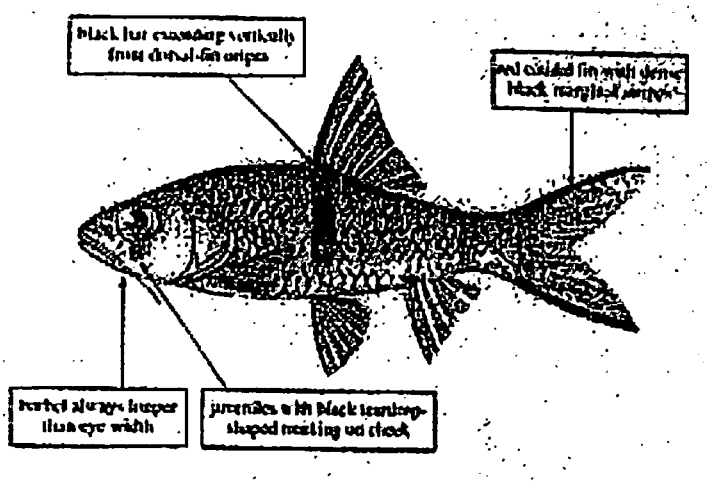
Habitat, biology, and fisheries: Apparently a Mekong endemic, found in slowly moving or standing water habitats of Thailand and Cambodia. Common in impoundments, with small individuals frequenting areas of dense vegetation. Breeds at the beginning of the rainy season and the young are found in seasonally flooded habitats in June. Feeds on some fishes, but mostly prawns, crabs and shrimVidthayanon & Collaeques, 1997 along with some insect larvae. Taken with seines, cast-nets, gill-nets and traVidthayanon & Collaeques, 1997. Marketed fresh.



1.4.1.2. ***Hapala macrolepidota*** (Valenciennes, 1842)

Size: To 70 cm. Commonly to about 35 cm.

Habitat, biology, and fisheries: Found in flowing and standing waters from Thailand to Indonesia. Not as commom as *H. dispar* in the middle Mekong , but more common in the lower Mekong. Frequently found in impoundments. Breeds throughtout the rainy season. Adults feed almost exclusively on fish. Taken with seines, cast-nets, gill-nets, and hook-and- line. Marketed fresh.

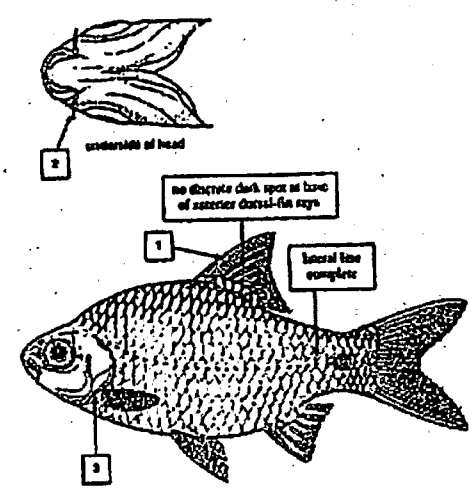


1.4.2. Genus *Puntius*.

(1) SMOOTH DORSAL - FIN SPINE;
(2) 2 MAXILLARY BARBELS (1 PER SIDE);
(3) GILL RAKERS 12 TO 20 ON FIRST ARCH.

1.4.2.1. *Puntius brevis* (Bleeker, 1860)

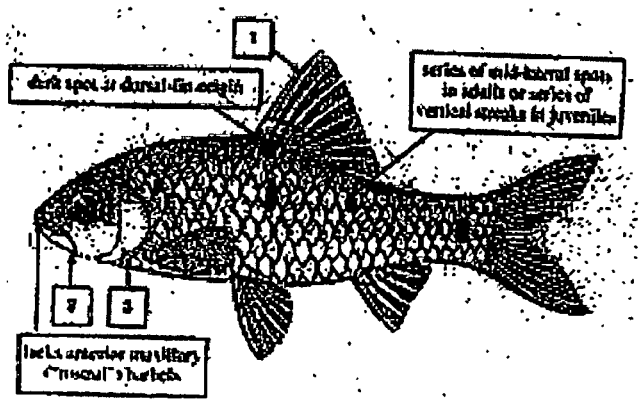
Synonyms/misidentification: *puntius leiacanthus, Puntius sophoroides* (non Gunther), *Puntius puntio* (non Hamilton).
FAO name: Sawamp barb.
Size: To 12 cm.
Habitat, biology, and fisheries: Found in floodplains, canals, ditches, and small sluggish streams from Indonesia to Thailand. Proliferates in impoundments, and inhasbits areas with abundant aquatic vegetation. Eats tustaceans, tbuficid worms, algae, and zooplankton. Move onto newly inundated land at flood season, and spawns there. Caught with seines, cast-nets, and traVidthayanon & Collaeques, 1997. *Puntius leiacanthus*, listed here as a synonym, is possibly a distinct species. Further studies are needed to ascertain its status. The variation in circumpeduncular scale counts noted by Smith (1945) is not known for any other species of the genus *Puntius*, which usually show constant veticale counts.



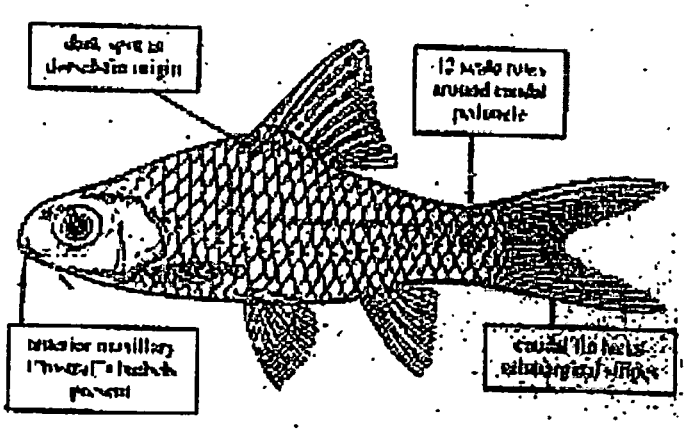
1.4.3. Genus *Systomus*.

(1) FINMELY SERRATED DORSAL-FIN SPINE;
(2) 2 OR 4 BARBELS;
(3) GILL RAKERS FEWER THAN 12 ON FIRST ARCH.

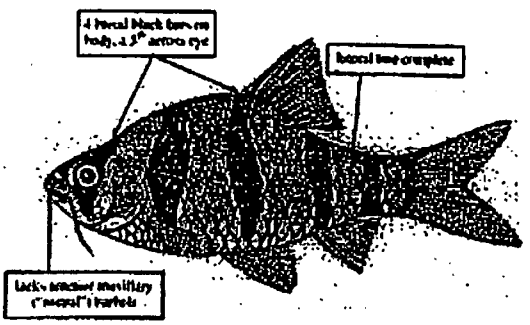
1.4.3.1. ***Systomus aurotaeniatus*** (Tirant, 1885)
Synonyms/misidentifications: *Puntius stigmatosomus, Puntius pessuliferus, puntius sametesis.*
Size : To 6 cm.
Habitat, biology, and fisheries : Found in small flowing streams, canals, ditches, and occasionally impoundments. Known from the middle and lower Mekong, the Chao Phryaa, and the small coastal drainages of the Gulf of Thailand. Feeds primarily on Zooplankton and insect larvae. Spawns during the rainy season. Half - grown young are caught in March. Taken wtith seines, cast-nets and traVidthayanon & Collaeques, 1997.



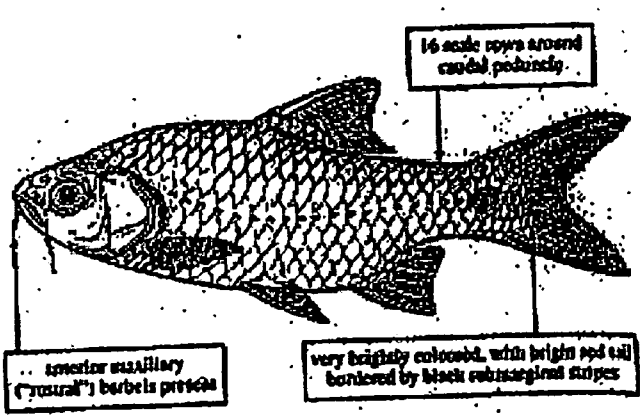
1.4.3.2. ***Systomus binotatus*** (Valenciennes, 1842)
Size: To 20 cm. but usually about 10 cm.
Habitat, biology, and fisheries: Found in small flowing streams, often in uplands and on islands from the middle Mekong of Thailand through Indonesia. Lives in stream headwaters and is most often found in isolated freshwater habitats on islands of the continentalsnelf. Probably does not migrate. Found in middle to bottom depths in fairly shallow waters where it feeds on zooplankton, insect larvae and some vascular plants. taken with seines, cast-nets, and traVidthayanon & Collaeques, 1997.



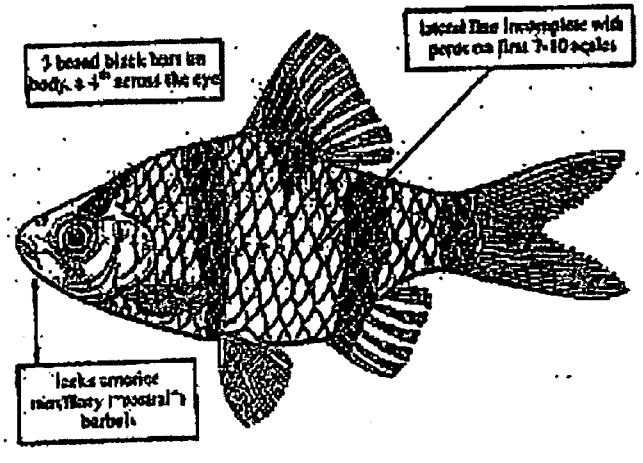
1.4.3.3. *Systomus johorensis* (Duncker, 1904)
Synonyms/misidentifications: *Puntius hexazona. Puntius pentazona* (non Boulenger).
Size : To 5.5 cm.
Habitat, biology, and fisheries: Found in small forest streams, ditches,and rivers from the lower Mekong to Sumatra. Usually found near the bottom in shallow waters, where it feeds on zooplankton and insect larvae along with some plant material. Caught with seines, cast-nets, and traVidthayanon & Collaeques, 1997.



1.4.3.4. *Systomus arphoides* (Valenciennes, 1842)
Synonyms/misidentifications: *Puntius sarana* (non Hamilton), *Puntius caudimarginatus. Puntius simus, Puntius jacobusboe hlkei.*
Size: To 25 cm.
Habitat, biology, and fisheries: Found in rivers of all sizes, but primarily in smaller streams, canals, and on floodplains from Thailand to Indonesia. Occasionally found in impoundments, but usually stays in the flowing streams leading to the impoundment. Moves into seasonally inundated areas and breeds at the onset of the rainy season with the young of the year appearing in streams in July and August. Adults leave the floodpains as the water disappears in December or January. Taken in seines cast-nets, and traVidthayanon & Collaeques, 1997 marketed fresh or made into prahoc along the Tonl Sap.



1.4.3.5. *Systomus paritpentazona* (Flowler, 1934)
Synonyms/misidentifications: Puntius partip entazona, Puntius tetrazona (non bleeker).
Size: To 4 cm.
Habitat, biology, and fisheries: Known from midwater to bottom depths of small streams and weedy impoundments in the middle and lower Mekong where it is locally common. Most abundant in impoundments with dense growth of aquatic macrophytes feeds primarity on zooplankton, along with some aquatic insect larvae and plant matter. Taken with seines and cast-nets.



1.5. Tribe Semiplotini

- Reference not enough to report

1.6. Tribe Labeonini

- No epibranchial organ at top of gill carity Vomeropalatine organ present in the roof of the mouth. Up to pairs of barbels or barbels absent. Mouth subterminal to inferior. One or both liVidthayanon & Collaeques, 1997 many be covered with papillae. No spine in dorsal fin.

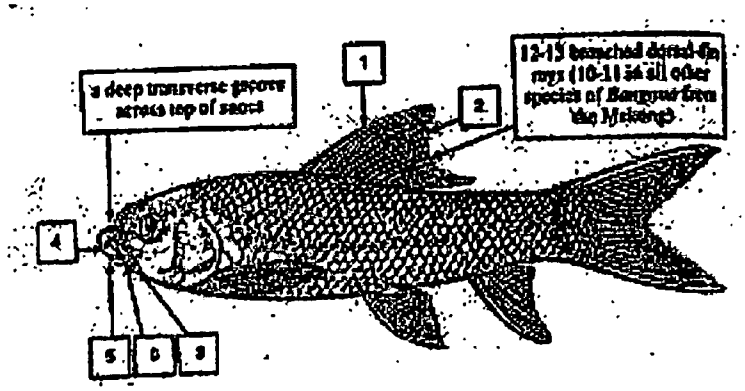
- Have only 6 genus and 18 species reported by Walter J. Rainboth, 1996.

1.6.1. Genus *Bangana*

(1) NO DORSAL-FIN SPINE;
(2) 10 TO 13 BRANCHED DORSAL-FIN RAYS;
(3) ANTERIOR AND POSTERIOR BARBELS OF APPROXIMATELY EQUAL SIZE;
(4) UPPER LIP SMOOTH AND ENTIRE, SEPARATED FROM SNOUT BY DEEP GROOVE;
(5) LOWER LIP THIN, PRESENT AT SIDES OF LOWER JAW;
(6) POSTLABIAL GROOVE BROADLY INTERRUPTED AND PRESENT ONLY AT SIDES OF JAW.

1.6.1.1. *Bangana behri* (Fowler, 1937)

Synonyms/misidentifications: *Labeo behri, Osteochilus tatumi.*
Size : To 40 cm.
Habitat, biology, and fisheries: Known from upland reaches of the Mekong. Although a single specimen was listed from Bangkok in Fowler's original description of *Labeo behri* (1937), many of the species recorded from Bangkok were market specimens. This species is not otherwise known from the Chao phrya, and may be endemic to the Mekong Occurs in rocky stretches of the main stem during the dry season, and moves into tributary streams during high waters. Herbivorous, feeding on algae, phytoplankton, and periphyton. Not known to persist in impoundments. Taken with seines, gill-nets, and cast-nets. Marketed fresh.Several other species of this genus are known from the Mekong, all inhibiting upland rivers. Other species of this genus probably occur in Cambodia. But have not yet been recorded.

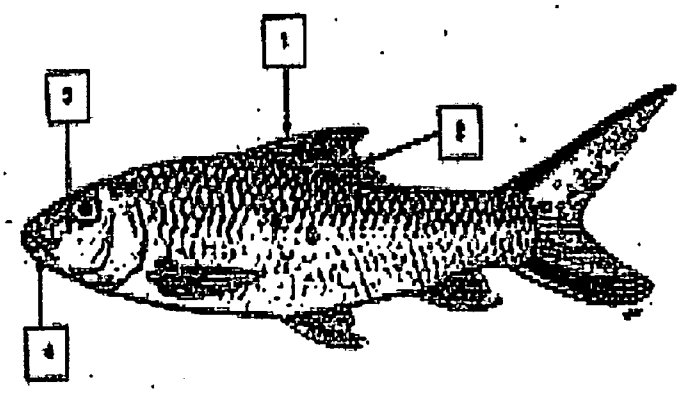


1.6.2. Genus *Barbichthys.*

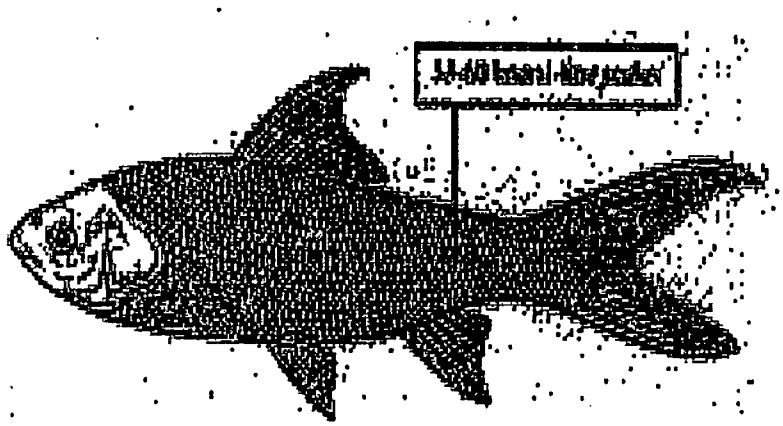
(1) NO DORSAL-FIN SPINE;
(2) 8 BRANCHED BORSAL-FIN RAYS;
(3) BROAD SUBORBITAL BONES COVERING MOST OF CHEEK;

(4) LOWER JAW WITH SMALL SYMPHYSEAL KNOB, FOLLOWED BY A PAIR OF RIDGES ON FLOOR OF MOUTH THAT PROJECT WELL UP INTO MOUTH CAVITY.

1.6.2.1. ***Barbichthys nitidus*** (Sauvage, 1878)
Synonyms/misidentfications: *Barbichthys laevis* (non valenciennes).
Size: To 25 cm.
Habitat, biology, and fisheries: Known from large and medium-sized rivers of Thailand and Cambodia. Occurs in large rivers during the dry season and in floodplain streams and canals during the wet season. Feeds on algae and phytoplankton. Most often seen in the tonl— Sap from October through December as flood waters recede. Formerly common in the Tonl— Sap as reported by Blache and Goossens (1954), but fishermen now report it as rare. Not known to persist in impoundments. Taken with seines, gill-nets, and traVidthayanon & Collaeques, 1997. Not seen in markets. Another species of this genus, Barbichthys laevis, adapts well to aquaria and is occasionally seen in the aquarium trade.



1.6.2.2. ***Cirrhinus microlepis*** (Sauvage, 1878)
Synonyms/misidentifications: *Cirrhinus auratus, Labeo pruol.*
Size: To 65 cm.
Habitat, biology,and fisheries: An important fishery species found in large rivers and lowland floodplains of Thailand, Cambodia, and Vietnam. Moves out into the flooded forest where it feeds on leafy plant matter, phytoplankton, and insects. Returns in large numbers to the Tonle Sap in December, with catch steadily declining as the fishing season progresses. Individuals taken in dais or traVidthayanon & Collaeques, 1997 are often immediately drooed into fish cage and kept alive for future sale. Caught with seines, gill-nets, traVidthayanon & Collaeques, 1997, and hook-and-line. Marketed fresh and sometimes dried and salted in markets. Not known to persist in impoundments.

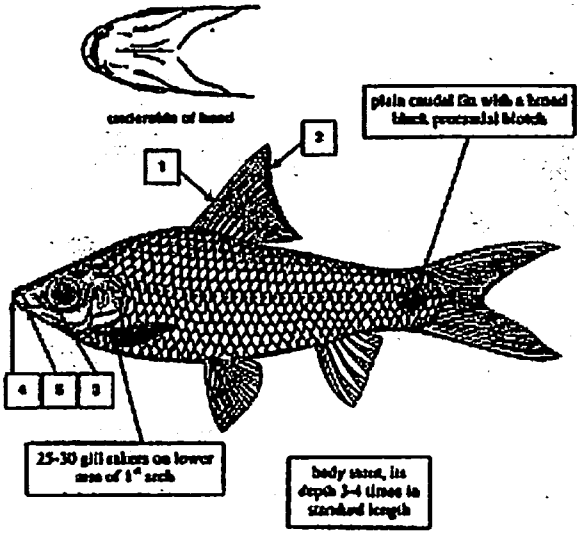


1.6.3. Genus *Henicorhynchus*

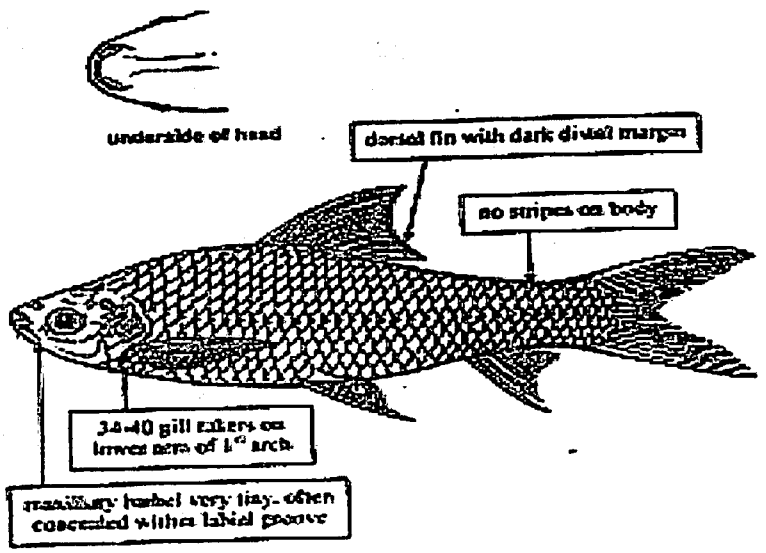
(1) NO DORSAL-FIN SPINE;
(2) 8 BRANCHED DORSAL-FIN RAYS;
(3) SUBORBITAL BONES NARROW;
(4) LOWER JAW WITH A SMALL SYMPHSYSEAL KNOB;
(5) LOWER LIP THIN AND TIGHTLY ATTACHED TO LOWER JAW.

1.6.3.1. *Henicorhynchus caudimaculatus* (Fowler, 1934)

Synonyms/misidentifications: *Cirrhinus jullieni* (non Sauvage), *Tylognathus entema.*
Size: To 13 cm.
Habitat, biology, and fisheries: Found at bottom depths in canals, ditches, and small streams in large river floodplains. Extremely common in central Thailand and expected from the lower Mekong. Most likely to occur in Cambodian rivers that flow into the western end of the Great Lake. Migrations up small rivers and streams and out onto floodplains are well-known in Thailand. Begins to return to permanent waters in October with migration peaking in November and December. Herbivorous, with a diet consisting of phytoplankton, periphyton, bottom algae, detritus, and some zooplankton. Caught with seines, cast-nets, set-nets, and traVidthayanon & Collaeques, 1997. Most likely used to make prahoc.



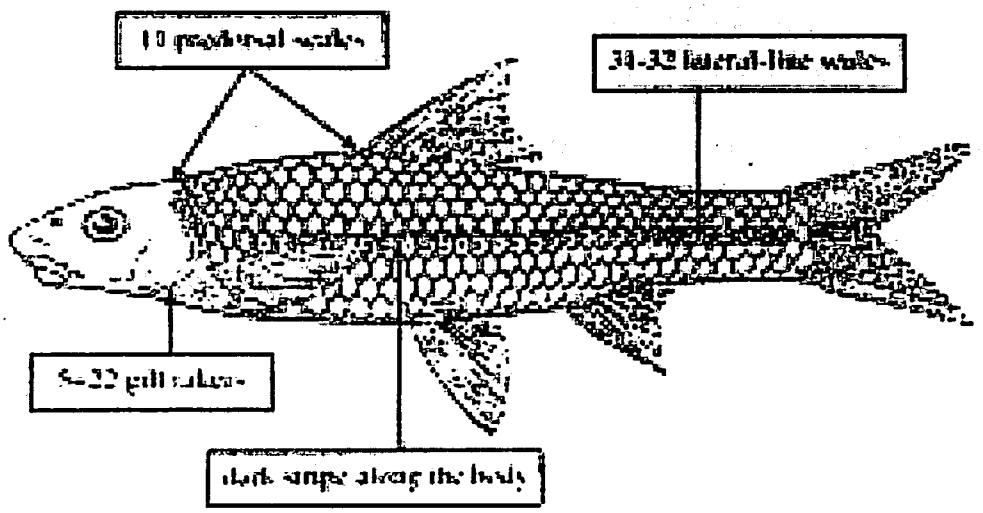
1.6.3.2. ***Henicorhynchus siamensis*** (deBeaufort, 1927)
Synonyms/misidentifications: *Henicorhynchus lobatus,Cirrhinus jullueni* (non Sauvage),? *Crosscheilus thai,*? *Cirrhinus marginipinnis.*
Size: To 20 cm.
Habitat, biology, and fisheries: Found often in great abundance at midwater to bottom depths in large and small rivers in the Mekong and Chao Phrya basins. Well known for its annual trophic migrations out to the floodplains in the wet season. Returns to the rivers as water levels begin to fall in October with numbers increasing through December and then slowly declining. Feeds on algae, periphyton and phytoplankton. Gill rakers are often coated with a thick layer of mucous and specimens are sometimes found with mouths full of fish scales. This is the most important fish in the annual dai (=set-net) fishery on the Tonl— Sap, and quite appropriately, shares its name with the basic unit of Cambodian currency (riel). Not known to prosper in impoundments. Caught with seines. cast-nets, set-nets and traVidthayanon & Collaeques, 1997. Used to make prahoc along the Tonl— Sap. Individuals are often seen in the aquarium trade as juveniles shipped with collections of *Gyrinocheilus* spp.



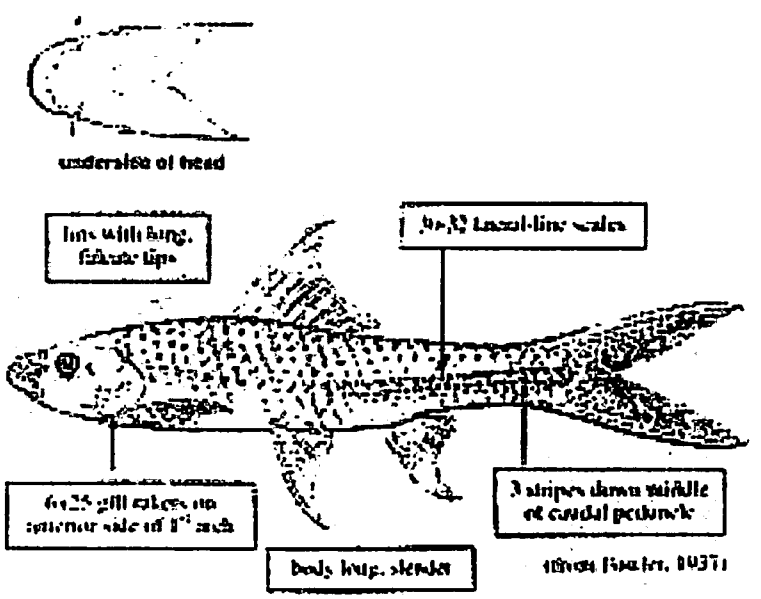
1.6.4. Genus *Lobocheilos.*

(1) NO DORSAL - FIN SPINE;
(2) TO 9 BRANCHED DORSAL - FIN RAYS;
(3) ROSTRAL AND MAXILLARY BARBELS;
(4) LIVIDTHAYANON & COLLAEQUES, 1997 ENTIRE;
(5) LOWER LIP ENLARGED TO FORM A THICK FLESHY PAD THAT COVERS THE LOWER JAW, BUT IS SEPARATED FROM IT BY A DEEP POST - LABIAL GROOVE.

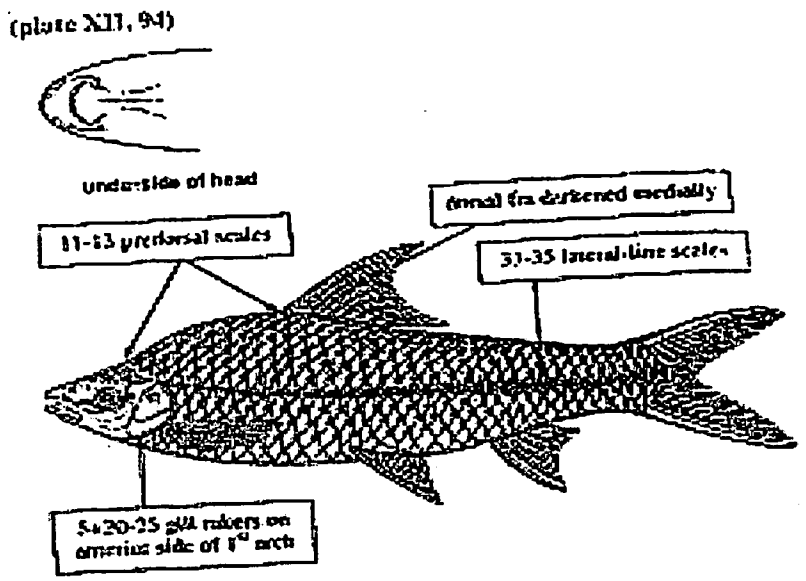
1.6.4.1. ***Lobocheilos delacouri*** (Pellegrin and Fang, 1940)
Synonyms/misidentifications: *Lobocheilus cheveyi.*
Size: To 12 cm. Known, probably grows slightly larger
Habitat, biology, and fisheries: Known from small to medium-sized high-gradient streams of the upper to middle Mekong basin. Likely to be found in similar streams in northern Cambodiao. Diet consists of periphyton and phytoplankton as in other members of the genus. Caught with seines, cast-nets, and traVidthayanon & Collaeques, 1997.



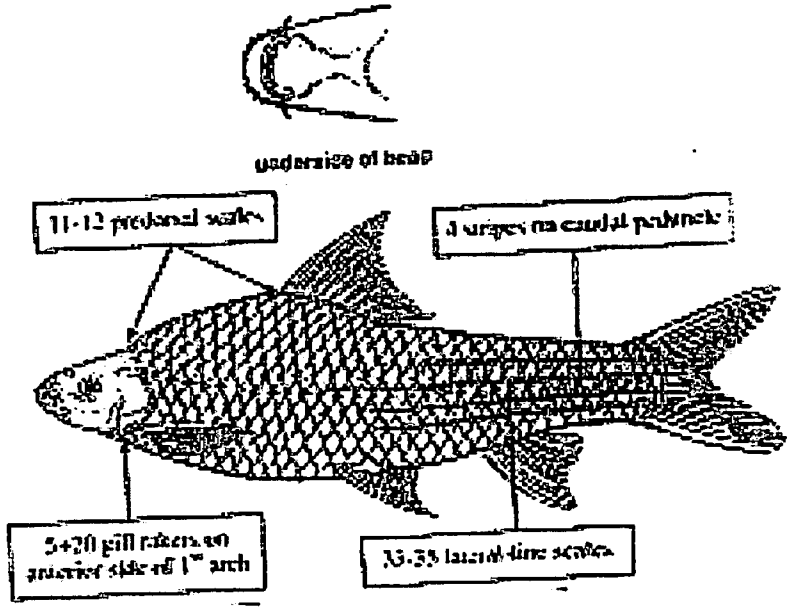
1.6.4.2. ***Lobocheilos gracilis*** (Fowler, 1937)
Size: To 24 cm
Habitat, biology, and fisheries: Found at bottom depths in large and medium-sized rivers of the Chao Phrya and Mekong basins. Although more commonly found in the upper Mekong of Northern Thailand and Laos, probably also occurs in northern Cambodia. Its preferred diet consists of periphyton and phytoplankton. Caught with seines, cast-nets, and traVidthayanon & Collaeques, 1997. Large enough to be marketed fresh, but not yet recorded from Cambodian markets.



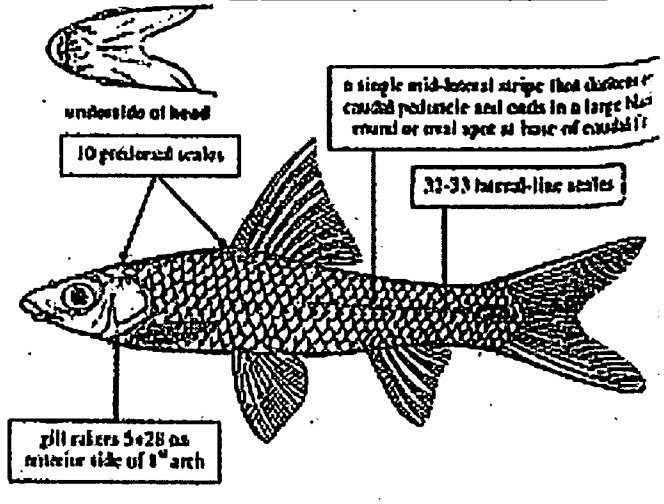
1.6.4.3. *Lobocheilos melanotaenia* (Fowler, 1935)
Synonyms/misdentifications: *Lobocheilus nigrovittatus.*
Size: To 16 cm.
Habitat, biology, and fisheries: Found along the bottom in large and medium-sized rivers of the Chao Phrya and Mekong basins. Returns to the Tonle Sap from the floodplains beginning in November with numbers peaking in December. Based on the size of the young of the year found in January, the species probably spawns at the onset of the rainy season. Feeds on periphyton and phytoplankton which it scrapes from rocks. In the Mekong of northern Cambodia schools of this species were observed to make scrape marks on rocks about 1 cm wide and 7 or 8 cm long. These marks begin at about a depth of 20 cm and become more and more dense on deeper surfaces. In captivity it sometimes feeds on scales of its tankmates. Taken with seines, cast-nets, set-nets, and traVidthayanon & Collaeques, 1997. Used to make nuoc mam. Occasionally seen in the aquarium trade.



1.6.4.4. *Lobocheilos quadrilineatus* (Fowler, 1935)
Size: To 28 cm; alarge species, usually found at sizes greater than 15 cm.
Habitat, biology, and fisheries: Found at bottom depths in large and medium-sized rivers of the Chao Phrya basin as well as streams of the Gulf of Thailand. Expected, but not yet recorded from the lower Mekong. Diet is probably similar to other species of *Lobocheilos.* Caught with seines, cast-nets, and traVidthayanon & Collaeques, 1997.



1.6.4.5. *Lobocheilos rhabdoura* (Fowler, 1934)
Size: To at least 7 cm.
Habitat, biology, and fisheries: Found at bottom depths in large and medium-sized streams in the Chao Phrya and Mekong basins. Probably spawns at the onset of the rainy season, and individuals with a length of 6 cm appear in streams in November and December. Feeds on periphyton and phytoplankton. Taken with seines, cast-nets, set-nets, and traVidthayanon & Collaeques, 1997. Used to make nuoc mam.



1.6.5. Genus *Morulius*

(1) NO DORSAL- FIN SPINE;
(2) 16 TO 17 BRANCHED DORSAL- FIN RAYR;
(3) LARGE ROSTRAL AND MAXIL- LARY BARBELS;
(4) BOTH LIVIDTHAYANON & COLLAEQUES, 1997 FRINGED WITH PAPILLAE;
(5) LOWER LIP SEPARATED FROM ISTHMUS BY DEEP POSTLABIAL GROOVE;
(6) FINS BLACK.

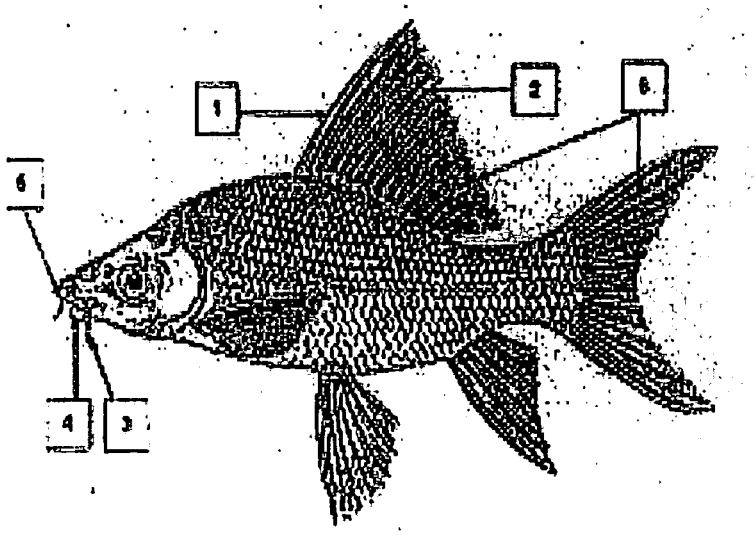
1.6.5.1. *Morulius chrysophekadion* (Bleeker, 1850)

Synonyms/misidentification : *Labeo chrysophekadion, Morulius erythrostictus, Morulius pectoralis.*

FAO name: Black sharkminnow.

Size: To 60 cm.

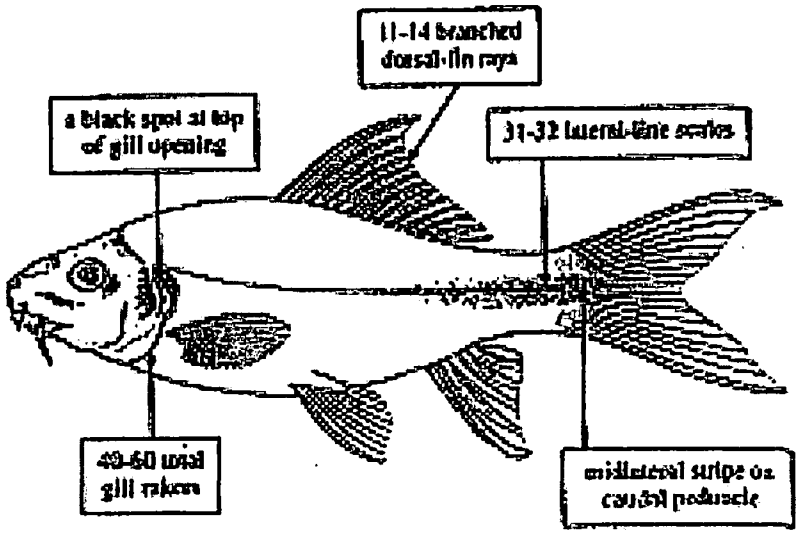
Habitat, biology, and fisheries: known from overs, streams, canals, and inundated floodplains from Thailand to Indonesia. Occasionally seen in impoundments, but not in great numbers. It may have a breeding pattern similar to its closest relative, Morulius calbasu (Hamilton) of Burma and the Indian subcontinent. Like in other large planktivorous and detritivorous carVidthayanon & Collaeques, 1997, spawning begins after the first thunderstorms of the coming rainy season. It spawns just uVidthayanon & Collaeques, 1997tream from shallow sandbars that line long river bends. The eggs settle out in the shallow water and hatch just as water levels begin to rise following the initiation of seasonal rains. The fry immediately move into inundated grasses along the bank and continue to follow the leading edge of advancing water as floodwaters spread over the land. Adults also migrate out into seasonally flooded areas where they feed on algae, periphyton and phytoplankton and detritus. They to return to rivers, including the Tonle Sap, from October to Decembcr. By this time the young of the year have attained a length of about 10 cm. Caught with seines, gill-nets, and traVidthayanon & Collaeques, 1997. A desirable food fish, marketed fresh or dried and salted. Imported in the aquarium trade, but grows extremely fast, quickly outgrowing its tank.



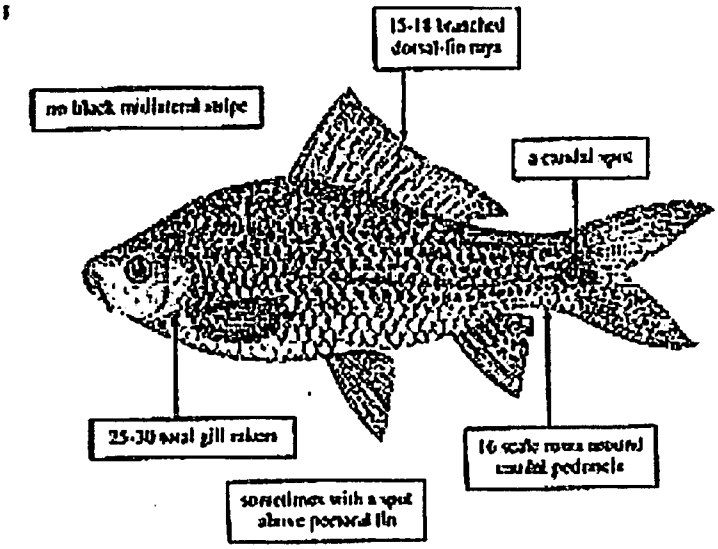
1.6.6. Genus *Osteochilus.*

(1) NO DORSAL FIN SPINE;
(2) 11 TO 18 BRANCHED DORSAL -FIN RAYS;
(3) LARGE ROSTRAL AND MAXILLARY BARBELS;
(4) BOTH LIVIDTHAYANON & COLLAEQUES,1997 FRINGED WITH PARILLAE;
(5) LOWER LIP NOT SEPARATED FROM ISTHMUS BY DEEP POST- LABIAL GROOVE;
(6) MEDIAN FINS DARKENED BUT NOT BLACK.

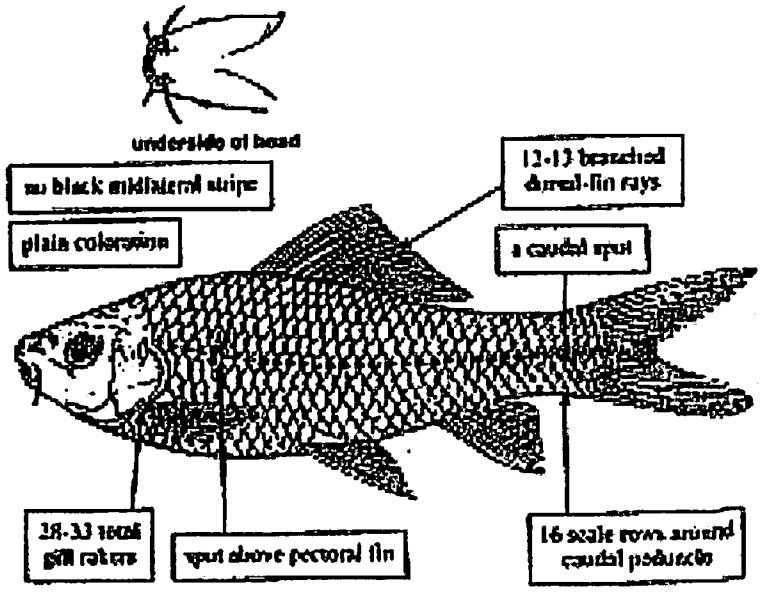
1.6.6.1. *Osteochilus enneaporos* (Bleeker, 1852)
Synonyms/misidentifications: *Osteochilus scapularis.*
Size: To 23 cm
Habitat, biology, and fisheries: Previously known from southern Thailand to Indonesia, and recently recorded from northern Cambodia by Roberts and Warren (1994). Feeds on periphyton, phytoplankton and algae, and probably migrates into seasonally flooded forests. Like other species of *Osteochilus* in northern Cambodia it is caught with seines, gill-nets, and traVidthayanon & Collaeques, 1997 that block return passage to the river.



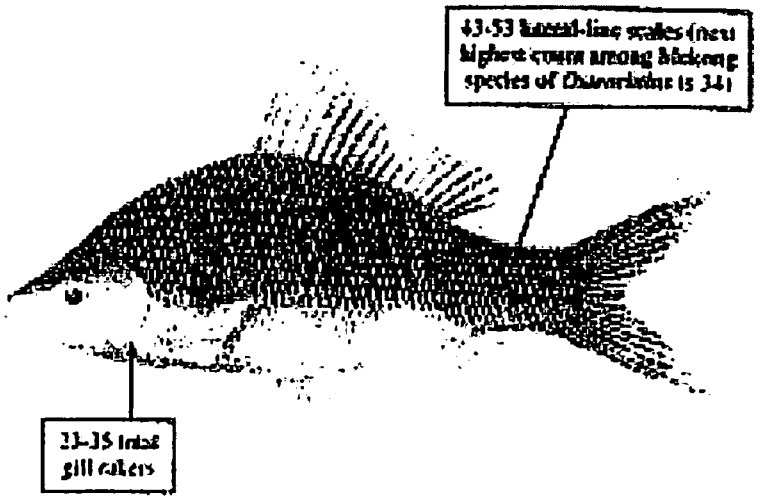
1.6.6.2. *Osteochilus hasselti* (Valenciennes, 1842)
Synonyms/misidentifications: *Osteochilus duostigma, Osteochilus vittatus.*
FAO name: Silver sharkminnow.
Habitat, biology, and fisheries: A common species, found from Thailand to Indonesia in rivers, streams, canals and swamVidthayanon & Collaeques, 1997 as well as in impoundments. Spends the flood season in seasonally inundated areas. Juveniles are usually seen first in August, they move back to permanent water as flooded lands dry up. Back in the rivers they are attracted to brush piles, tree roots, and other solid objects, Feeds on periphyton, phytoplankton, and bottom algae. Caught with seines, cast-nets, gill-nets, and traVidthayanon & Collaeques, 1997, particularly samra traVidthayanon & Collaeques, 1997. Marketed fresh or used to make prahoc.



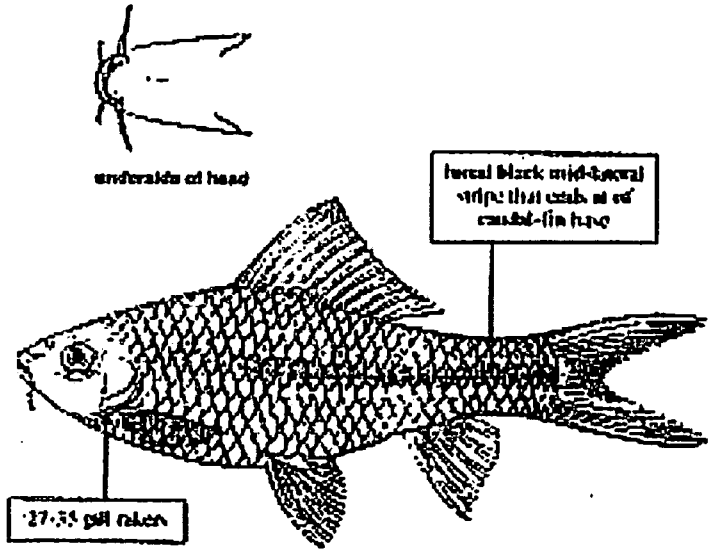
1.6.6.3. *Osteochilus lini* (Fowler, 1935)
Size: To 15 cm.
Habitat, biology, and fisheries: Known from midwater to bottom depths in large and medium-sized streams in the Chao Phrya and Mekong basins. Moves into flooded forests or open fields, and begins to re-enter rivers in October. Young of the year are first seen in August. Herbivorous, feeding on periphyton, phytoplankton algae, and some detritus. Taken with seines, cast-nets, gill-nets, and traVidthayanon & Collaeques, 1997. Usually used to make prahoc.



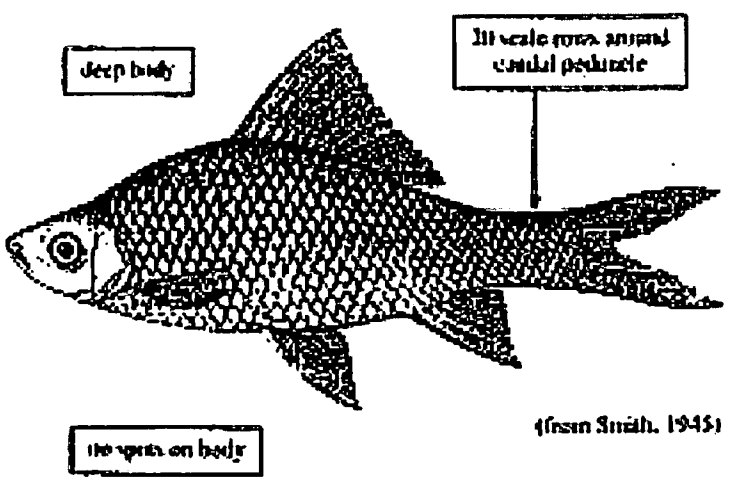
1.6.6.4. *Osteochilus melanopleurus* (Bleeker, 1852)
Size: To 40 cm
Habitat, biology, and fisheries: A common species, found at midwater to bottom depths in rivers, streams, canals, and swamVidthayanon & Collaeques, 1997 from Thailand to Indonesia. Large individuals are also found in impoundments. Moves into seasonally flooded habitats that supply its preferred diet of mostly periphyton as well as leafy plants such as aquatic macrophytes and inundated land plants. Feeds also on phytoplankton, filamentous algae, and bottom algae. Begins to return to the river in October, with numbers steadily increasing until January, when they begin to decline again. Caught with seines, cast-nets, set-nets, and traVidthayanon & Collaeques, 1997. Large individuals are sold fresh or dried and salted, smaller ones are made into prahoc.



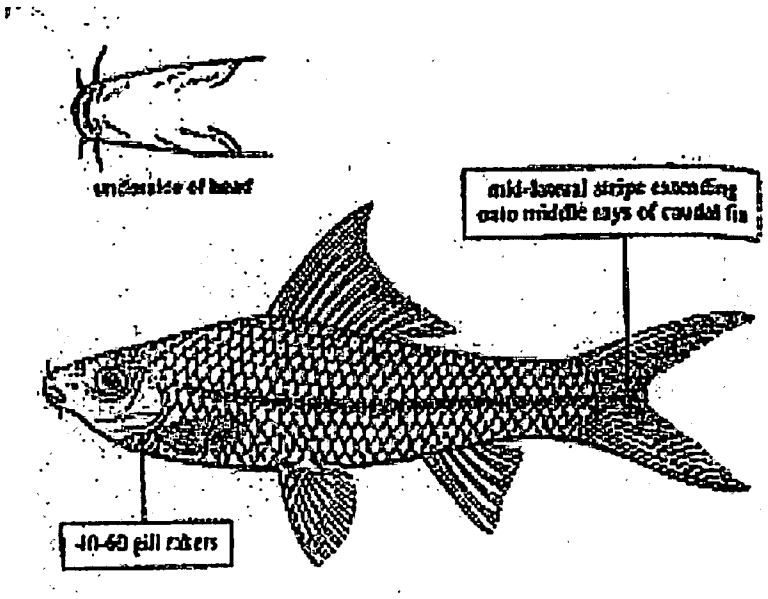
1.6.6.5. *Osteochilus microcephalus* (Valenciennes, 1842)
Size: To 40 cm.
Habitat, biology, and fisheries: A common species, found at midwater to bottom depths in rivers, streams, canals, and swamVidthayanon & Collaeques, 1997 from Thailand to Indonesia. Dietary habits are similar to *O. melanopleurus*. Also moves into flooded forests and grasslands during the flood season. A smaller species than *O. melanopleurus*, it returns to the rivers later, with highest numbers appearing from December to February. Caught with seines, castnets, gill-nets, set-nets, and traVidthayanon & Collaeques, 1997. Mostly used to make nuoc mam and prahoc.



1.6.6.6. *Osteochilus schlegeli* (Bleeker, 1851)
Size: To 40 cm. usually less in the Mekong.
Habitat, biology, and fisheries: Known from midwater to bottom depths in large and medium-sized rivers from Thailand to Indonesia. Found in the Great Lake, but apparently not persisting in the impoundments. Dietary preferences are similar to *O. melanopleurus* and its seasonal movements are like those of *O. Microcephalus*. Not as common as the three most important commercial species of *Osteochilus* (*O. hasselti. O. melanopleurus* and *O. microcephalus*), but does occur regularly in fisheries of the middle and lower Mekong. Caught mostly with seines, set-nets, and traVidthayanon & Collaeques, 1997. Usually used to make prahoc.



1.6.6.7. *Osteochilus waandersi* (Bleeker, 1852)
Synonyms/misidentifications: *Labeo soplaoensis*.
Size: To 20 cm.
Habitat, biology, and fisheries: Found at midwater to bottom depths in medium to small streams from the upper Mekong to Indonesia. Moves into flooded forests adjacent to upland streams during pering periods of elevated water levels. Dieatry habits similar to *O. Melanopleurus*. Caught with seines, cast-nets, and traVidthayanon & Collaeques, 1997.



1.7. Cyprininae - Garrae

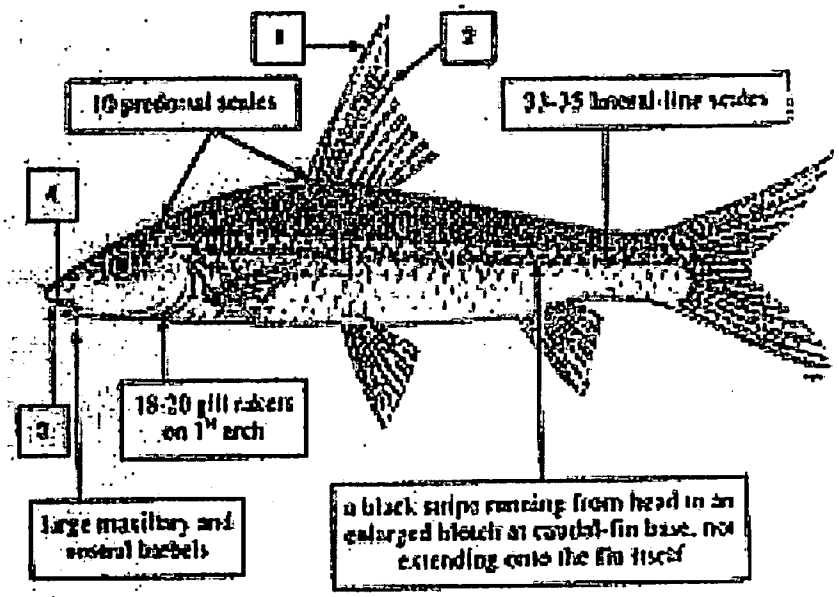
- Rostral fold replaces and serveres as upper lip, which is otherwise absent. Several genera.

- Have only 4 genus and 11 species reported Walter J. Rainboth, 1996.

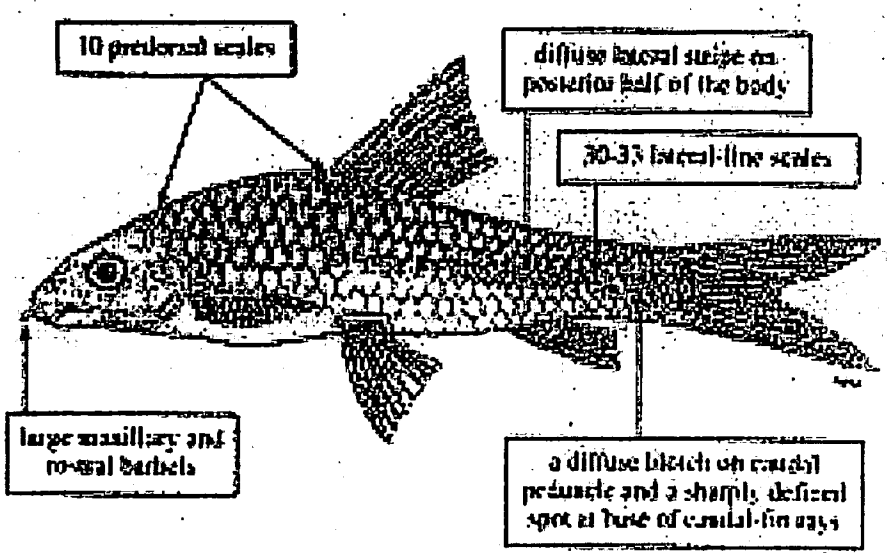
1.7.1. Genus *Crossocheilus*

(1) NO DORSAL-FIN SPINE;
(2) 8 BRANCHED DORSAL-FIN RAYS;
(3) UPPER LIP NOT CONNECTED WITH LOWER LIP, CONNECTED BY THIN MEMBRANE TO LOWER JAW;
(4) IMMOVABLE ROSTRAL LOBES.

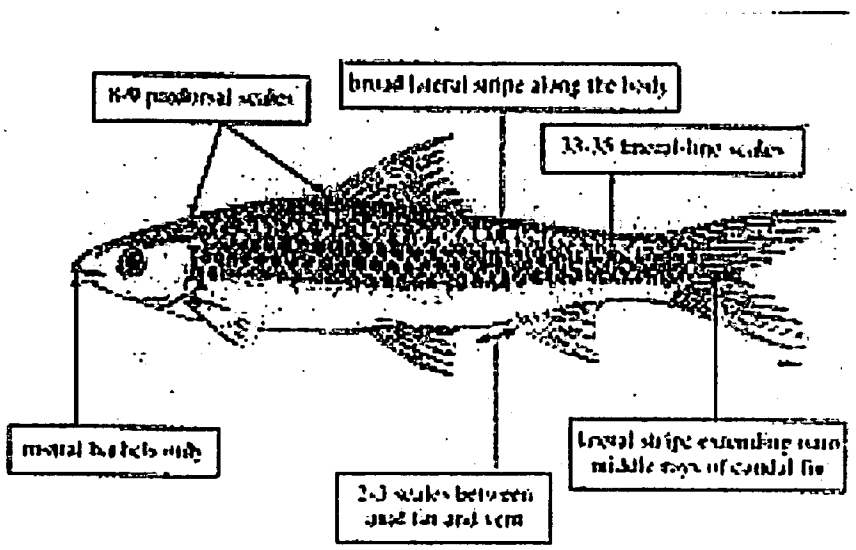
1.7.1.1. ***Crossocheilus cobitis*** (Bleeker, 1853)
Synonyms/misidentifications: *Crossocheilus Vidthayanon & Collaeques, 1997 eudobagroides, Epalzeorhynchos Kalliurus* (non Smith)
Size: To 9 cm.
Habitat, biology, and fisheries: Occurs at bottom depths of rivers from the Mekong to rivers of Malaysia and Indonesia. Probably moves into the floodplains during high water periods, and may spawn there. Specimens of this species were found by the author in dai catches (= set-nets) in the Bassac of Vietnam during October and November. By this time the young of the year had attained a total length of about 2.5 cm. Feeds on algae, periphyton, phytoplankton, and some zooplankton. Caught in set-nets and probably also by cast-nets. Used for prahoc or nuoc mam.



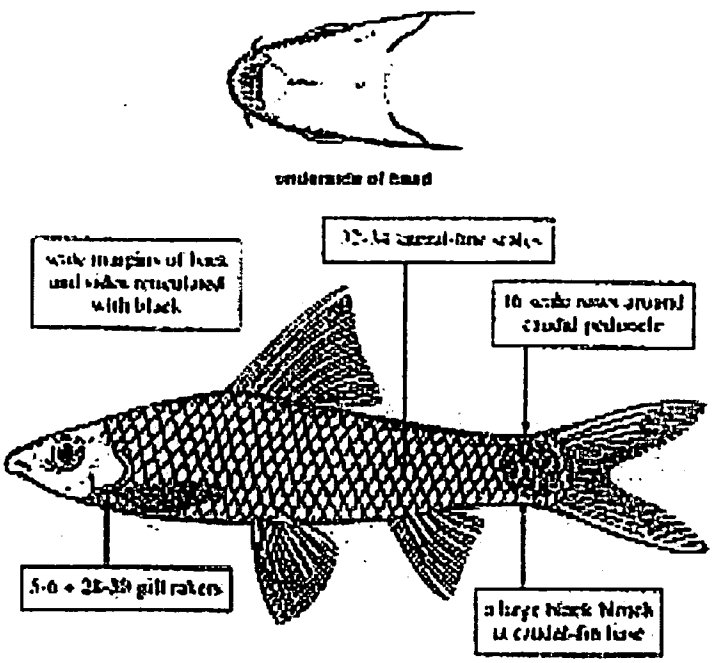
1.7.1.2. ***Crossocheilus kalliurus*** (Smith, 1945)
Synonyms/misidentifications : *Epalzeorhynchus kalliurus.*
Size: To 7 cm.
Habitat, biology and fisheries: Found at bottom depths in the middle and upper Mekong. May also occur in nothern Cambodia, but has not yet been recorded from thaed. Like other members of the genus, it is probably microphagous, feeding on algae, pleriphyton, and phytoplankton. Most likely caught with seines, cast-nets, or traVidthayanon & Collaeques, 1997. This species was placed in synonymy with *C. cobitis* by anarescu (1986), but is probably distinct, based on the different colour pattern and lateral-line scale counts.



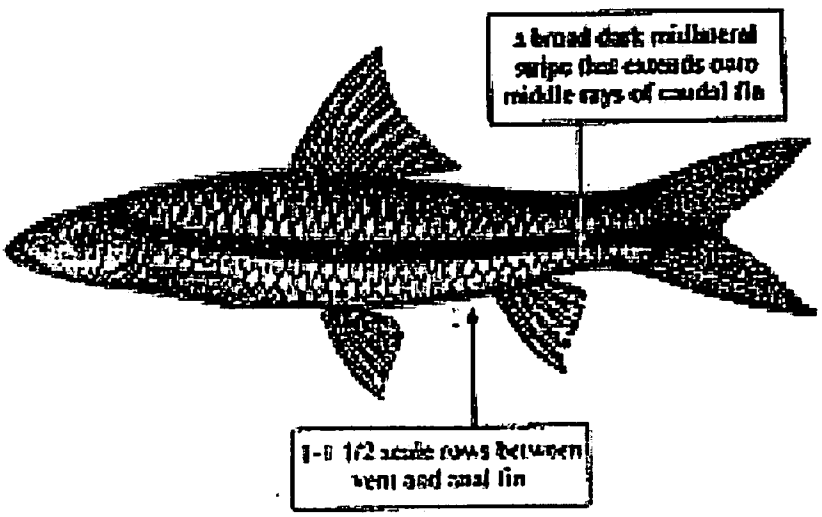
1.7.1.3. *Crossocheilus oblongus* (Valenciennes, 1842)
Size: To 15 cm.
Habitat, biology, and fisheries: Found at bottom depths of rivers and streams in Indonesia and on the Malay peninsula. Not yet recorded from the lower Mekong, although its occurrence is highly probable. Microphagous, feeding on periphyton, and phytoplankton. Most likely caught with seines, cast-nets, and traVidthayanon & Collaeques, 1997.



1.7.1.4. *Crossocheilus reticulatus* (Fowler, 1934)
Synonyms/misidentifications: *Holotylognaths reticulatus, Tylognatus coatesi, Epalzeorhynchos, coatesi, Crossocheilus tchangi.*
Size: To 17 cm.
Habitat, biology, and fisheries: Found at bottom depths in streams and rivers of the Chao Phrya and Mekong basins as well as streams entering the northern Gulf of Thailand. Moves out onto the floodplain during high water where it feeds on algae, periphyton, phytoplankton and some zooplankton. Caught with seines, cast-nets, set - nets, and traVidthayanon & Collaeques, 1997. Used to make prahoc on the Tonl— Sap. Occasionally imported in the aquarium trade.



1.7.1.5. *Crossocheilus siamensis* (Smith, 1931)
Synonyms/misidentifexations : *Epallzeorhynchos siamensis.*
Size: To 16 cm.
Habitat, biology, and fisheries: Found at bottom depths in streams and rivers of the Chao Phrya and Mekong basins. Moves into flooded forests during periods of high water and may spawn there. Dietary preferences as in other members of the genus, feeding on algae, periphyton, and phytoplankton. Caught with seines, cast-nets, and traVidthayanon & Collaeques, 1997. Most likely used to make prahoc.

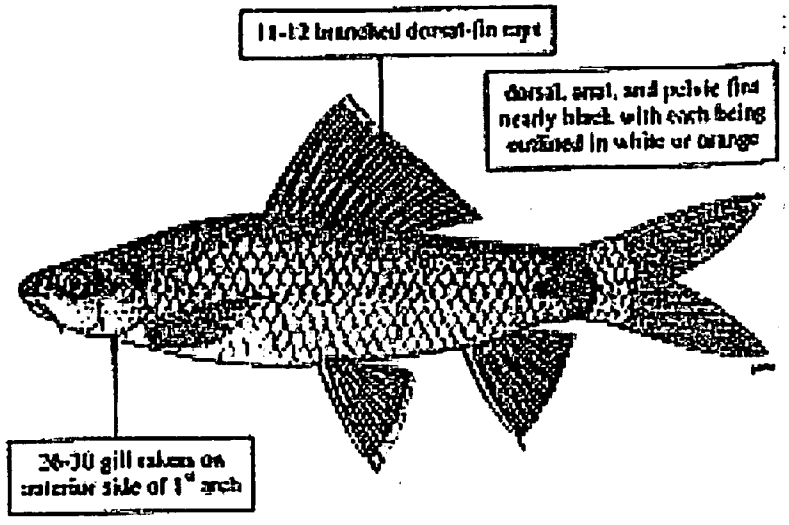


1.7.2. Genus *Epalzeorhynchos.*

(1) NO DORSAL-FIN SPINE;
(2) 10 TO 13 BRANCHED DORSAL-FIN RAYS;
(3) UPPER LIP CONNECTED TO LOWER LIP BY A THIN MEMBRANE;
(4) ROSTRAL LOBES RIGID AND FREELY MOVABLE.

1.7.2.1. *Epalzeorhynchos munense* (Smith, 1934)

Synonyms/misidentifications: *Labeo erythrurus, Labeo bicolor* (non Smith).
Size: To 12 cm.
Habitat and remarks: Known from midwater to bottom levels of streams and rivers in the Mekong basin. During the flood season, it moves into inundated forests and returns to the river as water levels recede. Diet consists of phytoplankton and zooplankton. Caught with sienes, cast-nets, and set-nets. Along the Tonl— Sap, it is used to make prahoc. May possibly be used in the aquarium trade. This species has not been recorded since its original description, probably because it was described to have a bhite caudal fin (Smith, 1934). It seems that specimens loose the red pigment in the caudal fin within three months after preservation, with the caudal fin subsequently becoming white. The holotype, however, was collected by a forest officer eight years prior to Smith's description. Due to its darkly pigmented dorsal, anal, and pelvic fins, this Mekong species has been confused with *Epalzeorhynchos bicolor* (Smith, 1931) of the Chao Phrya.



1.7.3. Genus *Garra*

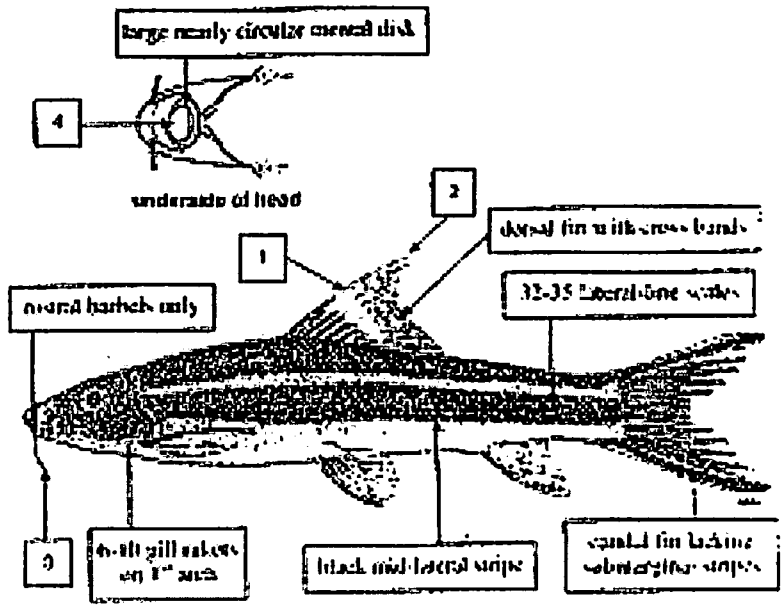
(1) NO DORSAL - FIN SPINE;
(2) 8 BRANCHED DORSAL - FIN RAYS;
(3) 1 OR 2 PAIRS OF BARBELS;
(4) LOWER LIP FORMING A MENTAL DISK, ENLARGED, REFLECTED BACKWARDS AND DISK-SHAPED.

1.7.3.1. *Garra cambodgiensis* (Tirant, 1884)

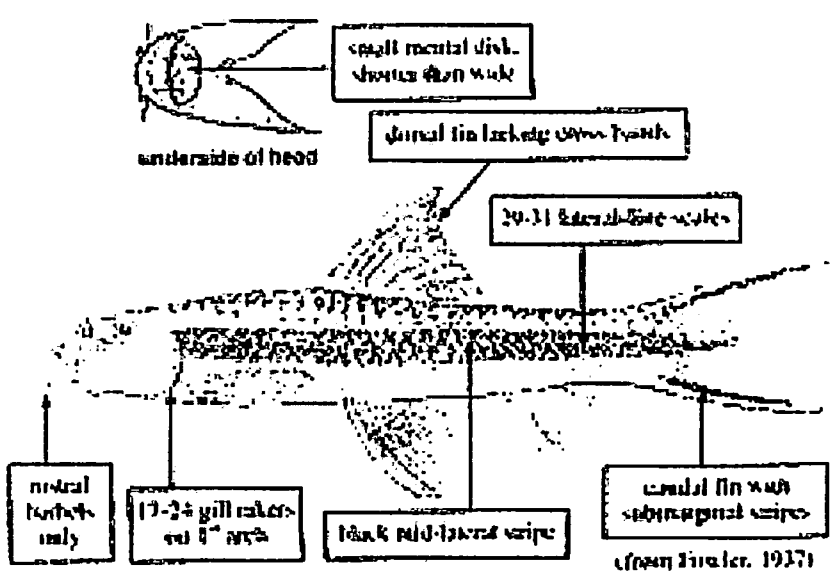
Synonyms/misdentification: *Garra miniata, Garra taeniatoVidthayanon & Collaeques, 1997,Garra paryifilum.*

Size: To 15 cm.

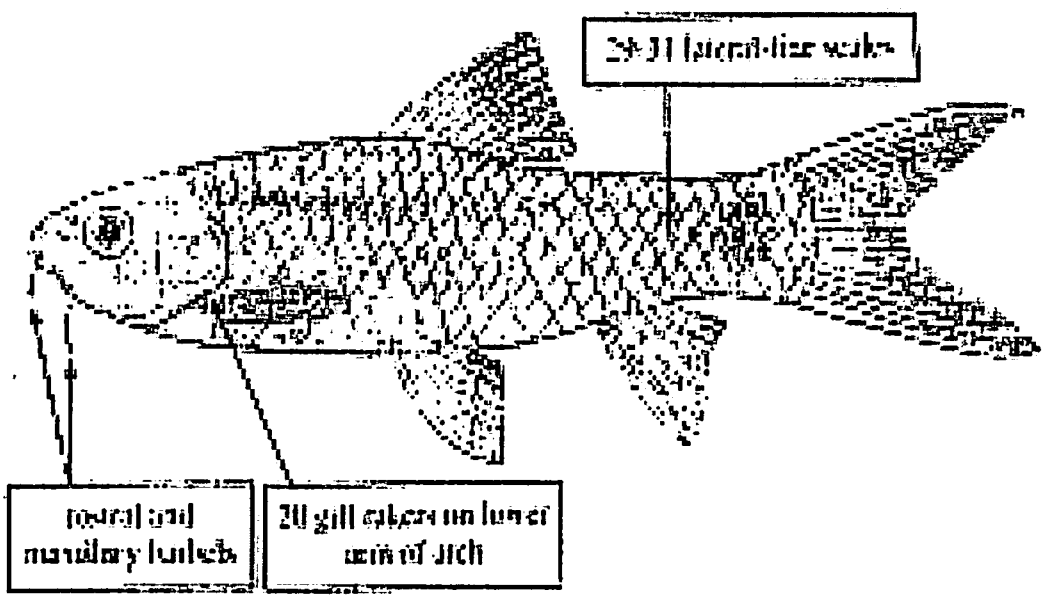
Habitat, biology, and fisheries: Found on rocky bottoms in swiftly moving water of small and medium sized streams of the Chao Phrya and Mekong basins. Feeds on periphyton, phytoplankton, and some insects. Occasionally taken with seines over a gravel bottom or among boulders in fast water. Not fished commercially but occasionally seen in the aquarium trade.



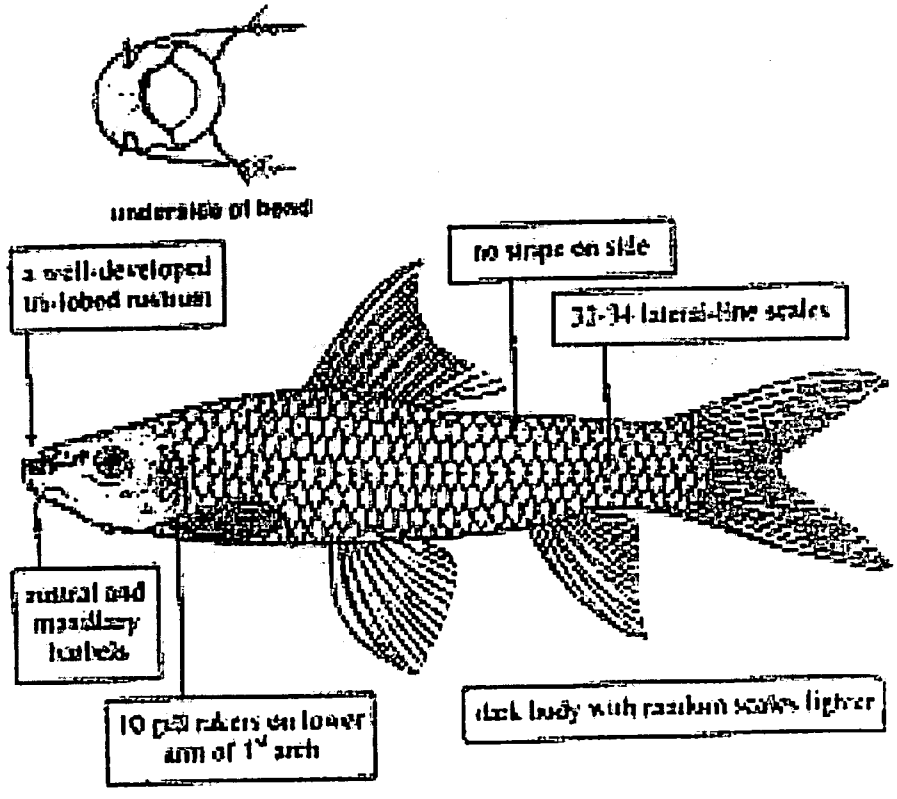
1.7.3.2. *Garra faseiacauda* (Fowler, 1937)
Synonyms/misidentifications: *Garra spinosa*
Size: To 11 cm.
Habitat, biology, and fisheries: Found along rocky bottoms in fast flowing water of all sizes of rivers and streams in the middle Mekong. Feeds on periphyton, phy toplankton, and some insects. Can be taken with trawls and is caught with large haul seines in the main stream of the Mekong in Thailand and Cambodia.



1.7.3.3. *Garra fisheri* (Fowler, 1937)
Size: Know only from juveniles of 5 cm. length.
Habitat, biology, and fisheries: Known from central Thailand and likely to occur in the Mekong. Like other species of Garra, it probably occurs in fast water over rocky or gravel substrates. Little is known about this species, for which adults have never been seen.



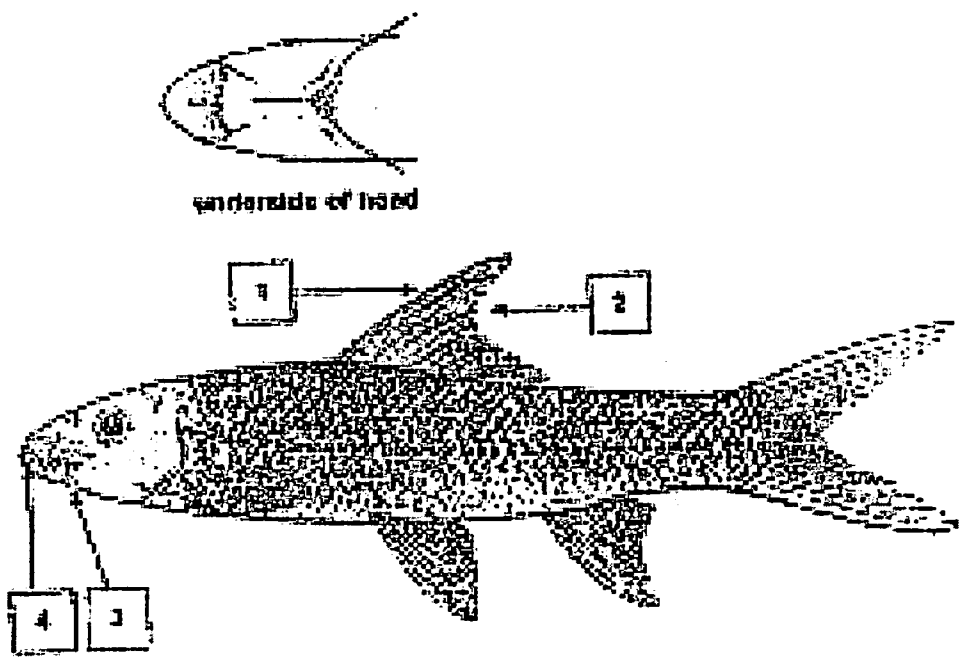
1.7.3.4. *Garra fuliginosa* (Fowler, 1934)
Synonyms/misidentifications: *Garra nasuta* (non M'Clelland)
Size: To 18 cm.
Habitat, biology, and fisheries: Found in swiftly flowing water over rocky bottoms in the Chao Phrya and Mekong basins. Feeds on periphyton, phytoplankton, and insects. An uncommon fish in larger rivers and rarely caught by commerial fishermen. Can be taken with trawls over gravel substrate. This species was placed in synonymy with *Garra nasuta* (M' Clelland) by Menon (1964), along with several other apecies that appear to be distinct. Its present name may prove to be a synonym of one of those names.



1.7.4. Genus *Mekongina.*

(1) NO DORSAL-FIN SPINE;
(2) 10 BRANCHED DORSAL-FIN RAYS;
(3) NO BARBELS;
(4) UPPER LIP CONTINUOUS WITH SKIN SNOUT.

1.7.4.1. ***Mekongina erythrospila*** (Fowler, 1937)
Size: To 45 cm.
Habitat, biology, and fisheries: A Mekong endemic, inhabiting rapidly flowing water in medium and large sized rivers. Feeds on periphyton and phytoplankton. A valuable and highly desired food fish in northern Cambodia. Taken with seines, gill-nets, cast-nets, and traVidthayanon & Collaeques, 1997. Sold fresh and is sometimes dried and salted.



2. Subfamily Danioninae

- Belly with or without a keel. Axillary scale only at base of pelvic fin. First dorsal ray non - spinous. Lateral line along lower half of caudal peduncle.

2.1. Tribe Oxygastrini

- Margin of belly keeled. Epaxial muscles extending forward at least to margin of orbit. Predorsal scales much smaller than scales along lateral line.

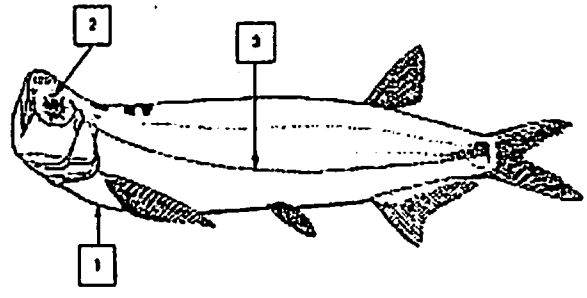
- Have only 5 genus and 9 species repored by Walter J. Rainboth, 1996.

2.1.1. Genus *Macrochirichthys*

(1) BELLY WITH A SHARPLY - EDGED KEEL:
(2) EPAXIAL MUSCLES EXTENDING FORWARD TO ORBIT;
(3) MORE THAN 100 LATERAL - LINE SCALES.

2.1.1.1. ***Macrochirichthys macrochirus*** (Valenciennes, 1844)
Size: To 70 cm.
Habitat, biology, and fisheries: Found from Indonesia to Thailand at medium to shallow depths in large rivers and lakes. Juveniles feed on insects, and adults on fishes. Moves out into the flooded forest during high water and returns to the river as soon as water levels

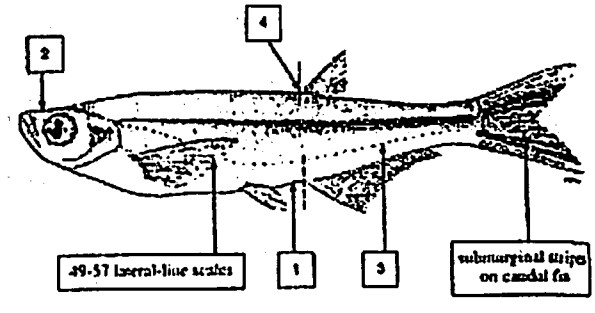
begin to subside. Most abundant in the lower Mekong in October at the finish of the rainy season and just before the inception of the fishing season. Usually moves on the fourth or fifth days before full moon in October and November. Taken by seines, cast-nets, gill-nets, set-nets, hook- and-line, weirs, and traVidthayanon & Collaeques, 1997. Usually marketed fresh and probably exproted to Thailand.



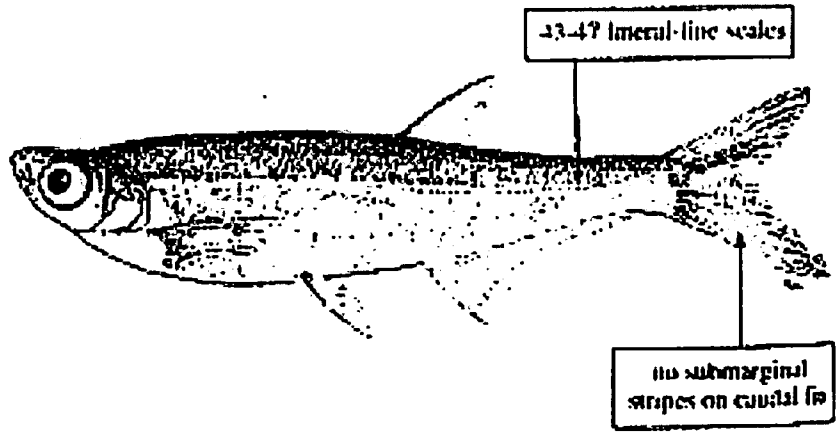
2.1.2. Genus *Oxygaster.*

(1) BELLY WITH A SHARPLY - EDGED KELL;
(2) EPAXIAL MUSCULATURE BARELY REACHING EYE;
(3) 43 TO 60 LATERAL - LINE SCALES;
(4) DORSAL-FIN ORIGIN ANTERIOR TO ANAL-FIN ORIGIN.

2.1.2.1. ***Oxygaster anomalura*** (van Hasselt, 1823)
Size; To 20 cm.
Habitat, biology, and fisheries: Found from Indonesia to Thailand at the surface of small mountain rivers with complete or nearly complete forest canopy. Probably with only sporadic occurrence elsewhere. Diet consists largely of exogenous insects and chironomid larvae. Caught by seines, cast-nets, and gill - nets. Very rarely seen at fish markets.



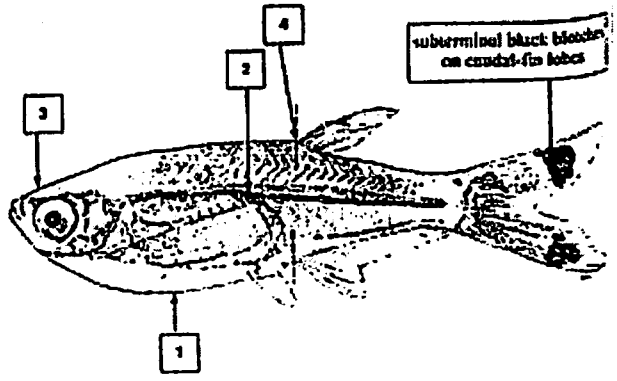
2.1.2.2. ***Oxygaster pointoni*** (Fowler, 1934)
Size : To 8 cm. possibly slightly larger.
Habitat, biology, and fisheries: Found at the surface in medium - sized rivers of mainland Southeast Asia. Little is known about this species, the distribution of which may be localized. Diet is probably similar to *O. anomalura* including chironomids and small mollusks. Occurrence seems to be sporadic in the main stem of the Mekong. Caught by seines, cast-nets, and traVidthayanon & Collaeques, 1997. Rarely seen at fish markets.



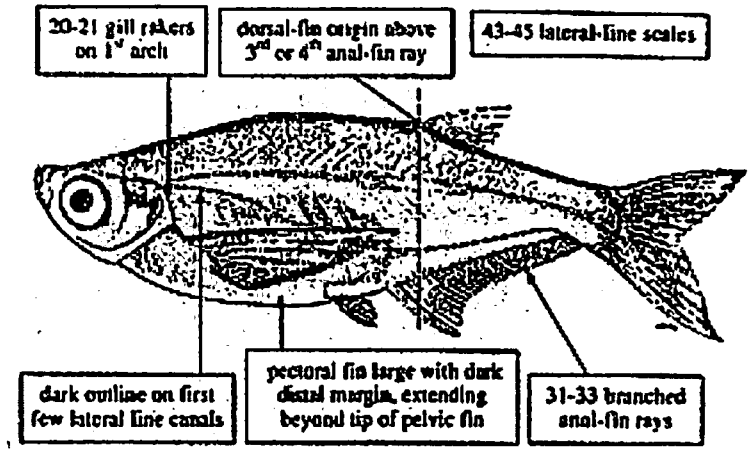
2.1.3. Genus *Parachela*

(1) BELLY WITH A SHARPLY -EDGED KEEL;
(2) 42 OR FEWER LATERAL-LINE SCALES;
(3) EPAXIAL MUSCULATURE REACHING INTERORBITAL SPACE;
(4) DORSAL -FIN ORIGIN POSTERIOR TO OR SLIGHTLY AHEAD OF ANAL-FIN ORIGIN.

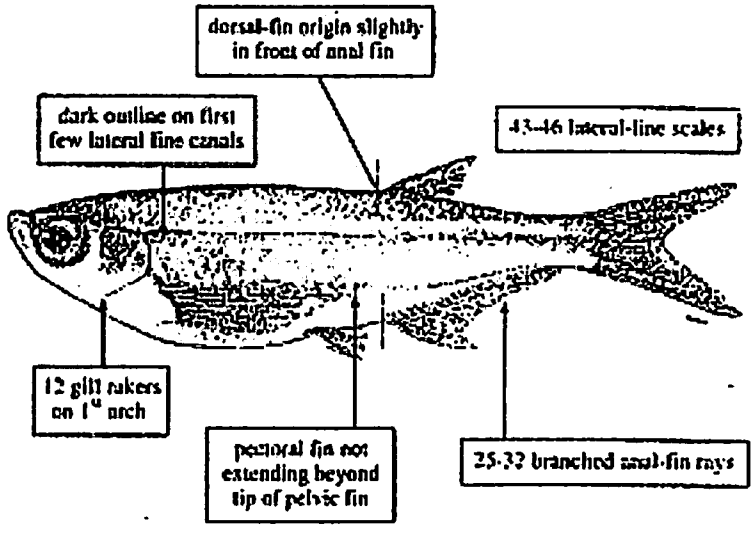
2.1.3.1. ***Parachela maculicauda*** (Smith, 1934)
Synonyms/misidentifications: *Oxygaster maculicauda.*
Size : To 6 cm, commonly to about 3 cm.
Habitat, biology, and fisheries: Occurs at the water surface in small and medium-sized rivers with nearby areas of floodplain forest. Known from mainland Southeast Asia, and has been recorded in the Mekong basin from near Vientiane to tributaries of the Great Lake. Usually caught by seines or cast -nets. Used to make prahoc.



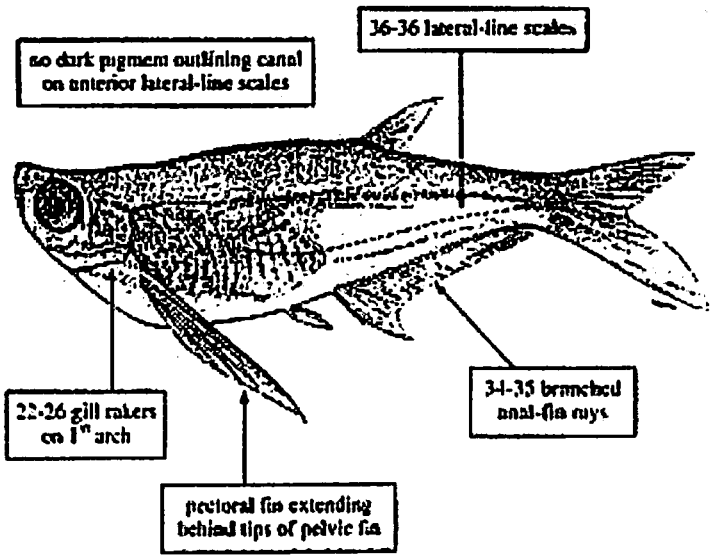
2.1.3.2. ***Parachela oxygastroides*** (Bleeker, 1852)
Synonyms/misidentifications: *Oxygaster axygastroides*.
Size: To 15 cm, commonly between 9 and 12 cm.
Habitat, biology, and fisheries: Occurs in medium to large -sized rivers and is a common resident of seasonally flooded forests. This species and *P. Siamensis* seem to be more tolerant of high amounts of suspended solids than *P. maculicauda* or *P. williaminae* and are more common in habitats disturbed by farming activities. Found close to the surface where it is easily recognized by the dark distal margin of the large pectoral fin. Leaves the flooded forest in November as the water levels begin to decline substantially. Diet includes zooplankton and insects taken by seines, cast-nets, trawls, weirs, and traVidthayanon & Collaeques, 1997. Used to make prahoc.



2.1.3.3. ***Parachela siamensin*** (Gunther, 1868)
Synonyms/misidentifications: *Oxygaster siamensis*, *Oxygaster oxygastroides* (non Bleeker).
Size: To 12 cm.
Habitat, biology, and fisheries: Found at the surface in large rivers and lakes from Indonesia to Thailand. Locally abundant and common in commercial catches. At high water it moves into the flooded forest, and probably leaves at the same time as *P. Oxygastroides*. Commonly occurs together with *P. oxygastroides* and *P. williaminae* with which it can be easily confused. This is the most common species of the genus in the Great Lake. Commonly taken by seines, cast-nets, weirs, and traVidthayanon & Collaeques, 1997. Used to make prahoc.



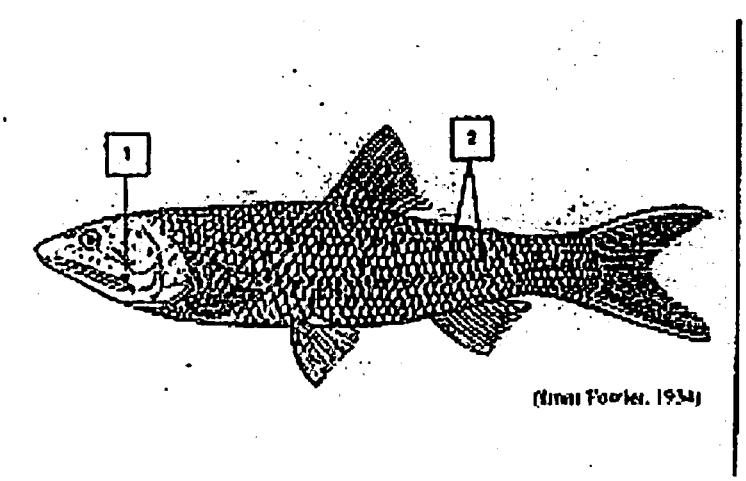
2.1.3.4. ***Parachela williaminae*** (Flowler, 1934)
Synonyms/misidentification: *Oxygaster siamensis*, *Oxygaster oxygastroides* (non Bleeker)
Size: To 12 cm.
Habitat, biology, and fisheries: Found in medium to large - sized rivers with fast current and relatively clear water. An apparently uncommon species, known from the main channel of the Mekong from northern Thailand downstream to the Great Lake. The original specimen described had no pelvic fins although the species ordinarily possesses them. Little is known about its seasonal movements. Taken primarily by seines and cast-nets. Used to make prahoc.



2.1.4. Genus *Raimas*

(1) MOUTH LARGE JAWS EXTENDING BACKWARDS FAR BEHIND EYE;
(2) BODY WITH SPOTS THAT ARE SLIGHTLY LARGER THAN A SINGLE SCALE.

2.1.4.1. ***Raiamas guttatus*** (Day, 1869)
Synonyms/misidentifications: *Barillius gutttatus.*
Size : To 30 cm.
Habitat, biology, and fisheries: Found over gravel substrate in clear, swift, small streams up to rapidly flowing stretches of large rivers. Occurs on the Southeast Asia mainland from the Irrawaddy to the Mekong. It has also been recorded from the Great Lake in Cambodia. Diet consists of insects and small fishes. Usually taken with seines, cast-nets, and large, individuals can be taken by hook-and-line. Rarely seen in markets.

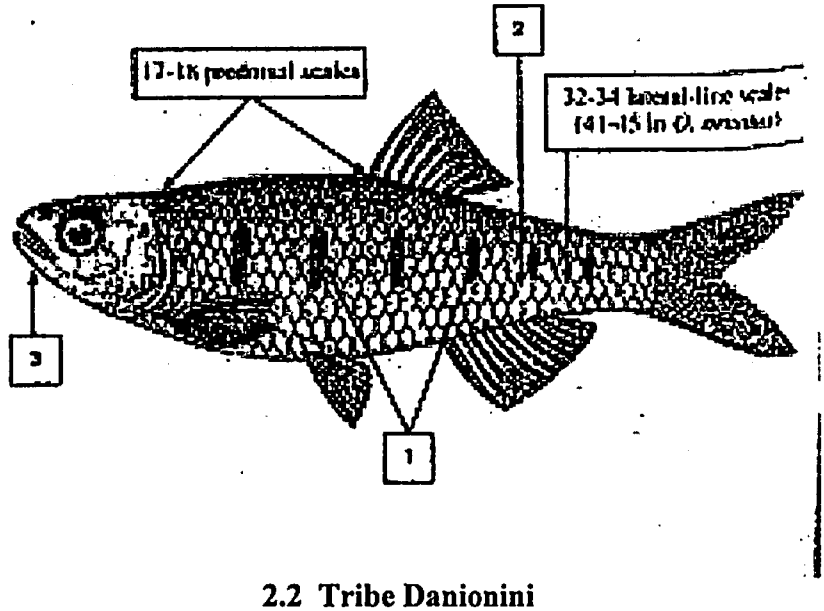


2.1.5. Genus *OVidthayanon & Collaeques, 1997 arius.*

(1) COLOUR PATTERN CONSISTING OF A SERIES OF BARS;
(2) LATERAL LINE ON LOWER HALF OF CAUDAL PEDUCLE;
(3) BARBELS PRESENT, BUT OFTEN TINY.

2.1.5.1. *Osarius koratensis* (Smith, 1931)

Synonyms/misidentifications: *Barilius koratensis, Barilius nanensis.*
Size: To 10 cm.
Habitat, biology, and fisheries: Found over gravel substrate in clear, swift, small streams on up to rapidly flowing stretches of large rivers from the Chao Phrya to the Mekong. Diet consists of insect larvae, especially trichopterans. Caught using seines and cast-nets. Rarely seen in markets.



2.2 Tribe Danionini

- Margin of belly rounded or keeled. Barbels present. Epaxial muscles not extending forward beyond preopercle. Predorsal scales large, about the same size as the lateral - line scales. Mouth usually small, but if large, with barbels as long as eye diameter. Many species in several genera.

- Have only 8 genus 20 species reported by Walter J. Rainboth., 1996.

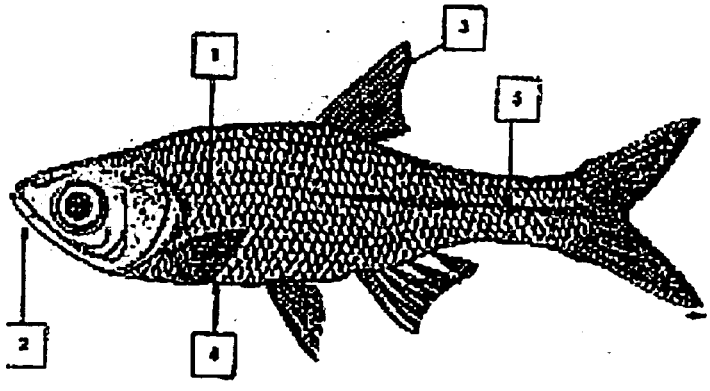
2.2.1. Genus *Amblypharyngodon*

(1) INCOMPLETE LATERAL LINE WITH 6 TO 7 PERFORATED SCALES;
(2) NO BARBELS;
(3) 7 BRANCHED DORSAL-FIN RAYS;
(4) BELLY LAKING AKEEL;
(5) 42 TO 50 SCALES IN LATERAL SERIES.

2.2.1.1. *Amblypharyngodon chulabornae* (Vidthayanon and Kttelat, 1991)

Size : To 4 cm.

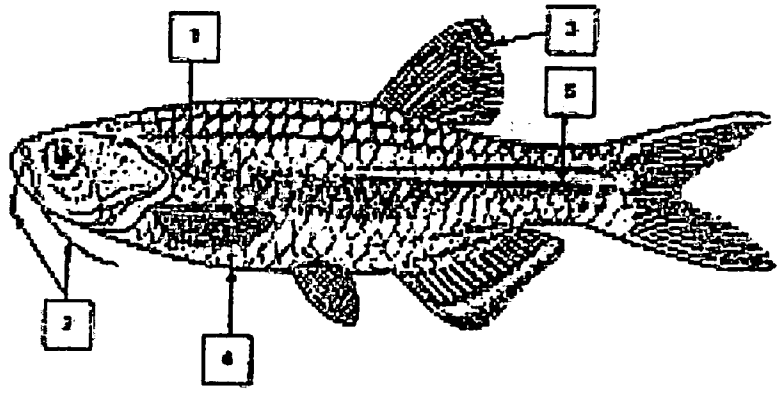
Habitat, biology, and fisheries : A floodplain species found in shallow standing water of paddy fields and ditches in the lower Mekong and Chao Phrya basins. It seems to prefer vegetated areas with floating aquatic vegetation as well as flooded terrestrial grasses. Caught with seines and traVidthayanon & Collaeques, 1997 at middle to deeper depths of shallow water. Not seen in markets.



2.2.2. Gennus *Brachydanio*

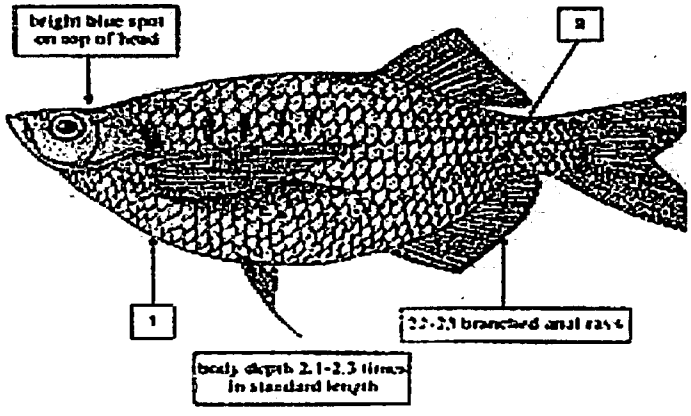
(1) INCOMPLETE LATERAL LINE ABSENT, OR ENDING BEFORE PELVIC FINS;
(2) 4 WELL-DEVELOPED BARBELS;
(3) 6 TO 7 BRANCHED DORSAL-FIN RAYS;
(4) BELLY LACKING A KEEL;
(5) ABOUT 30 SCALES IN LATERAL SERIES.

2.2.2.1. ***Brachydanio albolineatus*** (Blyth, 1860)
FAO name : Pearl danio.
Size: To 5 cm.
Habitat, biology, and fisheries : Found at the surface of small, clear streams from the Salween River to Malaysia and Cambodia. Feeds on exogenous insects and some zooplankton. Caught with seines, cast-nets, and traVidthayanon & Collaeques, 1997. Not seen in fish markets, but popular in the aquarium trade.

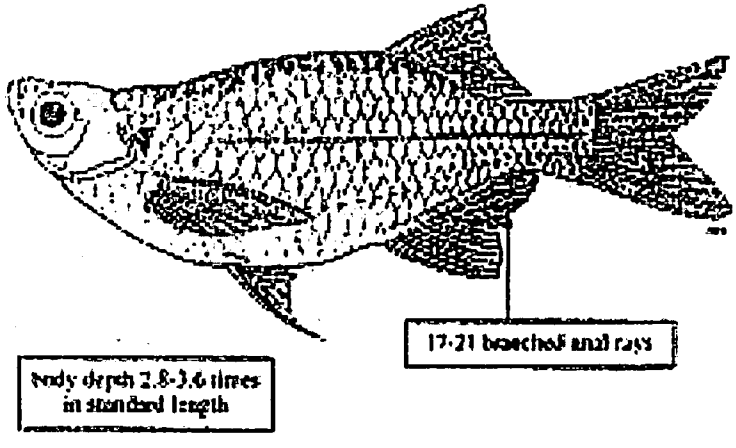


2.2.3. Genus *Chela*
(1) BODY DEEP, BELLY STRONGLY COMPRESSED, WITH A VENTRAL KEEL BETWEEN PECTORAL AND PELVIC FINS;
(2) LATERAL LINE COMPLETE, WITH 31 TO 37 SCALES.

2.2.3.1. ***Chela caeruleostigmata*** (Smith, 1931)
FAO name : Leaping barb.
Size : To 7 cm.
Habitat, biology, and fisheries : Found at the surface of large rivers and flooded forests along the main stream of the Mekong. It seems to move back in large rivers in March or April at the very end of the flood cycle. This species can easily be recognized by the bright blue spot on top of the head. It was a common resident of the flooded forest in the lower Mekong in the early 1950s (Blache and Goosens, 1954) but is now listed as "R" or rare by the IUCN. Originally described from the Chao Phrya in Thailand. Diet consists mostly of exogenous insects caught at the surface. Taken with seines and cast-nets. Probably used to make prahoc. Occasionally seen in the aquarium trade.



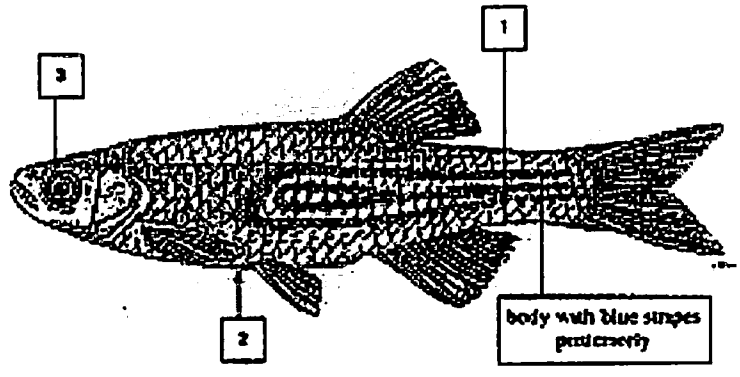
2.2.3.2. ***Chela laubuca*** (Hamilton, 1822)
FAO name: Indian glass barb.
Size: To 6 cm.
Habitat, biology, and fisheries: Found at the surface in small streams with clear water from India to Indonesia. Little is Known about its movement, but it likely also invades seasonal flooded forests. Probably feeds on exogenous insects. Taken with seines and cast-nets. Rarely seen in markets. Probably used to make prahoc. Occasionally imported in the aquarium trade.



2.2.4.Genus ***Danio.***

(1) LATERAL LINE COMPLETE;
(2) BELLY ROUNDED;
(3) RIM OF ORBIT WITH A SPINOUS ANTERIOR PROCESS.

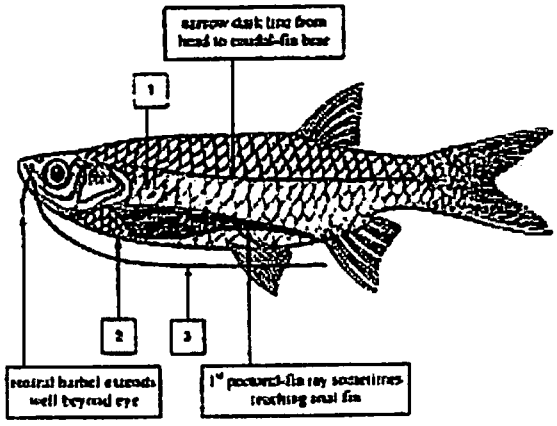
2.2.4.1. ***Danio aequipinnatus*** (M'Clelland, 1839)
Synonyms/misidentifications: *Danio malabaricus, Danio regina* (non Fowler).
Size: To 8 cm.
Habitat, biology, and fisheries: Found in schools at the surface in small high-gradient upland streams from India to the Indochinese Peninsula. Feeds primarily on exogenous insects. Taken by seines, cast-nets, and traVidthayanon & Collaeques, 1997. Not seen in markets, but popular in the aquarium trade.



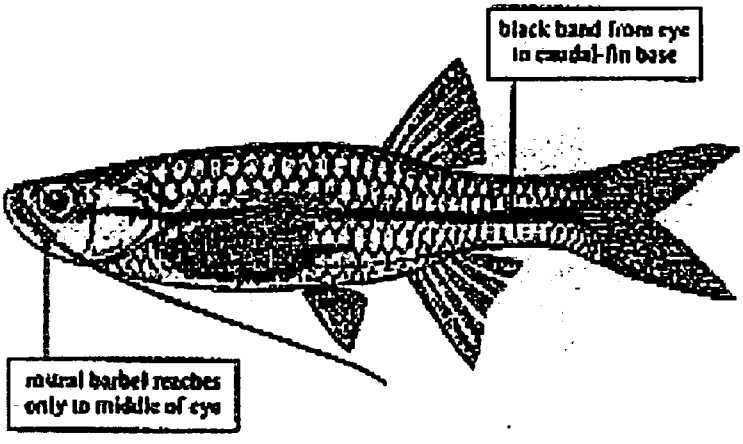
2.2.5.Genus ***Esomus***

(1) LATERAL LINE INCOMPLETE;
(2) BELLY ROUNDED;
(3) EXTREMELY LONG MAXILLARY BARBEL REACHING PAST PELVIC FIN.

2.2.5.1. ***Esomus longimanus*** (Lunel, 1881)
Synonyms/misidentifications: Esomus goddardi.
Size: To 1 cm.
Habitat, biology, and fisheries: Found in the Mekong from the Khorat Plateau in Thailand to the Great Lake. A common inhabitant of ditches, canals, and ponds often seen in areas with extensive growth of submerged aquaticplants. Diet consists of zooplankton and occasionally insects. Caught by seines, cast-nets, dip-nets, and traVidthayanon & Collaeques, 1997. Sometimes marketed fresh and used to make prahoc.



2.2.5.2. ***Esomus metallicus*** (Ahl, 1924)
FAO name: Striped flying barb.
Size: To 7.5 cm.
Habitat, biology, and fisheries: An abundant inhabitant of flooded rice - paddies, canals, ditches, as well as in most streams from northern Thailand to the Mekong delta. Avoid large rivers, and only moves from temporarily inundated habitats if necessitated by seasonal habitat disappearance. Moves into seasonally inundated areas as soon as they are flooded. Diet includes zooplankton, terrestrial insects, and aquatic insect larvae. Taken with seines, cast-nets and traVidthayanon & Collaeques, 1997. Occasionally marketed fresh and used to make prahoc.

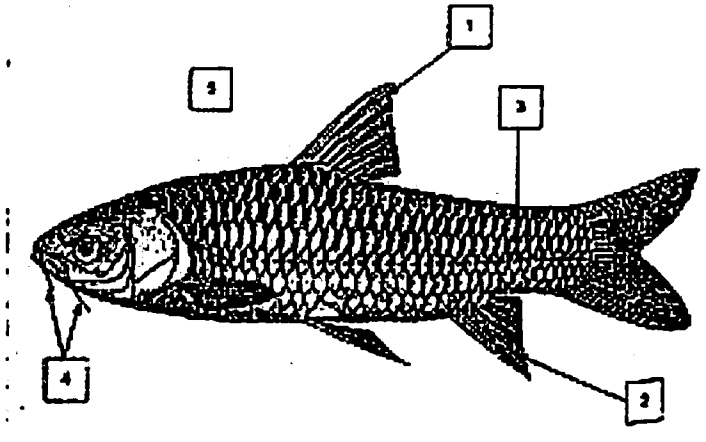


2.2.6. Genus *Leptobarbus.*

(1) DORSAL FIN WITH AN UNBRANCHED, NON-SPINOUS FIRST RAY AND 7 BRANCHED SOFT RAYS;
(2) 5 BRANCHED ANAL-FIN RAYS;
(3) LATERAL LINE PASSING DOWN THE LOWER HALF OF CAUDAL PEDUNCLE;
(4) 4 WELL-DEVELOPED BARBELS;
(5) BLACK LATERAL STRIPE OF JUVENILES DISAPPEARING IN ADULTS.

2.2.6.1. *Leptobarbus hoeveni* (Bleeker, 1851)

Synonyms/misidentification: *Filirasbora rubripinna.*
FAO name: Mad barb.
Size: To 70 cm. Commonly to about 50 cm.
Habitat, biology, and fisheries: Found most often in freely flowing rivers and streams and seasonally on floodplains. Although said to be non-migratory by Blache and Goossens (1954), it definitely does participate in local trophic migration to and from inundated forests. Juveniles feed on terrestrial in sects, tubificid worms, and zooplankton. Adults consume more plant matter. Known to feed on toxic fruits in floodplain forests and to behave strangely. Eating flesh of the fish at this time can cause nausea in humans. Of rather low commercial value. Taken by hook-and-line, seines, cast-nets, and traVidthayanon & Collaeques, 1997.

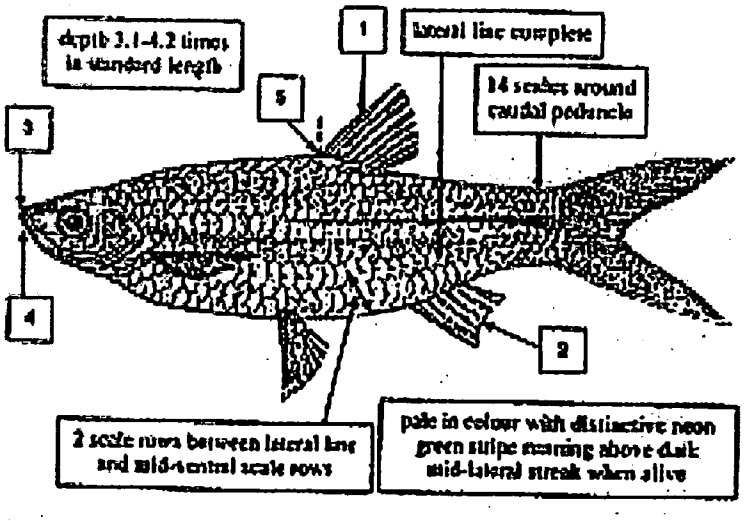


2.2.7. Genus *Rasbora.*

(1) DORSAL FIN WITH AN UNBRANCHED. NON-SPINOUS FIRST RAY AND 7 SOFT RAYS;
(2) 5 BRANCHED ANAL RAYS;
(3) MOUTH SMALL, NOT REACHING BELOW EYE;
(4) NO BARBELS;
(5) DORSAL-FIN ORIGIN AT MIDDLE OF BODY.

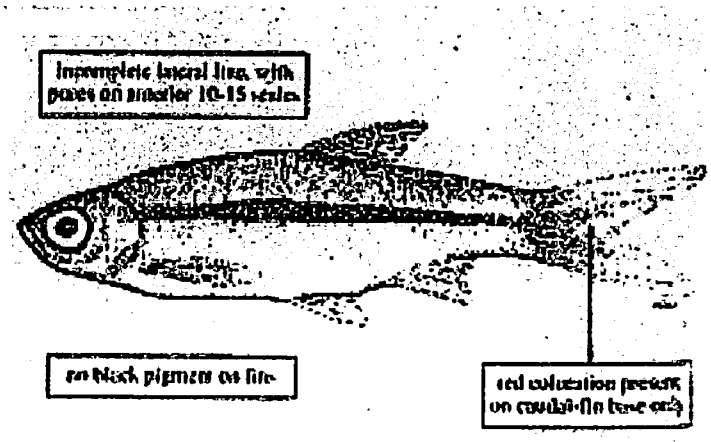
2.2.7.1. *Rasbora aurotaenia* (Tirant, 1885)

Synonyms/misidentification: *Rasbora retrodorsalis.*
FAO name: Pale rasbora.
Size: To15 cm.
Habitat, biology, and fisheries: Found near the surface of ponds carnals and streams. Often in turbid waters of the Mekong and Chao Phrya rivers. Probably feeds mostly on exogenous insects and also on some algae. Taken with seines, cast-nets, and traVidthayanon & Collaeques, 1997. Occasionally marketed fresh. Probably used to make prahoc.

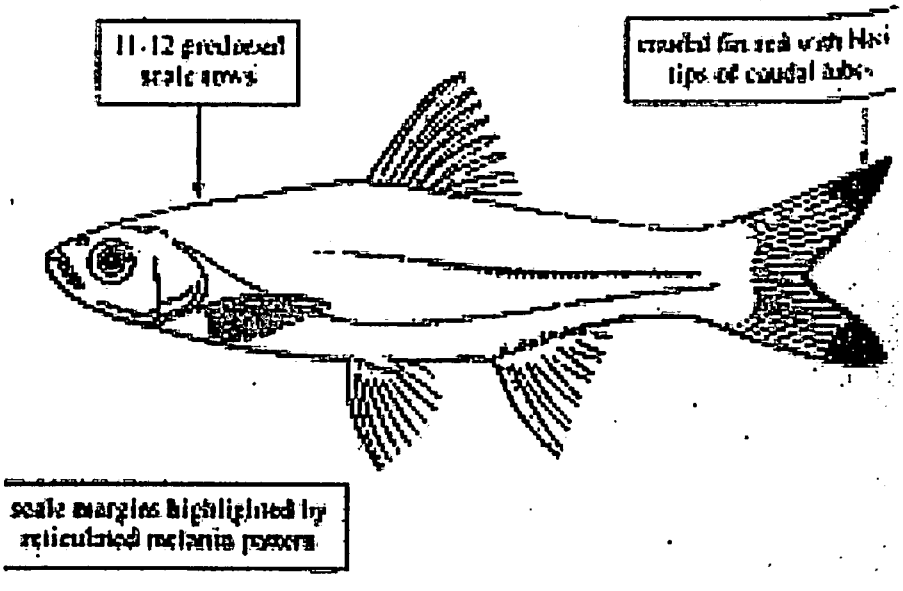


2.2.7.2. *Rasbora borapetensis* (Smith, 1934)

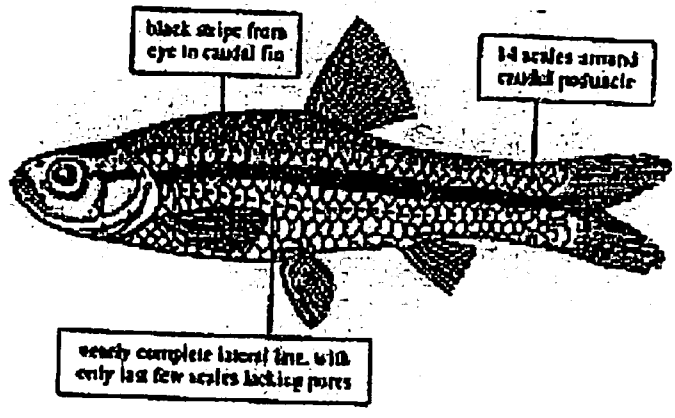
FAO name: Blackline rasbora.
Size: To about 4.5 cm.
Habtat, bilogy, and fisheries: A very common species found from midwater levels to surface in nearly all pond, ditches, canals, and reservoir margins of 2 m depth or less throughout the Mekong and Chao Phrya basins. Browses on zooplankton and occasional insects. Taken by seines, cast-nets, and traVidthayanon & Collaeques, 1997. Common in the aquarium trade.



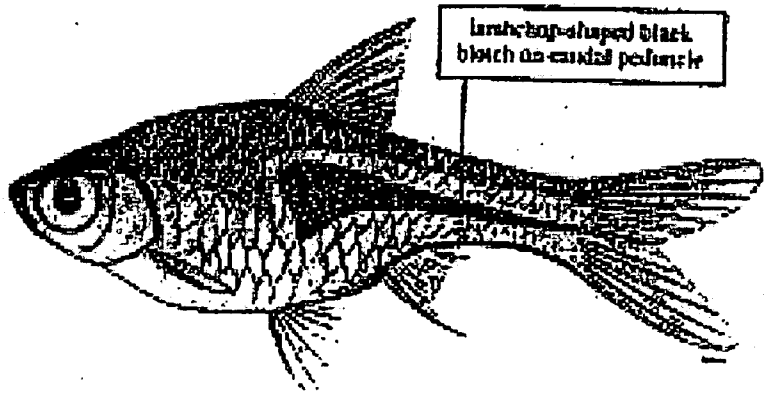
2.2.7.3. ***Rasbora caudimaculata*** (volz, 1903)
FAO name : Greater scissortail.
Size : To 17 cm.
Habitat, biology, and fisheries : Found near the surface of streams in Indonesia, Malaysia, and in the lower Mekong. Not a common species, with apparently localized populations. Feeds primarily on exogenous insects. Taken in seines, cast-nets, and traVidthayanon & Collaeques, 1997. Rarely seen in markets, but common in the aquarium trade.



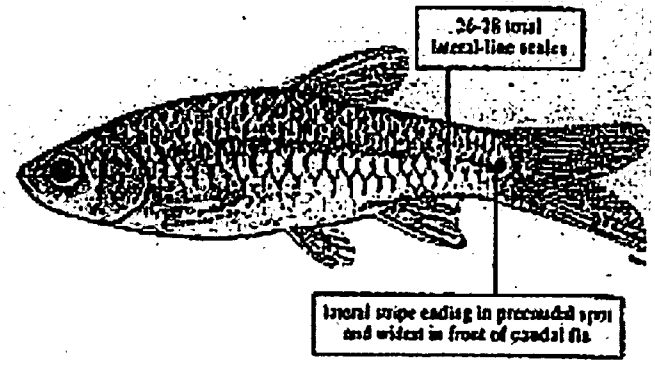
2.2.7.4. *Rasbora daniconius* (Hamilton, 1822)
FAO name: Slender rasbora.
Size: To 6 cm.
Habitat, biology, and fisheries: Known from India to Thailand and Cambodia. Found near the surface in shallow waters of ditched, rice paddies, small streams, and reservoirs. Feeds on crustaceans and insects. Caught with seines, cast-nets. and traVidthayanon & Collaeques, 1997. Seen regularly in the aquarium trade.



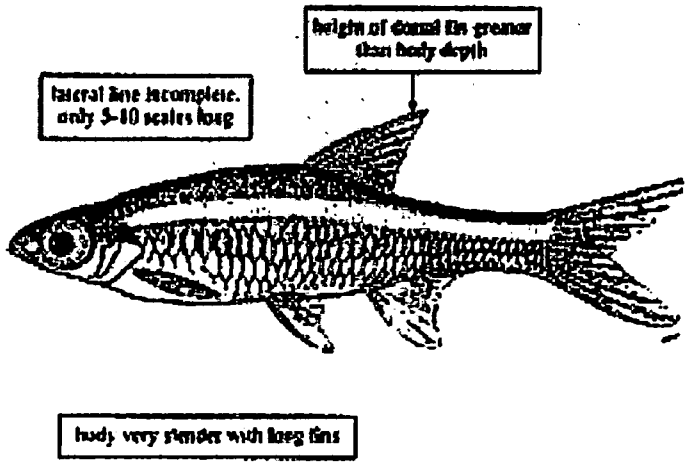
2.2.7.5. *Rasbora espei* (Meinken, 1967)
Synonyms/misidentifications: *Rasbora heteromorpha* (non Duncker).
FAO name : Lambchop rasbora.
Size : To 2.5 cm.
Habitat, biology, and fisheries : This diminuitive species is found in ponds, pools, marshes, and swamVidthayanon & Collaeques, 1997 with heavy growth of submerged aquatic plants. Commonly finds its way into the aquarium trade. Usually collected by seines or traVidthayanon & Collaeques, 1997.



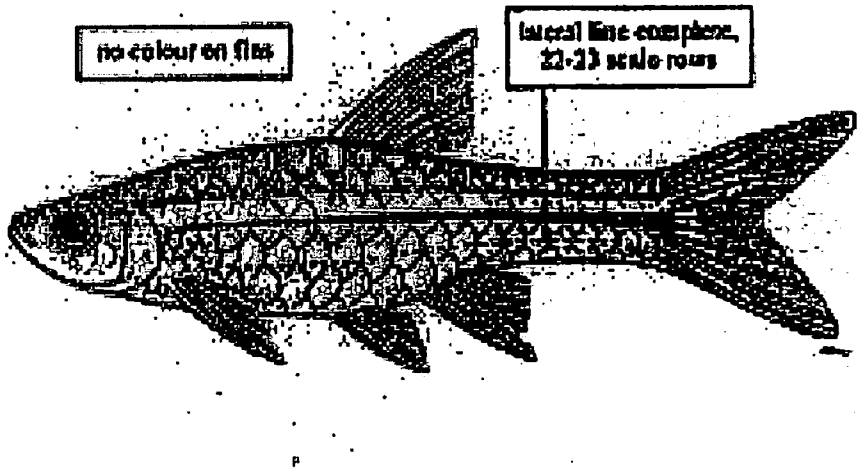
2.2.7.6. ***Rasbora hobelmani*** (Kottelat, 1984)
Size: To 6 cm
Habitat, biology, and fisheries: Found from midwater levels to surface in pools of small upland streams from Burma to Cambodia. Probably feeds mostly on exogenous insects. Taken with seines, cast-nets and traVidthayanon & Collaeques, 1997. Not seen in markets. May possibly be used in the aquarium trade.



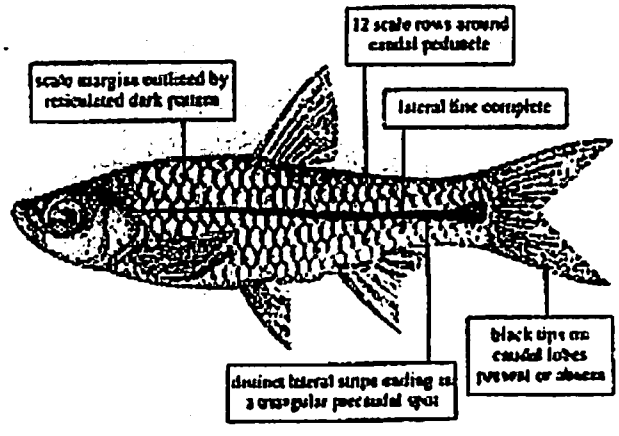
2.2.7.7. ***Rasbora pauciperforata*** (Weber and de Beaufort, 1916)
FAO name: Red-line rasbora
Size: To 3.5 cm.
Habitat, biology, and fisheries: Known from midwater levels to surface in shallow sluggish and standing waters, marshes and swamp, usually under forest canopies. Seems to prefer soft acidic water that is often tanninstained. Found in small openings of generally dens vegetation. Diet consists of zooplankton and some insects. Taken with seines, cast-nets, push -nets, and traVidthayanon & Collaeques, 1997. Not seen in markets, but popular in the aquarium trade.



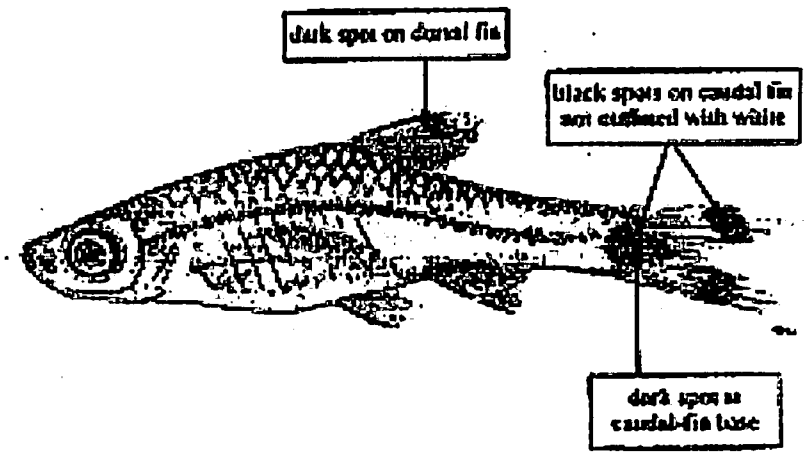
2.2.7.8. *Rasbora paucisquamis* (Ahl, 1935)
Size: To 4 cm. in Cambodia, slightly larger in Malaysia
Habitat, biology, and fisheries: Found in pools in clear, swift, forest streams in the upland area of the Mekong basin. Taken by seines cast-nets, and traVidthayanon & Collaeques, 1997. Individual from Cambodia seem to attain a much smaller size than would be expected from Indonesia, based on the type (Kottelat, 1991). Not seen in markets, rarely in aquarium trade.



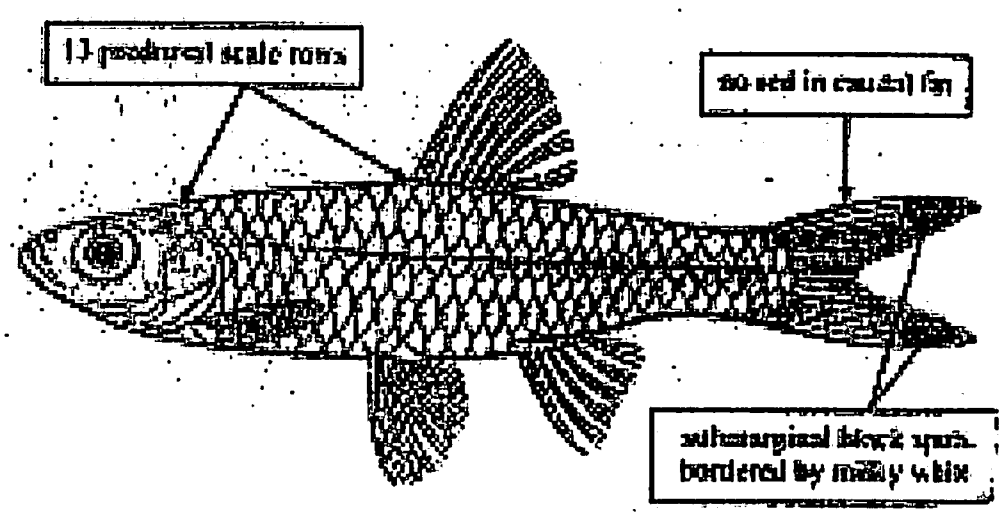
2.2.7.9. ***Rasbora paviei*** (Tirant, 1885)
Synonyms/misidentifications: *Rasbora lateristriata* (non van Hasselt), *Rasbora sumatrana* (non Bleeker).
FAO name: Sidestripe rasbora.
Size: To 12 cm.
Habitat, biology, and fisheries: Found near the surface in small to medium-sized streams in upland areas of Thailand and Cambodia. Individuals from high-gradient upland streams have a much darker stripe and often black tiVidthayanon & Collaeques, 1997 on the caudal fin lobes. Diet probably consists of exogenous insects. Taken by seines, cast-nets and traVidthayanon & Collaeques, 1997. Not seen in markets, but occasionally imported in the aquarium trade.



2.2.7.10. ***Rasbora spilocerca*** (Rainboth and Kottelat, 1987)
FAO name: Dwarf scissortail rasbora.
Size: To 2.5 cm.
Habitat, biology, and fisheries: Found near the surface in shallow marshes, swamVidthayanon & Collaeques, 1997, and inundated fields. Usually encountered in shallow layers of open water above beds of fineleaved aquatic macrophytes and submerged grasses. Diet consists of zooplankton and some insects. Taken with seines, cast-nets, push-nets, and traVidthayanon & Collaeques, 1997. Probably too small to be found in fish markets. Rarely seen in the aquarium trade.



2.2.7.11. ***Rasbora trilineata*** (Steindachner, 1870)
FAO name: Scissortail rasbora.
Size: To 6 cm.
Habitat, biology, and fisheries: A common resident of surface waters in streams, canals, ditches, and occasionally of reservoirs in lowland areas from Thailand to Indonesia. A fast swimmer that prefers open waters. Feeds mostly on exogenous insects. Taken with seines, cast-nets, and traVidthayanon & Collaeques, 1997. Not seen in markets, but very popular in the aquarium trade.



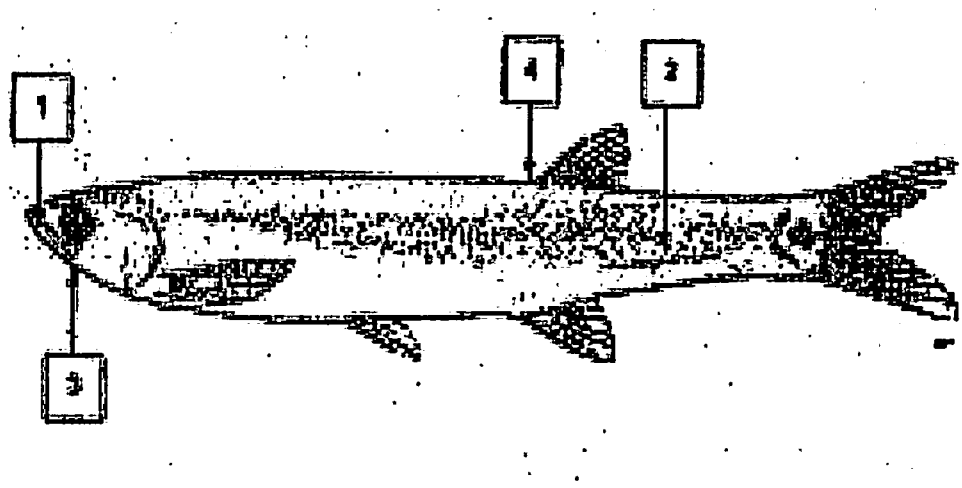
2.2.8. Genus *Thryssocypris* .

(1) MOUTH LARGE, EXTENDING BACK TO MIDDLE OF EYE ;
(2) SCALES SMALL, MORE THAN 42 IN LATERAL LINE;
(3) NO BARBELS;
(4) DORSAL-FIN ORIGIN BEHIND ANAL-FIN ORIGIN.

2.2.8.1. *Thrussocypris tonlesapenis* (Roberts and Kottelat, 1984)

Size: To 7 cm.

Habitat, biology, and fisheries: A Mekong endemic, found near the water surface from the Tonl Sap to the Mekong delta. Highest numbers primarily in the tidal zone of large deltaic branches of the lower Mekong. Diet consists of insect larvae. Taken by seines, cast-nets, set-nets, and traVidthayanon & Collaeques, 1997. Sometimes seen in markets, but usually used for making prahoc and tuk trey. The local name included here was found on a list at the Cambodian Department of Fisheries. However, due to its shape, size, and bright silvery colour when fresh. it is expected that the local fishermem might call it trey bawndul ampeou. That name is used for small, silvery pellonuline clupeids which this fish superficially resembles.



3. Subfamily Acheilognathinae

- Reference not enough to report.

4. Subfamily Gobioninae

- Reference not enough to report.

5. Subfamily Alburninae

- An axillary scale above the base of both the pelvic and pectoral fins. Belly with a sharp edged fleshy keel. First ray of dorsal non - spinous.

- Have 2 genus and 5 species reported by Walter J. Rainboth, 1996

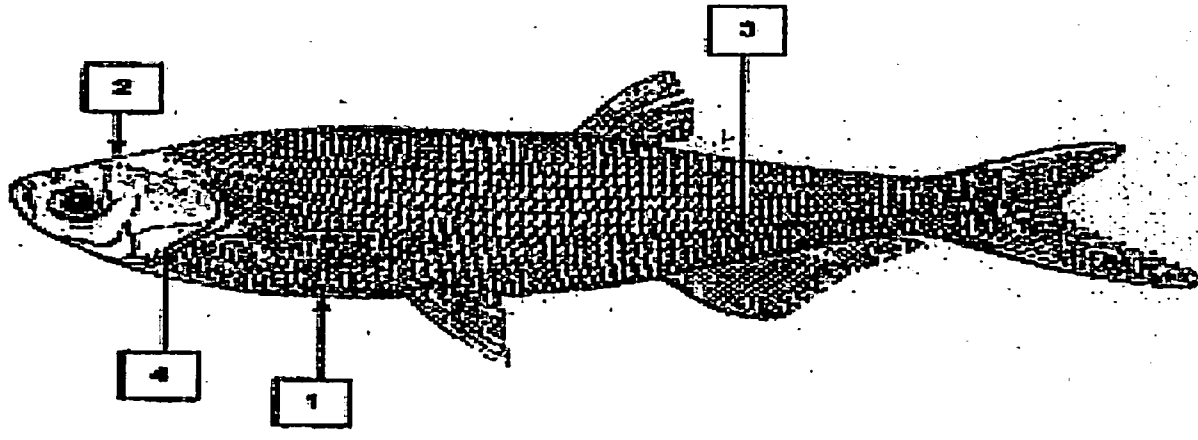
5.1. Genus *Longiculter*

(1) BELLY WITH A SHARPLY EDGED KEEL;
(2) EPAXIAL MUSCULATURE NOT EXTENDING BETWEEN EYES;
(3) 52 TO 85 LATERAL-LINE SCALE;
(4) OVER 100 GILL RAKERS ON FIRST ARCH.

5.1.1. *Longiculter siahi* (Fowler, 1937)

Size: To 20 cm.

Habitat, biology, and fisheries: Found in middle and upper water levels of large and medium sized rivers in mainland Southeast Asia. Little is known about this species, but it is apparently uncommon or at least localized in distribution. It has a high number (over 100) of gill rakers on the first arch and is probably a filter-feeder. Caught by seines, cast-nets, gill-nets, weirs, and barrages. The Cambodian species may be distinct from the one recorded from central Thailand (Kottelat, 1989).



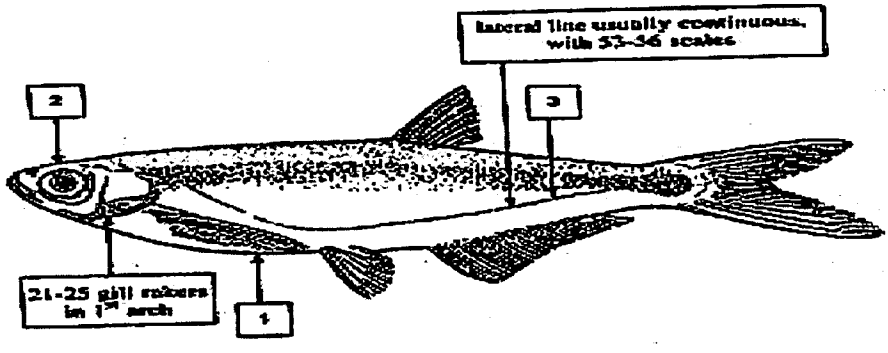
5.2. Genus *Paralaubuca*

(1) BELLY WITH A SHARPLY EDGED KEEL;
(2) EPAXIAL MUSCULATURE NOT EXTENDING BETWEEN EYES;
(3) 52 TO 85 LATERAL-LINE SCALES.

5.2.1. *Paralaubuca barroni* (Fowler, 1934)

Size: To15 cm, commonly to about 10 cm.

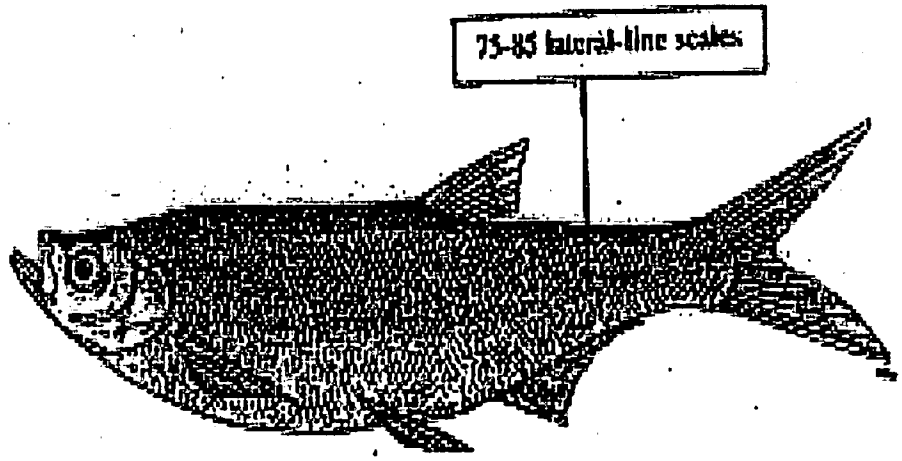
Habitat, biology, and fisheries: Found at shallow and medium depths of large rivers of continental Southeast Asia. Little is known about this species, because it resembles *P .typus* so closely that the two are usually not distinguished. Like other members of the genus, it feeds on zooplankton and occasionlly insects. Not as common as *P.typus* in the middle Mekong. Caught by seines, cast-nets, set-nets, weirs, and traVidthayanon & Collaeques, 1997. Probably used to make prahoc as done with other members of the genus.



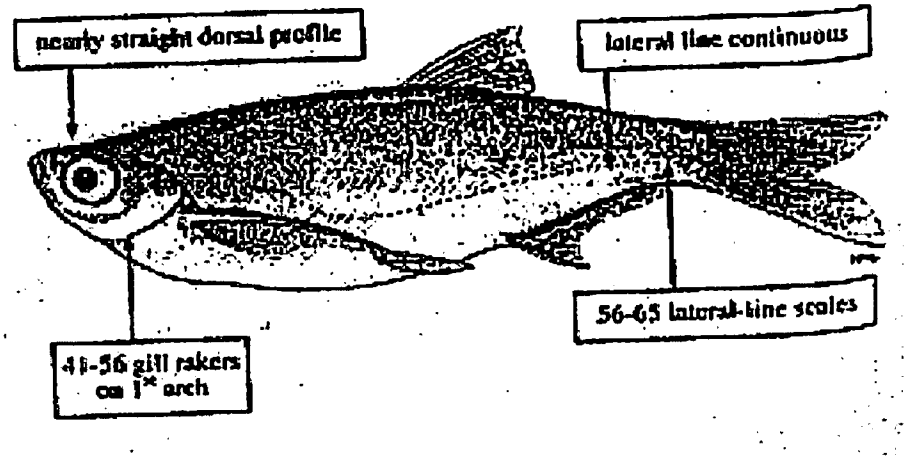
5.2.2. *Paralaubuca harmandi* (Sauvage, 1883)

Size: To 20 cm, commonly between 12 and 15 cm.

Habitat, biology, and fisheries: Found in shallow and medium depths of large rivers. Usually found as scattered individuals rather than in large schools like *P. barroni* and *P. typus.* Feeds on zooplankton and insects of larger size than seen in other members of the genus. Most commonly caught in the lower Mekong during November as the water levels distinctly begin to decline. Taken by seines, cast-nets, and traVidthayanon & Collaeques, 1997. Used to make prahoc.



5.2.3. ***Paralaubuca riveroi*** (Fowler, 1935)
Size: To 18 cm. usually smaller.
Habitat, biology, and fisheries: Found in Shallow and medium depths of large rivers, usually caught as scattered representatives in schools of the other species in thes genus. Feeds mostly on zooplankton and occasionally insects. Very difficult to distinguish from *P. typus*. Taken by seines, cast-nets, and traVidthayanon & Collaeques, 1997. Used to make prahoc.

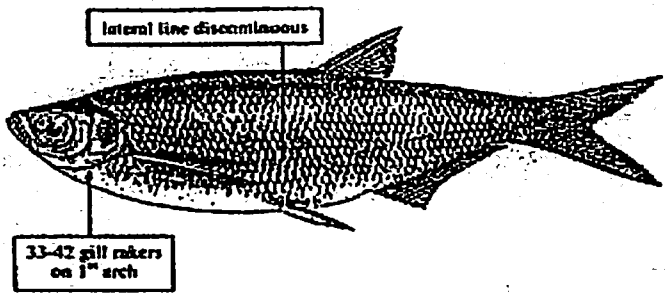


5.2.4. *Paralaubuca typus* (Bleeker, 1865)

Synonyms/misidentfication: *Paralaubuca stigmabrachium.*

Size: To 18 cm, usually smaller.

Habitat, biology, and fisheries: Found at shallow depths in large rivers. A schooling species that is usually harvested in large numbers throughout its range. It is very difficult to distinguish from *P. riveroi* without a dissecting microscope. Feeds on zooplankton and occasionally insects. Moves out into flooded forests during high water levels and returns to the mainstream after the water levels have already considerably declined. Its greatest abundance in the lower Mekong coincides with the peak fishing season of December. Taken by seines, cast-nets, set-nets, weirs, and traVidthayanon & Collaeques, 1997. Sometime marketed fresh, but usually used to make prahoc.



Part VII

REFERENCES

Ahl, E. 1922. uber zwei neue Rasbora-Arten des Indo-Malaiischen Archipels. Bl. Aquarienkunde, Stuttgart, 17 : 294-296.

Alfred, E. R. 1966. The Malayan cypriniod fishes of the family Homalopteridae. Zool. Meded.43(18) : 213-237, 2 pls

Areerat, Sopa. 1967. A taxonomic study of lizard fish(Family Synodontidae) in Thai Waters. Thesis for the Bachelor Degree (Fisheries) Kasetsart University. 68 p. (in Thai).

Banasopit, T. and T. Wongratana. 1967. A check list of fishes in the reference collection maintained at the Marine Fisheries Laboratory. Marine Fisheries Laboratory, Division of Research and Investigations, Department of Fisheries, Contribution no. 7, 73 p. (in Thai).

Bansopit, Thien. (n.d.). The Butterfly fishes (Family Chaetodontidae) of Thailand. Division of Research and Investigations, Department of Fisheries, Bangkok, Thailand. 75p. (in Thai).

Benh,G.and Klausenwitz,W.1962.Puntius somphongsin.sp.aus Thailand (Pisces. Cyprinidae). Senck.Biol., 43:21-26, pl.2.

Berg, L.S. 1965 Classification of fishes both recent and fossil. Reprinted by Documint Reproduction Unit, Thai National Documentation Centre, Applied Scientific Research Corperation of Thailand. p. 346-517.

Berra, T. M. 1981.An atlas of distribution of the freshwater fish families of the world. Univ.Nebraska Press. 197pp.

Bhukaswan, Thiraphan. 1966. The freshwater fishes survey at Ubolratana (Pong Neep) reservoir area before damed at Nampong Khon Kaen. Thesis for the Bachelor Degree (Fisheries) Kasetsart University. 145 p. (In Thai)

Boonyaratpalin, S. and Srirungroj, M.1971. ScaphognathoVidthayanon & Collaeques, 1997 bandanensis n.sp.new fish species of family Cyprinidae of Thailand.Annaul Rep., Unit Taxon., Inland Fish.Div., Dept. Fish., Bangkok, pp.23-28.

Bornbusch, A. H. and J.G. Lundberg. 1989. A new species of *Hemisilurus* (Siluriformes Siluridae) from Mekong River, with comments on its relationshiVidthayanon & Collaeques,1997 and historical biogeography. Copeia 1989 (2) :434-444.

Boulenger, G.A. 1898. Description of a new cypriniod fish from Siam.Ann.Mag Nat Hist. Ser.7 Vol. 1:450-451p.

Brittan, M. R. 1954. A revision of the Indo-Malayan freshwater fish genus, Rasbora. Philipine Inst. Sci. Tech., monogr. 3.224pp., 52figs., 3maVidthayanon & Collaeques, 1997.[Reprinted 1972 by TFH Press]

Brittan, M. R. 1956. A new species of the fish genus *Danio* (Cyprinidae)from Keddh, Malaya.Bull.Raffles Mus., 27:41-44, pl.3.

Chuesri, Chaloemwilai, 1963. An investigation in the species of ornamental fishes introduced to Bangkok. Thesis for the Bachelor Degree (Fisheries) Kasetsart University. 99 p. (in Thai).

Chu, X. L., Chen Y. R. et al. 1989. The Fishes of Yunnan,ChinaPart I Cyprinidae. Science Press.Beijing, China. 377pp.

Chu, X. L., Chen Y.R. et al.1989. The fishes of Yunnan, China Part II Cyprinidae. Science Press.Beijing, China. 313pp.

Compagno, L. J. V. and Roberts, T. R. 1982. Freshwater dasyatid stingrays of Southeast Asia and New Guinea, with description of a new species. Env. Biol. fishes 7(4) : 321-339.

Department of Fisheries. 1969. Annual report 1969. Taxonomic Section, Inland Fisheries Division, Department of Fisheries. 53p. (in Thai).

_____. 1970. Fisher in Songkhla Lake and vicinty, Research report on the third part of the study. Songkhla Fisheries Station, Coastal Aquaculture division, Department of Fisheries, Ministry of Agriculture & Cooperatives. 11 p. (in Thai).

Doi, A. and Taki, Y. 1994.A new cyprinid fish, *Hampala salweenesis* from the Mae Pai River System, Salween basin, Thailand. Japan. J. Ichthyol., 40 : 404-412.

Duangsawasdi, Maitree. 1968. A study on the groupers (Epinephelidae) in Thai Waters. Thesis for the Bachelor Degree (Fisheries) Kasetsart University. 146 p. (in Thai).

Fily, F. 1977. Danio maetaengensis,a new species of cyprinid fish from northern Thailand chthyol. Explor. Freshwater, 8(1); 41-48.

Fowler, H. W. 1943. A new barb from Siam(Puntiusviehoeveri). Fish Cult. 23:25-28.

Fowler, Henryw Weed. 1934a Zoological results of the third Schauensee Siamese expedition, part 1 fishes. Proc. Acad. Nat, Sci. Philad., 86:89-163.

_____ . 1934b. Zoological; results of the third Schauensee Siamese expedition, part 5, additional fishes. Proc. Acad. Nat, Sci. Philad., 86: 335-352.

_____ . 1935a. Zoological results of the third Schauensee Siamese expedition, part 6, fishes obtained in 1934. Proc. Acad. Nat. Sci. Philad. 87:89-163.

_____ . 1935b. Zoological results of the third Schauensee Siamese expedition, part 7, feshes obtained in 1935. Proc. Acad. Nat. Sci. Philad. 87:509-513.

_____ . 1937. Zoological results of the third Schauensee Siamese expedition, part 8, fishes obtained in 1936. Proc. Acad. Nat. Sci. Philad. 89: 125-264.

_____ . 1939. Zoological results of the third Schauensee Siamese Expedition, part 9, additional fishes obtained in 1936. Proc. Acad. Nat. Sci. Philad. 91: 39-76.

Gunther, Albert. 1861. Catalogue of the Acanthopterygian fishes in the collection of the British Museum, Vol.3. London, Printed by Order of the Trustees. 586 p.

Hora, Sunder Lal. 1923. On a collection of fish from Siam. Journ. Siam Soc. Nat. Hist. Suppl., 6: 143-184.

Hora, S.L. & Law, N.C. 1941. Siluroid fishes of India,Burma and Ceylon.IX. Fishes of the genera Gagata Bleeker and Nangra Day.X. fishes of the genus Batasio Blyth. Rec. Ind. Mus., 43:9-42.pls.1-2.

Howes, G.J. 1979. Note on the anatomy of *Macrochirichthys macrochirus* (Valenciennes, 1894), with comment on the cultriine (Pisces:Cyprinidae). Bull. Br. Nat. Hist. Zool. 36:147-206.

Howes, G.J. 1980. The anatomy, phylogeny and classification of bariline cyprinid fishes. Bull. Br. Nat. Hist. Zool. 37:129-198.

Imaki, A.and Taki, Y. 1976. Record of a rare cyprinid fish, *Xenocheilichthys loppei* from the Laotain and Vietnamese Mekong and peninsular Thailand. Jap. J. Ichhyol., 23(2): 105-108, fig.1-2.

Inland Fisheries Division, Department of Fisheries, Bangkok, Thailand. 1970. Report on the fisheries surveys of the Mekong River in the vicinity of the Pa Mong Dam site. Inland Fisheries Division, Research Report no. 8, 75 p.

_____ . 1984. Annual report 1984. Fisheries development in Ubolrat Dam. Inland Fisheries Division, Department of Fisheries, Ministry of Agriculture and Cooperatives. 66 p. (in Thai).

_____ . 1985a. Annual report 1985. Fisheries development in big compoundments Ubolrat Cam). Inland Fisheries division, department of Fisheries, Ministry of Agriculture and Cooperatives. (in Thai).

_____ . 1985b. Annual Report 1985. Nong Khai Fisheries Station. Inland Fisheries Division, Department of Fisheries, Ministry of Agriculture and Cooperatives. 81 p. (in Thai).

Johnsen, P. 1963-64. Notes on fishes along the river Kwai Noi in western Thailand. Siam Soc. Nat. Hist. Bull. 20(3-4):143-154, 257-263, 265-268.

Kaewpaitoon, Kamtorn. 1979. Systematic study of the fish genus *Barilius* found in Thailand. Thesis for the Master of Science Degree (Fisheries Science) Kasetsart University. 108 p.

Kajarngdara, T. 1994. Taxonomy and some biological aspects of fishes found in the impoundment of Rajjaprabha Dam, Surat Thani Province. Thesis for the Master of Science Degree (Fisheries Science) Kasetsart University. 298p.

Karnasuta, J. 1981. Revision of the southeastern Asiatic cyprinid genus Osteochilus, Gunther. Ph.D. Dissertation, Univ. Alberta, Edmonton.xiii+374pp.

Karnasuta, J. 1993. Systematic revision of Southeast asiatic cyprinid genus *Osteochilus*, with description of two new subspecies. Kasetsart Fisheries Research Bull. 19:105pp.

Khan, MS.; Lee, P.K.Y.; Cramphorn, J. and Zakaria-smail, M. 1996. Freshwater fishes of the Palang River basin, Malaysia. Wetland International-Asia Pacific Publ. No. 12:112p.

Kottelat, M., 1982a. A small collection of fresh-water fishes from Kalimantan, Borneo, with descriptions of one new genus and three new species of Cyprinidae. Rev. Suisse Zool., 89 : 419-437.

Kottelat, M. 1984. A new *Rasbora hobelmani* (Pisces: Cyprinidae) from Northern Thailand. Revue Suisse Zool. 91(3) : 717-723.

Kottelat, M., 1985a. Notulae ichthyologiae orientalis V.A synoVidthayanon & Collaeques, 1997 is of the oriental cyprinid genus Sikukia.VI. Ststus of the Kampuchea cyprinid Albulichthys krempfi. Rev. Suisse Zool., 91(1984[1985]:953-958).

Kottelat, M., 1988a. Indian and Indochinese species of *Balitora* (Osteichthyes: Cypriniformes) with descriptions of two new species and comment on the family group names Bolitoridae and Homalopteridae. Rev. Suisse Zool., 95:487-504.

Kottelat, M., 1990b. Indochinese nemacheilines.A revision of nemacheiline loaches (pisces:Cypriniformes) of Thailand, Burma, Laos, Cambodia and southern Viet Nam. Verlag Dr. F. Pfeil, Munchen 262 pp., 180 figs.

Kottelat, M., 1991. Note on the taxonomy of some Sundaic and Indochinese species of Rasbora,with descriptions of four new species (Pisces:Cyprinidae). Ichthyol. Explor. Freshwater, 2 (2) : 177-191.

Kottelat, M. 1996. The identity of *Puntius eugrammus* and diagnosis of two new species of striped barbs (Teleostie: Cyprinidae) from Southeast Asia. The Raffle Bull. Zool.44 (1) : 301-316.

Kottelat, M. & C. Vidthayanon. 1993. *Boraras micros*, a new genus and species of miniature freshwater fish from Thailand (Teleostie:Cyprinidae). Ichthyol. Explor. Freshwater 4 (2) : 161-176, 9figs.

Magtoon, W. and H. Uwa. 1988. First report of *Oxyzias melastigma*(Cyprinodontidae: pisces) in Thailand. The 26 th Kasetsart Univ. Press. p. 229-233.

Magtoon, W. and Ryoichi Arai. 1994. Karyotype of five *Rasbora* species and one *Danio* species (Cyprinidae) from Thailand. Proceedings of the Fourth Indo-Pacific Fish Conference Bangkok, Thailand, 28 Nov. - 4 Dec. 1993, systematics and evolution of Indo-Pacific Fishes. p. 484-496.

Phanil, Charoen. 1962. A preliminary study on the life history of *Esomus metallicus* Ahl. Thesis for the Bachelor Degree (Fisheries) Kasetsart University. 31 p. (in Thai).

Rainboth, W.J. 1981. Systematics of the Asiatic barbins (Pisces, Cyprinidae). Unpubl. Ph.D. thesis, University of Michigan, Ann Arbor, 253pp.

Rainboth, W.J. 1985. *Neolissochilus*, a new genus of South Asian cyprinid fishes. Beaufortia, 35:25-35.

Rainboth,W.J. 1986. Fishes of the Asian cyprinid genus Chagunius. Occ. Pap. Mus. Zool. Univ. Michigan, 712:1-17.

Rainboth, W.J. and M. Kottelat. 1987. Rasbora spilocarca, a new Cyprinid from the Mekong River. Copeia 1987 (2) : 417-423.

Rainboth, W.J. 1989. *Dishcherodontus*, new genus of cyprinid fishes from Southeastern Asia. Occ. Pap. Mus. Zool. Univ. .Michigan, 718:1-31.

Rainboth, W.J. 1991. Cyprinids of Southeast Asia. In Winfield, IJ. & Nelson, JS. eds. Cyprinid fishes, systematic, biology and exploitation. Fish & Fishery Ser.3. Chapman & hall.; 154-210.

Rainboth, W.J. 1996b. The taxonomy, systematics and zoogeography of HyVidthayanon & Collaeques, 1997 ibarbus, a new genus of large barbs (Pisces:Cyprinidae) from the river of southeastern Asia. Univ.of Calif. Publ. Zool. 129:xiii+199.

Rainboth, W.J., & M. Kottelat. 1987. Rasbora spilocerca,a new cyprinid from the Mekong River. Copeia, 1987:417-423.

Roberts, T. 1981. Sundasalangidae, a new family minute freshwater salmoniforms fishes from Southeast Asia. Proc. Calif. Acad. Sci. 42 (9) : 295-302.

Roberts, T. 1991. *Barbus speleoVidthayanon & Collaeques, 1997* new species, a blind cavefish from Tham Phu Khieo, Mekong basin, Thailand. Nat. Hist. Bull. Siam soc.39 ; 103-109.

_____. 1992. Revision of the Southeast Asian Cyprinid fish genus with two new species threatened by purposed construction of dams on the Mekong River. Ichthyol. Explor. Freshwater. 3 (1); 37-48.

Roberts, T.R. & M. Kottelat, 1984. Description and osteology of *Thryssocypris*, a new genus of anchovy-like cyprinid fishes, based on two new species from southeast Asia. Proc. Calif. Acad. Sci., 43:141-158.

Roberts, T.R. & M.Kottelat. 1994. The Indo-Pacific tigerperches,with a new species from the Mekongbasin (Pisces:Coiidae). Ichthyol. Explor. Freshwater 5(3):257-266, 6 figs.

Sukulpon, Paitoon. 1966. A survey on fresh-water fishes in Nongharn Sakolnakorn. Thesis for the Bachelor Degree (Fisheries) Kasetsart University. 54p. (in Thai).

Schultz, L. P. 1959. New Cyprynid fish from Siam. Trop. Fish Hobbyist May 9-11, 36-37.

Smith, H.M. 1931a. Descriptions of new genera and species of Siamese fishes. Proc. U.S. Nat. Mus. 79(7); 1-48.

_____. 1931b. Descriptions of new genera and species of Siamese fishes.Journ. Siam Soc. Nat. Hist. Suppl., 8 (3); 224-226.

_____. 1933a. New fish record. Journ. Siam. Soc Nat. Hist. Suppl., 9 (10); 75-87.

_____. 1933b. Contributions to the ichthyology of Siam. Journ. Siam Soc. Nat. Hist. Suppl., Vol. 9. p. 53-87.

_____. 1933c. Contributions to the ichthyology of Siam. Journ. Siam Soc. Nat. Hist. Suppl., Vol. 9, p. 245-260.

_____. 1934 Contributions to the ichthyology of Siam. Journ. Siam Soc. Nat. Hist. Suppl., Vol.9, p. 287-325.

Smith, H.M. 1945. The freshwater fishes of Siam or Thailand. Bull. U.S. Nat. Mus. 188. Xi+622pp., 9pls.

Sontirat, S. 1976. Revision of the southeastern Asiatic cyprinid fish genus Cyclocheilichthys. Ph.D. Dissertation Univ. Michigan, Ann Arbor. 140pp.

Sontirat, S. 1971.Report on fish - species compositions collected during accomporarying marine science's student on field study in the Andaman Sea and Bay of Bangal, from 1-26 April, 1971. Department of Marine Science, Faculty of Fisheries, Kasetsart University.13 p. (In Thai).

Sontirat, S. 1976. Revision of the Southeastern Asiatic Cyprinid Fish Genus *Cyclocheilichthys*. Ph.D. Thesis, University of Maichigan, Ann. Ardor. 133pp.

_____. 1981. Systematic studies on two species of fish of the genus *Rasbora* found in Thailand. Fisheries Gazette: 34(5) : 559-595.

_____. 1984a. *Leptobarbus hoeveni* (Bleeker) or *Filirasbora rubripinna* Fowler. Proc. 22 nd Conf., Fisheries Section, Faculty of Fisheries, Kasetsart University : 30 Jan - 1 Feb. 1984, 22 : 22 - 26.

_____. 1984d. A systematic study on the fish of the subfamily Garrinae of Thailand. Proc. 22 nd Conf., Fisheries Section, Kasetsart University : 30 Jan. - 1 Feb. 1984, 22; 17-21.

_____. 1984e. A systematic study on the fish of the Genus *Parachela Steindachner*. Proc. 22nd Conf., Fisheries Section, Kasetsart University 30 Jan.- 1 Feb. 1984, 22: 12-16.

_____ . 1988b. Cyclocheilichthys schwanefeldi. *Puntius foxi* or *Puntius schwanefeldi.* Proc. 26 th Conf., Fisheries Section, Kasetsart University. 3-5 Feb. 1988, 26; 361-366.

_____. 1988c. *Puntius sametensis, Puntius pessuliferus* or *Puntius stigmatosomus.* Proc. 26 th Conf., Fisheries Section, Kasetsart University. 3-5 Feb. 1988, 26: 367-372.

_____ . 1989. Four new species of freshwater fishes from Thailand. Kasetsart Journ. 23 (1) 97-109.

Sontirat, S. a. A new record of fishes in the Kasetsart University Museum of Fisheries. (Unpublished).

_____ ...b...A Systematic Study on the fish Genus *Cirrhinus* Oken found in Thailand. (Unpublished).

_____ . ...c... Revision of Cyprinid Fish Genus *Puntioplites* in Thailand. (Unpublished).

_____ . ...d... A Systematic Study on the Fish Genus Acanthophthalmus found in Thailand. (Unpublished).

_____ . ...f... Labeo rohita, An Important Introduced Species of Fish in Thailand. (Unpublished).

Ukkatawewat, Sompote. 1979. The taxonomic characters and biology of some important freshwater fishes in Thailand. National Inland Fisheries Institute, Freshwater Fisheries Division, Department of Fisheries, Technical Paper No. 32979, 43 p.

Vitthayanon, C. and M. Kottelat. 1990. *Amblypharyngodon chulabhornae* sp. nov., a new Cyprinid fish from Thailand and Kampucha. Nat. Hist. Siam soc. 38: 45-57.

Vidthayanon C., J. Karnasuta and J. Nabhitahata, 1997. Diversity of Freshwater Fishes in Thailand. Office of Environmental Policy and Planning, Bangkok. 102 p.

Walter J. Rainboth. 1996. Fishes of The Combodian Mekong. Departmentof Biology and Microbiology University Oshkosh Oshkosh, Wisconsin, U.S.A. p. 65-122.

Wongrat, Prachit, Suebsin Sontirat and Supap Monkolprasit. 1971. New record of some species of fishes in Kasetsart University Museum of Fisheries. Proceedings of the National Conference on Agricultural and Biological Sciences Tenth Session, Animal Science at Kasetsart University, February 3-5, 1971. 12p. (in Thai).

Wongratana, T. 1965. The Pla Soi (Cyprinidae) in Nong Bang Ngu at Rajburi. Thesis for the Bachelor Degree (Fisheries) Kasetsart University. 77p. (in Thai).

APPENDIX 3

Appendix 3

Documentation of Carp Genetic Improvement in China

Freshwater Fisheries Research Centre
of Chinese Academy of Fishery Sciences
Qitang, Wuxi,
China 214081

Documentation of Carp Genetic Improvement in China

1. Selective breeding

Selection, including mass selection and family selection, is an important breeding method. In China, over 20 fish species have been selected. The selective bred varieties of carp in China are described below:

- *Cyprinus carpio singuonensis*

(1) Breeding institute and agency : Red Carp Reproduction Farm of Singuo County and Biological Department, Jiangxi University.
(2) Background : More than 130 years ago, the variety was cultured in Singuo county. Since 1972, the native variety has been propagated. After six generations, the growth rate of its progeny has a 10% gain. Red individuals accounted for 86.6% of the population but now have reached 98.6%. The variety was identified by the Fisheries Bureau in 1985.
(3) Total production : about 5,000 tons, annually.
(4) Other : It is the parent of several hybrids : Fong carp, Lotus carp, and allogynogenetic crucian carp.

- *Cyprinus carpio wuyuanensis* (CCW)

(1) Breeding institute and agency : CCW Research Institute of Wuyuan County, and Biological Department, Jiangxi University, and Institute of Hydrobiology
(2) Background : The variety has been cultured in Wuyuan County for over 300 years. Since 1961, its biology has been studied by Institute of Hydrobiology, Academia Sinica and CCW Research Institute of Wuyuan County. After six generations of selection, its characters tend to be stable, and the red individuals are 89.54% of the population.
(3) Total production : about 5,000 tons, annually.
(4) Other : The variety is the parent of other varieties and hybrids, including Heyuan carp, Yue carp, Tri-back hybrid, and Jian carp.

- *Carassius auratus pengzenensis*

(1) Breeding institute and agency : Research Institute of Jiangxi province and Jiujiang city.
(2) Background :The variety has been cultured in lakes of Pengze County. Since 1980, systematic selection has been studied by Fisheries Research Institute of Jiangxi province. After six generations' selection, its growth rate is 56% higher than before selection.

2. Crossbreeding

Crossbreeding of fish species has been tried among about 2000 species, Unfortunately, most of the trials did not yield heterosis. In China, over 100 hybrid combinations have been tried in the family Cyprinidae. The hybrid progenies with good characteristic are: Fong carp, Heyuan carp, Yue carp, Baiyuan carp, tri-crossed carp and backcross carp.

All of the hybrids mentioned above possess economically good traits (such as, higher growth rate, lower feed conversion rate, higher fishing rate, etc.). Hence, they are becoming the main cultured freshwater fish throughout China.

The extended varieties and hybrids of common carp in China are described as following:

- *Cyprinus carpio var. jian*

(1) Breeding institute and agency : Freshwater Fisheries Research Center.
(2) Background : Parents are *Cyprinus carpio wuyuanensis* and *C. carpio yuankiang.* This line was developed by integration breeding including family selection, inter-line cross combining with gynogenesis . The genetic stability is over 95%.
(3) Total production : The variety has been extended to 29 provinces and autonomous regions. The culture area is more than 660,000 ha. The productivity is over 1,000,000 tons annually.
Growth rate : it is 49.75%, 46.8%, and 28.9% higher than that of *Cyprinus carpio wuyuanensis* and *C. carpio yuankiang*, and Heyuan carp, respectively.

- Anti-cold strain of *Cyprinus carpio wuyuanensis*

(1) Breeding institute : Heilongjiang Fisheries Research Institute.
(2) Background : The parents are a native carp strain in Heilongjiang Province and *Cyprinus carpio wuyuanensis.* Through F_1 selfing, an individual with anti-cold factor, red color and scaled has been obtained from F_2. The individual was used as the parent to keep the anti-cold factor combining with good characters from *Cyprinus carpio wuyuanensis.* In same culture conditions in frigid zone, its growth rate is 10% higher than that other varieties.

- Fong carp

(1) Institute : Institute of Hydrobiology, Academia Sinica.
(2) Background : Fong carp is a hybrid of female *Cyprinus carpio singguonensis* and male scattered mirror carp. Its appearance is similar as both female and male parent. In fingerling stage, the growth rate is obviously higher than its parent. It is 50% to 62% higher than its dam and 140%, higher than its sire. Because of its obvious hybrid vigor, it is welcomed by farmers.
Comparisons between body length and body weight of Fong carp and its parents at both the fingerling stage and adult stage indicated hybrid vigor.

- Ying carp

(1) Breeding institute : Chang Jiang Fisheries Research Institute.
Background : Ying carp is a hybrid of female scattered mirror carp and male F_2 of CyCa nuclear-cytoplasmic hybrid , hence it possesses a tri-hybrid vigor. Its growth rate is 47% and 60.1% higher than its parents at one year and two years of age, respectively.

In addition to the varieties and hybrids mentioned above, Heyuan carp, Yue carp, Lotus carp, and scattered mirror carp to be cultured in different zones throughout China.

3. Haploid breeding

Haploid breeding, gynogenesis and androgenesis of fish began as early as the 50's, and in China in the 1970s.

The gynogenetic progeny have characteristic similar to the dam in appearance and physiological function, are easier to establish as a pure line, the sex is controlled, and combined with the techniques of sex reversal, all-female fish can be produced.

Since the initial success of Pomawob (1960), artificial diploid gynogenesis has been achieved in more than 20 species. Chinese scientists improved the technique and utilize it in goldfish (*Carassius auratus)*, red variety of *C. auratus*, *Cyprinus carpio var. singuonensis*, grass carp (*Ctenopharyngodon idellus*), silver carp (*Hypophthalmichthys molitrix*), and others. A good example is allogynogenetic crucian carp, that is the results of female progeny from gynogenesis of Fangzheng crucian carp (a variety of *Carassius auratus gibelio,* a natural triploid) crossed with male *Cyprinus carpio singuonensis*, and that is welcomed by farmers because of its higher growth rate.

Occasionally, androgenesis is used for distant hybridization. Stanley reported (1979) that an individual androgen resulted from a crossing of mirror carp with grass carp. In 1987, Liu and his colleagues utilized a mechanical method rid oriental weatherfish gynokaryon of intergeneric crossing between oriental weatherfish (*Misgurnus anguillicaudatus*) x *Paramisgurnus dabryanus*, and to obtain a haploid embryo from androgenesis. When the embryo developed to blastula stage, blastula karyon were transplanted into the egg (to rid the nucleus in advance) of *Paramisgurnus dabryanus*. In this way, five tails of pure diploid animals from androgenesis were obtained.

4. Polyploid Breeding

Polyploid fish are found on rare occasions in nature. Generally, it is believed that polyploid fish have a higher growth rate and stronger adaptability than that of diploid. For this reason, the techniques inducing polyploid are being examined by breeders.

The most desirable method for producing triploids should be crossing of tetraploids and diploids. For example, Xiangyun carp, the new variety of common carp is hybrid of induced tetraploid, Hebao red carp and native diploid common carp from Xiangjiang River. The polyploid could also be induced by distant crossing.

In China, it was reported that artificial induction of triploid and tetraploid fish has been attempted on 10 experiments with cyprinids.

- grass carp (*Ctenopharyngodon idellus*),
- silver carp (*Hypophthalmichthys molitrix*),
- bluntnose black bream (*Megalobrama amblycephala*),
- *Cyprinus carpio* var. *wuyuanensis*,
- hybrid between *C. carpio* var. *singuonensis* x grass carp,
- hybrid between *Cyprinus carpio* var. *wuyuanensis* x *Carassius auratus cuvieri*,
- hybrid between grass carp x black bream (*Megalobrama terminalis*),
- hybrid between *Carassius auratus cuvieri* x red goldfish (*Carassius auratus* ,red strain).
- transparent colored crucian carp orcarassius auratus transparent colored varietyca.
- Xiangyun carp, Hebao red carpXitetreaploidtete common carp cdiploid, from Xiangjiang riverdi

Among these, the triploid of Xiangyun carp possesses commercial value.

5. Sex control

The sexual differentiation of some species of fish influences its growth rate and other economical characters, for example, the growth rate of male tilapia is higher than that of female, but female common carp and grass carp grow faster than male. To control the sexes of fish, interspecific crossing, and sex reversal are options.

6. Mutation breeding

Techniques for using mutagens, both chemical and physical, to obtain mutants have been examined. Since 1970's, γ-ray and quick-neutron have been tried to irradiate the gonad, embryo, fry and fingerling of common carp, grass carp, and other species to generate mutants, but no success has been obtained.

7. Integration breeding

Combining two or more breeding techniques together to obtain new varieties or strains has been productive. *C. carpio* var. *jian* is a good example of integration breeding because of its stable genetic characters with commercial value and nice appearance. To date, the new variety has been extended to 29 provinces, municipals and autonomous regions. This fish was developed by combining family selection and inter-family crossing with gynogenesis.

8. Transplant of karyon and cell culture

Since 1970's, Tong Di Zhou and Yan Sao Yi have developed the basic research dealing with transplant of karyon and cell culture, and utilized the technique and method economically important fish. Nuclear-cytoplasmic hybrid fishes, such as common carp x crucian carp (CyCa), crucian carp x common carp (CaCy), grass carp x bluntnose black bream, tilapia, common carp and others, especially CyCa have been achieved and completed the third generation.

To determine if any changes are induced at the genome level after *C. carpio* nuclei have been transplanted into *C. auratus* cytoplasm, their DNA reassociation kinetics have been studied. The DNA of nuclear-cytoplasmic hybrid fish (CyCa) F_3 is the same as *C. carpio*. The nuclear genome was not affected by heterologous cytoplasm in nuclear transplant process. This research has proceeded to the next step including economic trait evaluation.

9. Cell fusion

As early as 1914, cell culture of fish was initiated. To meet the demand of chromosome study : the technique of cell culture has been advanced since 1970's. The cells from different tissues and organs, such as blood, fin, scale, cardiac muscle, nephric cell and others, have been cultured in laboratories. These techniques possess practical value, and can be used in nuclear transplantation.

The study of cell fusion has a long history. Since the 1980's, a new technique, electric fusion, has been adopted in fish cell fusion with good results. The experimental material, *Paramisgurnus dabryanus*, however, has low commercial value. Therefore, our goal is to transfer the technique to economically important fish. Lasers will be evaluated to improve the technique of cell fusion.

10. Gene engineering

The new technique has been evaluated since 1980's in China. The isolation of antifreeze genes from fish, the cloning of antifreeze protein gene cDNA of fish, its expression in E. coli, as well as the insertion and recombination of growth hormone gene

have been accomplished. In the near future, the practical utilization in carp species will be evaluated.

11. Other research

In addition to the applied research, basic theoretical studies have been conducted by some academic institutes and universities. Projects include 1) isoenzyme analysis; 2) analysis and comparison the karyotypes of *Cyprinus carpio* and *Carassius auratus*; 3) investigation on the carp germplasm resources; 4) construction of the genomic libraries of cultured freshwater fish; 5) preliminary studies on the specificity of red blood cell antigens in various varieties (strains) of carp, and others.

APPENDIX 4

Appendix 4

Socio-economic Aspect of Genetic Improvement of Carp Species in Asia Bangladesh

Department of Agricultural Finance
Bangladesh Agricultural University
Mymensingh 2202
Bangladesh

Socio-economic Aspect of Genetic Improvement of Carp Species in Asia

Department of Agricultural Finance
Bangladesh Agricultural University

Questionnaire on Fish Species Priority
For Researcher

(Please read carefully the instruction sheet before filling in the questionnaire)

1. Researcher's Identifications

1.1 Name of Researcher _____

1.2 Name of Institute _____

1.3 Designation _____

1.4 Last degree obtained _____

1.5 Field of specialization _____

1.6 Experiance of research _____

2. Please specify the species and problem area you are working on?

Name of Species 1	Problem area on which you are currently working? 2

3. What specific types of research/problem do you anticipate working on?

Name of Species 1	Anticipated research/problem areas 2

4. How many researchers are working in the same research problem areas and species as yours?

Species		Reasearch/Problem	
Name	No. of researcher	Name of problem/research	No. of researcher
1	2	3	4

55. The following questions are designed to quantify the effect of research as much as possible. Please try to answer as accurately as possible.

[Hints: Successful research on fisheries may increase the yield of fish or reduce the per unit cost of production. It may improve the quality of fish in terms of calorie. It may also expand the area of fish farming.]

5.1 Please estimate the extent of yield increase or cost reduction if you successfully complete your research.

Name of Species 1	Yield (Kg/ha)		Cost of fish production (Tk/ha)	
	Before 2	After 3	Before 4	After 5

5.2 If you assume yield to increase then specify the extent of additional input required to achieve the expected yield. **(You are to fill in one box for one species. You may not fill in column 6 & 7.)**

Name of Species 1:

Inputs 1	Requirement of inputs		Cost of inputs		% change	
	Before 2	After 3	Before 4	After 5	Input 6	Cost 7
Chemical fertilizers						
Cowdung						
Traditional feed						
Improved feed						
Labor						
Fingerling densities						
Others (Specify)						

Name of Species 2:

Inputs 1	Requirement of inputs		Cost of inputs		% change	
	Before 2	After 3	Before 4	After 5	Input 6	Cost 7
Chemical fertilizers						
Cowdung						
Traditional feed						
Improved feed						
Labor						
Fingerling densities						
Others (Specify)						

Name of Species 3:

Inputs 1	Requirement of inputs		Cost of inputs		% change	
	Before 2	After 3	Before 4	After 5	Input 6	Cost 7
Chemical fertilizers						
Cowdung						
Traditional feed						
Improved feed						
Labor						
Fingerling densities						
Others (Specify)						

Name of Species 4:

Inputs 1	Requirement of inputs		Cost of inputs		% change	
	Before 2	After 3	Before 4	After 5	Input 6	Cost 7
Chemical fertilizers						
Cowdung						
Traditional feed						
Improved feed						
Labor						
Fingerling densities						
Others (Specify)						

5.3 What is your estimate about the probability of success of your research (Hints: probability lies between 0 to 100).

Name of Species 1	Probability 2	Remarks 3

5.4 How long will it take to make the key research results available to the fish producers after initiating the research?

Name of Species 1	Time (Years) 2	Remarks 3

5.5 If research is successful, will it affect the quality of the product (fish)?
Yes/No

(If the answer is no, skip question no 5.6 & 5.7)

5.6 Please state wheather quality of fish will improve or deteriorate.

Name of species 1	Will fish quality improve or deteriorate 2	If improve, would the yield also increase at the same time (Yes/No) 3	Remarks 4

Note for column 2: Answer "I" for improvement and "D" for deterioration

5.7 Please estimate the quantity of production/ha and price (Tk/kg) of fish.

Name of Species 1	Quantity, if yield (Kg/ha) increased		Quantity, if yield (Kg/ha) decreased		Price (Tk/kg), if quality improved		Price (Tk/kg) if quality deteriorated	
	Before 2	After 3	Before 4	After 5	Before 6	After 7	Before 8	After 9

6. What percent of the fish producers are expected to adopt the new (improved) technology once the results of research are available? **(Please use one box for one species)**

Name of species 1:

Year 1	% of area covered 2	Year 3	% of area coverd 4	Remarks 5
1		6		
2		7		
3		8		
4		9		
5		10		

Name of species 2:

Year 1	% of area covered 2	Year 3	% of area coverd 4	Remarks 5
1		6		
2		7		
3		8		
4		9		
5		10		

Name of species 3:

Year 1	% of area covered 2	Year 3	% of area coverd 4	Remarks 5
1		6		
2		7		
3		8		
4		9		
5		10		

Name of species 4:

Year 1	% of area covered 2	Year 3	% of area coverd 4	Remarks 5
1		6		
2		7		
3		8		
4		9		
5		10		

7.1 Do you expect the improved technology to be ineffective over time ?

Yes/No

7.2 If yes, please fill up the following box

Name of species 1	How many years after release 2	Reasons for being ineffective 3

8. Do you think that regional differences would exist in the level of adoption of the technology?
Yes No

8.1 If yes, then specify the level of adoption for different region **(use 'H'for high adoption,'M'for medium adoption and 'L' for low adoption).**

Regions 1	Level of adoption			
	Species 1 2	Species 2 3	Species 3 4	Species 4 5
Mymensingh				
Dhaka				
Faridpur				
Jamalpur				
Tangail				
Chittagong				
Comilla				
Noakhali				
Cht. Hill Tracts				
Khulna				
Jessore				
Kushtia				
Rajshahi				
Rangpur				
Dinajpur				
Pabna				
Sylhet				
Barisal				

9. Please prioritize species on the basis of the following criteria. (give score each criteria out of 100)

Name of species	Overall fish production	Genetic consideration	Taste	Income increase	Equity			Sustainability	
					Supply of protein at affordable price	Employment generation	Supply of micronutrient/vitamin	Improving environment	Enriching biodiversity
1	2	3	4	5	6	7	8	9	10
Rui									
Catla									
Mrigal									
Kalbasu									
Silver carp									
Grass carp									
Mirror carp									
Tilapia									
Sarputi									
Thaisarputi									
Pungas									
Nilotica									
Hilsa									

APPENDIX 5

Appendix 5

Baseline Survey of Aquaculture Households Vietnam

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Dinh Bang, Tien Son, Bac Ninh,
Vietnam

Research Institute for Aquaculture No. 2
116 Nguyen Dinh Chieu Street
District 1, Ho Chi Minh City
Vietnam

SURVEY SCHEDULE A
(Production)

BASELINE SURVEY OF AQUACULTURE HOUSEHOLDS VIETNAM

A Joint Undertaking of
Research Institute for Aquaculture No. 1 and No. 2 (RIA 1 and 2), and
the International Center for Living Aquatic Resources Management (ICLARM)

Name of household head :
Household serial number :
Commune :
District :
Province :

Name of respondent :
Relationship with household head :

Name of interviewer :
Date of interview :

I. BASIC INFORMATION OF THE FARM HOUSEHOLD

1. Ethnicity a) Kinh_____ b) Khmer _____ c) Chinese _____ d) Others_____
2. Household size _____
3. Information about HH. members

Serial No.	Relationship to the household head	Sex	Age	Education (No. of years of education)	Occupation		Working days available for aquaculture in a year (%)
					Primary	Secondary	

4. Distance of homestead farm from:

District headquarters	_____ km
Main road of the district	_____ km
Main river of the district	_____ km
Nearest village market	_____ km
Nearest fish seed supply	_____ km

5. Farm size (m^2)

Land Use Type	Privately owned	State owned (Bidden)	Rented in	Rented out
Homestead				
Garden / plantation				
Cultivated crop land[1]				
Areas for aquaculture				
Pond				
Cage/pen (lake/river)				
Rice-fish culture				
Others (specify)				
Total				

[1]Excluding rice-fish culture area

6. Household Income (1997)

Enterprise	Quantity Produced (unit / year)	Market Price (Dong / unit)	Estimated Gross Income (Dong)
ON-FARM ACTIVITY			
Rice (kg)			
None-rice crop (specify) (kg)			
Tree garden (specify) (kg)			
Livestock, Poultry			
Pig production (kg)			
Other livestock (kg)			
Poultry (meat) (kg)			
Poultry (egg) (pcs)			
Fish			
Fish culture (kg)			
Hatchery (VND)			
Other farm activities (VND)			
OFF-FARM ACTIVITY (VND)			
(Activity done on other farms)			
Wage labor (VND)			
Fish capture			
Other			
NON-FARM ACTIVITY (VND)			
Salaried employment/wage labor			
Business / trading / rural industry			
Leasing of property / equipment			
Remittances			
Other (specify)			
TOTAL			

[It is advisable to ask the questions on income during the later part of interview]

II. AQUACULTURE SYSTEM

1. General Characteristics of Ponds / Cages / Pens

Unit No.	Type(pond/ cage/pen/ rice-fish) r	Size (effective area in m^2)	Year of construction	Tenural Status (1)	Type of operation (2)	Culture Type (3)	Minimum water retention level (cm)		Does the pond get flooded under normal condition (4)	Distance of pond/cage from the household (m)	Mono / Polyculture (5)	Integrated Culture (6)
							Dry Season	Wet Season				
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												

(1): 1: privately owned; 2: state owned; 3: rented in; 4: other (specify)
(2): 1: single; 2: joint
(3): 1: seasonal; 2: perennial
(4): 1: yes; 2: no
(5): 1: monoculture 2: polyculture
(6): 1: pig; 2: chicken; 3: duck; 4: rice-fish 5: none

2. Pond / Cage management

[Note: 1) Group ponds / cages / pens into homogeneous categories;
2) Select one representative pond / cage from each category;
3) Collect information from each representative pond / cage for the last growing cycle (1997). For example, if a farmer has three different categories of pond/cage/pen, then the questions of this sub-section (II.2) have to be repeated three times.)]

a. Unit No.: _____ Area: _____

(i) Stocking

Name of species	Reasons for choosing the species [a]	Quantity stocked (kg)	Size stocked (g)	Time stocked (week/month)	Sources of fingerling [b]	Price of fingerling (VND/kg)	Price of fish at stocking (VND/kg)

[a] Code : (1) higher market price of fish, (2) Higher production, (3) High demand, (4) Rapid growth, (5) Good survival, (6) Easy to culture, (7) Better taste, (8) Less/no disease, (9) Easy availability of fingerling, (10) Lower price of fingerling, (11) Other (specify) _____

[b] Code : (1) Gov't hatchery, (2) Private hatchery, (3) Own produced, (4) Other (specify)

(ii) Input Use

Inputs / Outputs	Quantity	Price / Unit
Preharvest labor (man-day) Family: Hired:	 _____ _____	 _____
Chicken manure (kg) Self: Purchased:	 _____ _____	 _____
Pig manure (kg) Self: Purchased:	 _____ _____	 _____
Kitchen trash (kg) Self: Purchased:	 _____ _____	 _____
Rice bran (kg) Self: Purchased:	 _____ _____	 _____
Pellet (kg) Trash fish (kg) Other feed (kg)	_____ _____ _____	_____ _____ _____

Chemical fertilizer (kg) (specify) _____ _____ _____	_____ _____ _____	_____ _____ _____
Lime (kg)		
Pesticide (VND)		
Land rent (VND)		
Other pond specific cost (specify) _____ _____ _____	_____ _____ _____	_____ _____ _____
Harvesting cost: Labor (man-day) Hired: Family: Other (VND)	_____ _____ _____	_____

(iii) Harvesting and disposal of fish

Species	Time of harvest	Type of harvest (1)	Quantity of harvest (kg)	Average size of fish (g)	Disposal (kg)			Price if sold (VND)
					Consumed	Sold	Given away	

(1): 1: intermediate; 2: final

3. Other farm specific cost of aquaculture

Item	Cost (VND)
Gasoline / Kerosene / Diesel	
Electricity / Light	
Irrigation fee	
License fee	
Equipment rental	
Others (specify)	

4. Total fish production and disposal during 1997 production cycle

Species	Production (kg)						Consumed (kg)	Sold (kg)	Price (VND/kg)
	Pond No					Total			
	1	2	3	4	5				
1.									
2.									
3.									
4.									
5.									

5. Highest and lowest production during the last ten years in one representative pond

	Highest	Lowest
Year:		
Effective pond area: (m^2)		
Av. water depth (cm)		
Species stocked:		
_____		
_____		
_____		
_____		
_____		

Time of stocking:
Av. size of fingerling (cm):
Species stocked :

_____		
_____		
_____		
_____		
_____		

		Highest		Lowest
Input use (kg):				
Fertilizer:				
Lime:				
Rice bran:				
Feed:				
Others (specify):				
Quantity harvested (kg):				
Harvesting time:				
Reasons for highest/lowest yield:	a)		a)	
	b)		b)	
	c)		c)	

III. COST AND RETURN OF OTHER COMPLEMENTARY FARM ACTIVITIES

(Following questions will be asked only if these farm activities are part of integrated fish-poultry or fish-pig systems)

Type of integration : Pig/duck/chicken (Please check)

Pond area for integrated system (fish- pig/duck/chicken) : _____ m^2

Input	Quantity	Price / unit
Labor (man-day)		
family		
hired		
Chick / Pig-let (VND)		
own		
purchased		
Commercial feed (kg) (specify)		
Home-made feed (kg) (specify)		
Medicine (VND)		
Other cost (specify) (VND)		
Total production (kg)		
Quantity sold (kg)		
By Product (kg)		
Quantity sold (kg)		

IV. PROBLEM ANALYSIS

Has your farm had any serious technical (biotic/abiotic) problems. ___ Yes/No ___

If yes, please complete the following table :

PROBLEMS	Year of 1st occurrence	No of year over last 10 years	% of area affected during an affected year	Effect [a]	Financial loss (VND/year)
A. Water quality					
High turbidity					
Plankton bloom					
Low dissolve oxygen					
Filamentous algae/weed					
Other (specify)					
B. Water quality					
Shortage					
Flooding					
C. Soil problem					
Activity					
Seepage					
Other (specify)					
D. Disease (specify)					
Bacteria					
Parasite					
Virus					
E. Temperature					
High					
Low					
F. Other (specify)					
_____					
_____					

[a] Code : (1) Total loss , (2) Reduced harvest, (3) Market rejection, (4) Reduced price for product, (5) Farmer/worker heath, (6) Other (specify)

V. FARMER'S OPERATOR'S PERSPECTIVE

1. When did you start culturing carp species?

_____

2. Please indicate you preference for various freshwater species.

Freshwater species	Preference score (1 : highest, 10 lowest)	Reasons for higher/lower preference (a)

[a]Code : (1) higher market price of fish (2) Higher production (3) High demand (4) Rapid growth (5) Good survival (6) Easy to culture (7) Better taste (8) Less/no disease (9) Easy availability of fingerling (10) Lower price of fingerling (11) Easy to catch (12) Other (specify) _____

2. Please indicate your trait preferences for the following carp species.

Species trait	Preference score (1: highest, 10: lowest)						
	Common carp	Rohu	Silver barb	Mrigal	Grass carp	Silver carp	Bighead
Higher growth							
Better survival							
Better feed conversion							
Resistance to disease							
Resistance to cold							
Resistance to high temperature							
Resistance to poor water quality							
Resistance to soil problem							
Better meat quality							
Better flavor							
Higher dress-out %							
Better color							
Body shape							
Better harvestability							
Other traits (specify)							

4. What are your preferred size (no. of fish/kg), shape, and color for the following carp species?

Trait	Species						
	Common carp	Rohu	Silver barb	Mrigal	Grass carp	Silver carp	Bighead
Size (no. of fish/kg)							
Color (specify)							
Shape[1]							

[1]Code : (1) Long and thin, (2) Short and thick, (3) Short and deep, (4) Others (specify)

5. What problems have you encountered since you ventured into carp farming which limited your production or expansion? (Encircle codes and rank problems from most to least severe one).

	Code	Rank
None	10	_____
Poaching	11	_____
Bad weather (frequent storm occurrence)	12	_____
Flood	13	_____
Drought	14	_____
Water supply unreliable/shortage	15	_____
High cost of water	16	_____
Polluted water	17	_____
Sulphur upwelling	18	_____
Net / pond destruction / vandalism	19	_____
Poor / slow growth of fry / fingerling	20	_____
High fry / fingerling mortality	21	_____
Small size of fish at harvest	22	_____
Uncertainty of access to present location	23	_____
Proliferation of carp farms	24	_____
High prices of fry / fingerlings	25	_____
Increasing cost of inputs	26	_____
Difficulty in obtaining credit	27	_____
Lack of technical assistance	28	_____
Limited management expertise	29	_____
No skilled workers to hire	30	_____
High capital requirement	31	_____
High marketing cost	32	_____
Disease	33	_____
Cold	34	_____
No buyers or market	35	_____
Others (specify)	36	_____

6. What solutions have you tried to overcome these problem?

_____

7. What have been the results?

_____

8. What is your attitude to your future involvement in carp farming? _____

1: Expand
2: Continue
3: Shift to other species (other than carp)
4: Change culture system (e.g. polyculture to monoculture vice-versa)
5: Change species combinations
6: Increase feed use
7: Decrease feed use
8: Integrate with pig/chicken/rice
9: Increase stocking density

9. If expand / continue: List the encouragement factors.

_____

10. If you wish to expand, what would be the level of expansion?

Year	Area (m^2)
Within next year	_____
Within next 2 -3 years	_____

11. If shift / discontinue / undecided: List the drop out factors.

_____

12. If you intend to change culture system, what would it be and what % of your area would be under different systems? Culture system _____

System	% area
Monocultue	_____
Polyculture	_____

13. If you intend to integrate with other enterprise or wish to change the level of integration, what percentage of your area would be under different systems?

System	% of area
Fish-pig	_____
Fish-chicken	_____
Fish-duck	_____
Fish-rice	_____

14. If you intend to change species combinations, what would it be?

Species	%
_____	_____
_____	_____
_____	_____
_____	_____

15. Have you change species combinations during the last 10 years?

Last 10 years		Last 5 years	
Species	%	Species	%

16. If you have changed/introduced new carp species, what are the reasons?

a. Name of replaced species	Reasons

b. Name of introduced species	Reasons

17. If you intend to change stocking density or have changed it in recent years, please indicate the past, present, future level of stocking.

Farming system	Farming environment	Stocking density (fish/m^2)		
		5 years ago	Present	Future
Polyculture	Cage/pen			
	Pond			
Monoculture	Cage/pen			
	Pond			

18. Have you constructed new pond during the last 5 years? Yes/No (encircle)
If yes, please answer the following:

Year of construction	Area (m^2)	Peviously used for (eg. Rice field, fallow area, etc.)
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

19. Have Carp displaced any species in your farm/locality? Yes/No (encircle)

20. If yes, which carp species displaced what species.

Carp species	Displaced species
Rohu	_____
Catla	_____
Mrigal	_____
common carp	_____
Big head	_____
Silver carp	_____
Grass carp	_____
Silver barb	_____
Others (specify)	
_____	_____
_____	_____

21. What are the effects of Carp culture on water quality in your farm (both positive and negative)?

_____
_____
_____

22. Can you think of any other (positive / negative) effects of Carp on natural environment?

_____
_____
_____

23. If a better Carp breed will be available, are you willing to try it out in your farm?

Species	Yes/No	If yes, what % of your farm
Rohu	_____	_____
Catla	_____	_____
Mrigal	_____	_____
common carp	_____	_____
Big head	_____	_____
Silver carp	_____	_____
Silver barb	_____	_____

If yes, what percent of your farm area will be stocked? _____
If no, why not? _____
Are you willing to pay more for better quality fingerlings and up to what percentage of the present price? _____

VI. ENUMERATOR'S ASSESSMENT

How do you rate the sample operator's . . .
- . . . willingness and cooperation to give the desired information? _____
- . . . willingness to become a project cooperator? _____

1: high 2: medium 3: low

APPENDIX 6

Appendix 6

Food Consumption Survey
Vietnam

Research Institute for Aquaculture No. 1
Dinh Bang, Tien Son, Bac Ninh,
Vietnam

Research Institute for Aquaculture No. 2
116 Nguyen Dinh Chieu Street
District 1, Ho Chi Minh City
Vietnam

SURVEY SCHEDULE B
(Consumption)

FOOD CONSUMPTION SURVEY
Vietnam

Name of Interviewer: _____ Date: _____

1. Name of Household Head:

2. Address:

   Village: _____ District: _____ Province: _____

3. Household Size:
   [Definition of household size : Number of people who regularly eat food cooked from same stove and eat at same table]

   No. of Adults: male _____ female _____
   No. of Children: male _____ female _____

NOTE : Questions Nos. 4, 5 and 6 have to be asked 4 times a year.

4. Fish Consumption During the Last Month /15 days [to be asked 4 times a year]

   Month/duration : _____

Species consumed (specify)	Quantity consumed (kg)			Size of purchased fish (no. of fish/ kg.)	Price (VND/kg)	
	Home produced	Captured	Purchased		Paid	Ave price (market)
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

5. Household food expenditure during the last month/15 days (to be asked 4 times a year)

Month/duration : _____

	Amount Consumed		VND/kg (piece)
	Self	Purchased	
rice (kg)			
wheat (kg)			
vegetables (kg)			
pulses (kg)			
fish (kg)			
dry fish (kg)			
chicken (kg)			
meat (kg)			
egg (no.)			
sugar (kg)			
cooking oil (kg)			
salt (kg)			
bread (kg)			
other bakery foods (VND)			
Fruits: (pls. specify the name)			
_____ (no/kg)			
_____ (no/kg)			
_____ (no/kg)			
_____ (no/kg)			
_____ (no/kg)			
Other food items (specify) (kg/VND)			

6. Household non-food expenditure during the last 3 months (to be asked 4 times a year)

Duration : _____

Items	Amount spent (VND)
clothing	
housing (maintenance)	
Medicare	
schooling	
festival and social ceremonies	
maintenance of assets and equipment	
purchase of durable assets (TV, bicycle, radio, etc.)	
purchase of land	
others (specify)	

7. Most/Least Preferred Fish Species (need to be asked only during 1st interview)

Household Member	Age	Sex	Most Preferred Species		Least Preferred Species	
			Species	Reasons[a] (enter code)	Species	Reasons[b] (enter code)
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						

a. Codes

1. taste good
2. reasonable price
3. easily available
4. easy to prepare
5. not easily perishable
6. others (specify)

b. Codes

1. taste is not good
2. high price
3. not easily available
4. difficult to prepare
5. easily perishable
6. others (specify)

8. Preferred traits for various carp species (to be asked only during 1st interview)

Species trait	Preference score (1: highest, 10: lowest)						
	Common carp	Rohu	Silver barb	Mrigal	Grass carp	Silver carp	Bighead
Bigger size							
Color							
Body shape							
Better flavor							
Higher fat %							
Higher dress-out %							

9. Preferred parts of various carp species (to be asked only during 1st interview)

Preferred parts	Preference score (1: highest, 10: lowest)						
	Common carp	Rohu	Silver barb	Mrigal	Grass carp	Silver carp	Bighead
Egg							
Head							
Back meat							
Tail meat							
Belly							
Other parts (specify)							

10. What are your preferred size (no. of fish/kg), shape, and color for the following carp species? (to be asked only during 1st interview)

Trait	Species						
	Common carp	Rohu	Silver barb	Mrigal	Grass carp	Silver carp	Bighead
Size (no. of fish/kg)							
Color (specify)							
Shape[1]							

[1]Code : (1) Long and thin, (2) Short and thick, (3) Short and deep, (4) Others (specify)

APPENDIX 7

Appendix 7

Baseline Survey of Carp Hatcheries Thailand

National Aquaculture Genetics Research Institute (NAGRI)
Tumbon Klongha, Amphur Klongloung
Pathumthani 12120, Thailand

BASELINE SURVEY OF CARP HATCHERIES

A Joint Under Taking of

National Aquaculture Genetics Research Institute (NAGRI)

Fisheries Economics Division, and

The International Center for Living Aquatic Resources Management (ICLARM)

Name of the household head : _____

Household serial number : _____

Village : _____

City / Municipality : _____

Province : _____

Name of respondent : _____

Relationship with household head : _____

Name of interviewer : _____

Date of interview : _____

A. SAMPLE PROFILE

1. Name of hatchery operator : _____
2. Legal status (IF NOT INDIVIDUAL, specify registered name/name of establishment) : _____
3. Tenure status (enter Code) : _____

   1 = owner 2 = lessee 3 = share tenant 4 = others (specify) _____
4. Respondent's classification (enter code) : _____

   1 = owner/operator 2 = caretaker/knowledgeable HH member

B. OPERATOR'S/ HOUSEHOLD'S PROFILE

1. Age of hatchery operator : _____

   Education : _____

2. How long have you been engaged in carp / freshwater hatchery (years)?

   Carp _____ Freshwater _____

3. What motivated you to start carp hatchery?

   1 = profitable business
   2 = stable source of livelihood
   3 = easy to manage
   4 = low capital requirement
   5 = less risky
   6 = consumption
   7 = recreation
   8 = others (specify) _____

4. How extensive was your involvement in freshwater hatchery in the past

(when you started) and at present? (enter code)	Past	Present
1. = Full time primary occupation	_____	_____
2. = Primary occupation but not full-time	_____	_____
3. = Secondary occupation (specify primary occupation)	_____	_____

5. Are you an active member of any aquaculture association? (enter code) ____

   0 = No 1 = Yes

6. How many members of your household are currently residing here permanently? _____

7. How many members are involved in

	Male	Female
7.1 fry/fingerling production?	_____	_____
7.2 fry/fingerling marketing?	_____	_____
7.3 other on – farm activities?	_____	_____
7.4 non – farm activities?	_____	_____
7.5 off – farm activities?	_____	_____

8. What is your household's sources of income? (Encircle codes and rank sources of income from which income is derived most to less)

Source of income	Code	Rank	Source of income	Code	Rank
Salaried employment / wage labor	10	_____	Hatchery	60	_____
Business / trade / service	20	_____	Pension	70	_____
Crop / livestock farming	30	_____	Remittance (abroad)	80	_____
Fishing (capture)	40	_____	Others (specify)	90	_____
Fish culture (grow – out)	50	_____			

9. Is income derived from freshwater hatchery adequate to meet the needs of yours family? (enter code) : _____

   0 = No 1 = Yes

10. From whom did your learn the technique in freshwater hatchery? (enter code):
    1 = friends 4 = DOF technician
    2 = member in the household 5 = self – learned
    3 = other hatchery operators 6 = others (specify) _____

11. When did you last attend training on carp hatchery? (Enter month and year)

    _____

    11.1 What aspect of carp hatchery was taught during the training?

    _____

    11.2 If you will attend training again, what aspect of carp hatchery would you like to learn?

    _____

12. How would you compare your household's standard of living after engaging in freshwater hatchery? (enter code) : _____
    1 = better 3 = worse
    2 = same 4 = don't know

C. CARP HATCHERY PROFILE

1. When was carp hatchery introduced in your community (village)? (enter month and year) _____

2. How many were already involved in carp hatchery in your community (village) in the past (when you started) and at the present? Past : ___ Present : ___

3. How many kilometers is your freshwater hatchery from .....
   3.1 ....your residence? _____
   3.2.... The nearest market (for freshwater hatchery)?_____

4. Kindly state the reason(s) for selecting the site of your hatchery? (enter codes)
   1 = proximity to residence
   2 = recommended site of DOF
   3 = abundant supply (natural food)
   4 = not overcrowded
   5 = only site
   6 = others (specify)

5. What is your farm's main source of water? (Enter code):
   1 = irrigation
   2 = pump
   3 = river
   4 = others (specify) _____

6. Source of credit (enter code): _____
   1 = None
   2 = Formal / non-formal sources
      2.1 = Commercial Bank
      2.2 = Bank of Agricultural and cooperative
      2.3 = Private
      2.4 = Friends
      2.5 = Relatives
      2.6 = Others _____

7. Please indicate the past (when started) and present total effective area of your hatchery, your source of broodstock, address of the source, species, month and year acquired, stocking density, sex – ratio, duration of breeding, and frequency of changing broodstock?

Item	Species							
	.....		.....		.....		.....	
	past	present	past	present	past	present	past	present
Total effective area (m^2)								
Source of broodstock 1 =DOF 2 =private hatchery 3 =others								
Address of source of broodstock								
Month and year acquired								
Stocking density (No. of fish / m^2)								
Sex ratio of male to female								
Duration of breeding (no. of days from breeding to first harvest)								
Frequency of changing broodstock								

8. If you have changed area and management/hatchery practices, please answer the following questions: Why did you ...
   - 8.1 ...expand or reduce total effective area? _____
   - 8.2 ...change your source? _____
   - 8.3 ...change your stocking density? _____
   - 8.4 ...change the sex ratio? _____
   - 8.5 ...change the frequency of changing broodstock? _____

9. Have you changed species composition during the last 5 years?

Last 5 years		Last 2 - 3 years	
Species	% of area	Species	% of area
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

10. Why did you change species composition ? _____

D. HARVESTING/PRODUCTION/SALE

Note : Enter responses to questions 1 to 7 in the table below.
Use additional sheets whenever necessary.

1. What months did you breed the fish in the last 12 months?[1]
2. What was the total effective area of the hatchery you used?
3. How many broodstock did you use per breeding period?
4. What was the average size (weight) of the broodstock you used?
5. What months did you harvest fry / fingerlings?
6. How many fry / fingerling did you harvest?
7. How much did you receive per thousand for each harvest?

Species[1]	Q1 Breeding month	Q2 Total effective area (Rai)	Q3 No. of broodstock used	Q4 Average size (gram)		Q5 month of harvest	Q6 Number of fry harvested ('000 pcs)	Q7 Average price (baht)
				male	female			

[1]Note: For species with two or more production cycles per year, collect these information for all production cycles. Thus, there will be more than one row for species having multiple production cycles.

Note : Enter responses to questions 8 to 9 in the table below
Use additional sheets whenever necessary.

8. How many times did you harvest in your last production cycle?

9. Of your TOTAL fry/fingerling production (in month), how many were ...

9.1 ...used in farm?

9.2 ...sold?

9.3 ...used as allowance (for mortality)?

Species	Q8 No. of harvest (cycle)	Q9 How many did you ... ('000 pcs or %, PLEASE SELECT)		
		Q9.1 ...used in farm	Q9.2 ...sold	Q9.3 ...allowance

10. marketing/selling practices

Note: Enter responses to questions 10.1 to 10.6 in the table below. Use additional sheets whenever necessary.

10.1 To whom did you sell your produce in your last marketing transaction?

10.2 Where did you sell your produce?

10.3 What was the mode of transport in marketing your produce?

10.4 What was the mode of sale?

10.5 What was the mode of payment?

10.6 Who determined the price of the fry you sold?

Type of buyer	Q10.1 Buyer code	Q10.2 Place of sale *	Q10.3 Mode of transport *	Q10.4 Mode of sale *	Q10.5 Mode of payment *	Q10.6 Price determined by ... *
wholesaler	1	1 2 3 4 5	1 2 3 4 5	1 2	1 2	1 2 3
retailer	2	1 2 3 4 5	1 2 3 4 5	1 2	1 2	1 2 3
"agents"	3	1 2 3 4 5	1 2 3 4 5	1 2	1 2	1 2 3
Fish farmer	4	1 2 3 4 5	1 2 3 4 5	1 2	1 2	1 2 3
Others _____	5	1 2 3 4 5	1 2 3 4 5	1 2	1 2	1 2 3

Codes :

Q10.2 – place of sale
- 1 = same barangay
- 2 = other barangay, same municipality
- 3 = other municipality, same province
- 4 = other province, same region
- 5 = other region

Q10.3 – mode of transport
- 1 = Pick up
- 2 = Motorcycle
- 3 = Bicycle
- 4 = Truck
- 5 = Others _____

Q10.4 – mode of sale
- 1 = pick – up
- 2 = delivery

Q10.5 – mode of payment
- 1 = cash on delivery
- 2 = credit

Q10.6 – price determination
- 1 = operator
- 2 = buyer
- 3 = others _____

11. What percent of your hatchery production went to ...

11.1 ...wholesaler? _____

11.2 ... retailer? _____

11.3 ..."agent"? _____

11.4 ...fishfarmers (direct sale)? _____

11.5 ...others? _____

TOTAL 100 %

12. What was your method of counting the fry / fingerlings? _____

1 = weighting 2 = individual counting 3 = combination

13. What is your main source of information on fry or fingerling prices? _____

1 = word of mouth 4 = radio

2 = middlemen 5 = others _____

3 = newspaper

E. Cost of Production

1. Capital Investment

1.1 Structure / Building

Type of Pond	Size(rai,m^2)	No. pond	Cost/pond	value
Earth pond				
Concrete pond				
Other				
Total				

1.2 Equipment

Item	No. of unit	Price/unit	Purchased year	Age of Life	maintenance
Net					
Broodstock net					
Fry net					
Other net					
Cage					
Pump					
Pipeline					
Oxygen tank					
Air pump					
Plastic bag					
Weight machine					
Other					

2. Variable Cost per farm per year

Item	No of unit		Price/unit	value
	Self	purchased		
Broodstock - tilapia - chinese carp - thai silver barb - rohu - common carp _____				
Feed				
- Broodstock				
- Fry				
Manure				
Hormone				
Chemical				
Lime				
Gasoline				
Oxygen				
Electricity				
Labour				
- Household				
- Hired				
Interest				
Maintenance				
Transportation				
Other.....				

F. HATCHERY – OPERATOR'S PERSPECTIVE

1. What problems have you encountered since you ventured into freshwater hatchery which limited your production and/or expansion? (encircle codes and rank problems from most to least severe one identified)
2. What solution have you tried to over come these problem?
3. What have been the benefits?

Item	Q 1 (Problem)		Q 2 (Solution)	Q 3 (Results)
	Code	Rank		
None	10			
Poaching	11			
Bad weather	12			
Flood	13			
Drought	14			
Water supply unreliable / shortage	15			
High cost of water	16			
Polluted water	17			
Poor/slow growth of fry/fingerling	18			
High mortality of fry	19			
Low prices of fry/fingerlings	20			
Increasing cost of inputs	21			
Difficulty in obtaining credit	22			
Lack of technical assistance	23			
No skilled workers to hire	24			
High capital requirement	25			
Others (specify) _____				

4. What is your attitude to your future involvement in carp hatchery? (enter codes)
   1 = expand
   2 = continue
   3 = diversify/change species combination
   4 = shift to other species (other than carp)
   5 = discontinue
   6 = undecided

5. If expand/continue: list the encouragement factors.

_____

6. If diversify/change species combination, which new species you intend to introduce in your hatchery.

_____

7. If shift/discontinue/undecided: list the drop out factors.

_____

8. If a better carp breed will be available, are you willing to try it out in your hatchery?

Species	Yes / No	If yes, what % of your hatchery	If no, why not
Thai silver barb			
Common carp			
Rohu			
Mrigala			
Chinese carp			
Other _____			

9. Please indicate your preference for various freshwater species

Freshwater species	Preference score (1 = highest, 10 = lowest)	Reasons for higher/lower preference

CODE : 1 = higher market price of fry/ fingerling
2 = high demand
3 = rapid growth of fry/ fingerling
4 = higher production of fry/ fingerling
5 = better spawning
6 = easy to produce fry
7 = easy to handle
8 = good survival
9 = no/ less disease
10 = other (specify) _____

10. Please indicate your trait preference for the following carp species

Species trait	Preference score (1 = highest, 10 = lowest)					
	Thai silver barb	Common carp	Rohu	Mrigala	Chinese carp	Other (specify)
Higher growth						
Better survival						
Better feed conversion						
Resistance to disease						
Resistance to cold						
Resistance to high temperature						
Resistance to poor water quality						
Resistance to soil problem						
Better spawning						
Better color						
Other trait (specify) _____						