Asian Fisheries Science 3(1990): 185-196.
Asian Fisheries Society, Manila, Philippines

https://doi.org/10.33997/j.afs.1990.3.2.003

The Yield and Growth of Major Fish Species in a Large Chinese Reservoir

LI SIFA and ZHOU BIYU

Department of Aquaculture
Shanghai Fisheries University
334 Jun Gong Road
Shanghai 200090, China

LIN QUFEI

Shuzhou Mulberry Technical College
Shuzhou, Jiangsu Province, China

Abstract

Growth rates and parameters of six major fish species - *Hypophthalmichthys molitrix, Aristichthys nobilis, Xenocypris argentea, Cyprinus carpio, Erythroculter mongolicus* and *E. ilishaeformis* in the Xin'anjiang Reservoir, China are given. Average total yield for 1983-1986 was 90.2 kg·ha^{-1}, of which the planktivorous, stocked species *H. molitrix* and *A. nobilis* comprised 87%.

Introduction

The Xin'anjiang Reservoir, also known as the "Thousand Islands Lake" (it contains 1,073 islands larger than 0.5 ha at full reservoir level), was impounded in 1960. It lies on the Xin'anjiang River, one of two major tributaries of the Chitanjiang River. A multipurpose project, it provides electrical power, flood control and recreation. The annual average fisheries surface area is 40,000 ha. This is the largest reservoir fisheries complex in China. Fisheries activities include culture, capture, processing, net manufacture and a machinery factory.

The native fish community has been severely depleted by the impoundment, competition or predation by introduced species and human exploitation. Presently the fish community consists of indigenous and stocked populations, which support an annual fish yield of 90.2 $kg \cdot ha^{-1}$.

The knowledge of the biology of the major fish species and the character of the fish community is important for the reasonable fisheries management of the reservoir. This paper reports the growth and yield of major fish species and the present status of the fish community which has changed under the impact of fisheries management characterized by artificial stocking and capture over nearly 30 years.

Materials and Methods

The age and growth data presented in this paper were collected in October 1984 and 1987, and in April 1988. The fish used were taken from the commercial fish harvest.

Standard length (SL) was measured to the nearest 1 mm, and weight to the nearest 10 g. Scales were taken from the front of the dorsal fin above the lateral line. Ages were determined and measurements were made on scales to estimate the size of fish at certain stages in their early life. Lengths at each annulus were then computed by the Dahl-Lea (Dahl 1909; Lea 1919) formula: Sn/Sc = Ln/Lc, where

Ln	=	length of fish when annulus "n" was formed
Lc	=	length of fish when scale sample was obtained
Sn	=	radius of annulus "n" (at fish length Ln)
Sc	=	total scale radius

A computer program developed by Cao (1988) was used to calculate growth and to draw the associated curves using the von Bertalanffy (1938) equation which has the forms

for length:

$$l_t = L_\infty \{1-\exp(-K(t-t_o))\} \qquad \text{... 1)}$$

for weight:

$$w_t = W_\infty \{1-\exp(-K(t-t_o))\}^3 \qquad \text{... 2)}$$

A paired-difference test (Mendenhall 1979) was used to compare the growth condition and the point of inflection between the 1984 period and 1987-1988 period.

Origin and Nature of the Fish Community

The important limnological features of the Xin'anjiang Reservoir are shown in Table 1. The new lake offers various niches for the development of new fish communities. The species which can now inhabit the reservoir are those that have adapted to the abrupt transition from a lotic to lentic environment.

The fish species that occurred in the original river system consisted mainly of Gobininae and Barbinae such as *Hemibarbus meculatus, H. labeo, Abbottina* sp., *Acrossocheilus fasciatus,* etc. They are adapted to live in running waters, and feed mainly on algae and benthic invertebrates from the rocky bottom. No pre-impoundment survey was done. Therefore, early records of fish fauna and catch

Table 1. Important limnological features of Xin'anjiang Reservoir.

Parameters	Value
Climatology	
Incident solar radiation ($cal \cdot m^{-2} \cdot year^{-1} \cdot 10^3$	100-140
Rainfall ($mm \cdot year^{-1}$)	1,430
Year average air temperature (°C)	17
Year average water temperature (°C)	20
Morphometry	
Area at full reservoir level[a] (ha)	53,333
Annual average water level fluctuation (m) (1975-1983)	12.68
Mean depth at full level (m)	30.44
Maximum depth at full level (m)	100
Area of water catchment/area fish culture	26
Water volume at full level (m^3)	178×10^8
Forest cover of water catchment (%)	70
Hydrology	
Secchi disk water transparency (m)	1-7
Dissovled oxygen ($mg \cdot l^{-1}$)	5.65-9.68
Thermocline depth (m)	10-30
pH (1-10 m water column)	7-8.4
Total alkalinity ($mg \cdot l^{-1}$)	0.8-1.0
Hardness (German°)	2-4
Nitrate ($mg \cdot l^{-1}$ N)	0.02-0.06
Phosphate ($mg \cdot l^{-1}$ P)	0.005-0.01
Silicate ($mg \cdot l^{-1}$ S_iO_2)	4.6-10.4
Phytoplankton ($mg \cdot l^{-1}$)	8.045[b]
Zooplankton ($mg \cdot l^{-1}$)	1.22[b]

[a]At 108 m above sea level.
[b]From unpublished data at Chunan County Fisheries Research Institute, 1984.

statistics are not available. The reservoir was not cleared before submergence. During the initial phase of impoundment, most of the stream-type fish either moved upstream to seek suitable habitat and declined in significance in the reservoir fishery or they remained in the upper ends of the tributary embayments.

When the vegetated areas were initially flooded, plankton increased dramatically. The immediate biological processes were dominated by the snakehead *(Channa argus)* and *Hemiculter leucisculus*, which were able to spawn amongst flooded vegetation. Their populations increased rapidly. The strong year classes of snakehead were associated with rising water levels during their spawning seasons and flooded terrestrial vegetation.

The initial stages of the fisheries consisted almost entirely of the remaining species which colonized the reservoir from former refugia. Within 2-3 years the flooded vegetation became depleted, and the population of snakehead decreased sharply due to lack of spawning habitat. The population of *H. leucisculus* continued to increase because of plankton blooms and the temporary lag in the fish predator population. As the population of *H. leucisculus* rose, its predators, *Erythroculter mongolicus* and *E. ilishaeformis* increased, resulting in a depression of the *H. leucisculus* population.

The pelagic zone was enlarged as the reservoir formed, offering opportunities for plankton-feeders. High production of plankton and bottom fauna occurred during the first 2-3 years of reservoir formation. This was the most crucial phase of change for the fish community and fishery management. Selective stocking was done with a wide variety of fish, with a preference given to those having a short food chain like the silver carp *(Hypophthalmichthys molitrix)* and bighead *(Aristichthys nobilis)*. The unexploited pelagic zone allowed them to become firmly established, providing high yields in succeeding years.

At present, 100 fish species belonging to 14 families are known to occur in Xin'anjiang Reservoir (Xu, unpubl. data). In the middle and lower portion of the reservoir only 83 species belonging to 13 families (Appendix I) were found (Chunan County Fisheries Research Institute, unpubl. data).

Most of these species have been introduced to the reservoir either by deliberate planting, as accidental escapes from fish culture operations, or as chance immigrants. The present fish community in the reservoir is thus semi-artificial as a result of continuous stocking. *H. leucisculus,* yellow tail *(Xenocypris argentea),* round snout fish

(Distoechodon tumirostris), snakehead *(Channa argus)*, catfish *(Silurus asotus)*, common carp *(Cyprinus carpio)*, etc., represent the natural population. Silver carp, bighead, grass carp *(Ctenopharyngodon idella)*, blunt snout bream *(Megalobrama amblycephala)* and black carp *(Mylopharyngodon piceus)* are stocked because there is limited or no natural reproduction.

Growth

Growth rates of the major fish species are shown in Table 2. The growth rates of silver carp and bighead are close to those of their growth at their origin in Changjiang River (Zhou et al., in press).

Table 2. Size at age of major species in the Xin'anjiang Reservoir.

Fish species	Sample size	Back calculated SL (cm) of each age								
		1	2	3	4	5	6	7	8	9
Hypophthalmichthys molitrix										
1984	150	15.97	31.81	44.83	53.46	60.09				
1987-1988	126	14.95	30.73	42.50	52.22	59.24				
Aristichthys nobilis										
1984	98	17.51	32.02	50.16	65.30	74.11				
1987-1988	133	16.91	31.95	47.55	60.94	69.31	79.03			
Xenocypris argentea										
1984	97	10.07	19.38	26.49	33.50					
1987-1988	106	9.78	20.20	28.71	36.40					
Cyprinus carpio										
1984	124	19.60	28.69	37.72	45.51	52.87	58.04	62.09	68.46	
1987-1988	60	23.00	34.29	45.10	53.04	59.37	69.38			
Erythroculter mongolicus										
1984	98	7.56	19.29	26.43	32.21	39.60	48.61	53.63		
1987-1988	147	10.27	20.00	28.61	35.74	43.08	50.63	56.11		
E. ilishaeformis										
1984	35	16.51	30.06	38.83	50.69	59.21	68.06	74.13	79.78	
1987-1988	137	19.26	35.17	47.15	67.83	66.93	77.46	86.40		

The relationship of length-weight and the von Bertalanffy growth equation of the 6 major species in 1984 are shown in Tables 3 and 4.

The points of inflection (Table 5) of major species show two characteristics: (a) a coincidence between 1984 and 1987-1988 period; (b) except for the silver carp, point of inflection is much behind the age of maturity, which reflects the high potential in growth of these species.

Table 3. Relationship of length-weight of major species in Xin'anjiang Reservoir.

Species	a	b	Corr. coefficient
Hypophthalmichthys molitrix	0.01484	3.0653	r = 0.7994
Aristichthys nobilis	0.02111	3.0209	r = 0.9829
Xenocypris argentea	0.08195	2.4953	r = 0.8994
Cyprinus carpio	0.08818	2.6866	r = 0.9561
Erythroculter mongolicus	0.26100	2.8138	r = 0.9818
E. ilishaeformis	0.00930	3.0407	r = 0.9958

Table 4. von Bertalanffy growth and related parameters of major species in Xin'anjiang Reservoir.

Species	
Hypophthalmichthys molitrix	$l_t = 80.08\ \{1\text{-}\exp(-0.292(t\text{-}0.24))\}$ $w_t = 10145\ \{1\text{-}\exp(-0.292(t\text{-}0.24))\}^3$
Aristichthys nobilis	$l_t = 153.31\ \{1\text{-}\exp(-0.1350(t\text{-}0.19))\}$ $w_t = 84502\ \{1\text{-}\exp(-0.1350(t\text{-}0.19))\}^3$
Xenocypris argentea	$l_t = 272.54\ \{1\text{-}\exp(-0.1566(t\text{-}0.03))\}$ $w_t = 3595\ \{1\text{-}\exp(-0.1566(t\text{-}0.03))\}^3$
Cyprinus carpio	$l_t = 123.24\ \{1\text{-}\exp(-0.1068(t\text{-}0.85))\}$ $w_t = 24807\ \{1\text{-}\exp(-0.0912(t\text{-}0.85))\}^3$
Erythroculter mongolicus	$l_t = 100.25\ \{1\text{-}\exp(-0.1139(t\text{-}0.30))\}$ $w_t = 11149\ \{1\text{-}\exp(-0.1139(t\text{-}0.30))\}^3$
E. ilishaeformis	$l_t = 123.32\ \{1\text{-}\exp(-0.1283(t\text{-}0.08))\}$ $w_t = 21210\ \{1\text{-}\exp(-0.1283(t\text{-}0.08))\}^3$

Table 5. The point of inflection (years) on growth and age of maturity of major species in Xin'anjiang Reservoir.

	Hypophthalmichthys molitrix	*Aristichthys nobilis*	*Xenocypris argentea*	*Cyprinus carpio*	*Erythroculter ilishaeformis*	*E. mongolicus*
1984	4.00	8.20	7.00	9.20	8.40	9.00
1987-1988	4.30	7.80	7.00	11.00	9.30	11.00
Age of maturity	3-4	4-5	2	3	2-3	2
Point inflection/ age of maturity	1-1.43	1.56-2.05	3.5	3-3.7	2.8-4.65	4.5-5.5

Yield

The fish of Xin'anjiang Reservoir can be categorized into five groups according to food habits. The yield data in Table 6 reflect the structure of the fish community in the reservoir. They indicate that stocking contributes substantially to the reservoir production. The high yield is achieved by stocking species that do not propagate in the impoundment. Those species that reproduce naturally contribute less to the total yield.

Silver carp and bighead are the major species stocked. In 1983-1986, the total amount of these two species stocked was 2.18 million kg, or 29.35 million fish (Table 7). All stocked fingerlings are produced locally: brooder fish are caught from the reservoir; reproduction is induced and eggs are hatched in a boat on the spot; fry are transferred and nursed in ponds; and fingerlings and/or yearlings are raised in ponds, enclosed bays and cages. For 2-year-old stocked yearlings with body weight from 50 to 100 g, the average

Table 6. Fish landing statistics of Xin'anjiang Reservoir, 1983-1986, in tonnes.

Year	A	B	C	E			Other	Total
				a	b	c		
1983	2,576	124	75	33	3	10	167	2,978
1984	2,688	410	59	33	2	9	66	3,267
1985	3,535	285	37	11	4	4	50	3,926
1986	3,793	250	83	46	1	9	82	4,264
Average	3,148	267	64	31	3	8	89	3,610
%	87.23	7.40	1.77	0.86	0.08	0.22	2.47	

A - planktivorous, silver carp + bighead only.
B - detritivorous, *Xenocypris argentea, Distoechodon tumirosris, Plagiognathops microlepis.*
C - benthivorous, common carp only.
D - herbivorous, grass carp, blunt snout bream. Their yields were mixed with "other" and group A. According to the statistics of 1981-1983, the percentage of grass carp in total production was 0.26%, the percentage of blunt snout bream and *Parabramis pekinensis* was 0.38%.
E - piscivorous,
a - *Erythroculter mongolicus, E. ilishaeformis*
b - *E. bambusa*
c - Mandarin fish *(Siniperca scherzeri)*

Table 7. 1983-1986 stocking of silver carp and bighead in Xin'anjiang Reservoir.

Year	Weight (kg)	Number ($x 10^3$)
1983	596,217	6,980
1984	457,995	5,010
1985	585,667	10,800
1986	540,028	6,560
Total	2,179,907	29,350
Average	544,977	7,340

return rate (the ratio of the number of recaptured fish at marketable size to the number stocked (Li and Xu 1988) was 8.4%, the stocking efficiency (gross yield of a species/total stocking weight of that species (Li and Xu 1988)) was 4.4; for 1-year-old fingerlings (15-20 g), these values were 4.5% and 12.7, respectively (Luo and Jiang 1988). In 1981-1983, silver carp composed 33.6% of the total yield and bighead 42.8%.

Grass carp and black carp are stocked in lower numbers due to scarcity of their natural food. In 1981-1983, grass carp and black carp production combined was only 0.3% of the total yield.

Two other herbivorous species, blunt snout bream and grass bream *(Parabramis pekinensis)* not only subsist on macrophytes but also eat algal filaments, enabling them to grow well although they are not prolific. In 1981-1983, their production consisted of 0.4% of the total yield.

Detritus feeders such as the yellow tail have sufficient spawning grounds and food resources resulting in their abundance. In 1981-1983, their production was 8.5% of the total yield.

The common carp and other fish which require vegetation for spawning and nursery areas are unstable as a fishery resource. In 1981-1983, common carp production was 3% of the total yield.

Piscivorous fish such as *E. mongolicus* and *E. ilishaeformis* have an abundance and variety of food and are able to spawn successfully on a large scale, although in 1981-1983, their production totalled only 1.6% of the entire yield.

Discussion

The stocking program has provided the potential to increase the fish yield beyond that of large reservoirs in other countries which are not stocked (Table 8).

There were no significant differences ($t > 0.05$) of growth rates of silver carp, bighead, *X. argentea* and *E. mongolicus* between 1984 and 1987-1988, but there was a significant difference ($t < 0.01$) between 1984 and 1987-1988 for common carp and *E. ilishaeformis*. Perhaps the populations of the former four species were more stable under current stocking and harvesting conditions; the population of *E. ilishaeformis* was under a higher fishing pressure and was thinned considerably; the reason for low common carp catches was not clear.

Table 8. Fish yield and fisheries conditions of several large reservoirs.

Reservoir (country)	Surface area (ha)	Annual fish yield ($kg \cdot ha^{-1}$)	Major species	Stocking (Yes/No)	Source
Angat (Philippines)	2,300	37.8 (1986)	Tilapia (75% of catch)	No	Guerrero (1988)
Jatiluhur (Indonesia)	8,300	15	Tilapia, common carp	No	Atmadja and Suwignyo (1988)
Xin'anjiang (China)	40,000	90.2 (1983-1986)	Silver carp, bighead (87% of catch)	Yes	
Kaptai (Bangladesh)	58,300	36.8-72.8 (1976-1985)	Common carp (57% of catch in 1976)	No	Rahman (1988)
Nasser (Egypt)	326,700	25.5	Tilapia	No	Ryder and Henderson (1975)
Rybinsk (USSR)	45,500,000	11	Bream, roach	No	Gordeyev et al. (1974)

Based on the plankton biomass (Table 1), the estimated fish productivity (for detail of method, see Li and Xu 1988) may reach 374 $kg \cdot ha^{-1}$. It indicates that the fish yield can be considerably increased. In order to maintain a high fish yield, several management techniques have been introduced and implemented, including a stocking program, regulation of fishing gear and methods, restriction of fishing season and area, protection of nursery areas and spawning grounds, and the license limitation. Nevertheless, management practices have changed from time to time, usually resulting in an improvement of the stocking program. Some species of economic value have decreased, such as mandarin fish.

The management problems of the reservoir cannot be solved by stocking only. The yield and proportion of natural populations shown in Table 6 was 11.6 $kg \cdot ha^{-1}$ and 12.8% of total yield, respectively, which might be underestimated because part of their production is caught by artisanal fishermen for whom statistics are not available.

Considering that the forest coverage of the catchment area is over 70%, producing rich detritus for detritivorous fish, the potential yield of wild stock might reach one-third of the total production. Protection of four nursery areas in the reservoir resulted in increase of the yellowtail fish yield from 60 t in 1982 to 410 t in 1984.

The production of piscivorous fish was about 1.2% of the total yield. This can be increased through, e.g., high fishing pressure to remove large individuals which prey on yearlings, and restricting net mesh size to protect small individuals.

As a pioneer in reservoir fisheries management, Xin'anjiang Reservoir techniques have been introduced to many reservoirs in China. Future research areas should include optimum stocking procedures, culture techniques, predator-prey interactions, new intensive culture techniques (cages, net-pens, etc.), as well as the impact of management techniques.

Acknowledgements

I wish to express my gratitude to the staff of the Xin'anjiang Reservoir Fisheries Company who helped in field activities, especially to Mr. Lin Songguang for making the fish fauna and catch records available for study. Many thanks to Drs. J. Mathias and D. Bodaly of the Freshwater Institute, Canada, for their constructive comments on the manuscript.

References

Atmadja, H. and P. Suwignyo. 1988. The present status of the reservoir fishery in Indonesia, p. 8-13. *In* S.S. De Silva (ed.) Reservoir fishery management and development in Asia. Proceedings of a workshop held in Kathmandu, Nepal, 23-28 November 1987, IDRC-264e.

von Bertalanffy, L. 1938. A quantitative theory of organic growth. Hum. Biol. 10: 181-213.

Cao, Q. 1988. Programming of von Bertalanffy's equation on IBM computer system. J. Fish. China 12(1): 71-80. (In Chinese).

Dahl, K. 1909. The assessment of age and growth in fish. Int. Rev. Ges. Hydrobiol. Hydrogr. 2(4-5): 758-769.

Gordeyev, N.A., A.G. Poddubnyy and L.K. Il'ina. 1974. Estimation of the potential fish productivity of a reservoir. J. Ichthyol. 14(1): 15-20.

Guerrero III, R.D. 1988. The status of reservoir fisheries in the Philippines, p. 14-18. *In* S.S. De Silva (ed.) Reservoir fishery management and development in Asia. Proceedings of a workshop held in Kathmandu, Nepal, 23-28 November 1987. IDRC-264e.

Lea, E. 1919. On the methods used in herring investigations. Publ. Circonst. Cons. Perm. Int. Explor. Mer. 53.

Li, S. and S. Xu. 1988. Culture and capture of fisheries in reservoirs. Shanghai Scientific and Technological Publishers, Shanghai.

Luo, X. and Y. Jiang. 1988. Fisheries exploitation of Xin'anjiang Reservoir in new stages. Hydrofish. 3: 34-37. (In Chinese).

Mendenhall, W. 1979. Introduction to probability and statistics. 5th ed. Daxbury Press, North Scituate, Massachusetts.

Rahman, M.A. 1988. The need for reservoir fishery management in Bangladesh, p. 164-168. *In* S.S. De Silva (ed.) Reservoir fishery management and development in Asia. Proceedings of a workshop held in Kathmandu, Nepal, 23-28 November 1987. IDRC-264e.

Ryder, R.A. and H.F. Henderson. 1975. Estimates of potential fish yield for the Nasser reservoir, Arab Republic of Egypt. J. Fish. Res. Board Can. 32: 2137-2151.

Zhou, B., M. Ren, S. Li and Y. Chen. Growth property and age structure of populations of silver carp, bighead and grass carp in Changjiang, Zhujiang and Heilongjiang Rivers. *In* S. Li, L. Wu, J. Wang, O. Chou and Y. Chen (eds.) A comparative genetic study of the populations of silver carp, bighead and grass carp in three major river systems of China. Shanghai Scientific and Technological Publishers, Shanghai. (In press; in Chinese).

Appendix I. The fish community of Xin'anjiang Reservoir.

ANGUILLIDAE
1. *Anguilla japonica*
2. *Anguilla marmorata*

CYPRINIDAE
Rasborinae (Danioinae)
3. *Zacco platypus*
4. *Opsariichthys bidens*
5. *Aphyocypris chinensis*

Leuciscinae
6. *Ctenopharyngodon idellus*
7. *Mylopharyngodon piceus*
8. *Elopichthys bambusa*
9. *Ochetobius elongatus*
10. *Squaliobarbus curriculus*

Cultrinae
11. *Parabramis pekinensis*
12. *Megalobrama amblycephala*
13. *Megalobrama terminalis*
14. *Erythroculter ilishaeformis*
15. *Erythroculter mongolicus*
16. *Erythroculter dabryi*
17. *Hemiculter leucisculus*
18. *Hemiculter bleekeri*
19. *Culter erythropterus*
20. *Toxabramis swinhonis*
21. *Pseudolaubuca sinensis*
22. *Sinibrama macrops*
23. *Pseudohemiculter dispar*

Xenocyprinae
24. *Xenocypris argentea*
25. *Xenocypris davidi*
26. *Plagiognathops microlepis*
27. *Distoechodon tumirostris*
28. *Acanthobrama simoni*

Acheilognathinae
29. *Rhodeus sinensis*
30. *Rhodeus ocellatus*
31. *Pseudoperilampus lighti*
32. *Acheilognathus hypselonotus*
33. *Acheilognathus tonkinensis*
34. *Acheilognathus polylepis*

Barbinae
35. *Spinibarbus hollandi*
36. *Acrossocheilus fasciatus*

Gobioninae
37. *Hemibarbus labeo*
38. *Hemibarbus maculatus*
39. *Hemibarbus longirostris*
40. *Belligobio nummifer*
41. *Pseudorasbora parva*
42. *Pseudorasbora elongata*
43. *Sarcocheilichthys sinensis*
44. *Sarcocheilichthys parvus*
45. *Sarcocheilichthys nigripinnis nigripinnis*
46. *Gnathopogon argentatus*
47. *Pseudogobio vaillanti vaillanti*
48. *Abbottina rivularis*
49. *Abbottina tafangensis*
50. *Saurogobio dumerili*
51. *Saurogobio dabryi*

Cyprininae
52. *Cyprinus carpio*
53. *Carassius auratus*
54. *Carassius auratus gibelio*
55. *Carassius auratus curieri*

Gobiobotiinae
56. *Gobiobotia longibarba longibarba*

Hypophthalmichthyinae
57. *Hypophthalmichthys molitrix*
58. *Aristichthys nobilis*

COBITIDAE
59. *Botia superciliaris*
60. *Parabotia fasciata*
61. *Cobitis sinensis*

62. *Cobitis macrostigma*
63. *Misgurnus anguillicaudatus*

HOMALOPTERIDAE
64. *Vanmanenia stenosoma chekianensis*

SILURIDAE
65. *Parasilurus asotus*
66. *Silurus meridionalis*

BAGRIDAE
67. *Pelteobagrus fulvidraco*
68. *Pelteobagrus nitidus*
69. *Leiocassis longirostris*
70. *Leiocassis brevicaudatus*

HEMIRAMPHIDAE
71. *Hemiramphus kurumeus*

SYMBRANCHIDAE
72. *Monopterus albus*

SERRANIDAE
73. *Percichthyidae whitehensi*
74. *Siniperca chuatsi*
75. *Siniperca kneri*
76. *Siniperca roulei*
77. *Siniperca scherzeri*
78. *Siniperca undalata*

CICHLIDAE
79. *Oreochromis niloticus*

ELEOTRIDAE
80. *Hypseleotris swinhonis*

GOBIIDAE
81. *Ctenogobius giurinus*
82. *Rhinogobius giurinus*

CHANNIDAE
83. *Channa argus*

Manuscript received 28 May 1989; accepted 20 November 1989