Status and Conservation of Reeves Shad Resources in China

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An endangered fish species in China, Reeves shad, is finding hope of restoration and conservation in aquaculture and induced breeding efforts spearheaded by the Yangtze River Fisheries Management Commission. The author describes the history and sensitive traits of the fish which has made his and other colleagues' efforts difficult but successful. The techniques may be useful for other endangered anadromous species.

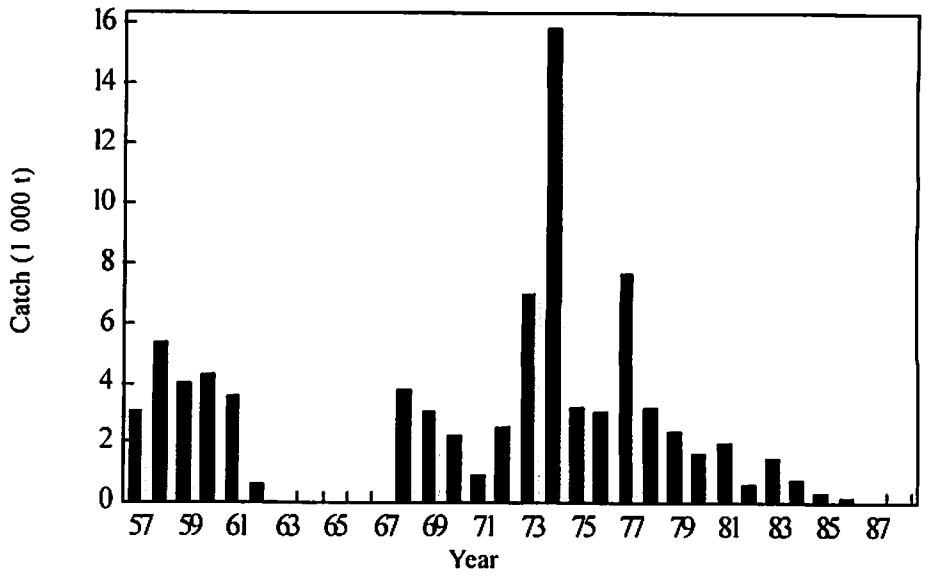
Introduction

Reeves shad *Tenualosa reevesii* is a famous anadromous species of the subfamily Alosinae, family Clupeidae. This species ranges on the south east coast from N 20° to N 36° and its linked rivers such as the Yangtze, Pearl and Qiantang Rivers in China. It has also been found in the eastern Indian Ocean (Phuket Island, Andaman Sea).

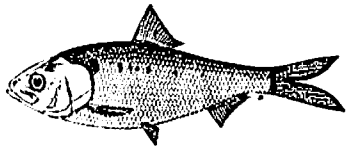
Annual landings of shad in the Yangtze River have shown marked fluctuations since the 1950s as shown in Fig. 1, reaching 1 577 t before declining rapidly. The shad resources in the other rivers experienced similar changes, causing the fishery to be closed in 1987. At present, the shad stocks in these three rivers are on the verge of extinction but a small population exists in the mouth of Pearl River. In view of the heavy crash of shad resources, the Chinese Ministry of Agriculture classified this shad as a protected species in 1987.

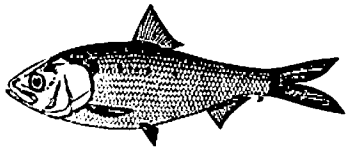
Reeves shad received much attention by fisheries workers in China. Early investigations included: (1) a survey of the life history and bionomics of the fish; (2) assessment of population dynamics; (3) appraisal of the effects of dams and obstructions on the migratory movement; and (4) artificial propagation to supplement the stocks of the fish in the rivers. Recent restoration efforts include artificial domestication and inducing breeding.

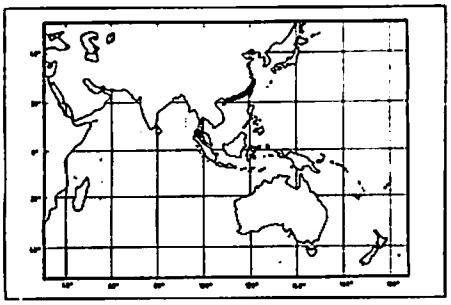
Fig. 1. Commercial landings of Reeves shad in the Yangtze River system, 1957-1987.



There is an urgent need to build up a shad culture and hatchery station and to standardize induced breeding, hatchery and nursery techniques, and further to release larvae and juveniles to supplement the stocks of fish in the rivers.







Geographical distribution (shaded) of Reeves shad.

Life History

Like the Hilsa shad, *(Tenualosa ilisha)*, and American shad *(Alosa sapidissima)*, Reeves shad matures at sea and returns to natal freshwater rivers to reproduce. Juvenile shad spend their first summer in freshwater and migrate to sea as water temperature declines in the autumn. Adult and immature shad make extensive coastal, nearshore migrations and feed largely on zooplankton.

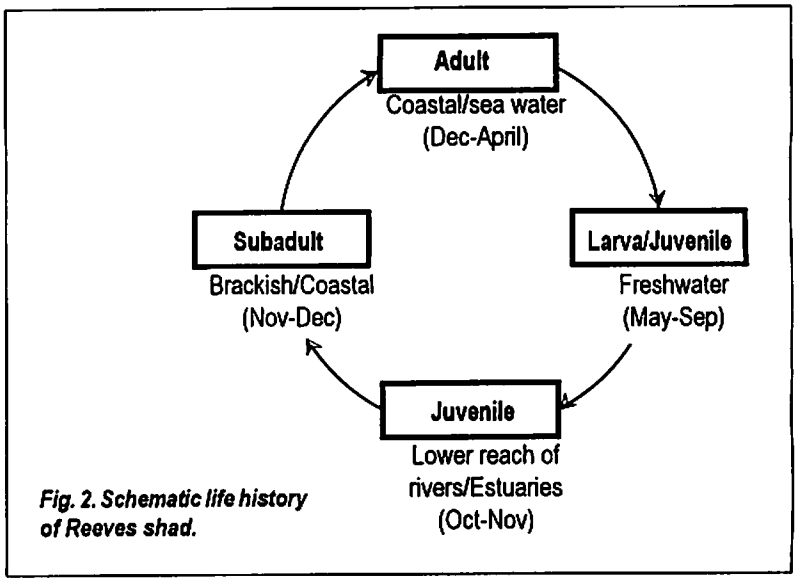


Fig. 2. Schematic life history of Reeves shad.

Population Dynamics

Cohort analysis of the catch data provided estimates of yield and population biomass (Table 1).

Table 1. Yield and population biomass of the Yangtze River shad as derived from cohort analysis for 1979-1986. TYN and TY are total yield number and total yield, TPN and TPB are total population number and biomass.

	1979	1980	1981	1982	1981	1984	1985	1986
TYN (x 104)	21.23	9.10	16.16	4.67	10.06	3.59	3.29	1.36
TY (t)	236.6	136.5	193.9	46.7	116.6	57.4	31.3	12.0
TPN (x 104)	62.01	32.33	43.18	9.43	27.16	12.33	4.35	3.00
TPB (t)	688.1	484.9	518.1	94.3	312.4	197.1	41.4	26.8

The assessment of the Yangtze River shad had to be based on fishery independent data after the closing of the fishery in 1987. The Shad Research Group in the Yangtze River Fisheries Institute (YE) estimated the population biomass in tonnes of spawning stock according to a regression model between biomass and catch-per-unit effort from the data of 1970 to 1986 as follows: 14.0 (1987), 2.2 (1988) and 13.8 (1989). Changes in the spawning stock abundance have been monitored in recent years by larval surveys. However, the correlation between the larval abundance index and the spawning stock biomass is not well established.

The commercial catches of adult Reeves shad were generally composed of 2- to 7-year age classes; the dominant age classes were usually 3 and 4. The yearly changes of reproductive population composition of the Yangtze River shad are presented in Table 2. Young fish increased in recent years, also a factor in the crash of Reeves shad stocks.

Table 2. The yearly age composition of the Yangtze shad (%).

Year	Age group (years)						Sample No.	Range	Mean Age
	2	3	4	5	6	7			
1962		31.30	51.17	14.39	2.71	0.43	1 626	3-7	3.87
1973-1975		52.65	40.39	6.74	0.22		2 803	3-6	3.55
1980-1986	36.48	55.19	6.60	1.73			636	2-5	2.74
1987-1989	49.06	42.28	6.66				63	2-4	2.69

Reeves shad in the West River (upper reaches of the Pearl River) was almost extinct in the 1980s. There now is a small stock in the lower Pearl River, but the catches decreased from about 175 to 78 t, averaging 144 t during 1980-1988, which was one-fifth of the average annual catch of the 1960s.

Management

Management of Reeves shad is a complicated problem because: (1) the reasons for the depletion are not entirely clear but contributing factors include habitat exclusion, degradation, and continued overfishing; and (2) biology of the marine stocks in relation to their environment is still unknown.

In 1991, the Yangtze River Fisheries Management Commission convened a symposium on conservation of the Yangtze River shad and made a suggestion to the Chinese government that the State should enact legislation to prevent the capture of Reeves shad and raise its protection status.

Aquaculture and Induced Breeding

Fisheries scientists in China have made many trials in artificial propagation and culture which are considered a fundamental way to save this species. However, because the shad is very skittish and easily dies during handling, the early studies were not quite successful in this aspect.

The first attempt to artificially propagate Reeves shad for stocking rivers was made in 1958; hatchlings were reared up to 2 months by 1963. YFI made good progress in artificial propagation of natural shad in the Yangtze River in the early 1980s, when about 3,000 100-day old juveniles were obtained. Because of the collapse of shad broodstock and its skittish temperament during handling, the propagation of wild stocks on a large scale is very difficult. Therefore, there has been an urgent need to domesticate shad from juvenile to adult and establish broodstock in pond environments. Several trials for this purpose were made, among which two 3-year old shads were obtained in a freshwater pond in 1982.

Besides enforcement of management and regulations, culture and stocking larval and juvenile shad will be fundamental ways for restoration of shad in the future

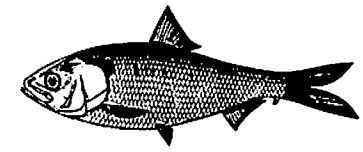
Successful experiments on domestication of the Reeves shad in brackishwater ponds were achieved by the author and colleagues during 1987 to 1994, in which shads were first domesticated to 5 years old, with mean body length of 418 mm and weight of 1 287 g, and a broodstock was established in a pond environment. Further, we recently succeeded in inducing maturation and ovulation of the domestic parent fish using long-term releasing hormones, and attained a yield of 1 170 kg/ha of yearling shad with an average weight of 203 g and 92% survival. Experimental results show that Reeves shad has good growth potential in pond conditions and its artificial culture is feasible.

Prospects

The encouraging successes in the domestication and induced breeding of pond-reared shad are bringing hope to this endangered species' future in China. Besides enforcement of management and regulations, culture and stocking larval and juvenile shad will be fundamental ways for restoration of shad in the future. There is thus an urgent need to build up a shad culture and hatchery station and to standardize induced breeding, hatchery and nursery techniques, and further to release larvae and juveniles to supplement the stocks of fish in the rivers. This way has been proven successful in the restoration of American shad to the Susquehanna River in the eastern United States where 10-15 million 18-day old shad fry and 50-100 thousand fingerlings have been stocked in the river every year since 1976. Estimates of hatchery contribution to the population of adults reached 90% in 1994 based on tetracycline marking and otolith microstructure.

Developing commercial culture of the shad in pond environments is another important way to save this species. At the same time this operation can supply the market with a high-value fish.

It is hoped that these restoration efforts can be supported by international organizations, because the restoration program and related techniques are not only important for restoration of Reeves shad, but are also very valuable for restoration and enhancement of hilsa shad stocks in the Bay of Bengal and Ganges, and American shad in the USA.



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