

Country reports

Introduction and management of alien aquatic species in China

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Though the major aquatic organisms used in aquaculture in China are indigenous species, the introduction of alien species and genetic selection to improve cultured strains have a significant role in the development of aquaculture, such as increasing total aquaculture production, supplying new species for aquaculture to meet market demands, and increasing farmers' income.

The benefits of introduced species are usually realized immediately, but the adverse effects of many exotic species surface after a long time. Any movement of aquatic organisms between natural ecological boundaries (e.g. watersheds) may involve risk to biodiversity. There is need for refinement and wider application of protocols, risk assessment methods, and monitoring programs for introductions of alien fish species, including genetically improved strains. Internationally accepted codes and protocols exist for reducing the risk of transboundary movement of pathogens including parasites. These cover incidental transfer associated with the movement of fish including alien species, but they need to be better promoted to increase awareness. In China, the management of introduction of alien species has been strengthened since 1991. This paper highlights the present status of introduced alien species in China, including their impacts, problems faced in fisheries and aquaculture, and related management issues.

Information on alien species introduction

Alien species and genotypes, such as tilapia, carps, rainbow trout, shrimp and prawns, are used throughout the world. The introduction or transfer of aquatic organisms in support of



aquaculture and various fishing initiatives has recently increased quite rapidly. Although China is rich in endemic aquatic genetic resources, introduction of different varieties of alien aquatic species has taken place since the 1960s. To date, introductions for aquaculture purposes have included over 50 species of fish, approximately 10 species of crustaceans, 12 species of mollusks, and 11 species of seaweed. Approximately 10% of these are important species in Chinese aquaculture (Table 1), and they comprise about 10% of national aquacultural production. The introduction of ornamental alien species is undertaken primarily by the private sector and there is no official record documenting these introductions. It is likely that more than 100 species of ornamental fish have been introduced.

Many species have been introduced illegally without pre-evaluation, quarantine, or post-evaluation. Only a few species were tested by research institutions before being released.

Table 1. Annual production of successfully introduced and cultured alien species in China

500-1000 ($\times 10^3$ t)	100-500 ($\times 10^3$ t)	10- 100 ($\times 10^3$ t)	1-10 ($\times 10^3$ t)
Tilapia (<i>Oreochromis niloticus niloticus</i>)	White shrimp (<i>Litopenaeus vannamei</i>)	Channel catfish (<i>Ictalurus punctatus</i>)	Red drum (<i>Sciaenops ocellatus</i>)
Scallop (<i>Argopecten irradians irradians</i>)	Giant freshwater prawn (<i>Macrobrachium rosenbergii</i>)	Pacu (<i>Colossoma brachypomum</i>)	Turbot (<i>Psetta maxima</i>)
Brown kelp (<i>Laminaria japonica</i>)	Tiger shrimp (<i>Penaeus monodon</i>)	Rainbow trout (<i>Oncorhynchus mykiss</i>)	
		Large mouth bass (<i>Micropterus salmoides</i>)	
		Africa catfish (<i>Clarias gariepinus</i>)	

Impact of introduction of alien species or genetically improved strains

Both positive and negative consequences can arise from introducing alien species. The following are a few notable examples from experiences in China:

POSITIVE IMPACT

The GIFT strain of Nile tilapia (*Oreochromis niloticus niloticus*) has been recognized as a genetically improved fish and been introduced into many Asian countries. Its performance was evaluated on research stations and farms in China between 1994 and 1996. It was revealed that growth of the GIFT strain fish was significantly higher (7-30%), and they were 2-3 times more likely to be caught than the existing Nile tilapia strains. This strain was certified as a good breed by regulatory authorities and distributed throughout China. Since 1996, further genetic selection through seven generations has resulted in an additional 30% increase in growth in comparison to the original strain introduced in 1994.

The Chinese government will use the strongest possible measures to prevent unauthorized introductions

The bay scallop (*Argopecten irradians irradians*) was introduced in the 1980s and formed a new industry with annual production of close to 1 million tons.

The white shrimp (*Litopenaeus vannamei*) was introduced in the 1990s and now is the dominant species of shrimp produced in China.

The turbot (*Scophthalmus maximus*) was introduced in 1992 and artificially reproduced in 1998. Because of its high value, turbot culture has developed into a significant industry in Northern China.

NEGATIVE IMPACT

Disease Transfer

In 1992, there were great losses to shrimp production in China due to the outbreak of white spot viral disease. This was thought to be due to importation of virus infected shrimp post larvae from abroad.

Ecological Disturbance and Invasion

The river perch (*Perca fluviatilis*) is a carnivorous species introduced from the Ertrix River basin in the north Xiangjiang Autonomous Region to the Bosten Lake in the south Xiangjiang Autonomous Region for fishery resource enhancement. It became a dominant fish in the new environment and caused the extinction of native bighead (*Apiorhynchus laticeps*) and the decline of many other species.

The red swamp crayfish (*Procambarus clarkii*) was accidentally introduced during World War II from the USA. It appeared in catches in Shanghai suburbs in the 1960s, and then spread along the Yangtze River basin up to Chongqing City, where it reproduces in surrounding water bodies. In some areas, populations are so abundant they are consumed by people during a

Table 2. Aquatic alien species certified by NCCA

Common name	Scientific name	Certification code
Nile tilapia	<i>Oreochromis niloticus niloticus</i>	GS03001-1996
Blue tilapia	<i>Oreochromis aureus</i>	GS03002-1996
Large mouth bass	<i>Micropterus salmoides</i>	GS03003-1996
Pacu	<i>Colossoma brachypomum</i>	GS03004-1996
Channel catfish	<i>Ictalurus punctatus</i>	GS03005-1996
Rainbow trout	<i>Oncorhynchus mykiss</i>	GS03006-1996
Rainbow trout (Donaldson strain)	<i>Oncorhynchus mykiss</i>	GS03007-1996
Leather catfish	<i>Clarias lazera</i>	GS03008-1996
German mirror common carp	<i>Cyprinus carpio</i>	GS03009-1996
Russia mirror common carp	<i>Cyprinus carpio</i>	GS03010-1996
Rohu	<i>Labeo rohita</i>	GS03011-1996
Giant freshwater prawn	<i>Macrobrachium rosenbergii</i>	GS03012-1996
Bay scallop	<i>Argopecten irradians irradians</i>	GS03015-1996
Pacific oyster	<i>Crassostrea gigas</i>	GS03017-1996
Turbot	<i>Scophthalmus maximus</i>	GS03001-2000
Bigmouth buffalo	<i>Ictiobus cyprinellus</i>	GS03002-2000

special festival and also harvested and processed for export. However, burrowing activity by the crayfish has damaged dikes and drainage systems by creating burrows as deep as 1.5 meters which may weaken dikes and cause flooding.

The piranha (*Serrasalmus nattereri*) was introduced from South America as an ornamental fish. This aggressive carnivorous fish is referred to as the “eat men fish”. It is easily propagated, and if released into natural waters could become established and decimate native fish populations. As a result of these concerns, this species was banned in 2003.

Genetic Introgression

Hybridization has been reported between the Nile tilapia *Oreochromis niloticus niloticus* and *blue tilapia Oreochromis aureus* (Li and Cai, 1995). There has also been mixed breeding between populations of the same species representing different introductions.

FORMULATION OF POLICY AND STRATEGIES TO MANAGE INTRODUCTIONS OF AQUATIC ALIEN SPECIES

Certification of Introduction of Aquatic Alien Species

Before the 1990s, China did not have any specific act to prevent the illegal introduction and spread of introduced alien species. Since 1990, a guideline and step-by-step process on exotic introductions and quarantine of aquatic animals has been prepared. The National Certification Committee of Aquatic Wild and Bred Varieties (NCCA) was established in 1991 under the Ministry of Agriculture (MOA). One of its mandates is to certify genetically improved aquatic breeds and alien species for aquaculture. Only certified genetically improved fish breeds and alien species can be released for commercial aquaculture. The current list of genetically improved fish breeds and alien species certified by the NCCA for commercial aquaculture are listed in Table 2.

Management and Regulation of Aquatic Alien Species Introductions

Recently, a proposal for national regulations to manage introduction of aquatic alien species has been developed. The regulation includes two parts: 1) the text of the rule, and 2) A list of species by category. This proposed regulation would apply to all life stages, including broodstock, gametes, embryos, larvae or young animals, spores, and other genetic materials intended for use in breeding for purposes of aquaculture and enhancement. More detailed information about this proposal can be found at: <http://www.chinabiodiversity.com/etf/annual-2002-en.htm#c>

- ▶ Proposals for any new introductions would be presented to the provincial and/or central government authority and should include:

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- ▶ Application report, including proposed place of introduction and objectives, area of origin, biological data (habitat, reproduction), cultivation system, disease condition, proposed number, size and life history stage.
- ▶ Capacity of the applicants to carry out the introduction, estimated ecological (competition, predation, hybridization, pathogen transfer), social and economic impacts.
- ▶ The local fishery management authorities would grant first approval.
- ▶ Final approval is under administrative authority of the provincial or central government and depends on the category of animals proposed for introduction (see appendix II).

For new introductions, the Ministry of Agriculture will organize experts to evaluate the need and justification for the introduction. The Chinese government will use the strongest possible measures to prevent unauthorized introductions. For example, in early 2003 possession of the piranha *Serrasalmus nattereri*, originally imported from Brazil was prohibited throughout China.

References

Li Sifa and Cai Wanqi. 1995. Introgression in hatchery stocks of *Tilapia nilotica* and *Tilapia aurea* in China (in Chinese). *J.-Fish.-China-Shuichan-Xuebao*: 19(2): 105-111.

