

Country reports

Aquatic alien species in Thailand (Part 1): Biodiversity

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Thailand has experienced exotic aquatic animal species since the 18th Century, when goldfish were introduced to high society households for ornamental purposes. For food fish aquaculture, Chinese common carp *Cyprinus carpio* was introduced in the early 20th Century to the Bangkok area and raised by Chinese farmers; Chinese major carps were subsequently introduced. Since this time, many species of “exotic” finfishes and shellfishes have been introduced for various purposes, including for food, as ornamentals, or for mosquito control. Introduced exotic species, imported for any purpose, have mainly contributed economic or social benefit and their status can be summarized as follows:

Escapee: 11 species accidentally spread in habitats but not established.

Flourishing: 17 species have established populations in nature. Aquatic species imported mainly for the aquarium or pet trade include:

- ▶ Finfishes and rays ca. 1000 species
- ▶ Amphibian ca. 50 spp.
- ▶ Reptiles ca. 40 spp.
- ▶ Mollusc 3 spp.
- ▶ Crustacean 4 spp.

In total, 17 species have flourished in natural waters, including 11 that appear not to have become invasive (or their status is unknown) and six invasive species (see Table 1).

The means of introduction to natural waters include:

- ▶ Escapee or unintentionally release, a result of natural disasters, traffic accidents and direct escape.



Most of escapees are aquarium or pet species. Eleven taxa are frequently seen in Thailand:

Arapaima *Arapaima gigas*
 Alligator gar *Lepisosteus* spp.
 African lungfish *Protopterus* spp.
 Bichirr *Polypterus* spp.
 Japanese eel *Anguilla japonica*
 Pacu *Colossoma macropomum*
 Piranha *Serrasalmus* spp.
 Bullfrog *Rana catesbiana*
 Caiman *Caiman crocodilus*
 New Guinea crocodile *Crocodylus novaguineae*
 Chinese softshell *Pelodiscus sinensis*
 Red cheek terrapin *Pseudemys scripta*

- ▶ Intentional release “for merit” as practiced in Thai Buddhist culture, or abandoning of some aquatic pets, sometimes to avoid legal problems.
- ▶ Official stocking, by the Department of Fisheries, for rehabilitation of inland waters and communal fishponds. This practice includes translocation of native species within their natural range.

The main reason for introducing exotic species are for social and economic benefit, especially for aquaculture. Positive or beneficial aspects of exotic species include:

FOOD SECURITY. Exotic species contribute more than 63% of freshwater fish production in Thailand or 160 000-170 000 mt annually, mainly from aquaculture. This statistic does not include yields from communal fishponds and natural waters. In 2001, fisheries statistics show that Thai people consume 28.8 kg of fish per capita, of which 41.6% is exotic species. Nile tilapia and its strains make the highest contribution, 8.52 kg per capita, following by hybrid walking catfish and common carp. Exotic fish aquaculture also plays an important role in the Thai rural economy, including employment, fish seed selling, polyculture with livestock and processing of fish product.

ORNAMENTAL. Up to 1 000 exotic species have been imported for the Thai aquarium trade. Many species have been bred and improved into famous breeds for the global market, such as discus, oscar, guppy and others.

PUBLIC HEALTH. Two ornamental species were introduced for mosquito control in urban and suburban areas of Thailand; the guppy *Poecilia reticulata* and mosquitofish *Gambusia affinis* that has high tolerance to polluted water. *Sailfins*, *P. velifera* and *P. sphenops*, were also utilized for algae control in brackish water shrimp ponds.

Some exotic species have become invasive alien species (IAS) to Thailand, with the following negative impacts:

PREDATORY. Several carnivorous fishes and amphibian can cause population decline in indigenous species, through predation, including egg predation. African and hybrid catfishes are claimed to have caused predation of small fishes in some wetlands. Tilapia in some man-made wetlands have been reported through local knowledge as egg predators of larger indigenous cyprinids i.e. *Osteochilus melanopleura* and *Morulius chrysophekadion*. Larger escapees i.e. Arapaima have potential to harm small fishes and frogs as well as bullfrogs can predate smaller native amphibians.

COMPETITOR. Most alien species have better adaptive living, an higher tolerance to habitat change and may compete with native species in foraging, niche and spawning grounds. Hybrid

walking catfish, several million of which are released annually for merit making, and escape from ponds, has been blamed for outcompeting the native species *Clarias batrachus*.

DISEASE, PARASITE TRANSMISSION. Chinese major carps were suspected as carriers of anchor worm and cotton disease in Thailand; it was banned for fry importing by Fisheries Act in 1970. Many diseases and parasites have been introduced in aquarium and pet species, including protozoa and helminthes, among others. The bullfrog was found to carry virus to native frog farms and sand goby culture.

HABITAT DISTURBANCE. Apple snails cause changes in wetland plant communities by foraging of soft and submerged species, leading to takeover by hard leaf species vegetation. Such vegetation change can lead to changes in fish diversity. Snails are also serious agricultural pests in paddy fields.

AGRICULTURE AND AQUACULTURE PEST. Apart from apple snails, the Mozambique tilapia has become a pest in brackish water shrimp farms throughout the Southeast Asia.

GENETIC POLLUTION OR EROSION. Establishment of alien taxa that are closely related to native taxa may cause genetic contamination through hybridization. Genetic examination of native walking catfish *C. macrocephalus* has found some contamination by the African species *C. gariepinus* in central Thailand.

ECONOMIC LOSSES. Pests may cause a reduction of farming product and incur costs for eradication. There may also be secondary impacts to the ecosystem from control and eradication activities. The obvious example is apple snail eradication, where chemical agents pose hazards to all non-target species in natural waters, including humans.

LEGISLATION RELEVANT TO ALIEN INTRODUCTION

There are three relevant legal instruments that control aquatic alien introductions in Thailand.

The Fisheries Act that prohibits imports of piranhas and sucker catfish, and regulates all imports of aquatic animals.

The National Park Act and Wildlife Conservation Act that prohibits carrying and release of any animal into National Parks and Wildlife Sanctuary areas.

The import of all living aquatic species is also controlled by the Ministry of Commerce.

Table 1. List of exotic species in Thai aquaculture

Species		From	Year	Origin	Reason	Established	Impact
Japanese eel	<i>Anguilla japonica</i>	Japan, China	1973	Japan, China	aquaculture	no	No
Chinese crucial carp	<i>Carassius auratus</i>	China	1692-1697	China	ornament	yes	No
Crucial carp	<i>Carassius carassius</i>	Japan	1980	Europe	aquaculture trial	no	No
Catla	<i>catla</i>	Bangladesh	1979	Bangladesh	aquaculture trial	no	No
Mrigal	<i>Cirrhinus cirrhosus</i>	Bangladesh	1980	Bangladesh	aquaculture	probably no	Unknown
African walking catfish	<i>Clarias gariepinus</i>	Lao PDR	Ca. 1987	Africa	aquaculture	yes	Invasive
Grass carp	<i>Ctenopharyngodon idella</i>	China, Hong Kong	1932	China	aquaculture	probably yes	Unknown
Common carp	<i>Cyprinus carpio</i>	China, Japan, Israel and Germany	1913+	China	aquaculture	yes	Unknown
Mosquitofish	<i>Gambusia affinis</i>	Unknown	unknown	Central America	mosquito control	yes	Unknown
Silver carp	<i>Hypophthalmichthys molitrix</i>	China	1919	China	aquaculture	no	Unknown
Bighead carp	<i>Aristichthys nobilis</i>	China	1932	China	aquaculture	probably yes	Unknown
Channel catfish	<i>Ictalurus punctatus</i>	USA	1989	USA	aquaculture	no	Unknown
Sucker catfish	<i>Hypostomus spp.</i>	Unknown	Unknown	Amazonia	aquarium	yes	Invasive
Sucker catfish	<i>Pterygoplichthys sp.</i>	Unknown	Unknown	Amazonia	aquarium	yes	Invasive
Rohu	<i>Labeo rohita</i>	India	1968	India	aquaculture	possibly	Unknown
Rainbow trout	<i>Oncorhynchus mykiss</i>	Canada	1973	Canada	aquaculture trial	no	Unknown
Trout	<i>Oncorhynchus rhodurus</i>	Japan	1981	Japan	aquaculture trial	no	Unknown

Species		From	Year	Origin	Reason	Established	Impact
Tilapia	<i>Oreochromis aureus</i>	Israel	1970	Africa	aquaculture	yes	Unknown
Mossambique tilapia	<i>Oreochromis mossambicus</i>	Malaysia	1949	Africa	aquaculture	yes	Invasive
Nile tilapia	<i>Oreochromis niloticus</i>	Japan	1965	Africa	aquaculture	yes	Inobvious invasive
Grey mullet	<i>Mugil cephalus</i>	Taiwan	1998	Taiwan	aquaculture trial	no	No
Amazon apple snail	<i>Pomacea canaliculata</i>	Taiwan	1990	Amazonia	aquaculture	yes	Invasive
Giant apple snail	<i>Pomacea gigas</i>	Taiwan	Unknown	Amazonia	aquaculture	yes	Invasive
American crayfish	<i>Procambarus clarkii</i>	USA	ca 1987	USA	aquarium	no	Unknown
Yabby	<i>Cherax quadricarinatus</i>	Australia	1995	Australia	aquarium	no	Unknown
Bullfrog	<i>Rana catesbiena</i>	USA	1977	USA	aquaculture	possibly	Inobvious invasive
Redbreasted tilapia	<i>Tilapia randalli</i>	Belgium	1955	Africa	aquaculture	yes	Unknown
Brineshrimps	<i>Artemia spp.</i>	USA, China	1978	USA, China	aquaculture	no	Beneficial
Whiteleg shrimp	<i>Penaeus vannamei</i>	Taiwan, Province of China	2000	USA	aquaculture	possibly	Unknown
Chinese abalone	<i>Haliotis diverticolor</i>	Taiwan, Province of China	1980	Taiwan	aquaculture trial	no	No
Sailfin	<i>Poecilia velifera</i>	Taiwan, Province of China	1960	Central America	algae contral	yes	Unknown
Chinese softshell	<i>Pelodiscus sinensis</i>	Taiwan, Province of China	1985	China	aquaculture	possibly	Inobvious invasive
Caiman	<i>Caiman crocodilus</i>	Australia	1990	Amazonia	pet, hide	no	Unknown
Red cheek terrapin	<i>Pseudemys scripta</i>	Japan	1972	USA	pet	possibly	Inobvious invasive