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"Alien fish problems in Thailand— How can we live together with alien fishes?" An academic conference for people

On Friday of 31 January 2020, an academic conference for people entitled "Alien fish problems in Thailand—How can we live together with alien fishes?", jointly hosted by Kasetsart University (Thailand), Kyoto University (Japan) and Department of Fisheries (Thailand), was held in the Faculty of Fisheries, Kasetsart University, Bangkhen campus, Bangkok, Thailand (Fig. 1). The conference was unique in that it was the first attempt to have a place to report and discuss on an important issue between researchers and people of all ages and occupations in the Thai language. Furthermore, it was also the first time that researchers of universities, in Thailand and Japan, and the Department of Fisheries of Thailand, had organized a conference on this topic together. Since alien species problems are often complex and include issues in various academic and administrative fields which require interdisciplinary approaches, they cannot be solved without the co-operation and understanding of people who are non-scientists. Communication between researchers and ordinary people is necessary. Furthermore, to establish the importance of recognition, prevention, extermination and handling of alien species within Thailand, public awareness campaigns are apparently necessary. So, this was the origin of the idea to organize the conference. To make contents of the conference understandable to all people, we used Thai language throughout the conference including presentations (all slides and presentations of Japanese presenters were translated and interpreted into Thai, respectively, by PM), and questions and answers (interpreted by a professional simultaneous interpreter and PM). The approximately 60 participants included university teachers and students, researchers from institutes such as the National Science Museum and fisheries research stations from many provinces, journalists, businessmen and a monk, representing the diverse interests of people throughout Thai society (Fig. 2A, B).

The conference was divided into two parts: a presentation part in the morning by six speakers who are working on alien fish species in Thailand and in Japan (Fig. 2), and an afternoon discussion session including panelists (the presenters of the first part) and participants on the floor (Fig. 3). The presentations were introduced in brief opening remarks by Assistant Professor Dr. Suriyan Tunkijjanukij, Dean of Faculty of Fisheries, Kasetsart University. Presentations of the six speakers are summarized as follows.

1. *"Alien fishes in Thailand: species, distribution and the present status"* by Dr. Prachya Musikasinthorn, Assistant Professor, Research Laboratory of Ichthyology (RLIKU), Department of Fishery Biology, Faculty of Fisheries, Kasetsart University, Bangkok (Fig. 2C)

Dr. Musikasinthorn explained the definitions and categories of alien species, and basic paradigms in this field of study. There are two major categories of alien species: 1) foreign alien species (species not distributed naturally in that country and intentionally or unintentionally released [introduced] by humans in that country from other countries), and 2) domestic alien species (species naturally distributed in that country but intentionally or unintentionally released [introduced] by humans in places which are out of their natural distributional ranges in that country) (Senou, 2013). The latter category or concept has not been recognized in Thailand so far, exemplified by the case of the Mekong giant catfish (*Pangasianodon gigas*)

or "pla buk", a species categorized by IUCN as Critically Endangered in the wild, which has become a domestic alien species in Thailand by being released in reservoirs and rivers all over the country (MUSIKASINTHORN, 2016). Dr. Musikasinthorn gave an overview of the present status of alien fish species in Thai waters, in which he recognized at least 23 species which had already been established in natural habitats up to that time, updated from an account listing 19 species which he published with his colleagues in 2007 (NICO *ET AL.*, 2007). He also pointed out that one of unique features of alien fish problems in Southeast Asia, including Thailand, is that because of the lack of sufficient faunal surveys, and documentation of introductions, the direct and indirect impacts from introduced alien fish species cannot be evaluated. This may result in threats to native regional faunas and in extreme cases, extinctions of some fish populations or of other organisms. Furthermore, it becomes more complicated in cases where indigenous species which are naturally distributed within the same country are intentionally or unintentionally (often brought with aquaculture species by contamination) released together to places which are out of their natural range within the same country. In many cases introductions may go unnoticed, because it is difficult to judge whether they were originally there or actually introduced because of the absence of accurate faunal studies in the past. Dr. Musikasinthorn further pointed out that a large source of alien introductions to natural habitats in Thailand and surrounding Buddhist countries is probably the fish-releasing ceremony, or "ploi pla", which has been conducted in temples as a kind of "tham bun" (merit-making) activity (Fig. 4). This practice should be banned or greatly restricted, as most fishes released in "ploi pla" ceremonies nowadays are invasive, alien species. Notorious examples of this include the Nile tilapia (*Oreochromis niloticus*), or "pla nin", from Africa, and the hybrid catfish, or so-called "big ui", a cross between the broadhead catfish (*Clarias macrocephalus*), an indigenous species, and the north African catfish (*Clarias gariepinus*) obtained from introduced aquaculture stocks (Fig. 4D).

2. *"Researches on alien fishes in Thailand: a case of peacock bass"* by Dr. Akihisa Iwata, Professor, Graduate School of Asian and African Area Studies (ASAFAS), Kyoto University, Japan (Fig. 2D)

Dr. Iwata reported on his and his colleagues' international research project "Clarification of negative impact of peacock bass on ecosystem in Thailand and its counterplan" mainly conducted during 2017 to 2019 in Rayong Province, where peacock bass (*Cichla* sp.) has recently been established in several places and presumably released mainly by anglers. The project is probably the first attempt to study the impact of an alien fish species in a freshwater ecosystem of Thailand by using a stable isotope and stomach content analysis to study its trophic position. Although data analysis had not been completed at the time, preliminary analysis revealed the potential influence of the peacock bass on the food webs of local fish communities, especially those dominated by carnivorous domestic species such as the snakeheads (genus *Channa*) based on stable isotope analysis. He pointed out that although, basically, alien species should be exterminated, in a recently developed concept, so-called "ecosystem service" (MILLENNIUM ECOSYSTEM ASSESSMENT, 2005), peacock bass can be recognized as a species which can provide "recreational profit" as a game fish to the human community. But there is a possibility that peacock bass have already had a negative impact on the ecosystem of the research area. Taking a comprehensive view of the situation, he proposed that the precautionary principle, "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures

Figure 1. A poster (also used as a flyer) of an academic conference for people "Alien fish problems in Thailand—How can we live together with alien fishes?"

Figure 2. Atmosphere of the presentation part of the conference. A and B, participants of the conference. The monk (front row) joined the discussion on fish releasing in temples at the end of the conference. Prachya Musikasinthorn (C), Akihisa Iwata (D), Yasuhiro Takemon (E), Tiwarat Thalerngkietleela (F), Siriwan Suksri (G) and Kaisarit Poonpanich (H) are giving their presentations. Photographs by Warin Nimsantijaroen.

Figure 3. The talking session part of the conference. A, speakers of the presentation part became panelists and answered questions and listened to comments from participants. Tuangtong Jutagate (B), Veera Vilasri (C) and Amornchai Lothongkham (D) are asking or commenting to panelists (see text for details of what they said). Photographs by Warin Nimsantijaroen.

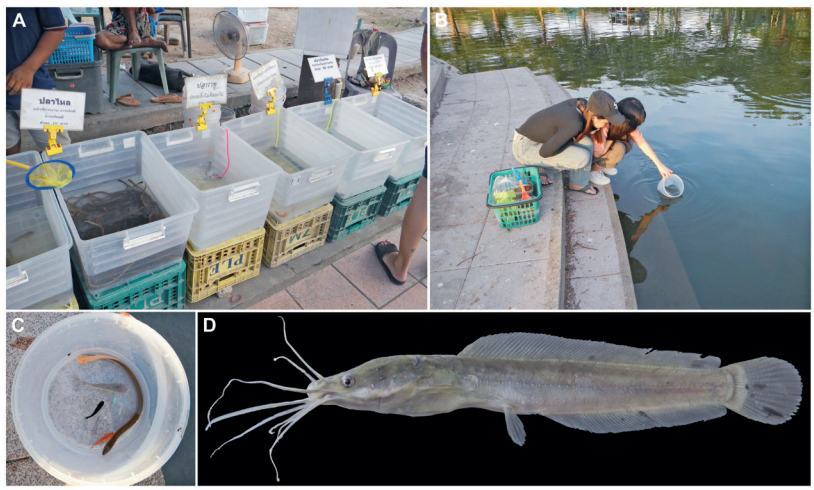

Figure 4. An example of fish-releasing ceremony or "ploi pla" conducted at a temple in Bangkok (January 2020). A: A shop selling fishes for release situated in the grounds of the temple. Most of the fishes for sale were alien species and artificially bred forms from aquaculture and ornamental fish stocks. B: A pair of young girls is releasing fishes which they bought from the shop to a large pond in the temple grounds, which is attached to a canal leading to the Chao Phraya River. During the rainy season the released fishes can escape to the canal. C: fishes released by the young girls. Of the six fish in the bucket, two are alien species (tropical American live-bearing poeciliids) and the rest include an Asian swamp eel (*Monopterus javanensis*), a climbing perch (*Anabas testudineus*), an artificially bred blue form of three-spot gourami (*Trichopodus trichopterus*), and an artificially bred albinoid form of walking catfish (*Clarias* sp. [cf. *batrachus*]). D: A young presumed hybrid catfish (84 mm in total length), a cross between *Clarias macrocephalus* and *C. gariepinus*, which was sold in the shop. This hybrid, the so-called "big ui", can grow up to nearly 1 m in length and is highly aggressive and voracious. Its release may cause serious feeding damage to indigenous fish populations as well as genetic pollution in natural populations of *C. macrocephalus*. Photographs by Prachya Musikasinthorn (A, B and C) and Chawwadol Puttaporntip (D).

to prevent environmental degradation" (Principle 15 of Rio Declaration on Environment and Development) be applied to management of peacock bass in the area. This means that there should be: 1) prohibition of transferring the bass from the area to other places, 2) a search for methods to control its impacts on the environment, and 3) investigation of its distribution.

3. *"Problems of alien fishes and countermeasures in Japan: a case of largemouth bass"* by Dr. Yasuhiro Takemon, Associate Professor, Disaster Prevention Research Institute (DPRI), Kyoto University, Japan (Fig. 2E)

Dr. Takemon reported on the catastrophic impact of the invasion of largemouth bass (*Micropterus salmoides*) and bluegill (*Lepomis macrochirus*) of North America, introduced to Japanese freshwaters in 1925 and 1960, respectively, as one of the worst cases of alien species problems in Asia, and showed how they have seriously altered freshwater ecosystems in Japan. He discussed the cases of Lake Biwa (Yodo & Iguchi, 2004), an ancient lake with many endemic aquatic species, and Mizoro-ga-ike, an ancient pond in Kyoto designated as a National Treasure of Japan, where long term ecological studies have been conducted (Abekura *et al.*, 2004). He also reported on the tremendous efforts of his team with local villagers to exterminate largemouth bass and bluegill in the pond. His example shows that even where alien fish species have become established, they can be reduced successfully by human efforts, although it is very difficult in most cases and long term monitoring will be required to achieve success. He also explained the importance of the "Invasive Alien Species Act", a specific and strict law to control alien species in Japan enacted in 2004 in Japan (Mito & Uesugi, 2004), as a strong support for activities of nature restoration by alien species control.

4. *"The present status of works on alien aquatic animals in Thailand of Department of Fisheries"* by Ms. Tiwarat Thalerngkietleela, Chief, Biodiversity Research Group, Inland Fisheries Research and Development Division, Department of Fisheries (DOF), Thailand (Fig. 2F)

Ms. Thalerngkietleela reported on recent activities of DOF related to aquatic alien species. DOF presently has three projects dealing with alien fish problems: 1) research on control and extermination of alien species, 2) development of regulations and control measures, and 3) Thai public relations. She also mentioned that recently (2018) the Ministry of Agriculture and Cooperatives, to which DOF belongs, declared a ban on import, export, brokerage and culture of three alien cichlid species: blackchin tilapia (*Sarotherodon melanotheron*), Mayan cichlid (*Mayaheros urophthalmus*) and zebra tilapia (*Heterotilapia buttikoferi*), in Thai waters.

5. *"Researches on alien fishes of Department of Fisheries"* by Dr. Siriwan Suksri, Fishery Biologist, Biodiversity Research Group, Inland Fisheries Research and Development Division, DOF (Fig. 2G)

Dr. Suksri reported on ongoing research on the biology of several alien fish species established in Thailand by DOF. From a study of the suckermouth armored catfishes (*Hypostomus plecostomus*, *Pterygoplichthys* spp.), which originated in South America but are now found in Thailand, it was found that the species can grow rapidly as compared to domestic catfishes (their mouths start to open only one day after hatching and all fins are developed within only three days after hatching). These species have advantages in survival over most domestic catfishes in Thailand. A study of the zebra tilapia (*Heterotilapia buttikoferi*) which originated in western Africa, collected from the Srinakharin Reservoir in Kanchanaburi Province, revealed that the species breeds all year round and shows aggressive behavior toward

native species. It is a possible ecological competitor of the Malayan leaffish (*Pristolepis fasciata*), a morphologically similar sympatric domestic species. A study of the blackchin tilapia (*Sarotherodon melanotheron*), which also originated in Africa, showed that it has invaded shrimp culture ponds and natural habitats in Thailand; it was found that about 80–95 % of stomach contents from juveniles to adults were algae and aquatic plants, suggesting potentially indirect impacts to shrimps in culture ponds.

6. *"Laws to control alien aquatic animals in Thailand"* by Mr. Kaisarit Poonpanich, Chief, Fisheries Import and Export Control Group, Fish Quarantine and Inspection Division, DOF (Fig. 2H)

Mr. Poonpanich reported on the history of Thai laws relating to aquatic alien species. Thai laws that ban the keeping and releasing of aquatic alien species started from 1947 when the Thai government banned the possession of piranhas, the world famous fierce and carnivorous freshwater fishes belonging to Family Serrasalmidae, naturally distributed in the Amazon and adjacent basins of South America. Since additional new alien fish species have been introduced and become established in Thailand in recent years, DOF established the Committee of the Institute of Biodiversity Conservation (IBC) in 2002 to discuss and determine regulations for controlling aquatic alien species problems.

In the afternoon discussion session (Fig. 3), many questions and suggestions were given and discussed among participants from the floor: the importance of recognizing not only foreign alien species but also domestic ones; the necessity of including active researchers of alien fish species (Thais and foreigners) as members of the committee of IBC (and not only members of DOF); and the urgent need for more studies on basic biology of established alien species, including estimation of impacts on Thai aquatic systems by Thai researchers so that the results may be used to plan priority and urgent measures to exterminate or control the alien species. Some persons doubted the ability of DOF to properly select the alien fish species to be regulated. Some questions and comments related to the fish-releasing activities of DOF to promote commercial benefits, which have allegedly caused alien fish problems, from the past to the present. Researchers from DOF emphasized that DOF now carefully considers and restricts fish-releasing activities in natural habitats (As an example, they said that DOF recently restricted release of the Nile tilapia to natural environments, including reservoirs).

Professor Dr. Tuangtong Jutagate (Ubon Ratchathani University) (Fig. 3B) asked about the possibility of separating economically important species like the Nile tilapia (which is not carnivorous or a predator) from other much worse invasive species, and to implement a relatively soft policy such as allowing its release in managed reservoirs. PM and AI commented that there must be careful evaluation of the potential impact of each alien species, as impacts can be direct or indirect. They pointed out the importance of evaluation of impacts of alien fish species in each ecological community or environment separately, since many alien fish species exhibit plasticity and may change their habits or diets depending on the environment they find themselves in. They pointed to an example of a recent ecological study on three invasive alien cichlids, done by their team in the lower Chao Phraya River basin around Bangkok and adjacent areas (TOMOJIRI *ET AL.*, 2019), in which Nile tilapia fed mainly on detritus and seemed to be harmless or had small influence on the environment. But this result may not necessarily apply to other areas where the species is introduced. So, more "case studies" on the same species need to be accumulated in order to understand the whole range of possible biological effects of introduction.

Dr. Veera Vilasri (National Science Museum, Thailand) (Fig. 3C) pointed out that release of Siamese fighting fishes (*Betta* spp.), especially *Betta splendens*, which are kept and bred with individuals from populations from other areas or with aquarium stocks which may be genetically different, may bring about changes in the natural fauna. *Betta* species are kept as pets for betting (called "kad pla kad") and as ornamental species, and are very popular all over Thailand. It is known that some betta breeders release offspring which they produce to natural habitats nearby. These so-called "luuk saad" then cross with natural populations in those areas, and the breeders will come back to retrieve offspring which appear after a while to utilize them for seeding their breeding stocks. Release of bettas is another potential case of domestic alien species introduction which may cause genetic pollution in local natural populations, and should be regulated.

Additionally, Assistant Professor Amornchai Lothongkham (Rajamangala University of Technology Lanna Nan) (Fig. 3D) reported and commented on introduction of giant snakehead (*Channa micropeltes*), one of the largest species of snakeheads reaching 1.3 m in length, to reservoirs and ponds in northern Thailand which are not naturally inhabited by the species. This is one of the many species introduced to lakes and ponds by the recreational angling industry. The release of these voracious predators may cause serious damage to local domestic species, many of them important food fishes. *Channa micropeltes* itself is not a desired food fish, unlike its smaller cousins.

At the end of the session, the necessity of restriction of fish-releasing ceremonies in temples was discussed by participants on the floor, including a monk and the panelists. While a university researcher (PM) strongly suggested banning fish-releasing ceremonies in all temples as soon as possible, other participants had differing views. It was argued that uncontrolled releases of all species should be banned since any domestic fish species not from the same local population could result in undesired hybridization between local populations and cause genetic pollution problems (Fig. 4). Nowadays this activity in fact has made temples become "alien fish factories", in which people positively think that they are doing good deeds, but actually they are destroying aquatic biodiversity. Researchers of DOF recommended restrictions or bans applying only to foreign alien fishes at present. From the discussion, in which the one monk present joined, it seems that this problem is relatively sensitive and complicated, since merit-making releases of animals (also including turtles, birds, etc.) have been a common religious practice from ancient times, and are still much a part of the Thai national culture. Nowadays, it is also connected to commercial profits to the sellers of animals for release in temples, and is firmly incorporated into the management practices of temples. PM also commented that it was important to realize that merit-making releases contradict the research findings and detailed policies of DOF on alien fish species, which almost have never been explained to the public or the general research communities in Thailand and abroad so far. Unfortunately, many valuable research results on the topic have not been published as scientific papers, or more usually, have appeared only in the form of in-house reports which are not widely distributed. Collaboration with university researchers both in Thailand and abroad can possibly make such valuable data more accessible to scientific communities of Thailand and abroad.

All participants of the conference might strongly feel that co-operation and collaboration between university researchers (Thai and abroad) and researchers of government departments such as DOF are really needed to solve alien fish problems in Thailand in the future, and this is also likely to be true for alien species problems of other types of organisms in Thailand.

Researchers of DOF (TT) confirmed that all valuable comments and ideas obtained from this conference will be used for reference in activities including making regulations concerning alien species problems of DOF in the future.

From the spirited atmosphere of the conference, number and diversity of participants and reactions from participants, the conference seemed highly successful and favorably received, which made the organizers willing to sponsor this kind of conference again in the near future, on other currently stimulating and fruitful topics.

Finally, as a representative of the organizers of the conference, I would like to express our sincere thanks to Dr. Sanga Leesanga, Director of Inland Fisheries Research and Development Division of DOF who inspired and encouraged us to organize this important, exciting and ground-breaking conference when we had a discussion on alien fish problems in Thailand together at DOF in early 2019. I am also thankful to Dr. Warren Y. Brockelman (BIOTEC, Thailand) for his valuable comments and improvement of English of this report. This conference was financially supported by Grants-in-Aid for Scientific Research (Grant Number 17H04601) of the Japan Society for the Promotion of Science.

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