Involving local communities in amphibian conservation: Taipei frog *Rana taipehensis* as an example

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ABSTRACT

Farmland is an important habitat for many amphibians. However, the widespread and prolonged use of agro-chemicals creates predictable difficulties and limitations for the conservation of agrobiodiversity. Farmland is an ecosystem in which human forces are greatly involved; therefore, conservation of natural resources in agricultural ecosystems must relate to the existence of humans in order to achieve its goal. The Taipei frog *Rana taipehensis* has become a seriously threatened species in Taiwan because of wetland destruction and extensive use of agro-chemicals on farmland. Nowadays the species can only be found in Taipei, Taoyuan, Tainan and Pingtung Counties. Since 1999, Taipei Zoo has been surveying the distribution of Taipei frogs in Sanzhi, a small town in northern Taiwan. Taipei Zoo has taken a two-pronged approach to its conservation project. Aside from collecting ecological data on Taipei frog populations, we also cooperated with a local school and the Tsu-Xin Organic Agriculture Foundation (TXOAF) to carry out habitat-improvement work and community-education programmes about wetland conservation. We persuaded and assisted a farmer to halt his use of pesticides and eventually adopt organic farming practices because his farm was located right in the center of the Taipei frog's breeding habitat and our sampling area. We also helped the farmer to sell his organically grown water lilies to TXOAF in order to provide a long-term and stable income. From October 2002, the farmer stopped using agro-chemicals on his fields. Beginning in 2003, despite the apparently increasing population of Taipei frogs, the farmer also became a follower of an organic lifestyle and is proud of the Taipei frogs on his land.

Key-words: agrobiodiversity, agro-chemicals, amphibians, conservation, education, farmlands, local community, organic farming, pesticides, Taipei frog, Taiwan, wetlands

INTRODUCTION

Almost half of the vegetation-covered land on the earth is devoted to agriculture (Polasky, 2007). Many invertebrates, fishes, amphibians, reptiles, birds and small mammals inhabit farmlands, so agrobiodiversity is an important part of global biological diversity. Owing to its climate and its rice-consuming culture, Taiwan's farmland consists mainly of paddy fields. These fields, along with the irrigating canals and farm pools of this agricultural system, have much to do with the area's amphibian biodiversity.

However, farmland is traditionally focused on producing agricultural products, a goal which can conflict with the conservation of biodiversity. For example, the use of pesticides, herbicides and fertilizers can threaten amphibians (Beebee, 1997). Also, farmland-use change may impact amphibian populations and distribution. Because biodiversity conservation in agricultural ecosystems involves considerations both of natural resources and of the interests of local people (e.g. farmers), it often requires careful deliberation and a practical approach. How to take both the farmer's profit and the preservation of natural resources into account is an important task for conservationists.

In Taiwan, the local community used to be excluded from natural-resource management. Community resident benefits were usually considered in conflict with resource conservation goals. Nevertheless, international natural-resource management practices are placing more emphasis on the rights of local communities, even considering the local community as an important partner of resource management (Lu, 2001).

In 1999, Taipei Zoo started the "Taipei Frog (*Rana taipehensis*) Conservation Project". Aside from investigating the status and ecology of the Taipei frog, the more important goals of this project were to implement a more effective conservation strategy and improve the natural habitat of the species. This article will present this case as an example of striking a balance with the cooperation between a conservation institute, a local school, a non-governmental organization (NGO) and farmers; that is, agricultural production and natural-resource conservation

THE STATUS OF *R. TAIPEHENSIS* IN TAIWAN

The Taipei frog is a member of Ranidae family. An adult male is about 4 cm in length while a female is about 3 cm. The body is slim, with a green or green–brown back and an obvious golden line running along each side of its spine (Plate 1). *Rana taipehensis* is distributed in areas of southern China, such as Yunnan, Guangdong and Hong Kong, Cambodia, Lao People's Democratic Republic, Myanmar, Taiwan, Thailand and Viet Nam, while the South Asian species, now synonymized under *Rana tytleri*, are found in India, Bangladesh and Pakistan (Ohler & Mallick, 2002; Yang, 2005). However, the holotype of this species was collected in Taipei and so it was named accordingly.

In Taiwan, Taipei frogs typically inhabit inland wetlands, such as swamps, pools, paddy fields and canals (Lue et al., 1999). There is a lack of long-term

observational statistics but limited records (Chou, 1993; Lin, 2000; Yang, 2005) and our own investigation indicate that at least 30 years ago Taipei frogs would have been widely distributed in the low-altitude areas of western Taiwan. Although the species is listed as Least Concern by IUCN (2006), Taipei frogs are seriously threatened in Taiwan with only small populations remaining in Taipei County, Toayuan County, Tainan County and Pingtung County (Lue et al., 1999; Yang, 2005) (Fig. 1a).

Research undertaken since 1999 shows that Taipei frog distribution and population are decreasing, and those that remain may have difficulty interacting because they are fragmented by long distances of mostly urban environment. Moreover, they are mainly distributed on private land, so their most critical threat is habitat destruction by human development and farmland-use changes, such as paddy fields becoming fallow or no longer irrigated. Another important threat is the use of pesticides. Although there is no specific research on the effect of agricultural chemicals on Taipei frogs, the species is not found on farmlands where pesticides are used frequently.

GOAL AND STUDY AREA

Although Taipei frogs are seriously threatened in Taiwan, ecological studies and information about the species are quite limited (Chou, 1993; Chou et al., 1993; Chuang, 2006). Therefore, in our project we first wanted to understand the life history and ecology of the Taipei frog clearly.

In July 1999, we found farmland in Hengshan village, Sanzhi town, Taipei County, inhabited by Taipei frogs (N25°15’41.4”, E121°31’21.8”) (Fig. 1b). Ninety percent of this farmland was stepped paddy field; the rest was grass field (Plate 2). The total area was around 9000 m2. In a preliminary survey, we found 15 frog species (including the Taipei frog) (Table 1), which were near a half of all native species in Taiwan. There were also two water snakes, *Enhydris chinensis* and *Sinonatrix annularis*, and other rare aquatic insects and plants. We therefore decided to designate this important wetland as a study area, and since February 2000 we have spent two nights of every month at the site for fieldwork purposes.

The owner of the farmland is 85 year-old farmer Yang Wenshih, who has planted water lilies in the paddy field by himself for more than 20 years. He prepares the soil and plants the water-lily spears in late April and commences harvesting in June to send produce to the market. Water-lily florescence lasts until the end of November, at which point the plants wither. To control the water lily’s main pest, *Eoophyla* sp., a small moth with larvae which eat water-lily

leaves, Mr Yang would sometimes spread pesticide on his plants (Plate 3). In order to keep the field tidy, he also used herbicides.

Our survey showed that Taipei frogs in the field would become active in April to May, reproduce in June to July, and enter hibernation in October to November (Fig. 2). Their active season almost completely overlaps with the water-lily cultivation season. Therefore, in addition to the ecological study, eliminating the threat from pesticides and effectively improving the habitat became additional important goals for our project. Renting or buying this farmland was not considered appropriate because maintaining its present pattern of use was the highest consideration for the habitat-improvement programme.

HABITAT IMPROVEMENT

Our first habitat-improvement initiative for Mr Yang was that Taipei Zoo would compensate him for any financial losses incurred when he stopped using agro-chemicals.

However, Taiwan has a long history of farmers using pesticides, which are considered necessary for improving the quantity and quality of agricultural products (Li & Lin, 1989; see also Pesticide Information Website at http://pesticide.baphiq.gov.tw/). In addition, owing to an aging population and the lack of labour power in the countryside, old farmers such as Mr Yang work alone and depend heavily on pesticides and herbicides. So it was a great challenge to persuade Mr Yang to stop using these chemicals.

In addition, although the Taipei frog is protected by law in Taiwan, landowners may not welcome this species for fear of disadvantageous limitations on land use and development. Mr Yang allowed us to study the frogs on his land but never showed any interest or attention towards them himself. Therefore, we decided not to approach him about halting pesticide use directly for fear that it might discourage his cooperation, end our access to his land for research and perhaps even jeopardize the study into R. taipehensis.

Taiwanese villagers maintain a traditional communication network that strengthens relationships between neighbours and within the clan. We hoped to work with Mr Yang by contacting his friends and acquaintances through this system. We first visited the Sanzhi Township Office and the Farmers' Association, hoping that the local government and farmers' organization could support our project. In addition, because teachers are influential in the Taiwanese countryside, we visited Hengshan elementary school near our

study area. This tiny school of less than 100 students is where we met Wu Jinchung, a teacher who loved nature and knew Mr Yang well. In this way we contacted Mr Yang through his acquaintances and asked them to determine the farmer's opinion about stopping the use of agro-chemicals.

Nevertheless, Mr Yang did not give us a specific response to our project. We invited Mr Wu and relevant members of the Sanzhi Township Office, Farmers' Association and Taipei County Government Bureau of Agriculture to make a formal visit to Mr Yang and promote our project. Mr Yang immediately rejected our proposal because he believed there would be no harvest without using pesticides and the loss in profit was inestimable.

Although our initial approach failed, we worked more closely with Mr Wu, who understood the importance of this land and sometimes joined us in our fieldwork. He also encouraged students to experience this valuable wetland. In November 2001, in the name of Hengshan elementary school, Mr Wu officially joined our team, participating in Taipei frogs habitat-improvement and wetland-education programme. He also proposed the idea of organizing students to cut weeds for Mr Yang, which would enable him to stop using herbicides. This suggestion was accepted and was our first breakthrough, inspiring us to think about how to persuade Mr Yang to stop using pesticides.

At the beginning of 2002, a new partner joined the programme: Tse-Xing Organic Agriculture Foundation (TXOAF), an NGO Buddhist group organized in 1997. One of the principal missions of this Foundation is to popularize organic farming and guide farmers to abandon agro-chemicals and take up organic farming methods. TXOAF's purpose for popularizing organic farming is for the love of the earth and life, so when we explained our project to the Foundation, we quickly received their support.

Taipei Zoo and TXOAF outlines a new habitat improvement programme under which TXOAF, Mr Wu and Taipei Zoo continued to persuade Mr Yang to alter his practices to organic farming, while the Zoo paid for any necessary expenses. If Mr Yang stopped using pesticides, TXOAF pledged that its organic stores would sell at least 120 bunches of the farmer's water lilies per day, thus providing him with a steady income to allow him to continue organic farming.

Beginning in February 2002, counsellor Li Fungchi of TXOAF was entrusted with the task of persuading Mr Yang to accept the new habitat-improvement programme. At that time, Mr Li already had 5 years experience of persuading farmers to join the organic movement. He initially talked to Mr Yang beside the paddy field as the farmer worked (Plate 4) but

found this difficult because Mr Yang seemed dispirited about the counsellor's visits. Perhaps lacking faith in us, Mr Yang did not seem interested in the new programme.

At the same time, we continued to try to gain more support from community residents and inform them of the presence of this precious wetland. In July 2002, with the cooperation of Mr. Wu, we held a 5 day wetland conservation study camp in Hengshan elementary school. The course included an introduction to wetland animals and plants, wetland–human relationships, and the crisis facing the wetland. It also contained night walks in the studying area (Table 2). More than 80 members from the Sanzhi, Danshui and Shimen communities joined the camp. Most of them were elementary- or high-school teachers and local social workers. After the camp, we received a lot of positive feedback. For example, three members said they were willing to provide their farmland for wetland restoration and Taipei frog relocation.

In October 2002, to demonstrate its practicability, the programme's head within TXOAF, Chung Chanhwa, suggested selling Mr Yang's water lilies in the TXOAF stores as an ornamental rather than an edible product, although they were not organic at that time. Although this thought did not fit within the Foundation's regulations, the proposal received complete support. Thus, in mid-October Mr Yang's water lilies were first displayed in TXOAF's biggest shop in Taipei City, Li Ruhn organic shop. Taipei Zoo designed a promotional poster and gave his flowers an ecological brand. The slogan was, "Buying Water Lily Flowers, Protecting Taipei Frogs" (Plate 5). Every day, the water lilies that Mr Yang delivered to the shop at 0500 hours were sold out within an hour. Those who knew the story behind the water lilies were willing to buy them. Mr Yang was amazed at the success of the sales. When he entered the shop in person 2 weeks later and saw customers enthusiastically buying his water lilies, he decided to accept our conservation programme and has stopped using pesticides on his farmland since 2003.

In April 2003, Mr Yang was hospitalized as a result of an injured leg, so the planting of water lily spears was postponed until May. Every team member visited the farmer in the hospital. In June, the water-lily pest *Eoophyla* sp. started to reproduce. We hoped that after stopping pesticide use, *Eoophyla* sp.'s natural predators, the insectivorous aquatic insects, such as *Cybister sugillatus* and *Laccotrephes japonensis*, would increase and control the pest. *Bacillus thuringiensis*, a pathogenic bacteria that infects *Eoophyla* sp. larvae and kill them, was used twice. We originally feared that Mr Yang would give up in this period but his attitude was unexpectedly resolute. At the beginning of

August, the presence of *Eoophyla* sp. was reduced to an acceptable level. Nature provided the best feedback— the Taipei frog population in the field doubled and the number and quantity of aquatic insect species significantly increased (Fig. 3). Unfortunately, a river construction work occurred during spring and summer 2004 on the stream bank beside the farmland. The irrigating water was polluted by considerable mud and concrete. As a result, the population of Taipei frog seriously declined in late 2004 and 2005. Until 2006, it seems starting recovery (Fig. 3) (Lin & Cheng, 2007).

However, one of the good things is that Mr Yang turns himself into a practicer of organic life and also a guardian of the Taipei frogs. In 2004, Mr Yang showed his newly designed name card, on which was printed a picture of a Taipei frog, to a TV reporter. He proudly described the frog species and ecology of his water-lily field (Plate 6). He also presented the reporter with fruit and bamboo shoots from the farmland and emphasized that these were all organic.

TXOAF has held at least five life education summer camps for college students since 2003, at which more than 6000 students have attended our team members' (HC Lin, LY Cheng and FC Li) lectures, presenting our conservation philosophy and all the efforts for saving Taipei frogs. They also shared Mr. Yang's story, changing his attitude from being reckless to willing to protect Taipei frogs. In 2006, Taipei Zoo held a "Wetland Conservation Festival", in which Mr. Yang was invited to show his pesticide-free water lilies to visitors and interpreted his deed of becoming Taipei frog's guardian.

This story, in which the zoo and NGO cooperate to persuade farmers to discard pesticide and secure species from threatening, brought more than 15 reports in newspapers and magazines. In addition, there were three special programs on TV to introduce this story. Among which, the program "Uncle Stone's Lotus Field" (Stone is Mr. Yang's middle name) (Wang, 2005), issued by the Taiwan Public Television Service, participated in Earth Vision, the 15th Tokyo Global Environmental Film Festival, and was nominated as the final top ten in all 131.

Through these educational activities and media, though we cannot estimate accurately how many people have learned Mr. Yang and Taipei frog's story, yet from the public responses during these years, we believe that many people have discovered in amazement that human and nature can coexist more harmoniously, as long as we can find a proper path.

CONCLUSION

When we decided to persuade Mr. Yang to stop using pesticides in order to improve the habitat of the Taipei frogs, the Taipei County Government Bureau of Agriculture and the Sanzhi farmers' association suggested that we buy or rent the land to prevent it from being destroyed. However, this was never in our interest because we did not want to eliminate its original use solely to conserve the Taipei frog (see also Chang et al., in press). In the past 20 years, there were several cases where conservation activity blocked land development, resulting in the misunderstanding that conservation and human development are conflicting approaches. In fact, seeking the balance between conservation and the local-community's benefit has become a new tendency of resource conservation and management (IUCN, 1993; Western & Wright, 1994; Pimbert & Jules, 1997; Holdgate & Phillips, 1999). Paddy fields are important frog habitats but they are also man-made wetland ecosystems. Therefore, it is not reasonable to exclude the original land usage in favour of conservation. Furthermore, the sudden change or stop of human-evolving factors would results in unpredictable environmental impact on the man-made ecosystems, such as farmland, and even likely cause habitat degradation. Thus, we hoped to maintain Mr Yang's original farming pattern while conserving the Taipei frog by stopping the use of herbicides and pesticides. Throughout this project, we have shown that agricultural development and resource conservation can co-exist.

Mr Yang did not accept our suggestion to stop using agro-chemicals until 2002. For an old farmer who has used agro-chemicals for more than 20 years, maintaining the status quo may have appeared to be the best strategy to ensure his harvest. Later, he accepted our programme because of the guarantee of basic profit, although he indicated that he was also moved by our ceaseless spirit. Mr Yang's actions after 2004 demonstrate that, although he initially accepted our programme for profit, as time went by the philosophy of "rejecting the use of herbicides and pesticides" had become incorporated into his life style. Therefore, he turned all his crops over to organic farming techniques.

Local-community profit should be included in resource-conservation and management strategy, or should even become its core thought (Lucas, 1992; Lu, 2001). When planning conservation actions, it is necessary to take into consideration not only natural-resource availability but also the needs of the local community. If the human element is ignored, conservation would become an unreachable goal.

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Table 1. Frog species discovered in the survey of the study area, Hengshan's farmland.

Species	Common Name
Bufo bankorensis *	
Bufo melanostictus	Spectacled toad
Rana guentheri	Guenther's Frog
Rana kuhlii	Kuhl's fanged Frog
Rana limnocharis	Indian Rice Frog
Rana latouchii	Latouche's Frog
Rana longicrus	Long-legged Frog
Rana rugulosa	Indian bullfrog
Rana taipehensis	Taipei frog
Microhyla ornata	Ornate Narrow-Mouthed Toad
Chirixalus idiootocus *	Meintein Tree Frog
Polypedates megacephalus	White lipped Tree Frog
Buergeia robustus *	Brown Tree frog
Rhacophorus taipeianus *	Taipei Green Tree Frog
Hyla chinensis	Chinese Tree Frog

* : Endemic species of Taiwan

Table 2. The Course of Wetland Conservation Camp for Community Residents in Sanzhin.

	Jul, 8	Jul, 9	Jul, 10	Jul, 11	Jul, 12
10:00-10:30	The Importance of Wetland Conservation and Education Introduction of Wetland Ecosystem Environmental Ethics	The Crisis and Conservation of Wetlands	Research of Freshwater Fishes in Wetlands	The Freshwater Spiral Shells in Wetlands	Wetland Yard Tour at the Taipei Zoo
13:30-15:30	Close to Nature	Potentiality of the Eco-community: Management and Planning of Tao-mi Village	A Case Study of Community Conservation : Using Farmland tree frog (*Rhacophorus arvalis*) as an Example	The Plan of Eco-Campus	Workshop
15:30-17:30	How to Classify “Animals”	The Hydrophyte of Wetlands	The Education of Wetland Conservation	The Aquatic Insects in Wetlands	Final Presentation
18:15-20:15	Practice of the Fieldwork	Practice of the Fieldwork	The Amphibian and Reptiles in Wetlands	Practice of the Fieldwork	

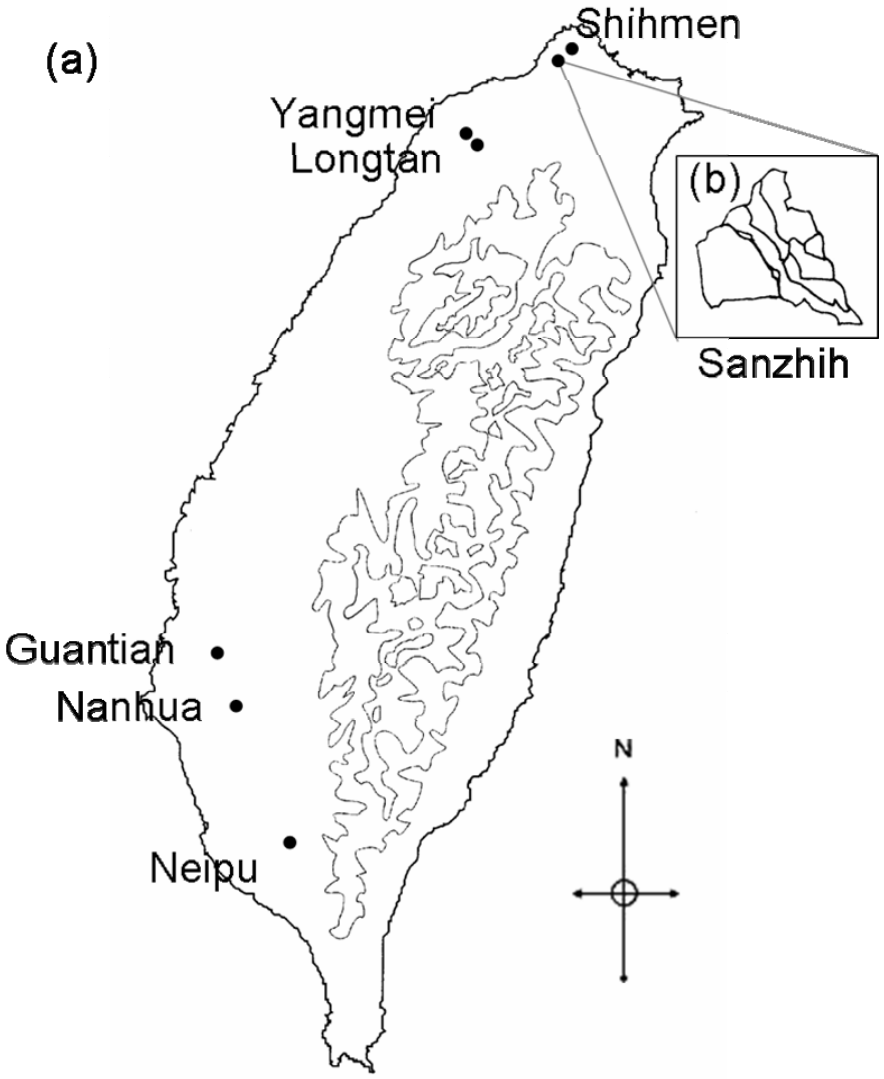

Fig. 1a. Taipei frog *Rana taipehensis* is threatened in Taiwan because only small populations remain. The dots show Taipei frogs distributed at Shihmen (Taipei County), Sanzhih (Taipei County), Yangmei (Toayuan County), Longtan (Toayuan County), Guantian (Tainan County), Nanhua (Tainan County) and Neipu (Pingtung County); b. Taipei frog studying area at Sanzhih.

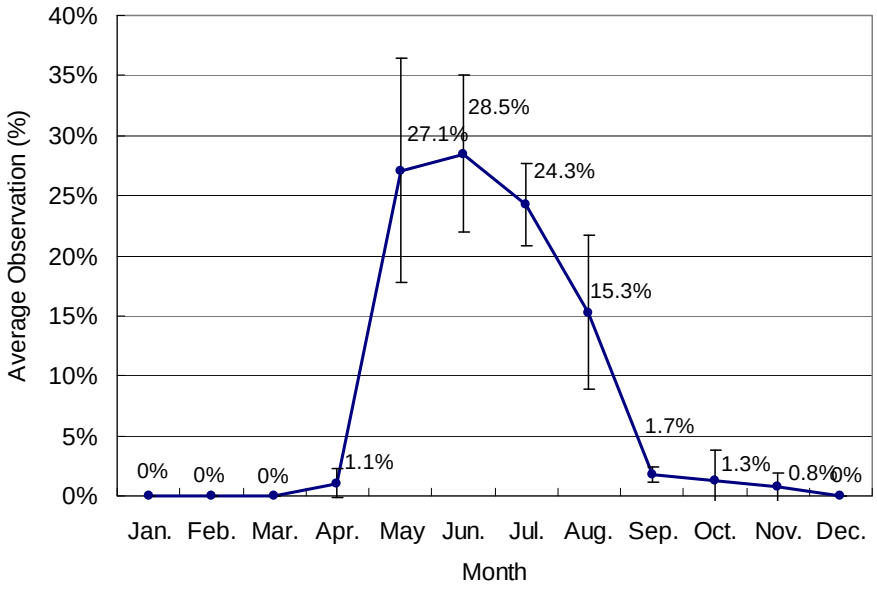

Fig. 2. Occurrence of Taipei frogs *Rana taipehensis* in each month during 2002–2006; total observation for 2002–2006: *n*=931.

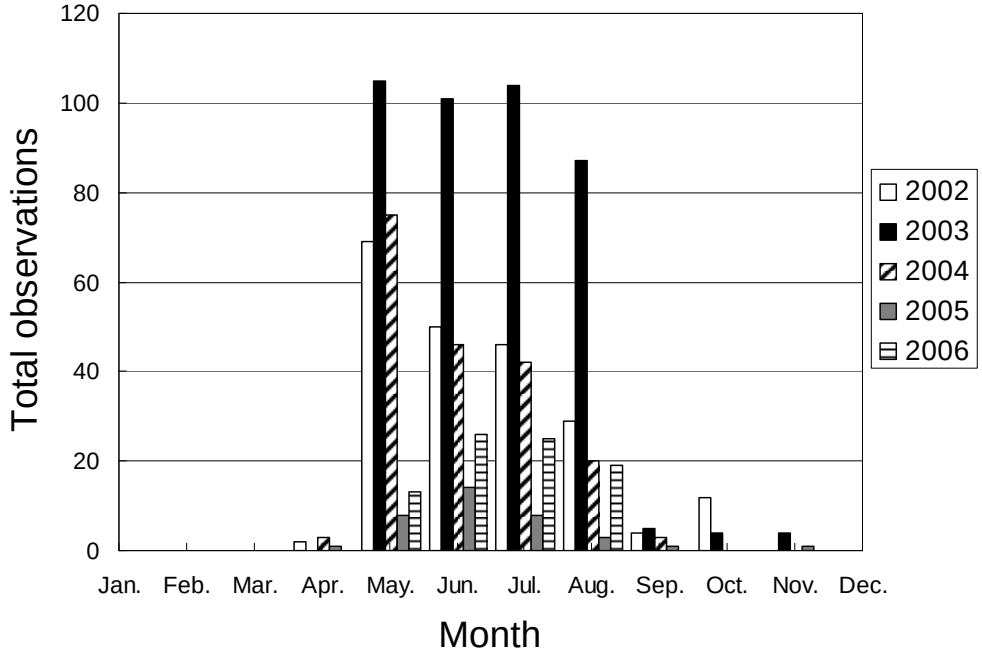

Fig. 3. Occurrence of Taipei frogs *Rana taipehensis* in each month during 2002-2006; total observation for 2002–2006: *n*=931.

Plate 1. Taipei frog *Rana* taipehensis is a threatened species of frog in Taiwan. *Chin-Fong Lin*.

Plate 2. Sample area includes stepped paddy fields and grass fields. This is a typical habitat for Taipei frogs *Rana taipehensis*. *Hwa-Ching Lin*.

Plate 3. Mr Yang spreads pesticides. *Hwa-Ching Lin*.

Plate 4. Staff of Taipei Zoo and TXOAF at the side of the paddy field persuading Mr Yang to stop using pesticides on his crops. *Hwa-Ching Lin*.

Plate 5. Taipei Zoo designed an ecological brand for Mr Yang's water lilies and displayed posters in the TXOAF's organic shop. *Li-Yi Chen*.

Plate 6. Mr Yang displays his newly designed name card, on which is printed a picture of a Taipei frog *Rana taipehensis*. *Li-Yi Chen*.