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An Investigation into Frog Consumption and Trade in Cambodia

by

Species, Habitats and Ecosystems Team

An assessment of the collection and trade of amphibians in Cambodia

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Report for The Angkor Centre for Conservation of Biology

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1. Introduction

Amphibians globally are facing a growing crisis, with between a third and one half of all known species threatened with extinction (Stuart et al., 2004; Attenborough, 2008). Although new amphibian species are being discovered and described every year, with 6433 species currently recognised worldwide (Frost, 2009) recent studies have shown that amphibian populations are drastically declining across the planet. This fact has lead to concern within the conservation community and prompted a number of initiatives aimed at highlighting the problem. The International Union for Conservation of Nature decided to declare 2008 the "Year of the Frog"; while the World Association of Zoos and Aquariums established the "Amphibian Ark" – an initiative to start a captive breeding programme for the most threatened species. The major causes of amphibian decline are varied. Human activities such as habitat destruction, pollution, and over-harvesting for food have seriously impacted certain species; while natural problems like the recent outbreak of chytrid fungus Batrachochytrium dendrobatidis and climate change (both exacerbated by human activities) have caused the extinction of many species (Stuart et al., 2004; Hopkins, 2007; Rowley et al., 2009).

The consumption of frogs worldwide and the impact it has on harvested populations has been well documented in some cases. Over-collection of *Rana draytonii* during the Californian gold rush of 1849 caused a significant depletion in the abundance of this species within 20 years (Jennings and Hayes, 1985). A similar fate has befallen the Indian bullfrog *Rana tigrina*, another large-bodied species that is harvested for human consumption. In China a ban on harvesting this frog was imposed after over-collecting resulted falling frog numbers but a reciprocal increase in the agricultural insect pests on which this frog feeds (Fugler, 1985).

Harvesting of amphibians is often associated with the rural poor supplementing their diet with any available protein. However, the trade in frogs particularly is a worldwide business. Legs of bullfrogs from Asia, mainly Indonesia, Bangladesh, India and Malaysia are exported to Europe as a gastronomic delicacy. In the Southeast Asian region, Indonesia has historically been the largest exporter of frog's legs (Warkentin et al., 2009) with 5,600 tons exported in 1992 (Kusrini and Alford, 2006); while in 1981 alone India exported an estimated total of 4,368 tons (http://www1.american.edu/ted/frogs.htm). It is reported that 6,000 tons of frog legs were imported to Europe each year during the 1990s (Jensen and Camp, 2003) – a figure which rose to 9700 tons in 1999. The chief importers were Belgium, Luxembourg and France (Warkentin et al., 2009; Patel, 1993; Teixeira et al., 2001). Currently the United States is reported to import more than 3000 tons of frog meat a year from abroad (http://amphibiaweb.org/) and harvested 5200 tons of wild caught frogs internally between 1998 and 2002 (Martin et al., 2005). Between 1981-1984, over 6 million rugulose frogs *Hoplobatrachus rugulosus*, presumably caught from the wild, were exported from Thailand to Hong Kong (Wai-Neng Lau et al., 1999). Such large numbers is likely to be causing an adverse effect among both frog populations and the ecosystems of which they are a fundamental part.

Trade in frogs is not restricted to meat. Frogs are also being caught for use in making novelties and curios for the tourist industry such as purses and key chains. Frog skin is used in the leather and glue trade (Pough et al., 1998) and in Sumatra, the depletion of a giant *Limnonectes* species to make stuffed ornaments is directly attributable to over collecting (Holden, pers. com.). Frogs also have medicinal value: in China thirty two species are recognised as components of traditional Chinese medicine (Carpenter et al., 2007) cited from (Ye et al., 1993) (Pough & Ye, 1993)

It is estimated that between 180 million to a billion frogs are currently collected from the wild in Asia alone each year (www.amphibiaweb.org/declines/exploitation.html). While the frog trade has raised concern related to the decline of certain frog populations around the world, the industry has not been properly monitored. To supplement the higher demand for frogs, and to counteract the effects of over-harvesting, some countries have introduced frog farming. Although this initiative may reduce pressure on wild populations, it comes with additional risks: the introduction of non-native and potentially harmful exotic species, and facilitating the spread of chytrid fungus (Jennings and Hayes, 1985).

Frog consumption among local people in Cambodia is widespread, and many communities still depend on collecting frogs to either supplement their limited protein intake or generate additional income (Allen et al, 2008). But the situation remains poorly documented due to a lack of research in the subject. Herpetological studies in Cambodia have been focussed on taxonomic and systematic work (Ohler et al., 2002; Stuart et al., 2006a, 2006b; Grismer et al., 2007a, 2007b, and 2008) with few if any ecological studies. Nao Tuok et al., 2001 did tackle the subject of frog trade, reporting that officially 15 tons of frogs were exported in the past few years, but without stating where these frogs were going, or what species were being collected. If this is an official figure, then the true scale of export from Cambodia is likely to be considerably higher.

The lack of reliable data on this subject from Cambodia is clearly a concern. This report is an initial attempt to address the issue of frog consumption and trade status and how it may have affected local amphibian populations. The information presented aims to be a reference for developing a regional amphibian assessment and will be useful in seeking regional cooperation in developing an action plan to ensure that amphibians are harvested sustainably in Cambodia.

The specific aims of this report are to:

- Identify species collected for local consumption,
- Assess the extent of trade within Cambodia,
- Assess the extent of export from Cambodia,
- Assess whether the current collection volume is sustainable,
- Assess the importance of the income generated from frog harvesting,
- Determine the possible threats arising from collection activities,
- Investigate the status of frog farming in Cambodia and identify farmed species,
- Recommend a strategic plan to monitor the volume of consumption and exports.

2. Method and Materials

Surveys were based on interviews with local participants in the frog trade. These were planned to coincide with the onset of the rainy season May, June and July 2009. This period represents peak activity in both frog populations and harvesting. Initial research was carried out in Takeo, Kampong Speu and Kampong Chhang provinces, and the markets and restaurants of Phnom Penh. A follow up survey investigated the north-western areas bordering Thailand including parts of Battambang, Siem Reap, Banteay Meanchey, and Oddar Meanchey provinces.

The survey team travelled by motorbike and taxi to and around the survey sites. Interviews were conducted across a broad spectrum of locales. In rural areas, local collectors and villagers; permanent frog sellers along national highways no.2, no.3, no.4 and no.5; frog vendors in provincial market towns; customs officials at the Cambodia-Thailand border; frog middlemen and frog retail sellers in major towns and markets; and restaurant owners in Phnom Penh. Visits were also made to a government vocational training centre in Battambang, which teaches frog farming techniques to local communities, and a frog farm in Takeo province. A standard questionnaire was used for interviews (see annex I).

3. Results

3.1. Species collected for consumption

Throughout Cambodia frogs are collected as a food source, and at some time or other, most species are probably gathered for human consumption. Rural communities living near forests will opportunistically utilize frog protein, especially the larger species, such as riverine Ranids and the IUCN listed spine-glanded mountain frog *Quasipaa fasciculispina*. This type of collecting, although it may be responsible for localized depletion of certain species, is potentially of minimal threat to native amphibian populations. Of greater concern is the wholesale collecting of the larger species found in agricultural landscapes that constitute the bulk of frogs harvested in Cambodia.

A total of six frog species were reportedly harvested on a regular basis for local consumption and trade (Table 1). In decreasing order of reported volume the species collected were as follows: Rugulose frog *Hoplobatrachus rugulosus* (*Plate 1*) paddy frog *Fejervarya limnocharis* (*Plate 2*) truncate-snouted frog *Glyphoglossus molossus* (*Plate 3*) Asian bullfrog *Kaloula pulchra* (*Plate 4*) Kokarit frog *Rana lateralis* (*Plate 5*) and black-spined toad *Bufo melanostictus* (*Plate 6*).

Rugulose frog *Hoplobatrachus rugulosus*. This species is one of the largest found in Cambodia, reaching up to 120 mm in length. They live in agricultural as well as natural environments, and are particularly suited to living around villages. These characteristics make this species one of the most popular for consumption and trade. The Khmer dish *Kangke-bauk* is made from this species, and it is prized by restaurateurs in Phnom Penh, appearing on the menus of premier restaurants in the capital. *Hoplobatrachus* has a wide distribution across Southeast Asia and is not currently threatened. However, over-collection could easily change that status, and this is a species that needs monitoring within the region.

Paddy frog *Fejervarya limnocharis*. An abundant, but small species that ranges across Southeast Asia that utilizes a variety of standing water sources to breed. *Fejervarya* is valued as a snack frog, often served on sticks as an accompaniment to rice wine. This species can be collected throughout the year. The nature of the Cambodian landscape, with vast areas of the country inundated by the swelling waters of the Tonle Sap, mean that this species is unlikely to suffer depletion from over-collecting.

Truncate-snouted bullfrog *Glyphoglossus molossus*. This unusual frog is perhaps one of the ugliest in Cambodia, but is also reported to be the most delicious, making it highly sought after. Records of frog distribution within Cambodia are still patchy, but this species appears to be restricted to the north western part of the country. *Glyphoglossus* is a fossorial species, spending most of its life unground or hidden beneath leaves, emerging to breed en masse only after periods of heavy rain. Given its habit of explosive breeding, large numbers of these frogs can be collected after the first heavy rains of the monsoon. According to interviewees, these frogs are often prepared in a similar way to the fermented fish paste known locally as *Phaork* in order to preserve the meat for longer periods. The sale of this species can be seen in the markets of Siem Reap (Handschuh pers. com.) and newspaper reports from 2007 describe it as being traded with neighbouring Thailand. IUCN has given this species a Near Threatened designation, reflecting the fact that over-collection in Thailand especially, has caused the mean size of adults frogs to shrink by 30% over the past decade (IUCN, 2010). Given its regionally endemic status, and restricted range within Cambodia, coupled with its over-collection in Thailand, this species requires special attention in Cambodia.

Asian bullfrog *Kaloula pulchra* is also a popular edible species. As with *Glyphoglossus*, it spends most of its life underground, emerging after heavy rain. Locals consume this species when only small numbers of frogs are caught. When larger volumes are taken at the onset of the monsoon, or after periods of heavy rain, they are taken for sale in provincial market towns. *Kaloula pulchra* has a wide distribution across Southeast Asia and is unlikely to become threatened in the near future. A similar species, *Kaloula mediolineata* has recently been found in Cambodia (Thy pers. obs.) and appears to be restricted to the northwest of the country. This frog may also be a subject of collection, and given its restricted range is of greater conservation interest.

Kokarit frog *Rana lateralis*. A pretty species that seems to occur only north of the Mekong river and is collected in small amounts during the wet season in Snoul district of Kratie province for local consumption (Khou Eang Hourt pers. com.).

Black-spined toad *Bufo melanostictus*. Despite being maligned in Khmer culture as being unclean, toads are also collected for consumption, albeit in relatively smaller volumes to the more popular species. It is likely that this species is more usually collected for use in the Chinese medicine trade. It is a common species, found even in large towns.

Table 1. Frog species collected in Cambodia listed in order of volume collected.

Family Name	**Common Name**	**Scientific Name**
Ranidae	Rugulose bullfrog	*Hoplobatrachus rugulosus*
Ranidae	Paddy frog	*Fejervarya limnocharis*
Microhylidae	Truncate-snouted bullfrog	*Glyphoglossus molossus*
Microhylidae	Asian bullfrog	*Kaloula pulchra*
Ranidae	Kokarit frog	*Rana lateralis*
Bufonidae	Black-spined toad	*Bufo melanostictus*

Frog species commonly collected for consumption and trade in Cambodia

Plate 1. Hoplobatrachus rugulosus

Plate 2. Fejervarya limnocharis

Plate 3. Glyphoglossus molossus

Plate 4. Kaloula pulchra

Plate 5. Rana lateralis

Plate 6. Bufo melanostictus

3.2 Local consumption

Generally, the common species of frogs – with the exception of tree frogs – are collected by local people as a protein supplement. Large volumes of frogs are caught after the first heavy rain of the wet season, when some species emerge after a six month aestivation period. During that time, both skinned and live *Hoplobatrachus* are on trays or in large bowls for sale in the local markets countrywide. *Fejervarya limnocharis* are widely collected by some individuals for consumption but are not as valuable as *Hoplobatrachus* because of their smaller size. As frogs are abundant during only a short period of the year they are highly prized by locals, middlemen and restaurants.

3.3 Methods used by the collectors

Most commonly collected frog species prefer agricultural landscapes (Neang and Holden, 2008). During the first heavy rains of the monsoon (usually occurring in early May) or during periods of heavy pre-monsoon rain, frogs are easily collected. Most species are more active at night, and collecting is usually a nocturnal activity involving handheld or head torches. Locals reported that frogs are more abundant on moonless nights. Local people also use traditional methods of frog catching. In the mid to late rainy period, when paddy fields are flooded and full of rice, bamboo gill traps baited with fermented fish (*Plate 7*) are used. The average hunter owns 5-15 gill traps. The traps are deployed in the paddy fields, lakes, ponds, ditches, and other irrigation systems where frogs are known to occur. One trap can catch up to 8 frogs and traps fill quickly if they are set in the right frog-abundant areas. These gill traps were observed in Kampong Chhnang, Pursat, and Oddar Meanchey provinces. Wooden harpoons, (*Plate 8*) similar to those used for spear fishing, are used to catch wary *Hoplobatrachus*. These large frogs learn to avoid light, and quickly dive at the sight of a torch. This method is being applied in Trach village, Kaheng commune in Samraungtorng district and Chrochteak village, Trapeang Chou commune, Aural district, Kampong Speu.

During the short dry period of early wet season in Takeo province, frogs are caught when farmers pump water from deeper canals into their paddy fields to seed or transplant rice. This flooding is similar to a heavy rain event as far as the frogs are concerned and they come out from their shelters and congregate in the flooded areas to breed. Both *Hoplobatrachus* and *Fejervarya* are collected in this way.

Plate 7. Wooden gill trap used to capture frogs.

Plate 8. Wooden harpoon guns for frog hunting seen in a village in Aural district.

3.4 Frog trading

Full time frog traders are a regular sight along arterial roads leading out of Cambodia's main towns. Some of these sellers reported that they had been in the business for 10-25 years and sell frogs all year round. *Fejervarya* paddy frogs, together with young and adult *Hoplobatrachus*, are the staple stock, and are collected locally for this purpose. While the smaller *Fejervarya* are served dried on sticks, the larger *Hoplobatrachus* are served stuffed and grilled in a dish known as *Kangkeb-bauk* (stuffed frog) (*Plates 9 & 10*). Frog selling is frequently associated with beverage stands, and frogs are eaten as an accompaniment to palm juice, beer and rice wine (Tithara, 2002). Some travellers and tourists buy cooked frogs to take away. Frog selling in this fashion is a year round activity, made possible because *Fejervarya* can also be collected throughout the dry season.

There are about 50-70 frog selling stands operating on national road No.2 outside Siem Reap village, Rean Thmar commune, Kandal Stoeung district and in Preah Molup village, Kandoeung commune, Bati district. One frog-trader interviewed (Long Chan Thol) buys frogs from 30-40 local collectors and distributes them to the frog sellers. Seventeen frog selling stands were also observed on road No.3 in Rung village, Kreangleav commune, Korngpisey district on the border of Kampong Speu and Takeo provinces. The frog sellers here buy frogs from the markets or receive frogs from other frog distributors. Similar shops also occur on road No. 5 in Salalek Pram of Kampong Chhnang, at the bus station near Skun of Kampong Chham, in the town at the bus station of Banteay Meanchey and at various locations in Phnom Penh.

Plates 9 & 10. Dried and grilled frogs for sale along national highways.

3.5 International trade

The truncate snouted bullfrog *Glyphoglossus molossus* has only been recorded in north western areas of Cambodia (Timo Hartman, pers. com.). The species occurs in northwest Battambang but is reportedly uncommon; while reports from Siem Reap, Banteay Meanchey, Oddar Meanchey suggest this species is common, but localized. With the exception of collection for family consumption, middlemen buy them seasonally from local farmers during the peak collection periods when the frogs emerge to breed. These frogs are reportedly for export, leaving the country through O'smach and Choamsra-ngam to markets on the Thai border. It proved impossible for the survey team to estimate the volume collected in an average year because information collected was vague, even from the custom officials at the O'Smach border.

However, informants reported that an average amount of around 10kg of both *Glyphoglossus* and *Hoplobatrachus* were collected by each collector. Middlemen traders buy up these frogs from individual collectors to form mass shipments for export to the Cambodia-Thai border. This intermittent trade happens only a few times a year when there are heavy rains after prolonged dry period. So, the total volume of local consumption and export quantity was impossible to estimate. The price of frogs fluctuates depending on the volume available. At collection localities the cost of 1kg of live frogs usually ranges from 5,000-7,000 riel (US$1-2) in the wet season, and up to 15,000-16,000 riel (~US$4) in the dry period when there are fewer frogs for sale. The price is higher at the border.

Hoplobatrachus were reported to have been traded by a middleman in Kampong Chhnang province to Vietnam. Orders from Vietnam are received over a period of 2 to 3 months per year. The requirement for export is that frogs are of a medium to large size (1kg comprises from 3-5 frogs), smaller sizes are rejected. The amount exported to Vietnam could not be verified. An intermittent trade with Chinese middlemen was also reported. Suy Sak, a frog middleman and retail sellers for around 10 years in Kampong Chhnang province reported one instance in 2005-2006 where five tons of toads, allegedly for the traditional medicine trade, were collected in Kampong Chhnang province. The toads were skinned and dried in the sun, the skin on the head left attached to prove that the animals were in fact toads.

It was reported that *Fejervarya* and juvenile *Hoplobatrachus* were exported to Thailand through the Poipet border crossing. The survey team observed delivery of 5-10 kilogram sacks containing both species to the house of a trader in Battambang. These frogs were destined for export to Thailand. While there is trade in small-bodied frogs from Cambodia to Thailand, the reverse appears to be the case, with large-bodied frogs reportedly imported from Thailand to Cambodia. The reason for this seems to be to meet the demand of Phnom Penh markets during the prolonged dry period when wild caught frogs are scarce. Puy Heun, a trader living in Sangke district of Battambang province, bought frogs of a similar species to *Hoplobatrachus* from Thailand to supply to the markets of Phnom Penh. She imported around 200-300 kgs of frogs from Thailand a day. These were added to around 70kgs per day of native wild caught *Hoplobatrachus* and sold directly to Phnom Penh. Another distributor in Chaba Ampov in Phnom Penh confirmed that he imported around 150-200kg frogs a day from Thailand in 2008.

Table 2. Internal trade in *Hoplobatrachus rugulosus*

From	Provincial suppliers	3 Permanent suppliers in each province	Estimated 4 provincial suppliers	8 major markets in Cambodia
To	Permanent traders	Phnom Penh markets	Phnom Penh markets	Phnom Penh market
Wet season	150-300 kgs	450-900 kgs	1800-3600 kgs	225-450 kgs
Dry season	50 kgs	150 kgs	600 kgs	75 kgs

3.6 Estimated quantity brought to markets in Phnom Penh

Frogs work their way through an intricate trading network to get to customers in the city of Phnom Penh. Many local collectors catch frogs in their respective landscapes and sell them to several local traders in their province. The traders deliver the frogs to a few permanent traders at fixed distribution centres in each provincial town. These traders supply frogs to those in the city. According to interviews with the traders, the provinces that feed the supply frogs to Phnom Penh are Kampong Chhnang, Kampong Thom, Kampong Cham, Pursat, Battambang, Siem Reap, Takeo, and Kampot.

The quantity of frogs coming into the Phnom Penh markets during the wet season is approximately 150-300kg per day per trader as indicated in Table 2. However, the quantity in the dry season was estimated to be around 25% of that brought in during the wet season (Long Rady pers. comm.).

The main frog markets in Phnom Penh are Chaba Ampov, Doeumkor, Central, Orussey, Kandal, Phsar Chas, Russian market, and Olympic markets, while smaller markets have an intermittent trade. There are, perhaps, one or two distributors responsible for distributing frogs to different frog vendors in each market. However, a larger volume goes to larger markets such as Chaba ampov, Phsa Deumkor, Orussey and Central market. The main customers who buy frogs are restauteurs of which there are around one hundred in the city serving frog dishes. The restaurants reportedly consume around 5-10kgs of frogs per day each.

The natural abundance of frogs favoured by collectors has reportedly changed over time. In areas where frogs have been traditionally collected for decades, some species are reported to have declined by up to 50%. Phorn Veasna, a former frog farmer trained by the agricultural NGO CEDAC and living near a wetland in Kampong Speu province, reported that the quantities harvested have declined by approximately 30-50% in his area. Suy Sak reported a 10-30% decline in Kampong Chhnang; while a 10% decline was reported in Banteay Meanchey and Oddar Meanchey. The numbers harvested in Pursat and Battambang have stayed stable according to Puy Heun and Long Rady. Individual frog size appears to be smaller than those caught in the past. The survey team observed that 60-70% of the *Hoplobatrachus* kept in rice sacks by permanent traders in Takeo province were of a small size, with 1kg = 8-10 individuals, and only 30-40% of the frogs of a large size (1kg = 3-4 frogs).

Plate 7. Skinned *Hoplobatrachus* in a Phnom Penh market. Provincial traders sell live frogs; market vendors sell skinned frogs with cranium removed.

Table 3. Value Chain from middlemen to retail sellers (Riels/Kg)

Species	Season	Provincial Trdrs	Permanent Trdrs	Large Trdr	Market price	
Hoplobatrachus	Wet period	3,500	4,500	6,500	7,500	
	Dry period	12,500	13,500	14,500	15,500	
Fejervarya					Live	Fried
	Wet period	3,500	N/A	N/A	5,500	80,000
	Dry period	5,500	N/A	N/A	7,500	90,000

US$1 = 4,000 riels

3.7 Value chain and income generation from frogs

The price of frogs varies depending on a variety of factors: season, species, size, and the locations where the frogs are sold. The price in collection localities is relatively low. Local traders set prices depending on the availability of frogs. As indicated in Table 3, each trader can expect to make a profit per kilogram of around 1,000-2,000 riel (US$ 0.25-0.50). The chance of making a profit depends entirely on the quantity of the supply for that season or year. While collectors usually get a set price, the retail sellers in the markets can bargain with customers and make a bit more profit. The live paddy frogs are delivered fresh to the markets and then fried which preserves them for at least a month before they are out of stock. One kilogram of fried frogs costs 70,000-90,000 riel (US$18-23).

While the price of 1kg of fried frogs is much higher than wet frogs (it takes 10kgs of live frogs to produce only 1.5kgs of fried frogs) the price paid by the market stall and the profit made is the same as for wet frogs.

3.8 Frog farming

The government vocational training centre (GVTC) located at Preykonkhla district, Battambang province and the Cambodian Centre for the Study and Development of Agriculture (CEDAK), a non-government development organization operating in across Cambodia, focus on training local communities on methods to improve their quality of life. Both use programmes involving frog farming.

The GVTC employs local specialists who can provide training on frog breeding. The facility's campus has tanks for breeding and raising froglets. So far it has trained more than 40 communities in Battambang province and adjacent areas. The facility also sells froglets to local development NGOs who provide them to local communities free of change to establish their own frog farms. Some frog farmers collect young *Hoplobatrachus* from the wild, while other individuals buy froglets from the centre. Froglets are priced at 300 riels (US$0.075c) each.

The minimum farming pond size advised by the centre is 2m by 4m in area and 0,5-0,6m depth, which is suitable for 200 froglets. The ponds are sealed with plastic to keep water from filtering into the ground. Insects are attracted to the ponds as a natural food source for the froglets by growing Lemon grass around the ponds, and by placing lights at night. Rice and fish offal is used to feed the frogs twice a day in the morning and afternoon. According to GTVC's Muth Kunthea, there is around 70% mortality of frogs over 5-6 months, at which point the adult frogs can be harvested and sold. In some instances, these semi-natural frog farming projects appear to have been unprofitable. The survey team visited the remains of a few frog farming sites in Kampong Speu province. These small scale farms were abandoned due to their unprofitably compared to the hunting wild frogs.

The centre reported that some frogs were introduced from Canada and Thailand. Determining the species of introduced frog was not possible during the course of this survey. However, these frogs superficially resemble *Hoplobatrachus*. Incidents of these imported species escaping have been recorded, especially during periods of flooding, a potentially common occurrence in Cambodia.

Two other frog farming sites in Takeo province were surveyed to identify the breeding species used, assess the scale of the farming, and possible threats. The frog farmers reported that the breeding frog species were provided by Japan International Cooperation Agency (JICA) in 2004. No data was available as to origin or specific identity of these frogs, but they were possibly from Malaysia and Thailand. The farmed species appeared different from *Hoplobatrachus* so tissue samples were taken and sent for analysis to Dr Lee Grismer in La Sierra University, USA in order to determine the species. The preliminary report from Dr Grismer indicated they were *Hoplobatrachus* (*Plate 11*).

Currently, the main purpose of many larger farms is to produce froglets for distribution to newer, smaller farms. The remaining unsold froglets are raised for 3-4 months to a saleable size. It is estimated that 150,000-200,000 froglets are produced per farm each year. Producing froglets for sale to starter farms is considered more profitable than raising frogs to adult size. This raises the notion that currently frog farming is not a profitable enterprise in Cambodia. It seems clear that this is not because low demand, but due to the ease with which wild frogs can be harvested.

Plate 11. Although appearing morphologically different, these farmed frogs in Takeo proved to be a genetic match with *Hoplobatrachus rugulosus* according to tests made by Dr Lee Grismer at La Sierra University.

Plates 12 & 13. Frog farm in Takeo province.

Plate 14. *Hoplobatrachus* cf. in a frog farm in Takeo province.

The export of frogs from Cambodia has not been well documented in the past. Surprisingly, this survey showed that frogs are being exported to both Thailand and Vietnam, but also that frogs are being imported from Thailand. It appears that while small-sized frogs are being exported, larger frogs, even of the same species, are being imported. This suggests that frogs are being used for different purposes in the respective countries. We know that the most valuable use for frogs in Cambodia is to serve the restaurant trade in Phnom Penh, where large *Hoplobatrachus* are the preferred choice. At present this species is not threatened, occurring as it does across Southeast Asia. However, it resembles *Rana tigrina* in size and habitat preference, and presumably has the same agricultural value. *Fejervarya limnocharis* is unlikely to be over-harvested in Cambodia, despite the rampant trade in this species. Of more concern is the status of *Glyphoglossus*. This has already been designated a Near Threatened status by IUCN after it was observed that mean adult size was decreasing in Thailand, where this frog is popularly eaten. This species' localized distribution of within Cambodia make it particularly vulnerable, as it seems to occur mostly in the provinces bordering Thailand and is therefore easily traded at border towns. No clear figures could be obtained on how prolific the trade in this species is, but it clearly needs further monitoring.

Increasing local consumption, higher demand for selling on roadside stands, demand from both local and the city markets and perhaps for export have changed collections from seasonal to all year round, pushing frogs at some localities to decline in numbers (Stephanie Stohr, 2009). The year round demand may be pushing the collectors to look for frogs further from their houses, to spend more time collecting, or to use more collectors to fulfil their deliveries to the markets. Over harvesting has reportedly reduced the average size of *Hoplobatrachus* as the larger individuals are picked off. It is likely that froglets born in the onset of the wet season in May are rarely able to escape the collectors at the end of the wet season in October or November. As such, not many frogs make it to their second year of growth and most *Fejervarya* and *Hoplobatrachus* are caught before reaching breeding ages. Fortunately, the burrowing behaviour of *Glyphoglossus molossus* helps it to escape heavy hunting throughout the year.

As frog meat is one of the main protein sources for local communities in the rural areas, and frogs are recognised as essential components of the agricultural systems used in Cambodia, GVTC and CEDAC advise communities to establish small scale frog farms as an alternative to collecting wild frogs. The frog farms pay US$14 for 200 froglets, which can be sold after 5-6 months. However, feeding costs and mortality mean that the schemes are hardly profitable in direct monetary terms (Tyler et al., 2006).

Reports from GTVC suggested that frogs used in Cambodian farms were introduced from Canada, Thailand and Malaysia, without knowledge as to what species were being used. Escaping non-native frogs could prove disastrous for native species (Carpenter et al., 2007; Kats and Ferrer, 2003; Lannoo et al., 1994). In Thailand the American bullfrog *Rana catesbeiana* is a species popularly farmed (Wai-Neng Lau et al., 1999), a species which has proved problematic as an exotic species in other countries. A further threat associated with importing frogs is the introduction of disease to local populations (Carpenter et al., 2007, Shlaepfer et al., 2005). Of particular concern at the moment is Chytridiomycosis or chytrid fungus, a recently discovered disease that has precipitated a decline in many amphibian species of the world. James P. Gaertner, a Ph. D candidate from Texas State University, has recently taken samples from Amphibians occurring in lowland areas near human habitations in Kien Svay, Kandal province, Kbal Spean in Siem Reap, and from *Hoplobatrachus* in Chaba Ampov market in order to test for chytrid fungus. Preliminary results showed that 25% of frogs from Kien Svay, 35% of frogs from Kbal Spean and 75% of frogs from the market have been infected by chytrid fungus; while chytrid infections were not found in Thailand (McLeod et al., 2008) and the Hong Kong (Rowley et al., 2007). However, Gaertner added that there was no clinical sign of sickness to the frogs. So, Cambodian amphibians may have been infected for sometime already and can exist with chytrid without adverse effect (Hopkins, 2007).

4. Conclusion

Traditional collection of frogs for local consumption and trading on a small scale basis seems to be relatively harmless for the commoner species. Declines have been noticed, but at present do not seem drastic. However, the growing demand in frog volume from the Phnom Penh's markets, and an increase in export trade, may change this. Reported frog decline in some localities may be driven by a combination of factors. These include: pesticide use, habitat loss, and over harvesting for consumption and trade. Data suggested two species potentially face a threat from the trade: *Hoplobatrachus* as a large valuable frog remains the species most likely to decline due to over-collection. This species is also the one favoured for frog farming, and is potentially the easiest and most profitable species to farm; while *Glyphoglossus*, because of its restricted range and explosive breeding strategy, is vulnerable.

A frog farming strategy seems the most logical initiative to both help maintain market needs and relieve the stress of over-collecting of wild frogs, particularly *Hoplobatrachus*. Frog farms may also pose adverse threats: the introduction of exotic species or disease. To date no non-native species have been found in Cambodian frog farms, but the threat remains and requires careful monitoring.

As chytrid has been discovered in Cambodian frogs without so far causing the levels of destruction seen in more temperate countries, this is less of a concern at present. This situation also requires careful monitoring, both within native populations, and those that are imported for farming.

5. Recommendations

1. All frog export or import for commercial purpose must have permits or certificates given by privileged authorized Fishery Administration of Ministry of Agriculture, Forestry and Fishery.

2. Authorized officials at all border checkpoints should check following the regulations of Fishery Administration for permits or certificates of the volume exported and imported. Failure to have valid permits results in confiscations and fines.

3. To avoid introducing potentially harmful exotic species, and to limit the possibility of spreading chytrid fungus, the import of non-native frog species for the purpose of stocking frog farms must be banned.

4. Following on from point 3: further study on which frog species are used in Cambodian frog farms should be undertaken to identify any potential problems before they occur.

5. All frog middlemen/women around the country should be registered by Fishery Administration.

6. All frog middlemen/women should be advised not to buy undersized rugulose frogs for trade to avoid future decline of the species from over-harvesting in the wild. Existing law enforcement teams from Fishery Administration should follow this up.

7. An educational programme for rural farmers outlining the benefits to agricultural productivity of maintaining a healthy frog population, and showing the negatives affects associated with the overexploitated of frogs .

8. As an adjunct to the above: A programme highlighting the beneficial effects on the careful use of pesticides to avoid frog and other crop pest predator mortality.

9. Further targeted studies need to be taken concerning harvesting and exportation of *Glyphoglossus molossus* from Cambodia.

References

Allen, D., Darwall, W. Dubois, M., Kimsreng, K., Lopez, A., McIvor, A., Springate- Baginski, O., and Try, T. (2008) Integrating people into conservation planning: An integrated assessment of the biodiversity, livelihood and economic implications of the proposed special management zones in the Stung Treng Ramsar Site, Cambodia. IUCN Cambodia Country Office, Phnom Penh.

Attenborough, S. D. (2008). Amphibian Ark 2008 YEAR OF THE FROG. Teach The Amphibian Crisis!

Carey, C., Bryant, C. J. (1995) Possible Interrelations among Environmental Toxicants, Amphibians Development, a Decline of Amphibian Populations. Environ Health Perspect 103(Suppl 4):13-17

Carpenter, A. I., H. Dublin,M. Lau,G. Syed, J. E.McKay, and R.D.Moore. (2007) Overharvesting. Amphibian conservation action plan. International Union for Conservation of Nature, p: 26–31.

Christina Hanson and Brend L. Brock (eds) (2007) The Amphibian Steward Network: Procedures and Guidelines V1.0. Tree Walkers International, p: 1-63

Davidson, C. (2004) Decline downwind: amphibian population decline in California and historical pesticide use. Ecological Application, 14: (6), pp.1892-1902.

Farmer finds fortune in frogs. http://vietnamnews.vnagency.com.vn/showarticle.php?num=01AGR160208 (accessed on 14 October 2009)

Food and Agricultural Organization of the United Nations helping to build a world without hunger. Fisheries and Aquaculture Department: www.fao.org › FAO Home › Fisheries & Aquaculture

Frost, Darrel R. (2009). Amphibian Species of the World: an Online Reference. Version 5.3 (12 February, 2009). Electronic Database accessible at http://research.am nh.org/herpetology/amphibia/ American Museum of Natural History, New York, USA.

Fugler, C., M. (1985). A Proposed Management Programme for the Indian Bullfrog, *Rana tigrina*, in Bangladesh, Comments Pertaining to its Intensive Cultivation with Observations on the Status of the Exploited Chelonians. Report for Fisheries Resource Survey System, Bangladesh.

Grismer, L., Neang, T., Chav, T. & Holden, J. (2007) A new species of *Chiromantis* Peters 1854 (Anura: Rhacophoridae) from Phnom Samkos in the Northwestern Cardamom Mountains, Cambodia, *Herpetologica* 63: 392-400.

Grismer, L. L., Chav, T., Neang, T., P. L. Wood, Jr., J. L. Grismer, T. M. Youmans,
A. Ponce, J. C. Daltry, & H. Kaiser. (2007) The herpetofauna of the Phnom Aural Wildlife Sanctuary and checklist of the herpetofauna of the Cardamom Mountains, Cambodia. *Hamadryad*, 31, 216.241.

Grismer , L., Neang, T., Chav, T., Wood, P.L Jr., Oaks, J.R., Holden, J., Grismer, J., Stutz, T.R., Youmans, T.M. (2008). Additional Amphibian and Reptiles from the Phnom Samkos Wildlife Sanctuary in Northwestern Cardamom Mountains, Cambodia, with comments on their taxonomy and the discoveries of three new species. *The Raffles Bulletin of Zoology* 56: 161-1

Hopkins, W. A. (2007) Amphibians as Models for Studying Environmental Change. Volume 48, Number 3: 270-277.

IUCN. (2010) IUCN *Redlist of Threatened Species*. IUCN Gland, Switzerland. {http://redlist.org}

Jennings, M. R., and M. P. Hayes. (1985) Pre-1900 overharvest of California red-legged frogs (*Rana aurora draytonii*): The inducement for bullfrog (*Rana catesbeiana*) introduction. *Herpetologica* 41:94-103.

Kats, L. B. and Ferrer R. P. (2003) Alien predators and amphibian declines: review of two decades of science and the transition to conservation, 9: 99-110.

Kusrini M.D., and Alford, R.A. (2006) Indonesia's Export of Frog's Legs. *Traffic Bulletin* 21: 13-24.

Lannoo, M. J., Lang, K., Waltz, T. and Phillips, G. S., (1994) An Altered Amphibian Assemblage: Dickinson County, Lowa, 70 years after frank Blanchard's survey. *American Midland Naturalist*, 131: 311-319.

Martin, A. S., Craig, H., and C. Kenneth D JR (2005) Challenges in Evaluating the Impact of the Trade in Amphibians and Reptiles on Wild Populations. Bioscience, 55: 256-264

McLeod, D. S., Sheridan, J. A., Jiraungkoorskul, W. & Khonsue, W. (2008) A Survey for Chytrid Fungus in Thai Amphibians. *The Raffles Bulletin of Zoology*, 56:199-204.

Ohler, A., S. R., Swan, and J. C., Daltry, (2002) A Recent Survey of the Amphibian Fauna of the Cardamom Mountains, Southwest Cambodia with Description of Three New Species. *The Raffles Bulletin of Zoology* 50: 465-481

Pough, F. H, Andrews, R. M., Cadle, J. E., Crum, M. L., Avitzky, A. H. and K. D. Wells, (1998) *Herpetology.* Prentice- Hall, Englewood Cliffs, NJ.

Rowley, J., Brown, R., Raoul, B., Kursrini, M., Inger, R., Stuart, B., Wogan, G., Neang T., Chanard, T., Cao T. T., Diesmos, A., Iskandar, D. T., Lau, M.,Tzi Ming, L., Makchai, S., Nguyen, Q. T. & Phimmachak, S., (2009) Impending Conservation Crisis for Southeast Asian Amphibians. Biol. Lett. published on line 9 December 2009, 1-3, (doi: 10.1098/rsbl.2009.0793)

Rowley, J. J. L., Chan, S. K. F., Tang, W. S., Speare, R., Skerratt, L. F., Alford, R. A.,Cheung, K. S., Ho, C. Y. & Campbell, R. (2007) Survey for the amphibian chytrid *Batrachochytrium dendrobatidis* in Hong Kong in native amphibians and in the international amphibian trade. Dis. Aquat. Organ. 78, 87–95. (doi:10.3354/dao01861).

Stephanie, S. (2009) Frog leg trade sending amphibians extinct. http://www.cosmosmagazine.com/news/2490/frog-leg-trade-sending-amphibians-extinction (Accessed 08 December 2009).

Stuart, B. L. and D. A. Emmett. (2006). A collection of amphibians and reptiles from the Elephant and Cardamom Mountains, south western Cambodia. *Fieldiana Zoology* (New series) 109:1–27.

Stuart, B. L., K. Sok, and Neang, T., (2006) A collection of the amphibians and reptiles from hilly eastern Cambodia. *The Raffles Bulletin of Zoology* 54:129-155.

Stuart, S.N., Chanson, J. S., Cox, N. A., Young, B. E., Rodrigues, A. S. L., Fischman, D. L., Waller, R. W. (2004) Status and trends of amphibian declines and extinctions worldwide. Science 306:1783-1786. doi:10.1126/science.1103538.

Thuok, N., Nam, S. and Sereyvath, S.T. (2001) Cambodia's Fish Processing and Marketing and Distribution of Fish and Fishery Products, focusing on Market Opportunities and Export Potentials by Nao Thuok, So Nam and Thor Sen Sereyvath. ??????

Tithara, M. (2002) Kang Keb Baob-Delicious stuffed frogs. Volume 2 No. 12 http://www.leisurecambodia.com/Leisure_Cambodia/No.19/Kkang%20Kep%20Baob.html,[accessed 2 January 2010].

Tyler, M.J., Wassersug, R., and Smith, B., (2006) How frogs and humans interact: Influences beyond habitat destruction, epidemics and global warming. *Applied Herpetology* 4: 1-18

Wai-Neng Lau, M., G. Ades, N. Goodyer, and F.-s. Zou, 1999. Wildlife Trade in Southern China including Hong Kong and Macau. The Biodiversity Working Group: China Council for International Cooperation on Environment and Development, Beijing.

Warkentin, I. G, Bickford, D., Sodhi, N.S., Bradshaw, C.J.A., 2009). Eating Frogs to Extinction. Conservation Biology,1-4,Dol:10.1111/j.1523-1739.2008.01165x.

Appendix I: Standard questionnaire for field surveys

Questions:

- Which species are collected for local consumption in general?
- Which species are collected for the local market & cost per kg?
- Which species are collected for trade and where they are exported & cost per kg?
- Which species are most abundant in the area?
- When did the frog trade begin in this area?
- Has frog consumption increased or decreased in the area?
- Why only a specific species are exported?
- Why not all species?
- Are frog collected all year round, or only during the breeding season?
- Who are the middlemen?
- Approximately how many kgs of frogs are exported each year?
- Where are these species collected: in the village, rice field, ponds, streams, in the forest,?
- What methods and tools do people use to collect frogs?
- How important is frog collecting to local livelihoods?
- What is the status of each species collected today compared to 3 years, 5 &10 years ago in terms of: 1. abundance; 2. size of frogs; 3. localities from which frogs are collected?
- Has there been a change in the species collected?
- What size of most frogs collected in the past 5 years and the sized of frogs collected now?
- If the population declines what is done to sustain it, if anything?
- Does any frog farming exist in the area? Describe the method of farming, where are froglets obtained, what food, timespan to reach the saleable size, markets, and consumers? and income generation.
- What are the main threats to frogs in the area? Habitat loss, overharvesting and others?
- What will you do if you can't catch them in the near future?
- What do you have for food if all frogs are gone?

Night survey with locals will be carried out to check the diversity of species collected. Photographs will be made as many as possible.

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ANGKOR CENTRE FOR
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The Angkor Centre for Conservation of Biodiversity (ACCB) is a nature conservation centre, established in 2003 and located at Kbal Spean in the Phnom Kulen National Park, 40 km north of Siem Reap. The ACCB is a collaborative project of the Münster Zoo and the Zoologische Gesellschaft für Arten- und Populationsschutz (ZGAP), both based in Germany. ACCB's aim is to contribute to the conservation of biodiversity in Cambodia, through activities in the following fields:

- Rescue, rehabilitation and release of native Cambodian wildlife
- Conservation breeding of selected globally threatened species
- Environmental education, awareness raising and capacity building for conservation
- In-situ conservation and research

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