

# Livelihood Situation of Water Snake Hunter and Conservation Option of Water Snake In Tonle Sap Lake, Cambodia

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**ABSTRACT.-** *As fish is in the declining state, many poor fishermen have turned to depend on other resources that they can have better benefit such as snake hunting. Harvesting of water snake in the Tonle Sap Lake was subject to uncontrolled exploitation. The minister for Agriculture, Forestry and Fisheries, Cambodia has expressed concern about the sustainability of hunting operations to formulate appropriate conservation measures. The aim of paper was to seek management and conservation options and to analyze livelihood of snake hunter. Interviews were conducted at five provinces around Tonle Sap Lake of Cambodia. Seven species of water snake were harvested around the Tonle Sap Lake and snake hunters are dependent on the sources and fish for their subsistence. *E. Enhydris* was more abundant while (*E. bocourti*) and (*H. buccata*) were rare species. Demanded from crocodile farms and meat processes including international live snake and skin trading making increased snake hunter to catch fish and water snake. The high price snake hunters were the main hunter aimed to catch Bocourt's Water Snake (*E. bocourti*) and Puff-faced Water Snake (*H. buccata*) while gill net for hunting technique were processed to catch snakes. Water snakes are vulnerable by gill net. We estimated all snake hunter did not have land for rice cultivation driving snake hunter needed to harvest snake and fish around year. The hunting operations were overlaps with the snake breeding season throughout the year for food of farmed crocodile and human are likely the main threat of wild snake population. However, the International live and skin snake trading were damaging wild population of (*E. bocourti*), (*H. buccata*) and other important snake in the Tonle Sap. The live Bocourt's Water Snake (*E. bocourti*) are reported trading across Vietnam toward China and the death Bocourt's Water Snake sold for local food. In the breeding season, 65% of stakeholders expressed they can stop hunting and trading in order to protect this species and 35% stakeholders noted can't stop hunting and trading snake in the breeding season. Promoting spiritual of snake conservation for local fisheries community to protect flood forest, grassland and conservation zone is essential management mechanism. The fundamental research to formulate long term conservation should be conducted on fishing give birth behaviors, trade and catch monitoring around the Tonle Sap Lake. Documentation of snake biology and threat to raise education awareness and further research to review to protect threat species by national law for managing export and trade in Cambodia are the alternative management dynamic to conserve wild snake population.*

**KEY WORDS:** Water Snake Trading, Crocodile Food, Water Snake Hunter, Conservation in Tonle Sap Lake.

## Introduction

The harvest of aquatic resource is estimated to supply for livelihood and market demand for local and international trading. Market dynamic is likely driving extremely exploitation of any wild fauna and flora throughout the world. To date, around 8000 reptile species have been described, however only a portion of these are regulated in national and international trade: for example, approximately 500 reptile species are listed in one of the three Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (hereafter CITES) that regulates international trade in around 30 000 animal and plant species (Auliya, 1990). Overall, 60% of the 50 most expensive reptile species observed at fairs in 1998 consisted of snake species (Boidae, Colubridae and Viperidae), all listed in CITES Appendix I or II (Auliya, 1990). In addition, several countries protect native reptile species from exploitation through harvest and trade restrictions.

Tonle Sap Lake system is the highly productive wetland ecosystem that supports one of the largest freshwater fisheries in the world. The fishermen living around this system depend on nature resource; fish, bird, snake and any reptile for daily life. Fishing is the major activities for people living at the floating village around the lake. As fish is in the declining state, many poor fishermen have turned to depend on other resources that they can have better benefit such as snake hunting. Many reptiles species are exploited from this terrestrial.

Current estimates suggest that around 6.9 million snakes (777 tones) from eight species are being removed from Tonle Sap Lake each years, although the total number caught is likely to be much higher and snake catches have decline by 74-84% between 2004 and 2005 raising strong concerns about its sustainability of hunting operations according to Brooks et al. (2006). And the harvest of this species is predicted to serve for crocodile farm, international live snake skin trading. Of the particular conservation concern is the heavy exploitation for crocodile and human food of the Tonle Sap Water Snake may be unsustainable, and management measures may be necessary to reduce exploitation to within sustainable level (Stuart et al. 2000). Whilst Brookes et al (2006) provided information on the trade, catch effort and population status of these resources, information to guide management is lacking particularly with respect to the implications of management interventions on the livelihoods of dependent stakeholders. Therefore, management and conservation measures are required to sustain these resources. There are species of water snake living in the Tonle Sap subject to uncontrolled exploitation. The minister for Agriculture, Forestry and Fisheries, Cambodia has expressed concern about the sustainability of hunting operations and has requested scientific guidance to formulate and implement appropriate management and conservation measures. There is also a need to identify with stakeholders effective management mechanisms. This consultation will seek the views of important stakeholders including snake hunters, traders, middlemen, fisheries manager, and fisher communities. Fisheries Administration's new analytical fact of livelihood of snake hunter and finding management and conservation option of *Tonle Sap Lake Water Snake* on exploitation of water snake examines Tonle Sap Lake water snake species for which market dynamics are likely to drive, or have already driven.

## **Objective of study**

This pilot project is to improve the FiA's knowledge of the socio-economic dependence of key stakeholders on the snake resources of the Tonle Sap Lake. The project will also seek the advice of these stakeholders to identify effective management mechanisms to sustain these resources.

It was presented benefit generated from catch, major markets for water snake, and major ports of landing. Each also describes the status of the species, the level of local knowledge and scientific regarding this status, of the history of management of the water snake species, and the status of trading.

## **Methodology**

### **Location**

Interviews and questionnaire were conducted at five province around Tonle Sap Lake of Cambodia namely Siem Reap, Kampong Chnang, Battam Bong, Kampong Thom and Pursat province. There are five stakeholder involved with our study; Water Snake Hunter, Middlemen, Trader, Fishermen and Fisheries Staff. This study selected landing sites at specific trade of water snake where middlemen taking both water snake and fish at the fish stores. In Kampong Chanang province interviewing were conducted at riverbank of fish store (landing site) nearby the Phsakrom Market where provincial trader and middlemen were interviewed. For hunting site of Kampong Chnang, we have interviewed with water snake hunters and fishermen communities at Braly Meas village and Kramal village, Bralay Meas commune, Kampong Leng District. In Siem Reap province, interviewing was conducted with provincial traders, fisheries communities and middlemen at the landings site in Chong Kneas areas, Chonkneas Commune, Siem Reap District. In Battam Bong province, we visited and interviewed middlemen, hunters and fisheries communities at Prek Toal area, Koh Chiviang Commune, Ek Phnom District. In Pursat Province, interview conducted with traders at the landing site in Kampong Loung village, Kampong Pour Commune, Krokor District, and middlemen, snake hunters and fishermen communities were interviewed at Along Riang village, Kampong Pour Commune, Kror Kor District. The stakeholders were interviewed from 4-7 January 2008 in Kampong Chanang Province, from 15-24 January in Siem Reap Province, from 29 January to 9 February in Battambang Province, from 12-23 January in Pursat Province and from 24 February to 5 March, 2008 in Kampong Thom province.

### **Questionnaires and observation**

The interviews were informal, structured and semi-structured. The questionnaires were aimed to collect data on their demographic information, socio-economic of the households and the perception about the implication of the management of water snake to achieve to above objective. In addition, the traders and middlemen were asked about the market rout of water snake, where existed water snake trading in the community, provincial and international. The informal interviews were aimed to generate information from water snake processor, skin processor, high price water snake hunters and reptile traders.

## Results

### Demographic Information

There were in the total 256 people from the stakeholders involved with our study and included 7 person of high price water snake hunter; 78 water snake hunter Male 86% (M) and Female 14% (F) at four province was excepted Siem Reap province which hunters wasn't interviewed, 42 fisheries officer 98% (M) and 2% (F) , 97 fishermen community 74% (M) and 26% (F), 20 trader 60% (M) and 40% (F) and 19 middlemen 68% (M) and 32% (F). The stakeholder 30% was water snake hunters, 39% fishermen communities, 16% fisheries officer, 8% traders and 7% middlemen. The age ranged in water snake hunter from 18-51 years, trader from 25-50 years, fishermen communities from 25-60 years, middlemen from 30-45 years and fisheries officer from 26-58 years. The author found 17% of water snake hunters were Vietnamese and 83% were Cambodians, interviewing at the period of this study. The mostly of water snake hunter were Buddhism and only one was Christian living in Pursat province. There were 4 water snake hunters who had born the different area of their present living village. The one hundred percent of water snake hunter have house which ranged from floating house to standing house, but all water snake hunters did not have farm for crop plantation or rice cultivation to earn income. While 35% of trader and 5% of middlemen have land, the maximum land size was 5h (traders in Siem Reap) and minimum was 0.5h. One of middlemen, two of traders and two of fishermen community were Vietnamese.

### Cause for snake hunting around the Tole Sap Lake

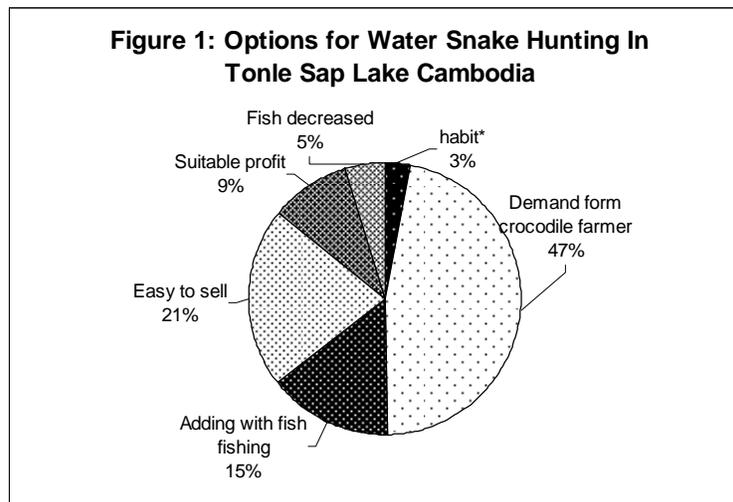


Figure 1. Option percentage of snake hunter for snake hunting in the Tonle Sap Lake, 47% hunter expressed demand from crocodile farmers, 15% adding with fish fishing, 21% easy to sell, 9% suitable profit, 5% Fish decreased. The lowest percentage was habit 3%. Demanding from crocodile farm making market for water snake is opened largely and value snake are increased. However hunters reported snake is easy to sell, earn suitable profit, adding with fish fishing and fish decreased driving this exploitation are rapid increased.

### Date of snake hunters started to harvest snake around the Tonle Sap Lake

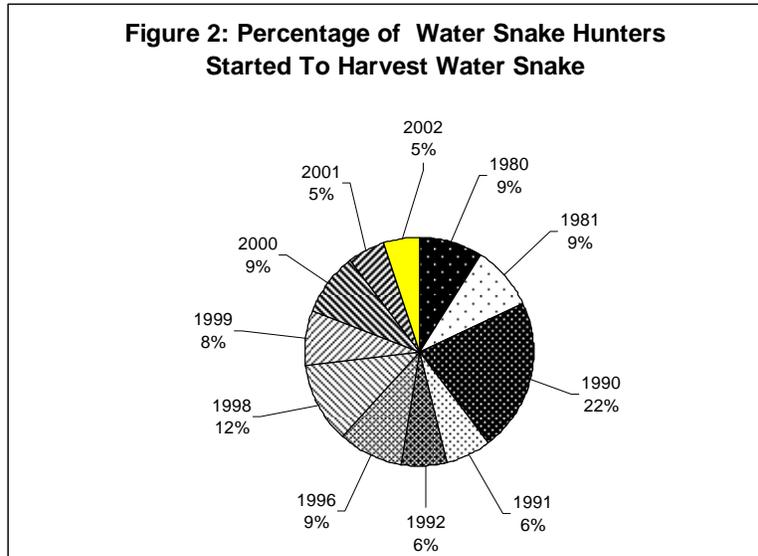


Figure 2. Percentage of hunter stated to harvest snake based on their experience, among total hunters there were 22% of hunter started to hunt water snake since 1990 and 9% since 1980. Although water snakes are harvested over the long time before Pol Pot regime for human food and skin demand based on interviewing. The variations of years in this figure are depended on the experience and age of hunters.

## Social Economic of Snake Hunter

### Occupation Ranking of Snake Hunter

Historically the water snake hunters living around the Tonle Sap Lake of Cambodia generate the income with the fishing, other aquatics species as well as wild life species to support their living. Fishing is the major activities for their daily activities based on interviews 100% of water snake hunter noted that it is the main occupation to support their daily family for food and save the daily income to buy rice and spice and to support their children to study at their community. Because of they did not have the land for farming since the past included their grandparent while the monkey trapping, turtle hunting, bird hunting, otter hunting were the additional activities to earn money during they waited to collect fish. Although, these activities are likely decrease extremely because of over exploitation of wild animal, and snake hunters tried to keep this information. It was notable the additional legal occupation of water snake hunter which based on interviewing; fish culture, snake process and head of villager. In the total, there were fish cultures 53%, snake process 44 % (Pursat) and 3% head of villager (Fig.3). The water snake hunter have additional occupation with fish culture ranked the first occupation was fishing and the second was fish culture and third was water snake hunting. The study revealed the water snake hunter didn't practice fish culture ranked fishing was the major activities and snake hunting as the second occupation. However snake hunter and communities reported snake hunter who actor in applying gill net at the grassy or flood forest where more abundance of water snake population and small fish waited to catch prey. In Pursat Province, most of water snake hunters were processor. They have processed snake meat into meat dried and brought snake dried to Krakor Market or sometime they waited middlemen to collect in the village.

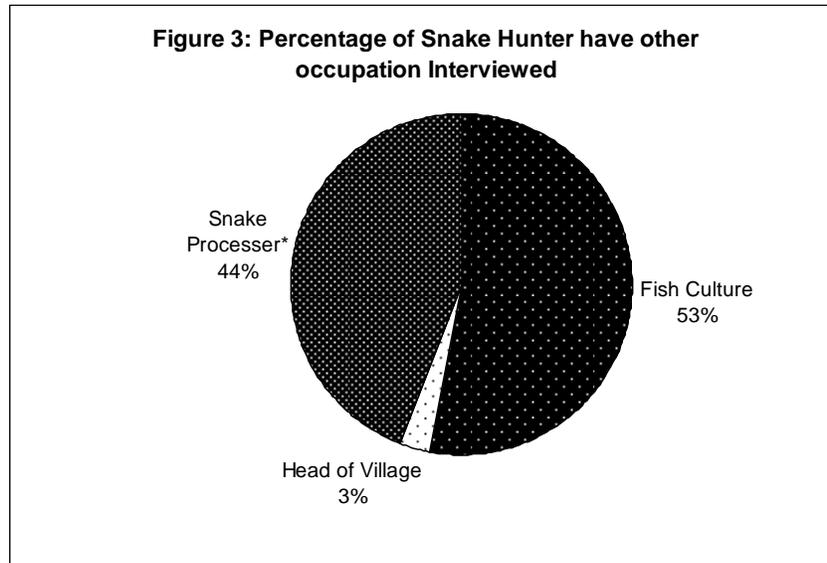


Figure 3. The percentage of the additional occupation of water snake hunters based interviewing; snake hunters have additional occupation with fish culture 53%, snake processor 44% (for hunters at case in Pursat Province) and head of village 3%. All hunter defined fishing is the first occupation, but mixed-water snake were caught by their gill net.

## Catch per hunting family

The quantity was included seven species of water snake living in Tonle Sap Lake of Cambodia; Frog Eating Water Snake (*Xenochrophis piscator*), Puff-faced Water Snake (*Homalopsis buccata*), Rainbow Water Snake (*Enhydris enhydris*), Bocourt's Water Snake (*Enhydris bocourti*), Tonle Sap Water Snake (*Enhydris longicauda*), Tentacled snake (*Erpeton tentaculum*), and Plumbea Water Snake (*Enhydris plumbea*). During observation, we did not see Redtailed pipe snake (*Cylindrophis ruffe*).

The highest percentage of catch for hunters caught snake was 4-5 kg/day (36%) and lowest percentage of snake hunters was 15-20 kg/day (12%) (Figure. 4). Large quantity mostly caught by hunter has long gill net. These quantities were not including the catch by Bor gears. The fishermen reported the maximum catch of live water snake by Bor gear was 50-60 kg per day and the minimum was 5-7 kg per day. The catch of Bor was variety depend on fishing site where the grassy and associated with the edge of forest are likely level of catch to be high.

The catch of Puff-faced water snake, Bocourt's Water Snake and Puff-faced were likely lowest than other species. According to experience of snake hunters, Puff-faced water snakes are caught to supply for skin processing to export to Thailand and live snake exporting to Vietnam toward China. The much attentions of snake hunter were to catch Bocourt's Water Snake and Puff-faced Water Snake and the gill net use to catch this snake It is possible to catch other high price snake. The middlemen collected from the local community to transport to Trader to trade in China and Vietnam as human food and traditional medicine. This activities was likely extremely threat for the population of this species. The international trading was the main factor driving the Bocourt's Water Snake to be high price water snake. The small Bocourt's Water Snake were caught by gill net 2-3cm- mostly died with other water sake species. The number of this species was

decreasing every year while snake hunters reported that live adults were caught by gill net 3.50-5cm, bamboo trap and Bor gear.

The peak period was variety. The snake hunter noted the peak period mostly during July to August and mid November to December. At the peak period, snakes were caught up to 60 kg per hunter (12%) and snake hunter 25% caught 13-15 kg per day (Figure. 5). This quantity, however, were closed with gill net long and new gill net as well as time spending to find good site to set up gill net in grassland and flood forest.

In Kampong Chnang Port, during December 2007, we found one died Puff-faced water snake among five species of water snake were traded amount 2.50 tone for crocodile farm by provincial trader.

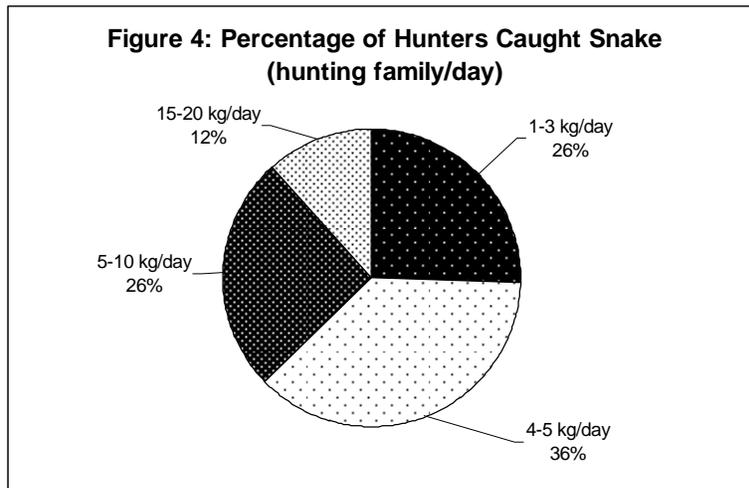


Figure 4. The maximum catch of water snake for a hunting family (12%) was 15-20 kg/day that is the large quantities and the minimum at least 1-3 kg/day. There were highest percentages (36%) of water snake hunters caught snake range from 4-5 kg/day. These catch information based on the snake hunters used gill net.

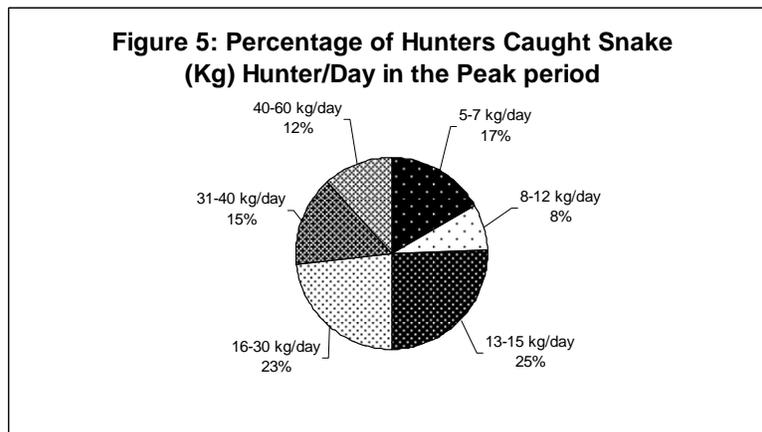


Figure 5. The percentage of water snake hunters caught snake (hunter/day) during the peak period, the highest catch quantities was 40-60 kg (12%) hunter/day, 5-7kg/day (17%), 8-12kg/day (8%), 13-15kg/day (25%), 16-30kg/day (23%), 31-40kg/day (15%) caught water snake used gill nets in the peak period.

## Fish Quantity

During hunting season, snake hunters getting two main outputs to sell and salt dried. They can collect both fish and snake. The optimal size of fish catch was 26-30 kg/day (4% hunters), but these highest fish quantities were caught for small percentage of hunters interviewed. The most of snake hunters caught fish 6-9 kg/day (36% hunter) (Figure 6). The snake hunters collected more fish are likely they have long gill net and new.

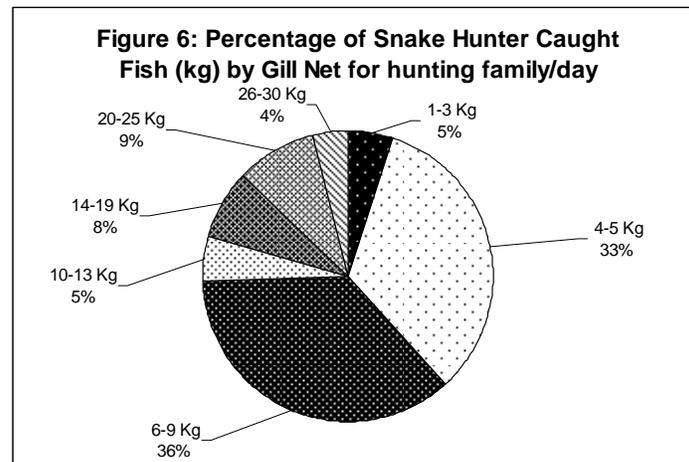


Figure 6. The percentage of hunters caught fish (kg) by gill net (hunter/day), the minimum of fish catch was 1-3 kg/day (5% hunters) and the maximum catch was 26-30 kg/day (4%). There were 36% hunter caught fish 6-9kg/day and 33 % hunter collected 4-5 kg/day. The lowest percentage 4% hunter caught fish ranged from 20-30 kg/day.

## Expenditure of Snake Hunter

In order to catch snake, hunters need to travel by boat to hunting sites. Some hunting site is far away from their villages. Some snake hunters spent time to far hunting sites. They selected hunting areas up to their experience and sometime they went the fishing site as group about 3-5 boat. Related to this activity, hunter need to expend for their daily living at those areas, the main expenditure was referred to rice, spices, medical and gasoline. Because of all hunters didn't have land for farming or rice field to harvest rice or crop to sell and getting back the money or food stock, fishing and snake hunting to be daily activities to earn money to buy rice for many poor families. The mostly of poor hunter didn't have the machines to set up their boat to travel to hunting. This condition making poor hunter carried out their activities in lowest expenditure ranged from 6000-10000 riel/day (figure 7). Hunters spending up to 2500 riel/day because of they went to far areas and try to find specific site to hunt snake by machine boat. A family up to four individuals which this number was included child and their wife traveled with. They prepared spices to cook, salt and smoke fish or snake. The average expenditure for a hunter was 15500 riel/day (table 1). Hunter in Battambang reported they smoked water snake and sell to middlemen. The snake smoked found in Thom Market of Battambang province. We noted the snake hunter in Pursat and Kampong Thom Province salted snake meat and dried. Snake dried was traded throughout Cambodia and especially in Phnom Penh for eating along with wine or beer. This notification were expressed the kinds of daily expenditure of snake hunter. However the annual expenditure related to boat repairing, rain caught, plastic and gill net.

Table 1. Daily Expenditure of Water Snake Hunter Related to Snake Hunting

Expenditure	Riel/day	USD/Day
Minimum	6000	1.50
Maximum	25000	6.25
Average	15500	3.87

Note: 1USD=4000riel

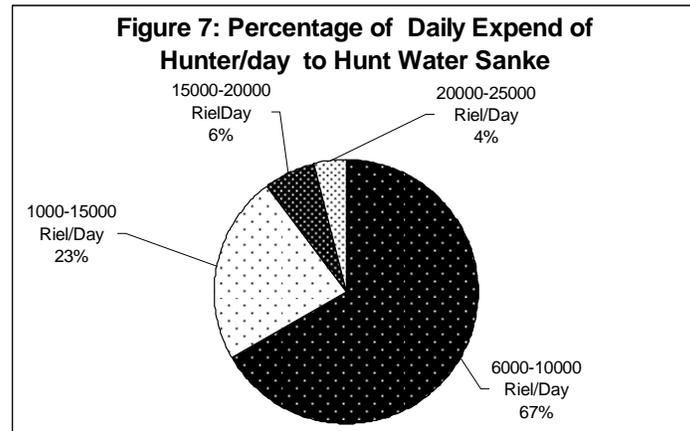


Figure 7. Percentage hunter daily expends related to snake hunting. There was snake hunter 67% spending form 6000-10000 riel/day related to snake hunting. It is the lowest expenditure for hunter did not use machine boat for driving to hunting areas. The largest expenditure was included spices, vegetable, medicine and petroleum or gasoline for diving boat to the fishing site. We calculated 4% hunter expended up to 25000 riel/day, but this was lowest percentage among total individuals spending cheap than.

## Daily Income of Water Snake Hunter

### Mixed-Water Snake Hunter

The daily income of snake hunters is received in to types from snake and fish harvesting. They sold snake and fish every day to middlemen driving boat to collect snake and fish at the hunting site and in communities. Other hand, some hunters bake to their village to bring snake and fish to sell middlemen supported the money for them to buy gill net and any daily livelihood requirement that they need in harvesting season. Hunters reported that they in debt middlemen in order to prepare gill net, repairer boat and spices as well as health care. They need to bring the snake and fish to supporter to reduce the debt. The debt was reduced through the hunting season. Money supporter bought fish and snake in the normal price or low a little bit from community price and allow hunter to keep on reducing in debt with very small value every day.

We calculated fish and snake quantities of hunter sold to reveal daily income. The maximum value of daily income for snake hunter was 35000 riel/day while the minimum was 4500 riel/day and the average value for hunter/day was 19750 riel (Table 2). The result of the exploring based on the price of snake and fish reported by hunter and the price was at the hunting site or in their villages (Table 3).

The additional value will be gained if they caught the Bocourt's Water Snake and Puff-faced water snake in the live condition and big Bocourt's Water Snake was sold ranged from 35000 riel to 50000 riel at the local community or hunting site and the weight up to 6g. Puff-faced Water Snake can be sold 6000-1000 riel/individual. Price was up to good

condition of skin and body length. Sometime hunter sold Puff-faced water snake to skin processor or sold live snake to middlemen look at wild life from hunter in the village.

Table 2. The daily income of snake hunter, in this section we calculated between the maximum price and minimum of fish and death snake with optimal catch size and lowest to find the total daily income of water snake hunter that sold snake and fish at the hunting site or communities around the Tonle Sap Lake ,Cambodia based on interviewed and observation price. We calculated only the fish and snake caught by snake hunter used gill net from 2 cm to 3cm to catch small fish and water snake.

Income	Riles /day		Total (Riel/Day)	Total (USD/Day)
	Snake	Fish	Snake and Fish	Snake and Fish
Maximum	20000	15000	35000	8.80
Minimum	3000	1500	4500	1.13
Average	11500	8250	19750	4.94

Table 3. The price of fish and death water snake and fish caught at the hunting areas or crossing communities. The price of fish and death snake were caught by gill net 2-3 cm. The price was varieties through the season. It will be decreased when the abundance of snake and fish were captured and increased when the catch effort being dropped. The price is reported by hunter and this price was at communities or hunting site.

Categories of Price	Riel /kg	
	Mix-Snake	Fish
Minimum	700	300
Maximum	1300	700
Average	1000	500

### High Price Snake Hunter

The high price snake hunters are the main hunter aim to catch Bocourt's Water Snake and Puff-faced Water Snake, python, cobra and other poisonous snake. Hunter in Trek Toil reported group of poisonous snake and python decreasingly over 6 years ago. While population of Bocourt's Water Snake were likely extremely debatable than Puff-faced Water Snake, five year ago they cough the mostly Puff-faced water snake. The optimal catch size of Bocourt's Water Snake was about 3 individuals/week and the minimum at least one individual/week. The Puff-faced Water Snake are caught about 5-6 individuals/day for the maximum catch size and lowest at least 2 individuals/day, and in the peak period about 30-60 individuals. Hunter reported peak period was mostly in August to October. In average they sold 4 individual of Puff-faced water snake per day and getting income about 32000 riel /day. And in average they sold at least 2 Bocourt's Water Snake and earned money about 85000riel/week for one hunter based on average price of Bocourt's Water snake (Table 4). The price of these snake increased every year are likely the catch effort can not supply demand both local and export. The price of Puff-faced water snake is depended on the length of snake and it categorized in three levels. First level is length up to 80 cm, second level is 7.50cm and third level is 8000 riel/kg. However Puff-faced water snake can be sold in 6000 riel/kg. Skin processor checked condition of skin before they buy and they prefer to buy live Puff-faced water snake because of the live condition is easy to process skin, pump up in air through snake mouth.

Table 4. Price categories of Puff-faced Water Snake and Bocourt's Water Snake at the hunting site or at communities, and the price of snake is variety.

Categories of Price	Riel/individual	Riel/kg
	Puff-faced Water Snake	Bocourt's Water Snake
Maximum	10000	55000
Minimum	6000	35000
Average	8000	42500

Table 5. The maximum and minimum catch of Puff-faced water snake/day and Bocourt's Water Snake/week, according to reported snake hunter.

Catch	Number/day for a hunter	Number/week
	Puff-faced water snake	Bocourt's Water Snake
Maximum	6	3
Minimum	2	1
Average	4	2

According to observation and reporting from hunters and middlemen, Bocourt's water snake is one very rare species of water snake because of International food trading and traditional medicine requirement. This snake can be traded across Vietnam toward China and Singapore. Puff-faced water snake is likely heavy exploitation for skin process in order to supply for international skin trading to Thailand. The catch of Bocourt's Water Snake decreased extremely. We found one Bocourt's Water Snake was bought by trader in Chonkneas Port in January 2008 and one in house of reptiles' trader of Prek Toil area. About 80 skin of Puff-faced water snake are stored at skin processor at Prek Toil. Skin processor reported there were six skin processors in Prek Toil and skin of Puff-faced water snake are processed from June to February every year. Processor collected alive and death Puff-faced water sake from hunters around the Prek Toil area. During the peak period about 150-250 individuals of Puff-faced water snake per day were processed by a skin processor (a household skin processor). The numbers of snake to make dry skin are based on the relationship between hunter and processor. Hunters collected the Puff-faced Water Snake are high price snake hunter. Hunters were allowed to process to hunt in the fishing lot by owner lot. Hunters/skin processor paid money from 250-300\$/hunter for one boat to hunt in fishing lot boundary. The value based on how big of process that they can apply gill net. These values are paid by processor to support hunters to get the permission form fishing lot owner. The skin processor paid this value at least six hunters to hunt these snake. Numbers of Bocourt's water snake are rare caught (Table 4). Skin processors in Prek Toil area are reptile trader. Reptile traders collected live Bocourt's Water Snake and other wildlife to sell to provincial trader in Siem Reap while they brought skin to Siem Reap province (Chong Khneas Village or Chay Kreng area). They brought about 700-800 skin of Puff-faced water snake per week to house of skin traders. Skin processor reported he process snake skin about 16 year and the number of Puff-faced water snake decreased over six year ago. Some fishermen sold Puff-faced about 5-6 individual per week. Skin processor reported Puff-faced water snake has skin thickly, big and long than other water snake. Bocourt's water snake are skinned when it died but because of it is important for human food or international trading while few skin are traded.

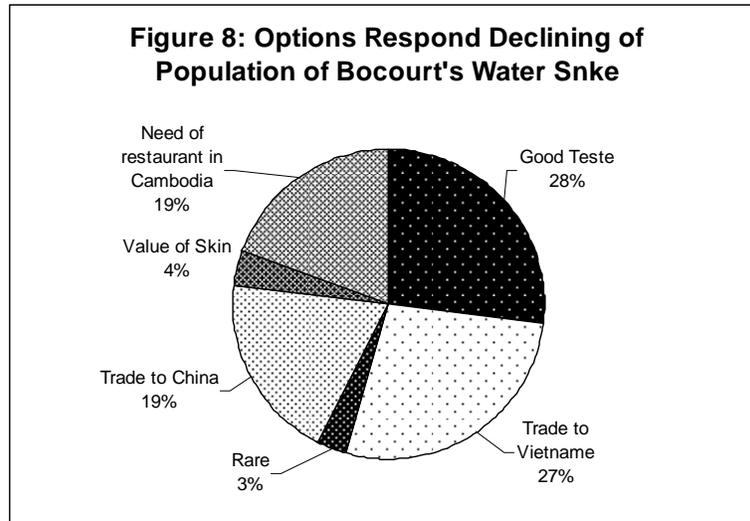


Figure 8. Option percentage of stakeholder for declining of population Bocourt's water snake, 28% option expressed because of good test, 27% trade to Vietnam, 19% trade to China, 9% need of restaurant in Cambodia and only 4% value of its skin.

## Perception for Water Snake Management and Conservation

Historically over long time of water snake hunting, fishermen reported the number of hunters were increased notable during 1997 because of the demands both human food and famed crocodile around the Tole Sap Lake. This exploitation remains from year to year. Increasing demand and declining of adult fish size engage water snake hunting agreeing with catching small fish. And this interaction driving increasing small size of gill net employed at the fishing sites. Fish and Mixed-Water Snake are caught by small gill net 2-3cm size. Most of small fish were used for aquaculture fish feed such as giant snake head, walking catfish and other culture fish were raised in the community as well as for crocodile food around Tonle Sap Lake. Hunter reported before 1980 water snake was used for human food in low demand and the market of water snake was very minor. Bocourt's Water Snake were collected for trading to Vietnam and Puff-faced water snake were skinned and sold to middlemen for international skin trade toward Thailand. While snake dried are likely processed during 1982, vendors-water snake dried in front of Royal Palace reported he sold snake dried since 1980. Demanding from crocodile farms, meat processes and livelihood development engaged increasing snake hunters using small gill net to catch fish and water snake. Livelihood development around Tonle Sap Lake was not only increased aquatic exploitation but also increased harvest the wild life resource and snake. Over long time snake exploitation without monitoring and management are likely effected snake population. Interviewing gained 97% option form stakeholders expressed water snake population was declining and 3% expressed not decline (Figure 9). There were many factors that affected declining of water snake population. Based on interviews we found factors that stakeholders noted during our study and we gained the information 25% increased hunters were the highest percent for their option for declining (Figure 10).

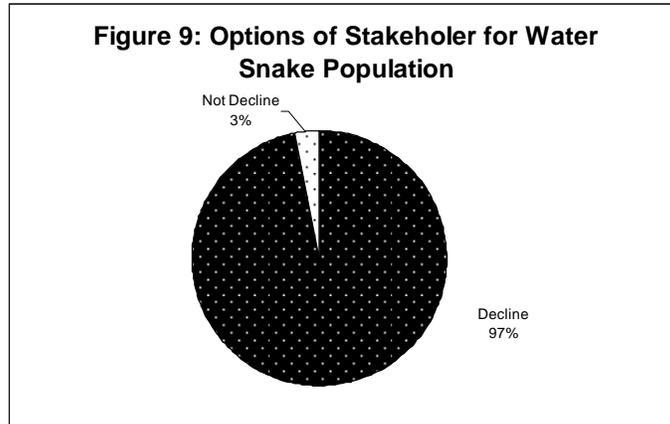


Figure 9. Option percentage of stakeholder for water snake population, we divided their answer into two sections (decline and not decline) to gain the information on declining population. Over the period of interviewing 97% stakeholder confirmed water snake population was declining and only 3% noted didn't decline.

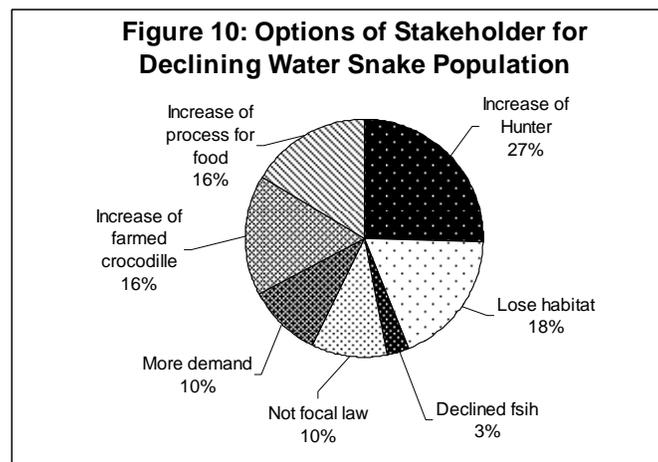


Figure 10. Option percentage of Stakeholder for water snake population declining based on interviews. Expressed increase of hunter 27%, lose habitat 18%, increase of process for food 16%, increase of farmed crocodile 16% were the high percent while lowest was declining of fish only 3%.

Declining of water snake population motivated stakeholder expressed strong concerned for management and conservation. 98% stakeholder aimed to conserve snake (Figure 11) and the ideas reflection (Figure 10). Only 2% confirmed not need to conserve snake and they reported because of snake was not necessary resource for human. For management and conservation purpose, author gained the comment form the stakeholder 98% we need the conservation of wild snake population for next generation.

However when asked them do they can stop harvesting and trading snake in the breeding season. There were 65% can spot and 35% can not stop (Figure 12). The people agreed to stop noted we need to find the real breeding season of wild snake and people need to stop in the specific time but is not for long period. However, we gained the ideas for this option (Figure 13). The people can not stop hunting and trading, because of the long period of breeding season of water snake (Figure 14). If they stop, so they can not earn money to buy rice and support their children to school and profit for their family.

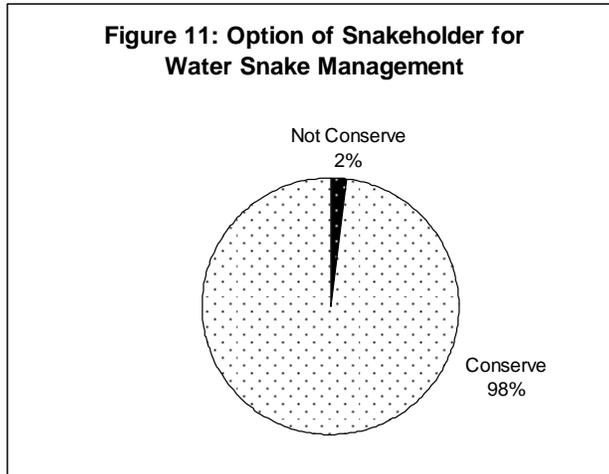


Figure 11. Option percentage of Stakeholder for conservation water snake, (98%) confirmed we need apply conservation measure while declining caused many factors especially increase hunter and lose habitat, not focal law, increase farmed crocodile, declining of fish and process for food as well as more demand. Only (2%) option noted wild population of water snake not decline because they usually know large quantities of water snake are traded every years.

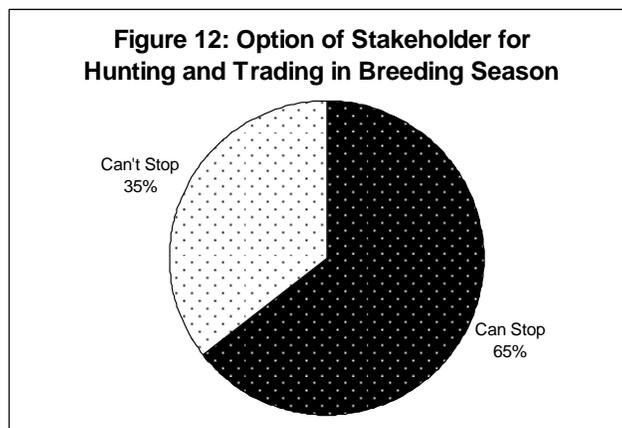


Figure 12. Option percentage of stakeholder for trading and hunting water snake in the breeding season, (65%) of stakeholder answered can stop hunting and trading in the breeding season in order to protect this species (35%) of stakeholder noted we can't stop hunting and trading snake in the breeding season.

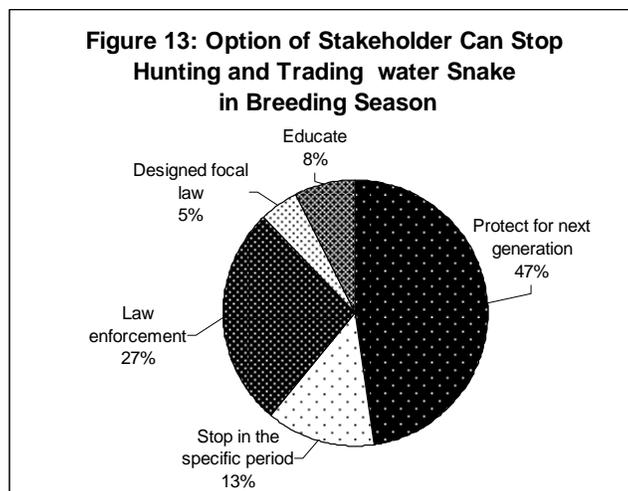


Figure 13. Relevance information of option percentage can stop hunting and trading water snake in the breeding season. The biggest option (47%) show they aimed to conserve snake for next generation. (27%) option urgently need for law enforcement to protect both trading and catch season. However (13%) of their option promoted stop trading and hunting in the specific period in the breeding season because of water snake have very long time for their breeding. (5%) is designed focal law, because of most of hunter used family fishing gear both open and closed fishing season. 3 % of their option was to educate to raise spiritual of conservation.

The breeding season was reported by hunters that it is occurs both in the wet season and dry season. It was related the closed and opened harvesting season. Water snake species are hunting and trading from June to February or March every year. The live mix snake is likely trade around the yea. Hunter in Prek Tol area reported from late February to April water snake was caught in the forest around the boundary of fishing lot. Hunter were allowed to there by agreement form lot owner which hunter need to spend money to have right to catch aquatic animal along the channels or small lake. They need to spend much more attention to catch aquatic animal up to they can to change the money spent. Live sank were caught in come out of the mud in the dry lake. Snake buried itself in the mud during dry season or floating mass of resembling solid ground. Live snake also caught by Bor fishing gear before dry lake. During this time it was open fishing season and when the wet season snakes were caught again. Catching snake under mud or floating mass of resembling solid ground was less hunters. It is very hard to stop hunting snake in the breeding season, because of very long period of breeding season. The mostly hunter reported is likely no equities for this intervention. Designation of focal law to against overexploitation around the year and law enforcement (current fisheries law) during breeding season to keep time for snake to give birth are the better way.

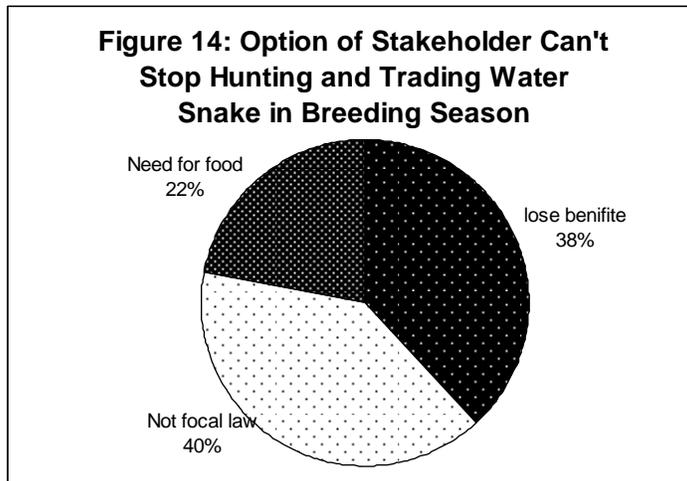


Figure 14. Option of stakeholder expressed can't stop hunting and trading in breeding season. (40%) option show not have focal law to ban hunter because of snake were caught by family fishing gear. (38%) option expressed stop hunting in the breeding season making lose benefits. (22%) confirmed they need food every day to live because hunter did not land for rice cultivation and the combination of snake and fish productive caught will be exchanged daily rice and spices which the mostly of this confirmation from hunter.

## Hunting Gears

Table 6. Fishing gear used by snake hunter around the Tonle Sap lake of Cambodia, snake mostly caught by gill net 2-3cm. Some hunter reported 2 cm size was higher capture than other size. However we not yet predict to indicate the accurate of this information while some hunter reported 2.50cm is the particular size

caught more mixed water snake. Mixed Live snake were incidental caught by Bor gear that it is new adaptation fishing gear from the bamboo trap and snake also incidental enter with bamboo trap.

Specific gear used by water snake hunter	Catch Remarks
Gill net (2 cm)	Fish and water snake
Gill net (2.50 cm)	Fish and water snake
Gill net (3 cm)	Fish and water snake
Gill net (4.50-6cm)	Fish and snakes
Bamboo trap	Many aquatic species
Bor (new fishing gear adapted from bamboo trap)	Many aquatic species

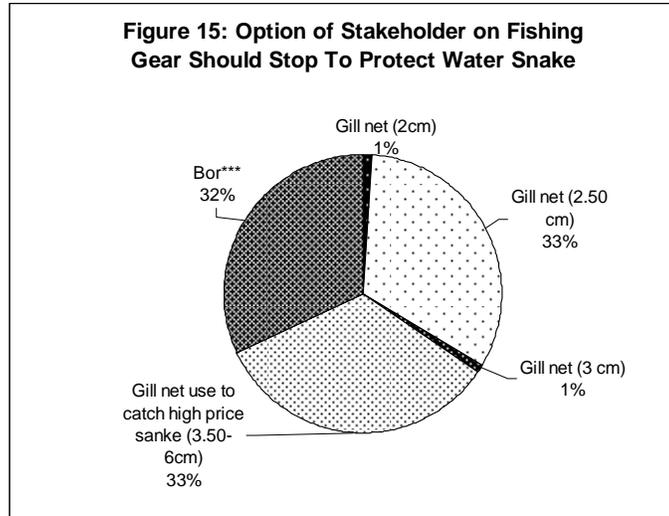


Figure 15. Option percentages of stakeholder to manage fishing gears are likely damaged water snake population. They confirmed gill net (2-3cm size) should be stop only in the specific time but the gill net of processed hunters aimed to catch high price water snake should be stopped (33% option), Bor (32% option) it is illegal fishing gear which mixed live water snake were caught. The lowest option percentage was gill net size 2 cm (1%) and 3 cm (1%).

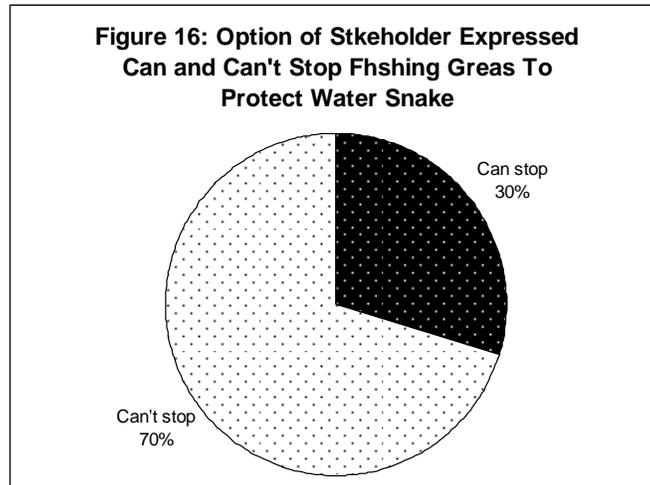


Figure 16. Option percentage of stakeholder expressed (70%) can't stop Bor fishing gear, Gill net use to catch high price water snake and other snake and gill net 2.50cm. (30%) option show that can not stop this fishing gear because of gill net are used as small-scale fishing gear and this should be allowed to apply all the time. The option show can stop unless have the equity, stop snake trading, law enforcement, create the focal law on small-scale fishing gear, and educate communities. However option stakeholder can not stop

these gears were hunter need daily foods and they did not have other occupation, applying gill net caught snake, and authorities can not monitor everywhere. Hunters reported that not go to fish or hunt no money to buy rice.

## Demand

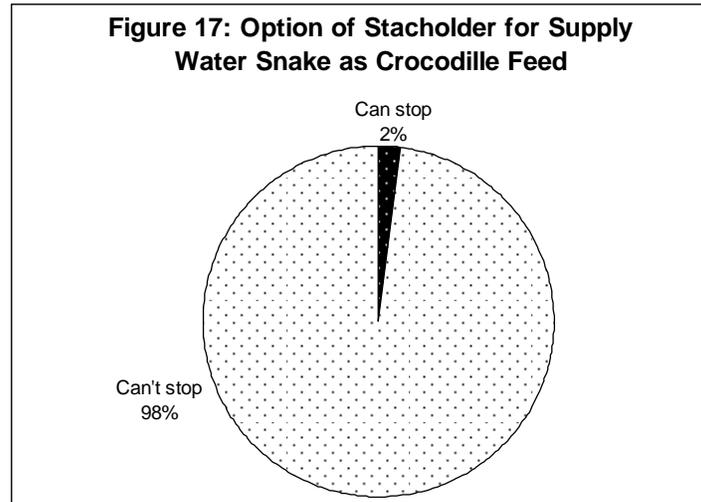


Figure 17. (98 %) option percentage of stakeholder can't not to stop providing water snake as crocodile food and only (2 %) option show can stop. Can't stop water snake trade because of we do not have law to prohibit and penalize crocodile farmer and it is freedom of trader and to trade water snake for crocodile farmer to make profit. The option can stop providing snake as crocodile food was unless create focal law, educate and law enforcement throughout county. These options reflect no focal law is the fundamental problem to protect snake population while stakeholder reported we do not have law to stop snake trading to crocodile farm. Process

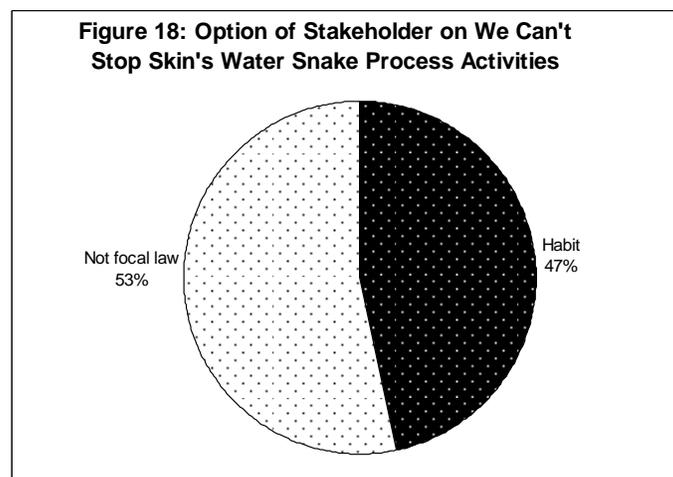


Figure 18. Option percentage of stakeholder expressed we can not stop processing skin of water snake that (53%) option were revealed not focal law to ban this activity and (47%) option expressed it is habit or occupation for skin processor.

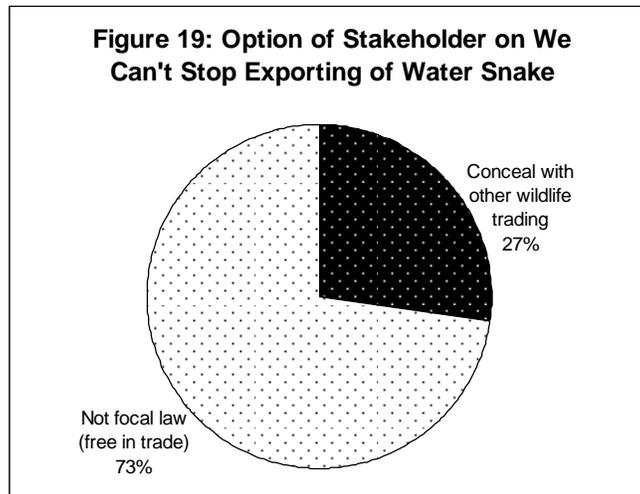


Figure 19. Percentage option of stakeholder for exporting water snake (live snake), they expressed we can not stop exporting or trading snake. The two main ideas were reported 73% option was not focal law to against exporting and 27% option was water snake exporting is concealed with other wild life trading.

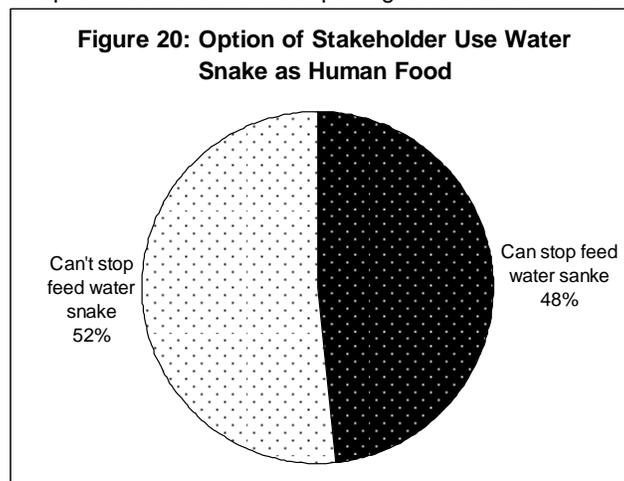


Figure 20. Option percentage 48% of stakeholder indicated we cant stop eating water snake, because of it is not necessary food. 52% option can not stop feeding water snake because of not law to prohibit and it is the habit of fishermen and communities both in the Tnle Sap Lake and other area.

## Discussion

### Livelihood

Fishing and agriculture, are the two main livelihoods for the three million people who live around the lake (FAO,1998). We found all snake hunter or fishermen living around Tole Sap Lake are depending on the fishing to support their subsistent and fish rising is the second occupation. While hunters confirmed that hunting is the second major activate after fishing for those who did not have fish to culture as additional occupation. We noted Pursat province ,in Anlong Raing village (study site), all snake hunters were the snake meat processors. Although mixed-water snake mostly caught when increasing small size of gill net and while size of adult fish had decreased. While the total fish production in the lake seems to have remained stable, evidence of over-fishing comes from a recent reduction in catch per unit effort, declining in size of commercially important species, and

even the extirpation of some species (MRC, 1999). All hunters did not have land for crop plantation or rice cultivation. Fishing will be turned snake and fish to sell to get money to buy rice and spices for their daily subsistence as well as to support their children to school. Fishermen reported water snake and fish were captured by gill net 2.50-3cm. Water Snake are used as crocodile food while crocodile farmer had believed water snake has good protein and can be maintained stomach of crocodile in longer time than fish and other hand the fish price is higher than water snake and options making more demands from many crocodiles farms around the Tonle Sap Lake. However, fishermen communities reported snake hunter that aimed to catch water snake taking time at hunting site that have more abundance of water snake at grassy, flood forest and near the floating mass of debris resembling solid ground. Fishermen reported in the past Tentacled Snake were thrown when they caught, but about more than then year this water sake are traded for crocodile and hunter gained income from water snake. In the past, the large crocodile farming industry around Tonle Sap has depended upon the productive fisheries for food supply (Stuart et al. 2000). We can only to predict that all snake hunters did not have land for farming and rice cultivation because of this study was at some areas in Tonle Sap Lake to evaluate the case study on water snake hunting to gain the general situation for urgently research and conservation activities for decision maker and to reveal strong concern of head unite of Ministry of Agriculture, Forestry and Fisheries. Fish species are raised in community are believed mostly giant snake head and catfish species. The small fish are supplied as food for those fish culture. Fisher did not have money to raise fish to save money, trying to catch fish to sell for villager are culturing fish and when they employed gill net snake were caught. Therefore fishing is very important for their subsistence while mixed-water snake were caught by gill net at the shallow water, grassy and flooded forest.

## Hunting Techniques

Research indicated mixed-water snake were caught gill get ranged size from 2 cm to 3 cm, Bor gear and bamboo trap. The snake mostly caught by gill net 2.50 cm and hunter reported the mortality rates are highly. The mixed- live snake are caught by Bor gear that is the new fishing gear adapted from bamboo trap about five years ago. However this gears are used to catch many aquatic species and sometime water birth were incidental caught. Bor is construed by net or seines are less than 2cm. The efforts to stop Bor gear are likely the main action to contribute for improve safety living of aquatic species around the Tonle Sap of Cambodia to promote the law enforcement and the large quantities of live mixed water snake traded is reduced. However, the length of small size gill net (2-3 cm) used by hunter are likely longer than quota limited in fishery law.

The gill nets 4 cm, 5 cm and 6cm are processed to catch different snake species included water snake and hunters go to hunt hide away. Authorities may not be able to monitor how long of gill net and types of gill net that hunter used at all time and everywhere. Due to the larger size at maturity of *H. buccata* and *E. bocourti*, most of the females captured using size-selective gill net techniques are immature and individuals are caught using traps and baited hood (Brooks et al. 2006). We tried to restricted about baited hooks to catch two species but was not gained the evidence to accept this information. Hunter reported snake were caught with hook in very small number and hooks may not apply aim to catch snake. Stuart et al. (2000) gained the information that large individual snake were caught by electro fishing gears. With this reason we obtained the new information that snake maybe were caught by electro fishing gear while hunter searching wild life around the forest.

The provocative in management and conservation of water snake around the Tonle Sap Lake, Cambodia are likely affected by normal gill net 2-3cm legally fishing gear and breeding season of water snake. Hunter reported the breeding season may occur two times per year while they found both in rainy and dry season. The gill net 2-3cm is employed through the year. The poor fishermen or hunter are the main actor to hunt water snake and their fishing gear is legally. The fishing gear 2-2.50cm are called snake net around the Tnle Sap Lake. Other hand, hunters pressed gill net 4 cm to 6 cm to catch high price water snake and other snake are called snake net too. Snake net for high price snake was set up around forest, grassy and floating mass of debris assembling solid ground. And net was setup to elevate up from the water surface about 15-20cm. However, how long and how many of gill net unmonitored, investigating to limit the number and long of their gill net to enforce fisheries law are likely effected subsistence of poor fishermen used gill net to catch mixed water snake. The most of poor fishermen used gill net 2 cm to 3 cm to catch both snake and fish. Using the small size perhaps the possibility of catch was higher than big size while adult commercial fish are decrease in unite effort. Using only one gill net about 50-70 meters in length may is not enough to collect fish or snake for fishermen to get money to buy rice, spices and support their children to study. Related to this condition our study found there were 23% of hunter sued gill net up to 15 pieces and 22% used 17 pieces of gill net (Figure 21). The number of gill net perhaps was not suitable with current fishery law. However the actual fishing maybe normal effort for living of fishermen, suing low number of gill net may can't supplied their subsistence. Adaptation of draft regulation to limit and define the freshwater fishing gear and small-scale fishing gears should be though this case.

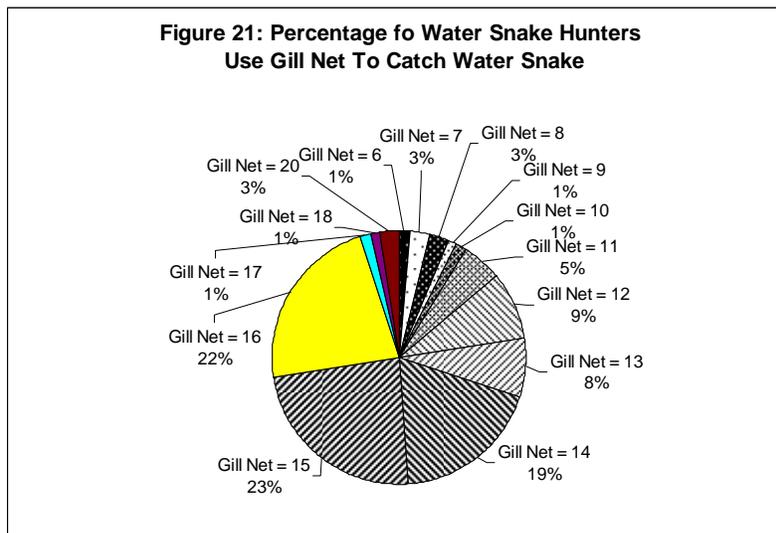


Figure 21. Percentage of hunter used gill net related to hunting water snake, maximum number of gill net and minimum. (23%) of hunter used gill net up to 15 pieces. The numbers of gill net are used range from 6-20 pieces. The maximum length was about 70-100 meters and minimum was about 50 meters.

## Breeding Season

Reproductive of fauna and flora are the main stage to produce new offspring on the planet. The morphological Constraint Hypothesis proposes that males have relatively longer tails to accommodate hemipenes and retractor muscles and female reproductive output hypothesis propose that females have relatively shorter tails as a secondary result of natural selection for increased reproductive reproduction capability (King, 1988). The degree of overlap between exploitation and reproduction provides and indication of

population vulnerability based on timing (Brooks et al. 2006). The reproductive value of an individual which is a measure of its expected contribution to the population change with age and the season (Mac Artur, 1960) and not all individuals are equally important to the growth of a population (Brooks et al., 2006). The species for which reproduction has been described are all viviparous and they are all considered mildly venomous (Minton, 1990). The homalopsines are usually associated with mud substrates, relatively small in size (most species <1 m adult size), primarily nocturnal, and live at low elevations (Voris et al., 2002). The local knowledge of hunter noted that the reproductive behaviors of water snake are occurred both the wet and dry season. While Brooks et al (2006) revealed that the proportion female breeding of seven snake in the Tonle Sap Lake are mostly in appeared both wet and dry season. And only one species *C. ruffus* (peak in July) breeding female appeared in from Late July to August. The female breeding *X. Piscator* (peak in July) and *E. tentaculatus* (peak in November) occurred from October to march, *E. enhydris* (peak in July to August) and *E. longicauda* appeared through the year. *E. bocourti* (peak late November to January) appeared breeding season from September to February and *H. buccata* appeared peak of breeding season from November to March.

Stuart et al. (2000) reported trading of Tonle Sap Water Snake that *E. jagorii*, *E. enhydris* and *E. longicauda* seen in trade of the relative abundance probably does not reflect their natural relative abundance. While Brooks's publication did not included *E. jagorii* in the trade species and female breeding season, we not found the relevant data on this species related to breeding season. We also did not note *E. jagorii* in our study. *Enhydris enhydris*, it is piscivorous, highly aquatic, reaches spectacularly dense populations (Mudphy et al. 1999), and is commercially exploited. The publication of Brooks et al (2006) suggested *E. enhydris* was the third strong concerned about exploitation and conservation while harvesting around the year and reproductive were around the year. However, publication of reproductive commented on its reproduction is largely anecdotal (Mudphy et al. 1999). The study of female reproductive in the Rainbow Water Snake was carried out in Cambodia published by Mudphy et al (1999), Thailand and Myanmar, while *E. enhydris* in Cambodia were collected the Tonle Sap Lake. However, gravid female in a sample from Cambodia larger average body size, clutch size, than do the sample from Thailand and Myanma. The maximum clutch size from the previously reported for *E. Enhydris* was 29 eggs in a female from northeast India (Biswas and Acharyo, 1977). However, Mudphy et al (2002) suggested some females may not reproduce every year, some may reproduce during one of two reproductive periods each year, or some may reproduce during both period of year. The linked suggestion of Mudphy et al (1999) exposed that it does appear females collected in early June had stage 7 embryos, and 18 of 19 gravid females collected in early August had embryos representing stages 15-35. Year-round sampling at Tonle Sap Lake is needed to confirm the reproductive cycle of Tonle Sap Water Snake to find the appropriate management mechanism. However, Brooks publication published detailed the breeding of Tonle Sap Water Sanke. They indicated female in Twante, Myanmar were gravid in December but had not yet formed embryos and none of the seven females in the sample from Myaungmya, Myanmar were gravid in January, and they suggested that this difference in either an artifact of small sample size of these two population are on very different reproductive cycle (Mudphy et al. 1999). The variation in body size, clutch size, reproductive clutch mass and reproductive timing across the geographic range of *E. enhydris* may be due to changes in local environmental conditions and food availability (Mudphy et al. 1999).

## **Habitat of Water Snake**

Homalopsines were reported are amphibious, primarily nocturnal, and usually associated with mud substrates (Karns et al. 2005). The previous publication of Heatwole et al (1999) indicated eight of the 34 species (24%) of Homalopsines are coastal marine species living in mangrove forests, tidal mudflats, near-shore coastal waters, and estuarial habitat. However, the freshwater species are found in streams, ponds, wetlands, lake and agricultural wetland (e.g., rice paddies) (Gyi, 1970).

In Cambodia the population abundance of water snake is in Tonle Sap Lake. Although, assessment of the distribution of water snake throughout Cambodia not yet conduct. Anyway, fishermen reported distributions of water snake are likely appears in many lake in Cambodia. Tonle Sap Water Snake were reported by hunter that they hidden in floating mass of debris resembling solid ground, grassy and flood forest. Stuart, et al (2000) reported *Enhydris longicauda* is found in the world only in Tonle Sap, and that the help of fisherman is needed to prevent the disappearance of the Tonle Sap Water snake while capture in alive should be release to wild. The population assessment of aquatic snake in Khorat Basin of Thailand, Karns et al (2005) did not reported name of *Enhydris longicauda* in their publication. The future investigation on distribution of water snake species in any lake in Cambodia to indicate this information, while we doubt *Enhydris longicauda* population distribution is likely not endemic only Tonle Sap. The connectivity of Tonle Sap ecosystems are likely effected the population variation of this species. The hunter reported that *Enhydris longicauda* are caught from other lake in Cambodia for human food and the harvesting also included the any water snake species, and especially *Enhydris Enhydris*. Karns et al (2005) reported the poor nutrition status and lower habitat productivity of the Khorat Basin in Thailand could influence prey availability and have important effects on top-order carnivores like snake and differences in habitat quality may also account for the coexistence of several relatively abundant homalopsine species. The topic are notable for the greater species richness of many taxonomic groups, but temperate zone semi-aquatic snake assemblage are likely called species rich and diverse (Gibbons and Dorcas, 2004)

The Tonle Sap ecosystem is likely supported the diversity of water snake species that have diversity habitat. However, perhaps different habitat qualities of other freshwater lake in Cambodia affect the population density, while little knows harvesting and trading of water snake in other lakes. We image distribution of water snake in Cambodia may appear in other freshwater lake. Reported the topography of the Khorat Basin rim and river basin drainage patterns of the region may restrict gene flowing, lead to genetic variation among populations, and ultimately, to speciation in some case (Karns et al. 2005)

## **Prey of Water Snake**

Hunters reported water snakes in Tonle Sap Lake eat small fish. They reported Frog Eating Water Snake (*Xenochrophis piscator*) eats frog and fish. The reported diets of two of other semi-aquatic snakes encountered (*Xenopeltis unicolor*) eat rodents, birds, mice, lizards and other snakes while (*Xenochrophis piscator*) are reported eat fish, frogs, and mice reflect the semi-terrestrial habit of these species (Cox et al. 1998). *Cylindrophis ruffus* is reported that eat other snakes and eels (Cox et al. 1998). Karns et al (2005) documented snake feeding by *Cylindrophis ruffus* in the study of Khorat Basin, Thailand while they indicated all the homalopsines were reported in their study eat fish, *Homalopsis buccata* and *Enhydris enhydris* eat fish and frogs and crustaceans, poorly known *Enhydris subtaeniata* eats fish and frogs. In Sabh, Malaysia, the study of

*Enhydryis plumbea*, amphibian eggs, tadpoles, or adult frogs comprised the diet of the majority of snake stomachs examined (Voris and Karns, 1996). However the further publication of Fishery Administration and Brooks, previous researcher documented trade and biology of water snake in Tonle Sap will be illustrated the food preference and biology of water snake In Tole Sap Lake, Cambodia.

## **National Law and international Treaties**

Many researchers have reported declines and overexploitation of snakes species, but it is difficult to identify the species requiring emergency concern (Zhihua and Zhigang, 2005). Increasing in harvesting throughout the Tonle Sap Lake is likely brought over-exploitation of any aquatic species. The scale of exploitation of snakes from Tonle Sap Lake Cambodia that it was the represents the largest documented snake hunting operation in the world and estimated minimum of 6.9 million snakes (777 tones) captured per year (Brooks et al. 2006). The information of highest exploitation brought the strong concerned from head unite of MAFF and FiA. The legislation of quota in hunting and trading is not yet written by the Fisheries Law of Cambodia. The national fisheries law enforces for management and conservation of fisheries resource which wrote the close and open fishing season. The close fishing season will be positive influence for aquatic species to reach habitat diversity for feeding and spawning. Water snake are harvested both close and open fishing season while most of poor fishermen use small-scale fishing gears (gill net).

Based on interviewed authors found huge declining of two species were *H. buccata* and *E. bocourti* and Brooks et al (2006) suggested (crocodile food and snake skin trade) causing the greatest declines. The quotas of live snake and skin trade of these two species are opened between national and international. As *E. bocourti* is known to occur only in northern Peninsular Malaysia, southern and south-eastern Thailand, Cambodia and southern Vietnam (Murphy and Voris, 1994). Hunters reported this species is a very rare water snake, but Brooks at al (2006) indicated the statistic of catch per unite effort *E. bocourti* was the second lowest abundance while *E. plumbea* was the first lowest of snake number of catch per 100 m<sup>2</sup> gill net per day. Awareness of the limitations of a single-species approach to fisheries management has led to global acceptance of the need to adopt a wider ecosystem approach to fisheries assessment and management (FAO, 2008).

According to Royal Sub Decree-CITES Cambodia, FiA should define the status of endangered aquatic population for management and conservation measure. Previous study was the sources for FiA to establish further management to review the status of previous and recent research to discuss two species threatened of water snake to include it in the list of endangered aquatic species or the appendix of CITES to control harvest and trading. The first effort should be add two these species as endangered is urgently need for FiA to against the huge exploitation from Cambodia for international skin trade and live snake trading. However, previous and recent research may not enough to decide for including in endangered species but it is the crucial information for detailed research on population status of water snake in Cambodia. The gills net are processed to hunt *E. bocourti* and *H. buccata*. The national fishery law prohibits using all kind of snake net. The population of two species may not support for commercial in crocodile food, skin and international live snake trading. However previous and recent studies are likely not gained enough information while we lack of information of trading on dried meat water snake, skin and live snake supply to oversea.

Version of the small-scale fishing gears is especially gill net to limit length for fishermen should be though about the catch per unite effort. However Bor gear it is the one new adaptation fishing gear that fishermen using in the Tonle Sap Lake. Bor not included in the listed fishing gears of Cambodia. In the past the gill net are used about 200-250 meters for a fishermen, but in the presently about 1300 meters (MoE and UNDP, 2006) while authors found the maximum gill net pieces of a hunter was 20 pieces and the total length about 1800 meters per hunter (Figure 21). The population of water snake supports for livelihood of poor hunter living in The Tonle Sap Lake. The complex of small-scale fishing gear use, snake net, poor hunter, crocodile food, free trade of skin and live snake, license to hunt snake in fishing lot, closing season and long breeding season of water snake are the subject to establish the national legislation for management and conservation of water snake in Cambodia. The appropriate management and conservation measure will be benefit for livelihood of poor fisherman as well as long term management and development crocodile industry in Cambodia.

## Water Snake Trading

### ***Market route for International trading of skins and live snakes***

Similar observations indicated where reptile species were sold in the thousands on local markets. The size of the illegal trade in reptiles is unknown, but globally it must certainly involve many thousands of specimens every year. However, the very nature of wildlife smuggling is such that no reliable data are available to confirm such an estimate, although reported seizures and confiscations can provide an important indication of the illegal trade in reptiles, including indications of trade routes and methods used (Auliya 1990). Information on illegal trade in wild animals is often difficult to obtain, due to the illegal and secretive nature of the trade.

Stuart et al. (2000) noted that further investigation is needed to the report exporting of Tonle Sap Snake by air from Phnom Penh to Hong Kong and Guangzhou, China and the verification of large-scale international export of the Tonle Sap Homalopsines will significantly affect the management practice required to sustain. The strongest concerned huge live snake trading were reported by the trader in Kampong Thom that directly traded from Phnom Penh by air to China did not continue about three to five year ago because of number of snake in Cambodia did not enough for demand to transport. Actually, author found indicating from a trader, in kampong Thom, without mention his name that the Golden China Group was the main trading agency had collected *H. buccata* and *E. bocourti* from Cambodia in relationship with KAMFIMEX, a Cambodian Government export agency for aquatic products and this exporting were likely from 1990 to 2002. Trader estimated this trading approximately 3-10 tone per day on every Thursday flied to China while Siem Reap, Kampong Thom, Pursat and Battambang were the main Provinces to collect these species. However *H. buccata* and *E. bocourti* had been collected from other province outside Tonle Sap Lake as well as Prash Vehea and other lowland areas throughout Cambodia. Trader in Kampong Thom reported that company dug some pound to keep alive water snake at Prey Pral village, Tropraing Rusey village, Kapong Svay district, Kampong Thom province for waiting to fly on every Thursday (Pouchentong Air Port) to China. Many ponds were likely dug in each Province of Tonle Sap Lake as well as in Phnom Penh to keep snake in live condition and wait to fly to China.

However, hunter reported the alive snakes trading to Vietnam remained appear from Cambodia. Water snakes are traded with other reptile species included wild birds crossing Vietnam toward China. On March 14, 2000 the Ninh Binh Forest Protection

Department (FPD) in Vietnam notified the project of the trade seizure involving 350 Kg of turtles, as well as snakes, ducks, and tockay geckos, shipping was included 200 kg of *E. bocourti* and 800 kg of *Python molurus*. (Compiled Notes on the Wildlife Trade in Vietnam Jan-May 30 2003). Shipments were reported the location of the province of origin, at the southernmost of Vietnam, is within the natural range of this species, though it is possible that these animals were shipped over Cambodia. On 28 May 2008, Nguyen The Cuong and Hoang Van Nguyen Ninh Binh rangers reported they stopped a public bus on Highway one in Tam Diep, Ninh Binh Province, carrying a cargo of reptiles and birds. The bus originated in Ca Mau Province in the south of Vietnam and was destined for the Mong Cai border crossing with China in Quang Ninh province which were included 360 kg of *E. bocourti* (Compiled Notes on the Wildlife Trade in Vietnam Jan-May 2000). The established trade network is believed to involve larger shipments that are sent directly to China.

The greatest threat to water snake in Tonle Sap Lake, Cambodia is harvesting for crocodile farm, domestic consumption, internal trade and unregulated export. Many reptiles and water snake are eaten for food, and many poisonous snakes are collected for their perceived value and traditional medicine. Turtles, monitors, other lizards, snakes and crocodiles are all used in traditional medicines. For example, villager reported uses traditional medicine for crocodile gall-bladders, head skin and teeth, for turtle scales, shells and gall-bladders, for python bone, oil and gallbladders, for monitor oil, for Water Dragon bones and chin meat, for pit viper bones, and for cobra and King Cobra bones. However, since many species are consumed not only for curing specific ailments but also because of general health benefits gained by eating the species, it is probably meaningless to attempt to distinguish between the food trade and medicinal trading (Aulya, 1990). Therefore, both trades are referred to here as the 'consumption trade'. The value of some reptile species, particularly turtles, for the consumption trade in Vietnam and China provides great incentive to local people in Cambodia to collect and sell them to middlemen and traders. Unpublished reports of a traditional family restaurant in Vietnam reported people said people come from all over to eat snake because snake is considered an aphrodisiac. Trading water snake to China is likely the value of its protein for human health. However we could not find the clear scientific publication to support this information.

A demand for snake skin by local trader collected from Cambodia to Thai traders has also been reported by skin processor in Prek Toal area, although work in our research indicated a much greater influence from Vietnamese traders to buy alive water snake and other reptile in Cambodia for trading to Vietnam border. The major trade routes for reptiles and other wildlife are likely originate in Cambodia and pass northwards through Hanoi (Vietnam) and onto China. Villager reported in some case reptile, water snake and residue of iron and plastics are collected by middlemen used machine boat seeking along the village. They are fraudulent as middlemen collecting residue. Although, snake hunter in Kampong Thom reported that most of high price water snake and other reptile are brought mostly toward Chay Kreng area of Siem Reap province is the main assemble of reptile site in Tonle Sap Lake and continue for trading to Vietnam or Thailand by local cars.

Trading to Vietnam are reported that cross corridor in Nak Leong (Kandal Province), Memot and Tnout village of Pornearkrek (Kampong Cham Province), and sometime *H. buccata* and *E. boourti* are traded with wild fish to Vietnam. Moreover, trader in Pursat reported water sake are traded to Cambodia-Thai bother at Poipet corridor to Thailand and some water snake were collected from lowland area of Bantay Meanchey province. Reflected this information indicated exploitation for the international trading is the major

causes making population of two species of water snake and reptiles are likely decreased extremely. Another option is perhaps of the environmental degradation such as habitat loses and the large exploitation for crocodile farm are likely affected the population of this species. The harvest every year in both the close fishing season and open for crocodile and human food perhaps reduced the population of adult female to reproduce.

### ***Major trading for crocodile farms and local consumption***

The trade volume for crocodile farms at Kampong Chnang port was reported by provincial traders that 2000 kg to 3000 kg per day of mixed-death water snake in the peak period were brought to supply for crocodile farm, meat snake processor and food at Markets in Kampong Chnang Province. While trader in Chong Kneas of Siem Reap reported mixed-snake from 3000 kg to 4000 kg per day are traded in the peak period and snake was transported from difference place of Battambang, Pursat and some in Siem Reap Province. In addition, traders in Slaket Port of Battambang reported about 2000 kg to 3000 kg of snakes per day is traded for crocodile farm and fresh food for human in several market in Battampong Province. Water snakes were brought by motor and boat to landing site and continue to markets.

The death *E. boccourti*, *H. boccata* and reptile are eaten by local people and demand from some restaurant in Siem Reap, Battambang, Kampong Thom, Kampong Chnang, Pursat and Phnom Penh City. Water snakes are processed for human food in difference kinds; snake meat dried and snake smoked to keep traded for long time. Only In Battambang water snakes are smoked for trading in Market of Battambang Province. The dried snake meats are processed in five provinces around the Tonle Sap Lake to supply for visitor, local consumption and transport to supply Aureusy Market at Phnom Penh. Many cart vehicle vendors buy dried meat snake from Aurusy Market to sell in front of the Royal Palace, along the road, near NAGA World and Some Market in Phnom Penh City. The high values of dried meat snake in the present market are likely the main factor driving snake hunting. Hunters in Anlong Raing of Pursat reported all species of water snake were processed and especially *E. tenaculum* have good test than other snake. While snake processor near the Kampong Chnang port reported *E. tentaculum* is not processed for food. *E. tentaculum* is provided only for crocodile food. In Kampong Chnang, bones and skin of mixed snake are continued to trade for crocodile feed.

## **Conclusion**

The livelihoods of fishermen living around the Tonle Sap Lake are depended on the fisheries resources. While water snake and fish harvesting are related with daily subsistent of snake hunter, based on interviewing we found all snake hunter did not have land for rice cultivation. The mixed-water snake hunter used gill net 2-3 cm to catch snake and fish. Snake were caught both close and open fishing season. Because of no land for rice cultivation, snake hunters paid attention to catch snake and fish to earn money to buy rice to support their living. Although, the gill net 2-3cm are legally but number or very long of gill net are used by hunter is not permission of current fisheries law. Other hand, if they used gill net respected to fisheries law, they are likely can not earn money to buy rice and spices or support for living expend. The mostly of mixed-live water snake are caught by Bor gear that is the new fishing gear in Cambodia.

Currently we can not stop providing water snake as crocodile feed, alive water snake trading and skin trading because of our regulation not written to prohibit these species

based on option of stakeholder and current fisheries law. The catch of two species *H. boccuta* and *E. bocourti* decreased extremely. Without regulation to against international trade, the two rare species of water snake will be influence by huge threat in the future due to overlap harvesting with the breeding season. In order to reduce hunting of water snake and conservation, the fundamental activities is to increase sustainable occupation and raise the spiritual of fisheries conservation. Flood forest and grassy areas are the main habitat for snake and other aquatic species. Establishing of conservation zone will be reduce extend of harvesting areas and reduce trade volume.

## Recommendation

Trading of water snake of Cambodia are traded in two main categories; trading for human food and crocodile farm. Previous study based on harvesting and trading suggested that any efforts to reduce hunting should focus on the second peak in trade occurring from October to December, in order to protect breeding females (Brooks et al. 2006). However, this suggests maybe had to manage and control, because of from October to December it is the open fishing season related national legislation. Recent study suggested the first activities should be though to motivate and build the spiritual of fisheries conservation for community and snake hunter according to Cambodian Fisheries Law for first peak in harvesting and trading. The second effort should be focus on to against the international alive and skin snakes trading form Cambodia to other country and this effort are likely to prevent the female breeding of two species *H. boccuta* and *E. bocourti* that is critical threaded species. Efforts to limit the quota in export of Fisheries Administration are urgently need to prevent two species from local extinction. We support for further research to estimate like trade monitoring, catch monitoring, skin and alive trade while have only three publication documented about water snake in Cambodia. Therefore Brooks's studies are likely the fundamentals information for management and conservation consideration of water snake in Cambodia.

The Tonle Sap water snake harvesting should be viewed by manager as an economically important fishery because of the inverse relationship between the homalopsine and fish harvests, and because of the use of homalopsines as an alternative protein sources for people and captive crocodiles (Stuart et al. 2000). The future detailed indication of, threat, breeding season, majority, and clutch size of Tonle Sap water snake should be published to raise conservation option in communities and relevant institute while previous research of Brooks et al (2006) collected on this information but not yet published. The collaboration between scientists and Fishery Administration to produce any conservation tools of water snake should be prepared. Although, information of the give birth place and mating system of Tonle Sap water snake not yet research (Brooks, per. com. August, 2008). Pressure on Vietnam and China from CITES to improve significantly their efforts on controlling international trade in listed species, should these countries wish to continue as signatory parties to the convention. CITES-listed reptiles, specifically tortoises, pythons, monitors and King Cobra, are currently imported into Vietnam and China with apparently little regard to the terms of the convention while alive water snake are exported though retile traders. Reducing trading CITES-listed wild animal are likely reduce water snake trading, because of water snake are exported with other wild life.

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