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Rapid assessment method for population estimation of softshell turtle (*Amyda cartilaginea* Boddaert, 1770) and reticulated python (*Python reticulatus* Schneider, 1801)

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Abstract. *Takandjandji M, Gunawan H, Sihombing VS. 2018. Rapid assessment method for population estimation of softshell turtle (*Amyda cartilaginea *Boddaert, 1770) and reticulated python (*Python reticulatus *Schneider, 1801). Biodiversitas 19: 265-271.* The decreasing number of soft-shell turtle and reticulated python in the wild is due to high demand of the animal in local as well as international market. The condition made the Indonesian government set particular collecting and trading quota for the reptiles, but unfortunately, it does not automatically guarantee their preservation. Current collecting practices will lead to population decline and even extinction of the species since the reptiles' population in the wild has not yet been accurately determined. The purpose of the research was to determine a rapid method of population estimation to establish a baseline for determining collecting quota for the reptiles, especially of softshell turtles and reticulated pythons. The study was conducted in East Kalimantan using the method of deep interviews of 20 respondents (exporters, fishers, traders, collectors) and 15 key respondents (government officials). The results of this survey showed that the collect reptiles were collected from the wild, since up to now, there has been no successful breeding program of reptiles. The collected reptiles were dominated by female adult softshell turtles collected from Kotabangun area which has collecting quota of 1,080/year (1/3 of the exporting quota for East Kalimantan). Softshell turtles collected from Kotabangun have bigger in stature than those found in West Java and Jakarta, and the reticulated pythons collected from Kotabangun are longer than those found in West Java and Jakarta. The number of reticulated pythons collected from Kotabangun reaches 4,800 individuals/year (1/4 of the quota set for East Kalimantan export).

Keywords: Quick population assessment, quotas, reticulated python, softshell turtle

INTRODUCTION

Softshell turtle (*Amyda cartilaginea* Boddaert, 1770) and reticulated python (*Python reticulatus* Schneider, 1801) are classified as non-protected wildlife under Indonesian law, but CITES has classified them as vulnerable species in Appendix II of IUCN. Softshell turtle and reticulated python are reptiles that can be found throughout Indonesia; in Kalimantan, Sumatra and their satellite islands (i.e. Bangka, Belitung, Riau Islands), and in Java, Bali, Lombok and their associated islands (Auliya 2007). The reptiles are included among the fauna that lives in freshwater (softshell turtle) and damp areas (reticulated python) and are well adapted for survival in the East Kalimantan area. There is significant potential for human utilization of softshell turtle and reticulated python in Indonesia; the reptiles can be consumed as food, their skins can be utilized as handicraft (bag, purse, shoes, jacket, waistbelt, and other souvenirs), or they can be cared for as pets. Kartzner (2011) stated that on-site encounter calculation was generally employed to estimate the population of the species. Carbone (2001), Houser et al. (2009), Rovero and Marshall (2009), and Funston (2010) in their studies stated that for indices of abundance, camera-taken images and track counts were often used. Density, then, could be predicted using double sampling calibration. However, accurate estimation of their numbers in the wild has not been known.

The quota for collecting softshell turtles and reticulated pythons in East Kalimantan is the highest compared to other regions in Indonesia. In several areas of the province, both reptiles have traditionally been hunted and consumed as food by local (Dayak) people and even sold to other countries. The quota set by CITES Appendix II for softshell turtle collecting in the wild in East Kalimantan in 2016 was 4,500 individuals for consumption purposes but not as pets, while the reticulated python's quota for 2016 was set at 18,500 individuals. Based on regulation, softshell turtles collected from the wild in Indonesia must weight less than 5.5 kg or more than 13.5 kg, thus leaving the more reproductively fit sector of the population in the wild for replenishment of the stock (ID CITES MA 2008). The quota for collecting *Python reticulatus* is always higher than on other snake types listed in Appendix II CITES since the population is still considered high and is widely dispersed around the region. The number of reticulated pythons permitted to be collected from the wild in Indonesia in 2015 was set at 175,000 individuals per year, with 90% of the captured python was allocated for international leather export, while the remaining 10% (17,500) was for fulfilling domestic demand (IUCN 2015). Anderson (2001) in his study stated that the use of

population information has frequently been criticized for assuming unchanging detection probabilities.

The current quota system has been set with the expectation of avoiding negative impacts on the populations of reticulated python and softshell turtles in the wild. However, the high demand, particularly for reticulated python's skin/leather for the craft industry, has brought about a situation of endangering the reptile population. There is a need for a rapid assessment method in estimating reptile populations in order to establish a more reliable basis for setting sustainable collecting quotas for softshell turtles (*Amyda cartilaginea*) and reticulated pythons (*Python reticulatus*). There are several rapid assessment approaches that are based on the number of individuals captured or trafficked and exported. Study of reptile reproduction in the wild, including counting the number of eggs, the percentage of survival, mortality, age, and sex, can be used to determine populations in the wild (Krebs 1999).

MATERIALS AND METHODS

The research was carried out in September 2016 at Kotabangun Subdistrict, Kutai Kartanegara District, East Kalimantan, Indonesia, as well as a series of field survey in Kahala River and Belayan River, tributaries of Mahakam River in Kutai Kartanegara District, East Kalimantan, Indonesia (Figure 1). We monitored reptile populations of softshell turtle (*Amyda cartilaginea* Boddaert, 1770*)* and reticulated python (*Python reticulatus* Schneider, 1801) by visiting and interviewing key informants involved in the collecting and trading of reptiles, and by field survey.

Depth interview method was used in this study with 23 questions regarding the reptiles' trade and demand**.** Deep interviews following structured guidelines were carried out on 20 respondents (fishermen, collectors, traders, exporters) and 15 key respondents belonging to the Association of Indonesia Traders of Turtles and Softshell Turtles for Consumption (APEKLI), the Association of Indonesia Reptile and Amphibia Industry (AIRAI), and the Regional Conservation Office (BKSDA).

A field survey was conducted using the *Catch per Unit Effort* (CPUE) method (Krebs 1999; Kusrini et al. 2009). The measurements included recording the number of reptile individuals caught, determining the population structure based on weight/size of individuals, and determination of the sex ratio of the catch. In addition to the estimation of the population, description of the habitat conditions was also recorded. A comparison of the advantages and disadvantages of the two approaches, i.e. the key informant interviews method and the field survey method, is presented in Table 1. A graphic depiction of the overall rapid population assessment procedure and its relation to collecting quotas, is shown in Figure 2.

RESULTS AND DISCUSSION

Characteristics of the habitat of *Amyda cartilaginea* in East Kalimantan

The first observation of habitat of *A. cartilaginea* was carried out in the lower reaches of the Kahala River, Kahala Village, Kenohan Sub-district, Kutai Kartanegara District, East Kalimantan (coordinates: S 00^{0}01'22,1"; E 116^{0}21'43,0"). The regions are partially covered with trees including, *Gluta* sp., *Hibiscus* sp., and *Lophopetalum* sp. Several species of herbaceous plants are also observed, among which are *Mimosa pudica*, *Panicum repens*, and *Hymenachne amplexicaulis*. The Kahala River's width is about 5-7 meters with a depth of 3-6 meters; the watercolor is muddy brown; there is a slight current; the substrate is sandy-mud. Many types of fishes and small river crabs have habitat in the Kahala River, and many of them are fished using traps and simple fishing tackle.

Figure 1. The study site in Kotabangun, Kutai Kartanegara District, East Kalimantan, Indonesia as well as field survey in Kahala River and Belayan River, tributaries of Mahakam River

Table 1. Advantages and disadvantages of visits to collector/ traders approach and of field survey approach (Kusrini et al. 2009)

Approach	Advantages	Disadvantages
Visits to, and interviews with, collectors/traders	Relatively cheap and fast. High probability of getting the latest information about collecting locations (local distribution) since the traders and collectors are actively seeking reptiles to fulfill market demand.	It is hard to determine the age composition of the populations since traders/collectors are collecting reptiles only of a certain age/size requested by the market. It is also hard to determine the actual conditions of the reptiles' habitats.
Field survey	The age composition of the reptile populations can be accurately determined, and the condition of the habitats observed empirically.	Relatively more expensive and required longer time since there is no certainty of finding the individual.

The second observation of habitat was carried out in the Belayan River, which is a tributary of the Mahakam, at Ulu Liang Village, Kotabangun Sub-district, Kutai Kartanegara District, East Kalimantan (coordinates: S $00^0$14'13,80"; E $116^0$34'15,40"). There is not much difference between the habitat at this site and the Kahala Village site. The *A. cartilaginea's* habitat at Liang Ulu Village is semi-open with several dominant water plants including *Eichhornia crassipes*, *Ipomoea aquatica*, and *Nymphaea alba*. The riverbank is overgrown with herbaceous species among which are *Mimosa pudica*, *Panicum repens*, and *Hymenachne amplexicaulis*. The width of the Mahakam river at the Liang Ulu Village is approximately 15 m; the depth varies between with 1 and 4 meters; after rain, the water is a murky brown, but it is slightly clear in the dry season. The substrate is muddy. There is a medium current with the water flow (Figure 3).

Characteristics of the habitat of *Python reticulatus* in East Kalimantan

Two locations on secondary swamp forest were used as the study sites for *Python reticulatus*. The sites were situated along the streams of the Belayan river and along the streams of the Kahala river. This is consistent with the statement of Mukherjee et al. (2012) that the reticulated python likes swampy habitats, adjacent to rivers, lakes, adjacent to the forests, paddy fields, and also rocky hills. The secondary swamp forest located in the Kahala Village is not always aqueous. Direct rainfall is the source of the water in the habitat. When it rains, there is a flow of water resembling a creek. But after a few days without rain, the creek dries up, leaving only puddles between tree roots. The forest floor is covered by heaps of litter derived from rotten leaves and dead roots of trees. The canopy cover is moderate, allowing the sun to penetrate to the forest floor.

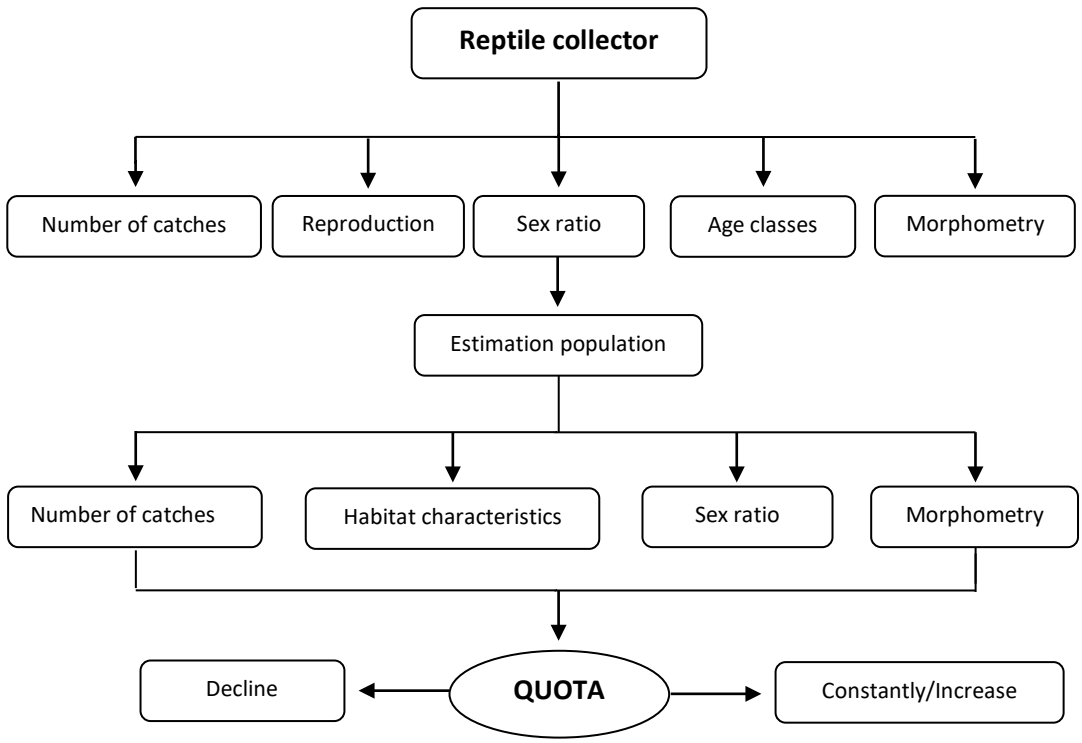

Figure 2. Overall procedure for rapid assessment of populations of softshell turtle and reticulated python

Figure 3. Habitat *Amyda cartilaginea* in the Kahala River (*left*) and Belayan River (*right*) at Kutai Kartanegara District, East Kalimantan, Indonesia

Table 2. Reproductive behavior of *Amyda cartilaginea* and *Python reticulatus* at the research site

Type of reptile	Breeding season	Breeding method	Number of eggs	Hatchery time (days)	age of maturity (yrs)	Hatching temp.	Humidity (%)	Hatchlings weight (g)	total feed	Gestation period (month)	Sex ratio
A. cartilaginea	Jul-Dec	Egg	10-30	45-50	2-3	25-30^{0}C	85-95	7-9	5% x bw	-	1:3
P. reticulatus	Sep-Mar	Egg	10-100	80-90	2-4	31-32^{0}C	Day 61-96 Night 72-99	-	5-10% x bw	4.5	1:2

Behaviors, reproduction and sex ratio

Observation in both Kahala and Belayan Rivers revealed that *A. cartilaginea* is rarely found in groups because it is a semi-aquatic turtle with a solitary pattern of behavior. *A. cartilaginea's* daily behavior in nature could be divided into two main activities, i.e. on land and in water. On land, their main activity was basking, while in the water, their activities are eating, poking their heads out of the water, resting in the shadow of water plants, and burying themselves in the mud at the swamp bottom. To detect the presence of *A. cartilaginea* and estimate their population, the bottom of the waterway was stirred with sticks to provoke the turtles to come out of the mud and swim to the surface. The amount of *A. cartilaginea*'s activity in the water tends to increase in response to the rise of temperature. In general, softshell turtles spend most of their lifetime in the water, except during spawning time when they come up onto the land. Softshell turtles, like other reptiles, are cold-blooded animals (poikilothermic), which means that their body temperature is adaptable to the temperature of the surrounding environment. At high external temperatures, softshell turtles are more active, while at low temperatures, they are usually less active, are rarely seen moving in the water, and immerse themselves longer in the mud.

Reproduction is one of the crucial aspects of attempting to estimate populations from a quick count; basic data of their reproductive behavior is required in order to increase the reliability of population estimation used in setting appropriate quotas. Reproduction data for softshell turtles and of reticulated pythons obtained at the study site included the sex ratios, the age of sexual maturity, spawning season, the breeding season, gestation period, egg counts, hatchability, and hatching time (Table 2).

The genders of individual turtles were determined by observing the form of the carapace, namely the convex and flat shape of the carapace, the ratio between curved carapace width (CCW) and curved carapace length (CCL). *A. cartilaginea* males have a flatter/thinner and tapering/oval form of the carapace, while the females have a more convex/thicker and rounder carapace. In general, a male *A. cartilaginea* individual has a shorter carapace and a long tail so that the tail-tip is visible outside the carapace, while a female is usually shorter and thick-set in shape and its tail is invisible outside the carapace.

The softshell turtles' breeding season depends on the maturity of their gonads, and it usually occurs in May and June when the water temperature ranges around 20ºC. Two weeks later, the females will spawn, laying their eggs on land in sandy places. In nature, softshell turtles generally spawn between July and December. The male reproductive organ in the form of a penis is located in the ventral rotodenum wall; after copulation, fertilization of the ova is internal (Mustalafin and Anggoro 2013).

Female softshell turtles spawn eggs 3-4 times a year with intervals of 2-3 weeks. They spawn 10-30 eggs in a single spawning. The egg has a round shape, with whitish-yellow or beige in color and a diameter of 1.5 to 2 cm. It has an average weight of 5 grams, and its outer texture is relatively hard. Eggs hatch into baby turtles after 45-60 days. When nesting, the female uses its hind legs to dig a hole as deep as 20 cm to store the eggs. Before the mother moves back into the water, the hole is closed again with sand.

Data collected on the reproductive behavior of pythons included observations of the age of sexual maturity, the mating season, mating process, gestation period, spawning season, and the number of eggs produced in a single spawn (Table 2). According to Matswapati (2015), reticulated pythons reach sexual maturity at the age of 2-4 years, with body length of about 2.0-2.5 meters on male and of about 3.0 meters on females. The breeding season takes place between September and March. Determination of the mating season is based on three techniques; observation of the size of spurs, observations on the thickness of the tail and by probing. The breeding season of reticulated pythons depends on a decrease in the length of daylight and a decrease of air temperature. However, it varies from one place to another. Reticulated pythons in Palembang (below the equator, in South Sumatra) spawn between September and October, while in Medan (above the equator in North Sumatra) spawning occurs between the months of April and May (Houston 1999; Nainggolan 2015). Male and female snakes are fasting during the breeding season; females will continue fasting until they spawn and they stay like that until the time the eggs hatch. Reticulated pythons gestation period is 4.5 months when it will search for suitable nest sites for optimal development of their eggs. Reticulated python females lay around 10 to 100 eggs in a single spawn, and the eggs will be incubated at a temperature of 31-32°C for 80-90 days, and sometimes, more than 100 days. A female reticulated python has a pair of ovaries and an oviduct as its reproductive tract (Amaliah 2012). A male python has a pair of testes and tubule seminiferous as its reproductive tract and a pair of hemipenis as its copulation tool. The cloaca is the opening of three channels; digestive, excretory and reproductive.

Age and morphometry

The results of measurements on CCL (Curved Carapace Length) of *A. cartilaginea* obtained from collectors in Kotabangun were classified into three age classes; juvenile, young adults, and adults. This is because adult individuals are more visible and the fishing tackle used (most anglers use a fishing pole) does not enable hatchlings/chicks to be caught by hook. However, if there is drought or flood, it is easier to ample the softshell turtles. In such circumstances, without the help of a fishing pole, softshell turtles (even young turtles) can be seen and be easily caught by their hunter on the surface of the rivers.

Morphological characters measured in the survey of softshell turtles include CCL (curved carapace length), CCW (curved carapace width), and body weight (BW). Measurements were taken on 30 individual softshell turtles. Among those 30 turtles, CCL ranged from 16 cm to 60 cm, and body weight ranged from 0.6 kg to 19.5 kg. Softshell turtles caught were dominated by the weight category of 2-9 kg. A summary of the results of measurement on the softshell turtles obtained during the survey in Kotabangun is presented in Table 3.

From the data, it can be concluded that the collected softshell turtles from Kotabangun were predominantly female with an average CCL of 31.6 ± 15.7 cm, average CCW of 29.2 ± 9.3 cm and average BW of 5.67 ± 6.7 kg. For the males, CCL averaged of 55.0 ± 6.9 cm, CCW averaged of 41.7 ± 2.3 cm, and BW averaged of 17.0 ± 2.2 kg. The distribution of CCL, CCW, and BW among the softshell turtles is presented in Figure 4.

The softshell turtles collected from Kotabangun are dominated by juveniles with the size of 2 kg. This is due to the demand of that category from abroad. From Table 2, it can be concluded that the female gender dominates the collecting (75%). This suggests that the availability of females in the wild population is greater than that of the males. The higher number of females than males in the natural catchment indicates that the population structure of *A. cartilaginea* is still favorable for replenishment.

The measurement results for reticulated pythons in three research locations (Jakarta, Bogor, Kotabangun) are presented in Table 4.

Table 3. Results of the survey of *A. cartilaginea* morphology measured in Kotabangun

Sex	Curveline Carapace Length (CCL)	Curveline Carapace Width (CCW)	Body Weight (BW)
Male	55.0± 6.9 cm	41.7 ±2.3 cm	17.0±2.2 kg
Female	31.6 ±15.7 cm	29.2±9.3 cm	5.7±6.7 kg

Table 4. Average size of reticulated pythons at three sites; Bogor and Jakarta in Java, and Kotabangun in East Kalimantan

Site	Number of individuals	Results measurement			
		Total Length (m)	Head circumference (cm)	Rim tail (cm)	Abdominal circumference (cm)
Bogor	9	3.26±0.83	17.4±2.3	16.6±1.4	38.2±1.5
Jakarta	5	3.43±0.51	17.4±1.1	15.9±4.2	30.7±8.8
Kotabangun	16	3.47±1.02	19.7±5.1	15.8±3.4	32.0±6.3

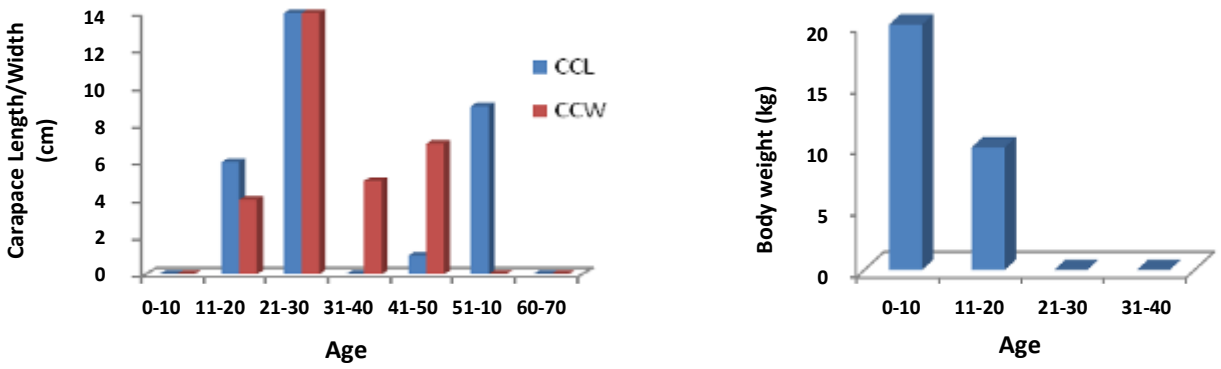

Figure 4. Curved Carapace Length (CCL), Curved Carapace Width (CCW) (*left*), and Body Weight (BW) (*right*) of *A. cartilaginea* from Kotabangun, East Kalimantan

Table 4 shows that the body size of reticulated pythons from Kotabangun (Kartanegara Kutai Regency, East Kalimantan Province) is longer than those from the two sites in Java. The reticulated pythons in East Kalimantan have greater total length and circumference of the stomach, head, and tail). Based on size and the weight ratio between male and female both python in Java and Sumatra, female python has higher value than male python. This is consistent with the statement of Shine et al. (2000) that female Reticulated Pythons grow much larger, and mature earlier with larger body size than males but male pythons were heavier than females at the same body length

In conclusion, it is well known that the collecting and utilization of softshell turtles still depend on natural populations in the wild; there is no successful cultivation of softshell turtle yet. Softshell turtles remain an export commodity and there is increasing demand. The collecting quota allocated for the province of East Kalimantan in 2015 was quite high (4,500 individuals per year); living turtles are for consumption, not for pets. The average collection from a collector in Kotabangun was 32 individuals per week. Assuming that there are three active collectors, then, the total softshell collected is estimated to be around 100 individuals per months. This means that, in one year, the region of Kotabangun alone accounted for 1,200 per year or 1/3 of the export quota. The quota set for collecting *Python reticulatus* in the Province of East Kalimantan in 2016 was 18,500 individuals in the type of living snakes, and they cannot be kept as pets. It is estimated that in a single year the region of Kotabangun reached 4,800 per year or 1/4 of the allowable export quota for East Kalimantan. Comprehension of spatial, as well as a temporal factor (reproduction and number of catches) impacting the daily movements, will improve estimation of density.

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