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Hunting and trading activities of reticulated python (*Python reticulatus*) in South Sulawesi, Indonesia: A report from the field

D A Wahab¹, R I Maulany², Nasri² and Nirsyawita¹

¹Natural Resources Conservation Agency of South Sulawesi Region, Makassar-Indonesia

²Faculty of Forestry, Universitas Hasanuddin, Makassar-Indonesia

Email: risma.maulany@unhas.ac.id

Abstract. One of the main causes of biodiversity loss apart from habitat destruction is wildlife trade and when those causes combined, the impacts are detrimental to the survival of the species. Among all of wildlife traded, wild-sourced reptiles are found to be the highest traded during 2000s particularly for reptile skins where 24% were exported from Indonesia with 50% were known to be originated from pythons. This was included reticulated python (*Python reticulatus*) where many have been hunted for its meat, skin, fat and other parts not only for livelihood needs but also for traditional medicines and recently used for fashion materials which has significantly increased its trade. South Sulawesi Province has been known to become one of the sources in python's skin trade. This study aims to 1) identify potential areas to catch reticulated python; 2) examine the profiles of hunters/collectors of python's skins; 3) identify distribution channel of the skin trade within the region; and 4) determine sustainability of the python skin trading in South Sulawesi Province. A comprehensive survey targeting on hunters/collectors was carried in the three regencies (Bone, Wajo, Luwu) known to be potential areas of catching pythons in the region. To provide information on hunter's/collector's profiles, python's population conditions, catching period and techniques used, structured interviews towards identified hunters/collectors were conducted. It was found that for the three regencies, there were total four hunters/collectors for reticulated python's skins which marketed the skins directly to 1-2 companies in Makassar. The catching areas were known to be 42 spots widely distributed across the three regencies with the highest found to be in Wajo Regency (17 spots). Most of the pythons were caught live with standard length of 2.5 m. Number of pythons per month was ranged from 20-200 individuals with sold prices ranged from USD 3-5 per individuals. The collectors sold the pythons only in skin form with the prices around USD 4-6 per meter. In South Sulawesi, the hunters/collectors sold directly to distributor companies without any middle men. Based on the previous quota and the results of findings in the field, the hunting of python skins is still below the allowable quota and did not exceeded the population in the wild. Therefore, the harvest of the species through hunting can be considered sustainable.



1. Introduction

One of the main causes of biodiversity loss apart from habitat destruction is wildlife trade and when those causes combined the impacts are detrimental to the survival of the species. It could potentially accelerated species losses to be higher than 50% towards extinction particularly in Southeast Asia [1]. Indonesia is identified as one of hotspots area for unsustainable and illegal wildlife in e trade in the region [2] where high demand on both plants and animals by consumers are used as sources for traditional medicine, pets, accessories, luxurious items, and [2–5]

Among all of wildlife traded, wild-sourced reptiles are found to be the highest traded during 2000s [2] particularly for reptile skins where 24% were exported from Indonesia with 50% were known to be originated from python [6].

Reticulated python (*Python reticulatus*) can reach over 8.5 meters and gain mass of 145 kilograms where it is later called as the longest snake in the world [7]. In the wild, this species has a wide distribution in Asia starting from India in the west, across Indo-China to Vietnam and south to the Indonesian Archipelago [5] Many has hunted the species for its meat, skin, fat and other parts not only for livelihood needs but also for traditional medicines and recently used for fashion materials which has significantly increased its trade [8,9].

In order to control and regulate the species being traded, Indonesian Government under the coordination of the Directorate General of Forest Protection and Nature Conservation along with the Convention on International Trade of Endangered Flora and Fauna Species (CITES), determines allowable amount of catching rates (quota). Reticulated python (*Python reticulatus*) is listed in Appendix II CITES where all exported species required the country of origin to guarantee the legality based on CITES permit. CITES permit is established if the *Scientific Authority* could claim that the wild population of the exported species is sustainable with non-detrimental findings and provides recommendation [10]. Based on that, catching and exporting quota can be determined in line with survey or monitoring results in the field and based on previous quota. The quota is proposed according to the provincial quotas through Nature Conservancy Agency located in each province.

Exported reptile skins of reticulated python has contributed more than USD 54,454,577 to Indonesia's income per capita and the quota set for the species by the government is constantly 100% met (157,500 pieces per year) [10,11]. South Sulawesi Province has been known to become one of the sources in python's skin trade [10,12]. Previous quota set by the Nature Conservation Agency of South Sulawesi for 2017 was 29,300 pieces. However, there is not much information available to propose for the quota set due to limited population survey on the species. To portray the population conditions of reticulated python (*Python reticulatus*), many studies have utilized indirect assessment due to wide extent of habitat and geographical distribution as well as the nature of the species which is difficult to be seen in the wild [13–15]. Additional information on wild conditions of the species are mostly gained from trading actors to acquire data. Therefore, in order to determine the exported quota of the reticulated python in South Sulawesi Province, this study aims to: 1) identify potential areas to catch reticulated python; 2) examine the profiles of hunters/collectors of python's skins; 3) identify distribution channel of the skin trade; and 4) determine sustainability of the python skin trading in South Sulawesi Province.

2. Study area and methods

Prior to the study, secondary data on previous quota and the areas of origin of reticulated python (*Python reticulatus*) were collected from the Natural Resources Conservation Agency of South Sulawesi Province Office (Balai Konservasi Sumberdaya Alam – BKSDA). Therefore, the study was then focused in the three regencies of South Sulawesi Province (Bone, Wajo, and Luwu) from March to April 2019. From Makassar, the capital city of South Sulawesi, Bone is located 131 km to the northeast while Wajo is around 209 km to the northern side. Luwu Regency is the furthest with almost 8 hours driving to the north (342 km). Comprehensive surveys were carried out targeting on

hunters/collectors in the three regencies to identify major hunters/collectors for reticulated python (*Python reticulatus*).

To portray the population conditions of reticulated python (*Python reticulatus*), indirect assessment through a structured interview towards identified hunters/collectors was carried out due to wide extent of habitat and geographical distribution as well as the nature of the species which is difficult to be seen in the wild. The interview towards identified hunters/collectors was also employed to provide information on hunter's/collector's profiles, catching period and techniques used for hunting. Coordinates of each sampling points were recorded and drawn into a map (figure 1). To determine sustainability of the python skin trading or whether the current practices of catching pythons affect the population of python in the area, sustainable indicators on harvesting were drawn from the interview results on number and size of individuals caught, catching frequency, catching efforts, as well as reports from the Natural Resources Conservation Agency of South Sulawesi Province Office.

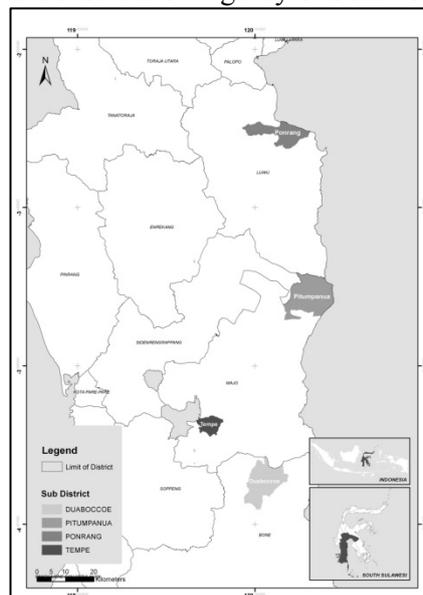


Figure 1. Map of study sites in Bone, Wajo, and Luwu Regencies (South Sulawesi), Indonesia

3. Results

Based on comprehensive survey, total of 42 spots of catching areas covering different type of habitats were recorded in the three regencies (Bone, Wajo, Luwu). There were four respondents acted as both hunters and collectors (hunters/collectors) of reticulated python (*Python reticulatus*) in the areas. Only in Wajo Regency, one respondent has been identified to make hunting/collecting python as the main source of living. Most of the respondents acted as both direct hunters and/or also collecting reticulated python individuals from other individual opportunist hunters. The four respondents have been running the business for more than 20 years in the area and have made the activities of hunting and collecting the snakes as additional jobs. Currently, these business are no longer served as main job as in the past. From the interviews, it was also found that most of these business in snake-skin hunters/collectors were inherited from their parents.

Table 1. Characteristics of Main Hunters/Collectors of Reticulated python (*Python reticulatus*) in 3 regencies of South Sulawesi

Respondent	Regency of Origins	Catching Areas		Type of Habitats	Working Experiences (years)	Type of Business	Other Living Sources
		Number of catching points	Areas Identified				
1	Ponrang, Luwu	15	Lare-lare, Lara', Labende, Lowa, Tirowali Village, Tanjung, Bassiang, Tobalo, Mappadeceng Sub Village, Tirowali Village (Padang Sappa, Ponrang District), Bastem, Latimojong Mountain, Posi (Bua), Sampano' (South Larompong District), Lindajang (Suli District)	Sago plantation, rivers, paddy field, primary and secondary forests	33	Additional	Gardening, shop
2	Pitumpaanua, Wajo	11	Paleko (District Kera), Benteng (District Pitumpanua), Tanete, Leworong, Kaluku, Pangi, Padang Pamekke, Siwa, Lompo Baku, Enrekang Village,	Lake, rivers, paddy field, secondary forests	25	Additional	Rice selling

Tempe Lake							
3	Sengkan g, Wajo	6	Anabanua, Lajokka, Tanah Sitolo, Tosora, Atapange, Tempe Lake	Lake, rivers, paddy field, secondary forests	39	Main	Trading
4	Dua Boccoe, Bone	10	Pallime (Cenrana District), Pattiro Bajo, Panyula, Barebbo, Solo Village, Tawaroe Village, Kampoti Village, Tocina Village, Unyi (Dua Boccoe District), Lake Tempe	Lake, rivers, paddy field, secondary forests	22	Addition al	Farming

The results of the interviews to the four key players of reticulated python trading have revealed that catching locations were varied in the three regencies. The pythons were mostly caught in various habitat such as sago plantation, rivers, lake, paddy field, swamp areas, primary and secondary forests. The locations with higher catching probability were in Wajo Regency with 17 catching points while in Bone only 10 catching points were known (Table 1).

The sources of live/dead snakes were from both other individual opportunistic hunters and gathered by the hunters/collectors themselves. Most of the tools used to catch the snakes were still conventional such as wooden stick and trawl/net. All respondents stated that the catching time were frequently conducted during the rainy season at night time when dark moon occurred. The hunters/collectors only targeted snakes with more than 2.5 m in length. Once the snakes caught, they were killed by hitting the head then the skins and meats were separated. The skins were dried prior to selling. Number of snake collected ranging from 20-200 individuals per month with buying prices from other individual hunters between USD 3-5 per meter. Meanwhile, the hunters/collectors sold to local traders/exporters (companies in Makassar) for around USD 4-6 per m.

Table 2. Hunting and Marketing of Reticulated Python's Skins (*Python reticulatus*) in South Sulawesi Province

Respondent	Catching tools	Processing Techniques	Standard length of snake caught (m)	Number of snake collected per month	Buying prices from hunters (USD/m)	Selling prices (USD/m)	Marketing Channel	Source of items
1	Wooden stick,	Head beaten,	2.5	100 – 200	3-5	4-6	Direct to company	Self-collection, gained
2	trawl/net	body		50 - 90			(PT.	

3	t	skinned	20 – 50	Sumber	from
4		and dried	20 - 50	Murni Lestari)	other hunters

Apart from hunting and collecting activities, trading in reticulated python was also involved other key players. It was identified from the interviews that all hunters/collectors of the snake-skins were usually sold their skins to two companies in South Sulawesi Province (UD Abadi Jaya and PT Sumber Murni Lestari). Both companies had formal license from the Office of Natural Resources Conservation Agency of South Sulawesi Province. However, there was only one company that was still active in trading during the study. Figure 2 shows the flow of market channeling from hunters to distributors. After the hunters caught the snakes, they traded them to the hunters/collectors to be processed and later, the skins were directly marketed to the local trader’s/exporter’s companies in the form of dried skins without any middle men. By the traders/exporters, the skins were processed into half-made products before exported.

The interviews with the respondents have also shown that there was a decreasing trend on the prices of reticulated python skins. Previously, a good quality skin of reticulated python was traded for USD 7 per meter but recently it decreased to only USD 4 per meter. Changes in pricing have made some hunters/collectors deciding to pile up their skin stocks and some have stopped sending to the companies due to low selling prices. Limited capital owned by some of the hunters/collectors have also been identified as one of the causes of the decreasing trend of snake-skins trading in the areas.

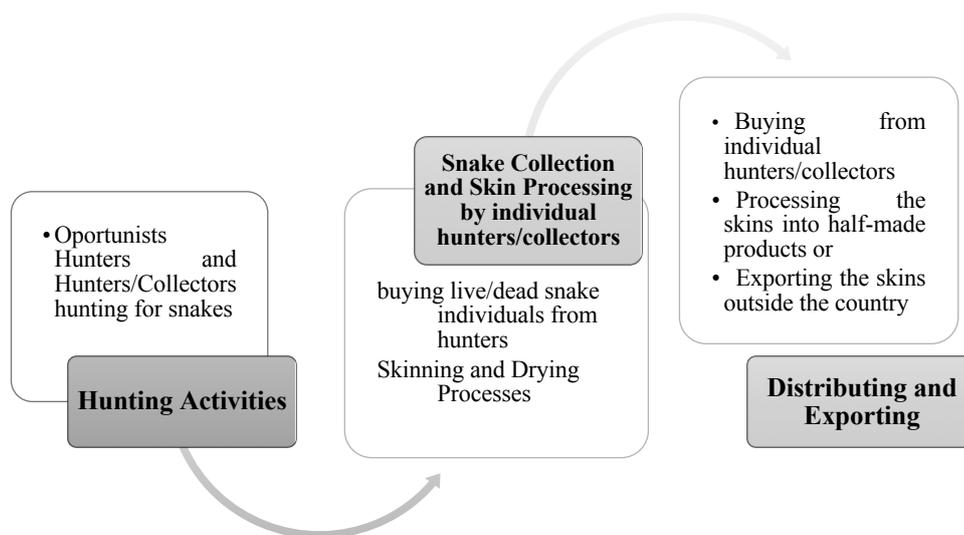


Figure 2. Trade chain of reticulated python (*Python reticulatus*) skins in South Sulawesi Province

Secondary data from the Nature Conservation Agency of South Sulawesi Province revealed that the average quota for the species was 29,282 individuals caught per year for the last 10 years (2009-2019). Since 2016, the government only decreased the quota 100 individuals less than previous years (23,400 to 23,300 individuals). However, still in that year, the realization almost dropped to half of the quota (15,600 individuals). It went back to 29,300 in 2019. According to the interviews with the hunters/collectors, one company of the industry suddenly stopped operating (Figure 3).

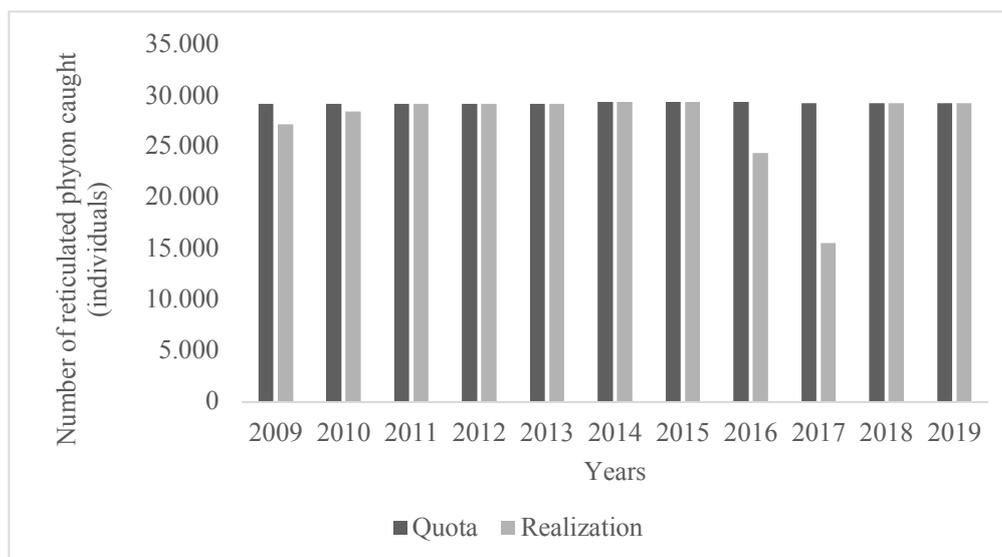


Figure 3. Quota of reticulated python (*Python reticulatus*) determined by Nature Conservation Agency of South Sulawesi Province (BKSDA 2019)

To determine the quota, sustainable indicators on harvesting reticulated python (*Python reticulatus*) were examined indirectly by using number and length of individuals caught, frequency, and comparison of field survey on the population (Table 3). It was found that the population of the python can be considered safe from trading as the catching frequency was low. However, based on the interviews it was assumed that the population can be threatened by habitat changes/modification for agricultural purposes and/or human settlement.

Table 3. Indirect Sustainable Indicators Reticulated Python (*Python reticulatus*) in South Sulawesi Province

Indirect Sustainable Indicators	Findings of the results
Number of individuals caught	Numbers of individuals caught were decreasing due to low demands from local traders/exporters.
Size of individuals caught	Standard size required by the distributors was 2.5 m measured from the head to the tail for individuals caught. Standardization on size has made individuals collected relatively in similar size.
Frequency	Catching frequency can be considered low as catching methods were mostly opportunistic catches and identified mainly as side jobs of both individual hunters and hunters/collectors.
Population Surveyed	Population of the species is predicted to be similar with the previous years as the catching efforts were low. However, habitat modification/degradation has become one of the threat to the species where habitats of the snakes have been converted to agricultural land and/or human settlement.

4. Discussion

The reticulated python (*Python reticulatus*) has become one of the largest commodity sold of wildlife in the international trade [12]. In South Sulawesi Province, this species has been traded for more than 30 years and yet the harvesting activities has never surpassed the quota given by the government for the last ten years. The survey has revealed that there were four hunters who acted as both hunters and collectors (hunters/collectors) in Wajo, Bone, and Luwu Regencies. Other opportunist hunters were only catching and handing in live/dead individuals to the hunters/collectors. In the areas, the snake-skin businesses were known to be passed down by the parents to their children and have served as side jobs. It is similar in most cases of python hunting in Indonesia where the job is mainly treated as subsidiary work [13,16]. Less dependency of the hunters/collectors towards the hunting activities has benefitted the population of python in the wild [13].

The catching tools used in Bone, Wajo, and Luwu were wooden stick and/or trawl or net. This type of tools are commonly used to catch python [14]. Most of the hunting activities in the three regencies were opportunistic which also affected the selection of tools used to catch the python where the hunters/collectors tended to make use any available sources nearby the catching areas. However, for professional hunters in Sumatera for example, they installed traps and snares which could elevate the rate of hunting [13]. More sophisticated hunting equipment will increase the cost of hunting and later will impact on selling prices as well as benefits gained from hunting activities (Siren & Wilkie, 2016). Even though the selection of hunting methods is sometimes determined by other factors such as type of animals being hunted including its behavioral activities, technology advancement and tradition, habitat conditions on where the animals live, and also the safety of hunting areas [17].

In the three regencies, the main sources of the skins were from the wild not from the captive breeding. Direct selling was applied from opportunist hunters to hunters/collectors up to the local traders/exporters of the snake skins. The chain was also simpler compared to other python business's in Indonesia. Shorter and simpler chain in wildlife trade may provide higher benefits for the livelihood of minorities [15] where from the conservation point of view, this means involving limited actors in the trade which in returns may indirectly limit the harvest of the species which can act as sustainable driver. More actors may provide wider benefit distribution among actors, however, in most cases, still lesser amount will be gained by the communities particularly at the lower ranks of the chain [15]. For example, python trading in Sumatera with a complex chain involving different hunters (from opportunist to professional), small collectors, big collectors, and local traders/exporters, the highest revenues were gained by the local traders/exporters to more than 70% while the lowest were hunters and small collectors with only less than 7% of the revenues [13,16]. In South Sulawesi, the absence of professional or full time hunters who solely devoted their time to hunt the animals has also played in securing the population of the species in the wild due to lesser hunting activities. Number of hunters/collectors in the three regencies can be considered very low with only four persons being both hunters and collectors while others were involved in incidental catching events. Thus, it will give a positive contribution together with simpler chain form of trading towards maintaining the population of reticulated python in the regencies.

Although business in snake-skins of reticulated python is known to involve low capital and relatively uncomplicated to handle, in the three regencies observed, not many people are interested in relying their living sources in the business. This can be mainly due to the seasonality of the business. Hunting snakes can be challenging where the snakes are categorised as animals that are very difficult to spot, target, and moreover, collecting many individuals of the reticulated python in one place at one time is sometimes impossible [14]. The animal's life history traits itself, other ecological factors or combined with the rare encounters of the species by the hunters (visibility) can contribute to the situations [12,13]. Both sexes of this species appear to be active during the rainy season [18] and as occurred in the three regencies, the highest abundance was also found during the period. Some snakes

species are known to have a slow reproduction while some others are different. For reticulated pythons, high hatching percentage and high ability to adapt can actually boost their populations [14,19]. However, habitat conditions may impede the growth if they are heavily disturbed, destructed, or even diminished [12]. In Wajo, Bone, and Luwu, it seems that the hunters could not shift from being opportunistic hunting to more intensive hunting activities. This might be related more to habitat conditions. Most habitats in South Sulawesi including Luwu, Bone, and Wajo, have changed since the expansion of agricultural practices and land conversion for various purposes [20]. The introduction of pesticide in late 1980s has also played part in disturbing food chain and decreasing ecosystem functions in the areas [21]

The rate of harvesting in Bone, Wajo, and Luwu as the main spots for the snake skins trade, is still under the quota set by the Natural Conservation Agency for 2019. In practices, the hunting and trading activities are still under the allowable quota set by the government. In addition, low catching efforts and conventional technology used to catch the python have indirectly limited the business away from over exploitation of the species. Moreover, unstable price occurring recently in the market has also pushed some of the respondents to pause the business (and even one local traders/exporters has closed down) or to temporarily store the snake skins rather than directly sell to the local traders/exporters with lower prices. As mentioned by Cooney, et al. (2015), stockpiling products may reduce negative impacts on the conservation of the reticulated python through pricing regulation and reduction of incentives for overharvest [15]. This situation might be also impacted by the low international trade situation, or currency rate fluctuations and perhaps due to changing orientation from leather industry to live animal trade for pet purposes [4]. However, in some other parts of Indonesia, stockpiling and smuggling for python skins can also be found to fulfill the demand made by traders even the quota had been reached which has led the harvesting efforts becoming unsustainable for those areas [12].

Standardisation in collected size occurring in the three regencies has also been proven to limit the unsustainable practices in snake skin trade apart from the scale of trade occurring. However, it is realized that monitoring and evaluation on harvest activities by the legal authorities were limited. In addition, intensive population survey of wild python in the habitats are needed to guarantee that the harvesting process are still sustainable and are in line with the regulation. Regular habitat assessment is also a priority as anthropogenic threats can be considered high in the three regencies. Therefore, best practices, regulations and public awareness need to be reinforced to guard the sustainable use of the species.

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