Traditional uses of herpetofauna practiced by local people in the island of Sumatra, Indonesia: Implications for conservation

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Abstract. Local people in Sumatra have long utilized herpetofauna to provide food, medicine, and other purposes. However, research related to wildlife utilization is still lacking. The objective of this paper was to provide an overview of the island-wide (i.e. Sumatra) traditional use of herpetofauna by the local people and analyze its implications for conservation. Published papers were collected and analyzed. From 11 papers, 22 wild-caught species (18 reptiles, 4 amphibians) were used by local people for their meat (water monitor, freshwater turtles, large-sized snakes), eggs (marine and freshwater turtles), or medicinal purposes (snakes, lizards, frogs; as skin-related remedies). Among them, 8 reptiles are listed in the IUCN Red List and CITES Appendices, including Batagur borneensis (CR, Appendix II), Chelonia mydas (EN, Appendix I), Notochelys platynota (VU, Appendix II), Ophiophagus hannah (VU, Appendix II), Ortilia borneensis (EN, Appendix II). Additionally, 5 reptiles are protected by Indonesian law. Batagur borneensis is also listed as a very high priority species for conservation by the Ministry of Environment and Forestry. No amphibian is protected by law, listed in the CITES, nor IUCN Red List. Traditional uses of protected species and listed under the IUCN Red List need to be managed properly to ensure their sustainability.

1. Introduction

Traditional uses of wildlife species have been practices by many local people all around the world, including in Sumatra. For the local people, the existence wildlife resources nearby are very important, as they could harvest wildlife freely in order to fulfil their daily need (i.e., subsistent use). Among the use of wildlife, traditional medicines play important roles, particularly in areas where health facilities are lacking or located far from their villages.

The subsistence use of the wildlife species may raise some concerns when the species is protected by the Indonesian law due to its rarity. In the global level, some species also have been listed into threatened species (Critically Endangered, Endangered, or Vulnerable). When forests are still abundant and wildlife have sufficient habitats, there is no concern about the survival and sustainability of the wildlife being harvested.

Sumatra Island has undergone rapid deforestation in the last four decades and has ranked the first among five major islands in Indonesia [1]. When forest areas are shrinking and the wildlife-human encounter intensifies, it is worrisome that wildlife species might extirpated due to the harvest.
Furthermore, the local people might also unaware that the species they harvested is in fact an endangered species and not allowed to be harvested.

The study that “seeks to understand how humans have perceived and interacted with faunal resources throughout history” is called ethnozoology [2]. Part of the main goal of ethnozoology is to understand how local people use wild species, including herpetofauna (reptiles and amphibians) for their daily use, particularly for consumption or traditional medicine. The local people in this paper defined as people that live nearby forest area and depend on the forest for their daily life, at least for some parts of their daily need.

Herpetofauna were selected as the focus of the study, as this taxon has been known to be widely used in Sumatra and in other areas as well. Due to the nature of data collection approaches (e.g., direct interview with resource persons), research on ethnozoology is usually conducted in selected locations in small geographic areas, by gathering information from relevant resource persons. To understand general pattern and draw lessons learned, gathering information from various local-based ethnomedical study need to be conducted.

The objective of this paper was to provide an overview of traditional use of herpetofauna by the local people on the island-wide (i.e., Sumatra), and analyse their implications for conservation. The traditional use in this study was restricted to subsistence use only and not a commercial scale, considering that some wildlife species have been intensively harvested and traded on commercial basis, for example Tokay Geckos (Gekko gecko), Javan Filesnakes (Acrochordus javanicus), Asiatic Softshell-turtles (Amyda cartilaginea) [3] and Monitor Lizard (Varanus salvator) [4].

2. Method

To examine the diversity of reptile and amphibian species used by local people in Sumatra, all published peer-reviewed papers, research reports, and theses (Bachelor, Master, and Doctorate) published since 2009 were collected, validated, and analysed. All publications were accessed via internet or by correspondence with university librarians if full publication is not available online. All study sites were conducted in a relatively remote areas, mostly near national parks where the local people heavily depend on the neighbouring forest and/or other natural ecosystem.

There were 16 published publications on ethnozoology in Sumatra, of which only 11 papers (Table 1) were related to reptiles and amphibians. These papers were used as the main references for generating dataset and analysis in this paper. Those papers were not distributed evenly in 10 currently recognized provinces in Sumatra: Nangroe Aceh Darussalam Province (number of papers, n=1), North Sumatra (n=1), Riau (n=1), Jambi (n=4), Bangka-Belitung Islands (n=3), West Sumatra (n=1); Riau Islands (n=0). Bengkulu (n=0), South Sumatra (n=0), and Lampung (n=0). There might be published theses or reports in Sriwijaya University in South Sumatra, Bengkulu University in Bengkulu, and Lampung University in Lampung, but, if any, they were not publicly made available through internet.

Data from the 11 publications were extracted and collated in a database. The database basically contained location, species and part(s) of species being utilized and uses (consumption or medicinal uses). If the species was used for medicinal purposes, specific medicinal uses were recorded as well. For each species used mentioned in the paper, the Relative Frequency of Citation (RFC) was calculated from the total number of papers that mentioned the species of interest divided by the total number of papers being used for analysis [5].

The conservation status of each species was assessed based on international and national categories. For international categories, conservation status defined by (1) the IUCN’s Red List: Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), and Least Concern (LC) (IUCN, 2020); and (2) the international trade (CITES Appendices): species that are not allowed to be internationally traded, with some strict exceptions such as Saltwater Crocodiles (Appendix I) and species that are allowed to be internationally traded in a certain number (Appendix II); were followed. Based on those international categories, high status can be given to species belonging to categories (1) CR and EN from IUCN's Red List and (2) Appendix I and II from CITES Appendices. For the national categories, the Ministerial Decree no. 106/2018 was used to assess
whether the species is protected by the Indonesian law or not. Additional assessment was performed to categorize the species into highly prioritized for conservation or not (based on Ministerial Decree no. 57/2008).

3. Results and Discussion

3.1. Herpetofauna for consumption and medicinal purposes

In this study, 22 species of herpetofauna (18 reptiles and 4 amphibians; see Figure 1) were recognized to have been used by local people in Sumatra (Table 2). Unfortunately, in some publications the authors did not specify herpetofauna up to the species level, so the number (i.e., 22 species) was only an approximate figure.

Among reptiles, turtles (8 species) were being used more than other species, including snakes (6 species), lizards (3 species), and crocodile (1 species). However, Reticulated Python was commonly used by the local people in almost all study areas, which shown by having the highest RFC score (0.45) among other species recorded in this study. Additionally, turtles (no specific species mentioned), Monitor Lizard, and Saltwater Crocodile, were also popular.

Relatively large-sized reptiles were consumed for their meat, mainly turtles (Malayan Flat-shelled Turtle, Malayan Giant Turtle, Asiatic Softshell Turtle, Malayan Soft-shelled Turtle) and snakes (King Cobra, Reticulated Python). In addition to consumption, those species were also used as traditional medicines, as also other small size herpetofauna such as Common Sun Skink and Green Paddy Frog. The use of reptiles was mostly related to skin remedies, including eczema, allergy, smallpox, and wounds, as well as haemorrhoid and respiratory problems (Table 3). Additionally, reptiles were used for remedies of various other diseases, including bone fractures and dislocation, fever, stomach problems, aphrodisiac, diabetes, rabies, and toothache, among many others. Similar to reptiles,

| Year | Authors            | Study location       | Province         | Scope of the study                  | Ref | Type of publication |
|------|--------------------|----------------------|------------------|-------------------------------------|-----|---------------------|
| 2009 | Hasibuan et al.    | South Tapanuli       | North Sumatra    | Wildlife utilization                | [13]| Research report     |
| 2009 | Muthiah et al.     | Indragiri Hulu       | Riau             | Ethnobiology, traditional people    | [16]| Research report     |
| 2013 | Hamdani et al.     | West Sumatra         | West Sumatra     | Herpetofauna, traditional medicine  | [6] | Journal             |
| 2014 | Farida et al.      | Merangin Sarolangun  | Jambi            | Ethnobiology                        | [12]| Journal             |
| 2014 | Novriyanti         | Sarolangun           | Jambi            | Ethnobiology, wildlife utilization, | [14]| Master thesis       |
|      |                    |                      |                  | Pangolin                            |     |                     |
| 2015 | Lusma              | West Bangka Islands  | Bangka Belitung  | Traditional medicine,               | [8] | Bachelor thesis     |
|      |                    |                      |                  | wildlife utilization                |     |                     |
| 2016 | Afriyansyah et al. | Bangka Lom Islands   | Bangka Belitung  | Ethnic Lom, traditional medicine    | [11]| Journal             |
|      |                    |                      |                  |                                     |     |                     |
| 2016 | Masyithah et al.   | Sarolangun           | Jambi            | Animal consumption, ethnozoology    | [7] | Journal             |
| 2018 | Paisal             | Sarolangun           | Jambi            | Animal utilization, traditional     | [10]| Bachelor thesis     |
|      |                    |                      |                  | medicine                            |     |                     |
| 2019 | Nukraheni et al.   | West Bangka Islands  | Bangka Belitung  | Jerieng ethnic, traditional medicine| [9] | Journal             |
| 2019 | Setyoko et al.     | Aceh Tamiang         | Nangroo Aceh Darussalam | Ethnobiology, Painted Terrapin | [15]| Journal             |

Note: There were 16 scientific papers of ethnozoology in Sumatra, and only 11 papers were related to reptiles and amphibians.
amphibians were used for meat (as frog leg) and for medicinal purposes. Interestingly, tadpoles, urine and eggs of frogs were also used for various health-related purposes.

**Figure 1.** Pictures of reptile species used by the local people in Sumatra. (a) *Naja sumatrana* - © Wolfgang Wüster; (b) *Ophiophagus hannah* - © Tom Charlton; (c) *Malayopython reticulatus* - © Bjorn Lardner; (d) *Python curtus* - © Maik Dobiey; (e) *Python molurus* - © Mark Auliya; (f) *Eutropis multifasciata* - © Claudia Koch; (g) *Varanus salvator* - © Tom Charlton; (h) *Chelonia mydas* - © Xanthe Rivett; (i) *Batagur borneensis* - © Douglas B. Hendrie; (j) *Notochelys platynota* - © Tom Charlton; (k) *Orlitia borneensis* - © Jérôme Maran; (l) *Amyda cartilaginea* - © Mirza D. Kusrimi; (m) *Dogania subplana* - © Tom Charlton; (n) *Crocodylus porosus* - © A. Susor;
3.2. Herpetofauna use and implication for conservation

This study revealed that most of the herpetofauna species used by local people of Sumatra were categorized as threatened species according to international and national laws. Among all reptiles, Painted Terrapin (CR), Green Sea Turtle (EN), and Malayan Giant Turtle (EN) have high conservation status from IUCN Red List (Table 4). Some reptiles also have high status in the international trade, either in Appendix I (i.e., Indian Rock Python) or Appendix II (i.e., Monitor Lizards, Saltwater Crocodile). In addition, five reptiles already protected by the Indonesian Law (Indian Rock Python, Green Sea Turtle, Painted Terrapin, Malayan Giant Turtle, and Saltwater Crocodile). For amphibians, no species is included neither in IUCN Red List species, CITES Appendix, or Indonesian Law, which imply that the amphibian species have currently low conservation status.

3.3 Discussion

The use of herpetofauna for medicinal purposes has been commonly practiced in many parts of the world, not only in Sumatra. Reviews on global use of herpetofauna revealed that at least 284 species of reptiles and 47 species of amphibians have been used as traditional medicine [17]. For this purpose, India has been reported to use herpetofauna quite intensively [18], so does Brazil [17,19,20].

Herpetofauna for subsistence consumption by rural community has been known to be a common practice in the tropical countries [21]. In this research, group of species commonly consumed by the local traditional people in Sumatra were turtles, snakes, and frogs. Turtles and large-size snakes were consumed due to their meat, while frogs were consumed most probably due to their taste. Eggs of turtles (both freshwater and sea) are also commonly consumed. Herpetofauna could be regarded as multi-purpose species, as almost all parts of their body and their product can be consumed and use for various purposes, including their meat, eggs, skins, shells, oil and even their faeces, in addition to body parts and organs. Biles were commonly used for various purposes (e.g., smallpox and other skin-related diseases, eye disease, fever), while blood were known to be popular for boosting stamina, similar to the practice of Chinese traditional medicine [22].
Table 2 List of herpetofauna species that have been used by local people in Sumatra for consumption and medicinal purposes.

| Class     | Suborder            | Species Name | Common Name           | Local Name                     |
|-----------|---------------------|--------------|-----------------------|-------------------------------|
| Reptilia  | Squamata            | Naja sumatrana | Equatorial Spitting Cobra | Ulae Sendok, Kobra [6]       |
|           |                     | Ophiophagus hannah | King Cobra          | Ular Tedung [7]               |
|           | Serpentes (snake)   | Malayopython reticulatus | Reticulated Python | Piton [6]; Ular Saba’ [8]; Ular Sabek/Sabak [9] [11]; Ular [10] |
|           |                     | Python curtus | Sumatra Python       | Ulo [12]                      |
|           |                     | Python molurus | Indian Rock Python   | Ulok Sa [13]                  |
|           |                     | Python sp.     | Python Snake         | Ular Pondok, Ular Sawo [7]    |
|           | Lacertilia (lizards) | Eutropis multifasciata | Common Sun Skink | Bingkaruang [6]               |
|           |                     | Varamus salvator | Common Water Monitor | Biawak [14]                   |
|           |                     | Varamus sp.    | Monitor Lizard       | Kuya Hana, Kuya Pungur, Kuya Kotom [7]; Biawak [10]; Kuyah [12]; Biaok [13] |
| Testudinata | Cryptodira (turtles) | Chelonia mydas | Green Sea Turtle     | Penyu Hijau [6]               |
|           | Geoemydidae sp.     | Turtles       | Kekura [8]; Kure-kure [9]; Kura-kura [11] |
|           | Batagur borneensis  | Painted Terrapin | Tungtung [15]       |                               |
|           | Notochelys platynota | Malayan Flat-shelled Turtle | Sibodo Mangkuk [7]; Sebodo [12] |
|           | Orlitia borneensis  | Malayan Giant Turtle | Biyuku, Pangko, Beneng | [7] |
|           | Testudo sp.         | Tortoises     | Kura-kura Darat [10]; Kura-kura [16] |
|           | Amyda cartilaginea  | Asiatic Softshell Turtle | Lelabi [7]; Labi-labi [14] |
|           | Dogania subplana    | Malayan Soft-shelled Turtle | Labi-labi [6] [10] [16]; Sesembung [7]; |
|           | Crocodylus porosus  | Saltwater Crocodile | Buaya [10] [14]; Buaya Muara [11] |
| Amphibia  | Crocodylia (crocodile) | Crocodylus porosus | Saltwater Crocodile | Buaya [10] [14]; Buaya Muara [11] |
|           | Anura (toads & frogs) | Bufo sp.     | Toads                 | Bertong [7]                   |
|           | Kaloula baleata     | Flower Pot Toad | Begetung [12]         |
|           | Hylarana erythraea  | Green Paddy Frog | Konek Hijau [6]       |
|           | Rana sp.            | Pond Frogs    | Katak [11]; Biyung [14] |
Table 3 The traditional use of herpetofauna for consumption and medicinal uses by local people in Sumatra; RFC - Relative Frequency of Citation.

| No | Latin Name         | RFC | Part Used         | Uses                                                                 | Source |
|----|--------------------|-----|-------------------|----------------------------------------------------------------------|--------|
| 1  | *Naja sumatrana*   | 0.09| Meat and skin     | Bone fracture and dislocate, bruised skin                           | [6]    |
| 2  | *Ophiophagus hannah*| 0.09| Meat              | Consumption                                                          | [7]    |
| 3  | *Malayopython reticulatus* | 0.45| Whole body        | Bone fracture and diseases, skin diseases                           | [6]; [8]; [9] |
|    |                    |     | Meat and skin     | Skin diseases, eczema, wounds, and allergy, diarrhea                 | [6]; [10] |
|    |                    |     | Feces             | Healing the wounds, skin disease                                    | [8]; [11] |
| 4  | *Python curtus*    | 0.09| Meat              | Consumption                                                          | [12]   |
| 5  | *Python molurus*   | 0.09| Blood             | Increasing the stamina                                               | [13]   |
| 6  | *Python* sp.       | 0.09| Meat              | Consumption                                                          | [7]    |
| 7  | *Eutropis multifasciata* | 0.09| Meat and skin     | Skin diseases, back pain, rheumatism, diabetes, leprosy, hemorrhoid, dyspnea, uric acid, toothache | [6] |
|    |                    |     | Bile              | Wounds, skin diseases                                                | [11]   |
| 8  | *Varanus salvator* | 0.09| Bile              | Consumption, sore eyes                                              | [14]   |
| 9  | *Varanus* sp.      | 0.36| Whole body        | Skin diseases                                                        | [10]   |
|    |                    |     | Meat              | Consumption, aphrodisiac, to maintain the body endurance             | [7]; [10]; [12]; [13] |
|    |                    |     | Bile              | Fever                                                                | [10]   |
| 10 | *Chelonia mydas*   | 0.09| Egg               | To increase the stamina and the body immunity                        | [6]    |
| 11 | *Geoemydidae* sp. | 0.27| Head              | Hemorrhoid                                                           | [8]; [11] |
|    |                    |     | Whole body        | Hemorrhoid                                                           | [9]    |
|    |                    |     | Liver             | Dyspnea                                                              | [11]   |
| 12 | *Batagur borneoensis* | 0.09| Egg               | Fever, increase stamina                                             | [15]   |
| 13 | *Notochelys platynota* | 0.18| Meat              | Consumption                                                          | [7]; [12] |
| 14 | *Orlitia borneensis* | 0.09| Meat              | Consumption                                                          | [7]    |
| 15 | *Testudo* sp.      | 0.18| Blood             | Dysentery                                                            | [10]   |
|    |                    |     | Meat              | Consumption                                                          | [16]   |
| 16 | *Amyda cartilaginea* | 0.27| Meat              | Consumption                                                          | [7]; [12]; [14] |
| 17 | *Dogania subplana* | 0.27| Whole body        | Impotence, premature ejaculation, prevent venereal disease (STDs)     | [6]    |
|    |                    |     | Meat              | Consumption                                                          | [7]    |
|    |                    |     | Bile              | Smallpox, eye disease                                               | [10]   |
|    |                    |     | Oil               | Skin diseases                                                        | [10]   |
|    |                    |     | Shell             | Rabies                                                               | [10]   |
| 18 | *Crocodylus porosus* | 0.27| Male genital      | Aphrodisiac, fever, resistant to cold                                 | [10]; [11]; [14] |
|    |                    |     | Teeth             | Toothache                                                            | [11]   |
| 19 | *Bufo* sp.         | 0.09| Meat              | Consumption                                                          | [7]    |
| 20 | *Kaloula baleata*  | 0.09| Meat              | Consumption                                                          | [12]   |
| 21 | *Hylarana erythrae*| 0.09| Meat              | Skin diseases, to increase stamina                                    | [6]    |
| 22 | *Rana* sp.         | 0.18| Tadpoles          | Deep wound                                                           | [11]   |
|    |                    |     | Urine             | Bitten by centipede                                                  | [11]   |
|    |                    |     | Egg               | Fever                                                                | [11]   |
|    |                    |     | Meat              | Consumption, toothache                                              | [11]; [14] |
Table 4 Conservation status of species commonly used by local people in Sumatra for consumption and medicinal purposes (CR: Critically Endangered, EN: Endangered, VU: Vulnerable, LC: Least Concern).

| No | Latin Name         | Common Name                      | IUCN | CITES | Indonesian Law |
|----|--------------------|----------------------------------|------|-------|----------------|
| 1  | Naja sumatrana     | Equatorial Spitting Cobra        | LC   | II    | Not Protected  |
| 2  | Ophiophagus hannah | King Cobra                       | NU   | II    | Not Protected  |
| 3  | Malayopython reticulatus | Reticulated Python | LC   | II    | Not Protected  |
| 4  | Python curtus      | Sumatra Python                   | LC   | II    | Not Protected  |
| 5  | Python molurus     | Indian Rock Python               | VC   | I     | Protected      |
| 6  | Python sp.         | Python Snake                     | -    | II    |              |
| 7  | Eutropis multifasciata | Common Sun Skink                | LC   | -     | Not Protected  |
| 8  | Varanus salvator   | Common Water Monitor             | LC   | II    | Not Protected  |
| 9  | Varanus sp.        | Monitor Lizard                   | -    | II    | Not Protected  |
| 10 | Chelonia mydas     | Green Sea Turtle                 | EN   | I     | Protected      |
| 11 | Geoemydidae sp.    | Turtles                          | -    | -     |              |
| 12 | Batagur borneoensis | Painted Terrapin              | CR   | II    | Protected      |
| 13 | Notochelys platynota | Malayan Flat-shelled Turtle     | VU   | II    | Not Protected  |
| 14 | Orlitia borneensis | Malayan Giant Turtle             | EN   | II    | Protected      |
| 15 | Testudo sp.        | Tortoises                        | -    | -     |              |
| 16 | Amyda cartilaginea | Asiatic Softshell Turtle         | VU   | II    | Not Protected  |
| 17 | Dogania subplana   | Malayan Soft-shelled Turtle      | LC   | II    | Not Protected  |
| 18 | Crocodylus porosus | Saltwater Crocodile             | LC   | II    | Protected      |
| 19 | Bufo sp.           | Toads                            | -    | -     |              |
| 20 | Kaloula baleata    | Flower Pot Toad                  | LC   | -     | Not Protected  |
| 21 | Hylarana erythraea | Green Paddy Frog                 | LC   | -     | Not Protected  |
| 22 | Rana sp.           | Pond Frogs                       | -    | -     |              |

In many parts of the world, herpetofauna often linked to religious practices [17]. In this study, however, there was no information regarding a religious practices or belief. In other part of Indonesia, namely in West Kalimantan, the local community used Asian Common Toad (*Bufo melanostictus*) and House Geckos (*Hemidactylus spp.*) in relation to good and bad omens [23,24], while the Dayak Tribe in the same areas also used the Flat-tailed House Gecko (*Hemidactylus platyurus*) as a mystic object for healing all kinds of diseases [25]. Thus, it does not mean that the religious practices related to herpetofauna were absence in Sumatra. It might simply overlook and surely need further research.

It is very likely that some herpetofauna species, mainly turtles, were accidental captures or by-catch, while snakes and monitors were casualties of human-wildlife conflict. The local people might not aware that the species they captured were actually protected by Indonesian law, as the local people in remote areas has limited access for numerous information and knowledge. Regardless the causes, cautions need to be taken when natural population of captured species were low, as indicated in the high values of conservation in the national and international level.

Of the species being used by the local people, the Painted Terrapin is the rarest and has the highest conservation status. IUCN has been listing this species as CR since 2003. This species is also listed as one of the 25 most critically endangered species in the world in 2018 [26]. Their eggs have been subjected to harvest with regards to belief that it can increase stamina and can be used as remedy for fever. A study in Aceh Province [27] revealed that illegal collections of Painted Terrapin for subsistence is still happening until now. This species has been very difficult to find in its natural habitat. Without proper conservation effort, the population of Painted Terrapin could become scarcer and lead to local extinction.

Considering various aspects discussed in this study, including the fact that local people in Sumatra and other countries, it is necessary to conduct further research to confirm the benefit of herpetofauna to cure numerous diseases and to improve health. However, conservation issues, to ensure the survival and sustainability of the exploited species, need to be considered as well. If necessary, captive
breeding can be initiate for some low-level population number but potentially harvested for various purposes in the future.

4. Conclusion
The local people in Sumatra have been using 22 species of reptiles and amphibians for various subsistence purposes, mainly for consumption and traditional medicine. Among the species being used, 8 species were threatened species, of which the local people might not aware of. The traditional uses of species that already have a high conservation status need to be managed properly to ensure their survival and sustainability.

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