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Literature Review: Distribution, Ecology, History and Conservation of Painted Terrapin (*Batagur borneoensis* Schlegel and Muller 1845) in Indonesia

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Abstract

Painted terrapin *or Batagur borneoensis* is one of critically endangered turtle species in Indonesia. Few researches have been conducted in Indonesia to study this species. Our research analyses reports and previous research on distribution, ecology, history and conservation of *B.borneoensis.* This species sustainability depends strongly on the nesting beach condition, mangrove ecosystem sustainability and river condition. Current policies of *B.borneoensis* conservation in Indonesia have yet to pay sufficient attention to its habitat and distribution, utilization by local communities, social-economic conditions of coastal communities, overlapping regulations, clear roles and contributions of related stakeholders. There have been some ecology studies, to our knowledge, however there has been no study previously conducted on *B.borneoensis* conservation policy.

Keywords: B.borneoensis; policy; habitat; population.

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1. Introduction

It is estimated that globally the total species of fresh water turtle was 300 species where where 29 species can be found in Indonesia with 5 species endemic to Indonesia [7]. More than half of these species (17 out of 29 species) has been classified as critically endangered species due to habitat destruction and over hunting for flesh consumption and trading as pet [21]. However, only 6 out of 29 turtle species have been protected within current regulation in Indonesia. In addition, 2 species was listed under CITES appendix I and 4 species in CITES appendix II (Table 1). 23 turtle species in Indonesia can be traded legally on domestic and international market. Trading and hunting has been prohibited for 6 protected species (Table 1). Moreover, permit for hunting and exporting species that have not been scientifically assessed are also halted. Thus, no harvest or trade quotas are issued for the these species.

B.borneoensis has a unique characteristic compare to other turtles in Indonesia. This species is one among the 3 species that can be found in mangrove ecosystem together with Batagur baska dan Batagur affinis. However, *B.borneoensis* is the only species that has a specific behaviour to migrate from fresh water to coastal area during nesting season. Therefore, its sustainability relies heavily on mangrove ecosystem sustainability, river and nesting beach condition.

Threats on biodiversity the conservation are generally due to habitat destruction and degradation, invasive alien species introduction, environmental pollution, disease and parasite, unsustainable utilization and climate change effect. Specifically, declining population of *B.borneoensis* in the wild habitat was due to trading as pet, human consumption both for flesh and egg and habitat destruction [4].

In the period of 1982-1986, *B.borneoensis* was classified as Vulnarable species *(V)* which later upgraded into Endangered (E) during 1998-1994. The conservation status was later updated as *Critically Endangered* (CR) species which indicates decreasing 80% of population size within the last 10 years or 3 generations [12]. International trade of this species since 1997 has to comply with Appendix II of CITES *(Convention on International Trade in Endangered Species of Wild Fauna and Flora)* regulation. Trading of this species collected from its natural habitat has also been prohibited since 2005 up until today as the implementation of the zero quota regulation. Painted terrain is also listed in the 25 most endangered turtle species in the world [20]. The Increasing status of *B.borneoensis* threats showed the importance this species conservation.

Policy is one of wild life conservation approaches. Conservation policies implementation without adequate consideration on ecological, socio-cultural and institutional aspects have been reported as a failed approach [10] [18,22]. Those researchers conducted their study on turtles and mahakam dolphins.

Thus, it is important to asses ecological, socio-cultural and governance in developing alternative conservation policies for *B.borneoensis* in order to capture the three conservation concept including protection, preservation and utilization. This paper elaborates important information in conserving *B.borneoensis* species. The information includes *B.borneoensis* characteristics, habitat distribution, review of existing regulations and utilization. Examining the latest ecological, socio-cultural and institutional data will enable us to formulate

suitable *B.borneoensis* conservation policy.

Table 1: Turtle species in Indonesia and its conservation status according to IUCN red list, CITES and protected species under Indonesian regulation (PP No.7/1999). IUCN red list categories include: CR= *critically endagered*, DD= *data deficient*, EN=*endangered*, LR = *lower risk*, VU= *Vulnerable*, - = unlisted ;C= listed in CITES appendix CITES (I,II; -=unlisted). DI= Protection status in Indonesia (D=Protected; -=unprotected) [11] [12] [13]

Taxonomy	IUCN 2010	CITES	DI
Testudines-Turtles and Tortoises			
Carrettochelydae			
1. Carrettochelys insclupta	VU	-	D
Chelidae			
2. Chelodina mccordi	CR	-	-
3. Chelodina novaeguineae	-	-	D
4. Chelodina parkeri	VU		
5. Chelodina reimanni	LR	-	-
6. Chelodina siebenrocki	LR	-	-
7. Elseya branderhorstii	VU	-	-
8. Elseya novaeguineae	-	-	D
9. Emydura subglobosa	-	-	-
10. Macrochelodina rugosa	-	-	-
Dermochelydae			
11. Dermochelys coriacea	CR	I	D
Bataguridae			
12. Batagur baska	CR	I	D
13. B.borneoensis	CR	II	-
14. Cuora amboinensis	VU	-	-
15. Cylemys dentate	LR	-	-
16. Heosemys spinosa	EN	-	-
17. Leucocephalon yuwonoi	CR	-	-
18. Malayemys subtrijuga	VU	-	-
19. Notochelys platynota	VU	-	-
20. Ortilia borneoensis	EN	-	D
21. Stebenrocktella crassicollis	VU	-	-
Testudinidae			
22. Indotestudo forstenii	EN	II	-
23. Indotestudo elongate	EN	II	-
24. Manouria emys	EN	II	-
Trionychidae			
25. Amyda cartilaginea	VU	-	-
26. Chitra chitra	CR	-	-
27. Pelochelys bibroni	VU	-	-
28. Pelochelys cantorii	EN	-	-
29. Dogania subplana	-	-	-

2. Materials and Methods

The method used in writing this article is the literature review, which is a search for international and national literature conducted using the EBSCO, ScienceDirect, and Proquest databases from 2014 to 2016 using "painted terrapin conservation" and "conservation policy" keywords, identified that not yet explored relevance with articles to compile. Found only about 53 articles considered relevant.

3. Finding

3.1. Distribution and Habitat

B.borneoensis distribution in Southeast Asia is limited in various areas including in the southern parts of Thailand, Indonesia, Malaysia and Brunei [8,9,16,17,22]. In Indonesia alone, this species can only be found in Sumatra and Kalimantan. In Sumatra it occurs in the east coast of Sumatra including in Aceh Tamiang District (Aceh), Langkat District (North Sumatra) and Riau. In Kalimantan, it can be found in the west coast areas and in the southern coast of Kalimantan. *B.borneoensis* distribution is restricted to the coast areas, especially in lower course rivers that have mangrove forests [16,17,21].

There is lack of information on *B.borneoensis* microhabitat [16,17]. The presence of *B.borneoensis* is also influenced by salinity and availability of Sonneratia spp in the mangrove ecosystem as the main feed source [16,17]. *B.borneoensis* can be observed near large rivers and lower course areas with salinity range from 0 to 50% [4,5,8,9]. *B.borneoensis* generally lives in river with 0 salinity level and located around 2.1 miles from nesting beaches. The dominant plant species of painted terrain areas are Sonneratia sp and Nypa fruticans [8,9].

A relatively complete report on *B.borneoensis* habitat in Indonesia is available only for Aceh. Thera are three main nesting beaches in Aceh include Pusong Cium, Kuala Genting and Kuala Berango [8,9]. The dominant vegetation in these locations were Sonneratia sp., Rhizophora apicullata, Rhizophora mucronata, Avicenia sp., And Nipa fruticans.

3.2. Ecology and Life History

B.borneoensis is a large fresh water turtle. the maximum carapace length of *B.borneoensis* was 60 cm. The average weight of *B.borneoensis* is 10,9 kg [2,8,9]. No literature was found on growth rate of this species.

Age estimation for male species can be done based on seasonal dichromatism or changing body pattern colour, while for female from the morphological assessment. Female and male *B.borneoensis* reached sexually-mature age at carapace length around 50 and 40 cm respectively [2]. A study in Perak river found the average length of Straigh Carapace Length (SCL) of male sexually-mature age was 28cm [16,17].

B.borneoensis is active both during the day and at night. Daily behaviors of *B.borneoensis* are influenced more by tidal compared to other factors [16,17]. This species also generally settles along the riverbanks and creeks which are affected by tidal throughout the year. When the tide rises, *B.borneoensis* moves to river due the flow pressure luckily to areas with abundant food supply. In natural conditions, adult *B.borneoensis* is a herbivore species mostly eating riparian plants including grass, aquatic plants,fruit of Pandanus spp and some parts of Sonneratia spp. including fruit, flowers and buds [16,17]. Juvenile individuals consume more small animal such as mollusks to obtain enough calcium to grow which at later state will become herbivores also when they become adults.

Reproduction of *B.borneoensis* is similar to other large freshwater turtles where they migrate seasonally and nesting communally in the same location where their was born. *B.borneoensis* is generally regarded as a beach

nesting turtle [16,17] but in some places this species is known to nest on river bank for example in Perak, Muda, Dungun, Terengganu and Besut river. During the nesting season, the adult female migrates annually as a group to find sandy areas as nesting place on the beach. Unlike the female, adult male *B.borneoensis* do not migrate to nesting beaches . Female turtle travels approximately 3 - 20 km from the river bank to nesting beaches [2,9].

Nest depth of *B.borneoensis* was around 17.1 cm. The average temperature of incubation nest is 29.2^{o}C. The average nest distance from the coastline and the nearest vegetation cover were 28.9 m and 15.4 m respectively. The average size of the egg is 8.72 cm long and 5.54 cm wide [6].

B.borneoensis females can lay eggs at least twice per season. One nest of painted terrain has around 15 eggs [16,17]. Number of egg per nest ranges from 12-18. The average of egg diameter was 6.8 cm and the average weight was 6.6 g. The incubation period of each nest is different. Hatching time was in the range of 75-95 days [8,9]

3.3. Conservation Challenges

Relatively sufficient information on *B.borneoensis* population in Indonesia is only available for Aceh Tamiang District, whereas in other areas the information remains unexplored. We suggest that it is likely that in some areas this species experiencing threats in its natural habitat. In Aceh alone, there are around 23 adults recorded in Aceh Tamiang [8,9] while in other areas such as Langkat there were only 2 adults left [14]. The main problem of *B.borneoensis* conservation is habitat destruction and poaching. The pressures on *B.borneoensis* habitat in Aceh Tamiang were due to oil palm plantations development, fishponds, logging of charcoal wood, hunting of turtle flesh and eggs [8,9].

The conservation obstacle of the species in Langkat North Sumatra is the decreasing of sandy areas as the nesting habitat due to abrasion and sedimentation of rivers, egg gathering, use of fishing nets around the nesting habitat, crab hunting activities and garbage in nesting locations [14]. However, further research on the impact of these disturbances on turtle population has not been carried out. Thus, we suggest further research is necessary to examine impact of each threat including on the size of habitat changes to formulate policy and decision making of *B.borneoensis* protection.

B.borneoensis is traded internationally as living specimens for flesh (adult individuals) and pets (juvenile) [22]. International trade of *B.borneoensis* from Indonesia was done from 1990 to 2001. *B.borneoensis* was exported to Japan, Switzerland, Hungary, Malaysia, the Netherlands, Russia and the United States. The United States is the major importing which accounted for 76% of the total exports. The traded animals were collected from its natural habitat with a certain quota. However, The quota continues to decline from 450 in 1999 to 180 individuals in 2000 and 2001. Indonesia stopped *B.borneoensis* export in 2001 after the imposed of zero export quota. Since 2005 until today B .borneoensis is listed in CITES Appendix II with zero quotas for specimens captured from the natural habitat [12].

Egg of *B.borneoensis* is commonly consumed by local community in Malaysia and Indonesia [1,8,9,22]. In Indonesia, gathering the egg by local community is recorded in Aceh Tamiang District.

Hunting of *B.borneoensis* eggs by the local people in Aceh Tamiang during spawn period is known as the 'mentungtong' tradition. During 'mentungtong' community collects all eggs that they find in the nest. Eggs are usually use as protein source by community while some will be traded to obtain some cash [1,8,9]. The price of one egg was around IDR 5000-6000. In addition, this turtle is also hunted to be sold in the market. The price of one *B.borneoensis* was IDR 20,000- 30,000 [6,7]. Based on preliminary observations conducted through unstructured interviews from 19 to 24 October 2015, We found that the hunting and trading of *B.borneoensis* eggs took place in several villages in Aceh Tamiang including Pusong Kapal, Kuala Genting and Kuala Penaga.

Research on behavior of community that hunting this turtle and egg at local scale in Aceh Tamiang District has not been carried out. Until now, there has been no data on the estimate number of egg collected by local community in Aceh Tamiang as well as in other natural habitat where this turtle is distributed. We suggest this type of study is important to estimate the actual pressure of the community hunting practice on population of *B.borneoensis*. These data play an important role in determining *B.borneoensis* conservation policies by considering community hunting behavior and turtle population size.

3.4. Recommendatios to strengthen B.borneoensis conservation

A successful wildlife conservation strategy depends on integration of different interests of the stakeholders. The stakeholder includes government, private sector, NGOs and the community. Species conservation can be executed when community understand and support the idea of preserving the species as an important subject [15]. Similar concept by introducing community-based conservation which states that the success of conservation is based on meeting the needs and expectations of the local community [3]. Therefore, it is pivotal to asses local community understanding on the importance of *B.borneoensis* species.

Examples of community-based conservation have been carried out in Vietnam for the turtle conservation project in Cuc Phuong area. This project was a model of turtle rescue project in the Southeast Asia region that can be replicated in other countries. The project was developed through community-based conservation and education involving 35 schools and 15 multidisciplinary community groups including group of researchers in social, economic and biological fields. The Cuc Phuong project has successfully managed the pressure and threat of illegal turtle trade due to high market demand from China since the 1990s until today.

B.borneoensis conservation programs by community groups in Aceh Tamiang District have yet to be done comprehensively. *B.borneoensis* protection programs that have been carried out was patrol to secure nesting habitat conducted by Satu Cita Lestari Indonesia Foundation in collaboration with Aceh BKSDA officers, Indonesian Navy and Police. However, due to limited government fund and personnel, the intensity of the security patrol is low and considered as incidental activity.

Protection of egg location and egg hatching in captivity have been conducted by the Satu Cita Lestari Indonesia Foundation starting in 2010 until now. However, the result is far below the number of eggs that illegally collected by the community. Breeding efforts is also being carried out by the Department of Maritime Affairs and Fisheries, however it is still in early stage including providing breeding facilities and infrastructure. First

attempt to hatch the egg conducted by the Department of Marine and Fisheries was also failed. None of the 500 eggs were successfully hatched [8,9].

Relatively successful *B.borneoensis* conservation activities have been performed by Malaysian. In this country, *B.borneoensis* Conservation was took place since the beginning of 1988 by the Department of Fisheries Malaysia (DOFM) through *B.borneoensis* ecological studies in Kuala Setiu, Trengganu and breeding efforts by PERHILITAN at the Wildlife Conservation Center (PKHL) which aimed at increasing the number of *B.borneoensis* population through captivity.

The PKHL conducts *B.borneoensis* egg collection to be incubated. Eggs were collected from egg hunters who have a legal permit. These hunter also being offered some incentives to hatch egg and raise the turtle cub that later can be released into the nature. The population number of *B.borneoensis* in PKHL of Bukit Pinang and Bota Kanan was 302 and 463 respectively. In addition to government initiatives, *B.borneoensis* breeding activities in Malaysia also involve other stakeholders including NGOs, universities, businesses and local communities. WWF-Malaysia in collaboration with local communities, local governments and several turtle conservation partners have carried out *B.borneoensis* conservation in Setiu Beach of Trengganu since the 1980s. The hatchery center in Kuala Setiu is jointly managed by WWF-Malaysia, the Setiu Regional Assembly, Kelab Marina UMT, the Women's Association of Kampung Mangkok Setiu, Penarik Inn and Djungle group. The hatchery can accommodate 200-300 turtle nests. This rescue center is also used as a tourist destination to provide additional income to the government and the local community.

In 1999 KUSTEM University was also involved in *B.borneoensis* conservation in Malaysia's Setiu River. This project activities include saving and hatching eggs in captivity. The breeding project successfully released 75 hatchlings in 2003. However, decreased number of turtle nests at Setiu River in 2014 compared to 2009 from 69 to 114 nests [1]. Unlike in Indonesia, *B.borneoensis* in Malaysia has been protected by the central government based on regulation 716 concerning the 2010 Wildlife Conservation Act, which was issued on 28 December 2010. This regulation stipulates financial penalty of RM. 500,000 and imprisonment of up to 5 years to anyone who violates the regulation by possessing, confining, or collecting *B.borneoensis* eggs without permission from the government .

While being listed as critically endangered species in the IUCN red list,this species has not been included in the list of protected animal by the central government in Indonesia. Nonetheless, this species is included in the high priority animal list for national conservation based on Minister of Forestry Decree No. P.57 / Menhut-II / 2008 concerning Strategic Direction of National Species Conservation 2008-2018.

This species is also protected under local regulation the Aceh Tamiang District through Regent Regulation No. 2/2014 concerning *B.borneoensis* Protection and Preservation, Decree No. 63/2014 on the of Painted Terrapin (*B.borneoensis*) determination as Protected Animals in Aceh Tamiang District and Qanun (shariah law) of Aceh Tamiang District No. 3/2016 on Painted Terrain Species Protection. Local protection by the Aceh Tamiang District is the only local initiative to protect painted terrain in Indonesia. Similar initiative is also available for other species established by local governments in West Java. For example, the protection of Belawa Turtles by

the Cirebon District Government based on the Regent's Decree No. 522.51 in 1993 on Flora and Fauna of Cirebon and Regional Regulation No. 13 in 1997 concerning Management of Protected Areas which stipulates Belawa Villages as Wildlife Reserve Areas. The Regent's Decree has enabled cooperation of the different stakeholders to facilitate the conservation of Belawa Turtles through scientific research and captivity.

The district regulations issued by government of Aceh Tamiang regulate the establishment and arrangement of captivity areas; protection and safeguard of captivity area, mangrove ecosystem and coastal areas protection as *B.borneoensis* habitat; the rights and obligations of the community in the conservation; establishment of captivity area management; and funding arrangement.

The regulations issued by the local government need to be analyzed further to assess the effectiveness of the regulations on *B.borneoensis* conservation in Aceh Tamiang district. In addition, it is also important to examine the level of stakeholder commitment to implement the regulation. Management of natural resources including conservation of *B.borneoensis* is influenced by a complex factors including socio-economic, environmental and socio-cultural. It is well known that indeed the natural resource management is a complex and dynamic system. Therefore, *B.borneoensis* management policy implemented by local governments at local scale requires improvement and availability of potential options so that it can adapt according to local conditions. One approach to determine and obtain *B.borneoensis* conservation management policies is to assess local socio-economic conditions. The approach to the concept of social capital is important for people to gain access to power and resources that are instrumental in strengthening decision making and policy formulation [19]. Threats to the habitat and population of *B.borneoensis* in addition to characteristics of local community in the nesting areas who utilize this species are the supporting reasons why *B.borneoensis* conservation policy model should accommodate the interests of local communities and at the same time maintain *B.borneoensis* population in its natural habitat. Sustainable benefits from *B.borneoensis* conservation to the relevant stakeholders can be done through institutional arrangements. This needs proper studies on legislation and regulation community right on the management of *B.borneoensis* and their habitat.

Based on our elaboration earlier, it is pivotal to examine the role of related stakeholders in determining *B.borneoensis* conservation policy in order to be relevant to different challenges faced by each parties at the local scale. The social and cultural study is an important complementary material in addition to ecological research.

Conservation policy including establishment of a protection area for the species sustainability will require district governments involvement where *B.borneoensis* is distributed. We urge that they have to collaborate with provincial government (Provincial Forest Management Units and Provincial Fisheries and Fisheries Offices) and central government (Natural Resources Conservation and National Parks).

Nesting habitat area authority is under the provincial government (Provincial Marine and Fisheries Service) according to Law No. 23 of 2014 on Local Governments which, among other things, regulates the expansion of provincial authority in the management and supervision of the sea. Initially, provincial authority was responsible to manage coastline from 4-12 miles however now is being expanded into 0-12 miles. This brought an

implication of increasingly difficult sea monitoring. Mangrove ecosystems and freshwater rivers, as the feeding habitat, are located in the forest area under the authority of the provincial government (KPH) as well as the central government (BKSDA and National Park), while feeding areas outside forest area is the under authority of the local government district / city.

We urge that local governments to develop policies that manage *B.borneoensis* utilization by the community and at the same time sustain the socio-cultural aspects of coastal communities. We also propose that district governments to establish a policy framework to encourage private companies involvement in protecting *B.borneoensis* and its habitat for example in watershed area through Corporate Social Responsibility.

4. Conclusion

The conclusion of this study is that there are policy innovations to improve *B.borneoensis* conservation performance in Indonesia, especially in Aceh Tamiang District. The policy innovations are mainly: (1) Establishment of a Coordination Body to improve coordination and communication among stakeholders, (2) raising funds to support *B.borneoensis* conservation programs, (3) strengthening the capacity of *B.borneoensis* conservation management agencies. The conclusion is a synthesis of the research findings in the form of a fairly extensive *B.borneoensis* habitat but spatial policies and designation of forest areas that do not support *B.borneoensis* conservation, *B.borneoensis* populations are still viable, weak internal factors of *B.borneoensis* conservation organizations (lack of source human power, not yet established marine conservation coordinating institutions, and limited funds) and external factors of the organization (community support, stakeholder support, support of key stakeholders, infrastructure utilization, access to funds and tourism development programs that provide great opportunities for successful *B.borneoensis* conservation.

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