A Report on the Status of the False Gharial (*T. schlegelii*) in Sumatra, 2016

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NATIONAL GEOGRAPHIC

Crocodile Specialist Group

Project Sponsors
IUCN Crocodile Specialist Group (*Tomistoma* Task Force) and National Geographic

Acknowledgements

This work would not have been possible without the funding and assistance from the IUCN Crocodile Specialist Group (*Tomistoma* Task Force) and National Geographic. We thank individuals who took the time to answer technical and logistical questions before and after this research took place. We appreciate the information provided by Grahame Webb, Charlie Manolis, and Tom Dacey prior to this project being started. Mark Bezuijen provided information regarding field work in Sumatra, which proved to be very helpful. Likewise, Agata Staniewicz provided detailed information regarding the research permitting process in Indonesia. Bruce Shwedick provided invaluable technical and logistical advice as well as feedback about research. Rob Stuebing, Mark Auliya, Wolfgang Böhme, Romulus Whitaker and Adam Britton were very helpful in gathering information about Tomistoma museum records and morphometrics. We are grateful to representatives of LIPI at the Museum Zoologicum Bogoriense for facilitating the study of crocodiles in Indonesia, as well as field research permits. We are grateful to the Ministry of Research and Technology of the Republic of Indonesia (RISTEK), for coordinating and granting research permissions. The Forestry Department of Indonesia kindly provided research permits for areas under their jurisdiction. We thank the local communities for their support, advice and kindness during our travels. We thank the members of the field expeditions throughout Sumatra, especially Wayhu Trilaksono. Park directors and officials at Berbak National Park were very helpful and their patience and assistance are much appreciated. We thank Agustinus Rante Lembang and Pak Dodi Kurniawan for their support. We thank Riziko and Rini for all their help. Imron and Rizal Andi Saputra helped a great deal. A special thanks to Pak Kasno, without whom travel through the dry season would not have been possible. There are many others who helped a great deal, including Alias, Bagas, Ferry, Muslimin in Berbak National Park and Khairil, Suandi and Udi in the Lower Kampar River System.

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SUMMARY AND RECOMMENDATIONS

Summary— This report describes the results of False Gharial (*Tomistoma schelegelii*) and Saltwater Crocodile (*Crocodylus porosus*) surveys conducted between 2014 and 2015. In 2015, we surveyed 10 tributaries in two separate river systems of Sumatra. Including the Lower Kampar River System (LKR), Riau Province, and Air Hitam Laut River (AHLR) System, Jambi Province. We focused mostly on *T. schlegelii*, but did collect data on *C. porosus* as well. We also include important information from our preliminary report in 2014 (Shaney et al. 2015). Interview information and survey results from our 2014 field work are included in the totals in this document; however, readers should refer to Shaney et al. (2015) for thorough mapping and area status information in the Bukit Batu/Giam Siak Kecil, Lalan River System (Including the Merang River), and Simpang Kanan River System (SKR). New mapping information, survey results and interview information from our 2015 field season in the LKR and BNP study areas are provided here.

In Riau Province, we confirmed the presence of *C. porosus* throughout the Lower Kampar River (LKR) System which had not been previously surveyed for crocodilian activity. We also confirmed the presence of *T. schlegelii* in a tributary of the LKR, in the Kerumutan River, which had not been previously surveyed. The *T. schlegelii* found in the Kerumutan River was found in a village, already deceased after drowning in a fish trap. The skin and skull were collected and brought to the Indonesian Institute of Science (LIPI). To the best of our knowledge, this is the first confirmed documentation of *T. schlegelii* in the Kerumutan River to date.

We recorded high *C. porosus* densities in the lower AHLR, Berbak National Park (BNP). However, these densities were highly skewed toward hatchling sightings. We also confirmed the persistence of *T. schlegelii* in the middle and upper AHLR, which has not been surveyed since Bezuijen et al. 2002. We surveyed two tributaries of the AHLR (Simpang Kubu and Simpang T), which had never been previously surveyed for crocodilian activity. No crocodilian sightings were recorded in Simpang Kubu, although dry season conditions precluded complete survey work into the far reaches of the upper tributary. High *T. schlegelii* densities were recorded in Simpang T, including multiple hatchling, juvenile and adult individuals. We recorded additional *T. schlegelii* sign and track marks throughout Simpang T. Most notably, we collected two *T. schlegelii* egg shells which had already hatched, as well as a 65 cm (Dorsal Cranial Length) *T. schlegelii* skull that was submerged in billabong (probably less than two years old).

We recorded the conditions of tributaries throughout our study areas and provide new maps for tributaries of the upper AHLR, with data that we believe has never been previously recorded. Some of the tributary names reported here are not recorded on local Indonesian maps or in past crocodilian surveys of the area, including Simpang T and Simpang Kiri creeks.We also review data from previous *T. schlegelii* studies in Sumatra and compare historic and contemporary data.

Recommendations

- Eliminate the use of fish traps in remaining patches of *T. schlegelii* habitat,
- Reconsider the conservation status of *T. schlegelii* as locally "Endangered" in Sumatra,
- Expand existing reserves around the Lower Kampar River (LKR) and Berbak National Park (BNP) study areas,
- Prioritize crocodile population surveys in remaining suitable habitat across the Sunda Region, particularly in remote areas.
- We recommend BNP be considered a key location for the preservation of *T. schlegelii* and *C. porosus*. Additional surveys are required on the upper Simpang Melaka, Simpang Kubu and Simpang T tributaries of the Air Hitam Laut River for *T. schlegelii*. Simpang Kiri is located in the center of BNP and based on local information (by an individual considered extremely reliable) Simpang Kiri likely holds the highest *T. schlegelii* densities in the park. The Benu River has not been surveyed since 2002 (Bezuijen et al. 2002) and never in depth. Therefore, we recommend additional survey work be conducted on the Benu River.
- The LKR system requires continued crocodilian survey work, especially in upper tributaries that could not be surveyed during our study because of dry season conditions; particularly the Eka River (a tributary of the Kerumutan River), the upper Serkap River, the upper Turip River and the upper Kutup River.
- The Giam Siak Kecil/Bukit Batu Reserves of Riau Province require immediate survey work and have still never been surveyed, although interviews with locals living near the reserves suggest the presence of *T. schlegelii*.
- We believe Sembilang National Park (South Sumatra Province) has never been previously surveyed and may be a stronghold for *C. porosus*.
- Additional areas for future research considerations: The persistence of False Gharials in Way Kambas National Park (Lampung Province) and Ujung Kulon National Park (West Java Province) is unlikely; however, these areas have not been surveyed for many years. These may be considered moderate priority survey areas if time permits. Based on local news reports and crocodilian attacks, *C. porosus* still persist in Way Kambas NP and Sumatra Selatan NP, suggesting those areas could be important for long term *C. porosus* viability.

1.0 Introduction

Indonesia is one of the world's most crocodilian diverse countries and at the epicenter of human-wildlife conflict. The Saltwater Crocodile (*Crocodylus porosus*, Schneider 1801) is found across most of Indonesia (Kurniati 2007, Webb et al. 2010) and is considered the largest crocodile in the world, growing to over 20 feet in length (Webb and Manolis 1992, Whitaker and Whitaker 2008). *Crocodylus porosus* is a coastal species, typically occurring in saline or brackish environments although individuals have been documented hundreds of kilometers inland in freshwater tributaries (Webb et al. 2010). *Crocodylus porosus* are considered a major threat to humans and livestock and have been implicated in more attacks on humans than any other crocodilian species in the last 20 years (http://www.crocodile-attack.info/). Furthermore, *C. porosus* skin exports are some of the highest in the world. From Indonesia alone, exports consisted of over 25,000 *C. porosus* parts in 2012 (http://trade.cites.org/) and overall exports from Indonesia have steadily increased since 2000 (http://trade.cites.org/). *Crocodylus porosus* are listed as a CITES appendix II species, and trade within Indonesia is only legal from the eastern provinces of Papua and West Papua. *Crocodylus porosus* is listed as "Least Concern" on the IUCN Red List, but their population status across most of Indonesia is unknown, particularly across much of the Greater Sunda Region (GSR, Webb et al. 2010).

The False Gharial (*T. schlegelii*, *Müller* 1838) also inhabits the GSR and is considered one of the least understood crocodilians in the world (Bezuijen et al. 1995, 1997, 2001, Auliya et al. 2006, Stuebing et al. 2006). They primarily inhabit black water, peat swamp forest, but unfortunately the majority of lowland swamp forest in the GSR has been lost due to deforestation throughout the region (Sodhi et al. 2004, Miettinen et al. 2014). *T. schlegelii* are a CITES Appendix I species and were listed as "Endangered" on the IUCN Red list until an update in 2014 changed the status to "Vulnerable" (http://www.iucnredlist.org/details/21981/0). Despite the recent status update, data on the population biology of *T. schlegelii* is sparse or nonexistent across most of the species' range. Simpson et al. (2014) conducted spotlight surveys in Peninsular Malaysia and suggest that *T. schlegelii* is nearing extirpation on mainland Asia after no sightings were recorded. Very little is known about populations on the Malaysian side of Borneo (Stuebing et al. 2004). Two *T. schlegelii* individuals were documented from a small, isolated area in Ujung Kulon National Park, west Java (Stuebing et al. 2006); however, no recent surveys have been conducted in order to confirm the persistence of that population. Given the lack of remaining primary habitat in Java, *T. schlegelii* is likely near extirpation there as well. Surveys have identified isolated *T. schlegelii* populations across the island of Borneo (Bezuijen et al. 2004, Auliya et al. 2006 Stuebing et al. 2006, Bonke et al. 2008, Staniewicz et al. 2010, Stuebing et al. 2014), and relatively high density populations have been documented in in

several locations (e.g. Lake Mesangat, East Kalimantan; Tanjung Puting National Park (TPNP), South Kalimantan).

T. schlegelii research in Sumatra has been particularly underrepresented and only 100 confirmed *T. schlegelii* records have been documented from the island (see Stuebing et al. 2006). Cox et al. (1990) and Bezuijen et al. (1995, 1997, 2001, 2002) identified populations in Jambi and South Sumatra Provinces within the Air Hitam Laut (AHL) and LR Systems (respectively). Bezuijen et al. (1997) note anecdotal evidence of *T. schlegelii* in Riau Province's Kubu and Teso Rivers; however, no confirmed sightings were recorded during surveys. Bezuijen et al. (1997) provided anecdotal evidence for the persistence of *T. schlegelii* in Way Kambas National Park, Lampung Province; however, no recent surveys have been conducted within the park. Follow-up surveys in most areas of confirmed activity have not been conducted for at least 13 years across Sumatra and many areas remain un-surveyed for False Gharial activity in Sumatra.

Here, we present the results of crocodilian surveys conducted between 2014 and 2015 across various locations in Sumatra and we also compare this data with surveys conducted in the past. We report all new data from 2015 and summarize data from 2014 surveys (Shaney et al. 2015).

2.0 Methods

2.1 Study Areas

We surveyed four study areas during 2014 and 2015, including the AHLR System, Lalan River (LR) System, LKR System and Simpang Kanan River (SKR) System. Fig. 1 provides an overview of all study areas, while each section below discusses each study area in greater detail.

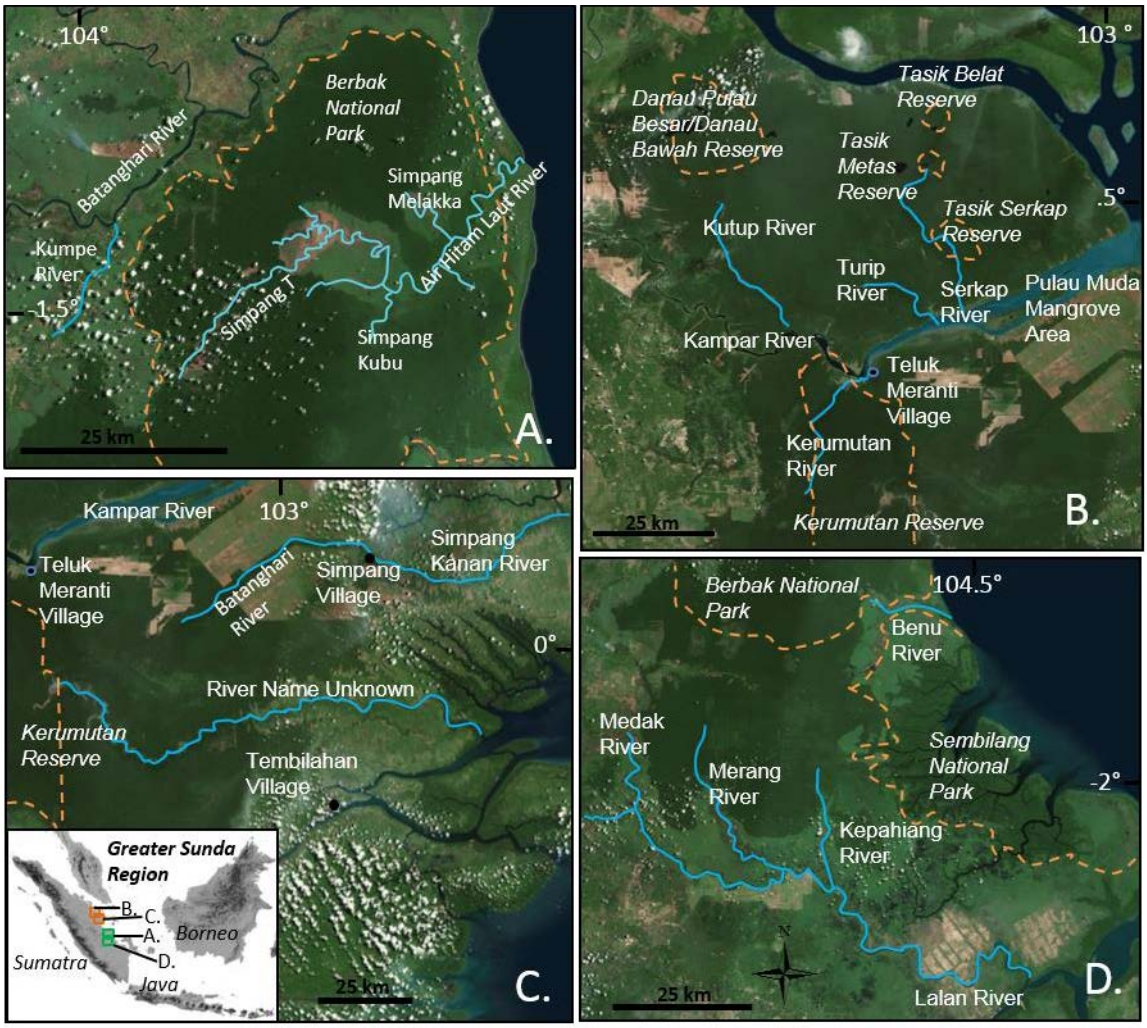

Fig. 1. A. BNP study area (BNP), intersected by the AHLR, B. LKR study area (LKR), C. Simpang Kanan study area (located immediately to the southeast of the LKR study area), D. LR System study area, located South of BNP. In the large inset map of the region, green boxes indicate areas previously surveyed, orange boxes indicate areas not previously surveyed.

2.1.1 Berbak National Park (Air Hitam Laut River), Jambi Province

BNP was previously surveyed by Cox et al. (1990) and Bezuijen et al. (1997, 2002). BNP is located along the southeastern edge of Jambi Province and includes one of the largest remaining tracts of peat swamp forest habitat in the world (Fig. 2). The park is intersected by the AHLR System and encompasses branches of the Batanghari River in the North (Air Hitam Dalam Tributary) and Benu River in the South. There are several main tributaries that pour into the AHLR, including previously mentioned tributaries, such as Simpang Melaka and Simpang Gajah on the lower sections of the AHLR.

Simpang T and Simpang Kubu tributaries require additional comment, because this study presents the first survey information for those tributaries. Simpang Kubu is located approximately 40 km upriver from the mouth of the AHLR and branches off to the South. We surveyed approximately 6 km of Simpang Kubu, which is quite small and only the first 1 – 2 km

can be travelled with the aid of a motor. The rest of the upper Simpang Kubu tributary must by travelled by canoe only. The tributary is surrounded by primary swamp forest and appears to receive very little human pressure. During the dry season there are no villagers or fisherman who visit the area, because low water levels and thick *Hanguana* mats make travel to the tributary extremely difficult. Based on local information, only one or two fisherman visit the tributary during the wet season. Simpang T appears to be the furthest reaching tributary of the AHLR and we believe the creek may be considered the headwaters of the river based on satellite imagery. Simpang T cannot feasibly be accessed by boat from the lower AHLR during the dry season, because of low water and thick *Hanguana* mats along the middle sections of the AHLR, but it is likely it can be reached during the wet season and potentially during shoulder seasons when water levels are moderately higher than the peak of the dry season. Simpang T can only be reached from the Kumpe River due West of BNP during the dry season; however, travel is extremely difficult. Researchers should expect to paddle and portage canoes for 2 to 3 days to reach the headwaters of the tributary. Simpang T was surveyed by BNP officials several months prior to our visit although no published report for their results is available. Simpang Kubu and Simpang T extend through some of the most remote stretches of BNP, encompass intact stands of primary swamp forest and receive little human pressure.

There are also other tributaries in the heart of BNP which have never been surveyed but were identified from satellite imagery and their names were provided by locals during interviews. Simpang Aru, Simpang Kiri and several small tributaries of Simpang Kiri (e.g. Simpang Kempanyang and Simpang Palembang) have never been surveyed, but lie in the most remote sections of the park. These tributaries are believed to be critical locations for *T. schlegelii* populations. Fig. 1 provides a detailed map of the study area, based on our survey experience. Areas which were not visited by us were given names based on interviews with locals.

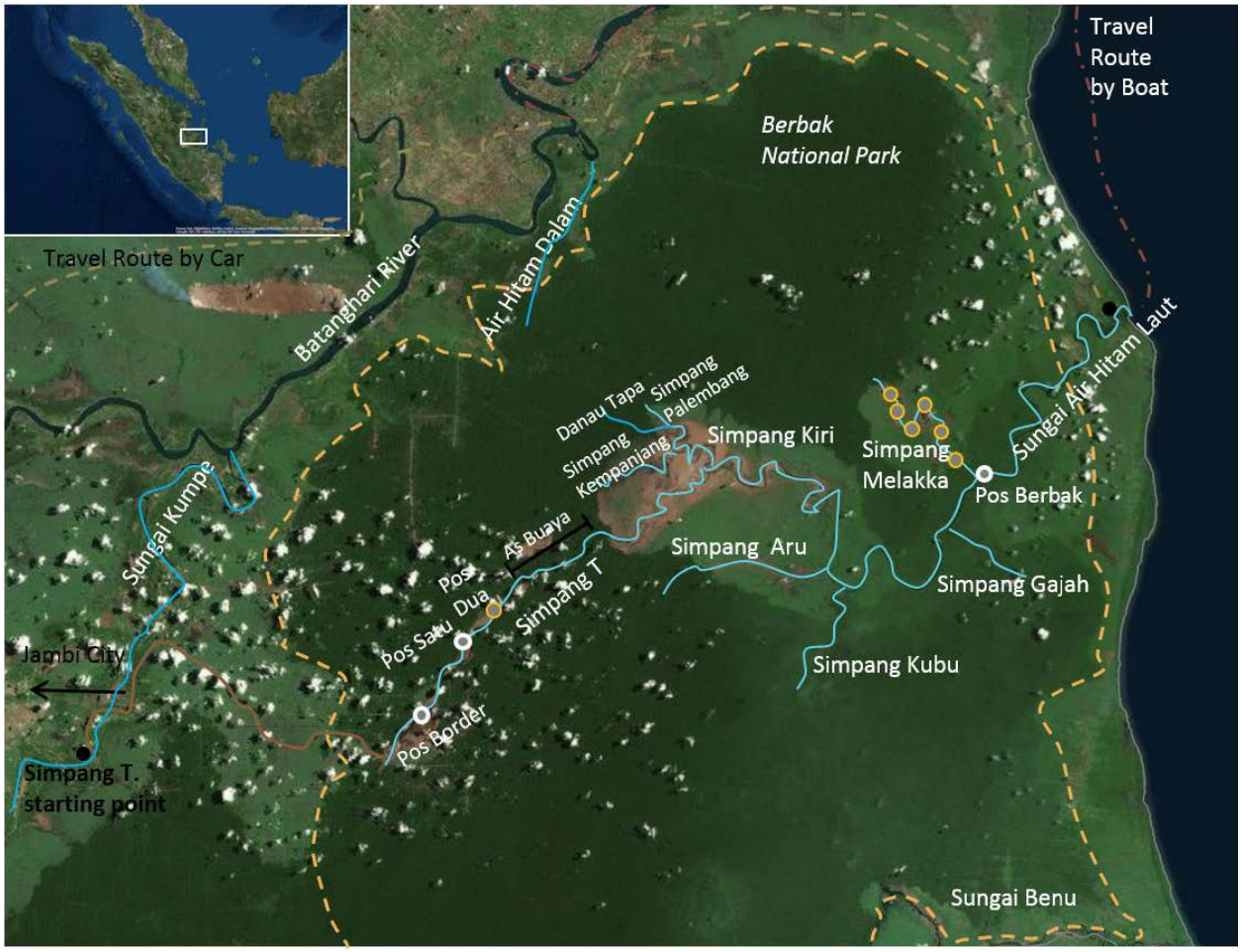

Fig. 2 Berbak National Park study area. The Air Hitam Laut River and all of its previously identified tributaries as well as new tributaries which were not mentioned in previous studies, including Simpang Kubu, Simpang Aru, Simpang Kiri, Simpang T, Simpang Kempanyang, Simpang Palembang, and other important locations. “As Buaya” is a stretch of river indicated by a black line and designates an area believed to be important for *T. schlegelii*. Danau Tapa is a small lake in the upper reaches of Simpang Kiri also believed to be an important location for *T. schlegelii*. White circles notated “Pos” indicate hut locations in good condition, while orange circles notated “Pos” or un-notated, indicate hut locations in poor condition. Travel routes to the mouth of the AHLR and Simpang T are marked by dotted red and solid brown lines respectively, while the border of the national park is marked by a dotted yellow line.

2.1.2 Lower Kampar River System, Riau Province

The LKR encompasses some of the last remaining patches of primary peat swamp forest in Riau Province (Fig. 1B) and only Shaney et al. (2015) have surveyed the area for crocodilian activity. Multiple black water tributaries originate in the surrounding forests and enter the river in various locations, immediately East and West of Teluk Meranti Village (Shaney et al. 2015). Two small reserves are located along the Serkap River (Tasik Metas and Tasik Serkap Reserves) and a

larger reserve along the Kerumutan River (Kerumutan Reserve). Reserves in the area are rarely monitored by wildlife officials and illegal logging, fishing and hunting activity continue to occur in multiple portions of these reserves.

2.1.3 Merang River, South Sumatra Province

The headwaters of the Merang River originate near the BNP study area; however the Merang River drains to the South, entering the LR System in South Sumatra Province (Fig. 1D). Among Sumatran Rivers, the Merang River has received the most survey attention for *T. schlegelii* activity in the past and the majority of historical *T. schlegelii* sightings in Sumatra have been recorded in the Merang River (Bezuijen et al. 1995, 1997, 2001, Stuebing et al. 2006). Bezuijen et al. (1995, 1997, 2001) and Shaney et al. (2015) provide thorough information on the study area).

2.1.4 Simpang Kanan Greater Area, Riau Province

We did not survey the SKR in 2015 (Fig. 1C); however, Shaney et al. (2015) provide information about a brief survey conducted in the area. We also provide further suggestions regarding future surveys of these areas in the discussion section of this report.

2.1.5 Giam Siak Kecil/Bukit Batu Greater Area, Riau Province

We also did not survey the Giam Siak Kecil or Bukit Batu areas in 2015; however, Shaney et al. (2015) provide information about the areas. We provide further suggestions regarding future surveys of these areas in the discussion section of this report.

2.2 Interviews

Interviews—We conducted thorough interviews with local villagers, fisherman, and park officials because they may provide information on the status of crocodiles in the study areas. Interviews were conducted opportunistically with individuals who lived near the study areas. A series of 16 pre-determined questions were used as a template for interviews (Table A1). Upon initiating interviews, we determined if the interviewee was sufficiently knowledgeable about crocodiles by screening their ability to differentiate between crocodile species. If individuals seemed knowledgeable on the subject we proceeded with our full set of interview questions. Appendices 1 – 2 show interview questions and results.

2.3 Spotlight Surveys

Survey Method—Surveys were conducted between June and August during 2014 and 2015 following techniques from Bayliss (1987). Nighttime spotlight surveys were conducted along four tributaries of the LKR system, including: Kerumutan River (22 km surveyed), Kutup River (2 km surveyed), Serkap River (41.2 km surveyed), Turip River (11.2 km surveyed) and sections of the main Kampar river (54.8 km surveyed). We also surveyed tributaries along the AHLR system, including: Simpang Kubu (4.6 km surveyed), Simpang Melaka (11.4 km surveyed), Simpang T (8.7 km surveyed) and sections of the main AHLR river (27.3 km surveyed) and Kumpe River

nearby (16.1 km surveyed). We surveyed 40.8 km of the Merang River (LR System), 25 km of the main LR and 45 km of the SKR. Start and end points of transects were recorded in decimal degrees with a Garmen, Etrex 30, Geographic Positioning System (GPS). Transect lengths were recorded and used to determine the number of crocodiles sighted per kilometer of river surveyed (No. crocodiles/km). Repeat surveys were only conducted in three locations and we subtracted potential repeat sightings from total crocodilian counts and densities. A total of 326.2 km of river were surveyed; 60 km were paddled and 266.2 km were travelled with the aid of small motors. Additional areas were travelled during the day that could sometimes not be surveyed. A total of 26 survey nights and 40 days were spent in the study areas. Of the survey nights, 12 survey nights were spent in BNP (AHLR System), 12 nights were spent on the LKR System, 1 night on the SKR and 1 night on the Lower Merang River. Transect lengths were only counted one directionally (e.g. crocodiles were not counted during return to starting point).

We used a five meter wooden boat, with a 25 hp motor on larger rivers and 4 meter canoes on small tributaries. Surveys were typically initiated 30 minutes to one hour after night fall (18:30 to 19:30). Crocodile eye shines were recorded using 10,000 lumen headlamps. We approached crocodiles after each sighting and when possible recorded a confirmed species ID and species size range. We defined crocodiles by the following age classes: hatchlings (young of the year, 1 – 2 feet), juveniles (not yet sexually mature, 2 – 7 feet), or adults (sexually mature, >7 feet). When crocodiles submerged before further identification could be made, we recorded the location as an “eye shine” and “probable” species ID. Because of the low number of historical *T. schlegelii* sightings we summarize confirmed historical records in Fig. 2 for contrast with our findings.

2.4 Nest Searches

Nest searches were only done in select areas when possible. We surveyed several one to three hundred meter sections of river bank along the Serkap and Kerumutan Rivers by foot. We also surveyed two, five hundred meter sections of river bank along the Simpang T tributary of the upper AHLR and a fifty meter section of river along Simpang Melaka. Surveys were done on foot and one to three individuals walked transects along the forest floor between five and twenty meters away from the water’s edge, scanning for evidence of crocodilian nesting activity.

2.5 Morphometrics

Attempts were only made to capture hatchling crocodiles. Captures were made by hand from the front of the canoe or boat. Morphometric data and single scute clips (triangular scales along the dorsal surface of the tail) were taken for each individual. Scutes were collected and stored in cell lysis buffer for potential molecular work. Tissue samples are held at the Indonesian Institute of Science, Museum (LIPI, MZB) for DNA analyses. All capture measurement data available in Appendix 3 – 4. We also collected additional measurement data from museum specimens held at LIPI, which can be found in Appendix 4.

3.0 Results

We recorded 15 False Gharial sightings across all study areas in 2015. We recorded 41 Saltwater Crocodile sightings across all study areas in 2014 and 2015. We also located two False Gharial egg shells (already hatched), a single 65 cm False Gharial skull, False Gharial track marks, and multiple crocodilian sightings during daytime travel along the AHLR and its tributaries. We broke down sightings for each study area by age class and whether the sightings was considered "confirmed" or "probable" in Table. 1. We provide a more thorough results section for each study area separately below. Locality data for all sightings can be found in Appendix 5.

Table 1. All crocodilian sightings separated by species, study area, age class, probable or confirmed ID, and daytime sightings and sign. We separated out eyeshine's which could not be given confirmed or probable species ID.

C. porosus	**BNP**	**LKR**	**Merang**	**SKR**	**Totals**
Hatchling	22	10	0	0	32
Juvenile	5	3	0	0	8
Adult	0	1	0	0	1
Total Species ID confirmed	22	10	0	0	32
Total Species ID probable	27	15	0	0	**41**
C. porosus Daytime Sightings/Sign	1	0	0	0	1
T. schlegelii					
Hatchling	5	0	0	0	5
Juvenile	5	0	0	0	5
Adult	5	0	0	0	5
Total Species ID Confirmed	8	0	0	0	8
Total Species ID Probable	15	0	0	0	**15**
T schlegelii Daytime Sightings/Sign	6	1	0	0	**7**
Eye Shine Only (No probable species ID)	0	1	0	0	**1**

3.1 Berbak National Park

By far, BNP held the highest *T. schlegelii* and *C. porosus* population densities of any study area we visited. Crocodilian abundance was relatively high throughout various sections of the park. *Crocodylus porosus* population densities were high in the lower AHLR and *T. schlegelii* populations were high in the upper black water tributaries of the AHLR, particularly in Simpang T. Although we recorded relatively high *C. porosus* population densities in the lower sections of the AHLR, population structure was largely skewed towards hatchling individuals, with only several juveniles being sighted in no adult animals. Because we surveyed the area during the peak of the dry season, it is possible that many mating and/or nesting adults may have moved out of the areas prior to our arrival for surveys. The vast majority of *T. schlegelii* sightings occurred in a remote upper tributary of the AHLR, Simpang T, where we recorded 12 sightings.

We also recorded three *T. schlegelii* sightings on the middle sections of the AHLR. We recorded 27 *C. porosus* sightings along the lower to middle sections of the AHLR and Simpang Melaka creek (Fig. 3, 4, 5). We also located a single False Gharial slide along a bank, two False Gharial egg shells, and a large *T. schlegelii* skull in Simpang T, and recorded one *T. schlegelii* and one *C. porosus* sighting during the day on the main AHLR; all of which occurred during daytime travel. Table 2 provides an overview of all sightings during night time surveys in the BNP study area. We captured a total of nine *C. porosus* and one *T. schlegelii* on the AHLR, cut a single unique identifying scute from each animal and collected tissue samples for potential DNA studies. Appendix 3 provides important capture information.

The discovery of the large *T. schlegelii* skull in a billabong in Simpang T is worth further comment. The skull and several bone fragments were discovered in roughly eight feet of water, extending up into the shallows along the bank. The skull measured 65 cm (Dorsal Cranial Length, DCL). The skull is currently one of the larger *T. schlegelii* skulls that has been discovered to date. We provide a list of the largest known *T. schlegelii* skulls being held in other collections in appendix 6. We estimate the animal was between 14 – 6 feet in length when it was alive, which confirms the presence of considerably large *T. schlegelii* remaining in the AHLR.

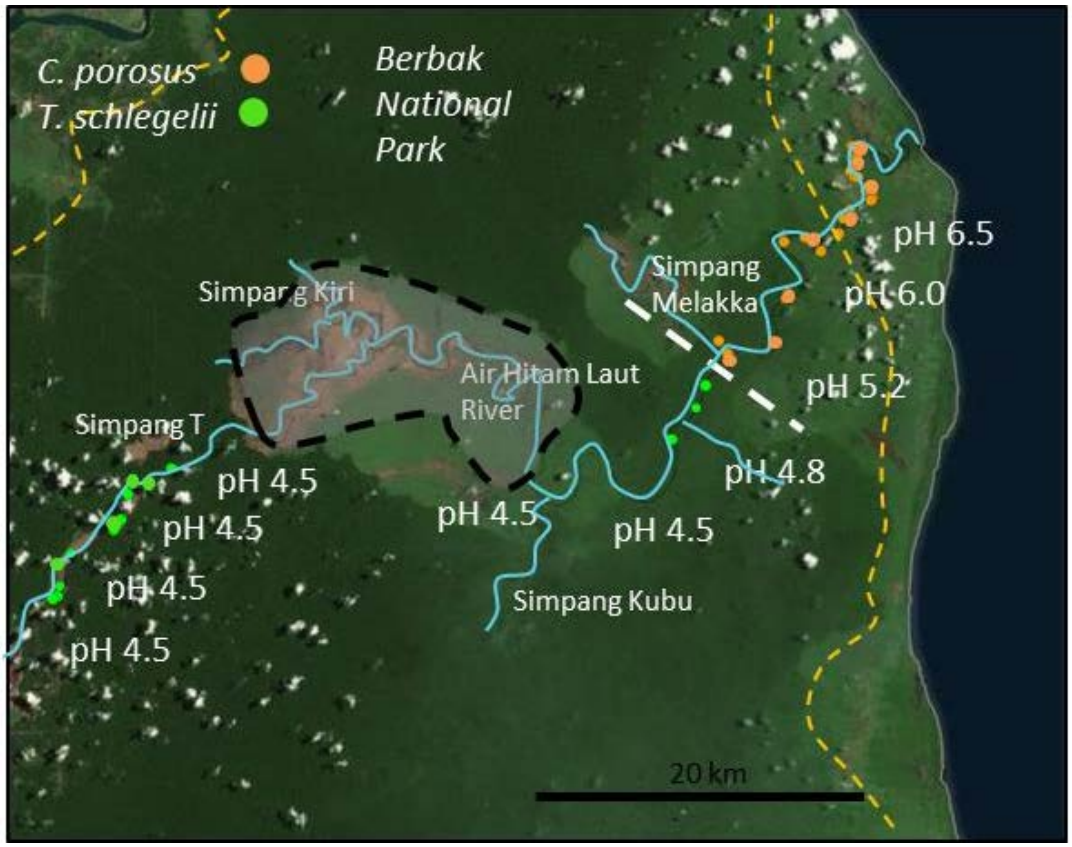

Fig. 3. Berbak National Park study area. Green dots represent *T. schlegelii* sightings, orange dots represent *C. porosus* sightings. The area that could not be surveyed because of dry season conditions is outlined with a black dotted line. The white dotted line denotes the shift in crocodilian species composition along a transitional zone in pH levels.

Table 2. AHLR (AHLR) system survey results for both species of crocodile, including crocodile densities in each river. Sign, eggshells or bones not included.

AHLR System	**Transect (km)**	***T. schlegelii***	***C. porosus***	***T.* density**	***C.* density**	**Eyeshines**
Main AHLR	27.3	3	26	0.109	0.952	0
Simpang Melaka	11.4	0	1	0	0.0877	0
Simpang Kubu	4.6	0	0	0	0	0
Simpang T	8.7	12	0	1.379	0	0
Kumpe River*	16.1	0	0	0	0	0
Total	**68.1**	**15**	**27**	**NA**	**NA**	**0**

For context, we compare our results with previous survey efforts on the lower AHLR and Simpang Melaka Creek, conducted by Cox et al. (1990) and Bezuijen et al. (1997, 2001, 2002, Table 3). We cannot compare our results from Simpang Kubu or Simpang T tributaries because this report marks the first documented effort to survey those areas; however, we discuss the importance of these upper tributaries for long term *T. schlegelii* viability in the discussion section.

Fig. 4. A. Shows *T. schlegelii* slide marks in the mud (~4 – 6 foot animal), B. *T. schlegelii* egg shell found on Simpang T, C. *Crocodylus porosus* hatchling on the lower Air Hitam Laut River, D. Large *T. schlegelii* skull found in billabong on Simpang T (65 cm DCL).

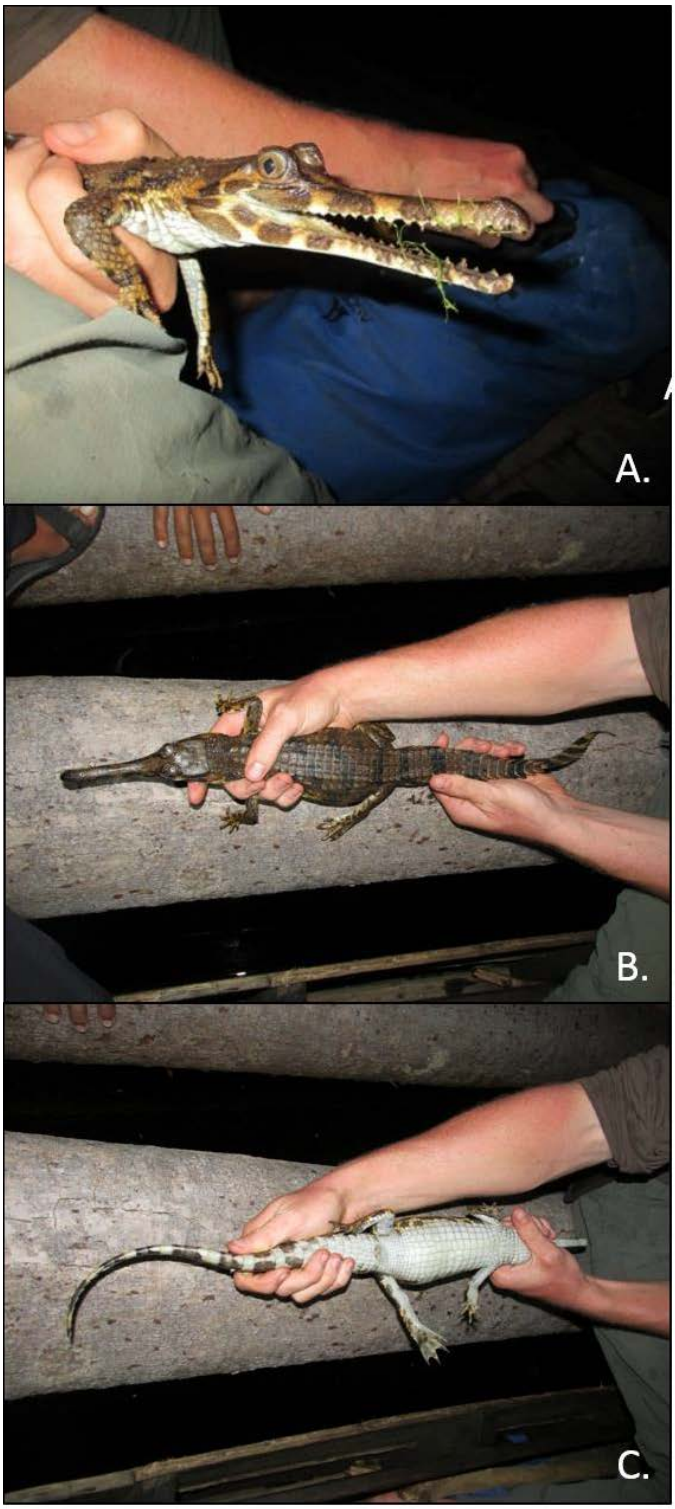

Fig. 5. A. *Tomistoma schlegelii* captured on Simpang T, B. Same individual, dorsal view, C. Same individual ventral view.

Table 3. Comparison of our survey results along the AHLR and Simpang Melaka Creek to previous surveys. We used the same structure provided by Bezuijen et al. (2002) for comparisons, although we changed foot classifications to age classifications.

Year	Surveyed	Hat.	Juv.	Ad.	ES	Tot.	Density (With ES	Density (no ES)	Source
AHLR									
1990	0 - 20.5	7 False Gharials seen, no size given				7	0.34	0.34	Cox (unpublished data)
1996	0 - 25	-	1	1	2	4	0.16	0.08	Bezuijen et al. (1997)
2001	0 - 31	1	-	-	3	4	0.13	0.03	Bezuijen et al. (2001)
2002	0 -32	-	1	-	3	4	0.13	0.03	Bezuijen et al. (2002)
2015	0 - 27.3	1	1	1	0	3	0.11	0.11	Shaney et al. (2015)
Simpang Melaka Creek									
1996	0 - 2	-	1	-	2	3	1.5	0.5	Bezuijen et al. (1997)
2001	0 - 7.2	2	1	-	2	5	0.69	0.4	Bezuijen et al. (2001)
2002	0 - 7.2	-	-	-	1	1	0.14	0	Bezuijen et al. (2002)
2015	0 - 11.4	-	-	-	1	1	0.09	0	Shaney et al. (2015)

Nest Searches

We conducted nest searches along sections of Simpang Melaka and Simpang T. We surveyed 2 km of Simpang Melaka's North bank between 2 and 3 km and between 5 and 6 km from the mouth of the river. A single nest was found between the 2 and 3 km section, but the nest was old and there were no eggshell fragments found. The local guides believed the nest was that of a *T. schlegelii*, however, given its proximity to the main AHLR and presence of a few *C. porosus* sightings nearby, we cannot exclude the possibility that it was a *C. porosus* nest.

We surveyed both banks along Simpang T, between 20 and 21 km upriver from the confluence of Simpang T and Simpang Kiri. Although nighttime surveys revealed high *T. schlegelii* densities throughout that section of river, we did not uncover any *T. schlegelii* nests in that section of water. Further downriver, approximately 18 km from the confluence of Simpang Kiri (at the end of our survey route), we found two old *T. schlegelii* eggshells (Fig. 4), which had already hatched. The shells each measured approximately 3.9 inches and were clearly *T. schlegelii* eggs.

Interviews

Interviewees consistently stated that both species of crocodiles remain common along the AHLR. Most individuals interviewed stated that although *T. schlegelii* had declined in abundance in the last 20 years, they believed their population status had remained approximately the same in the last 10 years. The consensus amongst the local fisherman, who commonly visited remote tributaries in the park, was: the upper reaches of Simpang Melaka, Simpang Kiri and Simpang T are the best locations for finding *T. schlegelii*. Most interviewees stated that *C. porosus* was common along the AHLR below the confluence of Simpang T, but very few *C. porosus* were seen further upriver (which was consistent with our findings and with the transitional zone in vegetation and pH levels in the same location). Interviewees stated that they did not know of anyone who had been attacked by a crocodile in recent years along the AHLR, although many of them did fear crocodiles. Some people knew of an attack that had occurred along the Benu River to the South of BNP. One knowledgeable interviewee, stated that he believed *T. schlegelii* can still be found in the upper reaches of the Benu River as well. Most interviewees stated that they no longer knew of anyone who hunted crocodiles in or near BNP. However, one interviewee said that some people will sometimes catch them for pets and in the recent past a few people were known to collect crocodile eggs. He himself had captured one small *T. schlegelii* on Simpang Melaka three years earlier and kept the animal in a small pond near his home, where the animal was eventually eaten by a local dog. All interviewees who were familiar with *T. schlegelii* nesting behavior, stated that *T. schlegelii* commonly nested in the upper Simpang Melaka and Simpang T tributaries.

Forest and River Conditions

Forest throughout the interior of BNP is largely in good condition. Much of the forest along the main Air Hitam Laut, lower and upper Simpang Melaka creek, Simpang Kubu, Simpang Kiri and Simpang T tributaries is primary and lacks evidence of human disturbance. In pristine sections of forest along Simpang T, we encountered evidence of other rare species, including hornbills, a Mitred Leaf Monkey and Sumatran Tiger tracks in several locations; which is also indicative of the health of interior BNP. Figures (6 – 14) below provide images of tributaries surveyed throughout the park.

Fig. 6. *Nypa* palm habitat lining the banks along the lower AHLR, approximately 5 km up from mouth of the river. There is only agricultural land or secondary forest beyond the edge of the *Nypa* Palm in this section of river.

Fig. 7. The mouth of Simpang Melaka creek, approximately 25 km up the Air Hitam Laut River (AHLR, From mouth of AHLR). *Nypa* palm is seen on the right side of the photo (East bank), while *Pandanus* palm is seen on the left side (West bank), indicative of a corresponding switch from saline water habitat to freshwater coming from upper tributaries. The mouth of Simpang Melaka creek is directly in the middle of a transitionary zone in pH levels and corresponds to a switch from *C. porosus* sightings to *T. schlegelii* sightings during our surveys.

Fig. 8. Simpang Melaka creek, approximately three kilometers from its mouth. The forest in this section is mostly primary swamp forest and an old crocodile nest was found near this location (species unknown). The habitat switches to a large burned area, barren of forest, a few kilometers upriver from this location as well.

Fig. 9. Simpang Melaka creek approximately six kilometers from its mouth in an area that was burned 10 – 15 years ago. Although lacking forest around the edge of the swamp here, primary forest up and downriver provide additional nesting habitat in relatively close proximity. Locals stated that *T. schlegelii* is still found in this section of swamp, although fish trapping pressure has impacted the population.

Fig. 10. Air Hitam Laut River, approximately 35 kilometers upriver from the mouth. There is virtually no human activity this far upriver during the dry season because large *Hanguana* mats cover sections of river, making travel quite challenging. Only light fishing pressure occurs past this point during the wet season because of its remoteness. We sighted an adult *T. schlegelii* (~8 feet in length) twice during the day a few kilometers downriver from this point in the river, both, on our trip upriver and on our return (believed to be same individual).

Fig. 11. Portaging canoes near the headwaters of Simpang T. Small channels link small to moderate sized billabongs for many kilometers and travel here during the dry season requires at least two days of portaging in this manner.

Fig. 12. Simpang T near the headwaters of the tributary (~25 kilometers upriver from Simpang Kiri confluence) after dropping in from a series of canals used for portaging our way into the river system. We reached this section after travelling from the Kumpe River and through many kilometers of burned land. The forest around this location is pristine and receives almost no human pressure. Fishing has been banned in this section of the park by BNP officials to help *T. schlegelii* populations, but still occurs illegally on a small scale. The ban has largely been effective.

Fig. 13. Simpang T approximately 20 kilometers upriver from the confluence of Simpang Kiri. Almost all of Simpang T is surrounded with pristine primary forest as pictured here. Many *T. schlegelii* individuals of all age classes were seen near this section of river.

Fig. 14. Primary swamp forest along Simpang T, approximately 20 kilometers from confluence with Simpang Kiri. Two hatched *T. schlegelii* eggs were found approximately two kilometers downriver from here.

3.2 Lower Kampar River System

We surveyed the Kutup River for the first time during 2015, but did not record any sightings (Fig. 15). We recorded a total of 14 saltwater *C. porosus* sightings across all tributaries during surveys in 2014 and 2015 combined (Fig. 17, Table 4). The highest *C. porosus* densities occurred along the lower section of the Serkap River, particularly between the mouth (0 km) and ten kilometers. Although no *T. schlegelii* sightings were recorded during our nighttime surveys, we recorded one eyeshine where no species identification could be applied (Serkap River) and we did locate a single deceased *T. schlegelii* individual in a village along the upper Kerumutan River. This marks the first documentation of *T. schlegelii* in the Kerumutan River and anywhere on the LKR System (Fig. 16). No previous historical surveys have occurred along the LKR System.

We also collected measurements and tissue samples from a single *C. porosus* captured on the main Kampar River and the single deceased *T. schlegelii* recovered on the Kerumutan River. Appendix 3 provides detailed information on these captures.

Fig. 15. Mouth of the Kutup River, West of the village of Teluk Meranti. Based on satellite imagery the Kutup River appears to still have intact forest along its banks further upriver. However, we could only survey the first two kilometers of river from the mouth, because of dry season conditions and time restrictions. The Kutup still requires survey work. Locals have seen

C. porosus near the mouth of the river and state that *T. schlegelii* is found further upriver. We did not encounter any crocodiles during our brief one night survey.

Fig. 16. Different images of the same 4 – 5 foot, deceased *T. schlegelii* individual, recovered in Kerumutan Village along the upper Kerumutan River. The fisherman found the animal, which had accidentally drown in a fish trap. A. Shows the decaying body of the *T. schlegelii* that the fisherman dug up for us after he had buried it in the yard two weeks earlier, B. slightly rinsed image showing flesh still intact, C. The skin of the animal that was dried by the fisherman. D. Shows the original photo that the fisherman took after finding the deceased animal. To the best of our knowledge, this is the first documentation of a *T. schlegelii* in the Kerumutan River and anywhere in the Lower Kampar River system. The Eka River slightly upriver from this location was stated to be an area where *T. schlegelii* still occur as well.

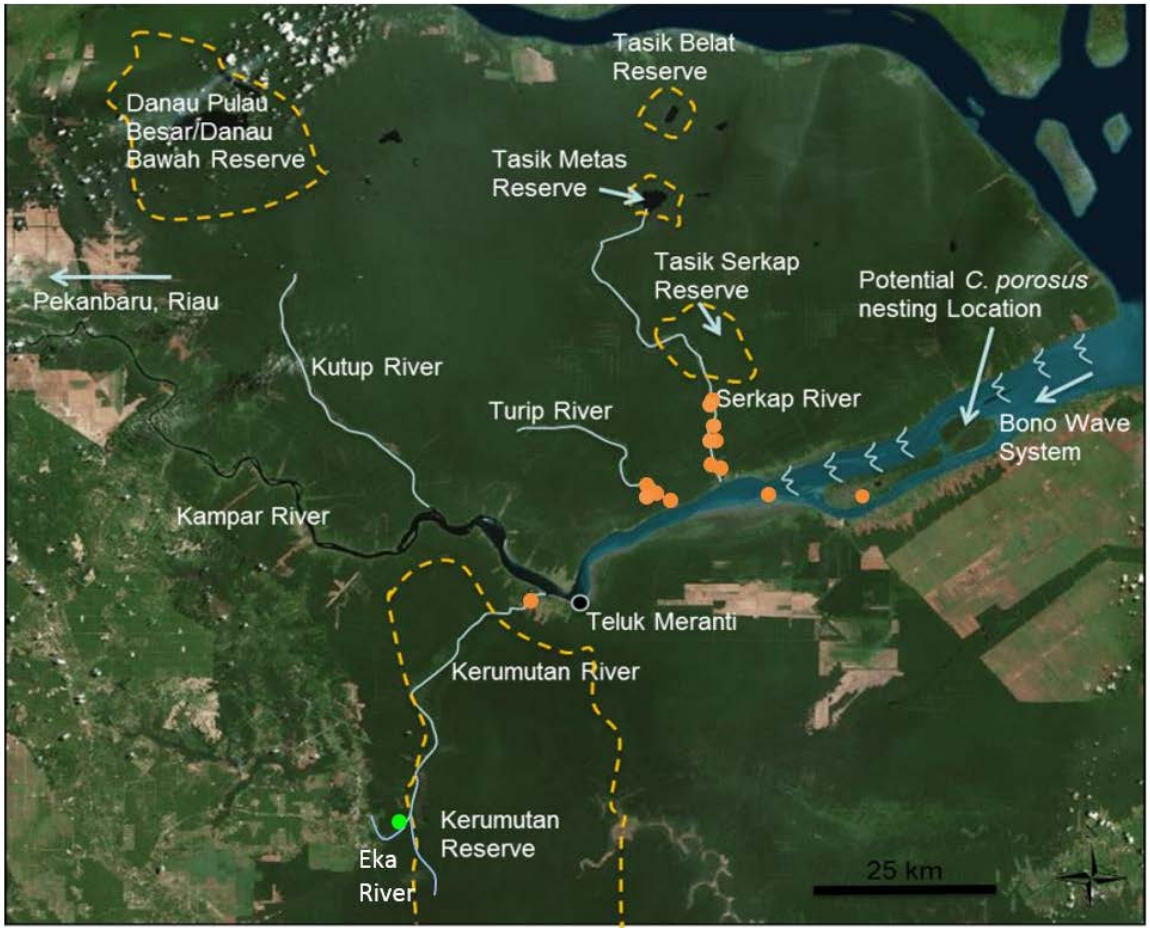

Fig. 17. Lower Kampar River study area. Reserves are outlined in orange dotted lines. Green dots represent *T. schlegelii* sightings, orange dots represent *C. porosus* sightings and black dots represent notable villages. Primary forest appears dark green in contrast to agricultural areas, where forest has been cut.

Table 4. Crocodile sightings during nighttime surveys on the Lower Kampar River System (excluding daytime finding of *T. schlegelii* in village).

LKR System	**Transect (km)**	***T. schlegelii***	***C. porosus***	***T.* density**	***C.* density**	**Eyeshines**
Serkap River	41.2	0	8	0	0.194	1
Main Kampar River	54.8	0	2	0	0.0365	0
Kerumutan River	22	0	1	0	0.0455	0
Turip River	11.2	0	3	0	0.268	0
Kutup River	2	0	0	0	0	0
Total	**131.2**	**0**	**14**	**NA**	**NA**	**1**

Nest Searches
We conducted nest searches very briefly along the Kerumutan River between the 30 and 31 km section (from the mouth). We surveyed approximately 300 meters of land along the West bank and 400 meters of land along the East bank, but did not uncover any nesting locations.

Interviews
There was a consensus among interviewees that *T. schlegelii* and *C. porosus* could both still be found in the LKR System; however, both species are believed to be less abundant than 10 or 20 years ago. *Tomistoma schlegelii* are believed to be found in highest densities along the upper Kerumutan and Eka Rivers, as well as the upper Serkap, Kutup and Turip Rivers on the North bank of the LKR. The local fisherman who had found the deceased *T. schlegelii* in his fish trap, stated that *T. schlegelii* were not common any more in the Kerumutan River, although he believed their population density was higher in the Eka River, which we could not survey during our time in the area. Interviewees in the village of Pulau Muda stated they were afraid of *C. porosus*, which were still common throughout the neighboring islands. We also recorded information about an attack that occurred near the village only two years earlier which was fatal and Shaney et al. (2015) report the neighboring islands as being potential *C. porosus* nesting grounds.

3.3 Merang River
We only surveyed the Lalan and Merang Rivers for a single night in 2014 and did not survey either river in 2015 because of time constraints (Table 5). Shaney et al. (2014) provide a thorough overview of the 2014 visit. We did not see any *T. schlegelii* or *C. porosus* during the 2014 visit across a 40.8 km survey route. We compare the results of our 2014 survey to previous work conducted by Bezuijen et al. (1995, 1997, 2001, 2002, Table 6). No nest searches were conducted along the Merang River in 2015 and readers should refer to Shaney et al. (2015) for interview and locality data.

Table 5. Survey results from the Lalan River (LR) System in 2014.

Lalan River System	Transect (km)	*T. schlegelii*	*C. porosus*	*T. density*	*C. density*	Eyeshines
Main LR	25	0	0	0	0	0
Merang River	40.8	0	0	0	0	0
Total	**65.8**	**0**	**0**	**0**	**0**	**0**

Table 6. Comparisons to previous surveys conducted along the Merang River.

Year	**1 - 2**	**2 - 3**	**3 - 4**	**4 - 5**	**5 - 6**	**ES**	**Tot.**	**Den.**	**Source**
Lower Reaches (0 - 45 km)									
1990	1 (no size given)	-	-	-	-	-	1	0.04	Cox (unpublished data)
1995	-	2	-	2	-	3	7	0.16	Bezuijen et al. (1995)
1996	-	1	-	-	-	1	2	0.04	Bezuijen et al. (1997)

2001	-	-	-	1	-	-	1	0.02	Bezuijen et al. (2001)
2002	-	1	-	-	-	-	1	0.02	Bezuijen et al. (2002)
2014							0	0	Shaney et al. (2015)
Upper Reaches (45 - 67 km)									
1995	-	2	-	-	-	5	7	0.34	Bezuijen et al. 1995
1996	-	2	2	-	1	5	10	0.49	Bezuijen et al. 1997
2001	1	9	3	-	-	1	14	0.64	Bezuijen et al. (2001)
2002	-	-	-	-	-	2	2	0.16	Bezuijen et al. (2002)

3.4 Simpang Kanan River Greater Area

We surveyed the SKR and adjacent mangroves for a single night in 2014 and did not survey the area in 2015. Although no eye shines were seen (Table 7), locals suggested that *C. porosus* were common along the coast and that *T. schlegelii* could still be found in the upper reaches of the river. Importantly, there is a river with an unknown name found immediately to the South of SKR which appears to hold a large tract of primary forest and its upper reaches fall within the boundaries of the Kerumutan Reserve. We were not able to survey the river; however, the unknown river may be an important location for future surveys because its habitat appears much more intact than the SKR. Readers should refer to Shaney et al. (2015) for interview information.

Table 7. Results from survey conducted on Simpang Kanan River (SKR) in 2014.

SKR System	Transect (km)	*T. schlegelii*	*C. porosus*	*T. density*	*C. density*	Eyeshines
Main SKR	45	0	0	0	0	0
Ocean Mangroves	16.1	0	0	0	0	0
Total	**61.1**	**0**	**0**	**0**	**0**	**0**

4.0 Discussion

4.1 Conservation Priorities

We recommend specific tributaries that should be considered high priority for *T. schlegelii* and several river systems and tributaries that may be considered moderate priority, and review each area in greater depth below.

High Priority

- Jambi Province: BNP, AHLR and tributaries; particularly Simpang T, Simpang Kiri, Simpang Kubu and Simpang Melaka.
- Riau Province: Tributaries of the LKR, specifically the upper Kerumutan River (including Eka River) and upper Serkap River.
- Riau Province: Bukit Batu Reserve and Giam Siak Kecil Reserve

- Sumatra Selatan Province: Upper reaches of the Merang River.

Moderate Priority

- Border of Jambi/ Sumatra Selatan Provinces: Benu River (Questionable).
- Riau Province: Unknown River found immediately South of SKR (Questionable, See Fig. 1C).

4.1 Berbak National Park Discussion

The AHLR system currently holds high densities of *T. schlegelii* populations in its middle and upper reaches and high *C. porosus* densities in its lower reaches and remains relatively well protected from human disturbance. Thus, BNP should be considered a critical location for the long-term viability of both species in Sumatra. Tributaries such as Simpang Kiri and Simpang Aru are still yet to be surveyed, but based on their remote location within the park, we suggest they may hold high *T. schlegelii* populations. Simpang T is also found in a remote section of the park and we found high *T. schlegelii* densities there. Although we did not confirm the persistance of *T. schlegelii* on Simpang Melaka, we believe the upper reaches of that tributary still hold *T. schlegelii* populations. Particularly, because Bezuijen et al. (2002) reports the presence of *T. schlegelii* in that river. We did not record any sightings on Simpang Kubu, but based on its remote location, we suggest future surveys allocate some time to revisiting the creek.

We also suggest that the BNP boundaries be expanded southward to include remaining tracts of primary forest before those areas are lost. See Merang River discussion below for more detail.

4.2 Lower Kampar River Discussion

We confirmed the presence of *T. schlegelii* in a tributary of the LKR (e.g. Kerumutan River) and local interviews suggest other tributaries also hold viable *T. schlegelii* populations. Thus, we suggest the LKR continue to be surveyed in the future, but we suggest a few key areas be specifically targeted. The upper and middle Kerumutan River, including a small tributary known as the Eka River, seem to be favorable for *T. schlegelii*. Local villagers believe the Eka River is particularly important for *T. schlegelii*, although we were not able to visit the river to confirm that. We also believe the upper reaches of the Serkap River still hold *T. schlegelii* populations; however, the upper reaches are quite difficult to access, as motorboats can only penetrate approximately 25 km upriver. Thus, canoes must be used to travel above 25 km and based on satellite imagery, it appears that there is approximately 65 total km of navigable river, which ends at a large lake to the North, Tasik Besar. Tasik Besar is a reserve which is almost never visited by outsiders. Apparently, very few locals have ever been all the way to the lake. Its remoteness and the large tracts of intact habitat surrounding it, suggest that the lake may be an ideal location for *T. schlegelii* to survive long term.

A challenge that must be considered, is the varying land ownership along the tributary. Some of the Serkap River is owned by a logging concession, with intermittent pockets of reserve along the way. When we attempted to travel far up the Serkap River in 2015 we were turned back by local owners of the logging concession, who asked that we secure permission from the logging company first. Because of the timing of Ramadan, we could not secure

permission in a timely manner and were forced to travel to alternative locations without ever visiting the upper reaches of the Serkap River. The upper reaches should be an important target area for future survey work, but will require a significant time commitment and permission from several entities (e.g. forestry for each reserve and logging company for land in between.

We also briefly surveyed the mouth of the Kutup River, which could not be fully surveyed because of low water levels. However, intact forest around the upper reaches of the river suggests that it may hold a *T. schlegelii* population. Likewise, we surveyed the Turip River to the East and did not record any *T. schlegelii*, but the upper reaches remain un-surveyed and may be ideal for a small *T. schlegelii* population.

Nearly all the mouths of blackwater rivers that drain into the LKR hold *C. porosus* populations and we recorded *C. porosus* near the mouth of the Kerumutan, Serkap and Turip rivers in 2014 and/or 2015. The main Kampar River also holds *C. porosus* populations particularly East of Teluk Meranti near the village of Pulau Muda. We did not travel much further East from Pulau Muda, but the crocodile attack database (http://www.crocodile-attack.info/) shows that attacks have occurred near the mouth of the Kampar where it meets the ocean. Shaney et al. (2015) discuss the safety hazards associated with surveying the main Kampar River channel because of a common tidal wave system that pushes up the river, known as Bono.

We highly suggest attempting to expand reserve boundaries around the Kerumutan, Tasik Metas (Besar), Tasik Pulau Besar and Kerumutan Reserve to include remaining tracts of primary forest in the area as well. Considering how small these reserves currently are, they may not provide enough of a buffer zone for long term *T. schlegelii* population viability if reserve boundaries are not expanded. Fig. (18) highlights areas with potential for reserve expansion.

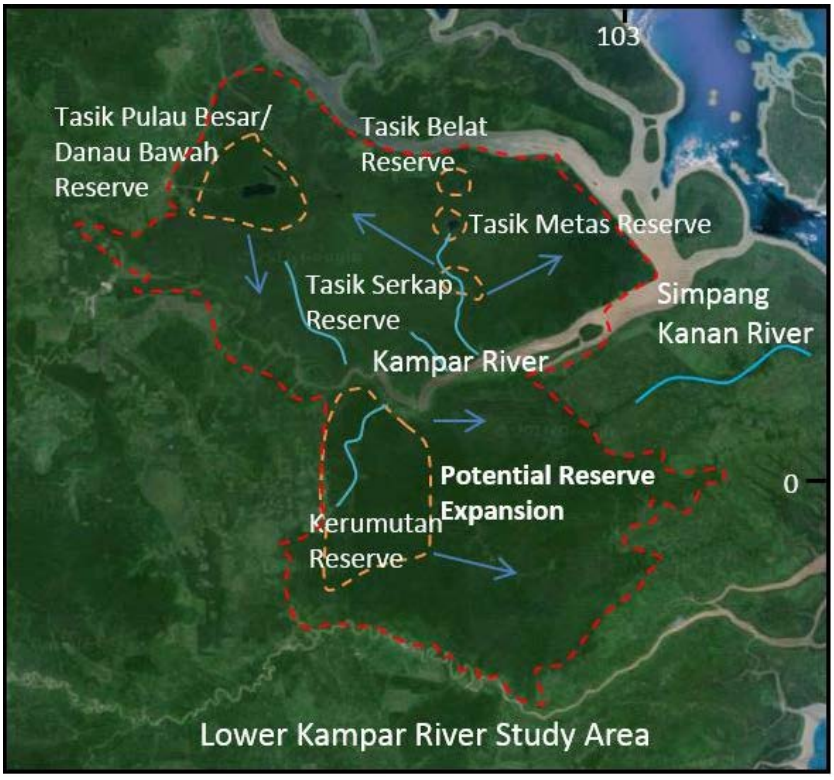

Fig. 18. Areas along the Lower Kampar River System which have the potential for reserve expansion.

4.3 Merang River Discussion

Historically, the Merang River has yielded high *T. schlegelii* densities. In fact, the majority of confirmed *T. schlegelii* sightings in Sumatra have occurred on the Merang River. Although we did not see either crocodilian species on the river, we did not survey the upper reaches beyond 45 km and we only surveyed the lower section for a single night, which may simply not have been enough time to record activity. Large log jams being carried downstream precluded travel beyond 40.8 km (Shaney et al. 2015). Because we could not travel the upper reaches we are unable to confirm the status of *T. schlegelii* in the Merang, particularly because the majority of *T. schlegelii* sightings on the Merang occurred between 45 and 67 km upriver. Logging operations may be having significant negative effects on the upper Merang population; however, previous interviews with locals suggest that *T. schlegelii* populations still persist in the upper reaches (Shaney et al. 2015). Because the headwaters of the Merang River originate near the headwaters of the Air Hitam Laut (but flow South rather than East like the Merang) the upper reaches of the Merang River lie near the border of BNP. We suggest significant effort be put into expanding BNP boundaries to include the upper reaches of the Merang River and potentially neighboring tributaries such as the Kepahyang River, which originates due East of the Merang River (also near the border of Berbak). The entire area immediately South of the BNP border, in Sumatran Selatan Province, holds tracts of intact forest that continue to be logged aggressively. If park boundaries were expanded southward, then a large tract of forest additional forest could connect BNP to the boundaries of Sembilang National Park along the coast. Fig. (19) provides recommendations for park expansion potential. For a brief discussion of the importance of Sembilang National Park see section 4.5 below.

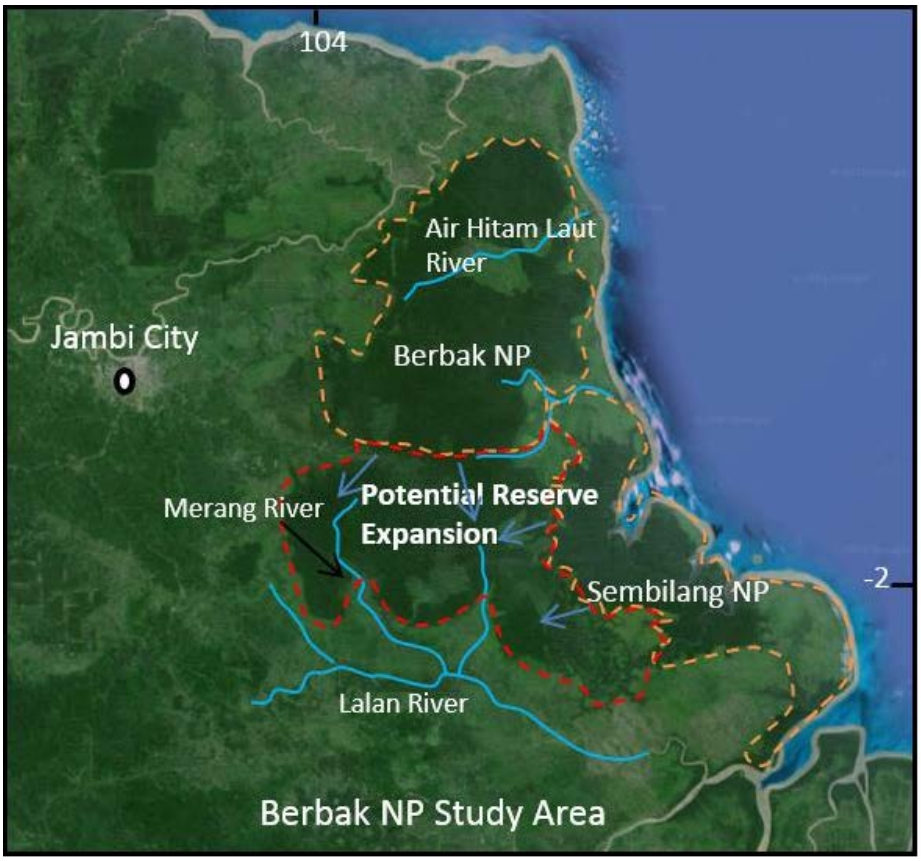

Fig. 19. Areas surrounding the Berbak National Park, Sembilang National Park and Lalan River System which have the potential for reserve expansion.

4.4. Simpang Kanan River Discussion

We suggest that future researchers target the river with "Unknown name" that originates slightly south of the SKR, because the unknown river appears to have a much larger amount of intact forest habitat than does the SKR. The Unknown River also originates in the Kerumutan Reserve immediately adjacent to the Kerumutan River where we confirmed the presence of *T. schlegelii*. Locals stated that *C. porosus* is still common throughout the mangrove systems along the coast throughout the region and that people are sometimes attacked near the village of Tembilahan (Shaney et al. 2015). This suggests that *C. porosus* populations may still be doing well in the area; however, the area requires more survey attention for that to be confirmed.

4.5 Other areas requiring further comment

We did not survey the areas discussed here, but review information obtained during our study about these areas as well as historical information about these areas, because they may still be relevant study locations for future work.

***Rokan River Area*—**To the best of our knowledge, the Rokan River (Riau Province) has never been surveyed for crocodilian activity by researchers. *C. porosus* sightings and several attacks have occurred along the river system and based on crocodileattackdatabase.com data, it seems that the river is a relative hotspot for *C. porosus* attacks, suggesting *C. porosus* population

densities may be high in the area. Stuebing et al. (2006) show a locality point in the vicinity of the Rokan River on a map of historical *T. schlegelii* localities; however, no mention of the Rokan River is given in the article. Based on satellite imagery there may be some suitable freshwater habitat for *T. schlegelii* remaining throughout the area.

Sembilang National Park—Located in South Sumatra province and immediately southeast of BNP, Sembilang National Park encompass large intact tracts of coastal mangrove forest. To the best of our knowledge, Sembilang National Park has never been formally surveyed for crocodilian activity by researchers; however, our discussions with local villagers in the village of Air Hitam Laut (North of Sembilang National Park) and with Sembilang National Park officials suggest the park may be a stronghold for *C. porosus* and the upper tributaries of some rivers may hold pockets of *T. schlegelii* habitat. Although the latter is yet to be determined, satellite imagery indicates highly valuable *C. porosus* habitat is present throughout the park.

Simpang Datuk Lake—Bezuijen et al. (2002) report visiting Simpang Datuk Lake and although no *T. schlegelii* sightings were recorded there, locals insisted *T. schlegelii* lived there at the time. The researchers also noted the crocodilian pathways that cut through the vegetation underwater and they believed it was further confirmation of the presence of crocodiles in the lake. The area surrounding Simpang Datuk Lake has been heavily deforested since Bezuijen et al. (2002) surveyed the area, but given its proximity to BNP, the area may still be worth survey attention in the future.

Way Kambas National Park—Bezuijen et al. (1997, 2001) surveyed Way Kambas National Park (Lampung Province) and only confirmed the presence of *C. porosus* populations. The area likely still holds viable *C. porosus* populations although no surveys have been conducted since 2001. The area is believed to have historically held *T. schlegelii* populations as well, but no confirmed records have been recorded in recent years. Stuebing et al. (2006) state that *T. schlegelii* may have already been approaching extinction in Lampung Province by that point in time.

Ujung Kulan National Park—Ujung Kulan National Park encompasses some of the last remaining lowland swamp forest habitat in Java and only two confirmed *T. schlegelii* sightings have been recorded in the park historically (Auliya et al. 2006). The park is likely still home to small *C. porosus* populations, which are free to migrate between the western tip of Java and the southern tip of Sumatra, across the Sunda Strait. *T. schlegelii* may now be locally extirpated in the park; however, no recent surveys have been done to confirm this.

Kubu and Teso Rivers (Upper Kampar River System)—Not to be confused with "Simpang Kubu" of Jambi Province, surveyed during our studies in BNP, the Kubu River is a tributary of the Upper Kampar River in Riau Province. Bezuijen et al. (1997) surveyed the Kubu and Teso Rivers, and recorded anecdotal evidence that *T. schlegelii* still occurred in those rivers at that time. Stuebing et al. (2006) records sightings of *T. schlegelii* in the Kubu river (Appendices of their paper), they reference Bezuijen et al. (1997); however, upon investigation of Bezuijen et al. (1997) it seems that sightings of *T. schlegelii* were not confirmed in the Kubu or Teso Rivers, only "potential" sightings occurred. Thus, it is unclear whether *T. schlegelii* documentation in

the Kubu and Teso rivers should be considered confirmed or not. Regardless, the habitat of those rivers has considerably degraded since surveys were conducted nearly twenty years ago and based on satellite imagery it is questionable whether *T. schlegelii* still occur in those upper tributaries of the Kampar River. Yet, because we confirmed the presence of *T. schlegelii* in the LKR during our study, there is nothing stopping migrating individuals from travelling to upper tributaries such as the Kubu and Teso Rivers and vice versa.

Giam Siak Kecil and Bukit Batu Area—Although we were unable to survey the Giam Siak Kecil or Bukit Batu rivers during 2014 or 2015, interviews with locals suggest the entire area encompassing both river systems, is likely to hold *T. schlegelii* and *C. porosus*. Muin and Romono (1994) note that the area may have been an important location for *T. schlegelii* 22 years ago and we suggest the area is still relevant today. Reserves have successfully protected peat swamp forest habitat throughout the area and based on satellite imagery there are still multiple upper tributaries and lake which may be suitable for *T. schlegelii* populations. Thus, we provide maps of the area in Shaney et al. (2015) suggesting future survey locations for *T. schlegelii*.

Tesso Nilo and Bukit Tiga Puluh National Parks—Tesso Nilo and Bukit Tiga Puluh National Parks both cover remaining forest in the East Sumatra lowlands; however, there is currently no data regarding crocodilian activity within or near those parks. Both parks still encompass some remaining crocodilian habitat; however, high human pressure suggests any crocodile populations in those parks may be small. It may be worth brief survey attention and interviews with locals near these locations to determine whether or not crocodilians still live in those areas, particularly *T. schlegelii*.

5.0 Cultural and Bureaucratic Considerations for Research

Scientific Research Permits in Indonesia—The scientific research permitting process in Indonesia requires a considerable amount of time, planning and often funding. Thus, we review some basic information which may be informative for future crocodilian research in Indonesia. This must be a key consideration before anyone can travel to conduct formal research in Indonesia. Although there may be changes and variations of this process available to foreign researchers in the future, this is the process which we have experienced.

Prior to obtaining research permits, researchers must identify an Indonesian counterpart for collaboration, as this is a requirement of the permitting process. Typically, researchers from Indonesian universities are chosen as counterparts. It may be possible to work with individuals from the forestry department, national parks, nonprofit organizations, or other organizations. However, we do not have experience partnering with any organization other than a university and attempts to do so will require further inquiry on the part of future researchers. Once a counterpart is chosen, agreements between that counterparts organization must take place, including a memorandum of understanding and the submission of a research proposal to the counterpart for consideration (and potentially other documents required by the

counterpart). Once agreements are made, foreign researchers can pursue formal research permits through RISTEK, Indonesia's permitting department. Submission of research proposals and several other required documents to RISTEK must be undertaken early, because the process can last several months before approval is made. However, we do not recommend submitting proposals more than six months prior to the initiation of field work, because RISTEK has a specific timeframe in which research visas can be obtained following the approval of research proposals and proposals can actually expire if submitted too early. We have found that submission of proposals three to four months prior to field work may be ideal, because it allows for paperwork to be approved and visas to be obtained in the appropriate timeframe. However, this advice should be taken with caution and this is only based on our experience. Researchers should review RISTEK's research instructions thoroughly prior to moving forward with the proposal process (http://frp.ristek.go.id/). It is also important to note some of the other requirements that RISTEK will require other than a formal research proposal. The following list provided comes directly from the RISTEK website.

Procedure:

- Online application: Complete the online application form. Once the form is sent, the applicant is provided with a unique user ID and initial password. Keep these information securely.
- Confirmation of application: Re-login to your personal page using the user ID and password, and confirm your application. If you wish, you can also change the password (recommended at your first login to keep your privacy and data secure).
- Uploading the required documents: Upload the electronic files, and the scanned ones for the copy of passport, recommendation letters, photographs, etc.
- Pre-approval: Once all required documents are completed, the application will be passed to the Coordinating Team for the Approval of Foreign Research Permit (TKPIPA) for reviewing process.
- Reviewing process
- Final approval: Once the application is approved by the TKPIPA, you will be noticed to collect your research Visa at the Indonesian Embassy or Representatives in your Home Country or other country as requested. The official permit (Letter and Card of Research Permit) will be available for the applicant AFTER the arrival and reporting to the Secretariat of Foreign Research Permit office in Jakarta.

General requirements:

- A formal letter of request to do research in Indonesia, a copy of which is addressed to the Indonesian Representative abroad (e.g. Indonesian Ambassador, Consul General, or Consul). This letter should explicitly state the address of the Indonesian Representative from which the researcher will obtain the visa. If this address is not given, it can cause delays in some cases.
- A copy of detailed research proposal, which should has a title, stated objectives, and description of the methodology and concepts. It must clearly state the locations where

field research will be done. If the work is to be done from one or more field stations, please indicate which one will be the Research Base Station.

- A copy of the researcher's curriculum vitae (CV) including a list of publications. For applications with multiple number of researchers, each researcher must submit his /her CV.
- Two letters of recommendation, one from a professor or equivalent senior researcher in the researcher's discipline and the other from an official of the researcher's home institute or university.
- Letter(s) of acceptance from Indonesian Counterpart (an Indonesian academic institution and/or a Research Centre).
- A letter guaranteeing sufficient funds to cover research and living expenses in Indonesia and fees for the Indonesian Counterpart(s).
- Health certificate from a medical doctor stating that the researcher is in good health, both physically and mentally, to carry out research in Indonesia.
- A letter of recommendation from an Indonesian Representative abroad.
- Four recent red background passport size (4x6 cm) photographs, and two copies of 2x3 cm size photographs.
- A copy of the researcher's passport. Note: the passport must be valid for at least six months after the date of completing research in Indonesia.
- A list of the equipment brought to Indonesia, if any, to support the research. The value of these equipment should be stated in US dollar.
- If a researcher plans to bring his/her spouse and children to Indonesia, the researcher must submit a copy of marriage certificate, spouse's curriculum vitae, children's birth certificate, four recent photographs of each family member and a copy of his/her family's passports.

Once notification of approval of research from RISTEK is obtained, foreign researchers should obtain their research visas from their local embassy. Then, researchers may visit the country. Upon arrival to Indonesia, researchers must visit the RISTEK office in the capital city of Jakarta and commence paperwork for final research permit approval. Researchers should expect to spend one to two weeks in Jakarta obtaining final research permits, which will consist of visits to multiple offices, including Immigrations and the Forestry Department. We suggest researchers consider utilizing local companies which specialize in assisting with this process, particularly if Indonesian is not spoken by anyone in the party. The cost of paying for assistance with the permit approval process with these companies can range from several hundred to several thousand US dollars. It may or may not expedite the permitting process in Jakarta. Once this process is finished, researchers will have final paperwork for research and are free to travel to their respective study areas.

Important Note: For each national park or reserve researchers intend to visit for research, they must first visit the provincial forestry/national park department office for approval first. This must be done for each province separately. Within each province, each separate reserve and park will have its own research fee requirements. Researchers should be prepared to

provide research presentations for national park/reserve officials, but this varies between provinces. If no work is to be conducted within parks or reserves than this paragraph is not necessary for consideration.

Cultural Considerations

Briefly, we want to note that during the Ramadan celebration period, which takes place over 30 days during June, July, or August each year (exact months dependent upon the year), many offices close for several days in Java and Sumatra. We found that most national park and reserve offices in Jambi and Riau provinces closed during the last week of Ramadan and many local villagers are not available for hire during part, or all of this celebration period. Also, almost all local businesses and departments are closed during the Idul Fitri celebration at the end of the Ramadan period. Foreign researchers should plan for these events far in advance if working in much of Java and Sumatra, and potentially other regions as well.

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Appendices

Table A1. Description of 16 questions commonly asked during interviews with local residents. We use some local names for crocodile species below. For additional local names, see Shaney et al. (2015) and Bezuijen et al. (1997).

Question	Description
Question 1	Have you or anyone you know seen crocodiles in the area?
Question 2	How often do you see crocodiles in the area?
Question 3	What size crocodiles have you seen?
Question 4	Do people hunt or kill crocodiles in the area?
Question 5	Have you seen Senyulong near here (*T. schlegelii*)?
Question 6	When was the last time you saw Senyulong (*T. schlegelii*)?
Question 7	Have you seen Buaya Muara near here (*C. porosus*)?
Question 8	When was the last time you saw Buaya Muara (*C. porosus*)?
Question 9	Are people afraid of crocodiles here?
Question 10	Do you know anyone who has been attacked by a crocodile? (If so, where did they occur?)
Question 11	How long since the attack?
Question 12	Do you know of other areas where there may be Senyulong (*T. schlegelii*)?
Question 13	Do you know of other areas where there may be Buaya Muara (*C. porosus*)?
Question 14	Do you know of areas where crocodiles nest?
Question 15	Are crocodiles more or less common than 20 years ago?
Question 16	Are crocodiles more or less common than 10 years ago?

Table A2. Responses to interview questions.

Interview #	Year	Location	Approx. Age	Time in Area	Occupation	Question 1
1	2014	Serkap	45	NA	Fisherman	Yes
2	2014	Serkap	50	10	Fisherman	Yes
3	2014	Kampar	23	23	Local Guide	Yes
4	2014	Turip	40	NA	Loggers	Yes
5	2014	Kerumutan	55	55	Fisherman	Yes
6	2014	Simpang Kanan	50	50	Village Leader	Yes
7	2014	Simpang Kanan	40	NA	Farmers	Yes
8	2014	Bukit Batu	35	10	Lecturer at University	Yes
9	2014	Merang	35	2	Fisherman	Yes
10	2014	Merang	35	NA	Logger	Yes
11	2015	Kampar	50	NA	Fisherman	Yes
12	2015	Kampar	35	25	Fisherman	Yes
13	2015	Kerumutan Village	55	55	Fisherman	Yes
14	2015	Kerumutan Village	45	45	Fisherman	Yes
15	2015	Air Hitam Laut	35	2	Park Official	Yes
16	2015	Air Hitam Laut	30	30	Fisherman/Park Assistant	Yes
17	2015	Air Hitam Laut	30	30	Fisherman/Park Assistant	Yes
18	2015	Air Hitam Laut	27	27	Fisherman/Park Assistant	Yes
19	2015	Simpang T	35	35	Park Official	Yes
20	2015	Simpang T	46	15	Porter	Yes
21	2015	Simpang T	35	NA	Park Official	Yes

Interview #	Question 2	Question 3	Question 4	Question 5	Question 6	Question 7
1	NA	All	Yes (Poison and shoot them)	Yes	2 Years	Yes
2	Once a month	All	Yes	Yes	More than a year	Yes
3	Once a month	All	Yes	Yes	1 year	Yes
4	Every Day	All	No	Yes	NA	Yes
5	Once a week	All	No	Yes	1 month	Yes
6	NA	All	No	No	NA	No
7	NA	Small	No	Yes	NA	Yes
8	Often	NA	No	Yes	Last visit 2 years ago	NA
9	NA	All	No	Yes	1 year	Yes
10	NA	All	No	Yes	NA	Yes
11	NA	NA	No	Yes	1 year	NA
12	Once a month	All	Yes (20 years ago)	Yes	10 - 15 years	Yes
13	Rarely	Small	Yes but in the past	yes	5 years	Yes
14	Once a year	All	No	Yes	1 month	Yes
15	Every week	All	No	Yes	1 month	Yes
16	Every week	All	No	Yes	1 month	Yes
17	Every week	All	No	Yes	1 month	Yes
18	Every week	All	No	Yes	1 month	Yes
19	Every day on the river	All	No	Yes	Last time on the river	No (Not on Simpang T)
20	Every day on the river	All	Yes but in the past	Yes	Last time on the river	No (Not on Simpang T)
21	Each time he visits	All	No	Yes	Last time on the river	No (Not on Simpang T)

Interview #	Question 8	Question 9	Question 10	Question 11	Question 12
1	NA	Yes	No	NA	Not Sure
2	1 month	Yes	No	NA	Serkap, Kerumutan
3	1 month	No	Yes (Kampar)	5 years	Serkap, Kerumutan
4	1 Day	No	No	NA	Serkap, Kerumutan
5	1 month	Yes	No	NA	Kerumutan
6	NA	No	No	NA	Not Sure
7	NA	No	No	NA	Upper Simpang Kanan
8	NA	NA	No	NA	Upper Bukit Batu
9	1 month	Yes	No	NA	NA
10	NA	No	No	NA	Upper Merang
11	NA	NA	NA	NA	NA
12	1 to 2 months	Yes	No	NA	Eka (Upper Kerumutan)
13	Very long ago	No	No	NA	Upper Kerumutan
14	Very Rare (More than a year ago)	No	No	NA	Eka (Upper Kerumutan)
15	1 week	Yes	Yes (Sungai Benu)	1 year	Simpang Melaka
16	1 week	Yes	Yes (Sungai Benu)	2 year	Simpang Melaka
17	1 week	Yes	Yes (Sungai Benu)	2 year	Simpang Melaka
18	1 week	Yes	Yes (Sungai Benu)	2 year	Simpang Melaka
19	Never	Yes	No	NA	Simpang T
20	Never	Yes	Person chased from nest	2 years ago	Simpang T, Simpang Kiri
21	Never	Yes	No	NA	Simpang T, Simpang Melaka

Interview #	Question 13	Question 14	Question 15	Question 16
1	Not Sure	NA	NA	NA
2	Not Sure	No	Less	Less
3	Serkap, Pulau Muda	Yes, *C. porosus*, Pulau Muda	Less	NA
4	Turip	No	Less	Less
5	Kampar	No	Less	Less
6	Near the coast	No	NA	NA
7	NA	No	NA	NA
8	NA	No	Less	NA
9	NA	No	Less	NA
10	Lower LR	Less	Less	NA
11	NA	NA	NA	NA
12	Kampar	No	Less	Less
13	Kampar	Yes Upper Kerumutan	Less	Less
14	Kampar	No	Less	Less
15	Lower Air Hitam Laut, Sungai Benu	Yes Upper Simpang Melaka	NA	NA
16	Lower Air Hitam Laut, Sungai Benu	Yes Upper Simpang Melaka	Same	Less
17	Lower Air Hitam Laut, Sungai Benu	Yes Upper Simpang Melaka	Same	Less
18	Lower Air Hitam Laut, Sungai Benu	Yes Upper Simpang Melaka	Same	Less
19	Lower Air Hitam	Yes, Many parts of Simpang T	Same	NA
20	Sungai Benu	Yes, Simpang T, Simpang Kiri	Same	Less
21	Lower Air Hitam, Sungai Benu	Yes, Many parts of Simpang T	Same	NA

Table A3. Capture, morphometric and tissue sample data (measurements in cm). SVL=Snout Vent Length, TL=Tail Length, MC=Midbody Circumference, HL=Head Length, SC=Scute Clip Taken where L refers to left side of scutes and the number refers to the scute taken. The scutes on the animal split in to a v-shaped pattern along the dorsal surface of the tail. If the animal is placed on its ventral and faced away there is a left and right side of the scutes. The scutes were counted down from the anterior to the posterior (e.g. 1L is the first, left scute on the anterior end of the tail). (D) = Deceased.

Capture	ID	Species	SVL	TL	MC	HL	SC	Tributary	Tissue
Capture 1		*C. porosus*	20.2	21	10.6	7.9	1L	Kampar	Yes
Capture 2		*C. porosus*	19	18.9	9.8	6.8	2L	Air Hitam Laut	Yes
Capture 3		*C. porosus*	16.2	17.4	8.3	6.4	3L	Air Hitam Laut	Yes
Capture 4		*C. porosus*	17.3	18.8	9	6.7	4L	Air Hitam Laut	Yes
Capture 5		*C. porosus*	17.2	18.1	9.7	6.7	5L	Air Hitam Laut	Yes
Capture 6		*C. porosus*	17.8	19.4	9.5	7.4	6L	Air Hitam Laut	Yes
Capture 7		*C. porosus*	17.5	19.3	9.2	6.6	7L	Air Hitam Laut	Yes
Capture 8		*C. porosus*	20.1	21.5	9.6	7.7	8L	Air Hitam Laut	Yes
Capture 9		*C. porosus*	20.2	22.8	12	7.8	9L	Air Hitam Laut	Yes
Capture 10		*C. porosus*	19.1	20.9	10	6.9	10L	Air Hitam Laut	Yes
Capture 11		*T. schlegelii*	30.1	30	16	13.5	1L	Simpang T	Yes
Capture 12		*T. schlegelii* (D)	NA	83.5	39.8	NA	NA	Kerumutan	Yes

Table A4. Morphometrics for *T. schlegelii* museum specimens found at LIPI. Additional measurements for single live individual captured during study, the large skull we discovered in Simpang T, and data for the deceased individual found in our study are provided (measurements in cm, P=Pending).

Individual #	Species	Skull, Skin, Preserved Specimen, Live animal	Museum	ID	Collection Locality	River	DCL
1	*T. schlegelii*	Skin	MZB	AK501	East Kalimantan	NA	NA
2	*T. schlegelii*	Preserved Specimen	MZB	AK523	Central Kalimantan	Barito River	16.7
3	*T. schlegelii*	Preserved Specimen	MZB	AK522	Central Kalimantan	Barito River	18
4	*T. schlegelii*	Taxidermy	MZB	AK524	East Kalimantan	Sentarum Lake	40.1
5	*T. schlegelii*	Skull	Berbak NP	KJS-P	Jambi	Upper AHL	65
6	*T. schlegelii*	Dead Animal/Skin	MZB	KJS-P	Riau	Kerumutan	30.5
7	*T. schlegelii*	Skull	MZB	Unknown	Unknown	Unknown	70.2
8	*T. schlegelii*	Skull	MZB	18	Unknown	Unknown	51.8
9	*T. schlegelii*	Capture	(KJS)	ENS17189	Jambi	Upper AHL	13

Individual #	DCW	Snout Width	Mandibular Length	Mand/DCL ratio	Eye Socket	Tooth Socket Width	Teeth Top (one side)
1	NA	NA	NA		NA	NA	NA
2	6.7		20.1	0.830845771	2.3	NA	20
3	7.8	3.2	21.16	0.850661626	NA	NA	20
4	19.5	8.8	45	0.891111111	5.5	NA	NA
5	28.1	13.5	NA	NA	8.2		21
6	9.7	4.6	34.5	0.884057971	6.2	NA	19
7	27.2 (slightly broken)	16.1	74 (slightly broken)	NA	9.4	1.7	21
8	21.3	10.1	61.3	0.84502447	7.1	NA	20
9	6.8	-	-	NA	0.857539503	-	-

Individual #	Teeth Bottom (one side)	Body and Tail	Flank Length	SVL	TL	Hand Width	Hand Length	Foot Width	Foot Length	Leg Length
1	NA	NA	NA	NA	67	4.9	7.7	8.1	13.9	19.3
2	19	NA	20.9	33	48.8	2.3	NA	3.8	NA	15.4
3	19	NA	26	56	48.2	2.5	4.8	4.5	8.6	16
4	NA	NA	50.5	127.6	119.8	5.6	9.3	7.8	16.5	33.5
5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6	19	136.2	26.6	NA	83.5	NA	6.2	NA	9.3	19.3
7	20	NA	NA	NA	NA	NA	NA	NA	NA	NA
8	20	NA	NA	NA	NA	NA	NA	NA	NA	NA
9	-	-	-	30.1	30	-	2.2	-	4.5	-

Individual #	Arm Length	Single Tail Scutes	Scutes after Split	Belly scales	Neck Scales	Midbody Circum.	Tail Circum.
1	18.2	19	18	18	7	57.5	49
2	10.1	19	19	17	9	31.2	24.2
3	11.2	20	18	18	7	NA	NA
4	24	16	18	20	7	78.9	60.6
5	NA	NA	NA	NA	NA	NA	NA
6	14.5	20	18	16	11	39.8	27.2
7	NA	NA	NA	NA	NA	NA	NA
8	NA	NA	NA	NA	NA	NA	NA
9	-	-	-	-	-	-	12.5

Table A5. Locality information for all crocodile sightings during our study, including daytime sightings/sign.

Year	Tributary	Lat.	Long.	Day or Night	Status	Species
2014	Serkap	0.301231	102.7123	Night	Confirmed	*C. porosus*
2014	Serkap	0.29051	102.7227	Night	Confirmed	*C. porosus*
2014	Serkap	0.290473	102.7225	Night	Confirmed	*C. porosus*
2014	Serkap	0.330561	102.7123	Night	Probable	*C. porosus*
2014	Serkap	0.28712	102.7221	Night	Probable	*C. porosus*
2014	Serkap	0.303892	102.7129	Night	Probable	*C. porosus*
2014	Serkap	0.286943	102.7217	Night	Unknown	Unknown
2014	Turip	0.258338	102.6723	Night	Confirmed	*C. porosus*
2014	Turip	0.263245	102.6713	Night	Confirmed	*C. porosus*
2014	Turip	0.26042	102.6681	Night	Probable	*C. porosus*
2015	Air Hitam Laut	-1.31704	104.4162	Night	Confirmed	*C. porosus*
2015	Air Hitam Laut	-1.31742	104.4169	Night	Confirmed	*C. porosus*
2015	Air Hitam Laut	-1.32149	104.4181	Night	Confirmed	*C. porosus*
2015	Air Hitam Laut	-1.32315	104.4181	Night	Confirmed	*C. porosus*
2015	Air Hitam Laut	-1.32705	104.4157	Night	Confirmed	*C. porosus*
2015	Air Hitam Laut	-1.3292	104.4173	Night	Confirmed	*C. porosus*
2015	Air Hitam Laut	-1.32933	104.4186	Night	Confirmed	*C. porosus*
2015	Air Hitam Laut	-1.33264	104.423	Night	Confirmed	*C. porosus*
2015	Air Hitam Laut	-1.33582	104.424	Night	Confirmed	*C. porosus*
2015	Air Hitam Laut	-1.33759	104.4244	Night	Confirmed	*C. porosus*
2015	Air Hitam Laut	-1.33831	104.4238	Night	Confirmed	*C. porosus*
2015	Air Hitam Laut	-1.34184	104.4156	Night	Confirmed	*C. porosus*
2015	Air Hitam Laut	-1.3425	104.4152	Night	Confirmed	*C. porosus*
2015	Air Hitam Laut	-1.34355	104.4141	Night	Confirmed	*C. porosus*
2015	Air Hitam Laut	-1.34529	104.413	Night	Confirmed	*C. porosus*
2015	Air Hitam Laut	-1.35129	104.4113	Night	Confirmed	*C. porosus*

2015	Air Hitam Laut	-1.35812	104.4043	Night	Confirmed	*C. porosus*
2015	Air Hitam Laut	-1.35263	104.3979	Night	Confirmed	*C. porosus*
2015	Air Hitam Laut	-1.3545	104.3899	Night	Confirmed	*C. porosus*
2015	Air Hitam Laut	-1.3981	104.3679	Night	Confirmed	*C. porosus*
2015	Air Hitam Laut	-1.31793	104.4171	Night	Probable	*C. porosus*
2015	Air Hitam Laut	-1.32961	104.42	Night	Probable	*C. porosus*
2015	Air Hitam Laut	-1.33273	104.4228	Night	Probable	*C. porosus*
2015	Air Hitam Laut	-1.39582	104.3683	Night	Probable	*C. porosus*
2015	Air Hitam Laut	-1.37562	104.3924	Night	Probable	*C. porosus*
2015	Air Hitam Laut	-1.40553	104.3655	Night	Probable	*C. porosus*
2015	Air Hitam Laut	-1.31573	104.4185	Daytime/Sign	Other	*C. porosus*
2015	Air Hitam Laut	-1.43758	104.3476	Daytime/Sign	Other	*T. schlegelii*
2015	Air Hitam Laut	-1.43133	104.346	Night	Confirmed	*T. schlegelii*
2015	Air Hitam Laut	-1.43144	104.3461	Night	Confirmed	*T. schlegelii*
2015	Air Hitam Laut	-1.41049	104.3593	Night	Confirmed	*T. schlegelii*
2015	Kampar	0.225612	102.6482	Night	Confirmed	*C. porosus*
2015	Kerumutan	0.167048	102.5269	Night	Confirmed	*C. porosus*
2015	Kerumutan	-0.05236	102.4203	Daytime/Sign	Other	*T. schlegelii*
2015	Pulau Muda	0.281959	102.8926	Night	Confirmed	*C. porosus*
2015	Serkap	0.290873	102.7221	Night	Confirmed	*C. porosus*
2015	Serkap	0.288979	102.7237	Night	Probable	*C. porosus*
2015	Simpang Melaka	-1.39305	104.3644	Night	Confirmed	*C. porosus*
2015	Simpang T	-1.46395	104.1309	Daytime/Sign	Other	*T. schlegelii*
2015	Simpang T	-1.43752	104.1444	Daytime/Sign	Other	*T. schlegelii*
2015	Simpang T	-1.48573	104.1091	Daytime/Sign	Other	*T. schlegelii*
2015	Simpang T	-1.45369	104.1345	Daytime/Sign	Other	*T. schlegelii*
2015	Simpang T	-1.49323	104.1052	Night	Confirmed	*T. schlegelii*
2015	Simpang T	-1.49256	104.1065	Night	Confirmed	*T. schlegelii*
2015	Simpang T	-1.4527	104.134	Night	Confirmed	*T. schlegelii*
2015	Simpang T	-1.44712	104.136	Night	Confirmed	*T. schlegelii*
2015	Simpang T	-1.46276	104.1313	Night	Confirmed	*T. schlegelii*

2015	Simpang T	-1.46659	104.1286	Night	Confirmed	*T. schlegelii*
2015	Simpang T	-1.49358	104.1048	Night	Confirmed	*T. schlegelii*
2015	Simpang T	-1.4555	104.1347	Night	Probable	*T. schlegelii*
2015	Simpang T	-1.45125	104.1337	Night	Probable	*T. schlegelii*
2015	Simpang T	-1.45804	104.1346	Night	Probable	*T. schlegelii*
2015	Simpang T	-1.47587	104.1128	Night	Probable	*T. schlegelii*
2015	Simpang T	-1.49379	104.1044	Night	Probable	*T. schlegelii*
2015	Simpang T	-1.44684	104.3462	Daytime/Sign	Other	*T. schlegelii*

Table A6. Dorsal cranial measurements (DCL in cm) of the largest *T. schlegelii* skulls documented. This list is not exhaustive and it is likely that other large skills need to be added. The skull found in our study on the Air Hitam Laut River, Jambi Province is highlighted in bold. There may be other large *T. schlegelii* skulls at museums, such as: Leiden, Stuttgart Germany, Cal. Academy, Field Museum, Kucing Museum and other museums which have not been fully searched for *T. schlegelii* holdings. Data was collected from Whitaker and Whitaker (2008) and combined with additional data collected during our study.

Museum	**Locality**	**DCL (CM)**
British Museum		84
Munich Museum	Central Borneo	81.5
Leiden		77
Munich Musuem	Borneo	76.5
AMNH		76.5
Brussels Museum		75.9
MMNB Berlin		70.4
MZB (LIPI)		70.2
MCZ, Harvard		67.8
MZB (LIPI)	**Berbak National Park, Sumatra**	**65**
Alexandar Koenig	Borneo	56.6