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Tebat Rasau Geopark: Ethnobiology and Ethnogeology of a Pleistocene River in Belitung, Indonesia

Ary Prihardhyanto Keim	Ethnobiology Research Group, National Research and Innovation Agency (BRIN), Cibinong, Indonesia
Fithrorozi	Belitung Regency Government, Belitung, Indonesia
Tukul Rameyo Adi	Coordinating Ministry for Maritime and Investment Affairs, Jakarta, Indonesia
R. Indarjani	Biology Department, Faculty of Science and Technology, As-Syafi'iyah Islamic University, Jakarta, Indonesia
Fauzi Akbar	Coordinating Ministry for Maritime and Investment Affairs, Jakarta, Indonesia
Yudi Amsoni	Komunitas Akar Bakau, Belitung Timur, Indonesia
Ida Farida Hasanah	Ethnobiology Research Group, National Research and Innovation Agency (BRIN), Cibinong, Indonesia
Wawan Sujarwo	Ethnobiology Research Group, National Research and Innovation Agency (BRIN), Cibinong, Indonesia
Corresponding email	wawan.sujarwo@brin.go.id

ABSTRACT

Belitung is an island on the south eastern coast of Sumatra, Indonesia. Geologically, Belitung is an continental island and during Pleistocene was united with Sumatra and Borneo to form a subcontinent named Sundaland indicated by the existence of an archaic Pleistocene river located in Tebat Rasau in the East Belitung Regency with the presence of Asiatic arowana (*Scleropages formosus*) and non-poisonous freshwater pufferfish from the genus Pao, which is identified here as resembling *Pao hilgendorfii*. The existence of these biota strengthening the concept of Sundaland and has put Belitung tributaries closer to mainland Borneo's river system rather than that of Sumatra's. Fascinating discoveries found in this current study are the fact that the people of Tebat Rasau acknowledge based on the presence of the Asiatic arowana and non-poisonous pufferfish about the union of Belitung with the mainland Borneo and Sumatra in the past long before the concept of Sundaland itself was formulated and published. This knowledge has put the people of Tebat Rasau more aware on the conservation of the area and fully supports the appointment of the Tebat Rasau vicinity as a National Geopark. The local products have also produced from the vicinity including the well-known herbal tea from the leaves of Pelawan tree (*Tristaniopsis merguensis*; Myrtaceae) known as "Pelawan Tea".

Keywords: Arowana, Belitung, Pelawan, Pleistocene, pupperfish, Sundaland

INTRODUCTION

Belitung is an island on the south eastern coast of Sumatra, Indonesia. Administratively the island belongs to the Bangka and Belitung Province and it is just one of the total 950 islands included in the province (Siregar, 2015; Hardi, 2017), in which 470

islands are registered with names and 51 inhabited. Thus, the rest of the islands are still uninhabited and possessed no name. Geologically, the island of Belitung is a continental island, which means that the island has never been a part of the ancient subcontinent of Sundaland or Sunda Shelf (Spellerberg and Sawyer 1999; Voris, 2000; Huggett, 2004; Barber *et al*., 2005; Barber and Crow, 2005; Hutchinson, 2005; Whittaker and Palacios, 2007).

Sundaland persisted at least throughout Pleistocene up to the end of Ice Age in Quaternary or also known as the Pleistocene Ice Age or the 3rd Ice Age, approximately 11,700 to 11,000 years ago, in which the ice in the northern hemisphere was melted that caused the increasing if sea level and drowned most of the large parts of Sundaland and left some parts of the subcontinent to become islands, which is now known as the Malay Archipelago (Barber *et al*., 2005; Hope, 2005).

The islands formed as the results of the rising of sea level are known as continental islands (Spellerberg and Sawyer, 1999; Whittaker and Palacios, 2007). Most of the islands in the western and eastern parts of the Malay Archipelago, including Belitung are of these continental islands. Nevertheless, some other islands in the western Malay Archipelago have already been islands even when the Sundaland subcontinent still existed. In other words, these islands have never been parts of the subcontinent or geologically known as oceanic islands. Sulawesi, some islands in the Lesser Sunda Islands and western coast of Sumatra belong to this type of island. As was previously mentioned, continental islands such as Belitung were highlands in the time of Sundaland and might contents ancient rock formations, which might have been older than Sundaland itself. In other words, the rock formation in Belitung might have been older than Pleistocene and this is shown by the composition of sediments in the island.

The geology of Belitung is dominated by the Jurassic sediment. The Jurassic itself belongs to the Mesozoic, which palaeontologically is also known as "the Age of Reptilians" or "the Age of the Conifers", in this particular era the Dinosaurs reached their peak. The large part of sediments that formed the mainland Sumatra itself is from the younger period than Jurassic, the Triassic. So far, the only sediments from the Jurassic period are found only in the Kuala Tuhur area near the Lake Toba. The intrusive rocks in Belitung belongs to the same era, Mesozoic, particularly the last Triassic up to Early Jurassic (Figure 1). The intrusive rocks were formed from magma that were crystalized and hardened under the surface of the Earth and penetrated the Earth's rock formation without appeared to the surface. In other words, geologically, Belitung is regarded as an old continental island from the Triassic, which is indicated by the conspicuous tin mineralization, which is also found throughout neighbouring islands such as Bangka Island, Lingga, Singkep, and Natuna Archipelagos (Crow and Van Leeuwen, 2005).

Tin or Stronsium (Sn) is considered as a rarely found mineral (Roberts *et al*., 1990; Nesse, 2000; Kamilli *et al*., 2017) and in Indonesia the deposits are mainly accumulated in an area known in the mining world as "the tin islands", in which Belitung and Bangka islands have the prominent deposits (Van Leeuwen, 2014). In 1851 a team of Dutch geologists found tin in Belitung Island (Verdoorn and Honig, 1945). Their discovery turned out to be more conspicuous than the largest tin deposit known at that time, the Cornwall deposit in England (Van Leeuwen, 2014). Since that, tin has become the most important industry in Belitung and Bangka. The tin mining and industry are still the most important major income to the two districts in the island; Belitung and East Belitung Districts regardless their disturbances to the precious environment (Nurtjahya *et al*., 2017).

Despite its status as a continental island, Belitung has very few types of sediment from Holocene-Pleistocene (Figure 2). This is straightforwardly differs Belitung Island from the eastern part of mainland Sumatra, where the sediments from those periods dominated the

geology. This geologically uniqueness of the island supports the appointment of Belitung as one of the *Geoparks* in Indonesia.

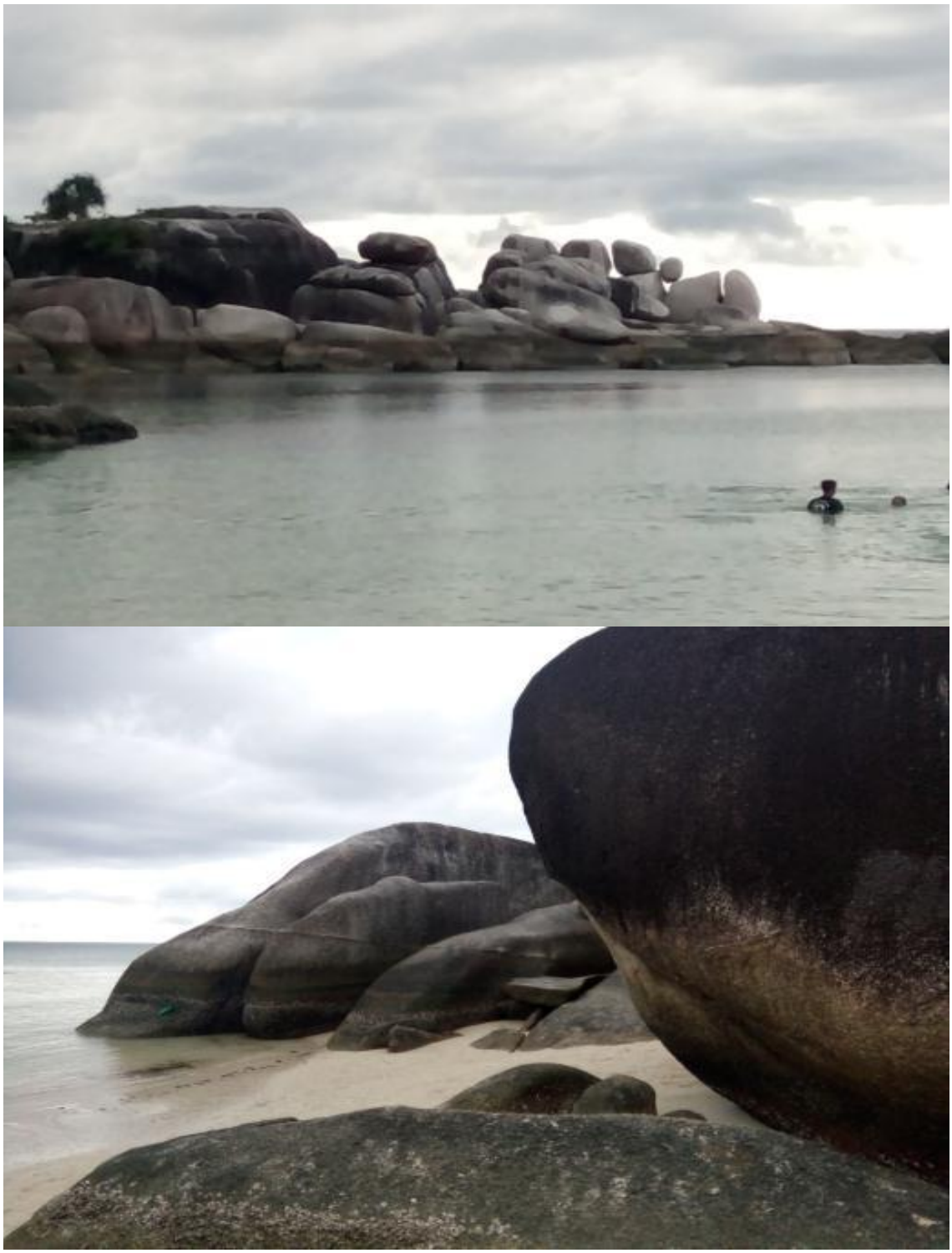

Figure 1. Intrusive rocks from Late Triassic up to Early Jurassic period found in the Laskar Pelangi coast, Tanjung Tinggi Village, Sijuk Sub-district, Belitung District

Figure 2. Tebat Rasau Ancient River Geosite, East Belitung Regency

Figure 3. The Information Centre on Tebat Rasau Ancient River Geosite with 'gelam' tree (*Melaleuca leucadendra*; Myrtaceae) planted in the front yard

Tebat Rasau: An Ancient River Geosite at Tebat Rasau

There are at least two noticeable geosites in the recently appointed Belitung Geopark, one of them is the Tebat Rasau Ancient River Geosite located in the Tebat Rasau village, East Belitung Regency (Figure 2). The Geosite is officially under the administration of the Bureau of Cultural and Tourism, East Belitung Regency and the Belitung Geopark Authority. The geosite is daily maintained and guarded by a Non-Governmental Organisation (NGO) established by the local fishermen by the name of "Kelompok Sadar Wisata" (simply translated as group of tourism awareness) Lanun, supported by the local government, and run an Information Centre on site (Figure 3).

Figure 4. Abundant and dense population of "rasau" (*Pandanus helicopus*) in Tebat Rasau Ancient River Geosite

The name "rasau" refers to the vernacular name in Malay language for *Pandanus helicopus* (Pandanaceae), which are abundantly found in the location (Figure 4). *Pandanus helicopus* is a common species found in riverine, freshwater swamps, and peat swamp forests in Borneo and Sumatra including the adjacent islands such as Belitung (Figure 5) (Keim *et al*., 2011; Agustika, 2018; Santiago, 2018). The other species from the genus *Pandanus* found in the Geosite is "lais" (*Pandanus lais*), which sometimes are found in cohabitant or within the proximity with *P. helicopus* in Borneo and Sumatra, including adjacent islands such as Bangka and Belitung (Santiago 2018). *Pandanus lais* is found in less abundant than *P. helicopus* in the Geosite.

Figure 5. *Pandanus helicopus* showing the habit (above, left), infructescence (above, right), grows in freshwater swamp and riverine (below, left), and densely covered the landscape in Tebat Rasau Ancient River Geosite (below, right)

Figure 6. Mats made from the leaves of *Pandanus helicopus* (left) and house walls from the leaves of *P. lais* (right)

Figure 7. Traditional hat (left) and food cover (right) made from the leaves of *Pandanus lais*

Nevertheless, both species are regarded important by the local people as the leaves from both species are harvested as source of materials for making several handicrafts and households. The leaves of *P. helicopus* are implemented in the making traditional mats known locally as *tikar pandan* (literally means pandan mat), while the harder, broader, and more rigid-strong leaves of *P. lais* are harvested for making hats, households (such as food cover) and house walls (Figures 6 and 7). This ethnobotanical finding is also commonly found throughout Malay societies in the neighbouring Bangka Island (Agustika, 2018; Santiago, 2018; Agustika *et al*., 2020).

In the periphery of the Tebat Rasau Ancient River Geosite the local people, who are members of NGO *Lanun* cultivate the 'gelam' tree (*Melaleuca leucadendra*; Myrtaceae; Figures 3 and 8). The natural distribution area of *Melaleuca leucandedra* is encompassing the

Moluccas, New Guinea, and some parts of Australia such as Northern Territory, Queensland, and Western Australia (Craven, 1999; Govaerts *et al*., 2008). The species now has been widely introduced and cultivated outside its natural distribution areas (Colton and Murtagh, 1999), including Belitung.

Figure 8. 'Gelam' (*Melaleuca leucadendra*; Myrtaceae; left) and the 'karamunting' or 'kemunting' (*Rhodomyrtus tomentosa*; Myrtaceae; right) fruits

Melaleuca leucadendra has been cultivated in Belitung Island mainly for the essential oil and also known locally as cajuput oil or "minyak kayuputih". The widely known "kayuputih" and "minyak kayuputih" actually refer to its closely relative, *M. cajuputi*. *Melaleuca cajuputi* has morphological appearance and the chemistry of essential oil that are exeptionally similar to *M. leucadendra* (Brophy *et al*., 2013). Furthermore, in the field *M. cajuputi*, particularly *M. cajuputi* subspecies *cumingiana* is found cohabitant and in many occasions planted alongside the introduced *M. leucadendra* especially in Borneo, Sumatra, and Java with both are traditionally recognised as "kayuputih".

Another species from the same family (Myrtaceae) is also found and cultivated in the vicinity, a species locally known as 'karamunting' or 'kemunting', which is identified here as *Rhodomyrtus tomentosa* (Figure 8). It is a wide spread species from India through Indochina to Java, the Lesser Sunda Islands, Sulawesi, southeast of China, Taiwan, and up to the Ryukyu Islands, particularly the Nansei-shoto Island (Latiff, 1992; Govaerts *et al*., 2008).

The people of Tebat Rasau eat the fruit of 'karamunting' (*Rhodomyrtus tomentosa*) and believe that the fruit can cure diarhea, dysentery, and other diseases related with the indigestion. This finding is in accordance with Heyne (1927), Burkill (1935), and Hamid *et al*. (2017). The traditional drink is also made from the young leaf of the tree and served like tea (Figure 9), thus it is called Pelawan Tea. It tastes like a mint tea and has been a wonderful refreshment especially in the hot humid air of Pelalawan.

Figure 9. Pelawan tree (*Tristaniopsis merguensis*; Myrtaceae) showing the distinctive reddish green young leaves (above, left), the tea drink made from the leaves of Pelawan tree (above, right), the tea is being served (below, left) and packed for selling (below, right)

The Pelawan tree is identified here as yet another species of Myrtaceae, *Tristaniopsis merguensis* (Figure 10). The species is also common in Sumatra and adjacent islands, including Bangka and Belitung Islands (Ridley, 1922; Oldfield, 1988; Lemmens *et al*., 1995; Sosef *et al*., 1998; Akbarini, 2016). In Belitung Island, the Pelawan tress are found throughout the island, including in the Bukit Peramun Geosite (the other Geosite in Belitung Island; Figure 11) and the vicinity of Tebat Rasau. In the neighbouring island, Bangka, there is an area with dense population of this species, so much that the area is known as the Pelawan forest (Anggraeni, 2018; Figure 11).

The local people of Tebat Rasau believe that Pelawan tea has medicinal purposes, at least for treating urinating related disorders any other internal disease. In other words, the people regard Pelawan tea as medicinal herbal drink; thus, it is not simply just a refreshment. Studies on the medicinal usages of Pelawan Leaf Tea have been previously by Jannah (2016), Sari (2016), Enggiwanto *et al*. (2018), and Kadri *et al*. (2019). The results of these studies indicate that the Pelawan tea has medicinal properties for treating some diseases and disorders such as kidney stones and diabetic, also as a good antioxidant (anti-cancer), and treatment of stroke.

Now, the tea has been hygienically packed and sold in the markets, including in the capital Tanjung Pandan and has been one of the important commodities of East Belitung Regency. The woods harvested from Pelawan tree (*Tristaniopsis merguensis*) are known as medium quality timbers and considered as rarely found in the markets or known as the lesser-known timbers (Samingan, 1982; Lemmens *et al*., 1995; Sosef *et al*., 1998). Nevertheless, the high demand of timbers in Bangka and Belitung Islands and the conversions of lavish

lowland tropical rainforests into plantation, especially palm oil (*Elaies guineensis*; Arecaceae) and massive extension of tin mining areas have threatened the existence of *Tristaniopsis merguensis* and other verious irreplaceable species, such as 'pelepak' (*Hopea billitonensis*; Dipterocarpaceae) and 'resak' (*Vatica bancanus*; Dipterocarpaceae) in the island.

Figure 10. Pelawan tree (*Tristaniopsis merguensis*; Myrtaceae) planted in the Bukit Peramun Geosite, Belitung showing the typical reddish brown cracking outer barks

Figure 11. The Pelawan tree (*Tristaniopsis merguensis*; Myrtaceae) found in Pelawan forest in Namang District, Bangka Tengah Regency, Bangka Island with distinctive reddish brown cracking outer bark similar with the trees found in Bukit Peramun Geosite in Belitung

Ancient River: Window to the Pleistocene of Belitung

One of the interesting natural concerning Belitung is the geological history of the island that was started from Palaeozoic, especially Permian period (Voris, 2000; Barber and

Crow, 2005; Crow and van Leeuwen, 2005; Hutchinson, 2005; Pillans and Gibbard, 2012) indicated by:

a. The presence of the Middle to Late Permian vulcanic plate,
b. The presence of granite stones, which are parts of the main granite belt, which is started from northern Thailand, eastern Myanmar through Malay Peninsula down to Belitung Island,
c. The presence of Palaeozoic Sedimentary Basin, which makes Belitung riches in tin,
d. The presence of the hydrology system, which origin is stretched back to the time of Sundaland, at least from Pleistocene or the existence of the third Ice Age until its ends in about 11,700 years ago, which started the Holocene.

Figure 12. Asiatic arowana fish (*Scleropages formosus*)

The Pleistocene river system in Sundaland had been reconstructed by Molengraaf and Weber (1919), see also Molengraaff (1921, 1922), Voris (2000) based on their studies on the geology and hydrology of the island that prove the existence of ancient rivers. Most of those ancient rivers had disappeared under the Java Sea following the drowning of the large parts of the Sundaland by the end of the third Ice Age (11,000 to 10,000 BC); thus, there are only few of them survive to this day (Hall and Morley 2004), one of them is the ancient river in the Geosite of Tebat Rasau. The antiquity of the Tebat Rasau River is also supported by at least two prominent biological evidences:

a. The presence of the Asiatic arowana fish (*Scleropages formosus*; Figure 12).
b. The presence of the freshwater pupperfish belonging to the genus *Pao* with morphology and predating ethology closely resembles the eastern Kalimantan species, *P. hilgendorfii* (Figures 13 and 14).

Asiatic Arowana (*Scleropages formosus*)

Asiatic arowana (*Scleropages formosus*) is a species of fish belonging to the family of bony tongue fishes or Osteoglossidae confined to the freshwater of Southeast Asia (Kottelat *et al*., 1993; Kumazawa and Nishida, 2000; Nelson, 2006; Kumazawa, 2013; Lavoué, 2015). In mainland of Sumatra this species was reported from a fish market in Pekanbaru, which

was believed to be collected in the neighbouring Siak River (Pouyaud *et al*., 2003; Kottelat, 2013) and later was supported by the presence of the species in Tasik Serkap Nature Reserved, Riau.

Figure 13. The freshwater pupperfish found in the ancient river of Tebat Rasau and identified as belonging to the genus *Pao* from a species closely resembles to the eastern Kalimantan species *P. hilgendorfii*

The species is also reported from Bangka Island (Pouyaud et al. 2003), an island just about 614.94 km offshore of mainland Sumatra. However, prior to this present study there has been no report on the species has from the nearby Belitung Island despite the fact that the island is separated from Bangka Island by a narrow strait of approximately 226.37 km. Thus,

the result of this study shows the new record of the great Asiatic arowana (*Scleropages formosus*) in the island of Belitung (Figure 12).

Figure 14. The freshwater pupperfish found in the ancient river of Tebat Rasau belonging to the genus *Pao* from a species closely resembles *P. hilgendorfii* kept on a display in the Information Centre of the Geopark

Furthermore, as Belitung Island is undoubtedly a continental island the presence of the Asiatic arowana (*Scleropages formusus*) in Belitung is regarded as an exceptional finding and raises the question on the geological and biogeographical connection that links Belitung with the mainlands of Sumatra and Borneo, and further north to Taiwan.

Nevertheless, this publication is not aimed to discuss the systematics and evolution of the species. For those, who interest with the subjects are suggested to refer primarily to previous studies done by Kumazawa and Nishida (2000), Poujaud *et al*. (2003), Hua Yue *et al*. (2004), Kottelat and Widjanarti (2005), Kumazawa (2013), van Oijen and van der Meij (2013), and Lavoué (2015).

It is the ethnobiology of the species, particularly in the context of the people of Tebat Rasau, which has been the aim of this publication, in which the concept of Sundaland is apparently understood well by the indigenous people of Tebat Rasau long before the theory itself was scientifically established.

The people of Tebat Rasau mentioned that they have known the presence of the Asiatic arowana (*Scleropages formosus*) in their river for centuries and recognised it as belonging to the same species found in the rivers of both Sumatra and Borneo. Apparently, based on this fact the people of Tebat Rasau believe that in the distant past (they described as prior to the coming of men to the island) Belitung Island was united with Sumatra and Borneo.

In other words, they believe that Belitung was once a part of an ancient vast land mass that united both Sumatra and Borneo, where the Tebat Rasau River was one of numerous rivers that flowed throughout this land mass with the arowana fish swim inside. This finding is interesting as this can be interpreted that the people of Tebat Rasau might have

acknowledged the existence of Sundaland long before the geological term itself was established in 1949 (Van Bemmelen, 1949, 1970; see also Tjia, 1980; Hutchinson, 2005).

Furthermore, the people of Tebat Rasau seem to understand that the Tebat Rasau River is an ancient river and a part of the river system that spread throughout the Sundaland indicated by the presence of the Asiatic arowana long before the presence of humans in that vast large land mass (i.e. Sundaland). This seems in accordance with the concept of ancient river system in Pleistocene Southeast Asia proposed by Molengraaff (1921, 1922), which even predated the concept of Sundaland itself. This is a fascinating finding concerning the ethnobiology of Belitung Island.

Unlike the Chinese, including the Chinese that live in Belitung (mostly of "Peranakan"), the indigenous people of Tebat Rasau, who are basically Malays, do not believe on the mythical significance of the Asiatic arowana (*S. formosus*). Prior to 1970s, the people of Tebat Rasau regarded the fish as a relatively inexpensive species and seldom sold it in the local markets. This was approximately the same situation found throughout Southeast Asia during that time (see Ng and Tan 1997; Rowley *et al*., 2008). However, the situation significantly changed during 1970s as a Chinese superstition arose that keeping the species brought good luck and fortune as the fish is regarded as a manifestation of a dragon, a sacred animal in the Chinese mythology (Ng and Tan, 1997). Consequently, the fish has been extensively harvested from the wild throughout the region (Yue *et al*., 2004).

The situation was the same in Tebat Rasau following the astronomical demand by first the "Peranakan" and later also by local people of Belitung, particularly from the large cities (Tanjung Pandan and Manggar). The local people mentioned that fish was once exported to the neighbouring island, Bangka and even directly to Jakarta. Subsequently, the population of the fish in the wild of Belitung was declining.

Fortunately, the local people of Tebat Rasau rarely consume the fish and in some way regard the fish as sacred being of the indigenous inhabitant of the ancient river (Amsoni, 2021 pers. comm.). Currently, the fish has been successfully bred in captivity (Aprionis, 2015); thus, at least reducing the tension of overharvested from the wild. The population of the charismatic Asiatic arowana in Tebat Rasau River is slowly increasing since.

The presence of Asiatic arowana and the believe of the antiquity of Tebat Rasau river have strengthening the awareness of the local people on the importance of the river and the appointment of Tebat Rasau river and surrounding areas as a national Geopark has been highly supported by the local people.

Freshwater Pupperfish (*Pao sp.*)

Freshwater pupperfishes are mainly classified as belonging to the genus *Pao* (Tetraodontidae) and mostly found in the Mekong River valleys in mainland Indochina down to Sumatra (Kottelat *et al*., 1993; Kottelat, 2013). Currently, there are four species found in the freshwater bodies of the western part of Indonesia: *Pao bergii*, *P. hilgendorfii*, *P. leiurus*, and *P. palembangensis*. *Pao bergii* is restricted to the western part of the then Dutch Borneo (today the Indonesian Province of West Kalimantan). Unfortunately, there has been no information regarding the species since it was published for the first time in 1905 based on a very few collections made from the tributaries of Kapuas River in West Kalimantan (Popta, 1905). There has been no new collection has ever been made since the type, which was collected by Nieuwenhuis during the 1893 to 1894 Dutch Borneo Expedition (Nieuwenhuis, 1900; Popta, 1995; Sellato, 1993); thus the existence of the species in present day tributaries of the mighty river of West Kalimantan is in question.

Nevertheless, Popta (1905) reported that based on the information given by the local Dayaks, Nieuwenhuis (1900) reported that in the wild *P. bergii* is a non-poisonous pupperfish species and completely safe to be touched and even consumed. *Pao hilgendorfii* has also been found in Kalimantan, which was also collected during the same expedition by Nieuwenhuis, but of a different location, which were in the riverine valley of Mahakam River in Eastern part of the then Dutch Borneo (now East Kalimantan Province). As in *P. bergii*, there has been no information or new collections made regarding the species since the type was collected. Thus, the presence of the species in the wild is also in question based on insufficient data.

Nieuwenhuis (1900) also reported that *P. hilgendorfii* also as a non-poisonous species and the Dayaks in East Kalimantan also mentioned that the species is completely safe to be touched and consumed. Thus, at least there are two non-poisonous and edible species of freshwater pupperfish from the genus *Pao* in Kalimantan, the western Kalimantan *P. bergii* and the eastern Kalimantan *P. hilgendorfii*.

The other species of pupperfish from the genus *Pao* in Indonesia is *Pao leiurus*, the only species in the genus that can live both in freshwater and brackish water (Kottelat *et al*., 2013). It is a wide spread species found from the Mekong River valleys (particularly Thailand) to Java, where the type was collected that was in the estuary of Batavia (now Jakarta; see Bleeker, 1850; see also Kottelat *et al*., 2013). Nevertheless, this species has never been reported to be poisonous and never consumed.

The other species is *P. palembangensis*, which also has a wide spread distribution areas stretching from the Mekong River valleys to Sumatra (Kottelat *et al*., 1993; Kottelat, 2013; Yamada *et al*., 2021). Thus, *P. palembangensis* largely is in cohabitant with *P. leiurus*, except in Java, where *P. palembangensis* has so far never been found. In Sumatra the species is mainly found in the tributaries in the vicinity of Palembang, the capital of Indonesian South Sumatra Province, where the type was collected (hence the epithet *palembangensis*; Kottelat *et al*., 1993). The species is also found further north in Serkap River in Riau (Yeliana, 2017). *Pao palembangensis* is also known to be poisonous and has never been consumed throughout mainland Southeast Asia (Saitanu *et al*., 1991; Zhu *et al*., 2020), and Sumatra (Kottelat *et al*., 2013).

Based on the toxin (particularly the neurotoxin *tetrodotoxin* or TTX; Saitanu *et al*., 1991) producing nature of *P. leiurus* and *P. palembangensis* have made them as unlikely to be in the same taxon with the non-poisonous taxon found in Tebat Rasau Pleistocene River. Moreover, the very inactive behaviour of *P. palembangensis* is not in accordance with the aggressive behaviour of the taxon found in Tebat Rasau River. Thus, there are only two candidate species left, the Borneo river dwellers: *P. bergii* and *P. hilgendorfii*.

Furthermore, based on the river system proposed by Molengraaff (1921, 1922), it is assumed here that the rivers in Belitung Island, including the Tebat Rasau River belong to a different river system that flow in mainland Sumatra. In other hand, during Pleistocene apparently at least throughout Pleistocene there were two great river systems in Sundaland, in which the ancient river of Tebat Rasau belongs to the eastern river system that includes most of the rivers and their tributaries in Borneo today. The western river system included rivers in Sumatra up to mainland Southeast Asia, including the Mekong River and its tributaries and do not include rivers in Borneo.

This apparently the reason of the complete absence of the supposed to be the Southeast Asian conspicuous wide spread species *P. leiurus* and *P. palembangensis* in Borneo and consequently disprove the possibility of the presence of any of these two species in Belitung despite the fact that Belitung Island is relatively close to the mainland Sumatra. In other words, the rivers in Belitung at least during Pleistocene have never been parts of

mainland Sumatra. Instead, the rivers belong to great river systems that flow in mainland Borneo. The result of this current study indicates that the people of Tebat Rasau acknowledge about this fact.

The people of Tebat Rasau described the Tebat Rasau River as was once a tributary of a great river in Kalimantan instead of any rivers in Sumatra. In order word, they are suggesting a possible hydrological link between Belitung and mainland Borneo, not with Sumatra. Surprisingly, despite the fact that they do not aware about the presence of *P. bergii* and *P. hilgendorfii*, through an oral tradition passed down from their predecessors they believe that there might have been the presence of a similar non-poisonous edible freshwater pupperfish species in Kalimantan similar with the one that they have in Tebat Rasau River. This is indeed a fascinating discovery, in which somehow is in accordance with Molengraaff (1921, 1922) and Kottelat *et al*. (2013).

Furthermore, the people of Tebat Rasau also report that the species of pupperfish found there is an obvious aggressive predator. This is echoing Nieuwenhuis (1900) that noted from the information supplied by the Dayaks that *P. hilgendorfii* is reported to be more aggressive than *P. bergii*. Thus, until the molecular data became available, the result of this current study suggests that the taxon found in Tebat Rasau River (Figures 13 and 14) is likely to be closer to *P. hilgendorfii* rather than it is to *P. bergii*.

The problem is *P. hilgendorfii* is found in the eastern part of Kalimantan, which is in Mahakam River, East Kalimantan. On the other hand, *P. bergii* is found in Kapuas River, West Kalimantan, where geographically closer to Belitung. However, as there is so far very limited information regarding the two species, until collections are more gathered, it is assumed here that the two species might have been cohabitants throughout Kalimantan and *P. hilgendorfii* might have also found in rivers of western Kalimantan and somehow found its way to the river in Belitung, which might have happened sometime in the Pleistocene. Nevertheless, the most important point here is that –the same as in the case of the presence of the Asiatic arowana– somehow the people of Tebat Rasau do recognise and aware about the existence of Sundaland, long before the geological term itself come into existence.

Another one important finding is that the people of Tebat Rasau know that the freshwater pupperfish that they have is much younger than the Asiatic arowana (*Scleropages formosus*; Figure 12). In other words, the people know that the arowana has been in the river long before the pupperfish. Long before the connection between Belitung Island and mainland Kalimantan come into existence. Thus, they regard the Asiatic arowana as a sign of the remote ancestors and thus, highly respected almost to the level of putting the fish as a sacred animal. This is fascinating as Asiatic arowana indeed have been spread through Southeast Asia long before the rise of the pupperfishes. The Asiatic arowana is believed to appear around Early Cretaceous (145 to 100.5 million years ago) with the ancestors of Asiatic arowana carried on the Indian subcontinent or smaller landmasses into Asia following the collision during Late Cretaceous to Oligo-Miocene (Potts and Behrensmeyer, 1992; Kumazawa and Nishida, 2000; Kumazawa *et al*., 2013).

On the contrary, they do not do that for the pupperfish and even once regularly consumed the fish. Fortunately, as Tebat Rasau has been appointed as Geopark, the practise of consuming the pupperfish is subsequently reduced as the people prefer to preserve and conserve the fish in relation with the more promising source of income, ecotourism. Apparently, the establishment of Tebat Rasau as Geopark has brought more benefits for the people and they deceptively support it.

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