



GEOSITES, BIOSITES, CULTURAL AND ARCHAEOLOGICAL SITES AND THEIR INTERRELATIONSHIPS FOR THE DEVELOPMENT OF KENYIR GEOPARK, TERENGGANU, MALAYSIA

**Dony Adryansyah Nazaruddin¹, Nor Bakhiah Baharim²,
Muhd Nur Ismail Abdul Rahman³, Salwa Shahimi⁴, Norhayati Ab Manaf⁵**

^{1,2,3}Marine Geoscience Program, Faculty of Science and Marine Environment,

*⁴Biodiversity Conservation and Management Program,
Faculty of Science and Marine Environment,*

*⁵Institute of Tropical Biodiversity and Sustainable Development,
UNIVERSITI MALAYSIA TERENGGANU*

Abstract

Kenyir Geopark in Terengganu, Malaysia has been declared as a national geopark on 30 May 2023 due to its wealth of geological heritage complemented by its valuable and unique biological, cultural, as well as archaeological heritage. This national geopark contains the land and lake environments, where the Kenyir Lake is the largest man-made lake in Southeast Asia and is used as a hydroelectric reservoir. This study aims to identify and classify key geological, biological, cultural, and archaeological sites and their interconnections which play vital roles for the development of the geopark. So far, a total of 15 proposed geosites have been identified and categorized based on geodiversity types: mineral, igneous and sedimentary rocks, fossils, tectonics/structures, and morphology. There are also currently 11 proposed biosites have been identified and classified based on their unique flora, fauna, and combination of both existing in both natural and artificial ecosystems. At least 11 proposed cultural sites have been identified and categorized into tangible and intangible heritage. Meanwhile, one proposed archaeological site has also been identified within the geopark area. The synergy between all these key components of Kenyir Geopark is significant to support this geopark's development, including research and educational opportunities, sustainable tourism, conservation, community development, as well as ensuring its legacy for future generations.

Keywords: Geosite, Biosite, Cultural Site, Archaeological Site, Kenyir Geopark

¹ Corresponding author. Email: dony@umt.edu.my

INTRODUCTION

Kenyir is the name of the largest man-made lake in Southeast Asia which was built from several rivers by constructing the dam on the Kenyir River, the upper stream of the Terengganu River (the main river in the state of Terengganu). The dam was constructed during the period 1978-1985 by inundating some villages then including the Kenyir Village to create the Sultan Mahmud Hydroelectric Power Station for the purpose of covering the electricity supply to Peninsular Malaysia. The lake covers an area of 370 km² within the district of Hulu Terengganu with the maximum water depth of 125 m and is underlain by granite (Hunt et al., 2013; Loganathan, 2014). Based on the Central Terengganu Development Authority (KETENGAH, 2024a), the Kenyir Lake area has been decorated by 340 islands and islets. It has been announced as a state park in 2018 which is situated next to the Taman Negara National Park (Terengganu State Park Management Council, 2018). However, it also becomes one of six areas with higher seismic activity in Peninsular Malaysia with mild earthquakes ($M < 3$) occurred several times. After the establishment of the dam, the Kenyir Lake is the location of the first reservoir-induced earthquake in the region occurred in 1985, since there was no any report on earthquake activity prior to the dam construction (Nazaruddin and Duerrast, 2021).

The lake and its surrounding land environment are rich of important geological, biological, cultural and archaeological sites, so that this area has been declared as a national geopark in 2023. This geopark is located within the latitude 4.67° - 5.28°N and longitude 102.50° - 103.08°E and covers an area of 2.449 km² or around a half of the Hulu Terengganu district, in the state of Terengganu, Malaysia. The geopark area is bounded by the boundaries of several subdistricts including Hulu Terengganu, Tersat, Kuala Berang, Jenagor, and Hulu Telemung subdistricts (Kenyir Geopark Main Committee, 2023). Figure 1 shows the map of location and boundaries of Kenyir Geopark with all its geosites, biosites, cultural, and archaeological sites. The recognition and rebranding are expected to conserve and develop its geological, biological, cultural and archaeological heritage, and in the same time to raise the name of Kenyir Geopark in the national and international stages, to empower local and indigenous communities, and to stimulate the growth of tourism and other sectors.

The concept of geopark arose in the mid-1990s in response to the need to conserve and enhance the value of geologically significant areas in Earth history. Since the early 21st century, UNESCO initiated the geopark concept not only to conserve and enhance the geological heritage, but also natural and cultural heritage, offering sustainable economic and social development (Fornaro & Fernandes, 2018; Martini, 2009; UNESCO, 2015). GGN (2010) defined a geopark as a geographical area where geoheritage sites are managed with a holistic concept of protection, education and sustainable development. The

connection between geological, biological, and cultural heritage must be highlighted as an integral part of each geopark. It is also necessary to include sites of ecological, archaeological, and historical values within each geopark. In many societies, natural, cultural and social history is inextricably linked and cannot be separated.

In order to propose this area to become a national geopark, the State Government of Terengganu with its mandate has established three types of committee and their management structures for Kenyir Geopark, namely the Main Committee, the Working Committee, and the Sub-Committee. The Kenyir Geopark Scientific Sub-Committee lead by Universiti Malaysia Terengganu (UMT) has been actively conducting research works to investigate all potential geosites, biosites, and cultural as well as archaeological sites within the geopark area. This study aims to identify and classify important geological, biological, cultural, and archaeological sites and their linkages for the sustainable development of the geopark area.

ESTABLISHMENT OF KENYIR GEOPARK

TRDI (2023) reported that the planning to propose Kenyir area to become a national geopark started in 2015. During 2017, several discussions and meetings have been organized to prepare all necessary documents needed to be raised to the National Geopark Committee. The State Government of Terengganu has approved the proposal to establish Kenyir Geopark based on their meeting on 4 October 2017. However, the progress became slow for several years due to several factors, mainly there was no agency or institution agree to lead the team and the Covid-19 pandemic during 2020-2021. In 2022, the efforts to propose Kenyir area to be a national geopark were reactivated after the state government through the Terengganu State Economic Planning Unit (UPEN Terengganu) approved that the Hulu Terengganu District Officer would lead the plan. During 2022, a lot of activities including meetings, workshops, and courses, have been conducted by stakeholders to promote the Kenyir Aspiring Geopark to public. In early 2023, the complete and final application dossier of Kenyir Aspiring Geopark has been submitted to the National Geopark Committee. The assessment session for this aspiring geopark has been organized on 7-11 March 2023. On 30 May 2023, the National Geopark Committee has certified the decision of the evaluation panel and declared this area as the ninth national geopark in Malaysia with the official name “Kenyir Geopark”.

METHODOLOGY

The study employed an exploratory, multidisciplinary research design that combined desk-based review, field surveys, expert consultation, and geospatial

analysis to identify and classify geosites, biosites, cultural sites, and archaeological sites within the Kenyir Geopark area. Secondary data from geological maps, biodiversity inventories, archaeological reports, and local historical records were first compiled to establish a preliminary list of potential heritage sites. These sites were subsequently verified through field observations and classified according to their diversity types, allowing the development of an integrated inventory to support geopark planning. In Kenyir Geopark, geodiversity types consist of minerals, igneous rocks, sedimentary rocks/stratigraphy, fossils, tectonics/structures, and morphology (landforms/landscapes). Biodiversity types comprises fauna, flora, and the combination of fauna and flora in a site. Meanwhile, the cultural heritage types can be divided into tangible and intangible heritage.

Several limitations should be acknowledged. Site identification and classification were based primarily on qualitative expert judgment because a universally standardized framework for assessing and comparing geoheritage, biodiversity, cultural, and archaeological values in an integrated geopark context is still lacking, particularly in Malaysia and Southeast Asia. The study did not employ quantitative sampling or statistical analyses, as its main objective was to produce a comprehensive baseline inventory rather than test hypotheses. In addition, some areas were difficult to access due to dense forest cover, rugged terrain, reservoir conditions, and weather constraints, which may have limited the documentation of certain sites and indicate that additional surveys may reveal further heritage resources in the future.

Several international studies provide a strong theoretical and methodological foundation for the integrated classification and management of geoheritage, biodiversity, and cultural resources in geopark development. Zouros (2016) discussed the role of the Global Geoparks Network in establishing internationally recognized criteria for site identification, heritage interpretation, and territorial management. Integrated heritage management is supported by Gordon (2019), who demonstrates that geoconservation principles should be applied alongside biodiversity conservation and cultural landscape management in protected areas, including UNESCO Global Geoparks (UGGp). In the Malaysian context, Abdul Aziz et al. (2011) argued that geoparks require integrated planning and management to conserve geological, biological, and cultural heritage while promoting local development, using Langkawi UGGp as a pioneering example.

GEOSITES OF KENYIR GEOPARK

Geology of Kenyir Geopark is generally dominated by sedimentary rocks (clastic and carbonate), metamorphic/metasedimentary rocks, igneous rocks (intrusive and extrusive rocks), and alluvium as shown in Figure 2. To date, a total of 15

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geological sites have been proposed to be geosites of Kenyir Geopark and classified based on their geodiversity types. Each geosite has also been characterized directly during the field visits in 2023. All geosites are listed in Table 1 and their locations can be seen in Figure 1.

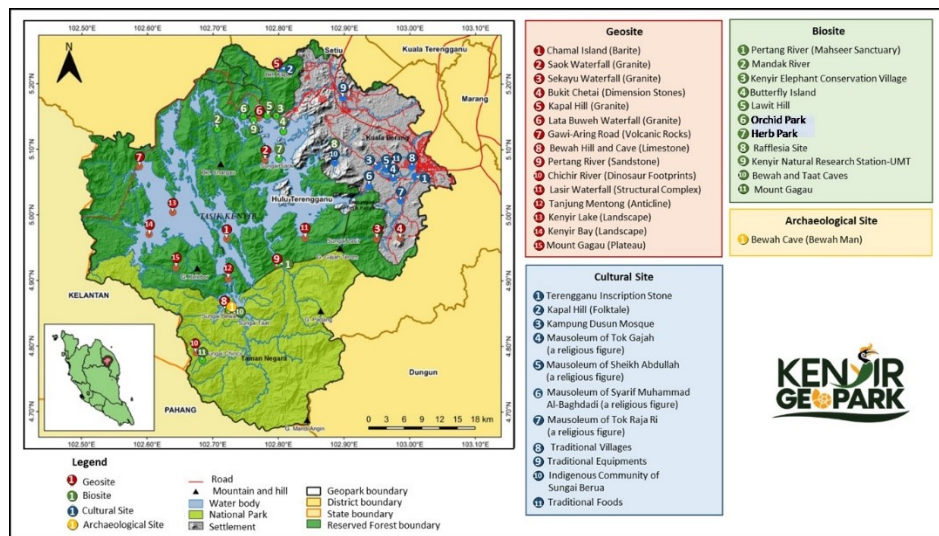


Figure 1: Location map of Kenyir Geopark with its proposed geosites, biosites, cultural, and archaeological sites, along with its official logo (Nazaruddin & Ab Manaf, 2024)

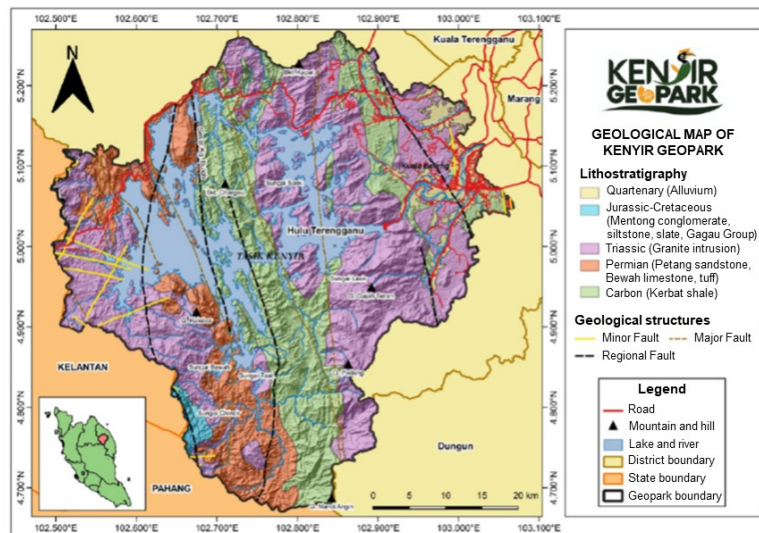


Figure 2: Geological map of Kenyir Geopark

Table 1: Geosites of Kenyir Geopark

No.	Code	Geodiversity Type	Geosite Name and Main Feature	Location (Subdistrict)
1	GS-1	Minerals	Camal Island (Barite)	Hulu Terengganu
2	GS-2	Igneous Rocks	Saok Waterfall (Granite)	Hulu Terengganu
3	GS-3		Sekayu Waterfall (Granite)	Tersat
4	GS-4		Chetai Hill (Dimension Stone)	Tersat
5	GS-5		Kapal Hill Rock (Granite)	Hulu Terengganu
6	GS-6		Lata Buweh Waterfall (Granite)	Hulu Terengganu
7	GS-7		Gawi-Aring Road (Volcanic Rocks)	Hulu Terengganu
8	GS-8	Sedimentary Rocks/ Stratigraphy	Bewah Hill & Cave (Limestone)	Hulu Terengganu
9	GS-9		Petang River (Sandstone)	Hulu Terengganu
10	GS-10	Fossils	Chichir River (Dinosaur Footprints)	Hulu Terengganu
11	GS-11	Tectonics/ Structures	Lasir Waterfall (Structural Complex)	Hulu Terengganu
12	GS-12		Tanjung Mentong (Anticline)	Hulu Terengganu
13	GS-13	Morphology (Landforms/ Landscapes)	Kenyir Lake (Landscape)	Hulu Terengganu
14	GS-14		Kenyir Bay (Landscape)	Hulu Terengganu
15	GS-15		Mount Gagau (Plateau)	Hulu Terengganu

Geosite of minerals

Camal Island (GS-1; Figure 3A) was proposed as a geosite due to its former barite (BaSO_4) mining site in Kenyir area. The mining operation was conducted by the company of TP Barite Sdn. Bhd. since 1981 and stopped in 1983 due to the impounding of the Kenyir Dam. The barite is hosted within a thick sequence of the Carboniferous-Permian black or dark gray siliceous shale, mudstone, with minor chert and siltstone (known as Kerbat Shale; Sum, 2001; Figure 3B). The ex-mining site is located atop this hilly and forested island with the maximum elevation of around 350 m above sea level. According to JMG (2009), the barite is associated with the granite intrusion into overlying sedimentary formation. Barite is formed as a result of several processes in different environments leading to their types of deposit, including marine sedimentary (bedded/stratiform) deposits, hydrothermal veins, and residual deposits with variety of colour from white and light to dark grey. This mineral is widely used in oil exploration as a mixture in drilling muds. Figure 3C shows an example of barite veins in Camal Island.

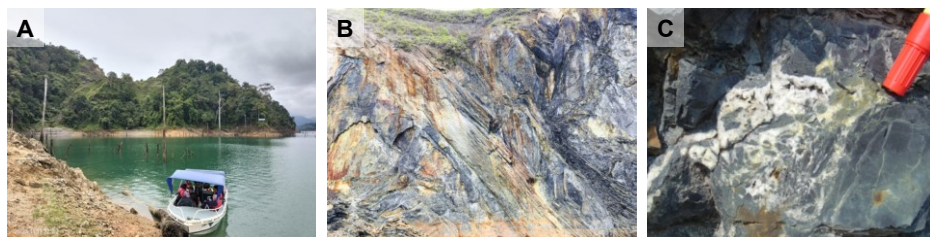


Figure 3: (A) Camal Island (GS-1); (B) Dark grey Kerbat Shale exposed in the island; (C) Barite veins in the shale

Geosites of igneous rocks

Igneous rocks in Kenyir area consist of intrusive and extrusive rocks. Intrusive rocks are exposed well in waterfalls and hills that are represented in several proposed geosites: Saok Waterfall (GS-2), Sekayu Waterfall (GS-3), Lata Buweh Waterfall (GS-4), Kapal Hill (GS-5), and Chetai Hill (GS-6). All these geosites consist of Triassic Kapal Granite as the dominant rock and a series of large-scale dolerite dike. The Kapal Granite is one of the largest granitic bodies (around 161 km long and between 19-38 km wide) in the Eastern Belt extending from the Setiu River area in the north (Terengganu) to Gunung Irong (Pahang) in the south. It takes its name after the Kapal Hill in the north but this hill is not the highest in the granite unit (Rajah et al., 1977). The composition of Kapal Granite ranging from diorite to monzogranite and dominated by granodiorite. This batholith body consists of several smaller granitic plutons such as Saok Granite, Chengal Granite, and Kesing Granite (Ghani, 2004). These granites are linked to the uplifting phenomena of the Eastern Belt Granite in the Mesozoic era as a result of subduction of the Tethys oceanic crust. The result of this tectonic activity has created various geological structures namely joints and faults, as well as other features such as schlieren, apophysis and xenoliths.

All above-mentioned waterfalls were created by a series of normal faults that cut across streams forming tiered waterfalls. These features combined with their main rivers and waterfall pools formed beautiful panorama and added value to these geosites. The **Saok Waterfall** (Figure 4A) is located within the Kenyir Lake and can be accessed by boat from Pengkalan Gawi Jetty. The underlying rock of this geosite is the Saok Granite which is part of the Kapal Granite. **Sekayu Waterfall** (Figure 4B) and **Lata Buweh Waterfall** (Figure 4C) are located outside the Kenyir Lake and can be accessed by the land transportation. The main rock components in the Sekayu Waterfall are granite (known as light gray monzogranite) and dolerite dikes. Meanwhile, the Lata Buweh Waterfall consists of granite, tamolite, and dolerite.

The **Kapal Hill** (Figure 4D) and **Chetai Hill** (Figure 4E) are located outside Kenyir Lake. The Kapal Hill is located within a reserve forest in

Kampung Gerdong, Hulu Telemong subdistrict, in the district of Hulu Terengganu, about 40 km from Kuala Berang town. The hill is around 800meter above sea level high and takes around 45 minutes hiking to the rock outcrop. It consists of a unique granite rock boulder with 21meter long and 4.5meter high that resemble a broken or split ship. In a geological context, the formation of such rock boulders requires millions of years through various processes, not only the intrusion of granite, but also chemical, physical, and biogenic weathering. The Chetai Hill is composed of light gray to gray (occasionally dark gray) granodiorite and green to dark green dolerite existing as small boulders less than 1 meter with a fine grain size. The Chetai Hill has once mined to produce dimension stones during 2008 to 2014 to supply within the country with the commercial names are Sekayu White and Terengganu Green (Anchor Resources Limited, 2017) referring to granite and dolerite, respectively.

The extrusive (volcanic) rocks are found in the **Gawi-Aring Road** (GS-7), and can be observed in the roadside (Figure 4F). The volcanic rocks are dated back to the early Permian and represented by trachyte, hornblende rhyolite, tuff, agglomerate, and andesite. Roselee et al. (2018) revealed that the volcanic rocks in this area consist of both pyroclastic and lava flow type of basaltic and andesitic composition with subordinate of slightly metamorphosed limestone and argillaceous rocks. These volcanic rocks mostly show dark colour and formed as aphanitic to less common porphyritic texture. There are also structures such as faults, fractures, and xenoliths. The occurrences of the volcanic rocks have the potential to be studied to unravel the volcanic history of Terengganu.

Geosites of sedimentary rocks/stratigraphy

There are two localities with significant sedimentary rocks or stratigraphic features selected as geosites due to their sedimentary or stratigraphic features in Kenyir Geopark: Bewah Hill & Cave (GS-8) and Petang River (GS-9). The **Bewah Hill & Cave** (Figure 5A, B, and C) and together with the neighbouring Taat Hill (Figure 5D) with its cave (Figure 5E and F) is characterized by two mogote hills with steep vertical cliffs composed of limestone formation that was formed in marine environment during the Permian. This geosite (both hills and caves) is located within the southern part of Kenyir Lake and is particularly unique as it is the only limestone hill area found in the state of Terengganu. Prior to the creation of the lake, there were several caves and some of archaeological remains. However, after flooding, most of them were lost underwater leaving only the Bewah and Taat Caves accessible to the public. Sometimes Taat Cave also can't be accessed due to the seasonal high level of the lake water. Sum (2001) elaborated that the round-shaped Bewah Hill rises from the floor at an elevation of 150 m to the peak at an elevation of 600 m, while the northeast-trending ridge Taat Hill rises at an elevation of 280 m and peaking at an elevation of 615 m.

According to Mohd Sharoum et al. (2015), there is another cave namely Tok Bidan Cave situated beneath the Bewah Cave, however, the Tok Bidan Cave is submerged under water at present after the completion of the Kenyir dam. The Bewah limestone consists of dolomite and calcite with several limestone facies and estimated to be Middle Permian (270-260 mya) in age and is believed to be the ancient mainland seabed. However, the tectonic uplift made the seabed to rise and formed the limestone hill (Mohd Sharoum et al., 2015). This geosite has an international significant due to the discovery of the rare giant clam species *Shikamaia* sp. (Figure 5G) in the Bewah Hill, which was found only in a few places in the world, and the discovery of artifacts and a prehistoric creature in the Bewah Cave called the “Bewah Man” dating back 16,000 years, the oldest of this kind in Malaysia. The finding of marine fossils such as corals (Figure 5H) as well as cephalopods, gastropods, bivalves, and foraminifera add the value to this geosite. The limestone hill also exhibits a karst landscape with various morphological features e.g. mounds and pinnacles as well as caves with various cave structures (stalagmites, stalactites, columns, rimmed pools, curtains, and flowstones). There is a mini gallery near the Bewah Cave entrance displaying geological, biological, cultural, and archaeological aspects of Bewah area.



Figure 4: Geosites of igneous rocks: (A) Saok Waterfall (GS-2); (B) Sekayu Waterfall (GS-3); (C) Lata Buweh Waterfall (GS-4); (D) Kapal Hill (GS-5); (E) Chetai Hill (GS-6); and (F) Gawi-Aring Road (GS-7)

The **Petang River** (Figure 5I) is a geosite with Carboniferous-Permian sandstone that was uplifted during the intrusion of Triassic granitic rocks. The arenaceous rocks are known as the Petang River Sandstone and are composed of dark grey to greyish brown or light brown sandstones which contain fine to coarse-grained, fairly well sorted quartz grains representing shallow water (near-shore) environment (Sum, 2001). The very massive and thick sandstone (Figure 5J) deposited here is intensely jointed, reaching a thickness of up to five meters and forms a distinct segment of the Petang Sandstone formation. The sandstone

is interbedding with minor shale, slate, and hornfels. Additionally, the river contains beautiful river landscape, including river channels, sandbars, mid-channel bars, and being a strategic location for Mahseer fish sanctuary.

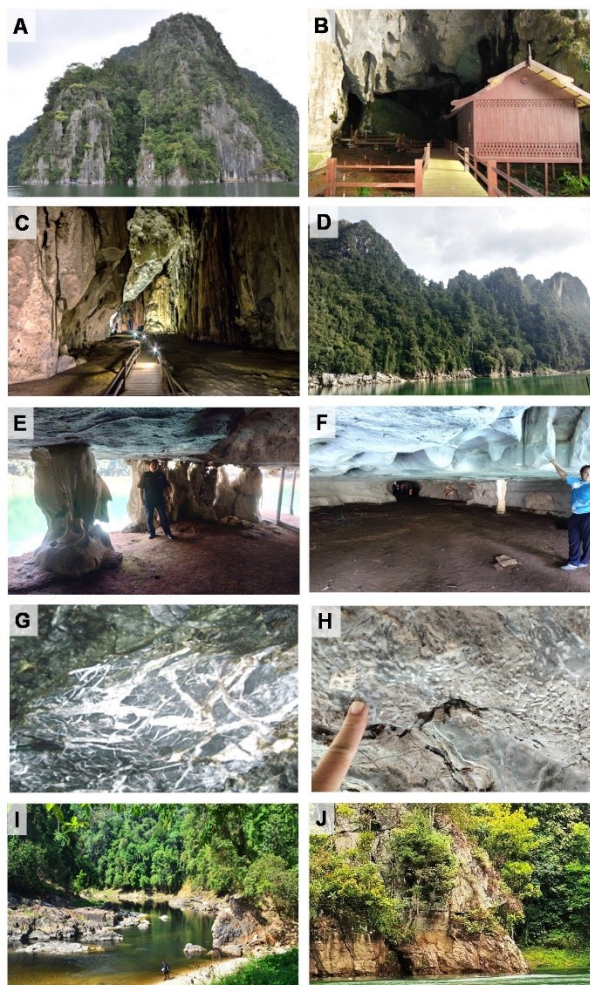


Figure 5: Geosites of sedimentary rocks/stratigraphy in Kenyir Geopark consist of Bewah Hill & Cave (with the Taat Hill & Cave; GS-8) and Pertang River (GS-9) with interesting features: (A) Bewah Hill, (B) Main entrance of Bewah Cave, (C) Main chamber of Bewah Cave, (D) Taat Hill, (E) Main entrance of Taat Cave, (F) Main chamber of Taat Cave, (G) Fossils of giant bivalves of *Shikamaia* sp. from the Bewah Hill, (H) Coral fossils inside Taat Cave, (I) Pertang River, (J) Typical sandstone outcrop in Pertang River (Pertang Formation)

Geosite of fossils

Chichir River (GS-10) is located within Mount Gagau area which is part of the *Taman Negara* National Park. Rishworth (1974) formalized several rocks units in Mount Gagau area as the Gagau Group which consists of a thick succession of Jurassic-Cretaceous continental (terrigenous) sedimentary deposits: the older Badong Conglomerate and the overlying younger Lotong Sandstone as well as the associated volcanic rocks. The Chichir River geosite is very significant due to the discovery of a dinosaur tooth fossil of *Iguanodon* species within a conglomerate block (Figure 6A and B) and three species of dinosaur footprints of *Iguanodon* (Figure 6C and D), *Sauropod* (Figure 6E), and *Tetrapod* (Figure 6F) on the surface of three different sandstone blocks. The discovery of these dinosaur fossils indicates the existence of dinosaurs in the state of Terengganu. In addition, this river is also the place where trace fossils of burrows known as *Scoyenia* were found. All these fossils found during the Jurassic-Cretaceous Expedition in 2014 organized by a group of local geologists.

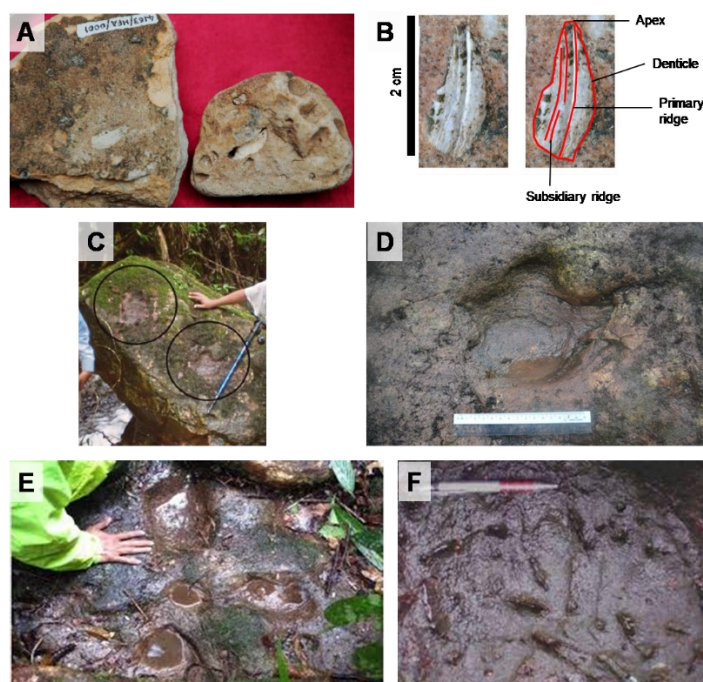


Figure 6: Dinosaur fossils found in Chichir River geosite (GS-10): (A) Fossils of *Iguanodon* teeth found in two conglomerate blocks; (B) A close-up view of one of the *Iguanodon* teeth; (C) A pair of *Iguanodon* footprints; (D) A close-up view of one of the *Iguanodon* footprints; (E) *Sauropod* footprints; and (F) *Tetrapod* footprints

Geosite of tectonics/structures

Two localities were proposed as geosites of tectonic deformation or geological structures, namely Lasir Waterfall (GE-11) and Tanjung Mentong (GE-12). The **Lasir Waterfall** geosite is another tiered waterfall within the Kenyir Lake which is similar to other waterfalls which are composed of Triassic Kapal Granite (Figure 7A). However, it also contains quartzite and hornfels due to Triassic granite intrusion into the Carboniferous-Permian sedimentary rocks. As the effect of granite intrusion, this geosite also showcases a structural complex with various geological features such as faults, joints, veins, rock boundaries, dikes, apophyses, and xenoliths. This highest waterfall in Kenyir area formed from a set of faults resulting in a step fault and creating a beautiful landscape (Figure 7B). Lasir Waterfall is the most famous waterfall in Lake Kenyir which is located 16 km from Pengkalan Gawi Jetty and takes 30 minutes by speedboat. The waterfall has a height of up to 500 feet (<https://tourism.ketengah.gov.my/tasik-kenyir/air-terjun-lasir/show>),

Meanwhile, the **Tanjung Mentong** (Figure 7C) is a geosite with important tectonic or structural feature, that is the folding of Petang Formation forming an anticline ridge (Figure 7D) in the N340E direction. This ridge also separates the Kapal Batholith in the eastern part from the western pluton. This anticline is believed to have formed due to tectonic activity during the Permian-Triassic period. This site is formed by the Early Permian Petang Sandstone Formation (Figure 7E) with the main lithology of massive sandstone and minor shale, siltstone, and hornfels (due to nearby granite intrusion). The presence of dolerite dikes, lamprophyre, and aplite is common in this area. Tanjung Mentong is the gateway to the National Park, where Plan Malaysia (2019) included Tanjung Mentong and the National Park as an ecotourism attraction in Terengganu. Tanjung Mentong is selected as one of the conservation areas with no development, farming or logging allowed except for low impact nature tourism activities, research and education. Department of Wildlife and National Parks (DWNP/PERHILITAN) Peninsular Malaysia (2024) stated that Tanjung Mentong can be reached from Pengkalan Gawi through the Kenyir Lake which will takes about 45 minutes by speed boat.

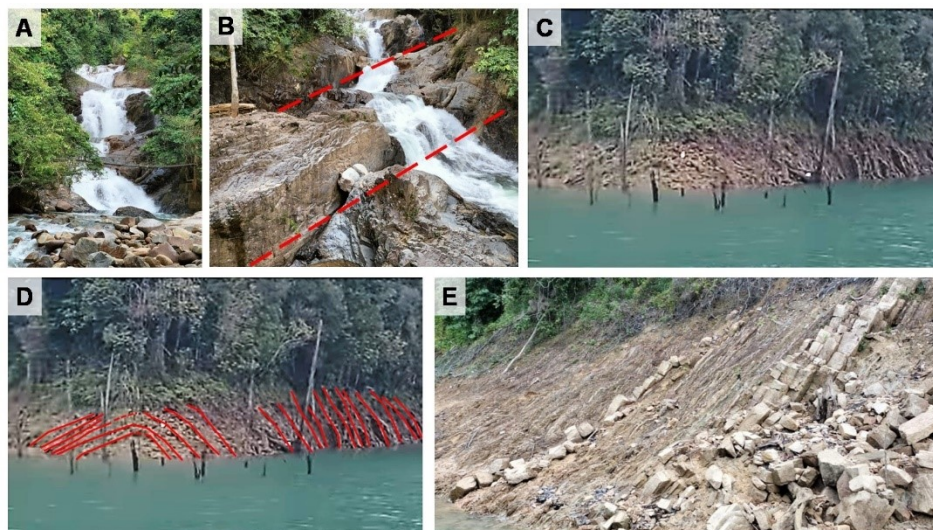


Figure 7: Geosite of tectonics/structures: (A) Lasir Waterfall (structural complex) geosite (GS-11); (B) A series of NS-trend normal faults forming the Lasir Waterfall; (C) Tanjung Mentong (GS-12); (D) An anticline feature in Tanjung Mentong; and (E) Outcrop of interbedded sandstone, siltstone, shale at Tanjung Mentong

Geosites of morphology (landforms/landscapes)

There are at least three prominent landscapes in Kenyir area which are suitable to be geosites, namely Kenyir Lake (GS-13), Kenyir Bay (GS-14), and Mount Gagau (GS-15). The **Kenyir Lake** formed by the damming of the Kenyir River and some other rivers in the upstream of Terengganu. The lake is very large and showcases a chain of partially submerged hills, creating around 340 islands scattered within the lake. It is surrounded by lush tropical rainforest and is renowned for its stunning and beautiful landscape (Figure 8A). The lake, as one of the areas under the Central Terengganu Development Authority, is so special as a tourism destination due to its clear water and the green environment from the tropical rain forest in the surrounding hills. The lake is also a favorite destination for fishing, boating, kayaking, jet skiing, rafting and so on.

Meanwhile, the **Kenyir Bay** landscape (Figure 8B) displays a panoramic and beautiful bay landscape adorned with the remnants of submerged tree trunks. This aesthetic landscape is exclusive to the Kenyir Lake. The landscape of Kenyir Bay that was selected as one of geosites is located on the west side of the Kenyir Lake (Abdullah and Omar, 2017).

Additionally, **Mount Gagau** or Gagau Mountain Ridge showcases the largest plateau landscape in Peninsular Malaysia (Figure 8C), where the plateau is located along the border Terengganu-Kelantan. The mountain was formed by

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Late Mesozoic continental sedimentary rocks overlying Late Paleozoic sedimentary rocks to the west and east, with Triassic granite intrusions in between. The rock formations here consist of conglomerates, sandstones, mudstones, and siltstones with very gently inclined layers. Mount Gagau, which is located nearby the Kenyir Lake, is part of Taman Negara National Park which is shared in three states: Kelantan, Terengganu, and Pahang (<https://tourism.ketengah.gov.my/tasik-kenyir/gunung-gagau-tasik-kenyir/show>). Other than a plateau, Mount Gagau area has also cuesta landscapes with different dip slopes (Nazaruddin, 2016).



Figure 8: Geosite of morphology (landforms/landscapes): (A) Kenyir Lake (GS-13); (B) Kenyir Bay (GS-14); and (C) Mount Gagau plateau (GS-15)

BIOSITES OF KENYIR GEOPARK

Kenyir area has a lot of iconic and endemic species of fauna, some are nearly endangered, some are endangered, and some others are critically endangered, including Asian elephant (*Elephas maximus*), Malayan tiger (*Panthera tigris jacksoni*), Asian tapir (*Tapirus indicus*), pangolin (*Manis javanica*), snail (*Kenyirus sodhii* and *Pearsonia tembatensis*), insect bat (*Kerivoula minuta*, *K. papilosa*, *Miniopterus schreibersi*, *Murina aenea*, *Myotis ridleyi* and *Hipposideros ridleyi*), fruit bat (*Dyacopterus spadiceus*), cricket-frog (*Fejervarya nicobariensis*), frog (*Limnonectes blythii*, *L. malesianus*, *Nyctixalus pictus*, and *Rhacophorus reinwardtii*), tortoise (*Heosemys spinosa* and *Manouria emys*), cave-dwelling rat snake (*Orthriophis taeniurus ridleyi*), bird (*Emberiza*

aureola and *Meiglyptes tristis*), hornbill (*Anthracoceros malayanus*, *Buceros bicornis*, *B. rhinoceros*, *B. vigil*), clown knifefish (*Chitala chitala*), and cyprinid fishes (*Poropuntius deauratus*, *Neolissochilus hexagonolepis*). Kenyir area has also many iconic and endemic species of flora such as Fairy Lanterns (*Thismia domei*, *Thismia terengganuensis*), Altenanthera (Famili Amaranthaceae), Begonia (*Begonia reginula*), Melunak tree (*Pentace excelsa*), Cat's claws (*Caesalpinia sumatrana*), Rafflesia (*Rafflesia cantleyi*), Rhizanthus (*Rhizanthus infanticida*), cycas or bogak tree (*Cycas macrocarpa*), Johore Banana (*Musa gracilis*), and palms (*Johannesteijsmannia altifrons*).

Eleven sites have been identified and proposed as biosites within the Kenyir Geopark area based on their types of biodiversity: fauna, flora, and both fauna and flora (Table 2). During the field visits in 2023, all biosites have also been characterized. The locations for all biosites can be seen in Figure 1.

Table 2: Biosites of Kenyir Geopark

No.	Code	Biodiversity Type	Biosite Name and Main Feature	Location (Subdistrict)
1	BS-1	Fauna	Pertang River (Mahseer Sanctuary)	Hulu Terengganu
2	BS-2		Mandak River (Fish)	Hulu Terengganu
3	BS-3		Kenyir Elephant Conservation Village (Asian elephant)	Hulu Terengganu
4	BS-4		Butterfly Island	Hulu Terengganu
5	BS-5		Lawit Hill (Hornbills)	Hulu Terengganu
6	BS-6	Flora	Orchid Park	Hulu Terengganu
7	BS-7		Herb Park	Hulu Terengganu
8	BS-8		Rafflesia Site	Hulu Terengganu
9	BS-9	Fauna and Flora Combination	Kenyir Natural Research Station UMT	Hulu Terengganu
10	BS-10		Bewah and Taat Caves	Hulu Terengganu
11	BS-11		Mount Gagau	Hulu Terengganu

Biosites of fauna diversity

There are five proposed biosites selected due to their fauna diversity: Pertang River (BS-1), Mandak River (BS-2), Kenyir Elephant Conservation Village (BS-3), Butterfly Island (BS-4), and Lawit Hill (BS-5). **Pertang River** is a sanctuary for Mahseer fish (*Tor tambroides*) or Kelah fish (local lingo) (Figure 9A) which has an estimated population of more than 5000 adults. The river has 91 streams flowing into it. This sanctuary is about 45 minutes from Pengkalan Gawi Jetty. It is an exciting place due to the chance for visitors to swim, catch the fish by hand,

and have their feet nibbled by the fish. Fishing is prohibited in this place. This fish species does not have a stomach but has a long intestine. This species eats by sucking as an adaptation to the structure of its mouth (Sopha, 1999). In terms of nutrition, this species is omnivorous. Despite not having a stomach, adult Mahseers eat small fish (2-5 cm long), shrimp, as well as brown and green algae, in addition to ripe fruit and seeds of some types of trees near the river bank such as neram tree (*Dipterocarpus oblongifolius*). Neram fruits are often used as bait to catch this lucrative species. Juvenile species eat various types of zooplankton, algae and aquatic insect larvae. Meanwhile, **Mandak River** (Figure 9B) is one of the rivers in Kenyir that is a paradise for anglers and inhabited by various fish populations such as giant snakehead or 'toman' (*Channa micropeltes*), hampala barb or 'sebarau' (*Hampala macrolepidota*), clown knifefish or 'belida' (*Chitala chitala*), giant gourami or 'kaloi' (*Osphronemus goramy*), and river carp or 'kelah' (*Tor tambra*). There are also other fish species found in the river, such as *Notopterus notopterus*, *Acanthopsoides molobrion*, *Cyclocheilichthys apogon*, *Labiobarbus leptocheilus*, *Mystacoleucus obtusirostris*, *Osteochilus vittatus*, and so on (Aqmal-Naser et al., 2023). Developed as a breeding area for mussel (*Anodonta woodiana*) which was later developed for the production of freshwater pearls. There are dead trees underwater as breeding grounds for fish, while tree branches as the main nutrition for fish here.

Kenyir Elephant Conservation Village (KECV) is a conservation village for local Asian elephants (*Elephas maximus*) (Figure 9C) as one of endangered mammals in Kenyir area (Afik Ramlee et al., 2020). This biosite is located in a part of Telemong River, a tributary of Terengganu River, near Pengkalan Gawi Jetty. It opened in 2012 by the Elephant Management Unit under the authority of the DWNP/PERHILITAN, KETENGAH, and the Terengganu State Government. Only 10% from 256 hectares of this area is developed, while the remaining 90% is maintained to protect and display the natural conditions of the tropical forest suitable as an elephant habitat. The main concept of this place is to educate people about the habitat and behavior of elephants in addition to bringing visitors closer to nature. For that purpose, a canopy path is provided for visitors to see the elephant habitat from various angles while enjoying the amazing scenery natural forest. Various activities are also provided for visitors to interact with elephants such as shows, riding, bathing, feeding and playing with these animals (<https://tourism.ketengah.gov.my/tasik-kenyir/perkampungan-konservasi-gajah-tasik-kenyir/show>).

There is a butterfly park in Kenyir area which is located in Lubuk Geras Island or also known as the **Butterfly Island** (Figure 9D). The island showcases live and preserved butterfly specimens of a wide variety of species. There are more than 100 specimens of butterfly on display including species of Rajah Brooke (*Trogonoptera brookiana*) and Golden Birdwing (*Troides aeacus*). The

park also has an informative and interactive insect museum that attracts visitors to learn more about butterflies and other insects. For the whole Kenyir area, Afiq Ramlee et al. (2020) discovered around 217 butterfly species from 6 families.

Lawit Hill (695 meters above sea level) is located in the north of the Kenyir Lake, a few kilometers northwest of Pengkalan Gawi Jetty (the main entrance to the Kenyir Lake). The hill elongates until the point near the boundary between Besut, Setiu, and Hulu Terengganu districts. This location is a focal point for hornbills (Figure 9E) and various other endangered species. The southern part of this hill is the location for bird watching activity where bird watchers and enthusiasts can see a wide variety of bird species here, mainly hornbills. There is a spot here called the Hornbill Valley where visitors can hear hornbills call. This area is the location of the most complete hornbill species in Malaysia, where nine out of 10 hornbill species can be found here (Afiq Ramlee et al., 2020): bushy-crested hornbill (*Anorrhinus galeritus*), oriental pied hornbill (*Anthracoceros albirostris*), black hornbill (*Anthracoceros malayanus*), great hornbill (*Buceros bicornis*), rhinoceros hornbill (*Buceros rhinoceros*), helmeted hornbill (*Rhinoplax vigil*), wrinkled hornbill (*Aceros corrugatus*), wreathed hornbill (*Aceros undulatus*), and white-crowned hornbill (*Aceros comatus*). The spot is easily accessible from Pengkalan Gawi Jetty via a pleasant drive along a small paved road that crosses the edge of the Kenyir reservoir. The road is now used by visitors for nature walks and to access houseboats, while researchers use it to access the UMT research station. The slope and its surroundings are covered by the lowland dipterocarp and hill dipterocarp forests which are locations of two forest reserves – Tembat Permanent Forest Reserve and Hulu Telemong Permanent Forest Reserve. The existence of the great hornbill in this area then becomes a part of the Kenyir Geopark logo.

Biosites of flora diversity

Three sites with significant flora diversity have been identified as biosites including Orchid Park (BS-6), Herb Park (BS-7), and Rafflesia Site (BS-8). The **Orchid Park** (Figure 10A) includes three islands within the Kenyir Lake: Hulu Selimbar, Hilir Selimbar, and Belit Islands which are interconnected by hanging bridges. It is located about 20 minutes from Pengkalan Gawi Jetty. In the Orchid Park, there are various orchids of local, international, and hybrid species for more than 700 species. Among the orchid species are *Brassia maculata*, Vanda Miss Joaquim (*Papilionanthe* Miss Joaquim), Moth orchids (*Phalaenopsis*), Catasandra Fanfare (hybrid orchid), *Oncidium papillao* and Terengganu's very own rarely-found orchid known as *Dendrobium roslii* (<https://www.gayatravel.com.my/10-activities-to-do-for-a-a-fun-trip-in-kenyir/>, <https://www.kenyirtravel.com/interesting-places/>). The orchids here are grafted and bloom beautifully which make visitors mesmerized by their colors. The

Orchid Park was established as a hub for orchid cultivation, preservation and research. The park maintains a natural ecosystem to allow the wonders of nature to survive and reproduce (KETENGAH, 2024b). Visitors can buy the orchids here.



Figure 9: Biosites of fauna diversity: (A) Pertang River (Mahseer sanctuary; BS-1); (B) Mandak River (BS-2); (C) Kenyir Elephant Conservation Village (BS-3); (D) Butterfly Island (BS-4); and (E) Lawit Hill with hornbill species (BS-5)

The **Herb Park** (Figure 10B) is located in Sah Kecil Island and it takes around 10 minutes to go here from Pengkalan Gawi Jetty. The park has an arboretum that stores and showcases various species of herbs with more than 200 species of traditional herbs, such as long jack or ‘tongkat Ali’ (*Eurycoma logifolia*), Fatimah’s betel cutter or ‘Kacip Fatimah’ (*Labisia pumila*), cat’s whiskers or Java tea or ‘Masai Kucing’ (*Orthosiphon aristatus*), mistletoe fig or ‘mas cotek’ (*Ficus deltoidei*), and God’s crown or ‘mahkota dewa’ (*Phaleria macrocarpa*). In addition to the interpretation center for detailed information about herbs, the park also provides fresh herbal drinks for visitors to try, such as long jack, Fatimah’s betel cutter, and God’s crown (KETENGAH, 2024c).

Rafflesia Site is a jungle trekking site to observe rafflesia in Kenyir Geopark area (Figure 10C). Rafflesia, or *Bunga Pakma* as the locals call the flower, was found in part of Tembat Forest Reserve compartment 231, nearby the indigenous people (Orang Asli) community in Kampung Sungai Berua in Jenagor subdistrict since 2019. According to Britannica (2024), Rafflesia (genus *Rafflesia*) is parasitic plants native to Southeast Asia and contains the world’s largest flowers. All Rafflesia species parasitize the root of *Tetrastigma* vines (the

host plant). Rafflesia flowers are commonly have five tepals (undifferentiated petals and sepals) surrounding the sex organs (unisexual) in the central cup. Siti Munirah et al. (2020) stated that in Peninsular Malaysia, Rafflesia species found in lowland to hill dipterocarp forests in Terengganu and other states (Kedah, Perak, Kelantan, and Pahang). Rafflesia species found in this area is *Rafflesia cantleyi* which grow abundantly due to the suitable condition of the host plant. Nais (2001) stated that this species needs six to 21 months for flower buds to mature and bloom within five to eight days before it decays. Due to the increase number of tourists from within and outside Terengganu after the discovery of this unique flower, Terengganu State Government (2023) has to put the rules for the visitors who want to see the flower. Among the rules is that the visitors have to get a permit first from the Hulu Terengganu Forestry Department, the government agency which is responsible to preserve the flower's habitat, before entering the forest reserve.



Figure 10: Biosites of flora diversity: (A) Orchid Park (BS-6); (B) Herb Park (BS-7); (C) Rafflesia Site (BS-8)

Biosites of fauna and flora combination

Three sites have been identified as biosites based on the combination of fauna and flora diversity: Kenyir Natural Research Station – Universiti Malaysia Terengganu (BS-9), Bewah and Taat Caves (BS-10), and Mount Gagau (BS-11). **Kenyir Natural Research Station UMT** (Figure 11A) is one of UMT's research stations which intends to become an internationally recognized main centre of reference for Kenyir Lake's biodiversity. The establishment of this research station was started by the establishment of the Centre for Socio-Economic Development (CSD) in 2011 as UMT, in line with its function as a university for society, endeavours to excel in research that is multi-disciplinary and social-

innovation oriented. CSD was then upgraded to Kenyir Research Institute (IPK – abbreviation in Malay) in 2013 due to the research development at UMT. In 2021, the institute was renamed to Kenyir Natural Research Station (SPAK – abbreviation in Malay) which was placed under the Institute of Tropical Biodiversity and Sustainable Development UMT. This research station aims to become a leading research and knowledge transfer centre in the country, mainly in the uniqueness that Lake Kenyir has, such as biological varieties, an array of aquatic resources, tourists' attractions, and authentic cultural heritage. The station, with modern building design adapting the tropical elements and Terengganu's traditional architecture, offers world-class research, teaching and learning facilities, such as two academic blocks that have research labs, lecture rooms, research rooms for postgraduate and postdoctoral students, lecturers' and researchers' rooms, two hostel blocks, and six guest houses. There are also two specimen galleries that are used to display a variety of biological specimens, natural history, and sociocultural elements at the lake. The station welcomes visitors from local and overseas universities, schools, other institutions, and the public to fulfil their research interest at Kenyir Lake. In terms of transport to access the Kenyir Lake, the research station has a jetty equipped with facilities such as boat houses and speed boats to enable researchers to explore the lake and locate specimens (UMT Highlight, 2022).

Another biosite of fauna and flora diversity is the **Bewah and Taat Caves**. The name of Bewah Cave is believed from the name of the hill housing the cave, the Bewah Hill (Figure 11B). The word “bewah” means “feast” where local people believe that it refers to the activity that people nearby the cave liked to do in the past. It is also known as “bat guano cave” due to plenty of bat droppings in the floor of the cave. Meanwhile, another cave, the Taat Cave (“taat” means very loyal, obedient, and respect to somebody referring to loyal villagers for their leader) was formed in the Taat Hill (kenyirlake.com/attraction_cave.htm). The flora in the area consists of various types of plants, from tall trees, medicinal plants, forest fruit trees, to moss species, ferns and climbing plants. Among the species found in the Bewah Cave are Elephant Ears, Tiger's Betel (*Piper porphyrophyllum*), False Ivy-Palm (*Aralidium pinnatifidum*), Smooth parameria (*Parameria laevigata*), Fig (*Ficus vasculosa*) and Monkey Jackfruit (*Artocarpus rigidus*). There is also a unique green luminous or fluorescent moss (*Schistostega pennata*) inside of the Bewah Cave (Figure 11C). Among the fauna found in Bewah and Taat Caves are bats, crickets, large cockroaches, cave centipedes, several large crabs (Figure 11D), and large spiders (Figure 11E). Mohd Azmir et al. (2021) have discovered that there are 12 species of herpetofauna (reptiles and amphibians), 24 species of birds, and 15 species of bats in this area. There is also a Melunak tree (*Pentace microlepidota*) nearby the Tanjung Bewah, a plain area separating the two caves,

where visitors have to go through a hiking trail to reach the giant tree. According to KETENGAH's website (<https://www.ketengah.gov.my/10-activities-to-do-for-a-fun-trip-in-kenyir/>), the 340- years-old tree is the biggest tree of its kind in Malaysia (Figure 11F) with circumference equaling to around 20 hugging adults combined.

Meanwhile, **Mount Gagau** is the second highest peak in the National Park after Mount Tahan and renowned for its pristine rainforest (Figure 11G) and rich biodiversity. At the top of this mountain, which is at a height of 1,376 meters, three states that are within the borders of the National Park, namely Kelantan, Terengganu and Pahang can be seen. This mountainous area has diverse flora and fauna. The forest area in Mount Gagau is divided into three main types of forest: hill dipterocarp, upper dipterocarp, and montane forests. Mount Gagau contains also mossy forest (Figure 11H). Various types of flora and fauna are recorded in Mount Gagau which includes 97 species of mosses, 89 species of ferns and lycophytes, 111 species of seed plants, 18 species of amphibians, 14 species of reptiles and 2 other animal species. The diversity of flora and fauna that inhabit Mount Gagau makes it a conservation site for all these three types of forest. According to All Trails (2024), visitors who wish to climb Mount Gagau will have the chance to hike from Camp Gagau through the breathtaking green hills, which offer a scenic background and conceal an abundance of medicinal herbs.



Figure 11: Biosites of fauna and flora diversity: (A) Kenyir Natural Research Station – Universiti Malaysia Terengganu (BS-9), (B) Bewah Caves (BS-10), Fluorescent moss inside Bewah Cave, (D) A large crab inside Bewah Cave, (E) A large spider inside Bewah Cave, (F) The largest Melunak tree in Peninsular Malaysia, (G) Rainforest of Mount Gagau (BS-11), (H) Mossy forest atop Mount Gagau

CULTURAL SITES OF KENYIR GEOPARK

Cultural heritage consists of two concepts, namely tangible and intangible heritage. Tangible heritage is something that can be permanently seen and held whether stationary or moveable, for example historical buildings, sites, and objects, including monuments, places of worship, mausoleums, villages, equipment, etcetera which are considered important to be conserved. Meanwhile, intangible heritage refers to knowledges, expertises, languages, and lingual utterances which are interpreted via verbal traditions, languages, musics and songs, foods, and traditional games. Both of these concepts are used in Malaysia based on the National Heritage Act 2005, and Kenyir Geopark offers both types of heritage. Table 3 lists all cultural sites and their locations can be seen in Figure 1.

Table 3: Cultural sites of Kenyir Geopark

No.	Code	Cultural Heritage Type	Cultural Site Name and Main Feature	Location (Subdistrict)
1	CS-1	Tangible heritage	Terengganu Inscription Stone	Kuala Berang
2	CS-2		Kapal Hill (Folktale)	Hulu Terengganu
3	CS-3		Kampung Dusun Mosque	Kuala Berang
4	CS-4		Mausoleum of Tok Gajah	Kuala Berang
5	CS-5		Mausoleum of Sheikh Abdullah	Kuala Berang
6	CS-6		Mausoleum of Syarif Muhammad Al-Baghdadi	Jenagor
7	CS-7		Mausoleum of Tok Raja Ri	Kuala Berang
8	CS-8		Traditional Villages	Kuala Berang
9	CS-9	Intangible heritage	Traditional Equipment	Hulu Telemung
10	CS-10		Indigenous Community	Kuala Berang
11	CS-11		Traditional Foods	Kuala Berang

Cultural sites of tangible heritage

At Kenyir Geopark, in line with the significance of the Hulu Terengganu district as the earliest governing center of Terengganu and an entrepot back then, the cultural remains can still be seen around the river banks in Kuala Berang and nearby areas, such as Terengganu Inscription Stone (CS-1), Kapal Hill (Folktale) (CS-2), and Kampung Dusun Mosque (CS-3). There are also several mausoleums of national heroes and prominent figures within the geopark, including Mausoleum of Tok Gajah (CS-4), Mausoleum of Sheikh Abdullah (CS-5), Mausoleum of Syarif Muhammad Al-Baghdadi (CS-6), and Mausoleum of Tok Raja Ri (CS-7). In

additions, traditional villages (CS-8) and traditional equipment (CS-9) are also cultural heritage that can still be found there.

The **Terengganu Inscription Stone** (*Batu Bersurat Terengganu* in Malay) is assumed as the oldest artifact bearing Malay text inscribed in Arabic script (Jawi writing). The original inscription stone was kept in the *Muzium Negeri Terengganu* (Terengganu State Museum; Figure 12A), meanwhile its memorial was built close to where the original one was discovered in Kuala Berang, Hulu Terengganu District (Figure 12B). Nik Abd Rahman et al. (2012) and Abdul Rahman (2016) described that the inscription stone has a dimension of 84 cm in height, 53 cm wide at the top, 27 cm wide at the bottom, 24 cm in thickness, and a weight of around 215 kg. Based on the writing on the tablet, it was written in 702 AH (Hijri) or 1303 CE. It was first discovered accidentally after partially submerged after the flash flood receded at the bank of Tersat River, in Kampung Buluh, a village about 3 km from Kuala Berang town, Hulu Terengganu district in 1887. After its first discovery, the stone was used as a stepping stone to enter a *surau* (a small place of worship used by Muslims). It was then rediscovered in 1902 by an Arab-Malay trader from Riau-Lingga, Syed Hussin bin Ghulam Al-Bukhari, when he washed his feet to prepare the midday prayer and he noticed the stone was inscribed with Jawi words. He had the stone moved to Kuala Terengganu and presented it to Sultan Zainal Abidin who then placed it on Bukit Puteri. It was moved to Raffles Museum in Singapore in 1920s and was returned to *Muzium Negara* (National Museum) in 1960s and finally sent back to Terengganu State Museum. Among the writings inscribed in the stone are the declaration and enforcement of Islamic Laws as the official religion of the state of Terengganu during the reign of King Mandalika and the teachings of Prophet Muhammad. It also consists of several Islamic Laws and their punishments. The following texts are the translation of the inscriptions:

- Panel A: *“The Messenger of Allah (Prophet Muhammad), together with those who have faith in the Supreme God (Allah), have been enslaved to implant the religion of Islam; with truth they have spoken of the Laws binding upon all the servants of the Supreme God here in my domain. The arbiters of the faith of the Messenger of Allah (peace be upon him) are the King Mandalikas who speak the truth on the side of the Supreme God here on earth. To decide on the right knowledge is statutory upon all the Muslim King Mandalikas, in accordance with the decrees of the Supreme God who speaks the truth; that the correct way for the two determiners of knowledge is to be in solitary seclusion. Thereupon, I, Seri Paduka Tuan declare that this edict be erected in this country of Terengganu on Friday, in the month of Rejab, year 702, in the era of the Messenger of Allah.”*

- Panel B: *“Families in distant lands give those who come. Fourth Law: Debtors must never take... where have you lost the gold. Fifth Law: Whosoever must never take the mould for the making of money, if he takes then he must forfeit his gold. Sixth Law: Whosoever... of trouble makers, be they male or female, as decreed by the Supreme God, if they are free persons and bachelors then give them 100 strokes of the cane. If they are free persons with wives, or women with husbands, then bury them up to the waist and stone them to death. If they revolt then torture them; if the bachelor son of a chieftain then...”*
- Panel C: *“The penalty is ten and a half sagas. If an unmarried minister, the penalty is seven tahils and one paha...half a saga. If an unmarried headman the penalty is five tahils...seven tahils and one pahagoes into the Treasury.....If....a free person. Seventh Law: A woman who wants...has not got a husband, if she causes trouble....”*
- Panel D: *“Not true, the penalty is one tahl and one paha. Ninth Law: Seri Paduka Tuan punishes those who fail to prepare the fine... if my son, of my playmate, or my grandchildren, or my family, or child...this edict, and whosoever ignores its contents shall be damned by the Supreme God, cursed by the Supreme God, all those who disregard this articles of this ordinance.”*

Abdul Rahman (2016) stated that this discovery proves that Islam has reached Terengganu in or before the 14th century. The stone is the oldest Malay text in Arabic script that is still exists and the earliest record of the introduction of Islam into the Peninsular Malaysia. It was listed as one of the eligible items for world heritage recognition during the UNESCO International Advisory Committee meeting in Barbados in 2009. This inscription stone is made up of dolerite, a dark greenish gray, fine-grained, homogeneous igneous rock that is frequently found in Hulu Terengganu District as small intrusions or dykes.

The **Kapal Hill**, as already explained before in the part of Geosites of Kenyir Geopark, is a unique granite outcrop that looks like a ship deck is stranded near its summit, with a clear stream flowing beside it amidst pristine nature, making it a captivating place of attraction. This hill is located in a forest reserve area in Kampung Gerdong, Hulu Temomong subdistrict. This hill is frequently visited by geologists and researchers who want to examine its distinctive rock features and forms. For travelers, it is an uncommon sight that undoubtedly makes their trip more special. Hiking is the popular activity here for nature lovers and adventure enthusiasts looking for a beautiful scenery with lush green trees and soothing fresh air (Discovery Terengganu, 2024a). The hill is maximum 800meter above sea level high. It takes around 45 minutes hiking to the rock outcrop that is approximately 21meter long and 4.5 meter high (TRDI, 2020). According to the myth among the villagers, the ship-like rock (Figure 12C) was originally a large ship owned by

Chinese merchants passing through the area to have a trade transaction in Kuala Berang and stranded on the sand bar when Terengganu hit by a big flood hundreds of years ago. Eventually, the ship turned into a rock such that it became known as the ship rock, and the area became a hill with a thick forest.

Kampung Dusun Mosque is one of 80 mosques in Hulu Terengganu district which is located in Kampung Dusun, Jenagor subdistrict. This mosque was built by a communal work since 1326 Hijri (1908) (<http://emasjid.terengganu.gov.my/viewmasjid.php?daerah=7>; <https://masjid.islam.gov.my/maklumatDetailMS/1/1106035>). This 116-year-old mosque is among the oldest mosques in Terengganu and built with chengal (*Neobalanocarpus*) wood and without nails. It still preserves the architectural features of a traditional house (Figure 12D). A *beduk* (a drum used to call for Muslim prayers) is still hung at the edge of the veranda (Figure 12E). It is generously decorated with khat calligraphy, especially at the air vents on the doors and walls (Figure 12F).

Mausoleum of Tok Gajah (Figure 12G), which houses the tomb of the Malay hero, is a historical place that holds the story of bravery and fighting spirit of a famous Malay warrior namely Tok Gajah or his real name is Imam Rasul Abdul Salam bin Shahrum, or known as "*Orang Kaya Imam Indera Gajah Pahang*", or "*Khatib Rasul*". It is located in Kampung Pasir Nering, near Kuala Berang town, Hulu Terengganu, around 4 km from the Terengganu Inscription Stone memorial site. Based on the history, Tok Gajah is one of the warriors of Pahang who was actively involved in the resistance against British colonialism at the end of the 19th century. He was born in Temau Village, Raub, in the state of Pahang. He received early education in the field of religion and became a respected *imam* (leader) in his community. A solid religious education gave him a strong foundation in ethical values and justice as motivation in his struggle against the colonialists. Tok Gajah is known as a leader who is brave, intelligent, and strongly adheres to the principle of defending the homeland and the dignity of the nation. He was a very strategic person in planning attacks against the British. He often held meetings with other warriors to strategize and gather strength. One of the famous battles was the Semantan War in 1891, where Tok Gajah together with his son, Mat Kilau, successfully defeated the British forces. In 1892, the British colonialists issued an order to arrest Tok Gajah, so he fled to Hulu Kelantan and then to Hulu Terengganu where he died in 1901 and was buried here. This burial place is a symbol of appreciation and respect for his services and sacrifices in defending the motherland. This tomb is often visited by those who want to remember the services of this Malay warrior as well as to learn more about the history of the struggle against colonialism. This tomb is not only the focus of local tourists, but also foreign tourists who are interested in the history and culture of Malaysia. In addition, this tomb is also a place of study for historians and students who want to

delve into the history of the struggle of the Malay nation (Discovery Terengganu, 2004b).

Meanwhile, the **Mausoleum of Sheikh Abdullah** (Figure 12H) is located in Kampung Pauh, around 6 km from Kuala Berang town, Hulu Terengganu. Sheikh Abdullah, or his complete name is Sheikh Abdullah bin Abdul Qahar bin Syarif Muhammad Al Baghdadi, or also known as Tok Pauh, was of Arab descent and a famous scholar in Terengganu in the 1660s. He is the father of a famous scholar, Sheikh Abdul Malik or also known as Tok Pulau Manis.

Mausoleum of Syarif Muhammad Al-Baghdadi (Figure 12I) is located about 15 km from Kuala Berang town, just on the left bank of the Kenyir Dam, in Jenagor subdistrict. Syarif Muhammad Al-Baghdadi came from Baghdad and is believed to be an early Islamic preacher and a scholar in Terengganu, estimated to be around the year of 1600. He is also the ancestor of Sheikh Abdullah and Sheikh Abdul Malek bin Abdullah. He spread the teachings of Islam to the local population during the era of Islamic rule in Kuala Berang, Hulu Terengganu. His tomb is the first tomb of the Ahlul Bayt discovered in this settlement. Apart from the tomb of Syarif Muhammad al-Baghdadi, there are also tombs believed to be his descendants, also buried around his tomb (<https://geopark.ketengah.gov.my/makam-syarif-muhammad-al-baghdadi/>).

In additions, **Mausoleum of Tok Raja Ri** (Figure 12J) is located on a hill in Kampung Kuala Por, about 2 km from Kuala Berang town, Hulu Terengganu. It is believed that he was a ruler who was once powerful and carried out Islamic administration at that time. He is likely the person who proclaimed the law at the Terengganu Inscription Stone. Another opinion states that Tok Raja Ri was a preacher and a palace official. On his tombstone, there is Arabic Persian writing containing the history of the arrival of Islam in Terengganu (Zainuddin, 2024).

There are several **traditional villages** that have been identified as cultural heritage within the Kenyir Geopark area, such as Kampung Gaung (Figure 12K) which is famous for growing corns (Figure 12L) and selling the corns and other fruits; Kampung Dusun which grows duku, dokong, langsung (*Lansium domesticum*) and durian; and Kampung Pasir Nering which is famous for its traditional orchards that are hundreds of years old with 200 Perah (*Elaterospermum tapos*) trees. In additions, there are also other traditional villages in the area such as Kampung Basung, Kampung Langgar, and Kampung Buluh (<https://ganupedia.com/?p=915>).

The local people are still practising and using **traditional equipment** in their daily life, such as the bamboo and rattan handicrafts to make fish trap (*bubu* – in local lingo), fishing net (*tangguk*), *taking* (a basket made of bamboo and used by the locals to carry their catches such as fish and shrimps from the river) in Kampung Chapu; *chekalok* (a bamboo slat into which a bubu may be placed to catch fish in the river) in Kampung Basung; and *derong* (a bearer worn on the back

of the body and used to carry heavy items) in Kampung Pasir Dula; screwpine mat and basket weaving (Figure 12M) in Kampung Nibong; and art activities using a traditional musical instrument known as *kertuk* (Figure 12N) which is made of bamboo in Kampung Payang Kayu.



Figure 12: Cultural sites of tangible heritage: (A) The original Terengganu Inscription Stone (<https://www.wonderfulmalaysia.com/attractions/batu-bersurat-terengganu.htm>), (B) The memorial of the Terengganu Inscription Stone (CS-1), (C) The Kapal Hill (CS-2), (D) Kampung Dusun Mosque (CS-3), (E) A *beduk* (a drum used to call for prayers) hung in the veranda of the mosque, (F) Decoration of calligraphy at air vents of the doors and walls, (G) Mausoleum of Tok Gajah (CS-4), (H) Mausoleum of Sheikh Abdullah (CS-5), (I) Mausoleum of Syarif Muhammad Al-Baghdadi (CS-6), (J) Mausoleum of Tok Raja Ri (CS-7), (K) Kampung Gaung as one of traditional villages (CS-8). (L) Corns as a product of Kampung Gaung, (M) Screwpine basket as a traditional equipment (CS-9), and (N) *Kertuk*, a traditional musical instrument from the area (CS-9)

Cultural sites of intangible heritage

There are at least two cultural sites of intangible heritage in Kenyir Geopark: indigenous community (CS-10) and traditional foods (CS-11). In Kenyir area, the **indigenous community** (called the *Orang Asli* in Peninsular Malaysia) resides in Kampung Sungai Berua, Kuala Berang subdistrict, in Hulu Terengganu district. They are mostly of the Semaq Beri tribe (90%) and the rest is the Batek tribe. Their original village has been inundated by the man-made Kenyir Lake and they have been resettled to the newly-opened village in Kampung Sungai Berua in 1977 (Abdullah et al., 2018). The government has provided permanent and cemented houses for their settlement (Figure 13A) and primary school for their children (Figure 13B). The number of the indigenous community living in the area is 334 people, with 172 males and 162 females. This indigenous community has rich customs and a living culture that are related to nature. For this community, particularly the Semaq Beri tribe, the rivers and forests are important for their life. Fish and other river products were initially taken for food sources for themselves, however, some of them are also sold to outsiders for the financial need. The indigenous community also carries out traditional agricultural activities on a small scale. They cultivate several types of plants near their homes and around the village. They also collect forest products such as agarwood (*gaharu*), bamboo, and rattan, besides making handicrafts from bamboo and screwpine leaves.

Hulu Terengganu has many unique **traditional foods** such as *susu kerbau masam* (sour buffalo milk that is processed in bamboo sticks; Figure 13C) in Kampung Pelandan and Kampung Ceting; *emping padi* (paddy crackers or chips produced from half-ripe paddy that is eaten with coconut milk cooked with sweetener and eggs); *lemang* (the traditional heritage of rice bamboo) of Kampung Nering; *sambal kepayang* (kepayang chili sauce produced from the kepayang fruit, *Pangium edule*, which is savoured with rice and grilled fish) in Kampung Dura; and other dishes based on the fish found in the rivers and lake which are available at the eateries around Kampung Telaga. Besides, there are also *ikan baung masak tempoyak* (Mystus catfish cooked in durian paste gravy), *ikan lampan goreng* (fried tinfoil barb fish), and *ikan lampan pekasam* (fermented tinfoil barb fish) which are popular around the lake and Kampung Basung (Figure 13D).

ARCHAEOLOGICAL SITE OF KENYIR GEOPARK

There is only one archaeological site proposed for the development of Kenyir Geopark, i.e. the Bewah Cave (AS-1) which is located in the southern part of Kenyir Lake area in Hulu Terengganu district. This cave is famous for its important archaeological discoveries. In 2009, excavation activities were conducted by the State Museum of Terengganu which successfully discovered an

ancient human skeleton of the Hoabinhian or Mesolithic period and it is believed that the skeleton was a teenager girl estimated to be over 16,000 years old based on a radiocarbon dating in 2010. During the discovery, most of the bones were already decayed and covered with the limestone. This discovery provides a glimpse into prehistoric human life in this area. In additions, there are also artifacts such as stone tools, such as stepping stones, knocking stones, inlay stones, pottery fragments, and food scraps found in this cave (Discovery Terengganu, 2024c; Terengganu State Museum, 2024). This skeleton was discovered at the site closest to the cave mouth (Figure 14A). It was observed that the exposed bones were a part of a femur that was folded to the tibia. Based on the position of these bones, it appears that the body was buried in a kneeling position (Figure 14B). Changes in the environment have caused many other bones, such as the skull, to be missing.



Figure 13: Cultural sites of intangible heritage: (A) The settlement of the indigenous community in Kampung Sungai Berus (CS-10), (B) The indigenous students in their school, (C) The *susu kerbau masam* (sour buffalo milk) as one of traditional foods from Kenyir Geopark (CS-11), and (D) Several fish-based traditional dishes from the area (CS-11)

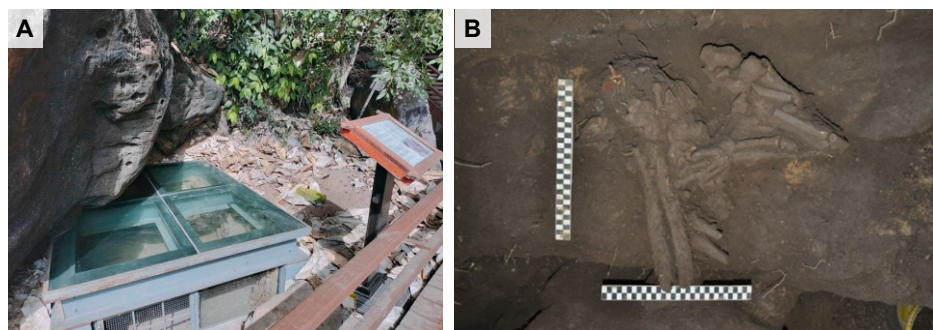


Figure 14: The one and only archaeological site in Kenyir Geopark is the Bewah Cave (AS-1): (A) The location where a prehistoric human skeleton was found near the cave entrance, (B) The 16,000-year-old skeleton

INTERRELATIONSHIPS BETWEEN COMPONENTS OF KENYIR GEOPARK

The key components within Kenyir Geopark are interconnected through a harmonious blend of geological, biological, cultural and archaeological elements that define its unique identity. The geopark's geosites, such as the cave, the river, and other landforms, serve as the foundation of its ecosystem, influencing soil types, water systems, and other life factors that support diverse flora, fauna, cultural as well as archaeological aspects. Biosites which thrive in this environment contributing to the rich biodiversity, including endemic and rare species, can be used for human life. The richness of its components and their interrelationships ensure the holistic management and sustainability of Kenyir Geopark as a living landscape of natural and cultural heritage. Additionally, these components and their linkages are potential for research and educational opportunities, sustainable tourism development, and increase global recognition of the geopark. Table 4 lists some interconnections of key components of the geopark.

Table 4: Examples of interrelationships between key components of Kenyir Geopark

No.	Interrelationship between components		Example
1	Geosite	Biosite	1. Bewah Hill & Cave as the main geosite of Kenyir Geopark is the home for various flora (such as moss, medicinal plants, ferns, caladiums, etc.) and fauna (bats, crickets, centipedes, crabs, large spiders, etc.).
			2. Pertang River is one of rivers in Kenyir area with massive sandstone outcrops and a strategic location for Mahseer fish sanctuary.
			3. Mount Gagau is the biggest plateau in Peninsular Malaysia and has recorded different types of flora

No.	Interrelationship between components		Example
			(97 moss species, 89 fern species, etc.) and fauna (18 amphibia species, 14 reptile species, etc.)
			4. Lata Buweh Waterfall (geosite) supplies its water to fulfill the need of water to the Kenyir Natural Research Station UMT (biosite)
2	Geosite	Cultural site	Kapal Hill has the ship-like granite outcrop atop the hill and is closely related to a folklore of a large ship that belonged to Chinese traders who were traveling through the region to conduct business in Kuala Berang and ended up stranded on the sandbar when Terengganu was struck by a big flood hundreds of years ago. In the end, the ship transformed into a rock, hence the "ship rock."
3	Geosite	Archaeological site	Bewah Hill & Cave geosite is the location of the discovery of the oldest (16,000 years) pre-historic creatures and archaeological artifacts in Peninsular Malaysia.
4	Biosite	Cultural site	Rafflesia site in Tembat Reserved Forest is situated near the settlement of indigenous community in Sungai Berua village. The indigenous people have long used the plant for medicinal purposes.
5	Biosite	Archaeological site	Biodiversity in Bewah Cave and Taat Cave is thought to be the foods for pre-historic creatures found in these two caves.

CONCLUSION

This study reaffirms Kenyir Geopark's significance as a vital resource for research and educational opportunities, sustainable tourism development, conservation, community development, as well as ensuring its legacy for future generations. This study makes a distinctive contribution to the geopark development literature by integrating key components (geological, biological, cultural, and archaeological heritage) into a single spatial and conceptual framework to demonstrate the interdependence between natural and cultural systems and to evaluate their interrelationships and collective significance for geopark planning. Within the Malaysian and Southeast Asian context, this holistic approach provides a more comprehensive model for identifying and managing multi-heritage resources to support sustainable development, education, conservation, economic growth, and community-based tourism.

The findings of this study provide an evidence-based inventory and spatial framework that can assist state agencies, planners, and conservation bodies in identifying priority areas for conservation and development within Kenyir Geopark area. By demonstrating the interrelationships among geological, biological, cultural, and archaeological sites, the study supports the designation of conservation zones, the development of integrated management plans, and the

formulation of land-use policies that balance heritage conservation with infrastructure development and community livelihoods. For tourism planning, the results can guide the design of thematic geotourism routes, educational programs, and visitor facilities that connect multiple heritage values in a coherent and attractive manner.

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Ethical Statement

All fieldwork conducted for this study complied with relevant institutional guidelines and national regulations governing research, conservation, and heritage documentation in Malaysia. Site visits and data collection were carried out with the permission and cooperation of the relevant authorities, including the Terengganu State Government, *Lembaga Kemajuan Terengganu Tengah* (KETENGAH, Central Terengganu Development Authority), *Jabatan Kebajikan Orang Asli* (JAKOA, Department of Orang Asli Development), and other agencies responsible for protected areas, biodiversity, and cultural heritage management. Where field investigations involved visits to indigenous communities, customary lands, or culturally sensitive locations, prior consent was obtained from community leaders or representatives and local stakeholders, and all interactions were conducted with respect for local customs, knowledge systems, and confidentiality.

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