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RESEARCH ARTICLE

A PRELIMINARY OBSERVATIONAL STUDY OF FLORA AND FAUNA AND HUMAN ACTIVITIES ON THE COASTAL ECOSYSTEM OF PANTAI BATU HITAM, PAHANG, MALAYSIA

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ABSTRACT

This preliminary observational study investigates the biodiversity and human impact on the coastal ecosystem of Pantai Batu Hitam, located along the east coast of Pahang, Malaysia. The study on April 28, 2024 involved photographing marine and terrestrial flora and fauna along the beach to document and identify species through taxonomic classification using digital tools and field guides. A total of 24 species were identified across 14 families, showcasing the rich diversity of the ecosystem, including notable plant-animal interactions. Alongside the documentation of species, evidence of human activities such as tourism and infrastructure development were observed, with particular concern regarding plastic pollution and habitat degradation. These findings highlight the need for targeted conservation efforts and sustainable practices to protect Pantai Batu Hitam's biodiversity while addressing the challenges posed by human activities. This study contributes to understanding the balance required between ecological preservation and local development in coastal regions.

KEYWORDS

Observational Study, Biodiversity, Species Families, Human Impact, Pantai Batu Hitam

1. INTRODUCTION

Pahang, located in Peninsular Malaysia, is the largest state in the region, covering approximately 35,960 square kilometres. The state features a 210-kilometer eastern coastline along the South China Sea, with a landscape characterized by a mountainous, forested interior. Pahang is situated within the expansive Pahang River basin, bordered by the Main Range to the west and the Eastern Highlands to the north. Several rivers dissect the state's central plains, and its coastline includes a 32-kilometre stretch of alluvial soil that forms the estuaries and deltas of rivers such as the Kuantan, Pahang, Rompin, Endau, and Mersing. The region is sparsely populated, with communities of Malays, Chinese, and Aboriginal peoples, some of whom lead semi-nomadic lifestyles (Ern and Ching, 2015).

Pahang's coastline is renowned for its beautiful beaches, including the famous Cherating Beach, popular for its surfing waves and the annual international surfing competition. Another notable beach is Pantai Batu Hitam, distinguished by its striking black basalt rocks, set against a backdrop of white sandy shores and turquoise waters. These unique geological features attract tourists, photographers, and nature lovers to the area (Taqieddin and Humidi, 2017). Despite its popularity, there has been limited comprehensive engineering research on the basaltic rocks of Pantai Batu Hitam (Othman et al., 2024).

Observational studies on biodiversity and human impact in coastal ecosystems highlight the complex relationships between urbanization and biodiversity. Research shows that human activities significantly affect terrestrial and marine species, with varying impacts depending on the proximity to urban areas and pollution levels (Yi and Kannan, 2016; Khairunnisa et al., 2012). Urbanization typically reduces coastal vertebrate species, with fewer individuals found near densely urbanized areas (Ballantyne et al., 2024). Conversely, surf zone fish assemblages demonstrate increased diversity near urban environments, reflecting complex ecological responses (Ballantyne et al., 2024). While showing lower overall biodiversity, polluted sites still support unique species that contribute to regional biodiversity and showcase the resilience of certain taxa (McIlroy et al., 2024).

Coastal ecosystems offer critical services, including climate regulation and nutrient cycling, which are increasingly compromised by habitat destruction and pollution. These ecosystem services are vital to maintaining environmental stability, but their degradation emphasizes

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the urgent need for sustainable coastal management strategies (Mhatre, 2024). This study aims to document and assess the biodiversity of marine and terrestrial species at Pantai Batu Hitam, Pahang, Malaysia, while simultaneously examining the impact of human activities on the coastal ecosystem. Through systematic photographic documentation and taxonomic identification of species, the study aims to provide a comprehensive overview of the diversity of flora and fauna in the area, highlighting the ecological interactions present within the beach environment. Additionally, the study seeks to identify and evaluate the effects of tourism, plastic pollution, and infrastructure development on the natural habitat, with the ultimate goal of promoting the need for conservation strategies and sustainable management practices to protect and preserve the coastal biodiversity of Pantai Batu Hitam.

2. METHODOLOGY

The study area for this observational research is located at Pantai Batu Hitam (3.8865° N, 103.3660° E) (Figure 1), approximately 9.6 km from Kuantan city centre, on the east coast of Pahang, Malaysia. Pantai Batu Hitam is part of a larger coastal system linked to other beaches along the Pahang coastline. Pantai Balok is a popular local beach to the south known for its ideal wind conditions, making it a favoured destination for windsurfing and kiteboarding. Its serene atmosphere draws both locals and tourists alike. Further northeast of Pantai Batu Hitam is another well-known beach, Pantai Teluk Cempedak (Figures 1-3), a coastal area also frequented for its scenic beauty and beach activities.

This observational study was carried out on April 28, 2024, with documentation from walking along the beach to collect data on the marine and terrestrial ecosystems. The fieldwork involved photographing the local flora and fauna and conducting detailed observations every 100 meters until the designated endpoint was reached. Photographic sessions were held to capture images of the marine and terrestrial species present in the area, with documentation conducted via both photographs and videos. After returning to campus, a thorough analysis of the observations was performed.

The marine life, beach ecosystem, and plant-animal interactions were recorded and categorized based on their scientific classification. Taxonomic identification of the photographed specimens was aided by various digital tools, including Google Lens, iNaturalist, the eBird app, and the Merlin app. Additionally, two field guidebooks authored by were utilized to aid in species identification (Francis, 2019; Erard, 1999). The documentation also captured human activities and infrastructural developments near the beach and the adjacent forest reserve. These activities were classified into recreational and commercial categories and documented through photographs taken with an iPhone 13, highlighting the human impact on the coastal environment.

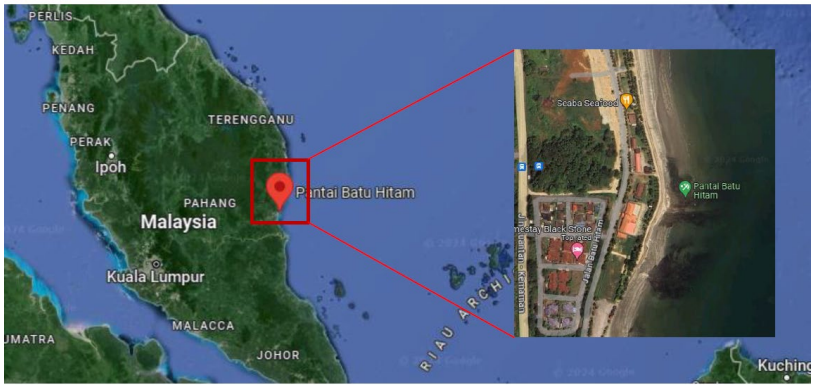

Figure 1: Map of Pantai Batu Hitam, Kuantan, Pahang (Source: Google maps)

Figure 2: wide view of Pantai Batu Hitam landscape (from sea to beach view)

Figure 3: wide view of Pantai Batu Hitam landscape (from beach to sea view)

3. RESULTS

The study identified a wide array of marine and land species recorded from Pantai Batu Hitam, Kuantan District, Pahang, Malaysia. Each species is categorized by its taxonomic classification into Class, Order, Family, and Scientific Name. In Class Bivalvia, the species *Venerupis decussata* from the Veneridae family is noted, belonging to the order Venerida. This species is indicative of the diverse mollusk community present in the area, reflecting the region's rich marine biodiversity.

Within the Class Gastropoda, there is significant representation of species across multiple orders. In the order Sorbeoconcha, the species *Turritella*

communis from the family Turritellidae is identified. Similarly, *Strombus marginatus* from the family Strombidae, part of the order Littorinimorpha, further highlights the rich diversity of gastropods in the region. Other gastropods include *Planaxis sulcatus* from the family Planaxidae and *Nerita chameleon* from the family Neritidae, all of which are characteristic of the intertidal zone, reflecting the area's variety of gastropods that thrive in these coastal environments.

For the Class Actinopterygii, the study documented a notable marine species, *Terapon jarbua*, from the family Terapontidae in the order Periciformes. This species is an essential part of the fish community and contributes significantly to the complexity and functioning of the marine ecosystem. Additionally, the Class Aves is represented by *Columbia livia domestica*, a terrestrial bird from the Columbidae family in the order Columbiformes, which illustrates the interaction between terrestrial and coastal habitats, showcasing the connectivity between land and sea environments.

The Class Malacostraca is represented by two species from the order Decapoda. *Dotilla myctroides*, from the family Dotillidae, and *Coenobita rugosus*, from the family Coenobitidae, are notable crustacean species that play vital roles in the coastal ecosystem, particularly in nutrient cycling and sediment processing. Furthermore, the Class Lilopsida is represented by the species *Cocos nucifera* from the family Arecaceae, which highlights the presence of significant plant species that are essential for the sustainability of the coastal ecosystem and its biodiversity.

Lastly, the Class Thecostraca is represented by *Amphibalanus amphitrite*, a sessile barnacle from the family Balanidae in the order Sessilia, which underscores the importance of sessile organisms in the marine environment. The Class Anthozoa includes the sea anemone species *Anthopleura dixoniana* from the family Actiniidae, further illustrating the diversity of marine invertebrates in the study area. These findings indicate a complex and diverse ecosystem, with species spanning multiple taxonomic groups, contributing to both marine and terrestrial biodiversity and reflecting the rich natural heritage of Pantai Batu Hitam.

4. Discussion

4.1 The Documentation of Pantai Batu Hitam

Black Stone Beach is one of the tourism places in Malaysia and is located along the South China Sea near Kuantan, Pahang state, Malaysia. It attracts many tourists, both locals and internationals. According to a study, Black Stone Beach got its name from its special feature of dark black and grey bedrock formations scattered along the seashore (Figure 3) (Khandaker et al., 2019). It is established that they are made of minuscule pieces of basalt and originated from a volcano. Prospectors and miners typically utilise them to show when a placer formation is present.

Marine life in Pantai Batu Hitam includes diverse fish, crustaceans, and molluscs that thrive in the intertidal zones created by the rocky outcrops. The region's biodiversity is further enhanced by offshore coral reefs, which are home to various anemones and fish species like clownfish and parrotfish. These reefs serve as crucial breeding and feeding grounds, contributing to the ecological richness of the coastal waters (Chowdhury, 2018).

Table 1: Checklist of marine and land species recorded from Pantai Batu Hitam, Kuantan District, Pahang, Malaysia

Class	Order	Family	Scientific Name
Bivalvia	Venerida	Veneridae	*Venerupis decussata,* Linnaeus, 1758
Gastropoda	Sorbeoconcha	Turritellidae	*Turritella communis,* Risso, 1826
Actinopterygii	Perciformes	Terapontidae	*Terapon jarbua,* Forsskål, 1775
Gastropoda	Littorinimorpha	Strombidae	*Strombus marginatus* Linnaeus, 1758
Magnoliopsida	Gentianales	Rubiaceae	*Richardia brasiliensis,* Gomes, 1802
Gastropoda	Littorinimorpha	Planaxidae	*Planaxis sulcatus,* Born, 1778
Gastropoda	Cycloneritida	Neritidae	*Nerita chamaeleon,* Linnaeus, 1758
Aves	Columbiformes	Columbidae	*Columbia livia domestica,* Linnaeus, 1758
Gastropoda	Neogastropoda	Muricidae	*Haustrum scobina,,* Quoy & Gaimard, 1833
Gastropoda	Neogastropoda	Muricidae	*Murex trapa*, Röding, 1798
Malacostraca	Decapoda	Dotillidae	*Dotilla myctiroides* H. Milne-Edwards, 1852
Malacostraca	Decapoda	Coenobitidae	*Coenobita rugosus,* H. Milne-Edwards, 1837
Liliopsida	Arecales	Arecaceae	*Cocos nucifera,* Linnaeus, 1753
Thecostraca	Sessilia	Balanidae	*Amphibalanus amphitrite,* Darwin, 1854
Anthozoa	Actiniaria	Actiniidae	*Anthopleura dixoniana,* Haddon & Shackleton, 1893

The study identified various marine and land species recorded from Pantai Batu Hitam, Kuantan District, Pahang, Malaysia. One of the dominant species in the area is *Venerupis decussata*, commonly known as the cross-cut carpet shell or *Kerang putih* in the local language. This infaunal bivalve, found in sandy and muddy gravel bottoms from mid-tide levels to a few meters deep, is one of the most commercially important bivalve species, harvested extensively across the Mediterranean and introduced to aquaculture in Italy during the 1980s (FAO, 2011). Its oval-shaped, slightly elongated shell is distinctive, with a surface crossing pattern, and it grows to a maximum length of six centimetres. The exterior shell colouration typically includes light brown, cream, or white with darker streaks or areas.

Another important species in Pantai Batu Hitam is *Turritella communis*, a gastropod molluscs from the Turritellidae family, often referred to as the auger shell or common tower shell. As a suspension feeder, *T. communis* feeds on plankton and organic particles in the water, using its proboscis to capture food from the water column. In the class Actinopterygii, the study documented *Terapon jarbua*, commonly known as the crescent grunter, or *Kerong jalur* locally. This euryhaline species is known for its wide salinity tolerance, allowing it to thrive in marine, coastal, estuarine, and freshwater environments. *T. jarbua* is a commercially significant species often traded in the aquarium industry. Morphologically, young individuals have strong, conical teeth on their palates, though these are absent in adults (Gupta and Banerjee, 2016).

The study also identified *Strombus marginatus*, the margined conch, which belongs to the family Strombidae and is commonly found in shallow tropical and subtropical marine waters of the Indo-Pacific, including the Indian Ocean and parts of the western Pacific. This species typically inhabits muddy and sandy substrates near seagrass beds and coral reefs. Another species of interest is *Richardia brasiliensis*, a medicinal plant in the Rubiaceae family, which is widely distributed in Brazil and used in folk medicine (Dornelles et al., 2022). Despite its widespread use, little is known about its toxicity or biological activity. This perennial herb grows to 30-60 cm tall and has branching stems with small white flowers.

Planaxis sulcatus, the furrowed clusterwink, is another gastropod species identified in the study. It primarily feeds on debris and microalgae by scraping algae off rock surfaces using its radula. Reproduction occurs via external fertilization, and its larvae are planktonic, undergoing several developmental stages before settling as juvenile snails. In addition, the study documented *Nerita chamaeleon*, the chameleon nerite, a grazer that plays a critical role in regulating algae growth on rocky shores. This species also serves as a food source for various predators, including fish, crabs, and birds.

In the bird category, *Columbia livia domestica* was observed. This common free-living bird, belonging to the order Columbiformes, is closely associated with human environments, often nesting on rooftops and ledges, and using man-made structures like lofts and nesting boxes (Al-Barwari and Saeed, 2012; Alkharigy et al., 2018). The student also documented numerous additional species in Pantai Batu Hitam, such as *Haustrum scobina*, *Murex trapa*, *Dotilla myctiroides*, *Coenobita rugosus*, *Cocos nucifera*, *Amphibalanus amphitrite*, and *Anthopleura dixoniana*.

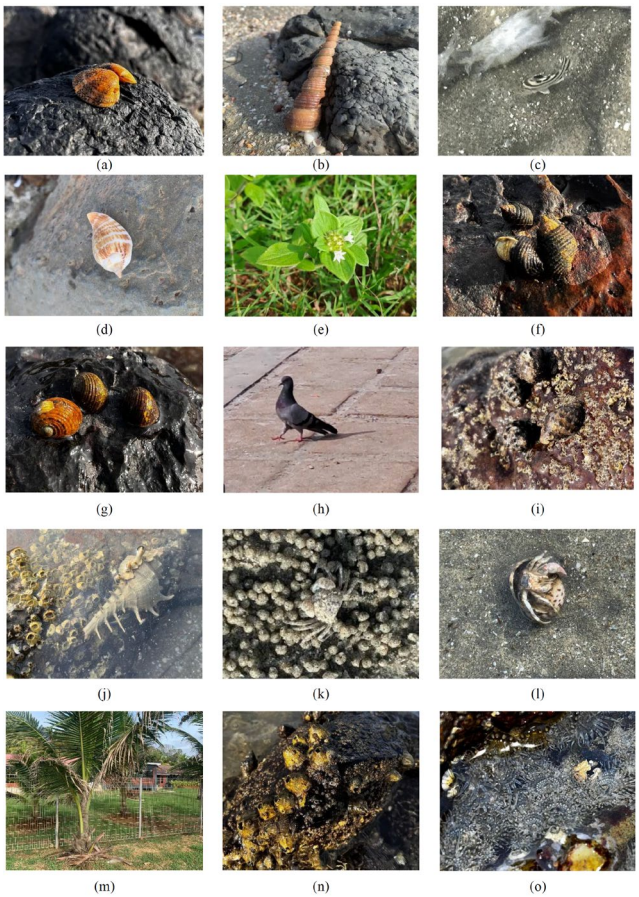

Figure 4: Marine and land species recorded from Pantai Batu Hitam, Kuantan District, Pahang, Malaysia: (a) *Venerupis decussata,* (b) *Turritella communis,* (c) *Terapon jarbua, (d) Strombus marginatus* , (e) *Richardia brasiliensis*, (f) *Planaxis sulcatus,* (g) *Nerita chamaeleon,* (h) *Columbia livia domestica,* (i) *Haustrum scobina*, (j) *Murex trapa,* (k) *Dotilla myctiroides,* (l) *Coenobita rugosus,* (m) *Cocos nucifera,* (n) *Amphibalanus amphitrite, and* (o) *Anthopleura dixoniana,*

4.2. The Problem Observed at Pantai Batu Hitam:

Pantai Batu Hitam, renowned as a tourist destination for its white sandy beaches and calming sea breeze, has attracted an increasing number of tourists from within and outside Malaysia. However, with the area's growing popularity, changes have been made to the landscape and coastal areas to accommodate tourists. Ironically, these changes have had negative impacts not only on the physical landscape and coastal environment but also on the species that inhabit the area. The increase in tourism has led to environmental degradation, threatening the diverse marine and terrestrial species documented in the study. Protecting the biodiversity of Pantai Batu Hitam requires careful management of tourism and conservation efforts to preserve its natural habitat.

Figure 4: The building of concrete structure on the coastal area of Pantai Batu Hitam.

Figure 5: Unresponsible waste disposal found on the barrier of the beach

Coastal beaches, as described by play a critical role as environmental buffers, protecting the shoreline from severe storms and powerful waves (Ariffin et al., 2016). These coastal zones serve as interfaces between land and sea, and are particularly vulnerable to natural hazards related to climate change, such as storms and sea-level rise. However, alongside natural threats, the development of coastal areas—with the construction of buildings and concrete barriers—has caused further harm to marine ecosystems. One of the growing concerns is the disposal of rubbish, particularly plastic waste, which has become a persistent global issue.

Plastic pollution on beaches, including those in Malaysia, stems from various factors, such as human behaviour and environmental processes. Research highlights that managing and mitigating the impacts of plastic pollution poses significant challenges for coastal communities. The plastic debris on beaches primarily originates from land-based sources, such as improper waste disposal and littering, which could be due to inefficient waste management systems (Rangel-Buitrago et al., 2021). Plastics discarded on land can easily be transported into oceans by rivers and other waterways, eventually accumulating on shorelines. This problem is particularly acute in areas with dense populations and inadequate waste collection services, where the accumulation of plastic waste becomes a visible and persistent issue.

The widespread use of plastics is due to their lightweight nature, low cost, and ease of production. However, these same characteristics make plastics highly problematic in the marine environment. Plastics are non-biodegradable, meaning they can persist in ecosystems for an extended period. Their light weight allows them to disperse widely across marine habitats, while their durability ensures they remain in the environment for years. Over time, plastics physically break down into smaller fragments, leading to the formation of microplastics. A group researcher highlighted the serious issue of microplastics entering the marine food chain, where marine organisms can ingest them (Rochman et al., 2013). As various species consume these microplastics, bioaccumulation and biomagnification can occur at higher trophic levels, potentially posing health risks to marine animals and humans.

Plastic debris, largely from human activities, can lead to visual pollution, microplastic contamination, and chemical pollution, negatively impacting both the landscape and marine life. Sources of plastic pollution include surface runoff from land, improper waste management practices, littering, and flooding events, all of which contribute to the accumulation of plastic waste along coastlines. Mismanaged plastic waste in coastal regions is particularly problematic, as it easily finds its way into the ocean and washes up on beaches, where it persists and accumulates over time (Esiukova, 2017).

In summary, while coastal areas like Pantai Batu Hitam are critical for protecting the shore and supporting biodiversity, they are increasingly threatened by plastic waste pollution. Addressing this issue requires comprehensive waste management strategies and community engagement to reduce the influx of plastic debris into marine environments and protect both the ecosystem and coastal livelihoods.

Figure 7: More unethical plastic and rubbish disposal mainly from tourist and nearby citizen.

Figure 8: Close-up view from Figure 7.

Addressing the growing concern of irresponsible waste disposal at Pantai Batu Hitam requires the implementation of effective strategies aimed at mitigating and ultimately solving the problem of plastic waste pollution. One of the key strategies is to reduce plastic usage through both individual decisions and broader legislative reforms. Encouraging individuals to opt for reusable alternatives instead of single-use plastics is a practical step toward reducing plastic waste. In parallel, legislative actions, such as outlawing single-use plastics and promoting policies that incentivize sustainable alternatives, are crucial.

Improving waste management infrastructure is another vital component of addressing plastic pollution. Coastal areas such as Pantai Batu Hitam can benefit significantly from enhanced waste collection systems, recycling facilities, and better-organized waste disposal services. Educating the public about proper waste management and the harmful effects of plastic pollution can be achieved through community outreach programs and educational campaigns. These initiatives should emphasize responsible waste disposal practices and encourage individuals to take ownership of their environmental impact.

Community involvement plays a pivotal role in ensuring the long-term success of these initiatives. Regularly organized beach clean-ups can engage local communities, tourists, and environmental groups, fostering a sense of collective responsibility for maintaining the beach's cleanliness. In addition, these efforts should be supported by laws against littering and illegal dumping, with strict enforcement to discourage individuals from improperly disposing of waste.

Promoting research and development into innovative recycling technologies is essential for addressing the growing plastic waste problem. Investments in new technologies and recycling methods can help transform waste management practices, making it easier to recycle and repurpose plastic materials. International cooperation is also critical in addressing global plastic pollution. Collaborative efforts through international agreements and partnerships can ensure that countries work together to tackle the transboundary nature of marine plastic pollution and share best practices for reducing waste.

In conclusion, a multifaceted approach is needed to tackle the plastic waste issue at Pantai Batu Hitam. This approach includes reducing plastic consumption, improving waste management, promoting community involvement, enforcing environmental regulations, and fostering international cooperation. Together, these strategies can create cleaner and healthier beach environments, both locally and globally.

5. Results

The observational study conducted at Pantai Batu Hitam and its surrounding beaches provided valuable insights into the rich biodiversity and the human impacts affecting the coastal environment. Through systematic documentation of marine and terrestrial flora and fauna, this research has identified the diverse species inhabiting the area, categorized taxonomically, and highlighted the ecological interactions within the beach ecosystem. Additionally, evidence of human activities, both recreational and commercial, underscored the ongoing environmental pressures, such as plastic pollution and infrastructure development, which pose threats to the natural habitat. This study emphasizes the need for better conservation efforts and sustainable management practices to protect the biodiversity of Pantai Batu Hitam while balancing the needs of local tourism and development.

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