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EDUCATION AND PARTICIPATION OF STUDENTS AND THE COMMUNITY IN THE PRESERVATION OF MANGROVE ECOSYSTEMS AND THE CONSERVATION OF MIGRANT BIRDS IN TANJUNG PIAI NATIONAL PARK MALAYSIA

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Abstract

This community service program was conducted at Tanjung Piai National Park, Johor, Malaysia, with the objective of enhancing environmental awareness and promoting community participation in mangrove ecosystem preservation and migratory bird conservation. The program involved students and local community members through educational and participatory approaches, including environmental education, biodiversity observation, mangrove ecosystem exploration, and discussions on the ecological importance of migratory birds along the East Asian–Australasian Flyway. The activities were implemented over three days, encompassing preparation, field implementation, and evaluation stages. The results demonstrated an increase in participants' knowledge and awareness regarding the ecological functions of mangroves as coastal protectors, biodiversity habitats, and carbon sinks. Participants also gained a better understanding of the significance of Tanjung Piai National Park as a critical stopover habitat for migratory birds. Furthermore, the program encouraged active community involvement in conservation initiatives, including ecosystem monitoring and environmental stewardship. The educational and participatory methods proved effective in fostering positive attitudes and behavioral changes toward environmental conservation. The program also strengthened collaboration among students, local communities, and park management authorities. Continuous support and multi-stakeholder cooperation are recommended to ensure the long-term sustainability of conservation efforts and environmental education initiatives in coastal ecosystems.

Keywords: community service, environmental education, mangrove ecosystem, migratory bird conservation, biodiversity, Tanjung Piai National Park.

INTRODUCTION

Environmental balance is something we must maintain as humans to ensure that the Earth's climate and natural conditions remain stable on land, at sea, and in the air, including the natural balance of coastal areas(Lomoljo, 2011; Rahman et al., 2025; Yong et al., 2021). Mangrove ecosystems are coastal ecosystems that play a strategic role in maintaining the natural balance of shorelines by acting as a buffer against incoming sea currents that can erode land over time, causing abrasion, serving as wave breaks and carbon sinks, and providing breeding and growth grounds for various marine organisms(Aswim et al., 2023; Rachman et al., 2023; Syah, 2020). These mangrove ecosystems also function to support biodiversity, serve as habitats for many flora and fauna species, and act as stopover sites for many migratory birds from other regions(Khery et al., 2022; Lawasi et al., 2025). The existence of mangrove forests also contributes to maintaining ecosystem stability and community resilience in the face of global climate change(Moustafa et al., 2023). Currently, there is significant pressure that could alter the global distribution map of mangrove forests, partly caused by human activities such as land-use changes and the impacts of climate change(Alongi, 2015). Malaysia is one of the countries with the largest mangrove ecosystems in Southeast Asia, with an estimated area of 620,000 hectares spread across various coastal regions in Peninsular Malaysia, Sabah,

Sarawak, and the state of Johor(Rahman et al., 2021). Johor itself has several strategic mangrove areas, one of which is Tanjung Piai National Park located in the Pontian District, Johor, Malaysia(Jorge and Patrícia, 2011). The Tanjung Piai National Park conservation area is known as the southernmost tip of the Asian mainland and has been designated as an international wetland conservation site due to its high ecological value(Foo and Numata, 2019). The uniqueness of this location makes it an iconic destination that connects the Strait of Malacca and the Johor Strait, offering value to every visitor to the area.

LITERATURE REVIEW

Tanjung Piai National Park has a conservation area of 500 hectares(Akhyar et al., 2025). This area is also equipped with infrastructure that supports field observations, including a walkway (boardwalk) that allows visitors to reach the interior zone of the mangrove forest without damaging the underlying ecosystem, an observation tower used for bird watching, and an information center that provides data on visitors, the history of the area, and species inventory(Prasetyo et al., 2019). The area contains several types of mangroves, including: *Bakau Pasir* (*Rhizophora stylosa*), *Bakau Minyak*, and *Bakau Kurap* (*Rhizophora mucronata*). The area is managed by the Johor National Parks Corporation. Its conservation status has been internationally strengthened since January 31, 2003, when Tanjung Piai was designated as a Ramsar Site(Razali et al., 2019). This status indicates that the area is a wetland of importance for biodiversity and migratory bird flyways(Mustafar et al., 2019). This conservation area is a very important habitat for many migratory bird species crossing the East Asian–Australasian Flyway. This flyway is the largest route for bird migration in the world, connecting several regions, including the Arctic, East Asia, Southeast Asia, Australia, and New Zealand(Yong et al., 2021).

In addition to acting as a migration corridor, this area also functions as a living laboratory vital for ornithological research and periodic monitoring of bird population dynamics. Besides ornithological monitoring, this area also serves as a study center for forest regeneration dynamics through the inventory of mangrove species composition, both at the seedling and mature tree levels(Adham et al., 2025; Bakray et al., 2025). Furthermore, active involvement through citizen science in bird watching has proven effective in improving public competence in morphological identification and biodiversity data recapitulation(Siddiq et al., 2024). In addition, similar educational initiatives in coastal areas have been proven to increase public ecological awareness through the provision of accessible information on flora for tourists(Mustofa and Sulthoni, 2025).

Tens of millions of birds migrate annually along this coastline, making the mangrove conservation area in Tanjung Piai National Park a key site. During their migration, birds use this conservation site as a stopover, feeding, and breeding ground(Yong et al., 2021). The environmental conditions, which are rich in natural resources and well-maintained vegetation, support the ecosystem's function as a provider of nutrients for birds traveling long distances from the Northern Hemisphere to Australia(Khairunisak et al., 2022; Rahman et al., 2024). These well-maintained habitat conditions facilitate the birds' energy needs in traversing the East Asian-Australasian Flyway, which is crucial for the sustainability of the global population(Tang et al., 2023). The presence of shorebirds in this area serves as a crucial biological indicator for monitoring the integrity of the wetland ecosystem and the overall function of the coastal habitat(Siddiq et al., 2024).

Figure 1. Tanjung Piai National Park as the 0-point of the southern Asian mainland

In addition to migratory birds, the Tanjung Piai National Park conservation area is also home to many other species, both aquatic and terrestrial(Razali et al., 2019), including:

Waterbird and shorebird species

Sandpipers, gulls, egrets, woodpeckers, herons, Pacific swallows, crested honey buzzards, and plovers. The presence of these species reflects the high level of biodiversity in the mangrove ecosystem, which is capable of providing ecological niches for various bird groups, whether as permanent residents or seasonal visitors (Khoirunnisa et al., 2025; Saleh et al., 2023). Beyond the avian groups, the mangrove ecosystem in this area also supports other fauna, such as reptiles and crustaceans, which play a crucial role in the local food chain (Hakim et al., 2023). These species interact with communities of fish, mollusks, and crustaceans that utilize the mangrove root structures as nursery areas and for protection from predators (Widiastuti et al., 2021). Common Flameback is a bird species belonging to the Picidae family (Avissa and Saptarini, 2025). This species is known as the common flameback or common goldenback and is frequently encountered in plantations, coconut groves, and low-lying forests. Furthermore, mangrove areas often function as essential feeding grounds that provide abundant food sources to support the survival of various resident and migratory bird species (Nugraha et al., 2021; Nurfitri et al., 2022). This habitat utilization pattern is consistent with findings in other mangrove areas, where vegetation heterogeneity is a primary determinant in supporting the presence of various bird species (Fahrani et al., 2025; Siddiq et al., 2024). The availability of mud substrates rich in benthic invertebrates in the intertidal zone ensures a consistent energy supply for coastal bird communities, aligning with the mangrove ecosystem's role as a crucial habitat that sustains coastal biodiversity (Fauzi et al., 2023; Pramudita and Khanafi, 2024).

Purple Heron:

Purple herons can be found worldwide. They are 40 inches long, slender-bodied, with long necks and legs, living in groups in aquatic areas including saltwater (Wicaksana and Utami, 2022).

Mammal Species

The mangrove area of Tanjung Piai National Park has extreme environmental characteristics due to tidal influences, therefore the mammals found here are species that have adapted to live in muddy and dense environments (Zulkarnain, 2018). One of the dominant mammals in this area is the long-tailed macaque, often seen actively foraging around the mangrove forest edge during low tide. Besides these primates, this area is also a habitat for several other mammal species such as langurs which use the mangrove canopy as an area for movement and protection (Yustian et al., 2024). Mammals inhabiting the Tanjung Piai National Park Mangrove Conservation Area include: long-tailed macaques, a type of monkey often found in mangrove areas (Razali et al., 2019). These monkeys are frequently seen on wooden boardwalks or below, searching for food such as crabs, clams, and fruits during low tide. Besides primates, this area also serves as a habitat for other mammal species like otters, which utilize tidal channels to hunt aquatic prey (Zakia and Lestari, 2022). Furthermore, the interaction between mammals and the mangrove ecosystem in this area shows behavioral adaptations similar to findings in other coastal habitats, where animal movement patterns are significantly determined by tidal dynamics (Bukhori et al., 2022).

Dusky leaf monkeys are a species of monkey that can be found in the trees. During community service activities at Tanjung Piai National Park, a guide reminded visitors not to look directly into the monkeys' eyes when encountering them along the mangrove forest paths, as the monkeys might perceive it as provocation and attack. Beyond direct interactions with visitors, the presence of primates in this area reflects the high adaptability of mammals to the mangrove ecosystem, which serves as a vital ecological niche for their survival (Ramadhan et al., 2023). In addition to primates, this area is also a habitat for other mammals that exhibit complex ecological interactions with mangrove vegetation, where diverse vegetation structures critically influence their food tree preferences and spatial distribution patterns (Damayanti, 2025).

Aquatic Biota

The aquatic biota in the Tanjung Piai National Park Conservation Area is a key component that makes this area a Ramsar Site, due to its location at the confluence of the Malacca Strait and the Johor Strait (Razali et al., 2019). These waters are rich in nutrients derived from decaying mangrove leaves. The decomposition process of this litter supports a complex aquatic food chain, providing essential nutrients for various types of fish, crabs, and shrimp that use the mangrove ecosystem as a spawning ground and primary protection area (Wardhani, 2022). The unique environmental conditions, with fluctuating salinity and temperature gradients, require aquatic biota to possess high

tolerance to survive and reproduce optimally in this coastal habitat (Driptufany et al., 2021). Marine biota inhabiting this conservation area include: mudskipper fish. This unique fish can walk on mud when the tide is out (Dewiyanti et al., 2022). It has the ability to breathe through its skin and mouth lining as long as its skin remains moist, and its protruding eyes on top of its head provide a 360-degree view to avoid predators (You et al., 2018). Additionally, mudskipper fish exhibit remarkable morphological adaptations through their strong pectoral fins, allowing them to actively move among mangrove vegetation while searching for small invertebrates in the muddy substrate (Hamidah et al., 2024). The presence of this biota directly contributes to the health of the mangrove ecosystem, where interactions between benthic organisms and mangrove vegetation play a crucial role in maintaining substrate stability and coastal nutrient cycles (Hartono et al., 2023).

Figure 2 Mudskipper Fish

There are also various crab families, such as the mangrove crab, which can burrow into the mud, and the fiddler crab, whose males are unique for possessing a single, brightly colored giant claw (Kartika et al., 2022). This claw is used to attract females and fight with other males. In addition to crabs, this aquatic ecosystem is also a habitat for various types of shrimp that utilize the spaces between mangrove roots as shelter from strong currents and

predators during their larval phase (Lestariningsih et al., 2021; Muhammad et al., 2023). The waters of Tanjung Piai serve as a nursery ground or natural breeding area for many commercial fish species before they migrate to the open sea. Species include the catfish, mullet, and scat (Warmadewanthi, 2021). These fish groups utilize the available natural food in the mangrove ecosystem, which functions not only as a foraging area but also as a temporary habitat and spawning ground for various types of aquatic organisms (Darmarini et al., 2023).

Figure 3. Activity of introducing telescope snails, mud snails, and clams

METHOD

This community service activity was conducted using an objective method. The service activities were carried out over three days, starting from proposal creation, preparation, implementation, and evaluation, to the reporting of the community service activity.

The steps for preparing the community service activity are as follows:

1. The proposal creation phase, which was intended to provide an overview of the activities to be carried out.
2. The preparation phase, including problem identification, analysis of the problems found, and coordination with UTHM partners.
3. The implementation phase of the community service activity, which took place over 3 days, from April 15-17, 2026. The report contains the results of the activities accompanied by evidence of observations during the service. This report serves as proof of accountability for the community service implementation team.

Environmental Awareness

Increasing environmental awareness is one of the most important strategies in maintaining the mangrove ecosystem and the biodiversity contained within it, in the context of sustainable development (Depari et al., 2025). Likewise, environmental awareness is not only related to science but also to the attitudes and behavior of the community in maintaining environmental stability (Rachman et al., 2023). From this, we can conclude that community service and education activities have an important role in building collective awareness regarding the importance of environmental conservation. Educational approaches through direct field exploration methods have proven effective in increasing in-depth understanding of the potential of coastal resources and the ecological linkages between fauna for the community and the younger generation (Merly et al., 2024). Furthermore, strengthening community participation through the formation of environmental care groups has proven to be key to sustainability in conservation area management and the wise utilization of coastal resources (Diniariwisan et al., 2026). This aligns with the need for structured area management, such as sustainable management efforts in mangrove ecosystems in other locations, to maintain ecological balance and socio-economic functions for the surrounding community (Andira et al., 2023; Pratiwi et al., 2023). Environmental awareness grows when we see the stark difference between the quiet of the mangrove ecosystem and the hustle and bustle of urban areas that bring pollution risks. This experience makes us realize that every growing mangrove tree has a very important role in absorbing pollution and protecting biodiversity (Fazari et al., 2025). It is hoped that this visit can be a call to act better in environmental preservation so

that this natural heritage remains intact for future generations. Furthermore, the integration of ecotourism-based education and monitoring of bioindicator biota such as gastropods and bivalves becomes crucial for detecting environmental quality fluctuations early on (Khadami et al., 2025; Putro et al., 2023).

UNRIKA Student Community Service Program

Community service activities carried out by UNRIKA students are one form of the university's tridharma (three pillars of higher education), specifically in the field of general education. Through this activity, UNRIKA students can contribute to and learn about environmental balance actively. This activity also provides students with direct experience about the importance of maintaining natural balance and applying knowledge practically in the field.

Figure 4. Students and Lecturer receiving information about the benefits of mangroves

RESULTS AND DISCUSSION

Mangrove forests are natural resources located in coastal areas that act as a buffer for coastal life, in addition to having important roles from economic, social, and ecological perspectives (Majid et al., 2016). The mangrove forest ecosystem is a system consisting of various organisms such as vegetation, animals, and microorganisms that interact with their environmental system in a mangrove habitat (Wasil and Muhsoni, 2023). Based on the definition above, it can be said that the mangrove forest is a coastal ecosystem that plays a role in supporting marine biota and ecosystem balance, while also having economic, social, and ecological roles for coastal communities (Jayanegara et al., 2021). Preservation efforts through the edupark concept have now become a crucial strategy to integrate environmental education with community-based tourism service diversification (Rahmawati et al., 2023a, 2023b). The implementation of this edupark allows for the active involvement of local communities in tour management and mangrove restoration, which is directly capable of increasing collective understanding regarding ecological values while stimulating independent economic growth (Elazhari et al., 2024; Suciati et al., 2026). Furthermore, edupark initiatives that combine conservation education with active community participation have proven capable of changing behavior and increasing awareness of the importance of maintaining mangrove ecosystem sustainability for the sake of environmental and economic functions (Diniariwisan et al., 2025; Priyansah and Kurnia, 2022).

Through the Community Service Program, it is hoped that students and the local community can understand the benefits of the mangrove forest ecosystem, biodiversity, and the conservation of migratory birds at Tanjung Piai National Park, Pontian District, Johor, Malaysia (Suciati et al., 2026). This activity was carried out with enthusiasm and excitement. The implementation of the Community Service Activity in the Tanjung Piai National Park area showed an increase in public awareness regarding the importance of environmental preservation, particularly the mangrove ecosystem. This was evidenced by the increased active participation of participants in efforts to rehabilitate and restore critical land, as well as the growing community initiatives in developing educational facilities as a form of coastal area protection against abrasion (Putri et al., 2022), (Norsidi, 2021). Furthermore, the change in public perception regarding the economic and ecological value of mangroves has become the main foundation in creating

sustainable tourism based on conservation (Fasandra et al., 2024; Zallesa, 2023). This participatory strategy not only strengthens the ecological resilience of coastal areas against the threat of abrasion but also fosters a sense of community ownership towards the long-term sustainability of biological resources (Rafik and Nisa, 2024). This increase in awareness is inseparable from the participatory approach method used by students, by involving the community directly in every activity. This inclusive approach ensures that every stage, from technical socialization to collaborative seedling planting, is recognized as a concrete step in community empowerment to achieve independence in coastal environmental management (Erfinda, 2025; Putra et al., 2025).

Socialization activities and field practice succeeded in increasing public understanding of the ecological functions of mangroves, including: as a natural fortress capable of mitigating the impacts of coastal abrasion and as a crucial habitat for various marine biota in maintaining the continuity of the food chain (Setyawan, 2025), (Syah et al., 2025). In addition, the active involvement of local groups in ecosystem monitoring has proven to be an effective instrument to ensure the effectiveness of long-term conservation programs (Sumardani et al., 2025), (Sukuryadi et al., 2025). The synergy between academics and the community also serves as a strategic model in strengthening local regulations and innovation in developing sustainable coastal resource-based products (Andriyono et al., 2025; Murni et al., 2025). The mangrove planting program carried out with the community also provided direct experience regarding ecosystem rehabilitation techniques. Monitoring results showed a fairly good success rate of planting, which indicates effective knowledge transfer.

Through educational activities and field observations, the community has become more familiar with the biodiversity that exists in the area, including various species of crustaceans and mollusks that thrive within the complex root structures of the mangrove forest (Peni, 2025). This increased familiarity fosters a heightened sense of stewardship, ensuring that residents remain vigilant against illegal logging and environmental encroachment (Alwiyah and Budiman, 2025; Sumarmi et al., 2024). Such efforts to foster local stewardship are highly effective, as seen in similar initiatives where participatory educational methods significantly increased environmental literacy and the motivation of stakeholders to engage in sustained conservation actions (Apriansyah et al., 2025).

This knowledge is important for fostering a sense of belonging to the environment, so that the community is encouraged to help maintain its preservation. Moreover, the integration of multi-stakeholder collaboration—involving local government, academic institutions, and community groups—remains a fundamental pillar for ensuring the long-term viability of these restoration initiatives (Sukarmen et al., 2023). Such institutional alignment facilitates the provision of necessary policy frameworks and livelihood projects that reinforce the community's commitment to protecting restored habitats (Nishi et al., 2021). Ultimately, the success of these comprehensive strategies depends on balancing anthropogenic demands with ecological preservation, ensuring that restored coastal zones continue to provide essential services to both nature and the surrounding population (Bhagarathi and DaSilva, 2024).

One of the main focuses of the activity is the conservation of migratory birds that use Tanjung Piai as a stopover habitat. The results of the activity show that participants have gained a significant appreciation for the park's role in global avian migration, leading to a concerted effort to limit human disturbances in sensitive nesting areas. By establishing community-led monitoring protocols, residents have begun documenting avian arrival patterns and habitat utilization, which informs localized adaptive management strategies (Saswini et al., 2025). These community-driven surveillance efforts effectively bridge the gap between scientific observation and site-specific conservation, as decentralized monitoring allows for the rapid identification of ecological stressors and the subsequent implementation of corrective measures (Sattayapanich et al., 2022).

Students also introduced the concept of community-based conservation, which emphasizes that the protection of migratory birds is not only the responsibility of the government but also the local community. By facilitating meaningful dialogues and providing practical training, this approach ensures that local populations are equipped to take autonomous, precautionary measures in safeguarding vital migratory stopovers (Nishi and Subramanian, 2023; Wambugu et al., 2025). This collaborative framework mirrors successful models where local capacity building and empowerment are central to the success of coastal management, fostering deep-seated environmental responsibility among residents (Purba et al., 2023).

CONCLUSION

The community service activity in the Tanjung Piai National Park area, Pontian District, Johor, Malaysia, has generally had a positive impact on increasing public awareness and participation in environmental preservation. The program, which focused on the mangrove ecosystem, biodiversity, and migratory bird conservation, successfully fostered changes in knowledge, attitudes, and behaviors toward a more environmentally conscious mindset.

Through an educational and participatory approach, the community not only gained theoretical understanding but also practical experience in conservation activities, such as mangrove planting and biodiversity observation. This contributed to the growth of a shared sense of responsibility for maintaining the sustainability of the coastal ecosystem. Furthermore, an increased understanding of the importance of the area as a habitat for migratory birds has opened opportunities for the development of sustainable, environment-based ecotourism. This program also successfully strengthened the synergy between students, the community, and regional management in conservation efforts. Nevertheless, the sustainability of the program still requires ongoing support, whether in the form of guidance, community capacity building, or collaboration with various stakeholders. Therefore, continuous efforts are needed so that the results achieved are not merely temporary, but can provide long-term benefits for the environment and the local community.

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APPENDIX