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SEA TURTLE CONSERVATION IN RANTAU SIALANG, INDONESIA: NESTING CHARACTERISTICS, HATCHING SUCCESS, EFFECTIVENESS AND LOCAL COMMUNITY PERCEPTION

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Abstract
Sea turtle conservation efforts in Indonesia are regulated by several laws and government regulations. One of the embodiments of these laws and regulations is to provide the sea turtle conservation stations in various regions. However, studies related to the ecological characteristics of sea turtle habitat, the effectiveness of the sea turtle conservation station, as well as perceptions and attitudes of the local community toward sea turtle conservation, are still incompletely described. Hence, this study aims at monitoring the distribution and abundance of sea turtles, nest characteristics, program effectiveness, as well as community perceptions around the Rantau Sialang Sea Turtle Conservation Station, Indonesia. Data were collected from face-to-face interviews, direct observation and the station's administrative data. A total of 4,051 sea turtle eggs were successfully recorded during 2014-2020. The highest number of eggs was obtained in 2018, while the lowest was in 2014. Most sea turtle nest locations were distributed around the Rantau Sialang Sea Turtle Conservation Station. The diameter of the sea turtle nests ranged from 27 to 35cm. The slope of the nest ranged from 9 to 45°, while the depth ranged from 30 to 40cm. The performance of the Rantau Sialang Sea Turtle Conservation Station was categorized as effective with a score of 30. The parameters with the highest scores were the origin of eggs, hatchling release location, hatchling release time, sea turtle rearing facility and egg hatching facility. While the parameters with the lowest score were the hatching success and coastal monitoring. Taste, perception of its usefulness and local culture were the considerable reasons for consuming sea turtle eggs and meat in the local community around the sea turtle conservation station. This research provides valuable information that can be used as a basis for identifying threats to turtle populations in the Rantau Sialang conservation area.

Keywords*: Coastal management; Nest characteristics; Program effectiveness; Local community perceptions*

Introduction

As one of the largest archipelagic countries, Indonesia's waters are considered one of the world's richest in marine biodiversity, including sea turtles [1-4]. Six of seven species of sea turtles were reported to inhabit Indonesian seawaters, namely green turtles (*Chelonia mydas*),

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olive ridley (*Lepidochelys olivacea*), loggerhead (*Caretta caretta*), hawksbill (*Eretmochelys imbricata*), leatherback (*Dermochelys coriacea*) and flatback (*Natator depressus*) [3]. Unfortunately, based on the IUCN Red List, five species of these turtles are categorized at different levels of threat: vulnerable (olive ridley, loggerhead and leatherback), endangered (green turtles) and critically endangered (hawksbill).

Sea turtle conservation efforts in Indonesia are regulated by several laws and government regulations, for instance, Law Number 27 of 2007 (concerning the conservation of sea turtles' habitat), Law Number 5 of 1990 (concerning the list of protected animal species) and Government Regulation of the Republic of Indonesia Number 7 of 1999 (concerning the protection and law enforcement of protected animal species). One of the embodiments of these laws and regulations (Law Number 27 of 2007 and Law Number 5 of 1990) is providing the sea turtle conservation stations in various regions in Indonesia. The sea turtle conservation station has a significant role in managing and protecting the sea turtle conservation area, assisting the hatching of sea turtle eggs, releasing hatchlings, monitoring and preventing the exploitation of sea turtle eggs and meat and educating the public regarding the importance of sea turtle conservation [5]. However, various obstacles such as lack of infrastructure, lack of officer skills, low participation and conservative perceptions from the local community are still common challenges found in sea turtle conservation programs in Indonesia [6].

The Rantau Sialang Sea Turtle Conservation Station (established in 2010) is one of two sea turtle conservation stations in Aceh Province, Indonesia. Based on the recording data, there were three species of sea turtles that regularly visited the Rantau Sialang Beach area to lay their eggs, namely green turtles (*Chelonia mydas*), leatherbacks (*Dermochelys coriaceae*) and olive ridley (*Lepidochelys olivaceae*). Currently, the station conducts various conservation programs, such as area monitoring, documentation of data related to sea turtle nests, eggs, mature sea turtles, semi-natural hatching of sea turtle eggs, hatchling care, community capacity building in handling sea turtle eggs and public education regarding sea turtle conservation.

The study of nest characteristics is indispensable to understand the reproductive behavior of sea turtles, to select conservation sites and to replicate semi-natural nests [7-9]. The program's effectiveness (such as beach monitoring, hatching activity and hatchling care) needs to be evaluated to find out the strengths and weaknesses [10]. Moreover, the perception of the surrounding community needs to be known to find solutions for conservation problems that may arise from the community [11-13]. To date, studies related to nest characteristics of sea turtles, program effectiveness and local community perceptions around Rantau Sialang Sea Turtle Conservation Station still have not been studied. Hence, this study aims at monitoring the distribution and abundance of sea turtles, nest characteristics, program effectiveness, as well as community perceptions around the Rantau Sialang Sea Turtle Conservation Station, Indonesia. This research provides valuable information that can be used as a basis for identifying threats to turtle populations in the Rantau Sialang conservation area.

Materials and methods

Study site

Rantau Sialang Beach (02°56'19.2" N and 097°25'12" E) is located within Gunung Leuser National Park (Fig. 1), approximately 10km from Bangko Lake South Kluet District, South Aceh Regency, Indonesia. Rantau Sialang Beach (the only coastal area in the park) is about 67.52 hectares, with a 12km long shoreline. The topography is sloping and ranges from 0 to 25 meters above sea level, with fine sand sediments. The temperature and humidity range from 20.5 to 25.7°C and 9-89mm/year, respectively. Most people around Rantau Sialang work as fishermen and farmers, while a small number are traders [14].

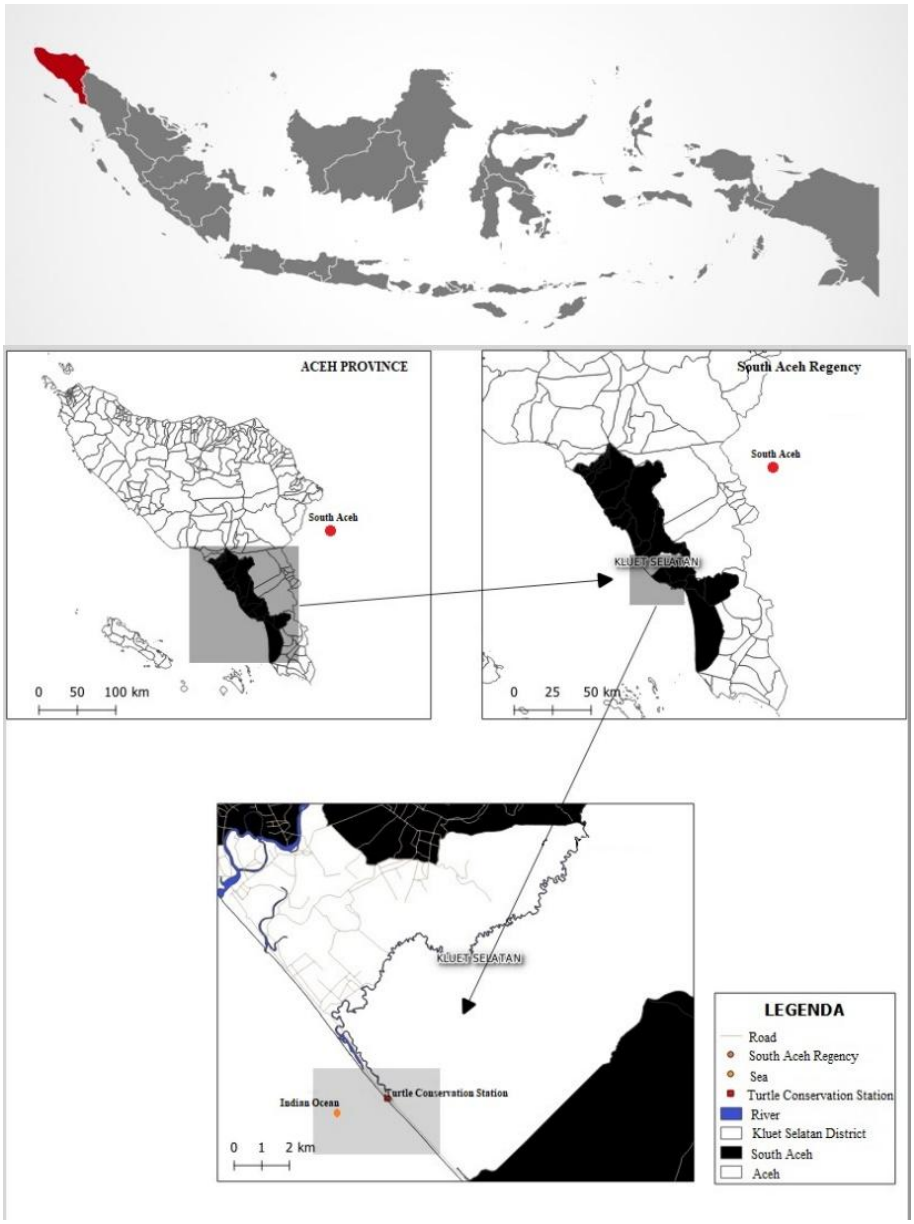

Fig. 1. Location of the study sites

Data collection

Data were collected from face-to-face interviews, direct observation (including beach monitoring activity, egg collection, hatchling release, hatching facilities, hatchling enlargement facilities and sea turtle care facilities) and other supporting data obtained from the station's administrative data (for instance, nest distribution and characteristics, abundance of eggs, hatching success and environmental parameters). As many as 4 officers of the sea turtle conservation station and 50 respondents (50% of the local population around the sea turtle conservation station have been selected randomly from various genders, professions and ages) were interviewed for their perception regarding sea turtle conservation efforts. The design of the interview was open-ended and semi-structured. It included questions related to the number of

people who consumed sea turtle eggs, the time of consuming sea turtle eggs, the process of obtaining sea turtle eggs and the reasons for consuming sea turtle eggs. Respondents were also asked regarding the impact of sea turtle egg exploitation on the economic, tourism, conservation, health and food availability sectors (see supplementary information). Each interview was conducted face-to-face using the local language and recorded with a digital voice recorder or video camera. The interview was conducted during the period of October 2021 to February 2022.

Based on supporting data provided at the station, data related to sea turtle nests were just recorded between January 2017 and December 2019, while data related to sea turtle eggs were recorded between January 2014 and December 2020. Sea turtle nests were characterized based on location, depth and diameter, slope of nest and the number of eggs per nest. Global Positioning System (GPS) was used to determine the nest position. Nest depth and diameter were measured using the protocol described by *S. Najwa-Sawawi et al*. [9]. Egg hatching rate was calculated from the number of clutches hatched divided by the number of eggs incubated. Additionally, weather data, including beach temperature and humidity for the study period, were obtained from the Climate Data Store (https://cds.climate.copernicus.eu/).

The effectiveness of the sea turtle conservation program was measured using the scoring method described in *K. Firliansyah et al*. [15]. Evaluations were made based on nine key parameters, including beach monitoring, origin of egg, hatching success, hatchling rearing facility, hatchling release location, hatchling time release, sea turtle rearing facilities, egg hatchling facility and hatchling release activity. Data were quantified based on the scoring point as described in supplementary data (see supplementary information). The program's effectiveness was evaluated based on the following ranges category: a score of 9 – 18: less effective, 19 – 24: moderately effective, 25 – 30: effective and 31 – 36: very effective [15].

Data analysis

Data related to nest characteristics, hatching success and effectiveness were analyzed descriptively and presented in graphs and figures. The Spearman rank correlation was used to correlate the number of eggs with (1) the diameter of the nest, (2) the depth of the nest and (3) the slope of the nest, as well as the depth of the nest with the diameter of the nest. Respondents' responses and perceptions were presented in graphs based on the frequency. Statistical analyses were performed using SPSS software for Macintosh (Version 22; SPSS Inc., Chicago, IL, USA).

Results and discussion

Results

Nest distribution and characteristics

A total of 29 sea turtles were observed between 2017 and 2019, with records of the species *Chelonia mydas* (n = 2), *Dermochelys coriacea* (n = 3) and *Lepidochelys olivacea* (n = 24). The highest number of sea turtles was observed in 2018 (n = 11), followed by 2019 (n = 10) and 2017 (n = 8). During 2017, sea turtles were found in November and December, while in 2018 they were found in January, February and March and in 2019, sea turtles were only found in December. No sea turtles were recorded between April and October in any of the years sampled (Fig. 2).

Most sea turtle nest locations were distributed around the Rantau Sialang Sea Turtle Conservation Station (Fig. 3). The diameter and depth of the sea turtle nests ranged from 27cm to 35 and 30cm to 40cm, while the slope of the nest ranged from 9° to 45°. There was a positive correlation between nest diameter, nest depth and the number of eggs, while a negative correlation was observed between the slope of the nest and the number of eggs. However, nest diameter, nest depth and nest slope were not significantly correlated with the number of eggs produced (Spearman rank correlation, rs = 0.172, P = 0.494; rs = 0.357, P = 0.146; rs = -0.350, P = 0.156, respectively) (Fig. 4A-4C). Meanwhile, nest diameter was significantly correlated with nest depth (Spearman rank correlation, rs = 0.697, P = 0.001) (Fig. 4D).

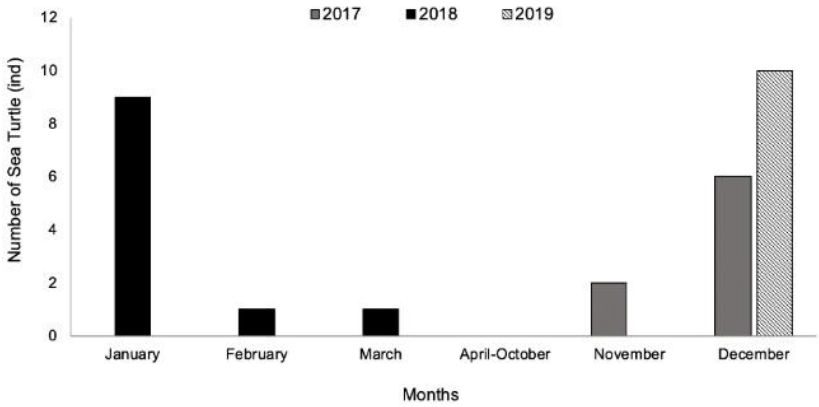

Fig. 2. Number of sea turtles recorded monthly on Rantau Salang beach from 2017 to 2019

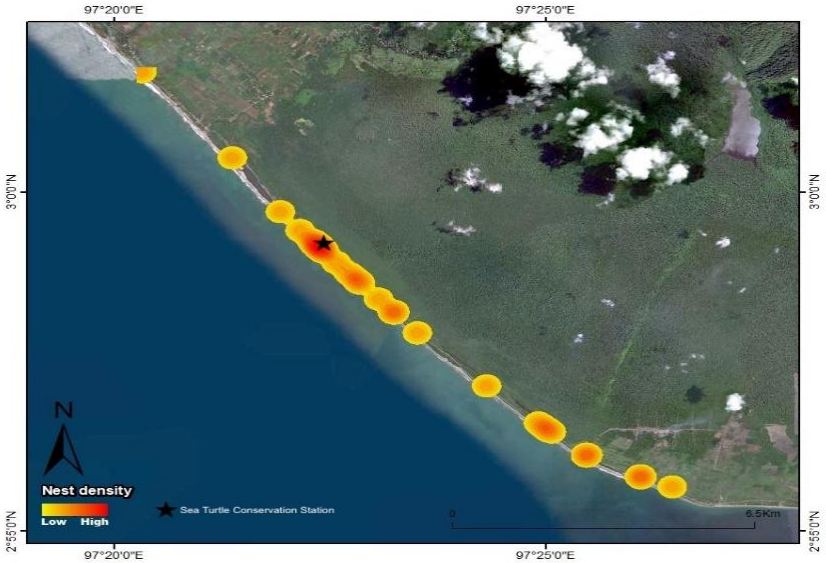

Fig. 3. Spatial distribution of nest locations on Rantau Sialang beach between 2017 and 2019

Distribution and hatchability of sea turtle eggs

A total of 4,051 sea turtle eggs were successfully recorded during the period from 2014 to 2020. The highest number of eggs was obtained in 2018 (n = 1,464), while the lowest (n = 30) was in 2014. Based on the monthly distribution, the highest number of sea turtle eggs were collected in December (n = 1848), followed by January (n = 1003) and November (n = 584). No sea turtle eggs were collected from May to August (Fig. 5). The hatching rate from 2014 to 2020 ranged from 34 to 78%, with an average value of 70%. The highest hatching rate was recorded in 2018, while the lowest was in 2014. The hatching rate showed an increasing trend until 2018 before decreasing in 2019. Based on the monthly distribution, the highest hatching rate was observed in January (87%), while the lowest was in April (23%) (Fig. 6).

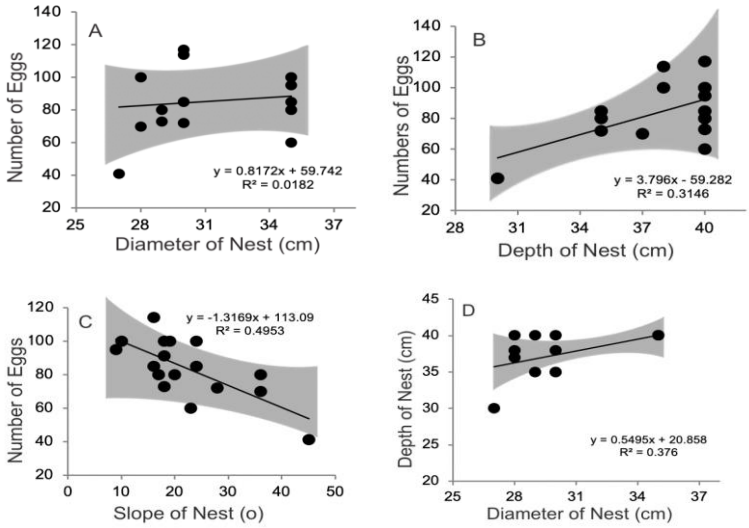

Fig. 4. Correlation between diameter of nest and number of eggs (A), depth of nest and number of eggs (B), slope of nest and number of eggs (C) and diameter of nest and depth of nest (D)

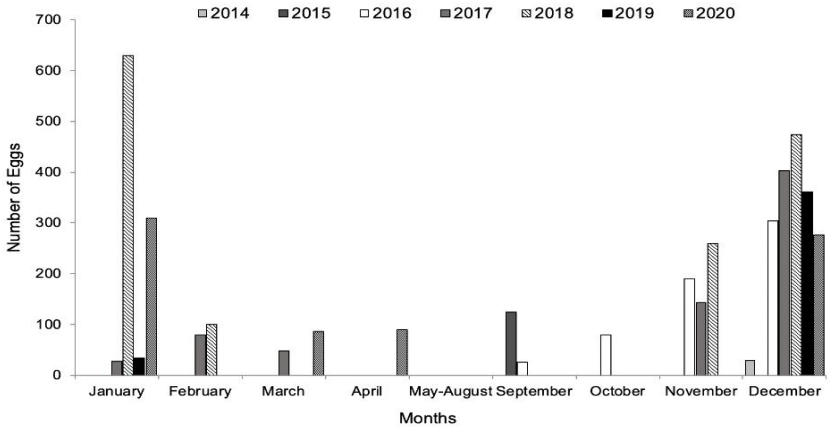

Fig. 5. Recapitulation of turtle eggs collected at Rantau Sialang by month from 2014 to 2020

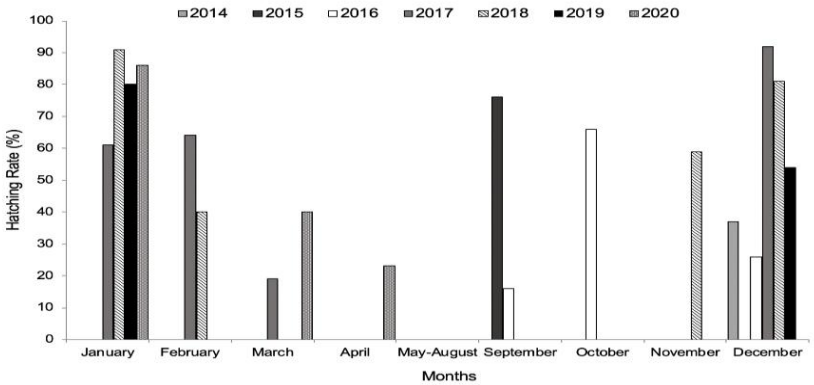

Fig. 6. Hatching rate of turtle eggs at Rantau Sialang by month from 2014 to 2020

Weather data

The temperature around Rantau Sialang Beach during 2015-2020 ranged from 20.5 to 25.7ºC (Fig. 7A).

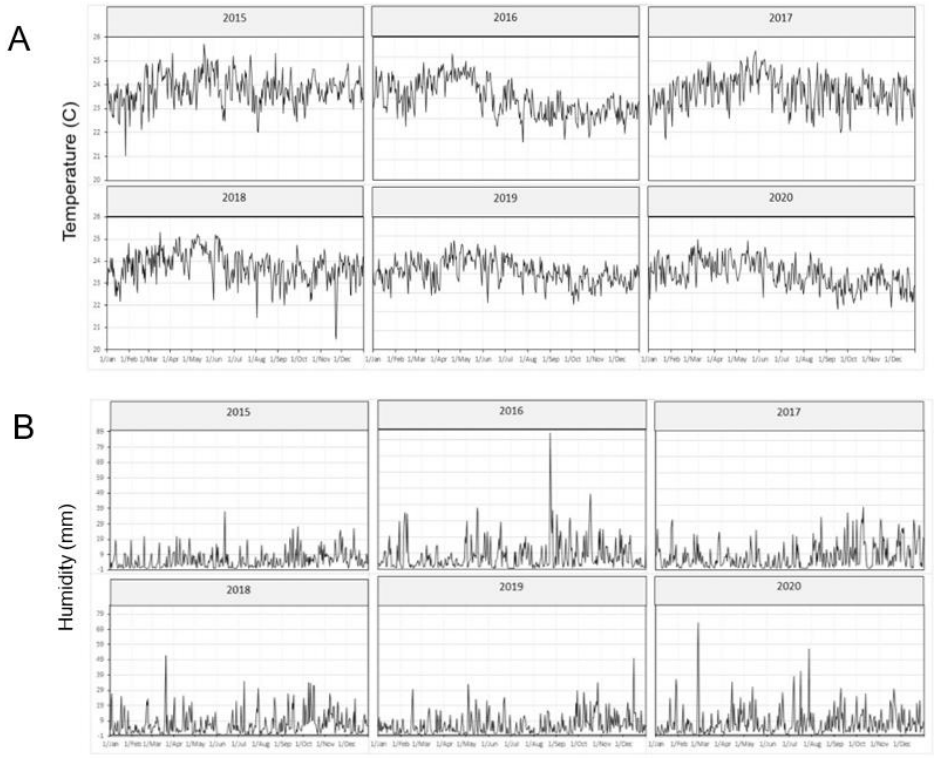

Fig. 7. Fluctuations in coastal temperature and humidity in Rantau Sialang from 2015 to 2020

Temperature fluctuation was observed at the beginning and the end of the year compared to the middle. The temperature ranged from 20.5 to 24.9ºC during November to January and 21.3-25.7ºC during February to October. During the observational period, the lowest temperature was recorded in December 2018 (21°C), while the highest was in May 2015 (25.5ºC). Humidity ranged from 9 to 89mm/year (Fig. 7B). In contrast with temperature, the humidity value fluctuated more in the middle of the year compared to the beginning and the end of the year. The lowest humidity was recorded in August 2019 (10mm), while the highest was in September 2016 (83.31mm).

The effectiveness of conservation programs

Effectiveness analysis showed that the performance of the Rantau Sialang Sea Turtle Conservation Station was categorized as effective with a score of 30. The parameters with the highest scores were the origin of eggs, hatchling release location, hatchling release time, sea turtle rearing facility and egg hatching facility (the score for each parameter was 4 of 4). While the parameters with the lowest score were the hatching success (score: 2 of 4) and coastal monitoring (score: 2 of 4) (Fig. 8). Most of the collected eggs came from surrounding the conservation station. In addition, the hatchling release location was also carried out around the conservation station. The release time was in the afternoon (around 05.00-06.00 PM, Western Indonesian Time; WIT) and the morning (around 05.00-06.00 AM, WIT). Hatching and rearing facilities were available in sufficient numbers with good quality. The hatchling rearing facilities at the Rantau Sialang Sea Turtle Conservation Station were rectangular (2.5×1.5m) and made of

ceramic. Before being released into the sea, the fry are quarantined for 3-5 days to eliminate the smell of fish. The food served during this period was Spanish mackerel (*Scomberomorus commerson*) and mackerel tuna (*Euthynnus affinis*) and the newborns were fed once a day in the afternoon. Coastal monitoring was carried out irregularly and did not cover all the conservation areas, particularly occurring during the sea turtle nesting season. Of the total 12km of the conservation area, around 8km were monitored. The average hatching success rate at the Rantau Sialang Sea Turtle Conservation Station was 70%.

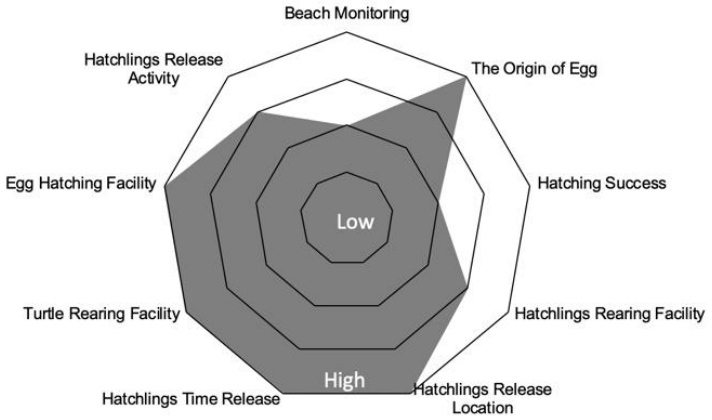

Fig. 8. The performance of the Rantau Sialang turtle conservation stations based on nine parameters

Local community perception

Most respondents (86%, n = 43) presumed that most local communities had and often consumed sea turtle eggs (Fig. 9A). They obtained the sea turtle eggs by taking them directly from the nest (44%, n = 22) and bought them from illegal sellers (34%, n = 17) (Fig. 9B). About 8% (n = 4) of respondents consumed sea turtle eggs once a week, while 40% (n = 20) and 52% (n = 26) of respondents were about once a month and once a year, respectively (Fig. 9C). Most respondents associated their consuming activity of sea turtle eggs with a delicious taste (50%, n=25) and health benefits (28%, n = 14), while some respondents (4%, n = 2) still believed that sea turtle egg consumption was traditional family paradigms and mystical beliefs (Fig. 9D). Regarding the impacts of sea turtle egg exploitation, the majority of respondents (ranging from 32% to 50%) claimed to perceive a positive impact on several sectors, including the economy, tourism and health (Fig. 10). The majority of respondents (50%) did not know the impact of consuming sea turtle eggs on conservation activities. They thought that hunting, selling and consuming sea turtle eggs were not directly related to food availability in their area. However, around 40% of respondents acknowledged that the consumption of sea turtle eggs could harm sea turtle conservation activities.

The Rantau Sialang Sea Turtle Conservation Station is a representation of the Indonesian government's efforts to support sea turtle conservation, especially in Aceh Province. However, these efforts are still facing many problems. Our study revealed that, although the conservation station was established in 2010, the recording of sea turtle eggs around conservation areas and semi-natural hatcheries only started in 2014, while the recording of the mother sea turtles only started in 2017. The limited operational budget and staff were the main factors for this problem. Until 2013, there was only one officer for the Rantau Sialang Sea Turtle Conservation Station. Data collection and semi-natural hatching of sea turtle eggs only started in 2014 after receiving additional operational budgets and two station officers.

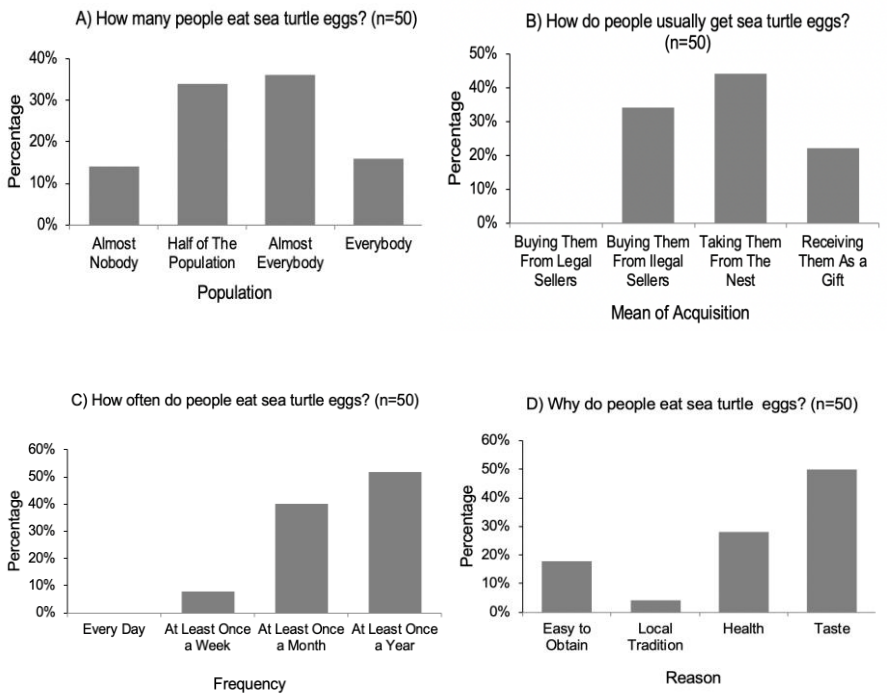

Fig. 9. Local community perceptions on turtle egg consumption

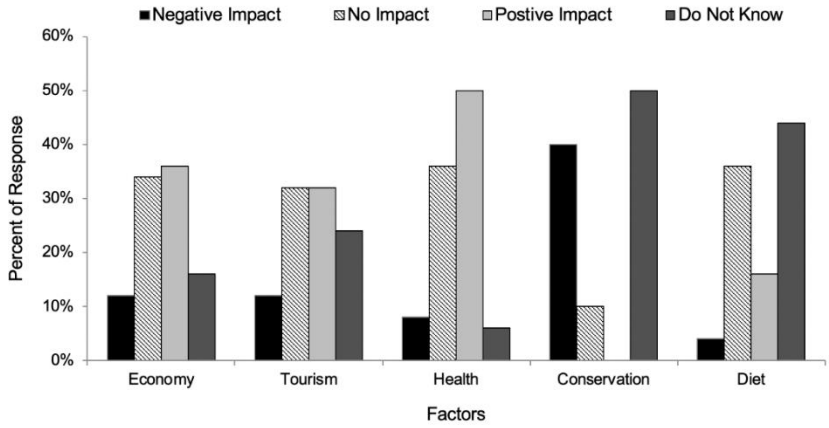

Fig. 10. Community perceptions on the impact of turtle egg consumption

Limited budgets and human resources in sea turtle conservation efforts are common challenges in Indonesia and other developing countries [16-20]. A study conducted by [17] revealed that limited finances were a primary factor that caused insufficient beach protection and inadequate management in supporting the sea turtle conservation program at Playa Cuixmala, Jalisco, Western Mexico.

In the present study, the majority of sea turtle nests are found around conservation stations that have coastal vegetation such as tamanu (*Calophyllum inophyllum*), portia tree (*Thespesia populnea*), casuarina (*Casuarina equisetifolia*), beach almond (*Terminalia catappa*), screw pine (*Pandanus tectorius)* and sea lettuce (*Scaevola taccada*). This vegetation is also commonly found around sea turtle nests in other locations, including Tambelan Archipelago [3], Pangumbahan

Beach [21], Lhoknga Beach [22] and Serangan Beach and Saba Beach [23]. According to Manurung and Rifanjani [24], the vegetation can provide good shade and protection for the sea turtle and eggs during the laying and hatching process.

There was a positive correlation between nest diameter, nest depth and the number of eggs/nest. The deeper and broader nest triggers produce more eggs. Similar results were also reported to be observed for sea turtle nests on Pulau Redang [9] and Similan Island [25]. A previous study by *S. Najwa-Sawawi et al.* [9] revealed that sea turtle nests with 40-90 eggs have a depth ranging from 50-70cm, while nests with 80-110 eggs have a depth ranging from 80-100cm. According to *N.P. Banoet et al*. [26], the depth of the nest maintains humidity and water content in the nest even though it is exposed to direct sunlight. Therefore, direct sunlight on the sand will increase the temperature in the nest and create suitable temperature conditions for the development of each sea turtle egg embryo. In addition, a deeper nest can maintain the stability of humidity and water contained in the nest and avoid the nesting predator [9, 27, 28]. The larger diameter also potentially speeds up the process of opening the nest by hatchlings to reach the beach surface.

The results showed a negative correlation between the degree of beach slope and the number of sea turtle eggs produced. The slope of the beach is one of the essential factors for sea turtles to determine the nest's location. Sea turtles with more eggs tended to choose gentler beaches. In contrast, sea turtles with fewer eggs tended to prefer beaches with a high slope. Similar results were also observed for sea turtle nests in the Tambelan Archipelago [3] and Pangumbahan Beach [2].

The number of eggs successfully recorded at the Rantau Sialang Sea Turtle Conservation Station (n = 4,051) is lower than that recorded by other sea turtle conservation stations in Indonesia (insert references). *A.R. Umama et al.* [29] reported that the number of sea turtle eggs transferred to semi-natural nests by the sea turtle conservation station at Boom Beach Banyuwangi was 4495 in just four months (April-July 2018). The Pangumbahan Beach Sea Turtle Conservation Station, Sukabumi Regency, West Java, collected a total of 126,176 eggs in 2019 [30].

The majority of sea turtle eggs are collected at the end and beginning of the year (November to January). This peak period is similar in several areas in Indonesia, including Pangumbahan Beach (August-January) and Sindangkerta Beach, Tasikmalaya Regency (October to December) [31-33]. The peak time of finding sea turtle eggs in a location is thought to be related to various environmental factors such as high waves and tidal currents. High waves and tidal currents make sea turtle nests vulnerable to being submerged in seawater [34]. In addition, removal of beach sand by erosion could result in steeper slopes that prevent nesting sea turtles from accessing the nesting site [35, 36]. The results show that humidity in the middle of the year tends to be more fluctuating than at the beginning and end of the year. Humidity fluctuations are closely related to wind movements, which have an impact on wave height and tidal currents.

The average hatchability of sea turtle eggs in Rantau Sialang Conservation Station was 70%. This value is similar to Boom Banyuwangi Beach Sea Turtle Conservation Station (75-79%) (Kushartono and Hartati, 2016), but is still lower than the Sebubus Beach Sea Turtle Conservation Station in Sambas Regency (87.69-93.13%) (Sheavtiyan and Lovadi, 2014) and Sukamade Beach Sea Turtle Conservation Station in Banyuwangi, East Java (93.33-94.44%) [29, 37, 38]. The trend showed that the success rate of hatching sea turtle eggs tends to decrease in the middle of the year. Higher temperatures with low humidity in the middle of the year are thought to affect the incubation temperature of sea turtles, impacting the development of sea turtle egg embryos. Studies related to the effect of temperature and rainfall on the hatching rate of sea turtle eggs have not been performed comprehensively. *T.R.S. Sheavtiyan and I. Lovadi* [38] stated that low humidity could cause the release of water in sea turtle eggs, which results in disruption of embryogenesis.

The low score of the coastal monitoring component is thought to be the key factor causing the low recapitulation of sea turtle eggs. Meanwhile, officers' lack of knowledge and skills in handling sea turtle eggs is thought to have contributed to the low rate of hatching success. Coastal monitoring by the Rantau Sialang Sea Turtle Conservation Station officers has not been carried out periodically and is still in a narrow scope. Scheduled monitoring is only carried out during the sea turtle nesting season (November to March) and only reaches 2-3km away from the research station. As a result, the potential for disturbing sea turtle nests by predatory attacks accompanied by illegal exploitation of sea turtle eggs is relatively increased.

Efforts to upgrade the knowledge and skills of sea turtle conservation station officers in handling sea turtle eggs are still facing a challenge in Indonesia. *U. Umroh et al*. [39] stated that the lack of knowledge and skills of the sea turtle conservation station officers in Batavia Bangka Beach, especially on the incubation, relocation and captivity processes, impacted the low hatching rate of sea turtle eggs. Sea turtle conservation stations with high hatching rates provide intensive training to their officers and the community, especially regarding the technique of relocating sea turtle eggs from the nest. The relocation of sea turtle eggs needs to be carried out carefully without removing the mucus and sand attached to the sea turtle eggs to get optimal results [39].

The increasing demand and the high selling price are causes of the illegal exploitation of sea turtle eggs in Rantau Sialang. The increasing demand for sea turtle eggs could be indicated through the number of consumers as well as eating frequency. Most respondents thought that most of the people around Rantau Sialang had consumed sea turtle eggs, at least during the sea turtle nesting season. On the other hand, the price of a sea turtle egg in the community settlements around the Rantau Sialang is IDR 5,000, much higher than a poultry egg, around IDR 2,000-3,000. Additionally, the lack of monitoring activity from the authorities creates no obstacles for the sea turtle egg hunter during the direct retrieval from the nest. To the best of our knowledge, various illegal exploitations of sea turtle eggs in various locations in Indonesia have also been previously reported, including in the Meru Betiri and Alas Purwo Sea Turtle Conservation areas, Sukamade Beach area, Banyuwangi, East Java and the Bali Coast [15, 38, 40]. In fact, the prohibition on selling sea turtle eggs and consuming and using other parts of sea turtles is contained in Law Number 15 of 1990 and it is stated that perpetrators of animal trafficking, including sea turtle eggs, can be threatened with a prison sentence of 5 years and a fine of IDR 100 million.

Most of the consumed sea turtle eggs were collected directly from the nest. Taste, perception of its usefulness and local culture are the considerable reasons for consuming sea turtle eggs and meat in the local community. For instance, Balinese people consume sea turtle meat and eggs, especially in traditional ceremonies such as marriages, deaths and offerings [41-43]. In this study, the consumption of sea turtle eggs by the community around the Rantau Sialang Sea Turtle Conservation Station tends to be influenced by the taste and perception of its health benefits. Most respondents who have consumed sea turtle eggs admit they taste better than poultry eggs. They also believe that sea turtle eggs can increase stamina, improve blood circulation and treat congestion. Similar perceptions have also been reported in communities around Northwestern Mexico [44], the Mediterranean coast of Egypt [45], Redang Island [46] and Tortuguero in Costa Rica [47]. Interestingly, most respondents considered that consuming sea turtle eggs could increase tourism activities in the surrounding area and the community's economy with an additional daily income of up to IDR 250,000/day (17.28 USD/day) and changing this perception of the local community so that sea turtles have more value alive is one of the great challenges of conservation.

Efforts to improve people's perceptions to become more conservative have been carried out through outreach by Rantau Sialang conservation station officers collaborating with the government and local non-governmental organizations. One of them is by educating the public and students about the importance of conserving sea turtles. In addition to ecotourism, edutourism might be an alternative economic program that can be implemented to reduce the exploitation of

sea turtle eggs around the Rantau Sialang Sea Turtle Conservation Station. Sea turtle conservation activities can be a tourist attraction and an alternative solution for sea turtle protection that can provide economic benefits to the community. Several locations in the world, such as Gandoca in Costa Rica [48], South Coastal Village in Australia [49], Praia do Forte in Brazil [50, 51] and Ras Al Hadd in Oman [52], have made a concept in developing ecotourism and edutourism for sea turtle conservation.

Conclusions

This research describes the ecological characteristics of sea turtle nests, the effectiveness of conservation programs carried out and the perception of the community around the Rantau Sialang Sea Turtle Conservation Station. A total of 4,051 sea turtle eggs have been successfully collected during the 2014-2020 period, with an average egg hatchability of 70%. The performance of the Rantau Sialang Sea Turtle Conservation Station is in the effective category with the highest scores on origin of eggs, hatchling release location, hatchling release time, sea turtle rearing facility and egg hatching facility. Illegal exploitation of sea turtle eggs around the conservation area was caused by the lack of conservative perception from the surrounding community. Several recommended programs that can be implemented to reduce the illegal exploitation of sea turtles in the Rantau Sialang area, including intensive outreach, capacity building for officers and monitoring facilities and development the programs for ecotourism and edutourism.

Acknowledgments

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