

Research Article

The First Record of *Elysia* Species from the Mangrove Ecosystem of the Kamphuan Canal, Ranong Province, Thailand

Nantapong Kimpai* and Worawit Pannak

Andaman Coastal Research Station for Development, Faculty of Fisheries, Kasetsart University, Ranong 85120, Thailand.

ABSTRACT

Article history:

Received: 2025-03-04

Revised: 2025-11-19

Accepted: 2026-01-27

Keywords:

Elysia;
 Sacoglossan sea slug;
 Plakobranchidae;
 Mangrove ecosystem

One of the most fascinating organisms inhabiting mangrove ecosystems is the sacoglossan sea slug of the genus *Elysia*. Although *Elysia* species are globally distributed, their diversity and distribution within mangrove ecosystems, particularly in Thailand, remain understudied. This study reports the first recorded occurrence of *E. bangtawaensis* and *E. leucolegnote* in the Kamphuan mangrove forest, Ranong Province, Thailand. Both species were found inhabiting small tide pools and footprints in areas where gaps in the mangrove canopy allowed light gap to reach the forest floor. The specimens showed comparable size ranges to those reported in previous studies, which have documented their distribution in Thailand, including the Gulf of Thailand (Chumphon, Surat Thani, Nakhon Si Thammarat, and Pattani) and the Andaman Sea (Phang Nga, Krabi, and Trang). However, no previous records have been reported from Ranong Province. Organic matter contents were analyzed in areas with and without the presence of these species. Significantly higher organic matter levels were observed in habitats where *Elysia* species were found ($p < 0.05$), suggesting a positive correlation between habitat quality and species occurrence. The presence of *Elysia* in this mangrove ecosystem indicates that the Kamphuan mangrove forest provides favorable environmental conditions for *Elysia* species. This study represents the first record of *E. bangtawaensis* and *E. leucolegnote* in Ranong Province, expanding the known distribution range of the genus *Elysia* in Thailand and providing baseline data for future biodiversity and conservation research.

© 2026 Kimpai, N. and Pannak, W. Recent Science and Technology published by Rajamangala University of Technology Srivijaya

1. Introduction

The mangrove forest of The Kamphuan canal is an ecologically significant area that encompasses important coastal zones and serves as a habitat with high biological diversity. This ecosystem is rich in biodiversity and productivity, making it an ideal location for researchers to study and investigate the diversity of plants and animals (Rachmuangkwan, 2014).

One of the most fascinating organisms inhabiting the mangrove forest is the sacoglossan sea slug of the genus *Elysia*. These sea slugs are known for their bright coloration and unique ability to photosynthesize by retaining functional chloroplasts from the algae they consume, a phenomenon known as kleptoplasty (Rumpho *et al.*, 2008). This adaptation allows them to survive in nutrient-poor environments.

Sacoglossian opisthobranchs have no jaws, and their radula comprises a single, longitudinal row of teeth, the older teeth being held in an ascus during their life. *Elysia* is the most speciose genus. The clearest feature of *Elysia* is the presence of wing-like parapodia, which play an important role in increasing the surface area for light absorption, thereby enhancing photosynthetic efficiency through kleptoplasty. This structure is closely related to environmental factors, as *Elysia* tends to thrive in habitats with suitable light intensity and abundant epiphytic algae, conditions that indicate good environmental quality (Buatip *et al.*, 2022), making *Elysia* an intriguing subject for scientific research.

Although *Elysia* species are globally distributed, their diversity and distribution within mangrove ecosystems, in

* Corresponding author.

E-mail address: nantapongkimpai@gmail.com

Cite this article as:

Kimpai, N. and Pannak, W. 2026. The First Record of *Elysia* Species from the Mangrove Ecosystem of the Kamphuan Canal, Ranong Province, Thailand. **Recent Science and Technology** 18(2): e266568.

<https://doi.org/10.65411/rst.2026.266568>

Thailand, remain understudied. Previous studies by Swennen (1998, 2011) and Buntip *et al.* (2022) have documented the presence of *Elysia* along the Andaman coast of Thailand and the Gulf of Thailand, including the provinces of Krabi, Phang Nga, and Pattani. Five *Elysia* species have been reported from mangrove ecosystems, including *E. bangtawaensis* Swennen, 1998, *E. leucolegnote* Jensen, 1990, and *E. siamensis* Swennen, 2011, which are found in Thailand; *E. singaporensis* Swennen, 2011 from Singapore; and *E. bengalensis* Swennen, 2011 from the Bay of Bengal, India. Although there have been reports from other regions, information on the genus *Elysia* in Ranong Province is still lacking, and studies on the diversity of these sea slugs within the mangrove ecosystem have not yet been conducted.

Consequently, this study aims to investigate the species diversity of *Elysia* in the Kamphuan Canal mangrove ecosystem.

2. Materials and Methods

2.1 Study area

The study area is located in the southeastern part of the Andaman Coastal Research Station for Development, southern Thailand (Figure1), and connected to the Andaman Sea. The mangrove forest covers approximately 1.4 hectares (0.014 km²), as shown in Table 1.

Rhizophora apiculata is the dominant species. The mangrove forest area is part of the Kamphuan Canal, which is influenced by runoff and connected to the Andaman Sea coast. A random walking survey was conducted on 4 December 2024, after the rainy season during low tide, covering an area of approximately 16 m² in total. The site receives sufficient sunlight reaching the forest floor.

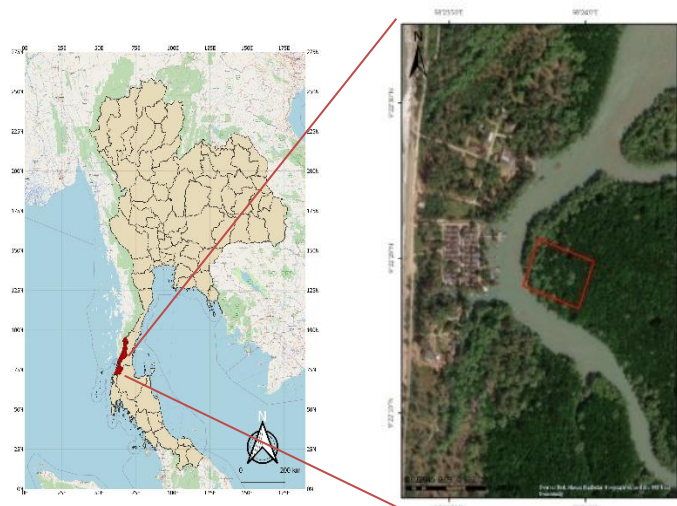


Figure 1 Sampling areas in the Mangrove Ecosystem of Kamphuan Canal, Ranong Province.

2.2 Sampling method

Elysia specimens were surveyed from the innermost part of the mangrove forest to the mangrove area adjacent to the canal.

In the field, morphological characteristics and coloration were observed.

Fifteen individuals of *Elysia* per observed type were randomly collected to measure body length and width using vernier calipers, and weight was measured with a digital scale in the laboratory. Species identification was conducted following the guidelines of Swennen (2011) and Jensen (1996).

Table 1 Geographic coordinates of survey area.

Corner	Geographic co-ordinates
Top left	9.372630° 98.398996°
Top right	9.372240° 98.399971°
Bottom left	9.371744° 98.398843°
Bottom right	9.371483° 98.399805°

2.3 Environmental factors

Environmental parameters were measured in the field to describe the baseline conditions of the habitats where both species occur. A total of 10 sampling sites were investigated, consisting of 5 sites where *Elysia* individuals were observed and 5 sites where *Elysia* were absent. The measured environmental parameters are summarized in Table 2.

2.4 Statistical analysis

Data were analyzed to compare %Organic matter between *Elysia*-observed and *Elysia*-absent areas. An independent t-test was conducted using Microsoft Excel to determine significant differences between the two groups

3. Results and Discussion

3.1 Species

The survey found two species of *Elysia*: *Elysia bangtawanensis* and *Elysia leucolegnote*. The absence of previous records of *Elysia* in Ranong Province may be attributed to the extensive and complex mangrove ecosystems in the region, covering approximately 30,000 hectares (Doydee and Buot, 2011). Such large and structurally diverse mangrove areas are difficult to survey comprehensively. Moreover, *Elysia* species are small, making them challenging to detect in the field.

Elysia bangtawanensis Swennen, 1998

Live coloration: There are marked rosy to bright red and orange glandular spots along the parapodia borders. White spots of various sizes and fine rosy dots are scattered on the dorsal and ventral parts, including the foot base. The green ductulus of the digestive gland covers the renal part in many specimens; it does not reach the tips of the rhinophores. The tips are pale or shaded with white and orange spots. (Swennen, 1998; Swennen, 2011)

Table 2 The environmental factors were measured from the sampling areas.

Environmental factors	Equipment and Methodology
Salinity, ppt	Refractometer
Temperature, °C	YSI Model Pro1020
pH	YSI Model Pro1020
Dissolved Oxygen, mg·L ⁻¹	YSI Model Pro1020
Depth, m	Ruler
Organic matter, %OM	Walkley Black titration method

Fifteen individual slugs of various sizes were measured, with lengths ranging from 16.5 to 50.4 mm, widths from 9.89 to 30.75 mm, and weights from 0.085 to 1.197 g.

Elysia leucolegnote K. R. Jensen, 1990

Live coloration: A narrow white line runs along the borders of the parapodia and is often locally expanded. A white triangular mark on the head is connected to a white line extending over the dorsal surfaces of the rhinophores. Some specimens exhibit a few white spots on the renopericardial prominence, while white spots are rarely observed on the dorsal sides of the parapodia. The tips of the rhinophores, as well as frequently the posterior region of the renocardial prominence, lack tubules of the digestive gland (Swennen, 2011)

Fifteen individual slugs of various sizes were measured, with lengths ranging from 3.6 to 17.3 mm, widths from 1.38 to 9.22 mm, and weights from 0.009 to 0.537 g.

E. bangtawaensis can have a length of 35–52 mm (Swennen, 1998; 2011), and lengths of 35–40 mm have been recorded in India (Jagtap *et al.*, 2009). The lengths observed in this study were similar to those reported in previous studies.

Swennen (2011) reported that *E. leucolegnote* in Thailand can reach up to 41 mm in length in live specimens. In Indonesia, Assuyuti and Wardiatno (2020) recorded specimens ranging from 6 to 18 mm in length, while in the Philippines, Sanchez-Escalona (2019) reported lengths ranging from 30 to 35 mm. The specimens recorded in this study exhibited smaller but comparable sizes to those reported in previous studies (Figure 2).

They were distributed in small tide pools and shallow footprints. In some tide pools, two species were found coexisting, whereas in other pools and footprint depressions, only one species was present (Figure 3).

All sites were covered by *Rhizophora apiculate*. The habitat where *Elysia* was observed in the upper mangrove forest exhibited canopy gaps, allowing greater light penetration to the forest floor (Figure 4A). In contrast, areas where *Elysia* was absent were characterized by dense mangrove coverage, which limited light availability (Figure 4B). This difference in light levels may influence the growth and distribution of microalgae. Previous research has indicated that light plays an important

role in algae production (Kathiresan and Ingam, 2001) and that algae are the main food source of *Elysia* (Jensen, 1992). Moreover, Studies have shown that *Elysia* can use chloroplasts obtained from algae to help absorb energy from sunlight and improve their ability to survive in environments with low light or limited food resources (Jensen, 1992; Rumpho *et al.*, 2008)

E. bangtawaensis was first discovered in Pattani Province, Thailand. It is distributed in the intertidal zone. and the mangrove forest habitats (Swennen, 1998). This species occurs on both the Gulf of Thailand (Nakhon Si Thammarat, Pattani) and the Andaman Sea coast (East of Krabi) in mangrove habitats (Swennen, 2011; Buatip *et al.*, 2022)

In Thailand, *E. leucolegnote* has been reported along both the Gulf of Thailand and Andaman Sea coasts. In the Gulf of Thailand, it has been observed in Chumphon, Surat Thani, Nakhon Si Thammarat, and Pattani, while in the Andaman Sea, its distribution includes mangrove habitats at Ko Libong and the eastern mangrove forests of Krabi (Swennen, 2011). which was first discovered in Hong Kong (Swennen, 2011). Previous studies have not documented the presence of *E. bangtawanensis* and *E. leucolegnote* in Ranong Province.

3.2 Environmental factors

Water quality in the Kamphuan mangrove forest area, where *Elysia* was observed, is shown in Table 3. Organic matter values were categorized into two distinct groups: regions where *Elysia* species were present and regions where they were absent (Figure 5). Shenai-Tirodkar *et al.* (2012) reported the ecological parameters in the habitat of *E. bangtawaensis* in the Mondovi estuary, Goa, along the west coast of India, from November 2007 to October 2008, included a water temperature range of 25–30 °C, pH levels between 6 - 7.59, and salinity ranging from 0.08 - 29.57 psu, and Buatip *et al.* (2022) reported in the newly-grown mangrove habitats, Pattani, included a water temperature range of 25.2-27.5 °C, pH levels between 7.33-7.61, salinity ranging from 13.5-16.5 psu, and dissolved oxygen ranging from 2.07-3.11 mg·L⁻¹. In comparison, this study recorded a water temperature of 26 °C, pH levels between 6.33 - 7.72, salinity 20 ppt, and dissolved oxygen ranging from 2.07-3.11 mg·L⁻¹. However, in this study, the environmental factor values were similar in both areas.

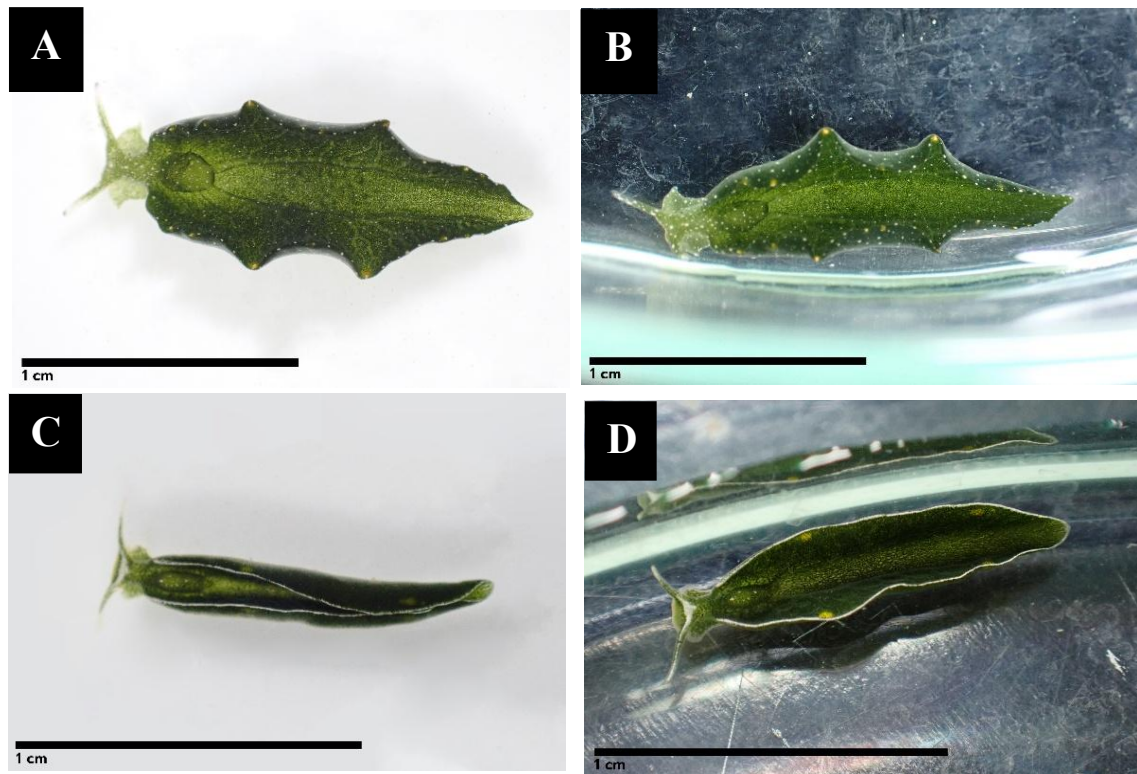


Figure 2 Specimens photographed under laboratory conditions. A–B: *E. bangtawaensis*; C–D: *E. leucolegnote*.

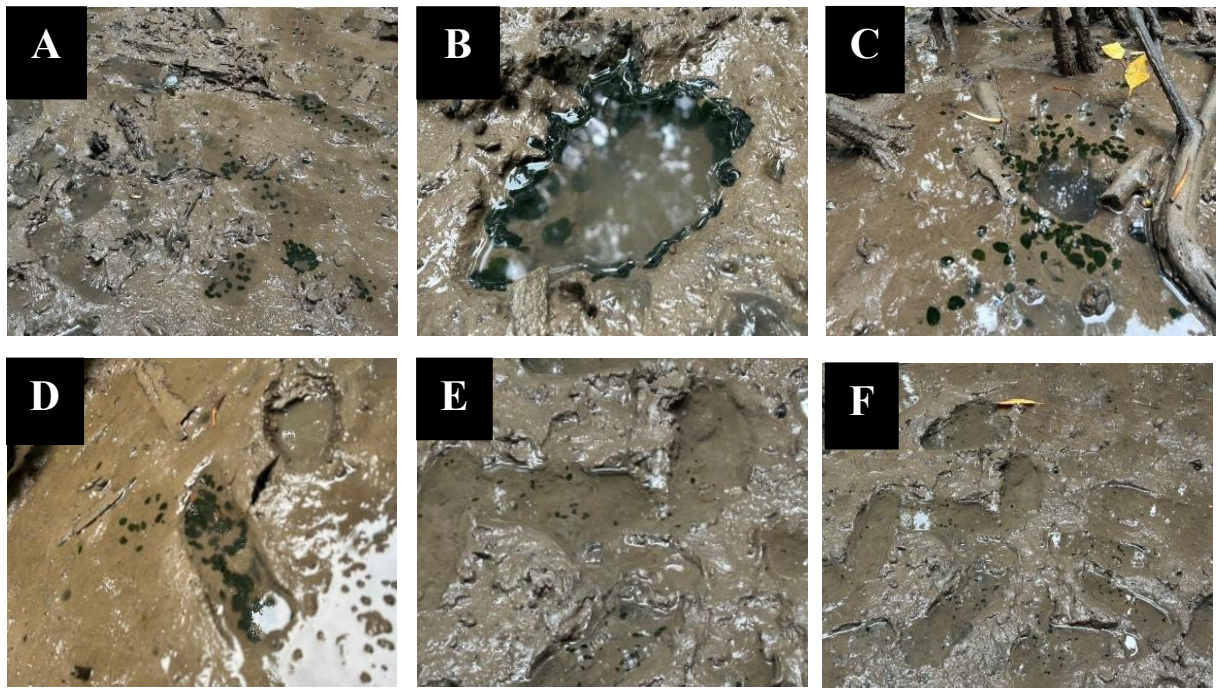


Figure 3 Specimens photographed in the field. A: a small tide pool where two species were found living together. B, C, D: *E. bangtawaensis* found in small tide pools and footprint depressions. E, F: *E. leucolegnote* found in footprint depressions.

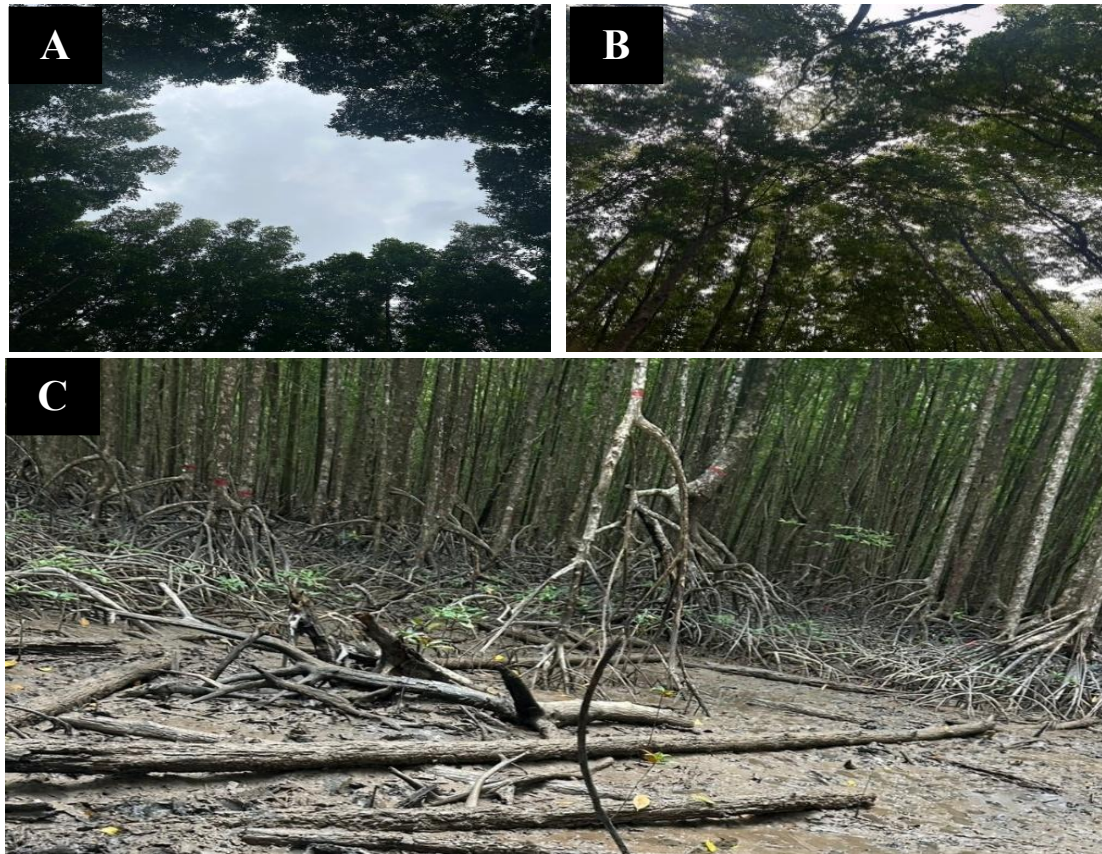


Figure 4 Habitat where *Elysia* was found. A: Upper mangrove forest exhibiting canopy gaps; B: Upper mangrove forest with no canopy gaps; C: Sites covered by *Rhizophora apiculata*.

Table 3 Environment parameters in the mangrove ecosystem of the Kamphuan Canal, Ranong Province.

Parameter	Volume Data	
	<i>Elysia</i> - observed	<i>Elysia</i> -absent
Salinity, ppt	20	20
Temperature, °C	26.00	26.00
pH	6.33-7.72	5.33-7.30
Dissolved Oxygen, mg·L ⁻¹	3.38-4.32	3.22-3.92
Depth, cm	1.5-8.0	1.2-6.0

The organic matter content in areas where *Elysia* species were observed was $4.77 \pm 0.68\%$, whereas in areas where they were absent, values were $3.20 \pm 0.35\%$. These findings align with the study by Buatip *et al.* (2022), which reported a range of 2.33% to 4.73%, indicating comparable levels of organic matter. As shown in Figure 5, organic matter concentrations were significantly higher in regions where *Elysia* species were present. An independent t-test confirmed a statistically significant difference between the two areas ($p < 0.05$). This is consistent with the study by Shenai-Tirodkar *et al.* (2012) in the Mondovi estuary, Goa, India, which found that *Elysia bangtawaensis* is commonly found in areas with high organic matter content, supporting the relationship between the presence of *Elysia* and the amount of organic matter in the environment. It was found that *Elysia* was frequently observed

in areas with a high percentage of organic matter, which may be related to the abundance of food sources such as epiphytic algae that thrive in organic-rich environments (Nakpan *et al.*, 2023). These conditions provide sufficient food resources to support the survival of *Elysia*. In addition, areas with high organic matter often contain elevated nutrient concentrations and exhibit high primary productivity, creating favorable environmental conditions for small organisms, including *Elysia* (Barrón *et al.*, 2014).

Although *Elysia* sp. can obtain energy through photosynthesis via retained chloroplasts (kleptoplasty), this process serves only as a supplementary energy source. The primary energy source for *Elysia* remains the direct consumption of algae (Pierce and Curtis, 2012; Schmitt *et al.*, 2014). Therefore, areas with higher organic matter that promote algal

growth provide abundant food availability, explaining the higher occurrence of *Elysia* in such environments.



Figure 5 The organic matter in *Elysia*- observed and *Elysia* - absent regions

However, the existence of these two types of sea slugs still needs to be monitored on an annual basis and combined with seasonal reports to understand their biology and ecology. There should be further expansion of the area in the mangrove forest. There may be a spread in nearby areas. Mangrove forests are highly productive ecosystems that support diverse marine life and provide suitable habitats for many species. Their ecological complexity may facilitate the discovery of previously unreported or new species, highlighting the importance of conservation and research in these areas. Studying the biology of sea slugs (*Elysia* spp.) is particularly valuable for understanding their ecological roles, distribution, and adaptive mechanisms. Expanding knowledge on sea slugs in this region will contribute to biodiversity assessments and inform conservation strategies for mangrove ecosystems.

4. Conclusion

This study documented the presence of *Elysia leucoleognote* and *E. bangtawaensis* in the mangrove forest of Kamphuan, Ranong Province, in areas characterized by light gaps and high organic matter content. These findings represent the first record of these species in this location, indicating that the Kamphuan mangrove forest provides a suitable habitat for *Elysia* species. This discovery contributes new insights into the distribution of this genus in Thailand and emphasizes the significance of this area for future conservation and ecological research.

5. Acknowledgments

I sincerely thank ACRSD for providing the facilities and support essential to the successful completion of this research.

6. References

- Assuyuti, Y. M. and Wardiatno, Y. 2020. New distribution record of *Elysia leucoleognote* (Jensen, 1990) (Sacoglossa Plakobranchidae) in mangrove ecosystem of Biak Numfor, Papua - Indonesia. **Biodiversity Journal** 11(1): 259-262.
- Barrón, C., Apostolaki, E. T., and Duarte, C. M. (2014). Dissolved organic carbon fluxes by seagrass meadows and macroalgal beds. **Frontiers in Marine Science** 1: 42.
- Buatip, S., Saengkeaw, S. and Buatip, S. 2022. Discovery of large mangrove-dwelling *Elysia* species in the newly-grown mangrove habitats, Pattani, Thailand. **Journal Tropical Resources and Sustainable Science** 10(2): 24-28.
- Doydee, P. and Buot Jr, I. E. 2011. Mangrove vegetation zones in Ranong coastal wetland ecosystem, Thailand. **Journal of Fisheries and Environment** 35(1): 14–28.
- Jagtap, T. G., Shenai-Tirodkar, P. S., Savant, S. B., Kulkarni, V. A. and Ansar, Z. A. 2009. *Elysia bangtawaensis* Swennen (Nudibranch) from the mangrove habitat of Mandovi estuary, Goa (central west coast), India. **Current Science** 96(1): 30-33.
- Jensen, K. R. 1992. Anatomy of some Indo-Pacific Elysiidae (Opisthobranchia: Sacoglossa), with a discussion of the generic division and phylogeny. **Journal of Molluscan Studies** 58(3): 257-296.
- Jensen, K. R. 1996. Phylogenetic systematics and classification of the Sacoglossa (Mollusca, Gastropoda, Opisthobranchia). philosophical transactions of the royal society of London. **Biological Sciences** 351(1335): 91-122.
- Kathiresan, K. and Bingham, B. L. 2001. Biology of mangroves and mangrove ecosystems. **Advances in Marine Biology** 40: 81-251.
- Nakpan, A., Mayakun, J. and Wangkulangkul, K. 2023. Population ecology and habitat use of the sea slug *Elysia pusilla* (Bergh, 1872) (Sacoglossa) in a tropical Halimeda macroloba Decaisne meadow. **Trends in Sciences** 20(1): 6402.
- Pierce, S. K. and Curtis, N. E. 2012. Cell biology of the chloroplast symbiosis in sacoglossan sea slugs, pp. 123-148. In K. W. Jeon, eds. **International Review of Cell & Molecular Biology** (Vol. 293).
- Rachmuangkwan, S. 2014. **Freshwater Fish Species in Ranong Province**. Kasetsart University. (in Thai)
- Rumpho, M.E., Worful, J.E., Lee, J., Kannan, K., Tyler, M.S., Bhattacharya, D., Moustafa, A., and Manhart, J.R. 2008. Horizontal gene transfer of plastid genomes in *Elysia chlorotica*. **Proceedings of the National Academy of Sciences** 105(46): 17867–17871.
- Sanchez-Escalona, K. P. 2019. *Elysia leucoleognote* (Opisthobranchia: Sacoglossa) Jensen 1990, a new record for the Verde Island Passage, Philippines. **The Palawan Scientist** 11: 42-48.

- Schmitt, V., Händeler, K., Gunkel, S., Escande, M. L., Menzel, D., Gould, S. B., Martin, W. F. and Wägele, H. 2014. Chloroplast incorporation and long-term photosynthetic performance through the life cycle in laboratory cultures of *Elysia timida* (Sacoglossa, Heterobranchia). **Frontiers in Zoology** 11: 5.
- Shenai-Tirodkar, P. S., Desai, N. M. and Jagtap, T. G. 2012. Ecological observations and GC-MS analysis of methanolic extract of Sacoglossan *Elysia bangtawaensis* (Swennen). **The Bioscan** 7(3): 457-461.
- Swennen, C. 1998. Two new gastropods, *Elysia bangtawaensis* and *E. siamensis* from Southern Thailand (Opisthobranchia, Sacoglossa, Elysiidae). **Bulletin Zoölogisch Museum, University of Amsterdam** 16: 33-39.
- Swennen, C. 2011. Large mangrove-dwelling *Elysia* species in Asia, with descriptions of two new species (Gastropoda: Opisthobranchia: Sacoglossa). **Raffles Bulletin of Zoology** 59: 29-37.
- Walkley, A. J. and Black, I. A. 1934. Estimation of soil organic carbon by the chromic acid titration method. **Soil Science** 37: 29-38.