Key Findings: Seagrass and Dugongs as Indicators of Ecosystem Health on the Andaman Coast of Thailand

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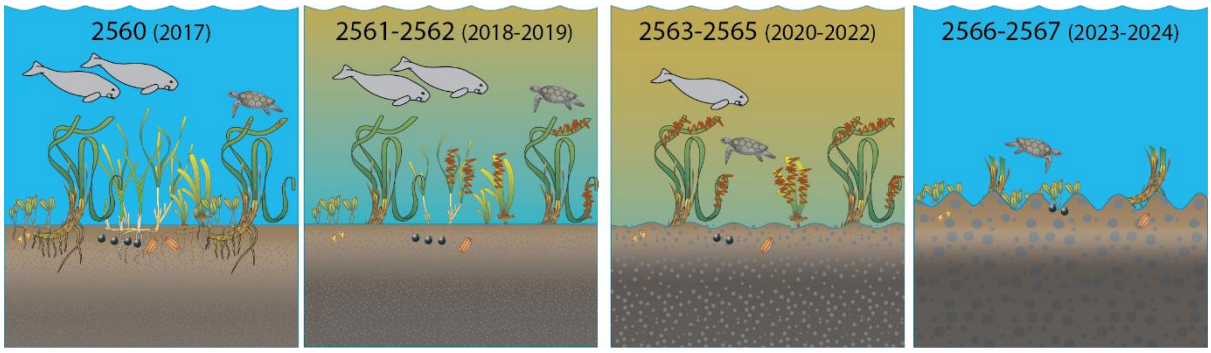

With grateful thanks to WWF Thailand and DMCR for organizing and supporting our fact-finding mission.

Background

- A recent evaluation of the global status of dugongs[1] concluded that the Andaman coast of Thailand is of high global significance for dugongs as one of only 6 locations with confirmed populations more than 100 dugongs, outside Australia.
- In response to government and community concern about the recent loss of seagrass and increase in the number of dead and emaciated dugongs along the Andaman Coast, WWF Thailand organized and supported a fact-finding mission with the cooperation of the Department of Marine and Coastal Resources (DCMR). The Mission Team of 13 (see Appendix 1) comprised two international experts, a local expert, 7 staff of WWF Thailand and 3 DMCR staff.
- The Mission Team spent five days on the Andaman Coast (19-25 January 2025), bookended by briefing sessions with DCMR in Bangkok on January 18 and 27th. The team inspected the condition of seagrass meadows, was briefed on attempts at seagrass restoration, observed the use of drones to monitor the distribution, abundance and behavior dugongs at local (bay) scales and met with local experts from universities and DMCR, NGOs and community groups (Appendix 2).

[1]Marsh, H, Loates, PJ & Schramm, L (eds.). [In press]. A global assessment of dugong status and conservation needs. Bonn: United Nations Environment Program.

Key Findings

- At least 10 species of seagrass occur along the Andaman coast. They vary in their physiological traits and ability to either resist disturbances, or to recover following loss (Figure 1).

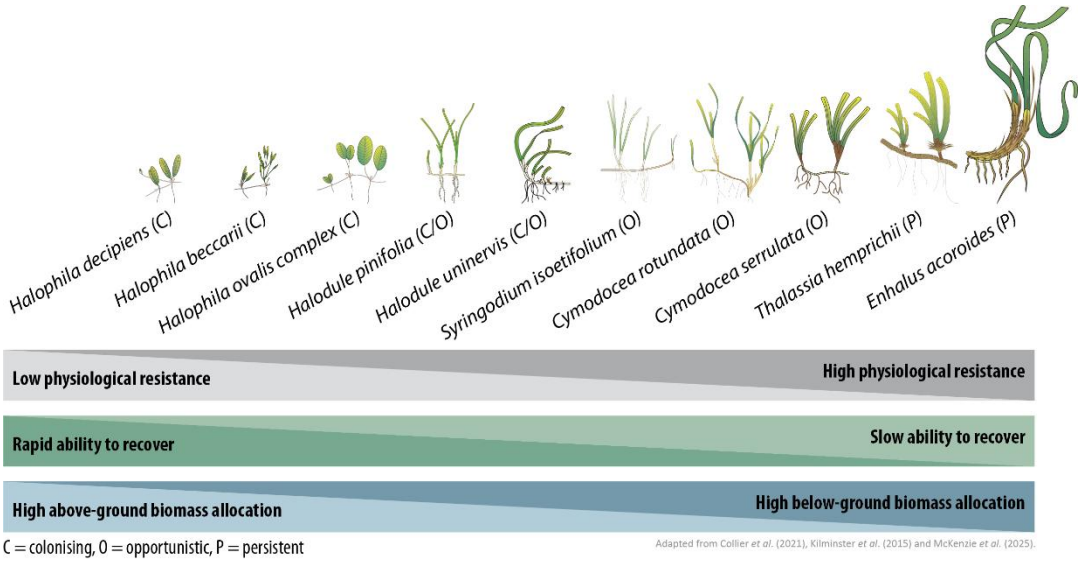

Figure 1: The seagrass species known to occur along the Andaman coast of Thailand and their physiological traits and ability to either resist disturbances, or to recover following loss.

- The Mission concluded that the root cause of the recent seagrass loss along the Andaman coast is unknown. The impacting factors are unclear and cumulative, but are summarized in the conceptual model in Figure 2 and appear to be:
  - reduced light availability from siltation
  - chronic and diffuse land runoff/river discharge
  - acute and point source human activities, e.g., dredging, reclamation, *etc*.
  - elevated sea temperatures
  - elevated daytime tidal exposure
  - elevated dissolved nutrients
  - Green turtle herbivory of remaining shoots.

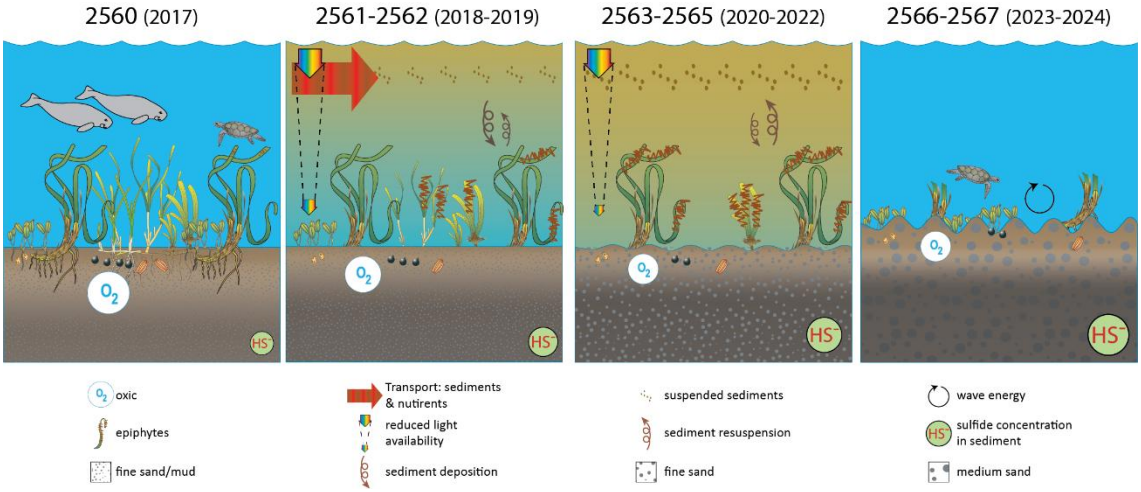

Figure 2: Conceptual model of the progression of seagrass loss along the Andaman coast of Thailand from 2017 to January 2025. The years starting with 256 are from the Buddhist calendar.

- Different parts of the Andaman coast are at different stages of the continuum in Figure 2. The seagrass meadows inspected in Trang were at the stage depicted at the right hand of Figure 2. In contrast seagrass appears in fair to good condition in Krabi and Phang Nga- Phuket and dugongs are still present, some in good condition and breeding is still occurring. A very young dugong (which later died) stranded in Krabi in August 2024 and dugongs were videoed from a drone mating in Tangken Bay, Phuket in January 2025.

- Dugongs are responding to seagrass dieback along the Andaman coast in a manner similar to that observed in 10 seagrass diebacks recorded in Australia, since the 1970s[2] with increased strandings, reduced breeding and moving from the area of dieback as follows. Dugong strandings along the Andaman Coast in 2023-24 averaged 42 per year compared with an average of 20 per year in 2019-22[3]; 40% of strandings were in an emaciated state, especially along the Trang coast[4].

    - Calf counts on aerial surveys have declined from 9% in 2020-2023 to 3 % in 2024[5].

    - The Mission Team received consistent reports that the dugongs are no longer sighted in the waters of Trang Province.

- The Mission Team was told that there is no evidence of reports of unusual numbers of Green turtles in poor condition or dead, a situation unlike that reported in Australia e.g., Figure 3. This difference is likely due to greater opportunities in Thailand for turtles to feed on surviving *Enhalus* (which is rare in or absent from several of the locations where seagrass dieback has occurred in Australia) and eat fish in nets. Anecdotal reports of increased turtle sighting are likely the results of local movements, rather than population increase as a result of head-starting, the effects of which may not be evident for several years[6].

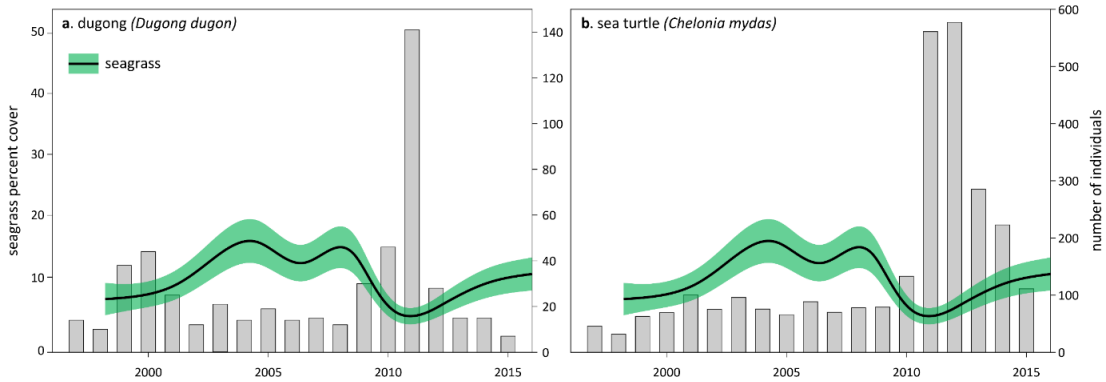

Figure 3: Relationship between seagrass condition and strandings of: (a) dugongs and (b) Green turtles on the urbanized coast of Queensland 1997-2015 (Len McKenzie unpublished data. Stranding data courtesy StrandNet, Department of Environment and Science).

[2] Marsh, H, Albouy, C, Arrau, E, Castelblanco-Martínez, DN, Collier, C, Edwards, H, James, C & Keith–Diagne, L (2022). How might climate change affect the ethology and behavioral ecology of dugongs and manatees? In 'Ethology and Behavioral Ecology of Sirenia'. Marsh, H (ed.). Springer. Chapter 8.; Hodgson, A, McMahon K, Sobtzick S, Grech A, Loneragan N, Lavery P, Smith J (2024) Regional movements of dugongs as an indirect response to climate change and the importance of alternative critical habitat. Abstract, 25th Biennial Conference on the Biology of Marine Mammals Perth, Western Australia / November 11-15

[3] Piyarat Khumraksa DMCR unpublished data

[4] Piyarat Khumraksa DMCR unpublished data

[5] Calculated by Marsh from DMCR data

[6]Musick, J.A. and Limpus, C.J. 1997. Habitat utilization and migration in juvenile sea turtles. In: P.L. Lutz and J.A. Musick (eds), The Biology of Sea Turtles, pp. 137-164. CRC Press, Boca Raton, Florida, Book..

- The recovery time for seagrasses and dugongs along the Andaman coast of Thailand will depend on several unknowns: (1) identifying and ameliorating the root cause of the dieback; (2) what proportion of the dugong population has died rather than undertaken temporary migration. Experience in Australia, where dieback has usually been a response to extreme weather suggests that seagrass recovery and the return of migrating dugongs may be possible within 5-10 years[2].

Suggestions

- The Mission Team was advised by DCMR Director General, that a Strategic Plan would be developed for the response to the seagrass-dugong situation on the Andaman Coast. The international experts made the following suggestions: (a) based on their understanding of the proposed responses to the seagrass-dugong situation on the Andaman Coast (Table 1); and (b) as possible ideas to address key unknowns for consideration by DMCR: Table (2) seagrass and (3) dugongs.

Table 1: International experts' comments on the proposed responses to the seagrass-dugong situation on the Andaman Coast of Thailand.

Proposed response	Comments	Suggestions
High priority		
Increase protection from human-caused mortality: net entanglement and vessel strike	Adult mortality main driver population change	Possibly increase size of go-slow zones and netting restrictions
Maintain necropsy program	Vital to understand causes of death	Publish results in international literature as soon as possible[7]
Maintain count surveys for dugongs using both aircraft and drones	Vital to understand distribution, relative abundance and behavior	Also monitor areas where dugongs not seen before Coordinate with drone seagrass mapping and monitoring Develop Standard Operating Procedures with expert international review
Low priority		
Continue program of artificial feeding stations	Unlikely to work at population level Expensive Increases nutrients in water at local scale Risk of dugongs becoming dependent, if successful	Only attempt at sites where risk of other human-caused mortality is low Use cultivated seagrass only Do not link to tourism
Not recommended at this time		
Catch and rehabilitate wild dugongs in poor condition	Risk of capture mortality	
Satellite track dugongs	Risk of capture mortality Need to track at least 20 animals for meaningful results as dugong movements are individualistic.	Use reports of known naturally marked individuals Postpone satellite tracking at least until seagrasses recover and dugongs in good condition

[7] Marsh has offered to help DMCR scientists with publication of this work

Table 2: Key unknowns regarding seagrass on the Andaman Coast and suggestions for addressing them.

Key unknowns: seagrass	Suggestion for consideration
What caused the loss? Impacting factor unclear, but likely cumulative pressures. Unknown how long-term data (rainfall, river discharge, sea temperature, tidal height, water color) compares with each year in the last decade. Do local seed banks persist and what is fragment movement potential from north to south *(Halodule, Cymodocea + Thalassia)*? *Limited restoration success if key impacting factor persists*	Examine long-term data (rainfall, river discharge, sea temperature, tidal height, water color) compares with each year in the last decade. • Map seagrass <6m depth annually by satellite, (field validate every 3-4 years) • Monitoring annual/biannual at sentinel sites (replicated) + more locations (3-4?) • Include additional measures (e.g., leaf height, epiphytes, seed banks) • Include continuous pressure data logging (light + temperature) • Include participation of community • Citizen Science, e.g.https://www.eyeonwater.org/
What is the extent and condition of deeper subtidal (>6m) meadows?	Enhance monitoring + mapping: • Map seagrass >6m depth every 3-4 years • Monitoring annual/biannual at sentinel sites (replicated) + more locations (3-4?) • Include additional measures (e.g., leaf height, epiphytes, seed banks) • Include continuous pressure data logging (light + temperature) • Include participation of community • Citizen Science, e.g.https://www.eyeonwater.org/
What are the optimum techniques for seagrass recovery on the Andaman coast?	Continue to develop Andaman coast seagrass recovery plan: • Convene international working group • Develop best practices for restoration (peer review)

Table 3: Key unknowns regarding dugongs on the Andaman Coast and suggestions for addressing them.

Key unknowns: dugongs	Suggestion for consideration
How serious is the current crisis? The current situation offers valuable insights into dugongs along Thailand's Andaman coast. Current surveys provide a strong foundation but there are opportunities for improvement by expanding habitat coverage and refining methods to address water turbidity, leading to a more accurate understanding of population size and distribution.	• Convene international working group to design survey to estimate size of the dugong population along the Thai Andaman coast to 20m contour line (8640 km$^{2)}$ using aircraft or large fixed-wing drone(s)
Have some Thai dugongs temporarily migrated to Myanmar or Malaysia	• Work with local NGOs and WWF to conduct interview surveys along Thai coast and adjacent areas in Malaysia and Myanmar (if possible)[8]
What is national importance of Gulf of Thailand dugong population?	• Conduct further work on dugong distribution, abundance in the Gulf of Thailand[9]. • Establish additional highly protected MPAs in key dugong areas in the coastal waters of the Gulf of Thailand and the Andaman coast based on comprehensive distribution and abundance surveys.

[8] Dr Petch Manopawitr also has Myanmar contacts

[9] If techniques are developed to estimate the size of the dugong population along the entire Andaman coast of Thailand accurately, similar techniques could be used to estimate the absolute abundance and distribution of the Gulf of Thailand population.

- If published in the peer-reviewed, international scientific literature, well-designed research on dugongs and seagrasses in Thailand has the potential to make key contributions to informing dugong and seagrass conservation across the ASEAN region, especially in the fields of research summarized in Table 4.

Table 4: Field of research in which Thailand has the potential to develop and implement best practice techniques for the ASEAN region.

Seagrass	Dugongs
• Successful nursery culture of tropical species *(e.g., Enhalus, Halophila, Thalassia, Oceana)* • Restoration methods and engagement of broader community, including fishers	Use of rotor drones with LIDAR to develop and implement best practice techniques for: • Monitoring dugongs at local (bay) scales • Studying dugong behavior and health status • Better estimating local-scale dugong population size and carrying capacity

Appendix 1: Participants in Fact-Finding Mission (Mission Team)

International Experts

1. Dr. Helene Marsh (Emeritus Professor, Environmental Science, James Cook University)
2. Mr. Len McKenzie (Chief Scientist, Seagrass-Watch; Principal Researcher, James Cook University)

Local Expert

1. Asst. Prof. Porntep Wirachwong (RMUTSV)

WWF Bangkok

1. Dr. Michael Roy (Conservation Director)
2. Dr. Robert Stienmetz (Conservation Senior Biologist)
3. Mr. Eknarin Ariyavongvivat (Program Manager)
4. Ms. Peerapun Baikwang (Corporate Engagement Manager)
5. Dr. Boonchanit Wongprapinkul (Project Manager)
6. Ms. Kewalin Tawandharong (Administration Officer)

WWF Trang

1. Ms. Tika Kimkue (Field Coordinator)

DMCR Bangkok

1. Mr. Suwan Nanthasarut (Environmental Expert)
2. Dr. Wimolporn Wainipee (Fishery Biologist, Senior Professional Level)
3. Mr. Itsaret Poungthong (Fishery Biologist, Practitioner Level)

Appendix 2: Schedule of Fact-Finding Mission

Agenda
"International Experts visiting for Emergency Seagrass and Dugong in Trang, Krabi, Phang Nga and Phuket"
Dates: January 18th – 27th January 2025

Bangkok

January 18th, 2025
19:00 – 20:00: Transport and Check-in at Quarter Ari Hotel (Helene and Lan).

January 19th, 2025
09:00 – 17:00: Preparation for DMCR meeting and Field trip (Helene and Lan).

January 20th, 2024
08:15 – 09:15: Departure from Quarter Ari Hotel and WWF to DMCR.
09:30 – 12:00: Meeting with DG-DMCR, Directors and representatives of DMCR.
12:00 – 12:30: Transportation to Restaurant
12:30 – 13:30: Lunch together at Zap Yua Yuan Restaurant (near Government Complex)
13:30 – 14:15: Transportation to Don Mueang Airport and check-in
15:20 – 16:45: Departure from Bangkok DMK to TST Trang Airport (Thai Lion Air, SL 826).
17:00 – 18:00: Transport to Pak Meng and check-in at Dugong Village resort.
18:00 – 19:30: Dinner and Meeting with SAN: SAVE ANDAMAN NETWORK FOUNDATION at Dugong Casa Restaurant

Trang

January 21st, 2025
07:30 – 08:00: Transport to Hat Yao Pier for Koh Libong Island.
08:00 – 11:30: Assess the current condition of seagrass and dugong population around Libong.
11:30 – 13:30: Lunch together and meeting with Volunteer Dugong Conservationists on Libong Island at Jah Nai Seafood Restaurant, Libong Island
13:30 – 15:00: Transport to Marine and Coastal Resources Research Center
15:00 – 17:00: Meeting and Visiting Marine and Coastal Resources Research Center, Lower Andaman Sea, Faculty of Science and Fisheries Technology Rajamangala Aquarium Trang, and Dr Milica Stankovic, Dugong and Seagrass Research Station Prince of Songkla University
17:00 – 17:30: Transport to Dugong Village
18:00 – 19:00: Dinner and Wrap-up at Kamnan Kiew Restaurant

January 22nd, 2025
07:00 – 08:00: Check-out and Transport to Leamsai.
08:00 – 10:30: Assess the current condition of seagrass and dugong population around Leamsai and meeting with Village Headman.
10:30 – 13:30: Meeting with Bor Him Farm stay community enterprise and Marine Coastal Reservation Center (Sikao) Lunch together at Bor Him Farm stay
13:30 – 15:00: Transport to Saline Hot Water Springs Resort (Krabi) and Check-in
15:00 – 18:00: Focus group discussion
18:00 – 19:00: Dinner together and Wrap-up at Saline Hot Water Springs Resort

Krabi

January 23rd, 2025
07:30 – 08:15: Check-out and Trasport to Chao Camel beach.
08:15 – 12:00: Assess the current condition of seagrass and dugong population around Chao Camel beach and meeting with Village Headman and staff of SAN
12:00 – 12:30: Transport to restaurant
12:00 – 13:30: Lunch together at Krua Bangchak Restaurant, Khlong Thom
13:30 – 15:00: Transport to Hat Nappharat Thara-Mu Ko Phi Phi National Park (short visit to Wongpanich Factory)
15:00 – 17:00: Meeting with Head of Hat Nappharat Thara-Mu Ko Phi Phi National Park and Drone Demonstration

17:00 – 17:15: Transport and check-in at iCheck inn Sky beach Krabi (Ao Nang)
18:00 – 19:00: Dinner together and Wrap-up at Yim Restaurant, Ao Nang

Phang Nga - Phuket

January 24th, 2025

08:30 – 10:00: Check-out and Transport to Marine and Coastal Resources Office 6
10:00 – 11:00: Meeting with Local DMCR and Ban Bang Phat Community representatives
11:00 – 11:15: Transport to Seagrass breeding pond at Ban Bang Phat Community
11:15 – 12:00: Visit and observe the seagrass cultivation pond
12:00 – 12:30: Transport to restaurant
12:30 – 13:30: Lunch together at Pitak's Authentic Southern Thai Cuisine, Mueang Phang-nga
13:30 – 15:00: Transport to Thala beach
15:00 – 16:30: Demonstrate the Autonomous Drone Docking Station for survey dugong
16:30 – 18:00: Transport and check-in at ibis Styles Phuket City
18:00 – 19:00: Dinner together and Wrap-up at Khun Jeed Yodpak Restaurant

Phuket

January 25th, 2025

08:30 – 09:15: Transport to Tangkhen Bay (Panwa beach)
09:15 – 12:30: Assess the current condition of seagrass and dugong population around Tangkhen Bay and observe the DMCR's implemented measures on Seagrass and Dugong
12:30 – 13:00: Transport to restaurant
13:00 – 13:30: Lunch together at Parlai Seafood Restaurant, Chalong
13:30 – 14:00: Transport to Phuket Marine Biological Center
14:00 – 18:00: Meeting at Phuket Marine Biological Center
18:00 – 18:30: Transport to ibis Styles Phuket City
19:00 – 21:00: Wrap-up and Summarize findings at ibis meeting room
21:00 – 22:00: Dinner together at Bang Ris Restaurant

Phuket - Bangkok

January 26th, 2025

07:30 – 08:30: Check-out and Transport to Phuket Airport (for SL753 and TG 202)
09:40 – 11:00: Departure from Phuket HKT to Don Mueang Airport DMK (SL 753) for DMCR and WWF representatives.
09:50 – 11:20: Departure from Phuket HKT to Suvarnabhumi Airport BKK (TG 202) for WWF representatives and Experts.
11:30: Transport and check-in at Quarter Ari Hotel (Helene and Len)

Bangkok

January 27th, 2025

08:15 – 09:15: Departure from Quarter Ari Hotel to DMCR.
09:30 – 12:00: Meeting with DG and Directors of DMCR.
12:00 – 13:00: Lunch together (TBC)
13:00 – 14:30: Meeting with COBSEA at DMCR's meeting room (TBC)
15:00 – 16:30: Transport to Suvarnabhumi Airport (Helene and Len)
18:00: Departure from Suvarnabhumi Airport BKK to Sydney Airport SYD
