10.1071/WR24110

Wildlife Research

Supplementary Material

Temporal variation in utilisation distribution and direction distribution of dugong feeding trails in intertidal seagrass beds in Talibong Island, Thailand: an insight into dugong feeding routes

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Supplementary Material

Variation in topography of intertidal seagrass beds across survey seasons

Our results, as detailed in the main manuscript, demonstrated that the frequency distribution of the feeding trail direction determined in the main manuscript was consistent throughout the year. Furthermore, a correlation was observed between body axis direction and estimated tidal current direction, suggesting a correlation between the feeding trail direction and tidal current direction. Based on these findings, we inferred that the consistent distribution of feeding trail directions could be attributed to the year-round consistency of tidal current direction within the observation area.

In general, the topographical changes (deposition and erosion) of coastal area are predominantly influenced by the tidal current and the wave's energy and propagation direction (Xu *et al*. 2016). If there were no significant topographical changes in these sites, we could assume that the direction of the dominant tidal current flowing through these sites was relatively constant. Therefore, any topographical changes in the observation area were examined in this section.

The digital elevation models (DEMs) generated alongside the orthophotos described in the main manuscript were compared across survey seasons. For each of the four survey seasons, one representative DEM was selected for comparison. Three evaluation lines were set up within each site, as shown in Fig. S1. Since the accuracy of the DEM decreases outside of and distant from the GCPs (Goetz *et al*. 2018; Martínez-Carricondo *et al.* 2018), the evaluation lines were placed within the boundary set by the outermost Ground Control Points (GCPs). Elevation differences were calculated at evaluation points set every 10 m along the evaluation line. The evaluation point was set at 31 locations at Site A, and 90 locations at Site B.

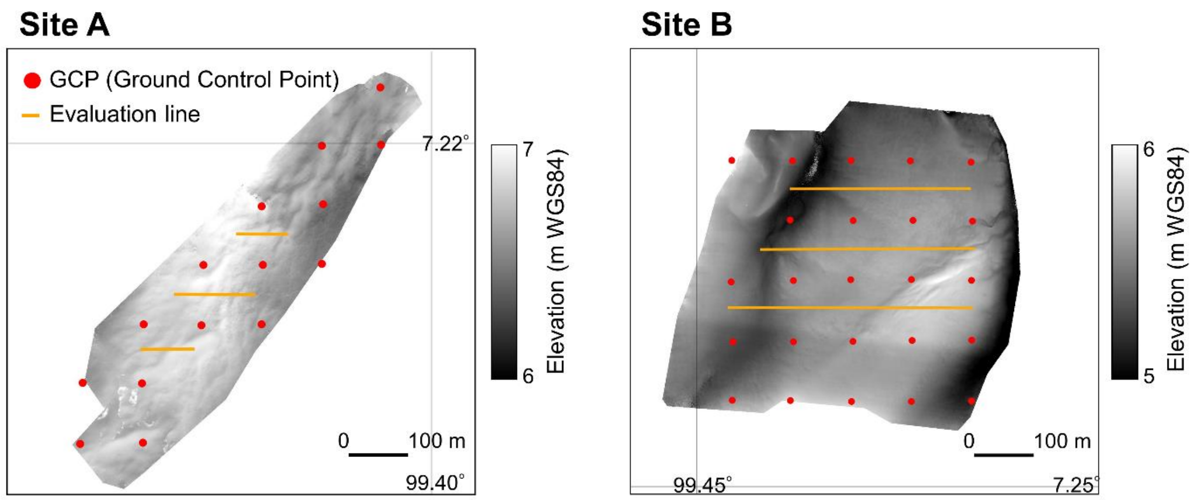

Fig. S1. An example of the digital elevation model (DEM) with the evaluation line. The red point indicates the ground control point (GCP) used for georeferencing during the DEM generation process.

We observed no significant topographic changes at these sites. The average elevation difference in root mean square error (RMSE) was 0.12 ± 0.04 m for Site A and 0.21 ± 0.14 m for Site B, with no noticeable change in specific direction over time (Table S1). The maximum difference of elevation at Site A was 0.18 m (RMSE) between May and November. The maximum difference of elevation at Site B was 0.37 m (RMSE) between May and September (Table S1). The equilibrium profiles of these sites indicated that the directions and locations of the shorelines at both Sites A and B, as well as the creek at Site B, remained stable (Fig. S2). At Site B, the elevation on the western side decreased across all the evaluation lines in May (Fig. S2). Excluding May, the maximum difference of elevation at Site B was 0.10 m (RMSE) between February and September (Table S1).

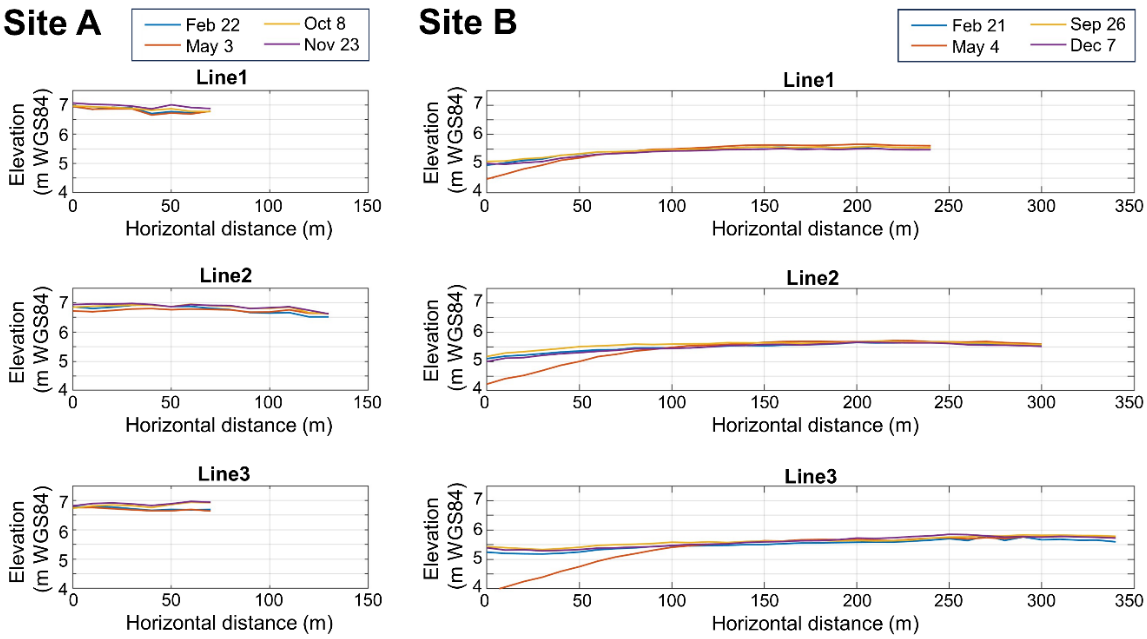

Fig. S2. Equilibrium profiles of the intertidal seagrass beds along the evaluation lines.

Table S1. Elevation differences at evaluation points across survey seasons. Differences are represented both in RMSE (root mean square error) and ME (mean error). Evaluation points were set at 31 locations at Site A, and 90 locations at Site B.

Site A RMSE (m)

	Feb	May	Oct	Nov
Feb		0.07	0.11	0.15
May			0.13	0.18
Oct				0.07
Nov				

Site A ME (m)

	Feb	May	Oct	Nov
Feb		-0.03	0.08	0.13
May			0.11	0.16
Oct				0.06
Nov				

Site B RMSE (m)

	Feb	May	Sep	Dec
Feb		0.32	0.10	0.07
May			0.37	0.33
Sep				0.09
Dec				

Site B ME (m)

	Feb	May	Sep	Dec
Feb		-0.09	0.08	0.01
May			0.16	0.10
Sep				-0.06
Dec			-	

References

Goetz J, Brenning A, Marcer M, Bodin X (2018) Modeling the precision of structure-from-motion multi-view stereo digital elevation models from repeated close-range aerial surveys. *Remote Sensing of Environment* **210**, 208-216. https://doi.org/10.1016/j.rse.2018.03.013

Martínez-Carricondo P, Agüera-Vega F, Carvajal-Ramírez F, Mesas-Carrascosa FJ, García-Ferrer A, Pérez-Porras FJ (2018) Assessment of UAV-photogrammetric mapping accuracy based on variation of ground control points. *International Journal of Applied Earth Observation and Geoinformation* **72**, 1-10. https://doi.org/10.1016/j.jag.2018.05.015

Xu Z, Kim D, Kim SH, Cho YK, Lee SG (2016) Estimation of seasonal topographic variation in tidal flats using waterline method: A case study in Gomso and Hampyeong Bay, South Korea. *Estuarine, Coastal and Shelf Science* **183**, 213-220. https://doi.org/10.1016/j.ecss.2016.10.026