Seagrass Surveys 2023: Extent, Coverage and Condition

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Abbreviations table

Abbreviation	Definition
CWT	Cumbria Wildlife Trust
EA	Environment Agency
NE	Natural England
HRA	Habitat Regulations Assessment

1. Introduction

Seagrasses are ecosystem engineers that form sparse to dense meadows in the intertidal and shallow subtidal areas of the seabed (Bunker & Foster-Smith, 1996). They provide shelter for juvenile fish and a habitat for many epifaunal and crustacean species, making them ideal feeding grounds for overwintering wildfowl (Pollard,1984). As well as supporting biodiversity, seagrass beds also provide several additional ecosystem processes and services including: sediment stabilisation; erosion control; flood protection; water filtration; primary productivity; as well as carbon sequestration which can help buffer against the effects of climate change (Fourqurean et al., 2012; James et al., 2019).

Seagrass has been experiencing a period of severe decline since the 1980s, with an estimated 29% loss in extent globally (Waycott et al., 2009) and a 39% loss within UK waters (Green et al., 2021). Historically, this has been attributed to a wasting disease that originated in the 1930s (Butcher, 1934; Garrard and Beaumont, 2014). However, comparatively little attention has been paid to pollution and poor water quality as a potential cause for decline (Green et al., 2021). Industrial activities such as dredging and mining have potential to release toxic chemicals into the water column, along with sediment plumes that can smother seagrass and limit photosynthesis (Fraser & Kendrick, 2017; Green et al., 2021). The effects of nutrient discharge from rivers into coastal environments can also cause algal blooms that inhibit photosynthesis, and cause eutrophication (Jones et al., 2018). Physical disturbances such as bottom trawling and boat moorings also contribute to the decline of seagrass meadows and critically, have hampered their natural recovery (Davison et al., 1998). Meanwhile, climate change is expected to have an impact on seagrass through ocean warming and acidification, by reducing photosynthesis and causing die-offs (Repolho et al., 2017). These stressors in combination have potential to greatly impact seagrass extent.

In response to the biodiversity crisis and the need for marine nature recovery in line with reduced net CO_2 emissions, numerous independent seagrass restoration projects have been developed in the UK (e.g. Project Seagrass, Seagrass Ocean Rescue, Seawilding and multiple Wildlife Trust projects). These projects use experimental techniques in small areas located in regions with good environmental conditions for seagrass to grow and establish itself (e.g. low pollution levels and reduced abrasion from boat moorings) (van Katwijk et al., 2015; Valdez et al., 2020; Clifford, 2021). Monitoring of seagrass extent is necessary before restoration can occur to help to deduce which areas are in decline and thus highlight areas suitable for restoration.

Zostera noltii beds have been recorded along the north west coast in the Walney Channel, along with smaller beds in the Ravenglass Estuary. The extent of these beds has been monitored over the past three years by Cumbria Wildlife Trust (CWT) (Clifford, 2021; Cale & Churn, 2021; Gould, 2022), and this project aims to build on the work already undertaken in order to understand the suitability of sites in the Walney Channel for restoration. As such, the objectives of this study are:

1) To produce an up to date and complete map of seagrass extent in Cumbria

2) To assess condition and coverage of *Z. noltii* at Roosecote Sands, an area never before surveyed by CWT.

2. Survey methodology

2.1 Initial survey location: Roosecote Sands

Whilst there is limited historical data outlining seagrass extent in Morecambe Bay, a study carried out in 1998 suggests that there used to be a significant seagrass bed located at Roosecote Sands, located north-west of Roa Island, and south-west of the docks at Barrow-In-Furness (Tittley et al., 1998). It is thought that this bed experienced severe decline due to an outfall pipe that used to discharge into the bay, causing ephemeral green algal blooms (Clifford, 2021). This outfall pipe has since been moved and consequently is no longer damaging the seagrass beds. It is likely that natural recovery in this area would be minimal, as high inputs of organic matter can cause hypoxia and increased sediment mineralisation (Holmer et al., 2016). This in turn can restrict growth and limit distribution (Mascaró et al., 2009; Kilminster et al., 2014). For this reason, Roosecote Sands has been highlighted as a potential area for restoration in Cumbria (Figure 1), and was chosen as our initial location for the seagrass survey.

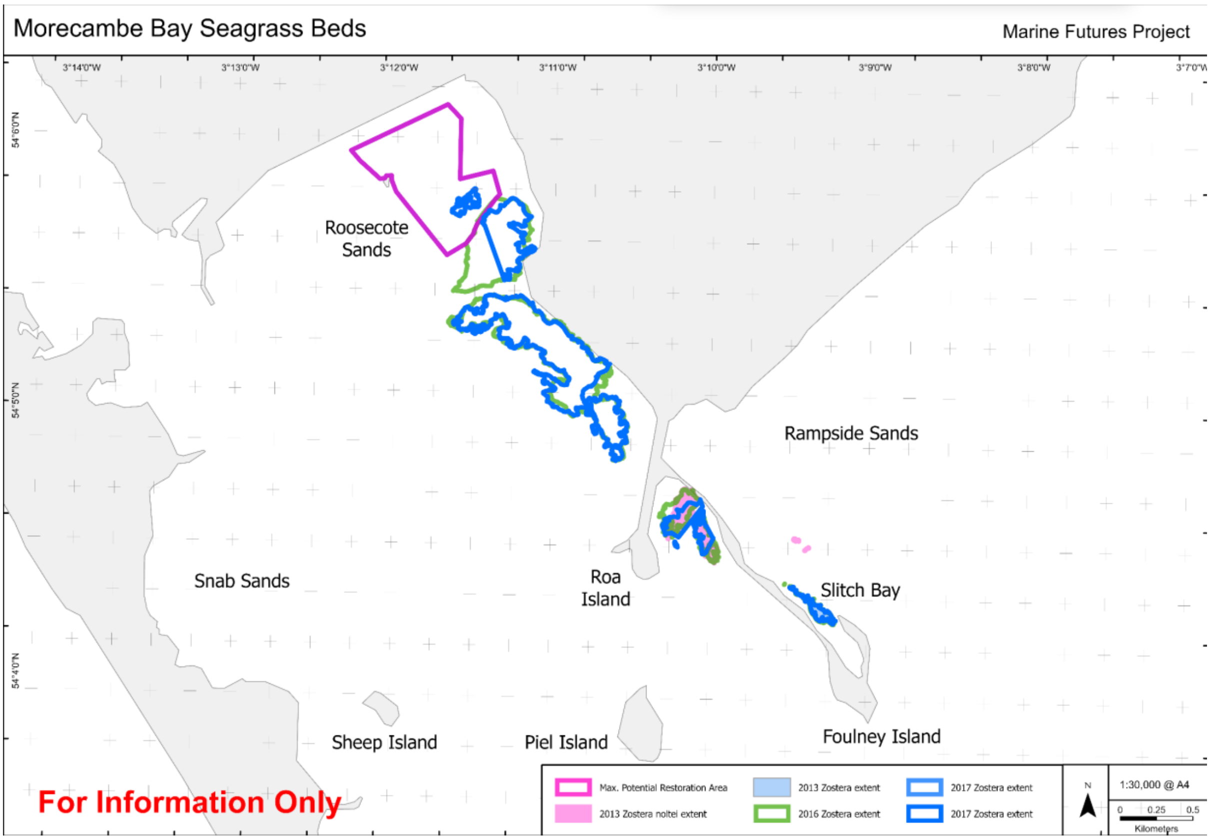

Figure 1: Historic seagrass extent in Morecambe Bay according to 2013, 2016 and 2017 Natural England surveys, along with potential restoration area (Clifford, 2021).

2.2 Roosecote Sands mapping walkover

A preliminary site visit was conducted on the 4th of August 2023 to confirm the presence of *Z. noltii* and *Z. marina* and map the outer perimeter of the whole extent using a combination of the Topo GPS app and handheld GPS devices. A seagrass bed is defined as having higher than 5% continuous cover (OSPAR, 2009). For this bed, there were many large patches with greater than 5m diameter in very close proximity separated by bare sediment. Due to time and number of volunteer constraints, this was treated as one continuous bed. For patches with less than 5m diameter, the boundary of the patch was not walked; instead, a waypoint was recorded. The extent tracks and waypoints were then uploaded to QGIS (3.32.1). This was used to create polygons that represent seagrass beds >5m in diameter and patches with a diameter <5m were recorded as waypoints, marked with a point.

2.3 Additional site visits

On the 29th and 30th August 2023, extent surveys were conducted at Roa Island, Concle Bank, Foulney Island, and Roosecote Sands. This was organised by the Environment Agency (EA) to collect data for their Water Framework Directive obligations. EA methods for extent mapping were the same as CWT (outlined in section 2.2), using only handheld GPS units. They processed the data and shared it with CWT to be included in this report.

On the 4th and 5th September 2023, surveys were conducted at Snab Sands and Ravenglass Estuary, respectively. Beds of *Z. noltii* were already confirmed for these locations (Cale & Churn, 2021; Gould, 2022). Extent was re-mapped using the method outlined in section 2.2.

2.4 Roosecote Sands quadrat survey

Using the "**Random points Inside Polygons**" command in QGIS (3.32.1), 40 random points were highlighted within the overall bed perimeter. This gave an unbiased overview of the patchiness of the bed, as some points were directly over patches while others contained bare cover. A route between these points was assembled and exported to Topo GPS (installed on mobile phones) and a handheld GPS unit for navigational purposes. Google maps was also used on the day, as Topo GPS did not have sufficient resolution to adequately navigate to exact quadrat points. A labelled photo of each quadrat was also recorded for future reference (see appendix).

The quadrat survey was conducted on the 7th of August 2023. Each quadrat was 0.5m by 0.5m, which was placed at each randomised point. The quadrats were labelled 1 through 40, and the following parameters were recorded:

- Sediment type
- Water depth (measurement of the deepest point in millimetres within the quadrat along with whether the water was standing or in a channel)
- % cover of *Z. noltii* (this was agreed by both surveyors within a pair and a reference sheet displaying what each percentage cover looked like was supplied to help gauge coverage)
- % cover of *Z. marina* (the same process for *Z. noltii* was used)
- % bare cover
- Condition of seagrass, categorised as good, partially blackened or blackened (again, a reference sheet displaying conditions was supplied)

- Average blade length (recorded by measuring three blades within the quadrat at random and taking a mean)
- % epiphyte cover
- % *Spartina sp.* cover
- % algae cover
- Anything noteworthy, for example commonly associated species or pollution

3. Consents, Licenses and Permissions

3.1. Access Permissions

This was a non-intrusive survey as nothing was removed or deposited at the site, so no access permissions were required.

3.2. Licenses

This sample did not require sample collection, meaning no licenses were required to undergo the survey, according to the Wildlife and Countryside Act 1981.

3.3. Habitat Regulations Assessment (HRA)

This survey was non-intrusive as no samples were removed and nothing was deposited at the site, so no HRA was required.

4. Results

4.1 *Zostera* extent

4.1.1 Mapping

Using the extent data from surveys, the map of seagrass meadows in the Walney Channel below was produced (Figure 2).

Figure 2: Map of seagrass extents in the Walney Channel, 2023. Purple dots represent patches, green polygons represent continuous cover. Purple dots represent patches, green polygons represent continuous cover. Source of data- internal surveys and Environment Agency.

Roosecote Sands consisted of many closely situated patches of seagrass, including both *Z. noltii* and *Z. marina,* with a diameter >5m and as such have been presented as one continuous bed (Figure 3). Ravenglass Estuary displayed more sparse, disconnected beds of seagrass (Figure 4) with the majority of beds being small, only just consituting >5m along the bank of the estuary. There were also many patches present here, with <5m continuous cover, represented by points.

Figure 3: Map of seagrass extent at Roosecote Sands (northern two beds) and Concle Bank (southern long bed), 2023. Purple dots represent patches, green polygons represent continuous cover.

Figure 4: Map of seagrass extent at Ravenglass Estuary, 2023. Purple dots represent patches, green polygons represent continuous cover.

At Snab Sands, extent was more continuous than Roosecote Sands and Ravenglass (Figure 5). However, coverage on raised sediment was often sparse and only just constituting 5%, while shallow pools were packed with dense beds of *Z. noltii.* Meanwhile, *Z. marina* dominated creeks and channels. Patches of bleached white seagrass, algae, and sediment were occasionally observed, and the cause of this is unknown (Figure 6).

Figure 5: Map of seagrass extent at Snab Sands, 2023. Purple dots represent patches, green polygons represent continuous cover.

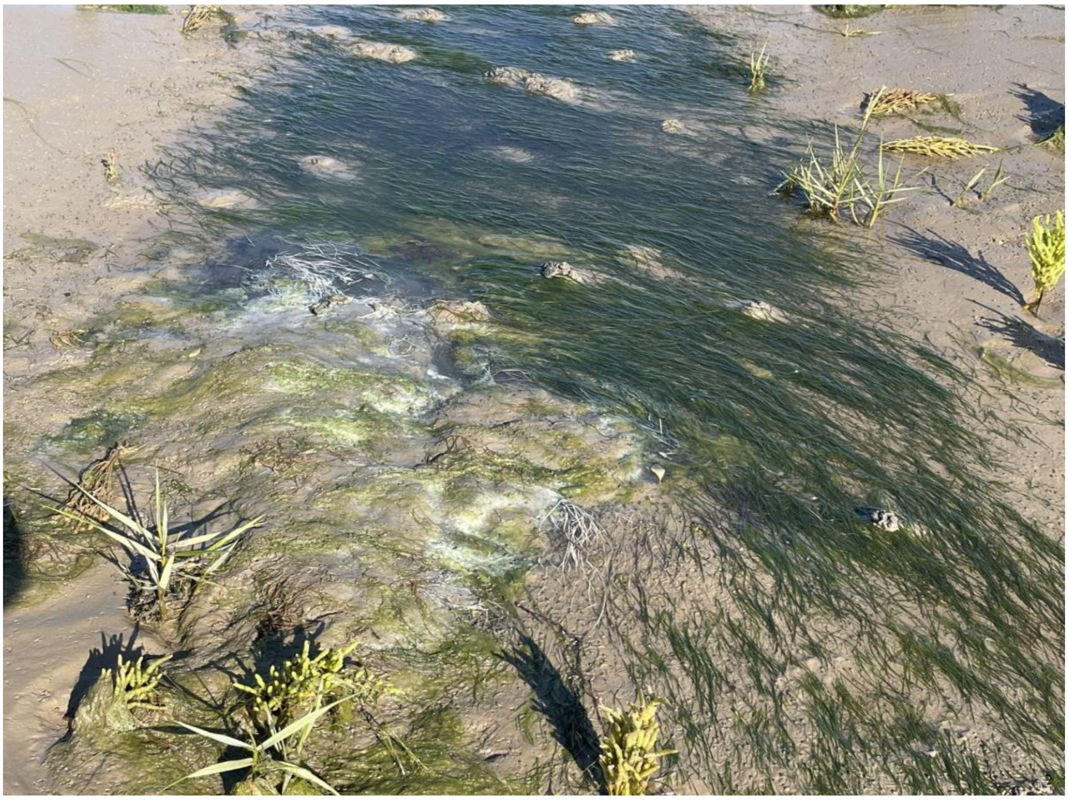

Figure 6: Bleached white patch of *Z. noltii* located in a pool at Snab Sands.

Foulney Island was the smallest bed surveyed in the Walney Channel (Figure 7). This survey was conducted by the EA and no data was collected on how patchy the distribution of seagrass was within the beds. The EA also conducted the surveys for Roa Island, however volunteers from CWT participated, and found very dense beds of Z. noltii (Figure 8). However, there was a lot of anoxic sediment present, and surveyors noted small patches of bleached white seagrass with a sulphuric smell in the air.

Figure 7: Map of seagrass extent at Foulney Island, 2023. Green polygons represent continuous cover. Data source- Environment Agency.

Figure 8: Map of seagrass extent at Roa Island, 2023. Green polygons represent continuous cover. Data source- Environment Agency.

4.1.2 Substrate preferences & *Z. marina* co-location

At each location, *Z. noltii* was generally found growing in vast beds on both raised sediment and shallow standing pools (Figure 9). *Z. marina* was predominantly present in standing or lightly flowing water, forming dense beds in channels and creeks (Figure 10). This could be because *Z. noltii* is more tolerant of high light intensities than *Z. marina*, which is believed to be more suited to subtidal habitats, and thus is more likely to be found in standing water (Vermaat and Verhagen, 1996; Park et al., 2016).

Figure 9: Photograph of the seagrass beds at Snab Sands showing *Z. noltii* growing sparsely on raised sediment and densely in standing water, in the absence of *Z. marina.*

Figure 10: Photograph at Roosecote Sands displaying *Z. marina* growing in a channel next to *Z. noltii* growing on raised sediment.

4.2. *Zostera* quadrat survey results: Roosecote Sands

4.2.1 Coverage

The most prevalent sediment type recorded within the survey quadrats at Roosecote Sands was sandy mud. Mean water depth varied from 0 to 4.4cm due to uneven terrain creating channels and pools.

Both *Z. noltii* and *Z. marina* were observed during the surveys with varying frequencies. At Roosecote Sands, Z*. noltii* was recorded in 37.5% of quadrats. Percentage cover of *Z. noltii* varied considerably between quadrats, ranging from 0% to 90% coverage. Mean total coverage for *Z. noltii* was was 14.9%.

Z. marina was recorded in 52.5% of quadrats. Percentage cover ranged from 0% to 75% and mean total coverage for *Z. marina* was 12.1%.

Z. noltii density decreased as the seagrass extended west, and was almost entirely replaced by *Z. marina* in the western bed (Figure 11). The gap visible in Figure 11 separated the beds, with the eastern bed being made up of almost entirely *Z. noltii* and the western bed being made up of *Z. marina* beds separated by bare sediment.

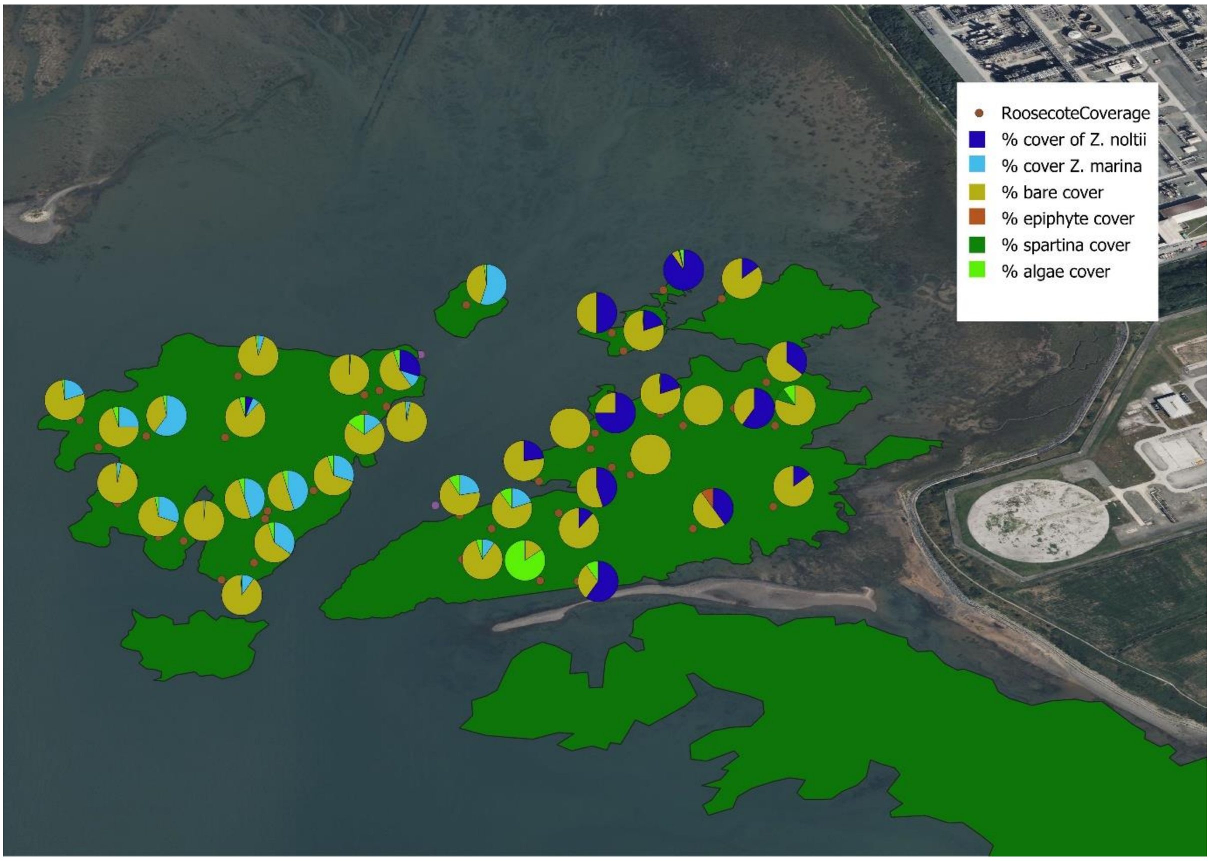

Figure 11: Percentage cover of *Z. noltii* (dark blue), *Z. marina* (light blue), bare sediment (dull yellow), epiphytes (dull red), *Spartina* (dark green), and algae (light green) at Roosecote Sands. Green polygons represent seagrass extent.

In quadrats where it was present, the percentage cover of *Z. noltii* was generally good with a mean coverage of 39.4%. The mean cover of *Z. marina* in quadrats where it was present was lower, 23.0%.

4.2.2 Condition

The condition of the Zostera beds was predominantly recorded as 'good' for both *Z. noltii* and *Z. marina* with little evidence of poor health indicated by the blackening of blades. However, 9 quadrats were recorded as 'partially blackened' which makes up 22.5% of survey points. It is of note that within these quadrats not all seagrass was blackened and that blackening of *Zostera* was not restricted to a particular area along the shoreline (Figure 12). Low levels of algae were observed within 62.5% of quadrats and the mean algae cover across all quadrats was 4.94%, however the mean algae cover within quadrats containing algae was only 7.90%. Epiphyte cover was only recorded in one quadrat.

Figure 12: Condition of *Z. noltii* and *Z. marina* (white=no coverage, light green= good condition, dark green= partially blackened) at Roosecote Sands. No completely blackened seagrass was found during this survey. Yellow polygons represent seagrass extent.

4.3 Comparison of extent

The walkover survey on the 4th August 2023 of Roosecote Sands identified a total of seven large (>5m) seagrass patches and two small (<5m) seagrass patches spanning the largest area of any of the beds (Table 1). The smallest bed was at Ravenglass, which was 87.84% smaller than that of Foulney Island (the second smallest patch). The largest patch recorded was at Roosecote Sands spanning 38.4 hectares.

All areas appear to have grown since 2012, 2013, 2016, and 2017, however, some of these sites were incompletely surveyed which may have resulted in exaggerated levels of growth. This is particularly the case for Roosecote Sands, in which a large section was missed in the 2017 survey. Furthermore, large areas surveyed in 2023 appear to be missing from the 2017 maps (Figure 3). This could be due to beds not being present at the time. Conversely, it could be down to human error and the beds may have been missed in 2017. As such comparison of extent is unreliable.

Table 1:Seagrass extent (hectares) at the five survey sites in 2023, 2017 and 1998. Roosecote Sands has been split into the north and south patches, with the south named Concle Bank, in order to facilitate comparison. N/A = area not surveyed. * = area incompletely surveyed.

Location	**2023 extent (ha)**	**2021-2022 extent: CWT (ha)**	**2017 extent: Natural England (ha)**	**2016 extent: Natural England (ha)**	**2013 extent: Natural England (ha)**	**2012 extent: Gateway/AMEC (ha)**
Roosecote Sands	32.71	N/A	11.30*	20.67	N/A	7
Concle Bank	38.38	N/A	34.332	36.91	N/A	22
Roa Island	10.69	N/A	3.00*	4.06	3.317	N/A
Snab Sands	6.01	N/A	N/A	N/A	N/A	5.5
Foulney Island	1.48	N/A	1.04	1.73	1.14	N/A
Ravenglass Estuary	0.18	0.17	N/A	N/A	N/A	N/A

Although they did not record extent in hectares, a 1998 study by the Natural History Museum (Tittley et al., 1998) provides a useful visual comparison of extent at Roosecote Sands (Figure 13).

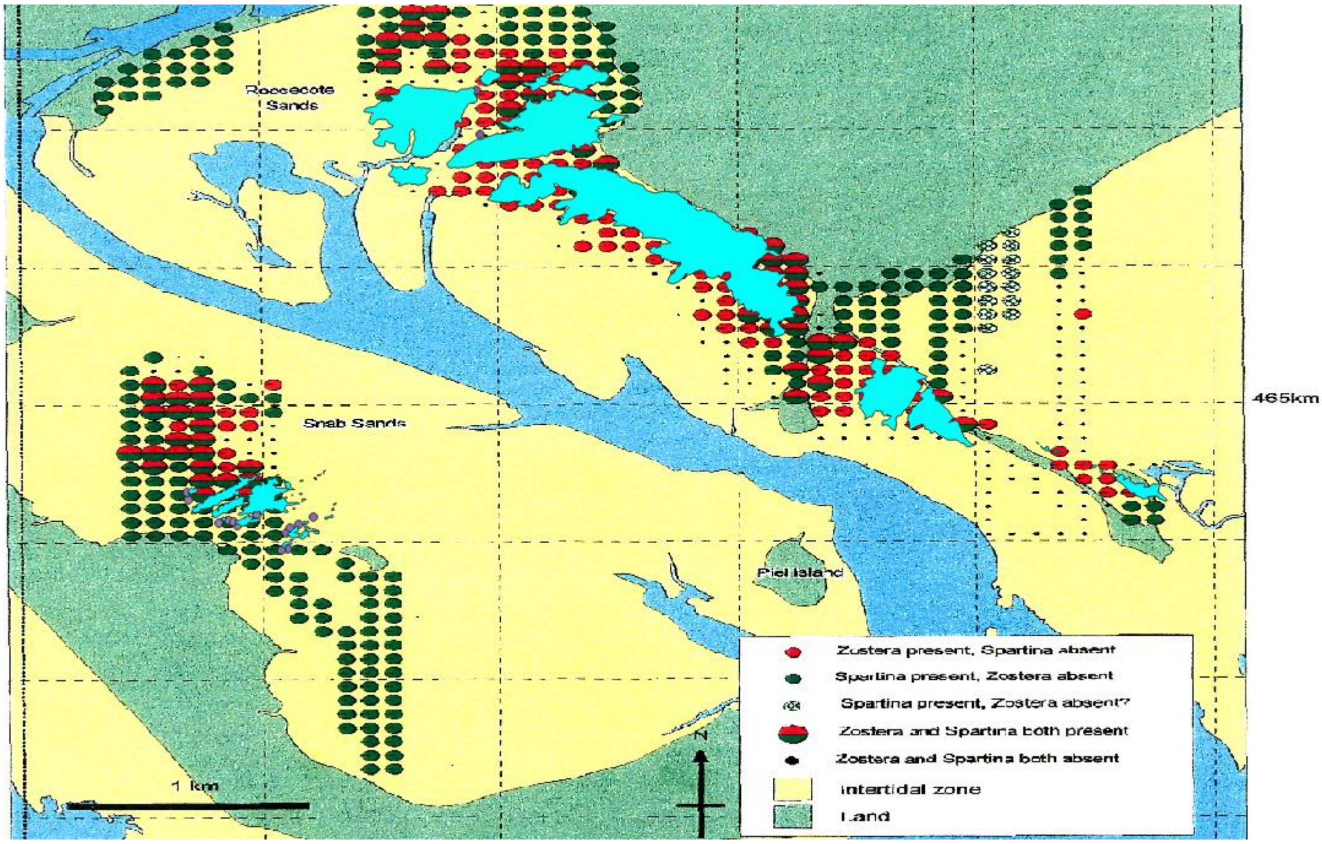

Figure 13: Comparison of 2023 and 1998 *Zostera* extent in the Walney Channel, from a study by the Natural History Museum (Tittley et al., 1998). Purple dots represent patches, light blue polygons represent continuous cover.

At Snab Sands, Foulney Island, and Roa Island, Figure 13 indicates that several areas to the north of each of the beds were potentially missed from surveying, or that the beds have shrunk. However, most importantly, it also indicates that the beds at northern Roosecote Sands that were highlighted for restoration (Figure 1) have shrunk in extent since 1998.

5. Discussion

At each site we observed more *Z. noltii* on exposed sediment, experiencing longer dryer periods resulting in higher light intensities, meanwhile *Z. marina* was found to be more abundant lower down the shore. Furthermore, most quadrats only contained one species which is in accordance with the two species differing tolerances for different environmental conditions. However, although *Z. noltii* was predominantly found higher up the shore, small patches were also found in close proximity to *Z. marina* on the lower shore, separated by small bare areas (Figure 14). These small patches were often found on drier, slightly raised sediment, while the surrounding *Z. marina* was found more in flowing or in standing water. Overall, this study found values for coverage at Roosecote Sands that confirm the presence of *Zostera* beds in accordance with OSPAR (2009) as plant densities provide at least 5% coverage.

5.1 Suitability for restoration

Seagrass condition and bed density was overall good, with some evidence of blackening in the quadrats containing *Z. noltii*. There was very little algae and epiphyte cover, and almost no *Spartina* present. This indicates the bed is still a seagrass habitat, and is not actively transitioning into saltmarsh.

Figure 14: Bed of *Z. marina* with intermittent patches of *Z. noltii* on raised beds at Roosecote Sands.

Figure 13 indicates that extent at Roosecote Sands has shrunk since 1998. This may have been due to pollution and construction, as the area has historically hosted many different industries (Figure 15). However, Table 1 indicates that extent has grown since 2016. The EA corroborated this, by comparing 2023 extent data to data from their 2016 and 2017 surveys, and found that Roosecote Sands, Roa Island, Foulney Island, and Concle Bank had all increased in extent. This suggests that perhaps environmental conditions have improved over the last decade. This is likely the case, as the power plant has closed and sewage treatment has improved (see section 5.2). As such, Roosecote Sands is most likely suitable for restoration, as anthropogenic pressures have reduced, and historic extent indicates natural environmental conditions are suitable for seagrass growth (Campbell, 2002; van Katwijk et al., 2016; Clifford, 2021). However, more research is still need to investigate the environmental conditions and pressures at the site before we can confirm the sites suitability.

5.2 Notes on local pollutants and industry

Water quality is often crucial to the success of seagrass restoration projects, and as such assessment of potential pollution sources is critical (Greening and Janicki, 2006). Roosecote has been home to local large-scale industry since 1892, when a paper mill commenced production (Figure 15), and since then has hosted a power station, gas terminal, and sewage works (Figure 16). However, the paper mill closed in 1973 (British Association of Paper Historians, 2016), and thus (depending on the dispersal ability of the pollutants and how much they contaminated sediment) is unlikely to have been the cause of *Zostera* decline seen since 1998.

Figure 15: Paper mill demolished in 1973. Seagrass beds at Roosecote Sands positioned on the seaward side of the seawall, directly in front of the power station.

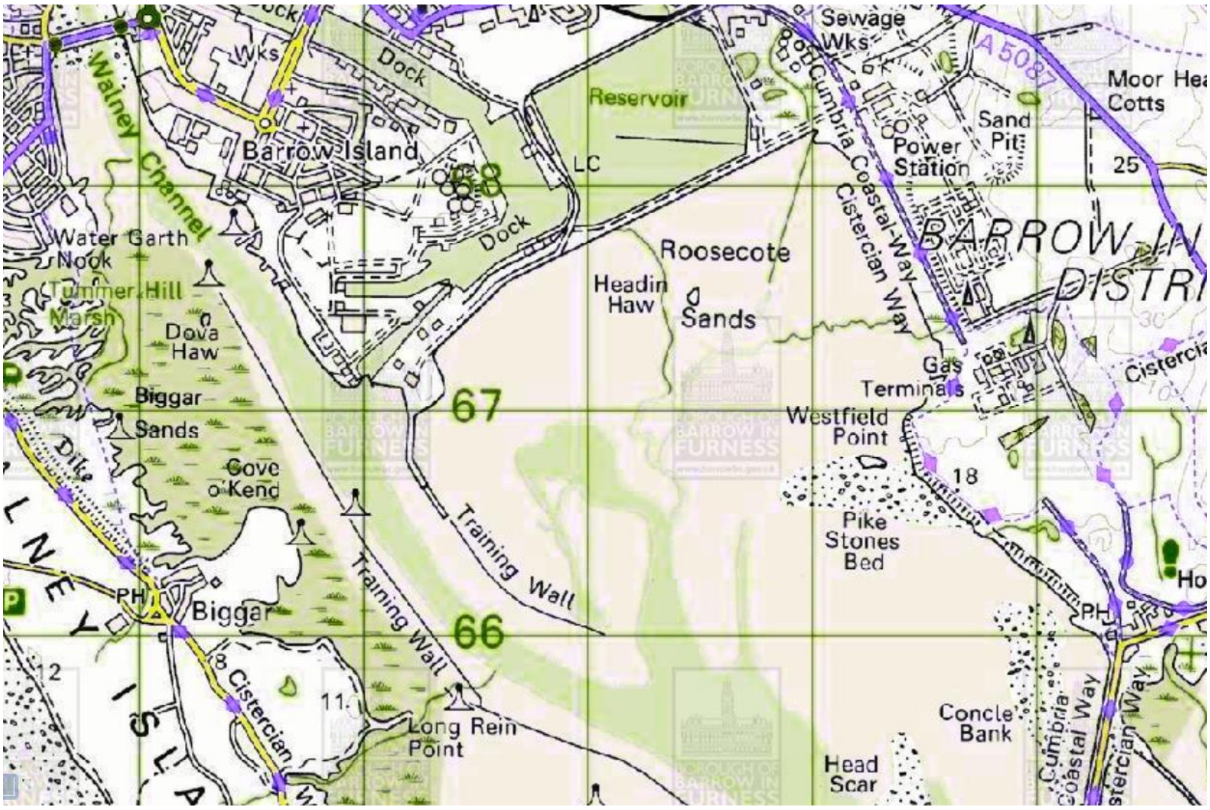

Figure 16: Map of past industry surrounding Roosecote Sands. The sewage works and gas terminals are still in place, however Roosecote Power Station has now been demolished. Credit: Westmorland and Furness Council.

The three most likely sources of local pollution and disturbance that have caused decline since 1998 are the Roosecote Power Station (opened in the 1950s as a coal fired station, converted to gas powered in 1991, and demolished by 2015), the sewage works (opened in 1996 and still operational), and Rampside Gas Terminal (inaugurated in 1985 and also still operational). The power station involved construction of a cooling pipeline, running through terrestrial marshland to the reservoir (now Cavendish Dock), which is likely to have disturbed seagrass through the outfall pipe under the seawall (Figure 17). Rampside Gas Terminal also required pipeline construction, as it is connected to the Morecambe Bay Gas Field by a buried pipeline that cuts through Roosecote Sands (Spirit Energy, n.d.). Due to the scale of these development projects, it is likely recovery will take many years.

On top of recovery from physical disturbance, *Zostera* beds have likely had to recover from sewage pollution. The original outfall pipe serving the sewage works was constructed in 1913, discharging effluent directly onto Roosecote Sands. This was altered in 2015 in order to comply with the Habitats Directive and to protect *Z. noltii* beds, extending the pipe by 2.4km, greatly improving effluent dispersion (Berry & Dempsey, 2015). Although construction will have undoubtably had an impact, this extension is likely to have greatly reduced the pressure of sewage pollution, potentially facilitating partial recover

Figure 17: installation of the cooling pipeline for now demolished Roosecote Power Station. Credit: Graham Pinder.

6. Conclusion

This study has produced the most up to date map of seagrass in Cumbria (Figures 2 and 4), and has confirmed Roosecote Sands as a likely suitable area for restoration, although further suitability assessments should be undertaken. The total extent of *Zostera* species in 6 locations was quantified as 89.45 hectares, with 32.71 hectares located at Roosecote Sands. Overall, seagrass condition and coverage were good at Roosecote Sands, with an average of 39.4% coverage in quadrats containing *Z. noltii*, and only partial blackening recorded. Interestingly, beds of *Z. marina* were recorded at Roosecote Sands, which had not been present covering large areas constituting seagrass beds at any other sites surveyed by CWT. Overall, extent has increased since the 2016/2017 NE and EA surveys, however historical data shows an overall decline since 1998. This indicates natural environmental conditions at Roosecote Sands were once suitable for seagrass growth. Furthermore, the partial recovery in recent years could possibly be due to a reduction in pollution pressure from local industry that has improved water quality, although further research is needed to assess this. This site may therefore be suitable for future restoration activity. It is also of note that comparison with historical extent is difficult as it is unknown whether previous surveys at Roosecote Sands by NE and the EA were incomplete, or if sections of the beds were not present. As such, future monitoring is recommended in order to better understand whether *Z. noltii* beds are recovering naturally.

7. Acknowledgements

Thank you to CWT staff for assisting with the Roosecote Sands quadrat survey, and providing feedback on report drafts. Also, thank you to Joe at the EA for organising the surveys of Concle Bank, Roa Island, and Foulney Island, and for processing his survey data and kindly sharing it for this report. Thank you to Beth and Amber at CWT, and Chris at Lancs WT, for valuable education and assistance with QGIS. Finally, thank you to Graham Pinder for providing amazing insight and photos of local industrial history in the Roosecote area.

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9. Appendix

9.1 Eastern bed quadrats

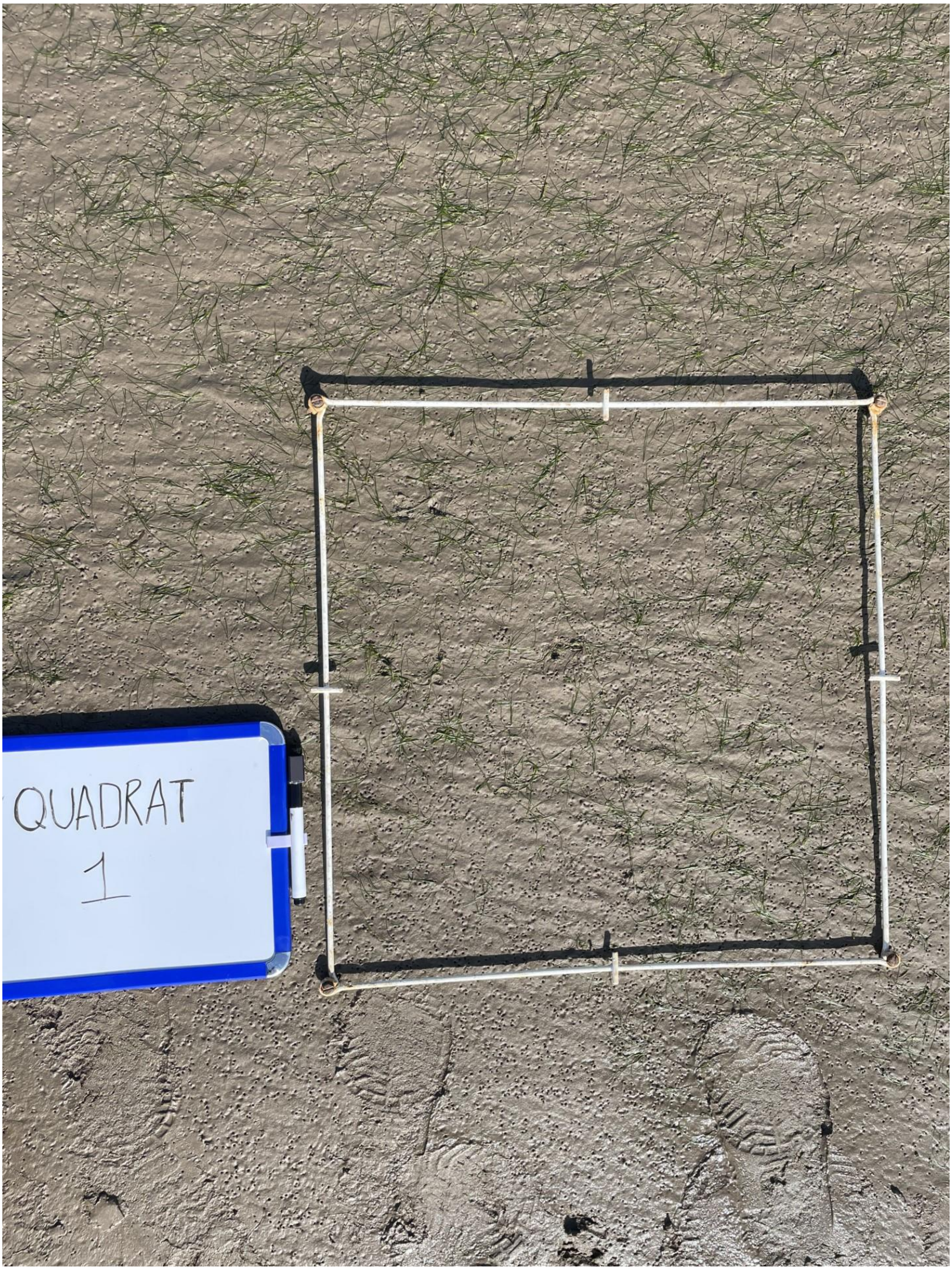

Figure 18: Quadrat one for seagrass survey at Roosecote Sands, eastern bed.

Figure 19: Quadrat two for seagrass survey at Roosecote Sands, eastern bed.

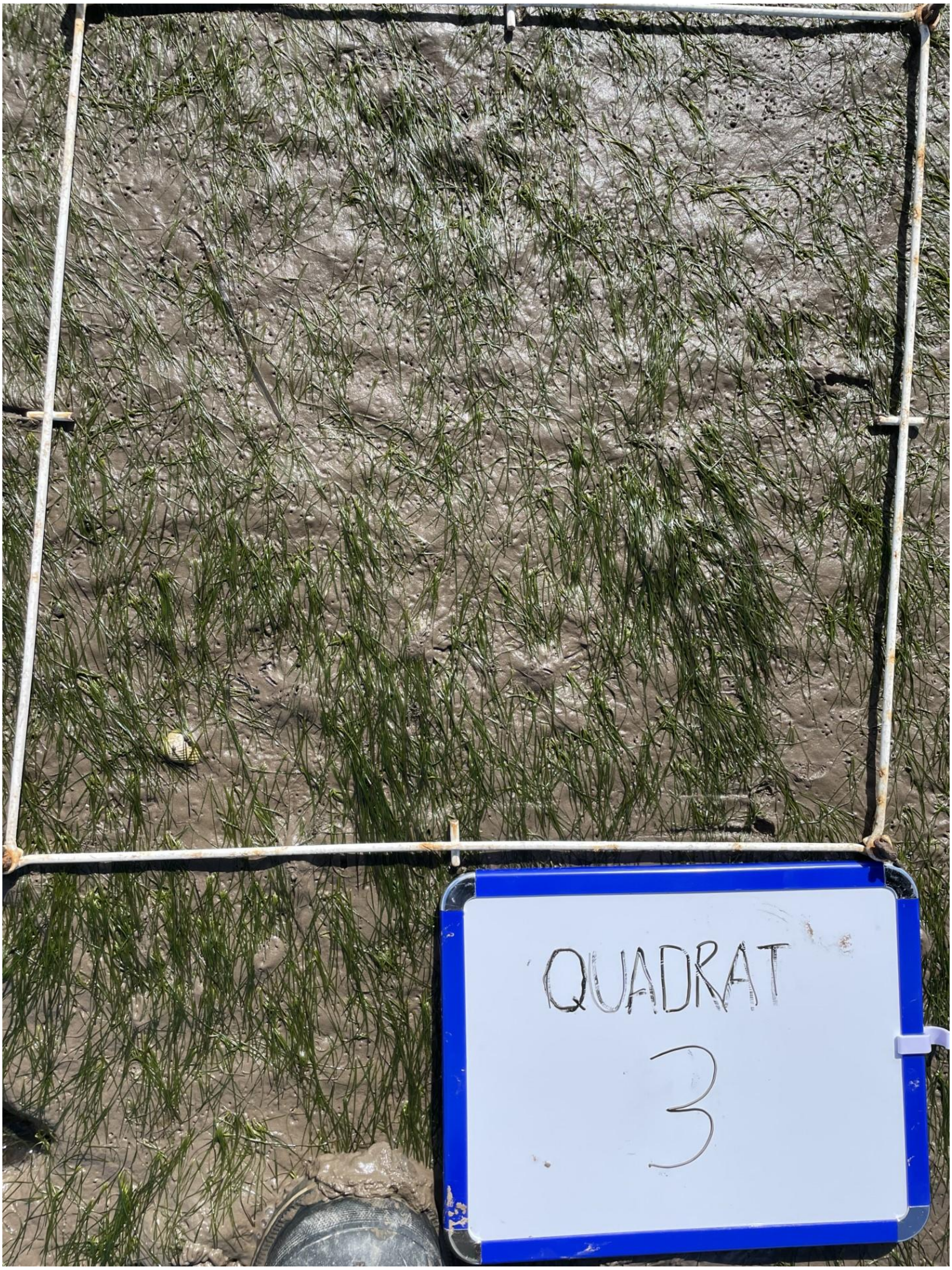

Figure 20: Quadrat three for seagrass survey at Roosecote Sands, eastern bed.

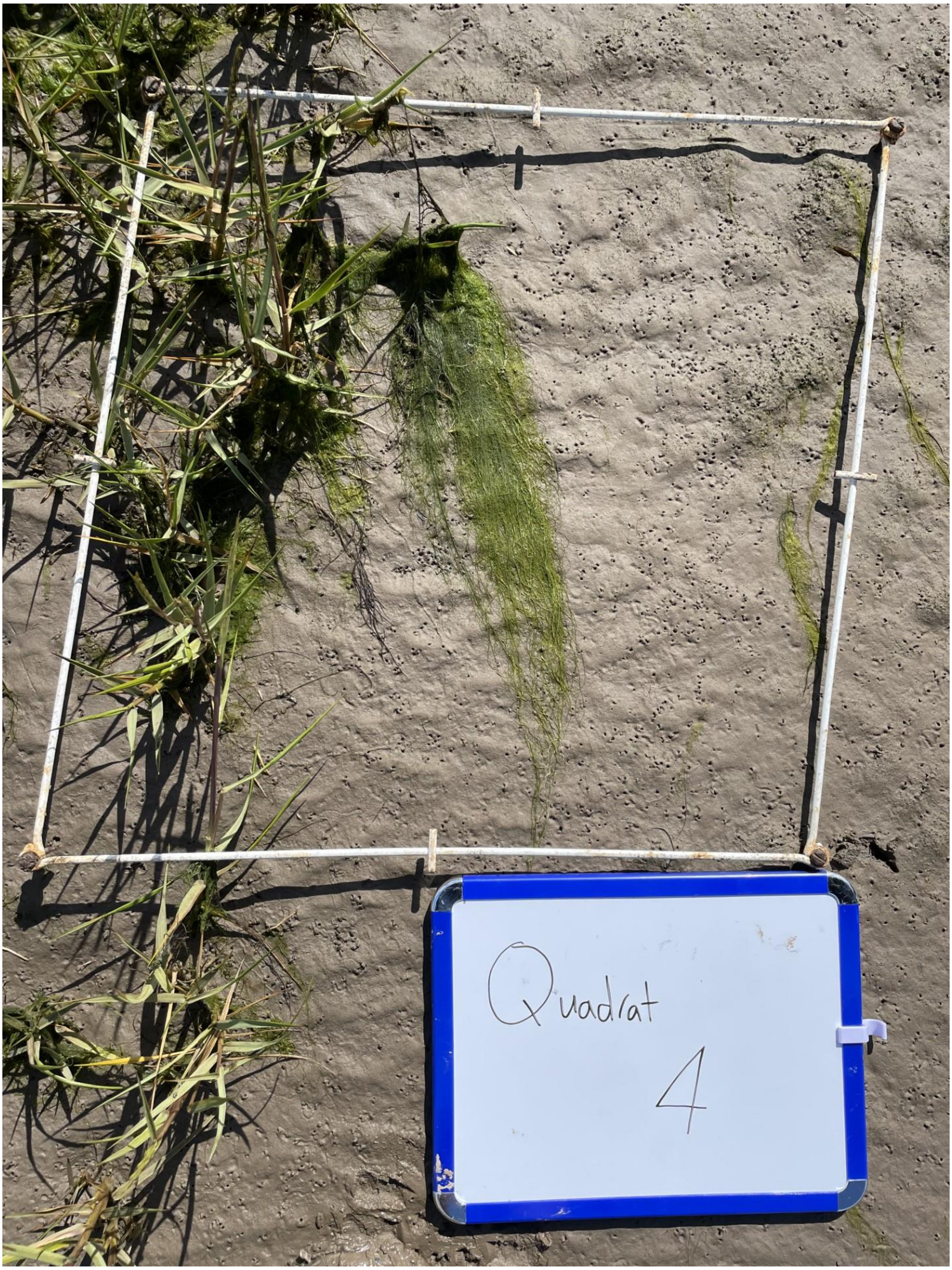

Figure 21: Quadrat four for seagrass survey at Roosecote Sands, eastern bed.

Figure 22: Quadrat five for seagrass survey at Roosecote Sands, eastern bed.

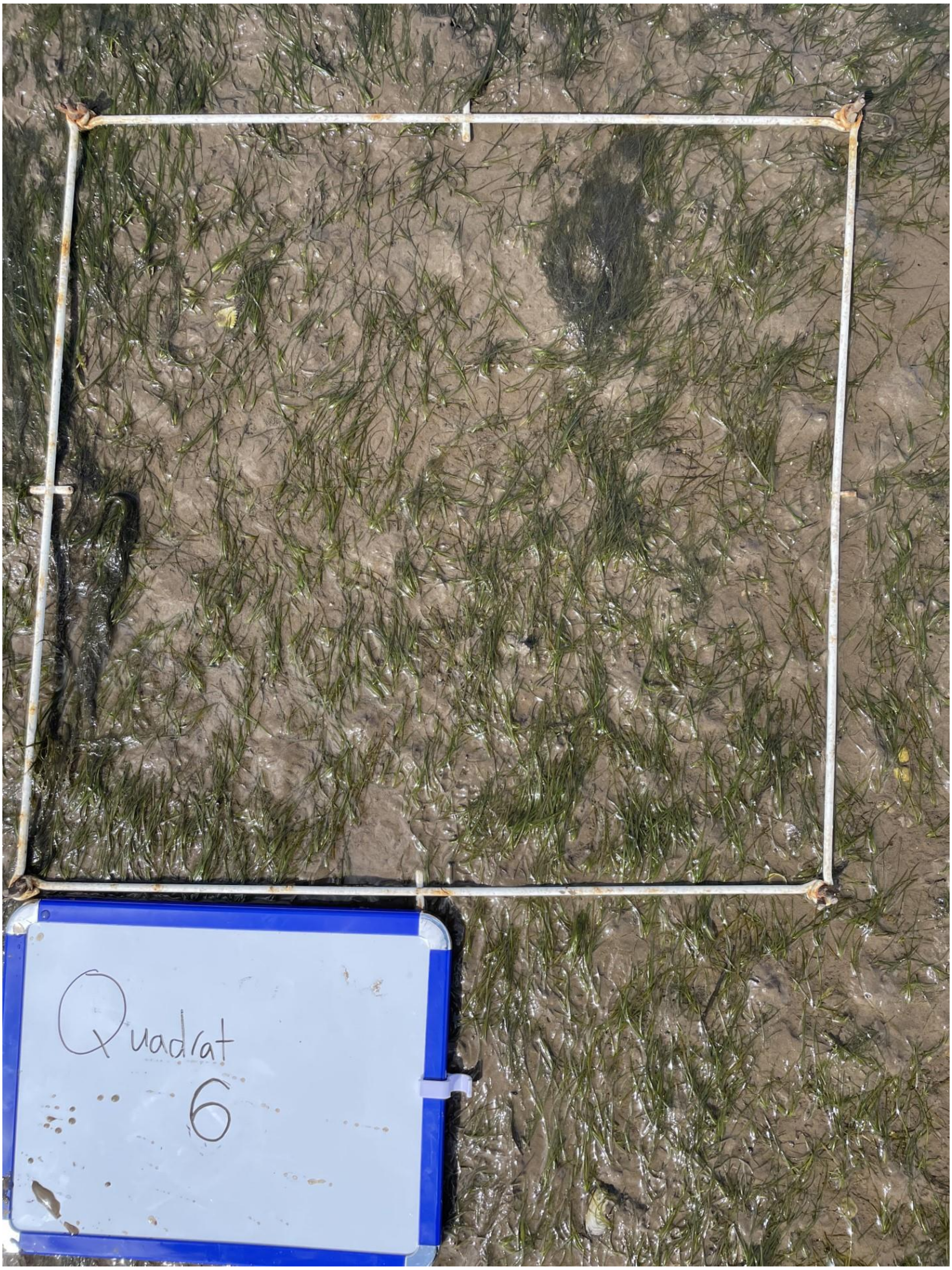

Figure 23: Quadrat six for seagrass survey at Roosecote Sands, eastern bed.

Figure 24: Quadrat seven for seagrass survey at Roosecote Sands, eastern bed.

Figure 25: Quadrat eight for seagrass survey at Roosecote Sands, eastern bed.

Figure 26: Quadrat nine for seagrass survey at Roosecote Sands, eastern bed.

Figure 27: Quadrat ten for seagrass survey at Roosecote Sands, eastern bed.

Figure 28: Quadrat eleven for seagrass survey at Roosecote Sands, eastern bed.

Figure 29: Quadrat twelve for seagrass survey at Roosecote Sands, eastern bed.

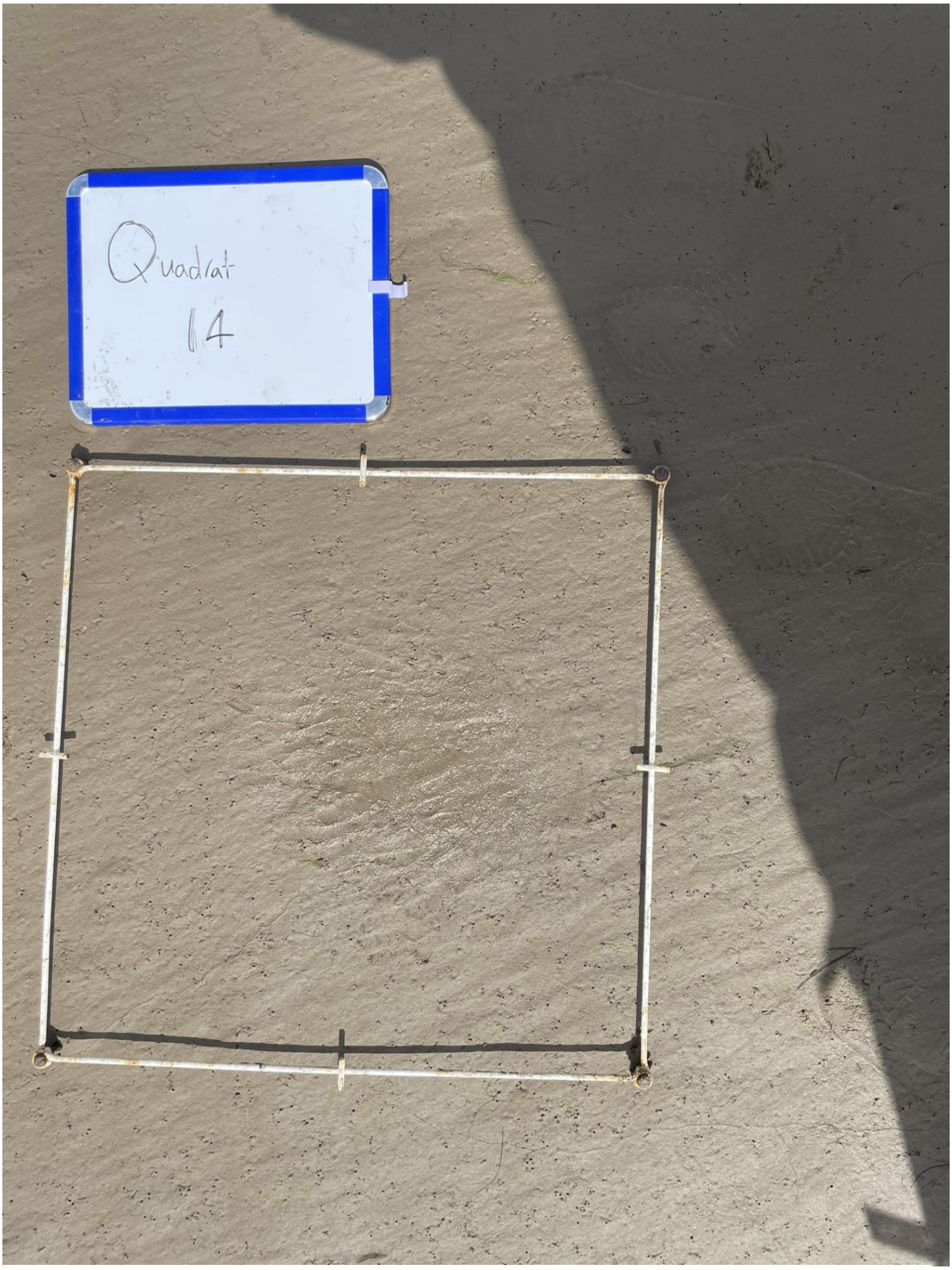

Figure 30: Quadrat fourteen for seagrass survey at Roosecote Sands, eastern bed.

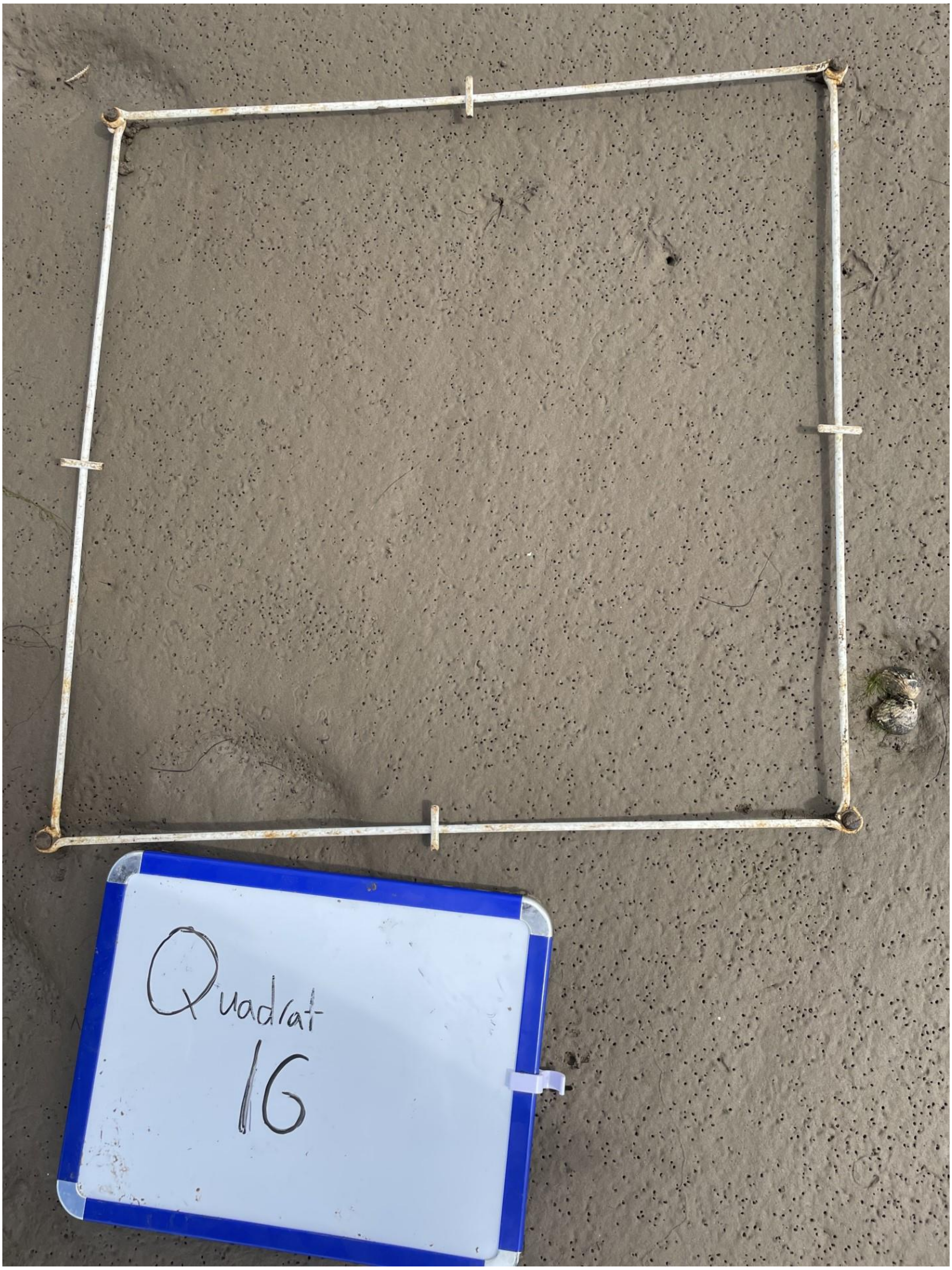

Figure 31: Quadrat sixteen for seagrass survey at Roosecote Sands, eastern bed.

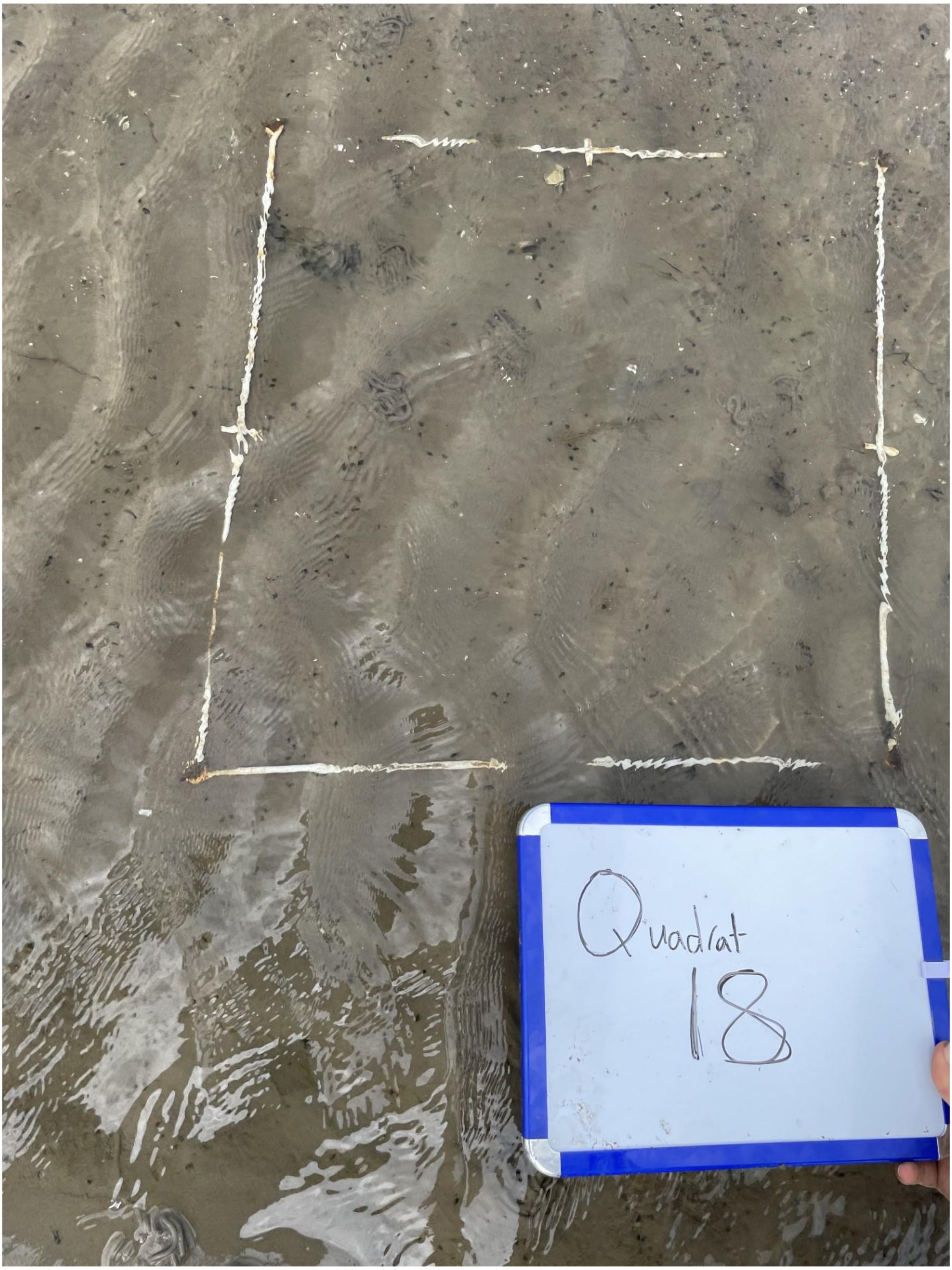

Figure 32: Quadrat eighteen for seagrass survey at Roosecote Sands, eastern bed.

Figure 33: Quadrat twenty for seagrass survey at Roosecote Sands, eastern bed.

Figure 34: Quadrat twenty-one for seagrass survey at Roosecote Sands, eastern bed.

Figure 35: Quadrat twenty-two for seagrass survey at Roosecote Sands, eastern bed.

9.2 Western bed quadrats

Figure 36: Quadrat one for seagrass survey at Roosecote Sands, western bed.

Figure 37: Quadrat two for seagrass survey at Roosecote Sands, western bed.

Figure 38: Quadrat three for seagrass survey at Roosecote Sands, western bed.

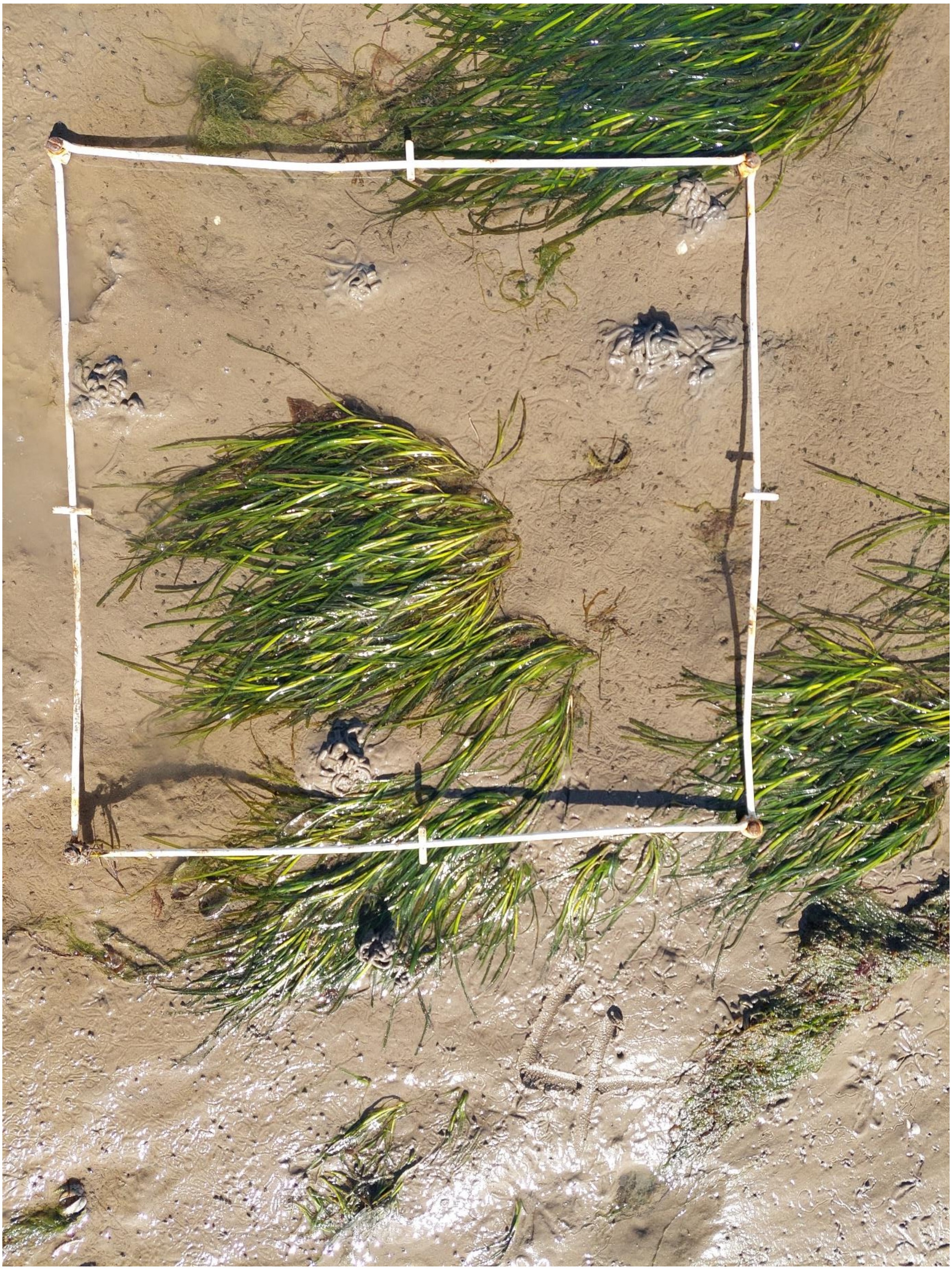

Figure 39: Quadrat four for seagrass survey at Roosecote Sands, western bed.

Figure 40: Quadrat five for seagrass survey at Roosecote Sands, western bed.

Figure 41: Quadrat seven for seagrass survey at Roosecote Sands, western bed.

Figure 42: Quadrat eight for seagrass survey at Roosecote Sands, western bed.

Figure 43: Quadrat nine for seagrass survey at Roosecote Sands, western bed.

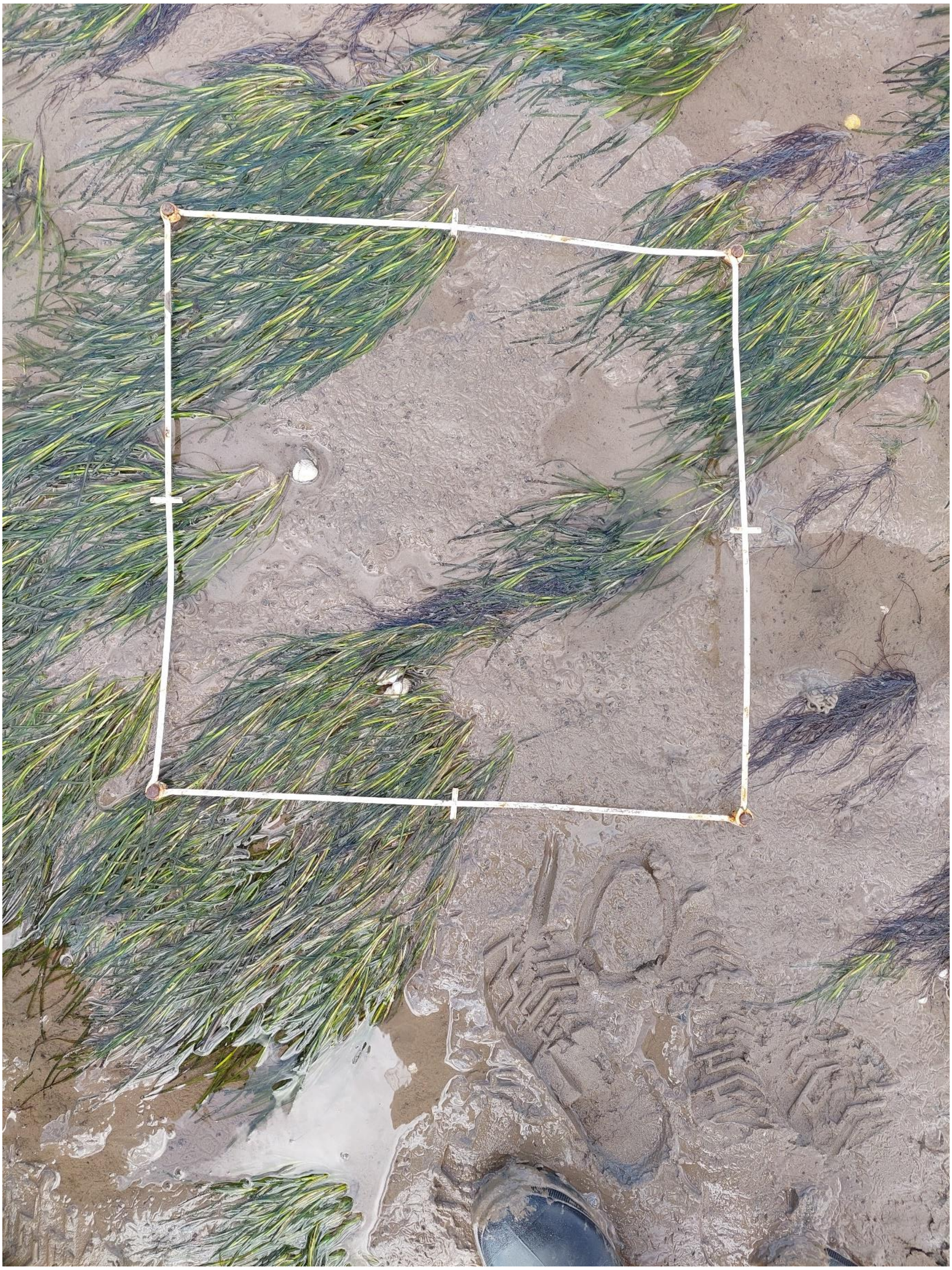

Figure 44: Quadrat ten for seagrass survey at Roosecote Sands, western bed.

Figure 45: Quadrat eleven for seagrass survey at Roosecote Sands, western bed.

Figure 46: Quadrat twelve for seagrass survey at Roosecote Sands, western bed.

Figure 47: Quadrat thirteen for seagrass survey at Roosecote Sands, western bed.

Figure 48: Quadrat fourteen for seagrass survey at Roosecote Sands, western bed.

Figure 49: Quadrat fifteen for seagrass survey at Roosecote Sands, western bed.

Figure 50: Quadrat sixteen for seagrass survey at Roosecote Sands, western bed.

Figure 51: Quadrat seventeen for seagrass survey at Roosecote Sands, western bed.

Figure 52: Quadrat eighteen for seagrass survey at Roosecote Sands, western bed.