Distribution, Extent and Condition of *Zostera noltii* in the Ravenglass Estuary, Cumbria, UK

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NATURAL ENGLAND

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North West Wildlife Trusts

Introduction

Background

Seagrass species are ecosystem engineers and form hugely important ecosystems worldwide, providing habitat for numerous species, ecosystem services such as food through fisheries support, protection from coastal erosion and flooding (Mtwana Nordlund et al., 2016), as well as their importance as a blue carbon habitat, capturing carbon at a rate higher than rainforest ecosystems (McLeod et al., 2011). Despite their importance, seagrass ecosystems have seen considerable declines over the last century. The UK has suffered particularly drastic losses of its seagrass beds; most recent loss estimates of the two species found in UK waters, *Zostera marina* and *Zostera noltii,* range as high as 92% within this time period (Green et al., 2021).

Though a wasting disease has been attributed to as the main cause of seagrass loss in the UK (Butcher, 1934), anthropogenic activities have hampered seagrass meadow recovery and exacerbated declines attributed to more "natural" perturbations (Turschwell et al., 2021). The restoration of seagrass meadows in the UK is therefore of immense importance as well as opportunity, as it provides a chance to kickstart recovery of coastal species reliant on these meadows, contribute towards the effort to meet net zero carbon emission targets and additionally provides an investment opportunity for offshore developers in the face of upcoming policy on marine net gain (Department for Environment Food and Rural Affairs, 2021).

Targeting areas with historical evidence of seagrass presence is a logical approach to restoration efforts, as the environmental conditions are more likely to be favourable to support a meadow. However, historical records of seagrass are often anecdotal or circumstantial in relation to records of other species, such as Brent geese which feed on *Zostera* meadows (Ganter, 2000), leaving uncertainties in historical extent for restoration efforts to rely on.

Report rationale and objective

The incidence of seagrass *Z. noltii* in the Ravenglass Estuary, Cumbria, UK, was first recorded in October 2013 as a small approximately $1m^2$ patch and was noted within an intertidal survey on the Drigg Coast Special Area of Conservation (SAC), as part of the Improvement Programme for England's Natura 2000 Sites (IPENS) (Natural England, 2015). This incidental recording of *Z. noltii* is the most recent record of seagrass in the Ravenglass area, with no further seagrass-specific surveys conducted beyond this time. The purpose of this report is to summarise the findings of surveys carried out on the Ravenglass Estuary area in July and August 2022, which aimed to map the extent and survey the condition of the seagrass meadows present in the Ravenglass Estuary.

Survey methodology

Survey Location

The survey focused on the intertidal area at the location where *Z. noltii* was recorded in the Natural England 2013 survey (Figure 1, Appendix 1). This area is within the estuary of the River Irt, adjacent to the Saltcoats settlement in Cumbria, UK (Figure 2).

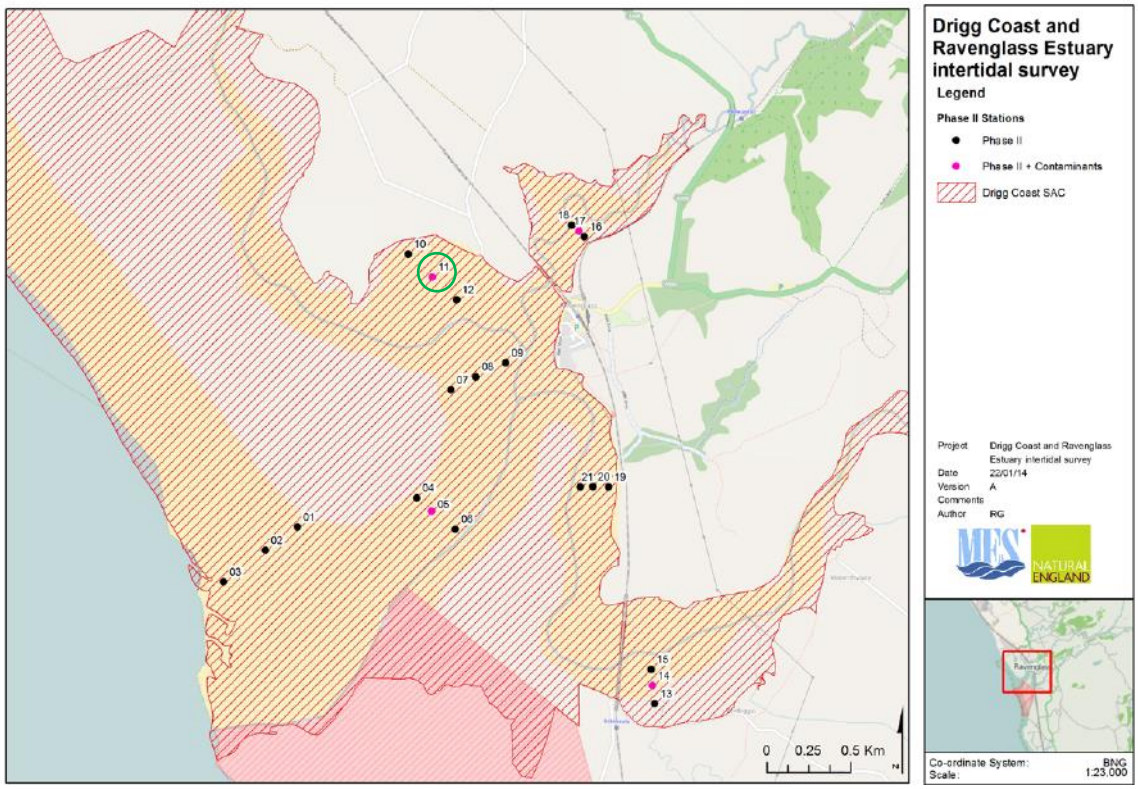

Figure 1: Map of the Ravenglass Estuary, with locations of stations sampled as part of the Drigg Coast SAC survey, October 2013. Z. noltii was recorded at Station 11 (circled in green), in the estuary of the River Irt.

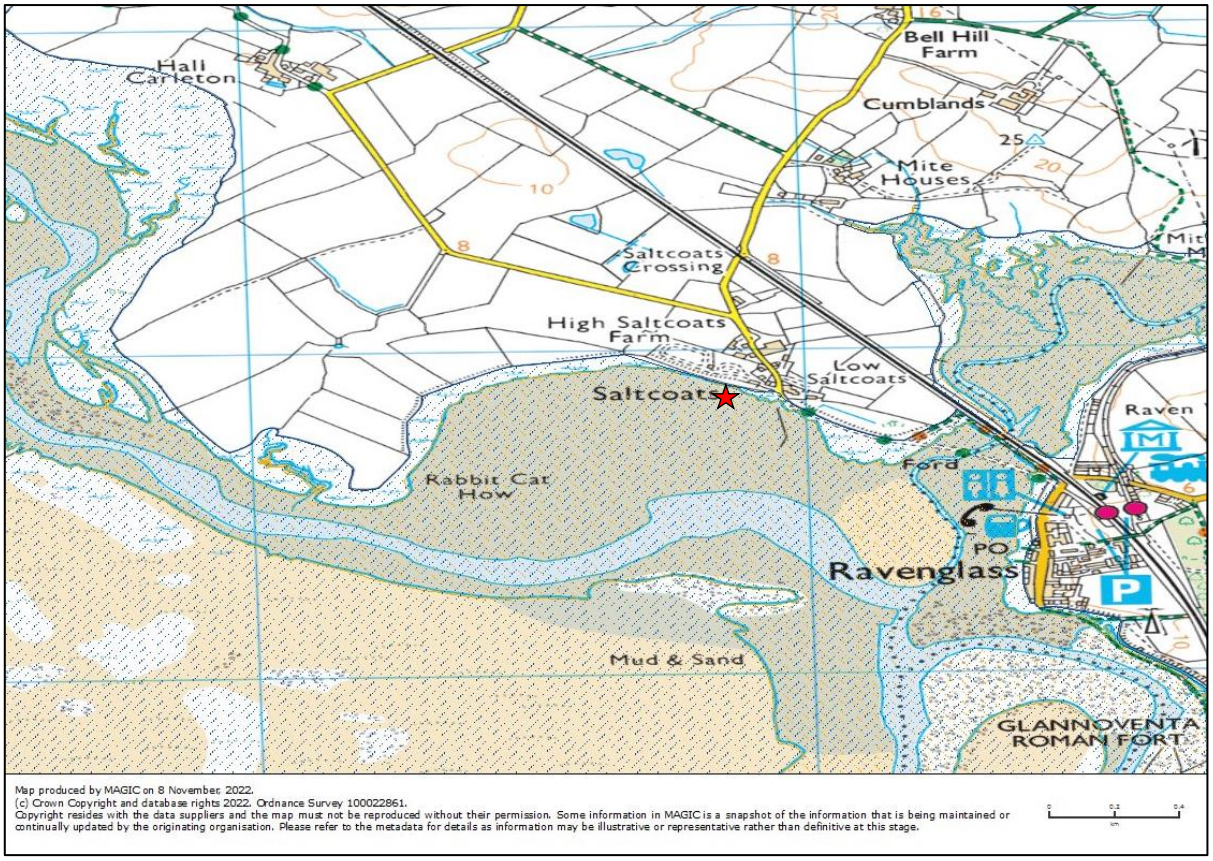

Figure 2: Overview of the Saltcoats area and survey site. Access to the site is at the point marked (★) at Low Saltcoats.

Pre-survey visit and extent mapping

An initial visit of the Ravenglass site was completed on the 10th of May 2022, which consisted of a walkover and visual survey of the area to confirm presence of *Z. noltii.* Once presence was confirmed, a second walkover survey was conducted on the 11th of July 2022 to map the extent of any existing seagrass patches. The boundaries of seagrass meadows and patches were walked by surveyors and a combination of GIS tracking software was utilised to record the boundaries of meadow areas. Where the area of a seagrass patch was observed to be less than 5m in diameter, the boundary of the patch was not walked; instead, the location of the patch was recorded as a point on the GPS tracker. Points and routes were uploaded to QGIS (version 3.26.1) in order to generate digital representations of the seagrass areas and randomly select points within the areas of seagrass for quadrat surveys.

Consents, Licenses and Permissions

Access Permissions

As this was classified as a non-intrusive survey with no material removed from the site, no access permissions were required.

Licenses

As this survey did not involve the collection of samples or specimens, as per the Wildlife and Countryside Act 1981, no license was required to conduct the survey.

Habitats Regulations Assessment (HRA)

No HRA was required as the survey was non-intrusive with no samples being taken.

Survey Dates

The initial extent mapping survey was conducted during the low tide on the 11th of July, 2022. Quadrat surveys were completed on the low tide on the 9th of August, 2022, to coincide with the peak blooming season for *Zostera* species (Foden & Brazier, 2007).

Survey Techniques

Intertidal mudflats quadrat survey

40 random points were selected from the mapped seagrass area. Random points within the larger bounded areas of mapped seagrass meadow were generated using the **"Random Points in Layer Bounds…"** function in QGIS (version 3.26.1). Random points were selected from the set of points representing seagrass patches of less than 5m in diameter using the "Random Selection" function. The points were assembled into a route, labelled subsequently from 1-40 and exported using EasyGPS software to a portable GPS unit. Owing to time pressures and extreme weather conditions experienced on the day, the quadrat survey was shortened to 30 points, with alternate points of the final 20 points surveyed in order to still achieve coverage of the full survey area. A further 2 points in the initial survey area were discarded due to GPS devices malfunctioning *in situ,* invalidating the credibility of the results for these two points.

A 0.5m by 0.5m quadrat was placed at each survey point, at which point the following information was recorded:

1. Sediment type within the quadrat
2. Water depth within the quadrat area – recorded as an average by taking three random measurements of water depth where water was present
3. Coverage of channels, creeks or standing water (recorded as a percentage of the total quadrat)
4. *Zostera noltii* cover (recorded as a percentage of the total quadrat). The percentage coverage of *Z. noltii* within each quadrat was agreed by both surveyors.
5. Bare sediment cover (recorded as a percentage of the total quadrat)
6. Blade length in canopy – the length of three individual *Z. noltii* blades was recorded within each quadrat and the mean value given as the final recorded value
7. Spathes present, where spathes are the part of the *Z. noltii* plant which contain seeds
8. Condition of *Z. noltii* within the quadrat (categorised as Good or Blackened)
9. Spartina cover (recorded as a percentage of the total quadrat)
10. Algae cover (recorded as a percentage of the total quadrat)
11. Epiphyte presence (recorded as a percentage of the total quadrat)
12. Notation of anything of additional interest e.g. notable associated species

Photographs of each quadrat were taken alongside a label to relate them to individual survey points. A copy of the original survey sheet and examples of the quadrat photographs taken have been included in the Appendix of this report (Appendices 2 and 3).

Results

Zostera extent and distribution

The walkover survey on 11th July 2022 identified a total of 12 larger (>5m in diameter) patches of seagrass and 51 smaller (<5m) patches across the survey area. The largest patch recorded within the survey had an approximate area of 558m^2. The total area of seagrass recorded, excluding the small patches, totalled approximately 1697m^2. Patch size and inter-patch density decreased as the seagrass extended to the Western area of the survey site (Figure 3).

*Figure 3: The survey area showing results of the walkover survey, with large Z. noltii patches shown as unique green polygons representing the border of the patch, and small (<5m) patches represented by a green * symbol. The largest patch (by area) is delineated by a yellow box.*

Z. noltii was the only seagrass species recorded in the area, with *Zostera marina* absent from both mudflats and intertidal channels. The density of seagrass both between and within larger patches varied considerably, as further evidenced in the quadrat surveys (Figure 4 and Appendix 3). *Z. noltii* was observed on raised areas of intertidal mudflat, with water-filled channels absent from the survey area during the spring low tide (Appendix 5).

Z. noltii cover and condition

Sediment type for all quadrats surveyed was described as “sandy mud”. No standing water, creeks or channels were observed in any of the quadrats surveyed. The cover density of *Z. noltii* varied considerably with the lowest coverage estimated as 5%, and highest as 90%, with an average cover of 44.64% of the total area (± 26.80). Spatial distribution of seagrass density varied across the survey area, with higher densities recorded to the far west and east of the survey area and lower densities generally recorded in the centre of the survey area (Figure 4, Appendix 3). As both average densities and lowest recorded densities were valued as at least 5% cover within patches, the area qualifies as containing a *Zostera* bed (OSPAR, 2009).

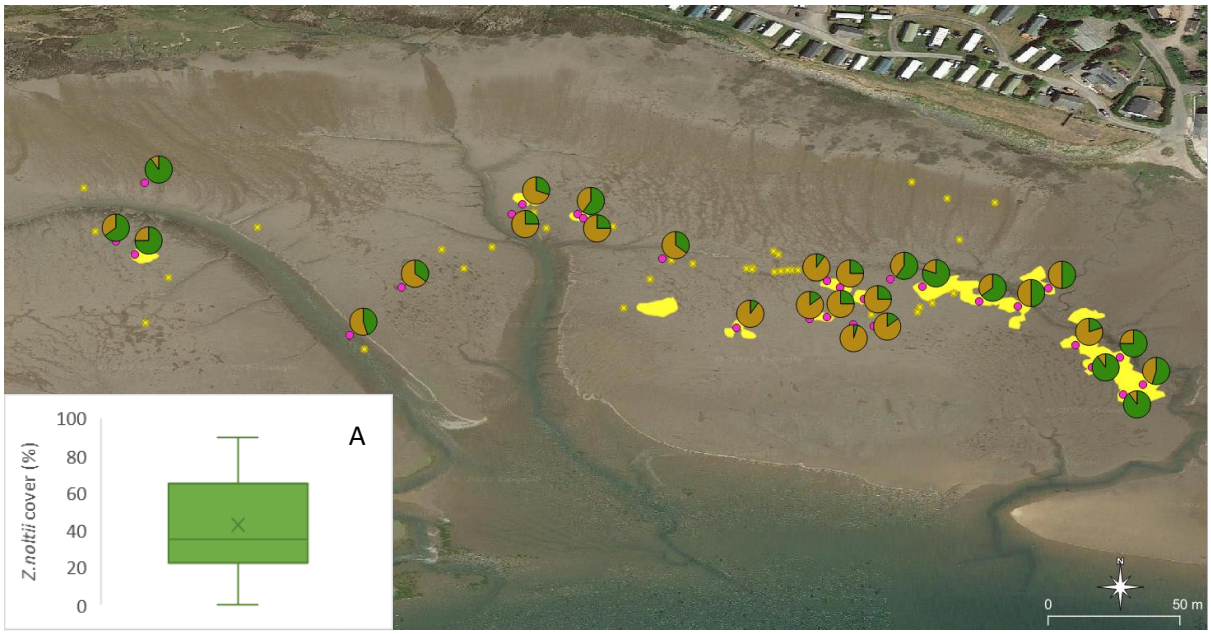

Figure 4: QGIS map showing percentage cover of Z. noltii (green) compared to bare sediment cover (brown) within quadrats surveyed at Ravenglass Estuary. Quadrat survey location points are shown as pink circles. ***A:*** *boxplot of mean percentage cover of* Z. noltii *across all quadrats surveyed.*

Seagrass condition was good overall, with seagrass condition recorded as "Good" in 75% (21/28) of quadrats surveyed and recorded as "Blackened" in the remaining 25% (7/28) (Figure 5). The mean blade length recorded across quadrats was 76.11mm (±14.55). Spathes were present in 93% (26/28) of the quadrats surveyed (Figure 6). Algal presence within quadrats was high but percentage cover within quadrats was low; algae was recorded as present within 75% (21/28) of quadrats (Figure 7), however mean cover across all quadrats was 3.32% (±3.22) and 4.43% (±2.98) within quadrats where algae was present. No epiphyte species were recorded within any quadrats. Additional species were recorded within 7 quadrats; species noted were green shore crab *Carcinus maenas* (4 counts) common periwinkle *Littorina littorea* (2 counts) and marsh samphire *Salicornia europaea* (2 counts). Additionally, cordgrass *Spartina* species were observed colonising the upper intertidal portion of Saltcoats Estuary. Evidence of human activity was observed within the survey area in the form of recent footprints transecting several seagrass patches (Figure 8).

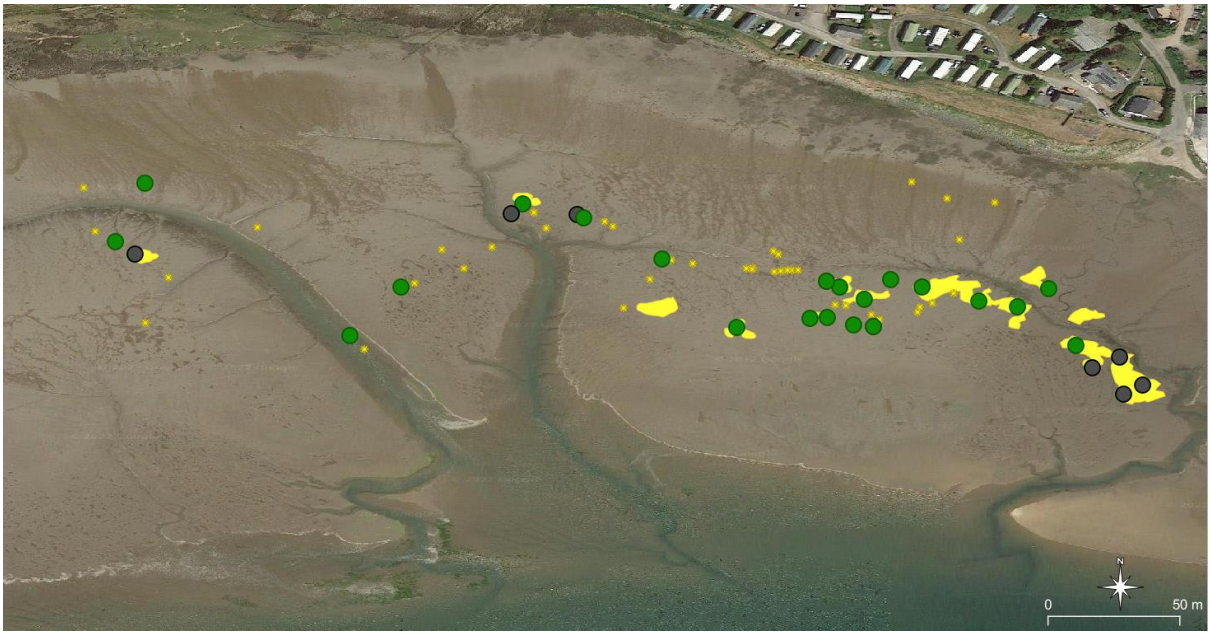

Figure 5: QGIS map screenshot showing seagrass condition in quadrat surveys. Green circles represent "good" condition whereas black circles represent "blackened" condition.

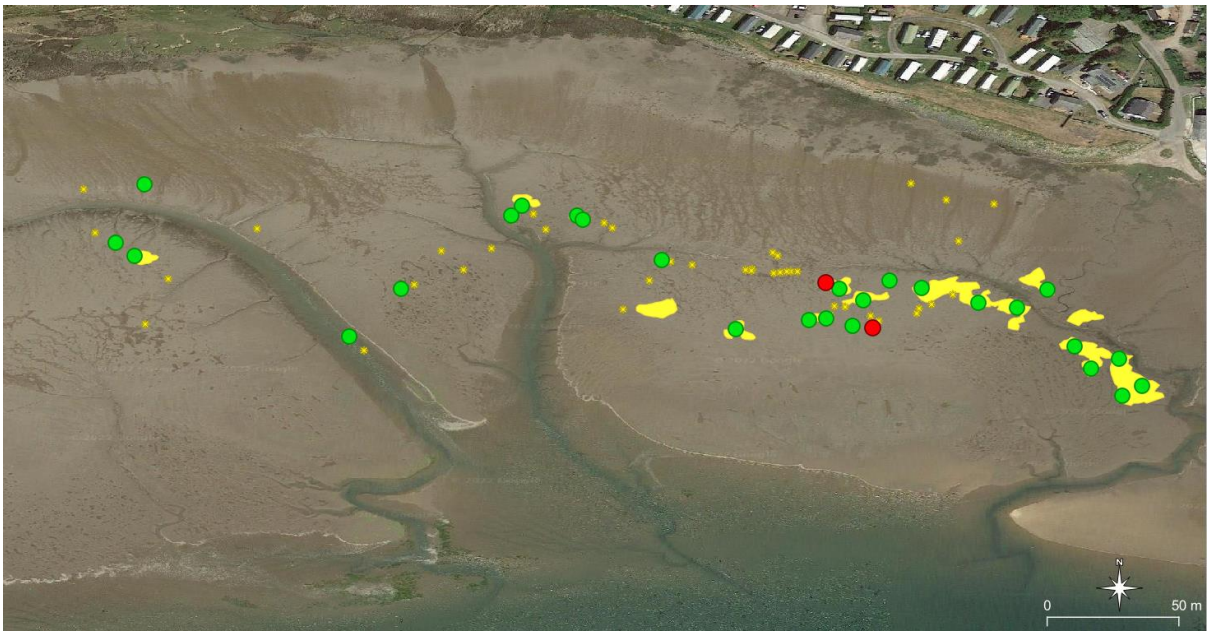

Figure 6: QGIS map screenshot showing spathe presence (green circle) and absence (red circle) in quadrat surveys of Ravenglass Estuary.

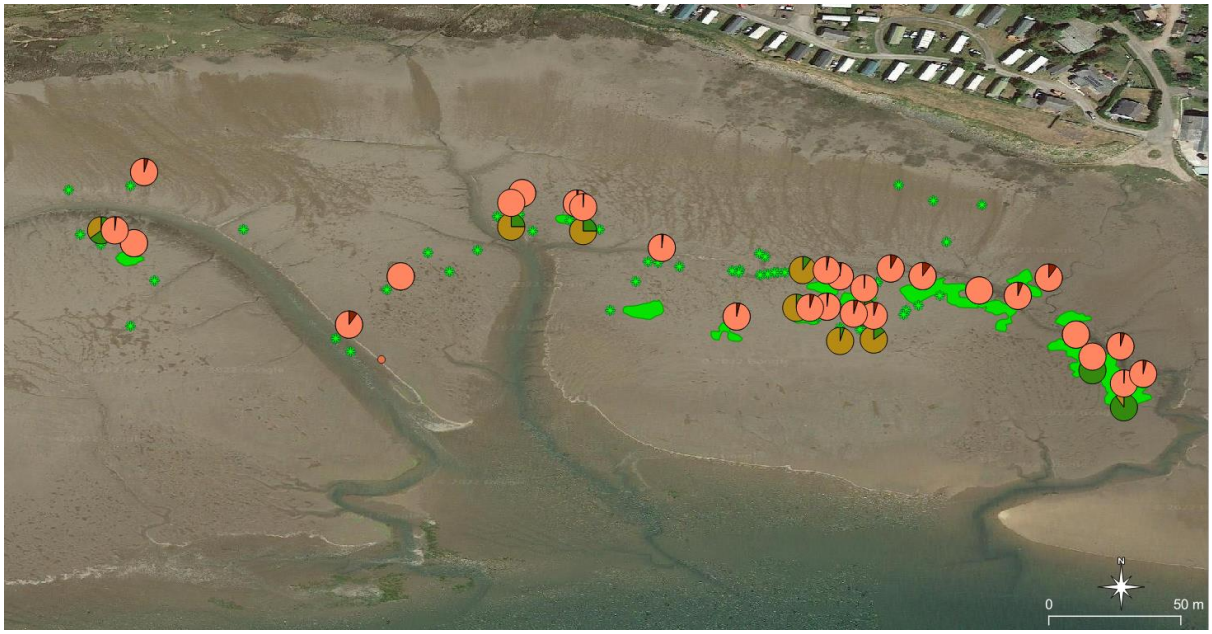

Figure 7: Diagram showing algal cover (%) in surveyed quadrats. Algae presence is shown in dark red, in comparison to pale red.

Figure 8: Human footprints recorded as traversing Z. noltii *patches in Ravenglass Estuary.*

Discussion

This survey was the first to measure the extent and condition of *Z. noltii* in the Ravenglass estuary since the discovery of its presence in 2013 (Department of Environment, Food and Rural Affairs, 2015). This survey was successful in confirming the presence and persistence of a seagrass bed at the Ravenglass Estuary site, and gives early indications of its condition. *Zostera noltii* was present at all surveyed locations at densities sufficient to classify the area as a *Zostera* bed (OSPAR, 2009). However, walkover surveys indicated the distribution of *Z. noltii* in the estuary to be present in numerous smaller patches rather than one continuous bed.

This survey provides the first baseline assessment of the extent and condition of *Z. noltii* in the Ravenglass estuary. Due to the absence of survey data prior to this study, it is not possible to determine from visual surveys alone whether the patchiness observed is a result of growth from colonisation and patch formation or from fragmentation of a large meadow. Further surveys and regular monitoring are required to allow comparisons to be drawn with the baseline assessment within this report to understand the growth or decline of *Z. noltii* in the Ravenglass Estuary. In future surveys, an increased number of quadrats surveyed would be beneficial to give a more comprehensive report of the condition of seagrass within the Ravenglass area, increasing the robustness of the data collected in this survey.

The presence of *S. europaea* was recorded in some quadrats, as well as the anecdotal observation of the saltmarsh cordgrass species *Spartina* in the upper intertidal zone of the survey site. *S. europaea* and *Spartina* species are both colonising saltmarsh species, which stabilise sediment and encourage the transition of the mudflat to a saltmarsh environment, which is an unsuitable habitat for *Zostera* species. It is therefore important to continue revisiting and resurveying this area and the coverage of *Z. noltii*, *S. europaea* and *Spartina* within it, to monitor the development of the habitat area.

The study also observed human activity as a direct impact on seagrass in the survey area. Numerous sets of footprints were observed transecting smaller seagrass patches on the survey site and, given the tidal regime and substrate, were assumed to have occurred within six hours of the survey. Physical disturbance is known to cause long-term degradation and damage to seagrass beds (Bourque et al., 2015) and as such, the discovery of human physical impacts on this area should be treated with appropriate concern when considering the health and persistence of the beds. As the presence of *Z. noltii* is apparently fairly recent in this area, it is recommended that further efforts to monitor and conserve *Z. noltii* beds in the Ravenglass estuary are accompanied by some form of public information notifying the general public of seagrass presence, its importance and recommendations of how best to avoid damaging the beds present.

Conclusion

This survey provides the first baseline assessment of the extent and condition of *Z. noltii* in the Ravenglass estuary. Surveys undertaken in summer 2022 confirmed the presence of the seagrass *Z. noltii* in the Ravenglass estuary and recorded approximately 1697m^2 of *Z. noltii* bed, excluding 51 smaller (<5m diameter) patches also recorded at the site. As one of only

two recorded areas known to possess seagrass ecosystems in the North West, it is imperative that we further survey, monitor and study this area to better understand the health and development of this bed, as well as understanding and minimising the human impacts that may be impeding its survival.

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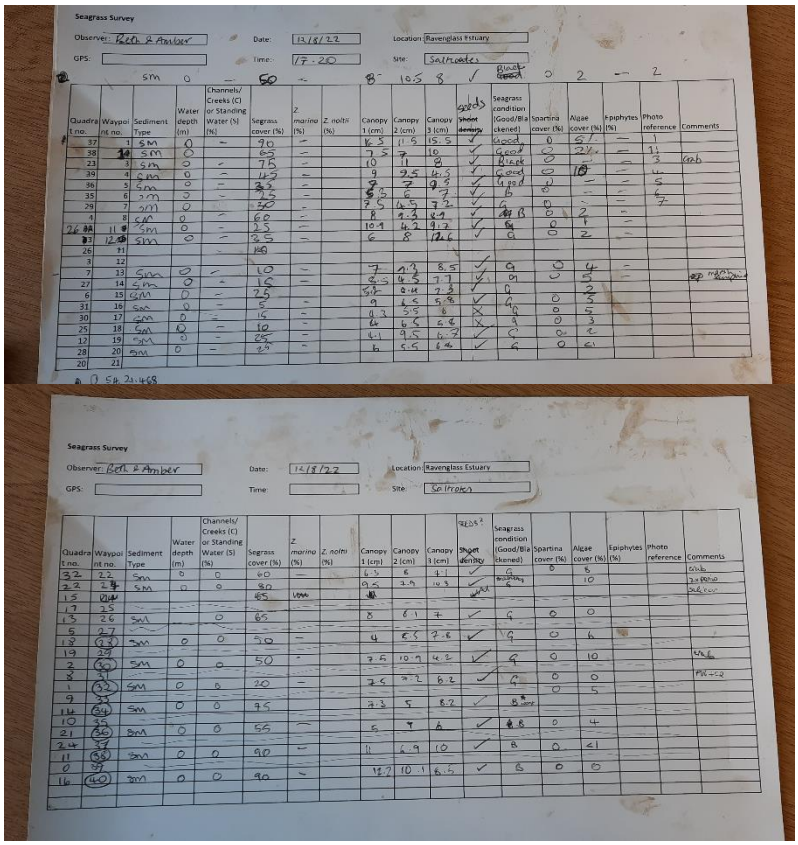
Appendix

Appendix 1: photograph of the Z. noltii patch discovered at Station 11 during the 2013 Drigg SAC intertidal survey (Natural England, 2015).



Appendix 2: Original survey sheets from the Ravenglass seagrass condition survey on 9th August, 2022.

Appendix 3: Example photographs of quadrats taken during the Z. noltii *condition survey.*