SAMFHIRES

Saltmarsh Function and Human Impacts in Relation to Ecological Status

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Issue 3

Introduction

The **Saltmarsh Function and Human Impacts in Relation to Ecological Status (SAMFHIRES)** project is a 36-month multi-disciplinary collaboration between Botanical, Environmental and Conservation (BEC) Consultants Ltd. and the Department of Botany, Trinity College Dublin (TCD). Through field survey, collation of existing data, modelling and analysis, the project will link anthropogenic pressures to changes in saltmarsh communities and investigate the ecosystem services and ecological functions of saltmarshes in Ireland. By integrating the outputs of this research, it will refine the tool developed by the recent SMAATIE (Saltmarsh Angiosperm Assessment Tool for Ireland) project for the purposes of the Water Framework Directive. The tool, which assesses ecological status for part of the angiosperm Biological Quality Element in coastal and transitional waters, will be tested in the field and applied to a selection of water bodies.

The project consists of three work packages (WPs). There is synergy between WP1 and WP2, with outputs from both feeding into WP3.

Work Package 1: Anthropogenic pressures on Irish saltmarshes

The objectives of this WP are to:

1. Review the literature pertaining to anthropogenic pressures on saltmarshes
2. Collate existing data on anthropogenic pressures on Irish saltmarshes
3. Investigate impacts of grazing pressure on Irish saltmarsh communities
4. Investigate patterns and impacts of eutrophication on Irish saltmarsh communities
5. Identify potential refinements to SMAATIE related to anthropogenic pressures

Work Package 2: Ecosystem services and ecological function of Irish saltmarshes

The objectives of this WP are to:

1. Review the literature pertaining to ecosystem services and ecological function
2. Investigate the regulating services/functions of saltmarshes
3. Investigate the habitat/supporting services/functions of saltmarshes
4. Identify potential refinements to SMAATIE related to function/services

Work Package 3: Refinement and testing of SMAATIE

The objectives of this WP are to:

1. Finalise list of water bodies for which saltmarsh monitoring is needed
2. Record data on under-recorded saltmarsh communities
3. Refine tool and methodology
4. Field test the tool and methodology at a selection of contrasting sites

Expected Outputs:

The SAMFHIRES project outputs will include a fully detailed final report, a non-technical synthesis report and a revised Practitioner's Manual reflecting the revised assessment tool. Other project outputs will include final metric and Ecological Quality Ratio (EQR) data for all assessed water bodies in Microsoft Excel format, vegetation quadrat data in Turboveg format and GIS data in ESRI format defining Potential Saltmarsh Area. At least two oral conference presentations will be made and three to four papers will be published in peer-reviewed journals. TCD will hold two seminars where progress on the project will be presented and feedback can be received, and more newsletters will be produced and disseminated in PDF format.

Inside this Issue:

Project term: January 2016—January 2019 **Funder:** EPA

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The project team would like to thank the support and advice received from the steering committee: Karen Roche (EPA), Robert Wilkes (EPA), Deirdre Lynn (NPWS), Kate Harrington (Irish Water), Claire Young (DAERA, NI), Clare Scanlan (Scottish EPA), Cilian Roden (Cilian Roden Associates) & João Neto (Universidade de Coimbra).

Work Package 1: Anthropogenic pressures on Irish saltmarshes

Grazing pressure on Irish saltmarshes

One of the objectives of this work package is to investigate impacts of grazing pressure on Irish saltmarsh communities. This was assessed via (i) an observational survey at multiple sites utilising existing spatial differences in grazing regimes and (ii) short-term experimental manipulation of grazing levels at contrasting sites through fenced exclusion of livestock. Results from the grazing exclosures were presented in the previous newsletter, while preliminary results from the observational survey are presented here.

Figure 1. Observational grazing survey where sites were selected by identifying areas where fences divided grazed and ungrazed saltmarsh. Bannow Island, Wexford, 2017.

Sites for this survey were selected by identifying areas where fences divided ungrazed and grazed saltmarsh (Fig. 1) on the basis of gross vegetation structure, presence of livestock and dung, and discussions with landowners. Due to this selection process, our aim in this survey was to elucidate specific effects of livestock grazing on saltmarsh vegetation, having accepted the hypothesis that grazing livestock would have a visually significant effect on vegetation structure.

Fieldworkers recorded 17 pairs of plots across six sites with between 2 and 4 pairs of plots being recorded at each site. A single pair of plots was recorded from Annex I habitat 1410 with the rest being from habitat 1330. Cattle were the main livestock grazing with just one site grazed by sheep.

Mixed-effects models showed that grazing treatment had a significant impact on height ($F_{1,16} = 6.998$, $p = 0.018$) and species richness ($F_{1,16} = 9.328$, $p = 0.008$), with vegetation being taller in ungrazed plots and species richness higher in grazed plots (Fig. 2).

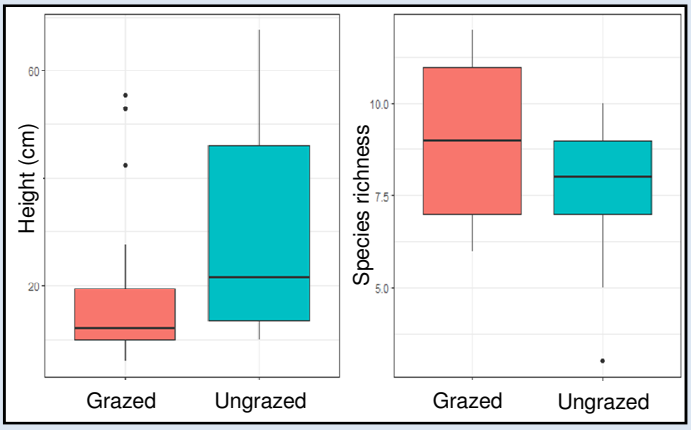

Figure 2. Box-and-whisker plots of field values for height and species richness in grazed and ungrazed saltmarsh plots, $n = 34$.

We ran an NMDS ordination of the collected data (Fig. 3). Axis 1 primarily represents a gradient from upper marsh species lower on the axis, to lower marsh species higher on the axis. Whilst there is considerable overlap between the grazed and ungrazed treatments, there is some separation between communities along Axis 2. The woody species *Atriplex portulacoides* and *Sarcocornia perennis* are associated with ungrazed plots and taller vegetation ($r^2 = 0.542$ for height vector), whilst the annual plants *Spergularia marina*, *Suaeda maritima* and *Salicornia* spp. are associated with grazed plots and more disturbed plots ($r^2 = 0.181$ for disturbed vector).

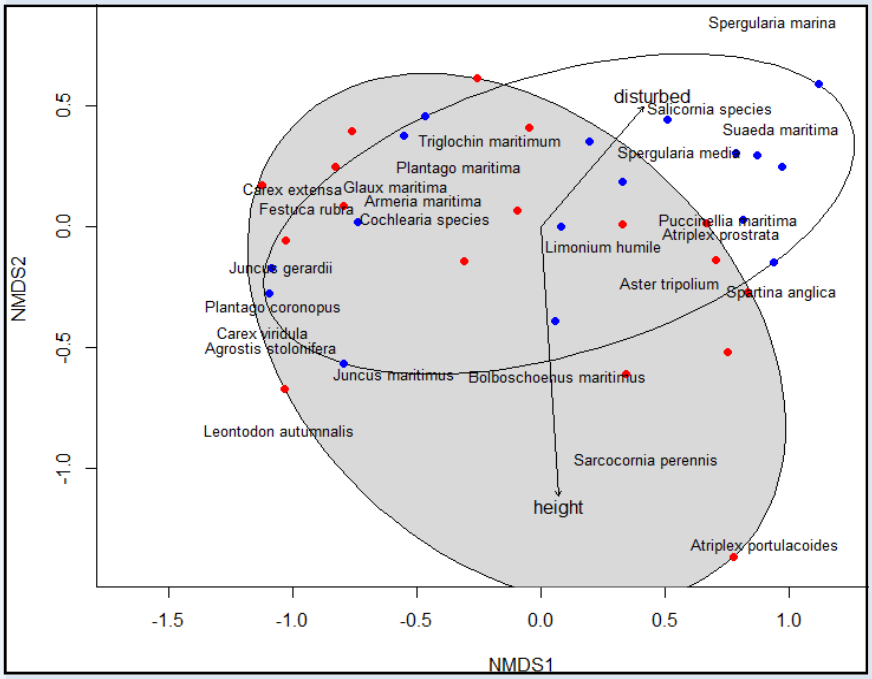

Figure 3. NMDS ordination of grazed saltmarsh plots (blue points and empty ellipse) and ungrazed saltmarsh plots (red points and shaded ellipse). Arrows indicate fitted vectors (height = plant height, disturbed = disturbed ground).

Our results broadly concur with those from elsewhere in Europe, with livestock grazing resulting in shorter, more diverse and more disturbed vegetation, with positive effects on annual species and *Puccinellia maritima* but negative effects on *Atriplex portulacoides*. Chronic heavy grazing on the Irish west coast is therefore likely to have resulted in retrogressive succession. Additionally, high levels of grazing can have negative impacts on certain bird species, on invertebrate communities and ecosystem functioning. Promoting diversity is a common objective of conservation management, but this can be complicated where the benefits of management actions to different taxa are not correlated. Hence, site-specific grazing plans that account for localised priorities are likely to be required for conserving saltmarsh sites. Providing a range of grazing intensities may benefit overall diversity, although this is only likely to be practical on larger sites.

Work Package 1: Anthropogenic pressures on Irish saltmarshes

Relationship between tidal inundation and Irish saltmarsh communities

In early 2017, ground elevation of 246 plots (established for the eutrophication survey) was recorded with differential Global Navigation Satellite System (Trimble R8 receiver with TSC3 logger; Sunnyvale, CA, United States) as an index of tidal inundation regime. To standardise measurements for the differences in tidal amplitude among saltmarshes, elevation was expressed as a proportion of the amplitude of the highest astronomical tide (HAT) for each location from the EPA (unpublished data; measured for Bull Island and Jamesbrook Hall and modelled for other saltmarshes using Admiralty TotalTide v15 software).

Vegetation data, recorded as part of the eutrophication survey, were utilised in conjunction with the elevation data in order to examine the relationship between saltmarsh vegetation communities and tidal inundation (Fig. 4), and also the relationship between individual saltmarsh plant species and tidal inundation (Fig. 5). The saltmarsh communities discussed here were defined from the Irish Vegetation Classification (IVC) and are described in more detail on page 4.

Saltmarsh plant communities are generally found at elevations corresponding to between 50 and 100% HAT amplitude (Fig. 4). With an exception of SM1 communities (dominated by *Salicornia* spp. and *Spartina anglica*; Fig. 5n, 5o) saltmarshes are found above the mean high neap tide line, and thus they are not always covered by high tides. Moreover, plant communities within SM3, SM4 and SM5 (dominated by *Plantago maritima*, *Festuca rubra* and *Juncus maritima*, respectively; Fig. 5l, 5g, 5i) extend well above the mean high spring tide line, and thus some of them are only inundated by sea water during the highest of the spring tides (Fig. 4). Interestingly, the vertical spread of individual Irish saltmarshes does not exceed 1 m, even though some stretch out for 1 km out from the shore. So the broad range of plant communities observed on a saltmarsh occurs over a very fine scale of tidal inundation regimes.

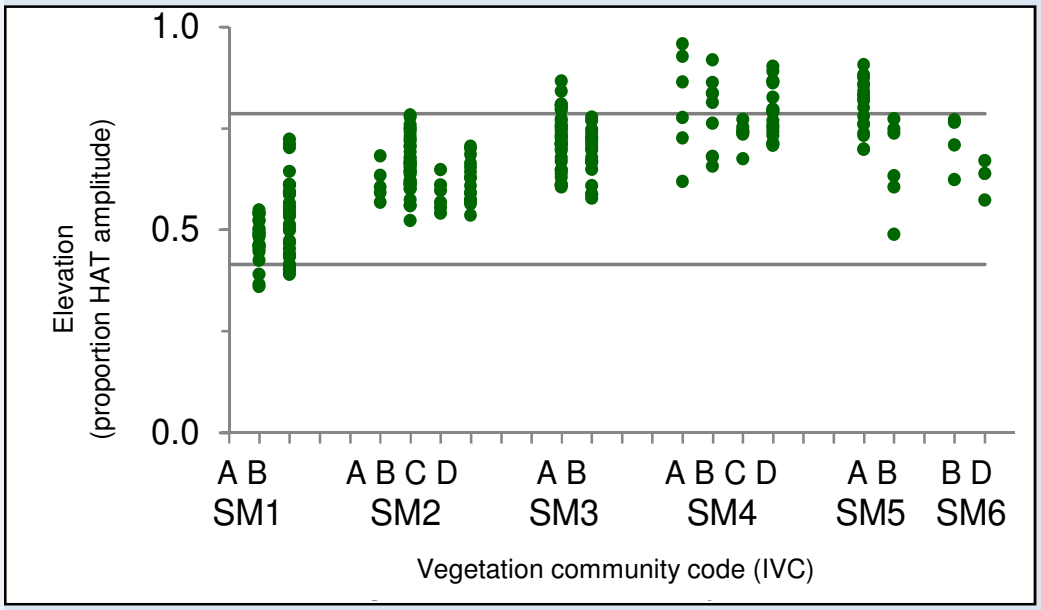

Figure 4. Distribution of IVC saltmarsh communities in relation to elevation (proportion HAT), where the upper horizontal line represents high spring tide relative to astronomical amplitude and the lower to high neap tide.

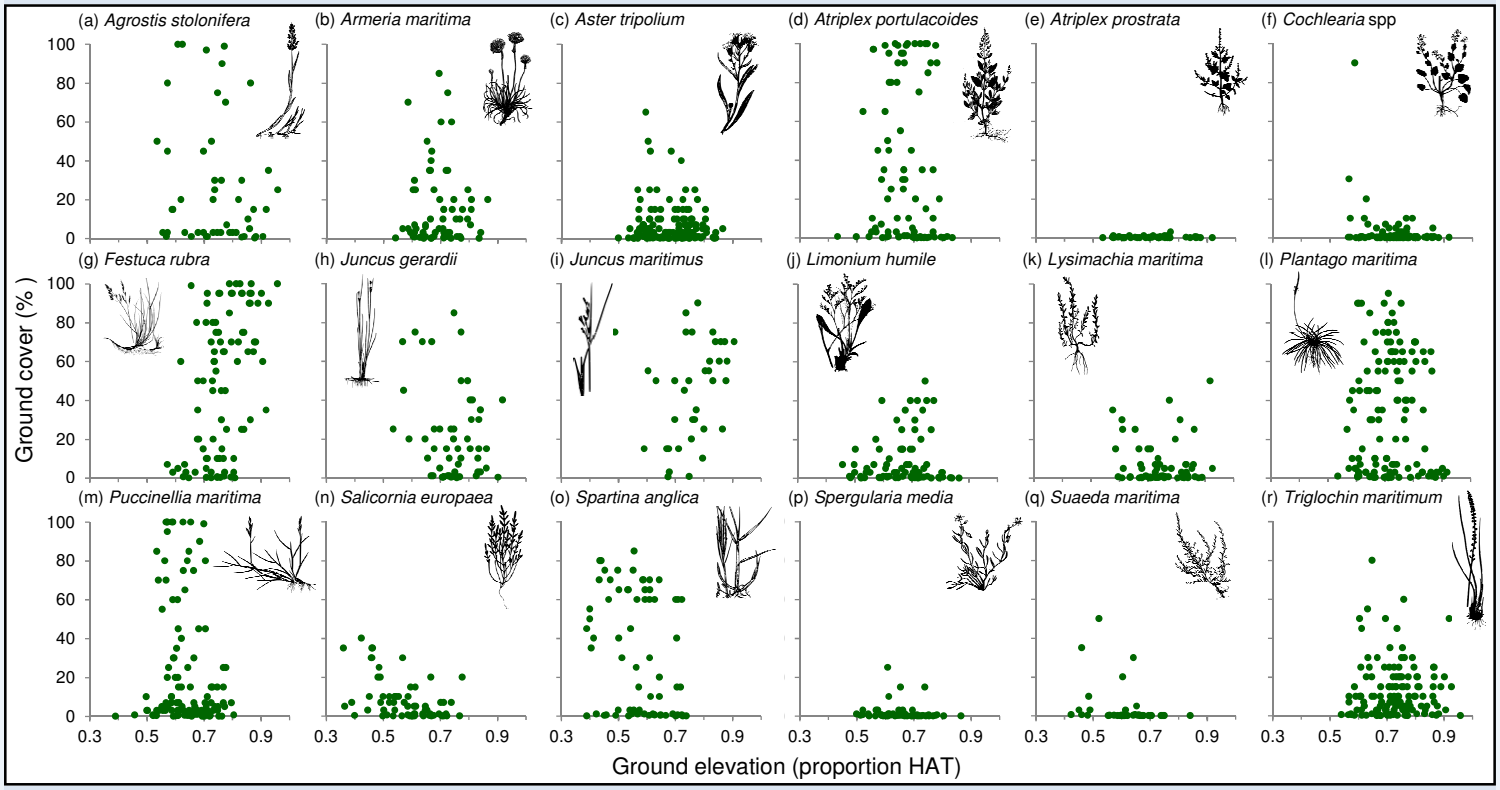

Figure 5. Ground cover (%) of saltmarsh species plotted against ground elevation (proportion HAT)

Work Package 3: Refinement and testing of SMAATIE

Field testing of the SMAATIE tool using defined saltmarsh groups

Data have been collected for the assessment of saltmarsh condition for both the Habitats Directive and the Water Framework Directive. Previous mapping at sites surveyed around the country has been improved by the use of recently defined saltmarsh vegetation groups from the Irish Vegetation Classification. These groups, and their constituent vegetation communities, are as follows:

SM1 *Salicornia* agg.—*Spartina* agg. group (Fig. 6)
- SM1A *Salicornia* agg. saltmarsh
- SM1B *Spartina* agg. saltmarsh

SM2 *Puccinellia maritima*—*Spergularia media* group (Fig. 7)
- SM2A *Puccinellia maritima*—*Glaux maritima* saltmarsh
- SM2B *Atriplex portulacoides*—*Puccinellia maritima* saltmarsh
- SM2C *Puccinellia maritima*—*Limonium humile* saltmarsh
- SM2D *Puccinellia maritima*—*Aster tripolium* saltmarsh

SM3 *Plantago maritima*—*Armeria maritima* group (Fig. 8)
- SM3A *Plantago maritima*—*Armeria maritima* saltmarsh
- SM3B *Plantago maritima*—*Puccinellia maritima* saltmarsh

SM4 *Festuca rubra*—*Seriphidium maritimum* group (Fig. 9)
- SM4A *Festuca rubra*—*Agrostis stolonifera* saltmarsh
- SM4B *Festuca rubra*—*Juncus gerardii* saltmarsh
- SM4C *Festuca rubra*—*Armeria maritima* saltmarsh
- SM4D *Festuca rubra*—*Plantago maritima* saltmarsh

SM5 *Juncus maritima*—*Oenanthe lachenalii* group (Fig. 10)
- SM5A *Juncus maritima*—*Festuca rubra* saltmarsh
- SM5B *Juncus maritima*—*Plantago maritima* saltmarsh

SM6 *Agrostis stolonifera*—*Juncus gerardii* group (Fig. 11)
- SM6A *Bolboschoenus maritimus*—*Agrostis stolonifera* saltmarsh-swamp
- SM6B *Agrostis stolonifera*—*Triglochin maritimum* saltmarsh
- SM6C *Agrostis stolonifera*—*Potentilla anserina* saltmarsh
- SM6D *Agrostis stolonifera*—*Juncus gerardii* saltmarsh

Details of each vegetation community can be found at:

http://www.biodiversityireland.ie/ivc/explore/

By using the IVC categories as the mapping units, far more detailed habitat maps can be produced as evidenced by comparing Fig. 13 overleaf with Fig. 12 below. Fig. 12 shows Bull Island, Dublin, mapped during the Saltmarsh Monitoring Project when Annex I saltmarsh habitats were used as the mapping units (McCorry & Ryle, 2009). As the Annex I habitat 1330 is related to SM2, SM3 and SM4 and parts of SM6, far more detail is recorded by using the IVC saltmarsh groups (Fig. 13).

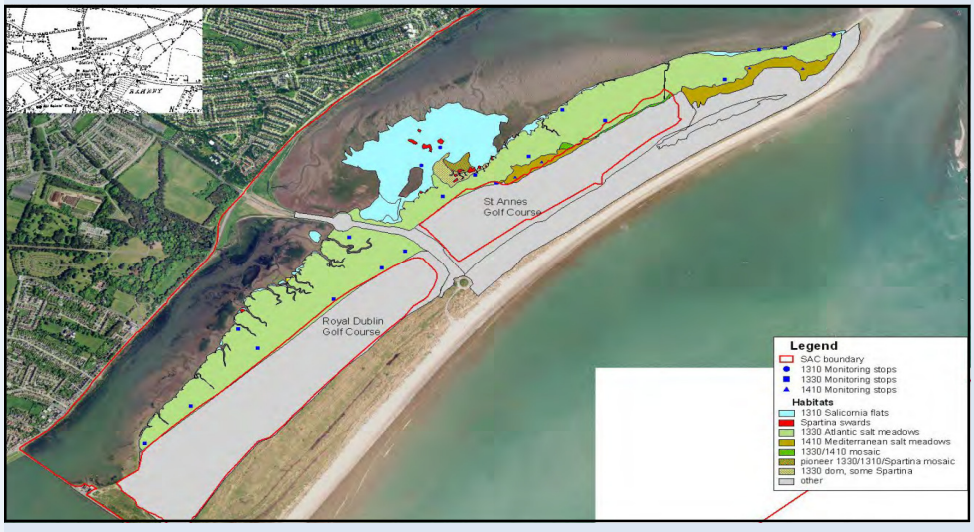

Figure 12. Example of a habitat map produced during SMP using Annex I habitats as the basic mapping units (taken from McCorry & Ryle, 2009)

Figure 6. SM1A *Salicornia* agg. saltmarsh

Figure 7. SM2B *A. portulacoides*—*Puccinellia maritima* saltmarsh

Figure 8. SM3A *Plantago maritima*—*Armeria maritima* saltmarsh

Figure 9. SM4B *Festuca rubra*—*Juncus gerardii* saltmarsh

Figure 10. SM5A *Juncus maritima*—*Festuca rubra* saltmarsh

Figure 11. SM6B *Agrostis stolonifera*—*Triglochin maritimum* saltmarsh

Work Package 3: Refinement and testing of SMAATIE

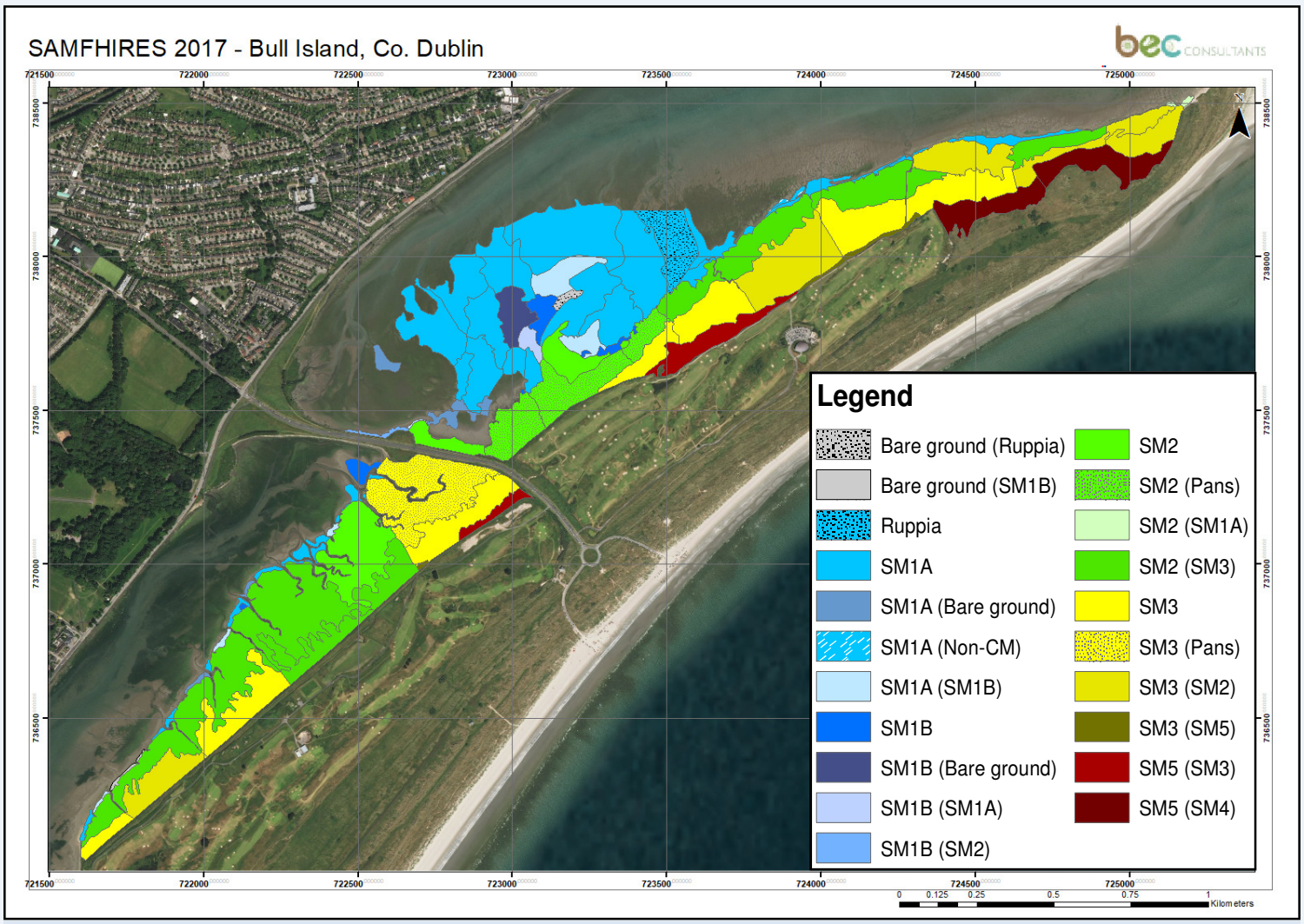

Figure 13. Example of a habitat map produced during SAMFHIRES using IVC categories as the basic mapping units.

Milestones for the next 6 months

* Complete fieldwork (resurvey exclosure sites, survey more sites for observational grazing study and rare communities, complete survey of mapping/assessment test sites, visit sites with unmanaged/managed realignment)
* Continue with analysis of impacts of sea level rise on Irish saltmarshes
* Complete analysis of biodiversity indices and associated manuscript
* Complete eutrophication study analysis and associated manuscripts
* Complete GIS work measuring Potential Saltmarsh Area

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