Natural England Commissioned Report NECR153

Survey and analysis of vegetation and hydrological change in English dune slack habitats

Annex 3 - Site report for Sandscale Haws

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Executive Summary

- Dune wetlands at Sandscale were surveyed and mapped in the summer of 2012, repeating the wetland component of the earlier Sand Dune Survey of Great Britain (SDGB) at this site in 1987. Some vegetation quadrats from the 1987 survey were relocated and re-surveyed, and soil samples taken. Hydrological interpretation is also provided for this site.

- There has been no substantial change in area of wetland habitats between 1987 and 2012. Analysis of change in area was made difficult due to a poor base map in 1987. However, new primary and secondary slack habitat is forming at the north east edge of the site.

- There were no clear signals of floristic change in repeat quadrats. Species richness increased significantly, but whether this change in species composition is desirable from a conservation perspective is not known.

- Soils are highly decalcified or are acidic across much of the site, apart from in the early successional slacks.

- The hydrological conditions at this site are affected by the drainage channels around the dunes. Care should be taken if for whatever reason there are plans for management of these channels outside their ‘normal’ range.

- Site management should consider re-installing a network of co-located piezometers and vegetation quadrats to capitalise on previous measurements.

Contents

1 Introduction

This work was conducted under a Memorandum of Agreement between Natural England and the Centre for Ecology and Hydrology (CEH). It comprised two elements: hydrological studies at key sites and a re-survey of the dune wetland resource, repeating where possible mapping and survey work conducted as part of the Sand Dune Survey of Great Britain (SDGB) (Radley 1994). Work conducted at Sandscale under these two components is reported here.

2 Site Description

The site description is separated into hydrological and ecological components, both focusing primarily on the wetland features of the site.

2.1 Geological and hydrological setting

Sandscale Haws NNR is situated on the Duddon Estuary in Cumbria, approximately 4 miles north of Barrow-in-Furness (Figure 1). It is a foreland dune system comprising a compact area of blown sand (2 by 1½ km) over tidal flat deposits backed by raised marine deposits over till. The dunes are composed of calcareous windblown sand over shingle. Glacial clays and gravels at least 80 m thick underlie the shingle. Bedrock comprises Lower Carboniferous Limestone (Geology map 48).

Figure 1. The location of Sandscale dunes in the UK.

The grey clay immediately beneath the sand and shingle appears to represent glacial lacustrine deposits containing wood fragments. In some areas, as at Lowsy Point, buried saltmarsh sediments probably represent periods of higher sea level. The clays and sediments are occasionally exposed on the foreshore when the beach level drops after storm tides.

The marshland to the east of the dune system drains in two directions. The Wet Meadow has a single ditch along its length which flows north towards Sandscale Cottages, into a culvert beneath the cottage gardens. This culvert may be partially obstructed (Neil Forbes, Ranger, *pers comm.*). It then emerges into the small beck in the National Trust compound to the east of Hawthwaite Lane. It finally flows into Nigel Pit, the outflow of which is via the small beck adjacent to the byway onto the foreshore (Figure 2).

A series of ditches and old tile drains take water off the south marsh and into Red Gutter which drains into the sea at Scarth Bight. The lower section of South Marsh is regularly inundated by high tides and the entire marsh on storm surges. A metal mine adit discharges adjacent to the site and may ingress the sand to influence groundwater chemistry.

Sandscale is a wet dune system exhibiting a perched water table supported by impermeable clays. Water levels typically peak in spring at the end of March/early April and reach their lowest level in late September/October. The maximum annual difference recorded in the period 1986 to 1997 was 1.5 metres. This can be enough to flood approximately 30-40 ha of slack. The lowest level reached by the water table leaves no surface water present.

Figure 2. Aerial photo of Sandscale Haws dunes. © Next Perspectives.

The frontal dune ridge, which extends around the western side of the dunes, reaches an elevation of 16 m AOD (Figure 3). To the east (inland) of this, there is a band of lower lying slacks with an elevation of ~ 6 m AOD, and east of this are two further dune ridges, interspersed with dune slacks. In the north of the site, the drainage area to the east of the dunes has an elevation above that of the slack floors (Figure 3, Profile A) whereas in the south of the site, the drainage area to the east has a lower elevation than the slack floors (Figure 3, Profile B). In addition, the site slopes downwards from north to south (Figure 3, Profiles C and D). The implication of this is that the drainage network may support water levels in the northern part of the dunes, whereas it might lower water levels in the southern part.

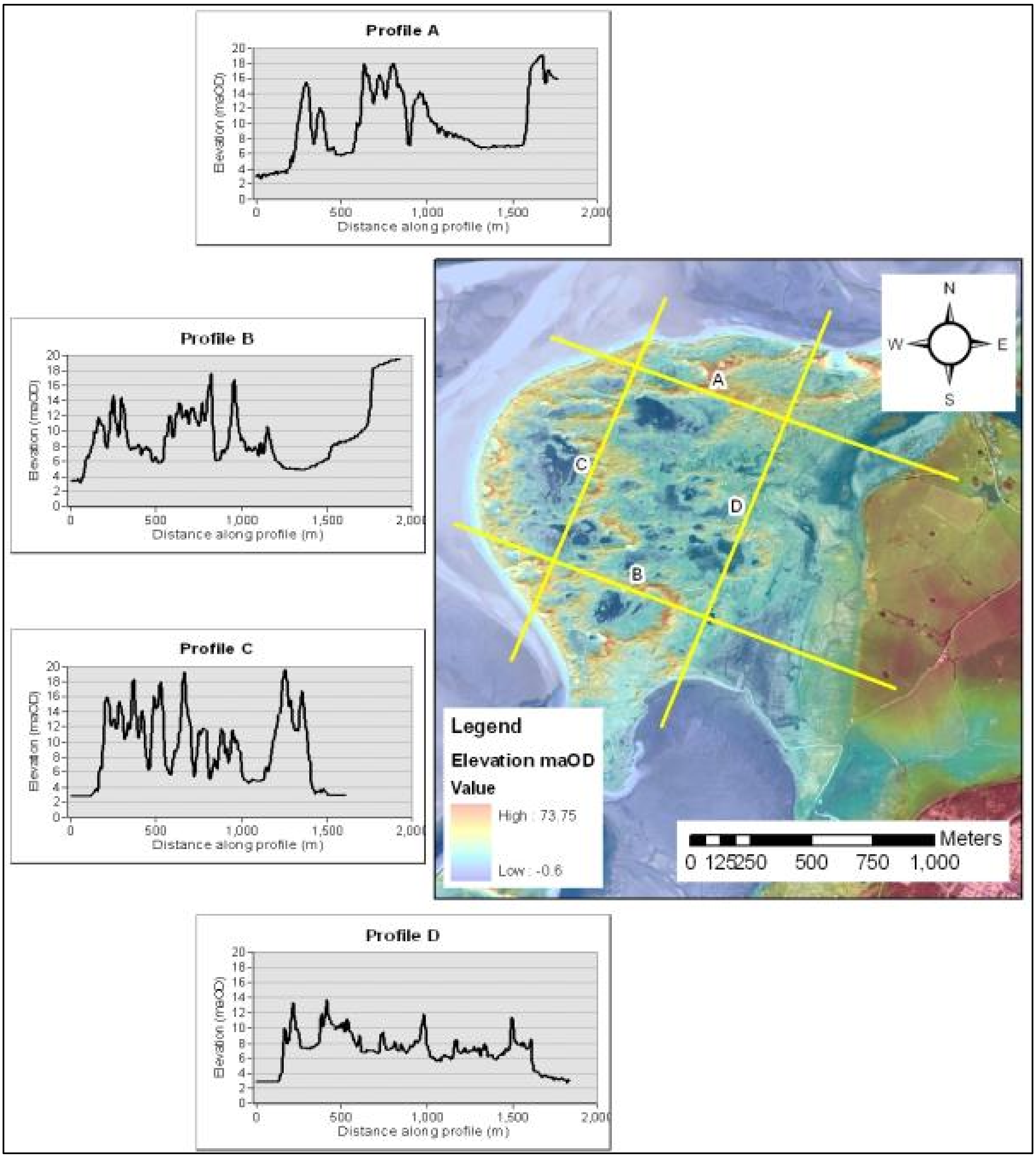

Figure 3. Elevation profiles at several locations along Sandscale Haws dunes. Values represent the elevation of the top surface, not of the ground surface, so are affected by vegetation height. © NERC (CEH) 2013, © Next Perspectives.

Long-term data for the basic hydrological drivers (rainfall and evaporation) are shown in Figure 4. Whilst evapotranspiration is broadly similar across many of the UK sites, rainfall varies considerably, and Sandscale is the site that receives the highest average annual of rainfall. The long term (1961 to 2012) average annual rainfall for this area (area defined as the 40km x 40km grid square calculated using the Meteorological Office Rainfall and Evapotranspiration Calculation System (MORECS)) is 1153 mm, and the long term (1961 to 2012) average annual net (rainfall – actual evaporation) is 580 mm (Figure 4). This suggests that in most years, rainfall recharge is sufficient to support the groundwater system.

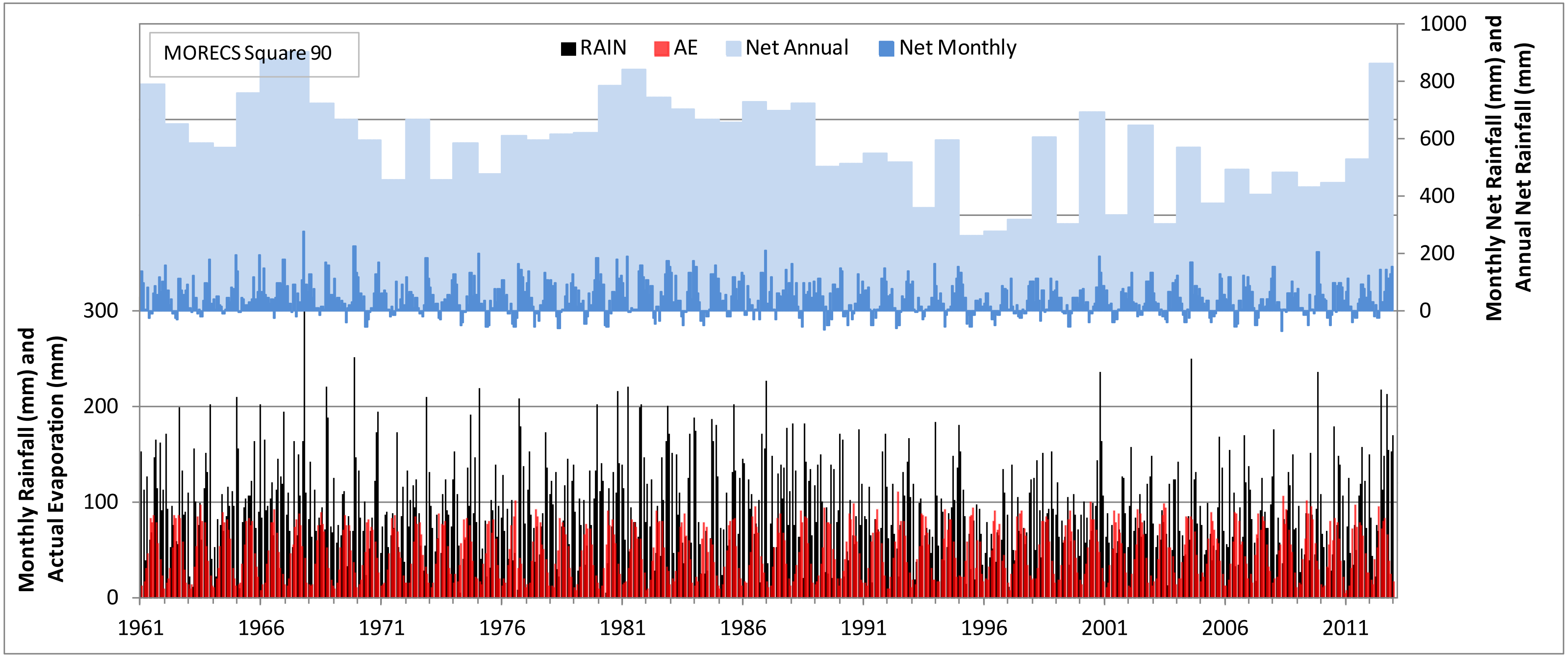

Figure 4. Monthly Rainfall and Evaporation data for MORECS square 90. Net (Rainfall - actual evaporation) monthly and annual totals also shown. MORECS data © Crown copyright 2013, the Met Office.

Interpretation of MORECS data must remember that the data reflect the average conditions for the whole grid square. It is quite possible the conditions at a single coastal dune system will not be accurately represented by MORECS data and the results should therefore only be used as very broad indicator.

2.2 Ecological setting

Sandscale Haws is an exceptionally rich site with over 600 species of vascular plant recorded within its 282 ha. The dune system was one of the first areas recorded as part of the National Sand Dune Vegetation Survey (Waite and Crawford 1987). According to the original survey, strandline vegetation referable to the SD2 *Honkenya peploides-Cakile maritima* community is patchy in the northern part of the Haws. The following successional stage of mobile dunes is generally represented by the SD6 *Ammophila arenaria* community, but the SD5 *Leymus arenarius* community was noted as localised patches in 1987. Both SD7 *Ammophila arenaria-Festuca rubra* semi-fixed dunes and SD8 *Festuca rubra-Galium verum* fixed dune grassland were mapped as widespread in the 1987 report and comprised the greater part of the interior of the dune system. Some areas of M23 mire were erroneously ascribed to MG5 in the 1987 survey.

In 1987 the main dune slack vegetation was the SD16 *Salix repens-Holcus lanatus* community, although SD17 *Potentilla anserina-Carex nigra* tended to occupy much of the larger slacks. Mire communities were also recorded in 1987, although M23 *Juncus effusus/ acutiflorus–Galium palustre* rush-pasture was regarded as limited, as was the M28 *Iris pseudacorus-Filipendula ulmaria* mire. The survey of 2012 indicated that some of the larger slacks were heterogeneous, whilst the largest slacks (especially in the east part of the site) were mapped as relatively uniform M23. Three dune-slack communities (SD15 *Salix repens-Calliergon cuspidatum*, SD16 *Salix repens-Holcus lanatus* and SD17 *Potentilla anserina-Carex nigra*) were mapped as dispersed through the site in 2012, with SD16 the most widespread. Wetter mesotrophic grasslands transitional to SD17 were present as the MG11 *Festuca rubra-Agrostis stolonifera-Potentilla anserina* community.

Although several nationally scarce species are represented, only *Epipactis dunensis* (part of the *E. leptochila* group) may be regarded as nationally rare. At Sandscale *E. dunensis* is found most regularly on dune slopes, sometimes at reasonably high elevations and in the drier slacks. It is also found under Grey Willow scrub on the edges of Slack 1 and Slack 25. Other species typical of the margins of dune-slacks are *Corallorhiza trifida* and *Pyrola rotundifolia* ssp *maritima*.

Before being acquired by the National Trust (NT), the majority of the site was leased for grazing and run as a rough shoot during the ownership by BCL. A small part of the site was used as a waste tip.. The margins of the NT car-park are affected by recreational usage. However, the main management regime applied to Sandscale Haws is grazing, mainly from sheep and rabbits, though cattle grazed the middle of the site during the 1980s, and graze the site now.

3 Hydrological work

Figure 5. Former dipwell monitoring network (1 – 31) at Sandscale Haws NNR, and new CEH dipwell location. © NERC (CEH) 2013, © Next Perspectives.

A network of 31 water level monitoring points was installed by site staff at Sandscale in the 1980s, and these points were monitored on an approximately weekly basis from December 1986 to January 2001 (Figure 5). Groundwater levels indicate an east to west flow with the highest piezometric level in the area of the Wet Meadow. Based upon the 1986 to 2001 monitoring data, the water level in the middle of the site (Figure 5, monitoring well no. 25) is typically 1 m above that in monitoring well no. 9. Seepage onto the foreshore occurs notably where the frontal dunes are undercut by high tides.

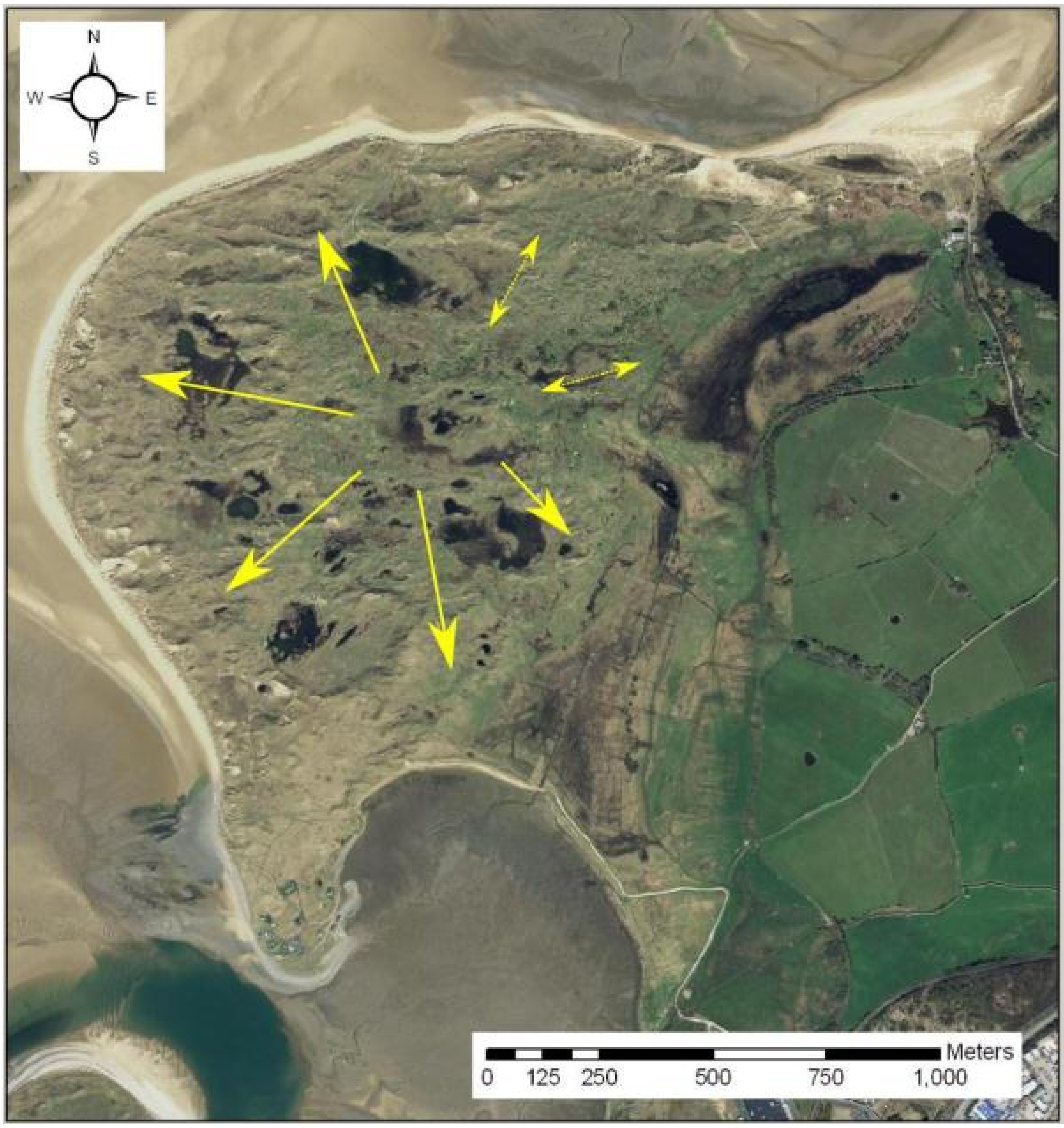

Figure 6. Sandscale Haws NNR conceptual groundwater flow diagram. The yellow arrows indicate the direction of groundwater flow. © NERC (CEH) 2013, © Next Perspectives.

Groundwater levels also indicate a north to south flow with the water level in monitoring well no. 1 approximately 1 m above that observed in monitoring well no. 25. This monitoring data helps to inform the conceptual groundwater flow model which has the appearance of a cross between a radial flow pattern, centred on the middle of the site close to well no. 25, and a linear flow pattern, flowing from north to south. Depending on the relative water levels in the central dunes and boundary areas, it is possible that flow directions in the may change. Further data would be required in order to test this fully, but the conceptual flow diagram (Figure 6) accounts for this with bi-directional dashed arrows in the north eastern section of the site. It is suggested that if the water levels in the central dunes are high (likely caused by high rainfall), and the water levels in the north eastern boundary area are low (likely caused by low tides and maintenance of low ditch levels), then flow may be from the central dunes out towards the north east. The reverse situation would be more likely through a combination of lower rainfall, and raised ditch/high sea level conditions. The sensitivity of the flow velocity in the dunes to the boundary conditions is worthy of further investigation.

A small amount of water quality data exists, and this shows that the groundwater has a pH of 7.4-8.0. It also shows a steep pH gradient of increasing acidity from the base rich frontal slacks to the older base poor slacks at the rear of the system.

4 Vegetation Survey

4.1 Methodology

4.1.1 Field Mapping

The use of GPS-linked portable electronic tablet PCs in the field equipped with Arcpad GIS software enabled a variety of layers to be loaded simultaneously and selected or made semi-transparent as required. GIS layers included aerial photos covering the extent of the dunes, scanned and geo-referenced copies of the original survey maps, the editable layers for mapping and, where available, additional survey information for dune slacks recorded since the SDGB survey.

As the project focused very specifically on dune wetlands, there was no scope to map the more widely distributed (dry) dune communities. For each prioritised area surveyed, every slack or wetland mapped in the original survey was revisited as far as possible, aided by printed copies of the SDGB survey maps with wetland habitats highlighted. Additional slacks were then located by covering as much of the intervening ground on foot as possible, and using georeferenced aerial photos as guidance. To aid the surveyors in distinguishing boundaries between dune wetlands and dry dune communities, it was helpful to identify certain indicator species that could be used to help delineate the edge of dune slacks. The basic premise that dune slacks are influenced by the water table meant that in many cases the extent of species strongly associated with damp habitats provided a useful guide. The relative significance of species differed slightly with each site, but usually included *Hydrocotyle vulgaris* (Marsh pennywort), *Carex nigra* (Common sedge), *Agrostis stolonifera* (Creeping bent), *Eleocharis* sp. (Spike-rush) and *Epipactis palustris* (Marsh helleborine) as well as a range of bryophytes. *Calliergonella cuspidata* was particularly useful where it occurred (particularly in NVC communities SD14-15 and SD17) due to its abundance and mat-forming habit. Conversely, certain species strongly associated with dry habitats such as *Ammophila arenaria* (Marram grass) and *Chamerion angustifolium* (Rosebay willowherb) usually helped identify areas outside the extent of the slack.

Once a dune slack was located and delineated, surveyors identified apparently homogenous stands of vegetation, following NVC guidance (Rodwell, 2006). The boundaries of each stand were walked and digitised using the GPS-tracking functionality in Arcpad. Occasionally the GPS accuracy could drop to as low as 20m, at which point the aerial photos were helpful in confirming the location. Associated with each polygon drawn, the information listed in Table 1 was captured.

Table 1. Digital mapping data collection form filled in for each polygon digitised.

Field	*Data entry method*
ID	Unique polygon ID generated by Arcpad
NVC community	Selected from list OR free text
NVC sub-community	Selected from list OR free text
Notes	Free text field for target notes relevant to each polygon; surveyors included dominant species and previous slack ID where relevant
NVC community 2 (mosaic)	Selected from list OR free text
Proportion NVC community 1	Where a mosaic of two habitats occurs the proportion of each was specified
Proportion NVC community 2	

Due to the time constraints of the survey, it was not possible to follow the standard NVC guidance to record at least 5 quadrats in each stand of vegetation (Rodwell, 2006). A variety of resources were used to identify communities, including surveyors' personal experience, NVC habitat keys & descriptions, NVC floristic tables and the use of TABLEFIT software *in situ*. TABLEFIT can perform a useful function with reduced species lists with or without cover data (as well as single or multiple full quadrats), so mappers were able to make use of this for guidance throughout the survey, where the scale of the project otherwise precluded the recording of full quadrats. Close contact throughout the survey of the mappers with those surveyors who were recording quadrats provided an extra level of quality assurance in the mapping exercise.

All wetland communities within the interior of the dune system were mapped at the NVC sub-community level where possible with a minimum mappable unit of 10 x 10m. Although dry dune and other habitats were not mapped, transitions between wet and dry communities were. Former slacks that are now dry and no longer contain slack vegetation were identified by target notes, but their boundaries were not mapped.

4.1.2 Location of vegetation quadrats

Using the GIS resources described above in the mapping methodology, SDGB quadrats for which data were available were re-located. Some expert judgement by the surveyors was required to re-locate the original quadrat position, particularly where error or distortion in the SDGB survey map was evident. Additional quadrats were recorded adjacent to grid referenced hydrological monitoring locations (dip wells). Occasionally it was not possible to locate the exact position of dip wells in which case the quadrat was positioned as close as possible. Where dipwells were fenced, and either could not be located or the fenced area was impenetrable due to scrub, quadrats were placed outside the fence touching its SW corner. Where dip wells were not visible at all quadrats were located according to the grid reference. Where possible, additional new quadrats were recorded in less common habitats and young natural slacks formed since the SDGB survey. Locations of quadrats recorded in 2012 are shown in Figure 9.

4.1.3 Vegetation quadrat recording methodology

Once quadrat positions were located, a 2x2m quadrat oriented north-south was surveyed. The location of the centre of the quadrat was recorded using a Garmin Etrex GPS, to around ±5 m accuracy. Within the quadrats all vascular plants and bryophytes were identified and percentage cover recorded. Where cover of a species was <1%, a value of 0.1% was recorded where a single individual was present, and 0.5% where more than one individual was present, to enable conversion to Domin values (+ and 1 respectively). Cover values between 1 and 10 were recorded to the nearest 1%, and above that to the nearest 5%. Where species identification was not possible in the field (primarily bryophytes), samples were collected and later verified by a specialist.

Table 2. Data collected associated with each quadrat.

Category	***Sub-category***	***Data entry method***
ID	Unique quadrat ID generated by arcpad	n/a
1990 ID	Quadrat number assigned in 1990 survey	Free text
Characteristics	GPS location	Free text
	Angle of slope (degrees)	
	Aspect (compass degrees)	
	Vegetation height (cm; 5 measurements)	
Management	Grazed?; Rabbit; Sheep; Cattle; Horse; Other animal (specify); Mown; Scrub-cut; Trampled by people; Evidence of fires; Other disturbance (specify)	Choice (yes/no/don't know) & free text to specify 'other'
Additional info.	Flooded at time of survey; Soil sample taken	Choice (yes/no)
	Depth(cm); Photographic record; Soil features	Free text
NVC community	NVC community description	Free text
Vegetation data	Name and % cover for each species	Drop down choice for name and free text for %cover

Additional parameters such as bare ground, aspect, slope, as well as data regarding management in evidence such as grazing, dunging, urine patches, evidence of scrub clearance, etc. were recorded (Table 2). Vegetation height was measured by placing a metre ruler at 5 random locations within the quadrat, and estimating the sward height to which 80 % of the vegetation reached, within a 20 cm radius of the ruler. A unique ID number was assigned to each quadrat within the database, and where relevant the associated quadrat number from the SDGB survey was noted within the recording form. Two photographs were taken at each quadrat facing North; one looking down on the sward, and the other including the surrounding habitat for context. Unique quadrat ID and a four letter site code were included within photographs. Photographs are stored in the database of quadrat data, handed over to Natural England. The south west corner of each quadrat was marked with a blue plastic pipe hammered in to 5 - 15 cm above ground surface, depending on the surrounding vegetation, to aid exact relocation in subsequent years. Quadrats were allocated to a NVC community following the methodology described for mapping above, though if required TABLEFIT analysis could be delayed until later on with reference to the full species list.

4.1.4 Soil sampling

A soil sample was taken from the SW corner of each quadrat recorded. A plastic corer of 5 cm diameter and 15 cm depth, labelled with quadrat ID and date was hammered into the ground and removed using pliers, and the tube and soil sample within were placed in a plastic bag and sealed. Samples were kept in portable cool boxes with ice packs before being returned to CEH Bangor, where they were stored in cold rooms at 5˚C prior to analysis.

4.1.5 Species nomenclature

Plant species nomenclature follows that of Stace (2010) for vascular plants and Smith (2004) for bryophytes. Biological Records Centre (BRC) species codes are associated with all vegetation data within the database.

4.1.6 Analysis of change in vegetation

As described above, the survey team in 2012 re-visited all areas that were mapped as wetland in 1987, mapping dune wetland vegetation, including new primary and secondary slacks which had formed at the north east end of the site. There were some issues with the 1987 map, which appeared to have been poorly orthorectified prior to mapping. Correspondence of mapped units with features on the ground was almost non-existent at some locations, while at others the mapped features were present but considerable distortion was evident.

Change in mapped area was assessed for all mapped dune wetlands. Polygons for wetlands in 1987 which corresponded to areas mapped or revisited in 2012, were digitised from the scanned and georeferenced hard copy vegetation survey map of 1987. The area comparison included the following:

- Locations mapped as wetland in 1987, but deemed no longer to be wetland vegetation in 2012 based on lack of slack vegetation indicator species (see main report Stratford et al. (2013), and methods section above). Note that only wetland vegetation types were mapped in 2012, so where vegetation had changed to a non-wetland type this was noted in a target note, but the extent was not mapped. These therefore represent a contraction in the area of wetland at the site.

- Locations mapped as wetland in both 1987 and 2012.
- New wetland features mapped in 2012.

Each polygon (1987 and 2012) was assigned a code for broad vegetation type (Table 3) for ease of interpretation of multiple vegetation classes and communities. The 1987 survey used the draft version of the NVC for coastal habitats, which meant only a simplified cross-comparison over time was possible. The draft NVC only distinguishes between calcareous-type slacks and acid-type slacks. Patches of Juncus M23 grassland were classed as ‘wet pasture’. Polygons mapped in 2012 are shown in Figures 10-13.

Table 3. Broad vegetation codes used for reporting of change in mapped area.

Code	Vegetation type
c	Calcareous slack type (Final NVC SD13, SD14, SD15, SD16)
a	Acid slack type (Final NVC SD17)
s/d	Slack to dry transitional
d	Dry habitats
sm	Saltmarsh
wp	Wet pasture (usually frequent Juncus spp) (M23, MG8, MG10, MG11, MG12, OV28)
w	Other wetland type (including swamp, mire, open water, wet woodland, ponds etc.)
t	Trees or scrub (most sites this will be conifer plantations)

Change in vegetation composition was assessed by analysis of a number of quadrats from 1987 in wetland areas which were resurveyed in 2012. Quadrats were relocated based on maps from 1987 and interpretation of likely location on the ground in combination with maps and high resolution orthorectified recent aerial photography. GPS grid-references were taken for quadrat locations in 2012, accuracy + 5m. Due to the poor quality of the 1987 map, we estimate that at best these quadrats were relocated within 20m of the original quadrat location. At each quadrat, vegetation height was recorded and a soil sample taken for basic physical description (organic horizon thickness, pH, moisture content and organic matter content) and archiving for future chemical analysis, should resources become available.

Where available, species composition of quadrats from 1987 was entered by hand from floristic tables in the Waite and Crawford (1987) report. Species names were harmonised to Biological Recording Centre (BRC) names, and mean Ellenberg indices for environmental indicators (L=Light; F=Moisture; R=Reaction/pH; N=Nutrients; S=Salinity) and for climate indicators (Tjan=Minimum January temperature; Tjul=Maximum July temperature; Prec=Annual precipitation) were calculated for each quadrat in each time period based on the presence/absence of species in the quadrat. Percentage abundance data for 2012 were converted to 10-point DOMIN as in Rodwell (2006).

4.2 Results

4.2.1 Change in mapped area of dune wetlands

Changes in mapped area of dune wetlands at Sandscale between 1987 and 2012 are summarised in Table 4 below. Figures 10-13 show the extent of the area mapped in 2012, with polygons colour-coded by broad vegetation code (Table 3), and labelled with the NVC communities assigned.

Table 4. Sandscale. Mapped area (ha) of broad vegetation classes in 1987 and 2012, showing net change, and percentage change for classes with area > 1 ha in 1987.

Area summaries	1987	2012	Net change	%change
Slacks+slack/wet transitions	23.7	25.5	1.8	7.8
Slack/dry transitions	7.9	3.0	-4.9	-62.2
Dry habitats	0.0	0.8	0.8	
Other wetlands	30.2	38.4	8.2	27.2
Total slacks	31.6	28.5	-3.1	-9.7
Total slacks and other wetlands	61.8	66.9	5.1	8.3
(Total Mapped Area)	61.8	67.7	5.9	9.5

There was a small net increase in wetland area of around 5 ha, around 8% of the wetland area in 1987, however this is within the error of mapping (Hearn et al. 2011). Detailed change analysis using a change matrix was not possible within the scope of this study. However, based on Table 4 and interpretation of the maps and database (available electronically from Natural England), the following broad changes are apparent from this analysis.

There was a decrease of around 5 ha in slack/dry transitions, and an increase of 8 ha in the area of other wetlands. This relates primarily to areas of M23 Juncus pasture which covers relatively large areas of the eastern half of the site, and which was indistinctly mapped in 1987. Overall, we feel there has been little net change in area of wetland communities, and the small changes observed are likely to be due to differences in interpretation of surveyors.

4.2.2 Vegetation change revealed through analysis of repeated quadrats

In 2012, 35 quadrats were surveyed at Sandscale. These included 6 which were repeat quadrats and could therefore be used for analysis of change over time. An additional 24 quadrats were recorded adjacent to previous piezometer locations. Some of these were deeply flooded at the time of recording, so quadrats were recorded nearby. A further 5 new quadrats were recorded, either in new secondary or embryo slacks, or in other older vegetation types. This analysis concerns the 6 repeat quadrats only. These are listed, together with basic descriptive information in Table 6 at the end of this report, with locations shown in Figure 9.

Changes in Ellenberg environmental and climate indicators are summarised in Table 5. There was no significant change in environmental indicator scores. There was a significant increase in the July temperature indicator and a significant decline in the precipitation indicator. Species richness increased markedly, but the nature of the change in species composition has not been investigated. For example, there may be an increase in undesirable or weedy species.

Table 5. Sandscale. Change in environmental and climatic indicators between 1987 and 2012 showing mean, standard deviation (s.d.) for each year, and whether there was a significant difference over time (in bold, * <0.05, ** <0.01, * < 0.001). N = number of quadrats. See methods for description of indicators.**

N=6	Indicator	1987	2012	Significance
Mean	Light	7.46	7.35	
Mean	Moisture	6.54	6.47	
Mean	pH	5.66	5.60	
Mean	Nutrients	3.34	3.63	
Mean	Salinity	0.37	0.31	
Mean	JanTemp	3.54	3.55	
Mean	**JulTemp**	**14.34**	**14.46**	*
Mean	**Precipitation**	**1127**	**1102**	*
Mean	**Spp Richness**	**14.00**	**23.33**	**
s.d.	Light	0.23	0.10	
s.d.	Moisture	0.70	0.61	
s.d.	pH	0.30	0.19	
s.d.	Nutrients	0.54	0.36	
s.d.	Salinity	0.07	0.05	
s.d.	JanTemp	0.03	0.04	
s.d.	JulTemp	0.06	0.05	
s.d.	Precipitation	11.21	11.34	
s.d.	Spp Richness	5.22	3.93	

4.2.3 Analysis of soils data

Simple physical data from soil cores are shown in Figure 7 and Figure 8 below, grouped by broad vegetation type. Soil pH (Figure 7) was high only in the early successional slacks at the north east of the site. pH values in all other sampled slacks are below 6.5, indicating considerable decalcification. Lowest pH values occur in the wet pasture quadrats, around pH 5.5.

Organic matter contents (Figure 8) are high in the majority of vegetation types, all above 6%, except the early successional slacks where values are <1%. Very high values, >9% occur in the wet calcareous slack types and the wet pasture. Compared with other west coast sites, these are reasonably high, and are typical of slacks over 60 years old (Jones et al. 2008; 2010).

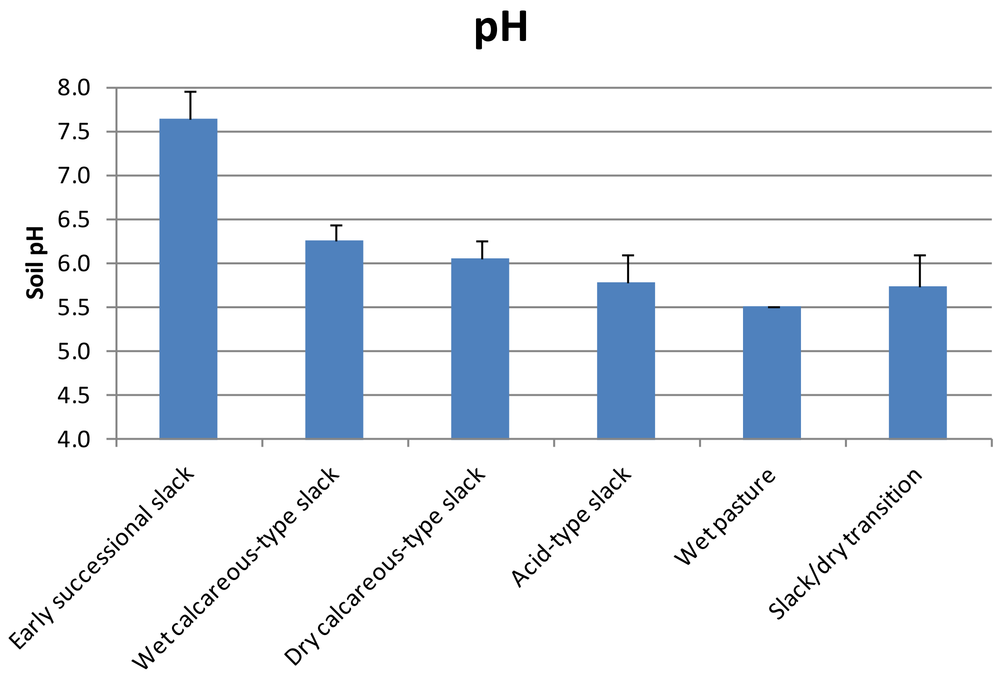

Figure 7. Sandscale. Soil pH, by broad vegetation type. Early successional slack=SD13; Wet calcareous slack = SD15; Dry calcareous slack = SD16; Acid-type slack = SD17.

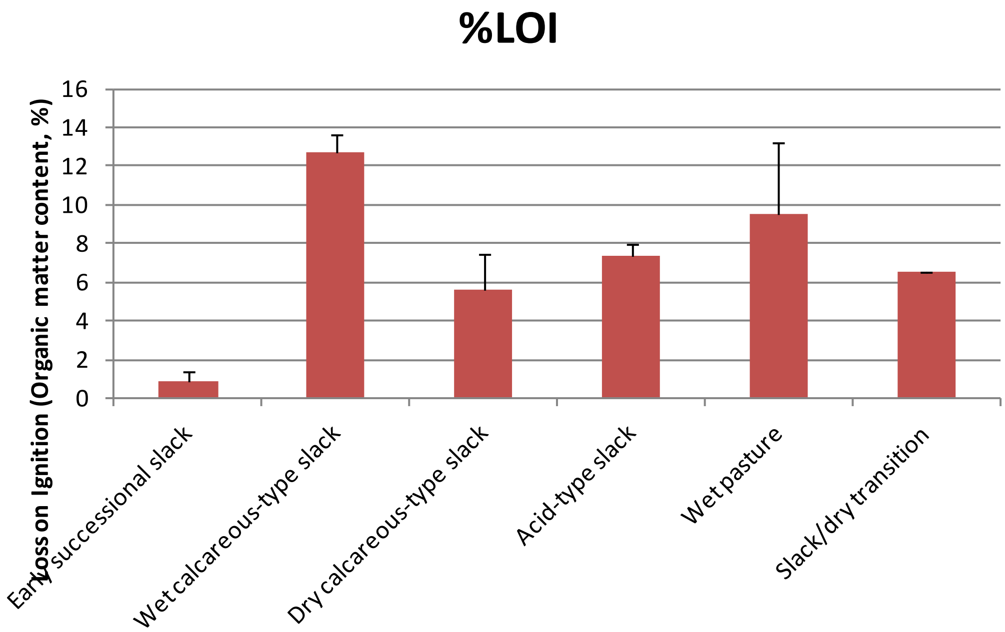

Figure 8. Sandscale. Organic matter (as Loss On Ignition, %), by broad vegetation type. Early successional slack=SD13; Wet calcareous slack = SD15; Dry calcareous slack = SD16; Acid-type slack = SD17.

4.3 Discussion (in context of hydrological & other key local drivers)

There are few signals of change at Sandscale. The only potential signal is an increase in the July temperature indicator. The site rapidly decalcifies to the eastern end, where the vegetation communities overlie acidic soils and turn to acidic pasture and mire-type communities. However, calcareous communities persist on the western edge and new primary and secondary slack areas are forming at the north east of the site.

The hydrological monitoring data are as yet underexploited and additional work on this would be very worthwhile. The results so far show the impact of the drainage network on water levels within the dunes. As the original monitoring network is now almost entirely lost – in such a dynamic part of the landscape, it is quite common for monitoring points to be 'lost' over time. CEH/BGS therefore plan to re-visit Sandscale in order to install additional monitoring points so that monitoring can be continued.

5 Implications for management

- The importance of the drainage network on affecting water levels within the dunes has been identified, however not thoroughly quantified. Whilst a better understanding is required, care should be taken over any activities that may cause the drainage network to operate outside its current range.

- It is recommended that a network of dipwells is reinstated to capitalise on previous records, in the same, or similar, locations where possible.

- It is also recommended that permanent vegetation quadrats be set up adjacent to these dipwells to link potential changes in vegetation to changes in hydrology.

6 References

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7 Quadrat information

Table 6. Sandscale. List of quadrats, with associated environmental data. OM (organic matter) = organic horizon thickness. LOI% (Loss On Ignition) = % organic matter content.

1990 Quad Code	x	y	ANGLE SLOPE (degrees)	ASPECT (degrees)	Veg Height (cm)	OM thickness (cm)	Soil pH	LOI %	Quad Type
T14	319477	475439	0	0	53.2	10	5.4	5.55	RepeatQuadrat
Q4	319353	475607	0	0	28.4	6	5.74	4.69	RepeatQuadrat
Q18	318936	474805	10	225	6	3	6.53	6.48	RepeatQuadrat
Q5	319236	475743	0	0	20.2	3	6.8	5.73	RepeatQuadrat
Q2	319462	475595	0	0	23	9	5.32	6.70	RepeatQuadrat
Q15	318824	475441	0	0	20.6				RepeatQuadrat
N1	319299	475007	0	0	12.4	9	5.22	6.78	NewQuadrat
N2	319118	474879	0	0	16.8	12	5.46	9.81	NewQuadrat
N4	319487	475676	0	0	1	0	8.13	0.24	NewQuadrat
N5	319885	475717	0	0	6.2	3	7.74	1.15	NewQuadrat
N3	319797	475726	2	180	8.1	0	7.06	1.09	NewQuadrat
D15	318622	474690	0	0	26	13	6.71	9.28	DipwellQuadrat
D1	319390	475624	0	0	27.2	5	6.12	5.92	DipwellQuadrat
D31	319514	475394	2	180	8	5	5.99	3.51	DipwellQuadrat
D29	319339	475173	0	0	19.8				DipwellQuadrat
D26	318975	475214	0	0	14.2	7	5.37	8.97	DipwellQuadrat
D26	318975	475214	0	0	14.2	5	6.09	4.04	DipwellQuadrat
D25	318904	475122	2	240	34	6	6.3	4.92	DipwellQuadrat
D22	318905	474928	0	0	53.8	12	6.34	14.04	DipwellQuadrat
D14	318532	474687	0	0	18.6	9	6.05	13.58	DipwellQuadrat

1990 Quad Code	x	y	ANGLE SLOPE (degrees)	ASPECT (degrees)	Veg Height (cm)	OM thickness (cm)	Soil pH	LOI %	Quad Type
D20	319080	474748	0	0	67.6	5	5.42	5.09	DipwellQuadrat
D19	319227	474752	2	180	32.8	10	5.37	6.61	DipwellQuadrat
D16	318854	474503	0	0	30.4	9	5.64	6.12	DipwellQuadrat
D8	318327	475204	0	0	24.6	7	5.34	8.45	DipwellQuadrat
D12	318388	474726	10	45	24.4	9	7.3	5.13	DipwellQuadrat
D4	318838	475617	0	0	26.2	4	6.26	3.36	DipwellQuadrat
D10	318251	474984	0	0	39.8	3	7	4.75	DipwellQuadrat
D11	318486	474952	0	0	22	10	5.91	48.64	DipwellQuadrat
D23	318702	474886	0	0	19.2	8	5.47	9.54	DipwellQuadrat
D24	318670	475071	0	0	33.2	7	6	4.87	DipwellQuadrat
D2	318969	475441	0	0	70	6	5.53	6.11	DipwellQuadrat
D3	318665	475424	0	0	17	5	6.57	4.94	DipwellQuadrat
D5	318591	475589	0	0	23	8	6.28	6.31	DipwellQuadrat
D6	318349	475480	0	0	20.4				DipwellQuadrat
D9	318464	475271	0	0	19.2	5	5.91	7.35	DipwellQuadrat
D18	319329	474707	1	180	60.6	14	5.34	25.75	DipwellQuadrat

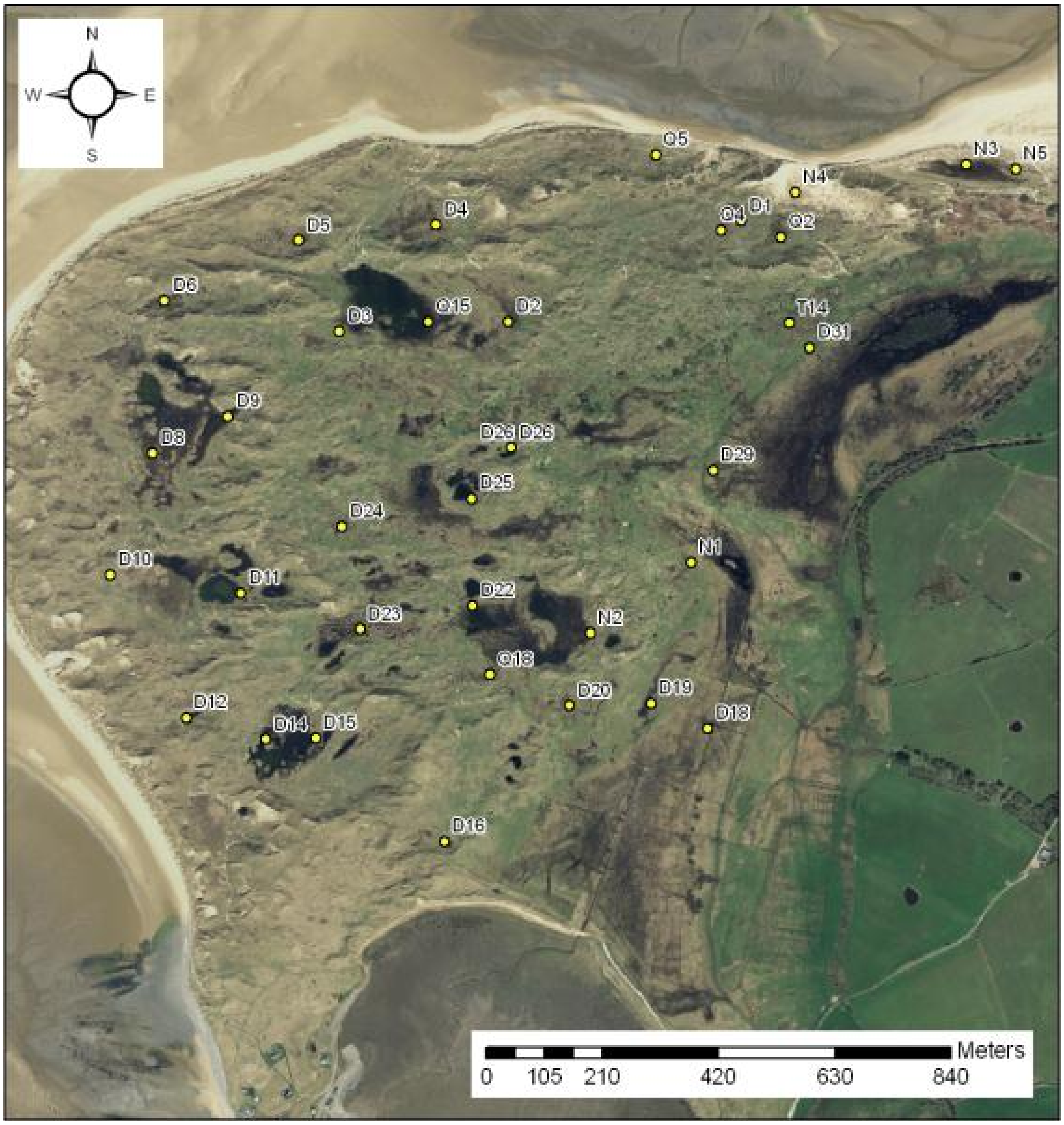

Figure 9. Locations of quadrats surveyed at Sandscale Haws NNR dunes. © NERC (CEH) 2013, © Next Perspectives.

8 Survey maps

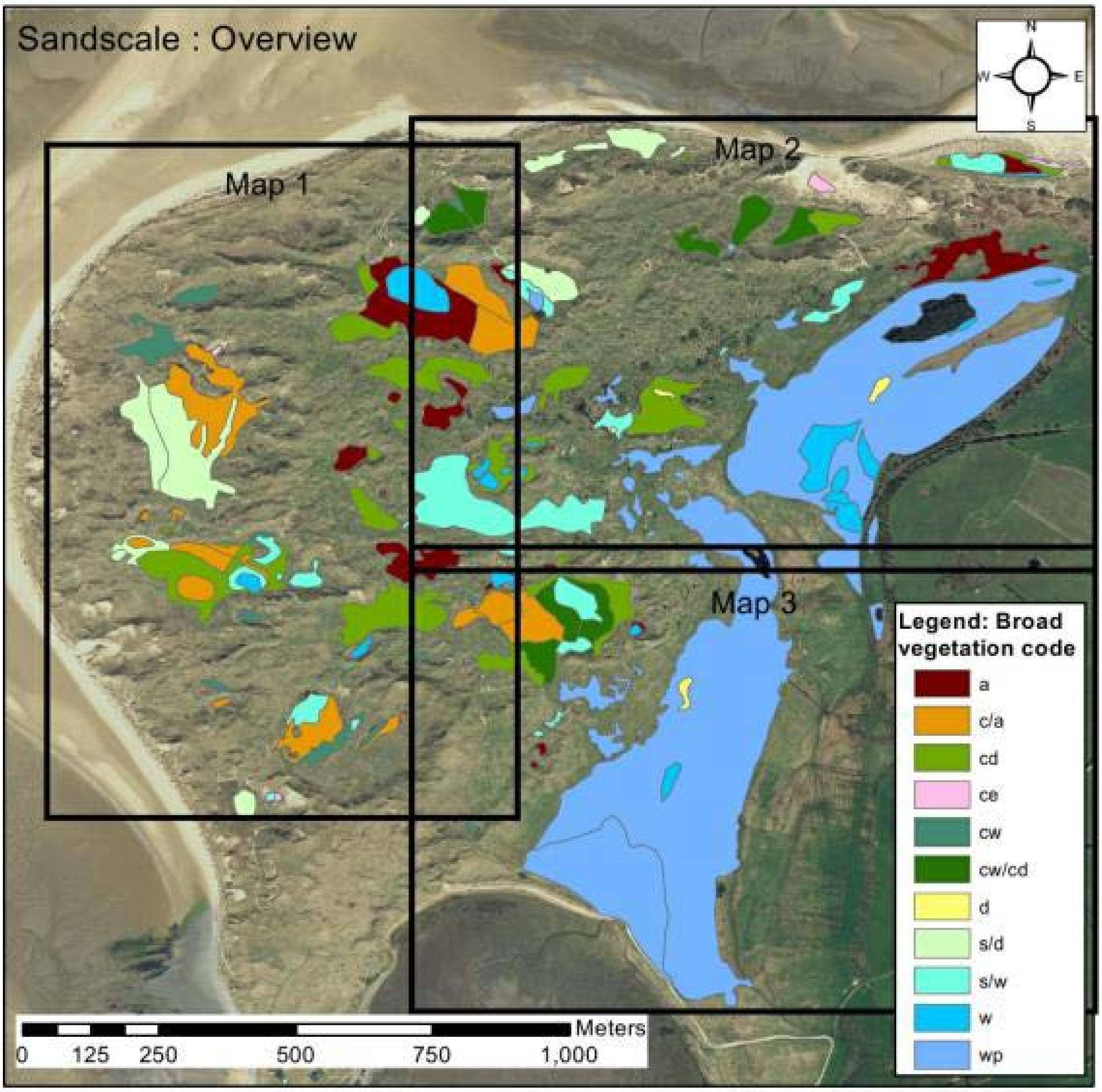

Figure 10. Sandscale. Overview of NVC communities mapped during 2012 vegetation survey, with reference to areas covered by maps 1-3 (Figures 10-12). Broad vegetation codes are described in Table 3. © NERC (CEH) 2013, © Next Perspectives.

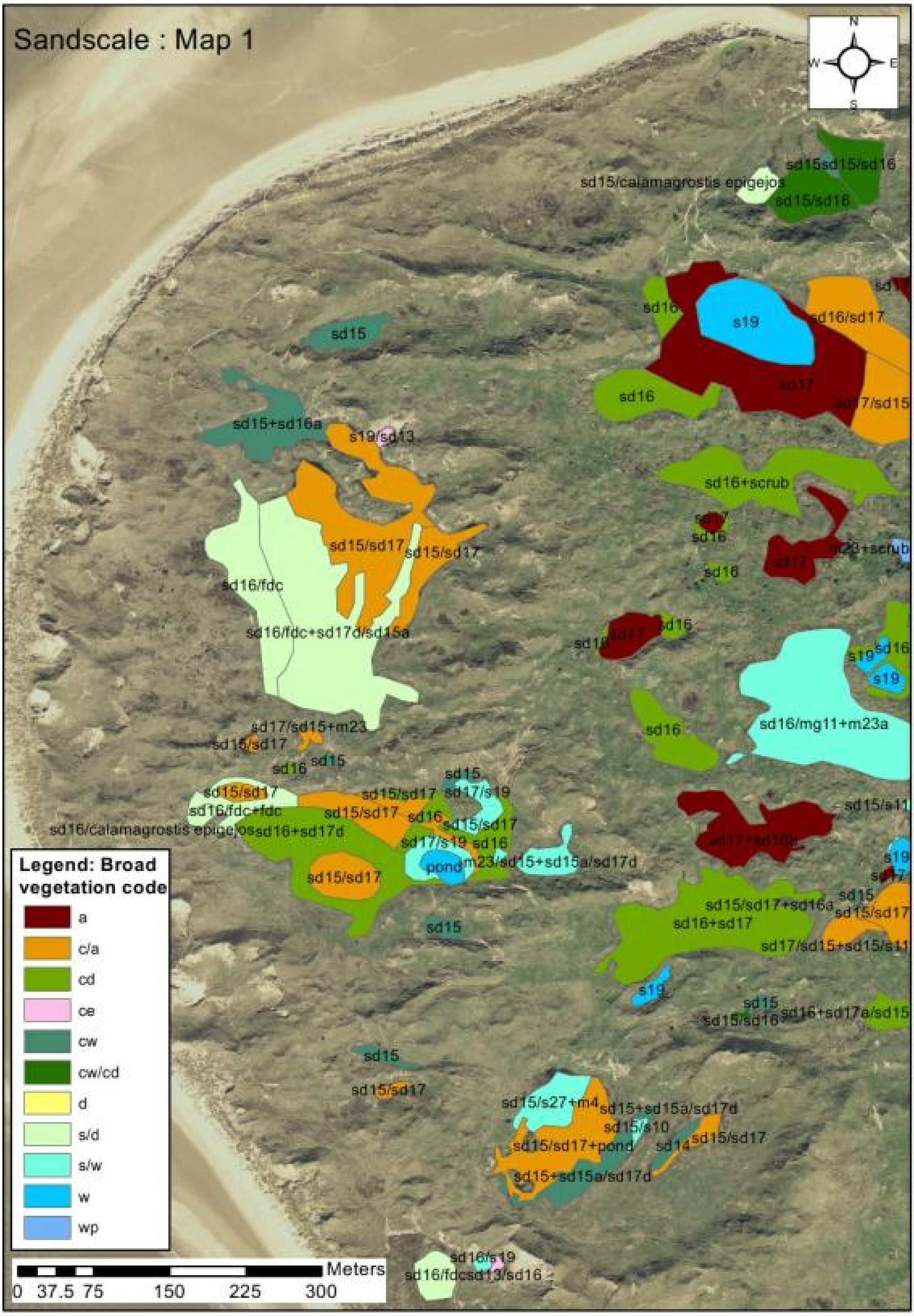

Figure 11. Sandscale Map 1. NVC communities mapped during 2012 vegetation survey. Broad vegetation codes are described in Table 3. © NERC (CEH) 2013, © Next Perspectives.

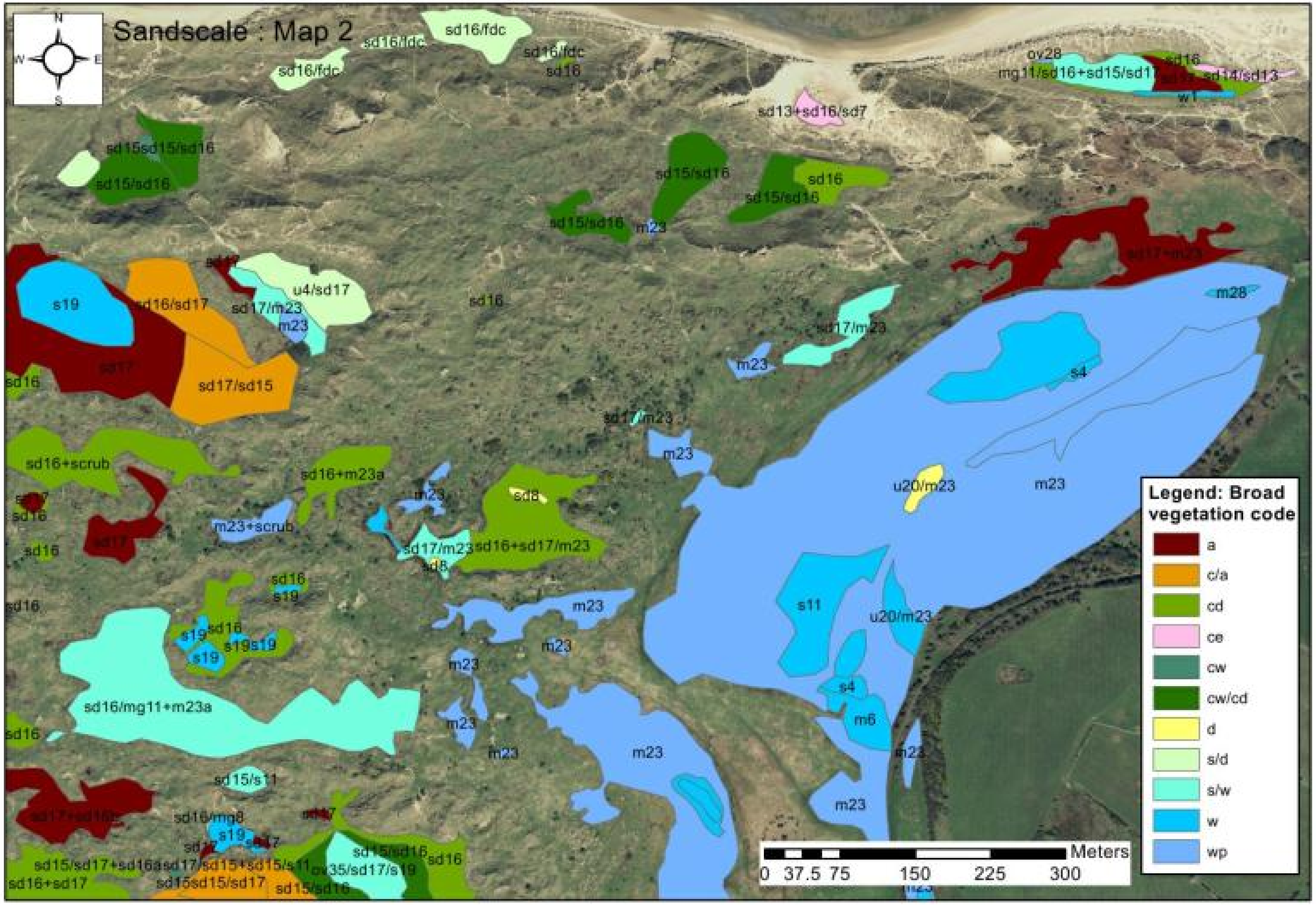

Figure 12. Sandscale Map 2. NVC communities mapped during 2012 vegetation survey. Broad vegetation codes are described in Table 3. © NERC (CEH) 2013, © Next Perspectives.

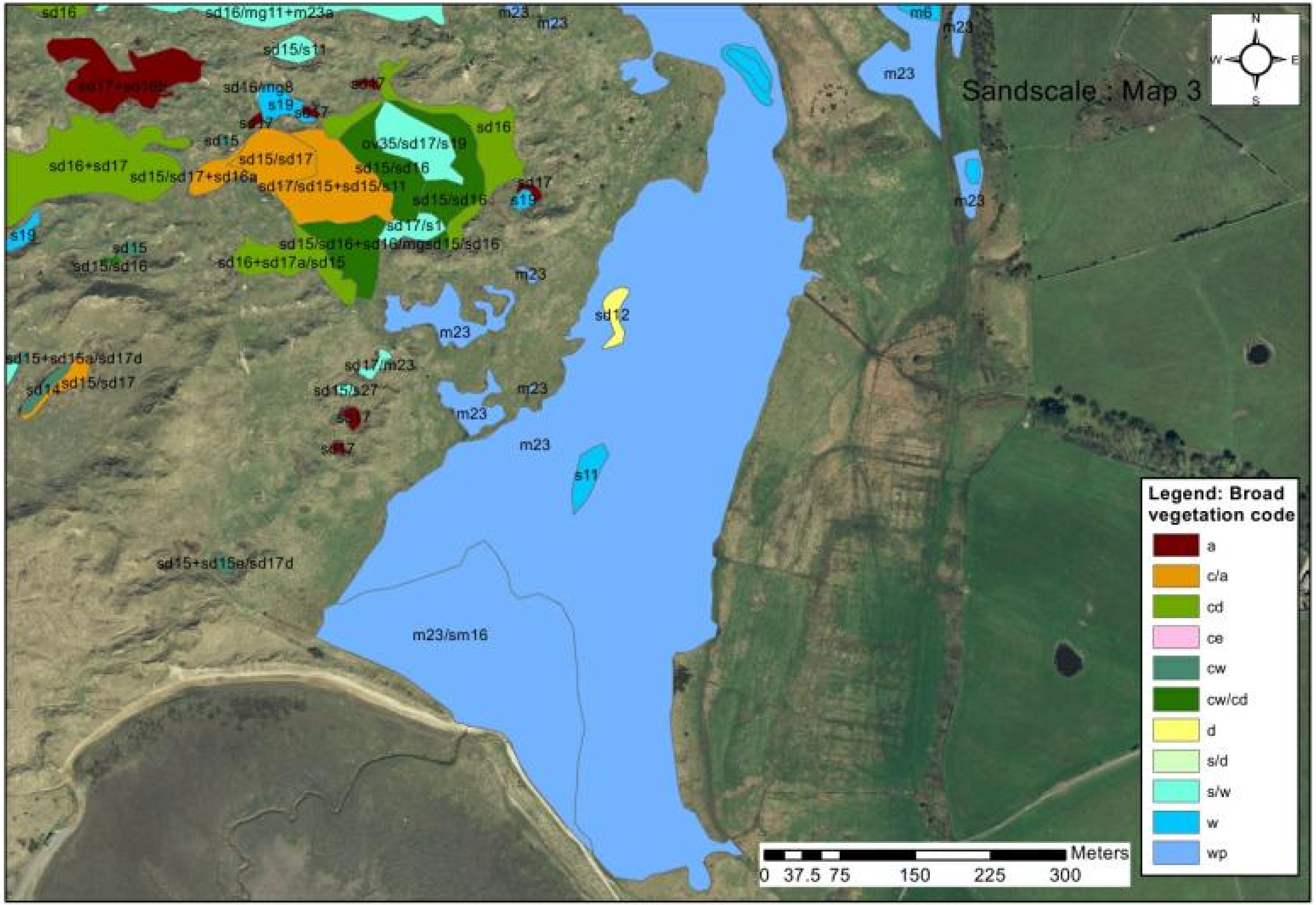

Figure 13. Sandscale Map 3. NVC communities mapped during 2012 vegetation survey. Broad vegetation codes are described in Table 3. © NERC (CEH) 2013, © Next Perspectives.