

# Sand Dune Habitat Map using CASI & LIDAR

## Data

The Habitat Maps classifications were carried out on a site by site basis, with the attribute 'Site' containing the site name. This product is derived from CASI multispectral data gathered on the date provided in the Attribute 'CASI\_Date' and LIDAR elevation data gathered on the date provided in the Attribute 'LIDAR\_Date'. It also uses ground truth data collected by Natural England/ Environment Agency after the CASI capture. The year of analysis and version number of product are in the attributes 'AnalysisYr' and 'Version' accordingly.

## Ground Data

Ground data was collected by Natural England / Environment Agency staff. This involved the habitat classes being identified onto field maps or more recently collected digitally using ESRI collector software. These samples cover all habitat classes being identified at the site with as great geographical range as possible. This information was then digitised into a polygon Shapefile and used for the classification training and ground truthing of the habitat map.

## Description

This habitat map is a remotely sensed product, using CASI and LIDAR data and potentially other GIS products. The data is in Shapefile format and can be loaded in a GIS. Please display these using the optimal display classes contained in layer file. The analysis extent for each site was defined according to ancillary data and adjusted according to field notes made during the Ground Truthing Survey.

It classifies the habitats into site relevant classes, visible at the time of CASI image capture. The attribute 'Class' provides the classified habitat, with some polygons also containing a 2nd habitat class in the '2nd\_Class' attribute. As this output layer is a merged product of many years work the class name has been updated to the most suitable recent name if it fits the current naming structure, for example Sea Buckthorn has been renamed Dune Scrub - Sea Buckthorn to bring it in line with the more up to date classification structure, these changes can be seen in the 'OldClassNa' column.

For habitat class descriptions refer to:

- Sand Dune Mapping 1 classes for sites: Saltfleetby Dunes, Studland Dunes & Winterton Dunes.
- Sand Dune Mapping 2 classes for sites: Dawlish Warren, Haverigg Haws, Lindisfarne, North Walney, Sandscale Haws, Sandwich Dunes & Drigg Dunes.
- Sand Dune Mapping 3 classes for sites: North Norfolk Coast.
- Sand Dune Mapping 4 classes for sites: Berrow Dunes, Braunton Burrows, Gibraltar Point Dunes, Great Yarmouth and North Denes Dunes, Gwithian to Mexico Towans, Northumberland Dunes, Penhale Dunes & Sefton Coast Dunes.
- Sand Dune Mapping 5 classes for sites : Saltfleetby Dunes (v.2), Teesmouth Dunes, South, Walney Dunes, Silloth and Grune Point Dunes, Studand (v.2), North Walney (v.2), Dawlish Warren (v.2), Humber Lower and Humber Spurn.

These classes were created, and habitat mapping was being carried out for the Environment Agency & Natural England Collaboration: Operational Use of Remote Sensing for Environmental Monitoring.

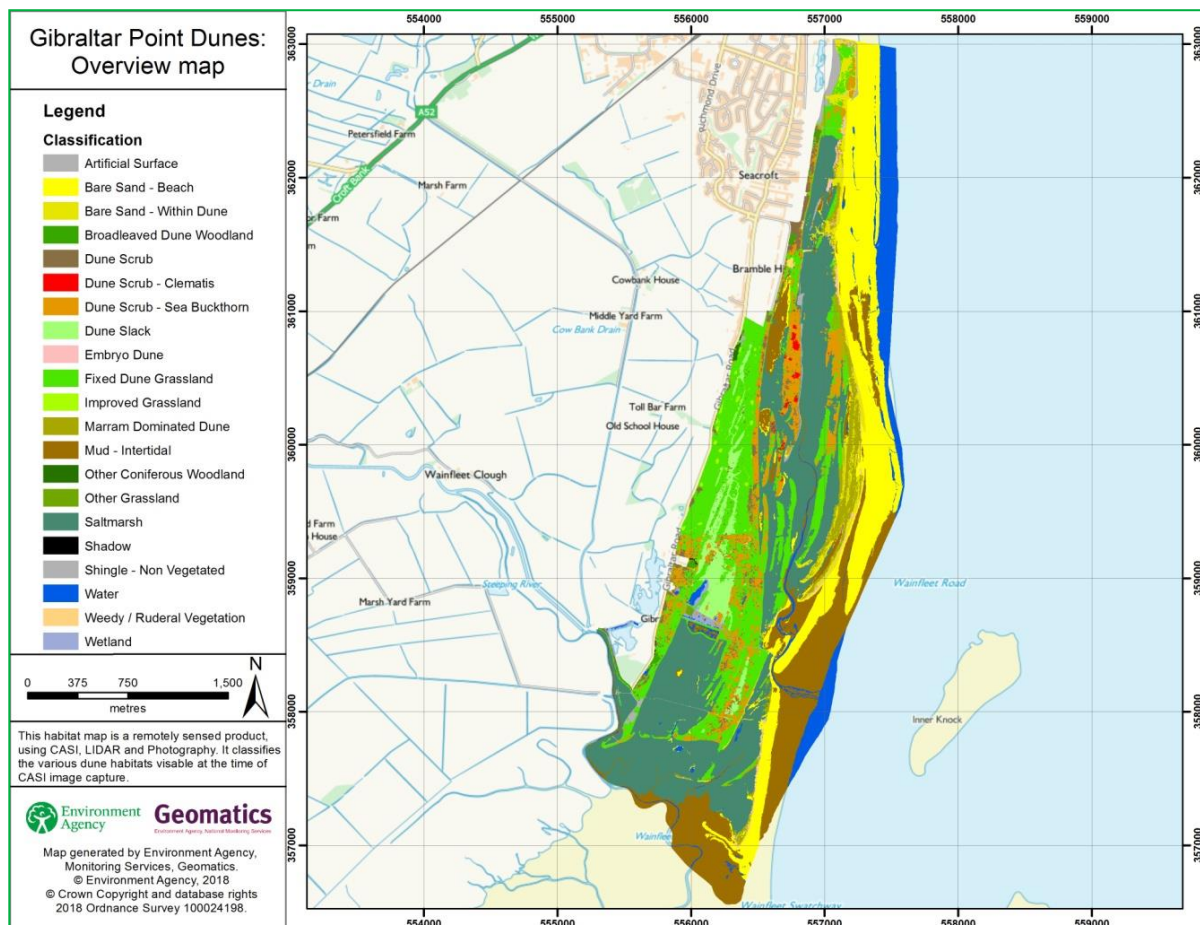
The habitat map was created using a spectrally segmented image, which means that instead of individual pixels being classified, groups of similar pixels were combined together and classified. This limits the possible confusion from individual pixels, especially in vegetation mosaics, where it's the group of species that make the community and habitat class. The classification used a supervised technique called Rule based spectral segmentation classification, and Boolean operations. These techniques used the CASI, LIDAR and Ground data for the classification and to identify the characteristics of the different habitats and to fit them into one of the classes.

The classifications had a quantitative accuracy assessment carried out on them in the form of a confusion matrix using ground data set aside and not used in training the classifier. Alongside this aerial photography was used to check and make final improvements to the habitat map.

Data Collation Date: 30/04/2021

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Example Map of the Habitat Map Product:



## Sand Dune Mapping 1 - Class descriptions

**Artificial Surface** – The Artificial Surface class includes built artificial surfaces, such as buildings, roads, car parks and tracks.

**Bare Sand** – Within this class are sandy beaches, bare sand paths and.

**Embryo Dune** – These are sparsely vegetated areas with pioneer plant species and potentially some species from the succeeding class mobile dunes. Embryo Dunes also have a low dune form.

**Mobile Dune** – Mobile Dunes are defined by their dominance of *Ammophila arenaria* (Marram Grass). Generally they are on higher dune ridges positioned landward of Bare Sand and any Embryo Dunes. They are also found on ridges surrounding blow outs. As long as *Ammophila arenaria* is the dominant species, with bare sand mixed in or next to this species, it is classified as Mobile Dune.

**Fixed Dune Grassland** – This class includes any grassland, other than those within the Embryo and Mobile Dunes, including communities such as lichen dominant, moss dominant grasslands and semi-fixed dunes (dunes still with a dominance of *Ammophila arenaria*, however with a number of other flora). It also includes humid dune grasslands found within dune slacks.

**Fixed Dune Heath** – Any heath, whether wet or dry on the site is included within this class.

**Dune Scrub** – Vegetation which in the Canopy Height Model (CHM), was between 0.5 – 2m tall is classified as Dune Scrub, unless it is bordered to the Woodland class or identified specifically as Sea Buckthorn scrub. Areas of vegetation which were over 2m tall, but under the minimum area to be considered Woodland, are also considered as Dune Scrub.

**Sea Buckthorn** – Sea Buckthorn was identified in a class of its own, due to the dominance it had within the dune system and the importance this habitat is considered to have. Both as an Annex 1 listed habitat and potentially invasive species.

**Woodland** – The Woodland class is defined by its height and area. The vegetation height needs to be over 2m tall, or over 0.5m and bordering vegetation over 2m tall. It also needs to have an area of over 2000m<sup>2</sup>.

**Invasive** – This class includes dominant areas of species which are considered invasive plants in the UK.

**Cleared Area** – This class is defined by vegetation succeeding in areas which have been recently cleared of Dune Scrub or Sea Buckthorn.

**Open Water** – Any open water bodies, whether sea, ponds, lakes or artificially created water bodies are included in this class.

**Wetland** – This class contains species generally adapted to permanently or seasonally flooded ground conditions, and can contain areas of a single dominant species or a mosaic.

**Saltmarsh** – Saltmarsh is defined by halophytic vegetation, which is generally found where there is regular immersion by the sea. Some areas of low lying ground may have been regularly immersed, but have since been cut off may still contain halophytic vegetation and these to have been identified as saltmarsh.

**Dune Slack** – A secondary class, applied to areas identified by the Dune Slacks Likely Locations product.

Table 1: Classes used in the habitat mapping which relate to an Annex 1 class.

Habitat Map Class	Annex I
Embryo Dune	2110 - Embryonic shifting dunes
Mobile Dune	2120 - Shifting dunes along the shoreline with <i>Ammophila arenaria</i> ("white dunes")
Fixed Dune Grassland	2130 - Fixed dunes with herbaceous vegetation ("grey dunes")
Fixed Dune Heath	2150 - Atlantic decalcified fixed dunes (Calluno-Ulicetea)
Sea Buckthorn	2160 - Dunes with <i>Hippophae rhamnoides</i>

## Sand Dune Mapping 2 - Class descriptions

**Artificial Surface** – Built artificial surfaces, such as buildings, roads, car parks, tracks and groynes.

**Bare Sand Beach** – Sand beaches are the only feature included within this class.

**Bare Sand – Within Dune** – Within this class are areas of bare sand, which are not considered beach. This may include bare sand paths, blowouts and bare sand sections of man-made flood defences.

**Shingle** – Any areas of shingle found on the site, whether these are part of the main beach, or within the dune system are included within this class.

**Bare Soil/Rock** – Bare Soil or Rock that are not man-made features, i.e. Groynes, however the bare soil or rock may be visible due to footpath erosion or coastal processes. Shingle is the only a natural bare rock feature not classified in this class.

**Permanent Water** – Any Permanent water bodies, whether sea, ponds, lakes or artificially created water bodies are included in this class. These are identified only from the CASI data.

**Seasonal Water** – Any Seasonal water is included in this class. This is areas which are mapped as water during the winter flown LIDAR data, however appear as sand or vegetation during the Summer CASI data. Seasonal Water will only be recorded in the '2nd\_Class' attribute.

**Embryo Dune** – These are sparsely vegetated areas with pioneer plant species and potentially some species from the succeeding class mobile dunes. Embryo dunes also have a low dune form and are only found at the seaward side.

**Marram Dominated Dune** – Marram-dominated dune are defined by their dominance of *Ammophila arenaria* (Marram Grass). Generally they are on higher dune ridges positioned landward of Bare sand and any Embryo Dunes. They are also found on ridges surrounding

blow outs. Mostly the *Ammophila arenaria* will have bare sand mixed in or next to this species, although limited bryophytes may also be present. *Ammophila arenaria* can also be dominant in semi-fixed dunes with other grass species such as *Festuca* spp (Fescue)., however, as long as *Ammophila arenaria* is the dominant species it is classified as Marram-dominated dune.

**Fixed Dune Grassland** – This class includes any natural and semi-natural grassland, other than those within the Embryo and Mobile Dunes, including communities such as lichen dominant and moss dominant grasslands.

**Fixed Dune Heath** – Any areas of dominant heath, whether wet or dry on the site is included within this class.

**Dune Slack** – This class was only identified within areas already identified from the Likely Dune Slack Locations Product. The class includes humid dune grasslands found within dune slacks, even if these are forming dune slacks, potentially with some halophyte species.

**Dune Slack – Creeping Willow** – This class includes any areas of dense *Salix repens* (Creeping Willow) which are within the Likely Locations of Dune Slacks product.

**Dune Scrub** – Vegetation which in the Canopy Height Model (CHM), was between 0.5 – 2m tall is classified as Dune Scrub, unless it is bordered to the Woodland class. Areas of vegetation which were over 2m tall, but under the minimum area to be considered Woodland, are also considered as Dune Scrub. This class does not include any *Salix repens* or *Hippophae rhamnoides* (Sea Buckthorn).

**Dune Scrub - Sea Buckthorn** – *Hippophae rhamnoides* was identified in a class of its own, due to the dominance it had within the dune system and the importance this habitat is considered to have. Both as an Annex 1 listed habitat and potentially invasive species.

**Dune Scrub – Creeping Willow** – Any areas of dense *Salix repens* which are not considered to be within a dune slack are included within this class.

**Broadleaved Dune Woodland** – The woodland classes are defined firstly by their height and area. The vegetation height needs to be over 2m tall, or over 0.5m and bordering vegetation over 2m tall. It also needs to have an area of over 2000m<sup>2</sup>. Within this height and area defined woodland, Broadleaved Dune Woodland is separated from Coniferous Dune Woodland.

**Coniferous Dune Woodland** – The woodland classes are defined firstly by their height and area. The vegetation height needs to be over 2m tall, or over 0.5m and bordering vegetation over 2m tall. It also needs to have an area of over 2000m<sup>2</sup>. Within this height and area defined woodland, Coniferous Dune Woodland is separated from Broadleaved Dune Woodland.

**Invasive** – This class includes dominant areas of species which are considered invasive plants in the UK, and have not been provided with an individual class, i.e. Sea Buckthorn.

**Weedy Ruderal Vegetation** – This class includes Weedy / Ruderal Vegetation which has formed dominant patches within the dune system. These areas often have little or no understory species and may have been cleared of scrub in the past.

**Wetland** – This class contains species generally adapted to permanently or seasonally flooded ground conditions, and can contain areas of a single dominant species or a mosaic.



**Improved Grassland** - This class includes improved agricultural or recreational grasslands, i.e. Lawns, Golf Courses or Improve Pasture. Short even swards, flat, with limited species which is managed by grazing or mowing, usually little litter or thatch layer and no herb species are present.

**Saltmarsh** – Saltmarsh is defined by halophytic vegetation, which is generally found where there is regular immersion by the sea. Some areas of low lying ground which used to have been regularly immersed, but have since been cut off may still contain halophytic vegetation. It is also possible that halophytic vegetation is surviving due to saline percolating through sand layers.

Table 2: Classes used in the habitat mapping which relate to an Annex 1 class.

Habitat Map Class	Annex I
Beach	1140 - Mudflats and sandflats not covered by seawater at low tide
Embryo Dune	2110 - Embryonic shifting dunes
Marram-dominated dune	2120 - Shifting dunes along the shoreline with <i>Ammophila arenaria</i> ("white dunes")
Fixed Dune Grassland	2130 - Fixed dunes with herbaceous vegetation ("grey dunes")
Fixed Dune Heath	2150 - Atlantic decalcified fixed dunes (Calluno-Ulicetea)
Dune Slack	2190 – Humid dune slacks
Dune Slack – Creeping Willow	2170 - Dunes with <i>Salix repens</i> ssp. <i>argentea</i> (Salicion arenariae)
Dune Scrub – Creeping Willow	2170 - Dunes with <i>Salix repens</i> ssp. <i>argentea</i> (Salicion arenariae)
Dune Scrub - Sea Buckthorn	2160 - Dunes with <i>Hippophae rhamnoides</i>

**Classes and descriptions are the same as in Sand Dune Mapping 2, with the following additions & changes:**

**Annuals** – This class contains annuals colonising sand or bare soil/ mud, which are not considered part of the Saltmarsh.

**Floodplain and Coastal Grazing Marsh** – Pasture and grassland with ditches to maintain the water levels, containing standing brackish or fresh water. These areas are normally grazed and some are cut for

hay or silage. Bog, fen or flush vegetation also make up this class, however Reedbeds are recorded separately.

**Mud - Intertidal** – This includes all bare mud within the Intertidal Zone.

**Other Grassland** – All grassland not on a dune system, except Improved Grassland and that associated with Floodplain and Coastal Grazing Marsh is included within this class.

**Other Broadleaved Woodland** – The woodland classes are defined firstly by their height and area. The vegetation height needs to be over 2m tall, or over 0.5m and bordering vegetation over 2m tall. It also needs to have an area of over 2000m<sup>2</sup> and not within the dune system. Within this other woodland, Other Broadleaved Woodland is separated from Other Coniferous Woodland.

**Other Coniferous Woodland** – The woodland classes are defined firstly by their height and area. The vegetation height needs to be over 2m tall, or over 0.5m and bordering vegetation over 2m tall. It also needs to have an area of over 2000m<sup>2</sup> and not within the dune system. Within this other woodland, Other Coniferous Woodland is separated from Other Broadleaved Woodland.

**Other Scrub** – These definitions are for scrub not within the dune system. Vegetation which in the Canopy Height Model (CHM), was between 0.5 – 2m tall is classified as Other Scrub, unless it is bordered to a woodland class. Areas of vegetation which were over 2m tall, but under the minimum area to be considered woodland, are also considered as Other Scrub. Bramble (*Rubus fruticosus*) is also included within this class.

**Reedbeds** – Reedbeds are defined by *Phragmites australis* (Common Reed) as the dominant vegetation. There may or may not be standing water beneath this vegetation. Commonly this habitat is found in and along freshwater/ brackish waterbodies. This class does not include *Phragmites australis* found within the intertidal zone, instead this would be included within the Saltmarsh class.

**Other Intertidal Vegetation** – This class contains intertidal vegetation not mapped in another class. The majority of this class will be made up from newly formed saltmarsh to the 2013 Saltmarsh Extent, Seagrass (*Zostera* spp.) or algae. No distinction was made between these habitats.

Replacing Shingle are:

**Shingle – Non Vegetated** – Any areas of shingle found on the site, without vegetation, whether these are part of the main beach, or within the dune system are included within this class. There is no separation of shingle within the Intertidal zone and that which is not, with shingle within either zone included within this class.

**Shingle – Vegetated** – Any areas of shingle with vegetation found on the site, whether these are part of the main beach, or within the dune system are included within this class.

Table 3: New classes used in the habitat mapping which relate to an Annex 1 class.

Habitat Map Class	Annex I
Intertidal Mud	1140 - Mudflats and sandflats not covered by seawater at low tide

### Sand Dune Mapping 4 - Class descriptions

**Classes and descriptions are the same as in Sand Dune Mapping 3, with the following additions:**

**Cloud** – If there is cloud cover in the CASI image the area is masked and classified as cloud as it is not possible to ascertain the habitat below.

**Dune Scrub - Clematis** – With some widespread areas of clematis covering scrub a specific category created to identify the extent of Dune Scrub clematis.

**Dune Scrub - White Poplar** – Specifically created for Sefton Dunes where areas of White Poplar were asked to be mapped.

**Hard Cliff** – Due to the hard cliffs present at the north of the site at Gwithian to Mexico Towans, this class was included.

**Invasive - Bracken** – In a move to separate the Invasive category into species have introduced sub-classes within Invasive.

**Other Maritime Grassland** – Grassland that is within the dune system area but on maritime rock and not considered dune grassland.

**Shadow** – Due to capture times of the CASI, shadows can be cast across the image and areas that are in full shadow are mapped accordingly as it is uncertain of the habitat in that area.

### Sand Dune Mapping 5 - Class descriptions

**Classes and descriptions are the same as in Sand Dune Mapping 4, with the following additions:**

**Disturbed Ground** – Areas of vegetation that have seen vegetation cleared and the terrestrial area moved.

**Dune Slack – Scrub** – Dune Slack class split out to identify areas of scrub within the slack this allows both classes to be shown.

**Dune Slack – Vegetation** – Dune Slack class split out to identify areas of dune slack vegetation (this class was used for Studland dunes after discussions with local site manager).



**Dune Slack – Wetland** – Dune Slack class split out to identify areas of areas of wetland within the slack, this allows both classes to be shown.

**Dune Slack – Woodland** – Dune Slack class split out to identify areas of areas of woodland (specifically Wet Woodland, originally used at Studland Dunes).

**Fucus** – Areas of *Fucus vesiculosus* identified in the intertidal zone.

**Industrial Deposit - Unvegetated** – Areas of unvegetated Industrial deposit, added on Teesmouth Dunes where "slag" from steel works deposited on dune system.

**Industrial Deposit - Vegetated** – Areas of vegetated Industrial deposit, added on Teesmouth Dunes where "slag" from steel works deposited on dune system. Vegetation mainly short and mixed.

**Intertidal Sediment** – Areas of intertidal zone that are an undefined sediment.

**Intertidal Vegetation** – Vegetation within the intertidal zone however undefined – could be Saltmarsh, Seagrass, Macro Algae etc

**Invasive – Rhododendron** - Separate class within the invasive category for *Rhododendron ponticum*.

**Invasive – Rosa rugosa** – Separate class within the invasive category for *Rosa rugosa* (Japanese Rose).

**Invasive or Scrub** – Classified at the Silloth and Grune Point site where ground data was interpreted from aerial imagery, where no real distinction could be made.

**Sand Dune / Saltmarsh Transition** – Class to identify the transition zone between saltmarsh and sand dune. This area may be below HAT and less open to the regular tide.

**Semi Improved Grassland** – Used on golf courses mostly for the fairways. Where they are not as natural as the rough areas which are generally classed as fixed dune grassland, nor the golf greens which are generally classed as improved grassland.

**Unimproved Grassland** – Grasslands that are semi-natural habitats, which have developed as a result of sustained grazing, and they support a wide range of associated plant and animals