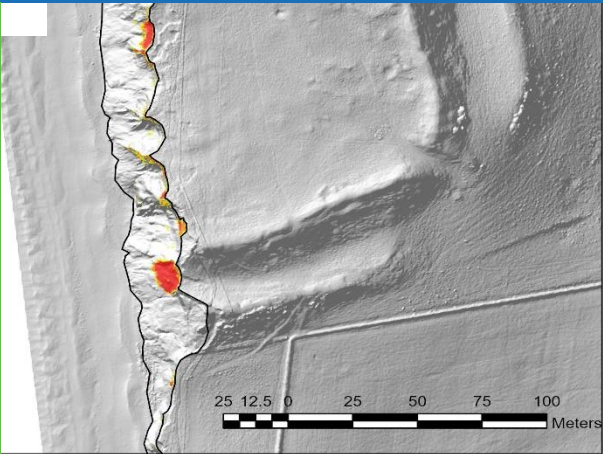


Project: CHERISH Dinas
Dinlle

Title: DEM of Difference

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1 Introduction:

The Royal Commission on the Ancient and Historical Monuments of Wales (RCAHMW) conducted a photogrammetric unmanned aerial vehicle (UAV) survey of Dinas Dinlle Prehistoric Coastal Fort, Gwynedd, Wales in June 2018 and March 2021. Point clouds were generated to produce a Digital Elevation Model (DEM). TechWorks Marine (TWM) were contracted to produce a DEM of Difference from these point clouds to compare sediment change over the interval.

2 Data acquisition

The RCAHMW Phantom 4 UAV was used to capture photogrammetric images of the fort and georeferenced using ground control points (GCPs) surveyed in using a Leica GS16 used in RTK mode using Leica SmartNet. The imagery was processed using Structure from Motion (SfM) software Agisoft Metashape. Processed derived data comprises an xyz pointcloud.

3 DEM of Difference Creation

The DEM of difference was produced using the following methodology.

- 1 XYZ pointclouds for 2018 and 2021 converted to .las files
- 2 .LAS files imported into ArcGIS Pro 3.0
- 3 A raster produced for each year with cells at 0.25 m resolution.
- 4 2018 DEM elevation values were subtracted from the 2021 DEM elevation values to provide assessment of change at each cell location.
- 5 Colour change was applied with breaks provided at intervals to highlight sediment change (Figure 1).

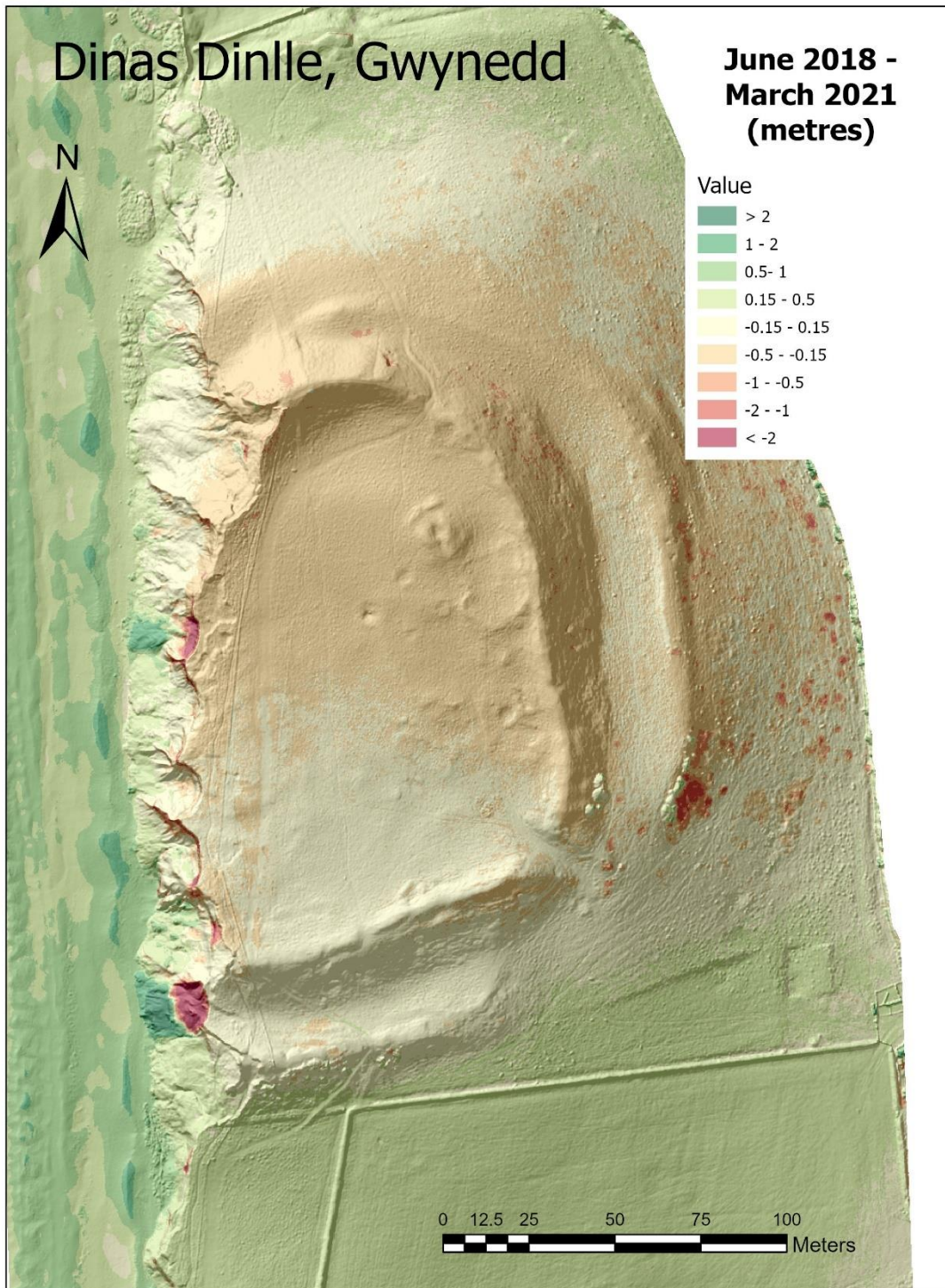


Figure 1: DEM of Difference. Red is land surface lowering (e.g. erosion), green is land surface raising (e.g. deposition)

4 Change Analysis

The 2018 UAV survey was conducted in June with full vegetation cover, while the 2021 survey was conducted in March with reduced vegetation cover. As the photogrammetry process includes

vegetation cover in the DEM formation, changes in both vegetation cover and sediment transport will be recorded (Figure 1). Changes in elevation on the eastern side of the fort are likely caused by vegetation cover change.

Elevation changes interpreted as sediment transport are noted on the sandy cliff face on the western and southwestern margin of the fort (Figures 2&3). Sediment loss is localised, indicating discrete points of erosion. Higher volumes of erosion are recorded along the top of the cliff, with up to 5.6 m elevation change recorded. While sediment loss is noted from the top of the cliff, sediment gain (up to 3.7 m) is recorded beneath, indicative of slumping. Sediment gain is recorded along the beach front (Figure 1), indicating net accretion between the two survey dates.

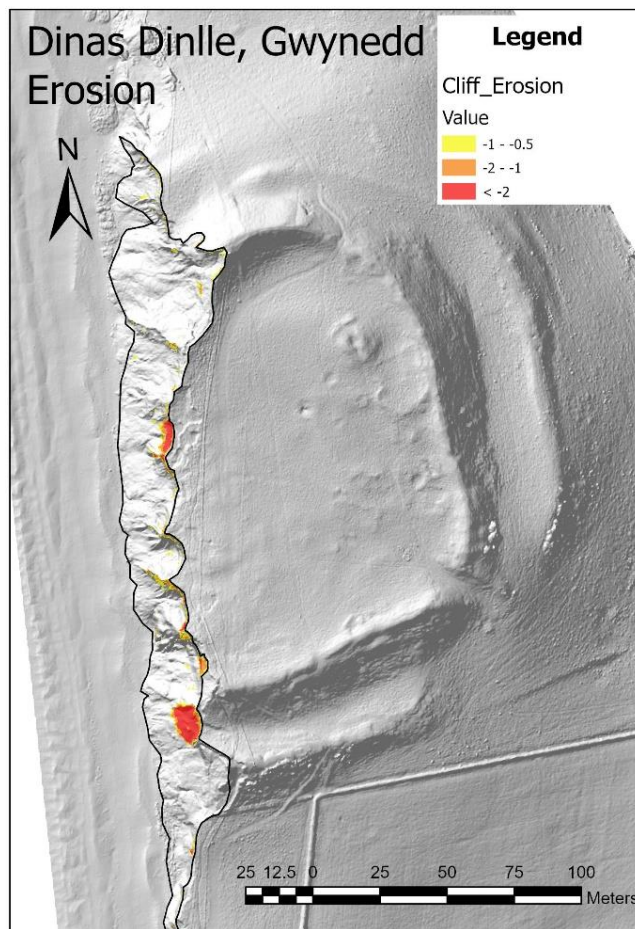


Figure 2: Erosion >0.5 m recorded on the cliff face, with area of investigation (black polygon)

Indicative sediment volume change in the cliff face was calculated by analysing elevation change > 0.5 m within the western cliff. 0.5 m was chosen to minimise the impact of vegetation change. This process results in 580 m³ sediment erosion from the top of the cliff (Figure 2). Much of this sediment was redistributed to the base of the cliff where elevation gain is recorded (Figure 3). Taking cells with > 0.5 m elevation gain, results in an indicative value of 696 m³ deposition, mostly at the toe of the slope. This reveals a total of 116 m³ sediment added to the cliff area. This net sediment gain may be due to beach accretion and could indicate a process for erosion other than wave action (e.g. erosion from rainfall events).

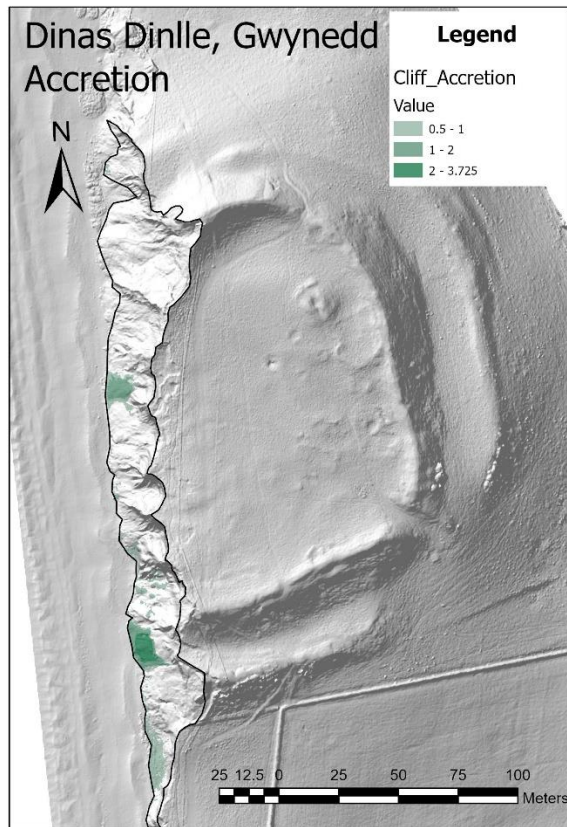


Figure 3: Accretion >0.5 m recorded on the cliff face, with area of investigation (black polygon)

5 Conclusion

At Dinas Dinlle, Gwynedd sediment transport is focused at discrete locations along the sandy western margin of the fort. Erosion of up to 5.6 m has occurred between June 2018 and March 2021. Sediment transport appears to occur by slumping with erosion at the top of the cliff, and deposition at the toe. Overall, there is a net elevation gain along the beach and cliff face, though this includes both sediment and vegetation change.