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MULTI-DECADAL MONITORING OF COASTAL DUNE VEGETATION AND WATER DYNAMICS USING HIGH-RESOLUTION SATELLITE IMAGERY

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Long-term monitoring of vegetation and surface water dynamics is crucial for effective conservation and management of coastal dune systems. This study investigates multi-decadal changes in the Sheskinmore Nature Reserve, Donegal, Ireland (1951 - 2023) and maps vegetation communities for 2023 using high-resolution satellite imagery.

Historical aerial imagery (1951, 1977, 2000, 2023) was digitized in QGIS to assess geomorphological and land cover changes. Sentinel-2 and Landsat 5/8 imagery (2000 - 2023) was analysed in Python and Google Earth Engine (GEE) using NDVI, NDWI, and MNDWI indices to quantify vegetation and water cover changes. Automated classification results, validated against digitized historical data, achieved over 85% accuracy. For 2023, spectral data from a major pond was correlated with field vegetation surveys using the EUNIS habitat classification system, achieving over 0% accuracy when validated against an independent blowout.

Results indicate a significant increase in vegetation cover from 1951 to 2023, with losses of 87% bare sand, 48% semi-bare sand, and 94% sandy vegetated surface, while vegetated dunes expanded by 110%. Despite erosion along the southern beach, dune slack coverage remained stable, with continuous pond formation and loss. Automated mapping proves effective for monitoring land cover changes, though seasonal variations in vegetation phenology affect classification accuracy, thus should incorporate multi-seasonal imagery to refine habitat classification and ensure consistent monitoring in future studies.