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Habitat Mapping, Assessment and Monitoring with High-resolution Unoccupied Aerial Vehicle Imagery (iHabiMap)

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What did this research aim to address?

The research demonstrated how Unmanned Aerial Vehicle (UAV) and computer machine learning technology offer an alternative complementary approach to map, assess and monitor habitats. Habitat assessment carried out by qualified ecologists during field visits, is demanding and time-consuming, particularly in remote and inaccessible areas.

The developed approach used a combination of botanical and UAV surveys, image analysis and machine learning to develop methods to accurately map Annex1 habitats in grassland (one site in Glenasmole, Co. Dublin), upland (two sites in Slieve Mish, Co. Kerry and Kippure gates, Co. Wicklow) and coastal (two sand dunes sites in Maharees, Co. Kerry and Bull Island and one saltmarsh site in Bull Island). This novel integration of ecological, AI and Geospatial knowledge produced highly accurate maps of vegetation.

This newly developed methodology would be highly beneficial to the National Parks and Wildlife Service (NPWS), who are legally obliged, under Article 17 of the Habitats Directive (HD), to conduct an assessment of Annex I habitats throughout Ireland, every six years and also complete assessments for reporting under the Water Framework Directive.

What did this research find?

The integration of expert knowledge from experienced ecologists with high resolution UAV, Geospatial and AI expertise in the iHabiMap project produced very accurate habitat maps (accuracies >90%). iHabiMap demonstrates the feasibility to use this method to map habitats over large areas in a routine fashion.

Some insights: Relatively homogeneous habitats that occur in undulating or gently sloping terrain can be characterised by UAV remote sensing with high accuracy. Habitats with distinct spectral signatures and typically defined by elevation (coastal dunes) can be very accurately mapped with UAV multispectral and topographic information.

Heterogeneous habitats, occurring in mosaics e.g. upland habitats, can be more challenging to characterise due to complex spectral characteristics. High-altitude or rugged terrain leads to data quality issues, including shadowing effects and variations in UAV sensors' perspectives due to steep slopes and changing elevations.

Optical UAV remote sensing may not be suitable for classifying understory habitats. Dense canopies often obstruct the sensor's view of the ground, making understory vegetation difficult to detect.

Future studies could explore other sensors, such as LiDAR, which can penetrate the canopy more effectively.

How can the research findings be used?

The main target audience is the NPWS and private companies operating in the ecological monitoring and assessment space. To facilitate the implementation and roll out of the research, in the land cover types assessed in iHabiMap, additional technical capability would likely be needed by NPWS to make operational use of the methodology. Further research should also be carried out to determine; 1. how transferable and interoperable the model is in different environments and 2. how to roll this out to areas of interest across the country.

The methods developed in this research can be applied to monitor degradation and rehabilitation of Dune systems, Salt Marshes, Uplands and Grasslands nationally. The methods are excellent for the implementation of monitoring, reporting and verification for policies such as the Nature Restoration Law.

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