

**Project number:** 6765  
**Funding source:** EPA

**Date:** Dec, 2018  
**Project dates:** May 2015-Sep 2017

## Biomass Retrieval in Ireland using Active Remote Sensing- BRIAR



### Key external stakeholders:

EPA, DAFM

### Practical implications for stakeholders:

We have shown that Hedgerow biomass cannot be accurately estimated directly by active RADAR satellite. We demonstrate that a Hedgerow survey of Ireland can be carried out using OSI point cloud and the techniques developed in an earlier project

- Main points

High resolution RADAR earth observation data cannot accurately directly estimate hedgerow biomass due to saturation effects.

### Main results:

High resolution RADAR earth observation data cannot accurately directly estimate hedgerow biomass due to saturation effects.

A new upper limit on the extent of boundary biomass has been established and a new field approach to mapping estimates of hedgerow biomass using drones has also been developed.

### Opportunity / Benefit:

The developed model and field approach could be used to conduct a national hedgerow survey within 6 months using a desk-based study. It would use OSI photogrammetric 25cm point cloud and the same 1km sample selection detailed in the national hedgerow survey guidelines.

### Collaborating Institutions:

Fers Ltd., UCC

**Teagasc project team:** Stuart Green (PI)

**External collaborators:** Dr Kevin Black, Fers Ltd.  
Dr Fiona Cawkwell, UCC

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### 1. Project background:

The EPA funded project, BRIAR, Biomass Retrieval in Ireland using Active Remote sensing, was a follow on project to an earlier EPA funded project (Carbon Sequestration by Hedgerows) led by Kevin Black of FERS that used LIDAR data.

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### 2. Questions addressed by the project:

Can new high resolution RADAR imagery be used to measure biomass in hedgerows directly? This would offer a more accurate representation than the current modeling approach.

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### 3. The experimental studies:

The study area around Fermoy in Co. Cork was field surveyed using drone technology to collect data on a sample of hedgerows from which estimates of biomass could be drawn. These field estimates were used with new high resolution Terrasar-X staring spotlight (TSX SS) radar imagery to model hedgerow directly from radar backscatter.

This study shows that hedgerow biomass cannot be derived directly from RADAR backscatter. This is due to a number of factors including the fact that the hedgerow biomass density (average of 10kn/m<sup>2</sup>) was above the threshold of saturation for RADAR in the X-band frequency range. Furthermore, other RADAR sensors with lower frequencies and thus higher saturation limits do not have the spatial resolution to map hedgerows. An alternative method of investigating hedgerow structure, and thus inferring biomass, interferometry fails as the level of incoherence between the observations in the study dataset was too high to build a 3D model (i.e. the backscatter from the hedgerow changed too much between observations).

This research thus shows that RADAR data does not seem to be an appropriate technology for estimating hedgerow properties in Ireland.

As RADAR seems to be inappropriate for hedgerow evaluation (except for identifying complete removal) the existing national LIDAR surveys from GSI were examined for their appropriateness. In the test site a Digital Canopy model derived from these data successfully estimated heights (mean and max.) for the trial test site with an r<sup>2</sup> value of 0.79.

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### 4. Main results:

In order to estimate the national stock of hedgerow, the new Prime 2 spatial data storage model was applied in conjunction with maps developed in this project showing probability of a field boundary being a stone wall or a hedgerow to give a new national upper estimate of 689,000km of field boundary biomass in Ireland. This estimate is double the frequently quoted figure of 300,000km for hedgerow alone- but our estimate includes a much wider definition of "hedgerow " and includes curtilage/road boundaries, tree lines, forest boundaries and overgrown banks.

Net change in hedgerow length was examined using the aerial photographic record from 1995, 2005 and 2015, along with county level survey records. These give a provisional estimate of net removal of hedgerows between 1995 and 2015 of between 0.16-0.3% pa, though the rate is much slower in the latter half of that period.

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### 5. Opportunity/Benefit:

As RADAR seems to be inappropriate for hedgerow evaluation (except for identifying complete removal) the existing national photogrammetric 25cm point cloud from the OSI should be used to provide a national boundary biomass survey using the 1km survey samples recommended in hedgerow mapping guidelines. In the test site a Digital Canopy model derived from these data successfully estimated heights (mean and max.) for the trial test site with an r<sup>2</sup> value of 0.79. The approach used in this study could be used to conduct a national hedgerow survey within 6 months using a desk-based study.

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### 6. Dissemination:

Saeid Gharechelou, Stuart Green, Fiona Cawkwell. Hedgerow Detection and Characterization Using Very High Spatial Resolution SAR DATA. ICGRS 2017: International Conference on Geoscience and Remote

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Sensing, Rome, Italy, September 18-19, 2017.

**Popular publications:**

March Map of Month- Likelihood of finding a Stonewall in Ireland

[https://www.teagasc.ie/media/website/rural-economy/rural-economy/spatial-analysis/MOM\\_March.pdf](https://www.teagasc.ie/media/website/rural-economy/rural-economy/spatial-analysis/MOM_March.pdf)

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**7. Compiled by:** Stuart Green

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