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Science Agency



BIODIVERSITY

GISERA | Gas Industry Social and Environmental Research Alliance

Using drones and satellites to monitor habitat in the Northern Territory

CSIRO researchers have used drones (UAVs) fitted with LiDAR sensors and satellite-based remote sensing platforms to map a key area of vegetation in the Beetaloo Sub-basin.

Key points

- The Beetaloo Sub-basin contains large shale gas resources and has been identified as a potential area for onshore gas production.
- There are community concerns about the potential for gas development to impact the biodiversity of the region, including degradation, fragmentation and habitat loss.
- This project used UAV-LiDAR and spaceborne remote sensing for site survey and habitat condition monitoring in the Beetaloo.
- The project results confirm the potential for upscaling and developing a systematic, cost-effective habitat monitoring program.

This project, conducted through CSIRO's Gas Industry Social and Environmental Research Alliance (GISERA), explored the development of a scalable and systematic approach for monitoring the structural condition of vegetation in the Beetaloo region of the Northern Territory.

Scientists successfully demonstrated the application of high-resolution UAV-LiDAR (sensor-equipped drones) to characterise a study site in the Beetaloo.

LiDAR (Light Detection and Ranging) is a remote sensing method that uses laser pulses to measure distances. When mounted on drones, LiDAR sensors can produce detailed three-dimensional maps of vegetation and terrain.

The research addresses community concerns about the potential for gas development to have long-term impacts on the biodiversity of the Beetaloo Sub-basin.

The Beetaloo Sub-basin

The Beetaloo Sub-basin lies southeast of Katherine in the Northern Territory and spans approximately 30,000 square kilometres.

One of the most promising areas for shale gas production in Australia, the estimated gas resources for the Beetaloo sub-basin are of similar size to other major gas producing basins in Australia, such as the Surat Basin in Queensland and the Bonaparte/Browse basins in Western Australia.

The development of a gas industry in the Beetaloo Sub-basin has the potential to impact in terrestrial biodiversity, ecosystem function and landscape amenity. Communities have raised concerns about these impacts.

In 2018, GISERA partnered with the NT Government to deliver independent and transparent research on gas development.



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Building on previous studies

This study forms part of a suite of other [CSIRO research activities](#) conducted in the Northern Territory through GISERA.

It also builds on a range of other studies and research projects. These include the 2021 Geological and Bioregional Assessment (GBA) for the Beetaloo region, which noted that habitat degradation, fragmentation and loss have the potential to impact on a broad range of environmental values.

The 2022 Strategic Regional Environmental and Baseline Assessment (SREBA) for the Beetaloo Sub-basin collected extensive new baseline data. It provides a reference point for ongoing monitoring, and cited the need for a regional monitoring framework for the Beetaloo Sub-basin. This project was developed to partly fill this key gap.

Key objectives

The primary objective of this project was to develop a scalable approach for monitoring the structural condition of vegetation in the Beetaloo region.

Researchers aimed to demonstrate the application of high-resolution UAV-LiDAR to study site characterisation.

The project was also designed to test the potential for upscaling to larger areas via satellite-based remote sensing platforms – Sentinel satellites, built and operated by the European Space Agency and the Copernicus Programme.

Project methods

To develop a scalable approach to habitat condition monitoring, researchers combined high-resolution UAV-LiDAR surveys with open-access satellite remote sensing and machine learning.

Survey-grade UAV-LiDAR equipment was used to collect detailed three-dimensional data across a range of vegetation types in the Beetaloo region during both dry and wet seasons. This high-quality dataset captured structural metrics such as canopy height, density, gap fraction and plant area index.

Researchers processed multiple years of Sentinel-1 Synthetic Aperture Radar (SAR) imagery creating monthly, seasonal and annual composites. SAR is particularly valuable in dynamic tree-grass landscapes, where multispectral reflectance data can be limited by soil brightness and vegetation complexity.

The UAV-LiDAR data was used to calibrate and validate the sensitivity of Sentinel-1 SAR imagery to spatial and temporal variation in vegetation structure.

Building on this, machine learning models were developed to predict vegetation structure across broader unsampled areas, with the inclusion of multispectral imagery from Sentinel-2 further improving predictive accuracy.

This fusion of drone and satellite data demonstrated how remotely sensed information can overcome the spatial and temporal limitations of field surveys and provide a foundation for ongoing, broadscale habitat monitoring.

Key outcomes

The study confirmed that UAV-LiDAR can effectively capture key attributes of vegetation structure in the Beetaloo region, and that these attributes can be reliably modelled across large areas using satellite data.

These models can undergo continuous improvement through the inclusion of additional LiDAR collections, and by building long-term temporal records of vegetation structure from LiDAR to better assess sensitivity to dynamics.

By bridging the gap between field data and satellite imagery, this work lays the groundwork for a systematic, cost-effective monitoring program. The approach has the potential to reassure stakeholders that any habitat degradation resulting from development activities can be detected early and addressed appropriately.



Top image: CSIRO scientists used drones fitted with LiDAR sensors to map biodiversity in the Beetaloo (photo credit: Shaun Levick). Bottom image: The Sentinel 2 satellite (image credit: ESA/ATG medialab).

More information

Read more [about this project](#)

Learn about other [GISERA research in the Northern Territory](#)

Find out about [GISERA's other biodiversity research](#)

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GISERA is a collaboration between CSIRO, Commonwealth and state governments and industry established to undertake publicly-reported independent research. The purpose of GISERA is to provide quality assured scientific research and information to communities living in gas development regions focusing on social and environmental topics including: groundwater and surface water, greenhouse gas emissions, biodiversity, land management, the marine environment, and socio-economic impacts. The governance structure for GISERA is designed to provide for and protect research independence and transparency of research.