Queensland Spatial BioCondition Framework (SBC) Factsheet

What is Spatial BioCondition?

Spatial BioCondition (SBC) is a mapping framework, aligned with Queensland's Regional Ecosystem (RE) and BioCondition frameworks. Spatial BioCondition integrates site-based vegetation condition assessment methods and remote sensing (RS) to predict the condition of vegetation for biodiversity across most ecosystems in Queensland. The current version provides 2021 condition predictions for the Brigalow Belt, Central Queensland Coast and Southeast Queensland bioregions only (Figure 1). The approach is systematic, repeatable, and able to incorporate new site-based and RS data as they become available.

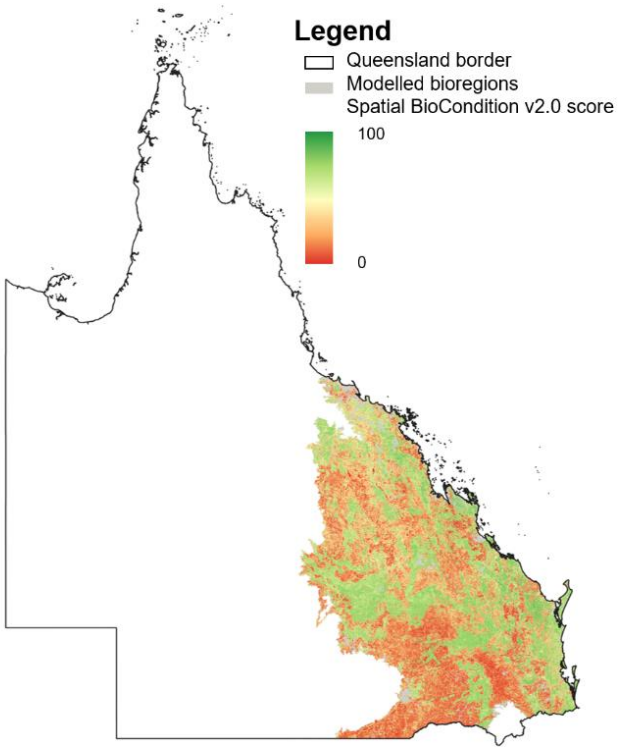

Figure 1: SBC version v2.0 for the Brigalow Belt, Central Queensland Coast and Southeast Queensland bioregions in 2021.

Background:

Spatial BioCondition is being developed to support reforms to the Queensland Vegetation Management Act 1999 and to provide more holistic reporting on vegetation extent and condition in Queensland. It is a collaboration between the Queensland Herbarium and Biodiversity Science business unit and Remote Sensing Sciences in the Queensland Department of Environment, Science and Innovation. Version 2.0 of SBC is the second release of this product and serves to replace version 1.0.

Condition of vegetation for biodiversity may be influenced by fire regimes, agricultural practices, grazing land management, urban development, incursion of invasive species, industrial logging, and mining. There is an increasing need to measure vegetation condition at scale to inform the biodiversity protection and conservation goals of the state.

The BioCondition framework measures the relative capacity of an ecosystem to support the suite of species expected to occur in its relatively undisturbed (reference) state. The greater the difference from the reference state, the worse the condition. At the site level, this is measured using a suite of vegetation attributes which are compared against an ecosystem-specific benchmark. The benchmark or reference characteristics are derived from a set of sites in the same RE that are known to be in the best available condition for biodiversity. To move beyond a site-based approach, SBC uses a model based on a series of vegetation specific remote sensing data to map condition across the state.

Method

In brief, the difference in RS values between training site locations and reference locations are used to train a machine learning model which is applied to predict Spatial BioCondition for each 30 m pixel in the bioregion.

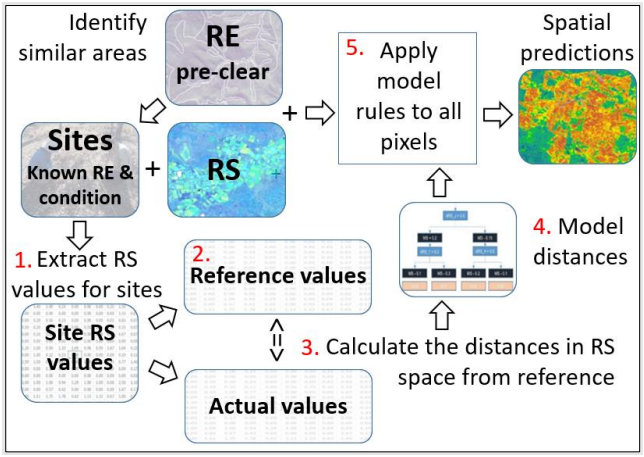

Figure 2: Modelling workflow for SBC.

There are three critical inputs for the modelling approach: RE pre-clearing mapping; verified and

georeferenced training sites with known RE and BioCondition score; and a suite of RS predictor variables (Figure 2). The steps involved in the modelling are:

1. RS values for all predictor variables are extracted for all training sites.
2. For each RE, a reference dataset of RS values is derived using a set of sites known to be in best available condition state.
3. The distance (in RS space) from the reference dataset for each RE is calculated for every training site (all condition states).
4. The derived distances are used to train a Gradient Boosting Decision Tree Regression model to fit a set of decision rules that relate the target variables (BioCondition score) to the predictor variables.
5. The model rules are applied across the full geographic extent of that RE to predict Spatial BioCondition for every pixel (30 m resolution).

The SBC score assigned to each pixel is the result of the comparison against a RE specific reference.

Accuracy

Independent field validation was undertaken with field data collected from 270 sites in the Brigalow Belt, Central Queensland Coast and Southeast Queensland bioregions. The sites were selected using a stratified random sampling protocol to maximise both condition range and geographic spread. Comparison of BioCondition scores for independent field sites with model predictions from version 2.0 yielded a R^2 value of 0.70 and a mean absolute error of 13.4 (Figure 3). Model accuracy was lowest for intermediate condition scores where there are fewer sites.

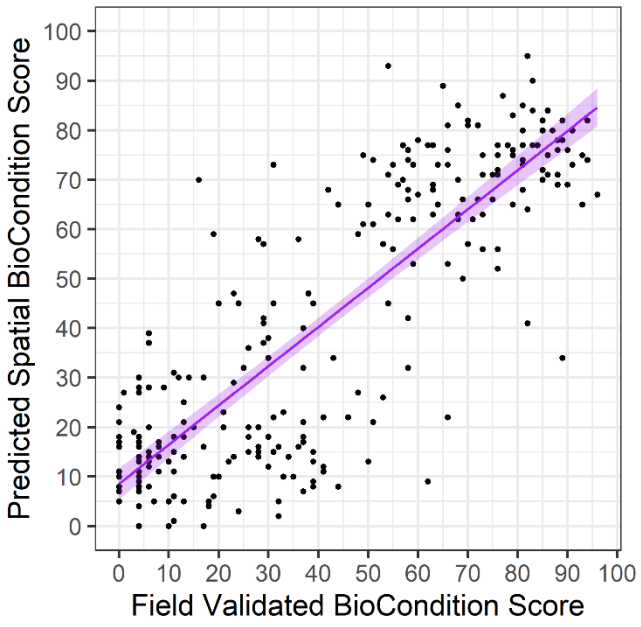

Figure 3: Predicted (SBC v2.0) versus expected (BioCondition scores from independent field sites) with linear regression.

Product constraints

Spatial BioCondition provides a robust measure of BioCondition at the regional scale, and hence with successive versions can be used to determine regional scale trends in BioCondition. However, SBC shares limitations of the input datasets, which include but are not limited to resolution, detectability and currency for RS inputs; scale and heterogeneity for RE mapping; volume, quality, currency and accessibility of training site data. Some important BioCondition attributes such as plant species diversity, large trees or below canopy attributes (e.g. fallen woody debris) are either currently not measurable or are difficult to detect using RS at the scale required. Therefore, SBC is only a partial representation of BioCondition.

Spatial BioCondition is not suitable for the measurement of changes in condition over time at pixel-scale nor should it be used below the RE scale of mapping. Furthermore, SBC does not identify nor attribute the underlying causes or drivers of reduced condition for biodiversity. Direct comparisons of SBC predictions between versions 1.0 and 2.0 are not advised.

Applications

Spatial BioCondition predictions should be interpreted in conjunction with and at a similar scale to the RE mapping. Potential uses of the SBC product are inclusive of but not limited to biodiversity monitoring, natural capital accounting, State of Environment reporting, ecosystem services, environmental offsets, and biodiversity markets.

Product description

The SBC product is a raster dataset with a spatial resolution of 30 m (one pixel). Access to Geographic Information System (GIS) software is required to obtain full functionality of the product. The product contains three bands where band 2 is the predicted SBC score ranging from 0 to 100, with higher values representing better BioCondition. Bands 1 and 3 are the 5th and 95th percentile for the prediction interval (i.e. the true BioCondition value will be found within this range with a likelihood of 90%). The version 2.0 SBC score is predicted for the year 2021.

The product covers most vegetated terrestrial ecosystems in each bioregion, except the following exclusions which are masked and for which no predictions are provided.

- Intertidal ecosystems on landzone 1
- Urban, suburban, and industrial areas
- Intensive use reservoirs, dams, lakes, estuaries and canals
- Predominantly unvegetated areas such as open water, bare sands, and rock pavements
- Natural grasslands, sedgelands and forblands
- Regional Ecosystems with insufficient reference site data.

Product improvements

There have been several product improvements in version 2.0, which incorporates version 13 of the RE pre-clearing mapping, 2021 RS data, updated site data and sites scored using the latest BioCondition benchmarks. Model accuracy improved in version 2.0 with field validation R^2 increasing from 0.68 to 0.70 (~2.94% percentage increase) and mean absolute error decreasing from 15.0 to 13.4 (~10.67% percentage decrease). Version 2.0 also adds 1,263,016 hectares with the addition of the Central Queensland Coast bioregion, as well as increasing model coverage by 3,988,826 hectares across the Brigalow Belt and Southeast Queensland Bioregions.

Data availability

Spatial BioCondition version 2.0 – 2021 for the Brigalow Belt, Central Queensland Coast and Southeast Queensland bioregions is available on Qspatial and TERN, with the code used to generate the model available from GitLab from 2025.

Next steps

The project team are currently working on expanding SBC to include other bioregions as well as collecting additional sites for REs with insufficient data within currently modelled bioregions. We are also continuing to investigate ways to further improve model performance, incorporate ecological connectivity and landscape context into the SBC framework.

Contact

For more information about accessing Spatial BioCondition products, email: queensland.herbarium@qld.gov.au