# **Nature network map**

# Use and Applications

**Purpose:** to identify the most important areas of mainland Cornwall for biodiversity and the provision of ecosystem services that are currently excluded from any statutory protection.

**What does the map show?** The nature network map identifies the most valuable 20% of mainland Cornwall not currently subject to statutory protection. The area is sub-divided into three exclusive bands representing the most valued 5%, 5-10% and 10-20% of unprotected areas.

**Intended uses:** The map is intended to inform a range of strategic planning application such as:

* the expansion of the existing network of protected areas;
* the strategic targeting of resources to protect biodiversity and ecosystem services;
* identification of key areas where future change in land use or development risks a strategic loss of biodiversity or ecosystem service provision.

**Notes on the use and interpretation of the nature network map:**

* The spatial unit of prioritization is 100 square metre cells although some finer resolution features are accounted for (such as ancient and venerable trees).
* Existing protected areas (irrespective of their condition) are assumed to be preserved and maintained. Their presence informs the prioritization of non-protected areas.
* Cell rankings are dependent upon maintaining the landcover and existing services of more highly ranked cells. This dependence is most evident by considering how the value of a habitat ‘corridor’ is only meaningful if the two habitats that it links are maintained.
* Rankings are assigned uniquely on the basis of *current* land cover and the maps are not suitable for use in future scenarios.
* The exclusion of an area from the top 20% of cells do *not* imply that the area lacks any strategic biodiversity value or service provision.
* Similarly, a high ranking does not necessarily imply that the biodiversity or services provided cannot be augmented by changes to management, land cover or use.

# Method of spatial prioritization

The mapping is produced using the Zonation model of spatial prioritization (Lehtomäki *et al.* 2016), which has been widely used for the identification of new protected areas or conservation zones, and the expansion of existing networks. The approach exploits both spatial data and expert judgement concerning the relative importance of different services and habitats. The method focuses on key factors for which there is sufficiently reliable information available. Basing decisions on the Zonation prioritization can contribute to more informed decision-makingbased on the available evidence and data concerning the spatial distribution of Cornwall’s habitats.

The mapping methodology followed the following steps:

1. **Identify existing protected areas:** statutory protected areas are designated as the last areas to be removed, ensuring that they inform the ranking of all cells in terms of connectivity and aggregation.
2. **Identify areas to exclude *a priori***: no areas were excluded *a priori* from the nature network map.
3. **Identify the benefits of existing habitats**: each benefit will be assigned a positive weighting. The calculation of benefits involves estimation of the existing biodiversity value and provision of ecosystem services.
4. **Identify ‘constraining’ factors**: constraints likely to reduce the likelihood, or increase the cost, of realising benefits are assigned a negative weighting that will lower the relative value of a cell during the ranking process. Factors include:
   * + man-made infrastructure, such as main roads and railways;
     + certain kinds of recreational use (golf courses, playing fields)
     + the percentage of an area that is covered with buildings;
     + certain recreational uses such as golf courses;
     + china clay extraction areas.

The suitability of an area for alternative land use (*ie* opportunity costs) have not generally been included as doing so would result in a prioritization that maximises the difference between costs and benefits, rather than one seeking to maximise ecological and biodiversity benefits which is the primary intension of the nature network map.

1. **Spatial prioritization of cells:** was carried out using the Zonation model of spatial prioritization (Lehtomäki *et al.* 2016), which ranks all non-excluded cells on the basis of their weighted potential benefits, facilitating factors and constraints.

# Key data types

The type of data used included:

* Mutually exclusive presence / absence data, such as the dominant land cover type.
* Non-exclusive presence / absence data, such as statutory designations.
* Non-exclusive scaled quantitative data that provided an indication of the relative importance of different features (for example hedgerow lengths or catchment quality) or service provision (such as quantified estimates of ecosystem services).

The relative importance of different services, habitats and features informing the prioritization is determined by assigning weights. Positive weights describe the relative value or benefits of different services and features. Negative weights indicate a constraint or cost of realising benefits. Major data types included:

**Dominant landcover type:** derived from a compilation of several landcover data sources. Each cell was attributed to a single dominant landcover type. Weightingswere attributed according to a judgment of their capacity to support biodiversity benefits. In addition, the dominant landcover is often determinant of the capacity of an area to deliver many ecosystem services (accounted for separately).

The following general weightings were applied:

* + BAP priority habitats: +2
  + Other semi-natural habitats: +1
  + Urban, arable and improved grassland: 0

In effect therefore approximately 77% of mainland Cornwall is attributed a zero weighting in terms of its dominant landcover type.

**Landcover features:** in addition to dominant land cover types, additional data on habitat features contained within cells included linear and point features, such as open river, hedgerows, and the presence of ancient and venerable trees. Such data was non-exclusive (a cell could contain several features of the same or different types) and could be recorded as the presence/absence of a feature (such as a river bank) or scaled according to a measure of the abundance of a feature, such as the total length of hedgerows within a cell or number of recorded ancient/venerable trees. Features providing additional habitats such as hedgerows or open waterways were given a positive weighting dependent upon length and/or quality of the feature. Other landcover features, such as main roads and buildings (see the identification of constraints above) were given a negative weighting.

**Habitat & biodiversity designations:** land designations relating to biodiversity were used as strong indicators of the biodiversity value of areas, whether these were statutory protections (e.g. SSSIs) or other designations such as County wildlife sites or ancient woodland. Such designations are generally non-exclusive and the same areas can be classified under several different designations. Undue bias towards multiple-designated areas was prevented by either suitable weighting scores or by creating synthesis layers bringing together several different designations. Statutory designated areas were defined as all areas designated as SSSI, SAC, SPA, national or local nature reserves.

**Habitat condition and quality indicators:** very little spatial data is available on the current condition of habitats in Cornwall. Where available, catchment ecological quality data was used as indicators of aquatic habitat condition and SSSI condition data was used as indicator of habitat condition within those sites. Areas participating in Higher level or Organic countryside stewardship schemes could be considered indicative of good condition of arable and grassland areas.

**Ecosystem service benefits: a** comprehensive list of data sources used in the calculation of ecosystem services is detailed under their individual methodologies.Service layers were calculated on the basis of existing demands such as current sources of drinking water, location of aquaculture or buildings at risk of flooding.Weightings vary according to a judgement of the relative importance of the service and confidence in its estimation. No ecosystem services dependent upon public access to the land (*eg* recreation, tourism, health benefits).

**Contextual information:** additional data was used to provide contextual information to the mapping but was not used in the calculation of cell rankings.

# Cell ranking

The spatial prioritization works by iteratively removing the least ‘valuable’, lowest ranked cells (see figure 1) on the basis of:

* Areas explicitly excluded from consideration, on the basis of existing landcover or other features, are removed first, for example urban areas.
* Weighted fraction of all remaining features that values cells containing a high overall proportion of individual features (*ie* it will most value cells containing a high proportion of a habitat type or service).
* An ‘added benefit function’ that sums the normalised distribution across all features and so tends to remove cells with low feature diversity before cells with higher feature diversity, such as cells providing *both* valuable habitat *and* ecosystem services.
* Aggregation of protected areas – a ‘boundary length penalty’ seeks to reduce edge to area ratio of *all* remaining cells (irrespective of the type of features within those cells). In effect this will aggregate and connect together all prioritized areas rather than specific habitat types.

Existing protected areas are designated as the last areas to be removed, ensuring that they inform the ranking of all other areas.

The highest ranked cells were separated into three areas corresponding to approximately 5, 10 and 20% of unprotected land in mainland Cornwall.

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**Figures 1:** show the iterative ‘removal’ in grey of the least valued or lowest ranked (i) 20% (predominantly urban and infrastructure areas), (ii) 60% and (iii) 80% of cells for the Fowey valley region, the remaining cells shown in (iv) correspond to the highest 20% of ranked cells (red) and areas under existing statutory protection (yellow).

# Important considerations

**Vulnerability and ranking:** the most highly ranked cells are assigned to areas supporting biodiversity and delivering ecosystem services. It is important to note that these do *not* equate to the most vulnerable habitats. The lack of opportunity costs in the prioritization method means that pressures associated with alternative land uses are not accounted for.

For example, it could be argued that many areas of moorland are less vulnerable than habitats around urban centres or more agriculturally productive land as the pressures for development will be greatest for these latter areas.

**Valuing urban and agricultural land** - currently all cells with a dominant land cover that is urban, suburban, arable or improved grassland are given a zero weighting. In effect these land cover types are unlikely to be heavily represented in the proposed nature network but are not excluded *a priori*. Such land cover types may be valued due to the presence of other positively weighted features, such as hedgerows and rivers.

We recognize that the biodiversity potential of urban and agricultural land is very variable. Urban and suburban areas often have the capacity to support higher levels of biodiversity than many arable and improved grassland landscapes. Equally however, methods of land management of rural environments have significant implications for their biodiversity value. How these areas are best represented within the spatial prioritization model should reflect the policy applications of the nature network mapping. Currently, for example, the zero weighting applied to most agricultural and urban areas does not imply they lack any biodiversity value, but that such value is unlikely to change if these areas do not receive any additional protection, or that their value depends on policies or management options that are unaffected (or not targeted) by the nature network mapping.

# References

Lehtomäki J, Moilanen A, Toivonen T Leathwick J 2016. *Running a Zonation planning project*. Unigrafia, Helsinki. ISBN: 978-951-51-1923-0 (PDF).

Moilanen A, Pouzols FM, Meller L, Veach V, Arponen A, Leppanen J, Kujala H 2014 Zonation - *Spatial conservation planning methods and software. Version 4. User Manual*. University of Helsinki, Helsinki.

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