



USER MANUAL · CALCULATION HANDBOOK

Biological Importance Mapper

Step-by-step guide, index formulas and a fully worked example

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1. What the tool does

The Biological Importance Mapper divides your study area into a grid of square cells. For each cell it combines **plant richness, wildlife richness, threatened species (IUCN), rarity, group diversity, habitat quality, water and protected-area overlap** into one score from 0 to 100. The score is grouped into five classes (Very low to Very high) and shown on a web map and on print-ready map sheets.

Species records come from **GBIF** (open biodiversity database) and from your own field CSV. Habitat, water and protected areas come from **OpenStreetMap**. The result is a **relative** index: it ranks cells inside your area and is not an absolute conservation value.

2. Quick start

- 1 Study area.** Upload your boundary as a polygon **.kml** file. The map zooms to it and shows its area in hectares.

- 2 **Species data.** Tick the groups you want (Plants, Birds, Mammals, Reptiles, Amphibians, Fishes, Insects). Choose the maximum GBIF records per group. Optionally upload a field CSV.
- 3 **Ecology and grid.** Keep OpenStreetMap habitat ticked (recommended), choose a cell size (or Automatic) and keep smoothing on.
- 4 **Index weights.** Keep the defaults or move the sliders. Check the class breaks (default 20, 40, 60, 80).
- 5 Click **Run analysis**. Wait for the progress box to close. Results appear as the map, summary tiles and three tables.
- 6 Change weights or breaks: the map updates instantly (no need to re-run). Open **Map composition** to design and download map sheets.

Open the HTML file from your computer or website (not inside a preview window), because the tool must connect to GBIF and OpenStreetMap.

3. Preparing your inputs

Study area KML

One or more **Polygon** shapes (holes are supported). Points and lines are ignored. Several polygons are merged into one study area.

Optional field CSV

First row must be column names. Required: **lat, lon, species**. Optional: **group** (plant, bird, mammal, reptile, amphibian, fish, insect), **status** (IUCN code CR, EN, VU, NT, DD, LC), **local_name**.

```
lat,lon,species,group,status,local_name
25.6101,85.1402,Panthera tigris,mammal,EN,Tiger
25.6120,85.1455,Shorea robusta,plant,LC,Sal
```

Records outside the study polygon are ignored. A record with no group is treated as a plant.

4. Settings explained

Setting	What it does
Max GBIF records per group	Upper limit of records downloaded for each ticked group (300 to 3000). Higher gives more data but takes longer.
Grid cell size	Automatic or fixed (250 m to 10 km). Automatic formula: $size = \max(50, \text{round}(\sqrt{(area \text{ in } m^2 \div 450) \div 25}) \times 25)$ metres, giving about 450 cells. The grid never exceeds 12,000 cells (size is enlarged by 25% steps if needed).
Smoothing	Blends each cell with its 8 neighbours to reduce gaps where nobody has surveyed (see step 2 of Section 5).
Weights	Relative importance of each component (0 to 50). Only ratios matter; they are re-scaled automatically.
Disturbance penalty	Maximum percentage cut applied to cells covered by built-up land and farmland (default 20%).
Class breaks	Four score values that split the 0 to 100 range into five classes.

5. How the score is calculated

Every cell goes through the same six steps.

Step 1: Count raw values per cell

Component	Raw value
Tree / plant richness (tr)	Number of distinct plant species in the cell
Wildlife richness (wl)	Number of distinct non-plant species in the cell
Threatened species (thr)	Sum of IUCN weights of all species in the cell
Rarity (rar)	Sum of $1 \div (\text{number of cells the species occupies})$ over all species in the cell
Group diversity (tax)	Number of taxonomic groups present (plants, birds, mammals ...)

IUCN weights:

CR	EN	VU	NT	DD	LC / none
5	4	3	1.5	1	0.3

A rare species found in only one cell adds 1.0 to rarity; a species found in 10 cells adds only 0.1. A species with no IUCN status adds 0 to the threatened sum.

Step 2: Smooth (if ticked)

$\text{smoothed} = 0.6 \times \text{cell value} + 0.4 \times \text{average of the neighbouring cells}$

Step 3: Scale each component to 0 to 1

$\text{scaled} = \min(1, \text{smoothed value} \div \text{P95})$

P95 = 95th percentile of all cells that have a value above 0

group diversity: $\text{scaled} = \min(1, \text{smoothed groups} \div \text{groups present in the data})$

Step 4: Habitat components (only when OpenStreetMap data is found)

Each cell is sampled at **16 points** (4 × 4). Each point takes the first matching cover in this order: water, wetland, forest, scrub, built-up, grassland, farmland; otherwise "other".

Cover	Naturalness value
Forest, wetland	1.00
Water	0.90
Scrub	0.80
Grassland	0.70
Other / unmapped	0.40
Farmland	0.25
Built-up	0.00

$p = \text{share of points in each cover (count} \div \text{points)}$

$\text{naturalness} = \sum p \times \text{naturalness value}$

diversity $H = -\sum p \times \ln(p)$ (over water, wetland, forest, scrub, grassland, farmland, built-up)

$\text{eco} = 0.65 \times \text{naturalness} + 0.35 \times \min(1, H \div \ln 5)$

$\text{water} = \min(1, 2 \times (\text{water} + \text{wetland share}) + 0.3 \text{ if a stream or river crosses the cell})$

$\text{protected area} = \text{share of points inside a protected area}$

$\text{disturbance} = \text{share built-up} + 0.5 \times \text{share farmland}$

Step 5: Weighted mean

$$\text{weighted score} = \Sigma(\text{weight} \times \text{scaled value}) \div \Sigma(\text{weights})$$

Without habitat data only the first five components are used, and no penalty is applied.

Step 6: Penalty, final score and class

$$\begin{aligned} \text{score} &= \text{weighted score} \times (1 - \text{penalty} \times \text{disturbance}) \times 100 \\ \text{class} &= \text{number of class breaks that the score reaches or exceeds} \quad (0 = \text{Very low} \dots 4 = \text{Very high}) \end{aligned}$$

6. Worked example (one cell)

Example study area of **4,500 ha** with default weights, 20% penalty, smoothing on, breaks 20/40/60/80. We calculate **Cell 17**.

Grid size

$$\begin{aligned} \text{area} &= 45,000,000 \text{ m}^2; \sqrt{(45,000,000 \div 450)} = 316.2 \\ 316.2 \div 25 &= 12.65, \text{ rounded } 13; 13 \times 25 = \mathbf{325 \text{ m cells}} \end{aligned}$$

Step 1: raw values for Cell 17

Threatened sum

$$1 \text{ EN } (4) + 2 \text{ VU } (2 \times 3 = 6) + 1 \text{ NT } (1.5) + 3 \text{ LC } (3 \times 0.3 = 0.9) = \mathbf{12.4}$$

Rarity

$$\begin{aligned} &2 \text{ species found only here } (2 \times 1/1 = 2.0) + 4 \text{ species in 2 cells } (4 \times 1/2 = 2.0) + 6 \\ &\text{species in 10 cells } (6 \times 1/10 = 0.6) + 20 \text{ species in 40 cells } (20 \times 1/40 = 0.5) = \\ &\mathbf{5.1} \end{aligned}$$

Other raw values: 12 plant species, 20 wildlife species, 3 groups present (so 32 species in total, matching the rarity count above).

Steps 2 and 3: smooth, then scale

$$\begin{aligned} \text{Example: thr smoothing} &= 0.6 \times 12.4 + 0.4 \times 8.0 \text{ (neighbour average)} = 7.44 + 3.20 \\ &= 10.64. \end{aligned}$$

Component	Raw	Smoothed	P95	Scaled
Plants (tr)	12	11.0	16	0.688
Wildlife (wl)	20	18.0	24	0.750
Threatened (thr)	12.4	10.64	14.0	0.760
Rarity (rar)	5.1	4.6	6.0	0.767
Groups (tax)	3	2.8	3 groups	0.933

Step 4: habitat from 16 sample points

Cover counts

forest 8, wetland 2, water 1, scrub 1, grassland 2, farmland 2, built-up 0 (total 16).
Shares: 0.5, 0.125, 0.0625, 0.0625, 0.125, 0.125.

naturalness = $0.5 \times 1 + 0.125 \times 1 + 0.0625 \times 0.9 + 0.0625 \times 0.8 + 0.125 \times 0.7 + 0.125 \times 0.25 = \mathbf{0.85}$

$H = 0.347 + 3 \times 0.260 + 2 \times 0.173 = 1.473$; $H \div \ln 5 = 1.473 \div 1.609 = 0.915$

eco = $0.65 \times 0.85 + 0.35 \times 0.915 = 0.5525 + 0.3203 = \mathbf{0.873}$

water = $2 \times (1 + 2)/16 + 0.3$ (stream present) = $0.375 + 0.3 = \mathbf{0.675}$

protected area = $4/16 = \mathbf{0.25}$

disturbance = $(0 + 0.5 \times 2)/16 = \mathbf{0.0625}$

Step 5: weighted mean

Component	Weight	Scaled	Weight × scaled
Plants	15	0.688	10.31
Wildlife	20	0.750	15.00
Threatened	25	0.760	19.00
Rarity	10	0.767	7.67
Groups	5	0.933	4.67
Habitat (eco)	15	0.873	13.09
Water	5	0.675	3.38
Protected area	5	0.250	1.25
Total	100		74.37

weighted score = $74.37 \div 100 = 0.7437$

Step 6: penalty, score and class

penalty factor = $1 - 0.20 \times 0.0625 = 0.9875$

score = $0.7437 \times 0.9875 \times 100 = 73.4$

breaks 20, 40, 60, 80: the score reaches 3 of them (20, 40, 60) → class 3 = **High**

Cell 17 therefore appears in the "High" colour. Its popup shows score 73.4, 32 species (12 plants, 20 wildlife) and 3 threatened species (1 EN and 2 VU; the NT species adds to the threatened sum but is not counted as threatened).

7. Class areas and mean index

Each cell has 16 sample points; edge cells that are only partly inside the study area use fewer points.

cell area (ha) = $\text{size}^2 \div 10,000 \times (\text{points inside area} \div 16)$

class area = sum of cell areas in that class; % of area = class area ÷ total area

mean index = $\Sigma(\text{cell area} \times \text{score}) \div \Sigma(\text{cell area})$

Example (325 m cells, full cell = 10.56 ha)

Cell	Points inside	Area (ha)	Score	Area × score
17	16	10.56	73.4	775.1
18	16	10.56	52.0	549.1
19 (edge)	8	5.28	30.0	158.4
Total		26.40		1,482.6

Mean index = $1,482.6 \div 26.40 = 56.2$

Top priority cells are the 10 cells with the highest scores. **Threatened species** in the summary counts only CR, EN and VU species.

8. Map composition and exports

Web map tab: switch base maps (OpenStreetMap, Esri Satellite, Esri Topographic) and layers (importance grid, habitat, protected areas, study area, species records). Click a cell for its score, species and record counts.

Map composition tab: builds print pages: Page 1 map with legend, north arrow, scale bar and graticule; Page 2 method and statistics; Page 3 onward species list.

- **Text:** title, subtitle, prepared by, notes (shown on page 2).
- **Page:** A4, A3, A2, A1 or Letter; landscape or portrait; font; resolution (150, 300 or 600 dpi).
- **Styles:** title and text size, colour, bold/italic, class colours.
- **Map elements:** graticule, cell grid lines, species points, highlight threatened, protected areas, cell ID labels (top 10) and cell ID labels (all cells).

Downloads: each page as PNG or SVG, all pages as PNG, or one PDF. Data exports in the left panel: **Export KML** (grid and species for Google Earth), **GeoJSON grid** (for GIS software), **Cell scores CSV** and **Species CSV**.

9. Limits and good practice

- The index is **relative**. A score of 80 means "high compared with the rest of this study area".
- GBIF holds observations, not a full inventory. Poorly surveyed areas score lower. Add field CSV data and verify in the field.
- Plant records include all plants, not only trees.
- OpenStreetMap habitat is skipped if the study area is larger than about 2 degrees. Then habitat, water and protected-area components are left out.
- Smaller cells give finer maps but fewer records per cell. Use cells of 500 m to 1 km for most forest divisions.
- Always report the data sources, date and weights shown on page 2 of the map sheets.

10. Troubleshooting

Problem	What to do
"No polygon found in KML"	Export the boundary as a Polygon (not a line or point) and upload again.
"GBIF fetch failed"	Check your internet connection and open the file from your computer or website, not a preview.
GBIF returned 0 records	Try other groups, or upload a field CSV.
Habitat "not reachable" or "skipped"	OpenStreetMap server was busy or the area is very large. Run again later, or accept the index without habitat.
CSV error	Make sure columns named lat, lon and species exist in the first row.
PNG or PDF failed	Lower the dpi, use a smaller page size, or download SVG.
Logos missing in header	Keep the folder image with BILogo.png and Logo.png next to the HTML file.

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Data: GBIF.org and OpenStreetMap contributors