



Cross-Border Sustainable Renewable Energy Acceleration in Ukraine - Mapping Synergy Renewable Energy Acceleration Areas between Ukraine, EU Member States, and Moldova

Task 4. Data Collection and Analysis

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Chapter 1. Characteristics of collected data

The data for the purposes of environmental criteria assessment has been collected from public institutions, non-governmental (community) organisations and online open sources. The collected data has varied characteristics described in the table below.

Table 1. Input data characteristics

Collected data	Data sources	Data formats	Coordinate systems	Resolution	Metadata
<i>Criterion 1.1: Areas protected under international legislation</i>					
Areas of Emerald Network Sites.	The official web-map of European Environment Agency on Emerald Network Sites: https://emerald.eea.europa.eu	GeoJson	WGS-84	Not applicable	Available
Geospatial data in vector format on location of Wetlands of International Importance (protected under the Ramsar Convention).	The official web-site of Ramsar Convention (https://www.ramsar.org)	Shape-file	WGS-84	Not applicable	Available
Areas of UNESCO Biosphere Reserves.	The official web-site of the UNESCO Man and the Biosphere Programme: https://www.unesco.org/en/mab	Shape-file	WGS-84	Not applicable	Available
<i>Criterion 1.2: Areas designated under national protection schemes for nature and biodiversity conservation</i>					
Registers and Geospatial data in vector format on location of Nature Reserve Fund of Ukraine.	Open Data Portal: https://data.gov.ua/dataset/mepr_05	Shape-file	UCS-2000	Not applicable	Available
<i>Criterion 1.3: Major bird migratory routes</i>					
Geospatial data in vector format on pathing major bird	Map of seasonal bird migration routes across Ukraine. National report of Ukraine on the state of the natural environment http://nature.org.ua/nr98/ukrvers/indicators/map_18.htm	Shape-file	UCS-2000	Not applicable	Available

Collected data	Data sources	Data formats	Coordinate systems	Resolution	Metadata
migratory routes along the territory of Ukraine.					
Geospatial data in vector format on locations of areas defined as Important Bird and Biodiversity Area.	BirdLife International (2025) Digital boundaries of Important Bird and Biodiversity Areas from the World Database of Key Biodiversity Areas. March 2025 Version. Available at https://datazone.birdlife.org/contact-us/request-our-data	Shape-file	WGS-84	Not applicable	Available
Criterion 1.4: Other sensitive areas identified through sensitivity maps and relevant tools					
Geospatial data in vector format on observations of endangered species of flora and fauna listed in the Red Book of Ukraine and international lists.	<i>Global Biodiversity Information Facility</i> Records of protected animals species in Ukraine https://www.gbif.org/dataset/2b00ca94-c839-4a28-8c58-1412523958f1#description	Excel	WGS-84	Not applicable	Available
Geospatial data in vector format on location of peatlands to be protected.	Global estimates of land use/land cover (LULC), derived from ESA Sentinel-2 imagery at 10m resolution. This dataset was generated by Impact Observatory https://planetarycomputer.microsoft.com/dataset/group/io-land-cover	Geotiff	WGS-84	10 m	
Criterion 2.1: Elevation & Criterion 2.2: Steep slopes					
Elevation model.	30-meter resolution elevation data from the Shuttle Radar Topography Mission: https://dwtkns.com/srtm30m	Geotiff	WGS-84	30 m	Available
Criterion 2.3: Areas prone to flooding					
Geospatial data in vector format on areas with a	Joint Research Centre Data Catalogue: River flood hazard maps for Europe - version 1	Geotiff	WGS-84	100 m	Available

Collected data	Data sources	Data formats	Coordinate systems	Resolution	Metadata
probability of flooding of 1%.	Last updated: 20 Mar 2024 Dottori, Francesco; Alfieri, Lorenzo; Bianchi, Alessandra; Lorini, Valerio; Feyen, Luc; Salamon, Peter (2016): River flood hazard maps for Europe - version 1. European Commission, Joint Research Centre (JRC) [Dataset] PID: http://data.europa.eu/89h/8e49997c-ba99-4ed1-9aec-059bb44001b				
Criterion 3.1: Areas of forest fund					
Geospatial data in vector format on location of the lands of forest fund.	Global estimates of land use/land cover (LULC), derived from ESA Sentinel-2 imagery at 10m resolution. This dataset was generated by Impact Observatory https://planetarycomputer.microsoft.com/dataset/group/io-land-cover	Geotiff	WGS-84	10 m	Available
Criterion 3.2: Areas of water fund					
Waterbodies areas and lines.	Global estimates of land use/land cover (LULC), derived from ESA Sentinel-2 imagery at 10m resolution. This dataset was generated by Impact Observatory https://planetarycomputer.microsoft.com/dataset/group/io-land-cover	Geotiff	WGS-84	10 m	Available
Criterion 3.3: Agricultural lands					
Geospatial data in vector format on location of the lands of agricultural purpose.	Global estimates of land use/land cover (LULC), derived from ESA Sentinel-2 imagery at 10m resolution. This dataset was generated by Impact Observatory https://planetarycomputer.microsoft.com/dataset/group/io-land-cover	Geotiff	WGS-84	10 m	Available
Criterion 3.4: Recreational lands					
Geospatial data in vector format on location of the lands of recreational purpose.	Кадастрова карта України https://kadastrova-karta.com/	GeoJson	WGS-84	Not applicable	Available
Criterion 4.1: Artificial and built surfaces					

Collected data	Data sources	Data formats	Coordinate systems	Resolution	Metadata
Areas covered artificial and built surfaces.	Global estimates of land use/land cover (LULC), derived from ESA Sentinel-2 imagery at 10m resolution. This dataset was generated by Impact Observatory https://planetarycomputer.microsoft.com/dataset/group/io-land-cover	Geotiff	WGS-84	10 m	Available
Criterion 5.1: State border regime areas					
Geospatial data in vector format on location of the state border of Ukraine.	Open data on administrative-territorial structure of Ukraine shared by the Ministry for Development of Communities and Territories of Ukraine https://mtu.gov.ua/content/kodifikator-administrativnoteritorialnih-odinic-teritoriy-teritorialnih-gromad.html	GeoJson	UCS-2000	Not applicable	Available

Chapter 2. Evaluation of the suitability of data for the environmental criteria assessment purposes

The collected data has different level of suitability for the environmental criteria assessment purposes depending on:

- relevance of the received data to the request;
- type of data received;
- format of data received;
- completeness of data received;
- currentness of data received;
- accuracy of data received.

Table 2. Assessment of input data sets

Dataset	Relevance	Type	Format	Completeness	Currentness	Accuracy	Assessment
Areas of Emerald Network Sites.	Relevant	Digital	Spatial	High	High	High	Acceptable
Geospatial data in vector format on location of Wetlands of International Importance (protected under the Ramsar Convention).	Relevant	Digital	Spatial	High	High	High	Acceptable
Areas of UNESCO Biosphere Reserves.	Relevant	Digital	Spatial	High	High	High	Acceptable
Registers and Geospatial data in vector format on	Relevant	Digital	Spatial	High	High	High	Acceptable

Dataset	Relevance	Type	Format	Completeness	Currentness	Accuracy	Assessment
location of Nature Reserve Fund of Ukraine.							
Geospatial data in vector format on pathing major bird migratory routes along the territory of Ukraine.	Relevant	Digital	Spatial	High	Medium	Medium	Acceptable
Geospatial data in vector format on locations of areas defined as Important Bird and Biodiversity Area.	Relevant	Digital	Spatial	High	High	High	Acceptable
Geospatial data in vector format on observations of endangered species of flora and fauna listed in the Red Book of Ukraine and international lists.	Relevant	Digital	Table	High	Medium	Medium	Acceptable
Geospatial data in vector format on location of peatlands to be protected.	Relevant	Digital	Spatial	High	High	Medium	Acceptable
Elevation model.	Relevant	Digital	Spatial	High	Medium	Medium	Acceptable
Geospatial data in vector format on areas with a probability of flooding of 1%.	Relevant	Digital	Spatial	High	High	Medium	Acceptable
Geospatial data in vector format on location of the lands of forest fund.	Relevant	Digital	Spatial	High	High	Medium	Acceptable
Waterbodies areas and lines.	Relevant	Digital	Spatial	High	High	High	Acceptable
Geospatial data in vector format on location of the lands of agricultural purpose.	Relevant	Digital	Spatial	High	High	Medium	Acceptable
Geospatial data in vector format on location of the lands of recreational purpose.	Relevant	Digital	Spatial	High	High	High	Acceptable
Areas covered artificial and built surfaces.	Relevant	Digital	Spatial	High	High	High	Acceptable
Geospatial data in vector format on location of the state border of Ukraine.	Relevant	Digital	Spatial	High	High	High	Acceptable

Chapter 3. Processing and unification of collected data

A number of operations are used to prepare and unify data, which use tools and processing algorithms in a QGIS environment.

- Geopackage conversion operation.
- Changing the coordinate system.
- Raster to vector conversion operation.
- Operation to create a buffer around polygonal feature.

1. Geopackage conversion operation in QGIS environment (version 3.38):

Method A. One layer via “Save As...”

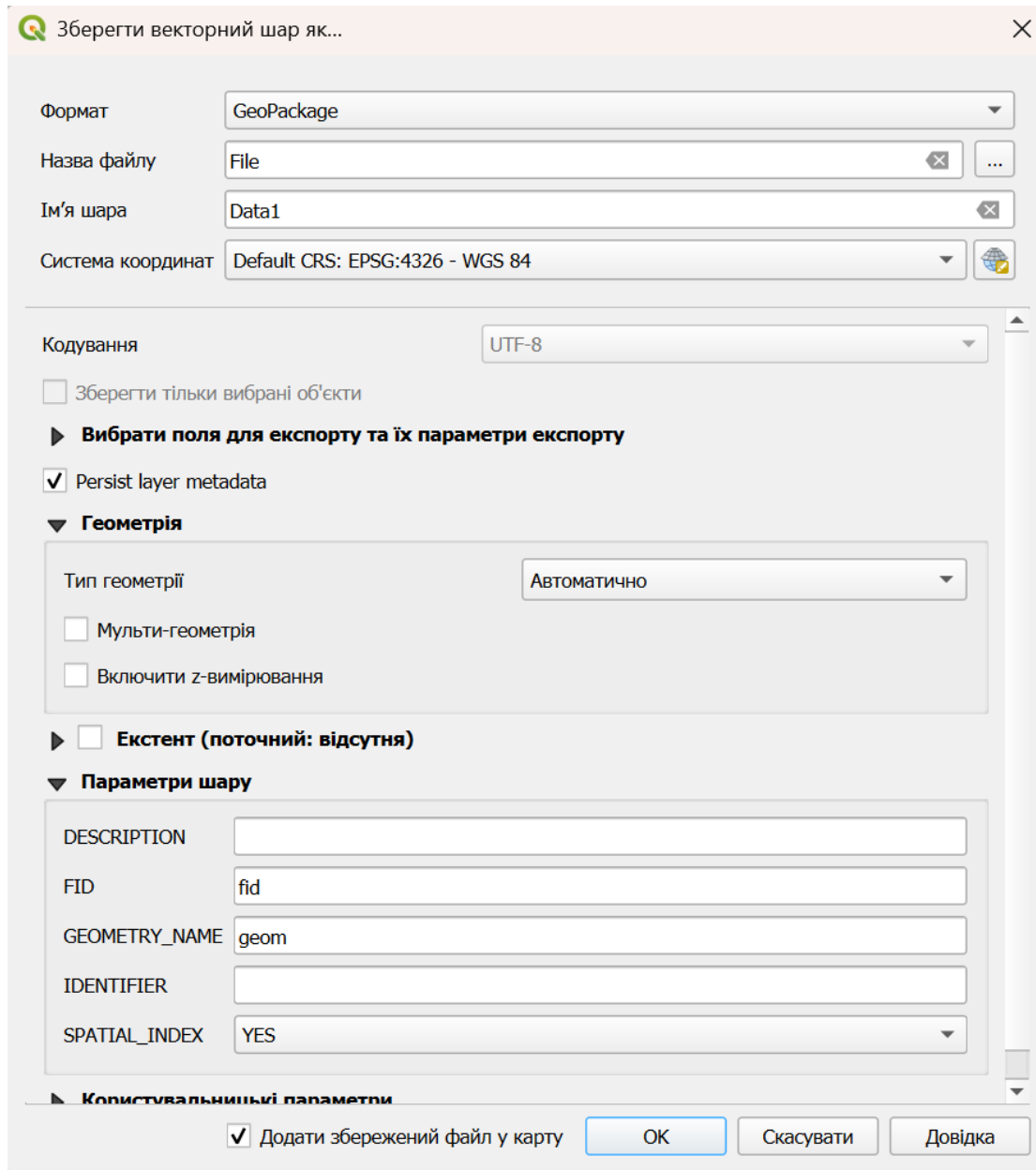
1. Add the shapefile to QGIS.
2. In Layers panel → right-click the layer → Export → Save Features As...
3. Format: *GeoPackage* File name: choose (create) e.g. data.gpkg
4. Layer name: set a clear name (this becomes the table name).
5. Options I recommend:
 - CRS: pick your target CRS (or keep the original).
 - Geometry: *Automatic* (or force Multi with “*Promote to multipart*”).
 - Encoding: *UTF-8*.
 - Create Spatial Index: ✓
6. Click OK (optionally Add saved file to map ✓).

Method B. Import via Browser panel (great for many layers)

1. Open Browser panel (View → Panels → Browser).
2. Right-click your target GeoPackage (or create a new one: New → GeoPackage).
3. Choose Import Layer/File... → select the .shp → set Layer name → OK. Repeat to collect multiple layers inside the same .gpkg.

Method C. Processing tool (batch convert many shapefiles)

1. Processing Toolbox → GDAL → Vector conversion → Translate (Convert format).
2. Input layer(s): your .shp (use Batch to add many).
3. Output: set to a .gpkg. For multiple inputs, give unique Layer names.
4. Optional parameters worth using:
 - Layer creation options: SPATIAL_INDEX=YES
 - Geometry type: *Promote to Multi* (avoids single/multi mix problems).



2. The operation of changing the coordinate system to WGS-84 in QGIS environment (version 3.38):

Method A. Vectors (Shapefile/GeoPackage/any)

Fast way (one layer):

1. Add the layer → Right-click → Export → Save Features As...
2. Format: your choice (e.g., GeoPackage)
3. CRS: choose EPSG:4326 – WGS 84
4. (Optional) Geometry → *Promote to multipart*; Encoding: *UTF-8*; Create spatial index: ✓

5. OK.

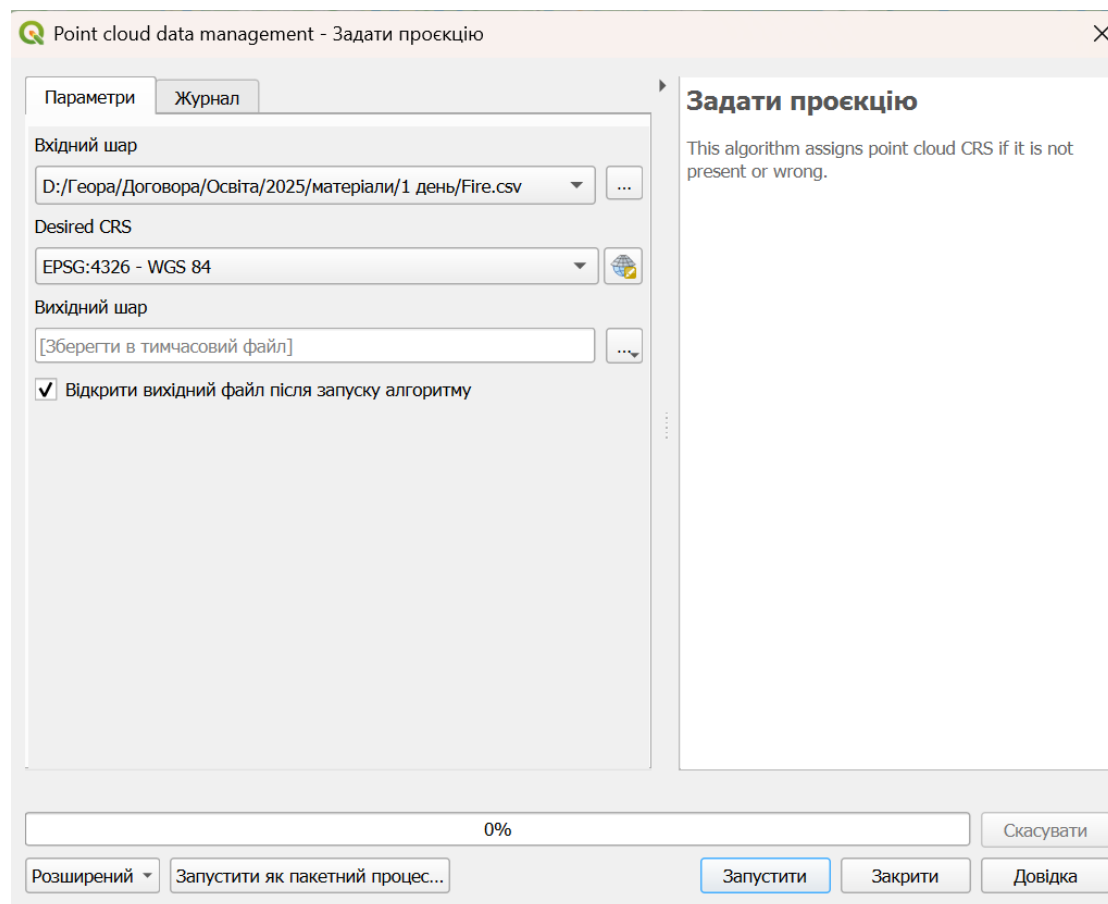
Batch (many layers):

1. Processing Toolbox → Vector table → Reproject layer (search “Reproject layer”).
2. Target CRS: EPSG:4326.
3. Click the Batch button, add all inputs, set outputs, run.

If QGIS asks for a *datum transformation*, pick the one with the smallest accuracy value (best available).

Method B. Rasters (GeoTIFF, etc.)

1. Processing Toolbox → GDAL → Warp (reproject).
2. Target CRS: EPSG:4326.
3. Resampling:
 - *Nearest* for categorical data (land use, classes)
 - *Bilinear/Cubic* for continuous data (elevation, imagery)
4. Set output resolution if needed → Run.



3. Raster to vector conversion operation in in QGIS environment (version 3.38):

Method A. Categorical raster → polygons (classes/land-use)

Use this when pixel values are discrete (1=forest, 2=water, ...).

Steps

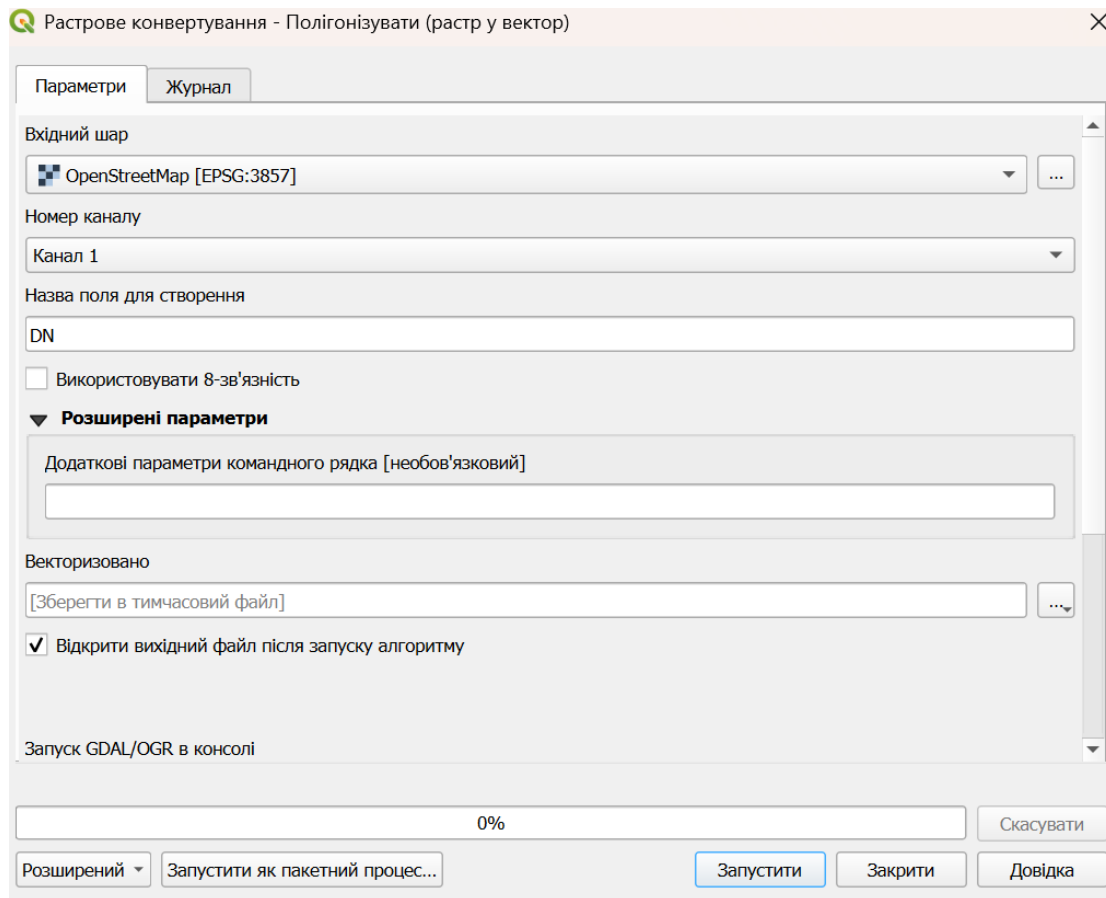
1. (Optional) Clean values: Raster Calculator to set NoData/merge classes, e.g. $(\text{"landuse@1"} = 0) * \text{nodata}(\text{"landuse@1"}) + (\text{"landuse@1"} \neq 0) * \text{"landuse@1"}$
2. Processing Toolbox → GDAL → Polygonize (raster to vector).
 - *Input layer*: your raster
 - *Field name*: e.g. class
 - *Use 8-connectedness*: ✓ (usually better)
 - *Mask layer*: set if you want to ignore outside area
3. Post-process (recommended):
 - Dissolve by class to merge same-value parts.
 - Remove small parts (QGIS) or v.clean.rmarea (GRASS) to drop tiny slivers.
 - Fix geometries if needed, then Smooth (gentle) if the “stair-step” look bothers you.

Method B. Continuous raster → contour polygons (isobands)

Want elevation/temperature *zones* as polygons?

Steps

1. Processing → GDAL → Contour polygons (GDAL ≥ 3)
 - Provide *Intervals* or *Breaks* (e.g., 0, 200, 400, 600...). If you don't see this tool, use SAGA → Contour Lines from Grid + Polygonize by bands.
2. Dissolve by band/min/max fields if you want single polygons per band.



4. Operation to create a buffer around polygonal feature in QGIS environment (version 3.38):

Method A. Standard buffer (fixed distance)

1. Add your polygon layer to the project.
2. Open Processing Toolbox → Vector geometry → Buffer.
3. Input layer: your polygon layer.
4. Distance: set the buffer distance (in meters/km if the layer uses a meter-based CRS; see tips below).
5. Parameters:
 - Segments: 8–16 (higher = smoother arcs, heavier geometry).
 - Join style: *Round* (smooth corners).
 - Dissolve result: ✓ if you want one merged buffer for all polygons.
6. Run → you'll get outward polygon buffers.

Want the buffer inside the polygon? Use a negative distance (e.g., -50 m).

Method B. Variable (field-based) buffer

When each feature needs its own distance:

1. Add/prepare a field (e.g., buf_m) with distances in meters.
2. In Buffer, click the fx icon for Distance and pick the buf_m field or enter an expression (e.g.,
CASE WHEN area(\$geometry) > 100000 THEN 100 ELSE 30 END).
3. Run. Each polygon gets its individual buffer.

Method C. Ring buffer (annulus)

If you need a “donut” rather than a filled buffer:

1. Create an outer buffer (e.g., 100 m).
2. Vector overlay → Difference:
 - Input: the outer buffer
 - Overlay: the original polygons
→ result is a 100 m ring outside the boundary.
Alternatively, make an inner buffer (–50 m) and use Symmetrical difference between outer and inner.

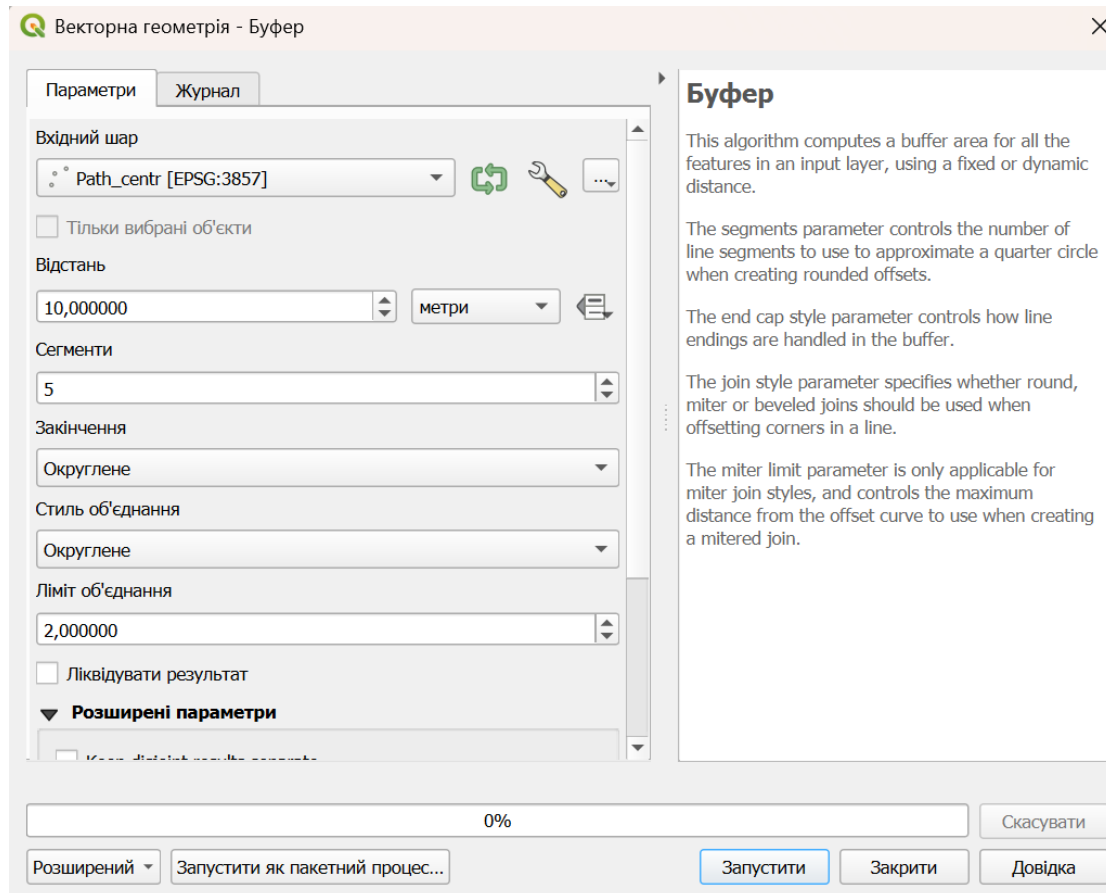
4) Buffer only outside (exclude the original area)

If you don't want the buffer to cover any area inside the polygon:

- Create a standard outer buffer, then run Difference with the original layer (as above) → you'll keep only the outer band.

5) Batch processing

For many layers: in the Buffer tool window click Batch, add all inputs, set common parameters, specify outputs, run.



Also, *special processing techniques* were used in the preparation of some data sets.

Methodology for calculating zones of observations of endangered species of flora and fauna listed in the Red Book of Ukraine and international lists.

Input data: Table of encounter locations with endangered species of flora and fauna listed in the Red Book of Ukraine with coordinate information.

Input data processing procedure:

Stage 1. Converting tabular data to format Geopackage.

Using latitude and longitude table fields to create a point feature layer

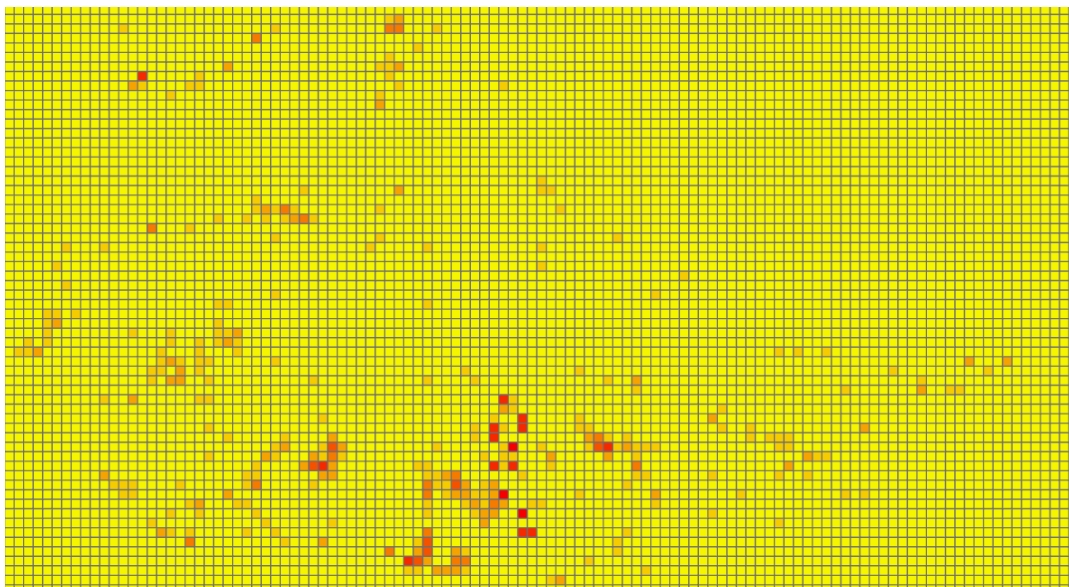
Stage 2. Construction of a regular grid over the study area.

Based on the analysis of the location of the points, a 5 by 5 km network was chosen.



Stage 3. Calculates the number of points in each grid square.

The number of dots in each square is calculated as the sum of the dots that are within the grid square.

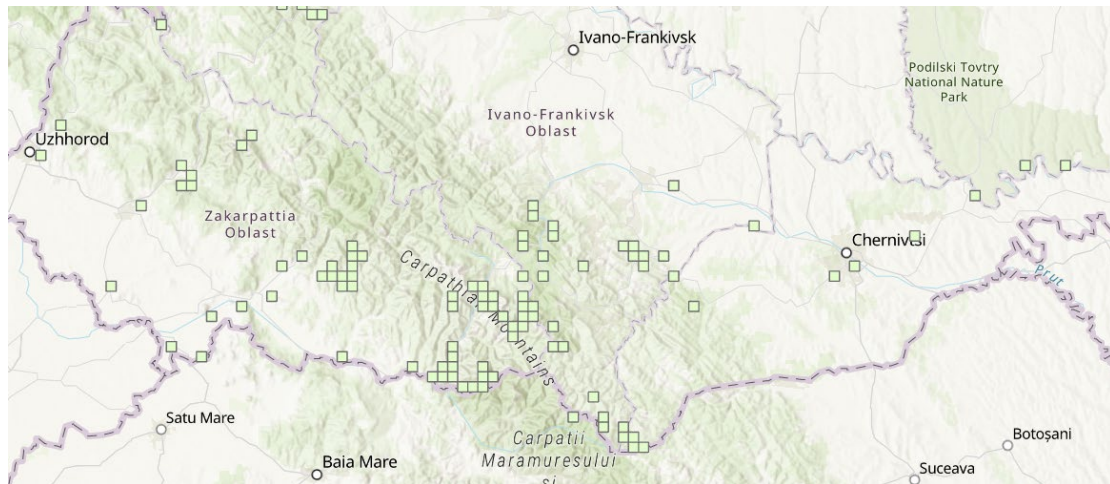


Stage 4. Calculating the average number of observations for grid squares.

The average value of the number of points for grid squares is calculated, excluding squares with zero values.

Stage 5. Selection of grid squares with values above average.

Grid squares that have values above the average for all squares are selected.



Stage 6. Generalization of selected areas.

Generalization of the selected territories is carried out by combining squares with a common border and simplifying their contours.

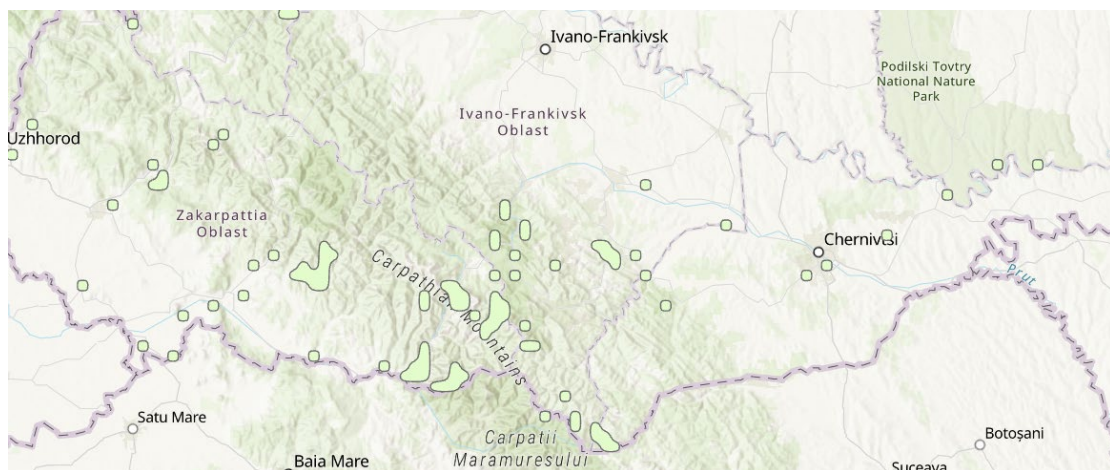


Table 3. Matrix of procedural operations on data sets

Dataset	Format conversion	Coordinate system conversion	Raster-vector transformation	Buffer creation
Areas of Emerald Network Sites.	Geopackage conversion	Not needed	Not needed	completed
Geospatial data in vector format on location of Wetlands of International Importance (protected under the Ramsar Convention).	Geopackage conversion	Not needed	Not needed	completed
Areas of UNESCO Biosphere Reserves.	Geopackage conversion	Not needed	Not needed	completed
Registers and Geospatial data in vector format on location of Nature Reserve Fund of Ukraine.	Geopackage conversion	WGS-84	Not needed	completed
Geospatial data in vector format on pathing major bird migratory routes along the territory of Ukraine.	Geopackage conversion	WGS-84	Not needed	completed
Geospatial data in vector format on locations of areas defined as Important Bird and Biodiversity Area.	Geopackage conversion	Not needed	Not needed	completed
Geospatial data in vector format on observations of endangered species of flora and fauna listed in the Red Book of Ukraine and international lists.	Geopackage conversion	Not needed	Not needed	completed
Geospatial data in vector format on location of peatlands to be protected.	Geopackage conversion	Not needed	Spatial	completed
Elevation model.	Without conversion	Not needed	Not needed	Not needed
Area above 800 m	Geopackage conversion	Not needed	Completed	Not needed
Geospatial data in vector format on areas with a probability of flooding of 1%.	Geopackage conversion	Not needed	Completed	Not needed
Geospatial data in vector format on location of the lands of forest fund.	Geopackage conversion	Not needed	Completed	completed
Waterbodies areas and lines.	Geopackage conversion	Not needed	Not needed	Completed

Dataset	Format conversion	Coordinate system conversion	Raster-vector transformation	Buffer creation
Geospatial data in vector format on location of the lands of agricultural purpose.	Geopackage conversion	Not needed	Completed	Completed
Geospatial data in vector format on location of the lands of recreational purpose.	Geopackage conversion	Not needed	Spatial	Completed
Areas covered artificial and built surfaces.	Geopackage conversion	Not needed	Not needed	Not needed
Geospatial data in vector format on location of the state border of Ukraine.	Geopackage conversion	WGS-84	Not needed	Completed