Professional Certificate in GIS for Biodiversity Conservation

Gis Fundamentals For Conservation

Adjacency – a spatial relationship where two polygon features share a common boundary. Related terms: Contiguity, neighbor analysis. In habitat mapping, adjacency helps identify edge effects where forest patches meet agricultural land, influencing species movement. Practical use includes calculating edge length for corridor design. A challenge is handling sliver polygons that create false adjacency due to digitizing errors.

Accuracy – the degree to which spatial data represent the real world. Related terms: Precision, error, ground truth. Accuracy is assessed through positional error metrics such as RMSE. For species occurrence records, high accuracy ensures reliable niche modeling. Challenges involve balancing cost of field verification with required accuracy thresholds.

ArcGIS – a commercial GIS software suite by Esri providing tools for data creation, analysis, and visualization. Related terms: Desktop GIS, ArcMap, ArcPro. Conservation analysts use ArcGIS to overlay protected area boundaries with threat layers. Limitations include licensing costs and steep learning curve for advanced spatial statistics.

Attribute – a non-spatial data column associated with a GIS feature, describing characteristics like species name or canopy cover. Related terms: Field, attribute table, metadata. Attributes enable querying, e.G., Selecting all wetlands with >50% vegetation. Challenges arise when attribute data are missing, inconsistent, or lack standardized coding.

Atlas – a collection of maps, often thematic, compiled for reference. Related terms: Map book, cartographic series. An atlas of endangered species can guide policy makers. Modern digital atlases integrate interactive GIS layers, but require regular updates to stay current.

Basemap – a reference layer providing geographic context such as topography, roads, or satellite imagery. Related terms: Background map, base layer. Basemaps are essential for locating conservation sites within broader landscapes. Selecting an appropriate basemap balances resolution, coverage, and licensing constraints.

Buffer – a zone created at a specified distance around a feature. Related terms: Proximity analysis, zone of influence. Buffers around rivers can define riparian protection zones. Challenges include choosing ecologically meaningful distances and managing overlapping buffers that inflate area estimates.

Cartography – the art and science of map design and production. Related terms: Symbology, layout, map elements. Effective cartography communicates biodiversity data to stakeholders. Poor symbol choices can mislead interpretations; thus, standards such as ISO 19125 guide design.

Coordinate Reference System (CRS) – a framework that defines how the two-dimensional coordinates of GIS data relate to real locations on Earth. Related terms: Projection, datum, EPSG code. Using a consistent CRS (e.G., WGS 84 / UTM zone 33N) avoids misalignment when overlaying layers. Transforming between CRSs can introduce distortion, a common source of error in multi-source analyses.

Digital Elevation Model (DEM) – a raster representation of terrain elevation. Related terms: Terrain model, elevation grid. DEMs support slope, aspect, and watershed analyses critical for identifying landslide-prone habitats. Limitations include voids in steep terrain and resolution constraints affecting micro-habitat detection.

Ecological Niche Modeling (ENM) – a set of techniques that predict species' potential distribution based on environmental variables. Related terms: Species distribution model (SDM), MaxEnt, habitat suitability. ENM informs reserve placement by highlighting suitable but unprotected areas. Model reliability depends on quality of occurrence data and selection of ecologically relevant predictors.

Edge Effect – ecological changes that occur at the boundary between two habitat types. Related terms: Habitat edge, matrix. GIS can quantify edge length using adjacency tools, guiding mitigation such as buffer creation. Edge effects may increase invasive species pressure, complicating restoration planning.

Feature – a spatial object (point, line, or polygon) representing a real-world entity. Related terms: Geometry, object class. Points may represent nesting sites; lines can depict migration corridors; polygons delineate protected areas. Managing feature topology (e.G., Avoiding gaps) is essential for accurate area calculations.

Geodatabase – a database designed to store, query, and manage spatial data and its attributes. Related terms: File geodatabase, enterprise geodatabase, GDB. Geodatabases support versioning, enabling multiple analysts to edit conservation data concurrently. Complexity increases with relationship classes and network datasets.

Georeferencing – the process of aligning a non-spatial image (e.G., Scanned map) to real-world coordinates. Related terms: Rectification, control points. Georeferenced historical land-use maps allow assessment of habitat change over decades. Accuracy depends on the number and distribution of control points; sparse points may cause distortion.

Ground Truthing – field verification of remotely sensed or modeled data. Related terms: Validation, field survey. Ground truthing confirms forest cover classifications derived from satellite imagery, improving model reliability. It is labor-intensive and may be limited by accessibility in remote conservation areas.

Habitat Fragmentation – the process whereby large, contiguous habitats are broken into smaller, isolated patches. Related terms: Patch size, connectivity. GIS quantifies fragmentation using metrics such as patch density and edge-to-core ratio. Addressing fragmentation often involves designing corridors; however, land tenure complexities can hinder implementation.

Interpolation – estimating unknown values between measured points. Related terms: Kriging, IDW (inverse distance weighting). Interpolated climate surfaces support ENM. Choice of algorithm influences smoothness and bias; over-smoothing may erase micro-refugia important for specialist species.

Land Cover Classification – assigning each pixel of a raster image to a categorical land-cover type (e.G., Forest, agriculture). Related terms: Supervised classification, unsupervised classification, thematic map. Accurate classification underpins habitat suitability assessments. Challenges include spectral similarity between classes and cloud contamination.

Metadata – descriptive information about a dataset, including source, scale, accuracy, and usage constraints. Related terms: Data documentation, ISO 19115. Proper metadata ensures reproducibility of conservation analyses. Lack of metadata hampers data sharing across organizations.

Network Analysis – a suite of GIS tools that model movement or flow through linear features. Related terms: Least-cost path, corridor modeling, graph theory. Conservation planners use network analysis to identify optimal wildlife corridors linking protected patches. Data quality of resistance surfaces heavily influences results.

Overlay Analysis – combining two or more spatial layers to extract areas meeting multiple criteria. Related terms: Intersect, union, erase. An overlay of high-biodiversity cells with low-deforestation risk yields priority zones for new reserves. Overlays can become computationally intensive with large rasters, requiring data generalization.

Protected Area (PA) – a geographically defined space recognized and managed for biodiversity conservation. Related terms: IUCN category, reserve, sanctuary. GIS maps PAs to assess coverage of key species’ ranges. Gaps often appear where critical habitats lie outside existing PAs, prompting expansion proposals.

Raster Data – spatial data stored as a matrix of cells (pixels) each with a value. Related terms: Grid, continuous data. Elevation, temperature, and land-cover are typical rasters used in conservation modeling. Raster resolution influences the scale of ecological inference; high resolution may increase processing time.

Remote Sensing – acquisition of information about Earth’s surface without physical contact, typically via satellites or drones. Related terms: Imagery, sensor, platform. Remote sensing provides up-to-date forest cover maps for monitoring deforestation. Atmospheric interference and sensor saturation are common challenges.

Resistance Surface – a raster where each cell value represents the difficulty for an organism to move through that cell. Related terms: Cost surface, friction layer. Resistance surfaces feed least-cost path analyses to design corridors. Deriving realistic resistance values requires ecological expertise and validation.

Scale – the spatial resolution or extent at which data are analyzed. Related terms: Grain, extent, resolution.

Choosing an appropriate scale ensures that patterns such as species turnover are captured without unnecessary detail. Mismatched scales between layers cause misalignment errors.

Shapefile – a popular vector file format comprised of at least three files (.Shp, .Shx, .Dbf). Related terms: Vector data, file format. Shapefiles are widely used to exchange species occurrence points. However, they lack support for complex relationships and can store only one geometry type per file.

Spatial Autocorrelation – the principle that nearby locations tend to have similar values. Related terms: Moran's I, semivariogram. Ignoring spatial autocorrelation in statistical models can inflate Type I error rates. GIS tools allow calculation of autocorrelation to guide model selection.

Spatial Extent – the geographic boundaries covered by a dataset. Related terms: Study area, envelope. Defining a clear spatial extent prevents edge effects in analyses such as hotspot identification. Overly large extents may dilute focus, while too small extents can miss broader patterns.

Species Distribution Model (SDM) – a statistical model that relates species presence/absence to environmental variables to predict distribution. Related terms: ENM, habitat suitability model. SDMs guide reintroduction site selection. Model transferability across regions is a frequent challenge due to differing ecological contexts.

Topology – the spatial relationships that govern how features share geometry (e.G., Adjacency, containment). Related terms: Rules, integrity. Maintaining topological rules prevents gaps between adjacent protected area polygons, ensuring accurate area calculations. Complex topologies may slow editing performance.

Vector Data – spatial data stored as points, lines, or polygons with associated attributes. Related terms: Shapefile, geodatabase feature class. Vectors are ideal for representing discrete features like fire stations or river networks. Converting between vector and raster can introduce generalization errors.

Watershed – the land area that drains to a common outlet, defined by topographic divides. Related terms: Catchment, basin. GIS-derived watersheds support identification of riparian corridors for aquatic species. Delineation accuracy depends on DEM resolution and proper sink filling.

Web GIS – GIS functionality delivered through internet browsers or web services. Related terms: Web mapping, WMS (Web Map Service), REST API. Web GIS enables public participation in biodiversity monitoring via citizen-science portals. Performance can be limited by bandwidth and server capacity.

Zonal Statistics – summarizing raster values within each zone of a vector layer. Related terms: Zonal mean, raster extraction. Conservationists calculate mean forest canopy height per protected area to monitor habitat quality. Issues arise when zones overlap or when raster and vector extents differ.