

**FROM BIRD ATLASES TO PLANNING LAYERS:
INTEGRATING AVIFAUNA DATA INTO CITY-REGION
SPATIAL PLANNING**

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Abstract

Spatial planning and strategic environmental assessment frequently rely on coarse biodiversity descriptions that are insufficient to locate high-value habitats and to anticipate ecological consequences of land-use change along the urban-rural gradient. Birds respond rapidly to habitat configuration and management, and avifauna datasets can serve as an operational indicator for diagnosing ecological sensitivity in urban regions and peri-urban cultural landscapes. Using three regional Polish avifauna monographs that differ in scale and mapping approach as comparative knowledge products, the paper shows how their outputs can be translated into planning-relevant environmental information: baseline layers, constraints and opportunity maps, alternatives appraisal and monitoring indicators. It then synthesises recurrent barriers that limit uptake of biodiversity data in planning practice (data access and licensing, lack of standardisation, scale mismatch, limited institutional capacity and uncertainty management) and proposes a minimum evidence standard for integrating avifauna data into planning documents and SEA workflows. High-quality regional syntheses that separate historical and contemporary records and provide reproducible cartography can act as boundary objects linking ornithology with planning practice and supporting biodiversity-inclusive development.

Keywords: spatial planning, avifauna, birds, peri-urban landscapes, biodiversity data, strategic environmental assessment

1. INTRODUCTION

Urban regions are increasingly expanding into surrounding cultural landscapes, transforming farmland mosaics, river valleys and managed forests into a patchwork of housing, infrastructure and intensively managed green space. Land-use change is widely recognised as a dominant driver of biodiversity loss [1]. At city-region scale, the urban-rural gradient concentrates pressures including habitat fragmentation, loss of semi-natural elements, disturbance, artificial light and noise, and shifting management regimes in agriculture and forestry. These processes modify the

structure and functioning of ecological networks that connect urban cores with peri-urban and rural habitats.

Bird communities respond strongly to habitat configuration, resource availability and disturbance, and therefore provide a practical lens for diagnosing ecological sensitivity and ecological opportunities in city-regions. Urban ecology has documented both biotic homogenisation and the conservation value of specific urban and peri-urban habitats, including river corridors, wetlands, extensive grasslands, brownfields and mature tree stands [2-4]. Bird data can capture patterns that are directly relevant for planning—such as breeding and wintering concentrations, migration stopovers and the use of linear corridors—while being comparatively cost-effective to collect and communicate. Recent syntheses further emphasize that maintaining avian biodiversity in urban areas enhances overall ecological resilience to stressors such as climate change and rapid urbanization, providing a strong rationale for its explicit integration into planning frameworks [5]. Emerging global studies confirm that fine-scale urban planning decisions—such as the configuration and connectivity of green spaces—play a critical role in shaping avian diversity and associated ecosystem services, often outweighing broader landscape factors [6].

Despite this evidence and the growing availability of biodiversity observations, spatial planning and strategic environmental assessment (SEA) still often rely on descriptive, coarse or outdated biodiversity information. Planning documents may acknowledge 'valuable natural areas' yet lack spatially explicit, quality-controlled layers that can guide zoning, evaluate alternatives and define monitoring indicators. In practice this gap is reinforced by mismatches between planning scales and ecological processes, limited institutional capacity, data licensing constraints and uncertainty about how to interpret heterogeneous biodiversity datasets in decision contexts.

This commentary focuses on avifauna datasets as a component of environmental information for planning. It argues that high-quality ornithological syntheses—especially regional avifauna monographs and atlases that provide transparent methods and reproducible cartography—can function as boundary objects linking science and planning practice. Building on three Polish regional examples, international urban bird atlas initiatives, and on the international literature on biodiversity-inclusive spatial planning [7-8], I propose minimum standard evidence for integrating avifauna data into urban and peri-urban planning documents and assessment workflows. River valleys and forest complexes, typically spanning administrative boundaries, are pivotal components of city-region spatial planning and therefore should be explicitly addressed in both spatial plans and Strategic Environmental Assessment (SEA).

2. METHODOLOGY

The paper combines (i) a narrative review of international and Polish literature on the use of biodiversity data in planning and SEA and (ii) a comparative analysis of three regional Polish ornithological syntheses (monographs/atlasses). The goal is not to re-analyse raw bird records but to evaluate how knowledge products that are typical in ornithology can be operationalised for planning.

The three monographs were selected to represent variation in spatial extent (regional to landscape scale), habitat context (upland cultural landscape, large river valley and managed forest matrix) and mapping strategy. Each provides: (a) documented survey effort, (b) species-level information on breeding and/or non-breeding occurrence, and (c) cartographic outputs suitable for georeferencing. Together, they approximate the range of data products that planners might

encounter (atlas grids, point-based breeding records, habitat-linked observations, and narrative habitat accounts). [9-11].

Using these sources, I derive a typology of avifauna data products and define their potential roles in a planning workflow: baseline diagnosis, identification of constraints and opportunities, appraisal of spatial alternatives, and design of monitoring indicators. Based on recurrent limitations reported in the literature (e.g. data availability, scale mismatch, uncertainty), I then formulate minimum evidence standard for integrating avifauna data into planning documents that is intended to be transferable beyond the Polish context.

3. RESULTS

3.1. AVIFAUNA DATA PRODUCTS AND THEIR PLANNING RELEVANCE

Avifauna information can enter planning as raw records, interpreted distributions, or decision-ready layers. For planners, the key question is not only whether birds occur but what the records imply for land-use decisions: which habitats require avoidance, where mitigation should be prioritised, and what baseline can be used to evaluate change.

Table 1 summarises common avifauna data products and how they can support planning and SEA in urban and peri-urban contexts. The typology is intentionally pragmatic: it focuses on outputs that can be georeferenced, quality-checked and linked to decision points.

Table 1. Practical typology of avifauna data products and their relevance for spatial planning and strategic environmental assessment in urban and peri-urban landscapes.

Data product	Typical sources	Planning / SEA use	Strengths	Main limitations / caveats
Georeferenced occurrence records (points or grid cells)	Citizen-science platforms, atlases, monitoring schemes, museum records	Early screening, baseline diagnosis, identification of areas requiring field verification	High spatial detail; scalable; can cover large areas	Sampling bias; variable detectability; needs temporal filtering and quality control
Breeding evidence and key breeding sites (colonies, territories, nests)	Targeted surveys, breeding bird atlases, regional monographs	Defining constraints, avoidance zones and seasonal restrictions; mitigation hierarchy	Directly linked to reproduction; high conservation relevance	Sensitive data; requires confidentiality protocols; may change between years
Abundance / density estimates and trends	Standardised monitoring, repeated surveys, long-term datasets	Comparing alternatives; evaluating significance; selecting indicators and thresholds	Supports quantitative impact assessment and monitoring	Requires consistent methods and comparability; often limited spatial coverage
Community metrics and indicator sets (e.g. farmland or urban bird indices)	National monitoring, published indicator frameworks	Monitoring of plan implementation; reporting ecosystem service proxies	Communicable indicators; connects to policy targets	May mask local hotspots; needs habitat-appropriate interpretation
Habitat suitability / sensitivity layers (modelled or expert-derived)	Species distribution models, expert elicitation, synthesis products	Spatial alternatives appraisal; designing ecological networks; targeting restoration	Decision-ready; integrates multiple datasets	Model uncertainty; depends on assumptions and input data quality
Temporal layers (migration stopovers, winter roosts, phenology windows)	Seasonal counts, ringing/telemetry studies, local knowledge	Timing of works; lighting and disturbance management; seasonal zoning rules	Captures seasonal ecological bottlenecks	Often under-represented in planning baselines; requires multi-season data

3.2. REGIONAL AVIFAUNA MONOGRAPHS AS PLANNING-RELEVANT KNOWLEDGE PRODUCTS

Regional ornithological monographs and atlases are common in Europe and often contain the most detailed, place-based synthesis of bird occurrence available for a given landscape. They typically combine long-term observational knowledge with targeted fieldwork and provide species accounts that include breeding status, habitat associations, phenology and spatial distribution. From a planning perspective, such products can be treated as intermediate 'knowledge layers' that bridge between raw records and decision-ready environmental information.

In Poland, the three analysed monographs represent contrasting landscape contexts. The Świętokrzyskie example documents avifauna in a heterogeneous cultural landscape with a strong interface between forest complexes, open farmland and dispersed settlement. The Middle Vistula Valley example focuses on a large river corridor, where gravel islands, floodplain grasslands and oxbows host species of high conservation concern and where river regulation and development pressure interact. The Kozienice Forest example represents a forest-dominated matrix with internal wetlands and adjacent agricultural and urban edges. These three sources are [9], [10] and [11].

Across these contexts, the translation to planning layers follows a similar workflow: (1) georeference distribution maps and standardise spatial units; (2) classify records by temporal validity (e.g. historical vs contemporary) and by season (breeding, migration, wintering); (3) identify 'planning-relevant features' such as breeding colonies, lek sites, high-density areas, and movement corridors; (4) assign sensitivity classes and recommended management actions; and (5) attach transparent metadata describing survey effort, uncertainty and data access restrictions.

Similar translation of atlas and monograph data into planning tools has been demonstrated internationally. For example, fine-scale surveys of urban green spaces in Paris revealed substantial avian biodiversity patterns that directly inform habitat management and green infrastructure design in densely built environments [12]. Likewise, scenario modelling in other urban regions shows that targeted expansion of green areas based on avian data significantly outperforms other interventions in maintaining bird diversity and associated ecosystem services [13]. Recent urban breeding bird atlases in European cities further illustrate this potential. The ongoing atlas of Bucharest (Romania), based on data from 2016–2023, provides detailed distribution maps that explicitly support urban planning and conservation prioritization in a rapidly developing metropolitan area [14]. Similarly, the first Breeding Bird Atlas of the City of Milan (Italy) integrates citizen-science and standardized surveys to produce high-resolution outputs directly applicable to municipal green infrastructure planning and impact mitigation [15].

3.3. BARRIERS TO USING BIODIVERSITY DATA IN PLANNING AND SEA

The literature on biodiversity-inclusive planning repeatedly points to a set of practical barriers that prevent robust ecological evidence from informing decisions, even where data exist [7, 16-18]. For birds, these barriers include:

- Accessibility and licensing: key datasets may be held by NGOs, research groups or administrations with restrictive terms, or may contain sensitive locations that require controlled access.
- Standardisation and metadata: heterogeneous survey methods, uncertain effort and inconsistent breeding criteria reduce comparability and complicate integration across sources.

- Scale mismatch: planning decisions may operate at parcel or neighbourhood scale, while many bird datasets are aggregated to atlas grids; conversely, city-wide plans may require regional connectivity information.
- Temporal validity: planning baselines often mix historical and contemporary records, or fail to separate seasons. This is critical in urban regions where land use changes rapidly.
- Capacity and competencies: planning teams may lack ecological data expertise and tools (e.g. geospatial processing, detectability concepts), while ecologists may not package outputs in planning-ready formats.
- Uncertainty management: decision makers may interpret uncertainty as a reason to ignore ecological evidence, rather than as information that can be managed through precaution, adaptive monitoring and iterative plan revision.

In Poland, additional constraints include limited coverage of local plans, uneven access to digital environmental layers across municipalities and the tendency to treat SEA as a formal requirement rather than an evidence-generating process. These issues are not unique to Poland but illustrate how institutional settings shape the usability of biodiversity evidence.

3.4. A MINIMUM EVIDENCE STANDARD FOR INTEGRATING AVIFAUNA DATA INTO PLANNING

To make avifauna information usable in planning and SEA, evidence needs to be packaged into a form that is both scientifically defensible and decision-ready. Based on the synthesis above, I propose a minimum evidence standard (MS1–MS5) that can be applied when a planning document claims to incorporate bird data (Table 2). The standard is designed for urban and peri-urban contexts, where rapid change, multiple stakeholders and cumulative effects are common.

The minimum standard does not prescribe a single dataset or method. Instead, it specifies what must be reported and how avifauna information should be connected to planning decisions: the spatial and temporal validity of records, the resolution and uncertainty of mapped outputs, and the explicit link between ecological sensitivity and zoning, mitigation and monitoring commitments.

Table 2. Proposed minimum evidence standard (MS1–MS5) for integrating avifauna data into urban and peri-urban spatial planning documents and strategic environmental assessment.

Minimum standard element	What must be provided in the manuscript / planning document	Why it matters for decisions
MS1. Data inventory and temporal validity	List all avifauna sources used (monographs, atlases, monitoring schemes, expert knowledge) with date ranges; separate historical vs contemporary records; separate seasons (breeding, migration, wintering); specify update horizon.	Prevents mixing incomparable periods; supports defensible baseline for rapidly changing urban regions.
MS2. Spatial resolution and georeferencing	Provide georeferenced layers or clearly defined spatial units (grid size, buffers); document coordinate system and scale; justify resolution relative to decision scale.	Enables zoning and alternatives appraisal; reduces scale mismatch and 'map inflation' effects.
MS3. Quality assurance and uncertainty reporting	Describe survey effort or data validation procedures; report confidence classes and known biases; indicate sensitive data handling; identify gaps requiring field verification.	Allows precautionary interpretation; helps target additional surveys and avoids false certainty.
MS4. Decision linkage and mitigation hierarchy	Translate bird evidence into explicit planning rules: avoidance areas, seasonal restrictions, disturbance buffers, lighting/noise guidance, habitat retention/restoration targets; explain how these rules were derived.	Moves from description to actionable commitments; supports the mitigation hierarchy and cumulative impact management.
MS5. Monitoring indicators and adaptive feedback	Define measurable indicators (species, guilds, indices) with thresholds and timelines; specify monitoring responsibilities and data repositories; commit to adaptive plan review when thresholds are exceeded.	Ensures that plans can be evaluated and corrected; turns biodiversity evidence into an adaptive governance tool.

4. CONCLUSIONS

Bird data can provide spatially explicit, decision-relevant evidence for biodiversity-inclusive urban and peri-urban planning, but only when accompanied by transparent metadata, appropriate scale and explicit links to planning rules and monitoring.

Regional avifauna monographs and atlases can serve as boundary objects between ornithology and planning practice, especially when their cartographic outputs are georeferenced and separated by season and time period.

The proposed minimum evidence standard (MS1–MS5) offers a pragmatic checklist for authors and practitioners to assess whether avifauna information used in planning and SEA is fit for purpose. Adopting such standards can reduce the risk of 'biodiversity washing' in planning documents and strengthen the role of evidence in mitigating cumulative impacts along the urban–rural gradient.

The proposed framework aligns with broader calls to integrate biodiversity evidence into spatial planning and assessment by explicitly addressing scale, uncertainty and

decision relevance [7-8]. It also supports policy agendas that seek to mainstream biodiversity targets into sectoral policies and plans, including spatial planning [18-19]. Emerging international studies confirm the global applicability of this approach, showing how avian data integration not only supports biodiversity conservation but also enhances urban ecological resilience and ecosystem service delivery in rapidly changing city-regions [5, 13]. Fine-scale analyses further underscore that strategic expansion and connectivity of urban green spaces, informed by bird atlas data, can yield disproportionate benefits for avian communities and broader urban sustainability goals [6, 14].

Using birds as planning evidence has limitations: distributions can respond to short-term resource pulses and management practices not captured by land-use categories; sensitive species may require confidentiality; and the absence of records is not evidence of absence. Therefore, avifauna layers should be applied within a precautionary and adaptive logic, with uncertainty reporting, field verification for decision-critical sites and monitoring feedback to planning decisions.

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Received: February 13, 2026

Accepted: February 16, 2026

Revision: April 12, 2026