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Abstract

Ecological connectivity has become a major policy concern in Europe, but the language used to describe connected green–blue interventions is still fragmented. We analysed 3,868 articles with first authors based in Europe, published between 1956 and 2025, to examine how 15 related terms have been used across time, contexts, disciplines and keyword networks. Green infrastructure clearly dominates the literature, followed by ecological network, while corridor-, belt- and pathway-related terms occupy a smaller but diverse space. Since the early 2000s, the field has moved away from a mainly conservation-focused vocabulary towards broader concepts linked to urban planning, climate adaptation and ecosystem services. We show that broad terms connect debates across planning, ecology and climate, whereas more specific terms remain narrowly used. To improve comparable monitoring and policy alignment, we propose a pragmatic ‘umbrella + mechanism + scale’ heuristic for naming connected green-blue interventions.

Keywords

Environmental policy; Urban planning; Policy-ready approaches; Green-blue infrastructure; Landscape ecology;

Ecological connectivity in Europe has moved from a niche conservation concern to a mainstream policy objective. The EU Green Infrastructure Strategy and the EU Biodiversity Strategy for 2030 emphasise coherent, multifunctional networks of green and blue spaces, while the Nature Restoration Law introduces binding restoration and reporting obligations that relate directly to habitat continuity and landscape-scale connectivity, including in urban areas [1, 2, 3].Connectivity is also embedded in climate policy frameworks such as the European Green Deal and the EU Adaptation Strategy, where nature-based approaches are positioned as part of climate-resilient urban transformation [4, 5].

Delivering on these commitments requires not only implementation, but also comparable monitoring and evaluation across jurisdictions, an effort that depends on shared concepts and stable terminology. Without shared terminology, the same type of intervention may be reported, funded or evaluated under different labels, while different interventions may be treated as equivalent [6]. Such conceptual ambiguities can create practical barriers to comparing outcomes, scaling successful approaches across cities and countries, and integrating evidence into planning practice. They may also translate into methodological misalignments, as shown in urban blue-green infrastructure planning, where differences in scope, scale and modelling approaches can hinder integration across disciplines and complicate the translation of ecological connectivity assessments into planning practice [7].

Cities are a critical arena for such commitments. Urban areas already accommodate more than half of the global population and are projected to host around two-thirds of humanity by mid-century, making them central sites for addressing biodiversity loss and advancing sustainability transitions [8]. Yet, urban expansion continues to convert and fragment natural and semi-natural habitats, disrupting ecological processes and accelerating biodiversity loss [9, 10]. This places growing responsibility on cities to integrate biodiversity conservation, climate adaptation and ecosystem service delivery into urban development pathways [11, 12].

A key response is to increase not only the quantity of urban nature but also its spatial configuration and connectivity. Connected systems of green and blue spaces, such as parks, riparian buffers, street-tree corridors and stepping-stone habitats, can support species movement and ecological functioning while also providing co-benefits including cooling, flood regulation, recreation and health outcomes [13, 14].

However, translating these ambitions into practice is complicated by persistent terminological ambiguity. Multiple overlapping terms are used, often interchangeably, to describe connected green-blue interventions in science and planning. As noted in a technical report for the Convention on Biological Diversity (CBD), even the term “corridor” may refer either to an ecological linkage or to a recreational route [15]. This problem has grown in Europe as additional policy vocabularies, including nature-based solutions, ecosystem-based adaptation and blue-green infrastructure, have become more common [16, 17]. Terminology

shapes intervention design, justification, indicator choice, monitoring and the distribution of responsibilities across institutions [18, 19]. When the same term is used for different interventions, or different terms for similar ones, implementation becomes less consistent and results become harder to compare across projects and countries [20, 21].

Despite the growing prominence of ecological connectivity in research and policy, there is limited synthesis on how connectivity-related terms are used to describe interventions, planning concepts and policy instruments. This matters because “connectivity” itself spans multiple ecological concepts and measurement traditions, including structural and functional connectivity, which already complicates comparison across studies [22, 23, 24]. These difficulties are compounded when related labels such as green corridor, ecological corridor, greenway, ecological network, green infrastructure and blue-green infrastructure are used across different disciplinary and policy contexts, sometimes to describe overlapping interventions and sometimes to describe distinct planning objectives.

We therefore treat terminology not as a purely semantic issue, but as an operational condition for evidence synthesis, monitoring and policy implementation. To address this gap, we analyse European-affiliated English-language literature using a priori terms drawn from CBD guidance and European policy discourse. Specifically, we ask:

RQ1. How has connectivity-related terminology changed over time in the scientific literature?

RQ2. In Europe, how do selected connectivity terms vary across disciplinary and thematic contexts and application settings (e.g., urban versus non-urban), and what patterns help explain their prevalence?

RQ3. How can these observed patterns be translated into a practical naming heuristic that links umbrella concepts to mechanism- and scale-specific terms and associated evaluation criteria?

By clarifying where terms overlap and diverge, the study supports clearer scientific communication and more consistent translation into European policy and planning for biodiversity conservation and nature-based urban development.

Results

Country and terms distribution

A total of **15,102 unique records** were retrieved from Scopus and Web of Science after cross-database deduplication. Restricting the dataset to the document type Article yielded 12,171 journal articles published between 1956 and 2025. Of these, **3,868 articles (31.8%)** had first authors affiliated with European countries (defined by first-author affiliation in geographic Europe; Fig. 1; see Supplementary Information Table S2 for details).

Within Europe, the leading contributors are the United Kingdom (n=641; 16.6% of the European subset), Italy (n=509; 13.2%), Spain (n=388; 10.0%), and Germany (n=378; 9.8%). In contrast, 22 European countries individually account for less than 1% of the European subset, with Eastern Europe presenting the highest number of under-represented countries (n=13), including Georgia (n=37; 0.9%), Ukraine (n=33; 0.8%), and Serbia (n=31; 0.8%). In the subset of records for which a focal label has been assigned (n = 3,865), the most frequent term is *green infrastructure* (n=2,255; 58.3%), followed by *ecological network* (n=560; 14.5%), *greenbelt* (n=178; 4.6%), *ecological corridor* (n=143; 3.7%), and *green and blue spaces* (n=141; 3.7%).

Yearly publication

Annual term trajectories show a marked intensification after the early 2000s, although terms differed strongly in timing and magnitude of uptake (Supplementary information Fig. S1). Consistent with these descriptive patterns, log-linear count models fitted to the 1970–2023 period indicate the fastest long-run growth for green infrastructure (37.7% yr^{-1}) and green and blue spaces (25.2% yr^{-1}; Supplementary information Table S3). Corridor- and network-related terms also show positive trends, whereas several terms remain low-frequency or episodic.

Together, these trajectories reveal three historically structured phases of terminology uptake: a conservation-network phase dominant until the early 2000s, a green-infrastructure integration phase through the 2010s, and an urban–climate restoration phase from 2020 onwards, whose links with European policy agendas are examined in the Discussion.

Urban versus non-urban context

Across a total of 3,865 articles with an assigned focal term, the distribution of connectivity terms differed strongly between urban-tagged and non-urban records ($\chi^2(14)=999.6$, $p=1.94\times10^{-204}$; Cramér's V=0.51). At the term level, *green infrastructure* was strongly urban-leaning (OR=6.50, 95% CI 5.64–7.49, $p_{adj}=4.57\times10^{-161}$). In contrast, multiple terms were consistently non-urban-leaning, including *ecological network* (OR=0.113, 95% CI 0.0896–0.142, $p_{adj}=3.83\times10^{-100}$), *reserve network* (OR=0.0237, 95% CI 0.00579–0.0973, $p_{adj}=8.68\times10^{-20}$), *ecological framework* (OR=0.168, 95% CI 0.106–0.267, $p_{adj}=2.24\times10^{-17}$) and *transfrontier conservation area* (TCA) (OR=0.00963, 95% CI 0.000591–0.157, $p_{adj}=4.16\times10^{-14}$). Corridor- and pathway-related terms such as *ecological corridor* (OR=0.294, 95% CI 0.204–0.424, $p_{adj}=1.33\times10^{-11}$) and *greenway* (OR=0.398, 95% CI 0.270–0.586, $p_{adj}=3.70\times10^{-6}$) were also non-urban-leaning, while several terms (e.g., *biodiversity corridor, greenbelt, green and blue spaces*) showed no robust context difference after FDR control ($p_{adj}>0.05$) (Supplementary information Fig. S2). Standardised residuals indicate that most of the context separation is driven by the over-representation of green

infrastructure in urban-tagged records and by the over-representation of ecological network and conservation-linked terms in non-urban records.

Research categories

The disciplinary profile is highly structured (Supplementary information Table S5). Most publications fall within Ecology & Biodiversity and Environmental Sciences & Earth Systems, with a substantial contribution from Urban & Regional Planning / Geography. Planning and policy-oriented terms, particularly *green infrastructure*, *greenbelt*, *greenway* and *green corridor* - are concentrated in the Urban & Regional Planning / Geography and Environmental Sciences groups. In contrast, corridor/network terms linked to conservation (*ecological corridor*, *biological/biodiversity corridor*, *reserve network*, *transfrontier conservation area*) are dominated by Ecology & Biodiversity, with secondary contributions from Environmental Sciences. *Ecological framework* stands out for its links to the Health & Social Sciences group, reflecting health-oriented nature-based interventions (Fig. 2). These disciplinary affinities mirror the non-urban (remainder) reported above: planning-oriented terms are comparatively urban-leaning, whereas corridor/network terms are comparatively non-urban-leaning and conservation-leaning.

Keyword co-occurrence networks

The combined co-occurrence and temporal-overlay map reveals a structured thematic landscape within the European corpus (Fig. 3). *Green infrastructure* is the most central node, bridging urban-planning concepts (e.g., urban planning, sustainable cities) and ecological themes (e.g., biodiversity, ecosystem services). Bridging keywords such as ecosystem services, urban, and nature-based solutions reinforce this integrative vocabulary. Across the author keywords retrieved, 587 met the ≥ 10-occurrence threshold used to construct the full co-occurrence network; applying the visualisation threshold of ≥ 30 occurrences yielded 59 high-frequency keywords grouped into four coherent thematic clusters. The network presents high modularity (Q = 0.511) and low edge density (0.0012), indicating sparse structure with strong community partitioning.

In contrast, classical conservation terms such as *ecological network*, *ecological corridor*, and *reserve network* appear more peripheral, consistent with their more specialised ecological framing.

The temporal overlay reveals a clear shift in conceptual emphasis: conservation-linked terms are predominantly associated with earlier publication years (blue–purple tones), while more recent research (yellow–green tones) foregrounds *nature-based solutions*, *urban resilience*, *blue–green infrastructure*, *climate adaptation*, and related cross-sectoral vocabulary. This transition signals an ongoing reframing of ecological connectivity from a

corridor-centric conservation paradigm toward multifunctional, policy-oriented approaches integrating urban systems, climate governance, ecosystem services and public health.

Taken together, these patterns reveal a structured semantic system in which term use is shaped by discipline, application context and national policy vocabulary rather than by shared definitional consensus.

Discussion

Terminology for connected green spaces in Europe has evolved through distinct phases, but our results show that this variation is not random. Term use is structured by historical period, disciplinary field and application context. Apparent synonymy between corridor, network and green-infrastructure language can therefore obscure differences in mechanism, function and scale, weakening evidence retrieval, monitoring design and comparison across projects. This problem reflects long-standing conceptual inconsistencies in connectivity research, particularly the distinction between structural and functional connectivity [22, 24, 25], and the tendency for broad planning concepts such as green infrastructure to be used without clear operational criteria [26, 27].

Three phases help explain this pattern (Fig. 4). A **conservation network phase**, dominant until the early 2000s, was centred on species movement, protected areas and landscape connectivity, reflecting earlier ecological-network and corridor-based approaches to conservation planning [15, 28, 29]. A **green-infrastructure integration phase** through the 2010s broadened connectivity language towards multifunctionality, ecosystem services, water management and urban planning [26, 30, 31]. Since 2020, an **urban-climate restoration phase** has further expanded the vocabulary around nature-based solutions, resilience, green–blue infrastructure and climate adaptation [32, 33, 34, 35, 36]. This evolution has increased the policy relevance of connectivity terminology, but it has also widened the range of meanings attached to the same labels.

Cross-domain uptake amplifies this polysemy. Bridging terms such as green infrastructure connect planning, ecology, ecosystem services, health and climate adaptation, increasing visibility but not necessarily precision [17, 37]. Conversely, more specialised corridor and network terms often remain closer to conservation and landscape-ecology traditions. This creates a false sense of consensus when similar labels are used to justify different interventions, targets or indicators [38].

These patterns support a pragmatic classification into four functional families. The urban–non-urban contrast, disciplinary clustering and co-occurrence structure show that terms already segregate by function in practice: broad umbrella terms bridge planning, climate and biodiversity debates, whereas corridor- and network-related terms remain more strongly

associated with conservation and landscape ecology. We therefore organise the terms into four functional families and propose a naming heuristic linking umbrella concepts, mechanism and scale. This operational logic is summarised in Fig. 5.

i) Strategic umbrella concepts, such as green infrastructure, green and blue spaces, ecological network and green network, frame connected green–blue systems as multi-component territorial strategies rather than single spatial mechanisms. Their value lies in governance integration and multifunctionality, but they require explicit specification of the mechanisms and outcomes being assessed [26, 37].

ii) Land-use containment terms, especially greenbelt, primarily refer to metropolitan growth management, buffering and spatial containment. Greenbelts may protect open space and support ecosystem services, but they should not be treated as evidence of corridor function unless such function is explicitly designed and monitored [39, 40].

iii) Human-connectivity terms, including many uses of greenway and green corridor, often prioritise active mobility, recreation and urban linkage. These interventions may generate ecological co-benefits, but their biodiversity function depends on design, habitat quality and landscape context [41].

iv) Species-connectivity terms, including ecological corridor, biological corridor, biodiversity corridor, conservation corridor, reserve network, transfrontier conservation area and TSES, are most appropriate where the intended mechanism concerns habitat linkage, movement, permeability or landscape-scale conservation. Here, the distinction between structural and functional connectivity is critical: spatial continuity alone should not be presented as functional connectivity without evidence of species movement, habitat use or permeability [22, 24, 25].

The practical consequence of terminological inconsistency is that connectivity interventions may become difficult to compare, monitor and fund across governance levels. For researchers, heterogeneous terms inflate bibliometric noise and obscure disciplinary boundaries [37]. In policy and implementation, inconsistent terminology weakens comparability across monitoring frameworks and can reduce accountability across projects [42, 43, 44]. This is particularly relevant as the EU Nature Restoration Regulation establishes binding restoration targets, including requirements related to river connectivity and urban ecosystem restoration [3]. For cities, inconsistent terminology can translate into practical confusion. Recreational mobility routes may be labelled as ecological corridors despite lacking evidence of ecological function, while local or national terminology may fail to translate into internationally recognisable categories.

Spatial variation among the ten highest-output countries (Fig. 1b) suggests that term choice reflects national policy vocabularies as much as disciplinary consensus. France's *Trame Verte et Bleue* and the Czech and Slovak Territorial System of Ecological Stability illustrate the problem: both represent mature connectivity frameworks, but their terminology has limited visibility outside specific linguistic and policy contexts [45]. Even rigorous national systems may therefore become semantically isolated when not paired with internationally recognisable equivalents.

We propose a practical interoperability heuristic for cities and policy actors: first declare the dominant function of an intervention, then specify the spatial mechanism, scale and minimum monitoring criteria. This helps align terms with mechanisms rather than appearance or precedent. For example, a district-scale active-mobility route is more appropriately described as a greenway, whereas a landscape-scale wildlife linkage should be described as an ecological corridor only when its ecological function is specified. Where local or national terms are retained, they should be paired with an internationally recognisable equivalent and a short operational definition.

This study has three main limitations. First, the corpus is restricted to English-language records indexed in Scopus and Web of Science, which may under-represent national-language scholarship and policy traditions. Second, the corpus is defined by first-author affiliation in Europe rather than by study location, so geographic patterns should not be interpreted as maps of where connectivity interventions occur. Third, urban tagging and single-label assignment simplify a more complex literature in which records may address multiple contexts and terms simultaneously. In addition, the 15 terms were selected a priori from CBD guidance and European policy discourse, so other national or emerging vocabularies may be under-represented.

Europe's terminology for connected green spaces is best understood as a structured semantic system rather than a set of synonyms. A pragmatic 'umbrella + mechanism + scale' heuristic can improve comparability, monitoring and policy alignment across contexts. Future work should extend this approach into a multilingual ontology linked to measurable ecological and social outcomes.

Methods

Literature search

A bibliometric analysis was performed using Scopus (Elsevier) and the Web of Science Core Collection (Clarivate) combining descriptive performance indicators, temporal modelling, and keyword co-occurrence mapping following established bibliometric workflows [46]. Searches were executed on 22 August 2025. We targeted 15 connectivity-related terms identified a priori from CBD guidance on ecological networks and corridors and from closely related European

policy and planning discourse: *ecological framework; green infrastructure (GI); ecological network; green and blue spaces; biodiversity corridor; greenbelt; greenway; transfrontier conservation area (TCA); green corridor; ecological corridor; biological corridor; green network; reserve network; conservation corridor; territorial system of ecological stability (TSES).* "Urban context" was identified via keyword tagging; all records not matching the urban tag were treated as non-urban in the main contrast (see Supplementary Information Table S1). For term-level analyses, each record was assigned to a single focal label. The study corpus was defined as journal articles whose first authors were affiliated with countries in geographic Europe (that is, affiliation-based rather than study-location based). Unless otherwise stated, all analyses reported below refer to this corpus.

Highly generic terms (e.g., *corridor* on its own) were avoided because they returned unmanageably large numbers of irrelevant records and are strongly polysemous across disciplines. Instead, searches focused on more specific multi-word terms that qualify the corridor concept (e.g., *ecological corridor*, *biological corridor*, *biodiversity corridor*, *conservation corridor*) as well as established umbrella and network concepts used in policy and planning (e.g., *green infrastructure*, *green network*). During an initial screening phase, we also excluded candidate terms that yielded very small corpora (e.g., fewer than 10 records across both databases), as such sparse results do not support robust temporal, contextual, or network analyses. Examples of excluded low-frequency terms include "ecoregion plan", "sustainable-development corridor", "freshwater systems network", and "flyway sites network". Search strings were adapted to each database syntax (Scopus: TITLE-ABS-KEY; Web of Science: TOPIC), with common morphological and spacing variants incorporated through phrase searches and wildcards where appropriate (e.g., "greenbelt" OR "green belt", as well as singular/plural variants). Full queries are reported in Supplementary Information Table S1.

To support interpretation of term use, we compiled operational definitions for the focal labels from scientific literature, policy documents and technical guidance. These definitions were used to characterise the dominant planning logic, diagnostic cues, typical spatial scale and evaluation emphasis associated with each term, and to support the development of the functional grouping and naming heuristic. The definitions were used for interpretation and framework development, not as additional screening criteria. Full definitions and source references are provided in Supplementary Information Table S6.

To characterise application setting, records were tagged as urban if the title, abstract or keywords contained any of: "urban", "city", "municipal*", "town*". All remaining records were treated as non-urban for the main contrast.

Data preprocessing

Records retrieved from Scopus and Web of Science were consolidated and cleaned using standard bibliometric workflows. Raw exports include records returned by the broad query and stratified downloads; the study corpus corresponds to records retained after deduplication and document-type screening. Because Scopus exports were downloaded in stratified batches (e.g., urban versus rural subsets), records could appear in more than one file; we therefore performed within-source deduplication prior to cross-database merging.

Duplicate records were identified primarily by DOI. When DOI was missing, we used a hierarchical matching rule based on exact title–year matching, supplemented by fuzzy title matching combined with first author and source information. After merging Scopus and WoS, cross-database duplicates were removed using the same rules. We excluded non-research items (e.g., editorials, book reviews and conference abstracts) and retained only journal articles. From each record we extracted publication year, title, abstract, author keywords (including Keywords Plus for WoS), source title, citation counts and affiliation metadata [47, 48]. The search, screening, and selection workflow is summarised in Fig. 6.

Data analysis

We conducted five complementary analyses to characterise how connectivity-related terms are used in the literature: country and term distribution, temporal change over time, differences by application context (urban versus non-urban), variation across disciplinary domains, and semantic proximity inferred from keyword co-occurrence patterns.

Country and term distribution. To characterise the geographic composition of the European-affiliated corpus, we summarised publication counts by first-author country using affiliation metadata extracted during preprocessing. Because the corpus was defined by first-author affiliation in geographic Europe, country counts reflect author affiliation rather than study location (Supplementary information Table S2). We also summarised the frequency of focal labels across the corpus and, for visual comparison, calculated within-country shares of the most frequent terms among the ten highest-output countries.

Temporal trends. For each term, annual counts were computed from the study corpus. We modelled yearly trends using log-linear count regression fitted to complete years only. Poisson models were used by default; Negative Binomial models were selected when overdispersion was detected. We report the estimated annual rate of change as exp(β) minus 1, where β is the fitted year coefficient (full outputs in Supplementary information Table S3).

Urban versus non-urban contexts. Within records with an assigned focal label, we tested whether label distributions differed between urban-tagged and non-urban records using a chi-square test of independence and report Cramér's V as effect size. Records were tagged

as **urban** when the title, abstract, or keywords contained any of the following terms (case-insensitive): *urban*/city*/municipal*/town*/metropolitan*. All remaining records were treated as **non-urban** for this contrast. Standardised residuals from the chi-square test were examined to identify which terms contributed most to context separation. For each term, differences were summarised as odds ratios (OR) with 95% confidence intervals estimated using Fisher's exact test. Multiple testing across terms was controlled using the Benjamini–Hochberg false discovery rate (q = 0.05).

Disciplinary framing. WoS subject categories were aggregated into macro disciplinary groups for Sankey visualisation; the mapping is reported in Supplementary information Table S5.

Keyword co-occurrence networks. Keyword co-occurrence networks were generated in VOSviewer [49] using association strength normalisation. A minimum co-occurrence threshold of ≥ 10 was applied to construct the full network; a more selective threshold of ≥ 30 was used for visualisation to improve interpretability. Network modularity (Q) and edge density were computed in R from the VOSviewer-exported co-occurrence graph.

Data availability

The bibliographic records analysed in this study were retrieved from Scopus and the Web of Science Core Collection under institutional access and cannot be redistributed in full because of database licensing restrictions. The search strings, screening criteria and term definitions are provided in the Supplementary Information. Processed data supporting the results and figures, including annual term counts, country-level summaries, urban/non-urban classifications, model outputs and keyword co-occurrence matrices, will be made available in a public repository upon publication.

Code availability

The R scripts used for data cleaning, deduplication, statistical analyses and figure generation, together with VOSviewer parameter settings and network output files, will be made available in a public repository upon publication.

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Author contributions

A.C.P. conceived the study, developed the conceptual framework, designed the methodology, conducted the literature search and data analysis, prepared the figures, and led the writing of the manuscript. C.A.R. and F.C. contributed to the methodological discussion, conceptual development, interpretation of results, supervision and manuscript revision. E.M.-P. contributed to the conceptual framing and revised the manuscript. J.R.V. contributed to the conceptual framing, methodological refinement, interpretation of results, and manuscript revision. J.A.C. contributed to the conceptual framing, supervision, interpretation of results, and manuscript revision. All authors reviewed and approved the final manuscript.

Competing interests

The authors declare no competing interests.

Additional information

Supplementary Information The online version contains supplementary material.

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Figures

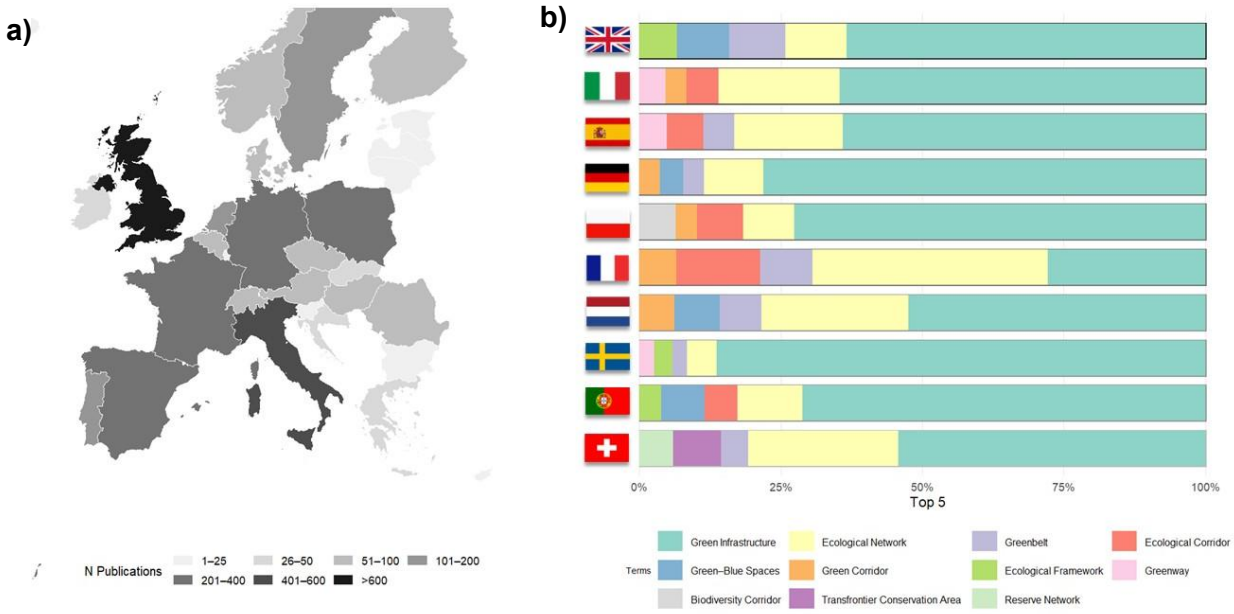


Fig. 1 | First-author affiliations and terminology patterns across Europe (1956–2025). a, number of publications per country based on first-author affiliation. **b,** within each of the ten highest-output countries shares of the five most frequent terms.

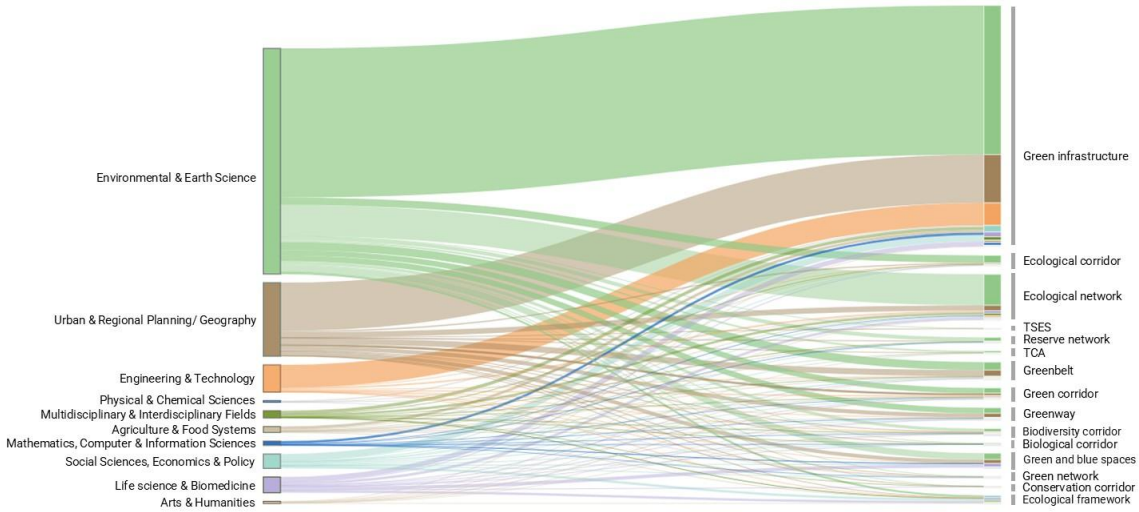


Fig. 2 | Sankey diagram linking thematic Web of Science groups (left) to connectivity terms (right). WoS subject categories were merged into broader thematic groups (see Methods and Supplementary Table S5). Link width is proportional to the number of articles.

The diagram highlights the dominant disciplinary bases of each term and the contrast between planning-oriented and conservation-oriented terms.

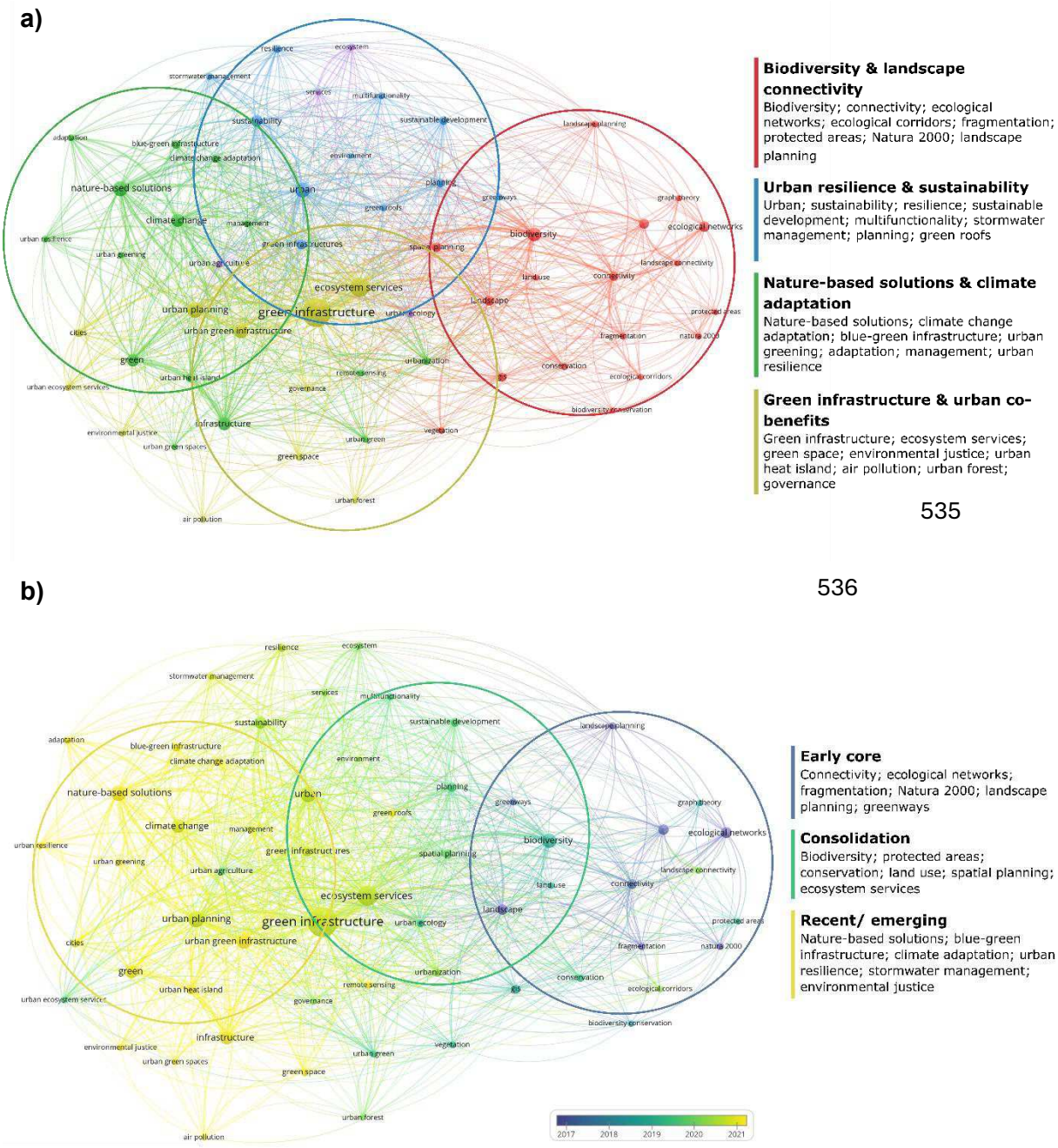


Fig. 3 | Author-keyword co-occurrence structure and temporal dynamics. a, Keyword co-occurrence network (minimum 30 occurrences). Node size is proportional to keyword frequency; link thickness reflects co-occurrence strength. Colours indicate thematic communities, annotated here as: *Biodiversity & landscape connectivity*, *Urban resilience & sustainability*, *Nature-based solutions & climate adaptation*, and *Green infrastructure & urban co-benefits*. **b,** Temporal overlay of the same network, where node colour represents the average publication year (dark/blue = earlier; light/yellow = more recent). Highlighted regions

summarise three temporal phases (*early core*, *consolidation*, *recent/emerging*), showing a shift from classical connectivity/landscape-planning terms towards climate-adaptation and nature-based solution concepts.

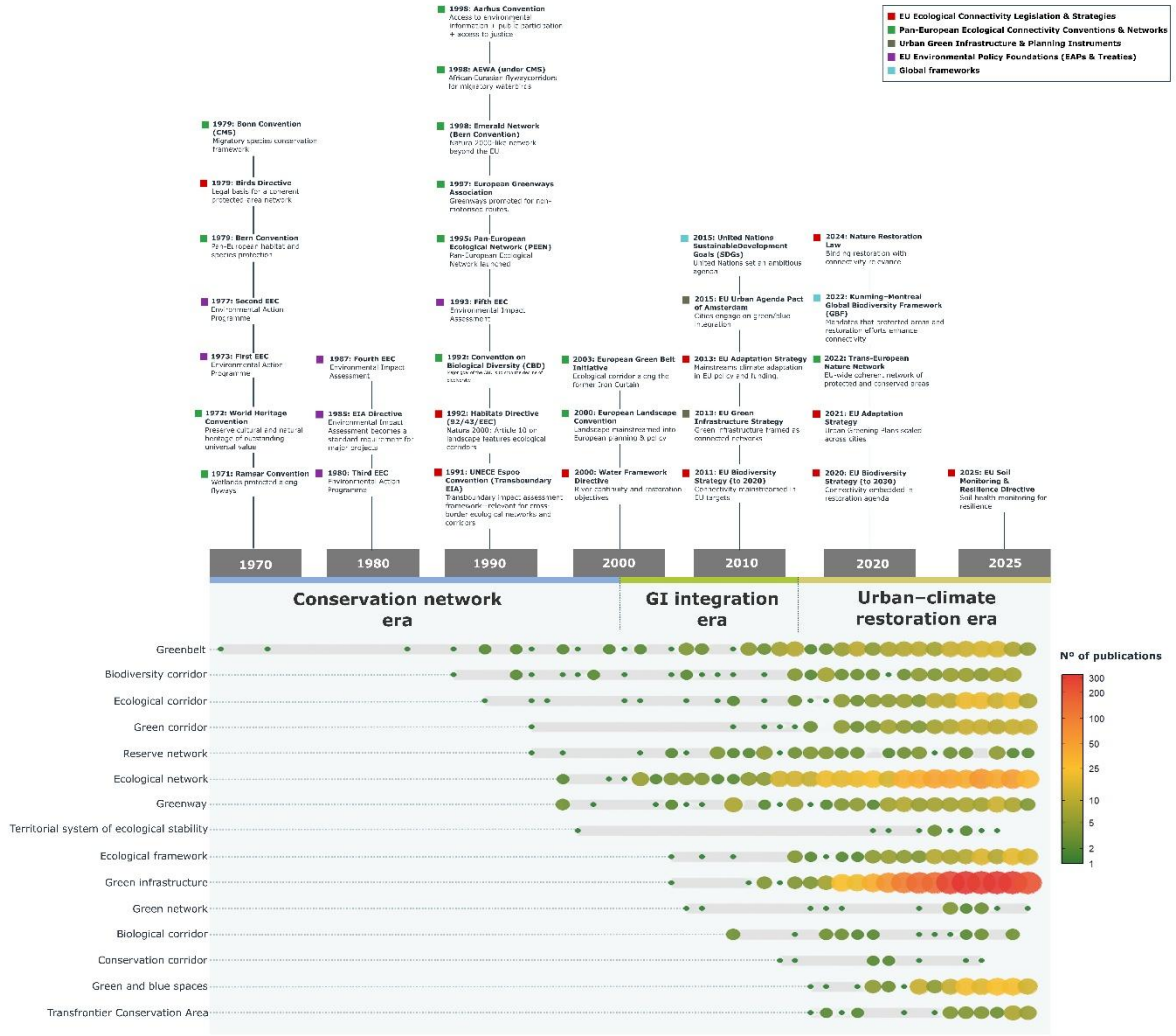


Fig. 4 | Policy milestones that mandate and support urban biodiversity conservation and the emergence of connectivity terminology in the European literature (1970–2025). Top panel: selected EU and pan-European policy instruments relevant to ecological connectivity, grouped by thematic lane (legend). Bottom panel: term timelines for the study corpus. For each term, the first dot marks the earliest year of occurrence; subsequent dots represent annual publication counts (colour scale; dot size proportional to the same count, displayed on a log scale). Horizontal bars indicate the observed period of use (first to last year in the corpus). Shaded bands delineate three phases of terminology uptake: *Conservation network era*, *Green infrastructure* (*GI) integration era*, and *Urban–climate restoration era*.

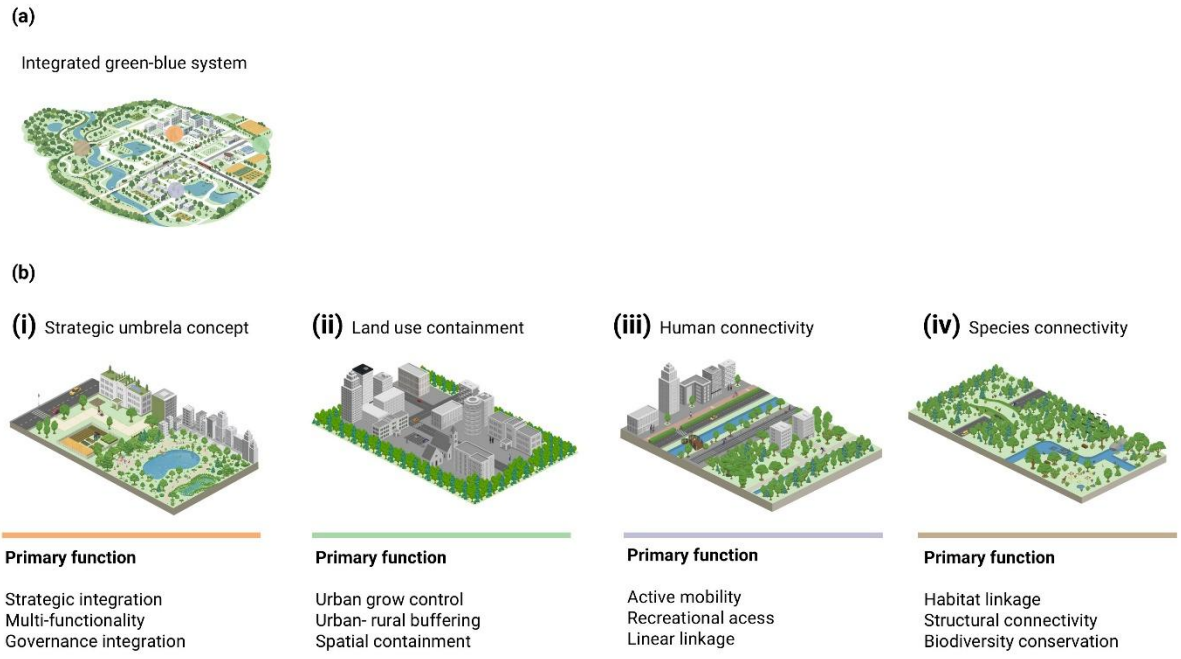


Fig. 5 | Integrated urban green–blue system and its functional components. a, Conceptual representation of an integrated urban green–blue system in which spatial containment, strategic framing, human connectivity and ecological connectivity operate within the same territorial structure; **b,** Functional families commonly used in planning and policy discourse, shown here through simplified spatial mechanisms and their primary roles: strategic umbrella concepts, land-use containment; human connectivity; and species connectivity. Examples are illustrative and not exhaustive. Operational definitions of the terms included in each family are provided in Supplementary Table S6. The framework is intended to support more consistent naming, monitoring and comparison of green–blue connectivity interventions across planning and policy contexts.

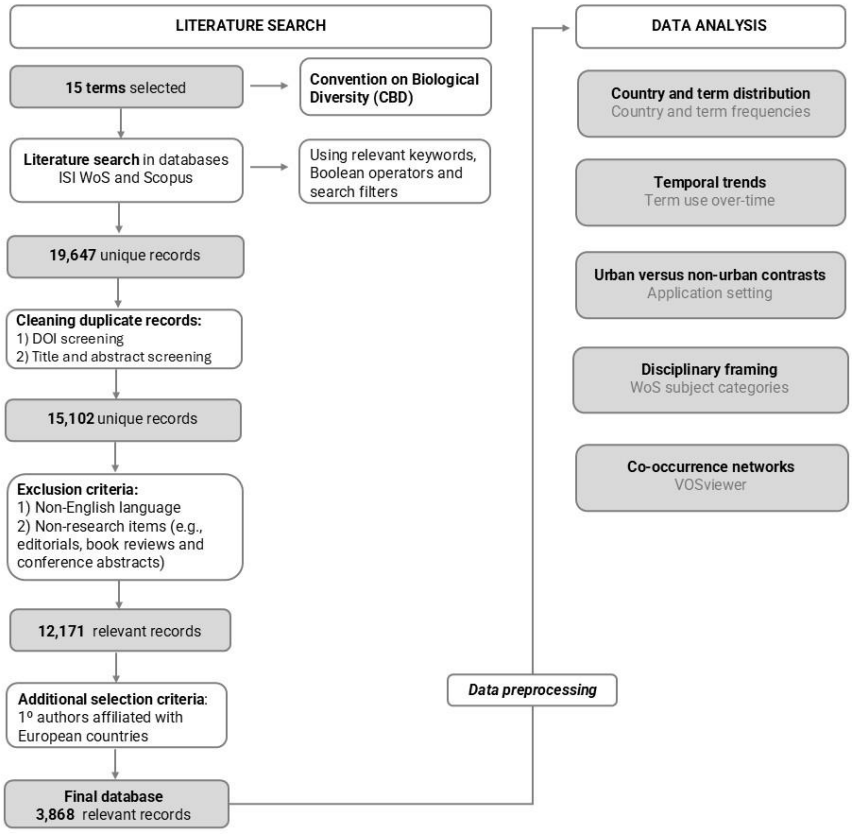


Fig. 6 | Literature search, screening and analysis workflow. Records were retrieved from the Web of Science Core Collection and Scopus, deduplicated, and filtered using staged inclusion/ exclusion criteria to assemble the final corpus, which was then analysed for temporal trends, urban versus non-urban contrasts, disciplinary framing and keyword co-occurrence.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- supplementaryinformation.pdf