Harnessing hidden synergies in conservation planning: do "umbrella action plans" reduce redundancy and improve efficiency?

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Conservation Action Plans (APs) are widely used to guide biodiversity interventions, but they are often developed in isolation, leading to redundancy and poorly coordinated implementation. We assess whether identifying thematic overlap among APs can reveal practical opportunities for coordination, and introduce the concept of Umbrella Action Plans (UAPs) as a framework to streamline conservation planning. We distinguish two complementary forms of UAPs: coverage UAPs, defined as one or a small set of coordinated plans that together capture most conservation actions in a region, and alignment UAPs, which are plans that are highly aligned with others and can serve as practical hubs for joint implementation, monitoring, and resource sharing. Using a dataset of 85 APs from West Africa, we compared conservation actions across plans to evaluate overlap, grouping patterns, and the minimum number of plans needed to collectively cover the full action space. We found that most APs share substantial similarity in their actions, revealing widespread but underutilized coordination potential. A subset of 5–6 plans could together cover all conservation actions, with three consistently emerging as strong coordination hubs. These findings suggest that maximizing conservation impact may depend less on creating new APs and more on strategically aligning existing ones. Practitioners can use coverage UAPs as coordination anchors to ensure comprehensive representation of the conservation action space, and alignment UAPs as focal hubs for operational alignment and shared implementation. This framework provides a practical, transferable screening tool to guide more efficient and integrated conservation planning in resource-constrained contexts.

conservation action plans | redundancy | West Africa | coordination strategy | efficiency | implementation

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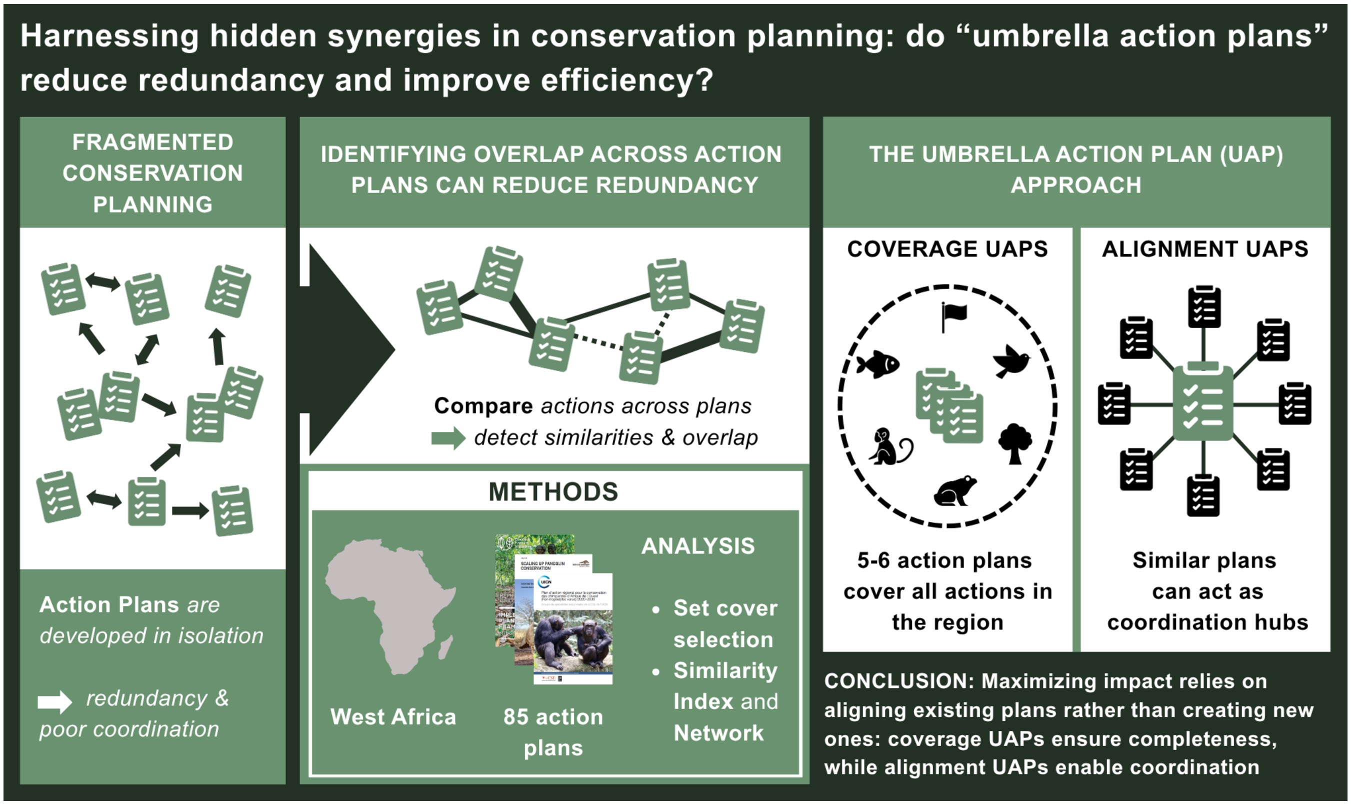
1 Introduction

The current global biodiversity crisis poses one of the greatest threats to our planet. Because biodiversity loss is both driven by and affects multiple sectors (Jaureguiberry et al. 2022), effective conservation requires cross-disciplinary strategies that address linked drivers of decline and build resilience across landscapes. In response to the interconnected nature of threats to biodiversity, more holistic and cross-sectoral approaches to conservation planning have emerged (Arponen et al. 2012; Kark et al. 2015; Hermoso et al. 2022), such as strategies that simultaneously prioritize species conservation, habitat connectivity, and sustainable land use across multiple governance sectors. However, many conservation interventions remain ineffective because the key phases of the conservation cycle (i.e., planning, implementation, and evaluation) are poorly integrated, and the planning process itself is often fragmented, occurring in isolation or without coordination (Adams et al. 2019; Botts et al. 2019; McIntosh et al. 2018).

Conservation Action Plans (APs) are formal strategic documents that translate broad biodiversity goals into specific, implementable measures (Glowka et al. 1994; Groves et al. 2002; Lees 2023). They define priority actions, responsible actors, timelines, locations, and mechanisms needed to conserve species, habitats, or ecosystems, and can operate across multiple spatial scales, from regional to national and subnational. In doing so, APs coordinate efforts, allocate resources efficiently, and guide policy and on-the-ground interventions toward measurable conservation outcomes. These documents are typically developed by a range of entities (including governments, NGOs, and private companies) through collaborative, multi-stakeholder processes that integrate scientific evidence, threat assessments, and local knowledge. Although they play a central role in conservation practice (Fuller et al. 2003; Reuter et al. 2022), the proliferation of APs has not been sufficient to halt biodiversity loss (Xu et al. 2021; Cardona Santos et al. 2023).

Despite the increasingly multisectoral scope of APs, conservation planning remains highly fragmented. Here, fragmentation refers to APs being developed largely independently, with limited coordination of actions, timelines, or responsible actors, leading to disconnected activities, duplicated efforts, and missed opportunities for synergy (Lausche 2019; Adams et al. 2019; Senior et al. 2024). This fragmentation inflates transaction and coordination costs, creates implementation bottlenecks, slows progress, and ultimately reduces effectiveness compared with what could be achieved through strategically aligned, coordinated planning (Kark et al. 2009; Mazor et al. 2013). Such fragmentation is largely driven by practitioners' limited capacity to implement large-scale interventions in a coordinated, adaptive, and reflective manner, often limited by time, funding, or institutional constraints for cross-platform or cross-scale coordination (Cardona Santos et al. 2023). These dynamics are unsustainable for practitioners operating under chronic funding and capacity constraints (Waldron et al. 2017; Mace et al. 2000). While increasing and streamlining investment to conservation is vital to slow these losses, it is equally important to develop strategies that optimize conservation outcomes within existing budgets (Gordon et al. 2013; Ward et al. 2020). Consequently, improving planning processes by fostering coordination, alignment, and strategic prioritization, can enhance cost-effectiveness, maximize conservation impact, and sup-



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FRAGMENTED CONSERVATION PLANNING

Action Plans *are developed in isolation*

➡ *redundancy & poor coordination*

IDENTIFYING OVERLAP ACROSS ACTION PLANS CAN REDUCE REDUNDANCY

Compare *actions across plans*

➡ *detect similarities & overlap*

METHODS

West Africa

85 action plans

ANALYSIS

- **Set cover selection**
- **Similarity Index and Network**

THE UMBRELLA ACTION PLAN (UAP) APPROACH

COVERAGE UAPS

5-6 action plans cover all actions in the region

ALIGNMENT UAPS

Similar plans can act as coordination hubs

CONCLUSION: Maximizing impact relies on aligning existing plans rather than creating new ones: coverage UAPs ensure completeness, while alignment UAPs enable coordination

Visual abstract

port more efficient, scalable implementation.

While greater coordination across APs is often recommended (Gordon et al. 2013; Kark et al. 2015), it remains unclear how it can practically be achieved, and whether and in which situations it would materially improve conservation outcomes or resource efficiency. A potential solution to address the fragmentation of conservation planning lies in the concept of biodiversity’s inherent interconnectedness, where interventions targeting one component of the environment (such a species or an ecosystem) create cascading effects on others. In taxonomic conservation, this idea is embodied in the concept of umbrella species, which are species whose broad habitat requirements are assumed to encompass the needs of co-occurring species (Roberge and Angelstam 2004). However, the efficacy of umbrella species as surrogates for other conservation targets is inconsistent across taxa and scales, and the approach has attracted substantial criticism (Tälle et al. 2023; Hunter et al. 2016). These mixed results highlight the limitations of applying biological surrogacy as a universal strategy, but they do not undermine the broader insight that improved coordination around shared conservation targets can generate wider benefits.

Here, we propose an analogous concept at the level of APs: the Umbrella Action Plan (UAP). We distinguish two complementary ways in which APs can function as UAPs: coverage UAPs and alignment UAPs. Coverage UAPs consist of one or a small set of explicitly coordinated APs that together capture most conservation actions in a region. Rather than replacing other plans, they act as coordination anchors, identifying the smallest set of plans needed to collectively represent the full conservation action space. Alignment UAPs, in contrast, are plans that are highly aligned with others in terms of their conservation actions. Because they share many actions across plans, they serve as practical hubs for joint implementation, monitoring, and resource sharing.

The UAP framework enables planners to maintain comprehensive coverage of conservation actions while leveraging synergies among thematically aligned plans. Importantly, applying either or both approaches of the UAP concept does not require creating new APs; planners can use one or a few strategically selected existing plans to systematically compare actions, identify shared priorities, and coordinate timelines, responsibilities, and resources. This integrated strategy allows multiple conservation objectives to be pursued in parallel while reducing fragmentation, duplication, and inefficient use of limited resources. Unlike biological surrogacy approaches (Hunter et al. 2016), a UAP approach emphasizes complementarity and coordination rather than substitution. By framing coordination as the central mechanism, UAPs provide a practical way to improve coherence across conservation efforts by highlighting where plans could be strategically aligned, though without directly assessing ecological or socio-economic outcomes or cost savings.

However, it is not obvious that coordination based on shared actions or themes will consistently deliver practical benefits. Coordination itself entails costs, including time, financial resources, and institutional effort, and apparent similarities among APs on paper may not always translate into feasible or meaningful opportunities for joint implementation. We therefore treat the potential benefits of a UAP approach as an empirical question, assessing in this study whether and under what conditions identifying commonalities across APs reveals coordination opportunities that are both actionable and likely to add value in practice. We interpret overlaps among conservation actions listed in different APs as potential indicators of coordination opportunities.

To empirically examine the utility of the UAP concept, West Africa offers a compelling case study. The region harbors high biodiversity (Wieringa and Poorter 2004) but faces rapid human population growth, infrastructure expansion, and mounting economic pressures (Herrmann et al. 2020; Ofoezie et al. 2022). Despite substantial international conservation efforts, interventions in the region are fragmented, severely underfunded (Holmes 2012; Brockington and Scholfield 2010), and can conflict with local economic priorities (Bazilian et al. 2013).

Understanding how existing APs align or overlap in this region could therefore reveal opportunities to streamline conservation efforts and strengthen multi-scale and cross-sector coordination, thus enhancing impact within resource and budget constraints. In this study, we ask whether, and under what conditions, identifying commonalities across APs reveals coordination opportunities that are likely to add value in practice. We address these questions through two complementary analyses. First, we quantitatively assess thematic similarity among APs (operationalized as overlaps in listed conservation actions) to identify individual or groups of plans with aligned priorities and higher potential for joint implementation (candidate alignment UAPs). Second, we identify the smallest set of APs that together encompass the full range of actions across our dataset, as a way to pinpoint plans that can serve as coordination anchors (candidate coverage UAPs).

For conservation planners and practitioners, this approach offers a potential practical framework to support decision-making, specifically, a way to (i) systematically scan existing APs for overlapping actions, (ii) identify which plans are most suitable to coordinate around, and (iii) prioritize where limited coordination effort is most likely to be beneficial. In practice, this could inform decisions such as which APs to implement jointly, where duplication can be reduced to avoid waste of resources, or which plans could serve as regional anchors for shared funding applications, monitoring systems, or stakeholder platforms. Our results are intended not as a universal prescription to adopt the UAP approach, but as guidance on when coordination based on shared actions is likely beneficial versus when specialized plans may be equally or more effective, providing a transferable workflow for assessing coordination opportunities among APs in other regions.

2 Methods

2.1 Selection Criteria.

We defined APs as documents that set out concrete conservation objectives, associated actions, timelines, and responsible actors. Although many types of documents can establish conservation priorities and needs (e.g., environmental laws, descriptive reports, and Environmental and Social Impact Assessments), we restricted our focus to APs because they specify implementable interventions and therefore provide the most relevant basis for assessing where coordination could improve alignment and efficiency. We used the Regional Action Plan for the Conservation of the Western Chimpanzee (Pan troglodytes verus) 2020-2030 (IUCN SSC 2020) to define the geographic scope of our analysis, which spans eight West African countries: Senegal, Mali, Guinea, Guinea-Bissau, Liberia, Sierra Leone, Côte d'Ivoire, and Ghana. We further restricted our focus to APs whose primary objective was biodiversity conservation, focusing on terrestrial and freshwater/coastal species and ecosystems. Resource-management APs (e.g., for forests or agricultural lands) were only retained when biodiversity protection was an explicit conservation target. Finally, to ensure contemporary relevance, we only included APs published in 2000 or after. In cases where multiple plans existed for the same target, we retained only the most recent version. APs were identified through structured online searches, queries of major international plan databases, and consultation with IUCN Specialist Groups and regional practitioners. More detailed descriptions of search terms, data sources, and screening steps are provided in Supplementary Material (SM) S1.1. The full dataset used for the analysis is available at OSF: https://osf.io/57cre/

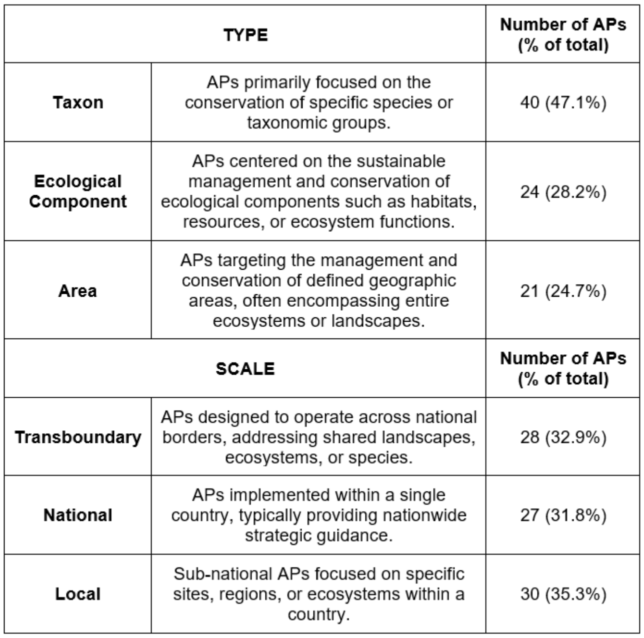
2.2 Classification and Thematic Coding.

Each AP was classified according to its primary focus (type) and spatial coverage (scale). Although APs often address multiple issues relevant to the target species, habitat, or resource, plan type was defined by the plan's primary conservation focus and grouped into three types (Taxon, Ecological Component, or Area), and scale into Local, National, or Transboundary (Table 1).

To enable quantitative comparison of APs, we used a thematic content analysis approach (Mayring 2015) to summarize textual information by assigning portions of text to predefined categories (or codes; see Table 2). We manually coded each conservation action per AP using ATLAS.ti (v. 23; ATLAS.ti Scientific Software Development GmbH, 2023) according to the IUCN Conservation Actions Classification Scheme (v. 2.0; IUCN 2012), which includes 39 distinct categories aligned with internationally recognized frameworks.

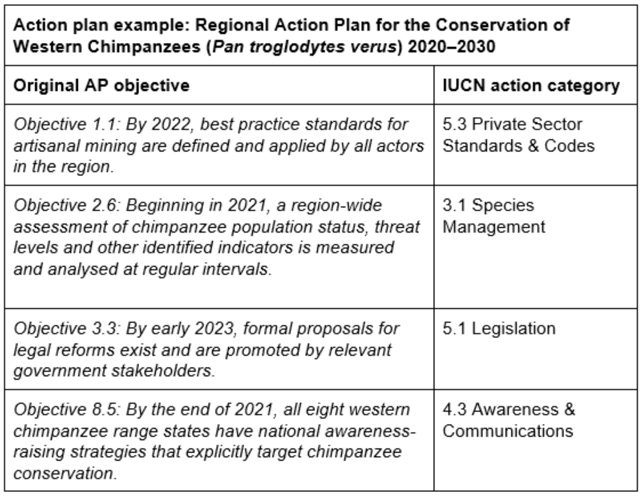
Our unit of analysis was, therefore, the set of action categories within each AP, rather than the plan as an undifferentiated whole, which links our analysis directly to how actions are typically implemented on the ground. This focus reflects that coordination occurs through shared or complementary interventions, rather than at the level of entire plans. By assigning each action to an IUCN action category, we establish a common language that allows us to systematically identify when different APs propose similar types of inter-

Table 1. Definitions of the categories used to classify APs by Type (Area, Taxon, Ecological Component) and Scale (Local, National, Transboundary), and number and proportion of the 85 APs analyzed in each category, broken down by category.



TYPE		**Number of APs (% of total)**
Taxon	APs primarily focused on the conservation of specific species or taxonomic groups.	40 (47.1%)
Ecological Component	APs centered on the sustainable management and conservation of ecological components such as habitats, resources, or ecosystem functions.	24 (28.2%)
Area	APs targeting the management and conservation of defined geographic areas, often encompassing entire ecosystems or landscapes.	21 (24.7%)
SCALE		**Number of APs (% of total)**
Transboundary	APs designed to operate across national borders, addressing shared landscapes, ecosystems, or species.	28 (32.9%)
National	APs implemented within a single country, typically providing nationwide strategic guidance.	27 (31.8%)
Local	Sub-national APs focused on specific sites, regions, or ecosystems within a country.	30 (35.3%)

Table 2. Illustration of how conservation objectives from the Regional Action Plan for the Conservation of Western Chimpanzees (Pan troglodytes verus) 2020–2030 (IUCN SSC 2020; left) are systematically matched to IUCN Conservation Actions Classification Scheme v2.0 categories (right).



Action plan example: Regional Action Plan for the Conservation of Western Chimpanzees (*Pan troglodytes verus*) 2020–2030	
Original AP objective	**IUCN action category**
Objective 1.1: By 2022, best practice standards for artisanal mining are defined and applied by all actors in the region.	5.3 Private Sector Standards & Codes
Objective 2.6: Beginning in 2021, a region-wide assessment of chimpanzee population status, threat levels and other identified indicators is measured and analysed at regular intervals.	3.1 Species Management
Objective 3.3: By early 2023, formal proposals for legal reforms exist and are promoted by relevant government stakeholders.	5.1 Legislation
Objective 8.5: By the end of 2021, all eight western chimpanzee range states have national awareness-raising strategies that explicitly target chimpanzee conservation.	4.3 Awareness & Communications

ventions, highlighting opportunities for coordination while standardizing terminology across languages and reducing semantic variation. The outcome of this process is a distinct "action category profile" for each AP, defined by the set of IUCN action categories it contains.

All action categories were analyzed as unweighted, binary features, reflecting whether a category was present or absent in each AP; results should therefore be interpreted as representing the categorical breadth of conservation actions rather than their relative emphasis. Further discussion of the implications of category aggregation and heterogeneous reporting is provided in SM S1.2.

2.3 Analytical Framework and Statistical Models.

2.3.1 Pairwise Thematic Similarity.

Our first objective was to understand if APs tend to propose similar sets of conservation actions as a basis for evaluating where coordination might be most feasible or beneficial, thus identifying plans that could function as alignment UAPs. To explore thematic overlap among APs, we calculated a pairwise Dice Similarity Index based on shared IUCN action categories. The Dice similarity measures the proportion of categories two APs have in common relative to the total number of categories they each include (Dice 1945). In practice, knowing which plans are most similar allows planners to identify opportunities for coordination, reduce overlap, and concentrate resources where plans can mutually reinforce each other (although such thematic similarity does not, by itself, guarantee cost savings or improved biodiversity outcomes).

Because plans draw variable numbers of actions from a fixed pool of possible IUCN action categories, a baseline level of Dice similarity could arise purely from plan size and category prevalence. Therefore, to also distinguish this combinatorial baseline from genuine thematic convergence, we generated a degree-preserving null model to test whether the observed similarity distribution exceeded what would be expected by chance given the observed plan breadth and category frequencies. Using a swap algorithm, we generated 1,000 randomized matrices that preserved both row sums (number of categories per plan) and column sums (number of plans per category), recalculated pairwise Dice similarity for each matrix, and derived standardized effect sizes (SES) for both the global median as well as for each plan pair.

Further, we may also anticipate that APs of similar types and scales would tend to propose similar sets of actions (e.g., species-focused plans may be more alike to each other than to ecosystem- or area-focused plans, or local plans may resemble other local plans more than national ones). Therefore, we fitted a beta regression model with multi-membership structure in which Dice similarity was modeled as a function of plan type agreement and scale agreement (i.e., whether the two plans were of the same type and spatial scale), and their interaction, to test whether the effect of type depended on the scale. Because broader plans may appear more similar simply by covering more actions, we additionally included plan comprehensiveness (expressed as average number of action categories between the two plans) as a covariate. We also controlled for characteristics which may bias similarity between plans, specifically year of publication and organizational overlap (i.e., whether plans were designed by the same kind of organization based on the lead authoring institution). For practitioners, this analysis highlights characteristics of plan groupings where coordination is likely to be the most promising (e.g., is cross-scale plan coordination more efficient?). Each pairwise similarity value involved two

APs, so we included a random intercept to account for the non-independence of observations. As the response (Dice similarity) was bound between 0 and 1, we used a beta regression with a logit link using the brms package (Bürkner, 2017).

To test whether patterns in similarity persisted after controlling for compositional effects, we re-analyzed plan similarity using SES-standardized Dice values. We refitted the multi-membership model using pairwise SES as the response, interpreting values above and below zero as higher or lower similarity than expected under the degree-preserving null. We centered (i.e., z-transformed) continuous pair-level predictors (difference in publication year, average number of action categories and mean publication year) on their dataset means prior to analysis, so that the intercept could be interpreted as the expected SES similarity for a typical pair of plans. Details of the null model implementation, including diagnostic checks and the distribution of SES values, are provided in SM S1.3.

2.3.2 Network Community Detection.

Because practitioners might more efficiently coordinate through joint processes involving multiple plans at once (e.g. regional workshops, thematic working groups) rather than pairwise approaches, we next asked whether APs formed coherent clusters that could be addressed together. We therefore sought to identify potential clusters of APs with similar action portfolios that could be coordinated together. We constructed a weighted network in which nodes represent APs and edge weights reflect pairwise similarities predicted by our multi-membership model (Model 1). We then applied the Revised Medoid-Shift (RMS; Li et al. 2024) community detection algorithm to identify groups of thematically similar plans. To assess robustness, we compared the RMS results with results from four additional community detection methods using standard grouping similarity metrics (ARI, NMI, and VI; Vinh, 2010), to ensure identified clusters were not sensitive to the method applied. If consistent, these clusters could provide a practical basis for prioritizing joint workshops or harmonization efforts. See SM S1.4 for further methodological details.

2.3.3 Identifying UAPs.

While the first two analyses clarify how APs cluster thematically, they do not directly answer a central practical question of this study: can a small number of plans serve as UAPs that anchor coordination and reduce redundancy? In other words, if planners want to streamline implementation, how many APs would they need to coordinate, and which ones, to ensure that all key conservation actions are covered?

To address this, we evaluated which APs could serve as candidate coverage UAPs by jointly covering all conservation action categories in the region and quantified how many plans are needed to achieve full coverage. We implemented a greedy selection algorithm analogous to the set-cover or portfolio-selection problem in systematic conservation planning, where the goal is to identify the smallest subset of units that collectively cover a set of features (e.g., species, habitats; Kang et al. 2022; Moore et al. 2003). In this context, each AP represents a set of conservation action categories, and the algorithm iteratively selects the plan that provides the largest marginal gain in coverage (i.e., the greatest number of previously uncovered categories) continuing until all categories are represented. Greedy selections were estimated across the full 2000-2025 corpus, as we did not adjust for plan age. We repeated this greedy selection 1000 times using the complete dataset to account for potential variability due to ties in selection order. To assess the robustness of each AP's contribution, we performed jackknife analyses by systematically excluding one AP and all possible pairs of APs before rerunning the greedy algorithm again.

APs selected early in the process (mean selection position <3) have broad category profiles and high overlap with other plans, and therefore high coverage UAP potential. The total number of APs required to reach full coverage indicates how dispersed the regional action portfolio is across plans: needing many APs implies that actions are scattered and often duplicated across numerous documents (high fragmentation and redundancy), whereas needing only a few APs suggests that most actions are concentrated in a small, more easily coordinated subset. We chose this approach for its transparency and relevance to real-world conservation planning, where planners could only add plans incrementally to fill remaining gaps rather than optimizing across all plans simultaneously. From a practitioner's perspective, the greedy selection process then provides a concise shortlist of plans that could serve as coordination anchors within this landscape.

Because the greedy algorithm treats all action categories equally, it does not by itself reveal which APs are important for capturing rare or otherwise under-represented actions. Therefore, in parallel, we identified rare categories as those present in eight or fewer APs (i.e., the bottom 10% of the 39 potential categories), and for each AP counted how many rare categories it contained. Considering rare categories during the greedy selection process allowed us to distinguish between APs that were consistently selected early due to broad coverage and those that were selected later primarily to capture rare or unique categories. On the basis of mean selection position across algorithm iterations and rare category content, we classified APs into three functional groups: core UAPs, which were consistently selected in the initial three positions by the greedy algorithm (reflecting their comprehensive coverage of conservation actions) and are distinguished from other early-selected APs by their inclusion of rare categories; rare-category-driven APs, which were selected after position three and contained at least one rare category; and common peripheral APs, which were also selected later but included only commonly represented categories, serving to fill remaining gaps without adding unique contributions. Some APs were never selected by the algorithm and are therefore considered non-UAP candidates.

Finally, to assess whether plan characteristics such as type or scale influenced the likelihood of being selected as a coverage UAP, we fitted a beta model using the glmmTMB package (Brooks et al., 2017). Because beta regression requires responses on the open interval (0, 1), and many plans were never selected (proportion = 0), we applied a standard boundary correction to the selection proportions, following Smithson and Verkuilen (2006). This shifted boundary values slightly inward, allowing all plans to be analyzed within a single beta-distributed response model rather than specifying a separate zero-inflation component. We included the corrected proportion of times each plan was selected by the greedy algorithm across bootstrap iterations as response, AP type and scale as predictors, and the number of action categories and year of publication as control variables. We then checked the model for overdispersion (see SM S1.5), and compared this model to a null model containing only the intercept term using a likelihood ratio test. All analyses were performed in R version 4.4.2 (R Core Team 2024).

3 Results

In total, we analyzed 85 APs covering all combinations of types and scales, with even distribution across scales but clear biases in plan type (Table 1). Nearly half of all plans were Area-focused plans, followed by Taxon plans and Ecological Component plans. Across all APs, the median number of IUCN action categories per plan was 14 (range: 5 to 23 categories) out of a total of 39 possible categories, with half of all plans containing between 12 and 17 categories. Descriptive analysis of action categories revealed clear patterns in their frequency across APs, with awareness, capacity-building, and site-level management actions included in nearly all APs, whereas specialized interventions such as captive breeding were much rarer, reflecting their relevance to few targets (see SM Table S1). Of the eight West African nations considered, AP representation was uneven, with transboundary APs covering all the eight countries accounting for more than a third of plans, followed by national or sub-national plans for Senegal, Guinea, Côte D'Ivoire and Liberia. Several countries (Sierra Leone, Mali, and Guinea-Bissau) were represented by fewer than four plans each, indicating distinct geographic biases in AP development and coverage across the landscape. For more details on plan-level information and patterns of action occurrence across plans, see SM Table S1; Table S2).

3.1 Pairwise Thematic Similarity.

We first examined the similarity among APs in terms of the conservation actions they include, and assessed whether this similarity varies by plan type or geographic scale. Median pairwise Dice similarity was high (0.71; range: 0.17–0.97), with 23% of pairs showing very high similarity ($\geq$0.8), indicating that most APs share a substantial portion of action categories. However, after accounting for plan size and the overall prevalence of each category using the degree-preserving null model, the observed overlap largely matched expectations based on these features (median= 0.71; range: 0.70–0.71; permuted p = 0.52). SES values were centered near zero (mean ± SD= −0.09 ± 1.78), with only a small minority of pairs (6%) showing strong above-null similarity (SES > 2). These results suggest that, although absolute overlap among plans is high, this similarity largely reflects plan breadth and the ubiquity of categories rather than alignment beyond chance (i.e., overall overlap is close to what would be expected if categories were randomly assigned to each AP). Nevertheless, the presence of pairs with unusually high similarity highlights plans that could act as focal points for coordination, functioning as alignment UAPs. For more detailed SES results, see SM S2.1, Table S2.

APs matching in type or scale had higher absolute similarity than pairs differing in these characteristics, with a strong positive interaction between the two factors (CrI95%= 0.12 to 0.20; see SM Table S3). However, when we tested whether type or scale predicted similarity beyond what would be expected by chance using SES-standardized similarity instead of Dice similarity as the response, their effects were small and indistinguishable from zero (all CrI95% overlapping zero; Figure 1; full model in SM S2.2, Table S4). In other words, sharing the same type or scale did not systematically increase similarity above null expectations; instead, these patterns likely reflect that plans with shared characteristics tend to have similar action portfolios. Nevertheless, some faint temporal patterns emerged, as plans that were more similar in publication date (CrI95%= −0.01 to 0.00) as well as newer pairs of plans were more likely to be similar (CrI95%= 0.00 to 0.04). See SM S2.2 for more detailed descriptions of each respective model.

3.2 Network Community Detection.

When assessing whether APs naturally clustered into thematically similar groups (or communities), our RMS community detection method identified two distinct but inconsistently stable communities of APs. Mean pairwise similarity among plans within communities (0.71) did not strongly differ from the overall dataset average or from between-community similarity (0.70). Moreover, APs were assigned to the same community about 65% of the time on average across different community detection methods, indicating that community structure is not consistently stable across methods. Overall, the network exhibited weak modular structure, with detected communities representing loose groupings rather than distinct clusters, indicating that thematic-based coordination opportunities are spread haphazardly across APs rather than assembling to distinct groups. For further description of community detection and modularity results, see SM S2.3.

3.3 Identifying UAPs.

A detailed summary of the greedy algorithm selection results assessing whether a small subset of APs could act as coverage UAPs covering all actions across the region (including selection frequency, mean selection position, counts of rare action categories, and the functional role, type, and scale of each AP) is provided in SM Table S2. Using an unweighted presence/absence representation of IUCN categories, the greedy algorithm consistently identified a set of 5-6 APs that together cover all action categories. This specific set of APs was selected in over 80% of iterations, including those in

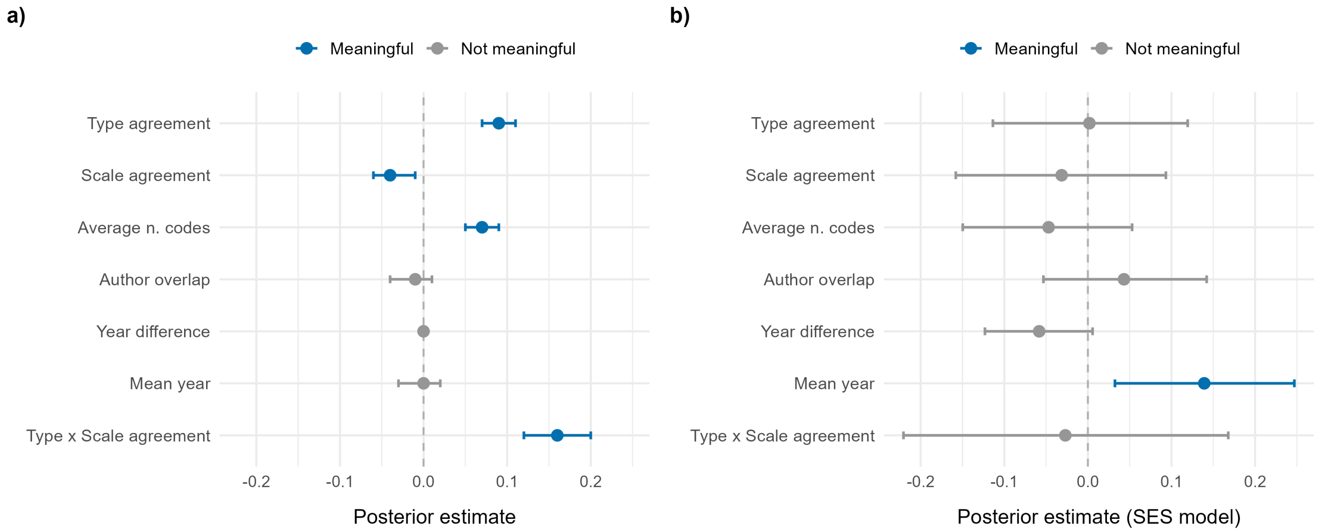


Figure 1. Posterior means and 95% credible intervals for fixed effects from (a) the beta regression model of raw Dice similarity and (b) the Gaussian model of SES-standardized similarity. Effects were considered meaningful if their 95% credible interval did not include zero (indicated by the dashed vertical line). Note that the x-axes share the same numeric range for visual comparability, but the scales differ: panel (a) shows effects on the beta regression link scale of raw Dice, whereas panel (b) shows effects in standardized effect-size units (departure from a degree-preserving null model in SD units).

which one or two APs were excluded under the jackknife scenarios, indicating high consistency, with each adding distinct action categories that collectively achieve full coverage with minimal redundancy (Figure 2). The first plan selected by the algorithm alone covered 76.3% of all action categories; coverage increased only slightly with each additional plan, reaching 81.6% by the third and 100% by the sixth. By contrast, random selection where APs were chosen without regard to their contribution to new categories required a median of 26 plans to reach full coverage (Figure 3), accumulating coverage more slowly and with high variability. These results indicate that, in principle, a very small number of carefully chosen APs could cover the full range of conservation action types invoked for regional goals, greatly reducing the number of separate plans that need to be coordinated.

Nevertheless, greedy-selected coverage UAPs did not correlate with plans that most frequently appeared in high-SES pairs (Pearson's $r = 0.02$, $t_{5,1} = 0.11$, $p = 0.91$; Figure 4). The greedy algorithm prioritized broad plans that also efficiently captured rare actions, while high-SES plans tended to cluster around common actions. This distinction indicates that APs most efficient for covering the full regional action space (coverage UAPs) are not necessarily those most closely aligned with many other plans in terms of their action portfolios (alignment UAPs), highlighting that the two UAP perspectives capture different but complementary coordination roles.

In total, 63.5% of APs (n=54) were selected at least once by the greedy algorithm. We found a clear hierarchy among APs in terms of their functional roles (Figure 5). The median number of categories covered by core UAPs was higher with 23 categories (mean ± SD = 22.0 ± 1.73), relative to a median of 15 categories for the other types of APs (mean ± SD = 15.3 ± 3.25). Descriptively, all core UAPs were Ecological Component plans operating at national or transboundary scales. We found ten rare-category-driven APs in our dataset (11.7%) that were generally narrower in coverage than Core and non-UAP plans (median= 13.5 categories; range: 9–21). Half of these APs were classified as Area, 30% as Ecological Component, and 20% as Taxon-focused, and most were implemented at the local level (50%), followed by national (30%) and transboundary (20%) scales. These results indicate that rare-category-driven APs tend to be moderately narrow in scope, often targeting specific components of the ecosystem or protected area, and primarily focusing on local or national scales. Their role in capturing rare categories make them an essential component of an AP-toolkit for achieving full regional coverage of the full set of conservation actions. Common peripheral APs were the most numerous group of greedy-selected APs (n= 41, 48.2%) and contained a similar number of conservation action categories (median=15; range: 9 - 23) as the 31 APs (36.5%) which were rarely or inconsistently selected across the greedy iterations.

In our model assessing the effect of AP characteristics on the likelihood of UAP selection, the full model performed significantly better than the intercept-only null model (likelihood ratio test: $\chi^2_6 = 22.02, p = 0.001$). We found that the number of action categories covered by an AP was the only meaningful factor influencing an AP's likelihood of being selected by the greedy algorithm as a candidate coverage UAP (Estimate ± SE = 0.10 ± 0.03, p < 0.001). In contrast, other plan-level attributes, such as type or spatial scale, had no significant effect, indicating that a plan's comprehensiveness in terms of action types, rather than its overall thematic or spa-

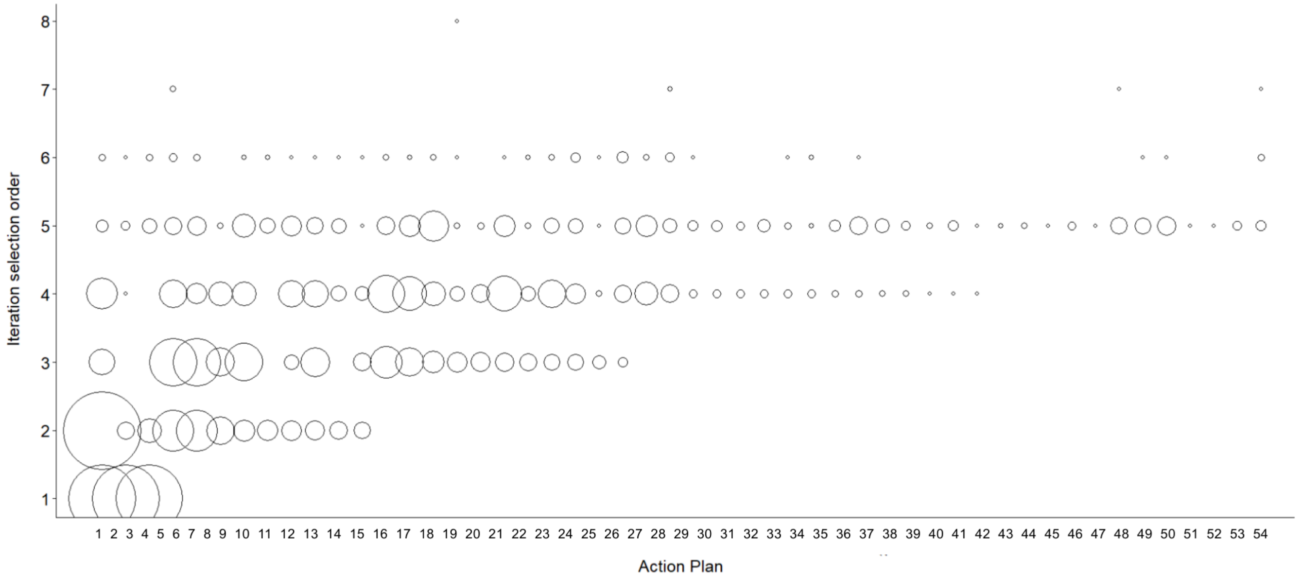


Figure 2. Selection frequency and order of APs identified by the greedy algorithm. Bubble area indicates how frequently each plan was selected across algorithm iterations, and the y-axis shows the selection order (plans chosen earlier include more action categories). APs on the x-axis are shown as numerical labels indicating their order of selection by the algorithm (see SM Table S2).

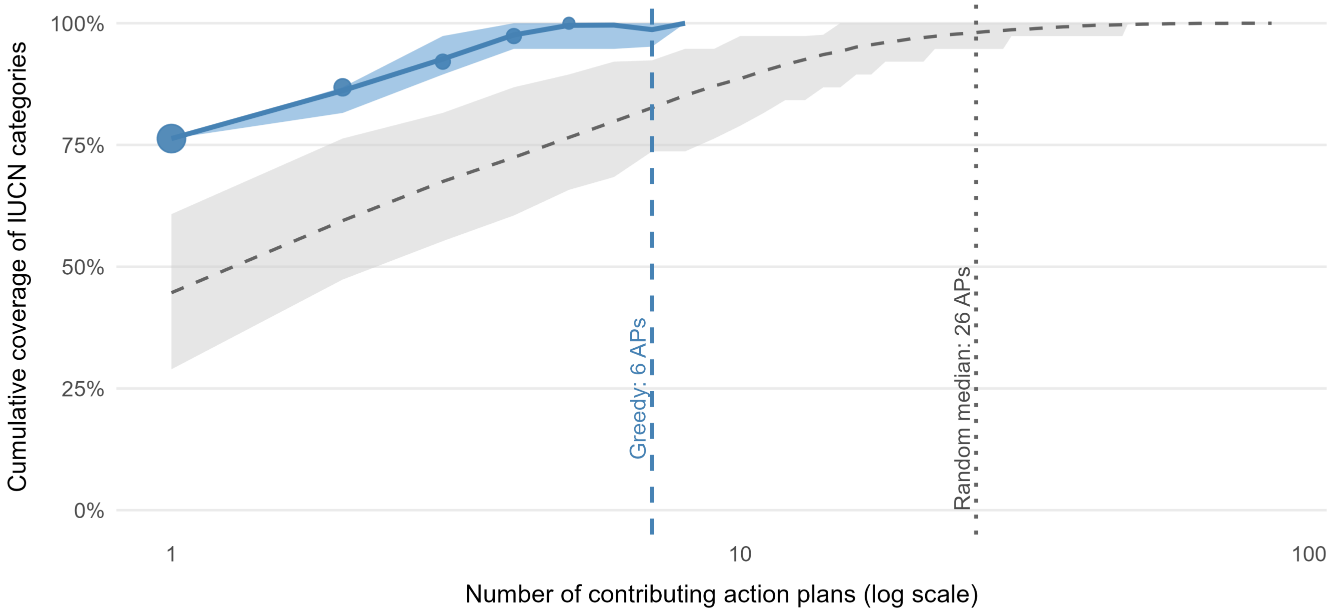


Figure 3. Comparison of cumulative coverage of IUCN categories between greedy and random AP selections. The blue line shows the mean cumulative coverage when APs are added using the greedy algorithm, which selects at each step the plan contributing the most new conservation categories. Blue points mark each contributing AP from a representative greedy run, with their area proportional to the number of new categories added. The light blue shaded area represents the 95% confidence interval across 1000 greedy runs. The x-axis shows the order in which APs are added (log scale). The grey dashed line and shaded area show the mean and 90% interval for 200 random sequences of plans. Vertical lines indicate the median number of plans needed to reach full coverage: 6 for the greedy selection (blue dashed) and 26 for the random selection (grey dotted).

tial focus, drives its coverage UAP potential (see Table 3).

4 Discussion

By comparing the action category content of existing West African APs, we found that most regionally overlapping plans already show substantial similarity, suggesting opportunities to concentrate conservation effort by prioritizing a small number of plans as coordination hubs. By interpreting overlap in conservation action categories across APs as a measure of potential synergy, we identified opportunities to implement shared interventions, advance multiple plan objectives simultaneously, reduce duplication of effort, and simplify monitoring and reporting. However, the applicability of these findings depends on whether high thematic overlap among APs actually yields real-world efficiencies or enhanced conservation results. Synergies are most likely

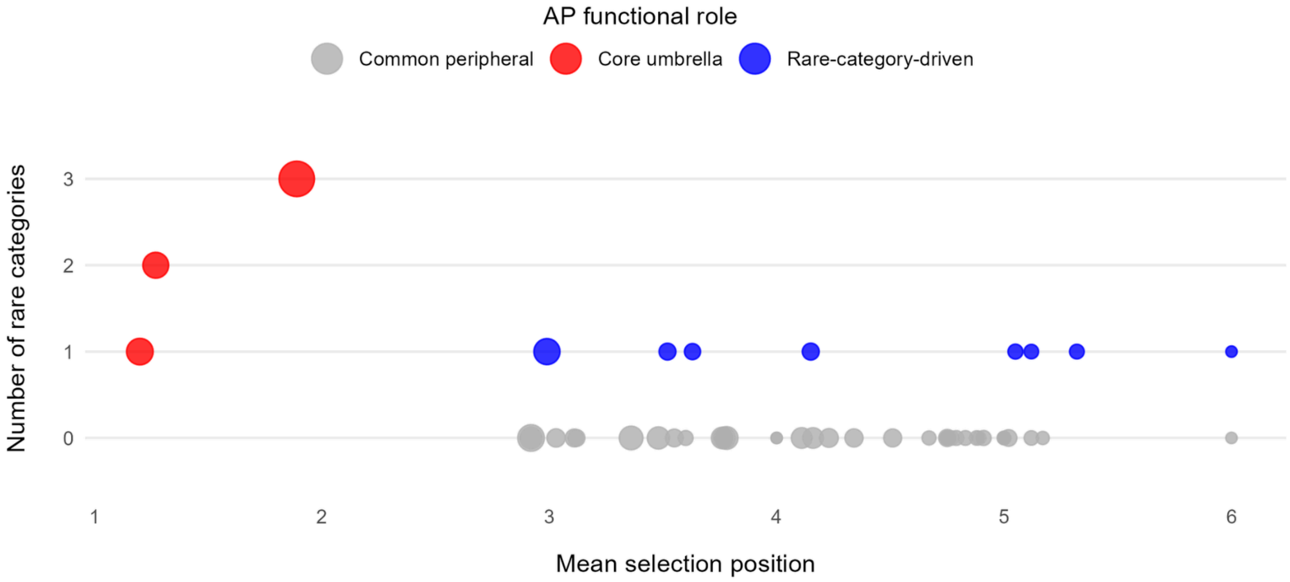


Figure 5. Classification of APs based on greedy algorithm selection and category profile. Each point represents an AP, with the x-axis showing its mean position in the greedy selection iterations (earlier positions mean that the AP covers more categories) and the y-axis showing the number of rare categories in that AP. The area of the points indicates how frequently each AP was selected in the algorithm iterations. Core UAPs (red) are consistently selected early, rare-category-driven APs (blue) cover uncommon categories, and peripheral APs (gray) contribute less to overall coverage.

to materialize where overlapping actions occur in similar geographic areas, involve compatible institutions or stakeholder groups, and can be aligned without undermining plan-specific priorities. Actual coordination outcomes will also depend on factors such as institutional capacity, political will, funding arrangements, and transaction costs (Kark et al. 2009; Mazor et al. 2013; Kark et al. 2015; Jung et al. 2024). Therefore, while our study highlights substantial potential for conservation coordination, we view our results primarily as a screening tool that identifies promising opportunities for coordination, which should be further assessed in light of local context, governance, and feasibility.

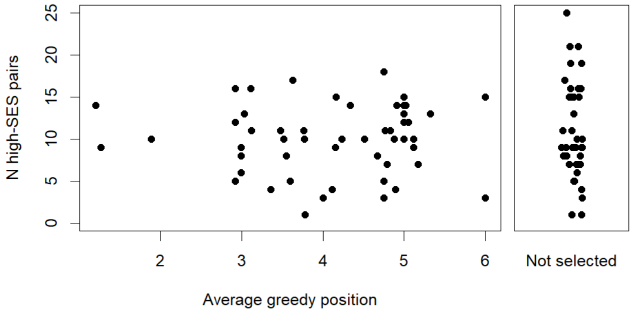
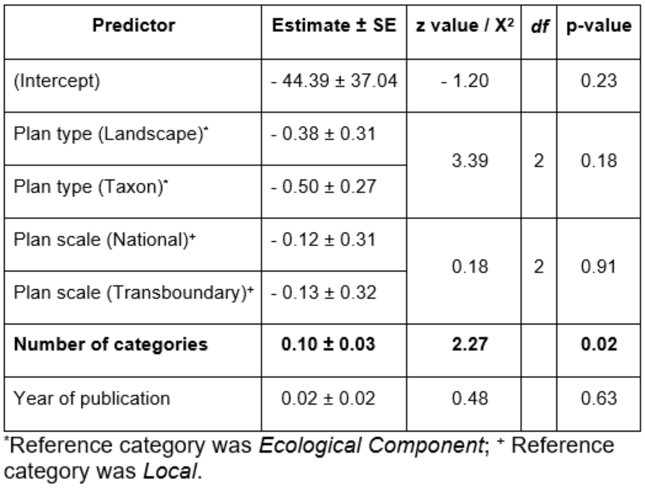


Figure 4. Relationship between a plan's frequency of selection as a greedy UAP candidate and its role as a coordination hub in the SES analysis. Left: number of high-SES pairs (N high-SES pairs) for plans with a defined average greedy selection position (Average greedy position); points show no clear trend, indicating that plans frequently chosen by the greedy algorithm are not systematically more likely to be involved in above-null similarity clusters. Right: distribution of N high-SES pairs for plans that were never selected by the greedy algorithm ("Not selected"), showing a comparable spread in coordination roles even among non-umbrella plans.

Broadly, we found that absolute overlap in conservation actions among APs was high, meaning that many plans share substantial portions of their action portfolios. This indicates strong practical potential for coordination where spatial and institutional conditions allow. While similarity initially appeared higher among plans of the same type and spatial scale, our analyses indicated that this pattern largely reflects compositional features, with broader plans or those containing common categories naturally appearing more similar, rather than systematic alignment beyond chance. This was supported both by the SES-based results and by the strength of the few core UAPs in concentrating conservation actions into just a small number of plans. In practical terms, coordination opportunities should therefore be identified based on actual action overlap rather than plan type or scale, although these dimensions may sometimes coincide. In other words, aligning plans that already overlap in actions, regardless of their thematic focus or spatial scale, can leverage existing synergies and enhance efficiency. Planners could prioritize APs with substantial shared actions for joint workshops, shared platforms, or collaborative implementation to reduce duplication and transaction costs (Kark et al. 2009; Mazor et al. 2013; Amahowe et al. 2013). Overall, the pervasive overlap of actions across APs in the region suggests that coordination is both operationally feasible and thematically justifiable, but it must be guided by action-level similarity rather than coarse plan labels such as type or spatial scale.

While the community detection analyses offered a complementary view of thematic groupings among APs, the weak and unstable modular structure of these communities suggest that West Africa's AP landscape forms a largely interconnected network, with gradual rather than discrete thematic

Table 3. Beta model examining factors influencing the likelihood of an AP being selected by the greedy algorithm as a candidate UAP.



Predictor	Estimate ± SE	z value / X^2	*df*	p-value
(Intercept)	- 44.39 ± 37.04	- 1.20		0.23
Plan type (Landscape)*	- 0.38 ± 0.31	3.39	2	0.18
Plan type (Taxon)*	- 0.50 ± 0.27			
Plan scale (National)+	- 0.12 ± 0.31	0.18	2	0.91
Plan scale (Transboundary)+	- 0.13 ± 0.32			
Number of categories	**0.10 ± 0.03**	**2.27**		**0.02**
Year of publication	0.02 ± 0.02	0.48		0.63

*Reference category was ***Ecological Component***; + Reference category was ***Local***.

differences and no clearly defined blocks. These results indicate that coordination opportunities are widespread rather than confined to a few narrowly defined groups, but they also imply that effective coordination will require careful, context-specific planning and implementation aligned to clearly defined goals (e.g., broad vs tight action coverage), rather than a group-based one-size-fits-all approach.

Our analyses revealed two complementary dimensions that can guide such coordination, reflecting different goals. Coverage UAPs, identified via the greedy algorithm, are a small set of broad APs that together capture all action categories in the region, including rare or specialized ones, and thus support region-wide coverage well. These plans provide a structured foundation for regional planning by ensuring that the full portfolio of conservation actions is represented and by organizing APs into complementary roles: core UAPs that maximize coverage, rare-category-driven APs that fill critical gaps, and common peripheral APs that reinforce widely shared actions. Conceptually, this approach applies the set-cover principle from systematic conservation planning to APs rather than to sites or species (Moore et al. 2003; Kang et al. 2022), resulting in an optimized portfolio of plans that collectively addresses the full range of conservation actions.

In parallel, alignment UAPs, identified through SES-standardized similarity, represent a distinct dimension of planning relevance. These are plans that are unusually well aligned with others, forming clusters of above-null thematic similarity, with some plans consistently acting as hubs and others rarely doing so, indicating heterogeneity in alignment potential. Although they do not necessarily cover the widest range of actions, alignment UAPs serve as natural focal points for joint implementation of actions such as shared training or pooled monitoring, supporting swift and efficient coordination among a subset of closely aligned plans. That coverage UAPs and alignment UAPs only partially overlap highlights these concepts are not the same; the plans most efficient for covering the action space are not always those best suited for operational alignment. Considering both dimensions allows planners to choose a combination of strategic completeness at the regional scale with practical coordination among highly aligned plans, providing a flexible framework to improve both the design and implementation of conservation planning while preserving the complementary roles of different APs.

4.1 Lessons for designing APs.

Given the high degree of thematic redundancy across the planning landscape, our study underscores that improving the effectiveness of APs depends less on creating additional plans and more on fostering integration among existing ones (Gordon et al. 2013). Considering the substantial costs involved in developing new APs (including consultancy fees, workshops, organizational resources, etc.), creating additional plans without accounting for existing coverage often adds limited value, since much of the relevant action space is already represented. Instead, we suggest that any new AP should be designed with a careful review of existing plans to assess whether it is truly needed to fill gaps, and to determine which actions will be shared, which will be unique, and how it will integrate with existing APs. Organizations designing new APs should therefore engage early with others in the conservation landscape to ensure new plans complement rather than duplicate existing efforts (Mpofu et al. 2025; Ray et al. 2021; Cil and Jones-Walters 2011; Bode et al. 2011).

This kind of early engagement is feasible because many of the same individuals and institutions already contribute to multiple APs, reflecting a limited pool of expertise within regions or thematic domains, and indicating that the building blocks for a more integrated, less redundant system are already in place. However, the key challenge for implementing more integrated AP systems is realizing it will depend on sustained communication and coordination among the organizations and agencies involved (Pressey and Bottrill 2009; Bode et al. 2011). Given the high overlap among APs and the costs of creating new plans, the biggest gains for regional biodiversity likely come from better coordination, alignment, and joint implementation of existing APs, rather than from continued proliferation of new plans. It should be noted, however, that our conclusion concerns the efficiency in covering action categories; it does not evaluate, and therefore does not preclude, the additional social, political, or legal value that an AP might provide (Bordignon 2020; Sarkki et al. 2016).

4.2 Lessons for improving AP implementation.

Regarding implementation, the UAP approach provides practical guidance for increasing impact within the existing planning landscape by emphasizing complementarity among APs rather than substitution (Moilanen et al. 2013; Moilanen and Arponen 2011); as they serve different but related purposes, they can be applied either in combination or individually depending on coordination goals. In practice, practitioners designing a regional coordination framework could begin with a small number of broad, national or transboundary core UAPs as strategic coordination hubs to ensure that the full suite of conservation actions is represented, and then layer in specialized, rare-category-driven plans to fill remaining gaps. In parallel, alignment UAPs could be used to identify clusters of plans that are unusually well aligned, providing natural focal points for joint implementation and resource pooling for widely shared actions, structuring collaborative efforts within thematically coherent groups. Resources saved by avoiding duplication can be redirected to rarer or context-specific actions in narrower local or taxon-focused APs.

As an example, a transboundary AP in West Africa spanning multiple countries could function as a core UAP, with widely shared actions such as anti-poaching patrols or community engagement forming a foundation for coordinated implementation across multiple plans. Regional planners or donors could prioritize this core UAP as a primary vehicle for fundraising, shared training, or region-wide monitoring, while implementers of narrower, more specialized plans, such as those targeting forest-dependent species in Guinea or chimpanzee conservation in Côte d'Ivoire, would focus on rare or site-specific interventions and explicitly plug into the core UAP for support with the broader, commonly shared actions. Similarly, practitioners working on a single AP within alignment UAPs can recognize that their work on widely shared actions, such as community engagement or law-enforcement training, may advance implementation in several other plans, creating opportunities for broader fundraising and joint delivery of those actions.

Taken together, a two-tier approach (i.e., starting with coverage UAPs to ensure completeness, then layering in alignment UAPs to streamline operational alignment) allows implementers to simultaneously cover the full conservation action space and exploit existing synergies among plans for efficient, coordinated conservation delivery. The two dimensions of the UAP approach can also be applied separately where conservation goals focus primarily on completeness or on operational alignment, respectively. Regardless of which tool is applied, deliberate integration can reduce redundancy across scales and targets while fostering both complementarity and effective coordination (Beger et al. 2015; Cardona Santos et al. 2023; Olivares-Rojas et al. 2024). As such, UAPs can be used as meta-planning tools, functioning above existing APs as coordination scaffolds rather than as another type of plan. This framework not only can improve operational alignment and efficiency but also offers a strategic guide for funding: donors can prioritize one or a small set of core UAPs for broad impact while supporting targeted, narrower APs within alignment UAP clusters to address underrepresented actions (Eklund et al. 2025). In practice, an AP's ability to act as a UAPs will also depend on strong political mandate and regional buy-in, which underpin legitimate coordination and implementation across multiple jurisdictions.

4.3 Key implications for practitioners.

Our results indicate that plan similarity is not well predicted by simple labels such as plan type or spatial scale. From a coordination standpoint, this suggests that practitioners should be cautious about assuming that species plans are naturally aligned with other species plans or that plans at the same scale will necessarily coordinate most efficiently. While a screening step based on actual action portfolios (e.g., SES-standardized similarity) would be ideal, such analyses can be technically demanding and may not always be feasible within the time and resource constraints faced by practitioners. We therefore suggest a set of simple screening questions practitioners can use when considering coordination among APs: (i) Do the APs share several major action categories (e.g., at least half of their main actions)? (ii) Are the overlapping actions intended for the same or adjacent geographic areas? (iii) Do the APs involve the same or closely connected institutions or stakeholder groups? (iv) Would implementing these actions jointly reduce duplication (e.g., fewer separate training programs or patrol systems), improve access to funding, or simplify reporting to donors? When the answer to several of these questions is "yes", coordination is likely to be worthwhile. This approach is particularly valuable for multi-species or multi-site conservation planning, where different APs may target overlapping habitats, ecosystems, or species assemblages, allowing practitioners to increase efficiency while maintaining complementary, context-specific interventions.

4.4 Limitations and future work.

We acknowledge several limitations that shape the interpretation of our findings. Throughout this study, we treated high overlap in IUCN action categories, high SES similarity, and early selection by the greedy algorithm as indicators of potential synergy across APs. These metrics suggest that the plans propose similar or complementary actions that could, in principle, be implemented jointly or coordinated, despite currently being fragmented across the region. However, these conditions are necessary but not sufficient for real-world synergy for several reasons. First, our analysis focuses on the content of APs rather than their implementation or outcomes. High overlap in written objectives and actions does not guarantee that interventions were coordinated on the ground, nor that coordination would have been feasible or beneficial in practice. Second, we rely on coding conservation actions into the standardized categories of the IUCN Conservation Actions Classification Scheme. While this widely used framework allows for consistent quantification of coverage and identification of UAP potential, it necessarily aggregates diverse interventions into broad categories. As a result, some specialized or context-specific aspects of actions are homogenized, and similarity between plans may be overstated. Two APs assigned the same category may implement similar actions in very different ways, reflecting differences in intensity, quality, or local context. Practitioners should keep this in mind when applying our results to coordination or the design of new strategies. Third, our dataset is limited to formally documented APs in West Africa. Informal, community-based, or sectoral plans, as well as plans not readily accessible online or in major databases, may be under-represented. Fourth, we do not explicitly consider costs, feasibility, institutional mandates, or political constraints, all of which are crucial for determining whether potential synergies can actually be realized and candidate UAPs can be useful coordination anchors in practice. Future work could integrate financial data, implementation records, and stakeholder perspectives to assess more directly when and how UAP-style coordination improves conservation outcomes.

Finally, our case study is set in West Africa, a region characterized by high biodiversity, chronic funding shortfalls, and a complex mix of national, transboundary, and international planning initiatives. Many features of this planning landscape, such as reliance on standardized planning templates and limited implementation capacity, are likely shared with other regions. This suggests that, although our results arise from a West African context, our workflow and key insights are likely to be broadly applicable elsewhere. The extent to which similar approaches exist in other regions will naturally depend on local factors, including the number and quality of existing APs, governance structures, and the level of donor and government coordination. We therefore present our West African case study as a proof-of-concept that demonstrates a generalizable approach for structuring AP coordination.

Acknowledgements

Thanks to Roger Mundry for his support in the greedy algorithm process, and the Cooperative Evolution Lab at the German Primate Center for their helpful feedback on earlier versions of this manuscript. The authors thank the Arcus Foundation for their support of the Western Chimpanzee Conservation Regional Alliance, within which the framework of this paper has been developed, and through which the extensive western chimpanzee conservation stakeholder network supplemented the core set of action plans used for these analyses. We extend our sincere thanks as well to the several IUCN SSC Specialist Group chairs for the fruitful exchange and support in aggregating potential plans. EGW was supported by the Emmy Noether Programme of the German Research Foundation (DFG, 513871869).

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Supplementary Material: *Harnessing hidden synergies in conservation planning: do “umbrella action plans” reduce redundancy and improve efficiency?*

S1 Methods

S1.1 Selection criteria (full description)

We defined Action Plans (APs) as documents that articulate concrete conservation objectives, associated actions, timelines, and responsible actors. We focused on APs because these elements are directly implementable and thus provide the most relevant basis for identifying where coordination could improve the efficiency and alignment of conservation efforts. We excluded higher-level legal instruments, such as environmental laws, because such instruments typically do not specify actionable conservation strategies, and our focus is on conservation planning and coordination rather than legal enforcement or compliance monitoring. We also excluded reports and Environmental and Social Impact Assessments (ESIAs), as these primarily document past activities or assess current threats rather than consistently outline coordinated strategies for future implementation. Because APs follow structured and comparable frameworks with actionable steps for implementation, by using APs as the unit of analysis, we target the instrument of the conservation planning system where quantitative comparison is feasible and where improved coordination is most likely to translate into tangible outcomes on the ground.

Since the authors of this study are overseeing the implementation of the *Regional Action Plan for the Conservation of the Western Chimpanzee (Pan troglodytes verus) 2020 - 2030* (IUCN SSC 2020), we used this plan to define the geographic scope of our analysis. This plan spans eight West African nations (Senegal, Mali, Guinea, Guinea-Bissau, Liberia, Sierra Leone, Côte d'Ivoire, and Ghana) and a diverse array of socio-economic contexts and ecosystems), making it a suitable anchor for this analysis and allowing us to capture a sufficiently heterogeneous conservation landscape.

We selected APs with the conservation of biodiversity as their primary objective, focusing exclusively on terrestrial or freshwater/coastal species and ecosystems, as marine conservation typically follows different frameworks that are structured around distinct goals, scales, and sectoral integrations (Frazão Santos et al. 2025). We included APs targeting the management of key resources (e.g., forests or agricultural lands) only when such management was explicitly aimed at protecting biodiversity, and excluded cases where biodiversity benefits were indirect or secondary to broader goals such as economic development or poverty reduction (e.g., national land-use programs that promote agroforestry primarily to increase crop yields and rural livelihoods, where biodiversity conservation is an ancillary outcome rather than an explicit target). Only APs published on or after the year 2000 were included to ensure that our set of APs reflects contemporary and relevant strategies. If multiple APs existed for the same target (e.g., iterations of or sequential APs for the same protected area), we prioritized the most recent version.

To identify relevant APs for analysis, we (i) conducted extensive online searches using keywords including "conservation strategies", "biodiversity action plans", "national biodiversity strategies and action plans | NBSAP", "species conservation action plans", "protected area management plans", (ii) searched specialized online databases and institutional repositories, including the FAOLEX Database, the IUCN Database of Strategies & Action Plans, the IUCN SSC Species Plan Library, and the Convention on Biological Diversity website to locate officially recognized documents, (iii) directly contacted chairs of all mammalian and avian IUCN Species Specialist Groups that overlap regionally to access unpublished or site-specific plans, and (iv) engaged the professional network of the Western Chimpanzee Conservation Regional Alliance (www.westernchimp.org) including governmental authorities, researchers, and conservation practitioners working in West Africa to obtain additional plans.

S1.2 Further details on classification and thematic coding

While the IUCN scheme enables standardization, it aggregates diverse interventions, and categories were not weighted by action counts, emphasis, or budgets. As a result, similarity between APs may be somewhat overstated and the discriminatory power of set-cover analyses reduced. This action-level focus strengthens the link between our analysis and practical implementation, as coordination ultimately occurs through shared or complementary actions on the ground. We note however that some textual overlap across APs may partly reflect standardized conservation terminology and institutional conventions, rather than exact duplication of on-the-ground interventions.

S1.3 Pairwise thematic similarity: Null-model implementation and SES diagnostics

S1.3.1 Degree-preserving null model

We implemented a degree-preserving null model on the binary plan × action matrix to test whether observed similarities among action plans exceeded those expected under random assignment of action categories given their observed marginal totals. Specifically, we treated rows as plans and columns as IUCN conservation action categories, with entries indicating presence/absence of each action in each plan. We generated randomized matrices using a swap algorithm that preserves both row sums (number of categories per plan) and column sums (number of plans per category). For each randomization, we recalculated all pairwise Dice similarity values among plans and recorded the median Dice similarity across all pairs.

We repeated this procedure for 1,000 null matrices (each with a burn-in of 10,000 swap steps before sampling), yielding a null distribution of median Dice similarity. We then computed a standardized effect size for the global observed median Dice value (i.e., across all pairs):

$$SES_{median} = (D_{obs\_median} - mean(D_{null\_median})) / sd(D_{null\_median})$$

Where D_{obs_median} is the observed median Dice similarity across all plan pairs, D_{null_median} is a vector of median Dice values from all null randomizations, and mean and standard deviation were calculated across randomizations. The permuted p-value therefore was the proportion of null medians greater than or equal to the observed median.

S1.3.2 Pairwise SES for plan pairs

To examine fine-scale structure in similarity, we derived a standardized effect size for each plan pair. For each of the 1,000 randomized matrices, we recalculated pairwise Dice similarity among all plans. For each pair (i, j), we then computed its SES as

$$\mathrm{SES}_{ij} = (\mathrm{D}_{ij\_obs} - \mathrm{mean}(\mathrm{D}_{ij\_null})) / \mathrm{sd}(\mathrm{D}_{ij\_null})$$

Where for each pair of plans *i* and *j*, D_{ij_obs} is the observed Dice similarity between plans *i* and *j*, D_{ij_null} is the vector of Dice similarities between plans *i* and *j* across all null randomizations, and the mean and standard deviation of the null Dice similarities are calculated for that pair across all randomizations. This procedure yields an SES matrix in which positive values indicate pairs that are more similar than expected given plan breadth and category prevalence, and negative values indicate pairs that are less similar than expected. All null-model and SES analyses were implemented in R using the *vegan* and *brms* packages.

We performed several diagnostic checks to assess the robustness of the null model and SES calculations, including evaluating the stability of the null distribution, and standard Bayesian diagnostics. More specifically, we examined the distribution of null medians across the 1,000 randomizations and confirmed that it was narrow and approximately symmetric around its mean. Increasing the number of null iterations (e.g. from 500 to 1,000) did not materially change the mean or spread of the null median, indicating that 1,000 randomizations were sufficient for stable estimates. For the Gaussian model of SES similarity, we checked standard Bayesian diagnostics, including the potential scale reduction factor (R_{hat}), effective sample sizes (Bulk_ESS and Tail_ESS), and trace plots for all fixed and random effects. All R_{hat} values were ~1.00 and effective sample sizes were high, indicating good mixing and convergence. Posterior predictive checks supported that the Gaussian likelihood provided an adequate description of the SES_dice distribution.

S1.4 Network community detection

The Revised Medoid-Shift community detection algorithm (RMS; Li et al. 2024) groups nodes by iteratively shifting each node toward the most representative member (i.e., medoid) of its neighborhood. Intuitively, the algorithm repeatedly “pulls” each AP toward the central plan it most closely resembles, allowing clusters to form around these central medoids. RMS is particularly effective for large weighted networks and provides a stable framework for identifying communities even when edge weight distributions pose challenges for traditional modularity-based methods. To assess the robustness of the RMS communities, we compared its partition with four additional community detection algorithms (Louvain, Walktrap, Infomap, and Edge-betweenness) which use different principles (modularity maximization, random walks, information flow, and edge removal, respectively; Li et al. 2024) using Adjusted Rand Index (ARI), Normalized Mutual Information (NMI), and Variation of Information (VI) to quantify similarity (Vinh, 2010). This multi-method comparison allowed us to evaluate whether clusters identified by RMS were broadly consistent across alternative frameworks, and allowed our results to be agnostic to method employed.

S1.5 Beta model overdispersion

We checked for overdispersion of the beta model by computing a Pearson-type chi-square statistic from the model’s residuals and comparing it to a chi-square distribution with the appropriate residual degrees of freedom. In this model we observed modest overdispersion (dispersion parameter=1.37), indicating that the data are somewhat more variable than the beta distribution assumes, but not to an extent that we believe invalidates the model. Practically, this means our point estimates remain interpretable, but standard errors and p-values are likely anti-conservative (i.e., we may somewhat overstate the strength of evidence), so we therefore treat the interpretation of any marginally significant results in this model with appropriate caution.

S2 Results

S2.1 Pairwise thematic similarity

Across all pairs of action plans, the observed median Dice similarity was 0.71 (mean= 0.69), while the degree-preserving null model produced a very similar median similarity (mean_{1000}= 0.71; range 0.70–0.71). The resulting distribution of pairwise SES was centered close to zero (mean= −0.09), with about half of potential pairs (52%) more similar than expected under the null, and about 6% of pairs showing strong above-null similarity (SES > 2). Thus, overall thematic overlap among plans is close to what would be expected from their observed breadth and the prevalence of each action category, but a non-trivial minority of plan pairs exhibit much higher-than-expected alignment. The SES distribution was centered close to zero (median ≈

0.08, mean ≈ −0.09), but with a wide distribution (SD= 1.78). Approximately 52% of plan pairs had SES > 0, indicating slightly higher than expected similarity, while about 6% of pairs had SES > 2, indicating strongly above-null thematic alignment. These high-SES pairs define a set of tightly aligned plans that form the basis for identifying alignment UAPs that serve as coordination hubs (see Table S2).

S2.2 Multimembership models

S2.2.1 Multimembership model with Dice similarity

Regarding whether opportunities for coordination align with intuitive plan characteristics, our beta regression multi-membership model suggested that action category profile similarity is systematically structured by both type and scale, with a strong positive interaction between the two (posterior mean = 0.16, $CrI_{95\%}$ = 0.12–0.20; see Table S3), indicating that APs sharing both the same type and scale are substantially more similar than expected based on either characteristic alone (e.g., taxon-based national plans). Simply put, this result suggests that plans addressing similar topics and operating at the same spatial scale tend to propose very similar sets of actions.

S2.2.2 Multimembership model with SES similarity

When we refit the same model, but with SES-standardized similarity as the response in a Gaussian error distribution and multi-membership structure to account for non-independence of plan pairs (Table S4), the intercept was close to zero (posterior mean= −0.10, $CrI_{95\%}$= −0.24 to 0.05), indicating that a typical pair of plans with different types, different scales, and different author types were on average very close to the null expectation of similarity. Sharing the same plan type or spatial scale did not systematically increase similarity beyond null expectations: the effects of type agreement (posterior mean= 0.00, $CrI_{95\%}$= −0.11 to 0.12), scale agreement (posterior mean= −0.03, $CrI_{95\%}$= −0.16 to 0.10) and their interaction (posterior mean= −0.03, $CrI_{95\%}$I= −0.23 to 0.17) were all small and compatible with zero. Temporal covariates showed modest patterns; pairs of plans that were further apart in publication year were slightly less similar than expected (year difference effect: posterior mean= −0.01 SES units per SD increase, $CrI_{95\%}$= −0.01 to 0.00), whereas more recent pairs of plans tended to be marginally more similar than expected (mean SD effect: posterior mean= 0.02 SES units per SD increase from the mean, $CrI_{95\%}$= 0.00 to 0.04). Effects of average plan breadth and shared author type were small and highly uncertain ($CrI_{95\%}$ spanning zero). The multi-membership random effects indicated substantial heterogeneity among plans in their tendency to be more or less similar to others than expected (plan-level SD≈ 0.66), overlaid on large residual variation among plan pairs (σ ≈ 1.71). This pattern, together with the long right tail of the SES distribution, suggests that while overall similarity roughly matches null expectations, a subset of plans forms particularly strong above-null clusters of thematic overlap that are not well predicted by broad type- or scale-based classifications. These clusters would then be natural candidates for alignment UAPs.

In summary, our null-model analysis shows that the high absolute levels of overlap among action plans are largely consistent with what we would expect given their breadth and the overall prevalence of each action category; once we hold these compositional features constant, the median similarity between plans under the null is almost identical to the observed median, and SES-standardized similarities are centered close to zero.

S2.3 Network community detection result details

The RMS community detection method identified two communities of APs (Figure S1a). Mean pairwise similarity among plans within communities (0.71) did not meaningfully differ from the overall dataset average or from between-community similarity (0.70). However, community sizes differed substantially, resulting in far fewer pairwise comparisons in *Community 1* than in *Community 2*. Descriptively, *Community 1* was small (15 APs) and dominated by Area-focused plans, mostly implemented at the Local scale, with only a single Ecological Component plan and one Transboundary plan (Figure S1b). *Community 2* comprised a larger (70 APs) and more diverse grouping, encompassing plans of all types and scales (Figure S1b).

Similarity among plans in *Community 1* averaged 0.72 ± 0.11 (SD; n= 105 unique pairs), relative to 0.70 ± 0.12 (SD; n= 2,415 unique pairs) in *Community 2*. These values indicate that, despite differences in community size, the degree of overlap in conservation actions is broadly similar within and between communities; functionally the grouping of these plans offers no additional meaningful value in similarity structure than is provided by global treatment. While local, area-focused APs tended to group together, not all local, area-focused plans were assigned to *Community 1*, with only 35% of all Area plans and 50% of all Local plans included in this community. APs were assigned on average to the same community about 65% (range: 53% - 67%) of the time across different community detection methods.

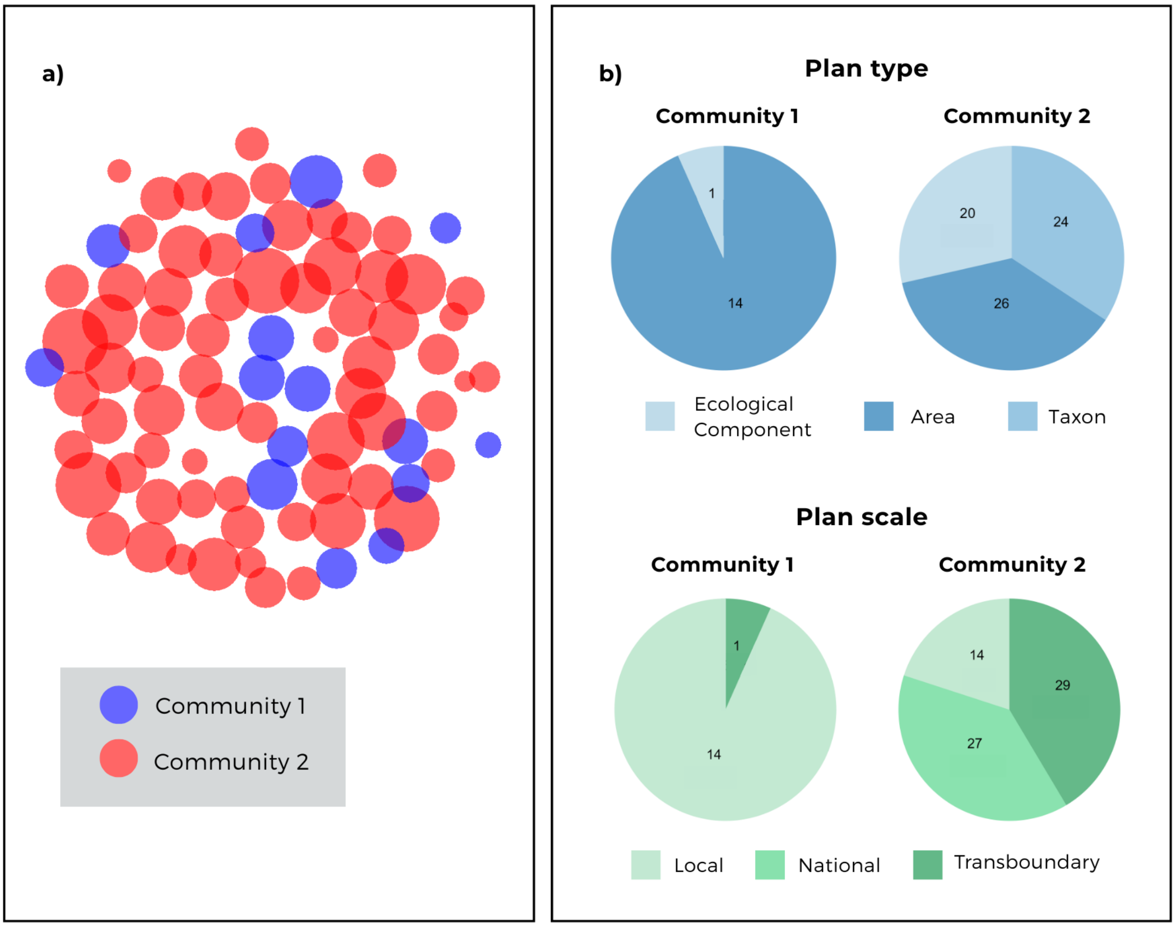

Figure S1. Communities of APs detected with the RMS method. a) Community network of APs. Nodes represent individual APs, with area proportional to the number of IUCN action categories in each plan. Two communities were identified: *Community 1* (15 APs, blue), and*Community 2* (70 APs, red). Although the communities differ thematically, substantial connections remain across the network, thereby allowing for no visual separation between the groups. **b) Community composition by AP type (top) and scale (bottom).** Numbers indicate the count of APs in each category. *Community 2* is large and diverse, including APs of all scales and types, while *Community 1* is smaller and primarily composed of Local, Area-focused plans, with only one Transboundary plan and one Ecological Component plan (*n.b.*, they are not the same plan)

Table S1. Summary of the percentage of APs that include each IUCN conservation action category, with rows representing action categories and columns showing plan types and plan scales, where values indicate the proportion of APs in each group that address the corresponding category (expressed as a percentage).

IUCN action category	**AP Type %**			**AP Scale %**		
	Ecological Component	**Area**	**Taxon**	**Local**	**National**	**Transboundary**
1.1 Site/area protection	90.5	77.5	79.2	82.1	88.9	73.3
1.2 Resource & habitat protection	71.4	37.5	20.8	50	29.6	43.3
2.1 Site/area management	95.2	100	91.7	100	92.6	96.7
2.2 Invasive/ problematic species control	47.6	25	0	32.1	33.3	6.7
2.3 Habitat & natural process restoration	90.5	85	70.8	89.3	77.8	80
3.1 Species	61.9	47.5	95.8	64.3	59.3	70

management						
3.1.1 Harvest management	19	2.5	25	3.6	11.1	23.3
3.1.2 Trade management	23.8	5	41.7	7.1	18.5	33.3
3.2 Species recovery	0	27.5	20.8	39.3	3.7	13.3
3.3. Species re-introduction	4.8	7.5	25	10.7	3.7	20
3.4 Ex-situ conservation	38.1	0	12.5	0	25.9	13.3
3.4.1 Captive breeding/artificial propagation	38.1	0	4.2	0	29.6	3.3
3.4.2 Genome resource bank	23.8	0	4.2	0	18.5	3.3
4.1 Formal education	47.6	45	33.3	53.6	44.4	30
4.2 Training	95.2	100	83.3	100	92.6	90

4.3 Awareness & communications	95.2	100	100	100	100	96.7
5.1 Legislation	76.2	72.5	75	71.4	66.7	83.3
5.2 Policies and regulations	90.5	77.5	75	67.9	85.2	86.7
5.3 Private sector standards & codes	81	65	41.7	60.7	70.4	56.7
5.4 Compliance and enforcement	66.7	70	95.8	75	66.7	86.7
6.1 Linked enterprises & livelihood alternatives	90.5	100	83.3	96.4	96.3	86.7
6.2 Substitution	42.9	7.5	8.3	7.1	29.6	13.3
6.3 Market forces	66.7	17.5	20.8	14.3	37	40
6.4 Conservation payments	19	7.5	16.7	10.7	11.1	16.7
6.5 Non-monetary values	42.9	10	12.5	14.3	22.2	20

7.1 Institutional and Civil Society Development	85.7	50	75	42.9	77.8	76.7
7.2 Alliance & Partnership Development	90.5	85	87.5	85.7	92.6	83.3
7.3 Conservation Finance	90.5	80	75	67.9	96.3	80

Table S2. Summary of all APs included in the analysis, reporting for each plan its full title, type, spatial scale, country of implementation, percentage of total IUCN action categories covered, frequency of selection and mean selection position in the greedy algorithm, number of rare categories covered, functional-role classifications (with values recorded as NA for plans never selected), and number of high-SES pairs.

AP name	AP type	AP scale	Country	Action category %	Greedy- mean selection position	Greedy- selection frequency	Rare category count	UAP functional role	High SES pairs
Stratégie Nationale et Plan d'Action pour la Diversité Biologique, Mali	Ecological Component	National	Mali	82.1	1.27	39.2	2	Core UAP	9
Stratégie Nationale et Plan National d'Actions pour la Biodiversité	Ecological Component	National	Senegal	82.1	1.28	37.3	1	Core UAP	14
Africa Union Biodiversity Strategy and Action Plan (2023-2030)	Ecological Component	Transboundary	West Africa	71.4	1.94	93.2	3	Core UAP	10
Plano de Gestão do Parque Natural das Lagoas de Cufada 2022-2031	Area	Local	Guinea-Bissau	60.7	2.82	7.3	0	Common peripheral	13

East Nimba Nature Reserve Management Plan	Area	Local	Liberia	64.3	2.91	39.4	0	Common peripheral	5
Plan De Gestion De La Réserve Naturelle D'Intérêt Communautaire De La Somone (2010 – 2014)	Area	Local	Senegal	50	3	37	1	Rare-category-driven	8
Plan De Gestion De La Réserve Naturelle De Popenguine (2010 – 2014)	Area	Local	Senegal	42.9	3	37	1	Rare-category-driven	9
Plan De Gestion Du Parc National Des Îles De La Madeleine (2010-2014)	Area	Local	Senegal	46.4	3	37	1	Rare-category-driven	6
Plano de Gestão do Parque Nacional Orango-Orizonte 2017 -2021	Area	Local	Guinea-Bissau	57.1	3.02	15.9	0	Common peripheral	16

Plano de Gestão Parque Natural dos Tarrafes do Rio Cacheu 2008 – 2018	Area	Local	Guinea-Bissau	46.4	3.02	15.9	0	Common peripheral	12
Strategy and National Action Plan for the Biodiversity 2015 - 2020	Ecological Component	National	Guinea-Bissau	82.1	3.3	21.6	0	Common peripheral	4
Plan de Gestion du Parc du Parc National des Oiseaux du Djoudj 2022-2026	Area	Local	Senegal	42.9	3.33	4.2	1	Rare-category-driven	10
Sierra Leone’s Second National Biodiversity Strategy and Action Plan 2017-2026	Ecological Component	National	Sierra Leone	71.4	3.34	3.5	0	Common peripheral	11
Forêts denses humides et aires protégées forestières d'Afrique de l'Ouest - État des lieux et perspectives	Ecological Component	Transboundary	West Africa	67.9	3.41	5.1	0	Common peripheral	16

Plan d'Action pour la Conservation de la Diversité Biologique et l'utilisation Durable de ses Ressources	Ecological Component	National	Guinea	60.7	3.45	20.1	0	Common peripheral	11
Stratégie Pour La Conservation Des Éléphants D'Afrique Occidentale	Taxon	Transboundary	West Africa	50	3.47	1.9	0	Common peripheral	5
Keta Lagoon Complex Ramsar Site Management Plan 2023-2032	Area	Local	Ghana	42.9	3.63	4.9	0	Common peripheral	8
Plan d’aménagement de Gestion du Parc National de la Langue de la Barbarie	Area	Local	Senegal	32.1	3.64	5.8	1	Rare-category-driven	17
Stratégie et Plan d'Action pour la Biodiversité Biologique nationale 2016-2020	Ecological Component	National	Côte D'Ivoire	82.1	3.66	12.1	0	Common peripheral	11

Draft Management Plan for the Grebo-Krahn National Park 2022 –2026	Area	Local	Liberia	64.3	3.87	22	0	Common peripheral	1
Agreement on the Conservation of African-Eurasian Migratory Waterbirds Plan of Action for Africa 2019-2027	Taxon	Transboundary	West Africa	60.7	3.98	19.2	0	Common peripheral	15
Forest Action Plan FY16–20	Ecological Component	Transboundary	West Africa	64.3	4.01	15.8	0	Common peripheral	4
Regional Action Plan for the Conservation of Western Chimpanzees (*Pan troglodytes verus*) 2020-2030	Taxon	Transboundary	West Africa	64.3	4.1	13.4	0	Common peripheral	15
Pangolin Specialist Group Conservation Action Plan	Taxon	Transboundary	West Africa	50	4.24	8.9	0	Common peripheral	10

West African Vulture Conservation Action Plan 2023-2043	Taxon	Transboundary	West Africa	42.9	4.34	6.5	1	Rare-category-driven	9
Cercocebus and *Mandrillus* conservation action plan 2024-2028	Taxon	Transboundary	West Africa	35.7	4.47	7.6	0	Common peripheral	14
Regional Conservation Strategy for the Cheetah and Wild Dog in West, Central and North Africa	Taxon	Transboundary	West Africa	46.4	4.5	0.6	0	Common peripheral	14
Plan de convergence pour la gestion et l’utilisation durable des écosystèmes forestiers de l’Afrique de l’Ouest (2013-2023)	Ecological Component	Transboundary	West Africa	64.3	4.6	1.5	0	Common peripheral	14
Red Colobus Conservation Action Plan 2021-2026	Taxon	Transboundary	West Africa	42.9	4.67	1.5	0	Common peripheral	7

Parc National du Haut Niger Plan d’Aménagement 2006-2010	Area	Local	Guinea	53.6	4.67	0.3	0	Common peripheral	12
Plan d’Aménagement et de Gestion du Parc National du Niokolo Koba et de sa Périphérie 2019-2023	Area	Local	Senegal	60.7	4.68	5.9	0	Common peripheral	10
Plan National de Conservation des Chimpanzés de Guinée 2020 - 2030	Taxon	National	Guinea	57.1	4.81	2.1	0	Common peripheral	10
Conservation de la biodiversité dans le complexe Taï-Grebo-Sapo	Area	Local	Côte D'Ivoire	42.9	4.82	1.1	0	Common peripheral	3
Sustainable Forest Management Framework for Africa (2020 - 2030)	Ecological Component	Transboundary	West Africa	60.7	4.86	0.7	0	Common peripheral	18

Spatially Explicit Conservation Action Plan for the Northern Lion in Central and West Africa	Taxon	Transboundary	West Africa	42.9	4.89	6.1	0	Common peripheral	5
African Elephant Action Plan	Taxon	Transboundary	West Africa	53.6	4.91	1.1	0	Common peripheral	11
National Action Plan for the Conservation of the Pygmy Hippopotamus in Liberia	Taxon	National	Liberia	46.4	4.91	1.1	0	Common peripheral	8
Liberia National Elephant Action Plan 2016-2025	Taxon	National	Liberia	50	4.94	1.8	0	Common peripheral	11
Plan d'Aménagement et de Gestion du Parc National du Banco 2019-2028	Area	Local	Côte D'Ivoire	50	4.94	1.6	0	Common peripheral	4
National Biodiversity Strategy and Action Plan	Ecological Component	National	Ghana	75	5	2.1	1	Rare-category-driven	9

Stratégie Nationale sur la Diversité Biologique pour la Mise en Œuvre en Guinée du Plan Stratégique 2011-2020 et des Objectifs d'Aichi	Ecological Component	National	Guinea	71.4	5	1.5	0	Common peripheral	10
ECOWAS Environmental Action Plan 2020-2026	Area	Transboundary	West Africa	53.6	5	0.5	0	Common peripheral	21
Plan d’action pour l’application du Programme de travail sur les aires protégées de la Convention sur la Diversité Biologique	Area	National	Mali	25	5	0.4	0	Common peripheral	12
Plan d’action pour l’application du Programme de travail sur les aires protégées de la Convention sur la Diversité Biologique	Area	National	Guinea	42.9	5	0.4	0	Common peripheral	9

Conservation Strategy for the Lion in West and Central Africa	Taxon	Transboundary	West Africa	60.7	5	0.3	0	Common peripheral	3
Plano de Gestão do Parque Nacional de Cantanhez (2017 - 2022)	Area	Local	Guinea-Bissau	53.6	5	0.3	0	Common peripheral	3
Programme de Travail des Aires Protégées du Senegal (Powpa)	Area	National	Senegal	32.1	5	0.1	0	Common peripheral	13
Western Area Peninsula National Park Management Plan 2014-2018	Area	Local	Sierra Leone	57.1	5	0.1	0	Common peripheral	7
Bia-Diambarakro Trans-frontier Conservation Area Management Plan	Area	Transboundary	Côte D'Ivoire	53.6	5	0.1	0	Common peripheral	10

Réserve Spéciale d'Avifaune du Ndiael, Plan de gestion 2018-2022	Area	Local	Senegal	46.4	5	0.1	0	Common peripheral	13
Western Derby Eland (Taurotragus derbianus derbianus) Conservation Strategy	Taxon	Transboundary	Senegal	57.1	5.03	3.2	0	Common peripheral	14
National Biodiversity Strategy and Action Plan 2017-2025	Ecological Component	National	Liberia	67.9	5.25	1.6	1	Rare-category-driven	12
Action Plan for the implementation of the FAO Strategy on Mainstreaming Biodiversity Across Agricultural Sectors 2024–2027	Ecological Component	Transboundary	West Africa	53.6	5.38	1.3	1	Rare-category-driven	13
Moyen-Bafing: Plan d’action 2018-2020	Area	Local	Guinea	39.3	5.4	0.5	0	Common peripheral	15

Plano de Acção para a Conservação de Hipopotamo na Guiné-Bissau	Taxon	National	Guinea-Bissau	60.7	5.75	0.4	1	Rare-category-driven	15
Action Plan for Implementing the Programme of Work on Protected Areas of the Convention on Biological Diversity	Area	National	Ghana	35.7	NA	NA	NA	NA	15
Action Plan for Implementing the Programme of Work on Protected Areas of the Convention on Biological Diversity	Area	National	Liberia	32.1	NA	NA	NA	NA	11
Action Plan for the Conservation of the West African Manatee	Taxon	Transboundary	West Africa	50	NA	NA	NA	NA	7
Ankasa Conservation Area Management Plan	Area	Local	Ghana	46.4	NA	NA	NA	NA	16

Approche-Programme Du Fem Pour La Préservation De La Diversité Biologique En Afrique De L'Ouest Et Afrique Centrale	Ecological Component	Transboundary	West Africa	25	NA	NA	NA	NA	19
Biodiversity Action Plan	Ecological Component	Local	Ghana	25	NA	NA	NA	NA	5
Estratégia Nacional De Comunicação Em Matéria De Intercâmbio De Informações Sobre A Biodiversidade 2015-2020	Ecological Component	National	Guinea-Bissau	17.9	NA	NA	NA	NA	10
Ghana-Cocoa and Forest Initiative National Implementation Action Plan 2018-2020	Ecological Component	National	Ghana	46.4	NA	NA	NA	NA	19
Gola Forest National Park Management Plan	Area	Local	Liberia	53.6	NA	NA	NA	NA	10

Ivory Coast-Cocoa and Forest Initiative National Implementation Action Plan 2018-2020	Ecological Component	National	Côte D'Ivoire	39.3	NA	NA	NA	NA	15
Loma Mountains National Park, Preliminary Management Plan 2013-2017	Area	Local	Sierra Leone	60.7	NA	NA	NA	NA	16
Managing Forest Resources for Sustainable Development in Africa - African Forest Forum Strategy (2021-2025)	Ecological Component	Transboundary	West Africa	53.6	NA	NA	NA	NA	21
Microchiropteran bats: global status survey and conservation action plan	Taxon	Transboundary	West Africa	35.7	NA	NA	NA	NA	9

PACCSEN - Plan d'Action pour la Conservation du Chimpanzés d'Afrique de l'Ouest au Sénégal pour la Période 2021-2030	Taxon	National	Senegal	42.9	NA	NA	NA	NA	10
Plan D'Action Pour Lutter Contre Les Prélèvements De Viande D’Animaux Sauvages Aquatiques En Afrique De L'Ouest	Taxon	Transboundary	West Africa	35.7	NA	NA	NA	NA	7
Plan d'aménagement et de gestion du Parc national de la Comoé 2015-2024	Area	Local	Côte D'Ivoire	57.1	NA	NA	NA	NA	5
Plan D'Aménagement Et De Gestion Du Parc National De Taï	Area	Local	Côte D'Ivoire	53.6	NA	NA	NA	NA	1

Plan De Gestion de la Réserve Spéciale de Faune de Gueumbeul (2010 – 2014)	Area	Local	Senegal	21.4	NA	NA	NA	NA	25
Politique Commune d'Amélioration de l'Environnement de l'UEMOA	Area	Transboundary	West Africa	32.1	NA	NA	NA	NA	9
Politique Environnementale de la CEDEAO (ECOWAP)	Area	Transboundary	West Africa	46.4	NA	NA	NA	NA	15
Politique Nationale de l'Environnement	Area	National	Guinea	50	NA	NA	NA	NA	9
Programme d'action panafricain sur la restauration des écosystèmes axée sur l'accroissement de la résilience	Area	Transboundary	West Africa	50	NA	NA	NA	NA	3

Projet De Gestion Et De Conservation Durable Des Écosystèmes du Delta Du Saloum	Area	Local	Senegal	28.6	NA	NA	NA	NA	16
Roadmap for the Conservation of the Leopard in Africa	Taxon	Transboundary	West Africa	42.9	NA	NA	NA	NA	7
Sapo National Park Management Plan	Area	Local	Liberia	46.4	NA	NA	NA	NA	16
Stratégie de Conservation de l’Hippopotame Pygmée	Taxon	Transboundary	West Africa	60.7	NA	NA	NA	NA	9
Stratégie de gestion durable des éléphants en Côte d'Ivoire - 2005-2014	Taxon	National	Côte D'Ivoire	39.3	NA	NA	NA	NA	9
Stratégie Nationale de Gestion des Aires Protégées du Sénégal	Area	National	Senegal	39.3	NA	NA	NA	NA	6

Stratégie nationale de gestion des éléphants en République de Guinée, 2007-2016	Taxon	National	Guinea	50	NA	NA	NA	NA	17
Stratégie nationale pour la mise en œuvre de la hiérarchie d'atténuation et la compensation des impacts sur la biodiversité et les écosystèmes	Area	National	Guinea	46.4	NA	NA	NA	NA	11

Table S3. Posterior estimates from the beta-regression multi-membership model examining similarity among APs as a function of plan characteristics, using Dice similarity as the response, with estimates, standard errors, and 95% credible intervals reported.

Predictor	**Estimate**	**2.5% CrI**	**97.5% CrI**
Intercept	8.05 ± 21.67	- 33.29	52.18
Type agreement[*]	**0.09 ± 0.01**	**0.07**	**0.11**
Scale agreement[*]	**- 0.04 ± 0.01**	**- 0.06**	**- 0.01**
Author overlap[*]	- 0.01 ± 0.01	- 0.04	0.01
Difference in publication year	0.00 ± 0.00	- 0.00	- 0.00
Mean number of codes	**0.07 ± 0.01**	**0.05**	**0.09**
Mean year	0.00 ± 0.01	- 0.03	0.02
Type agreement[*] **: Scale agreement**[*]	**0.16 ± 0.02**	**0.12**	**0.20**

[*] Agreement variables are dummy coded with "*False*" as the reference category; estimates represent the effect of "*True*" relative to "*False*".

Table S4. Posterior estimates from the Gaussian multi-membership regression model examining similarity among APs as a function of plan characteristics, using pairwise SES as the response, with estimates, standard errors, and 95% credible intervals are reported.

Predictor	**Estimate ± SE**	**2.5% CrI**	**97.5% CrI**
Intercept	- 0.10 ± 0.07	- 0.24	0.05
Type agreement*	0.00 ± 0.06	- 0.11	0.12
Scale agreement*	- 0.03 ± 0.07	- 0.16	0.09
Author overlap*	0.04 ± 0.05	- 0.05	0.14
Difference in publication year	- 0.06 ± 0.03	- 0.12	0.01
Mean number of codes	- 0.05 ± 0.05	- 0.15	0.05
Mean year	**0.14 ± 0.05**	**0.03**	**0.25**
Type agreement* : Scale agreement*	- 0.03 ± 0.10	- 0.22	0.17

* Agreement variables are dummy coded with “*False*” as the reference category; estimates represent the effect of “*True*” relative to “*False*”.

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