

## Supplementary Material 1

### Extended description of the dataset extraction and the coding process

Following the preliminary articles identification via keywords, we screened the general dataset and excluded publications based on the following criteria. We only selected publications written in English and original research publications (e.g opinion papers were excluded). Additional inclusion criteria were that the research took place in at least one UNESCO Biosphere Reserve and that publications full texts should be accessible online. Based on these criteria, we retained 3,304 publications for the overview of Biosphere Reserves research. Furthermore, we screened the preliminary selection of transdisciplinary publications and excluded publications that did not involve any non-academic actors in the research process, resulting in the selection of 336 transdisciplinary publications for in-depth analysis.

To ensure validity of results across the 10 coders, the following measures were implemented. First, C.H.D., C.H. and F.W. created guidelines for all coding variables. The guidelines contained comprehensive descriptions of the coding variables and facilitated a shared understanding and consistent application of these variables across coders. In a one-day workshop, the objectives, variables, guidelines and coding procedure were presented by C.H.D., J.H., C.G. and F.W. to all coders and A.F.F. and H.v.W.. Additionally, all coders engaged in parallel analysis of several publications over the course of two weeks. They compared and discussed results in daily meetings, which ensured a consistent interpretation of the coding guidelines. Finally, a set of the variables was independently coded by two different coders in 292 randomly selected articles. By comparing these duplicates, we were able to calculate the accuracy rate in coding and quantify potential coder bias (calculations by F.W., see Fig. S5).

To gain an overview of the general characteristics and topics of interest in Biosphere Reserves research and of their evolution over time, we used meta data such as publication date, and word occurrence analysis. We examined all publications in terms of geographic location and gender distribution, to identify potential bias in representation and participation (Table S1). We categorized all publications according to the geographic location of first and last authors' affiliation. We also categorized the continent and country of study area. Articles studying several Biosphere Reserves in different continents were classified as "transcontinental". To assess in more detail the quality of participation and diversity in transdisciplinary research, we categorized publications according to the following variables (Table S1). First, we counted the number of authors, whose affiliations were not academic, to appraise whether transdisciplinary research fostered the participation of non-academic actors in scientific outputs. Second, we recorded whether or not the publications mentioned non-academic actors in the acknowledgements, as a further indicator of the involvement and recognition of non-academic actors. With in-depth analysis of the articles, we then categorized the type of actors involved in the research process, adapting the list of Ferreira et al. (2020).

We also recorded their level of involvement, categorized as consultation, collaboration or empowerment (Brandt et al. 2013, Fritz and Binder 2020, Jahn et al. 2021). To capture the transformative potential of transdisciplinary research in Biosphere Reserves, we categorized transdisciplinary publications according, first, to the type of knowledge they produced (Brandt et al. 2013, Lawrence et al. 2022) and, second, to the leverage points they addressed (Dorninger et al. 2020, Riechers et al. 2021a, Zimmermann et al. 2023) (Box 1). With regard to knowledge types, we categorized the contributions of the transdisciplinary articles as systems, target, transformation or process knowledge (Table S1). Furthermore, to better appraise the contributions of transdisciplinary research to the understanding and development of solutions, we categorized articles according to the leverage points they addressed (Meadows 1999, Meadows 2012, Abson et al. 2017). The leverage points framework distinguishes interventions, such as policies or innovations, according to the more or less radical impacts they might have on the systems they target.

Table S1: Description and operationalisation of review variables

| Variables                                                   | Description                                                                                                                                               |
|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Geographic location of study area                           | Continent and country of the studied Biosphere Reserve(s)                                                                                                 |
| Geographic location of first and last authors' affiliations | Continent and country of the first affiliation attributed to the first and last authors                                                                   |
| Gender of first and last authors                            | Categorization of first and last authors' first names as female/male/unknown using genderize.io                                                           |
| Number of non-academic co-authors                           | Number of publication authors without academic affiliation                                                                                                |
| Acknowledgement of non-academic actors                      | Whether or not non-academic actors are acknowledged in the publication                                                                                    |
| Type of actors                                              | Types of actors that are involved in the transdisciplinary research process, e.g. Biosphere Reserves representatives, Indigenous People, land users       |
| Level of actor involvement                                  | The extent of involvement of non-academic actors in the transdisciplinary research process, categorized as consultation, collaboration and/or empowerment |
| Knowledge types                                             | Types of knowledge produced in the publication, categorized as system, target, transformation and/or process knowledge                                    |
| Leverage points                                             | Types of leverage points targeted in the publication, categorized as parameters, feedbacks, design and/or intent                                          |

Tab. S2: Review process

| <b>Review step</b>                               | <b>Procedure</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Publications identification                   | Identification of 5,208 publications on Web of Science and 4581 Scopus in March 2023 based on search string on title, keywords and abstract: “biosphere reserve*” OR “biosphere region*” OR “biosphere area                                                                                                                                                                                                                                                                                      |
| 2. Data cleaning                                 | Selection of 3,304 publications based on the following criteria: (1) original research, (2) accessible full texts, (3) English language, (4) at least one study site in a Biosphere Reserve                                                                                                                                                                                                                                                                                                      |
| 3. General coding                                | Coding of the 3,304 selected publications according to: geographic location; authors gender                                                                                                                                                                                                                                                                                                                                                                                                      |
| 4. Transdisciplinary publications identification | Identification of 451 publications from the general dataset of 3,304 selected publications , based on transdisciplinary search string in title and abstract: mode 2, knowledge integration, consult*, collabor*, empower*, participatory, participation, stakeholder*, real-world, multidisciplinary, interdisciplinary, citizen science, adaptive management, co-management, co-creat*, co-produc*, action research*, indigenous knowledge, ILK, actor-based*, transformative*, transformation* |
| 5. Transdisciplinary data cleaning               | Selection of 336 transdisciplinary publications that complied with the inclusion criteria of involving non-academic actors in the study design                                                                                                                                                                                                                                                                                                                                                   |
| 5. Transdisciplinary coding                      | In-depth coding of the 336 transdisciplinary publications based on full-text analysis on: (1) participation (non-academic actors co-authors; acknowledged actors; type of actors; and level of involvement) and (2) transformative impacts (knowledge types; leverage points)                                                                                                                                                                                                                    |

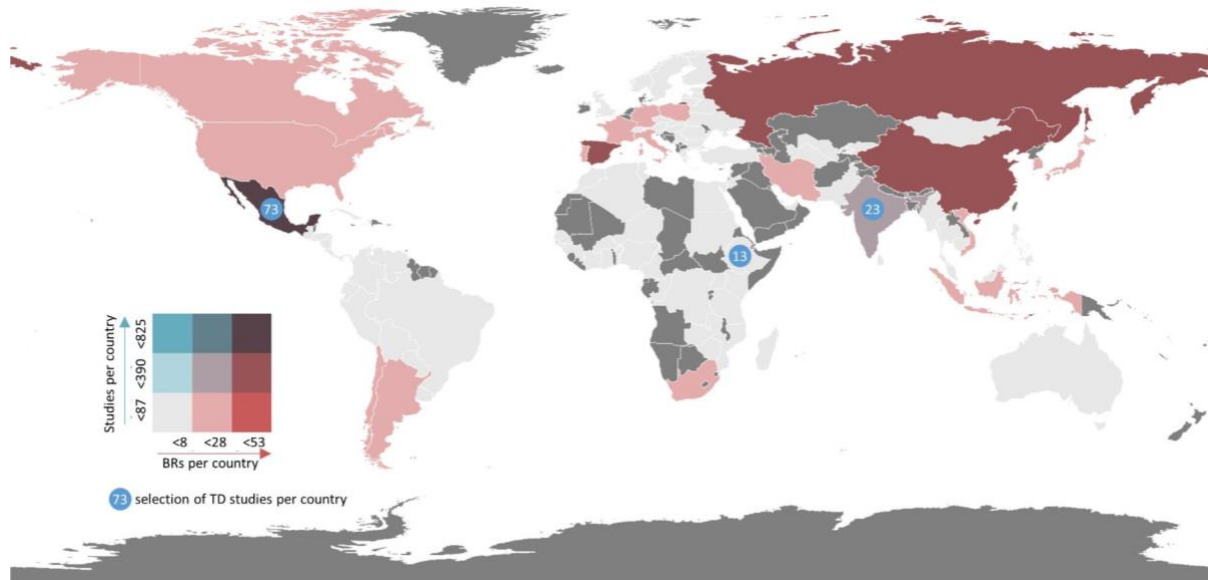


Fig S1: Bivariate map with number of general publications on Biosphere Reserves (n =3,304) and Biosphere Reserves per country. Light gray shows countries with few publications (1-87) and few Biosphere Reserves (1-8). Dark red shows countries with a high number of publications (390-825) and a high number of Biosphere Reserves (28-53). Countries with the highest numbers of transdisciplinary publications are depicted. Mexico 73, India 23 and Ethiopia 13. Countries with no publications on Biosphere Reserves and no Biosphere Reserves shown in dark grey.

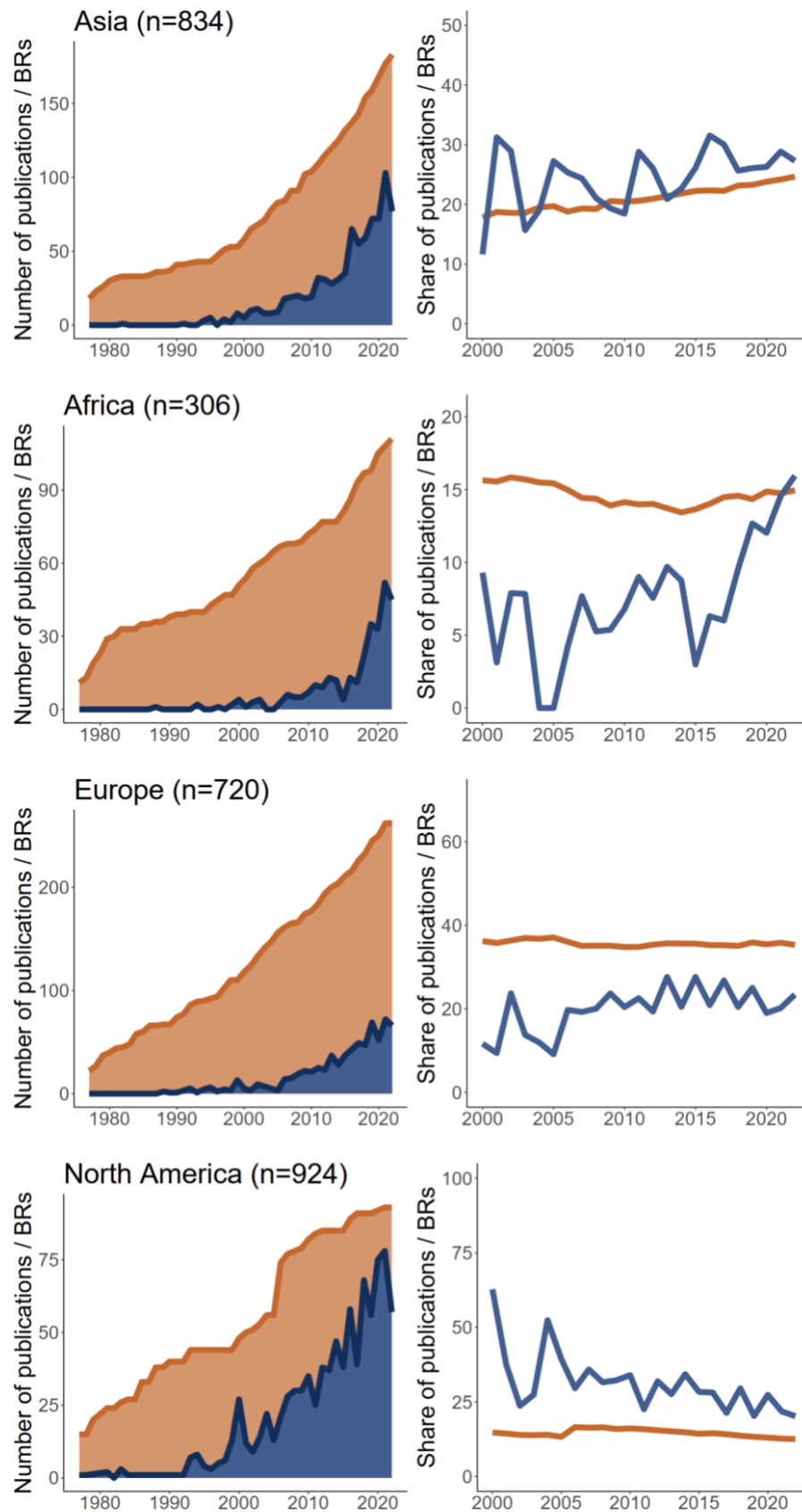


Fig. S2: Left: Cumulative number of designated Biosphere Reserves (BRs) in yellow and annual numbers of general publications on Biosphere Reserves in blue ( $n = 3,304$ ) from 1975 to 2023 for all continents. Right: Annual share of Biosphere Reserves and publications in %.

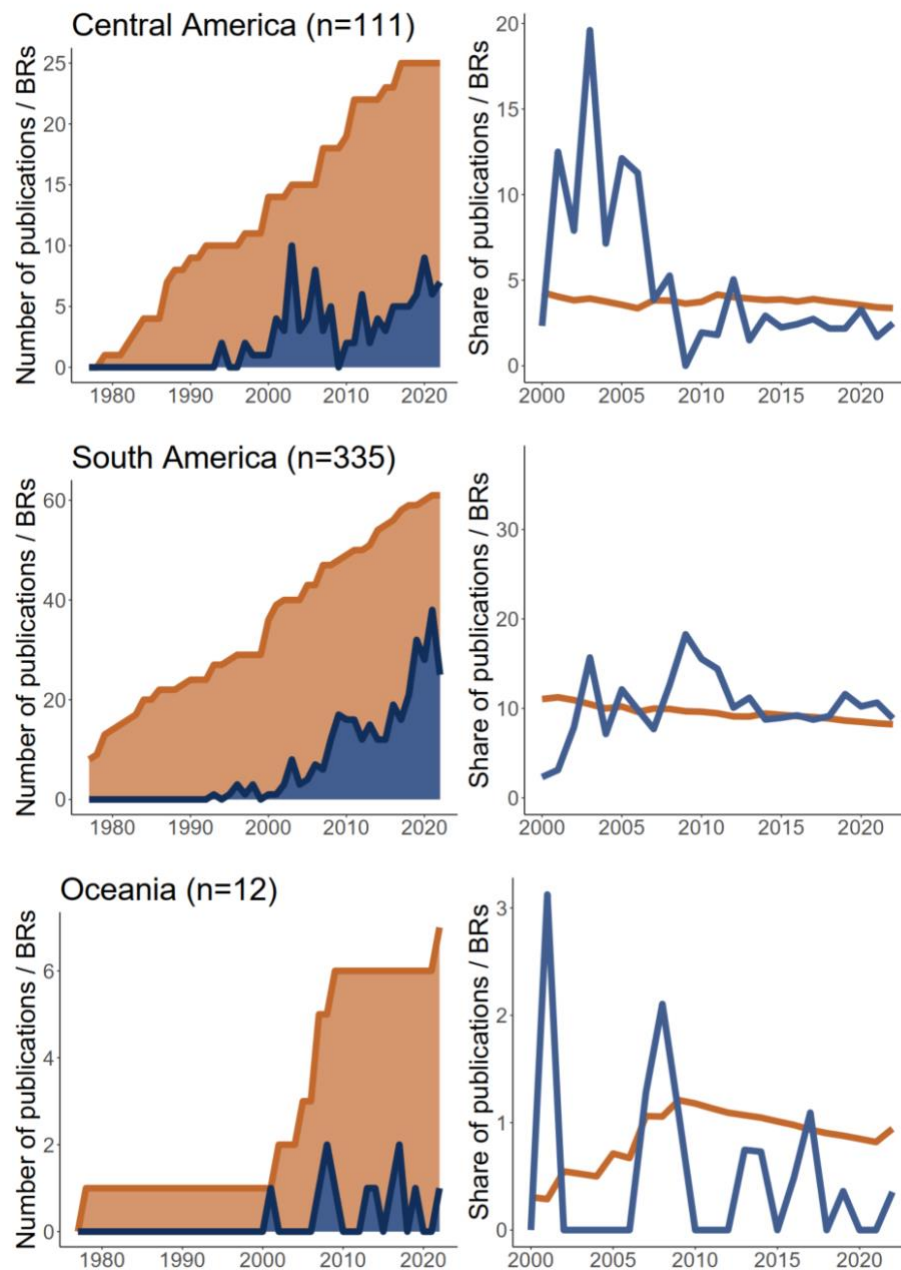


Fig. S2 (continued): Fig. S1: Left: Cumulative number of designated Biosphere Reserves (BRs) in yellow and annual numbers of general publications on Biosphere Reserves in blue ( $n = 3,304$ ) from 1975 to 2023 for all continents. Right: Annual share of Biosphere Reserves and publications in %.

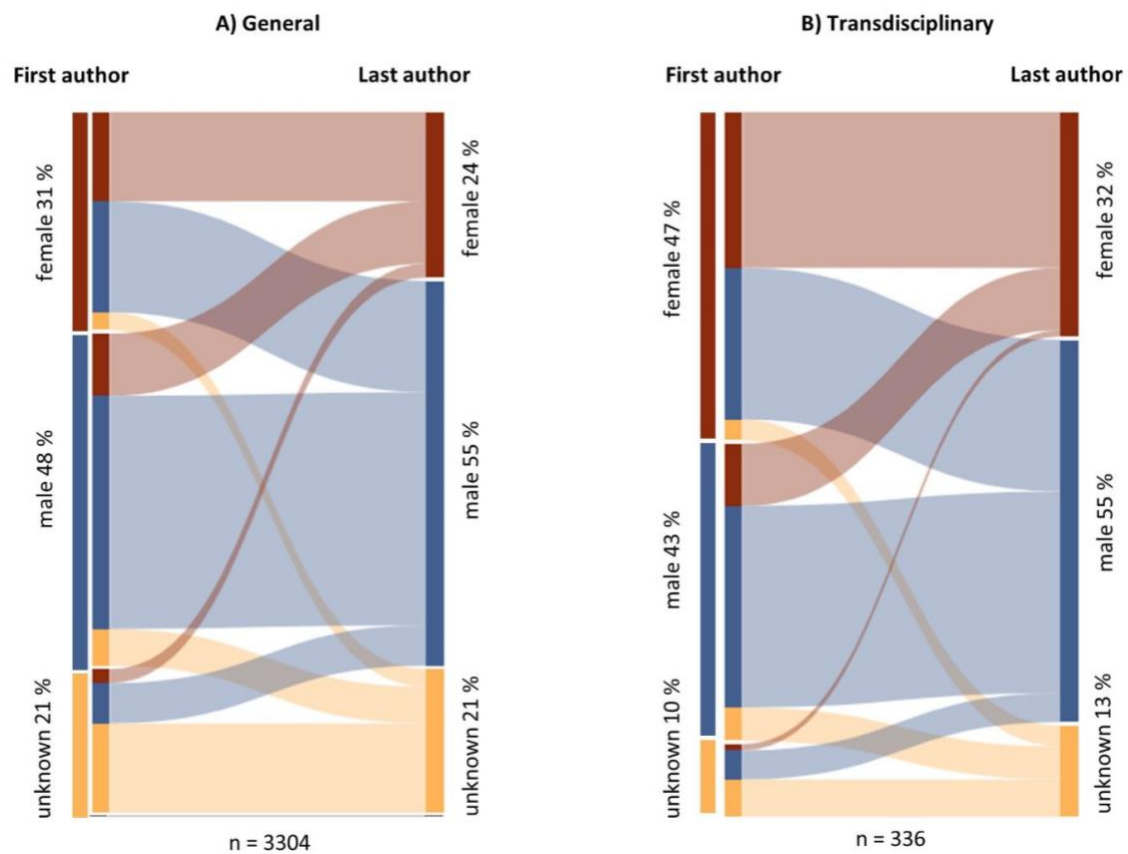


Fig. S3: Proportion of the gender of the first author in relation to the gender of the last author for A) the general dataset (n = 3,304) and B) the transdisciplinary dataset (n=336).

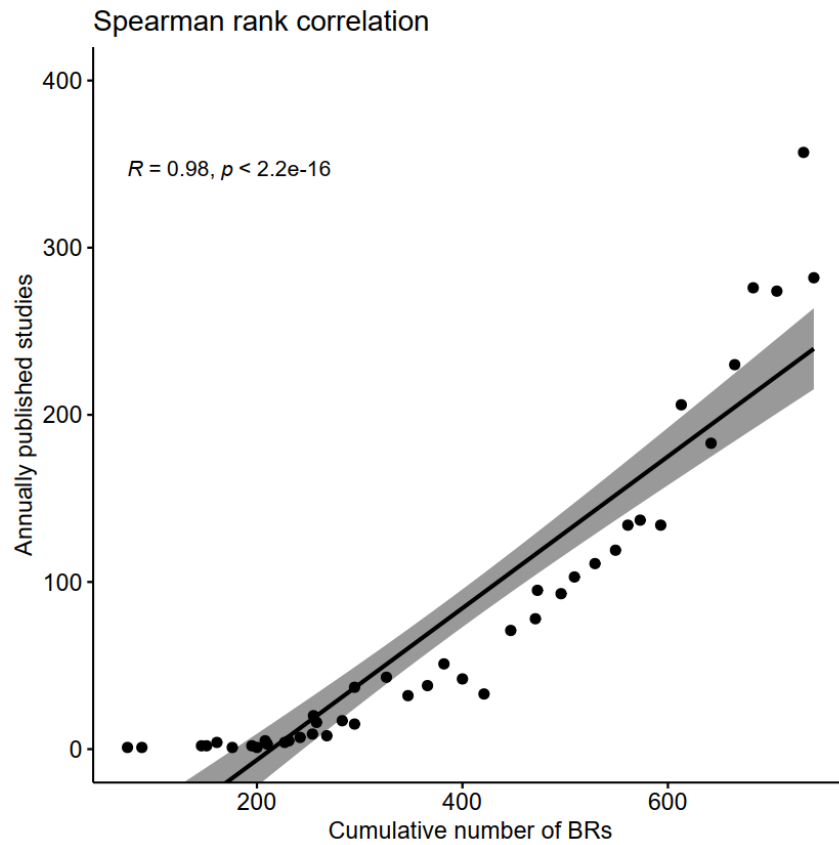


Fig. S4: Spearman rank correlation for number of annually published studies on Biosphere Reserves of the general dataset ( $n = 3,304$ ) and the cumulative number of designated Biosphere Reserves ( $n = 748$  in December 2023).

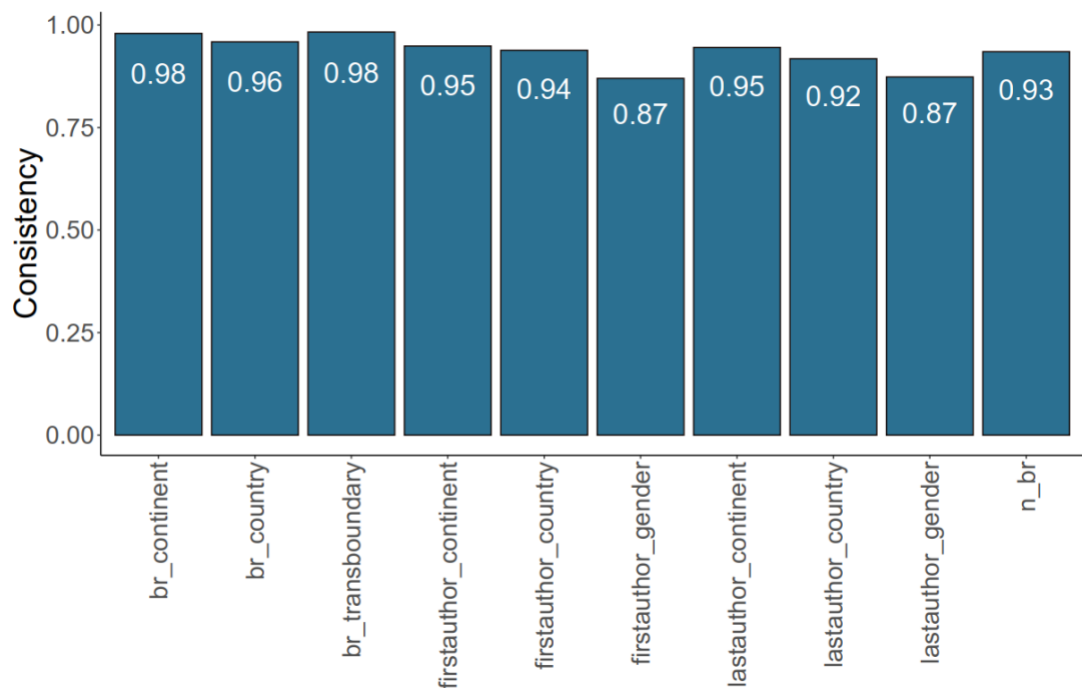


Fig. S5: Validation results for coded variables based on a set of publications (n=292) coded twice by two independent coders. The coded variables were (x-axis from left to right): Continent of the Biosphere Reserve, country of the Biosphere Reserve, transboundary Biosphere Reserve (yes/no), continent of the first authors institution, country of the first authors institution, gender of the first author, continent of the last authors institution, country of the last authors institution, gender of the last author, number of Biosphere Reserves covered in the study.