

Co-BreeD: A milestone resource for studies on cooperative breeding

Antica Culina*

Ruđer Bošković Institute, Zagreb, Croatia

aculina@irb.hr

Abstract

Research Highlight: Ben Mocha, Y., Woith, M., Scemama de Gialluly, et al.. (2025): An integrative, peer-reviewed and open-source cooperative-breeding database (Co-BreeD). *Journal of Animal Ecology*, <https://doi.org/10.1111/1365-2656.70154>. The Cooperative-Breeding Database (Co-BreeD) is an open, peer-reviewed resource that collects data on cooperative breeding across birds and mammals, including humans. As such, it serves as a valuable resource for studies on sociality and cooperation. Currently, Co-BreeD provides population-level data on nearly 40,000 breeding events from 316 species and is growing. The database allows for cooperative breeding to be treated as a continuous rather than binary trait, and at a finer spatial and temporal scales, enabling detailed exploration of the ecological and evolutionary drivers of cooperation. This novel approach revealed that alloparental care, and hence cooperative breeding, is likely more widespread than previously recognised. The importance of curated, high-quality, and accessible data across ecology and evolution is becoming evident; Co-BreeD has great potential to contribute to such collaborative, reproducible, and robust research.

Keywords

alloparental care; social evolution; Aves, Mammalia; behavioural ecology; database; open science.

Main text

Why do individuals assist in rearing offspring that are not their own, often foregoing their own reproduction, remains one of evolution's most intriguing puzzles. Cooperative breeding behaviours—from birds that help feed their siblings to primates that care for offspring of others—have provided fundamental insights into the evolution of cooperation and sociality (e.g. Macleod et al. 2015; Burkart & van Schaik). Yet, despite decades of comparative research, understanding how and why cooperation arises has been constrained by the limitations of existing datasets (Fig 1 A), including: the use of vague parameters to binary classify species in cooperative or not, unclear certainty in this classification, errors, and a lack of finer temporal and spatial (population level) data (e.g. Ben Mocha et al., 2023; Brouwer & Griffith, 2019; Griesser & Suzuki, 2016). For example, the binary categorisation of species into either cooperative or non-cooperative breeders might obscure the variation in how commonly and under what conditions individuals help others.

In their new study, Ben Mocha et al. (2025) introduce the Cooperative-Breeding Database (Co-Breed), an integrative and openly accessible resource designed to address these limitations. Co-Breed establishes a flexible, transparent, and collaborative foundation for comparative research on cooperative breeding in birds and mammals (including humans) enabling analyses that recognise cooperation as a continuum rather than a binary state (Fig 1 B). Further, unlike traditional cooperation datasets that assign each species a single label, Co-Breed is sample-based: each record is linked to a specific population and time. This structure enables quantification of both interspecific and intraspecific variation in cooperative breeding. Currently, Co-Breed compiles 487 samples from 448 populations across 316 bird and mammal (including human) species.

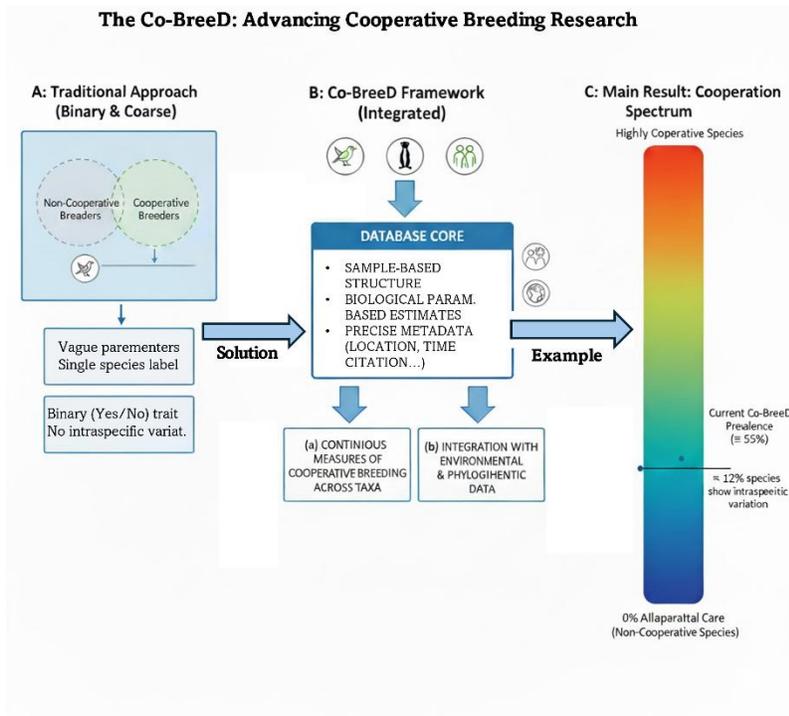


Figure 1 The Cooperative-Breeding Database (Co-BreeD) provides an important methodological step in the study of cooperative breeding by enabling classification of cooperative behaviour on a continuous scale. (A) Traditional approach relies on a coarse, species-level binary categories of ‘Cooperative’ and ‘Non-cooperative’ breeders using vague parameters. Such an approach fails to capture natural variability, lacks the resolution needed for modern comparative analysis, and could be prone to errors. (B) Co- BreeD Framework is an integrated, sample- based approach that offers an alternative. Data from three major taxa—birds, mammals (including humans)—feed into the Database, which stores high- resolution biological estimates (e.g., % alloparental care) linked to precise metadata (species, population, time, and reference). The database structure supports collaborative curation and quality control, enabling flexible calculation of intra- and inter- specific variation using continuous measures of cooperative breeding. These data can easily be linked with other relevant data, such as environmental or phylogenetic. (c) As an example of Database application, Ben Mocha et al. (2025) treated cooperation as a gradient of alloparental care. Co-BreeD revealed that cooperative breeding might be present at higher rates than previously thought (approx. 55% of included species) and that it is also highly flexible within the same species. In roughly 12% of species represented of 5% of breeding events with alloparents). This quantitative framework greatly increases the explanatory power for comparative studies on social evolution.

Following the FAIR principles (Findable, Accessible, Interoperable, Reusable, Wilkinson et al. 2016), the database is fully open-source and supported by transparent metadata and reproducible R code. Each entry includes estimates of the values or prevalence of biological traits and breeding behaviours previously proposed to define cooperative breeding, allowing users to filter species based on their chosen definition of cooperative breeding. Entry-level meta-data (e.g. location, species) enable linkage with environmental, phylogenetic, or other relevant data. Co-BreeD's also addresses a persistent challenge in behavioural ecology: data reliability. Each entry undergoes a three-step verification process, including peer review by multiple curators and, where possible, consultation with the authors of the original studies.

Perhaps most importantly, Co-BreeD is designed for community-led updates and curation, a model that has already demonstrated success in ecological and evolutionary research (e.g. Culina et al. 2021; De Moor et al 2025). Researchers can submit new data, corrections, or even entirely new behavioural parameters (such as allonursing frequency or litter size). In this way, the database plans to expand to new species, new cooperation related behaviours, and increase the sample sizes for the existing species. The project's collaborative model ensures that contributors receive appropriate recognition. Data providers are acknowledged and can be invited to co-author methodological papers describing subsequent database updates.

Using its first dataset (the prevalence of breeding events with potential alloparents) Ben Mocha et al. (2025) quantify cooperative breeding as a continuous measure: the percentage of breeding events in which individuals other than the parents provide care (Fig 1 C). Overall, 55% of species included in Co-BreeD display systematic alloparental care. While likely an overestimate, as Co-BreeD is currently biased towards species that are cooperative breeders, it still shows a striking increase relative to earlier estimates (3–14% in birds: Downing et al., 2020; Cockburn, 2006;

Griesser et al., 2017; 3% in mammals: Lukas & Clutton-Brock, 2012). Ben Mocha et al. (2025) also document considerable intraspecific variation: in roughly 12% of species represented by multiple populations (81 species), some populations exhibit cooperative breeding while others do not (using a commonly used threshold of 5% of breeding events with alloparents). This means previous studies would have had classified these species as cooperative or not only depending on the reference populations.

By replacing categorical classification with a quantitative framework, Co-BreeD enables researchers to treat cooperation as a gradient. This shift offers far greater explanatory power in comparative analyses, allowing for study of the influence of climate variability, predation pressure, or life-history strategy on helping frequency. Moreover, the continuous data approach reduces false positives and negatives that arise when species are labelled “cooperative” based on a single observation of helping. Instead, each estimate in Co-BreeD reflects weighted, population-level data, incorporating sampling uncertainty. This is particularly valuable for species where helping occurs occasionally or under specific ecological contexts, such as resource scarcity or high predation risk. Because Co-BreeD includes both cooperative and non-cooperative species—and even multiple populations of humans—it facilitates testing of hypotheses about the ecological and cognitive correlates of cooperation across taxa.

The main limitations of the current version of Co-BreeD are the database update system, and the findability of the database and its data. Ideally, it should be possible to add new entries without the need to fully upload the whole database. This limitation arises from the choice of data repository to host the database – not a common choice for updatable databases. It is also unclear how often new versions of the database will be published, which is important for both database

growth and the correction of incorrect data. Further, potential updates must be sent to an email of the main author, which is not a sustainable option.

Findability of the database is currently low. For example, a Zenodo search (where the database is uploaded) using ‘Co-BreeD’ or ‘cooperative breeding’ did not return the database. Furthermore, finding a specific entry in a database is only possible if the database is downloaded, but not using an outside search. Resolving the above-mentioned issues would, among other require more funding, which is not easy to achieve for smaller, community-curated databases. Thus, the current version of the database is an excellent start, that will hopefully attract funding for upgrades.

Concluding remarks

Co-BreeD represents an important step in how scientists can study one of evolution’s central puzzles: why individuals help others raise their young. By combining rigorous data curation with an open, collaborative model, it provides a novel opportunity to re-examine the prevalence and diversity of cooperative breeding across animals.

Conflict of Interest

The author declares no conflict of interest.

Data Availability Statement

Data have not been archived because this article does not use data.

Acknowledgments

A.C was supported by the Croatian Science Foundation under the project number IP-2022-10-2872.

References

Brouwer, L., & Griffith, S. C. (2019). Extra-pair paternity in birds. *Molecular Ecology*, 28(22), 4864–4882. <https://doi.org/10.1111/mec.15259>

Burkart, J. M., & van Schaik, C. P. (2010). Cognitive consequences of cooperative breeding in primates? *Animal Cognition*, 13(1), 1–19. <https://doi.org/10.1007/s10071-009-0263-7>

Ben Mocha, Y., Scemama de Gialluly, S., Griesser, M., & Markman, S. (2023). What is cooperative breeding in mammals and birds? Removing definitional barriers for comparative research. *Biological Reviews*, 98(6), 1845–1861. <https://doi.org/10.1111/brv.12986>

Ben Mocha, Y., Woith, M., Scemama de Gialluly, S., Bruscaignin, L., Kestel, et al.. (2025): An integrative, peer-reviewed and open-source cooperative-breeding database (Co-BreeD). *Journal of Animal Ecology*, <https://doi.org/10.1111/1365-2656.70154>

Cockburn, A. (2006). Prevalence of different modes of parental care in birds. *Proceedings of the Royal Society B: Biological Sciences*, 273(1592), 1375–1383. <https://doi.org/10.1098/rspb.2005.3458>

Culina A, Adriaensen F, Bailey LD, et al. (2021). Connecting the data landscape of long-term ecological studies: The SPI-Birds data hub. *J Anim Ecol*. 2021; 90: 2147–2160. <https://doi.org/10.1111/1365-2656.13388>

De Moor, D., Skelton, M.; Amici, F., et al. (2025). MacaqueNet: Advancing comparative behavioural research through large-scale collaboration. *Journal of Animal Ecology*, 94, 519–534. <https://doi.org/10.1111/1365-2656.14223>

Downing, P. A., Griffin, A. S., & Cornwallis, C. K. (2020). Group formation and the evolutionary pathway to complex sociality in birds. *Nature Ecology and Evolution*, 4(3), 479–486. <https://doi.org/10.1038/s41559-020-1113-x>

Griesser, M., Drobniak, S. M., Nakagawa, S., & Botero, C. A. (2017). Family living sets the stage for cooperative breeding and ecological resilience in birds. *PLoS Biology*, 15.6: e200. <https://doi.org/10.1371/journal.pbio.2000483>

Griesser, M., & Suzuki, T. N. (2016). Occasional cooperative breeding in birds and the robustness of comparative analyses concerning the evolution of cooperative breeding. *Zoological Letters*, 2(7), 1–11. <https://doi.org/10.1186/s40851-016-0041-8>

Lukas, D., & Clutton-Brock, T. (2012). Cooperative breeding and monogamy in mammalian societies. *Proceedings of the Royal Society B: Biological Sciences*, 279, 2151–2156. <https://doi.org/10.1098/rspb.2011.2468>

MacLeod, K. J., & Lukas, D. (2014). Revisiting non-offspring nursing: Allonursing evolves when the costs are low. *Biology Letters*, 10:2014037.

Wilkinson, M. D., Dumontier, M., Aalbersberg, Ij. J., Appleton, G., et al.

(2016). Comment: The FAIR Guiding Principles for scientific data management and stewardship. *Scientific Data*, 3, 1–9. <https://doi.org/10.1038/sdata.2016.18>