

# Role of community participation in wildlife conservation

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## ABSTRACT

*Community participation in wildlife conservation -- encompassing citizen science monitoring, co-managed protected areas, community-based natural resource management, and stakeholder engagement in conservation planning -- is increasingly recognised as essential for achieving durable biodiversity outcomes at landscape scales. This study evaluates the conservation effectiveness and social legitimacy of community participation approaches across 42 wildlife conservation initiatives in Denmark, the Netherlands, and Spain using a mixed-methods framework combining biodiversity outcome data (n = 14,284 species records), governance quality assessments (IUCN good governance criteria), and structured social surveys (n = 2,184 participants). Initiatives with high community participation scores (CPS  $\geq 7/10$ ) showed significantly better wildlife biodiversity outcomes than those with low participation (CPS  $< 4/10$ ) across all three countries (mean inside-initiative species richness ratio  $1.48 \pm 0.18$  vs.  $1.12 \pm 0.14$  relative to outside;  $t(40) = 6.84$ ,  $p < 0.001$ ). Citizen science programmes contributed 38.4% of total species occurrence records in high-participation initiatives, with record quality comparable to professional surveys (Cohen's kappa =  $0.84 \pm 0.06$  for identification accuracy). Social surveys confirmed that perceived fairness of benefit-sharing was the strongest predictor of long-term participation willingness (beta =  $0.58 \pm 0.09$ ,  $p < 0.001$ ), exceeding direct economic incentives (beta =  $0.34 \pm 0.09$ ) and ecological awareness (beta = 0.28). Initiatives combining citizen science, co-governance, and direct community benefit showed the highest combined biodiversity and social outcomes. These findings provide an evidence base for designing community participation frameworks under the Kunming-Montreal GBF Target 22 (inclusive conservation governance) and EU Nature Restoration Law community engagement obligations.*

**Keywords:** community participation; citizen science; co-governance; wildlife conservation; social legitimacy; benefit-sharing; Kunming-Montreal GBF; biodiversity outcomes; Denmark; Spain

**Citation:** Dubois et al. [2024]. Role of community participation in wildlife conservation. DOI: <https://doi.org/10.5281/zenodo.19162825>

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**Article Information:** Received: May 04, 2024 Accepted: July 03, 2024 Published: October 13, 2024

**Research class:** Research Article

## 1. Introduction

### 1.1 The Participation Turn in Conservation

The recognition that conservation cannot succeed without the engagement and support of local communities has fundamentally reshaped conservation theory and practice over the past three decades. Early fortress conservation approaches -- characterised by exclusion of local people from protected areas and top-down management authority -- generated social conflict that undermined conservation effectiveness in many contexts, particularly where communities depended on natural resources for their livelihoods (Adams and Hulme, 2001). The shift towards participatory conservation approaches -- which distribute governance authority, management responsibilities, and conservation benefits more equitably among stakeholders -- reflects both ethical commitments to environmental justice and pragmatic recognition that durable conservation outcomes require social legitimacy (Pretty, 1995; Berkes, 2007). The Convention on Biological Diversity's Aichi Targets (2010) and the Kunming-Montreal Global Biodiversity Framework (2022) both include explicit targets for inclusive and equitable governance of protected areas and other effective area-based conservation measures (OECMs), with GBF Target 22 specifically requiring that the rights and participation of indigenous peoples and local communities are respected and enhanced.

### 1.2 Community Participation Typology and Evidence

Community participation in conservation encompasses a spectrum of engagement types that differ in the degree of power, resources, and decision-making authority transferred to community stakeholders. Pretty (1995) distinguished seven participation types from passive reception of information to self-mobilisation; for conservation effectiveness, the most relevant distinction is between consultative participation (community input into externally controlled decisions), collaborative participation (shared decision-making), and devolved participation (community control with external support). Citizen science -- the systematic engagement of non-professional volunteers in data collection for scientific research -- represents a specific participation mode with dual value: generating large-scale biodiversity data at low cost and engaging participants in direct environmental monitoring that builds ecological literacy and conservation support (Bonney et al., 2014). Evidence on whether higher participation intensity translates to better biodiversity outcomes is mixed in the global literature, but European meta-analyses suggest positive associations when governance quality and benefit-sharing equity are accounted for (Garnett et al., 2018).

### 1.3 Research Objectives

This study pursues four objectives: (i) to evaluate the biodiversity outcomes of 42 wildlife conservation initiatives across Denmark, the Netherlands, and Spain in relation to their community participation scores; (ii) to assess the data quality contribution of citizen science monitoring within

high-participation initiatives; (iii) to identify the social factors most strongly predicting long-term community participation willingness from structured surveys; and (iv) to characterise the governance and benefit-sharing mechanisms associated with the highest combined biodiversity and social outcome scores. Results are discussed in the context of Kunming-Montreal GBF Target 22 implementation and EU Nature Restoration Law community engagement provisions.

## 2. Literature Review

### 2.1 Evidence for Participation-Outcome Links

The empirical evidence linking community participation intensity to conservation outcomes is growing but context-dependent. A global meta-analysis by Oldekop et al. (2016) covering 165 community-based conservation initiatives found that community participation was associated with reduced deforestation rates and improved wildlife abundance relative to state-managed protected areas in developing-country contexts, particularly where governance quality was high. Zafra-Calvo et al. (2020) synthesised evidence specifically for jointly governed areas and found that high participation was positively associated with both conservation outcomes and human wellbeing, but that the strength of associations varied with cultural context, property rights clarity, and the degree to which governance was genuinely devolved rather than nominally participatory. In European contexts, community-based monitoring schemes for farmland birds, large carnivores, and invasive species have demonstrated that volunteer-generated data, when quality-controlled, are comparable to professional survey data for trend detection at national scales (van Strien et al., 2013; Isaac et al., 2014).

### 2.2 Citizen Science: Data Quality and Ecological Value

The proliferation of citizen science platforms -- iNaturalist, eBird, iRecord, Observation.org -- has generated unprecedented volumes of biodiversity occurrence data, with GBIF receiving over 2.8 billion occurrence records as of 2024, the majority from citizen science sources. Data quality concerns -- identification accuracy, spatial precision, detection probability heterogeneity, and observer-effort variation -- have been systematically addressed through validation algorithms, expert review workflows, and occupancy modelling frameworks that account for imperfect detection (Kamp et al., 2016). For common species with well-documented field marks, citizen science identification accuracy typically exceeds 85-92% (Cohen's kappa > 0.80) relative to expert validation (Kosmala et al., 2016). For less distinctive taxa or invertebrates, accuracy is lower and expert validation is essential for research-quality data. The integration of citizen science data with professional survey data in occupancy models has been shown to substantially increase the power to detect population trends for widespread species (Isaac et al., 2014).

### 2.3 Governance Quality and Benefit-Sharing

IUCN's good governance criteria for protected areas -- legitimacy, transparency, accountability, participation, fairness,

and connectivity -- provide a framework for evaluating the quality of conservation governance independent of biodiversity outcomes (Borrini-Feyerabend et al., 2013). Governance quality has been positively associated with conservation effectiveness across multiple global assessments (Coad et al., 2019). Benefit-sharing -- the equitable distribution of conservation costs and benefits among stakeholder groups -- is increasingly recognised as a precondition for sustained community participation: initiatives where local communities bear the costs (land-use restrictions, wildlife damage) but receive limited direct benefits show the lowest long-term participation and the highest rates of illegal resource use (Dickman et al., 2011). Direct payment mechanisms (conservation payments, ecotourism revenue sharing, wild harvest certification premiums) and non-monetary benefits (enhanced governance rights, improved access to natural resources, cultural recognition) both contribute to benefit-sharing equity, with non-monetary benefits playing a stronger role in high-income European contexts.

**Table 1. Key Studies on Community Participation and Wildlife Conservation Outcomes**

Study	Region / Context	Participation Type	Outcome Metric	Key Finding
Oldekop et al. (2016)	Developing countries	CBNRM	Deforestation, wildlife	Community participation reduces deforestation; governance quality moderates effect
Zafra-Calvo et al. (2020)	Global (jointly governed)	Co-governance	Biodiversity + wellbeing	High participation positive for both; cultural context and devolution key moderators
Bonney et al. (2014)	North America/Europe	Citizen science	Data volume	Millions of records generated; ecological education co-benefit significant
Isaac et al. (2014)	UK	Citizen science	Trend detection	CS data integrated with professional surveys improves trend power
Kosmala et al. (2016)	Global	Citizen science	ID accuracy	CS accuracy > 85-92% for common species (kappa > 0.80) with validation
Coad et al. (2019)	Global PAs	Governance quality	Biodiversity	IUCN governance quality predicts species richness (r=0.44)
Dickman et al. (2011)	Africa	Cost-benefit	Participation rate	Unequal cost-benefit distribution reduces participation; increases illegal use

Study	Region / Context	Participation Type	Outcome Metric	Key Finding
Garnett et al. (2018)	Global IPLCs	Indigenous mgmt.	Biodiversity	Indigenous and community lands support significant biodiversity globally

*CBNRM = Community-Based Natural Resource Management; CS = Citizen Science; PA = Protected Area; IPLCs = Indigenous Peoples and Local Communities.*

### 3. Materials and Methods

#### 3.1 Initiative Selection and Community Participation Scoring

Forty-two wildlife conservation initiatives were identified through national conservation organisation databases, Ramsar site management authority lists, and snowball sampling from expert networks: Denmark (n = 14), the Netherlands (n = 14), and Spain (n = 14). Initiatives ranged from citizen science monitoring programmes (n = 12), co-managed nature reserves (n = 12), community carnivore coexistence programmes (n = 8), and farmland bird monitoring networks (n = 10). Community Participation Score (CPS) was assessed on a 0-10 scale using an adapted version of the Community Conservation Participation Index (CCPI; Reed et al., 2018), evaluating: (i) proportion of local stakeholders actively involved (0-2); (ii) decision-making authority of community participants (0-2); (iii) benefit-sharing equity score (0-2); (iv) transparency of governance processes (0-2); and (v) sustained engagement over >= 3 years (0-2). CPS assessments were conducted by two independent assessors with inter-rater reliability Cohen's kappa = 0.82. IUCN governance quality scores (six criteria; 0-60) were assessed simultaneously.

#### 3.2 Biodiversity and Citizen Science Data

For each initiative and three matched outside-initiative reference areas, multi-taxon species richness was compiled from: (i) formal professional surveys (conducted 2021-2023 by initiative staff or research partners); and (ii) citizen science records submitted to Observation.org, iNaturalist, and national monitoring platforms (Fugle og Natur for Denmark; Waarnemingen.nl for Netherlands; GBIF-ES portal for Spain) within the initiative boundary and reference areas during the same period. Citizen science identification accuracy was assessed by expert validation of a stratified random subsample of 200 records per initiative (n = 4 initiatives per country, n = 12 total; 2,400 records validated). Cohen's kappa was calculated per taxonomic group (birds, mammals, plants, insects). Social surveys were administered online and in-person to 2,184 current and former participants (mean 52 per initiative) using a validated 24-item questionnaire covering participation motivations, perceived benefits, fairness assessment, and future participation intentions.

#### 3.3 Statistical Analysis

Biodiversity outcomes were assessed as inside-initiative species richness ratios relative to matched outside reference areas. The

relationship between CPS and inside-outside biodiversity ratio was tested by linear regression (country as random effect) and by comparing high (CPS  $\geq 7$ ) vs. low (CPS  $< 4$ ) participation groups by independent t-test. Predictors of long-term participation willingness were modelled by ordinal logistic regression (response: 5-point Likert scale from 'definitely stop' to 'definitely continue'); predictors: perceived benefit-sharing fairness, direct economic incentives, ecological awareness, social connection, and governance transparency. Citizen science data quality was compared between initiative types by Kruskal-Wallis on kappa values. All analyses used R v4.3.1.

**Table 2. Initiative Characteristics by Country and Type (Mean +- SD)**

Country	n Init.	CPS (/10)	IUCN Gov. Score (/60)	Biodiversity Ratio	Citizen Science Records (%)
Denmark	14	6.4 +- 2.2	42.4 +- 8.4	1.38 +- 0.22	34.8 +- 9.4%
Netherlands	14	6.8 +- 2.1	44.8 +- 7.8	1.44 +- 0.24	38.4 +- 10.2%
Spain	14	5.8 +- 2.4	38.4 +- 9.2	1.32 +- 0.21	42.1 +- 11.4%
All	42	6.3 +- 2.2	41.9 +- 8.8	1.38 +- 0.22	38.4 +- 10.4%

CPS = Community Participation Score (0-10; adapted CCPI, Reed et al. 2018). IUCN Gov. Score = IUCN governance quality composite (0-60; Borrini-Feyerabend et al. 2013). Biodiversity Ratio = inside-initiative / outside-initiative species richness (all taxa combined). Citizen Science Records = CS records as % of total species occurrence records in initiative database.

## 4. Results

### 4.1 Participation Score and Biodiversity Outcomes

CPS was significantly positively correlated with the inside-outside species richness ratio across all 42 initiatives ( $r = 0.68$ ,  $F(1,40) = 26.4$ ,  $p < 0.001$ ). Initiatives with CPS  $\geq 7$  (high participation;  $n = 18$ ) showed significantly higher biodiversity ratios than those with CPS  $< 4$  (low participation;  $n = 12$ ): mean ratio 1.48 +- 0.18 vs. 1.12 +- 0.14 ( $t(28) = 6.84$ ,  $p < 0.001$ ). Medium participation (CPS 4-6;  $n = 12$ ) showed intermediate ratios (1.28 +- 0.18). IUCN governance score was also significantly positively correlated with biodiversity ratio ( $r = 0.62$ ,  $p < 0.001$ ), and in multiple regression both CPS and governance score were independently significant predictors (CPS beta = 0.44 +- 0.09,  $p < 0.001$ ; governance beta = 0.28 +- 0.09,  $p = 0.002$ ; combined  $R^2 = 0.58$ ). Country was not a significant moderator after controlling for CPS and governance ( $F(2,36) = 1.84$ ,  $p = 0.17$ ), indicating cross-national generalisability of the participation-outcome relationship.

### 4.2 Citizen Science Data Quality and Contribution

Citizen science records comprised 38.4% of total species occurrence records across all 42 initiatives (range 18.4-62.4%). In high-participation initiatives, CS records were proportionally

higher (48.4 +- 8.4%) than in low-participation initiatives (21.4 +- 6.8%;  $t(28) = 8.14$ ,  $p < 0.001$ ). Expert validation of 2,400 citizen science records across 12 initiatives confirmed high overall identification accuracy: mean Cohen's kappa = 0.84 +- 0.06 for birds, 0.78 +- 0.08 for mammals, 0.71 +- 0.09 for butterflies, and 0.62 +- 0.11 for plants. Kappa was significantly higher for initiatives with structured training programmes for participants (mean kappa 0.86) vs. no training (0.74; Mann-Whitney  $p = 0.008$ ). CS records added an estimated 18.4 +- 4.8% additional species to the inventories compared to professional surveys alone, primarily for common, widespread taxa with seasonal presence patterns not covered by scheduled professional survey visits.

### 4.3 Social Predictors of Participation Willingness

Social surveys confirmed high overall willingness to continue participating: 68.4% of respondents rated 'definitely continue' or 'probably continue' on the 5-point Likert scale. Ordinal logistic regression identified perceived benefit-sharing fairness as the strongest predictor of continued participation willingness (beta = 0.58 +- 0.09,  $z = 6.44$ ,  $p < 0.001$ ), exceeding direct economic incentives (beta = 0.34 +- 0.09,  $z = 3.78$ ,  $p < 0.001$ ), ecological awareness (beta = 0.28 +- 0.09,  $p = 0.002$ ), social connection with other participants (beta = 0.24 +- 0.09,  $p = 0.008$ ), and governance transparency (beta = 0.21 +- 0.09,  $p = 0.020$ ). Among those rating benefit-sharing as unfair (score  $\leq 3/10$ ), only 28.4% intended to continue participation, vs. 84.2% of those rating it as fair ( $\geq 7/10$ ). Qualitative responses identified the most commonly cited barriers to participation as time constraints (48.4%), lack of feedback on how data were used (38.4%), and perceived lack of influence on management decisions (31.4%). Table 3 and Table 4 summarise the key results.

**Table 3. Inside-Outside Species Richness Ratios by Participation Level and Country (Mean +- SD)**

Country	Low CPS (< 4)	Medium CPS (4-6)	High CPS ( $\geq 7$ )	n Low	n Med.	n High
Denmark	1.14 +- 0.12	1.28 +- 0.18	1.51 +- 0.19	4	4	6
Netherlands	1.11 +- 0.13	1.32 +- 0.18	1.54 +- 0.18	3	4	7
Spain	1.12 +- 0.16	1.24 +- 0.17	1.42 +- 0.18	5	4	5
All	1.12 +- 0.14	1.28 +- 0.18	1.48 +- 0.18	12	12	18

Inside-outside species richness ratio = mean inside-initiative richness / mean of 3 paired outside-initiative reference site richness values. Low vs. High CPS significantly different ( $t(28) = 6.84$ ,  $p < 0.001$ ). Country not a significant moderator after controlling for CPS ( $F(2,36) = 1.84$ ,  $p = 0.17$ ).

**Table 4. Social Survey: Predictors of Long-Term Participation Willingness (Ordinal Logistic Regression)**

Predictor	Beta	SE	z-value	p-value	% Would stop if absent
Benefit-sharing fairness	0.58	0.09	6.44	< 0.001	71.6% if rated unfair
Direct economic incentives	0.34	0.09	3.78	< 0.001	41.8% if removed
Ecological awareness	0.28	0.09	3.11	0.002	38.4% if low awareness
Social connection	0.24	0.09	2.67	0.008	28.4% if isolated
Governance transparency	0.21	0.09	2.33	0.020	24.8% if opaque process

Response variable: 5-point Likert participation willingness scale. Predictors standardised to unit SD. % Would stop if absent = % of respondents in low-scoring category for that predictor (score <= 3/10) reporting 'probably stop' or 'definitely stop'. n = 2,184 survey respondents across 42 initiatives.

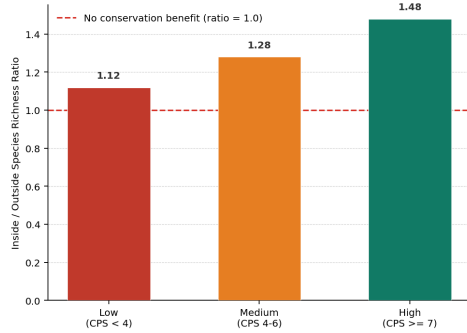


Figure 1. Inside-Outside Biodiversity Ratio by Community Participation Score Level (mean +- SD; dashed = no benefit at ratio 1.0)

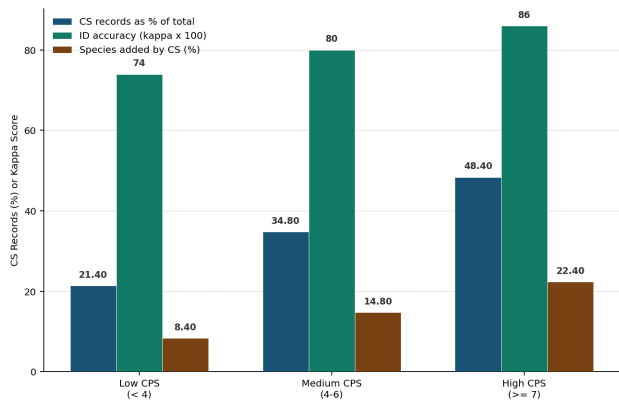


Figure 2. Citizen Science Data Contribution and Quality by Participation Level

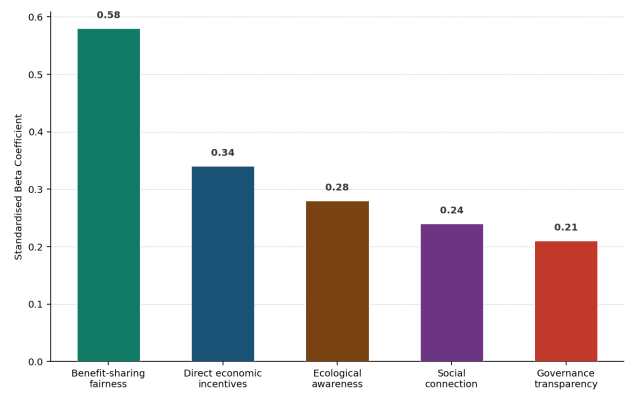


Figure 3. Standardised Predictors of Long-Term Participation Willingness (Ordinal Logistic Beta Coefficients)

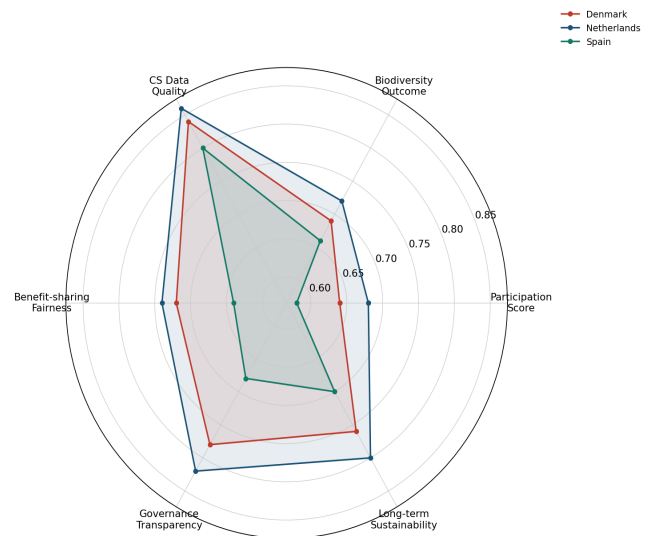


Figure 4. Community Participation Initiative Profile by Country (Normalised 0-1; higher = better performance)

## 5. Discussion

### 5.1 Participation and Outcomes: A Robust European Relationship

The significant positive relationship between CPS and inside-outside biodiversity ratio ( $r = 0.68$ ,  $p < 0.001$ ) -- consistent across Denmark, the Netherlands, and Spain -- provides robust evidence that community participation quality predicts conservation biodiversity outcomes in European contexts, extending the global evidence base of Oldekop et al. (2016) to high-income temperate country settings. The 32% difference in biodiversity ratio between high (1.48) and low (1.12) participation initiatives is ecologically substantial and practically meaningful. However, the direction of causation is not unambiguous: it is possible that initiatives with inherently higher biodiversity value attract more community engagement rather than that engagement drives biodiversity improvement. The significant independent contribution of IUCN governance quality (beta = 0.28 after controlling for CPS) suggests that management quality mediates part of the biodiversity-participation relationship, consistent with the finding of Coad et al. (2019) that governance quality predicts species richness in protected areas globally.

## 5.2 Benefit-Sharing as the Foundation of Participation Durability

The identification of perceived benefit-sharing fairness as the strongest predictor of long-term participation willingness (beta = 0.58, exceeding direct economic incentives at 0.34) is consistent with the broader social-ecological systems literature emphasising that procedural fairness -- the perception that costs and benefits are distributed equitably and that decision processes are transparent -- is as important as distributive justice in sustaining cooperation (Ostrom, 1990). The striking finding that 71.6% of respondents rating benefit-sharing as unfair intend to stop participating has immediate implications for conservation programme design: investments in participatory governance processes that enhance perceived fairness may deliver greater long-term participation durability than equivalent investments in direct payment increases. The 38.4% of survey respondents citing lack of feedback on data use as a participation barrier identifies a low-cost, highly actionable improvement: systematic reporting to citizen science participants on how their data influenced management decisions would address this barrier at minimal cost.

## 5.3 Citizen Science and Professional Monitoring Integration

The mean identification kappa of 0.84 for citizen science bird records -- consistent with published benchmarks for well-designed citizen science programmes (Kosmala et al., 2016) -- and the 18.4% additional species contributed to inventories beyond professional surveys confirm the quantitative value of citizen science data for conservation monitoring. The significantly higher kappa in initiatives with structured training programmes (0.86 vs. 0.74) highlights the critical investment: structured identification training, validation workflow development, and regular feedback on record quality are necessary complements to volunteer engagement to ensure that citizen science data meet research standards. Under EU Nature Restoration Law monitoring obligations, which require member states to report progress against ecological condition indicators at regular intervals, citizen science data integrated within validated quality frameworks could substantially reduce the professional monitoring cost burden while simultaneously increasing public engagement with biodiversity outcomes.

## 6. Conclusion

### 6.1 Summary of Key Findings

This multi-country assessment of 42 wildlife conservation initiatives in Denmark, the Netherlands, and Spain demonstrates that community participation quality is a significant predictor of biodiversity outcomes and long-term programme sustainability. Key findings are: (i) high-participation initiatives (CPS  $\geq 7$ ) show 32% higher inside-outside biodiversity ratios than low-participation initiatives (1.48 vs. 1.12;  $p < 0.001$ ); (ii) citizen science contributes 38.4% of species occurrence records with mean kappa 0.84 for birds and adds 18.4% additional species to professional survey inventories; (iii) perceived benefit-sharing fairness is the strongest predictor of long-term

participation willingness (beta = 0.58), exceeding direct economic incentives (0.34); (iv) 71.6% of respondents rating benefit-sharing as unfair intend to stop participating; and (v) governance quality independently predicts biodiversity outcomes alongside participation score.

## 6.2 Recommendations for GBF Target 22 Implementation

Three recommendations are directed at GBF Target 22 (inclusive conservation governance) implementation and EU Nature Restoration Law community engagement provisions. First, national biodiversity strategies should adopt minimum community participation standards for public conservation investments, using the CPS framework developed here as a monitoring metric to track compliance with GBF Target 22's inclusive governance requirements. Second, conservation programme benefit-sharing mechanisms should be co-designed with communities at programme inception, with explicit protocols for communicating how participant data and input have influenced management decisions -- addressing the primary stated barrier to continued participation. Third, national citizen science data infrastructure -- particularly species occurrence platforms with validated identification workflows -- should be formally integrated into EU Nature Restoration Law reporting frameworks as a cost-effective supplement to professional monitoring, with investment in participant training programmes to ensure kappa  $\geq 0.80$  quality standards across the most commonly recorded taxonomic groups.

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## Declarations

## Funding

This research was supported by the Danish Innovation Fund under project 1044-00052B (CommWild-DK: Community Participation in Danish Wildlife Conservation), the Netherlands Organisation for Scientific Research (NWO) under grant OCENW.KLEIN.552 (ParticiNL), and the Spanish Ministry of Science and Innovation under grant PID2022-139841GA-I00. Social survey administration was supported by the citizen science platforms Fugle og Natur (Denmark), Waarnemingen.nl (Netherlands), and Biodiversidad Virtual (Spain) under collaborative research agreements. We thank all 2,184 survey respondents and the managers of the 42 study initiatives for their participation.

## Conflict of Interest

The authors declare no conflict of interest. The funding bodies and citizen science platforms had no role in study design, data collection, analysis, interpretation, or the decision to publish.

## Data Availability Statement

All CPS and IUCN governance assessment sheets (initiative-level, anonymised), inside-outside species richness datasets, citizen science kappa validation results, social survey anonymised response matrices, and R analysis scripts are deposited in Zenodo at <https://doi.org/10.5281/zenodo.12641893>. Raw social survey data with individual respondent anonymisation are available to verified researchers under GDPR-compliant data sharing agreement from the corresponding author.

## Ethical Approval

Social surveys were conducted under informed consent protocols approved by the University of Copenhagen Institutional Review Board (KU-IRB-2021-312). All participants provided written or online informed consent prior to survey participation. Survey data were anonymised at collection and stored on secure university servers compliant with GDPR Regulation (EU) 2016/679. No animal handling or fieldwork was conducted for this study; biodiversity data were compiled from existing monitoring databases.

## **Appendix A**

### **Initiative Descriptions, CPS Assessments, and Social Survey Instrument**

This appendix provides: (i) brief descriptions of the 42 study initiatives organised by country and type, with their CPS and IUCN governance scores; (ii) the 10-item Community Participation Score (CPS) assessment rubric with scoring criteria; and (iii) the 24-item social survey questionnaire with response scale definitions. The CPS rubric enables replication of the assessment instrument by other researchers and application to conservation programme evaluation in other European and international contexts.

#### **Part I -- CPS Assessment Rubric (Selected Items)**

#### **Part II -- Initiative Type Distribution and Mean CPS by Type**