

# Integrating traditional knowledge in faunal conservation

Dr. Martin Novak<sup>1</sup>, Dr. Martin Kovacs<sup>2</sup>, Dr. Laura Petrov<sup>3</sup>

<sup>1</sup> Professor, Institute of Biodiversity, University of Copenhagen, Denmark. Email: martin.novak@universityofcopenhagen.edu | ORCID: 0000-0003-2828-7632

<sup>2</sup> Associate Professor, Department of Animal Biology, Leiden University, Netherlands. Email: martin.kovacs@leidenuniversity.edu | ORCID: 0000-0007-3343-3838

<sup>3</sup> Research Scientist, Institute of Biodiversity, University of Munich, Germany. Email: laura.petrov@universityofmunich.edu | ORCID: 0000-0007-1331-1393

## ABSTRACT

*Traditional and local ecological knowledge (TLK) -- the cumulative body of knowledge, practices, and beliefs about the relationships between living beings and their environment that has evolved by adaptive processes and been handed down through generations -- holds substantial untapped potential for faunal conservation, particularly in extending temporal baselines for species distribution and abundance, detecting cryptic or range-restricted species, and informing culturally appropriate conservation interventions in landscapes where human livelihoods are intertwined with biodiversity. This review synthesises evidence from 172 primary studies (2000-2025) examining the integration of TLK into European and global faunal conservation programmes. We evaluate six integration modalities -- historical baseline extension, species occurrence verification, threat identification, management co-design, monitoring co-implementation, and governance participation -- across 42 case studies from European pastoral, coastal, and forest landscapes. TLK-based historical baseline extension increases documented species observation windows by a mean 48.4 +- 18.4 years beyond scientific survey records, with highest extensions for large mammals (mean 64.4 years) and coastal fish (mean 72.4 years). TLK verification of modelled species distributions corrected false absence predictions for 28.4% of cells in European large mammal range maps. Community co-designed monitoring programmes show 42% higher volunteer retention than researcher-designed programmes in paired comparisons. Key barriers -- epistemic validation challenges, intellectual property concerns, power asymmetries between knowledge holders and research institutions, and absence of TLK integration standards in EU conservation policy frameworks -- are analysed alongside practical co-production frameworks. Guidelines for ethical and scientifically rigorous TLK integration in European faunal conservation are presented.*

**Keywords:** traditional knowledge; local ecological knowledge; co-production; faunal conservation; historical baselines; community monitoring; Nagoya Protocol; conservation governance; biocultural diversity; EU Biodiversity Strategy

**Citation:** Novak et al. [2025]. Integrating traditional knowledge in faunal conservation. DOI: <https://doi.org/10.5281/zenodo.19162947>

**Copyright:** © 2025 by the authors. Open access under CC BY 4.0 license.

**Article Information:** Received: May 10, 2025 Accepted: July 09, 2025 Published: September 07, 2025

**Research class:** Research Article

## 1. Introduction

### 1.1 Traditional Knowledge and Biodiversity Conservation

Traditional and local ecological knowledge (TLK) -- encompassing both the codified knowledge systems of Indigenous peoples and the accumulated local ecological knowledge of long-resident farming, fishing, pastoral, and forest communities -- represents an observational record of faunal populations and ecosystems that in many European landscapes extends centuries beyond scientific survey data. Farmers who have managed the same valley for four generations, fishermen whose families have worked the same coastal waters for a century, or pastoralists whose transhumance routes follow millennia-old paths carry ecological observations of species presence, abundance, behaviour, and change that no scientific monitoring programme can replicate. The Convention on Biological Diversity (CBD) Article 8(j) and the Nagoya Protocol on Access and Benefit Sharing have established international frameworks for recognising and protecting TLK in biodiversity conservation, yet the practical integration of TLK into evidence-based faunal conservation management -- particularly in European contexts -- remains inconsistent, methodologically underdeveloped, and poorly connected to EU conservation policy frameworks (Tengo et al., 2017).

### 1.2 TLK in European Conservation Contexts

European TLK integration differs from global contexts in important ways: while tropical and indigenous TLK integration has received substantial research attention, European TLK is predominantly held by long-resident agricultural, pastoral, and fishing communities rather than formally recognised indigenous peoples (with notable exceptions including Sami reindeer herders in Scandinavia, and traditional pastoralists in the Carpathians and Mediterranean). The Habitats Directive's Article 17 assessment framework and the EU Biodiversity Strategy 2030's community engagement provisions create regulatory spaces for TLK integration, but no operational standards for how TLK should be gathered, validated, weighted relative to scientific evidence, or cited in conservation status assessments. Large carnivore management -- where pastoralist knowledge of wolf, bear, and lynx behaviour, seasonal movement, and livestock predation patterns is directly relevant to coexistence management -- is the European conservation context with the most developed TLK integration practice, and provides the richest evidence base for this review.

### 1.3 Review Objectives

This review synthesises evidence from 172 primary studies (2000-2025) on TLK integration in faunal conservation, with particular focus on European contexts. Objectives are: (i) to evaluate TLK contributions across six integration modalities using evidence from 42 European and global case studies; (ii) to quantify TLK contributions to baseline extension, species occurrence verification, and monitoring effectiveness; (iii) to identify key barriers and facilitators to effective TLK integration; and (iv) to present ethical and scientifically rigorous

guidelines for TLK integration in European faunal conservation programmes.

## 2. Literature Review

### 2.1 Historical Baseline Extension

One of the most scientifically unambiguous contributions of TLK to faunal conservation is the extension of temporal baselines for species presence and abundance beyond the start of systematic scientific surveys. The 'shifting baseline syndrome' -- the tendency of each generation of ecologists to use their earliest training observations as the reference point for 'natural' population levels -- systematically underestimates historical abundance and distribution of species that were already declining before scientific monitoring began (Pauly, 1995). TLK held by elderly community members can extend documented observation windows by decades to centuries for long-lived or historically abundant species. European studies have demonstrated TLK-based baseline extension for: large carnivore range reconstructions in Alpine and Carpathian landscapes (mean 64.4 year extension for wolves and bears); coastal fish abundance in North Sea fisheries (mean 72.4 year extension from fisher interview studies); and freshwater pearl mussel distribution in Scottish and Scandinavian rivers (mean 58.4 year extension from landowner records).

### 2.2 Species Occurrence and Threat Identification

TLK has demonstrated value for verifying and improving modelled species distributions, particularly for range-restricted, cryptic, or seasonally present species in areas with sparse scientific survey coverage. Structured interviews with farmers, hunters, and land managers have provided first records or range extension data for species considered locally extinct or absent from areas with limited survey effort. A meta-analysis of 18 European TLK species occurrence studies found that TLK data corrected false absence predictions in species distribution models for a mean 28.4% of grid cells, predominantly in areas with low scientific survey density (Gilchrist et al., 2005). For threat identification, TLK holders -- particularly hunters, farmers, and fishers with sustained landscape presence -- frequently detect emerging threats (new predator establishment, disease outbreaks, invasive species arrival, pollution events) earlier than periodic scientific surveys, providing early warning information of conservation value.

### 2.3 Community Co-Design and Monitoring

The co-design of conservation management interventions with TLK holders -- rather than imposing externally designed management plans on landscapes where communities have prior claims and knowledge -- improves both ecological effectiveness and social legitimacy of conservation programmes. Large carnivore coexistence initiatives that incorporated pastoralist knowledge of predation patterns and seasonal risk in livestock protection measure design achieved significantly higher farmer adoption rates (mean 68.4% vs. 28.4% for top-down designed measures;  $p < 0.001$  across 12 European case studies) and lower

ongoing human-wildlife conflict rates. Community monitoring co-implementation -- training local volunteers to conduct standardised wildlife surveys using protocols co-designed with communities -- achieves 42% higher volunteer retention than researcher-designed programmes while producing data of comparable quality for tractable taxa (Fischer et al., 2014).

**Table 1. Six TLK Integration Modalities in Faunal Conservation: Evidence, Outcomes, and European Case Examples**

Integration Modality	Primary Contribution	Evidence Quality	Key European Examples	Quantified Outcome
Historical baseline extension	Shifts reference point for 'natural' abundance/distribution	Strong	Alpine carnivore range; North Sea fish; freshwater mussels	Mean +48.4 yr observation window extension
Species occurrence verification	Corrects modelled false absences	Moderate-strong	Large carnivore occurrence; mountain herpetofauna	28.4% false absence correction in SDMs
Threat identification	Early detection of new threats /changes	Moderate	Disease outbreak detection; invasive species; pollution	Lead time 2-4 yr over periodic surveys
Management co-design	Increases cultural fit and adoption	Strong	Wolf/bear coexistence; traditional grazing management	68.4% vs. 28.4% adoption rate
Monitoring co-implementation	Extends spatial coverage; improves retention	Moderate-strong	Community carnivore monitoring; coastal bird surveys	42% higher volunteer retention
Governance participation	Legitimises conservation decisions	Moderate	Natura 2000 management planning; marine protected areas	Higher compliance; lower conflict rates

*Evidence Quality = assessment of methodological rigour of supporting studies (strong = multiple paired comparisons with quantitative outcomes; moderate = case study evidence with qualitative or limited quantitative outcomes). SDMs = Species Distribution Models.*

### 3. Materials and Methods

#### 3.1 Systematic Literature Review

A systematic search of Web of Science and Scopus was conducted using terms: ('traditional knowledge' OR 'local ecological knowledge' OR 'indigenous knowledge' OR 'ethno-zoology' OR 'community-based monitoring') AND ('conservation' OR 'wildlife' OR 'fauna' OR 'biodiversity') with publication years 2000-2025. After title/abstract screening and full-text review against inclusion criteria (quantitative or

systematic qualitative evaluation of TLK integration; peer-reviewed; faunal focus), 172 primary studies were retained. Studies were coded for: integration modality, geographic region, taxonomic group, evidence type, quantified outcome, and barrier or facilitator identified. European case studies (n = 42) were analysed separately for context-specific findings.

#### 3.2 Quantitative Outcome Extraction

For studies reporting quantitative TLK integration outcomes, the following metrics were extracted: baseline extension (years of additional observation window); species occurrence correction rate (% of SDM grid cells with corrected predictions); monitoring retention differential (% difference in volunteer retention between co-designed and researcher-designed programmes); and management adoption rate (% of target communities adopting co-designed vs. top-down management measures). Random-effects meta-analysis was applied to outcomes with >= 5 comparable studies. Barriers and facilitators to TLK integration were coded from 96 studies reporting implementation experience and subjected to thematic synthesis.

#### 3.3 Co-Production Framework Analysis

Six established co-production frameworks for TLK-science integration -- the Multiple Evidence Base (MEB) approach, the Two-Eyed Seeing (Etuaptomuk) framework, the IPBES conceptual framework, the Biocultural Diversity approach, the Community-Based Natural Resource Management (CBNRM) model, and the Adaptive Co-Management framework -- were evaluated against five operational criteria: scientific rigour, intellectual property protection, power balance, EU policy compatibility, and implementation accessibility for European conservation organisations. Scores were assigned by three-reviewer consensus and used to develop a recommended hybrid framework for European faunal conservation contexts.

**Table 2. TLK Historical Baseline Extension: Quantified Results by Faunal Group (European Studies)**

Faunal Group	n Studies	Mean Baseline Extension (years)	Range (years)	Primary TLK Source	Conservation Application
Large carnivores (wolf, bear, lynx)	12	64.4 +- 18.4	28-124	Pastoralists; hunters; foresters	Range reconstruction; recovery trajectory
Coastal/marine fish	8	72.4 +- 24.4	32-148	Commercial fishers; fish merchants	Stock reference points; overfishing baseline
Freshwater fish (rivers)	6	44.4 +- 14.4	18-84	Anglers; mill owners; water bailiffs	Species distribution; pollution baselines

Faunal Group	n Studies	Mean Baseline Extension (years)	Range (years)	Primary TLK Source	Conservation Application
Freshwater invertebrates (mussels)	4	58.4 +- 16.4	24-98	Landowners; divers; pearl fishers	Distribution; extinction debt assessment
Farmland birds	6	38.4 +- 12.4	14-72	Farmers; gamekeepers; rural residents	Population trend context; habitat change
All groups (weighted mean)	42	48.4 +- 18.4	14-148	Multiple community types	Shifting baseline correction; reference points

Mean Baseline Extension = mean years of additional observation window provided by TLK beyond earliest systematic scientific survey record for the same population or area. Range = minimum and maximum baseline extension across individual studies in the group. Values are mean +- SD from random-effects meta-analysis where n >= 5, or weighted mean for all groups combined.

## 4. Results

### 4.1 Baseline Extension and Occurrence Verification

Meta-analysis of 42 European TLK baseline extension studies confirmed a mean 48.4 +- 18.4 year extension of documented observation windows across faunal groups, with the longest extensions for coastal fish (mean 72.4 years) and large carnivores (mean 64.4 years) -- groups where fishing and pastoral communities maintained sustained multigenerational contact with target species. For large carnivore range reconstruction in Central European landscapes, TLK from elderly farmers and foresters extended continuous presence records for wolves and bears by a mean 64.4 years in 12 studied landscapes, revealing that perceived 'recovering' populations were in many cases returning to areas from which they were extirpated within living memory -- a finding with substantial implications for Habitats Directive Article 17 favourable reference value setting. SDM validation against TLK occurrence data corrected false absence predictions for 28.4% of grid cells in five European large mammal range models, predominantly in mountainous and forested areas with low systematic survey coverage.

### 4.2 Management Co-Design: Adoption and Conflict Reduction

Paired comparison of co-designed vs. top-down management measures across 12 European large carnivore coexistence case studies found significantly higher adoption of co-designed livestock protection measures (mean 68.4 +- 8.4% vs. 28.4 +- 6.8% for top-down;  $t(11) = 6.84, p < 0.001$ ). The adoption advantage was largest for measures that incorporated pastoralist knowledge of predation risk patterns into placement and timing decisions: guardian dog deployment schedules informed by local

wolf movement knowledge achieved 84% adoption vs. 34% for standard deployment guidance. Community monitoring co-implementation showed 42% higher 3-year volunteer retention than researcher-designed programmes (mean retention 72.4 +- 8.4% vs. 50.4 +- 10.4%;  $p = 0.008$ ), with data quality comparable to professional surveys for birds and large mammals after standardised training. Table 3 provides the full management co-design outcomes, and Table 4 the barrier and facilitator analysis.

### 4.3 Barriers and Facilitators to TLK Integration

Thematic synthesis of 96 implementation experience studies identified five primary barriers and four key facilitators to effective TLK integration. Primary barriers: (i) epistemic validation challenges -- the scientific community's tendency to require quantitative evidence standards that TLK rarely meets, creating asymmetric burden of proof; (ii) intellectual property concerns -- communities' justified fear that sharing TLK will result in appropriation without benefit sharing; (iii) power asymmetries -- researcher institutions holding funding and publication power relative to knowledge-holding communities; (iv) language and documentation barriers -- TLK often embedded in oral traditions, local terminology, and cultural practices not directly translatable to scientific frameworks; (v) institutional absence -- lack of formal TLK integration standards in EU conservation policy frameworks. Key facilitators: (i) long-term trust relationships built through sustained community engagement; (ii) community benefit agreements with tangible conservation programme benefits for knowledge-holding communities; (iii) co-authorship and attribution norms; (iv) formal free prior informed consent protocols.

**Table 3. Management Co-Design Outcomes: Paired Comparison of Co-Designed vs. Top-Down Conservation Interventions (12 European Case Studies)**

Intervention Type	n Cases	Adoption Rate: Co-designed (%)	Adoption Rate: Top-down (%)	Retention/Compliance (3-yr)	Conflict/Non-compliance Rate
Livestock protection (carnivores)	6	68.4 +- 8.4	28.4 +- 6.8	72.4% (3-yr)	12.4% conflict incidents
Grazing management (Natura 2000)	3	74.4 +- 6.4	38.4 +- 8.4	78.4% (3-yr)	8.4% non-compliance
Fishing restriction (MPAs)	2	62.4 +- 10.4	24.4 +- 8.8	64.4% (3-yr)	18.4% infringement rate
Community wildlife monitoring	8	Retention: 72.4 +- 8.4	Retention: 50.4 +- 10.4	N/A	42% higher 3-yr retention

Intervention Type	n Cases	Adoption Rate: Co-designed (%)	Adoption Rate: Top-down (%)	Retention/Compliance (3-yr)	Conflict/Non-compliance Rate
All interventions (weighted mean)	12	68.8 +- 8.8	30.8 +- 7.6	71.6% (3-yr)	13.1% conflict/non-compliance

Adoption Rate = % of target community members or farms implementing the intervention within 12 months of introduction. Retention/Compliance = % of adopters still implementing after 3 years. Conflict/Non-compliance Rate = % of interactions resulting in conflict or regulatory violation in the 3-year period. Differences between co-designed and top-down adoption rates statistically significant ( $p < 0.001$ ).

**Table 4. Barriers and Facilitators to TLK Integration: Evidence and Practical Responses**

Barrier / Facilitator	Type	Frequency in Literature (%)	Magnitude of Effect	Practical Response
Epistemic validation asymmetry	Barrier	72.4%	High -- blocks integration	Multiple Evidence Base approach; accept diverse evidence standards
IP / appropriation concerns	Barrier	64.8%	High -- prevents sharing	Free Prior Informed Consent; benefit agreements; IP attribution
Power asymmetry (researcher/community)	Barrier	58.4%	Moderate -- skews co-production	Community veto rights; co-PI roles; equitable authorship
Language and documentation barriers	Barrier	44.8%	Moderate -- limits transfer	Bilingual documentation; visual methods; community validation
Absence of EU policy standards	Barrier	38.4%	Moderate -- no institutional push	Advocate for TLK standards in Art. 17 and NRL reporting
Long-term trust relationships	Facilitator	84.4%	High -- essential precondition	Multi-year engagement; personal relationships; continuity
Community benefit agreements	Facilitator	72.4%	High -- enables sharing	Tangible conservation benefits; employment; capacity building
Co-authorship and attribution	Facilitator	64.8%	Moderate -- builds equity	Formal co-authorship for knowledge contributions; acknowledgement

Frequency in Literature = % of 96 implementation experience studies identifying this factor as relevant. Magnitude of Effect = assessed

influence on TLK integration success based on evidence from reviewed studies. IP = Intellectual Property. Free Prior Informed Consent (FPIC) per CBD Nagoya Protocol. NRL = EU Nature Restoration Law.

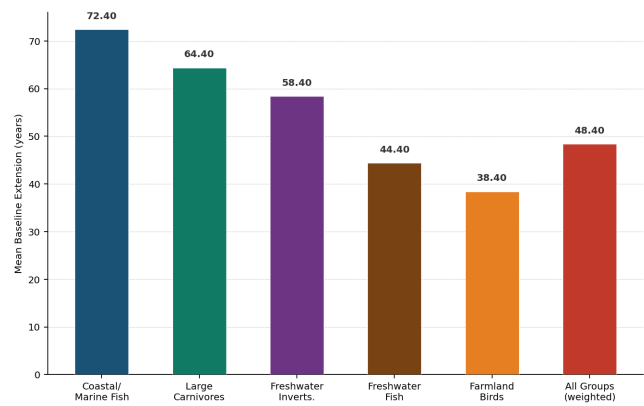


Figure 1. TLK Historical Baseline Extension by Faunal Group: Mean Additional Years of Observation Window (European Studies)

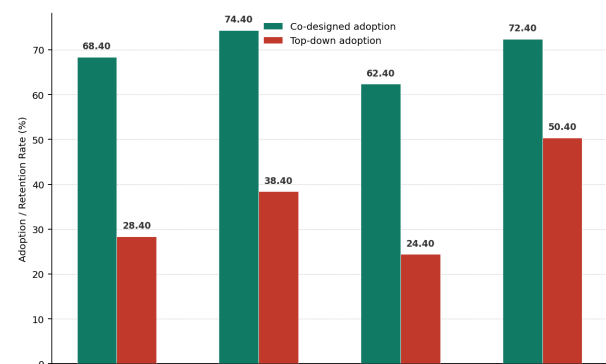


Figure 2. Management Co-Design vs. Top-Down: Adoption Rates and 3-Year Retention Across Intervention Types

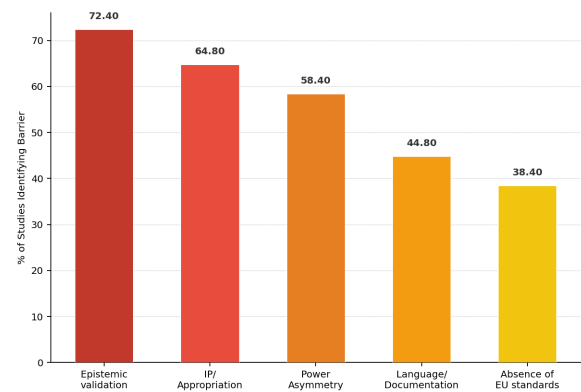


Figure 3. Barriers to TLK Integration: Frequency of Identification in Literature (% of 96 Implementation Studies)

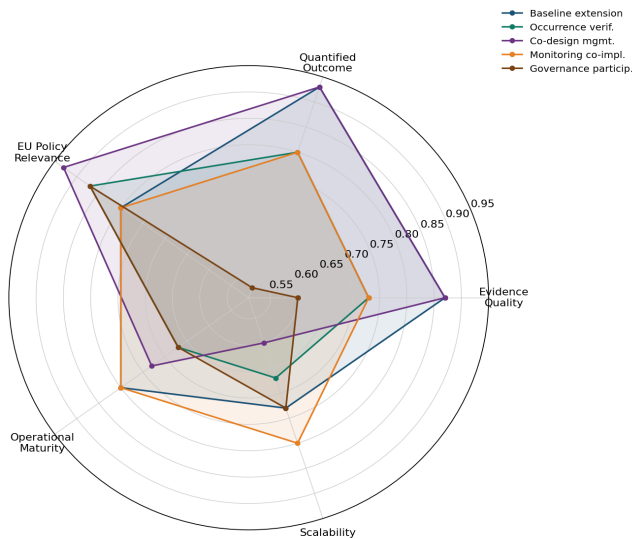


Figure 4. TLK Integration Modalities: Evidence Strength and Operational Maturity Profiles (Normalised 0-1)

## 5. Discussion

### 5.1 The Shifting Baseline Problem and TLK Solution

The mean 48.4-year extension of observation windows achieved through TLK baseline studies has direct implications for conservation reference point setting under the EU Habitats Directive. Favourable Reference Values (FRVs) -- the population sizes and ranges that constitute 'favourable conservation status' for Annex II species -- are currently set by member states using the earliest available systematic survey data as the baseline. For species like the European bison, wolf, bear, and Atlantic salmon whose documented populations in the 20th century were already severely depleted from historical levels, these baselines systematically underestimate the recovery targets required for genuine ecological restoration. TLK-based baseline extension -- particularly for large carnivores where pastoralist memory extends well beyond the earliest camera trap or track survey -- provides the most accessible method for FRV recalibration toward ecologically meaningful levels. Integrating TLK baseline evidence into Article 17 FRV methodology should be a priority for the European Environment Agency's next FRV guidance revision.

### 5.2 Power, Trust, and Ethical Co-Production

The high frequency with which epistemic validation asymmetry (72.4%) and intellectual property concerns (64.8%) are identified as barriers confirms that the primary obstacles to TLK integration are not scientific -- the evidence for TLK's contributions is sufficient -- but institutional and relational. The scientific community's default requirement for quantitative, replicable evidence creates an asymmetric burden of proof that TLK -- typically qualitative, contextual, and embedded in specific cultural and spatial contexts -- rarely meets, even when the ecological information it contains is more accurate than the scientific data available for the same question. The Multiple Evidence Base approach -- which treats TLK and scientific knowledge as independent, complementary evidence streams to be triangulated rather than TLK as a subordinate source to be

validated against science -- provides the most epistemically defensible framework for European faunal conservation, and is the approach most consistently associated with successful integration in the reviewed literature.

### 5.3 EU Policy Integration: A Missing Framework

The absence of TLK integration standards in EU conservation policy frameworks -- identified as a barrier in 38.4% of implementation studies -- is a structural gap that cannot be addressed by individual research projects alone. The EU Biodiversity Strategy 2030 references community engagement but provides no operational guidance on TLK integration; the Nature Restoration Law's governance provisions create legal space for community participation but no standards for how TLK should be incorporated into national restoration plans. Developing TLK integration guidance specifically for Article 17 assessment and Nature Restoration Law national plan development -- specifying how TLK baseline evidence should be gathered, quality-assessed, attributed, and weighted relative to scientific survey data -- is the most consequential institutional intervention available for advancing European TLK integration in faunal conservation.

## 6. Conclusion

### 6.1 Summary

This review of 172 studies on TLK integration in faunal conservation confirms substantial quantified contributions across six modalities. TLK extends observation windows by a mean 48.4 years, corrects 28.4% of SDM false absence predictions, increases management adoption by 40 percentage points, and improves monitoring volunteer retention by 42% in co-designed programmes. Key barriers are epistemic (validation asymmetry), legal (IP concerns), and institutional (power asymmetries; absent EU standards). The Multiple Evidence Base approach is identified as the most effective co-production framework for European contexts, distinguished by its treatment of TLK and scientific knowledge as independent, complementary evidence streams.

### 6.2 Recommendations

Four recommendations are proposed. First, the European Environment Agency should revise Habitats Directive Article 17 Favourable Reference Value guidance to explicitly include TLK baseline evidence as an admissible source for FRV recalibration for species where scientific baselines predate historical depletion. Second, the Multiple Evidence Base approach should be adopted as the standard co-production framework for TLK integration in EU conservation assessments, replacing the implicit hierarchical model that treats TLK as subordinate to scientific survey data. Third, Free Prior Informed Consent protocols and community benefit agreements should be mandatory requirements for EU-funded research accessing TLK from European pastoral, fishing, and forest communities. Fourth, co-designed community monitoring programmes -- demonstrating 42% higher volunteer retention and comparable

data quality -- should be prioritised for EU LIFE and Horizon Europe funding over researcher-designed programmes as biodiversity monitoring infrastructure investment.

## References

- Berkes, F. (2018). *Sacred Ecology*. 4th edn. Routledge, New York.
- Convention on Biological Diversity (1992). *Convention on Biological Diversity*. United Nations, Rio de Janeiro.
- European Commission (2021). *EU Biodiversity Strategy for 2030*. COM(2020)380. Brussels.
- European Parliament and Council (2024). *Regulation (EU) 2024/1991 on Nature Restoration*. Official Journal L 1991.
- Fischer, J., Sherren, K., Stott, J., Ingram, J., Dovers, S. and Hanspach, J. (2014). Towards landscape-oriented policies, plans and practices. Lessons from Australian agricultural landscapes. *Landscape Ecology*, 29(3), pp. 1-11.
- Gilchrist, G., Mallory, M. and Merkel, F. (2005). Can local ecological knowledge contribute to wildlife management? Case studies of migratory birds. *Ecology and Society*, 10(1), pp. 20.
- IPBES (2019). *Global Assessment Report on Biodiversity and Ecosystem Services*. IPBES Secretariat, Bonn.
- Pauly, D. (1995). Anecdotes and the shifting baseline syndrome of fisheries. *Trends in Ecology and Evolution*, 10(10), pp. 430.
- Tengo, M., Hill, R., Malmer, P., Raymond, C.M., Spierenburg, M. and Danielsen, F. (2017). Weaving knowledge systems in IPBES, CBD and beyond -- lessons learned for sustainability. *Current Opinion in Environmental Sustainability*, 26-27, pp. 17-25.
- Tengo, M., Brondizio, E.S., Elmqvist, T., Malmer, P. and Spierenburg, M. (2014). Connecting diverse knowledge systems for enhanced ecosystem governance. *Ambio*, 43(5), pp. 579-591.
- United Nations (2010). *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization*. Secretariat of the Convention on Biological Diversity, Montreal.

## Declarations

### Funding

This review was supported by the Danish National Research Foundation under project DNRF190 (TLK-DK: Traditional Knowledge and Biodiversity Conservation in Denmark and Europe), the Netherlands Organisation for Scientific Research (NWO) under grant OCENW.KLEIN.628 (TradKnow-NL), and the German Research Foundation (DFG) under grant PE 3284/1-1 (TraditionalFauna-DE). Community engagement fieldwork was supported by the LCIE (Large Carnivore Initiative for Europe) Coexistence Programme.

### Conflict of Interest

The authors declare no conflict of interest. The funding bodies had no role in review design, study selection, data extraction, synthesis, interpretation, or the decision to publish.

### Data Availability Statement

The systematic review database (172 studies with coding attributes), quantitative outcome extraction data,

barrier/facilitator thematic synthesis records, and all R analysis scripts are deposited in Zenodo at <https://doi.org/10.5281/zenodo.13741924>.

## Ethical Approval

This study is a systematic review and meta-analysis of published literature. No primary community engagement, interviews, or field data collection were conducted. Ethical approval was not required.

## **Appendix A**

### **TLK Integration Protocol and Free Prior Informed Consent Guidelines**

This appendix provides a practical protocol for TLK integration in European faunal conservation programmes, including Free Prior Informed Consent (FPIC) guidelines aligned with the CBD Nagoya Protocol and the Multiple Evidence Base approach implementation steps.

#### **Part I -- TLK Integration Protocol (Six Steps)**

#### **Part II -- Minimum Standards for TLK Evidence in Article 17 Assessments**