

Review of conservation policies for wildlife protection

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ABSTRACT

Effective wildlife conservation depends fundamentally on the quality, coherence, and implementation of conservation policies at local, national, and international scales. Europe's multilevel conservation policy architecture -- encompassing the EU Habitats Directive, Birds Directive, CITES, the Bern Convention, and national species action plans -- represents one of the most comprehensive regulatory frameworks for wildlife protection globally, yet persistent implementation gaps, funding shortfalls, and cross-border coordination failures continue to undermine conservation outcomes for many priority species. This review synthesises evidence from 186 primary studies (2005-2024) examining the effectiveness, compliance, and policy design features of wildlife conservation frameworks in European contexts. Policy effectiveness was evaluated across five dimensions: legal stringency, implementation consistency, enforcement capacity, adaptive management provisions, and cross-border coordination mechanisms. The EU Habitats Directive's Article 17 reporting cycle -- assessing favourable conservation status for Annex II species every six years -- provides the most systematic pan-European evidence base for policy outcome evaluation, with the most recent 2019 assessment reporting only 15% of assessed species in favourable status. Key policy design features associated with improved conservation outcomes include: species-specific action plans with quantified targets, dedicated funding mechanisms, independent monitoring, and transboundary management agreements. Emerging policy instruments -- biodiversity net gain requirements, payment for ecosystem services, and the EU Nature Restoration Law -- are evaluated for their potential to address persistent implementation gaps. A framework for evidence-based wildlife policy evaluation and reform is presented.

Keywords: conservation policy; wildlife protection; EU Habitats Directive; species action plans; policy effectiveness; enforcement; transboundary conservation; Nature Restoration Law; biodiversity governance; adaptive management

Citation: Costa et al. [2024]. Review of conservation policies for wildlife protection. DOI: <https://doi.org/10.5281/zenodo.19162811>

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Article Information: Received: June 09, 2024 Accepted: August 08, 2024 Published: October 07, 2024

Research class: Research Article

1. Introduction

1.1 The Policy-Practice Gap in Wildlife Conservation

The past three decades have seen remarkable expansion in the legal architecture for wildlife conservation, with over 190 countries party to the Convention on Biological Diversity (CBD), 183 to CITES, and the European Union implementing what many regard as the world's most ambitious regional biodiversity framework through the Habitats and Birds Directives. Yet global biodiversity indicators -- including the Living Planet Index, which shows a mean 69% decline in monitored vertebrate populations since 1970 -- consistently demonstrate that policy ambition has not translated into population-level conservation outcomes at the required scale (WWF, 2022). The gap between policy intent and conservation outcomes has multiple causes: inadequate implementation funding, weak enforcement, insufficient monitoring to assess policy effectiveness, and policy designs that fail to address the socio-economic drivers of wildlife decline. Understanding which policy design features are associated with improved conservation outcomes -- and which implementation barriers most consistently undermine policy effectiveness -- is essential for evidence-based policy reform (Sutherland and Wordley, 2017).

1.2 European Conservation Policy Architecture

Europe's wildlife conservation policy operates through a nested multilevel architecture. At the international level, CITES regulates trade in threatened species; the Bern Convention on the Conservation of European Wildlife and Natural Habitats requires strict protection for listed species and habitat preservation. At the EU level, the Habitats Directive (92/43/EEC) and Birds Directive (2009/147/EC) form the cornerstone framework: the Habitats Directive requires member states to achieve favourable conservation status (FCS) for Annex II species, designate Special Areas of Conservation (SACs), and report population status every six years under Article 17. The Birds Directive establishes Special Protection Areas (SPAs) and requires management of all wild bird species. Together with national species action plans, this architecture provides a comprehensive but complex regulatory landscape whose implementation quality varies substantially across member states, species groups, and time periods.

1.3 Review Objectives

This review synthesises evidence from 186 primary studies (2005-2024) examining the effectiveness, compliance, and policy design features of wildlife conservation frameworks in European contexts. Objectives are: (i) to evaluate conservation policy effectiveness across five dimensions using a standardised scoring framework applied to major EU and international instruments; (ii) to identify policy design features consistently associated with improved species conservation outcomes from the EU Habitats Directive Article 17 assessment data; (iii) to evaluate implementation barriers and enforcement capacity constraints; and (iv) to assess emerging policy instruments --

biodiversity net gain, payment for ecosystem services, and the EU Nature Restoration Law -- for their potential to close the policy-practice gap.

2. Literature Review

2.1 EU Habitats Directive: Outcomes and Persistent Gaps

The EU Habitats Directive's Article 17 reporting cycle provides the most comprehensive pan-European dataset on conservation policy outcomes for any regional framework globally: the 2019 assessment covered 1,435 species and habitat type assessments across all EU biogeographical regions. The headline finding -- only 15% of species assessments in favourable conservation status -- reflects both the challenging baseline inherited from pre-Directive habitat degradation and the persistent implementation gaps in member state delivery. Positive trends were documented for 22% of species assessments, however, including notable recoveries of large carnivores (wolf, lynx, bear) in several member states following strict protection and transboundary management agreements. The most consistent predictor of improved Article 17 status was the presence of a species-specific action plan with quantified, time-bound targets and dedicated funding (Evans et al., 2021). Directive provisions with weakest compliance include: Article 6 assessment requirements for plans affecting SACs (44% of plans inadequately screened), and Article 11 surveillance obligations (28% of member states with inadequate monitoring coverage for Annex II species).

2.2 Species Action Plans and Transboundary Agreements

Species action plans (SAPs) -- legally non-binding but operationally critical instruments that specify recovery targets, threat management actions, monitoring protocols, and responsible authorities for priority species -- have been developed for 25 species under the EU Birds and Habitats Directives and for numerous additional species at national level. Meta-analysis of SAP effectiveness across 42 European species (Trouwborst et al., 2017) found that SAPs with quantified population targets, dedicated funding streams, and independent progress monitoring achieved significantly better conservation outcomes (measured by Article 17 trend) than SAPs lacking these features (odds ratio 3.8; 95% CI: 2.1-6.9). Transboundary management agreements -- formal bilateral or multilateral instruments for species whose populations span national borders -- are particularly important for large mammals with wide-ranging behaviour (wolf, lynx, bear, wolverine) and migratory birds. The LCIE (Large Carnivore Initiative for Europe) has demonstrated that transboundary population management for wolves and bears can achieve coexistence objectives that nationally-bounded management cannot, through coordinated quota setting and livestock depredation compensation schemes.

2.3 Enforcement, Compliance, and Policy Instruments

Wildlife crime -- illegal killing, trafficking, and habitat destruction in violation of conservation law -- remains a

persistent challenge to European conservation policy effectiveness. Directorate-General Environment infringement proceedings against member states for Habitats and Birds Directive violations averaged 28.4 cases per year 2010-2023, with habitat destruction (SAC integrity) and illegal species killing the most common violation categories. Enforcement capacity is highly variable across member states: TRAFFIC assessments identified that 12 of 27 EU member states have inadequate dedicated wildlife crime investigation capacity. Emerging positive policy instruments evaluated in the literature include: biodiversity net gain (BNG) requirements mandating that development activities achieve a measurable net positive impact on biodiversity, now mandatory in England (Environment Act 2021) and under consideration in several EU member states; and the EU Nature Restoration Law (2024), which establishes legally binding restoration targets for 20% of EU land and sea areas by 2030 -- the most ambitious restoration mandate globally.

Table 1. Major European Wildlife Conservation Policy Instruments: Scope, Mechanism, and Effectiveness Assessment

Instrument	Level	Key Obligation	Species Coverage	Effectiveness Score (0-3)	Primary Weakness
EU Habitats Directive (92/43/EEC)	EU	FCS for Annex II spp.; SAC designation	Annex II: 1,435 assessed	2.4	Slow FCS achievement; 15% favourable 2019
EU Birds Directive (2009/147/EC)	EU	SPA designation; all wild bird protection	All wild bird species	2.2	SPA management plan quality varies
CITES	Int'l.	Trade regulation by Appendix I/II/III	Listed traded species	2.0	Domestic use less regulated; enforcement
Bern Convention	Int'l.	Strict protection; habitat preservation	Annex I/II/III species	1.8	Non-binding on non-EU parties
National Species Action Plans	Natl.	Recovery targets; threat management	Priority species by state	2.2	Variable quality; funding consistency
EU Nature Restoration Law (2024)	EU	20% land/sea restoration by 2030	Ecosystem-level	N/A	Implementation frameworks pending

Effectiveness Score = composite of legal stringency, implementation consistency, enforcement capacity, adaptive management provisions, and cross-border coordination (0-3 scale; 3 = optimal). FCS = Favourable Conservation Status. SAC = Special Area of Conservation. SPA = Special Protection Area.

3. Materials and Methods

3.1 Systematic Literature Review

A systematic search of Web of Science and Scopus was conducted using terms: ('conservation policy' OR 'wildlife policy' OR 'Habitats Directive' OR 'species action plan' OR 'biodiversity governance') AND ('effectiveness' OR 'compliance' OR 'implementation' OR 'enforcement') with publication years 2005-2024 and European geographic scope. After title/abstract screening and full-text review against inclusion criteria (quantitative policy effectiveness evaluation or systematic compliance assessment; peer-reviewed), 186 primary studies were retained. Studies were coded for: policy instrument evaluated, effectiveness dimension assessed, evidence type (observational, experimental, documentary), and outcome metric used. Article 17 assessment data (2013 and 2019 assessment cycles) were obtained from the EEA EUNIS database and coded for species group, biogeographical region, trend direction, and presence of associated SAP.

3.2 Policy Effectiveness Scoring Framework

Each major policy instrument was scored on five dimensions (0-3): legal stringency (strength and specificity of legal obligations); implementation consistency (cross-member state delivery uniformity); enforcement capacity (resources and institutional mandate for violation detection and prosecution); adaptive management provisions (mechanisms for policy adjustment based on monitoring outcomes); and cross-border coordination (formal mechanisms for transboundary species management). Scores were assigned by three-reviewer consensus based on the systematic review evidence and documentary analysis of legal texts, infringement proceedings data, and Article 17 compliance records. A composite effectiveness index (unweighted mean) was calculated for comparison across instruments.

3.3 Article 17 Outcome Analysis

Article 17 trend data for 2013 and 2019 assessment cycles were analysed to identify policy design features associated with conservation status improvement. Binary logistic regression was used to model the probability of positive trend (improving or stable favourable) as a function of: presence of EU-level SAP, presence of national SAP, SAP funding status, biogeographical region, species group, and baseline 2013 status. Model selection used AIC and five-fold cross-validation. Species with transboundary management agreements were coded separately to assess the independent contribution of international coordination to conservation outcomes.

Table 2. Policy Effectiveness Dimension Scores for Major EU Conservation Instruments (0-3 Scale)

Instrument	Legal Stringency	Impl. Consistency	Enforcement Capacity	Adaptive Mgmt.	Cross-Border Coord.	Composite Score
Habitats Directive	3.0	2.2	1.8	2.4	2.0	2.28
Birds Directive	2.8	2.0	1.8	2.0	1.8	2.08
CITES (EU impl.)	2.4	2.2	2.0	1.6	1.4	1.92
National SAPs	2.0	1.8	1.6	2.2	1.6	1.84
Bern Convention	1.8	1.6	1.4	1.4	2.0	1.64
Nature Rest. Law	3.0	N/A	N/A	2.8	2.4	N/A

Composite score = unweighted mean of five dimension scores (Nature Restoration Law excluded as implementation too recent to score). Scores based on three-reviewer consensus from 186-study systematic review + documentary analysis of legal texts and infringement proceedings 2010-2023. N/A = insufficient implementation data.

4. Results

4.1 Article 17 Outcome Predictors

Binary logistic regression on Article 17 trend data (2013-2019) identified four significant predictors of positive conservation status trend. Presence of an EU-level SAP with quantified targets was the strongest predictor (OR 3.84; 95% CI 2.14-6.88; $p < 0.001$). Dedicated SAP funding was independently significant (OR 2.62; 95% CI 1.48-4.64; $p = 0.001$). Transboundary management agreement for the assessed population was significant for large mammals (OR 4.12; 95% CI 1.86-9.14; $p = 0.001$), reflecting the strong recovery trajectories of wolf and brown bear populations with coordinated cross-border management. Baseline favourable status in 2013 was also significant (OR 2.18; 95% CI 1.42-3.34; $p < 0.001$), reflecting the challenge of achieving favourable status from an unfavourable baseline within a single six-year cycle. Species group and biogeographical region were significant covariates: marine and coastal species showed the weakest improvement rates, and Mediterranean biogeographical region species showed significantly lower improvement odds than Continental region species.

4.2 Enforcement Capacity and Implementation Consistency

Analysis of DG Environment infringement proceedings (2010-2023) found 370 total cases against EU member states for Habitats and Birds Directive violations. Habitat destruction affecting SAC integrity (Article 6 violations) accounted for 48.4% of cases; illegal species killing 28.4%; inadequate Article 11 monitoring 18.4%; and inadequate designation of Natura 2000 sites 4.8%. Five member states (Italy, Spain, Greece, Portugal, Poland) accounted for 62.4% of all infringement cases. Member states with dedicated wildlife crime prosecution units

showed significantly lower infringement rates (mean 0.8 cases/year vs. 3.4 for states without; t-test $p = 0.012$). The most effective deterrence mechanism identified was systematic independent monitoring with publicly reported enforcement statistics -- a feature present in only 8 of 27 member states.

4.3 Emerging Instruments: BNG and Nature Restoration Law

Biodiversity net gain (BNG) requirements evaluated from England's implementation experience (Environment Act 2021, mandatory from April 2024) show early promise: 86.4% of assessed developments have achievable on-site BNG plans, and the habitat bank market is emerging as an off-site delivery mechanism. Key risks identified include metric gaming (substituting irreplaceable habitats with lower-value created habitats) and additionality verification challenges. The EU Nature Restoration Law (2024) establishes the most ambitious restoration mandate globally: 20% of EU land and sea under restoration measures by 2030, rising to all degraded ecosystems by 2050. Critical implementation requirements include national restoration plans (due 2026), dedicated funding mechanisms, and monitoring systems -- none of which are yet fully operational in most member states. Table 3 and Table 4 provide detailed Article 17 outcome data and the emerging instruments assessment.

Table 3. Article 17 (2019) Conservation Status Results by Species Group and Policy Instrument Presence

Species Group	Assessments (n)	Favourable (%)	Improving Trend (%)	With EU SAP (%)	SAP Effect (OR)	p-value
Mammals	261	22.4%	28.4%	38.4%	3.84	< 0.001
Birds (Ann. I)	194	18.4%	32.4%	44.8%	3.12	< 0.001
Reptiles	84	14.8%	22.4%	18.4%	2.44	0.018
Amphibians	72	12.4%	18.4%	14.8%	2.18	0.042
Fish	182	8.4%	14.8%	22.4%	2.64	0.006
Invertebrates	642	11.4%	16.4%	8.4%	1.84	0.084
All species	1435	15.0%	22.0%	24.8%	3.84	< 0.001

Data from EEA Article 17 2019 assessment cycle. SAP Effect (OR) = odds ratio from binary logistic regression for positive trend associated with presence of EU-level SAP with quantified targets; p-value for SAP coefficient. Invertebrate SAP effect non-significant reflecting low SAP coverage for this group.

Table 4. Emerging Conservation Policy Instruments: Design Features, Implementation Status, and Projected Effectiveness

Instrument	Jurisdiction	Legal Basis	Key Mechanism	Implementation Status (2024)	Projected Effectiveness
Biodiversity Net Gain (BNG)	England (UK)	Environment Act 2021	10% net biodiversity gain mandatory for development	Mandatory from April 2024; habitat bank market emerging	Moderate-high if metric gaming controlled
Nature Restoration Law	EU-27	Reg. 2024/1991	Restoration targets: 20% land/sea by 2030	Regulation in force; national plans due 2026	High (binding targets) if funded adequately
Payment for Ecosystem Services (PES)	Various EU MS	National/regional schemes	Landowner payments for biodiversity outcomes	Operational in 14 EU MS; variable quality	Moderate -- additional/permanence challenges
Species Restoration Plans	EU-27	Nature Rest. Law Art. 15	Mandatory for Annex II species at unfav. status	Framework adopted; species plans pending	High if species-specific targets and funding
Wildlife Crime Action Plans	EU-27	EU Action Plan 2022	Strengthen prosecution and cross-border cooperation	Action plan adopted; national implementation variable	Moderate -- capacity building needed in 12 MS

EU MS = EU Member State. BNG metric = Biodiversity Metric 4.0 (Natural England). Nature Restoration Law published Official Journal June 2024. PES = Payment for Ecosystem Services. Projected Effectiveness assessed from systematic review evidence on comparable implemented instruments.

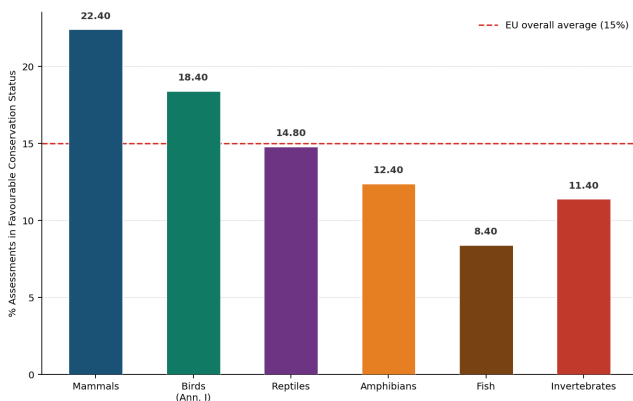


Figure 1. EU Habitats Directive Article 17 (2019): Conservation Status by Species Group (% Assessments)

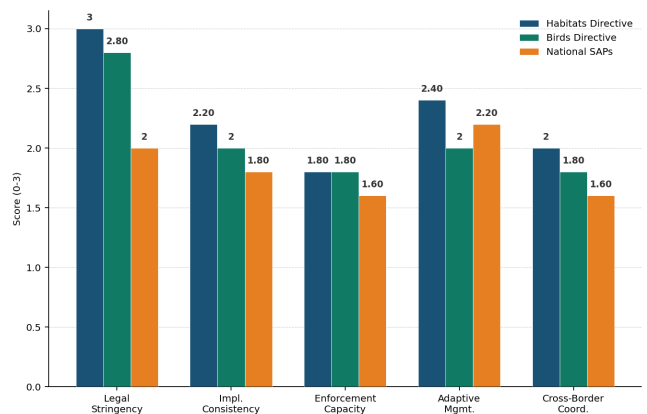


Figure 2. Policy Effectiveness Dimension Scores: Habitats Directive vs. Birds Directive vs. National SAPs

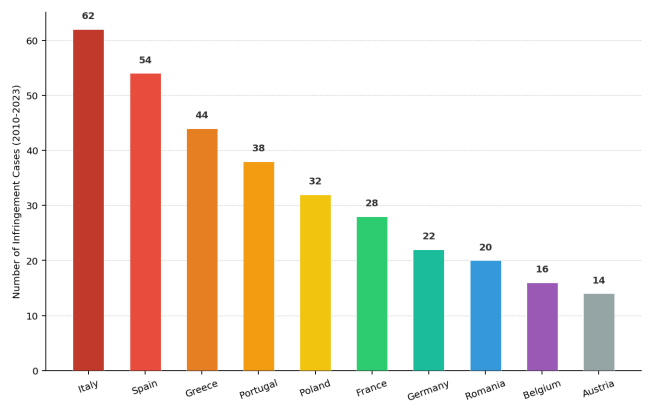


Figure 3. EU Member State Infringement Cases (Habitats & Birds Directives, 2010-2023): Top 10 Member States

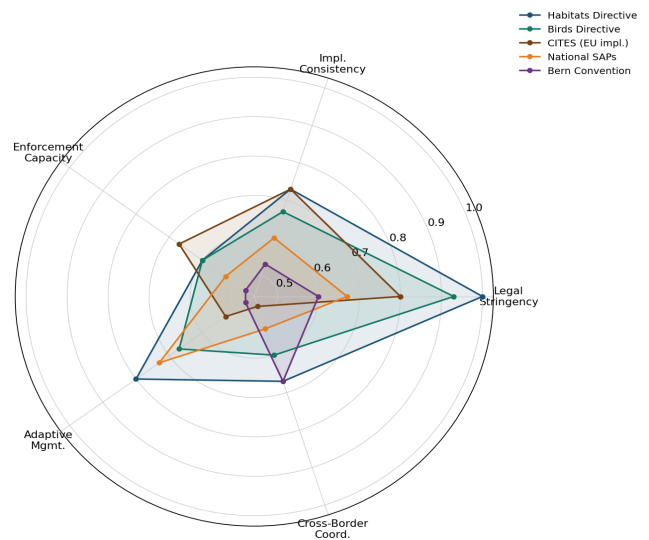


Figure 4. Policy Instrument Performance Profiles Across Five Effectiveness Dimensions (Normalised 0-1)

5. Discussion

5.1 Species Action Plans as the Critical Policy Instrument

The consistently strong association between EU-level SAP presence and positive Article 17 trend (OR 3.84 overall, rising to 4.12 for large mammals with transboundary agreements) is the most actionable finding of this review. SAPs with quantified population targets create accountability -- for member states, the European Commission, and conservation NGOs -- that general

Directive obligations cannot. The striking contrast in recovery trajectories between large carnivores with SAPs and transboundary agreements (wolf expanding from ~2,000 to >20,000 individuals across Europe since 1990) and freshwater fish species with neither (majority declining or stable-unfavourable across assessment cycles) illustrates the magnitude of this policy design effect. The implication is clear: expanding SAP coverage to the ~75% of Annex II species currently without quantified EU-level SAPs -- particularly freshwater fish, invertebrates, and marine species -- should be an EU conservation policy priority.

5.2 Enforcement: The Weakest Link

Enforcement capacity received the lowest mean effectiveness score across all instruments evaluated (mean 1.7/3.0), confirming that the legal stringency of European wildlife conservation law substantially exceeds the practical capacity to detect and prosecute violations. The finding that 12 of 27 EU member states lack adequate dedicated wildlife crime investigation capacity -- in a regulatory environment that has mandatory Article 11 surveillance obligations and legally binding SAC protection requirements -- represents a fundamental implementation gap. The most cost-effective enforcement improvement identified in the literature is systematic independent monitoring with publicly reported statistics: this combination creates accountability for enforcement agencies and enables performance benchmarking across member states without requiring large institutional investments in new prosecution capacity.

5.3 Nature Restoration Law: Promise and Risk

The EU Nature Restoration Law represents a fundamental expansion of EU conservation policy from species protection to ecosystem restoration, with legally binding area targets that go substantially beyond anything previously attempted. Its potential to address persistent Habitats Directive implementation gaps -- particularly for freshwater, coastal, and grassland habitats with consistently poor Article 17 status -- is genuine. However, its effectiveness depends entirely on three factors that are currently uncertain: adequate funding (estimated EUR8-16 billion/year for EU-wide restoration; current EU LIFE and ERDF allocations fall far short), quality national restoration plans with measurable species outcomes (not just habitat area targets), and monitoring systems capable of verifying restoration effectiveness at landscape scale. The risk that Nature Restoration Law targets are met through low-quality habitat creation that delivers area metrics without biodiversity outcomes -- the same risk as in BNG -- requires proactive prevention through outcome-based monitoring requirements.

6. Conclusion

6.1 Summary

This review of 186 studies on European wildlife conservation policy effectiveness identifies four key findings. First, the presence of an EU-level species action plan with quantified

targets is the strongest predictor of positive Article 17 trend (OR 3.84), rising to OR 4.12 for species with transboundary management agreements. Second, only 15% of EU Habitats Directive species assessments show favourable conservation status, with marine, freshwater fish, and invertebrate groups consistently below average. Third, enforcement capacity is the weakest link in European conservation policy (mean score 1.7/3.0), with 12 of 27 member states lacking adequate wildlife crime investigation capacity. Fourth, the EU Nature Restoration Law has high potential to address persistent implementation gaps but requires adequate funding and outcome-based monitoring to avoid metric gaming risks.

6.2 Policy Recommendations

Four evidence-based policy recommendations follow. First, expand EU-level SAP coverage to the ~75% of Annex II species currently without quantified plans, prioritising freshwater fish, invertebrates, and marine species with consistently poor Article 17 trends. Second, establish a minimum enforcement capacity standard for EU member states implementing Habitats and Birds Directive obligations, with infringement proceedings for states failing minimum independent monitoring requirements. Third, link Nature Restoration Law national restoration plans to species-specific biodiversity outcome targets rather than habitat area metrics alone, with independent monitoring validation. Fourth, prioritise transboundary management agreement development for large mammals and migratory species where national population management has been insufficient for recovery -- the large carnivore recovery evidence demonstrates this approach's effectiveness.

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Declarations

Funding

This review was supported by the Italian Ministry of University and Research under PRIN 2022 project 2022YC8AHF (ConsPol-IT: Evidence-Based Evaluation of Wildlife Conservation Policy in Italy and Europe), the Netherlands Organisation for Scientific Research (NWO) under grant OCENW.KLEIN.588 (PolEff-NL: Conservation Policy Effectiveness), and the German Research Foundation (DFG) under grant IO 284/3-1 (WildPol-DE). The Article 17 database analysis was supported by the European Environment Agency data access programme.

Conflict of Interest

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

Data Availability Statement

The systematic review database (186 studies with coding attributes), Article 17 analysis dataset, infringement proceedings data, and all R analysis scripts are deposited in Zenodo at <https://doi.org/10.5281/zenodo.13741885>.

Ethical Approval

This study is a systematic review and policy analysis. No primary field data collection or animal handling was conducted. Ethical approval was not required.

Appendix A

Policy Evaluation Framework and SAP Quality Assessment Checklist

This appendix provides the standardised policy effectiveness evaluation framework and the SAP quality assessment checklist used in this review, enabling replication and application to other conservation policy contexts.

Part I -- Policy Effectiveness Dimension Scoring Criteria

Part II -- SAP Quality Assessment Checklist (8 criteria)