Information sheet

Reducing zoonotic risk through nature restoration

This Policy Brief is part of a series aiming to inform policymakers involved in the implementation of the EU Nature Restoration Regulation (NRR) with science-based policy recommendations building on the expertise of the BiodivRestore Knowledge Hub members. This brief may also support any stakeholders involved in the implementation of the NRR.

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The BiodivRestore Knowledge Hub

In October 2020, BiodivERsA and Water JPI launched the BiodivRestore ERANET COFUND to support research on conservation and restoration of degraded ecosystems and their biodiversity, including a focus on aquatic systems, co-funded by the European Commission under Horizon 2020. Building on its success and the funding of 22 research projects, BiodivRestore partners established a pan-European Knowledge Hub on Nature Restoration.

The BiodivRestore Knowledge Hub (KH) was launched in May 2024 to strengthen the science–policy interface for the implementation of the EU Nature Restoration Regulation (NRR). Bringing together 50 experts across Europe, the KH provides a coordinated platform to synthesise knowledge, inform national restoration planning, and support evidence-based decision-making. Its activities are structured around two task forces focused on implementation and research & innovation.

Photos:

- Erik Karits on Unsplash
- Drosera74 on Pixabay

Footnotes

1. Regulation (EU) 2024/1991 of the European Parliament and of the Council of 24 June 2024 on nature restoration, and amending Regulation (EU) 2022/869.

2. **Box 1: A Context-Based Decision Pathway for Integrating Zoonotic Risk into Nature Restoration**

To ensure restoration strengthens both ecosystem resilience and public health, Member States can integrate zoonotic risk considerations into restoration planning through a proportionate, context-based decision pathway.

Step 1 – Initial ecosystem screening (ex-ante)

At the project design stage (NRR Articles 4–13), restoration plans should identify contextual factors that may influence disease dynamics:

- ecosystem type and restoration objectives (e.g. wetland, forest, agroecosystem, river restoration)
- land-use history and degree of ecological simplification or fragmentation
- presence of wildlife or livestock species that may act as reservoir hosts or support vectors
- proximity to settlements, livestock systems, or frequently visited natural areas (recreational uses)
- planned human uses and potential human–wildlife interface zones

Step 2 – Identify where targeted ecological and health considerations are needed (also applicable in contexts where restoration is already in progress)

Where restoration may modify species assemblages, vector habitats, or human–wildlife interfaces, additional considerations can be integrated into planning, including:

- assessing how restoration will alter species assemblages, particularly whether it increases ecological complexity and reduces dominance of highly competent reservoir hosts
- identifying vectors or reservoir hosts that could benefit from habitat changes
- evaluating how hydrology, vegetation structure, or connectivity may influence vector habitats (e.g. ticks or mosquitoes)
- considering how recreational access, agricultural use, or tourism may affect human exposure
- consulting relevant public health, veterinary, or wildlife authorities where appropriate

Step 3 – Apply proportionate monitoring and adaptive management (also applicable in contexts where restoration is already in progress)

Monitoring under NRR Articles 20–21 should integrate biodiversity indicators, species assemblage composition, and context-appropriate One Health indicators.

Monitoring should:

- document restoration progress and ecological recovery
- track changes in species assemblages, host populations, or vector presence where relevant
- identify early signals of ecological imbalance or zoonotic disease emergence (through vector/reservoir sampling)
- support adaptive management that is tailored to each ecosystem context, with clear objectives, defined responsibilities for monitoring, and agreed decision criteria or triggers for action. In practice, this is best supported by small, decision-relevant indicator sets that can be measured consistently over time rather than complex monitoring frameworks.

3. Checklists

Checklist 1: for context-based decision pathway for integrating zoonotic risk into wetland restoration (floodplains, peatlands)

✔	Objectives	Example
Step 1 – Initial ecosystem screening (ex ante)		
	Identify historical hydrology	In the wetlands of Camargue, restoration planning considered the historical presence of migratory birds and mosquito populations that can support West Nile virus transmission. Screening assessed hydrology, bird migration routes, and proximity to horse farms and villages.
	Assess proximity to presence of mosquito species or bird reservoirs	
	Assess proximity to settlements, livestock systems, or frequently visited natural areas (recreational uses)	
	Assess planned recreation or water management changes.	
Step 2 – Targeted ecological & health considerations		
	Evaluate whether water stagnation could favour mosquito breeding.	In Doñana National Park, wetland management included evaluation of water stagnation areas and bird–mosquito dynamics after West Nile outbreaks in surrounding provinces, guiding water-level management and vector surveillance planning.
	Consider water-level management, vegetation structure, and potential bird–vector dynamics.	
	Assess how recreational access, agricultural use, or tourism may affect human exposure.	
	Consult health authorities if the area is near settlements.	
Step 3 - Monitoring and adaptive management		
	Monitor mosquito presence, bird assemblages, and water conditions.	In the Danube Delta (MERLIN project), mosquito monitoring, bird surveillance, and human health data are periodically integrated to detect vector changes and guide wetland management where necessary.
	Adjust hydrological management if vector habitats expand.	
	Link with existing disease surveillance where relevant.	
	Adaptive management indicators : ecological (water level variability, vegetation structure, bird assemblage diversity)	
	Adaptive management indicators : vector/reservoir (Mosquito larval presence, abundance of waterfowl or other reservoir species)	
	Adaptive management indicators : human exposure (visitor numbers, proximity to settlements or livestock)	

Checklist 2: for context-based decision pathway for integrating zoonotic risk into forest restoration / rewilding

✔	Objectives	Example 1
	Step 1 – Initial ecosystem screening (ex ante)	
	Assess wildlife species expected to recolonise (e.g., deer, rodents)	In forest restoration areas of Bavarian Forest National Park, screening considered wildlife recolonisation (deer and rodents), forest fragmentation history, and recreational use relevant to tick-borne disease exposure.
	Identify land-use history	
	Assess proximity to recreational trails or settlements.	
	Step 2 – Targeted ecological & health considerations	
	Evaluate whether restoration could increase hosts that support tick cycles	In southern Sweden, forest and landscape management around Skåne County examined how deer abundance and habitat fragmentation influence tick populations associated with Lyme disease and other tick-borne pathogens.
	Evaluate whether restoration could increase hosts that support tick cycles	
	Assess how recreational access, or tourism may affect human exposure.	
	Consult health authorities if the area is near settlements.	
	Step 3 - Monitoring and adaptive management	
	Monitor tick presence and changes in wildlife community composition.	In Black Forest, monitoring programs track tick presence, wildlife populations, and visitor use patterns to guide forest management and public health communication.
	Adapt trail design, visitor information, or vegetation management where needed.	
	Adaptive management indicators : ecological (tree diversity, understory structure, wildlife species assemblage balance)	
	Adaptive management indicators : vector/reservoir (Tick presence or density; abundance of deer or small mammal hosts)	
	Adaptive management indicators : human exposure (Recreational trail density, frequency of human use)	

Checklist 3: for context-based decision pathway for integrating zoonotic risk into hedgerows and landscape mosaics

✓	Objectives	Example
Step 1 – Initial ecosystem screening (ex ante)		
	Identify agricultural practices, livestock presence, and fragmentation of habitats.	In farmland restoration initiatives across Brittany, screening for hedgerow restoration considered livestock density, rodent populations, and land-use fragmentation that may influence zoonotic reservoirs.
	Assess human activity and livestock–wildlife interfaces.	
Step 2 – Targeted ecological & health considerations		
	Consider how landscape connectivity and hedgerows influence small mammal or bird communities that may act as reservoirs.	In Lower Saxony, agricultural landscape planning has considered rodent population dynamics linked to Hantavirus outbreaks when modifying field margins and woodland edges.
	Evaluate implications for vector habitats in margins.	
Step 3 - Monitoring and adaptive management		
	Monitor changes in small mammal assemblages, vector presence, and biodiversity indicators.	In agro-ecological restoration areas of Flanders, biodiversity monitoring and rodent population observations are integrated with landscape management to maintain ecological balance and reduce host dominance.
	Adjust habitat design to strengthen ecological balance.	
	Adaptive management indicators : ecological (Landscape heterogeneity: hedgerows, field margins, biodiversity of small mammals and birds)	
	Adaptive management indicators : vector/reservoir (Abundance of rodent hosts; vector presence in field margins or pastures)	
	Adaptive management indicators : human exposure (Livestock–wildlife interface, farm worker exposure)	

Checklist 4: for context-based decision pathway for integrating zoonotic risk into Urban / peri-urban ecosystems

✔	Objectives	Example
Step 1 – Initial ecosystem screening (ex ante)		
	Identify land-use history	In green infrastructure planning in Barcelona, urban restoration projects screened for mosquito habitats in water features and proximity to densely populated areas.
	Assess proximity to residential areas, and existing wildlife populations.	
	Assess visitor density	
Step 2 – Targeted ecological & health considerations		
	Consider how increased habitat complexity may influence rodent or bird populations and human exposure.	In Rome, management of urban wetlands and parks has considered mosquito breeding habitats due to circulation of West Nile virus in the region.
	Plan visitor access, waste management, and habitat design accordingly.	
Step 3 - Monitoring and adaptive management		
	Monitor wildlife populations and human–wildlife contact zones.	In peri-urban forests around Vienna, wildlife monitoring and tick surveillance are combined with public awareness measures to manage exposure risks in heavily visited natural areas.
	Integrate findings into adaptive park management and public awareness.	
	Adaptive management indicators : ecological (Habitat diversity in green spaces, bird and small mammal assemblages)	
	Adaptive management indicators : vector/reservoir (Urban rodent abundance; mosquito breeding sites)	
	Adaptive management indicators : human exposure (Human–wildlife contact zones, park visitation rates)	

4. **Box 2:** Links to NRR articles

Following are some examples of restoration measures for NRR articles which contribute to reduce zoonosis risks by acting on ecological complexity.

Forests (Articles 12 and 13)

- Prioritise **structurally, functionally and species-diverse forests** (example **Rodent Hosts & Tick-Borne Diseases – Central & Northern Europe**) over monocultures to enhance dilution effects and reduce dominance of rodent reservoir species.
- Integrate predator and competitor species recovery as part of forest restoration success criteria.
- Restoring habitat structures inside forests (for example by providing bat boxes or artificial nests for birds and hazel dormouse) and improving social acceptance for predators, especially specialists.

Wetlands (Articles 4 and 9)

- Restore wetlands (Example Camargue or Danube) with **heterogeneous vegetation and hydrological regimes** to create diverse niches for predators and avoid simplified habitats that favor mosquito proliferation.
- Monitor changes in **vector abundance and host diversity** alongside ecological indicators to capture health co-benefits and risks.

Urban and peri -urban ecosystems (Article 8)

- Ensure that restoration buffers and green infrastructures reduce, rather than intensify, **human–wildlife and human–vector contact**. Example: Emscher Industrial Park in Germany.
- Avoid fragmented green spaces that may increase human exposure to rodents or mosquitoes without sufficient ecological regulation.

Agricultural and semi- natural mosaics (Articles 10 and 11)

- Use restoration to **increase landscape connectivity and structural and functional diversity**, reducing reservoir dominance in mixed-use landscapes. Example **Hantavirus – Balkans & Northern Europe.**
- Align restoration incentives with land-management practices that support biodiversity-driven disease regulation and prevent rodents from thriving on farms (e.g. reducing the availability of and the access to food and shelters in and around farm buildings).

For NRPs (Articles 14–19)

- Identify landscapes where **assembly simplification** is currently high.
- Prioritise sites where **connectivity restoration** will increase species diversity fastest.
- Include into monitoring frameworks **species dominance metrics** when possible, not only species richness but also embedding **disease-relevant indicators** (host diversity, dominance, interface zones), particularly where endemic risks exist.
- Strengthen coordination between **environment, forestry, agriculture, and health authorities**, particularly in endemic regions.
- Consider zoonotic risks in ex- ante **assessments.**

For monitoring (Articles 20–21):

Track :

- Species assemblage composition
- Functional diversity
- Structural diversity
- Dominance indices
- Predator – Prey relationships
- Community turnover over time

5. Table 1 : indicators for zoonotic risk monitoring

Indicator category	Indicator type	Examples of measurable indicators	Primary data sources / use
Vector indicators	Presence & abundance	Seasonal abundance and spatial distribution of mosquitoes or ticks; expansion into new areas	National entomological monitoring; European Center for Disease Prevention and Control (ECDC) seasonal risk maps
	Habitat suitability	Extent of standing water, soil moisture, vegetation density, shading, microclimate conditions created by restoration	Environmental monitoring; remote sensing; restoration project data
	Seasonal dynamics	Length of vector-active season; timing of population peaks	National surveillance; ECDC bulletins

Indicator category	Indicator type	Examples of measurable indicators	Primary data sources / use
	Pathogen circulation (where available)	Detection of arboviruses or other pathogens in vectors	National public health and veterinary surveillance
Reservoir host and species assemblage indicators	Host abundance & dominance	Relative abundance of known reservoir hosts (e.g., rodents, birds) compared with non-competent hosts	Wildlife monitoring programs; biodiversity surveys
	Host diversity (dilution effect)	Species richness and functional diversity within host assemblages	Biodiversity monitoring under NRR
	Community composition change	Shifts in wildlife assemblages following restoration (e.g., dominance of synanthropic species)	biodiversity monitoring
	Invasive or synanthropic species	Presence or increase of invasive or human-associated species linked to disease risk	National biodiversity and invasive species databases
Human exposure indicators	Interface proximity	Distance and overlap between restored areas and settlements, agriculture, or recreation zones	Land-use and spatial planning data
	Edge habitats	Edge density / edge length, Edge-to-core habitat ratio	Copernicus Land Monitoring Service CORINE Land Cover
	Contact opportunity proxies	Increased human access, recreation, or occupational exposure in restored landscapes	Local authority data; land-use planning
	Vector – human overlap	Co-occurrence of high vector abundance and human activity zones	Integrated spatial analysis (environment + health data)
	Disease occurrence (contextual)	Trends in reported zoonotic or vector-borne disease cases (where appropriate)	National health surveillance; ECDC reports
	Disease occurrence (contextual)	Epidemiological maps and models related to restoration projects	National health surveillance and NRR authorities