Ecosystems in the mitigation hierarchy

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Summary

- Alongside species and their habitats, ecosystems are important units of biodiversity to which the mitigation hierarchy should be applied.
- It is important to seek information about the types of ecosystems that are present at a project site, and their condition and risk status.
- Global standards for classifying and assessing ecosystems can help inform consistent and reliable application of the mitigation hierarchy to ecosystems.
- The mitigation hierarchy should be applied to reduce impacts on all ecosystems, but it is particularly important to avoid and minimise impacts on threatened ecosystem types and areas of high integrity.
- Applying the mitigation hierarchy to ecosystems can help developers, financiers, and decision-makers achieve national and international biodiversity goals.

INTERNATIONAL UNION FOR CONSERVATION OF NATURE

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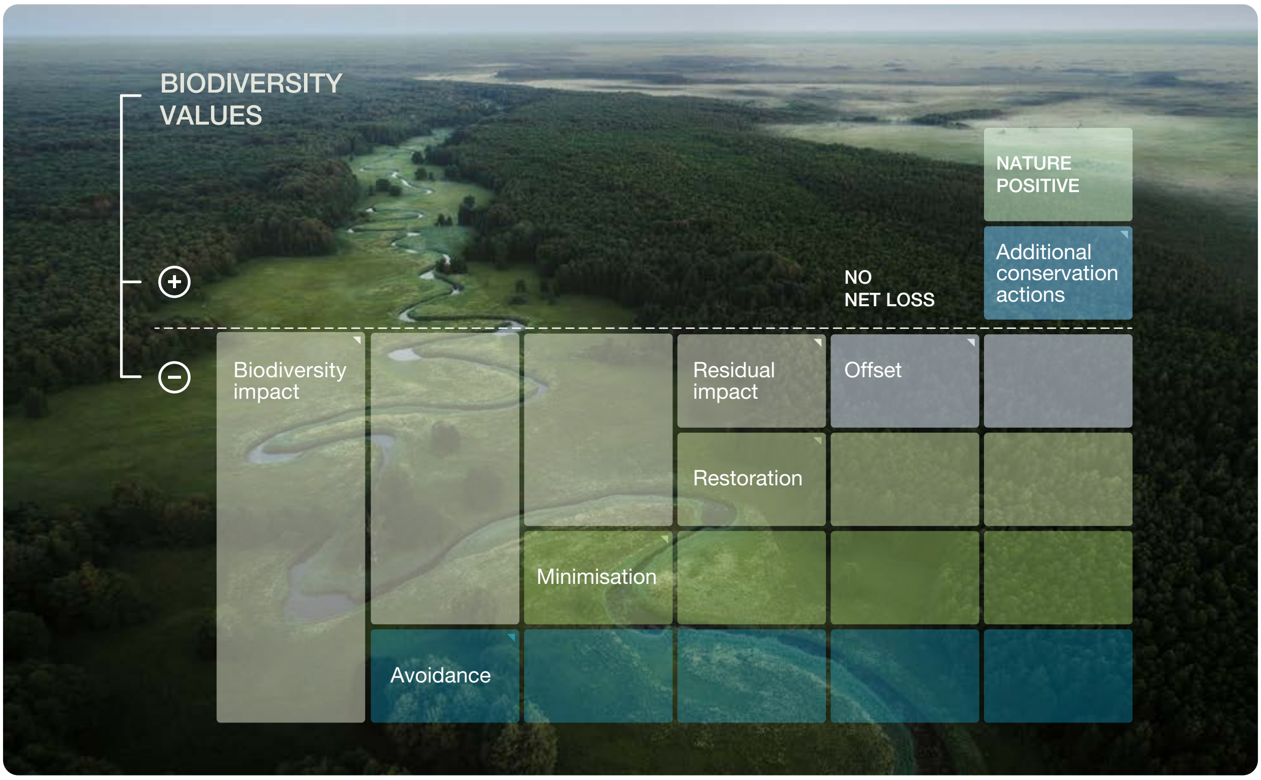


The **mitigation hierarchy** is a framework used to anticipate and address impacts to biodiversity in the context of a development project, like a mine, road, or commercial plantation. It is usually applied as part of an Environmental and Social Impact Assessment (ESIA) or Strategic Environmental Assessment (SEA). The mitigation hierarchy can also be applied to value chains, but this policy brief only considers application to projects.

The mitigation hierarchy intends first to avoid, to the greatest extent possible, predicted impacts on biodiversity, then to minimise losses that could not be avoided, and place damaged areas under restoration. Biodiversity offsets are the last resort in the mitigation hierarchy, to counterbalance any residual losses that remain. The goal of the mitigation hierarchy is to achieve no net loss or a net gain of biodiversity.

Robust application of the mitigation hierarchy requires information about the affected biodiversity components, especially ecosystems and species. **Ecosystem data** can be an important input to use when applying the mitigation hierarchy, and can complement information on species. Ecosystem types are well suited as units to assess impact, design mitigation measures, prioritise restoration and calculate offsets. They can be mapped consistently across a jurisdiction or project area of influence, allowing for full coverage across the development footprint and comparative evaluation of impact. They can be a good surrogate for other biodiversity patterns, although consideration of the requirements of key species is also necessary.

International standards (see next page) offer consistent methods to classify, map and assess ecosystems. Using accepted standards when applying the mitigation hierarchy to ecosystem types will mean that project funders and development decision-makers can easily understand, compare and have confidence in the information. The international standards also link directly to other global imperatives, like the Kunming-Montreal Global Biodiversity Framework, the identification of Key Biodiversity Areas, ecosystem accounting within the System of Environmental-Economic Accounting and nature-related disclosure frameworks like the Task Force for Nature-related Disclosure.

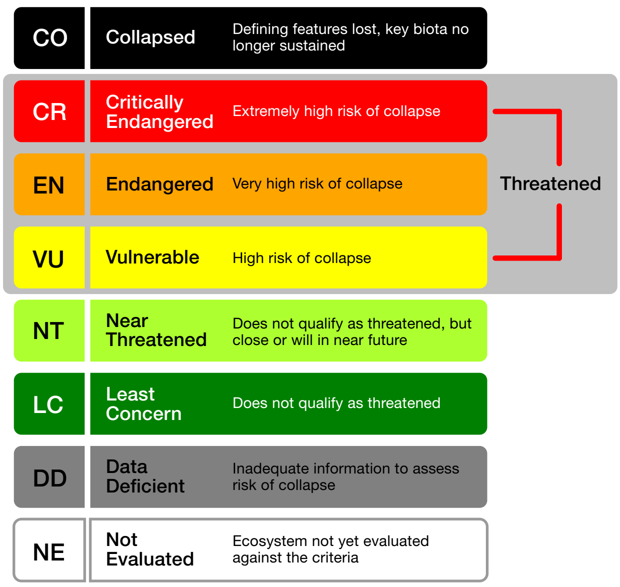
Ecosystem data

To apply the mitigation hierarchy to ecosystems, it is important to know:

- What ecosystem types are present at the site?
- What is the distribution of ecosystems that occur at the site?
- What is the risk status of ecosystems at the site?
- What is the condition of ecosystems at the site?

A **map of ecosystem types** is central to understanding the ecosystems that are present at a development site. Defining and classifying ecosystem types is a first step. Ecosystem types are differentiated from one another by a degree of uniqueness in composition, structure and function. The **IUCN Global Ecosystem Typology** provides a consistent system for classifying ecosystem types. For use in the mitigation hierarchy, national (level 5) or sub-national (level 6) ecosystem types offer the specificity needed to assess impacts. These can be cross-referenced to the Ecosystem Functional Groups (level 3) for comparisons, cross learning, and alignment with global reporting.

Once an ecosystem classification is in place, ecosystems need to be spatially mapped. The ecosystem map must be fit for use in the mitigation hierarchy. It should align with the concept of ecosystems as functional units, rather than using land-use or land cover classes directly. Ecosystems should be mapped at the finest scale available to be accurate at specific project sites. Scale refers to spatial resolution of the map (how finely mapped each ecosystem boundary is) but also to the scale of ecosystem typology used (how ecosystem types are grouped). Some countries already have national maps of ecosystem types (for example, South Africa, Mozambique, Finland and Colombia). Others can draw on global and regional datasets as a starting point. Global maps will almost certainly require refinement by local experts so that they can be used at the scales needed for the mitigation hierarchy.



Ecosystem risk status is a vital input towards the mitigation hierarchy because stronger mitigation measures can be applied towards ecosystems that are at greater risk. The **IUCN Red List of Ecosystems** is a global standard for assessing ecosystem risk of collapse. It uses five criteria – related to change in ecosystem area, restricted distribution, and degradation – to assign ecosystems to risk categories. The categories can be used across the mitigation hierarchy to evaluate impacts and design mitigation measures. A Red List of Ecosystems assessment also includes a synthesis of information about the ecosystem, like a description, conceptual model, map, and condition indicators. Condition is particularly useful for identifying alternative sites (sites already in poor condition) and considering options for restoration or offsets. The current remaining extent of threatened ecosystems in good condition are most important places in which to mitigate for impacts.

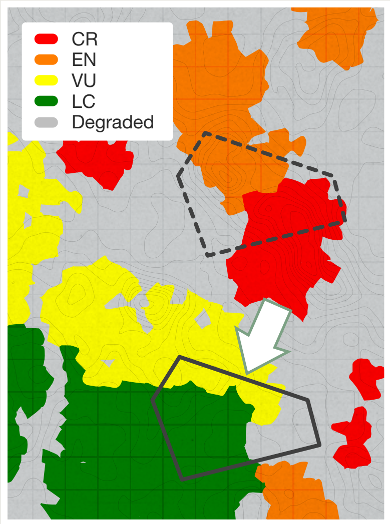
Field verification

It is important to be aware of the shortcomings of an ecosystem map and to therefore validate the map in the field. Project design and planning often takes place remotely, and an ecosystem map can be used to quickly assess the potential impacts (screening). However, to design other kinds of mitigation measures it will always be necessary to validate the type and condition of ecosystems through field work. Field work is needed to check the type of ecosystems present at the site, identify mapping discrepancies, confirm the condition of the ecosystems, and consider suitable options for restoration and offsets.

Using ecosystems in the mitigation hierarchy

Different legal obligations apply to each country or territory. It is useful for countries to integrate ecosystems into their mitigation policies. Similarly, businesses with a voluntary commitment towards no net loss or nature positive should consider ecosystems in their planning and decisions. Each step of the mitigation hierarchy must be followed in order, with sufficient attention paid to each step: first avoid, then minimise, then restore, and finally consider biodiversity offsets.

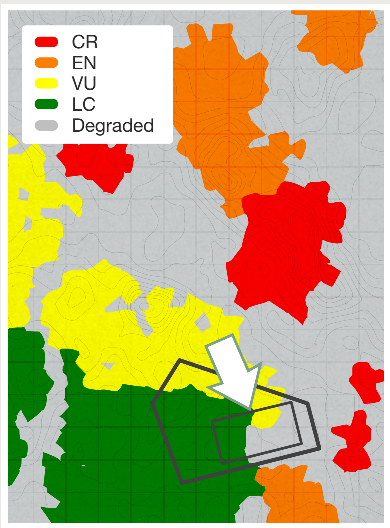
1 **Avoid** includes measures taken to avoid creating impacts from the outset, such as careful location of the project site to completely avoid impacts on certain components of biodiversity.



Avoidance is the first and most important step in the mitigation hierarchy. Ecosystem maps are very useful at these early stages. The Red List of Ecosystems provides information on the risk status and condition of ecosystems. These can be used in project design to select sites that avoid impacts on remaining areas of threatened ecosystems (Critically Endangered, Endangered or Vulnerable). Activities can be located and planned to instead impact areas that are already degraded and have low recovery potential. The highest integrity sites within any ecosystem type (such as old growth forest or free flowing rivers) should be avoided.

← In this hypothetical example, an alternative project site in a different location avoids impacts to remaining portions of threatened ecosystem types.

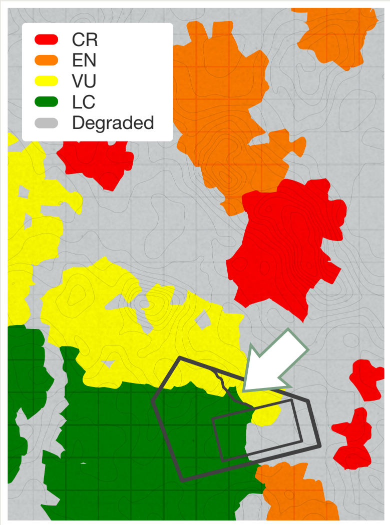
2 **Minimise** includes measures taken to reduce the duration, intensity or extent of impacts that cannot be completely avoided, as far as is practically feasible



Minimising impacts involves considering how the project can be designed to reduce the impacts on biodiversity. For ecosystems, priority must be given to minimise impacts on ecosystem functions, like hydrological flows, sediment balance, or nutrient cycling. The Red List of Ecosystems provides a conceptual model that gives the abiotic and biotic components of the ecosystem. It can be used to identify the essential functions that may be affected.

← In this hypothetical example, the primary infrastructure is placed within an area of the project site that is already largely degraded and has low recovery potential.

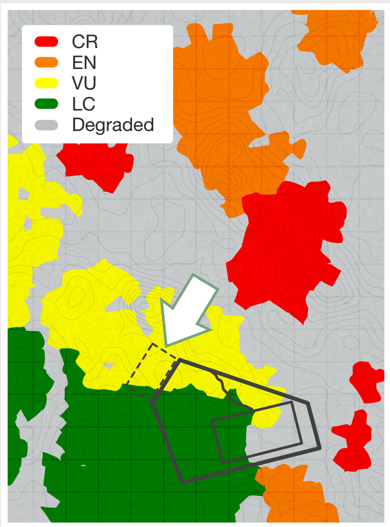
3 **Restore** includes measures taken to improve the condition of degraded or collapsed areas of ecosystems following exposure to impacts that cannot be avoided or minimised.



Restoration involves restoring ecosystems after they have been impacted. Maps and indicators of ecosystem condition are needed to understand what the pre-development condition of an ecosystem was and how it may be restored following the development impact. Information on the abiotic and biotic components of high integrity ecosystems can provide a benchmark reference condition and inform a pathway to ecosystem recovery. Importantly, full ecosystem recovery is difficult to achieve, and some ecosystems can be harder to restore than others.

← In this hypothetical example, the impact of a construction access road on a Vulnerable ecosystem type can be put under restoration after construction.

4 **Offsets** are measures taken to compensate for any residual significant, adverse impacts that cannot be avoided, minimised or restored.



Ecosystem maps can inform the identification of offset areas, searching for application of the like-for-like principle. Like-for-like means that potential offset areas should be of the same ecosystem type at level 5 or 6 of the Global Ecosystem Typology, with equivalent integrity to the ecosystems as they were before being impacted. Ecosystem maps and condition assessments can be used to identify offset receiving sites, such as alternative parts of the ecosystem type that could be protected elsewhere, or degraded areas that could be placed under effective restoration. Field verification of ecosystem type and condition is always essential, as well as understanding of restoration potential. Offsets should be designed at the landscape level, and can be used to improve connectivity that was lost due to the development.

← In this hypothetical example, the primary infrastructure is placed within an area of the project site that is already largely degraded and has low recovery potential.

The **IUCN Policy on biodiversity offsets** provides a guide to the design, implementation and governance of biodiversity offset schemes and projects.

References and useful information

Keith et al. (2022) A function-based typology for Earth's ecosystems. Nature 610, 513–518. https://doi.org/10.1038/s41586-022-05318-4

IUCN (2024). Guidelines for the application of IUCN Red List of Ecosystems Categories and Criteria, Version 2.0. Keith et al. (eds.). Gland, Switzerland: IUCN. https://doi.org/10.2305/CJDF9122

IUCN (2016) IUCN Policy on Biodiversity Offsets. Gland, Switzerland: IUCN. https://iucn.org/resources/file/iucn-policy-biodiversity-offsets

Valderrábano et al. (2021). Using ecosystem risk assessment science in ecosystem restoration: A guide to applying the Red List of Ecosystems to ecosystem restoration. Gland, Switzerland: IUCN. https://doi.org/10.2305/IUCN.CH.2021.19.en

Eyre et al. (2015). BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual. Version 2.2. Queensland Herbarium, Department of Science, Information Technology, Innovation and Arts, Brisbane.

Gorrod & Keith (2009). Observer variation in field assessments of vegetation condition: Implications for biodiversity conservation. Ecological Management & Restoration 10(1), 31-40. https://doi.org/10.1111/j.1442-8903.2009.00437.x

Mayfield et al. (2022). Guidelines for selecting an appropriate currency in biodiversity offset transactions. Journal of Environmental Management 322, p.116060. https://doi.org/10.1016/j.jenvman.2022.116060

McNellie et al. (2020). Reference state and benchmark concepts for better biodiversity conservation in contemporary ecosystems. Global Change Biology 26(12), 6702-6714. https://doi.org/10.1111/gcb.15383

Oliver et al. (2021). A new Vegetation Integrity metric for trading losses and gains in terrestrial biodiversity value. Ecological Indicators 124, 10734. https://doi.org/10.1016/j.ecolind.2021.107341

Parkes et al. (2003). Assessing the quality of native vegetation: The 'habitat hectares' approach. Ecological Management and Restoration 4(s1), S29-S38. https://doi.org/10.1046/j.1442-8903.4.s.4.x