UIC SUSTAINABILITY

European Railways: Strategy and Actions for Biodiversity

Ecological Effects of Railways on Wildlife (rEvERsE) Project

May 2022

ECOLOGICAL EFFECTS OF RAILWAYS ON WILDLIFE
REVERSE

INTERNATIONAL UNION
OF RAILWAYS

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CONTENTS

CASE STUDIES

TABLES & FIGURES

FOREWORD

It is undeniable that rail is the most sustainable form of transport, it is energy efficient by design and already the only mode of transport to be reducing its emissions. With a projected growth in demand for mobility, a dramatic increase in the use of the rail network is essential and urgent to tackle greenhouse gas emissions and reduce the effects of climate change, but this must not be at the risk of biodiversity.

The dual crisis, linked to climate change, is the dramatic loss of biodiversity across the planet. Rail is land efficient; the network requires only 7 m^2 of land per passenger transported compared with 100 m^2 per car passenger. The rail network acts as a green corridor for nature as well as for goods and people, lining other green spaces and providing habitat for a range of plants and animals. It also benefits such as including water regulation due to the permeability of rail beds.

As set out in our 2030 vision: Design a better future, our railways must continue to transform and develop in an ever more sustainable way so that it remains the clear choice as the backbone of a sustainable mobility system. In the decade ahead I see opportunities for our railway corridors to become even more biodiverse and with our growing digitalisation capacity we will be able to map and monitor this important change.

I welcome this Biodiversity Strategy and Actions for European Railways and invite all our members to use this as inspiration for how they can contribute to the protection and enhancement of our green corridors to the benefit of railways, our neighbours, customers and the planet.

François DAVENNE
Director General

1. CONTEXT

Scientists tell us that the Earth is undergoing a “Sixth Mass Extinction” as ecosystems are degraded through pollution and the effects of alien invasive species, land is lost to agriculture and urban development, and changing weather patterns from climate change disrupt the ecology of species. Organisations, such as the UN Convention on Biological Diversity (CBD) [1], the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) [2] and the WWF Living Planet Report 2020 [3], have given us a global perspective on how life on Earth is changing and point to a ‘biodiversity crisis’. The EU 2030 Biodiversity Strategy [4], the Green Deal [5] and the UK’s “Dasgupta Review” on The Economics of Biodiversity (2021) [6] all recognise that biodiversity and ecosystem services have a significant economic value to society.

The pressure on land in Europe is intensifying including the need to improve connectivity and infrastructure. This pressure to develop land risks further loss of habitats and biodiversity. For rail companies, the challenge is to increase the number of people and goods using rail without further impacting biodiversity and to look after the green assets that we are responsible for.

Rail is very land efficient; the network requires only 7 m² of land per passenger transported compared with 100 m² per car passenger (Figure 1) [7]. The structure and arrangement of the rail network also offers benefits such as water regulation due to the permeability of rail beds.

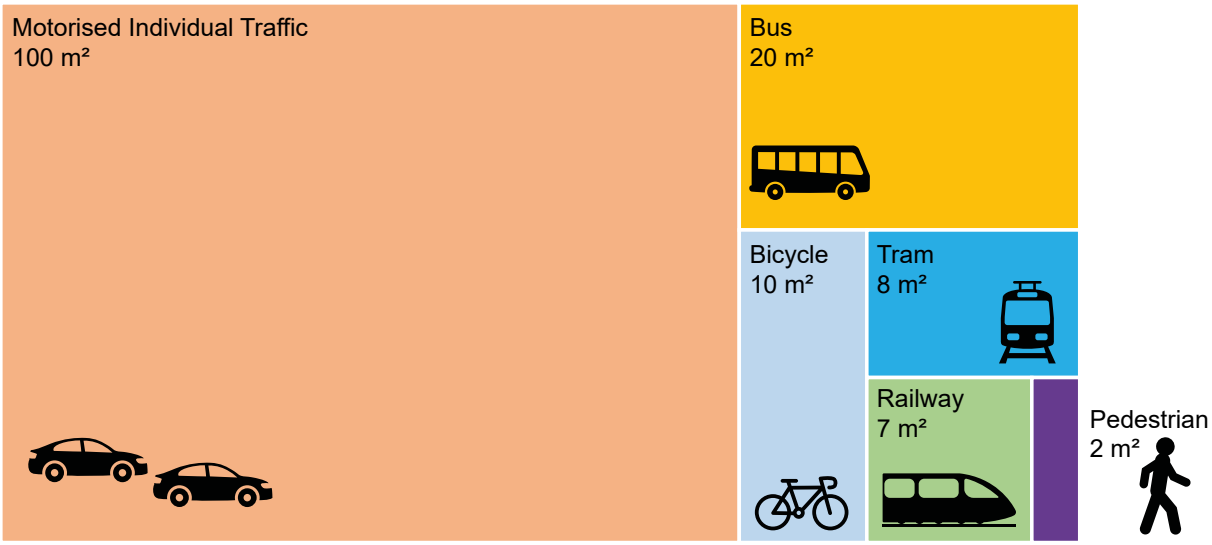


Figure 1: Land consumption by mode of transport in square metres per person transported in urban transport (Ref e: Allianz pro Schiene, 2020)

Rail companies, and the wider stakeholders that work with them or benefit from their infrastructure, have important responsibilities when it comes to nature conservation. While it's true that rail travel can have negative impacts on wildlife, which this report fully acknowledges, it's also true that Europe's rail companies can play a hugely positive role in supporting and protecting biodiversity. In fact, as the **13 recommendations** in this document make clear, UIC believes that it is the duty and obligation of rail companies to engage meaningfully with nature conservation. The range of case studies that we present demonstrates that many of the rEvERsE project partners have already made impressive commitments to addressing Europe's biodiversity crisis, but there is much more that could be done.

The next decade will be an important one for biodiversity as governments pledge to achieve no net loss by 2030 and a net gain by 2050. Addressing climate change and loss of biodiversity are not separate: natural ecosystems lock up carbon in plants and soils, so restoring and creating habitats are important ways in which rail companies can help to tackle both issues. This strategy outlines our vision for nature conservation across the European rail network and describes the positive actions we will be taking to halt and reverse biodiversity decline in the coming decades.

UIC Sustainable Land Use Sector

2. INTRODUCTION

DEVELOP A VISION FOR RAILWAYS AND BIODIVERSITY

Set out ambitions and commitment to conserving and enhancing biodiversity accompanied by a timeline to deliver changes. This will contribute to rail becoming the most environmentally friendly mode of transport.

This Strategy and Actions document sets out our collective vision for protecting and enhancing the wildlife value of the European rail network. We also include case study examples of the positive, practical actions that rail companies are already taking to significantly benefit Europe's declining biodiversity and ecosystems. The document has been produced as part of the International Union of Railways (UIC) rEvERsE project which explores the ecological effects of railways on wildlife. This project is funded by a consortium of railway infrastructure managers from nine UIC European members (Austria, Finland, France, Ireland, Italy, Netherlands, Sweden and the United Kingdom, see Figure 2). In addition, UIC also received support from other UIC member countries including Belgium, the Czech Republic, Denmark, Germany, Hungary, Lithuania, Norway, Portugal and Switzerland[1].

Biodiversity

As defined by international organisations and agreements such as the UN Convention on Biological Diversity and the EU Biodiversity Strategy, "biodiversity" refers to the variety of living organisms, including plants, animals, fungi and microorganisms. These work together in ecosystems to maintain balance and support life by providing human society with a wide range of so-called "ecosystem services". These services include providing clean air and water, capturing and storing carbon dioxide, the decomposition of organic and inorganic material to cycle nutrients, preventing natural hazards such as flooding and landslides, and the pollination of crops. It is also widely recognised that interacting with nature improves our physical and mental wellbeing. Despite this, human activities, such as habitat destruction, pollution and the introduction of alien species, are causing species and organisms to disappear from the planet at an alarming rate. If left unchecked, this ***'biodiversity crisis'*** *will threaten ecosystems and their provision of services that are vital to the survival of the human race. In response to this threat, governments across Europe have introduced policies aimed at urgently halting and reversing this biodiversity decline across the continent.*

1 For more information, please visit the project website: uic.org/projects/article/reverse

Central to the report is a set of 13 recommendations which we feel all railway companies should aim to adopt as their strategies and goals to maintain and increase the value of the European rail network for plants, animals and other wildlife.

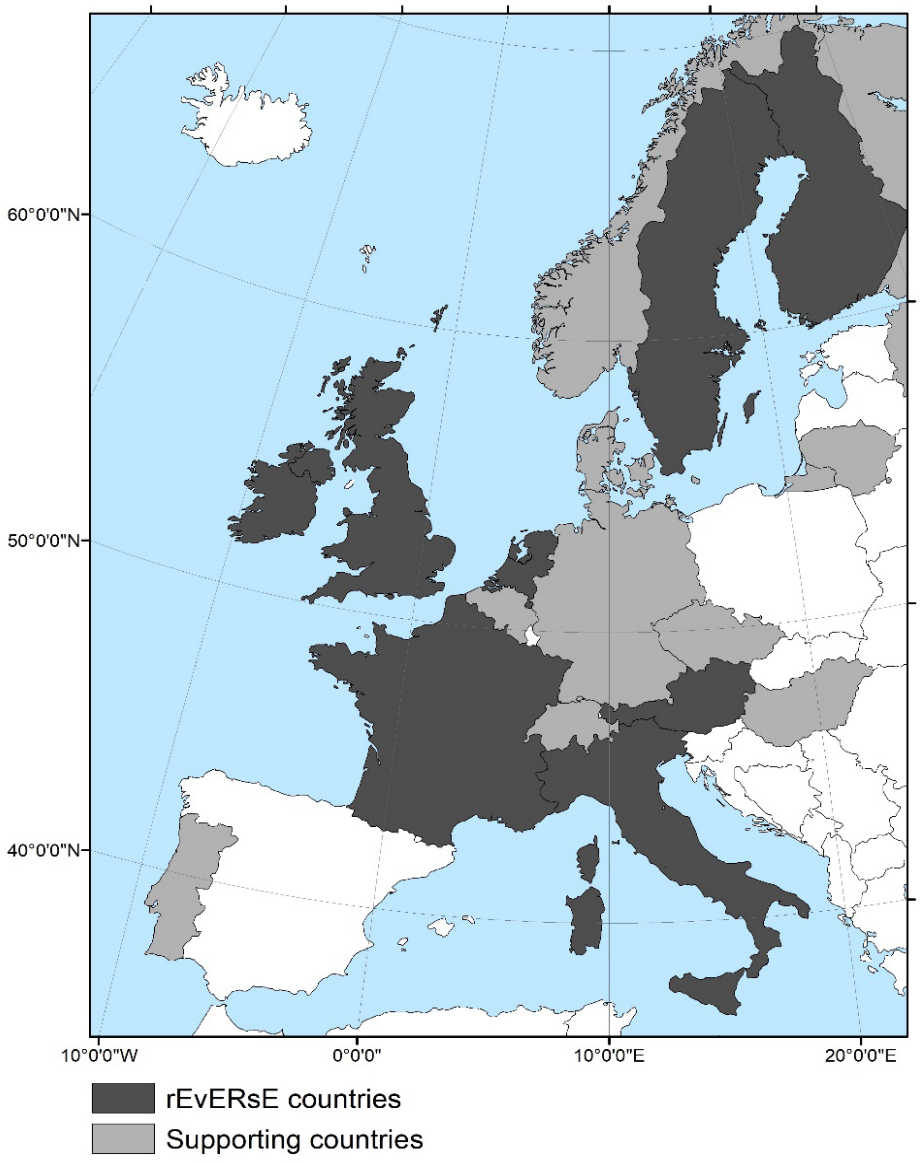


Figure 2: Map of rEvERsE partner countries and supporting countries

See **Strategic Goals & Action Guide** – page 12-13

STRATEGIC GOALS

Develop a vision for railways and biodiversity

Set out ambitions and commitment to conserving and enhancing biodiversity accompanied by a timeline to deliver changes. This will contribute to rail becoming the most environmentally friendly mode of transport.

Enable a cultural change to prioritise nature and the environment

Embed conservation and enhancement of biodiversity at every business level, alongside safety, performance and other environmental targets, such as achieving net zero greenhouse gas emissions.

Recognise the positive role railways have in conserving biodiversity

Engage with policy makers to ensure the beneficial role railways can have on biodiversity is recognised and incorporated into national and European Union nature conservation policies.

Value biodiversity and natural assets

Monitor and manage the status and condition of habitats and biodiversity associated with railways.

Put in place the specialist skills

Acquire specialist capabilities and competencies in ecology to fully understand these assets and deliver appropriate management actions.

Establish management plans to protect and enhance biodiversity

Develop innovative approaches to managing biodiversity assets, taking account of both the lineside and interactions with the wider landscape, and including nature-based solutions specific to railways.

& ACTION GUIDE

Implement the biodiversity mitigation hierarchy

Limit the negative impacts of railway development activities by following the principles of avoiding, minimising, restoring or offsetting impacts on biodiversity.

Monitor the outcomes of biodiversity management

Adopt consistent and repeatable approaches to monitoring the outcomes of land use management to conserve and enhance biodiversity. This is key to setting ambitious targets for biodiversity assets and improving their management, and for corporate accountability.

Take collective action for biodiversity

Work together to deliver landscape-scale benefits for biodiversity through the provision of wildlife corridors and enhanced landscape permeability for species movement.

Make a commitment to biodiversity net gain

Set ambitious targets for conserving and enhancing biodiversity, with no net loss of biodiversity by 2030, and net gain by 2050, with progress assessed through regular monitoring.

Partnership working

Seek partnerships with stakeholders to deliver benefits to biodiversity at scale and in the long term.

Share best practices

Publish and share best-practice guidelines for managing and conserving biodiversity management with one another and with stakeholders to improve their effectiveness.

Improve communications

Use a wide range of communication tools to openly communicate plans for, and approaches to, biodiversity management with employees, passengers, society and neighbours, and to disseminate progress and achievements.

2. BIODIVERSITY POLICY IN EUROPE AND ITS NATIONS

ENABLE A CULTURAL CHANGE TO PRIORITISE NATURE AND THE ENVIRONMENT

Embed conservation and enhancement of biodiversity at every business level, alongside safety, performance and other environmental targets, such as achieving net zero greenhouse gas emissions.

RECOGNISE THE POSITIVE ROLE RAILWAYS HAVE IN CONSERVING BIODIVERSITY

Engage with policy makers to ensure the beneficial role railways can have on biodiversity is recognised and incorporated into national and European Union nature conservation policies.

2.1 THE STATE OF BIODIVERSITY IN EUROPE

The recent European Environment Agency State of Nature Report (2020) [8] showed that, despite continued efforts by member states, biodiversity in the EU is continuing to decline. For example, of the 463 bird species that occur in the EU, only 47% have increasing or stable populations, while 39% of species are declining or threatened, a figure that has increased in recent years. Likewise, data on habitats (reported under Article 17 of the Habitats Directive) show that only 15% have good conservation status, with 81% having poor or bad status. One of the reasons for this is that most protected areas in Europe are small, less than 1 km^2 in area, and often isolated from one another.

Overall, considering all groups of species for which assessments have been made, 63% were classified as ‘poor’ or ‘bad’ with respect to their conservation status.

Key to improving this situation is the Natura 2000 network, which covers almost 20% of the land in the EU and is the largest coordinated network of conservation areas in the world. However, there is limited ecological connectivity between areas and the State of Nature Report (2020) [8] recognises the need to allow species to move more easily between sites, together with more effective habitat management and monitoring of wildlife inside and outside the network. European railways can, and do, play an important role in this regard, often in association with national and regional authorities, as **Case Study 1** from Germany demonstrates.

See Strategic Goals & Action Guide – page 12-13

2.2 EUROPEAN POLICIES AND STRATEGIES

Global strategies to halt and reverse biodiversity decline are led by bodies such as the United Nations Convention on Biological Diversity (CBD) [1] and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) [2]. These recognise five human-mediated causes of biodiversity loss:

- Habitat loss and degradation
- Climate change
- Overexploitation of natural resources
- Pollution
- Introduction of invasive alien species

These feed into EU's policies which in turn influence national policies and guidance on biodiversity. It is not possible to provide a comprehensive overview of all the relevant legislation and reports in this chapter, but some examples will show the scope and purposes of these instruments.

A range of EU policies are focused on halting biodiversity decline and improving the natural environment for people and for wildlife, whilst at the same time ensuring economic prosperity. The European Green Deal [5], for example, is central to the EU's recovery from the COVID-19 pandemic and is focused on transforming resource efficiency and energy use across member states, reducing greenhouse gas emissions by at least 55% by 2030 and to net zero by 2050. An important component of this is the EU's Biodiversity Strategy for 2030 [4], which seeks to protect, restore and create natural habitats across Europe which will in turn serve as carbon dioxide (CO_2) sinks. Targets include: the legal protection of a minimum of 30% of the EU's land area, integrating ecological corridors to form a Trans-European Nature; a 50% reduction in the overall use of chemical pesticides; and the planting of at least 3 billion trees in the EU, following the appropriate ecological principles of 'the right tree in the right place'.

Key to the success of these policies will be the ability of the EU and member states to track progress using physical and biological environmental monitoring. Some of this is already well established, for example the monitoring of air and water pollution, and regular surveys of breeding birds. Additional monitoring is proposed in the new European Pollinator Monitoring Scheme [9], which will build on existing schemes such as the European Butterfly Monitoring Scheme (EBMS) [10] and the UK Pollinator Monitoring Scheme (PoMS) [11]. These schemes engage 'citizen scientists', members of the public who are themselves often rail travellers of course.

Furthermore, the Taskforce on Nature-related Financial Disclosures (TNFD) [12] and the Global Reporting Initiative (GRI) [13] will be increasingly important for rail companies that wish to track their progress and accounting for activities that positively and negatively impact on nature.

2.3 NATIONAL POLICIES AND STRATEGIES

In addition to EU initiatives, all European member states and other European countries have their own national policies, strategies, commissioned reports and legislation which are driving action to conserve, enhance and monitor biodiversity. These are subject to periodic updates and revisions to reflect global and EU strategies and initiatives. Examples of key national strategies and policies from the countries contributing to the rEvERsE project include: the Biodiversity Strategy Austria 2020+ [14]; the Evaluation Française des Écosystèmes et des Services Écosystémiques (2019) [15]; the German National Strategy on Biological Diversity (2007) [16]; and The 25 Year Environment Plan (2018) [17] for the UK.

Case Study 1:
The interaction between laws, policies and railway company activities in Germany

As well as being subject to national and EU laws and policies concerning biodiversity, companies can also influence that legislation. The *Strategy for the Exemplary Consideration of Biodiversity Concerns for all Federal Land* ("Strategie zur vorbildlichen Berücksichtigung von Biodiversitäts-belangen für alle Flächen des Bundes" – StrÖff) is a "Subsidiary Strategy" of the German National Strategy on Biodiversity (NBS).

The objectives of the NBS are directed at all public sector actors, who should take a leading role in implementing this strategy. In numerous talks with the Federal Ministry for Environment, Nature Conservation and Nuclear Safety (BMU), the activities of Deutsche Bahn AG were highlighted by the StrÖff as leading examples of their kind, and include:

- Culverts to allow small animals to pass under noise barriers;
- Protection of birds from contact with overhead lines;
- IT support for biodiversity compensation obligations: the FINK tool (see Chapter 10);
- Deutsche Bahn's own protected area documentation containing mapping data on protected areas in accordance with the Federal Nature Conservation Act and the Federal Water Act;
- Guidance and information sheets for the non-chemical control of invasive alien species (IAS);
- Environmental education of employees with the aim of bringing the topic of biodiversity to the attention of a broader workforce.

3. EUROPEAN RAILWAYS AND THEIR IMPORTANCE FOR BIODIVERSITY

VALUE BIODIVERSITY AND NATURAL ASSETS

Monitor and manage the status and condition of habitats and biodiversity associated with railways.

3.1 THE RAILWAY ECOSYSTEM

The European railway network extends for almost 230,000 km across the continent and covers an estimated 315,000 to 420,000 ha of land (Table 1). It spans an enormous diversity of habitats, stretching from cold boreal tundra and coniferous forests in the north, to hot Mediterranean shrublands in the south, passing through mountain meadows, deciduous woodlands and coastal wetlands (Figure 3). Indeed, there is unlikely to be any single type of habitat that is not influenced or connected in some way by the European rail network. Importantly, the rail network intersects around 2,500 (17%) of protected sites of high nature conservation value (Table 1). The rail network intersects over 2,500 of the approximately 14,000 protected areas in Europe and more than 400,000 km^2 of protected areas are within 1 km either side of the European rail network. This figure corresponds to around 16% of the total protected land area in Europe. For some types of protection, this figure is much higher – over 30% of Natura 2000 site area, for example.

See Strategic Goals & Action Guide – page 12-13

Table 1: Rail network statistics and Protected Areas (PAs) and Natura 2000 sites (Ref: Eurostat [25])

	rEvERsE partner countries	rEvERsE supporting countries	Europe
Total rail length	81,893.61 km	61,765.96 km	229,854 km
Total number of Natura 2000 sites	13,632	8,620	29,734
Total area of Natura 2000 sites	606,245.6 km^2	211,123 km^2	1,240,260 km^2
Total number of Protected Areas (PAs)	59,741	46,704	139,123
Total area of PAs	456,930.9 km^2	285, 269.1 km^2	1,058,992 km^2
Number of PAs intersected by rail	2,760	5,018	9,930
Number of Natura 2000 sites intersected by rail	1229	1708	4,116
Rail length intersecting Natura 2000 sites	3,536.238 km	4,269.722 km	13,805.17 km
Rail length intersecting PAs	8,315.57 km	9,684.214 km	28,418.54 km
Area of Natura 2000 sites in 1 km buffer within either side of the rail network	9,320.287 km^2	9,171.829 km^2	31,988.07 km^2
Area of PAs in 1 km buffer within either side of the rail network	18,720.6 km^2	21,443.76 km^2	63,127.68 km^2

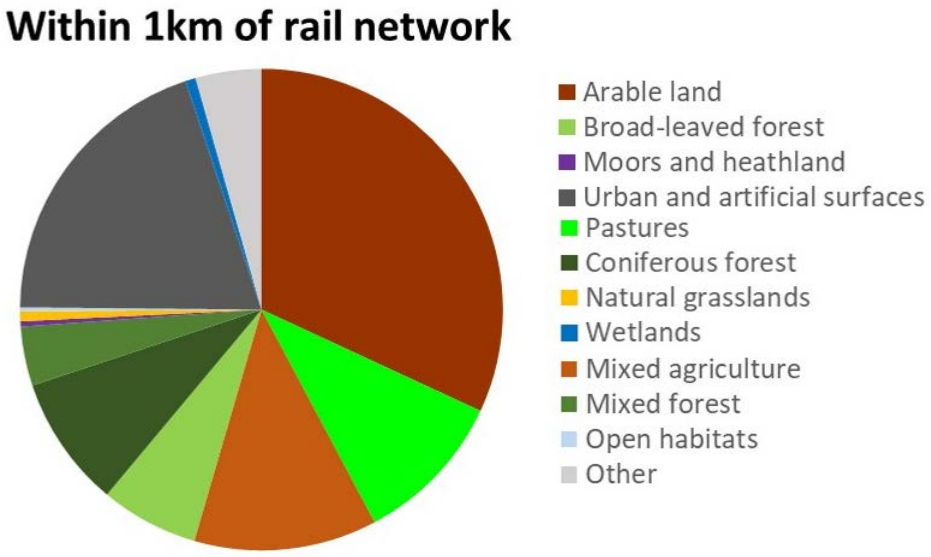
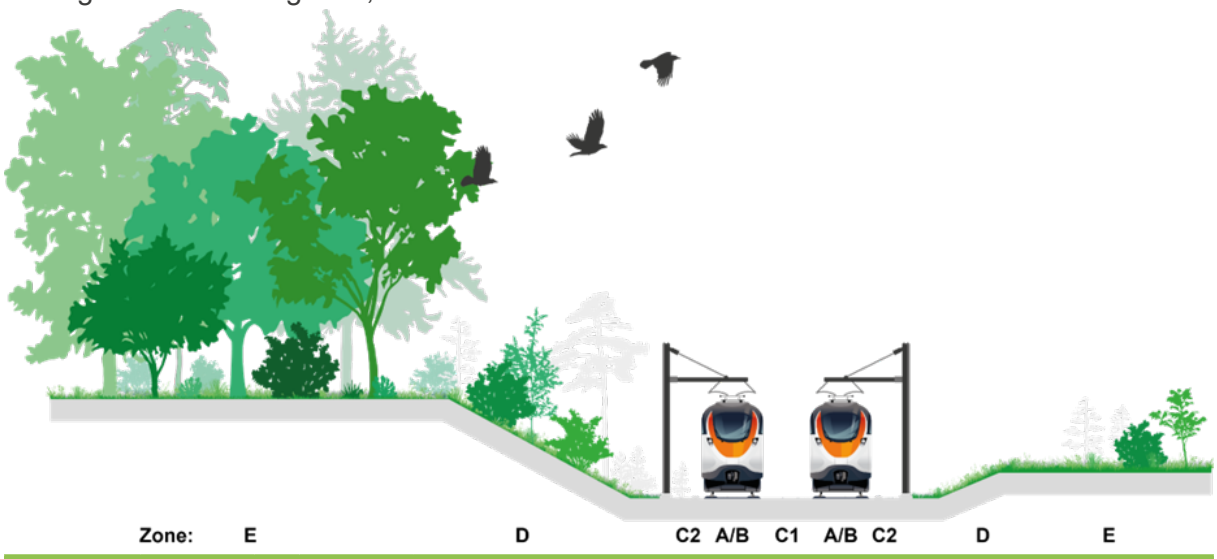


Figure 3: Proportion of different habitat types found within 1 km either side of the European rail network compared with the wider landscape [22] (Ref: Corine Land Cover Map)

The rail corridor itself comprises a diverse mix of habitats (Figure 3 and Figure 4), from open, unvegetated track bed typically comprising sleepers embedded in mineral ballast (Zone A-B), an unvegetated transition zone containing infrastructure, such as ditches and signal trenches (Zone C), and the lineside, comprising fully vegetated cuttings and embankments (Zone D). The lineside includes a wide range of habitats from grassland to areas dominated by shrubs and small trees. In some areas there is additional sealed and unsealed land associated with the rail corridor, such as sidings and depots (Zone E) which sometimes comprise so-called post-industrial 'brown field' sites. Many of the habitats associated with the rail corridor are included in the European Union's Habitats Directive legislation. These habitats are home to a huge diversity of birds and mammals, insects and other invertebrates, reptiles and amphibians, soil microbes such as fungi, as well as plants, which we collectively term 'biodiversity', many of them rare and protected by European legislation, natural and local regulations (**Case Study 2)**. The European rail network therefore can (and does) play an important role in the conservation of threatened biodiversity across the continent and there is the potential, with appropriate management and mitigation, for this to increase.



Zone	Terminology			Description
A	Ballast bed			Part of the track bed made of ballast or gravel, including embedded sleepers and rails
	Slab track			Concrete track bed structure
B	Ballast shoulder			Part of the track bed covering the slope on both sides of the ballast bed
	Slab track			Different concrete track bed structure types are possible and, in some cases, may include a ballast shoulder
C	Transition area	C1	Spacing area	Part of the track bed abutting the slope on both sides of the ballast bed and including a footpath for maintenance / inspections, as well as walkways and spacing areas between tracks in the case of double or multiple tracks. In some cases, drainage ditches are also constructed in area C
		C2	Side walkways	
D	Lineside (cuttings or embankments)			Slopes alongside the track adjoining Area C, in which vegetation may affect the operational envelope ((A/B + C)
E	Unsealed area outside of the tracks			Power stations, service facilities, unsealed paths, areas around substations, unsealed areas around railway stations, forest land, meadows and unsealed fallow land
A/B + C	Operational envelope			The area within which the railway infrastructure sits
A/B + C + D	Railway corridor			Operational envelope and lineside

Figure 4: Description of the railway corridor and associated habitats (adapted from the © Network Rail Habitat Design Guide with permission)

Case Study 2:
Using the Global Biodiversity Information Facility (GBIF) to assess the potential for railways to benefit Europe's declining species

In order to value biodiversity and natural assets, it is important for rail companies to understand where species and habitats occur in relation to their land holdings. As part of the rEvERsE project, staff at the UK Centre for Ecology & Hydrology used the Global Biodiversity Information Facility (GBIF) [18] to assess the number of Red List species occurring within 1 km either side of the European rail network. GBIF is a publicly accessible database of species occurrences across the world and the 1 km buffer was chosen because rail companies' activities are likely to have some kind of benefit or impact within this zone, especially on species that have been Red Listed because they are rare or declining. Table 2 shows the results of this exercise: the lives of more than 2,300 rare species could potentially be affected by European rail companies.

Table 2: The number of rare (Red List) species occurring within 1 km either side of the rail network across the whole of Europe [18]

Species group	Number of rare species within 1 km either side of the European rail network
PLANTS	
Ferns and their relatives	63
Flowering plants and conifers	391
Medicinal plants	270
INSECTS	
Bees	255
Beetles that live in dead wood	127
Butterflies	206
Dragonflies	89
Grasshoppers, locusts and crickets	139
MOLLUSCS	
Freshwater snails and shellfish	62
Land-living snails and slugs	62
VERTEBRATES	
Amphibians and reptiles	50
Fish (marine)	85
Mammals	87
Total number of species[2]	**2,302**

2 *Data downloaded from the GBIF database in July 2021 (www.gbif.org) for the rail network across the whole of Europe.*

3.2 IMPACTS OF RAILWAYS ON BIODIVERSITY

All human activities, including the construction, management and use of transport infrastructure, have the potential to affect biodiversity in ways that are both beneficial and adverse (summarised in Table 3). The impacts of railways on biodiversity have received limited attention in ecological literature compared to roads because of the greater difficulty in safely accessing them for study. Nevertheless, the potential of railways for both positive and negative impacts on biodiversity are described in detail in the book *Railway Ecology by Borda-de-Água et al. (2017)* [19]. As with other linear infrastructure, the interaction of railways with the environment is complex, with impacts spanning scales from local to landscape, and varying depending on the types of habitats and species considered. Balancing benefits and adverse impacts is an important task for the European rail system. Careful planning and scientifically sound impact analyses can reduce these effects and potentially increase the biodiversity occurring along the network during all lifecycle phases of a railway, from planning the route, through to construction, operation and finally decommissioning.

Table 3: Summary of the potentially beneficial effects and adverse impacts of the rail network on biodiversity

Beneficial effects	Adverse impacts
Provision of habitats and refugia to support species	Habitat loss associated with construction and upgrading infrastructure
	Direct collisions of animals with rolling stock
	Collisions of animals with infrastructure such as overhead cables and windows
	Entrapment of small animals between rails and other infrastructure
Restoration and creation of habitats	Habitat degradation due to lack of management / inappropriate management
Buffering adjacent wildlife habitats in the wider landscape	Pollution of air, water, soil (i.e. exhaust gases, wear emissions, accidental hazardous chemicals)
	Disturbance due to light, noise and vibration
Provision of green corridors for connecting habitats (‘ecological connectivity’)	Fragmentation of contiguous habitat
	Barriers to the movement of wildlife (depending on train frequency)

3.2.1 Potentially adverse impacts

Major adverse impacts could potentially include the direct destruction and fragmentation of wildlife habitats associated with the construction of new railway lines, and the upgrading of existing ones. Rail lines can also act as a barrier to movement due to safety fencing, sound barriers or high train frequencies. Mortality of vertebrates such as mammals, birds and reptiles, can result from direct impacts from trains, electrocution and wire strikes, as well as barotrauma (injury or death from sudden changes in air pressure) which may affect birds in particular. The noise and vibration from rolling stock may affect animal behaviour and movements, whilst small-bodied animals may be trapped between rails and die of dehydration or lack of food. Emissions arising from running trains may degrade habitat quality in an indirect way through pollution of air, water, soil (e.g., exhaust gases, wear emissions, accidental hazardous chemicals). Finally, the rail network may also act as a conduit for undesirable, invasive alien species, allowing them to disperse more widely through the landscape.

3.2.2 Beneficial effects

It is clear from the case studies that with careful planning and management, railways can play an ever more valuable role in helping to protect and enhance the continent's wildlife, and in helping the European Union meet its legal and strategic commitments to support and improve biodiversity. The primary direct benefit of railways is the extensive and diverse mix of habitats it provides that support significant levels of biodiversity. Through appropriate management actions there is also considerable potential to restore and create further wildlife habitats (Chapter 4). Restricted access to the lineside means that these habitats are also relatively free from disturbance by humans compared to the wider environment, and so can be considered a refuge for sensitive species. Similarly, railways can provide indirect beneficial effects for habitats in the landscapes they pass through. Railways can provide protective buffer zones around adjacent wildlife habitats. The network can also provide habitat corridors that connect different areas. Indeed, with appropriate planning there is the potential specifically that railways can serve to connect protected areas within the Natura 2000 network. By calculating measures of habitat connectivity, it is possible to map connectivity across Europe for key habitats, such as forests (Figure 5). These can be used to identify well-connected areas where current habitats around the rail network are of particular importance or poorly connected areas where restoration efforts centred on the rail network might be particularly valuable in re-connecting the landscape.

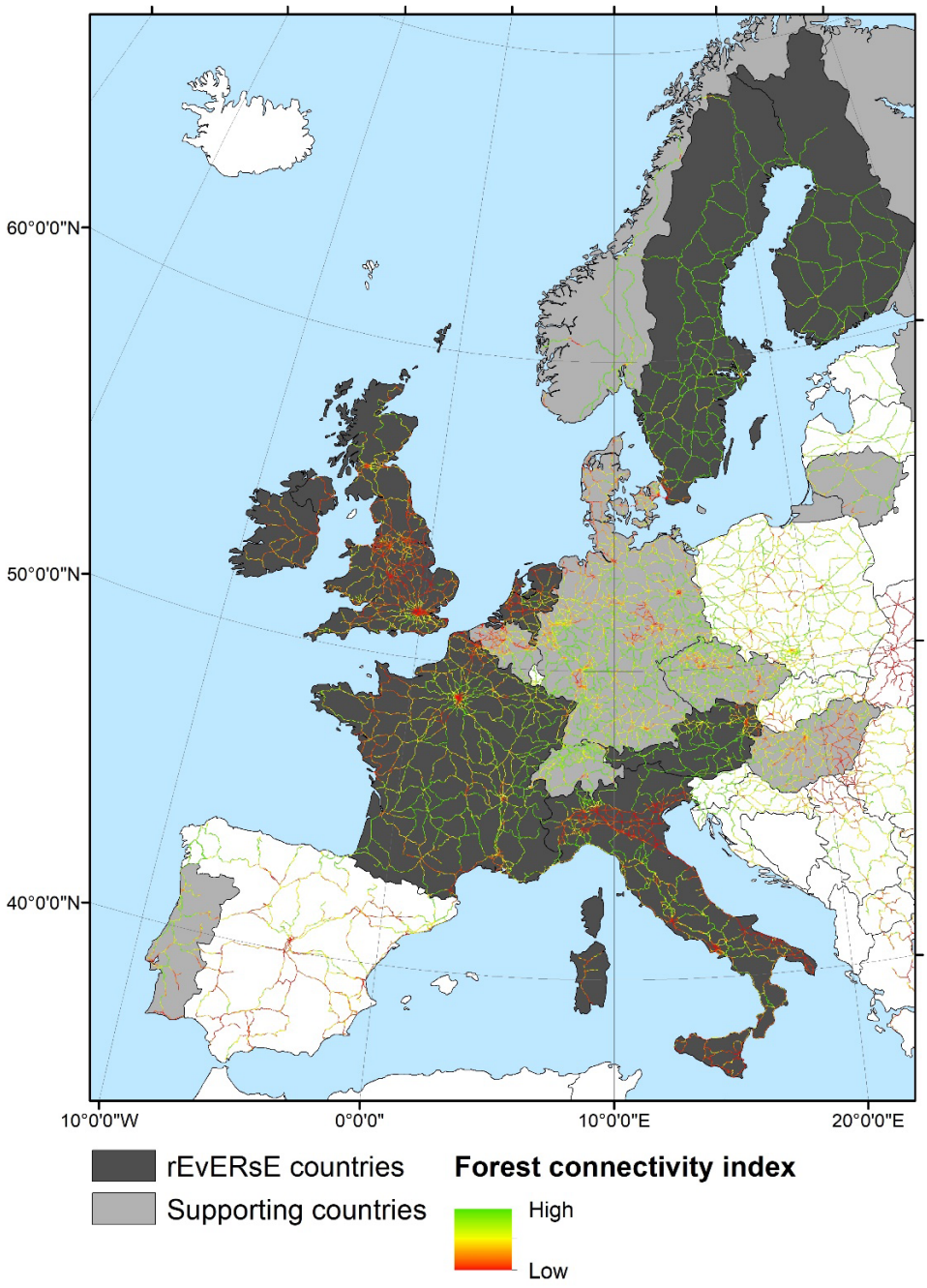


Figure 5: Mapping showing the role of the European rail network in connecting forest (green = zones of high connectivity; red = low connectivity)

In this example, we used the Corine Land Cover map to identify patches of forest present in the landscape either side of the European rail network at 100×100 m resolution. For each 100 m grid cell in a 1km corridor either side of the railway we calculated a simple score of forest connectivity. This was derived from the inverse of the mean Euclidean distance to the nearest 100 cells of forest habitat within a search radius of 10 km from each cell. [22] (Ref: Corine Land Cover and UKCEH).

4. MANAGEMENT TO PROTECT AND ENHANCE BIODIVERSITY ON EUROPEAN RAILWAYS

IMPLEMENT THE BIODIVERSITY MITIGATION HIERARCHY

Limit the negative impacts of railway development activities by following the principles of avoiding, minimising, restoring or offsetting impacts on biodiversity.

ESTABLISH MANAGEMENT PLANS TO PROTECT AND ENHANCE BIODIVERSITY

Develop innovative approaches to managing biodiversity assets, taking account of both the lineside and interactions with the wider landscape, and including nature-based solutions specific to railways.

TAKE COLLECTIVE ACTION FOR BIODIVERSITY ACROSS EUROPE

Work together to deliver landscape-scale benefits for biodiversity through the provision of wildlife corridors and enhanced landscape permeability for species movement.

4.1 POSITIVE ACTION FOR BIODIVERSITY

Rail companies across Europe are already undertaking a wide range of activities to manage, conserve, restore and create habitats to promote biodiversity through all the lifecycle phases of a railway, from planning the route, through to construction, operation (including practical action to protect wildlife from adverse impacts), upgrading and finally decommissioning. The purpose of this chapter is to highlight some of these practices and provide case studies that outline the best approaches to particular challenges, so that project partners can draw on this wealth of knowledge.

A survey of rEvERsE partners and other EU rail companies identified (see in Figure 6) that the highest priorities for biodiversity management were the protection and conservation of rare species and habitats, the safety and reliability of the rail network, and the removal of Invasive Alien Species (IAS).

See **Strategic Goals & Action Guide** – page 12-13

Constraints on the effective management of biodiversity that were identified were lack of resources, skills and knowledge, and the absence of a strategy or a plan. Tensions between biodiversity legislation, such as the protection of rare species, and rail safety was the most important conflicting factor.

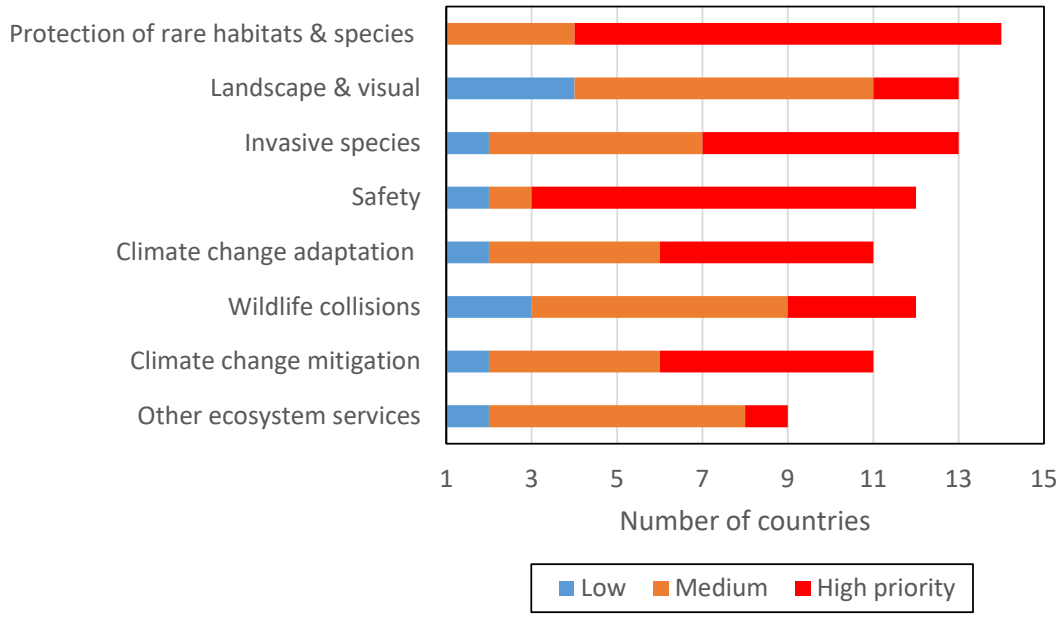


Figure 6: Results of a survey of 15 EU rail companies (rEvERsE and supporting countries) asking the question: What are the priorities of your company for biodiversity management? (Ref: UIC REVERSE project)[3]

4.2 MITIGATING IMPACTS ON BIODIVERSITY

A fundamental principle of biodiversity protection is that all works should be viewed in relation to the mitigation hierarchy which aims to prevent, minimise or alleviate adverse impacts on ecosystems. There are four levels to the mitigation hierarchy which need to be considered in turn when planning any work:

- **Avoid** impacts, for example by carefully choosing sites that steer clear of ecologically sensitive habitats or by scheduling disruptive work outside of a species' breeding season.
- **Minimize** impacts, if avoidance is not possible, by careful use of controls such as physical barriers or planned access routes.
- **Restore** damaged habitats back to their previous state if the first two preventative measures are not achievable.
- **Offset** any permanent, irreversible damage by the creation or restoration of off-site habitats. Ideally this would involve a biodiversity net gain in terms of area.

3 uic.org/events/REVERSE-survey

The Cross Sector Biodiversity Initiative (CSBI) has produced a comprehensive guide to the mitigation hierarchy [26], from which Figure 7 is reproduced for the REVERSE project. This flow diagram explains that preventive measures (avoiding and minimizing damage to habitats) should be explored first. Only if it is not possible to prevent damage should remediative steps be taken to restore the damaged habitat. If restoration is not possible, for example if the whole area of habitat has been built upon or otherwise permanently destroyed, then creation of new habitat as an offset should be carried out. By following the logical flow of the mitigation hierarchy, adverse effects on biodiversity from railway operations can be prevented or at least reduced.

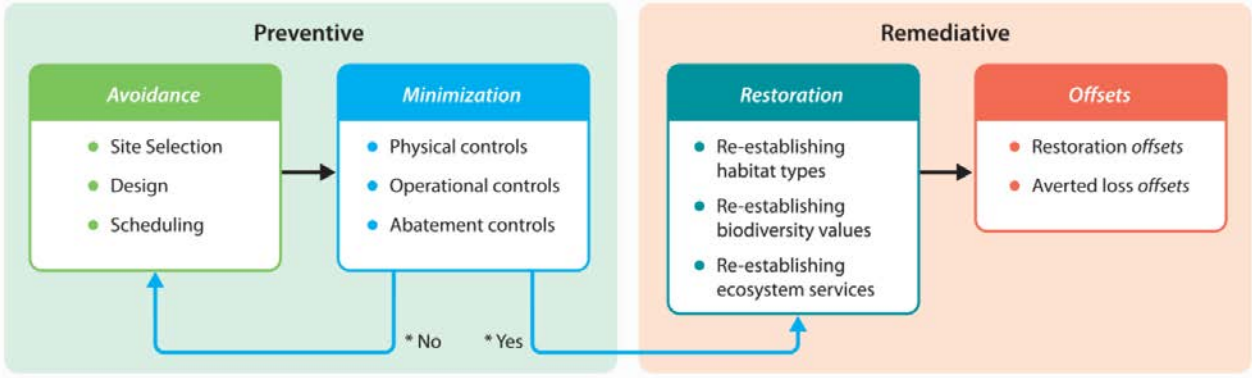


Figure 7: The four principles of the Mitigation Hierarchy to protect biodiversity, © CSBI [26]

4.3 HABITAT RESTORATION

The restoration of existing railway habitats to improve their value for wildlife is a key way in which companies can support rare or threatened species, and help to create ecosystems providing other beneficial functions, such as absorbing CO_2 to help alleviate the impacts of global climate change, and reduce risk of flooding by storing water. Lack of appropriate management can allow tall, competitive species of plant to dominate, and left unchecked will result in scrub and woodland – this is called vegetation succession. Whilst some woody habitat is good for biodiversity, the loss of more open habitats can be detrimental to wildlife.

4.4 HABITAT CREATION

The creation of natural habitats is another positive approach rail companies can take to support biodiversity and the associated ecosystem functions. Many of the rEvERsE partners are actively pursuing these kinds of projects. For example, the EU Life Project "Boosting Urban Green Infrastructure through Biodiversity-Oriented Design of Business Premises" (BooGI-BOP) presents the sustainable management of habitats that is being developed on the premises of Deutsche Bahn in Germany, supported by the Bodensee-Stiftung, Global Nature Fund and the

Institut für Lebensbezogene Architektur. In the first stage, new habitats for plants, insects and other species are being created, such as a wildflower meadow sown at a vehicle maintenance plant in Nürnberg, and a gravel lawn planted on the grounds of the Kaiserbahnhof Potsdam. Although the initial project will be completed by the end of 2021, the experience and knowledge coming from the pilot studies will be analysed and developed so that the concept can be easily transferred to other premises at Irish Rail (see also **Case Study 3**).

Case Study 3:
Creating habitat for pollinator species in stations

Irish Rail (Iarnród Éireann) are partners in the All-Ireland Pollinator Plan. As part of this, they are creating habitats for vulnerable pollinators throughout the entire railway network, across all 145 stations (example in Figure 8), and in some cases in collaboration with local community groups. Actions undertaken include:

- Developing a planting code to ensure pollinator-friendly flowers are planted within stations;
- Where possible, leaving amenity grassland areas uncut to allow wildflowers to flower;
- Reducing the use of herbicides and adopting various chemical-free weed control methods to promote the floral diversity of platforms and stations.

Figure 8: Pollen- and nectar-rich plant established in flower beds on Irish rail stations, © CIE

See Appendix for additional case studies on habitat creation:

- **Case Study A 1**: From dumpsite to nature sanctuary
- **Case Study A 2**: Abandoned railway tunnels as habitat for bats and measures for improving habitat quality
- **Case Study A 3**: Helping protected peregrine falcons to breed

4.5 HABITAT TRANSLOCATION

There are circumstances in which it is not practical or safe to prevent loss of natural habitat on the lineside or as a result of building of infrastructure. In these cases, the recommendation is that companies look to offset the loss of biodiversity through strategies such as species and habitat translocations and/or creation of at least equivalent habitat. This may be a legal requirement under some circumstances, e.g. where protected species such as bats or some reptiles are present.

Case Study 4:
Habitat translocation for the Large Blue Butterfly

In the 1970s, the Large Blue Butterfly became extinct in Britain and was the focus of a reintroduction programme, made more complex because of the symbiotic relationship the butterfly has with a grassland ant (*Myrmica sabuleti*). In the 1990s, a population was discovered to have spread onto a railway embankment owned by Network Rail. A land slide on this site required major engineering work to be undertaken. A plan was devised by the company and the UK Centre for Ecology & Hydrology (UKCEH) to translocate the Large Blue Butterfly colony and its habitat to two new sites on the lineside. The design of one of the sites included slopes with different aspects and soil depths providing a range of micro-habitats for the ant species to compensate for the effects of climate change in the future. One of the Network Rail sites now boasts one of the biggest populations of Large Blues in northern Europe. For this work Network Rail was awarded the prestigious Marsh Award for conservation.

Figure 9: Translocation of Large Blue Butterfly habitat on a lineside embankment, © NR[4]

4 *For more information, see* www.ceh.ac.uk/case-studies/case-study-large-blue-butterfly.

4.6 CORRIDORS FOR BIODIVERSITY AND RECONNECTING LANDSCAPES

The restoration and translocation of existing habitats, and the creation of new ones, can help to connect together otherwise isolated fragments of habitat across landscapes. This is the underlying premise of Network Rail's approach to habitat creation and management in the UK. Here detailed map layers have been produced calculating the current connectivity of a wide range of wildlife habitats, including species-rich grasslands, woodlands and wetlands (Figure 10).

We have applied a similar approach to map the connectivity of woodlands across the whole of Europe in Figure 5. This information on connectivity can be used by the company and neighbours to plan new wildlife corridors to connect together otherwise isolated sites, either by the creation of contiguous habitat between sites or the provision of 'stepping stones' that allow the dispersal of plants and animals.

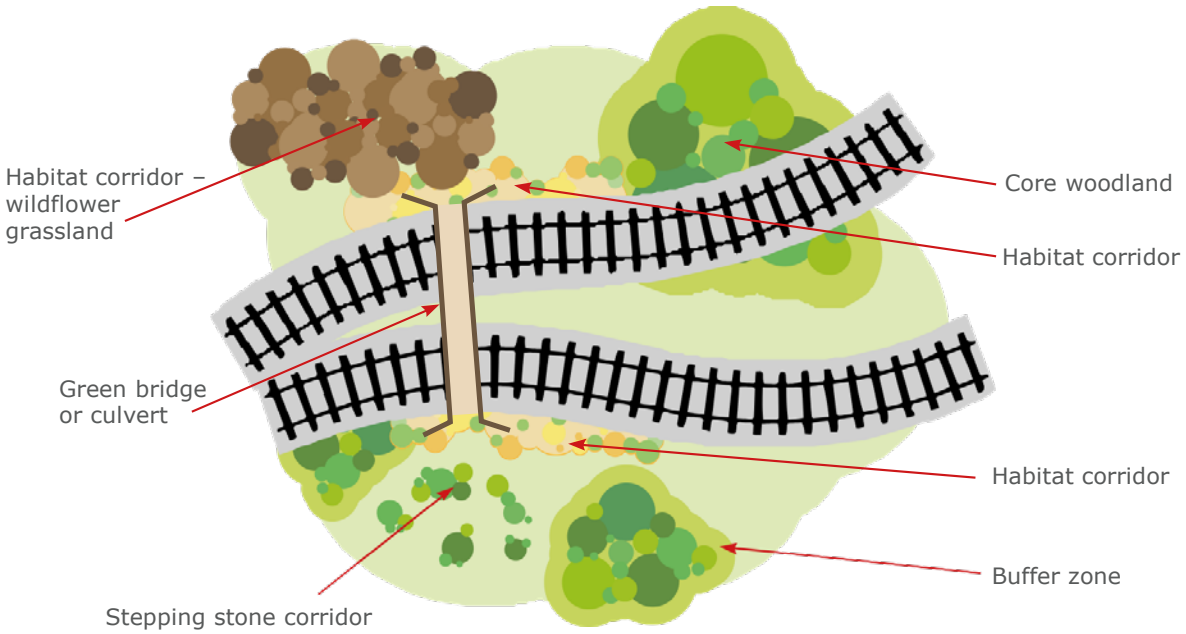


Figure 10: Examples of protecting and enhancing the lineside environment:
a) habitat creation (biodiversity off-setting);
b) managing habitat corridors to link core habitats;
c) creating stepping stone corridors;
d) creating buffer zones around core habitats
(Adapted from the © Network Rail Biodiversity Action Plan)

Case Study 5:

The Dutch approach to surveying biodiversity and habitat assets

Every five years, ProRail BV in the Netherlands instructs ecological companies to conduct field surveys of the whole of the Dutch Railway network and surrounding properties (see Figure 11). Plants, animals and a selection of invasive species are monitored. The results of these surveys are used for a broad variety of projects and activities, for example:

- The results are uploaded to the National Database of Flora and Fauna (NDFF), so all users of this database in the Netherlands can see and use this data;
- The data are used as input for building projects and maintenance actions, for asset information on where trees are growing, different types of vegetation, invasive species, and so forth;
- The results are input for the ProRail programme *More Nature on the Verge* ("Meer Natuur in de Berm" – MNiB).

A further aim of this programme is to combine all the information above into GIS-mapping tools to improve the biodiversity management of ProRail's 'green assets'.

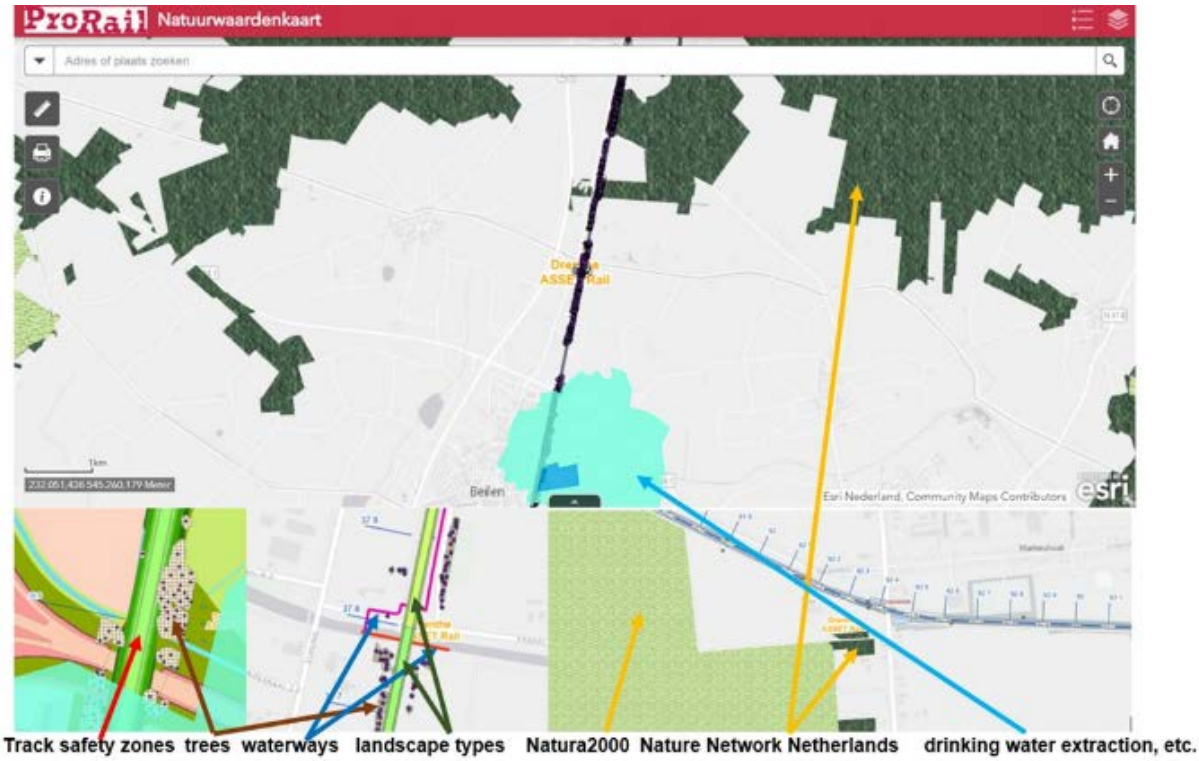


Figure 11: Spatial data layers showing protected sites and nature conservation assets on the Dutch railways, © ProRail

4.7 INVASIVE ALIEN SPECIES MANAGEMENT

Invasive alien species can be a significant economic burden on rail companies because of the damage that they directly cause and due to rising costs for maintenance and disposal. This is especially true for invasive alien species that companies are legally obliged to control and remove. It is estimated that the cost of invasive alien species in Europe may be more than €20 billion annually, and that they are considered one of the most significant factors causing loss of biodiversity, after habitat destruction and climate change (see **Chapter 2**). Moreover, some invasive alien plant species, such as giant hogweed and ragweed, also pose a health-risk for workers, neighbours and customers. The UIC's Transition Strategy on Vegetation Management (TRISTRAM) [20] report discusses the control of invasive alien plant species in more detail and provide case studies for alternative methods. For further guidance on vegetation management on railways, please also consult the "UIC Herbie Project's final report" [21].

See additional case studies in the Appendix:

- ↗ **Case Study A 7**: Tool for the detection and management of invasive alien species at DB Netz AG

Case Study 6:
Control of Japanese knotweed by grazing with sheep and goats

Railway embankments and other infrastructure properties often act as corridors for invasive alien species. In some cases, such as Japanese knotweed, conventional vegetation management using machinery can worsen the problem by transferring seeds and roots from one site to another. In 2014, ÖBB-Infrastruktur AG initiated a pilot project to control Japanese knotweed by grazing with goats and sheep (see Figure 12). Following double fencing to prevent the livestock escaping, the railway embankment was grazed as additional pastureland for a local organic farmer. The grazing keeps the Japanese knotweed from spreading and saves the money that would otherwise have been needed for disposal of the cut material. This has benefitted biodiversity, generated local income for the farmer through regional products, and provided positive media stories.

Figure 12: Goats grazing a railway embankment to control Japanese knotweed in Austria, © ÖBB-Infra

5. MONITORING BIODIVERSITY

MONITOR THE OUTCOMES OF BIODIVERSITY MANAGEMENT

Adopt consistent and repeatable approaches to monitoring the outcomes of land use management to conserve and enhance biodiversity. This is key to setting ambitious targets for biodiversity assets and improving their management, and for corporate accountability.

PUT IN PLACE THE SPECIALIST SKILLS

Acquire specialist capabilities and competencies in ecology to fully understand these assets and deliver appropriate management actions.

5.1 PRINCIPLES OF BIODIVERSITY MONITORING

Over 80% of the European railway companies surveyed currently monitor some aspect of biodiversity. However, there is considerable variation between companies and few of them monitor ecologically important groups, such as fish and insects (Figure 13). Biodiversity monitoring is generally undertaken as part of environmental impact assessments carried out prior to railway construction and development projects. These are often associated with the legal requirements specified in planning regulations. In addition, only 25% of companies undertake systematic and repeated monitoring of species and habitats, with most responding on an ad hoc basis to meet statutory requirements linked to development. Of those companies that did state that they undertook monitoring (Regular or ad-hoc) the focus of the surveys was most commonly species group, followed by habitat type then birds. Insects and fish by contrast were the least common focus of surveys (Figure 13).

See Strategic Goals & Action Guide – page 12-13

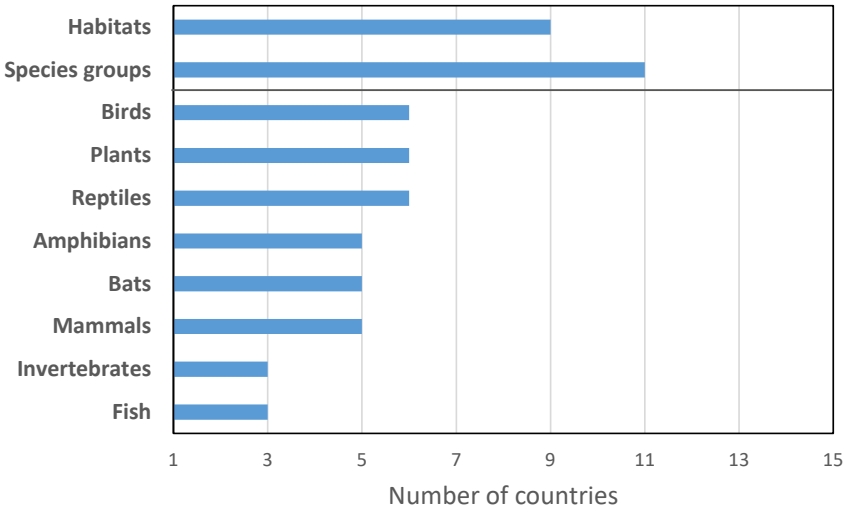


Figure 13: Results of a survey of 15 EU rail companies (rEvERsE and supporting countries) asking the question: Do you undertake monitoring of biodiversity? If yes, what is monitored? (Ref: UIC Reverse survey[5])

The process of monitoring biodiversity along the European rail network would ideally involve two linked activities. First of all, a stocktake must be carried out of the existing biodiversity, including habitats, associated with the rail network. Secondly, there must be regular assessments made of this biodiversity to assess change over time.

The collection of standardised data on the biodiversity associated with the rail network will be key for providing a baseline to our understanding of the current status of biodiversity. It will also enable the monitoring of future changes in both their extent and quality due to management actions and wider environmental drivers, such as climate change. Methods used for these assessments must be cost-effective, standardisable and repeatable across different countries. Crucially these methods must also account for the safety needs of staff undertaking work. It is also important that these data are compatible with other monitoring data so that the status of biodiversity on the rail network can be compared with that of the wider landscape.

To meet these requirements, we propose an approach which will build on, improve and connect together localised monitoring systems currently used by many railway companies, whilst recognising that there will be differences in data availability between countries. Where possible, these should be benchmarked against regional and national monitoring programmes. Methods should be modular (i.e. can be used independently) so that at some level datasets from different countries remain comparable, and countries can best utilise the different resources available to them.

5 uic.org/events/REVERSE-survey

5.2 AN INTEGRATED APPROACH TO BIODIVERSITY MONITORING

Ultimately, a robust and repeatable monitoring strategy is required which uses a range of methods that will allow rail companies to detect changes in the status of biodiversity across the land for which they are responsible. This should be integrated with the monitoring of other physical assets on the rail network (see **Case Study 8**). The approach to monitoring biodiversity needs to be standardised enough so that, at a basic level, rail companies in different countries are undertaking the same approach and the data can be combined to provide information across the whole of Europe. However, is should also allow for flexibility in building in more complex or high-resolution approaches in regions where this is possible, and data may be collected at different resolutions based on the capacity and funding available. For example, at a coarse level, changes in the extent of different habitats associated with the rail network could be assessed over time using satellite data. Other partners may have access to higher resolution satellite data or biological records data which allow for the assessment of habitat quality or species presence. Whichever approaches are used, it is important that each member country establishes a baseline from which repeated measures can be made, allowing reporting against objectives, as defined in high-level Performance Indicators.

The kinds of widely available data sources that should be drawn on are discussed in the following sections.

5.3 REMOTE SENSING DATA TO PROVIDE AN INVENTORY OF HABITAT TYPES AND HOW THEY HAVE CHANGED

Maps of the type and extent of land cover derived from remotely sensed imagery – for example, the CORINE land cover [22] inventory covers the whole of Europe – can be used to assess the habitats intersected by and surrounding the European Rail network to understand the extent of what is currently present and to measure future changes (Figure 14). The addition of high-resolution satellite data and aerial photographs may also be used to provide a finer-scale understanding of habitat type and changes in habitat extent on the lineside, and also the condition of particular areas of interest. Historical imagery, where available, could also be used to assess past changes. Data sensed remotely always requires integration with some form of ground survey to help classify the imagery and assess the accuracy of the land cover classes produced.

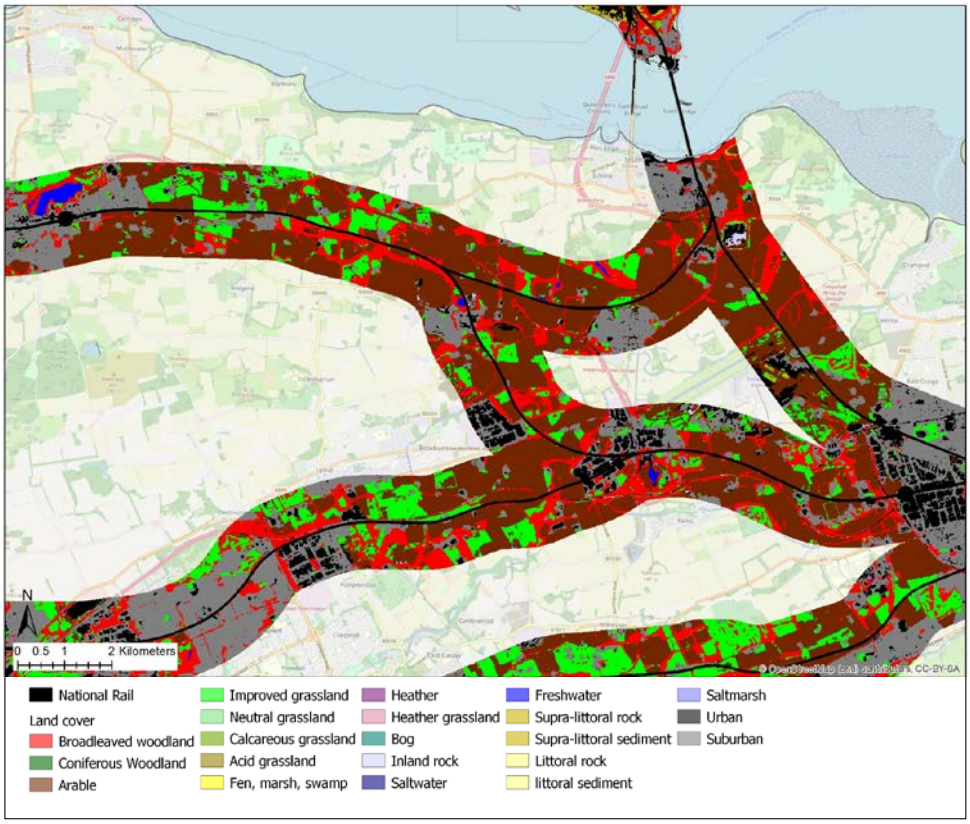


Figure 14: Habitat mapping of 1 km either side of the rail corridor in Scotland using a land cover map derived from Sentinel 2 [23], © Network Rail, UKCEH

5.4 USING RECORDS OF SPECIES OCCURRENCE

Many countries have existing databases of where species have occurred in the recent past (see **Case Study 1** and **Case Study 8**), held either in public national databases, such as the UK's National Biodiversity Network (NBN) Atlas, or uploaded to the international Global Biodiversity Information Facility (GBIF) platform (see **Case Study 1**). The existence of citizen science data, collected via local monitoring schemes or added to systems such as iRecord, provide information on the occurrence of different species at various spatial resolutions. The extent to which these data sources are available to be used will vary from country to country. Where such data is sufficient in volume, it can also be used to map the occurrence of native, rare or priority species in relation to the rail network. In addition, it can be used to map the occurrence of invasive alien species, such as Japanese knotweed, and inform control strategies for problematic species at a landscape scale.

For regions where data is lacking or deficient, species distribution models (SDM), which use knowledge of the requirements of species to predict their occurrence, could be used to ascertain where species are likely to occur in relation to the railway track and to identify areas of high predicted species richness. However, this approach generally works best where there is good knowledge of the ecological requirements of the species and there are reasonable numbers of records.

Case Study 7:
The Swedish approach to integrated survey of biodiversity

There are about 1,400 railway stations or designated stops on the Swedish rail network. The Swedish Transport Administration has developed a methodology for classifying and identifying stations with high biological diversity (see Figure 15). There are 237 railway stations that are classified as having high biological diversity, some of which are managed according to the template that has been developed.

The Swedish Transport Administration has also looked at all the bridges and pipes associated with water courses based on knowledge from county administrative boards, and surveyed for medium-sized mammals, such as otters, foxes and badgers. The Swedish Transport Administration has identified 655 bridges and pipes that may act as barriers to the movement of these species. Of these, 85 have been mitigated and the bridge and pipe has been adapted so that the animals can cross the railway without risk of collision. In addition, an inventory of some pilot areas concluded that 110 of the pipes that are placed in watercourses are barriers for aquatic organisms. Of these 27 have been adapted to date.

Figure 15: Pipes and ducts to facilitate movement of medium-sized mammals under Swedish railways, © Trafikverket

See additional case studies in the Appendix:

- **Case Study A 6**: Mapping invasive alien species on the Irish rail network
- **Case Study A 7**: Tool for the detection and management of invasive alien species at DB Netz AG

5.5 THE USE OF NOVEL TECHNOLOGIES TO MONITOR BIODIVERSITY

As technology has progressed, ever-more sophisticated ways of recording and monitoring wildlife have been developed, with novel approaches appearing every year. High resolution satellite imagery and drone photography may aid in the detailed mapping of vegetation extent and condition, especially if linked to LIDAR, a laser scanning system that produces 3D digital maps of habitat structure. In addition, existing image recognition technologies could be deployed that use on-train cameras to identify invasive alien species, and potentially different types of habitats. Finally, automated acoustic and visual detection of animals, such as bats, birds, small mammals and insects, are in development (see **Case Study 8**). eDNA protocols also exist for identifying the presence of species in water bodies, soils and (potentially) from air samples.

Case Study 8:
UK autonomous biodiversity monitoring station

Network Rail in the UK are working in collaboration with the UK Centre for Ecology & Hydrology to develop a fully autonomous biodiversity monitoring station for deployment on the lineside (see Figure 16). The station is solar powered and comprises acoustic sensors for birds, bats and crickets. It also operates a light trap to monitor moths and camera traps for small mammals and large mammals. The data is automatically analysed using image- and sound-recognition algorithms. The station also collects detailed weather data which are of interest to both ecologists and rail infrastructure managers. The data is continuously transmitted to the data server using the 4G mobile phone network.

Figure 16: Autonomous biodiversity monitoring station on the lineside (left), Small mammal camera trap (right), © Network Rail

5.6 SHARING THE SKILLS AND TOOLS FOR RECORDING BIODIVERSITY

Around 75% of the European rail companies surveyed now employ ecologists. It would be valuable for these professional ecologists to form a network for sharing best practice across the continent. In addition, building on the training and experience of these professionals, it should be possible to develop new protocols for the systematic collection of biodiversity data. Such ground surveys could themselves form the basis of dedicated monitoring schemes to track changes in biodiversity over time. However, they might also be deployed in parallel with remote sensing to deliver more detailed information on habitat condition for example, or as a means of validating the impacts of habitat management. Recent advances in image recognition and mobile phone technology (citizen science) mean that it should also be possible to train existing maintenance staff and provide them with the tools to record biodiversity information, for example animal deaths or presence/absence of invasive species, as they fulfil other tasks. Any ground surveys involving staff working on or near the lineside will inevitably bring increased issues around safety, of course, which needs to be factored into proposals. However, some of these technologies effectively automate the process of data collection, reducing the need for personnel on the lineside.

5.7 ENSURING THE INTEGRATION OF DATA ALREADY COLLECTED

Many rail companies already collect ecological data as part of routine surveys, for example to provide records of species occurrence and habitat management. It is important to capitalise on this existing data by putting in place proper procedures for standardised digitisation, cloud storage and sharing of such information so that it is not lost and can be readily integrated with other data sources.

5.8 DATA MANAGEMENT AND REPORTING

In addition to the effective protocols for biodiversity monitoring and data collection outlined above, it is crucial that systems are put in place for the proper storage of data, to allow their ready access and interpretation. As with monitoring, these protocols need to be standardised across project partners. Data should be stored and managed in the cloud to maximise accessibility and opportunities for sharing. The data may also be uploaded to national and international biodiversity repositories, for example the Global Biodiversity Information Facility (GBIF).

Ultimately, data such as indicators of coverage and condition of habitats along a given route or records of wildlife mortality need to be made available to decision makers to allow them to take action. These should be integrated with other spatial data sets within Geographical Information Systems so that end users can plan action on the ground (see **Case Study 4** and **Case Study 9**).

Examples of how easily understandable biodiversity data can be used include:

- Biodiversity hotspots can be identified, and actions taken to conserve or manage them;
- Wildlife mortality 'hotspots' can be identified, and actions taken to reduce the number of animal deaths;
- Progress in identifying and removing invasive plant species can be tracked;
- Opportunities for connecting together isolated habitat fragments can be identified;
- Measures that need to be implemented and monitored due to legal approvals, such as Environmental Impact Assessments, can be identified;
- Management plans for railway embankments, ditches and other green spaces on railway property can be drawn up.

Internal reporting must be undertaken regularly, with reports written in language accessible to non-specialists, to indicate the progress being made towards Performance Indicators (see **Chapter 6**). To ensure the transparency of rail companies' activities and progress towards meeting biodiversity goals within the context of the EU's Biodiversity Strategy for 2030 objectives (see **Chapter 2**), annual 'State of Nature' reports can be published. Once again, these should be accessible in terms of language and style, and easily understood and used by non-ecologists.

Case Study 9:
An integrated system for biodiversity recording and reporting

For German rail company, Deutsche Bahn, the planning, implementation and maintenance of nature conservation compensation measures involve many parties and there are frequent changes in personnel and responsibilities (see Figure 17). It must be ensured that all information is available to those involved. In addition, Deutsche Bahn must make information on compensation measures available to the approval authorities. All data on nature conservation compensation measures are recorded in the company-wide IT tool "Fachinformationssystem Naturschutz und Kompensation" (FINK).

The measures are documented and accompanied in the application throughout the entire process, i.e. from planning to implementation and maintenance. DB employees as well as external environmental planning offices can call up the current status of a compensation measure at any time. The system standardises the entire environmental planning process and makes high-quality management of compensation areas possible. At the same time, FINK is used to create documents for authorities.

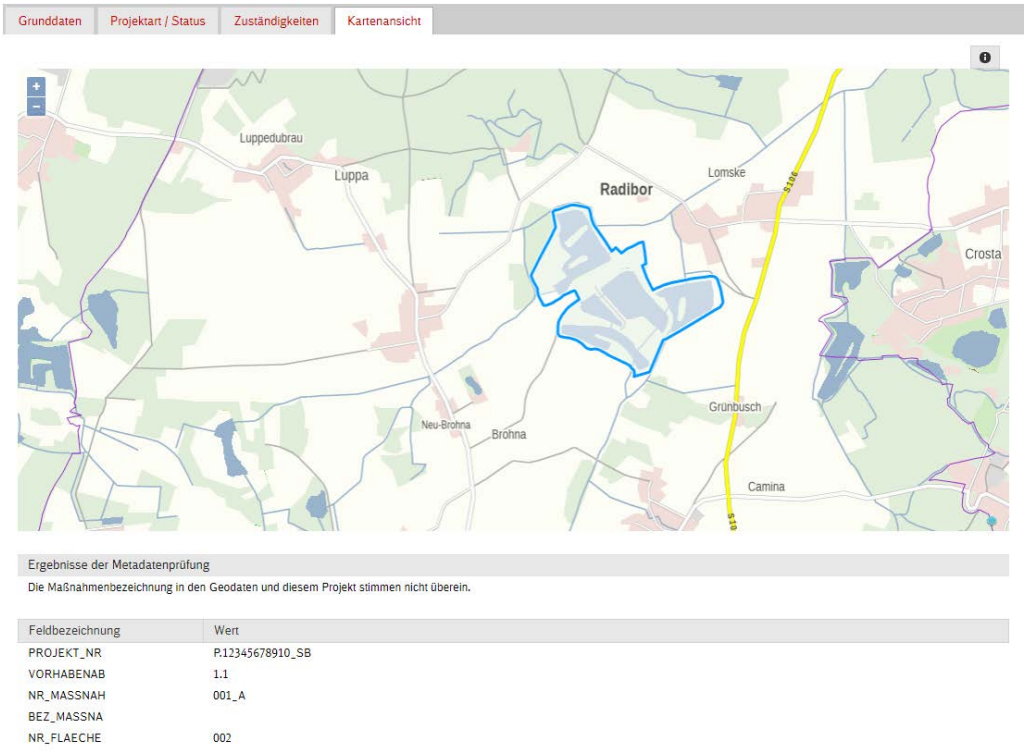


Figure 17: Geographic Information System (GIS) for the documentation of nature conservation compensation measures

6. PERFORMANCE MEASURES

MAKE A COMMITMENT TO BIODIVERSITY NET GAIN

Set ambitious targets for conserving and enhancing biodiversity, with no net loss of biodiversity by 2030, and net gain by 2050, with progress assessed through regular monitoring.

Biodiversity strategies are only as good as their outcomes. It is therefore important that a set of agreed measures of success are developed which are, to some degree, transferable across different parts of the rail network. However, there are important distinctions between measures of success applicable to the owners of the rail infrastructure and those relating to train operating companies. The former are likely to be longer term in ambition and the latter applicable over shorter timescales. In addition, there will be legal obligations – for both types of organisation – that vary from country to country. In this section, we suggest measures of success for both parties.

6.1 PERFORMANCE INDICATORS

These measures of success can be thought of as Performance Indicators (PIs) in just the same way as companies and organisations use PIs as traditional measures of their financial performance, health and safety, and so forth.

Biodiversity PIs are high-level outcomes focused on measuring changes in biodiversity across the rail network. These should be reported annually in a way that can be easily understood by non-ecologists and communicated both internally and externally.

PIs should be quantifiable and verifiable using the measures for monitoring biodiversity outlined in **Chapter 5.** They should also be linked directly to, and measure progress against, pre-agreed objectives or targets.

Regular monitoring of PIs provides an important method of evaluating progress towards those objectives. However, any set of strategies and actions for biodiversity should ideally also be evaluated against a set of external criteria that encourage best practice. Due to the complex nature of biodiversity, and its associated legislation and policies, this kind of benchmarking is more straightforward for some PIs than others. However, by, using standardised data collection and integration, and sharing ideas and case studies, it should be possible for the rEvERsE project partners to develop a set of agreed benchmarks.

See Strategic Goals & Action Guide – page 12-13

In Table 4, we suggest a number of high-level PIs together with appropriate benchmarks that have been developed in discussion with the rEvERsE project partners and are applicable and appropriate to the operation of the European rail network.

It may also be appropriate to have PIs that link to stakeholder engagement, which is the topic of the next chapter. For example, Network Rail's Biodiversity Action Plan includes the following as one of its key performance measures: 'Work in partnership with our neighbours and stakeholders to ensure that the lineside estate contributes to improving the biodiversity of the local area, and also maximises the value and connectivity of its routes as wildlife corridors' (see **Case Study 10**).

Case Study 10:
Network Rail's Biodiversity Action Plan

In 2020, Network Rail in the UK published their Biodiversity Action Plan. This committed the company to a series of time-bound, meaningful and measurable biodiversity targets:

- 2021: Publish a new biodiversity standard to help us better care for plants and other wildlife.
- 2024: Collect baseline information about our diverse railway habitats so that we can manage them effectively. Run a reliable railway and look after all existing plants and wildlife on our land in a way that causes no net loss of biodiversity.
- 2035: Increase levels of biodiversity near the railway by creating new habitats or managing invasive weeds. Lead the way in land management, advising others on how to manage and increase biodiversity.

Table 4: Suggestions for Performance Indicators (PIs) for biodiversity management

Objective	PI	Examples of appropriate measurements	Possible benchmark
Expanding the amount of wildlife habitat associated with the rail infrastructure	Increasing the proportion of natural habitat created or restored along the network, either de novo or as mitigation against loss of existing habitat. Increasing area of alien species management	Area of biodiverse habitat created or restored	An appropriate benchmark might be achieving the same proportion of natural habitat as found in the surrounding region
Increasing the connectivity of habitats along and adjacent to the network	Increasing connectivity as measured by consistent landscape connectivity measures	Positive trend in habitat connectivity indices	An appropriate benchmark might be achieving the same connectivity found in nearby high nature-value landscapes
Protection of rare species and habitats	Increasing population trends for target species that occur along the network over five years Also, see below 'Reduction in number of animals killed along the network'	Active monitoring of rare and threatened species and habitats Positive trend in population size or extent of habitat	A benchmark might be to compare trends on the railway to regional or national trends for rare or protected species
Reduction in number of animals killed along the network	Increasing length of track with measures to increase permeability to wildlife, such as green bridges and culverts, and which reduces deaths via wire strikes or entrapment between rails Active targeting of these measures to wildlife hotspots	(Wild) animal collisions: % of identified hot spots or identified line length [km] equipped with protection measures Permeability – number of culverts per km Bird protection at the overhead lines of tracks: % of track network or line/track length [km] equipped with bird protection measures	The ideal benchmark here would be zero animals killed along the network, which is something to aim for but not feasible
Management of invasive alien species	Proportion of habitat from which invasive species have been removed	Areas of invasive (plant) species treatment	Zero tolerance of species listed on the EU's Invasive Alien Species of Union concern: ec.europa.eu/environment/nature/invasivealien/list/index_en.htm
Improved Ground water and water quality	Increasing the proportion of estate that is unsealed	Proportion of sealed and unsealed railway real estate: %	
Reduced environmental pollution risk	Decreasing the proportion of estate that is classed as unsealed brownfield Decreasing length of track treated with chemical herbicides, increasing length of track treated with alternative weed control measures (note that the toxicity of the herbicide active ingredients should also be reduced)	Ecologically orientated vegetation management alongside the tracks: % of alongside track areas/areas in general managed in an ecological way or length of alongside track areas [km]/areas in general [ha] managed in an ecological way Use of herbicides: % of tracks treated with herbicides /non-chemical methods or track length [km]/track area [ha]/areas [ha] treated with herbicides/non-chemical methods	

7. STAKEHOLDER ENGAGEMENT

PARTNERSHIP WORKING

Seek partnerships with stakeholders to deliver benefits to biodiversity at scale and in the long term.

SHARE BEST PRACTICE

Publish and share best-practice guidelines for managing and conserving biodiversity management with one another and with stakeholders to improve their effectiveness.

IMPROVE COMMUNICATIONS

Use a wide range of communication tools to openly communicate plans for, and approaches to, biodiversity management with employees, passengers, society and neighbours, and to disseminate progress and achievements.

In relation to biodiversity along the European rail network, stakeholders can be thought of as any individuals or groups whose work or life are directly or indirectly impacted by railway biodiversity or activities around its management. These stakeholders may be internal to the rail network (employees or contractors) or external, such as passengers, neighbours or special interest groups, such as conservation non-governmental organisations (NGOs – e.g. WWF-CEE, see **Case Study 11**).

If these strategies and actions for biodiversity are to be successful in the long term, effective and transparent engagement with both internal and external stakeholders is essential.

Case Study 11:
Partnership working between UIC and the Worldwide Fund for Nature Central and Eastern Europe (WWF-CEE)

In 2020[6] UIC signed a memorandum of understanding (MoU) with WWF Central-Eastern Europe to promote environmentally conscious rail transport in Central and Eastern Europe by enhancing cooperation between stakeholders. In particular, this MoU aims strengthen partnership working in the region of Central and South-East Europe, known as the Green Heart of Europe, and act as a catalyst to promote this approach globally. The partnership between UIC members and WWF-CEE has established a dialogue and knowledge sharing in domains of common interest, including management of landscapes for ecological connectivity and corridors.

6 For more information, please consult: uic.org/com/enews/article/working-together-for-wildlife-and-railway-corridors-with-wwf-cee

See **Strategic Goals & Action Guide** – page 12-13

The REVERSE project meetings also provided a forum for members of the UIC-CEE partnership to share the latest outcomes of research and monitoring , including European projects, such as TransGreen and BISON. As such, this partnership has helped to identify and promote some of the many practical solutions urgently needed to secure a living planet for people and nature.

> *Travel by train is one of the more environmentally friendly modes of travel in terms of energy efficiency and emissions - anywhere between ten to 20 times less polluting than air travel.*
>
> ***Andreas BECKMANN, WWF-CEE***

> *A holistic approach is necessary if the railway is to be the champion of transport.*
>
> ***François DAVENNE, UIC***

See additional case study in the Appendix:

- **Case Study A 8**: Engaging internal stakeholders in assessing and conserving biodiversity

7.1 INTERNAL STAKEHOLDERS

Engaging internal stakeholders is crucial to ensuring that biodiversity management becomes embedded in the business planning and operational procedures of a company. Principles for effective engagement with internal stakeholders include:

- **Embedding biodiversity in the business:** ensuring that biodiversity management and conservation is considered at all levels of the business, e.g. by making it a material topic in the company's environmental and sustainability strategies and programmes.
- **Benefits of biodiversity across sectors:** making the benefits of biodiversity management clear to other parts of the business. In doing this, ensuring you have champions for your cause in other sectors of the business, and at all levels, from CEO to trainee or apprentice, thus creating an internal network of experts and ambassadors.
- **Clear communication:** transparent and effective communication of ideas, providing clear information and rationale for different activities.
- **Biodiversity as an asset:** ensuring that language is used which communicates biodiversity as a company asset that needs to be managed and cared for like other assets.

- **Staff engagement:** provision of training and further education of staff on the subject of biodiversity. Offering a volunteer programme of "habitat management" activities on railway property. Finally, the integration of eco- and biodiversity-focused excursions to railway projects and biodiversity hotspots for staff.
- **Biodiversity and wider sustainability:** measures include consideration of biodiversity impacts along the supply chain and the sourcing of biodiversity-friendly food for staff canteens and food outlets.

7.2 EXTERNAL STAKEHOLDERS

A key initial step to any successful biodiversity strategy is defining which stakeholders will be engaged in rail companies' processes and plans for biodiversity management and enhancement, and how their objectives are aligned with those of the rail companies. This has been done effectively in Austria (see **Case Study A 8**), Ireland (**Case Study 11**) and in the UK in the Network Rail Biodiversity Action [23].

Engagement with external stakeholders should be proactive rather than reactive. That is to say, rather than waiting for individuals or organisations to make contact about activities, reach out to them at an early stage to ensure that biodiversity management actions also meet everyone's needs through engagement in co-design.

Passengers waiting at a station or travelling in a carriage are an important audience who should be informed about the biodiversity-related work that a company is undertaking. This can be in the form of informative posters presenting data about biodiversity along the network, as well as videos, information leaflets, writers-in-residence and so forth. Most people (and therefore most passengers) in Europe care about the environment; a survey in March 2020 revealed that 94% of citizens in all EU member states say that protecting the environment is important to them and that 91% of citizens stated that climate change is a serious problem in the EU [24]. It follows that companies should publicise their biodiversity actions in order to demonstrate their commitment to the environment in which people live and work, and especially their efforts to combat climate change by restoring and creating habitats.

7.3 PARTNERSHIP WORKING

Whenever habitat creation and management projects are planned, opportunities for working in partnership with lineside neighbours and stakeholders must be explored from the outset. There is huge potential for adding value to habitat creation and restoration if it can link with similar existing or planned habitat nearby.

Scale is an important factor here and, as a general rule, 'bigger is better' when it comes to natural habitats. It is also important that activities are transparent and that the public and employees are kept informed of objectives and progress towards meeting biodiversity goals. As an example of this, the Network Rail Biodiversity Action Plan (BAP) has as one of its commitments: 'forming and maintaining partnerships with our stakeholders and neighbours to maximise the benefits a well-managed transport infrastructure can bring for biodiversity'.

The Network Rail BAP lists 26 stakeholder organisations with which they have engaged, ranging from small NGOs, for example the Bat Conservation Trust and Plantlife, through to government departments and agencies, such as the Department for Environment, Food & Rural Affairs (Defra) and Natural England. The main point of contact with partners is Network Rail's ecologists, and stakeholder workshops and meetings are conducted at a local level. Network Rail also produces a wide range of publicity materials to advertise its partnership working.

See additional case study in the Appendix:

- **Case Study A 10**: Partnership working on the Booterstown Nature Reserve, UNESCO Dublin Bay Biosphere Reserve

8. WHAT'S NEXT FOR RAILWAYS

As the world seeks to create solutions to the climate emergency and the biodiversity crisis, it is clear that all sectors of society, including the companies and authorities represented by the European rail network, have a part to play. Rail transport already has a strong reputation as one of the most efficient and environmentally friendly options for mass transport of people and freight. In its transition to a net zero carbon future, the rail industry can also play an important role in reversing biodiversity loss across the continent. Indeed, these two areas of environmental concern – climate change and declining biodiversity – are closely linked both in terms of their underlying causes and their solutions. The conservation, restoration and indeed creation of natural habitats along the rail network will help to lock up carbon dioxide in the soils and vegetation of grasslands, forests and wetlands. At the same time, these habitats can act as refuges and corridors for species, allowing them to move around the continent as climate change alters their existing habitats.

Based on the case studies presented in this document, UIC and its members call on the community to integrate biodiversity into their activities, throughout all the lifecycle phases of a railway, from planning the route, through to construction, operation and finally decommissioning.

The dissemination of best practice and sharing of data will go a long way towards promoting a shared vision of sustainable and biodiverse future railway infrastructure across the rEvERsE project partners and beyond. It will be vital to ensure that biodiversity conservation is one of the central environmental goals of all railway companies across the European rail network.

It is clear that European railways have a bright future, being core to the delivery of the commitments to protect and enhance nature laid down in the EU Biodiversity Strategy 2030 and, more widely, supporting the green recovery of the continent as part of the European Green Deal. Since railways are part of the solution to some of the most severe environmental crises, it can be expected that they will play a much more important role in the European transport sector. Further extension of the network and increases in transport capacities will have to be managed in line with biodiversity conservation goals and will even reduce the overall pressure on nature and ecosystems. Following the completion of the rEvERsE project, the next document to be released will strive to guide the railway sector in the execution of the strategies and actions outlined in this report and is scheduled to be published by UIC in 2023.

Figure 18: ÖBB-Infrastruktur AG

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10. GLOSSARY

Biodiversity	a contraction of "biological diversity" which refers to the variety of life on Earth at all its levels, from variation in genes within a population, to the number of species within a habitat, to the range of ecosystems in a region.
Ecological corridor	a continuous stretch of habitat that allows the movement of species between areas.
Ecosystem	all of the organisms in an area (i.e. the ecological "community") plus physical environment (water, geology, weather, etc.) with which they interact.
Ecosystem services	those aspects of ecosystems that directly benefit humans by enhancing our welfare or economies.
Fragmentation	the process by which contiguous ecological habitats become divided into smaller, separate patches.
Greenhouse gas	gases in Earth's atmosphere that trap heat and which affect global climate change, for example carbon dioxide and methane.
Habitat	a location in which the immediate requirements of a species are met, for example a woodland where the trees support a range of wildlife.
Habitat restoration	the process of assisting the recovery of an ecosystem that has been degraded or damaged, usually by human activities but sometimes by natural disasters.
Habitat translocation	the physical movement of a habitat from one area to another, for example stripping the turf and subsoil from a grassland and moving it to a new locality.
Invasive alien species	a species that has been moved by human agency into a habitat where it would not naturally occur, and which is causing significant ecological or economic impacts.
Mitigation hierarchy	a best-practice approach to avoiding, minimising and offsetting negative impacts from planned developments.

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12. ADDITIONAL CASE STUDIES

Case Study A 1:
From dumpsite to nature sanctuary

During the course of building a new high-performance railway line from Vienna to Salzburg, a 13.3 km system beneath the Vienna Woods was constructed. Excavation material from the tunnel was deposited in an old waste landfill site on Taglesberg in the Vienna Woods. Originating in the 1980s, this site did not meet environmental regulations and was a contamination threat to the groundwater in that area. Consequently, the site was registered as an area of suspected contamination. The entire clean-up, restoration and landfill activities took place over a seven-year period (between November 2001 and December 2008).

a)

b)

c)

Figure 19: (a) Waste dump site in 2005, (b) Landfill with tunnel excavation material in 2007, (c) aerial view of Taglesberg in 2010, © ÖBB Infra

In 2007, 1.1 million tonnes of excavation material were deposited at that site, most of it transported in a very environmentally friendly way using a conveyor belt. All the deposited material was profiled in order to fit into the typical landscape of the Vienna Woods, which is an important recreation area for the inhabitants of the city. In 2005, the region was declared a UNESCO Biosphere Reserve. Due to the zoning of the Biosphere Reserve, the dumpsite has become part of the Biosphere Reserve management zone. Hence, the huge landscape pit of the former waste dump has been transformed into a smooth terrain, ready to become part of the forest again. The whole area has been replanted with plants such as red clover and bur clover that grow roots deep into the ground. Thousands of local trees and bushes have been replanted as well. The reforestation took place, in part, in cooperation with local elementary schools, to keep children in touch with nature and to familiarise them with the transport infrastructure project.

Figure 20: Elementary school students and landscape management in Austria, ÖBB Infra

The reforestation was planned and coordinated by the Austrian Federal Forests. Whilst the forest authority required a complete reforestation of the dumpsite (8 ha), biological monitoring over the following years revealed that some sub-areas of the landfill site, especially where forest development did not meet expectations, showed highly valuable transition habitats for rare species of plants, insects, reptiles, amphibians and birds. This monitoring work enabled the retention of this valuable, open biodiverse habitat. The Biosphere Reserve management team will take care of the maintenance programme and organise volunteers for conservation activities.

Case Study A 2:

Abandoned railway tunnels as habitat for bats and measures for improving habitat quality

Twelve tunnels along the Tauernbahn railway line in Carinthia, Austria were abandoned due to the relocation of the main tracks. As part of the ÖBB initiative “Green Points”, a project was launched to investigate the function of the tunnels as habitat for bats. Furthermore, measures for improving the surrounding habitat quality for bats were planned and put into action. To obtain information about temperature and humidity conditions, data loggers were placed in the tunnels. Because different bat species have different temperature requirements for their hibernation, a detailed knowledge of temperature range and fluctuations is of great importance. The existing use of the tunnels by hibernating bats was checked visually during the winter months. During summer, automated recording devices for recording bat calls were used, as well as mist netting in front of the tunnels. So far, six bat species have been recorded in the tunnels: Lesser horseshoe bat, Natterers’ bat, Mouse-eared bat, Common pipistrelle, Barbastelle, and a species of the genus *Plecotus*. Based on these first results, we initiated work to ensure that:

i. the tunnel entrances enabled access for bats and supported the microclimatic conditions aimed for in the different tunnels;
ii. human disturbances in the tunnels were minimised; and
iii. hollow concrete blocks were placed in the tunnels to increase the number of available crevices for bats.

The effectiveness of these measures and the population trends of the bats will be monitored in the coming years. The results will provide important guidelines for the improvement of abandoned tunnels as habitat for bats.

a)

b)

c)

Figure 21: (a) Tunnel Tauernrampe Mallnitz © A.Wiltberger - ÖBB Infra , (b) the inspection of bricks, that have been installed for bats © H.Mixanig, - ÖBB Infra (c) brown-long eared bat © W.Forstmeier, - ÖBB Infra

Case Study A 3:
Helping protected peregrine falcons to breed

A pair of peregrine falcons repeatedly tried to breed on the bridge pier of an ICE line belonging to Deutsche Bahn AG. Due to the exposed location, all attempts were unsuccessful. There was a great willingness of employees on site to support the peregrine falcons, a protected and iconic species, in their efforts to build a nest.

The required solution had to fulfil several demands. The technical and operational issues, such as inspection of the bridge pillar at any time of the year, should not conflict with the legal requirements of not disturbing the birds' breeding. During numerous discussions between railway engineers and experts from a nature conservation association, all requirements were weighed up against each other.

As a result, the inspection schedules were adjusted so that they were outside the breeding season and, in the case that a spontaneous inspection would become necessary during the breeding season, this should be feasible in consultation with the experts of the nature conservation association. A nesting platform was installed on the bridge pillar head and since then the peregrine falcons have bred there successfully several times.

Figure 22: Nesting boxes for falcons, © Deutsche Bahn AG / Frank Kniestedt

Case Study A 4:
Management of railway embankments and other properties in Austria to increase landscape connectivity

The federal state government of Upper Austria approached ÖBB-Infrastruktur AG with the suggestion that the nature protection authority take over the landscape management of specific railway sites that are home to rare species of plants and animals.

The authority agreed to fund landscape management measures in order to protect and enhance valuable habitats. The nature protection authority subcontracted the practical work to landscape management companies, whose staff had to undergo the necessary safety training. To date, 33 sites with a total area of 4.5 ha in Upper Austria have been selected to be managed in this way.

Figure 23: Landscape management in Austrian Railways © ÖBB Infra

Case Study A 5:
Enhancing crossings for amphibians and monitoring the impact

The Swiss Federal Railway (SBB) initiated a project in 2017 to allow amphibians such as frogs and salamanders to cross railway tracks to get to breeding sites. They started by lowering the stone ballast between every 11th and 12th sleeper (and in some places more frequently) and by installing "amphibian plates" on the inside and outside of the rail on both sides (see Figure 24). These ingenious plates encourage the amphibians to cross the lines at the places where the ballast is lowered. The manufacturing of the plates was developed by the Cantonal Department of Nature Protection of Aargau. A video of how the amphibian plates function can be seen here: link.

A two-year monitoring of the effectiveness of the system has been funded by the National Department of Environment (BAFU) and conducted by WLS GmbH and should be completed by the end of 2021. However, it is clear to date that it allows faster and more direct crossing of the rail tracks by amphibians, and that no animals have died due to the air pressure of the trains.

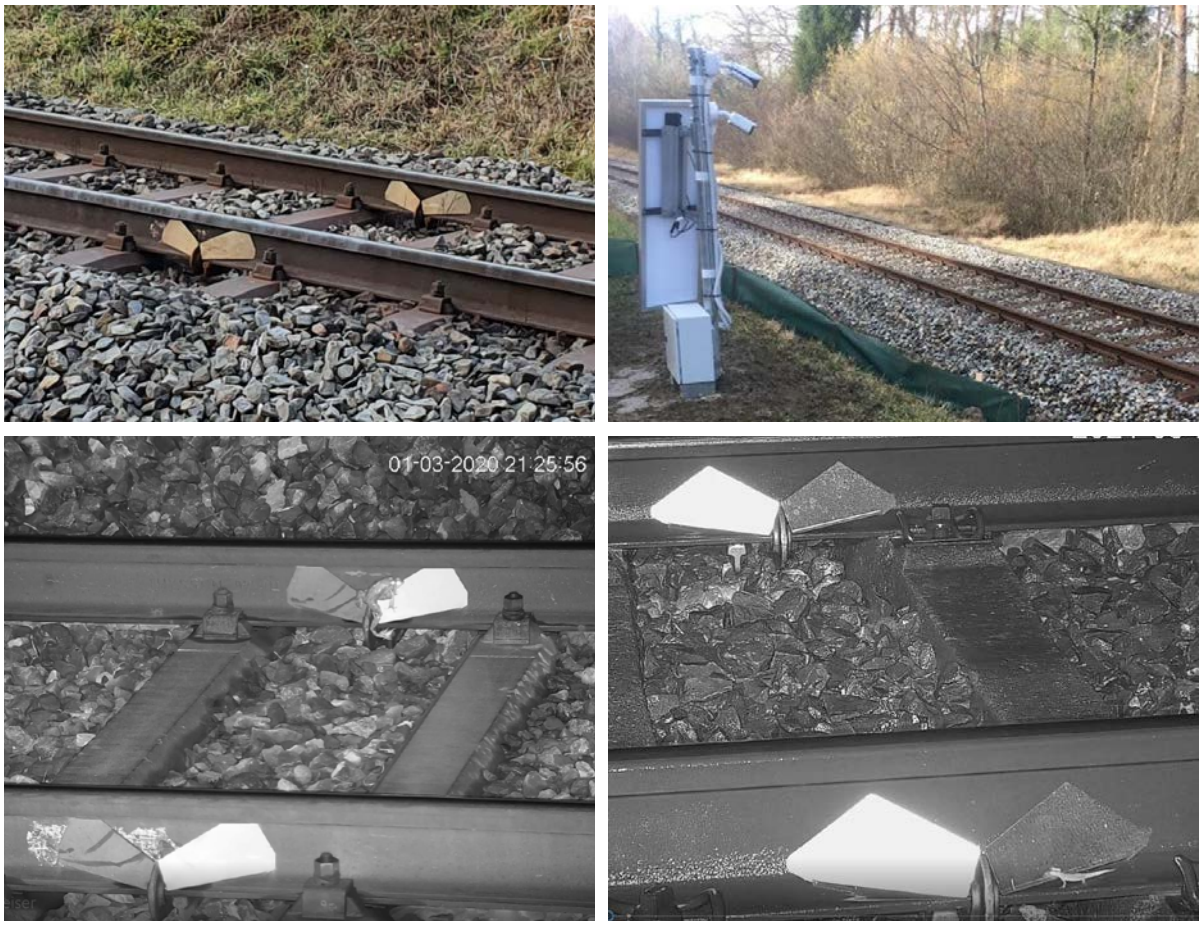

Figure 24: Amphibian protection on train tracks, Swiss Railways ©SBB – Kanton Aargau (Abt. Landschaft und Gewässer, Kt. Aargau), WLS.CH GmbH (Stefan Suter)

Case Study A 6:
Mapping invasive alien species on the Irish rail network

Irish Rail (Iarnród Éireann) carry out regular surveys of their lineside environmental assets to identify any signs of infestation by invasive alien species. A standard recording sheet is used to describe the infestation, including species, location, mileage and if there is any potential damage to nearby assets or third-party property. The information is added to the internal GIS system (IAMS) where it can be combined with other spatial data layers, viewed by engineers prior to projects, and highlights treatment planned or previously carried out. In this way, it is possible to efficiently plan management actions and track their effectiveness over time.

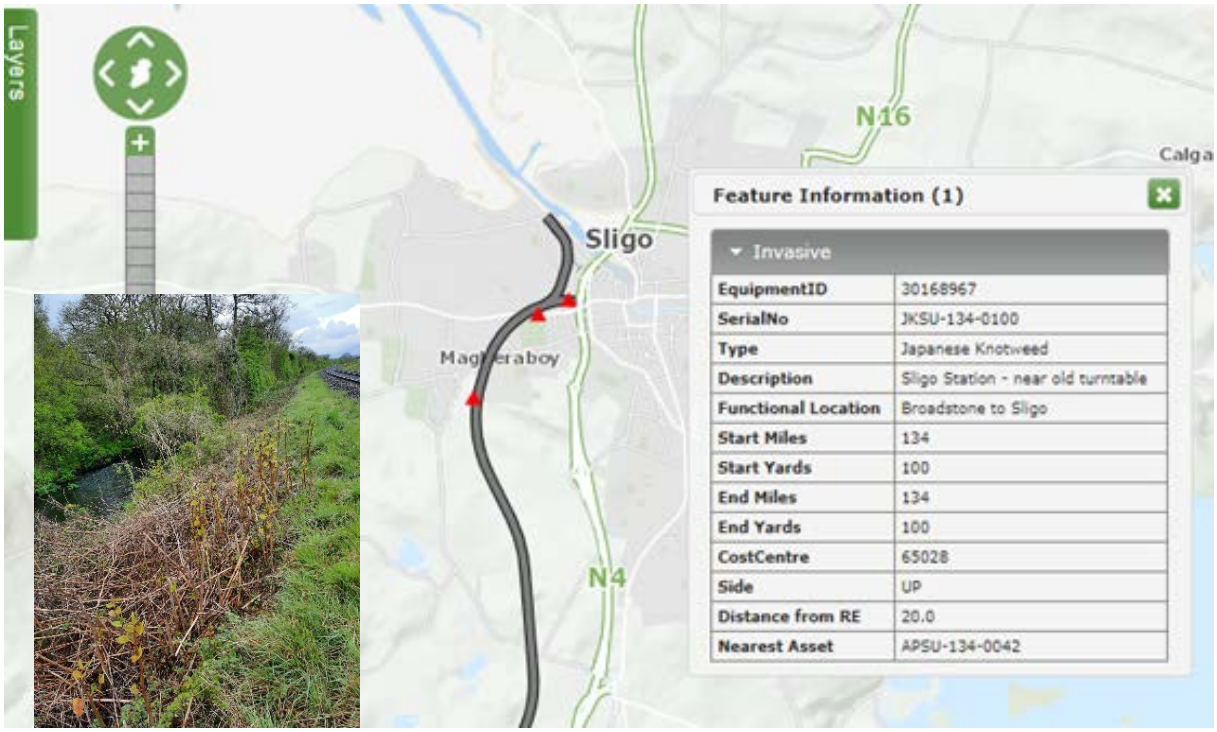

Figure 25: Spatial data layer in Irish Railway GIS for mapping biodiversity assets © CIE

Case Study A 7:
Tool for the detection and management of invasive alien species at DB Netz AG

In order to assess the traffic safety of vegetation along railway lines, DB Netz AG - Group subsidiary DB Fahrwegdienste has arranged for a Geographical Information System to be set up to record and manage the flora. This system, "*Digitales Management von Geodaten aus den Sparten UPM und Vegetation durch das Fahrwegdienste Fachinformationssystem*" (FaFIS)[7] also records invasive alien species.

During regular inspections of the vegetation in the immediate neighbourhood of railway lines, the inspectors collect data on a tablet device. The following species have been recorded: Japanese knotweed (Fallopia japonica), giant hogweed (Heracleum mantegazzianum), ragweed (Ambrosia artemisiifolia), Himalayan balsam (Impatiens glandulifera), tree of heaven (Ailanthus altissima) and ragwort (Senecio jacobaea). A timestamp is automatically set when the process is started. Other information collected includes spatial information, such as route kilometres and regional jurisdiction within Deutsche Bahn.

In addition to the identified species, there is further information on the spatial extent and size of the plants found, which in some cases is supplemented by photos. Furthermore, information on the accessibility of the site for machinery as well as information on legal obligations is provided. These may result from both operational and traffic safety. Finally, in addition to advice on safety measures, suggestions are made on vegetation control measures to be taken.

Figure 26: Aerial view of a Deutsche Bahn railway line with a marked occurrence of invasive alien species documented in the FaFIS (© GeoBasis-DE/BKG2018, © DB Netz AG, © DB Fahrwegdienste GmbH)

7 More information: fahrweg.dbnetze.com/fahrweg-de/unternehmen/db_netz_ag/externe_organisationen/fahrwegdienste-1368662

Case Study A 8:

Engaging internal stakeholders in assessing and conserving biodiversity

Within the Austrian company ÖBB-Infrastruktur AG, biodiversity was not considered as a topic in the original environmental training courses that were offered to staff before 2010. Traditionally, environmental training was primarily focused on waste management, contaminated sites and energy management. In 2010, a new internal training programme called “Railway Ecology” was started. This is a three-day programme (two days indoors and one day outdoors) that touches on many environmental and sustainable development related topics, in the context of railway planning, building, maintenance and operation. Biodiversity and the understanding of the value of nature and ecosystem services are an important focus of the programme. To date, more than 200 participants from almost all the different departments and fields of the company have successfully taken part in the programme. In 2014, the “Railway Ecology” course was awarded a UNESCO certificate for its contribution to the UN Decade of Education for Sustainable Development.

Figure 27: Railway Ecology course in Busserl tunnel Nord portal - awarded a UNESCO certificate for its contribution to the UN Decade of Education for Sustainable Development © ÖBB-Infrastruktur AG

Case Study A 9:
Partnership working to install bird protection along the Danube

ÖBB-Infrastruktur AG operates a railway network of almost 5,000 km in Austria, of which approximately 3,560 km are electrified. The electrified network suffers from roughly 4,000 short circuits on average each year, caused by trees, bushes, facility breakdowns and also birds and small mammals. Each short circuit leads to a very high mechanical and electrical stress for the infrastructure. The damage can be so severe that parts of the facility have to be replaced. Such maintenance works can be the reason for train delays and increased financial costs and demands on personnel. In almost all cases, a short circuit caused by a bird or small mammal results in a fatality for the animal. Consequently, ÖBB-Infrastruktur AG decided to take measures to reduce the number of these short circuits. Two of these measures are the application of a guard-device in front of the insulator and a bird protection cap on top of the catenary pole, where the feeder runs from one catenary pole to the other. These two devices effectively protect animals from electrocution. The guard-device keeps animals from getting into the section between the grounded and live power part of the facility, which would cause a short circuit. The bird protection cap isolates the live parts on top of the power pole and provides a safe resting place for large birds.

Figure 28: Measures to reduce the number of these short circuits - application of a guard-device in front of the insulator and a bird protection cap on top of the catenary pol (left) Lanius collurio (right) © ÖBB - Infra

From a species protection point of view, this is of particular importance, because it is predominantly large birds of prey, storks, herons and other rare and protected species that are especially areas where rare and protected bird species can be found. As a basis for this prioritisation, ÖBB-Infrastruktur AG asked the bird protection NGO Birdlife Austria to create a nationwide map of these priority zones. This data layer was then integrated into the Geographical Information System of the railway infrastructure. In cases of facility re-investments, the electrification of existing lines or the construction of new railway lines, both guard-device and bird protection caps are attached as standard. ÖBB-Infrastruktur AG started to use the bird protection cap in 2016 and has installed about 20,000 of them so far. About 10% of all catenary poles in the network have now been equipped with the caps. To date, there has been limited practical experience of the impact of the caps on the maintenance procedures. The positive effect of these measures is currently being measured from daily operations.

Case Study A 10:

Partnership working on the Booterstown Nature Reserve, UNESCO Dublin Bay Biosphere Reserve

Irish Rail (Iarnród Éireann) are working in partnership with the National Trust for Ireland (An Taisce), Birdwatch and Friends of Booterstown, amongst others, to manage this small, saltmarsh and wetland ecosystem famous for its bird life (including Little Egret) and rare flora (Borrer's saltmarsh grass).

Figure 29: Information board at the Booterstown Nature Reserve explaining the partnership with Irish Rail, © CIE (picture: Jeff Ollerton)[8]

8 For more information: www.dlrcoco.ie/sites/default/files/atoms/files/biodiversitybooterstown.pdf

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