



'INFRASTRUCTURE CORRIDORS, ECOLOGICAL CORRIDORS ?'

Status report and recommendations



July 2015

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This report was produced as part of a joint project between Club infrastructures linéaires et biodiversité (CILB) (Linear Infrastructure and Biodiversity Club) and the French committee of the International Union for the Conservation of Nature (IUCN).

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Preface by François Letourneux

(Vice-President of the French committee of the IUCN)

For companies, both public and private, that build and maintain roads, railway lines or canals, that lay and monitor gas pipelines or power lines, the need to protect nature as much as possible implies a number of obligations such as avoiding, as much as possible, the destruction of valuable environments or the blocking of natural corridors. Reducing or, failing that, compensating for this damage implies complex and costly work. It is a question of respecting a legal obligation. There is no reason to be particularly proud.

For public bodies and associations dedicated to protecting nature, every new worksite is seen as a setback as biodiversity shall be decimated, even if they had fought against the work and, when the decision is made, the harm is reduced as much as possible and the consequences are offset. There is no reason to celebrate.

The strategies used to preserve biodiversity are too often exclusively defensive: avoid, reduce, compensate and, therefore, lose as little as possible. But still lose.

What if, while retaining this defensive strategy that is essential to preserve biodiversity that is crumbling away under our feet, we went on the offensive together, where it is possible? What if we tried, together, to repair some of the planet's living fabric?

This is the small-scale, linear transport infrastructure approach taken by the Linear Infrastructures and Biodiversity Club and the French committee of the IUCN. It has not been an easy process. In the case of companies, by committing themselves to transcending legal requirements, would they not run the risk of seeing the state and associations step into the gap and tighten these legal constraints? In the case of nature conservation associations, by accepting that we can work on infrastructure in such a way as to make it useful for biodiversity, would they find it less comfortable than speaking out against all infrastructure projects and, when one goes ahead, brandishing the palm of martyrdom?

We have all decided to take this risk. If biodiversity is no longer just a constraint or a victim but becomes a project, we will all enjoy bringing that project to life. Engineers, who know what it means to build a network, will be proud of themselves if they can contribute to building a network for biodiversity. Nature conservation bodies will be proud of themselves if they can win back some land for biodiversity.

This seminar is only one stage on a long and difficult journey. Optimism can be drawn from the satisfaction or, I would go so far as to say, the passion of all of the participants. I would like to thank all those within the CILB, the French committee of the IUCN and the seminar's workshops who set the ball rolling!

1. Introduction

The individual or collective carriage of people and the transportation of raw materials and energy make the creation of linear infrastructure essential. This infrastructure takes the form of road networks, different types of railway line, canals, power line corridors, gas pipelines, etc. **This network has grown significantly** due to the needs of modern society.

Alongside the development of transport and infrastructure, the protection of nature emerged in the 1960s with the creation of the first wildlife crossings (Carsignol, 2012). The protection of nature was enshrined in law in the 1970s with the 1976 general law on the protection of nature and grew with the need to protect natural areas, landscapes, species and natural resources. European law subsequently imposed more stringent obligations.

Planners must assess the impact of their projects on the environment. They must then identify measures to avoid, reduce and, as a last resort, compensate for the project's impact.

Consideration of biodiversity has also continued to grow. France committed itself to stopping the erosion of biodiversity as from 2004 through a national strategy (SNB)¹, thereby applying the international commitments of the Convention on Biological Diversity² that it had signed in 1994. The new strategy (SNB 2011-2020) invites all those concerned, particularly companies, to contribute to the SNB's aims by adhering to it and then by forming a commitment plan that contains specific, ambitious and operational measures with a view to receiving SNB recognition³.

Appreciation of biodiversity has gradually moved from single species and protected or emblematic natural environments to biodiversity as a whole, ecological networks and ecosystem services.

Concepts such as green and blue belts and ecological functionalities made their way into laws and regulations thanks to the laws of 2010 and 2011 that were passed after the Grenelle Environment Forum and developed by their implementing decrees.

Land management regulations evolved in the same way: the methods used to assess and attenuate the impact of projects were specified in greater detail and more stringent requirements were introduced. Consequently, environmental assessments are carried out at the planning stage.

Nevertheless, the decline of biodiversity and, in particular, ordinary biodiversity*, has been proven and continues. For example, the number of common 'specialist' bird species⁴ fell by 21% between 1989 and 2013 (MNHN - CRBPO, 2014). This reduction is attributable to habitat disturbance. The fact that bats in mainland France are becoming increasingly rare is another example. The number of widely distributed species fell by 57% between 2006 and 2013 (MNHN - CERSP, 2014). These trends are also reflected in the Red list of endangered species in France, where common species have become endangered, alongside species that are naturally rarer in the country⁵.

¹ First national biodiversity strategy 2004-2010. <http://www.developpement-durable.gouv.fr/-La-Strategie-nationale-pour-la-.html>

² <http://www.cbd.int/convention/>

³ Several CILB members (AFSA, Eiffage Concessions, GRTgaz, RTE, SNCF Réseau, TIGF, VNF) have adhered to the strategy and four members have submitted a project that was awarded SNB recognition (GRTgaz, TIGF, RTE, Eiffage Concessions).

⁴ 'Specialist' species are common species found in agricultural, forest and built environments.

⁵ <http://www.uicn.fr/Liste-rouge-France.html>

In response to these alarming observations and changes to regulatory requirements, **consideration of nature by companies has changed**, particularly under the influence of the Grenelle Environment Forum. Previously considered as a side note within a project, biodiversity has become an unavoidable subject and has gradually formed part of the heart of the project. While there were a few long-standing partnerships between environmental NGOs and companies (for example, ENEDIS and RTE with the Bird protection society, LPO), more and more firms are bringing ecologists into their teams. Furthermore, pilot operations are carried out and assessed, and several partnerships with NGOs, natural scientists or scientists have been formed.

This project is part of this change in direction and aims to **strengthen the response to the decline in biodiversity and help companies remain committed and improve and extend their actions.**

2. A joint project

2.1 The issues at hand

More than ever before, maintaining, restoring or even creating areas that favour biodiversity*⁶ is vital. The destruction of natural habitats and the fragmentation of land are two of the main reasons for which biodiversity is being eroded; there is also growing pressure on land. Furthermore, the preservation of ecosystem functionalities is clearly a collective priority.

Linear transport infrastructure*⁷ - roads, motorways, railway lines, canals, navigable waterways, gas pipelines, power lines - contributes to this fragmentation. This type of infrastructure has, in fact, a significant temporary and permanent impact and also disturbs species and destroys habitats. Nevertheless, green appurtenances* that run alongside the infrastructure can, under certain conditions, host various habitats and be used by a range of species. In total, this space represents several hundred thousand hectares. What role is currently played by green appurtenances in the preservation of biodiversity with regards to their management and connection to the network of habitats that they cross? How can they be improved?

The members of the *Club des infrastructures linéaires et biodiversité* (CILB), which comprises nine linear transport infrastructure managers [l'Association des Sociétés Françaises d'Autoroutes (AFSA), Eiffage Concessions, ENEDIS (formerly ERDF), GRTgaz, Ligne Sea Tours-Bordeaux (LISEA), SNCF Réseau (formerly RFF), Réseau de Transport d'Electricité (RTE), Transport et Infrastructures Gaz France (TIGF) and Voies Navigables de France (VNF)], have voiced their need to develop or receive support from ecological experts to construct a sustainable response to biodiversity challenges.

⁶ Each term followed by an asterisk can be found in the lexicon on page 30.

⁷ The various types of infrastructure are shown in diagrams on pages 26 to 28.

The CILB approached the French committee of the IUCN to work together on the following question:

'Under what conditions can linear transport infrastructure and its rights-of-ways contribute effectively to ecological networks*?'

This initiative is original for two reasons:

- It is an approach that is shared by the representatives of the different types of linear infrastructure and that focuses on the infrastructure's combined positive and negative effects;
- It is a call to ecologists so that they may confirm and specify the role of rights-of-ways for the ecological networks and, ultimately, guide companies in terms of the design of this essential part of their biodiversity project⁸.

2.2 The method

The aim shared by the CILB and IUCN France was to identify the conditions necessary (whether technical, legal, financial or ecological, etc.) to optimise the role of rights-of-ways as ecological corridors on the basis of a global and multi-scale approach.

As part of this process, **IUCN France created a discussion group called, 'linear transport infrastructure and ecological networks'**, made up of experts and members from its network.

With this group, IUCN France started to draft a status report on the challenges, current knowledge, active networks, conservationists and companies involved in this subject.

This report also drew on:

- around **20 telephone-based interviews** with scientists, public officials, engineering firms, environment managers within the companies, and project managers within structures that manage natural areas or environmental protection associations, etc.
- a collection of over **100 written documents** (scientific articles and reports, technical press articles, communication documents, etc.).

This work uncovered the main challenges connected to linear transport infrastructure and biodiversity, and nourished the discussions between the CILB and the IUCN France discussion group.

IUCN France and the CILB, believing that it is important to hold group discussions with all those involved, then organised a working seminar. It was held on 3 November 2014 and brought together 170 participants with different backgrounds and structures (companies, NGOs, public services and local authorities, researchers, farmers, etc.). Structured around ten workshops and presentations on French and foreign experiments (see agenda in the appendix), this working seminar allowed the participants to discuss their experience and voice their opinions to **shed light on three aims:**

⁸ This project is dynamic in nature and may be local or global. For example: a company's biodiversity strategy, biodiversity preservation tools, etc.

1. To assess the potential contribution of green appurtenances to ecological networks,
2. To raise awareness of specific operations that demonstrate a real desire and capacity to improve business practices,
3. To identify possible solutions to improve these practices and boost the contribution of green appurtenances to biodiversity.

The extensive involvement of those concerned and the quality and transparency of the discussions revealed that there was a common interest in working on this subject but also a need for dialogue between the various stakeholders.

The discussions, lessons drawn and recommendations made during the seminar enriched the status report. This document is based on the status report and the recommendations.

Figure 1, below, summarises the three stages that were necessary to produce this document.

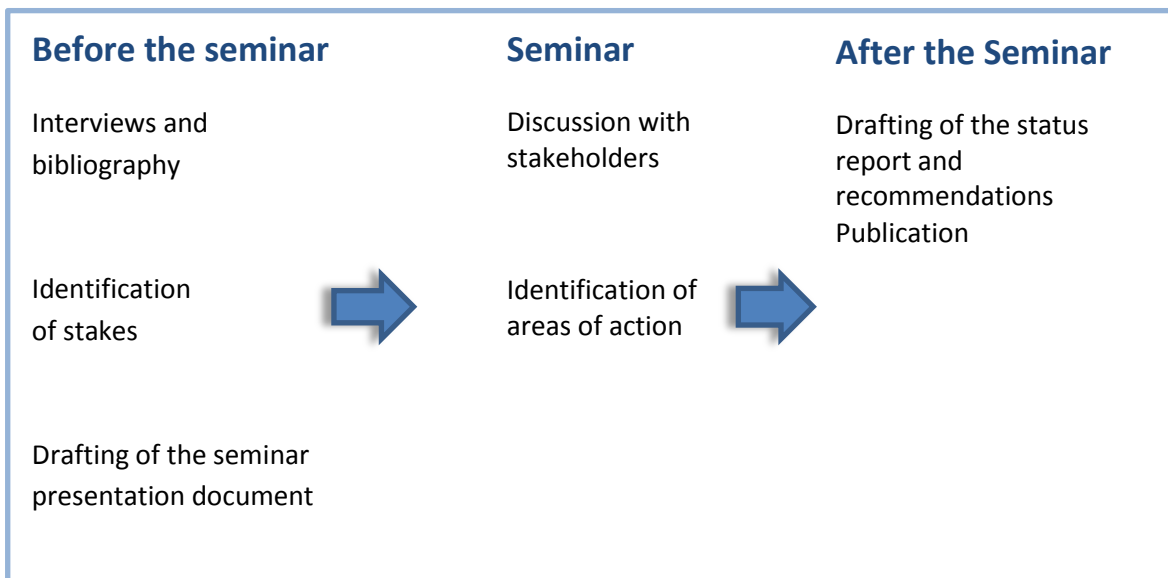


Figure 1: Process summary

2.3 The subjects discussed

As mentioned above, one of the two original characteristics of this process, permitted by the constitution of the CILB, is the opportunity to consider a **broad range of linear transport infrastructure**. The project therefore examined motorways, railway lines, power lines, canals and gas pipelines. To ensure a global approach, the secondary road network and its managers (public officials and local authorities) were included. The other networks, such as oil pipelines, were mentioned, although companies from this sector were not represented.

The initiative concerns **existing networks** and does not focus on future projects. Nevertheless, future projects are not ignored. In fact, in the case of future projects, biodiversity is generally incorporated as from the design stage; innovative measures are created and substantial financial provisions, often greater than those for the modernisation or upkeep of existing networks, are made to protect plant and animal life. The existing network, however, will still make up the majority of the infrastructure network in the coming years. Little is known of the initial condition of this 'old' infrastructure and its

ecological permeability* is less effective than that of recent infrastructure projects. The approach taken therefore aims to **formulate courses of action so that the modernisation of the old network becomes an opportunity to create ecological networks** (Switzerland and the modernisation of its motorway network serves as an example⁹).

Furthermore, the project leaders wish to prioritise **green appurtenances**, which are common to all of these forms of infrastructure. A lot of work, research and know-how have gone into the development of transversal networks: wildlife crossings, river crossings, etc. The project therefore focused on **networks that run parallel to infrastructure, known as longitudinal networks, and the means necessary to make them work**. These two types of network are studied together using a **multi-scale approach that ranges from a plot of land to the region as a whole**.

Finally, improving the transversal permeability of the structures is a constant concern and duly worries the stakeholders. This issue has given rise to numerous construction projects, which are ongoing, and is not the main subject of this project.

3. Prerequisites to reading the recommendations

To make the process and the choice of subjects retained in the comments that follow easier to understand, a number of preliminary points should be borne in mind:

- the controversial nature of this subject and the differences of opinion that it evokes,
- the diversity and particularities of the infrastructure to better understand why they should be considered as a whole,
- diverse opinions with regards to the quality of the rights-of-ways.

3.1 A controversial, unsettling and open question that provokes various reactions

The question, *'in your opinion, what could an ecological linear transport infrastructure be?'*¹⁰ gave rise to deeply felt reactions from experts during the initial interviews. The most representative answers are shown below.

⁹ Marguerite Trocme (2006). *Habitat Fragmentation due to Linear Transportation Infrastructure: An overview of mitigation measures in Switzerland*.

¹⁰ Question asked in the preliminary interviews.

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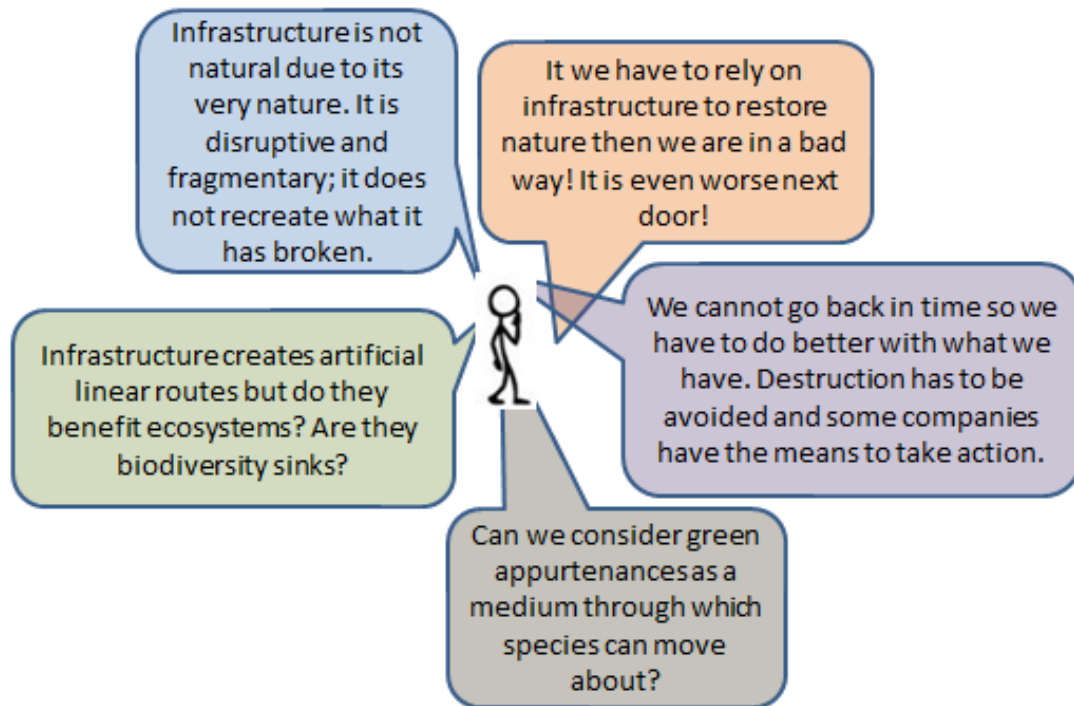


Figure 2: Examples of reactions obtained during the initial telephone-based interviews

While considering each of these answers to be valid, the CILB and IUCN France sought to enrich discussions and collect scientifically and technically 'robust' answers to the question asked in the seminar of 3 November 2014.

3.2 Each type of infrastructure has its own effects and margins of progress

The interviews and literature on the subject of biodiversity and linear transport infrastructure reveal a clear distinction between the various types of infrastructure with regards to their capacity to fragment or destroy the environment or, conversely, offer a habitat that favours biodiversity¹¹. Furthermore, each type of infrastructure has a specific amount of leeway to maintain and develop a natural area and to connect it to existing ecological corridors. Such leeway depends on the company, the project and the land crossed.

Table 1, below, and the diagrams in the appendix list the particular characteristics of the rights-of-ways of each type of infrastructure (width, habitats, topography, etc.). It should also be recalled that green appurtenances are not subject to the same maintenance requirements: their upkeep must be compatible with the safety rules and obligations of each company.

Consequently, each type of infrastructure affects nature differently, is subject to different management constraints and has different margins of progress.

¹¹ Different reference works put forward classification systems to differentiate between the nature of the infrastructure's effects (SETRA, 2000; Allag-Dhuisme F., Barthod C., Bielsa S., et al. 2010, etc.).

Table 1: key data and description of rights-of-ways by type of infrastructure belonging to CILB members

Linear infrastructure	Land management	Length of the network in France	rights-of-ways	Characteristics
Transmission of electricity	RTE has a right of way for its power lines RTE owns the substations	100,000 km of power line, including 80,000 km of corridors	The rights-of-ways represent 400,000 ha: 70% in agricultural areas, 20% in forest or natural areas and 10% in urban areas.	Plant life must not get close to overhead power lines and no deep-rooted trees are permitted above underground cables. The owners retain full right of use of the soil. When the growth of plant life threatens to affect the power lines, RTE takes action instead of the owner: this is generally the case in forest areas.
Distribution of electricity	ENEDIS does not manage any land.	1.3 million km, including 700,000 km of overhead line	Small number of rights-of-ways in general, except in the case of forest corridors (a few metres)	
Toll motorways	Motorways operated under a concession; motorway companies finance, build, operate and maintain the networks (roads and appurtenances) under concession contracts signed with the state	9,048 km of motorway	Around 80,000 ha of rights-of-ways, including 38,600 ha of green appurtenances (including 632 rest areas and 367 service areas)	99% of the network is protected by a line of fences to block access by animals 1,664 crossings for wild animals
Railway lines	SNCF Réseau owns the lines and the appurtenances	29,273 km of line operated, including 2,024 km of high-speed line	110,000 ha of green appurtenances	SNCF Réseau will own the lines and the appurtenances as from 1 January 2015. The high-speed lines are fenced
Transmission of gas	GRTgaz and TIGF own the buried pipelines, have a right of way over any private land that they cross and may occupy public land	GRTgaz: 32,100 km of pipeline TIGF: 5,000 km of pipeline	Width of the right of way from 5 to 20 m; rights-of-ways not calculated	The transmission pipeline's right of way is ' <i>non aedificandi, non sylvandi</i> ' and therefore forbids any form of construction and the planting of trees, but not agricultural or medium-sized plants.
Canals	VNF manages the country's public waterways, a role entrusted to it by the state. It is not, therefore, the owner of its rights-of-ways.	6,700 km of canals and rivers operated by VNF	The area entrusted to VNF represents around 40,000 ha	The tow paths are very often managed with local authorities, particularly in the case of green ways

3.3 Nevertheless, there is a lot of common ground

After it had been agreed that each type of infrastructure is different, seven common points encouraged the project's leaders to develop a common 'trans-infrastructure' approach.

1/ In the case of each type of infrastructure, the infrastructure project is first **defined and created in consultation with those concerned while avoiding, in particular, any possible impact on biodiversity**. This stage must be given priority as it will shape the rest of the infrastructure project's phases.

2/ Each infrastructure contractor **faces uncertainties** in terms of the suitability and effectiveness of measures that it has to take to avoid, reduce or compensate for the project's effects. Companies deal with common difficulties: imperfect, insufficiently explored or still hypothetical knowledge.

3/ Each infrastructure project begins with a **works phase that has a direct and significant impact** on biodiversity. This inevitable part of the project requires specific support so that the project's impact can be kept to a minimum.

4/ Each type of linear infrastructure **unquestionably divides the area into two, albeit temporarily during the works**.

5/ Each contractor has green appurtenances in the rights-of-ways under its responsibility. These rights-of-ways could be used to create or recreate ecological networks. **The combined effects, on the one hand, and the potential offered by these areas, on the other, deserve particular attention.**

6/ Each company must **manage and maintain 'green' areas** (rights-of-ways, rights of way, private land) close to its infrastructure. Day-to-day management may be optimised by taking into account, or even favouring, biodiversity. It is worth making use of and sharing this know-how.

7/ All CILB members are fully aware that some of the effects may be reduced and that they can perfect and promote know-how that favours biodiversity. They would therefore like to take part in maintaining and improving biodiversity but **require support from ecologists** with the creation of a project that contributes to biodiversity and takes technical constraints into account.

3.4 The green appurtenances of linear infrastructure: how does biodiversity benefit?

The management of longitudinal networks is one of the original features of this project and is a subject that has hardly been explored. We have therefore sought to highlight the benefits of or the potential offered by the various types of green appurtenance and explain how to manage them to favour biodiversity.

3.4.1 Sometimes of very limited interest...

Various experts and studies (*Scher, 2005; Dore, 2010...*) recall that their shape and narrowness, and the pollution and maintenance to which they are exposed call into question their benefits for nature. These areas are regularly mowed and cut back with a rotary slasher. They are also treated with herbicides and may be subject to gas emissions and come into contact with polluted run-off water. They can also favour the spread of invasive species. They often take the form of embankments

created with mixed types of soil or grass strips that have received 'rough treatment' (driven over by machinery, digging of ditches to evacuate water or to lay pipelines). These areas are themselves split or divided by transversal routes and can have a harmful 'sink' effect for animals. In light of these facts, the idea that green appurtenances may immediately constitute protected areas that are favourable to nature is put into perspective.

3.4.2 ...but they are also biodiversity and dispersal areas

Other opinions and studies tend to show that nature recovers and adapts after work has taken place. New species move in and important environments such as wetlands or meadows can develop and survive on a sustainable basis. Various scientific monitoring projects highlight the value of these rights-of-ways in terms of plant and animal life and the authors even put forward management methods to improve their biological diversity.

The aforementioned introductory prerequisites clearly show that the possible contribution of linear infrastructure to biodiversity is a complex and controversial subject. It evokes mistrust combined with curiosity and a tangible desire to believe in the margins of progress that are possible. The project has thereby managed to foster discussions and create a collective initiative in order to optimise the connection between 'ecological networks' and 'infrastructure networks'. These discussions led to the drafting of recommendations.

4. Optimising the connection between ecological networks and infrastructure networks: recommendations

At the end of the process, a total of **five recommendations were identified**.

- Improve governance and the consultation process,
- Improve the design of the infrastructure,
- Improve the return of land to nature,
- Improve biodiversity through day-to-day management practices,
- Improve knowledge.

These recommendations concern all types of infrastructure, whether old or new, for the transmission of electricity or gas, or the carriage of people or goods. Nevertheless, they will sometimes be more suitable for certain types of project due to the specific nature of the areas that are divided, the impact caused and the shape of the right-of-way (see table 1 and the diagrams in the appendix).

Furthermore, they are aimed at all those with a direct or indirect connection to this subject (companies, public departments, local authorities, researchers, associations, etc.), from decision-making bodies to operators in the field. These recommendations have two goals. On the one hand, they identify margins of progress and suggest improvements that will have to be made to current systems. On the other, a number of areas of consideration are provided to encourage those concerned to work together on the definition of new goals that favour biodiversity.

In the following recommendations, we look at biodiversity in terms of its function and development (habitats, ecological networks, ecological functionalities, etc.). A natural area, whether protected or not, is characterised by its diversity, its role in terms of the biology of species, whether ordinary or endangered, but also the services that it provides for human society. Decision-making processes must therefore abandon an approach that aims to minimise the risk of a dispute (by avoiding protected areas) and move towards an approach that focuses on environmental risks and takes existing interactions into consideration.

4.1 Improve governance and the consultation process

Building and managing linear infrastructure so that it may become a part of the green and blue belt requires the setting of clear goals as well as specific knowledge in the field of ecology. **It is therefore necessary to work and hold regular discussions with ecologists and local stakeholders** to optimise the project, measure the risks of failure and the chances of success and draw the best possible lessons. Identifying priorities and constructing ambitious (and not necessarily costly) solutions will constitute the main challenges of this collaborative work.

4.1.1 Build the structure with local stakeholders

To facilitate the emergence of a serene working environment during a linear infrastructure creation, modernisation or restoration project, a **partnership culture has to be developed** between the companies (designers, licensees, foremen, etc.) and local stakeholders (local authorities, farmers, foresters, hunting federations, environmental associations). These discussions let the various parties

understand the constraints and aims of the project, on the one hand, and local ecological factors, on the other.

The relationship between the contractor, local stakeholders and public departments must be sustainable over the long term and begin early on, and before the Declaration of public utility ('DUP') is made. **The relationship must continue downstream** for the day-to-day management of the structure and for the joint construction and running of the monitoring system (ecological monitoring, etc.). The appointment of local referees for agriculture, hunting, forests and nature conservation would allow continuous mediation between the various sectors concerned and the project.

Furthermore, national partnerships between the companies and environmental associations or public bodies would foster trust, transparency and the undertaking of joint actions. Ultimately, they will contribute to the **emergence of a joint integrated-project culture** that considers transport, the region and ecology. National partnerships already exist within several companies. These partnerships can take the form of framework agreements that are subsequently applied on a regional level, the joint drafting of technical guidelines or research projects. This partnership-based work needs to be adopted by all planners to ensure that everyone is advised by a local body.

As is the case in any other consultation process, **knowledge** and, in particular, the environmental data gathered **must be shared**, to facilitate the accumulation of data on both the diversity of species and the spatial and temporal development of population groups. The sharing of knowledge and data thereby allows greater consideration of the stakes at hand. The sharing of environmental data gathered by companies allows, for example, the management of a site to be optimised after work has taken place. It is therefore recommended that existing environmental data pooling and sharing systems are implemented or used ('Nature and landscape information system' (SINP) - an initiative that is being run with the National natural history museum (MNHN))¹². These systems may contain data from stocktaking operations conducted along the routes studied and knowledge on ecological networks. It is important to clearly identify local sources of expertise, whether local experts or reference documents, and to share these 'skill bases' among companies.

Another solution to foster this spirit of partnership is to develop joint projects that seek to **acquire new knowledge or new know-how**. The gathering of feedback is an effective means to co-construct knowledge and nourish a common culture between companies and ecologists. Databases that contain the experience acquired by the various stakeholders, experience-sharing seminars, resource centres (see, in particular, the green and blue belt resource centre), and skills sponsorship programmes are all solutions that can be used to make use of know-how and interconnect the various sources of expertise: companies, public departments (CNP, ONEMA, ONCFS, etc.), local stakeholders, etc. The sharing of experience must include successful and unsuccessful events so that suitable conclusions can be drawn for future developments. The need to pool know-how regarding landscape ecology (ecological networks, fragmentation) and technical standards was identified in particular.

The project cannot respond to all social, economic and ecological expectations as some expectations may clash with others; choices must therefore be transparent and justified. For example, developments that favour biodiversity may sometimes undermine safety standards, particularly along motorways or railway lines. There is also the fact that some ecological choices may favour certain species over others. It is by taking a multi-stakeholder approach, which allows the diversity of ecological dynamics to be considered, and conducting real consultations (information and consultation, listening to one another, transparent choices, monitoring of commitments and co-construction of solutions, etc.) that a climate of trust will be able to be created.

¹² 'A status report on the knowledge and expectations of stakeholders regarding the impact of land transport infrastructure on the landscape and ecosystems', by the engineering firm, Biotopie; <http://www.ittecop.fr/>

With regards to biodiversity, the state must lead by example. Furthermore, the state guarantees compliance with regulatory standards. It must therefore remain neutral to assess projects and ensure that regulations are applied. Recommendations have nevertheless been made to enable the state to adapt to a project-based method of working as well as possible: ensure dossiers are monitored in a consistent manner, create standards to avoid conflicting laws, carry out preliminary scoping operations in the field, and adapt procedures to each project and the experiments put forward.

4.1.2 Give greater importance to biodiversity in the process as a whole

At each stage in the structure's construction or modernisation process, matters regarding ecology and the ecological networks are to be given more importance to ensure that the structure and its rights-of-ways contribute to the ecological networks as much as possible. The following question must therefore be asked and be considered as a leitmotiv throughout the project: what are the short- and long-term and the small- and large-scale priorities of the ecological networks, while bearing in mind that other local dynamics exist (climate change, urban or agricultural development, other planned infrastructure projects, etc.) and shall interact with the ecosystem?

This question must be raised **as from the opportunity study**: the prior analysis and preliminary project stage. This will allow, on the one hand, the **avoidance strategy** to be improved by providing time to study alternatives during the preliminary project stage and, on the other, the information given to the public during public discussions on the project's possible consequences (based on the route selected) to be improved. It is also a matter of defining the infrastructure project's biodiversity project.

The environmental assessment must be strengthened upstream of the decision-making process and be refined over time with increasingly detailed field data.

In the case of new projects, it would be wise to consider in the structure's design study: 1) the feasibility of the structure's maintenance and, in particular, the maintenance of the rights-of-ways, and 2) the changeable nature of the structure (modernisation or even reversibility) while better integrating the notions of lifetime and temporary occupation of space.

Ecological networks and functionalities must continue to be a part of the project during the construction phase and while the infrastructure is in use (see section on management).

For the **construction phase**, which is a very sensitive stage as it is the most disruptive for ecosystems, the following recommendations are made:

- **take into account the species' life cycle**, and especially the periods of reproduction and hibernation of animals, when deciding on the schedule of works (site clearing, stripping of overburden, maintenance, etc.);
- **develop self-checking**, bring an ecologist on to the worksite and involve foremen in ecological measures;
- **develop the ability to monitor nature** to follow how species react to the works (emergence of new environments, arrival and departure of species, reproduction on the worksite, etc.) and put forward solutions on a case-by-case basis. This will allow, in particular, the impact on species to be reduced and sink effects to be detected quickly, among other things.
- **limit the worksite's rights-of-ways**;
- **avoid the dispersal of invasive alien species**: avoid transporting earth (so as not to spread seeds), wash the tyres of vehicles, do not leave disturbed environments without any vegetation, etc.

During **infrastructure modernisation** projects, it will also be a matter of analysing very early on in the project, the needs of the longitudinal networks alongside the transversal networks to increase the permeability of the existing structure and minimise fragmentation.

Furthermore, longitudinal and transversal networks should be **integrated into local planning schemes** (on a national and a regional scale), for example: the motorway stimulus plan, mobility plans, national transport planning, etc.

4.1.3 Bring the views of companies and ecologists closer together

One of the key solutions to improving the integration of ecological networks into the infrastructure project is to **make ecology part of business culture**: biodiversity must no longer be seen as a constraint but as an opportunity and as an indicator of success. Biodiversity should thereby become a task that is entrusted to the contractor and a responsibility in its own right. The contractor, accompanied by conservationists and supported by the state and local authorities, should, in the future, build its project around biodiversity.

To make this possible, several recommendations are made. First, **awareness-raising and training measures** in all land management occupations - planning, training, design, works, maintenance, landscaping, etc. and at every level of responsibility, including management - must be developed and maintained over the long term. These measures not only serve to inform employees about ecological concepts (definition of biodiversity, purpose of ecological networks, SRCE¹³, SNB and SRB¹⁴) but also to change attitudes with regards to the management of appurtenances (i.e. an area is only considered to be tidy when plant life has been cut back). Awareness-raising can take the form of simple actions such as '15 minutes on biodiversity', like the approach adopted for safety. It must be based on the recognition of each person's skills: the ability to handle a worksite vehicle can also be valued on the basis of ecological grounds (to limit the site's impact, preserve and bypass plant life, create features such as shallow areas of water by varying slopes, shapes and the topography, focus on details, etc.). It is also important to develop initiatives that let people come into contact with nature, such as moments dedicated to observing biodiversity on the site, photography competitions, involvement in participatory science events such as VIGIE Nature or the participation of sites in events such as Fête de la Nature. **Training** also plays an essential role either in the form of continuing education or initial training in landscape ecology, plant engineering and ecological land management, depending on the trade. Training modules that are common to companies and involve local biodiversity stakeholders (CREN, PNR, etc.) could be implemented. Feedback from the field would be a very important part of these courses.

Formulating a policy on a specific subject is a good way to make employees aware of the importance given to the subject in question by the company and to involve management and personnel. A policy is a 'soft law' solution as it is binding and makes people assume responsibilities. **The drafting of a biodiversity policy within each infrastructure management body should therefore be given priority.** The application and monitoring of this policy in the field could be analysed in meetings: a biodiversity working group or committee made up of representatives from the various areas of activity within the company and even external partners. Tools specific to the management of green appurtenances should also be adopted. It is a question of introducing a specifications sheet for the management of these environments, which will be an integral part of the infrastructure's maintenance specifications (a right-of-way management plan, for example).

¹³ Regional ecological coherence plan

¹⁴ National biodiversity strategy and Regional biodiversity strategy

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Finally, a specific real-estate or legal status would have to be given to green appurtenances whose contribution to green and blue belts is recognised so that their ecological function may be protected, while also making sure that they can fulfil technical goals (safety, maintenance, rights-of-ways, etc.) that are linked to the infrastructure's own operating characteristics.

Bringing the views of companies and ecologists closer together also requires conservationists to **familiarise themselves with the constraints faced by companies** and to learn about the experiments, whether successful or not, that they have carried out. All discussions between these two cultures will facilitate the search for a balance between protecting nature and ensuring the operational feasibility of projects. Worksite visits will be an ideal occasion for these discussions. Eventually, a **common language** will have to be created.

4.1.4 Leading by example

In order to nourish the company's culture, image and trust with conservationists, there is nothing better than pointing to **exemplary actions** carried out, if possible, with local partners and ecologists. A successful consultation process is also a good communication opportunity. For example, reinstating land next to a motorway rest area can raise public awareness, educate people (internally, within companies and the public) and make use of competencies. Sharing and raising awareness of such examples within companies and among public and private decision-makers facilitates the dissemination of best practice and contributes to the creation of common standards.

4.2 Improve the design of the infrastructure and its appurtenances

The design of the infrastructure, that is to say, the definition of its route, takes protected environments and important species into account. Nevertheless, margins of progress exist and concern the following issues: the design of green appurtenances, the design of crossing structures and collision-avoidance measures. The following recommendations are based on one idea that is both simple and complex: the structure must seek to blend into the landscape as much as possible, from a regional to a local level, while respecting the functionalities of the various types of environment.

4.2.1 Think big when defining the new routes

In the case of new projects, the structure's integration into the landscape and ecological integration must begin with a **broad approach and be considered on the scale of the region in terms of ecological landscapes**. The aim is to consider the project from a regional perspective and to adopt a preventive - not a corrective - approach. This means that the **Avoid-Reduce-Compensate process** has to be respected. However, emphasis should be placed on 'Avoid' so as to only 'Compensate' as a last resort. For example, the ecological impact of all possible routes will have to be assessed to ensure that the route chosen is the least harmful for biodiversity and the functionalities of the natural environment in its initial condition. If the measures identified are unsatisfactory with regards to the ecological stakes, the project's sponsor must consider withdrawing the project.

It would therefore be useful if national stakeholders first outlined a **spatial biodiversity strategy or policy** with map references taken from planning and urban planning documents (SRCE, PLU, SCOT, etc.) while specifying: 1) the conservation or restoration priorities of the corridors and biodiversity areas, 2) the most important ecological functionalities to be maintained, and 3) the ecosystem services to be maintained. These choices will be of paramount importance as they will allow the Avoid-Reduce-Compensate process to be applied to the structure while identifying the right priorities as from the beginning of the route's design; they will permit the functionality losses of the various designs to be compared on the basis of a multi-criteria analysis and within the framework of a regional and strategic diagnosis.

This diagnosis has to **anticipate tomorrow's landscape** as the structure adds a rigid component to the landscape: it is designed to last a long time and, furthermore, ecosystems are constantly evolving due to global and local changes. The **twinning of infrastructure** is a matter that has to be raised to understand how the fragmentation of areas that are still hardly affected may be limited, how redundant or separate structures can be avoided (there is a need to coordinate wildlife crossings or even merge them into a single structure) and how to improve the combined effects of the green appurtenances of overlying structures. The project partners (companies, managers, local authorities, state, etc.) will therefore have to work together on the twinning of infrastructure.

In light of these diagnostic elements, it may have to be necessary to **innovate in terms of the infrastructure's new performance** in order to better connect the project to the area: adapt to the area's topography differently, discuss the design of infrastructure that is often subject to speed requirements (which may be reconsidered), look for alternatives to the usual methods used, etc.

Anticipating therefore means identifying big goals, planning very early on with regards to regional policy and the dynamics at work, and keeping some leeway (spatial and financial) to adapt to the situation based on a progressive approach.

4.2.2 Develop the structure's permeability and enhance the corridor effect

Once the **conservation goals have been ranked** with regards to the routes studied and then the optimum route has been defined on the basis of these routes, the next step will be to identify the rights-of-ways that will play a role in the ecological network in order to minimise the effects, to build connections in the ecological network and to favour the structure's permeability. It is also at this stage that consideration will have to be given to compensatory measures, particularly in terms of the areas to be prospected so that they can also form part of this **relandscaping strategy**. The return of ownership of rights-of-ways could also play a role here. It will also be necessary to involve agricultural stakeholders to ensure farm and forest land development procedures are consistent with the strategy defined for the ecological networks.

It is therefore important to **integrate the structure into the natural landscape** while also focusing on the details: adapt to the topography and characteristics of the soil, include groves to recreate aerial networks (for bats, birds), adopt a 'flyover and cut-and-cover' approach (rather than backfill/excavated material), vary the gradient of slopes to create diverse environments, choose between the creation of transversal and longitudinal networks depending on the circumstances, identify host environments that are the most favourable for fauna and flora, etc. Recreating a landscape within a landscape by diversifying the topography, by planting local and adapted species and by designing areas that appeal to large and small animals (meadows, wetlands, etc.) and plant species are all challenges that have to be addressed at this stage. The nuisances associated with the use of the infrastructure also need to be managed. Preference could be given to longitudinal

networks (revegetate the base of transmission towers, widen embankments, etc.) whose route already exists as they will run alongside the structure.

When **designing longitudinal corridors**, it is important to make sure that they are: 1) accessible for the species targeted, 2) connected to regional or national ecological networks on a sustainable basis; the long-term survival of the areas to which the aforementioned networks are connected will also have to be ensured; 3) consistent with the crossing structures and, sometimes, not accessible by man or at least vehicles to maintain a certain level of tranquillity, and 4) wide enough to play an ecological role and retain a certain amount of leeway throughout the infrastructure's lifetime.

The location of fencing is an important matter when creating these longitudinal corridors, particularly with regards to large animals. It is important to ensure animals can access green appurtenances and to foresee other methods to mark land boundaries. This could take the form of fencing that is closer to the infrastructure, thereby ruling out green appurtenances, more permeable fences with escape ways or, better still, the creation of boundaries made up of various plant species that do not block the movement of animals.

Attention also has to be given to ensuring the continuity of the appurtenances when secondary roads or infrastructure cut across the structure (foresee overpasses or alter the bed of the bridges) and the continuity of pond networks to avoid collisions or a sink effect.

The installation of wildlife crossings has to be outstanding if a successful green and blue belt integration strategy is to be built. These mitigation measures are among the oldest: they form part of regulations, are well documented in guidelines and studies, and probably the best understood by companies. The recommendations are already clearly laid down in the various publications, particularly those of CEREMA¹⁵ (formerly SETRA). A number of elements should nevertheless be recalled to make the structures as effective as possible. On the one hand, with regards to their design:

- identify the most appropriate location to install a wildlife crossing. This is an important point as the structure could be a great achievement on a technical level but inconsistent in terms of ecology. It is therefore a matter of considering the natural corridors used by the species to move about and targeting the species to be favoured. Furthermore, as our level of knowledge and changes to the landscape do not always allow the most suitable solution to be chosen, it is also important to design reversible crossings that may be dismantled or relocated.
- ensure the structure is of an appropriate size to benefit as many species as possible without being too expensive,
- pay attention to details when completing the project. A 10-cm difference can substantially alter the effectiveness of a structure, particularly in a waterway. Extending the length of a bench terrace along a waterway can increase the flow rate and thereby create a barrier for certain aquatic species,
- choose suitable materials, namely, limit the creation of an artificial environment and give preference to a crossing that is colonised by plants or trees,
- ensure that it is attractive to wildlife, including small animals. Preference has to be given to crossings reserved for wildlife over mixed wildlife/agriculture crossings. Groves rather than lines of trees should be planted; fauna should be attracted/repulsed by odours, etc. Insects must not be forgotten. To do this, wildlife bridges that comprise ponds for dragonflies may be created,
- increase the number of low-cost structures such as channels that can be used by several species, while taking into account the local environment and basing their size on the species targeted. Build fish passes for all fish species (not only those that are fished), while

¹⁵ Centre of research and expertise on risks, the environment, mobility and land management
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considering the return of certain species as well as their descent from freshwater to salt water, etc.

On the other hand, attention also has to be given to ensuring **consistency between these measures and changes to land alongside the main structure**, particularly with regards to the secondary road network or procedures to develop agricultural land. Maintaining or recreating networks of hedges and ensuring the circulation of water in adjacent streams will be key. This work must be approached with the same quality requirements and be consistent with the main worksite.

Designing a structure that contributes to the ecological networks also means **limiting the number of collisions between the structure itself or vehicles (trains, cars) and animals**. This concerns roads and railway lines but also power lines. These types of collision are already taken into account for certain species and types of infrastructure (extensive work on birds and power lines, etc.). Experiments involving bats and large animals on secondary roads are being conducted. Nevertheless, there is still room for improvement: for example, the use of plant-based fences (along the green appurtenances after adapting, if necessary, technical aspects), vigilance by drivers (lowering the speed of vehicles in environmentally-sensitive areas), the identification of collision areas, etc.

Finally, a **right to experiment** is necessary if permeability is to be developed and the corridors are to be improved. Nature is diverse, complex and difficult to predict. Consequently, it must be possible to experiment, adjust and improvise solutions during works or the day-to-day management process with the support of ecological monitoring campaigns and observations in the field. These day-to-day experiments must be undertaken rigorously and intelligently (rigorous protocol, observation and assessment with experts, definition of a model zone) so that objective and repeatable lessons may be drawn. Experiments in different areas are already taking place: amphibian ramps (particularly the collection of amphibians in storage basins), bat bridges, green tree frog corridors, etc. Several other subjects have been suggested for the future: testing of various ground-based structures, better management of artificial light to conserve a 'black belt' and limit the impact on insects and chiroptera*, experimenting with the design of groves, creation of fish passes. The effectiveness of these experiments must of course be monitored and assessed.

With regards to the **modernisation of the bridges or passes, continuous improvement cycles must be introduced**: rebuild wildlife crossings when absent or ineffective (e.g. fish passes), restore the banks of canals, reinstate the natural flow rate of rivers, modify fences along appurtenances, etc. This improvement work is based on the identification and prioritisation of challenges, in conjunction with land management and urban planning documents, including the SRCE.

When land is scarce, it also becomes necessary to **optimise the areas' multifunctional ecological role** (and also consider species that are less able to share their territory, particularly with people).

4.3 Improve the return of land to nature

The **dismantling and removal of infrastructure** is a matter that is almost never foreseen. Efforts could be made upstream to identify the role of the land after the structure is no longer required (for example, former railway lines turned into green ways or routes for soft modes of transport).

In addition to the rights-of-ways, a linear infrastructure management company can make use of other areas that would benefit biodiversity and ecological networks. Several real-estate opportunities have already been identified.

First, **compensatory measures** should benefit the ecological network. It would require a move away from a case-by-case approach to the grouping of all of these measures in one cohesive project. The application of a regional approach to the compensatory measures exceeds the remit of the infrastructure project (for example, we could envisage the reinstatement of networks that cover important areas that are not crossed by the structure) but it could serve to release land close to the structure that would host sustainable longitudinal and transversal corridors. This first real-estate opportunity requires a change to regulations to envisage the pooling of compensatory measures and to move from a species-based approach to one that is based on the habitat and functionality¹⁶.

Secondly, at the time **ownership of Declaration of public utility ('DUP') land is returned**, some of this land could be integrated into the biodiversity project without harming farmers. Partnerships could be formed with farmers to manage this land in an extensive manner or in a manner that favours the environment.

Thirdly, companies own **land** around their infrastructure network. This adjoining land could be better used or restored (removal of obsolete buildings or structures, restoration, etc.) to make it more favourable for biodiversity.

Fourthly, and finally, **building synergies between local stakeholders** - contractors, developers, owners or farmers - in order to **create a more ambitious and sustainable ecological corridor project together** would be worthwhile. For example, the new Common Agricultural Policy requires each farm to manage a certain percentage of agricultural land in a manner that benefits the environment. This land could be chosen to widen or extend the infrastructure's green appurtenances for the purposes of the ecological networks (at the base of or between transmission towers, for example). A specific partnership therefore needs to be formed between the agricultural sector and the managers of natural areas to seize these opportunities and strengthen the regions' green and blue belts on a sustainable basis.

4.4 Improve biodiversity through day-to-day management practices

Once the strategic ecological goals have been defined - namely, species have been targeted, the functionalities of the rights-of-ways have been identified, and the biodiversity project has been drafted on the basis of these goals - day-to-day management techniques that create favourable conditions for these goals to be met have to be identified. A total of six recommendations may be envisaged.

¹⁶ At the time of writing (June 2015), there is a biodiversity bill ('projet de loi pour la reconquête de la biodiversité') that foresees legislative changes to compensation.

The first recommendation is to make the rights-of-ways favourable to nature and, consequently, to **minimise disturbance** in terms of light, noise, chemicals (minimise the inflow of salt and phytosanitary products, treat polluted water, etc.) and mechanical equipment, and even to clean up the sites.

The second recommendation is to **favour biological diversity**. Depending on the proximity to the structure and technical constraints, a differentiated management approach is recommended. It is important to strike a balance between management measures that are necessary for the infrastructure to function correctly and measures that favour the ecological functionalities sought. This may require a **review** and modification of the companies' **technical reference documents**. Various examples prove that such a balance is possible and is often financially beneficial: lower management costs and/or use of new amenities. With regards to the upkeep of open spaces, extensive pastoralism is a well-known example. To favour local species, it is sometimes necessary to create seed banks and build partnerships with local nurseries and botanical conservatories to ensure the existence of local tree species.

There should therefore be a **management plan that is created with** ecologists and local stakeholders and that focuses on the appurtenances; this is the third recommendation. This medium-term and renewable management plan would help to respond to the ecological challenges of each environment identified and influence their quality by specifying the management goals, means and actions to be implemented. It would also allow the management process to adapt to changes. A 'framework' management document could also be applied and adapted on a local level. This would allow a global approach to the quality and diversity of the appurtenances to be taken and also allow necessary measures to be identified more easily.

While regular operations are justified in certain environments, a '**principle of naturality**' could be applied in other areas; this means that the environment should be left alone to develop freely without any interference by man, when compatible with safety and maintenance constraints.

The fourth recommendation, which is connected to the principle of naturality, is to **give nature time to recover on its own**. This approach lowers land management costs (less planting and landscaping) and the risk of introducing foreign species and materials unwittingly. Furthermore, it increases the chances of recreating a resilient environment with native species.

The fifth recommendation is to **fight against invasive alien species**, to avoid the homogenisation of the landscape and to limit the negative impact of alien species. Preventive actions would consist of limiting the movement of earth and, therefore, seeds. Once these species have settled, an action plan will have to be defined - including the identification of technical (management methods), human and financial resources to be provided - in order to fight against these species.

Finally, the last recommendation is to **train company and service provider personnel** (landscape gardeners, foremen, maintenance workers, etc.) on the **ecological management** of the appurtenances and to encourage them to become biodiversity ambassadors (see the section entitled, 'Bring the views of companies and ecologists closer together'). This need for training concerns not only companies but also managers which will be entrusted with certain areas, particularly compensation areas. It is therefore a range of occupations within a given sector that has to be structured around ecology with the support of experts in this field (scientists, engineering firms, managers of natural areas, etc.). In addition to those who are directly involved in managing the structure, it is important to maintain a relationship with local people and to raise their awareness of certain matters to avoid any deadlocks. A record of management goals will also have to be kept so as not to lose any measures through forgetfulness or negligence.

4.5 Improve knowledge

As is the case for any other science, the acquisition of knowledge in the field of ecology demands humility and perseverance. Integrating the concept of ecological continuity along linear infrastructure into scientific ecological and land development work depends on the creation of a specific dynamic: laboratories have to be mobilised over periods of time that are long enough to create robust data for the purposes of analysis, means have to be found to fund this research and scientists have to be induced into pursuing this work. Work has already begun on this subject as part of the ITTECOP¹⁷ programme, which brings together a community of scientists and operators around transport infrastructure and biodiversity. In 2014, the CILB, the FRB and the ITTECOP programme launched a joint request for proposals¹⁸ to support research projects, exploratory projects and a state-of-the-art/summary report on proven facts¹⁹. To consolidate this field of research, the creation of a long-term ad hoc structure such as a scientific interest group ('GIS') was suggested.

The need for knowledge primarily concerns knowledge of the species present along or in the vicinity of the route of the planned structure. Once the linear transport infrastructure is up and running, these needs can be grouped under three main areas: 1) the effects of the infrastructure, 2) the measures to minimise these effects, and 3) compensatory measures.

With regards to the **effects**, knowledge of the right-of-way's effects, that is to say, what is lost during the works (surface area, habitat, species, etc.), appears to be stable and extensive. Less is known about:

- the **structure's side-effects on ecological functionalities** and, in particular, ecological connectivity: on the one hand, there are no indicators to identify these effects and to quantify them and, on the other, there are no 'technical biodiversity standards' to guide companies. The impact of climate change and the needs of corridors to facilitate the development and movement of species in this context must also be included in these discussions;
- **the impact on mortality**: data has to be shared better and on the basis of common protocols;
- **the impact on the behaviour and adaptation of species** and, in particular, small and micro fauna, as well as flora: the barrier effect, collision, disease and invasive alien species need to be studied further. The impact of infrastructure on migratory species, particularly certain birds and fish, is also hardly documented;
- **the effects on watercourses**: changes to pH, the temperature of the water and the living conditions of micro-organisms are to be studied when riverside vegetation is altered. While the continuity of watercourses has been relatively well studied with regards to the return of fish, less is known about their descent; there is also a lot to be done regarding the free movement of small land animals connected to watercourses and wetlands, for which thalwegs and banks are major ecological corridors.
- **the effects of disturbance** - chemicals (heavy metals, additives in surface materials, underground leaks, lime in backfill, etc.), noise, heat (thermal barriers), electromagnetism, etc.;
- **the combined effects** of nearby and/or parallel structures that divide or modify ecosystems, particularly the secondary effects linked to the redistribution of land or to the modification of secondary road networks.

¹⁷ ITTECOP: Land transport infrastructure, ecosystems and landscapes. <http://www.ittecop.fr/>

¹⁸ <http://www.ittecop.fr/index.php/76-apr-2014>

¹⁹ The summary report on proven facts, entrusted to the National natural history museum (MNHN), consisted of collecting, assessing and summarising facts, scientific results and knowledge as transparently and as objectively as possible. It thereby allows decisions to be made on the basis of proven facts.

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With regards to the **measures taken** to minimise these effects, new approaches are being developed to monitor the effectiveness of wildlife crossings (cameras, various sensors, etc.). Some measures are recognised for their effectiveness, particularly measures to avoid the death of birds on transmission pylons or to favour the movement of large animals through transversal crossings. Knowledge on how to increase the effectiveness of certain measures exists but it is not widespread (guidelines, orders that enforce general rules, etc.). Furthermore, several questions on the following subjects remain open:

- the quality of monitoring operations (particularly as part of the Internal transport guidance law ('LOTI') assessments): it is necessary to reconsider the aims of these operations to **move from an assessment of means to an assessment of results** (balanced scorecard, grading system, etc.). The concept of 'services provided by the infrastructure's rights-of-ways', including continuity, could also be included. The aims of these assessments would thereby be widened to include more than just protected species. It also necessary to **homogenise protocols** by defining common standards and benchmarks in the country and develop, in particular, genetic monitoring operations. Furthermore, **inspections at the time of LOTI assessments would have to be bolstered**: more regular inspections, penalties if measures are not implemented. This would make them more effective and credible. Finally, these monitoring operations need to be extended geographically and in terms of time to be able to **measure the corridor effect** on a geographic scale that is coherent with the biology of the species. **Monitoring operations have to be entrenched over time** (every five to 10 years) so that interpretable trends can appear and corrective actions may be envisaged;
- the **search for new measures or improvements to measures**: current methods must continue to be perfected, best practice guides need to be updated, measures that are less costly but just as effective have to be found with production or installation systems that are lighter and easier to install; a better understanding of the effectiveness of the measures taken (for particular species and under particular conditions) is required and we have to admit our limits in terms of recreating habitats;
- the **contribution of green appurtenances** to ecological corridors: data acquisition and research on this subject have to be stepped up.

Regarding **compensatory measures**, regulatory room for manoeuvre and knowledge could be improved - also with the support of research/action projects - for the following questions:

- How can collective compensatory strategies be developed on a regional level? Who would act as the contracting party for these strategies?
- What surface area is necessary to compensate for the structures and for which species?
- How can indicators other than those that concern surface-based elements be put forward? How can compensation be widened to include unprotected species and how can this compensation be used as part of the aim to consolidate or create corridors?
- And, more generally, how can ecological debt be assessed? How can we ascertain its size? How can the principles of equivalence and additionality be applied?

This need for knowledge, which reflects a diverse range of expectations and questions, highlights the large number of questions raised by the contribution of linear infrastructure to ecological networks. New experiments, based on rigorous protocols, are to be carried out and discussions between ecologists and CILB companies are to be developed.

Summary of recommendations

SUBJECT	MAIN RECOMMENDATIONS
IMPROVE GOVERNANCE AND THE CONSULTATION PROCESS	<p>Develop a partnership culture between companies and local stakeholders - encourage the emergence of an integrated project culture</p> <p>Foster a long-term relationship between the contractor, local stakeholders and public departments by establishing contact very early on and by maintaining the relationship downstream.</p> <p>Share knowledge</p> <p>Develop joint projects to acquire new knowledge and know-how</p> <p>Pursue the integration of biodiversity as from the opportunity study while putting impact avoidance first</p> <p>Define the infrastructure project's biodiversity project</p> <p>Analyse the ecological network needs of infrastructure modernisation projects at a very early stage</p> <p>Incorporate ecological networks into regional planning schemes</p> <p>Encourage company culture to embrace ecology: awareness raising and training, adopt a biodiversity policy</p> <p>Create a common language and synergies between companies and local stakeholders</p>
IMPROVE THE DESIGN OF THE INFRASTRUCTURE AND ITS APPURTENANCES	<p>When defining the future structure, consider a large geographical area</p> <p>Set out, through local stakeholders, a spatial biodiversity strategy or policy</p> <p>Anticipate tomorrow's landscape and consider the twinning of infrastructure</p> <p>Integrate the structure into the natural landscape as well as possible</p> <p>Design functional longitudinal and transversal corridors</p> <p>Ensure the developments made for the structure are coherent with changes to nearby land</p> <p>Carry out experiments with clearly defined protocols and goals</p> <p>Continuously improve results</p>
IMPROVE THE RETURN OF LAND TO NATURE	<p>Envisage the dismantling and removal of the structure</p> <p>Move away from a case-by-case approach to compensation to the identification of a cohesive project</p> <p>Optimise the return of ownership of land with a biodiversity project</p> <p>Make better use of and restore the land owned by companies</p> <p>Create synergies among local stakeholders to create a joint ecological corridor project that is more ambitious and sustainable.</p>
IMPROVE BIODIVERSITY THROUGH DAY-TO-DAY MANAGEMENT PRACTICES	<p>Minimise light, sound, chemical, mechanical, etc. disturbance</p> <p>Develop a differentiated management approach that favours biological diversity by modifying the technical reference documents of companies</p> <p>Create green appurtenance management plans with ecologists and local stakeholders</p> <p>Give nature time to adapt and develop</p> <p>Fight against invasive alien species</p> <p>Train employees and service providers in the ecological management of green appurtenances</p>

IMPROVE KNOWLEDGE

Improve public knowledge of the species present along or in the vicinity of the planned routes

Improve knowledge of the impact on ecological functionalities, mortality, the behaviour of species, the combined effects, etc.

Improve knowledge of the effectiveness of the measures taken by assessing the results rather than the means, by bolstering inspections or by studying the contribution of green appurtenances to the ecological corridors

Improve knowledge of compensatory measures and the size necessary to optimise these measures

5. Conclusion and outlook

The lessons and recommendations contained in this report were collected from a large number of biodiversity and land management experts, scientists and employees of companies involved in environmental matters. They therefore reflect a diverse range of experience and different points of view.

Several lines of work have been put forward in the **recommendations to improve dialogue, reduce the fragmentation of land and the destruction of habitats and provide new carefully chosen areas** to strengthen ecological networks. Companies are already testing some of these suggestions; they only need to be generalised and perfected. Other lines of work, which are more experimental, will have to be tested, monitored and assessed before they are developed.

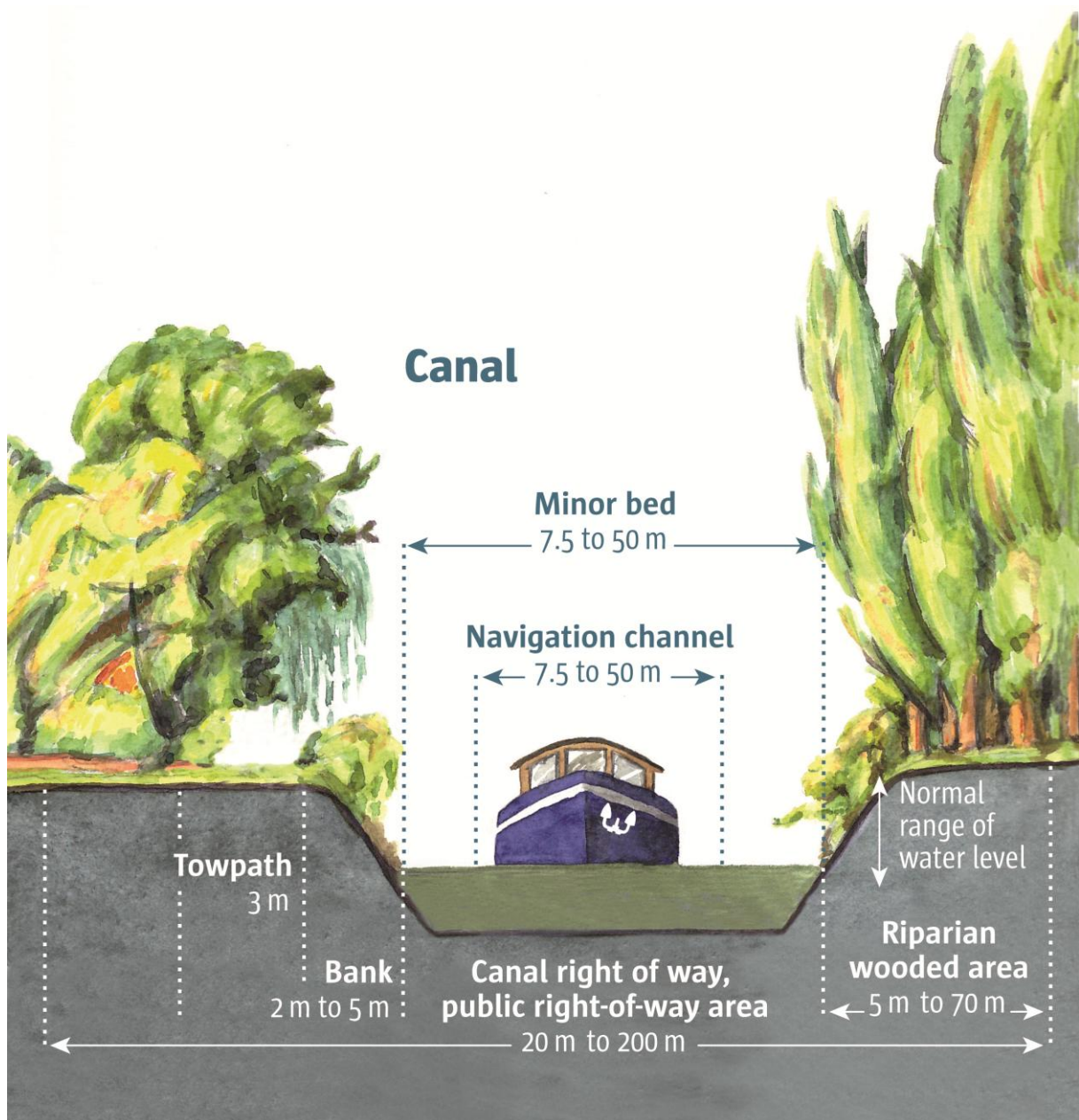
These recommendations, whether innovative or proven, are **not only intended for new projects but the whole of the existing network** so that the ecological networks can be repaired and rebuilt using a territorial and partnership-based approach. They could therefore constitute for a company, the CILB or anyone concerned by this subject a **foundation on which to hold discussions and carry out work so that action plans may be drawn up**.

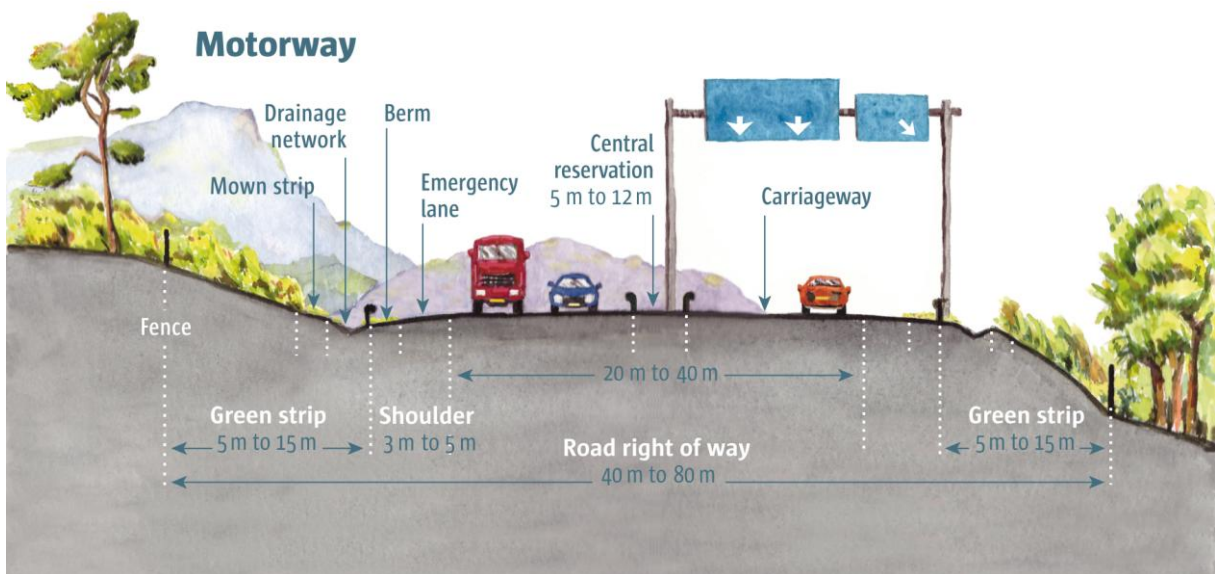
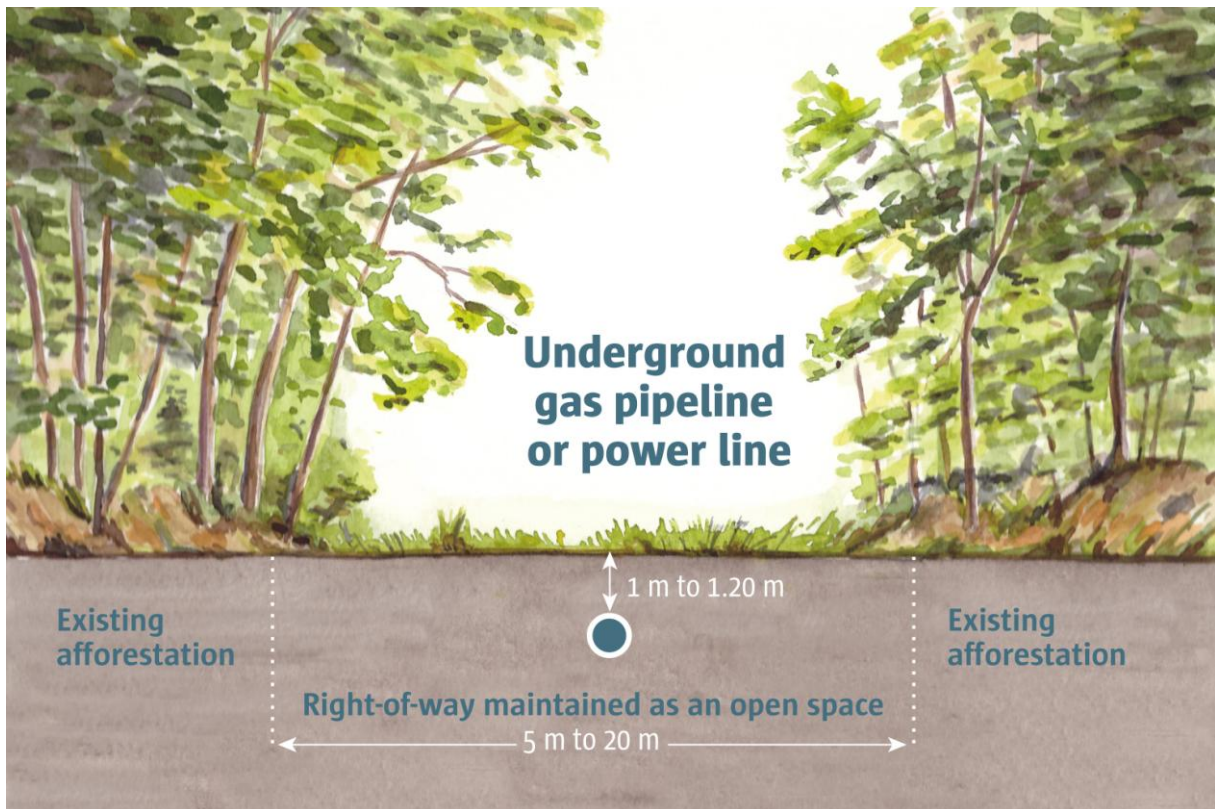
The quality of these recommendations and of the discussions between stakeholders, particularly during the seminar held in November 2014, confirms that, on the one hand, **transport infrastructure and its rights-of-ways can make a contribution if a number of precautionary measures are taken** to avoid a negative impact on biodiversity and to manage areas as well as possible. All of this would take place in a concerted manner and with the support of specialist structures.

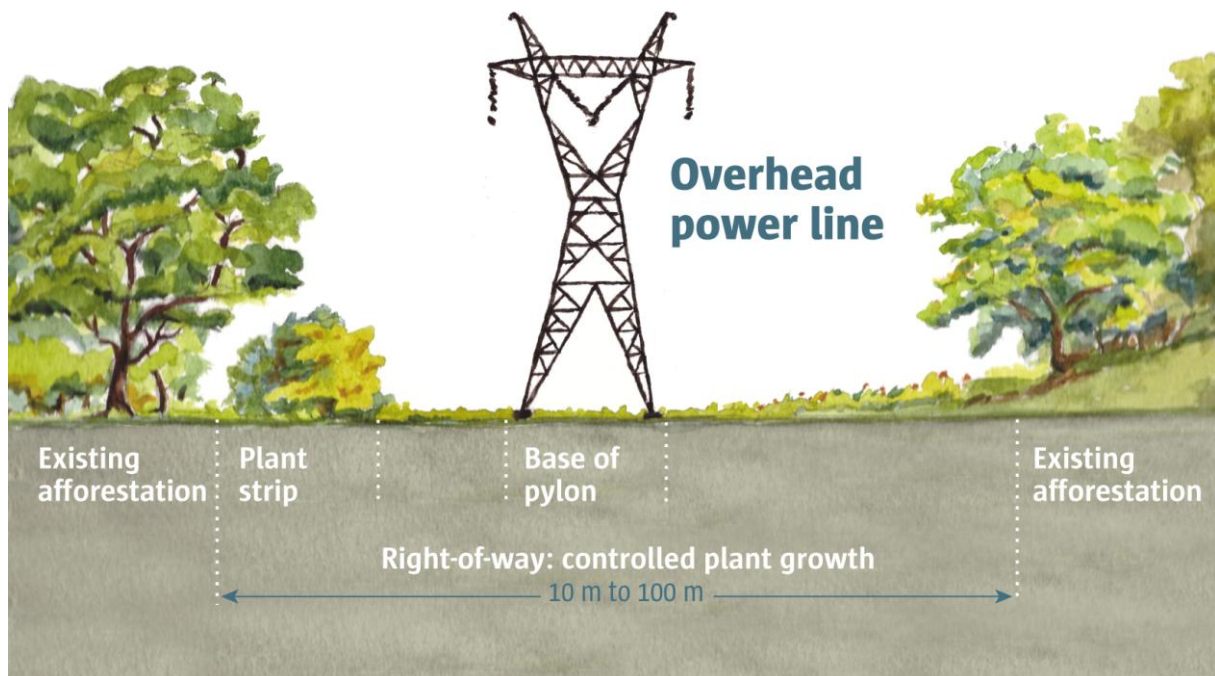
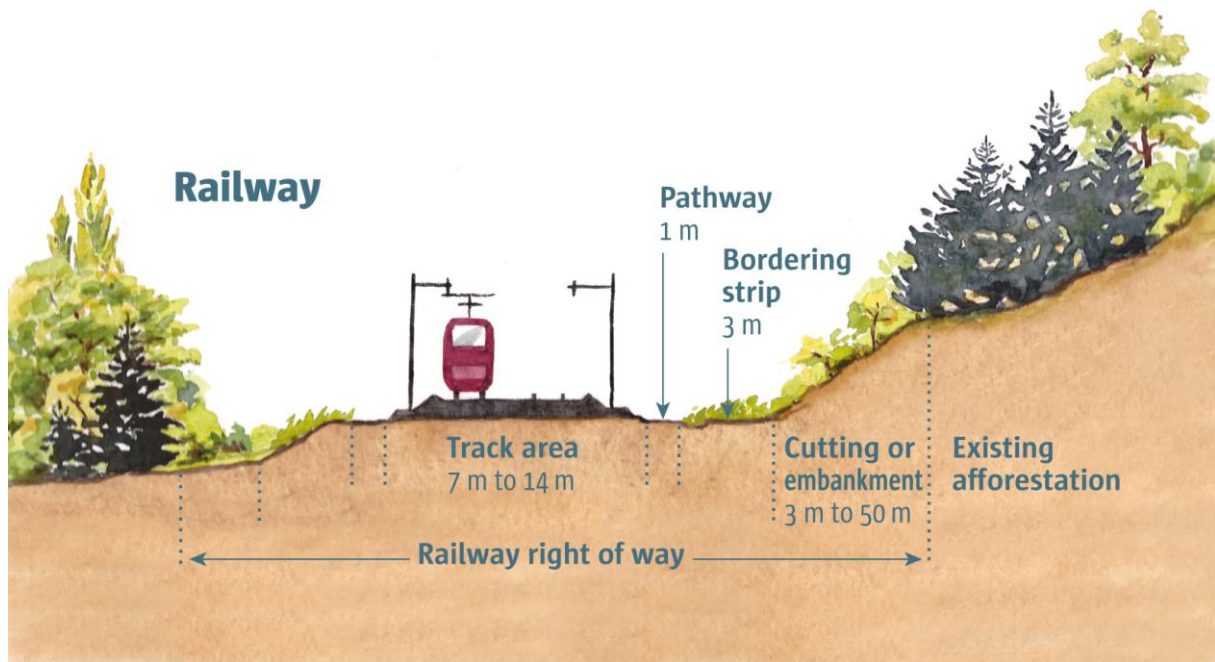
On the other, a **real desire for dialogue and cooperation** between the world of business and the world of ecology has emerged. If these recommendations are to be implemented, **companies need to be supported and they need to work towards a common goal with other local stakeholders**. A broad field of research and numerous partnership opportunities appear to have arisen. Furthermore, a range of interests and diverse sources of knowledge are available to help structure this research and these partnerships.

In a few years from now, **another discussion and working seminar on this subject could be organised**. It would be an opportunity to take stock of the actions undertaken and to identify new areas of consideration while taking the progress of knowledge in this subject into account.

Linear infrastructure diagrams







**'Infrastructure corridors, ecological corridors.
Under what conditions can linear transport infrastructure and its
rights-of-ways contribute effectively to ecological networks?'**

9.00 a.m. - 9.30 a.m. Welcoming of participants

9.30 a.m. - 9.50 a.m. Opening of the seminar

By *Jean-Christophe Louvet*, Chairman of the Sustainable Development committee of the FNTF, *Jean-François Lesigne*, CILB, and *Bernard Cressens*, Chairman of the French committee of the IUCN

9.50 a.m. - 11.05 a.m. Plenary

- 9.50 a.m. - 10.10 a.m. Presentation of the organisation, aims and context of the seminar chaired by *Frédéric Denhez*, with *Anne Guerrero* (CILB) and *François Letourneux* (IUCN)
- 10.10 a.m. - 11.00 a.m. Three speeches:
 - **Foreign experience:** presentation of the Swiss system for the modernisation of the road network by *Marguerite Trocmé*, *Swiss Federal Roads Office*
 - **Infrastructure and the green and blue belt:** what is ecological infrastructure? by *Sylvie Vanpeene*, *IRSTEA*
 - **Longitudinal corridors:** creation of pond networks by *Gérard Jadoul*, *Coordinateur Life+ biodiversité ELIA-RTE*

11.05 a.m. - 12.15 p.m. Workshops

Under what conditions can linear transport infrastructure and its rights-of-ways contribute effectively to ecological networks?

12.15 p.m. - 1.40 p.m. Lunch

1.40 p.m. - 1.55 p.m. Plenary

Feedback from the morning's workshops by *Frédéric Denhez*

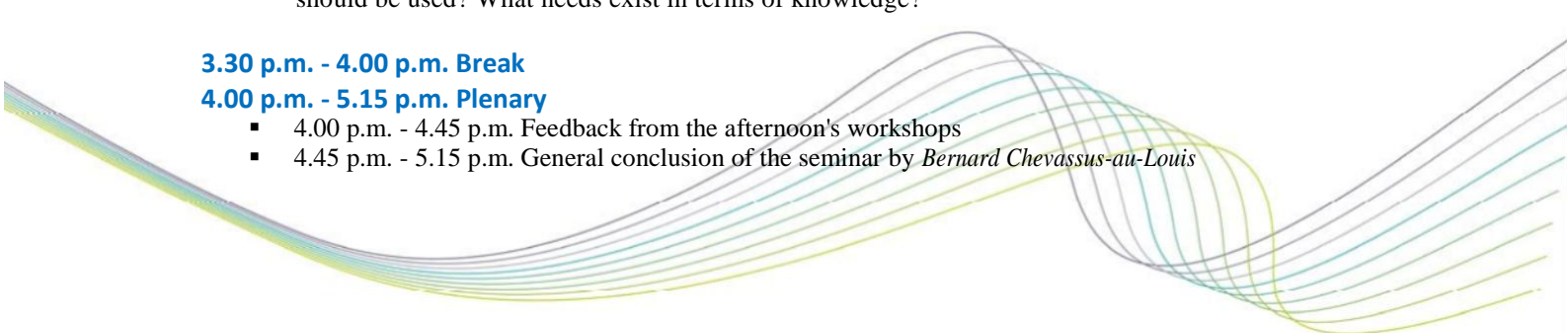
1.55 p.m. - 3.30 p.m. Workshops

1. How can the quality and functionality of green appurtenances and biodiversity areas under the responsibility of infrastructure managers be improved?
2. How can infrastructure managers improve cooperation among themselves and/or with local stakeholders in order to optimise the connection between ecological networks and infrastructure networks?
3. How can the design of infrastructure be optimised to allow green appurtenances to play a positive role in green and blue belts?
4. How can developers improve the integration of ecology into their line of work while taking the other environmental challenges and tasks that they face into account?
5. Why and how can the effectiveness of measures be assessed? What spatial and temporal scale should be used? What needs exist in terms of knowledge?

3.30 p.m. - 4.00 p.m. Break

4.00 p.m. - 5.15 p.m. Plenary

- 4.00 p.m. - 4.45 p.m. Feedback from the afternoon's workshops
- 4.45 p.m. - 5.15 p.m. General conclusion of the seminar by *Bernard Chevassus-au-Louis*



Lexicon

Biodiversity: contraction of the words, biology and diversity; represents the diversity of living organisms and ecosystems: fauna, flora, bacteria, environments, but also races, genes and domestic varieties (<http://www.developpement-durable.gouv.fr>).

Ordinary biodiversity: has no intrinsic value as such but due to its abundance and the extensive interaction between its component parts, contributes to varying degrees to the functioning of ecosystems and to the production of ecosystem services that benefit human society. Source: Chevassus-au-Louis report (2009).

Ecological networks: comprise ecological corridors and biodiversity areas.

Ecological corridors: spaces that provide a connection between biodiversity areas, thereby offering species conditions that favour their migration and the completion of their life cycle. Ecological corridors may be linear, interrupted or based on the landscape (www.trameverteetbleue.fr).

Green appurtenances: all surface areas that form part of the infrastructure's right-of-way, except for the structure's direct foundations. They are subdivided into two categories: those that are directly associated with the operating of the structure (hard shoulder, ditch, etc.) and those that accompany the structure (embankment, surplus land, etc.).

Linear transport infrastructure: railways, roads, motorways, navigable waterways, gas or oil pipelines, and power lines.

Biodiversity areas: areas in which biodiversity is the most diverse or the best represented, where species can complete all or part of their life cycle and where natural habitats of a sufficient size can fulfil their function; areas that host population nuclei from which individuals can spread or that can host new populations of species. (www.trameverteetbleue.fr)

Ecological network: see the definition of a green and blue belt.

Green and blue belt: a network made up of terrestrial and aquatic ecological networks identified in 'regional ecological coherence plans' (SRCE) as well as documents that belong to the state, local authorities and their consortia. It constitutes a sustainable management tool for the region. The green and blue belt contributes to the favourable conservation of natural habitats and species and the good ecological condition of water bodies. It extends to the low-water line and, in the case of estuaries, to the point that separates the estuary from the sea ('LTM') (www.trameverteetbleue.fr).

Ecological permeability: a landscape that does not block the movement of individual animals, species or genes.

Black belt, or night belt: a network of unlit corridors that allows the movement of nocturnal species.

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For the inside front cover or the back cover:

The CILB (Club des infrastructures linéaires et Biodiversité) brings together within an informal group nine linear infrastructure managers: AFSA, Eiffage Concessions, ENEDIS, GRTgaz, LISEA, SNCF Réseau (formerly RFF), RTE, TIGF, and VNF. In accordance with its charter, the Club was set up to exchange its members' best practices, feedback and know-how in the field of biodiversity, to work on major current concerns and to provide a visible organisation for its partners.

The French committee of the IUCN is the network of bodies and experts of the International Union for Conservation of Nature in France. It comprises two ministries, public bodies and non-governmental organisations, and relies on a network of more than 250 experts, while also involving local authorities and companies. Its purpose is to respond to biodiversity challenges by producing accurate biodiversity status reports, by putting forward recommendations in order to improve public and private policies and by implementing action programmes.