

Habitats and protected species compensations for Alpine underground works: a pilot experience between France and Italy

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ABSTRACT: The works for the construction of the 57 km of Transalpine Base Tunnel of the Turin-Lyon railway link involve the installation of outdoor building sites in the Alpine ecological context. The areas affected by these installations have been minimized to reduce the use of soil as much as possible and areas with low ecological value have been chosen as far as possible. The residual impact of the works on habitats, protected species and ecological corridors has been assessed on the basis of detailed inventories. In line with the European doctrine of "avoiding - reducing - compensating", an extensive program of compensatory environmental measures, covering an area of more than 170 hectares, is being implemented to guarantee a balance sheet without net biodiversity losses. This article describes the compensation program implemented and analyses the similarities and differences in the approach to environmental compensation in the two countries – France and Italy.

1 THE BASE TUNNEL OF THE NEW TURIN-LYON LINK

1.1 *The project*

The new rail link from Turin (Italy) to Lyon (France) will complete the European rail network. It will constitute the key element of the east-west axis of the Mediterranean corridor, and will be one of the three main rail routes south of the Alps planned by the European Community.

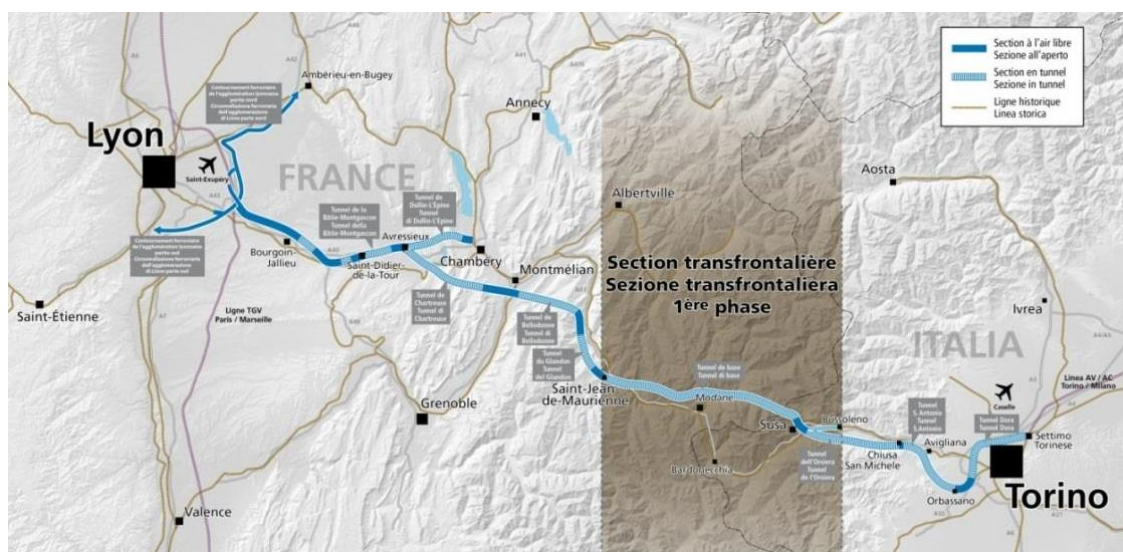


Figure 1. Location of the cross-border section of the new Lyon - Turin rail link.

This new rail link will have its profile at the base of the Alpine massif, at an altitude of around 600 m, and will have a maximum gradient of 1.2%, allowing the development of combined transport and authorizing the introduction of high-gauge and high-performance “rail-motorway” services. The project is designed for mixed traffic, it will allow freight trains as well as passenger trains to circulate.

The bi-national cross-border section between Italy and France includes a 57.5 km-long 8.70 m-diameter single-way twin-tube base tunnel, one of the longest in the world, which crosses the Alps roughly 45 km in France and 12.5 km in Italy (see figure 1) between Saint-Jean-de-Maurienne and Susa. The base tunnel incorporates many ancillary works: communications between tubs, sidings, exploratory adits and emergency access tubs, wells and ventilation tunnels, technical rooms for a total of 164 km of underground works. Design of the base tunnel includes four exploratory adits and geognostical tunnels.

Three French exploratory adits were completed between 2007 and 2010: Saint-Martin-La-Porte (2.4 km), La Praz (2.5 km) and Modane (4.0 km). The Italian exploratory tunnel of La Maddalena (7.1 km) was completed in February 2017 and the French exploratory tunnel of Saint-Martin-La Porte (9 km) has been under construction since 2014, more than 5 km of which have already been excavated.

1.2 *The Alpine natural environment and the areas occupied by the project*

As 90% of the cross-border section of the new Lyon-Turin rail link consists of tunnels, the ecological impacts and land use are significantly lower compared to a rail line of the same length located outdoors. The ecological impacts are therefore those of the outdoors construction sites. The problems of ecological continuity, which constitute one of the main issues of linear transport infrastructures when they are located outdoors, are rather limited.

The ecological dimension has been taken into account in the choice and definition of work sites. For example, in France, material transit sites are ruderal sites on the edge of the Arc river with few ecological stakes, while Italians final disposal sites are old quarries already in a compromised state from an ecological point of view. Moreover, it should be noted that the vast majority of the surfaces used during the work will be rehabilitated and restored to their natural state at the end of the work.

The precise knowledge of natural habitats, fauna and flora species, ecological functionalities, etc., enabling us to understand the ecological issues present on construction sites and around, is based on bibliographic studies but, above all, on numerous hours and days of ecological inventories in the field. On the French side, the over-sides investigated represent almost double the impacted areas presented below. This represents a cumulative inventory pressure of more than 200 man-days. On the Italian side, the areas involved are smaller but the planned investigation activities are proportional.

On the French side, the work sites are located in the central part of the Maurienne. This area, around the Arc valley, benefits of a climate with some precipitation and warm weather in summer, especially on the well exposed slopes. These conditions are suitable to the extension of natural environments of southern affinity. There is a great diversity of plant groups, related to the variety of local substrates. The sector allows the observation of some species of remarkable mesicolous plants (plant species whose life cycle are adapted to the harvest cycle, in particular of cereal grains and are associated with traditional cultures). The fauna is also very varied, with alpine species occasionally reaching the lower slopes, forest species or species associated to more open environments. The lower valley, heavily urbanized near the river and the roads of communication, quickly finds all its naturalistic interest when one progresses towards the tops.

In terms of habitats and natural environments, hay meadows, cliff and scree areas, coniferous forests and wetlands are particularly noteworthy habitats in the Maurienne, home to a diversified fauna and flora; but there are also uplands and high moors, including steppe grasslands. The Maurienne steppe grasslands are very localized environments on a national scale: they are present only in the internal valleys of the Savoy and Queyras Alps. These grasslands have a major ecological interest, both because of their rarity and because of the specific flora they host, including *Festuca valesiaca* or *Thesium linophyllum*. *Cypripedium calceolus*, in forest gaps, and *Erica carnea*, in dry pine forests very poorly represented in France, are present in forest environments. Remarkable species of flora found in open environments, sometimes formerly agri-

cultural, are also contacted, including several species of tulips, some of which are endemic to Savoy. Wildlife representatives include *Parnassius apollo* for insects, *Bufo calamita* for amphibians, *Upupa epops* and *Otus scops* for birds, and *Rhinolophus ferrumequinum* for chiropterans. Some of these species are representative of the Sites of Community Importance (SCI) of the “Perron des Encombres” and of the dry forest and herbaceous formations of the internal Alps listed in this part of the valley.

On the Italian side, the areas affected by the project are mainly in the lower Susa Valley, crossed by the Dora Riparia river. Characterized by a typically alpine climate, as in the valley of the Arc in France, the Susa Valley is home to a vast natural heritage, with a rich variety of fauna and flora. In fact, the strongly anthropized areas of the central part of the valley contrast with a well-preserved context, especially as far as the slopes are concerned, characterized by important naturalistic values, both in terms of habitat and of single species.

In flat areas, there are agricultural surfaces with stable meadows, grasslands or alfalfa fields and wooded areas, partly dominated by oaks and partly by *Robinia*. The slopes are characterized in part by xeric grasslands because of the particularly mild microclimate that favours Mediterranean gravitation species, many of which are extremely rare and localized, while in the lower areas a sub-Mediterranean thermoxerophilic and steppe vegetation prevail, as well as numerous grassy formations and shrubs.

There are numerous habitats of conservation interest and some rare plant species of considerable floristic importance, such as the *Carex Alba* and the *Typha minima*. Regarding the fauna, the area is characterized by a great biodiversity, with presence of numerous species of interest such as the lepidopteran *Zerynthia Polyxena*, species of Community interest in the “Habitats Directive,” many species of chiropterans of conservation interest including the bat *Myotis bechsteinii*, in addition to a significant presence of wild ungulates, especially deer, and wolves. The great naturalistic value of the areas is confirmed by the presence of two Sites of Community Interest (SCIs) in the immediate proximity: the SCI of the “Oasi Xerothermiche” and the SCI of the “Gran Bosco di Salbertrand.”

The table below summarizes the surfaces affected by the project in France and Italy, by major type of environment, and the areas rehabilitated in general (it being understood that “rehabilitation” tends to recreate woodland or open and shrubby environments).

The affected areas are significantly higher in France than in Italy (71% of the total), but this remains proportional to the location of the route of the cross-border section, mostly located in France (78% of the total). In France and in Italy, in particular, it can be observed that more than 50% of these impacted areas are not natural environments in their own right but artificial and ruderal zones, which confirms that the ecological dimension is taken into account in the choice and definition of work sites. Moreover, on each side of the border, more than 55% of the impacted areas are subject to ecological rehabilitation, which corresponds to an area larger than the truly natural environment impacted.

Table 1. The number of hectares affected and restored by the project.

Major types of environment	France		Italy		Total	
	Affected Surface	Restored Surface	Affected Surface	Restored Surface	Affected Surface	Restored Surface
Woodland	49		23		72	
Open / shrubby environments	33	94	5	38	38	132
Artificialized and ruderal environments	84		37		121	
Total	167	94	65	38	232	132

2 THE REGULATORY AND PROCEDURAL CONTEXT FOR IMPACTS ON PROTECTED SPECIES

2.1 *International conventions and European directives*

Certain species are protected “at all times, in all places and over the entire territory” on a European scale, or more widely, within the framework of international conventions. At European level, the texts and conventions relating to the protection of species are:

- The Berne Convention, in force since June 1982 and regarding the conservation of Europe's wildlife and natural environment, commonly aims to ensure the conservation of wild flora and fauna and their natural habitats, in particular species and habitats whose conservation requires the cooperation of several States.
- The Bonn Convention, in force since November 1983 and relating to the conservation of migratory species of wild animals, has as its objective the protection and management of all migratory wild species (terrestrial, marine and aerial). A significant portion of those populations traverses one or more parts of the national territory in a predictable cyclical pattern.
- Directive 2008/99 of 19 November 2008 on the protection of the environment through criminal law defines a range of serious environmental crime at Community level and requires Member States to provide for criminal penalties.

Projects likely to have impacts on protected species or their habitats are governed by European Directive 85/337 of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment, better known as the “impact assessment” directive. This assessment shall include in particular the data necessary to identify and assess the main effects that the project is likely to have on the environment and a description of the measures proposed to avoid, reduce and, if possible, remedy significant adverse effects.

2.2 *The concrete application of protected species procedures in France and Italy*

TELT, the contracting authority of the project, has obtained the environmental authorizations, on both the French and Italian sides, which enable it to carry out the work of the cross-border section, on the basis of dossiers resulting from the impact study drawn up in accordance with the European directive. The particular procedures concerning protected species comply, both in France and in Italy, with the conventions and directives previously presented.

In particular, in France, in order to be able to derogate from the prohibitions on the destruction of protected species or their habitats (Nature Protection Law of 1976 - Art. L. 411-2 of the French Environmental Code), it is necessary to submit a specific request for authorization, in accordance with the conditions indicated in Art. R. 411-6 et seq. of the Environmental Code.

The Environmental Code sets three conditions for obtaining the exemption:

- The project for which a derogation is requested must be based on an overriding reason in the public interest;
- There is no other more satisfactory solution;
- The derogation does not prejudice the favourable conservation status of the species in its natural range.

The applicant for a derogation must therefore be able to demonstrate that these conditions are met by describing in an impact study the size of the project, the justification for its major public interest, the methodology used to design a project that minimizes its impact on the natural system (fauna, flora, ecosystems) and the measures it undertakes to put in place in accordance with the European doctrine of “Avoid-Reduce-Compensate” for residual impacts.

The derogation, which specifies the conditions of execution of the authorized operations, is granted by prefectural decree, based on the opinion of the National Council for the Protection of the Nature (CNP) and after collecting the observations of the public.

TELT was granted a derogation by a prefectural decree in 2016.

In Italy, Legislative Decree no. 152 of April 3, 2006, as amended, implemented the mandate conferred on the Government by Law no. 308 of 2004 to reorganize, coordinate and integrate environmental legislation. This legislation requires an Environmental Impact Assessment (EIA) procedure to be activated in order to obtain the necessary authorizations. The procedure, introduced in Europe by Directive 85/337/EEC of 1985 on the assessment of the effects of certain

public and private projects on the environment, is based on the principle of prevention, i.e. the identification and assessment during the design phase of potential impacts produced by human intervention on the environment, meaning by Environment a system consisting of man, flora and fauna, soil, water, air, climate, landscape, material assets and cultural heritage. Specifically, the environmental assessment of projects aims to verify the effects on the components, providing for the maintenance of species and the preservation of the reproductive capacity of the ecosystem, as an important resource for life. To this end, the environmental impact study identifies, describes and evaluates the direct and indirect impacts of the project on fauna and flora, also studying all the measures to mitigate the effects generated by the work and the necessary environmental compensations.

On the basis of the documentation submitted by the applicant throughout the procedure, and taking into account any comments and opinions received during the public consultation phase, the Technical Commission for Environmental Impact Assessment (“CTVA” in Italy) of the Ministry of the Environment, carries out the technical investigation to verify whether the project has potential significant environmental impacts. On the basis of this preliminary investigation, the Minister for the Environment, the Protection of Natural Resources and Sea adopts an environmental compatibility assessment, which is then sent to the Ministry of Infrastructure and adopted by the Inter-ministerial Committee for Economic Planning (CIPE) at the same time as the project is approved.

TELT obtained the approval of the project with regard to environmental compatibility with the CIPE Resolution 19 in 2015 and environmental compatibility of the variant project with the CIPE Resolutions 30 and 39 in 2018.

In conclusion, it may be noted that the French part of the project was authorized by a particular concept of “derogation” from the prohibitions on protected species, constituting a specific authorization procedure distinct from other environmental procedures and which doesn’t exist in Italy. In Italy, the project was authorized by a single authorization procedure which groups together all environmental subjects: the assessment of impacts, which therefore groups together different environmental themes, is more general.

3 ENVIRONMENTAL COMPENSATION FOR PROTECTED SPECIES

3.1 *Definition of “compensatory measure”*

The purpose of compensatory measures is to compensate or offset the expected or foreseeable damage to biodiversity caused by the realization of a work project, through the implementation of field actions favourable to the species, habitats and functionalities impacted. They are basically to be distinguished from avoidance and reduction measures - the purpose of which is to eliminate or mitigate the direct impacts of works - and can in no way replace them.

Aiming at an objective of zero net loss or even gain of biodiversity, a compensatory measure must theoretically lead to a state of the environment considered functionally normal or ideal. It must result in an obligation of results and be effective throughout the duration of the effects. The compensatory measures relate exclusively to sites distinct from the work areas and their implementation must begin before the residual impacts that they must offset occur. These are ecological and non-financial or social measures, which may consist, for example, of actions to restore and manage environments and species, and also include operations to protect or raise awareness, always with the aim of maintaining the good conservation status of species and habitats.

Beyond the purely surface aspect, for compensatory measures to be effective, they must satisfy several rules:

- Targets: all protected habitats and species with residual impacts must be represented, in proportion to these impacts, within the over-sides of the compensatory program;
- Geographical proximity: compensatory measures must be located in the same geographical area as the works;
- Feasibility: compensatory measures must be technically and ecologically feasible; this includes not implementing actions with uncertain success and ensuring that they can actually be put in place: land control, partnerships to be set up, possible administrative procedures, etc.

- Anticipation: compensatory measures must be anticipated as far upstream as possible by the contracting authority so as to disturb the conservation status of the target species as little as possible;
- Additionality: compensatory measures must generate environmental added value that would not have been achieved in their absence.
- Objectives: compensatory measures must be accompanied by performance objectives and arrangements for monitoring their effectiveness and effects.
- Duration: compensatory measures must be long-term (30 to 50 years); sustainability can be ensured through the acquisition of land or long-term contractual arrangements with landowners.

3.2 *Compensation projects in progress for the France side project*

3.2.1 *Definition of compensatory need*

As indicated in paragraph 2.2 above, the exemption from the prohibitions on protected species was obtained on the basis of the impact study carried out, in agreement with the administration, in accordance with current practices in France, namely according to the doctrine known as Avoid-Reduce-Compensate.

As part of this study, an articulated set of measures to avoid and reduce impacts, both during the construction phase and during the operation phase, was identified and integrated into the design of the infrastructures themselves.

Despite this, residual impacts have been identified; the residual impact represents the foreseeable gross impact of the work less the effects of the implementation of avoidance and reduction measures.

Once the residual impacts have been calculated habitat by habitat and species by species, the applied method foresees that the compensatory need is assessed by assigning, according to the level of conservation stake of the species/habitat concerned by the impacts, a specific coefficient that multiplies the residual areas impacted. The coefficients for calculating the compensatory need are logically progressive from the lowest to the highest stake levels and vary from 1.2 to 2.

According to the concept of mutualisation, an area compensates for several species which frequent the same type of habitats. By applying this method, it was calculated that the overall compensatory need amounts to 82 ha for wooded areas and 86 ha for open and shrubby areas. In addition, compensation is provided in pioneering environments, mainly for the *Bufo calamita*, which is the subject of functional compensation through the creation of permanent breeding sites.

Following the calculation of the compensatory need, the compensatory measures had to be identified and defined in accordance with the principles set out in paragraph 3.1 above. The knowledge of the general and specific ecological and territorial contexts made it possible in the first place to target a certain number of compensatory measures areas. Afterwards, precise investigations have been carried out on the surfaces where the compensatory measures areas were located, in order to define the actual perimeter of the compensatory measure according to the environmental issues found and particular feasibility problems.

3.2.2 *Summary presentation of measures*

A total of 23 compensatory measures are being implemented on the French side of the project. A summary description is given in the table below.

Table 2. The number of hectares of the surfaces involved and the duration of activities in years.

"Biodiversity" environmental compensatory measures in France				
Environment	Measures	Surface	Actions to be implemented	Duration
Forester	Senescence Islands	20	Lack of management for biodiversity enhancement, targeting in particular avifauna and bats living in caves	30 years
	Preserved shoreline woodland	0.5	Improvement of bird and bat reception capacities: installation of nesting boxes, removal of exotic species, etc.	30
	Forest holes	5	Forestry management favourable to biodiversity, targeting in particular the <i>Cypripedium calceolus</i>	30
	Pine forest for heather	3	Lack of management for the preservation of plant species, targeting in particular the <i>Erica carnea</i>	50
	Shoreline forest	1	Biodiversity-enhancing forestry management, targeting in particular bryophytes	50
	Extended forest domain	28	Biodiversity-enhancing forestry management, targeting in particular birds and bats	50
	Sensitive wooded plots	25	Acquisition and management of wooded plots of high environmental value, various targets	50
Open and shrubby	Maurienne steppe grasslands	50	Inventories, diagnosis, animation and management of Middle Maurienne steppe grasslands	5-8
	Tulip Talus	0.1	Opening and management favourable to the expansion of tulips	30
	Mosaic of shrub and open environments	12	Reopening and management of dry mosaic grasslands and meadows, various targets	30
	Mow meadows	4	Extensive grassland management and hedgerow planting, targeting grove flora and fauna	30
	Shrub Talus	0.5	Reopening and management of tulip and <i>Ornithogalum nutans</i> environments	30
	Fallow meadow and terraces	1	Reopening and management favourable to the expansion of tulips	30
	Dry lawn with shrubs	0.5	Conservatory management for flora and fauna	30
	Steppe lawns of Châtel	7.5	Conservatory management of steppe mosaic lawns, various targets	30
	Upper Slope Grasslands	10	Various agro-environmental management for conservation purposes, various targets	30
	Dry lawns	20	Various agro-environmental management for conservation purposes, various targets	30
Pioneer	Forgotten grasslands and hedgerows	1.5	Grassland management and maintenance for tulip and garlic expansion	30
	Babylon ponds	0.1	Creation of 2 ponds and habitats in favour of amphibians and reptiles	5
	Functional pond network	1	Creation of a network of 6 temporary ponds and associated habitats, targeting <i>Bufo calamita</i> and pioneer flora in particular	30
	Ponds of the water body	1	Management of water environment in favour of amphibians	30
	Pond of Ferropem	0.2	Creation of a reproduction site for <i>Bufo calamita</i>	30

All these measures are the subject of detailed management plans describing the precise and complete initial ecological state of the site, the details of the actions and their implementation methods, and including protocols for scientific monitoring of the effectiveness of the measure, which will be carried out on a regular basis throughout the duration of the compensatory measures. All these measures were defined before obtaining of the administrative authorization.

3.3 *The flora-fauna habitat and ecosystem protection measures for the Italian side project*

As indicated in paragraph 2.2 above, the Italian side project was approved by the Ministry of the Environment on the basis of the results of the Impact Study, analysed during the technical investigation phase by the Technical Commission for Environmental Impact Assessment.

As already mentioned, one of the main objectives to be pursued with an analysis of the impacts carried out in parallel with the design of the work is to avoid or minimize the negative impacts and to enhance the positive ones. As part of the Impact Study, measures to avoid and reduce the impacts (mitigation) of the project were identified and sized, both during construction and during operation, in line with the natural context in which the project is located.

In addition, a highly developed monitoring system was defined in order to verify, during the entire construction period and for a year after works or beyond according to the stake of the species followed, that local disturbances linked to the implementation of the project do not cause permanent damage to the ecosystem and that the ecological balance is not compromised, as provided for in the impact assessment.

The conclusion of the impact assessment of the project on the Italian side is that, taking into account the context and the reduction and mitigation measures put in place, compensation works, as indicated in paragraph 3.1, are not needed, excepted for the ecological restoration of the areas around two specific construction sites (La Maddalena and Salbertrand) where species of great conservation interest have been found, such as *Aristolochia*, fundamental for the existence of *Zerynthia polyxena*, *Carex alba*, *Typha minima* and *Epipactis palustris*.

The "Plan" related to ecological restoration measures includes principles and guidelines aimed at promoting the use of local ecotypes as part of site restoration activities. The operational details of the implementation of this plan, including the physical extension of the measure (of approximately 20 ha), are being defined.

4 CONCLUSIONS

On the French and Italian sides, the project for the cross-border section of the new Turin-Lyon link pursues the same objective of minimizing impacts and preserving ecosystems, habitats and biodiversity. On both sides of the border, the technical authorities of the respective administrations have expressed their favourable opinion on the contents and results of the respective Impact Assessments which have shown how this objective is concretely pursued.

However, it should be noted that the volume of environmental compensatory measures for the fauna-flora, habitat and ecosystem components to be implemented is clearly unbalanced on the French side: more than 20 projects covering a total area of more than 170 ha on the French side, compared with a single equivalent project of about 20 ha on the Italian side.

This difference is explained, in part, by the fact that the project is less extensive on the Italian side and that the species directly involved in the project have overall a lower critical level than those on the French side of the project.

Nevertheless, it is also possible to highlight a certain difference in the scientific-cultural approach to the issue of species conservation and resilience. In fact, given equal mitigation measures, the competent authorities required an application "to the letter" of the doctrine of the sequence "Avoid-Reduce-Compensate" on the french side and aim at the absence of net loss of biodiversity, by applying multiplying coefficients to the areas affected by the project.

Necessarily, this approach requires the implementation of compensatory measures. Even when faced with a temporary and reversible impact like that of a construction site, the fact that certain species cannot absorb the disturbance generated by that impact is taken into account, unless favourable habitats where these species can find refuge are made available, even before

causing the impact.

On the Italian side, the impact study showed that impacts are temporary and reversible and monitoring is constantly carried out to make sure that this statement is justified. In fact, the ecosystem is considered to be capable of restoring its equilibrium on its own and monitoring activities are carried out to ensure that this is the case.

The fact that in France there is a specific procedure to ask for derogation in order to destroy protected species accentuates the approach differences.

It should also be noted that, although the implementation of the compensatory program on the French side is well under way, the implementation of environmental compensatory measures in favour of biodiversity is facing many difficulties. These can be inherent to the technical aspects of management operations: they must be as non-intrusive as possible. In addition, since this is not an exact science, differences between the expected responses of nature and those actually observed via ecological monitoring often exist. Moreover, supporting the development of one species is sometimes to the detriment of another one. However, the main difficulties are the surpassing of the “feasibility” rule mentioned above with regard to land control and the partnerships to be set up. There are only a few pragmatic legal tools to obtain and control the land needed to implement environmental compensatory measures. In a context of severe land fragmentation, the amicable acquisition of private land is a difficult task. The existence of pastoral land groupings represents an opportunity, but the dialogue between the biodiversity world and the agricultural world, which theoretically work in symbiosis, is sometime difficult. As for municipalities, which are essential partners, despite the rhetoric of well-meaning ideas, the implementation of environmental compensatory measures on their territory is almost unanimously perceived as the appearance of constraints hindering economic developments

From this experience, it can be concluded that a middle ground between the French and the Italian approaches should be favoured.

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