A STRATEGIC EVALUATION FRAMEWORK TO MEASURE AND GUIDE EFFORTS TO PROTECT BIODIVERSITY: EFFECTIVENESS OF THE NATURA2000 POLICY IN FRANCE

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Abstract: *Through the Natura 2000 policy, EU member states are committed to maintaining or restoring the favourable conservation status of a list of habitats and species throughout their territory. We show here that evaluating the effectiveness of this policy regarding its assigned objectives requires translating these objectives into normative reference and then describing the constraints on habitats and species that the policy seeks to conserve. We propose a strategic evaluation framework based on this principle, applied at the level of the Metropolitan French territory, by relying on the exploitation of several data sets, whose are generally not mobilised by the standard evaluation procedure. The results are broken down by natural ecosystems and biogeographical regions, providing a dashboard for the policy that is the basis for a comprehensive strategic evaluation.*
Keywords: *Strategic Evaluation, Environmental Management, Policy Evaluation, Spatial Planning, Natura 2000.*

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1. INTRODUCTION

To avoid biodiversity erosion, the European Union has adopted a wildlife conservation policy, focused on a selection of species and habitats, whose lists are provided in the annexes of the ‘Birds Directive’ which came into force 40 years ago, and the ‘Habitats Directive’ which came into force 25 years ago. Under these 'Nature Directives', member states designate a functional network of sites and appropriate management measures that ensure the restoration or maintenance of natural habitats and species of community interest at a favourable conservation status (EEC Council 1992). This Natura 2000 (N2000) network is one of the largest coordinated protected area networks in the world with more than 27,500 sites covering 18% of the EU’s land area (European Commission 2018, Orlikowska et al. 2016) and is presented as the EU's major tool for protecting biodiversity. If the N2000 policy consists of creating sites and implementing management measures, the desired effect must be evaluated Europe-wide and divided into large sectors: biogeographical regions. It is on this scale that states commit to improving biodiversity conservation status. Thus, every six years, they must provide the European Commission with a comprehensive diagnosis, for each biogeographical region, of the status of the target species and habitats, whether they are within the network of sites or not. This evaluation, called ‘reporting’, consists of assigning a conservation status score to each habitat and species on the lists set by the Directives. This evaluation is based on parameters defined at European level. So far, these summaries have painted an overall negative picture, with only 15% of habitats and 27% of species in a favourable condition (EEA 2020). In terms of evaluation, this monitoring system provides essential information in terms of results. But, as reporting does not differentiate between results from inside or outside the network, and does not tie into the management measures implemented, it does not allow appraisal of how the action of the N2000 network influences species and habitats conservation status. The problem of assessing the effectiveness of the N2000 policy is, however, a major issue. Given the wide diversity of approaches to environmental policy evaluation (Crabbe and Leroy 2008), three underlying rationales of public policy evaluation are generally distinguished : a juridical or judicial rationale (focused on the rule of law and the principle of good governance), an economic rationale (sometimes referred to as a business/ managerial rationale), which focuses primarily on the policy goal attainment, effectiveness and efficiency, and a political rationale (with reference to democratic principles, representativeness, transparency, participation, etc.). Together, they are known as the JEP Triangle (Arts and Goverde 2006). However, most existing evaluations that deal N2000 policy, carried out on the initiative of European Union (McKenna et al. 2014; Milieu et al. 2016; European Court of Auditors 2017; European Commission 2015), or from scientific literature (Beunen and De Vries 2011; Lordkipanidze et al. 2018; Winkel et al. 2014; Watzold 2010; Pellegrino et al. 2017) have focused on the types of contracts, actors' logics and the strengths and shortcomings of the rules of implementation. Whilst the value of such evaluations can only be emphasised, on the other hand it is regrettable that there are not focused on the evaluation of the ecological performance of the policy (Busca and Salles 2005; Leroy et al. 2006; Leroy and Mermet 2014).

However, several studies have gone further by questioning the effect of the N2000 policy on other policies, whether through its capacity to influence the environmental policies of other member states (Bouwma et al. 2017) or its integration through other sectoral policies (Blicharska et al. 2011, Christensen and Kornov 2011, Sarvasova et al. 2013). These studies are very relevant in that they do not consider the N2000 scheme to be an isolated policy but look at its interactions with other policies, both in terms of the multiplication of its effects and external factors that counterbalance its effectiveness. Nevertheless, they all have in common that they do not focus on the policy's conservation objectives, at the risk of not being able to truly measure its impact. This focus on the issues at stake is better integrated into studies based on measurements of the conservation status of certain species or habitats, on reduced scales, especially that of sites (Bretagnolle et al. 2011; Zehetmair et al. 2014a, 2014b; Brodier et al. 2013, Santana et al. 2014). While these works carried out on site, or even on the scale of individual plots, makes it easier to conclude on the specific effect of the management measures implemented by the N2000 policy, it does not give any indication of their effects on the biogeographical territories level, whereas it is on this level that states are committed to Europe. Some authors are looking for effects on a larger scale, by comparing temporal trends in conservation status indicators inside and outside the site network, either on a continental (Donald et al. 2007, Gamero et al. 2017) or country level, either using range parameters (Kubacka and Smaga 2019, Rodriguez-Rodriguez et al. 2019, Chetan and Dornik 2021) or population dynamics parameters (Silva et al. 2018, Princé et al. 2018, Rada et al. 2019), However, they are still too rare and only focus on a portion of the targeted biodiversity (often birds such as Gamero et al. 2017 or Princé et al. 2021). Finally, a significant part of the evaluations focused on the relevance of the policy, i.e. the way he conservation issues are considered within the different policy tools. They mainly on established site networks, in order to evaluate their coherence, and in particular their 'representativeness' namely their adequate coverage of the range of species and habitats to be protected. These studies are based on the principles of systematic conservation planning (Margules and Pressey 2000) and deals with the European scale (Jantke et al. 2011; Albuquerque et al. 2012; Gruber et al. 2012; Trochet and Schmeller 2013; Maiorano et al. 2015; Zisenis 2017; Times et al. 2018), or on certain states (Verovnik et al. 2011; Rosso et al. 2018; Times et al. 2017). These studies, which often conclude by a relatively imperfect representation, do not, however, provide any information on the effectiveness of the N2000 policy, i.e. the effects of the network on the conservation status of species and habitats. Despite their diversity, these studies therefore produce relatively disjointed evaluations that do not allow us to conclude on the adequacy or not of the N2000 policy to its mission of curbing the erosion of biodiversity in Europe. Rather than evaluating the environmental policy's effectiveness, they focus either on the ecological relevance of the management arrangements implemented (based mainly on the representativeness of the sites), or on the organisational relevance regarding the forms of coordination that these arrangements promote, or the coalitions that are deployed within them, which generally promise an outcome that should find itself improved, without this result being directly measured. Faced with these shortcomings, the objective of this article is to provide a strategic framework for analysis and measurement that will improve the evaluation of the effectiveness of the N2000 policy. It is based on the principle that this effectiveness, and therefore the efforts made by the functional network of sites, can only be measured can only be measured in relation to all the practices impacting the species and habitats they aim to preserve. As certain studies on public policy evaluation have shown, particularly those involving strategic environmental management analysis (Mermet et al. 2010 ; Billé 2007; Leroy, 2006), the evolution of the state of ecological systems, in this case the species and habitats covered by the Nature Directives, does not depend unequivocally on the protection actions being implemented, in this case the N2000 policy, but on all the actions and policies that affect, either positively or negatively, the state of these ecosystems. Because, without the ability to compare, on the one hand, the specific efforts undertaken in favour of the environmental policy objectives and, on the other hand, the resistance that sectoral development policies put up against these efforts, it is not possible to assess the extent to which an environmental policy is effective or not (Mermet et al. 2005). In concrete terms, the aim is to carry out a rigorous diagnosis of the ecological situation in relation to conservation issues in the identified territories by specifying (i) the choice of the prescriptive referential on which the evaluation is based: What are the ecological objectives targeted? (ii) the current ecological situation, assessed on the scale expected from the policy objectives : What is the gap, between these objectives and the current state that can be observed, that would have to be bridged to achieve them? (iii) the accountability system analysis: What are the factors that need to be addressed to explain this discrepancy? This implementation of a relative strategic evaluation, an "on-board" framework evaluation approach (Leroy and Mermet 2012), makes it possible to prevent blurring of environmental bottom-line and identify the levers to improve the situation. We applied this methodological framework to the French N2000 network. It is one of the largest in Europe, with an important diversity of ecosystems and socio-economic contexts, partly due to the presence of four biogeographical regions. Its size and complexity make it a appropriate case study for assessing the policy. In the first part, we will therefore present the analytical and methodological framework, and the data from various sources that we have triangulated in order to establish a robust diagnosis. Then we will present the results obtained for France through the proposed strategic evaluation framework. These results will be presented on the scale of ecosystems and biogeographical regions, according to a threefold breakdown: the translation of the prescriptive referential into issues in the field, the analysis of the conservation status and the deviation from the objectives, and the analysis of pressures on these same scales and therefore the factors to be acted upon. We will conclude on the perspectives opened up by such a strategic evaluation framework.

2. ANALYTICAL FRAMEWORK

Application of the Strategic Environmental Management Analysis framework to the N2000 policy

The framework for strategic environmental management analysis (SEMA, Mermet et al. 2005; Mermet 2011) that we have decided to apply to the evaluation of the N2000 policy is an evaluation process following four work stages (Mermet et al. 2010; Leroy and Mermet 2012). In this article, we have focused on the first two stages that provide the basis for strategic evaluation: (stage 1) understanding the issues for the territory under consideration using the prescriptive referential and (stage 2) the dynamics of effective management that make it possible to identify the gap between policy objectives and the current observable state, as well as the factors that may explain this discrepancy. We will not develop the other two stages, namely (stage 3) intentional management, i.e. the full description of the action implemented by the N2000 policy (regulatory mechanisms and management measures, the statistical effect of site creation on conservation status) as well as other environmental policies that might play a role in achieving the objectives set by the 'Nature Directives', nor (stage 4) the identification of room for manoeuvre to redirect N2000 from this strategic diagnosis of the system of responsibilities (Rouveyrol and Leroy 2020).

These first two stages are as follows:

Defining the issues of the N2000 policy in the territory concerned : this involves translating the prescriptive referential set by the Nature Directives, i.e. the species and habitats of Community interest, into concrete issues for the territory concerned.

To this end, on the one hand we have identified the ecosystems (grassland, coastal, forest, etc.) with which the species and habitats targeted by the Nature Directives are associated, and on the other hand, their distribution by biogeographical regions. The approach by ecosystem rather than individual species and habitats permits to synthetize data while at the same time taking into account the pressures and management measures that remain largely specific to these different ecosystems. Their distributions by biogeographical regions (**Figure 1**) allow us to reduce our data to the scale at which member states are committed to achieving results. This dual entry ecosystem /biogeography allows us to mobilise georeferenced datasets on the state of these ecosystems that go beyond the information produced by the N2000 policy alone.

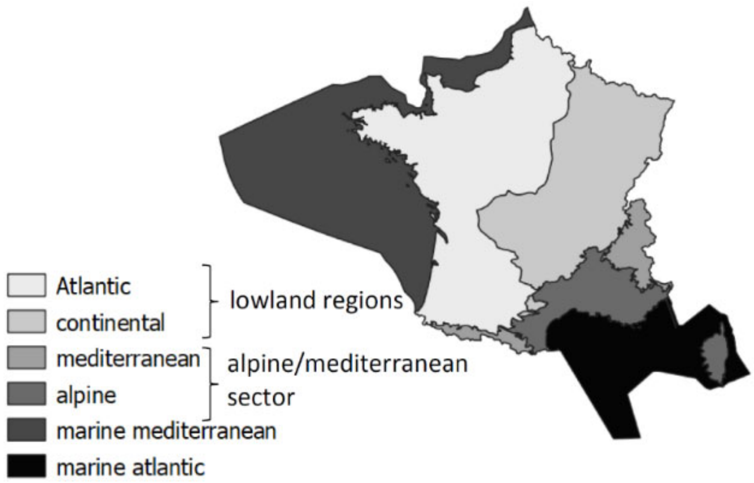

Figure 1. Biogeographical regions in France (Source MNHN 2011-EEA 2007): Regions with homogeneous ecological conditions on a European level. The Habitats Directive defines eleven terrestrial biogeographical regions and seven marine biogeographical regions.

Describing 'effective management' is based on an inventory of all practices, whether voluntary or not, of any actor and, more generally, of the sectoral policies that impact the conservation objective set, and assesses their effects. It allows identification of objective responsibilities in "de facto management." For N2000, it will result in, on the one hand, work on the conservation status of habitats and species, making it possible to ascertain the distance to the target of the policy, which is their restoration or maintenance at a favourable conservation status. On the other, we will study the nature, intensity and location of the pressures exerted on them, which are the factors that explain this distance. Let us now give details of the data mobilised to deploy such an analysis.

3. CONCEPTION AND CALCULATION OF THE INDICATORS

3.1 Data used

As previously mentioned, member states account for achievement of the objectives of the Nature Directives by means of reporting. For the Habitats Directive, it consists of providing an evaluation of the conservation status of each species and habitat of community interest on the level of each biogeographical region in which they are present. For the Birds Directive, the evaluation focuses on numbers and trends. The evaluations are made by experts (more than 400 experts mobilised for the Habitat Report in 2019), based on the best available knowledge (Bensetitti and Gazay 2019).

These data present two limitations in answering the questions being considered:

- They constitute an evaluation list by species or habitat, which are of little operational value for a global diagnosis. We have therefore broken them down into indicators, grouped thematically by ecosystem, and spatially according to biogeographical regions.
- They are open to criticism due to the excessive importance they give to expert opinions (Jeanmougin et al. 2017, Moser et al. 2016). In response, we have chosen to cross-reference them with several other sources of data relevant to the questions asked.

The information contained in the "Standard Data Forms" ("SDF database" in the article) is derived from biological field inventories describing each N2000 site. Their updating is the responsibility of the state services under the scientific responsibility of the MNHM. In 2017-18, a large amount of work was carried out to update this database on a national level (Rouveyrol et al. 2018). This SDF database is transmitted twice a year to the European Commission. We used here the version transmitted in December 2019

Table 1 presents all the data used to establish our diagnosis and the treatments they have been subjected to. On the one hand, we have benefited from important updates of N2000 data conducted by the French National Museum of Natural History (MNHN), and on the other hand, we produced data specific to this analysis, covering the mapping of the ranges of species and habitats and the major types of ecosystems, detailed in supplementary materials, Annex 1. As mentioned in table 1, Some data were used to define the issues the policy has to deals with and other to assess its effectiveness.

Table 1: data used for the diagnostic

Data / Source	Nature	Scale	Constructed indicator	Goal	Data processing
Reporting Fauna-Flora Habitats Directive *MNHN 2019*	Expert opinion (national)	Bioregion	Conservation status of habitats and species Major pressures cited for each ecosystem	Policy effect	1- Conversion of evaluations to scores (unfavourable-bad=1, unfavourable-inadequate=2, favourable=3) 2- calculation of average scores according to ecosystem and biogeographical region
Reporting Birds Directive *MNHN 2013*	Expert opinion (national)	National	Short term population trends by species	Policy effect	1- Conversion of trends to scores (reduction = 1, stable/fluctuating = 2, increase = 3) 2- calculation of average scores by ecosystem
Redlists *IUCN/MNHN 2009-2019*	Expert opinion (national)	National	Evaluation of risks of species extinction	Policy effect	1- Conversion of evaluations to scores (CR=1, EN=2, VU=4, NT=5, LC=5) 2- calculation of average scores according to environment and biogeographical region

Data / Source	Nature	Scale	Constructed indicator	Goal	Data processing
'SDF' Base *MNHN 2019*	Expert opinion (from sites)	Bioregion	Occurrences of species and habitats* Total surface area of habitats * State of conservation of habitats and species*	Issues Policy effect	1- Conversion of conservation notes to scores A=4, B=3, C=2, D=1) 2- calculation of average scores according to ecosystem and biogeographical region/ total area and species reported.
Layer Main types of ecosystem *MNHN 2019 (synthesis)*	Layer crossover	Bioregion	Surface area of different types of ecosystem	Issues	Cf. supplementary materials, annex 2 1- construction of layers. Main types of ecosystem 2- Crossover with biogeographical regions and calculation of total surface area by ecosystem and biogeographical region
Species distribution area *MNHN 2018*	Model-ling/ Kriging method or occur-ence data	Bioregion	Surface area of species distribution area	Issues	Cf. supplementary materials, annex 1 1- Assignment of each species to a type of environment 2- Calculation of total surface area by ecosystem and biogeographical region

* only within the Natura 2000 network

3.2 A double declination of data by ecosystems and biogeographical regions

• Declination by ecosystem

The analysis by large types of natural ecosystems was based on the European typology Corine Biotope (Bissardon et al. 1997). Six types of ecosystems have been defined: grassland (code Corine biotope 3), coastal (1), continental waters (2), forests (4), rocky (rocks, screes and sand) (6), wetlands (5). In order to establish the links between the species covered by the Nature Directives and these major types of ecosystems, a table was drawn up beforehand linking each species to its biotope. We excluded generalist species in order to select only species representative of these biotopes. These biotopes were then reduced to the level of the six types of ecosystem. The species-ecosystem and habitat-ecosystem link was made using the HabRef Knowledge Base (Gaudillat et al. 2017). The category "Agricultural land and artificial landscapes" has been excluded from our typology: analysis of species-habitats links has shown that only 4% of the links were related to this ecosystem. For the habitats covered by the Directive, none relate to agricultural or urban areas.

• Declination by biogeographical region

The data from each N2000 site in the SDF database was linked to the biogeographical region that covered it in the majority. For the other spatialised data, the connection to the biogeographical regions was done by cross-referencing with the biogeographical region layer.

3.3 Methodology for defining issues: construction and analysis of species and habitat distribution indicators

For the distribution of species and habitats, we evaluated, through several sub-indicators, the proportion of habitats and species present, for the ecosystem under consideration, in each of the biogeographical regions. The indicators were constructed calculating proportion of surface area for habitats, of distribution ranges or total occurrences for species and using at last average values. The results for each sub-indicator were reduced to three indicators: one species-specific (presence of species), one habitat-specific (habitat surface area) and one global indicator associated with both habitats and species (ecosystem coverage) (**Table 2**). The average of these three indicators is the final distribution indicator used for each ecosystem.

Table 2: construction of distribution indicators

Indicator	Sub-indicators used	Metrics
Ecosystem coverage	Surface area by major ecosystem type	Total surface area
Species populations	Species occurrences within the N2000 network (base SDF) a. Habitats Directive b. Birds Directive	Number of occurrences (=one mention by site)
	Terrestrial species: Distribution ranges on the biogeographical region scale a. Flora b. Terrestrial fauna c. Birds Marine species: Encounter rates within the SAMM programme network a. Marine mammals b. Birds	Total surface area Levels
Habitat surface area	Accumulation of surface area of habitats within the N200 network (base SDF)	Total surface area
	Distribution ranges on the biogeographical region scale	Total surface area

3.4 Effective management data: construction of indicators of conservation status and pressure

• Conservation status indicators

We considered that conservation status could be evaluated using three sources. First, we used the 'Reporting' data which are clearly aiming this evaluation. We added the 'SDF' database which provides a field named 'Conservation" for each species and habitats within each Natura 2000 site. At last, we integrated the 'Red Lists' categories as the parameters used are quite similar (Puissauve et al. 2016). Each data has been translated into numerical scores. To get reliable indicators for each ecosystem and bioregions, the effect of biogeographical regions and ecosystems variables on the value of the scores of status conservation was then tested by statistical analyses. It was measured by fitting mixed linear models and Tukey's post-hoc tests with the lmer function of the lme4 package (Kuznetsova et al, 2017). For SDF and Reporting scores, biogeographic regions and/or ecosystems and taxonomic groups are used as explanatory variables and site codes as random variables (ε) in the form:

$$\text{SDFi\_SCORE} = \alpha + \beta_1\text{biogeographic}_i + \beta_2\text{Taxonomic group}_i + \varepsilon_i$$

$$\text{SDFi\_SCORE} = \alpha + \beta_1\text{Ecosystem}_i + \beta_2\text{Taxonomic group}_i + \varepsilon_i$$

For red list scores, ecosytems are used as explanatory variables and taxonomic groups as random variables (ε) in the form of:

$$\text{SDFi\_SCORE} = \alpha + \beta_1\text{Ecosystem} + \varepsilon_i$$

• Pressure indicators from SDF and reporting database

Pressures are entered into SDF and reporting databases. We excluded pressures with a positive impact or with insufficient information. 61% of the 19,663 pressure data on the SDF database and all 6,106 pressure data from the Reporting database were included in the analyses. As the typologies used for these two data bases were different, an initial reconciliation of the two typologies had to be carried out beforehand, resulting in a classification comprising of 17 categories and 50 sub-categories.

Each mention of a pressure is associated with a site in the SDF database and with a species or habitat in a given biogeographical region in the Reporting database. We linked these pressures with biogeographical regions and ecosystems using the species or habitats / ecosystems and sites / biogeographical regions links we had already established (see 3.2). In both databases, the threat level is provided by the Reporting in three classes: low, medium and high. We have translated it into a score from 2 to 4 for each increasing level, and a score of 1 assigned to unknown pressure levels. These scores allowed averages to be established on the different scales under consideration.

• Pressure indicators from Corine Land Cover change of land use data

At national level, only Corine Land Cover data and Teruti-Lucas survey (Eurostat 2016) are available on this topic with sufficient temporal hindsight: We used Corine Land Cover data because of their more precise typology.

Six categories of change of land use have been defined:

Table 3: categories of change of land use

Land use 2006	Land use 2012	Category of change
Grasslands	Scrubland ou wooded areas	Agricultural decline
Scrubland ou wooded areas	Pastures and grasslands	Creation of pastures and grasslands
All ecosystems	Urban areas	Urbanisation
Grassland or natural areas	Crops	Agricultural intensification
Urban areas/crops	All areas except urban	Renaturation
Other land use changes		Other

4. RESULTS

4.1 Conservation issues: what ecosystems and territorial distribution?

The distribution of species and habitats listed in the Nature Directives has been shown by indicators of relative presence, showing the distribution of species and habitats in different biogeographical regions, and in 'density', relating this distribution to the surface area of these biogeographical regions (see 3.3).

The Atlantic and continental regions, which cover much larger areas than the others, are logically home to most of these targeted species and habitats (**Figure 2** : 'relative presence indicators'). This is the case for all ecosystems, with the exception of rocky ecosystems, which are mostly located in alpine and coastal regions. However, in terms of 'density', i.e considering the amount of species and habitats for the same surface area (**Figure 2** : 'density indicators'), the distribution is reversed: the Alpine region is the richest in rocky, grassland and forested ecosystems. The Mediterranean region is in second position for grassland and forest regions, whilst continental waters and wetlands are more evenly distributed. Variations in 'density' between the Atlantic and continental regions are smaller. However, the continental region is better supplied with regard to forest ecosystems.

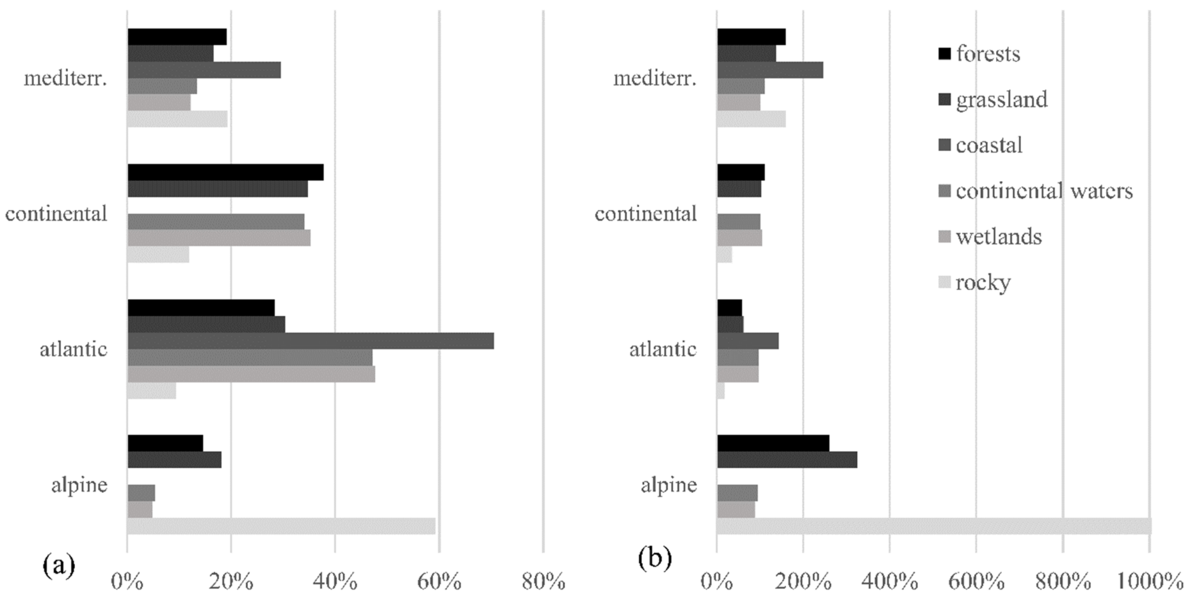

Figure 2. Distribution of habitats and species of community interest by ecosystem and biogeographical region for land: (a) relative presence indicator (b) density indicators

4.2 Effective management: how far wide of the target and what factors of degradation?

The evaluation of conservation status by ecosystem and biogeographical region is useful to prioritize the conservation needs, about the gaps to be filled in relation to the objectives set for favourable conservation status.

- **Conservation status by biogeographical region**

Comparisons between biogeographical regions is only possible with conservation status data from the SDF and Reporting databases. According to the SDF data, conservation status in Continental and Atlantic regions is significantly lower than in Mediterranean and Atlantic marine regions. According to the Reporting data, only the Alpine region stands out: its conservation status is significantly better than in the Mediterranean, Continental and Atlantic regions.

- **Conservation status by ecosystem**

To compile results from the three data sources (SDF, Red Lists or Reporting) analyses (see 3.4), the mean conservation status for each ecosystem was compared in pairs. All significant differences go in the same direction regardless of the data used: therefore, the results do not contain any contradiction between the three sets of data.

To prioritise the conservation status of the ecosystems relative to one another, we counted, for each ecosystem, the number of comparisons with other ecosystems for which its conservation status is significantly lower or higher (**Figure 3).**

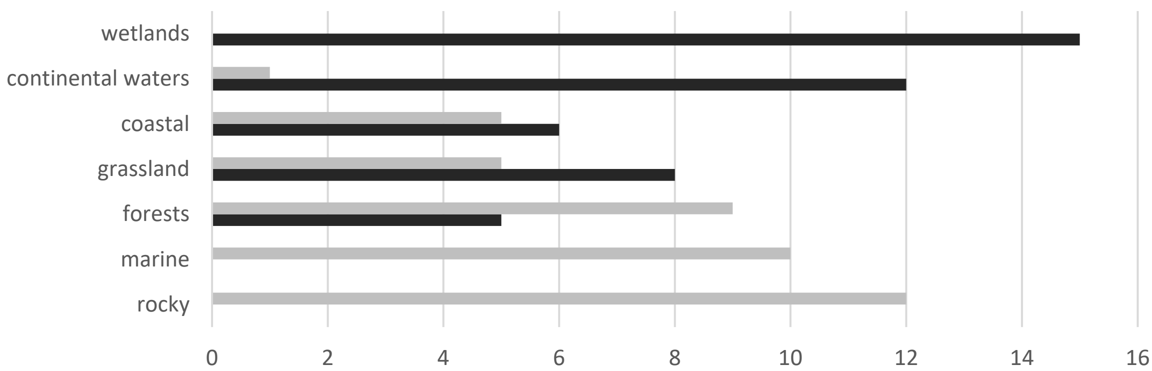

Figure 3. Number of comparisons in pair between ecosystems for which the average conservation status of the ecosystems is significantly higher (in grey) or lower (in black) than that of the ecosystem with which it is compared

The conservation status of wetlands is much lower than that of all other ecosystems, as all comparisons implying this ecosystem, and another showed wetland conservation status was the lowest. Continental waters are also almost systematically more degraded. Conversely, marine, and rocky ecosystems are in better condition than any other ecosystem. Between the two, coastal and grassland ecosystems are comparatively in a state of significant degradation, whilst forest ecosystems score higher than most other ecosystems.

- **Comparison between conservation statuses by ecosystem and biogeographical region**

We have grouped the Atlantic and Continental regions under the category ‘lowland regions’ as distinguished from the Alpine/Mediterranean sector. The scores are significantly higher in the Alpine/Mediterranean sector, so their conservation status is much better than in ‘lowland’ for all ecosystems according to SDF data and for grassland ecosystems according to Reporting data. Overall, lowland regions are significantly more degraded.

- **Summary of habitats and species distribution and their conservation status**

Due to their large surface areas, the Atlantic and Continental regions therefore contain most of the issues covered by the Nature Directives even though the Alpine region has the highest "density" of biodiversity. These lowland regions also show the worst conservation statuses. In terms of ecosystems, wetlands, and continental waters and, particularly for lowland areas, grassland regions are the most degraded. Marine and rocky ecosystems, and, to a lesser extent, forest ecosystems are in a more favourable condition.

In order to continue the evaluation and identify the levers for action, it is now necessary to consider the causes of these differences in conservation status. This is the second stage in the analysis of effective management, that of identifying responsibilities, which involves identifying the pressures that affect conservation targets.

- **Common transversal pressures, and a clear hierarchy of pressures, linked to ecosystems and biogeographical regions**

Of the 17 pressure types defined, 8 account for between 76% and 78% of the total number of mentions, depending on whether the "Reporting" or "SDF" databases are considered. These are, in descending order, agricultural intensification, forestry, urbanisation, human disturbance, changes in hydraulic conditions, transport networks, natural processes and agricultural decline. In the data used, the impacts of agricultural intensification correspond mainly to the conversion from grassland to crops, agricultural pollution and the impacts of irrigation, catchment, and drainage. Forestry is mainly cited due to the impacts of logging. Regarding urbanisation, by cross-referencing with the works of Fontes-Rousseau and Jean (2015), it is mainly attributable, over this period and on this scale, to individual habitat. Both data sources are consistent on these trends. However, some discrepancies add nuance to this conclusion: two of the most impacting pressures, forestry, and urbanisation, are less cited on the N2000 sites (SDF database), which may be a sign either that the policy is restrictive on these activities or that the sites have been placed in localities already spared from these pressures. On the other hand, attendance is a much more cited pressure on the sites (SDF database) than on the whole of the territory (Reporting). The attractiveness of N2000 sites to the public may be the reason for this, but it is nevertheless necessary to ensure that there is not a bias related to data producers (who include more managers for the SDF database), or on an observational level (greater ease in identifying this pressure on a site level than on a wider spatial level). **Table 4** classifies these results by biogeographical region, combining SDF and Reporting data. The first line gives the average number of strong negative pressures mentioned for each site: the Atlantic and Continental regions are the ones for which the most pressures are mentioned. The details of the categories on a national level, in the following lines, reflect both constants: the strongest pressures (agricultural intensification, urbanisation and even human disturbance) are found throughout the territory, but also geographical specificities: agricultural intensification is more pronounced in the Atlantic and Continental regions, whilst urbanisation particularly affects the Mediterranean region, and the problems related to disturbance are highest in the Alpine region. The most marked distinction is between land and marine ecosystems, with very specific issues for the latter: pollution, frequentation, and fishing.

Table 4. Distribution of the 8 most cited pressures in the Reporting (Rep.) and SDF data by categories and biogeographical regions. The occurrences of the pressures are weighted by their level of intensity.

	ALP		ATL		CON		MED		MATL		MMED	
	Rep.	SDF	Rep.	SDF	Rep.	SDF	Rep.	SDF	Rep	SDF	Rep.	SDF
Average number of intense pressures cited per site (SDF data)	2,4		3,4		3,1		2,6		2,6		2,7	
Agricultural intensification	19%	24%	20%	27%	27%	28%	18%	18%	7%	8%	0%	3%
Urbanisation	11%	7%	12%	8%	10%	8%	20%	12%	7%	7%	11%	7%
Forestry	15%	5%	10%	9%	12%	12%	10%	4%	1%	2%	0%	2%
Human frequentation and public safety measures	7%	29%	7%	12%	6%	12%	8%	21%	5%	24%	12%	26%
Mixed source pollution	5%	3%	9%	6%	7%	5%	5%	5%	17%	8%	24%	8%
Development and use of transport networks	7%	6%	5%	6%	6%	9%	7%	9%	5%	9%	4%	8%
Human-induced changes to hydrological systems from multiple or unknown causes	5%	8%	7%	10%	8%	10%	5%	6%	3%	9%	1%	4%
Agricultural decline	6%	4%	6%	6%	5%	2%	4%	3%	1%	6%	4%	5%

To clarify these findings, we analysed national land use change rates using Corine Land Cover data. They allow for triangulation of information provided by the 'SDF' and 'Reporting' data for the three most frequently cited pressures, which are correlated with an identifiable change of land use: urbanisation, agricultural intensification, and agricultural decline. Two reverse trends, renaturation for urbanisation and the creation of grassland for agricultural decline, were also represented.

However, these analyses are not relevant to pressures that do not result in changes in land use, such as pollution and impacts related to agricultural intensification, disturbance, overgrazing, etc.

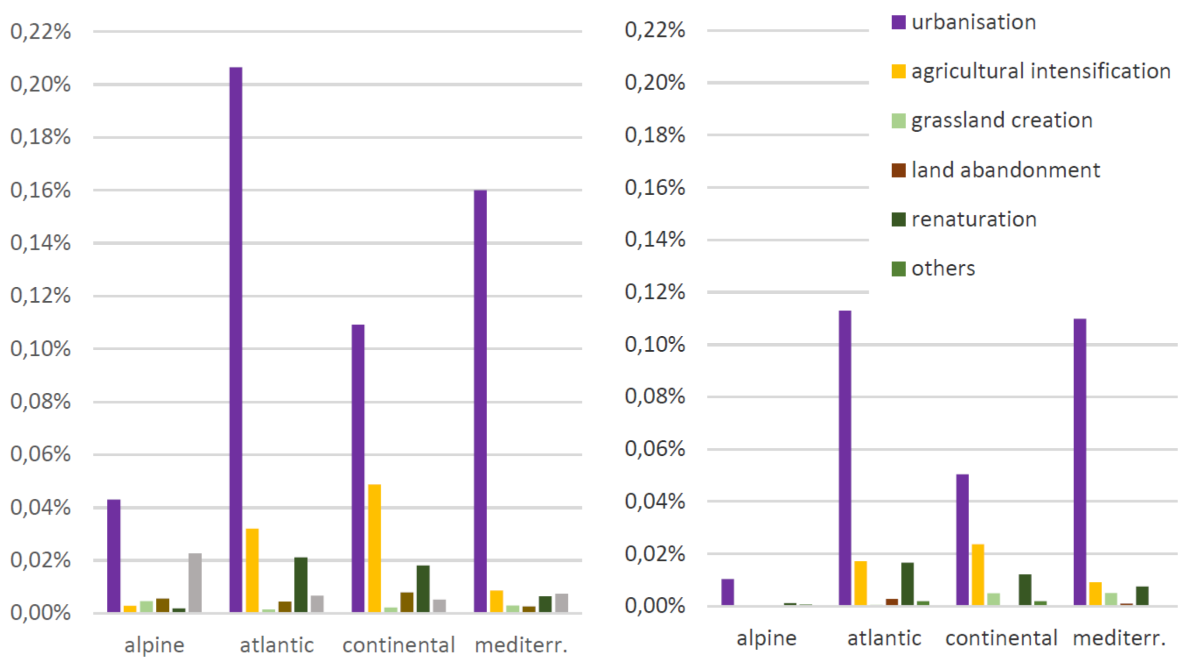

Figure 4. Proportion of territory affected by different types of land use change between 2006 and 2012 (left) and between 2012 and 2018 (right) - Corine Land Cover data

The results confirm the importance of urbanisation, the main cause of land use change for the entire territory. None of the other changes in land use considered reach comparable levels. Part of the phenomenon of agricultural intensification, that related to the planting of crops, mainly grassland reversals, is also visible. It mainly affects the Atlantic and Continental regions, confirming the results obtained by the SDF and Reporting data. Other land use changes are insignificant in comparison.

The comparison between the periods 2006-2012 and 2012-18 shows a significant decrease in the levels of land use change, covering all the major trends observed in the previous period. This possible sign of decrease in pressure levels has nevertheless been reversed by more recent data (Bocquet 2019).

Grassland ecosystems are most affected by the various pressures of land use changes. This is the case for agricultural activities: cultivation linked to agricultural intensification (land clearing), as conversely the phenomena of fallowing and reversion to shrub and forest. This is also the case for urbanisation: 13.1% of artificialized areas between 2006 and 2012 were previously occupied by pastures (January et al. 2015), making it the ecosystem the second most impacted by urbanisation after agricultural land.

The Reporting data allow to add ecosystems data to the pressure/biogeographical regions data (Table 5). Pressures are thus specific to certain ecosystems: silviculture for forests, changes in hydraulic conditions for wetlands and aquatic ecosystems, agricultural intensification and urbanisation for grassland ecosystems and human frequentation for rocky ecosystems.

Table 5. List of the three most frequently cited pressures in the Reporting results by ecosystem and biogeographical region.

	Alpine	Atlantic	Continental	Mediterranean
Grasslands	Ia, Ur, Sy	Ia, Ur, Sy	Ia, Ur, Sy	Ia, Ur, Da
Wetlands	Ia, Mh, Ur	Ia, Mh, Sy	Ia, Cc, Mh	Ia, Ur, Sy
Continental waters	Ia, Mh, Ee	Ia, Mh, Ur	Ia, Mh, Pn	Ia, Ur, Mh
Forest	Sy, Ia, Rt	Sy, Ia, Ur	Sy, Ia, Rt	Sy, Ia, Ur
Rocky	Cc, Fh, Ur	Ia, Fh, Rt	Ia, Fh, Ur	Ur, Fh, Ia
Coastal		Ur, Pn, Ia		Ur, Ia, Rt
Marine		Pe, Cc, Ur		Ur, Pe, Po

- Ia: Agricultural intensification
- Ur: Urbanisation
- Sy: Silviculture
- Da: Agricultural decline
- Mh: Hydraulic modifications
- Cc: Climate change
- Ee: Invasive species
- Po: Mixed source pollution
- Fh: human disturbance/security measures
- Rt: Transport networks
- Pn: Natural processes
- Pe: Fishing

5. DISCUSSION

Our results made it possible to construct an operational territorial diagnosis of the issues surrounding the N2000 policy in France. We showed that focusing the analysis on ecosystems and biogeographical regions allows identification of significant differences in conservation statuses, as well as the distribution of pressures on a national level. These differences also make it possible more solid hypotheses about the mechanisms at the origin of the degradations, in particular the impact of sectoral economic development policies, that will be developed in the later stages of the strategic analysis. It validates the methodological framework chosen for the evaluation.

Our results show the value of cross-referencing data from a variety of sources in order to put clearly into perspective the strategic challenges facing the N2000 policy, namely, to meet its objectives in the face of existing degradation dynamics. These data, some of which are only very rarely analysed, have points of convergence largely in the majority on the analytical grid used. While some authors have worked on occurrence data taken from the SDF database (Zub et al. 2018) or on conservation statuses taken from Reporting (Sanderson et al. 2016; Zisenis 2017), none of this work focused on a national diagnosis comparing the states of conservation with the levels of pressure, and therefore confronting the policy with the challenges that it really has to take up; and thus, making it possible to analyse whether the means implemented are up to the challenges. This is where the work presented in this article is innovative, by providing a strategic evaluation framework to measure and guide efforts to protect biodiversity in the face of clearly identified degradation dynamics at work on domestic territory.

For conservation statuses, the absence of contradiction between the different data used provides an additional guarantee of the reliability of the results. It supports the results of Puissauve et al. (2016) on the coherence of the Red List and Reporting data on a national level, whereas this coherence is much weaker on a European level (Moser et al. 2016). The pressure data from the Reporting and SDF databases had never, to our knowledge, been used in a comparable study in France. Ciapala et al (2014) and Tsiafouli et al (2013) analysed them in other territories but without linking them to other indicators: our work, by showing that land use change data can be correlated with the pressures identified in the SDF and Reporting databases, underlines the value of fully exploiting these types of sources in order to triangulate the data.

Our results place urbanisation and agricultural intensification at the top of the list of pressures and are therefore in line with the IPBES (2019) report, which identifies habitat loss as the primary cause of biodiversity extinction on a global scale and links this habitat loss primarily to these two pressures. Conversely, the N2000 data give little importance to invasive species and climate change, which are nevertheless cited among the five major pressures in France in 2017 (ONB 2017) and worldwide (IPBES 2019). Further work is needed on these two points to test the possible hypotheses explaining this discrepancy: scale-dependent perception, difficulty in apprehending future threats, etc. The extent of the impact of species disturbance in the SDF database, a pressure not reported by neither IPBES nor the French National Biodiversity Observatory, is also notable, as already highlighted by Ciapala (2014)'s work in the Alpine regions of Slovakia. It seems that the impact of leisure activities on biodiversity needs to be re-evaluated in the light of our data.

The difference between lowland regions and Alpine and Mediterranean areas is well documented, the first ones being, for example, known to be the most degraded of aquatic environments (Blard-Zakard and Michon 2018) or in terms of ecosystem fragmentation (ONB 2019). On the other hand, our findings add nuance to the great patrimonial responsibility usually placed on the Alpine and Mediterranean regions (Médail and Quezel 1997), showing that whilst these sectors are indeed richer, their small surface area and their relatively low level of exposure to degradation means that most of the issues are found elsewhere. Also, although many rare species and habitats are more present in Alpine and Mediterranean areas and indeed deserve to be well protected, it is important to remember that the Nature Directives aim for conservation of biodiversity in the broader sense, including "ordinary nature" (Mougenot 2003), which is still very present, although degraded, in the Atlantic and Continental regions.

6. CONCLUSION

The strategic evaluation methodology implemented in these first two stages has therefore made it possible to outline a genuine national scoreboard for the N2000 policy, fulfilling several conditions:

- objectivity, based on data from a wide range of sources,
- operationality, by providing information on (1) the location of needs: how are the ecosystems targeted by the Nature Directives and where intervention is needed spatially distributed? (2) the nature of the interventions to be carried out: in a given biogeographical region, which ecosystems require action and to counteract the effect of what pressure?
- legibility, by providing synthetic results, making it possible to compare the different situations (location, ecosystems, pressures) in order to identify priorities, segment the diagnosis and thus be able to compare it with other data.

This strategic evaluation framework for the N2000 policy provides at this stage a strategic diagnosis: it is intended to be one of the building blocks of a mechanism that makes it possible to compare the problems that need to be solved in order to achieve the objectives set out in the Nature Directives, on the one hand, with regard to the measures implemented within the framework of this policy, but also with other environmental programmes (intentional management), and on the other hand in the face of sectoral policies or external factors that have an impact on the results achieved (effective management).

Without downplaying the value of environmental policy evaluations that focus more on the logics of governance, representativeness, transparency and public participation, the current context of biodiversity degradation requires us to cross-reference these evaluations with strategic evaluations focused on the environmental effectiveness of public policies. Our work shows that starting from a clearly defined strategic analytical framework, which encourages the mobilisation of previously untriangulated data, we can effectively provide a scoreboard to measure the environmental effectiveness of a policy focused on biodiversity protection, the N2000 policy. The first, unavoidable, step is the analysis of the issues at stake. The work we have presented here provides a diagnosis of these issues on the scale where the results are expected: biogeographical regions over their entire surface area, and broken down by natural ecosystem, as close as possible to the realities of management. It is only the first stage of the evaluation, but this basis is essential for this evaluation to produce results that are useful for steering the policy, in order to improve its impact on biodiversity conservation throughout the territory.

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