

Article

# Natura 2000 Areas and Sites of National Interest (SNI): Measuring (un)Integration between Naturalness Preservation and Environmental Remediation Policies

Francesco Scorza , Angela Pilogallo \* , Lucia Saganeiti  and Beniamino Murgante 

School of Engineering, University of Basilicata, 85100 Potenza, Italy; francesco.scorza@unibas.it (F.S.); lucia.saganeiti@unibas.it (L.S.); beniamino.murgante@unibas.it (B.M.)

\* Correspondence: angela.pilogallo@unibas.it; Tel.: +39-320-421-0250

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**Abstract:** The Natura 2000 network was established as a tool to preserve the biological diversity of the European territory with particular regard to vulnerable habitats and species. According to recent studies, a relevant percentage of Natura 2000 sites are expected to be lost by the end of this century and there is widespread evidence that biodiversity conservation policies are not fully effective in relation to the management plans of the protected areas. This paper addresses the issue by analyzing a specific case in which there is a problem of integration between different competences and sectoral policies that leads to the lack of a monitoring system of territorial management performances. The study area, located in the Basilicata Region (Southern Italy), includes a Site of National Interest (SNI), for which several reclamation projects are still in the submission/approval phase, and a partially overlapping Natura 2000 network site. The tool used to monitor biodiversity in the study area is the degradation map obtained through the “habitat quality and degradation” InVEST tool which is used to assess the current trend and thus define a baseline for comparison with two medium and long-term scenarios applicable to the SNI’s procedure of partial and total remediation. The proposed methodology is intended to be a part of a larger and more complex monitoring system that, developed within the framework of ecosystem services, allows for the overcoming of the limits related to fragmentation and contradictions that are present in land management by offering a valuable support to decision makers and the competent authorities in biodiversity conservation policy design.

**Keywords:** habitat degradation; ecosystem services; Natura 2000 network; Site of National Interest (SNI); spatial planning; Basilicata Region

## 1. Introduction

According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) [1] about 25 per cent of both animal and plant species are threatened and around 1 million species already face extinction, many within decades. Even if during the last twenty years remarkable progress has been made in deeply understanding how biodiversity impoverishment affects ecosystems’ services (ES) and their relevant performance [2], and consequently the quality [3] of human life, the composition of the species’ communities is rapidly decreasing with potentially unpleasant consequences for the resilience of the ecosystems [4].

If the current challenges included in the Sustainable Development Goals (SDGs) point toward balancing the often conflicting objectives of human development and biodiversity conservation (see SDGs 1, 2, and 8) [5], the aims of biological diversity preservation and the protection of vulnerable habitats and species have already been addressed by the European Union (EU) through the Birds and Habitats Directives and the subsequent establishment of the Natura 2000 network (N2K network).

Stretching over 18% of land areas and about 9.5% of marine territories across all 28 EU countries, N2K represents the largest international network of protected areas. Although the goal of constituting a vital backbone of the EU's green infrastructure has been reached, a big challenge still lies ahead: the appropriate management of sites [6]. As a matter of fact, protected areas should not only be considered as reservoirs of biological diversity but also as the sustainers of an ecosystem resilience and the fundamental providers of functions, goods, and services that are essential for human well-being and wealth [7,8]. Although the N2K network potential for the achievement of the conservation objectives is widely recognized [9], the results to date are not considered to be fully satisfactory [10,11], and a number of studies have been carried out in order to identify the main weaknesses [12–15].

As far as territorial governance is concerned, it emerges that the effectiveness of site designation and management depends on the decision-making and policy-design process [16], as the support of local stakeholders in their approval and participatory role is crucial for the long-term success of site management [17,18]. Another point considered to be very critical is that of the overlapping policies and responsibilities at different government levels [12] that are often reflected in cross-scale political contradictions [19], conflicts related to other sectoral policies [20], and a top-down governance gap [21].

The European Commission (EC) [22], in declaring the gap between spatial planning and its instruments for the implementation of the N2K network as one of the most significant causes for the lack of conservation objectives, points to territorial planning as the most appropriate framework for the creation of an improved synergy between different sectoral and environmental policies and for ensuring that developments comply with the EU sectoral and environmental legislation. Furthermore, it promotes the adoption of geo-spatial information technologies (GIS) and remote sensing as reliable information sources for decision-making processes and identifies Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA) as key instruments to guarantee knowledge-based prevention, mitigation, and compensation of sector-specific impacts on N2K sites.

In the same perspective, Leone et al. [23] assume that the consistency between N2K site management plans (MPs) and municipal masterplans (MMPs), in terms of sustainability objectives, should be guaranteed by the SEA of MMPs and/or MPs and considered to be a very effective technical procedure in order to support the implementation of ES into spatial planning.

This work examines a case study from the Basilicata Region where a Site of Community Interest (SCI)/ Special Protection Area (SPA) and a Site of National Interest (SNI) coexist and partially overlap. This area was developed as an industrial site between the post-World War II years and the 70s. Public-driven industrial policies stopped during the 80s and the area underwent a period of abandonment and decline with consequent environmental issues that derived from extensive pollution in abandoned industrial parcels. At the end of the 90s a part of the study area was proposed as a SCI/SPA site thanks to the variety of species and biodiversity richness present there. The procedure for the recognition of sites as nodes of the N2K of the Basilicata Region was completed in 2003, but it was only in 2017, following the drafting and approval of their management plans, that sites were designated as Special Areas of Conservation (SACs).

At the same time, due to the high levels of pollution and related effects on health, environment, and the local economy, Law 179/2002 established the “Val Basento” as a SNI and assigned its remediation responsibility to the Ministry of the Environment, Land, and Sea (MATTM).

The fragmentation of competences in territorial governance led to a lack of integration between those acts promoted by the different competent authorities (Basilicata Region for N2K sites and MATTM for SNI), who operated without any coordination.

The aim of this work is to describe and explain the conflict between SCI/SPAs and SNI sites in our case study via ES land-use analysis and produce an estimation of the positive effects that remediation actions produce on the environmental components in medium and long-term scenarios.

“Habitat quality”, in referring to the recent debate on ES classification [24,25], is considered to be a provisioning ES as per the Millennium Ecosystem Services Assessment [26], but a supporting ES according to the most recent interpretation of The Economics of Ecosystems and Biodiversity

(TEEB) [27]. The last version of the Common International Classification of Ecosystem Services (CICES) [28], in reorganizing divisions and groups belonging to the “Regulating and Maintenance Services (biotic)”, further explores the various aspects related to biodiversity. The closest reference to the meaning by which we have dealt with habitat quality is the class “maintaining nursery populations and habitats (including gene pool protection)” (code 2.2.2.3—CICES v.5), representing the provision of suitable habitats for wild plants and animals and the maintenance of the appropriate ecological conditions necessary for sustaining these populations.

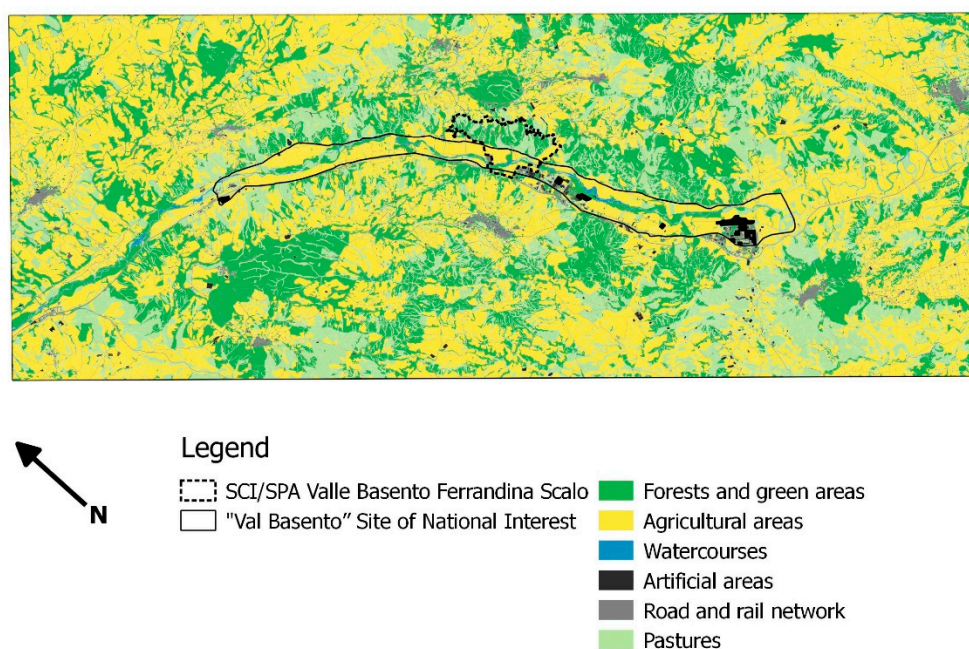
In this work, we refer to habitat quality as a measure (or even as a proxy) for biodiversity by applying a tool that produces a spatial assessment of habitat quality and degradation based on land-use classes without any additional hypothesis on “genetic diversity” or “species richness” or any other specific biological/ecological meaning.

The analytical tool used is InVEST Habitat Quality, that proved to be effective for the assessment of how different change scenarios in land cover or, as in our case study, habitat threats might affect habitat quality and, consequently, biodiversity [29]. The results obtained in the study area highlight the potential of the proposed methodology to support the decision-making process, orienting reclamation procedures and improving management actions for both SCI/SPA and SNI sites within an integrated approach.

## 2. Study Area

The study area, located in the Basilicata Region (Southern Italy), extends for about 742.5 square kilometers and is located along the middle valley of the Basento River, partially including the municipalities of Grassano, Grottole, Miglionico, Pomarico, Montescaglioso, Bernalda, Pisticci, Ferrandina, Salandra, Garaguso, and Calciano, all belonging to the province of Matera.

The interest in this study area (see Figure 1) is based on the simultaneous presence of a large industrial area, a SNI, and areas of acknowledged naturalistic-environmental value.



**Figure 1.** Represents the context of the study area from which emerges the dominance of agricultural land use linked to both cropland and extensive meadows. Along the Basento Valley there is one of the major industrial areas of the Basilicata Region, part of which was subsequently designated as a Site of National Interest (SNI). On the image is also visible the perimeter of the Natura 2000 (N2K) site and the overlapping area under investigation.

This area certainly falls within the Val Basento industrial agglomeration, one of the largest in Southern Italy, founded between the 50s and 60s subsequent to the discovery of a large methane deposit. After the starting phase of the construction works of the Ferrandina-Bari-Monopoli gas pipeline in 1961, many other industrial activities were established in the area, such as the petrochemical complex of the National Fuel Hydrogenation Company (ANIC). The international crisis that started in 1973 did not spare this industrial area and led to the shutdown of several establishments. A program agreement signed in 1987 gave the National Hydrocarbons Agency (Eni) full powers to relaunch the Val Basento industrial area, and the Matera Industrial Consortium was given the task of creating a technology park. In 1990 the so-called Tecnoparco Valbasento Spa was founded, which currently hosts production activities and companies involved in the environmental and energy sectors, providing services and infrastructures such as analysis laboratories; the production and distribution of electricity, nitrogen, and demineralized water production plants; and the collection, treatment, and disposal of liquid waste.

### 2.1. “Val Basento” Site of National Interest (SNI)

The Italian legislation defines SNIs as those areas in which the pollution of soil, subsoil, surface waters, and groundwater is so widespread and severe that they constitute a significant danger to public health and the natural environment.

Because of the seriousness of the contamination, with significant environmental, health, and socio-economic impacts, the administrative competence in remediation procedures is given to the MATTM, whereas local authorities are often involved in the role of operation-implementing bodies and are responsible for the development and protection of the territories affected by environmental contamination. The criteria for the identification of a SNI are defined by Law Number 134/2012, which, as a result, envisages the possibility that the SNI perimeter may change over time on the basis of new information on the potential and/or confirmed contamination of new areas or on the basis of a more accurate definition of the areas affected by potential contamination sources.

The Val Basento industrial area has been declared a SNI in accordance with Law Number 179/2002 “environmental provisions”, while its perimeter is officially defined by the Ministerial Decree of 26.02.2003, which identifies an area of approximately 34 square kilometers. It is located along the lower altitudes of the Basento River middle valley, brushing three municipal territories.

Industrial settlements deemed responsible for a higher potential environmental impact include the Eni Desulphurization Plant (formerly AGIP) in the Salandra municipality; the chemical cluster of Ferrandina, including an asbestos treatment company (Materit), a plant for biodiesel production (Mythen), a chemical production plant (ex-Liquichimica, ex-Pozzi, now Syndial); the chemical-pharmaceutical pole of Pisticci with the presence of active ingredient production companies (Gnosis Biosearch), the manufacturing of plastics and chemical fibers (Dow, Nylstar, Politex, Equipolymers), and industrial wastewater treatment plants, such as that of the Tecnoparco Valbasento company and landfill areas (2C Dump, Enrico Mattei Airstrip).

On 31 December 2018 the report on the state of the remediation procedure issued by MATTM [30] declared that only 1% of the SNI’s total area was under an approved project for the protection/remediation of both the soil and the aquifers.

### 2.2. “Valle Basento–Ferrandina Scalo” Natura 2000 Site

Since the 1980s, the struggle against the decline in biological diversity and habitat fragmentation has been extensively explored leading to remarkable progress toward understanding how biodiversity loss affects the functioning of ecosystems [3] and, consequently, human well-being. Aware that if this trend were to continue the sixth mass extinction would occur in less than 250 years [31], in 1998 the European Union approved a strategy to preserve biodiversity by actively implementing the Habitats Directive 92/43 and the Birds Directive 79/409 and proceeded with the establishment of the N2K network.

The N2K project assigns great importance to high-naturalness areas but also to semi-natural environments, which are essential for connecting areas that are spatially distant but close in ecological functionality [14]. This means that it assesses not only the current quality of a site but also the potential of the habitats to reach higher levels of complexity. The directive also takes into account those currently degraded sites where, nevertheless, habitats have retained their functional efficiency [32] and can, therefore, return to more evolved forms by reducing or eliminating degradation sources.

The habitats directive furthermore assigns the responsibility of ensuring the management of N2K sites, to member states. Although it is entirely left up to them to decide which option to follow among the management plans (either statutory or administrative measures), all have to take concrete actions to guarantee the conservation status of habitats and species. In Italy, the regions and autonomous provinces are responsible for the management of N2K sites. Most of them have delegated other administrations with this kind of responsibility.

The study area involves two sites of the N2K network: the SCI/SPA IT9220255 Valle Basento Ferrandina Scalo, which is entirely included, and part of the SCI/SPA IT9220260 Valle Basento Grassano Scalo. As it is assumed that the two sites are spatially connected within the ecological network of the Basilicata Region for the reasons mentioned above, the management plan approved by resolve of the Regional Council 1492/2015 is unique for both sites.

It is composed of two main parts: the first describes the characteristics of the two areas and illustrates the higher-ordered and sectoral regulatory framework in which the SCIs are located.

Although the management plan does not make explicit reference to the presence of the SNI, despite the spatial overlapping between these two areas, the planning tools to be considered include the regulatory plan of the industrial development area of Matera. It is prescribed that projects related to productive activities, in addition to their compliance with the obligations provided for by sectorial legislation, must be complemented by a specific report aimed at verifying the impacts and compatibility with neighboring activities and, more generally, with the territorial ecosystem and the urban settlements of the industrial and surrounding areas. Areas classified as SCIs and SPAs allow for the setup of craft activities and small and medium-sized industrial activities, characterized by low pollution levels or disturbances (gases, liquids, noise). Each plant, however, has to be subjected to ex ante Environment Impact Assessment (EIA).

As already mentioned, the interest in this case study arises from the overlay of a high naturalistic-environmental value area and a site considered to be particularly critical for the pollution level, especially with regards to the potential effects that this situation could cause from a social, health, and economic point of view. Equally critical is that no explicit reference to this conflicting situation is included in the management plan for the N2K site.

### 3. Methodology

The N2K network was created to meet the needs and wishes to preserve breeding and resting grounds for both rare and endangered species and certain endangered habitats. In other words, it was established to safeguard biodiversity [33].

In playing a key role at all levels of the ecosystem service hierarchy [34], biological diversity is the basis for the multifunctionality of N2K sites and is defined as a core planning principle [35] able to explicitly consider multiple and intertwining ecological, social, and economic functions. Sharing the positions of several authors [35–37], whereby an ES approach addresses crucial aspects relevant to multifunctionality planning, in this work we take a conservation perspective [34] by handling habitat quality as a proxy for biodiversity, i.e., as one of the ES provided by N2K sites.

As stated by Sallustio et al. [38], habitat quality assessment can, without a doubt, be considered an effective tool in order to both evaluate the effectiveness of tangible conservation policies and programs and orient management strategies toward improving biodiversity preservation. The tool is adopted in scientific literature to analyze how the intensity of human activity influences habitat quality [39,40] and determine the effects of ongoing threats [41] and expected reclamation actions on the current levels of biodiversity.

The habitat quality model, that belongs to the InVEST suite and is based on the hypothesis that a higher HQ corresponds to a higher abundance of species and vice versa [40,42–45], draws up two maps: habitat quality ( $Q_{xj}$ ) and degradation ( $D_{xj}$ ).

The HQ is directly related to the suitability of each land use/land cover (LULC) class to provide adequate conditions for the persistence of biodiversity ( $H_j$ ) [46] and to ( $D_{xj}$ ) according to the following formula:

$$Q_{xj} = H_j \left( 1 - \left( \frac{D_{xj}^z}{D_{xj}^z + k^z} \right) \right) \quad (1)$$

where  $z$  is a constant equal to 2.5 and  $k$  is a scaling half-saturation parameter [42]. By default,  $k = 0.5$  but users can modify its value in order to better highlight the spatial degradation on the landscape. In dealing with scenario analysis, users are recommended to set the  $k$  value equal to half the highest grid cell degradation and run all the subsequent elaborations with the same  $k$  value.

$H_j$  represents habitat suitability, and its score, ranging from 0 to 1 and summarized in Table 1, was assigned considering the most suitable ( $H_j = 1$ ) woodland and freshwater LULC classes as they are considered the least modified habitats and consequently the most suitable for native species. On the other hand, the lowest values ( $H_j$  close to 0) were attributed to anthropic LULC classes, such as industrial and residential buildings, roads and railways, and landfills and mining areas. Intermediate values were finally given to the semi-natural land-use classes—grasslands, arable lands, and agricultural crops.

Habitat degradation ( $D_{xj}$ ) is the function of the sensitivity of each LULC class to each threat ( $S_{jr}$ ), of the relative weight of each threat ( $w_r$ ), and of the impact  $i_{rxy}$  of the threat  $r$  in cell  $x$  originating in  $y$  and distant  $d_{xy}$ :

$$D_{xj} = \sum_r \sum_y \left( \frac{w_r}{\sum_r w_r} \right) r_y i_{rxy} \beta_x S_{jr} \quad (2)$$

where  $\beta_x$ , ranging from 0 to 1, represents the level of accessibility in grid cell  $x$ . In this work we always considered a complete accessibility; therefore  $\beta_x = 1$ .

With regards the assigned sensitivity values, it is possible to see from Table 1 that the highest values were allocated to woodlands, freshwaters, agricultural lands, and grasslands falling within the SCI/SPA area because they were considered to be of higher value and more vulnerable to the threats taken into consideration. In line with habitat suitability, zero sensitivity values were assigned to land-use classes with a strong anthropogenic component and, therefore, considered less vulnerable to threats. This process of value assignment comes from a qualitative expert interpretation of case-study-specific features in land use. In this specific case study, the assessment aimed to highlight, on the one hand, the greater suitability of the habitats included within the N2K site and, on the other hand, to amplify the value of the threat assigned to the industrial areas present within the SNI perimeter. The criterion was to transfer the overall approach of the research (comparing both the protected areas and the national interest sites remediation policies) to input values of the analytical model in order to verify the research hypothesis.

For each threat, users have to assign the maximum influence distance ( $d_{r_{max}}$ ), which is to be considered as the threshold over which the threat  $r$  no longer has any impact, and the distance-decay function (linear or exponential):

$$i_{rxy} = 1 - \left( \frac{d_{xy}}{d_{r_{max}}} \right) \text{ if linear} \quad (3)$$

$$i_{rxy} = \exp\left(-\left(\frac{2.99}{d_{r_{max}}}\right)d_{xy}\right) \text{ if exponential.} \quad (4)$$

The advantage of using the InVEST HQ model stems not only from the possibility of representing the cumulative impact of multiple threats in a spatially explicit way but also in adequately considering the variability in the effects of each threat on different habitats (i.e., on each LULC) [40].

In general, a correct interpretation of the results should be achieved by following a joint reading of both habitat quality and degradation maps. As a matter of fact, while the first map depends on LULC and habitat characteristics and on the distribution and intensity of threats, the habitat degradation (HD) map is useful to emphasize areas where cumulative impacts, by different threats, influence HQ. With the same low HQ values, the HD map allows one to distinguish areas of poor naturalness (low  $H_j$  values) from those areas characterized by high habitat suitability and affected by a strong impact.

As this work aims to compare the positive effects of remediation actions, three scenarios were formulated, based on the current trend (I scenario), medium (II scenario), and long-term (III scenario) reclamation programs. According to MATTM, the polygons bounded and classified as sources of pollution included by the SNI perimeter and corresponding to abandoned or still-active industrial and production sites, are divided on the basis of the environmental remediation program progress. For some sites (polygons) the reclamation plan has already been approved, while for others it has been elaborated and formally submitted to the competent authority (MATTM) but is still not approved, so it is fair to assume that the reclamation times will be longer. For this reason, the mid-term scenario was created considering that only the sites (polygons) that correspond to approved remediation plans have been reclaimed. The long-term scenario, on the other hand, analyzed the effects of the completely reclaimed site. Both these scenarios (partial and total remediation) were compared to the current trend in which the weight of the threats corresponding to these polygons takes on its maximum value.

The weights have a value between 0 (less important) and 1 (very important) and were assigned on the basis of expert advice. The highest value was attributed to the industrial areas included within the perimeter of the SNI considering that the effects of remediation have a weight reduction from 1 to 0.6 (a reduction of 40%). The hypothesis is that the remediation process cannot recover a full degree of naturalness but has to render the environmental conditions of the sites comparable with other industrial ones. The minimum value of 0.2 was assigned to residential buildings, which in the study area correspond mainly to rural housing.

All the values used for threat definitions are summarized in the following table (Table 2). As can be seen, the assessment made by the expert did not lead to any distinction between the decay functions of the different threats. However, a relevant difference existed between the distances to which every threat exerts its impact.  $d_{r_{max}}$  was in fact greater for the industrial areas included within the perimeter of the SNI.

**Table 1.** Sensitivity matrix in which the habitat suitability [0-1] for each land use/land cover (LULC) and the sensitivity of each habitat to the individual threat [0-1] is reported. Habitat suitability Site of Community Interest/Special Protection Area (SCI/SPA) regards the LULC inside the SCI/SPA.

	Sensitivity for each LULC											
	Arable Land	Woodlands	Freshwaters	Residential Buildings	Secondary Roads	Landfills and Mining Areas	Green Areas	Renewable Energy Sources (RES)	Primary Roads	Industrial Buildings	Railways	Grassland
Habitat suitability	0,7	1	1	0,1	0,1	0,1	0,3	0,1	0,05	0,001	0,1	0,8
Habitat suitability (SCI/SPA)	0,8	1	1	0,1	0,1	0,1	0,4	0,1	0,05	0,001	0,1	0,9
Agriculture	0	0,6	0,4	0	0	0	0	0	0	0	0	0
Landfills and mining areas	0,6	1	1	0	0	0	0,3	0	0	0	0	0,6
Industrial buildings	0,6	0,8	0,9	0	0	0	0,5	0	0	0	0	0,7
RES fields	0,8	0,9	0,7	0	0	0	0,4	0	0	0	0	0,9
Residential buildings	0,6	1	0,8	0	0	0	0,4	0	0	0	0	0,6
Primary roads	0,7	0,9	0,7	0	0	0	0,3	0	0	0	0	0,7
Secondary roads	0,6	0,7	0,5	0	0	0	0,4	0	0	0	0	0,6
Railways	0,7	0,9	0,7	0	0	0	0,3	0	0	0	0	0,7
Industrial areas with implemented prevention measures	0,6	0,7	0,7	0,6	0,4	0,4	0,5	0,1	0,4	0,2	0,4	0,9
Industrial areas with reclamation plan presented but not approved	0,8	1	1	0,8	0,5	0,5	0,6	0,2	0,5	0,3	0,5	1
Industrial areas with reclamation plan approved	0,8	1	1	0,8	0,5	0,5	0,6	0,2	0,5	0,3	0,5	1

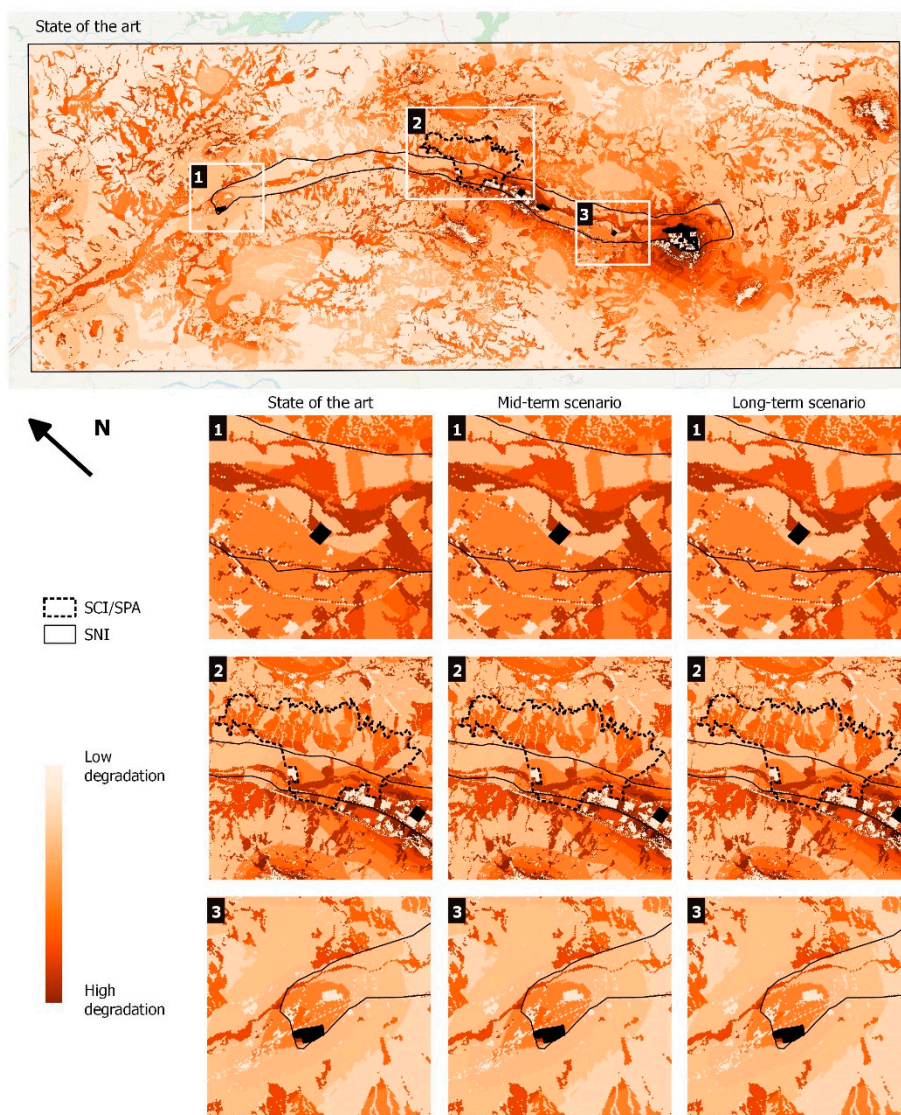
**Table 2.** Summary table of values used for threat definition.

Threat	Maximum Influence Distance ( $d_{r_{max}}$ ) (Km)	Distance-Decay Function	Weight		
			I Scenario (Current Trend)	II Scenario (Mid-Term Scenario)	III Scenario (Long-Term Scenario)
Agriculture	1.5	exponential	0.3	0.3	0.3
Industrial Buildings	2	exponential	0.6	0.6	0.6
Landfills and mining areas	2	exponential	0.8	0.8	0.8
Primary roads	1	exponential	0.6	0.6	0.6
Secondary roads	0.6	exponential	0.4	0.4	0.4
Renewable energy sources (RES) farms	1	exponential	0.4	0.4	0.4
Railways	0.8	exponential	0.5	0.5	0.5
Residential buildings	1.5	exponential	0.2	0.2	0.2
Industrial areas included by the SNI perimeter					
Industrial areas with implemented prevention measures	3	exponential	0.6	0.6	0.6
Industrial areas with reclamation plan presented but not approved	3	exponential	1	1	0.6
Industrial areas with reclamation plan approved	3	exponential	1	0.6	0.6



#### 4. Results

The degradation maps obtained for the current trend and some detailed boxes showing partial (mid-term) and total (long-term) remediation scenarios, respectively, are shown below (Figure 2). Color nuances represent the areas where the reclamation actions have a weaker (light red) or a greater effect (dark red).

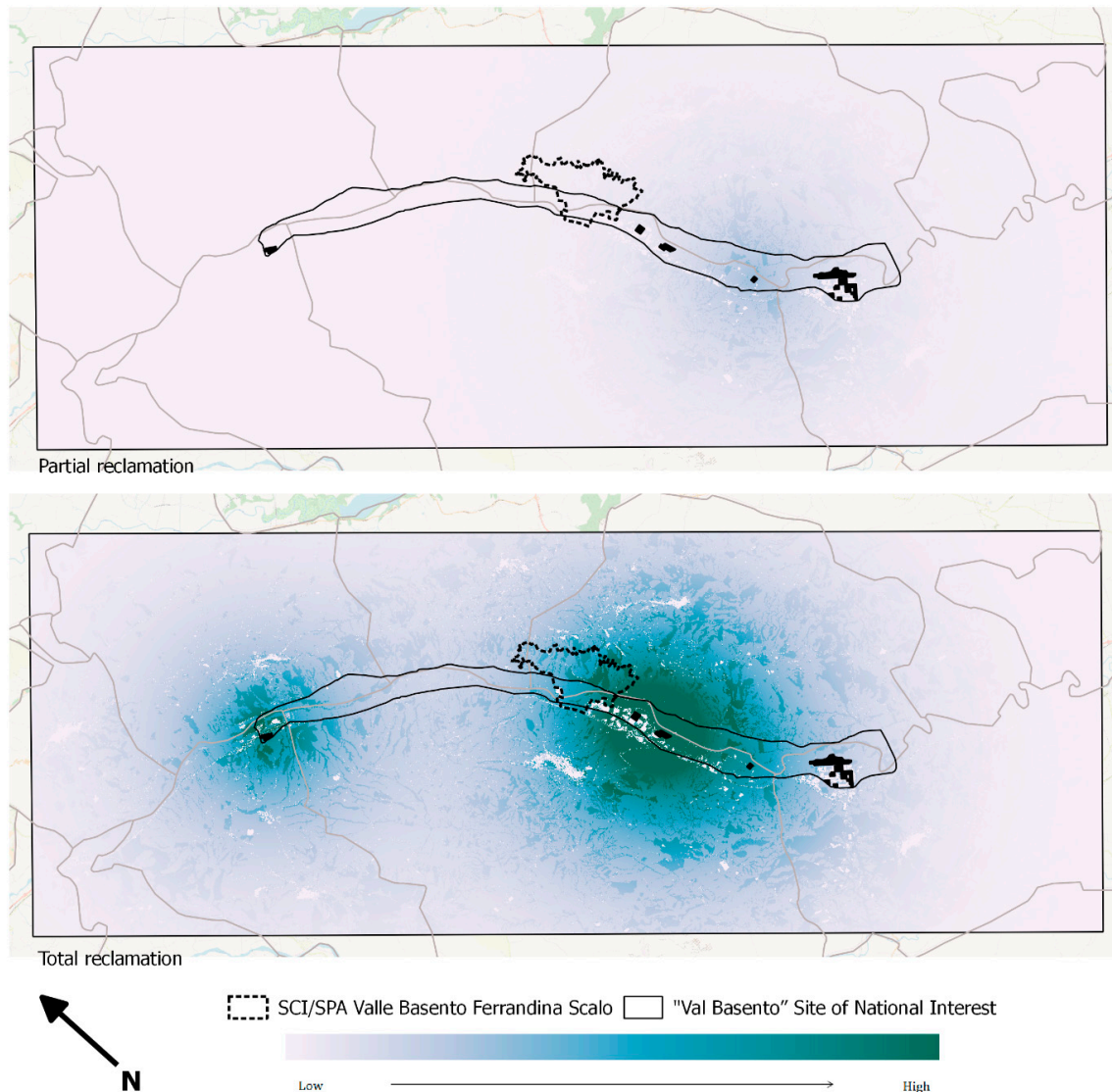


**Figure 2.** Degradation analysis: the large figure represents the entire study area in the current trend. The detail boxes display three areas where, thanks to the greater proximity to industrial sites that currently constitute a source of threat, the effects of remediation measures are more visible.

Out of a total of 21 polygons (i.e., industrial areas) identified as sources of impact according to the MATTM, the medium-term scenario showed the remediation effects of only one of these industrial areas accounting for 3.71 ha. The degradation decrease was, therefore, rather localized and was not extended to the entire study area

The effects of a complete remediation, which involves a total of three industrial areas, were more significant. One area was located in the northern part of the SNI zone and the other two were in the immediate downstream area with respect to the SCI/SPA perimeter. The surface area involved in this case was 30.06 ha, equal to 0.04% of the entire study area.

Figure 3, with respect to the difference in the degradation maps following partial and total remediation related to the current situation, shows the areas where the benefits of the interventions are felt.

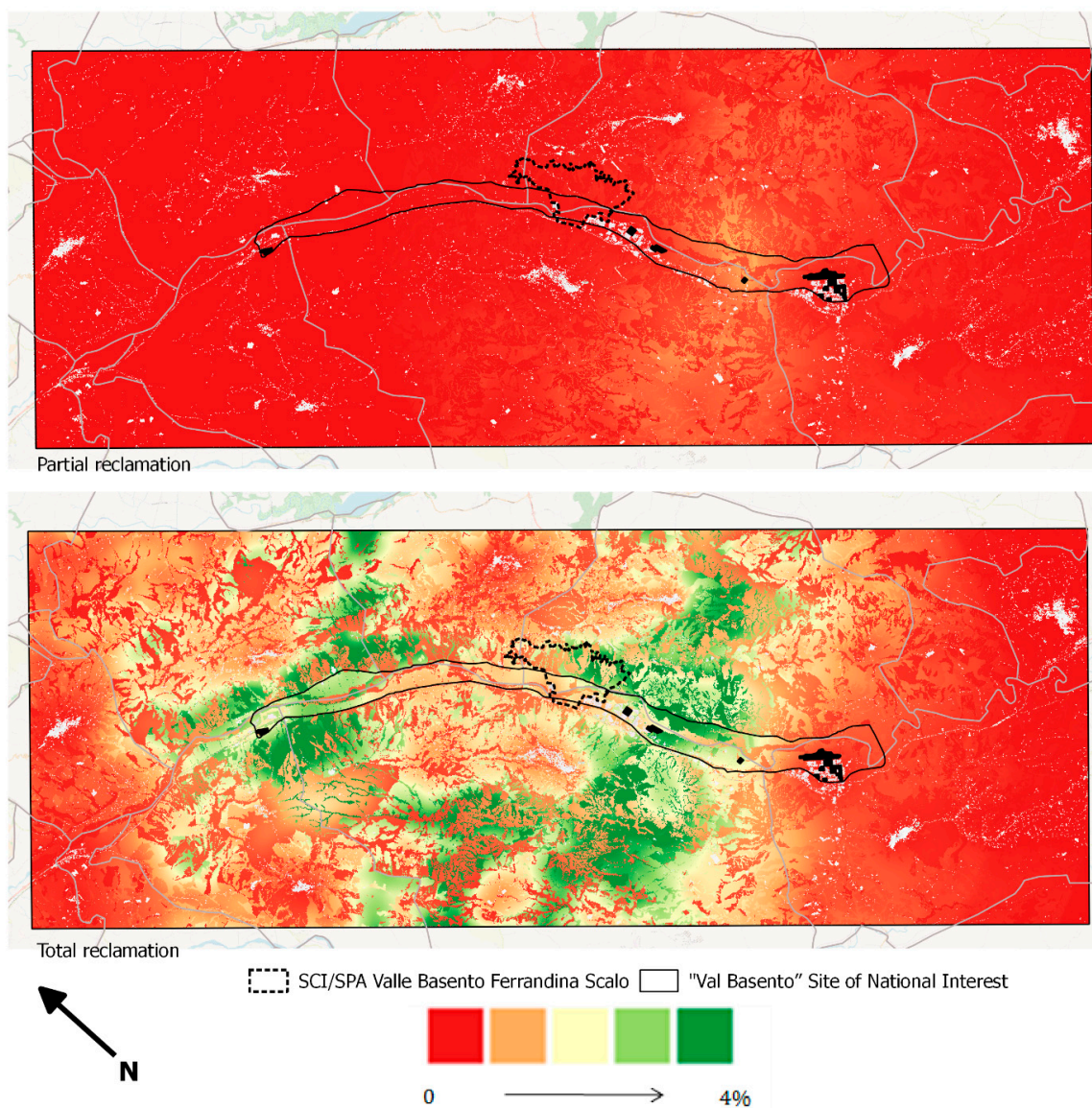


**Figure 3.** Effects of the reclamation procedure: decrease of the degradation degree in mid-term (partial reclamation) and long-term (total reclamation) scenarios. The figure shows the effects, obtained by difference, of the interventions foreseen in the medium and long-term scenario. While the area of influence for the partial remediation scenario is rather limited compared to the study area, total remediation has two much larger areas of influence.

In order to assess the variations following the implementation of a remediation program, the percentage changes were calculated using map algebra operations.

The maximum reduction in the degradation level (therefore corresponding to the long-term scenario) within the study area was 6%, whereas in the medium term, a decrease of less than 1% could be expected.

Within the SCI/SPA site, the partial reclamation (mid-term scenario) had no effect on changes in habitat degradation or quality. Differently, in the southern part of the area, the degradation reduction reached 3% as its maximum value (Figure 4).



**Figure 4.** Percentage reduction in habitat degradation in mid-term (partial reclamation) and long-term (total reclamation) scenarios. It is possible to note that the effects of land reclamation were highly dependent on land use, with priority being given to meadows and grasslands. It is also possible to see that in areas where there are several threats that give rise to a cumulative impact, the effects of remediation were less significant. This was the case, for example, of the riparian areas close to the primary road and the railway line.

By overlapping the results obtained in terms of the percentage degradation decrease and land-use map, it appeared that the main beneficiaries of land reclamation interventions were mainly riparian areas close to creeks (reduction in degradation degree up to 4%) and grazing grounds. On the contrary, the wooded areas were affected to a lesser degree by the reclamation operations which, in these areas, led to a reduction of a maximum of 2%.

## 5. Discussions

An interpretation of the results must take into account that the model neglects the morphology of the territory and, therefore, the privileged directions of pollutant diffusion. The results are linked to land-use class characteristics in terms of habitat suitability and vulnerability to different threats. Because it is, in actual fact, a valley riverbed with two converging sides, the expected spatial distribution

of reclamation effects—all other variables being equal—is not isotropic as, however, appears from the image. As a matter of fact, in the western part of the study area there is a sector along the slope where a relevant degradation reduction is recorded, especially with respect to meadows, grazing grounds, and agricultural crops. Moreover, no improvement in the wooded areas has been achieved, especially where they are surrounded by cultivated areas. This is due to the fact that agriculture is in itself a source of threat, and the relevant reclamation effects are clearly marginal.

However, in analyzing data distribution (Figure 5), it is evident that reclamation effects have a positive impact on different patches that, in the long-term scenario, are included in the lowest degradation class.

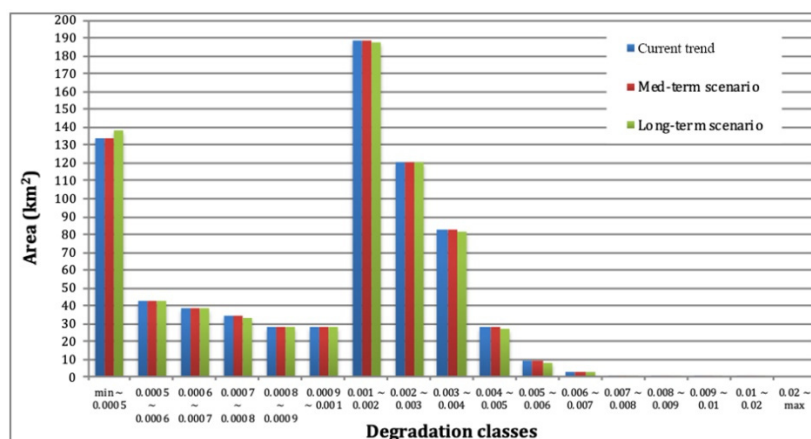


Figure 5. Distribution of degradation values in relation to the three scenarios.

In attentively analyzing the data, the partial reclamation (mid-term scenario) has an effect on a portion of territory that is equal to 0.56% of the total area. In particular, the classes that in the current situation are characterized by a high degradation, move to the low (0.43%) and medium (0.13%) degradation classes. The long-term remediation scenario, on the other hand, involves 3.79% of the total surface area which, from the higher degradation classes, shifts to the lowest degradation level.

The results show that habitat degradation in the study area is certainly due to the cumulative impact of multiple threats arising partially from the industrial area located along one of the main regional road infrastructures and partially from the road and rail network that from the river valley branches off along the slopes, also bordering or crossing areas of high naturalness.

## 6. Conclusions

Although the conservation of biodiversity is a priority on the European Union's agenda, the results reached so far are still lagging behind the objectives set [22]. The need to achieve a better integration between policies and stakeholders at all levels is highlighted with particular regard to the N2K network [16].

This work analyzes a case study where a strong contradiction in the management of the territory emerges. On the one hand, the presence of industrial areas with high pollution potential has led to the identification of a SNI whose remediation procedure is the direct responsibility of MATTM. On the other hand, the recognition of naturalistic and biodiversity conservation values has led to the identification of a N2K site, whose management plan, approved in 2015, completely neglects the presence of a SNI.

The aim of this work is to provide and test a methodology able to measure the effects of two overlapping and conflicting policy frameworks: the first is oriented toward naturalness preservation (N2K) and the second aims at solving environmental contamination issues (SNI). Both policies substantially ignore each other and demonstrate a fragmentation in the territorial governance system, where different authorities are responsible for specific fields of intervention.

As already pointed out by the authors in previous works [47–51], the ES framework allows for the integration and simultaneous consideration of multiple scales, multiple habitats, and multilevel environmental policies, thus offering the advantage of more holistic environmental management [52].

Therefore, the use of the InVEST Habitat Quality model allowed us to contribute to the general process for the provision of an effective territorial monitoring system, suitable to assess the effects of ongoing threats and environmental management actions on habitat quality. Although the model simplifies the complex reality linked to the phenomenon of pollutant diffusion, temporal and spatial variability, boundary conditions, and more generally the complex dynamics with which threats act to the detriment of habitat quality [46,53], it is useful to perform a scenario analysis in order to identify threats and habitats with respect to land use, especially in those areas in which information on species abundance and composition, endemism, and functional significance is poor [40].

Considering the emerged strengths and weaknesses presented in the discussion section, future research should deepen the proposed methodology that proves to be efficient in approaching the issue of territorial governance by overcoming the limits of sectorial policy fragmentation. Therefore, further developments will be oriented toward testing alternative tools so as to better model the remediation processes in detail, including information on specific remediation actions (today not available) and integration input data with additional layers, such as morphology, water quality, air pollution, noise pollution, and evidence of climate-change effects.

The ES approach is considered adequate to deliver a common spatial evaluation framework in order to achieve a better integration of territorial governance, which has been fragmented into different decision centers (see also the work by Balletto et al. 2020 [54]). The proposed methodology should be useful for the construction of a cognitive framework that supports a regional landscape plan which we consider to be the appropriate planning level to manage such a contradictory case (SNI and SCI/SPA overlapping). This planning level is still lacking in the Basilicata Region even if the Regional Planning Law (23/99) foresees its development as a structural node in hierarchy planning.

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