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Mapping Biodiversity Conservation and Anthromes in Italy

A look at National Parks and Natura 2000 areas, the surrounding land use and its implication for habitat conservation

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Summary

The importance of preserving local biodiversity and quality habitats intact has been highly discussed in recent years. Because of the role natural systems play in assuring local resilience to an everchanging environment, more conservation strategies and plans have been implemented on local, national, and international levels. Looking at Italy as a country, this thesis aims to assess how the implementation of these strategies affects the land use change of affected areas. The main conservation area types were considered: National Parks, Regional Parks, Nature Reserves and Natura 2000 areas.

The land use change within and around these areas was assessed through a Geographical Information System (GIS) analysis which compared the areas before the implementation of the 'protected statuses and the last available data (2017), using the Anthromes database (HYDE). This database lists global historical land use with a focus on the human influence of the territory and the human population density of an area. Given the resolution of the dataset, only the National Parks were studied individually.

The results show that the protected area status is not the main driver in land use change in protected areas. Most of the parks analysed did not show much difference during the decades, and those that did show trends that are seen elsewhere, regardless of conservation strategies. Urbanization of touristic destinations and land abandonment of remote areas in alpine regions were the main observed trends. People tend to move from remote areas to more clustered cities where facilities and communication are more available. While coastal parks, which receive much summer tourism, grow in urbanization, often disorganized in regard to habitat conservation.

It will be discussed that different factors might have influenced these results, such as differences in tourism trends, and data availability. These results lead to the conclusion that more future-oriented development is required in protected areas, as the observed trends are not expected to slow in the near future.

1. Introduction

Ecosystem Services and Biodiversity Conservation have become increasingly relevant topics in recent decades. It is clear and tangible all around the world, how human activities and land use change are triggering habitat destruction and species extinction (Kerr & Currie, 1995). Given the importance of such complex systems, nature reserve areas, national parks and other regulations and initiatives were instituted on all scales from local to global, following all theories on the spectrum to preserve important ecosystem services and crucial species.

The main pressures on the quality of habitats and their biodiversity are now known to be anthropogenic. Human-led land use change and activities on the land (such as resource harvesting, hunting, and settlement), in the last centuries, have brought significant changes to the natural patterns of the world ecosystems, which were once led only by physical, climatic conditions. The concept of 'Anthromes' (or anthropogenic biomes) was then introduced to include population activity and population density in the models, to have a better idea of the human activity influences a certain area is under (Ellis & Ramankutty, 2008). Given the effects of human activities, global environmental and climate change, and land use change; and given the importance genetic variation has in providing ecological resilience and ecosystem services, it is crucial to assess how conservation strategies can be planned to give the best results in today's setting.

Because of its extension in both latitude and altitude, Italy has the most diverse habitat presence of all the EU, which makes it the perfect country where to assess how different conservation strategies work in reference to different biomes and ecosystems (Blasi et al., 2017). In the setting of the European Union, the main biodiversity conservation legislation was introduced in 1992 with the Natura 2000 network, which brings together the Birds Directive and the Habitat Directive to protect the most vulnerable species in the EU territory. However, the Natura 2000 network takes concepts such as sustainability and climate change in outdated ways and looks at ecosystems as something detached from the economic and social settings, they are embedded in. While the current debate on sustainable development aims for a balance among social, economic, and ecological spheres (Kistenkas, 2013). Countries have much decisional space to implement the Natura 2000 network areas, and there is no significant limit on the type of land use that can be carried out within or around the area. These are two of the main reasons the Natura 2000 initiative is now considered outdated and often not as efficient as its potential. Other initiatives to implement biodiversity conservation are dealt with at the national, regional, and local levels. In Italy, these areas are listed under the Official List of Protected Areas and include Nature Reserves, and National or Regional Parks and focus on different ecological or cultural factors, with different degrees of freedom for the types of activities that can exist within.

Conservation Strategies, as can be deducted from the few mentioned above, also follow different theories. Habitat destruction and fragmentation, and resource overexploitation are so far considered the main causes of species extinction in the world's ecosystems (Bellard et al., 2022). Thus conservation planning policies usually look at either improving the quality and size of the endangered habitat or improving the connection between different patches of the habitat, so that species can move freely where the conditions are more fitting at the moment.

Work was done in scientific literature to assess the land use change in some of the protected areas of Italy. However, the Anthromes database was not yet considered in these studies. As mentioned above, the anthromes classification offers a good overview of the changes in the degree of human pressure experienced by an area, which in the case of protected areas can translate into the effectiveness of such area in protecting the local ecosystem. As different types of pressure require different conservation strategies, the findings can be used to plan future projects and spatial planning in light of the necessities of the local habitat.

This paper will assess conservation strategies implementation in the European Union, looking specifically at the Italian peninsula. The Natura 2000 network and the National Parks, together with other conservation strategies will be analysed firstly by mapping the areas in relation to human land use and the anthromes present within and nearby these areas. A literature review of both scientific literature and local journal articles will follow to answer the research question:

- What is the current state of conservation strategies in Italy and how do they interact with the land use within and around them?

Sub-questions:

- Where are protected areas located in relation to anthromes and human land use?
- How does this affect the biodiversity conservation efficiency of the protected area?
- What is the actual local perception of the conservation strategy, is this different from what is stated in the literature?
- What are possible pieces of advice to improve the conservation strategies planning in the country?

This thesis will be structured as follows. Firstly the main theories and concepts used in the study will be explained. This will touch upon the concept of the Anthromes, the main biodiversity and ecosystem dynamics and concerns and the most prominent conservation strategies in the Italian

context. Secondly, the methods of the study will be listed, followed by the results. Finally, such results will be discussed to answer the research question.

2. Theories and Concepts

Biodiversity and conservation planning are complex subjects, as their results are based on a variety of factors and a great degree of uncertainty. Besides this, there are different theories that experts rely on when approaching the matter. Here are the main theories the research will take into consideration.

2.1 Land Use and Anthromes

Anthromes, or anthropogenic biomes, are landscapes affected by human presence to any degree. It is a classification of land use that takes into consideration the population density of the area, as well as the main possible crops or land cover of the area. Since the birth of the first tribes and societies, humans have always interacted with the ecosystem around their settlements for food, protection, or tool production. As they travelled through the world, they imported species among different biomes, harvested other species to their extinction and domesticated plants and animals (Ellis & Ramankuttyn, 2008).
This inserted the human influence in the biomes to a point where its power was comparable to the physical and climate patterns that first dominated the species population of each biome.
The term 'anthromes' was first introduced by Ellis & Ramankuttyn (2008) and was later adopted and mapped by different studies. Maps are now available for most of human history. Anthromes cover most of the land on Earth and model land use considering the population density in each area, which then determines the effect human activities have on the existing biome. The anthromes classification and explanation can be found in Appendix 2.
Anthromes were considered more appropriate for this study, as human presence is the main driver of habitat fragmentation which as explained later plays an important role in biodiversity loss.

In this database, the land is classified following land use and population density. It differs from other land classifications, such as biomes, in the fact that it includes different degrees of human influence on the land. Since as explained before, the human presence in an area has the power to shape the ecosystem, and an ever-increasing amount of land is being inhabited, it is crucial to look at habitat conservation strategies also in mid-populated areas. The anthrome classification, in relation to nature conservation, can help plan future conservation strategies by looking at what kind and extent of disruption is brought into the local ecosystem by human activities (Martin et al., 2014).

Although the anthromes themselves do not offer an overview of the biodiversity of the classified areas, studies have been conducted to understand which anthromes are more likely to have high biodiversity indexes. Although trends vary on a global scale, the highest diversity in bird and mammal species was found in pastoral villages, residential rangelands and woodland. While the extinction risk for animal species was found to increase due to high levels of urbanisation or intensive use of croplands (Quinn et al., 2021).

2.1. Biodiversity

Biodiversity means the richness and number of species inhabiting a specific area or habitat. There are different measurements that one could use to assess species richness. The first, of course, is to

count the number of species present in the area, other indices take into consideration also the balance in the number of individuals per species and their role in the ecosystem (Begon et al., 2014).

High biodiversity has been linked to good ecosystem resilience, health and the ability to provide several ecosystem services. The fast rate of extinction experienced in recent decades is threatening the biodiversity in several areas of the world, putting at risk not only the specific species but also entire ecosystems and natural patterns with unpredictable results.
Besides ethical concerns about the role of humanity in shaping the natural world, biodiversity also offers several economic benefits linked to the ecosystem services species provide. Examples of these can be the pollination of fields which insects are responsible for, water retention and filtration, and oxygen production (Begon et al., 2014).

2.1.1. Fragmentation and Major Threats to Biodiversity

The birth of new species and the extinction of others is a phenomenon observed since the beginning of life on Earth. Species adapt and disappear due to changes in conditions, competition and other factors. However, it has been researched that the current rate of extinction seen in the world's habitats is much faster than what the recorded rate was according to fossil studies and modelling (Begon et al., 2014).

Habitat destruction, resource overexploitation, global climate change, pollution and species invasion are in most cases listed as the main causes of species extinction. However, experts also argue that these factors are highly context and species dependent. Agencies and researchers around the world have worked on independent lists and linked each factor according to how they work in real systems (Bellard et al., 2022). In the paper, different approaches will be examined to better understand what the main threats are in the European and Italian contexts.

Besides habitat destruction, some argue that habitat fragmentation is also an important threat to biodiversity. When a few patches of natural ecosystems are maintained, they are usually surrounded by a matrix of destroyed habitats; they are left fragmented or isolated, meaning species lack corridors to move from one place to another. This limits the access to resources for many species, inhibits their ability to migrate and increases the risk of extinction (Vandermeer & Carvajal, 2001).

2.2. Conservation

Conservation and conservation strategies indicate all kinds of actions that society, policymakers, and locals can take to protect, restore, or slow down the destruction of one species, a population, or an entire ecosystem. In this paper, conservation aimed at the ecosystem and habitats will be taken into consideration, since the current measures analysed aim at the protection of such scale.

There are several schools of thought about both the ethical concerns of conservation and the scientific strategies that should be first considered when planning protected areas. Ethically, people are mostly divided between conservationists, who look at nature and resources with their human value attached. They argue for humans to 'manage resources sustainably' so that their availability and value will be preserved longer. On the other hand, preservationists would argue to leave nature be itself, with no human interaction at all. Meaning to leave certain areas out of human reach for both tourist and resource benefits (Mason, 2018).

Conservation strategies also follow different scientific theories. The details of these theories will be analysed through the literature review. However, some examples that will be cited are the metapopulation theory and the functional connectivity theory.
The metapopulation theory has gained relevance in the ecology field since the 1950s and it is often used in the planning of conservation measures in urban or intensely human-used land. Following the metapopulation theory, the human-destroyed habitat is referred to as the matrix, a vast, connected area where conditions are not appropriate for the long-term survival of natural species anymore. The patches of habitat that remain are isolated and might be connected among each other by corridors (Vandermeer & Carvajal, 2001). Measures following this theory often focus mainly on providing corridors among patches, leaving the size and quality of the patches irrelevant. Although, more recent studies argue that the quality of both the patches and the matrix are important factors in the success of conservation plans (Hanski & Ovaskainen, 2003).

The functional connectivity theory, for example, looks at corridors as an important factor in conservation strategy, but also looks highly at the site of the protected area and the quality of the local habitat (*figure 1*).
Other theories will be researched during the literature review and will be collectively used to assess the advantages and trade-offs of different conservation strategies.

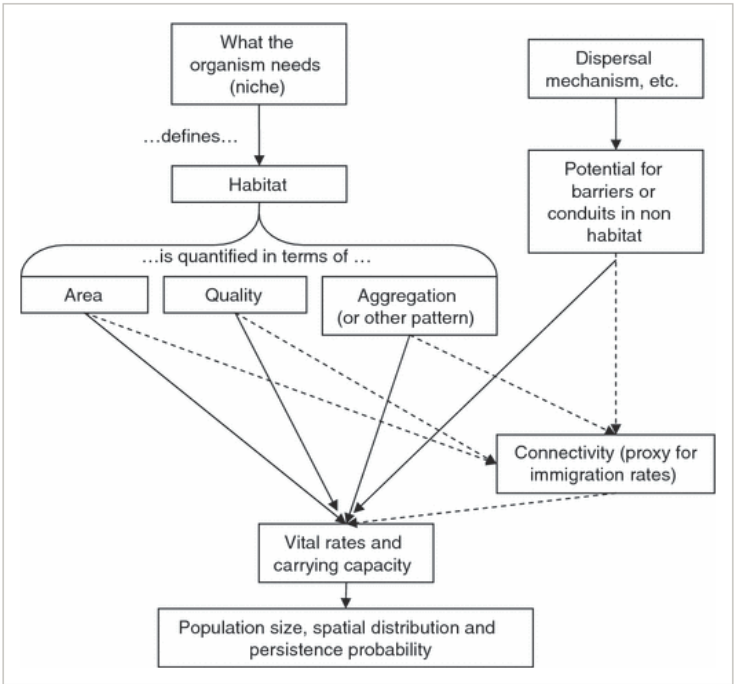

Figure 1 Functional Connectivity visualisation (Hodgson et al., 2009)

2.3.1 Conservation Strategies in Italy

As it is stated in the Constitution of the Italian Republic, '*The Republic safeguards the natural landscape and the historical and artistic heritage of the Nation*" (Art. 9). Since the introduction of this article, both the State and the different Regions have adopted protective measures for the conservation of the natural landscapes.

The Ministry for the Environment and Energy Security is in charge of updating the list of protected areas on the peninsula, the Official List of Protected Areas (Elenco Ufficiale Aree Protette, EUAP). According to the latest version available, in May 2010, the 871 areas cover 10,5% of the terrestrial area of the country and 8,8% of the coastal areas (Della Monica, 2021).
The Protected Areas that will be used for assessment in this paper are mainly National and Regional Parks, Natura 2000 Areas and Natural Reserves of the State.

National Parks are enclosed areas where tourist access is allowed only through authorization and human activities are strictly limited. In Italy, there are 24 national parks, covering 5% of the national territory. They are described as areas containing one or multiple physical, biological or geological formations of (inter)national relevance, to the point where the attention of the State is required to assure their conservation (Ministry for the Environment and Energy Security, 2022).

Regional Parks are similar in definition although generally give more attention to the cultural and human aspects of conservation efforts for local populations. (Della Monica, 2021). Tourists are allowed to enter the parks and some areas are also inhabited.

The **Natural Reserves of the State** on the other hand include much smaller areas, but with greater conservation importance. Their institution is strictly limited to conservation efforts and tourists' access might be limited or forbidden (Della Monica, 2021).

The **Natura 2000 Network** was introduced by the European Union in 1992 following the Habitat Directive and Birds Directive. It is a much 'freer' strategy, where each member state has decisional power in where and how to implement the areas. Human socio-economic activities are usually still allowed on the sites as long as they 'do not pose a threat to local species' (European Commission, n.d.). In Italy, these areas cover 19% of the national territory and their implementation is taken upon by the regions and provinces authorities (Della Monica, 2021).
Other areas listed in the EUAP were not taken into consideration in this study as less legislated, or too urban.

3. Methods

The research aimed at comparing different types of biodiversity conservation strategies in the Italian context and their relationship with surrounding anthromes. This comparison will then be used to assess the efficiency of the current conservation network in Italy and what possible improvements for the future can be. To complete this analysis, different quantitative and qualitative methods were used.

3.1 Literature Review

The research started off with a preliminary literature review to gain more insights into the historical and legislative background of biodiversity and habitat conservation areas in Italy, and the major conservation theories relevant to assess the strategies' efficiency and scientific and public perception of the conservation strategies adopted. The literature considered was mainly scientific, peer-reviewed articles found through search engines such as Google Scholar and WorldCat, using keywords such as 'National Parks Italy', 'Conservation Strategies', and 'Conservation Protected Areas Management'. The research was conducted both in English and Italian language, to get access to locally published studies.

The non-scientific literature considered for the research included the website of the Italian Ministry for the Environment and Energy Security, the website of the European Environmental Agency (EEA), online articles summarising the different conservation strategies and local journals, which gave some information on the history and perception of the changes in and around the park from its foundation. Possible synergies, trade-offs, and criticisms of the different conservation strategies were selected through the literature analysis. Links to databases, datasets and geo-packages were also found in the literature and then used in the geographical analysis of this research.

3.2 GIS Application

Following the literature review, the Natura 2000 areas, relevant Protected Areas from the official list of protected areas (EUAP) and the Anthromes within and surrounding them were mapped using the Geographical Information System (GIS) application QGIS. The use of this tool will make it possible to visualise the current conservation network in Italy and the land use that might be relevant to it.
Additionally, the use of databases and QGIS makes it possible to personalise the resulting map if needed to highlight the relevant information found.
Different databases will be used to map the conservation network:

- Natura 2000 areas: the dataset is public and downloadable by the European Environmental Agency (EEA, 2015). This dataset contains both geographical data that can be used to visualise the areas using GIS, and descriptive data that is submitted by each country or local authority.
- Nationally Designated Areas (CCDA): this dataset, also public and downloadable through the EEA website, offers the shapefile for nationally assigned areas for the protection and conservation of biodiversity and natural habitats for all European Countries. The Italian list (Elenco Ufficiale Aree Protette, EUAP) was then selected by isolating only the areas submitted by Italy in the dataset. As the EUAP contains very vast information about various types of conservation areas, a few, most relevant ones were selected and considered for the study, the complete list of the areas considered is found in Appendix 3.
    - National Parks: 25 in total
    - Regional Parks: 134 in total
    - Natural Reserves: 871 in total

- Anthromes: the Anthromes database was taken from the History Database of the Global Environment (HYDE, v 3.2.1) through Utrecht University. This dataset provides spatial anthromes data with a resolution of 48.84 km2, at intervals of about 10 years, at least for the last century. The data taken into account was starting from the year 1910 when no Parks were instituted yet, and from that it was taken with an interval of 20 years, with the exception of the interval 2010-2017 which links to the most recent data available. The last data available before the establishment of the area and the year 2017 were used for the comparison. In the case of areas used mainly for human settlements and infrastructure, the dataset identifies two types, urban (pop. density > 2500/km2) and dense settlements (pop. density > 100/km2). Given the rise in human infrastructure was identified as an increased risk of habitat fragmentation, these two categories were unified in the outcome maps.

Since the main changes the study aims to identify are in urbanisation and potential habitat fragmentation, the categories of urban and dense settlements were unified. In both categories, the main land cover is urban, although they differ in population density.

3.3 Final Assessment

The results of the literature review and the GIS application offer a comprehensive start to assess the efficiency, synergies, and trade-offs of the current Italian conservation strategy and its relationship with the included and surrounding anthromes during the course of the last century.

To conclude the analysis, the protected areas' changes in anthromes were classified into three categories: positive change, no significant change, and negative change. The areas were taken into consideration before the institution of the protected areas and at the latest anthromes data available (2017). The classification followed mainly the theory that major urbanisation tends to threaten the natural local habitat, while a process of reforestation or decrease of population density will bring benefit to the biodiversity of the area. The total area of the park and the relative changed part were taken into account. Only the national parks were classified individually because of their size and could be analysed using the anthromes database. The smaller areas were considered in a regional, more visual way, as considered too isolated to impact the anthromes changes (as the anthrome data resolution is of 48.84km2). The literature on biodiversity conservation strategies and the public/scientific perception of park management was used to explain and discuss the final results.

The main ecological conservation theories and frameworks found in the literature review will be applied to the Italian case. The literature on socio-political strategies and public perception will fill the gap between what is conservation on paper and what is effectively done in the protected areas and parks. The biodiversity indexes for the parks, if available, will be used to back up these results. The maps resulting from the GIS application will be analysed using theory on the impacts of specific land uses on the surrounding areas, and to show if this is in line with where the protected areas are located in relation to such land use.

4. Results

4.1 GIS Results

The data on the location of the main protected areas listed in the EUAP and the Natura 2000 areas were analysed in relation to the anthromes within and surrounding them and how these changed between the last data available before thor foundation, and the last data available on the HYDE database (2017). This should show how the institution of a protected area changed the land use in the area through time. The HYDE database was found to have a resolution of 5 arcminutes, which in Italy equals approximately 49 square kilometres. The areas taken into account were National Parks, Regional Parks, Natural Reserves and Natura 2000 network.

Among these categories, only the complete list of National Parks included areas big enough to be studied singularly. Given that the smallest of the National Parks in Italy is the Cinque Terre National Park which measures almost 40 square kilometres.
Regional Parks, Natural Reserves and Natura 2000 areas included mainly smaller areas, which were studied at a regional level, rather than individual.
Figure 2 offers an overview of the location of the studied areas in Italy.

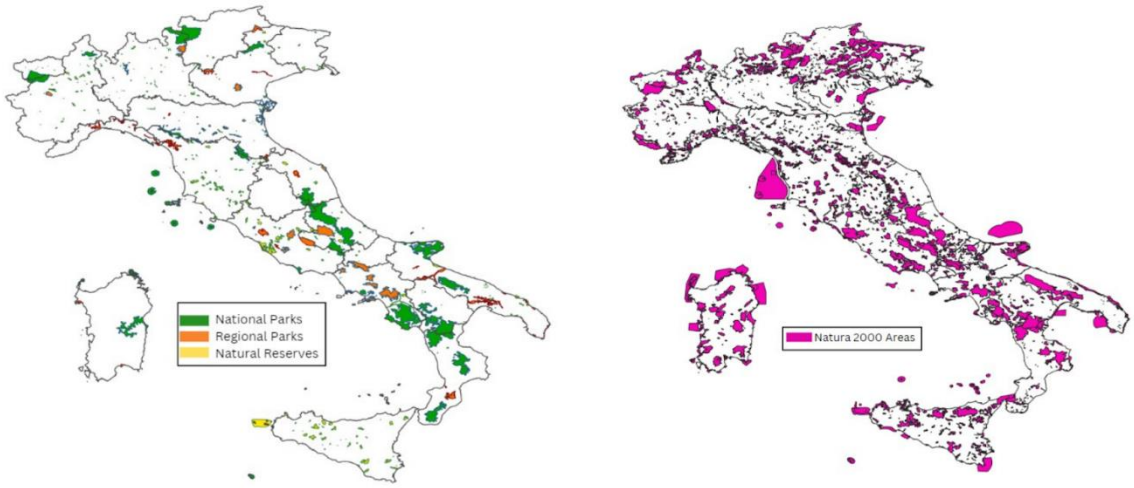

Figure 2: Map of the Protected Areas and Natura 2000 areas in Italy

4.1.1 National Parks

National Parks resulted to be individually more extended, although less in number. There are currently 25 national parks listed on the EUAP. For 2 of them anthromes data is not available as located on small islands (Asinara National Park and Pantelleria Island National Park). National Parks are instituted to protect crucial habitats and landscapes that are deemed of such national and international interest that State Government intervention is required. It is expected then that natural landscapes be found in the area of the park, both before and after the establishment of the park. Each park's land change was classified using a series of criteria into positive, negative or neutral change. The criteria are better explained in the above section on the basis of biodiversity theories. The results are summarised in Table 1, and comparison maps for each park can be found in Appendix 2.

TABLE 1 - National Parks classification of anthrome changes

Name of the Park	Changed Cells/Total	Change Classification	Main type of tourism based of site location
'Parco nazionale dell'Appennino Lucano - Val d'Agri - Lagonegrese'	2/7	neutral	mountain
Parco nazionale del Golfo di Orosei e del Gennargentu	3/10	neutral	seaside

Parco nazionale della Maiella	1.5/11	neutral	mountain
Parco nazionale delle Foreste Casentinesi, Monte Falterona e Campigna	0/6	neutral	mountain
Parco nazionale della Val Grande	0/3	neutral	mountain
'Parco nazionale dell'Alta Murgia'	2/8	neutral	mountain
Parco nazionale della Sila	1.5/10	neutral	mountain
'Parco nazionale dell''Aspromonte'	0/8	neutral	mountain
'Parco nazionale dell'' Arcipelago Toscano'	1/1.5	negative	seaside
Parco nazionale del Vesuvio	0/1	neutral	mountain
Parco nazionale del Circeo	1/2	negative	seaside
Parco Nazionale Isola di Pantelleria		no data	seaside
Parco nazionale del Gran Sasso e Monti della Laga	4.5/21	neutral	mountain
'Parco nazionale dell'Appennino Tosco-Emiliano'	0.7/5	neutral	mountain
Parco nazionale delle Cinque Terre	1/1,5	positive	cultural human landscape, seaside
'Parco nazionale d'Abruzzo, Lazio e Molise'	0.5/6	neutral	mountain
Parco nazionale dei Monti Sibillini	0.8/13	neutral	mountain
Parco nazionale dello Stelvio	2/25	negative	mountain
'Parco Nazionale dell'Arcipelago di La Maddalena'	1/2	neutral	seaside
'Parco nazionale dell'' Asinara'		no data	seaside
Parco Nazionale delle Dolomiti Bellunesi	1.2/6	neutral	mountain
Parco nazionale del Gargano	13/36	negative	seaside
Parco nazionale del Cilento e Vallo di Diano	7/27	negative	seaside

Parco nazionale del Pollino	0/21	neutral	mountain
Parco nazionale del Gran Paradiso	2/13	neutral	mountain

As it results from the classification above, most of the National Parks, 17 out of 25, did not experience any significant changes between the date of their foundation and 2017. Some minor trends of population movement were observed, mostly of people moving from woodlands within the park to villages around it. *Figure 4* shows the anthromes changes in the National Park of Mailella, which was classified as a neutral change from before the park birth date in 1991 and the most recent data available of 2017. It results that people tend to move from more remote areas to already populated areas usually at the border of the park. In most cases these changes were although not so important that seemed to balance out the stability of the area.

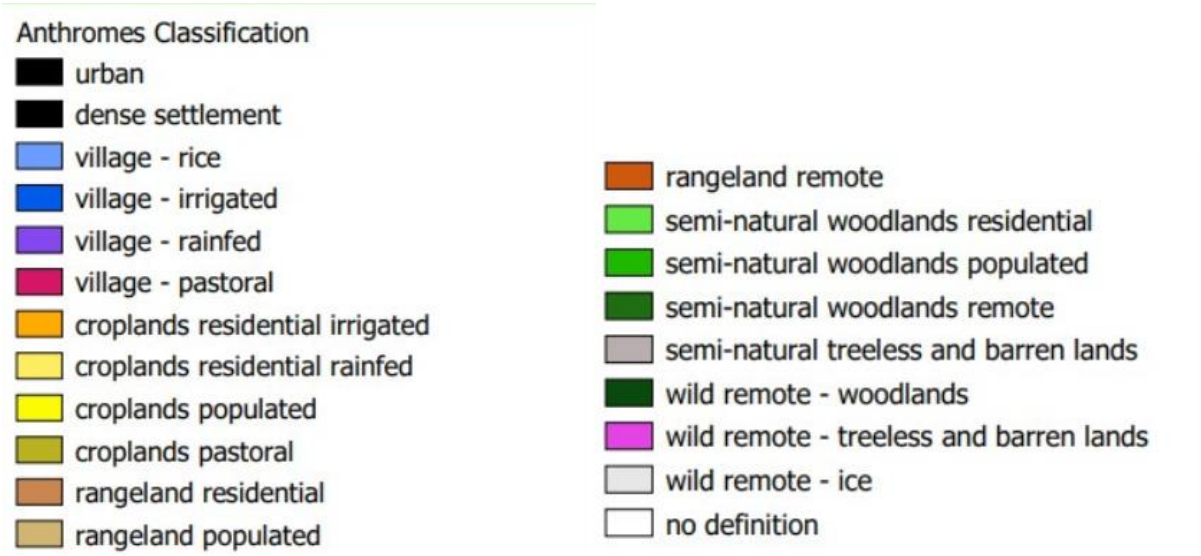

Figure 3: Anthromes Classification Legend to read the following figures (3-5)

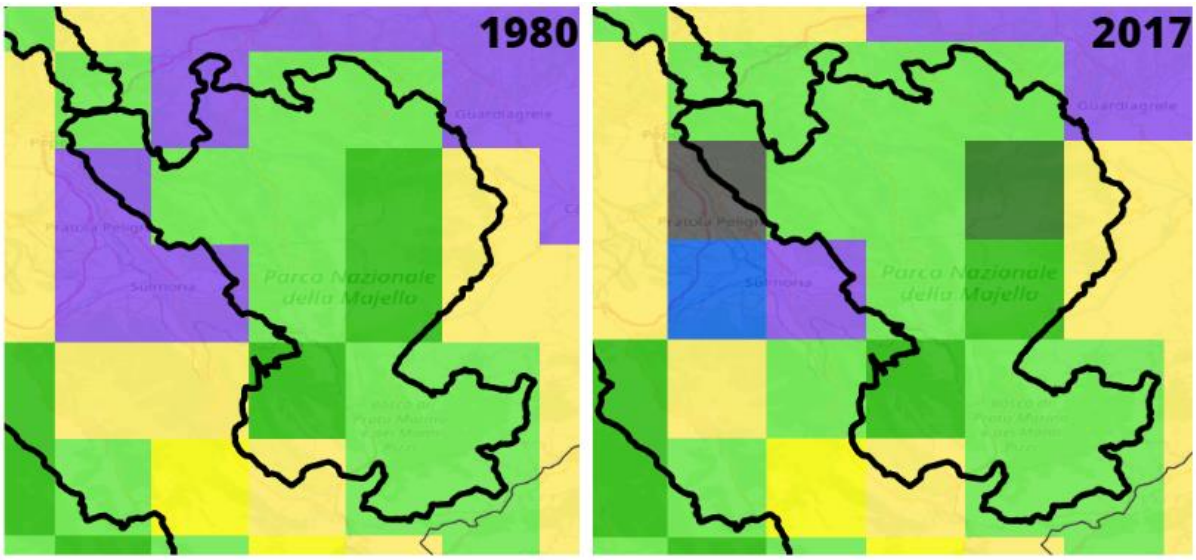

Figure 4: Anthrome Changes in the National Park of Mailella 1980-2017

Five of the national parks were classified as negative changes; four of these parks are mainly visited for seaside tourism. In these locations, a main trend of urbanisation was observed, mostly in the coastal section of the parks. *Figure 5* shows the anthrome change in the Gargano National Park, in the region of Puglia, as an example. The fifth park, the Stelvio National Park was deemed negative, with a cell ratio change of 2/25, because of the strong urbanisation trend which happened only on the perimeter of the park.

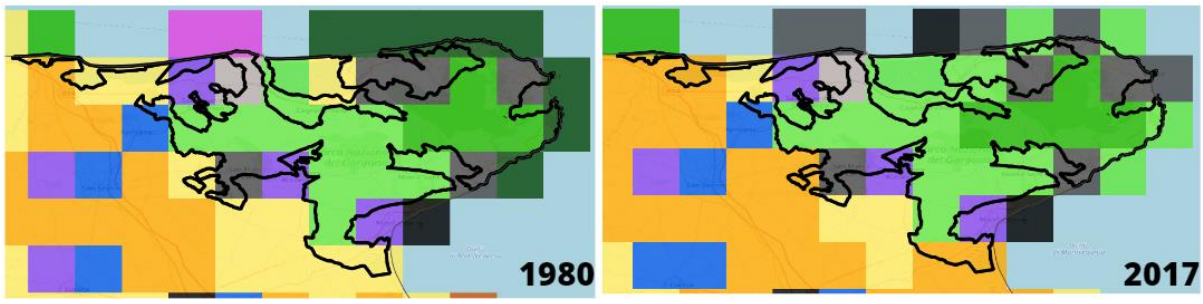

Figure 5: Anthrome Changes in the National Park of Gargano 1980-2017

Only one park was classified as a positive change, the Cinque Terre National Park (*Figure 6)*. Although being one of the smallest of the Italian National Parks, the most densely populated, the central part of the park lost a significant amount of population since its establishment in 1999, and from a dense settlement became classified as residential woodland.

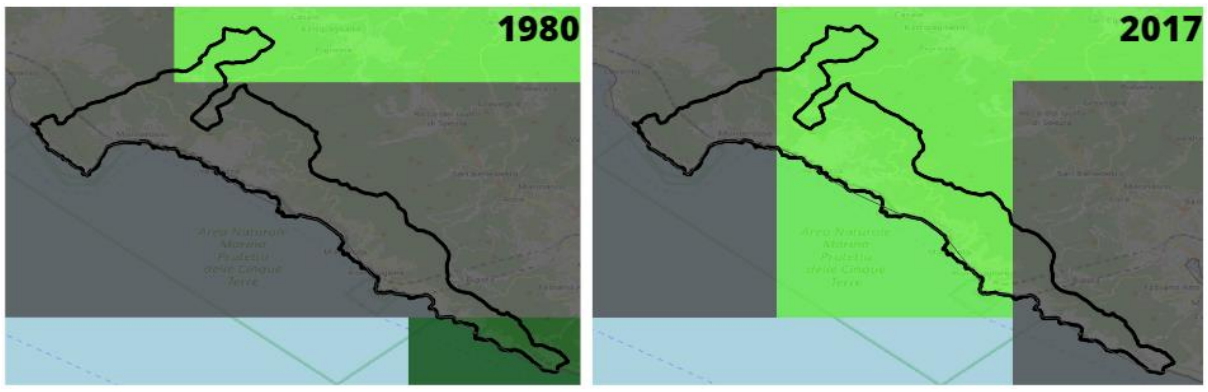

Figure 6: Anthrome Changes in the National Park of Gargano 1980-2017 (legend to add)

4.1.2 Regional Parks

The Regional Parks, in contrast with the National Parks, are usually established to maintain integer sites that are more of cultural interest, besides their biological importance, and their management is given to the Regional Governments. They are usually smaller than National Parks, but much more in number, as the last updated version of the EUAP (2010) counts 134 Reginal Parks. They were

found to be more populated in general, including more human activities or higher population densities than national parks. The larger parks were found in alpine regions, quite in proximity to already established National Parks. Although the territory within the regional park was still used for example to cultivate, an activity which is less popular in national parks. *Figure 7* shows an example of the anthrome analysis of regional parks in southern Italy in the regions of Campania and Puglia. As the picture shows, Regional Parks tend to be more populated and used in the production of crops and other irrigated fields. We can also see an extension of populated croplands over the decades mostly in the East of the region selected. Urban areas are also increasing, as cities expand in population.

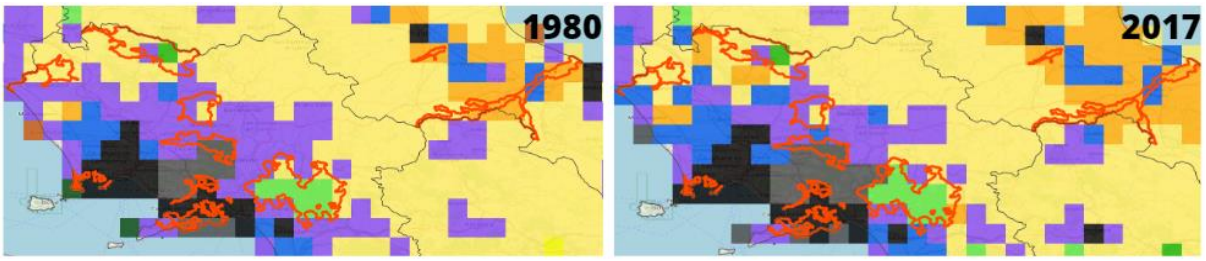

Figure 7: Regional Park analysis of the regions of Campania and Northern Puglia (Regional Parks of Campi Flegrei, Partenio, Taburno-Camposauro, Bacino Fiume Sarno, Diecimare, Maltese, Roccamonfina-Foce Garigliano and Monti Picentini)

4.1.3 Natural Reserves

These are usually very small areas, it is known that natural reserves are created specifically with the intention of protecting a particular habitat or species. However, most of them are of a too-small area to determine any changes in anthrome type. According to the literature, Natural Reserves are classified into different levels of protection, which range from total denied access if not for scientific purposes.

From a regional GIS analysis (1970-2017), the trends in urbanisation seem to continue in the proximity of the Nature Reserves, both in villages becoming dense settlements and land being abandoned in other areas.

Because of their higher regulation status though it is assumed that the land use within the reserve is maintained as intact as possible, with very limited or no dwellings and touristic activities within the border of the areas. *Figure 8* shows an example of an area rich in such areas, in central Italy. It can be noted that most of these areas are smaller than a grid cell.

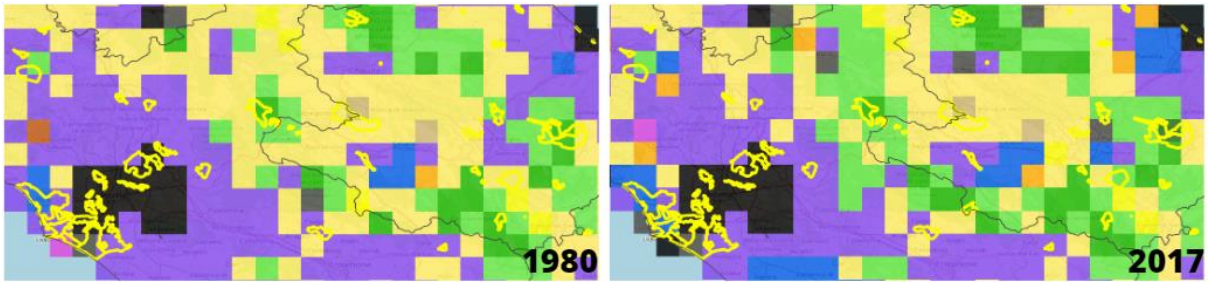

Figure 8: Nature Reserves Analysis of the regions of Lazion and Abruzzo in Central Italy

4.1.4 Natura 2000 Network

The Natura 2000 areas are scattered and small throughout the national territory (*Figure 2*). They are usually of smaller sizes, except when overlaying with pre-existing protected areas such as National or Regional Parks. They seem to be much more extended in the north of the country and alpine regions. Anthrome changes do not seem to follow the same trends as national parks. Urbanisation trends continue before and after the establishment of the area, mostly if this is not located in an already remote area. As mentioned above, the larger areas are found in concordance with already protected areas, while most of the Natura 2000 dedicated areas were found to be smaller than a grid cell of the HYDE database, making it impossible to determine what change the establishment of the area brought. At the Italian latitudes, each grid cell of the HYDE database (5 arcminutes) measures approximately 49 km2. Of the 2639 areas that are currently listed in the Italian Natura 2000 network, 2290 are smaller than this 49km2, meaning the anthrome database could not be used to study the change related to the singular areas.

4.2 Literature Research

4.2.1 Scientific Research

Different scientific publications can be found on the management and development of the National Parks in Italy, both on a national scale and specific case studies. The results of the literature research align with the findings of the GIS analysis of this paper.

Coastal parks, for example, were found to be the most ‘at risk’ of strong urbanisation trends. The Gargano National Park was taken as an example of this tendency. Studies show that the sudden increase in coastal tourism in the past decades has put much pressure on infrastructure on the coast, creating discord between the management and efficiency of the park in its coastal area and in the inland sections. The sudden increase in demand is responsible for the urbanisation of the coast and an ‘unorganised’ development (Cavuta, DiMatteo, 2016). As shown from the GIS analysis, the coast's sudden urbanisation happened during the 2010 decade.

Fragmentation, mainly due to urbanisation, is seen as one of the main threats to biodiversity. Garcia et al. (2013) offer a clear classification of the habitat fragmentation for each park. We recognize a correlation with the coastal tourism trend given by the findings above. The National Parks of Gargano, La Maddalena, Arcipelago Toscano, Pollino, Aspromonte and Appenino Lucano, result classified as Parks with a high level of habitat fragmentation due to urban infrastructure. The first four parks all contain coastal areas, while the Aspromonte.

4.2.2 Popular Articles

The popular articles analysed concerned mainly the parks observed to have a negative land change during the last decades. This offered some explanations about the fast increase in urbanisation within park borders regardless of its park status. Articles highlighted mostly the lack of permissions most urbanisation initiatives relied on. In the Gargano National Park, for example, a large area was taken away from its previous natural state to build a parking lot near the coast, a camping park for caravans and several touristic attractions. This was done in a private area, within the park and according to the local WWF complaints, no permission was given prior to the works being done (FoggiaToday, 2015).

What is a more concerning finding, are the external social phenomena that park institutions have to fight to maintain the natural state of the park embedded in anti-park groups. One tragic example found in such literature was the murder of Angelo Vassallo in 2010, mayor of a municipality within the park of Cilento was highly involved in the management of the park to make sure the natural state was preserved (Barolini, 2020).

5. Discussion

This research looked at the change in land use through the anthromes classification within and around Conservation Protected Areas in Italy. National Parks, Regional Parks, Nature Reserves, and Natura 2000 areas were taken into account and analysed using GIS tools. The results show that most parks did not change significantly from before their implementation and nowadays. The National Parks were studied on an individual level and showed interesting trends although they lack of significant results. After a classification of the change in land use experienced by the parks, 5 parks were identified as having strong urbanisation trends. Of these five, four were located along the coast in popular touristic destinations. Regional Parks were observed to be more used by human activities on a general scale, including anthromes such as croplands, residential woodlands and villages. Smaller protected areas such as nature reserves and Natura 2000 were found too small to be compared, although the anthromes around them seemed to be mainly urban or highly populated.

The results of this study show mainly that the protected area status is not the main driver in the land change of the area, as the urbanisation and population movement trends that are seen in the Italian Protected Areas are the same as seen in most areas of the world (Romano & Zullo, 2014). People abandon remote areas to live in already populated areas, where facilities are more available. The increase in the tourism sector drives the rise of infrastructure around mostly coastal areas or popular destinations, which is often in quick, and poorly planned ways. These trends combined bring discordance in the results of land change within and in the proximity of protected areas. While the main coastal park sees an increase in urbanisation, mostly on the seaside line, mountain or inland parks are increasingly losing population, and the land is often given back to its natural, remote state (Bracchetti et al., 2012). Results from studies on habitat fragmentation align with this view, as most of the parks with high value of fragmentation are located near popular coastal tourist destinations (Garcia et al., 2013).

Although not significant, these results offer much to discuss the observation and some of the factors that might have limited the results. Firstly, it was noticed, that although tourism trends are on the rise both for coastal and mountain areas, it was mainly the coastal areas that saw a rise in infrastructure within the park, while the alpine parks, saw a decrease in population density within the park and an increase of the same along the park borders and nearby towns. This does indeed follow the urbanisation trend of people moving towards where the condition is more favourable (facilities, good weather, connection etc.). However, it could also be argued that the perception of mountain tourism is closer to the idea of ecotourism, while coastal tourism is in most cases still highly linked to important tourist infrastructure such as hotels, resorts and pools (Bimonte, 2008). This reinforces the finding that it is not the protected status of the area that determines its development but rather its location and attractiveness.

Considering the conservation theories explained in section 2.3, these results do not seem positive for the effectiveness of biodiversity conservation. As also highlighted by scientific literature, high degrees of habitat fragmentation are found in parks located in touristic destinations, meaning that no real importance seems to be given to habitat quality and connection when the tertiary sector profits are on the rise. Referring to the Functional Connectivity Theory in Figure 1 (section 2.3), three factors were considered central for biodiversity conservation, size of the habitat, quality and

possibility of movement among patches. National Parks, except the ones identified before as negative, seem to take into consideration most of these factors. The areas are large enough and most are not used intensively by human activities. Anthromes such as woodlands, rangeland and remote areas are popular. Regional parks, Reserves and Natura 2000 on the other hand, are generally smaller, which could affect the area and connectivity factor. The anthromes, at least around or regionally where these areas are located are intensively used in urban or production spaces. Although the higher protection regulation, in nature reserves, these external conditions might threaten the quality of the area within (Hansen & Rotella, 2002).

5.1 Implication of the results and possible advice

The result found the trend in urbanisation and tourism to not be much influenced by the park legislation. Since these trends are not expected to slow down in the near future, solutions might need to be planned in the expectance of an increasingly urban area. Examples of such solutions might be found in the planning of land-sharing and land-sparing development strategies. Land-sparing urban planning aims at leaving a part of the land completely untouched by human infrastructure, where local biodiversity can dwell unbothered. This strategy has been proven effective in situations where a high degree of urbanisation is expected in the future (Soga et al., 2014). In the case of Italian protected areas, this would affect mostly coastal parks and parks adjacent to urban areas. Land-sharing, on the other hand, looks at integrating urban development within natural areas providing corridors and spaces for the species to thrive within the human settlements. Possibilities of this development are seen in alpine areas which are already scarce in population and where these corridors might be more respected.

Habitat fragmentation, which was identified as one of the main causes of biodiversity loss, although mainly caused by urbanisation trends, is also often linked to the intensive production of resources in croplands. This has effects mostly on the bird species dwelling in the area, as they are deprived of shrubs or trees where to nest (Quinn et al., 2014). A change towards more intensive crop production was seen in many Italian regions, often within or around smaller protected areas and regional parks. Future spatial planning in this case will need to consider keeping a degree of heterogeneity within the area and ensure the presence of corridors of shrubs or trees for the local bird species to dwell.

5.2 Limitations and Recommendations for future research

The current classification of the anthromes (HYDE 3.2) does not include protected areas in any way, as there is no identification of National, Regional or Natural Parks. There are negative and positive consequences to this factor. As the current classification of an area remains unbiased by its legal protection, the Anthromes database offers a valid tool to study the development of the areas, regardless of their protected status. Which made it possible to identify the parks and areas that saw negative trends in landscape conservation. On the other hand, the database focuses mostly on population density and gives no space for sustainable infrastructure and practices that might be used in the protected areas to balance the tourism flow and the conservation strategies.

Although the literature confirmed that the fast rise in tourism and urbanisation brought high disorganisation in the development of the infrastructure, other parks might invest a significant amount of effort and budget in such practices. Of this, the HYDE database would not keep track. I would argue that in the next version of the anthromes database, protected areas should be included but only on a ‘second note’ as the Anthrome classification of the park is important to keep track of

the habitat protection and population movement in the park. In view of the increasing new possibilities in sustainable infrastructure, such as corridors between patches, and green roofs, which can be expected to become more popular in the future, it is important to make it clear where such projects might arise, as the population density of the area and level of urbanisation, which is now seen as bad, might not be so accurate. As these areas do receive funds to implement their protection strategy, a note in the anthromes would help identify this possibility.

The EUAP database lists little less than 1000 protected areas, of all sizes and regulation status, already without including the Natura 2000 areas (unless overlaying with other areas). In this paper, only part of them was analysed in relation to the land change and anthromes. And because of their reduced size, most of the areas were considered on a regional level. The resolution of the anthromes database might also not be sufficient to study most of these areas. Primarily for the assessment of such change around the Natura 2000 areas. As mentioned above, many of the Natura2000 areas and Nature reserves could not be assessed as smaller than the database grid cells.

Lastly, it is to be noted that although being controlled and funded by the State and Regional governments, each of these areas is managed by individual committees that act according to several social and environmental conditions specific to each designated area. A GIS analysis like this is a great place to start analysing the land change within and around the protected area, but it should also include a look into the main decision-making processes that are currently relevant, and which could explain many of the results observed in a different light. Considering the findings in popular articles, the effectiveness of parks in habitat conservation is deeply embedded in social phenomena and political discrepancies within national and local governments.

Given then the large number of protected areas and the specific social environment they dwell in, this study was able to give general possibilities for solutions in future planning and management of these areas. Nevertheless, future research could research the effectiveness of these areas on a smaller scale, individual or regional. In this way, the specific habitat needs, and the socio-political framework of the areas can be taken into account and more appropriate solutions could be found to enhance the success of the protection areas.

6. Conclusion

This paper looked at the anthrome change within and around the main biodiversity-protected areas of Italy. Following the main conservation theories stating that habitat fragmentation and high human presence in an area are considered a major threat to biodiversity conservation, the larger areas were assessed as having a positive, neutral, or negative change. Most areas were found to not have any significant change in land use from before and after the establishment of the protected status. One interesting result was that most areas were found to have a negative change, meaning an increase in urbanisation were located along the coast, and in popular tourist destinations.
This led to the conclusion that it is not the ‘protection status’ in most cases driving the land use change, but rather economic and social processes which are observed also elsewhere.
Most areas were also found too small to be studied through the 49km2 grid cells of the HYDE database. This partly aligns with the expected results of the study which stated that the National Parks would result as the most consistent and efficient form of conservation strategies, while other areas would be found quite small and scattered. In terms of conservation strategies, this might lead to the conclusion that the risk of fragmentation is still high among protected areas. Mostly among natural reserves, Natura2000 areas and coastal National Parks.

To answer the research question, current conservation strategies in Italy do to some extent protect the local habitat and species, although further control over the human activities in the areas needs to be implemented. National Parks seem the most effective strategies as they include larger areas and less intensive land uses on a general scale. Other protected areas were found to be located closer to intensively used land such as urban or croplands. This was found, in line with the literature, to increase the fragmentation of the habitats also within protected areas, a threatening factor to biodiversity. While the literature focuses more on the scientific basis of conservation ineffectiveness, a sense of dissatisfaction with park regulation is also found in public, and local articles, which include complaints and particular cases of 'bad management' of protected areas.

Since tourism and urbanisation trends are not expected to diminish in the near future, the main advice we could gather from this paper is that future decision-making around land use in protected areas needs to be more controlled and protection focused. This does not mean a cease to all constructions and developments but a sustainable and future-projected management which considers the present economic needs but also the future of the local environment. For future spatial planning, more protection-focused strategies such as land-sharing, land-sparing and heterogeneity of croplands might need to be considered in protected areas as well as around them.

7. Acknowledgements

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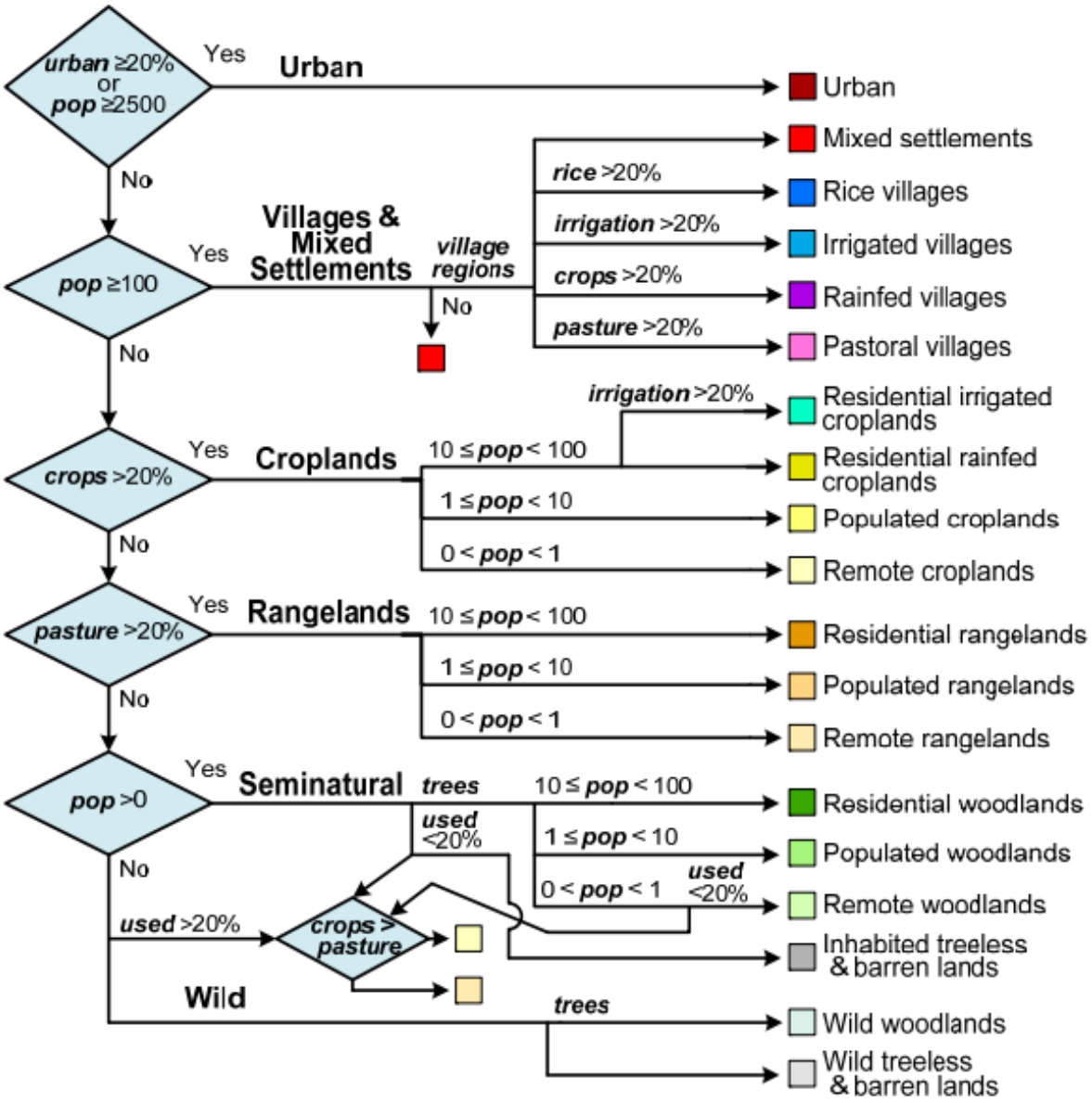
Appendix 1: Anthromes Classification

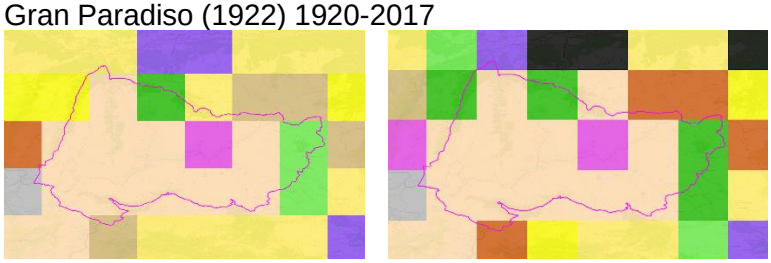


(Ellis et al., 2010)

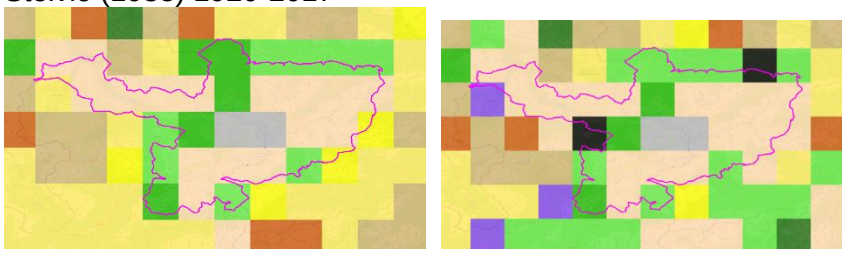
Appendix 2: Maps of the previous and current situation of the National Parks

Parco Nazionale Val Grande 1980-2017 (fund. 1991)

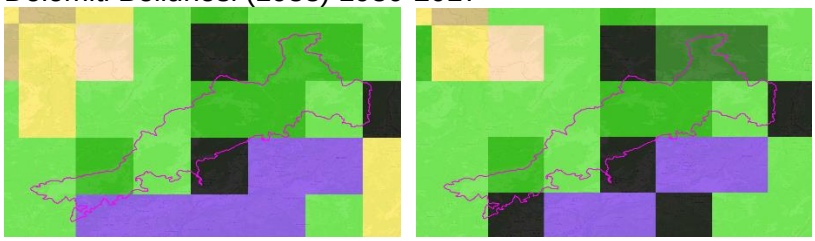
Gran Paradiso (1922) 1920-2017



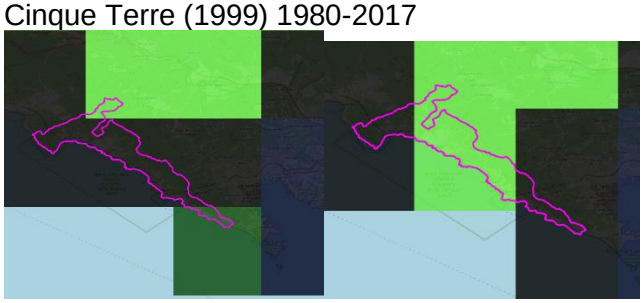
Stelvio (1935) 1920-2017



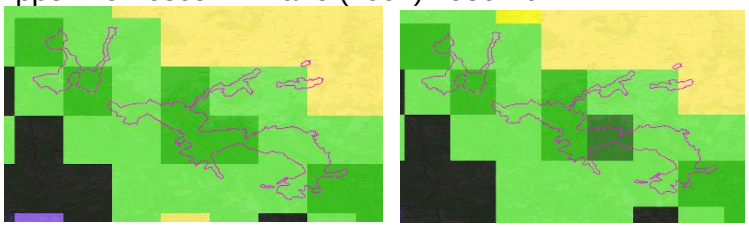
Dolomiti Bellunesi (1988) 1980-2017



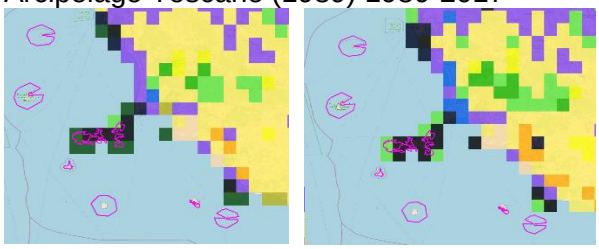
Cinque Terre (1999) 1980-2017



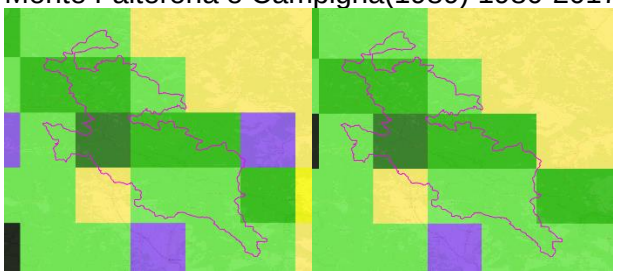
Appenino Tosco-Emiliano (1997) 1980-2017



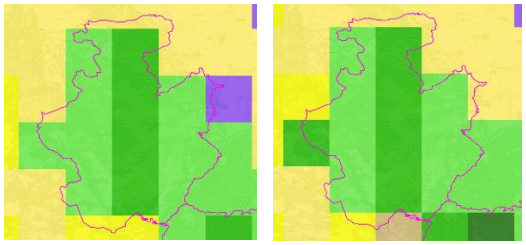
Arcipelago Toscano (1989) 1980-2017



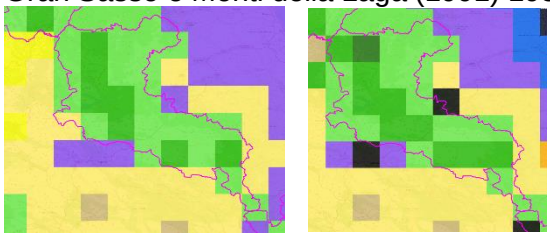
Parco nazionale delle Foreste Casentinesi,
Monte Falterona e Campigna(1989) 1980-2017



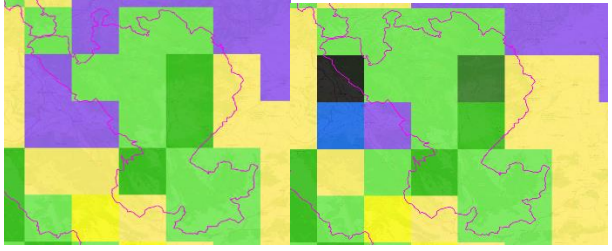
Monti SIbillni (1988) 1980-2017



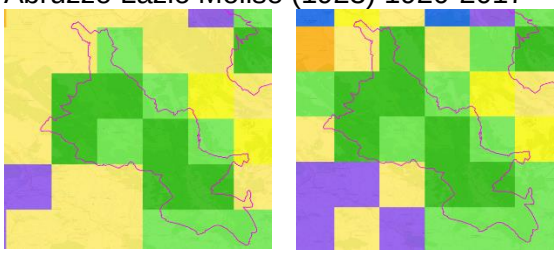
Gran Sasso e Monti della Laga (1991) 1980-2017



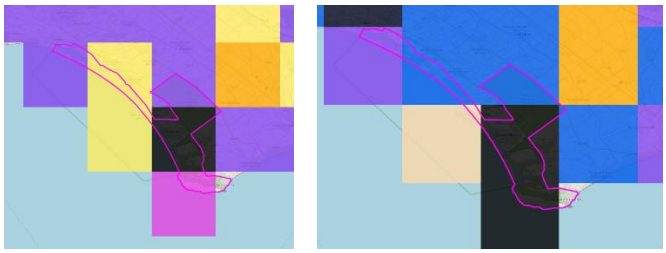
Maiella (1991) 1980-2017



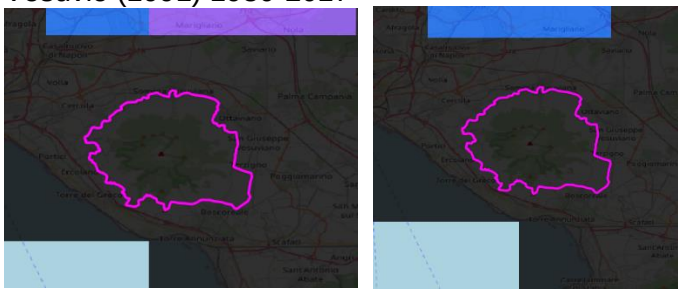
Abruzzo Lazio Molise (1923) 1920-2017



Circeo (1934) 1920-2017

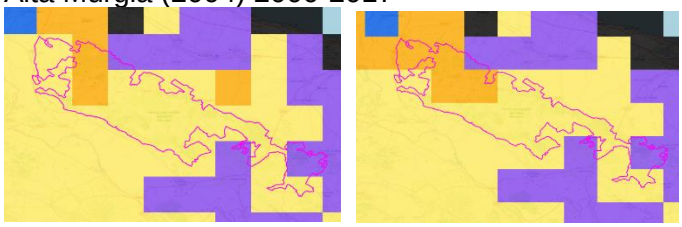


Vesuvio (1991) 1980-2017

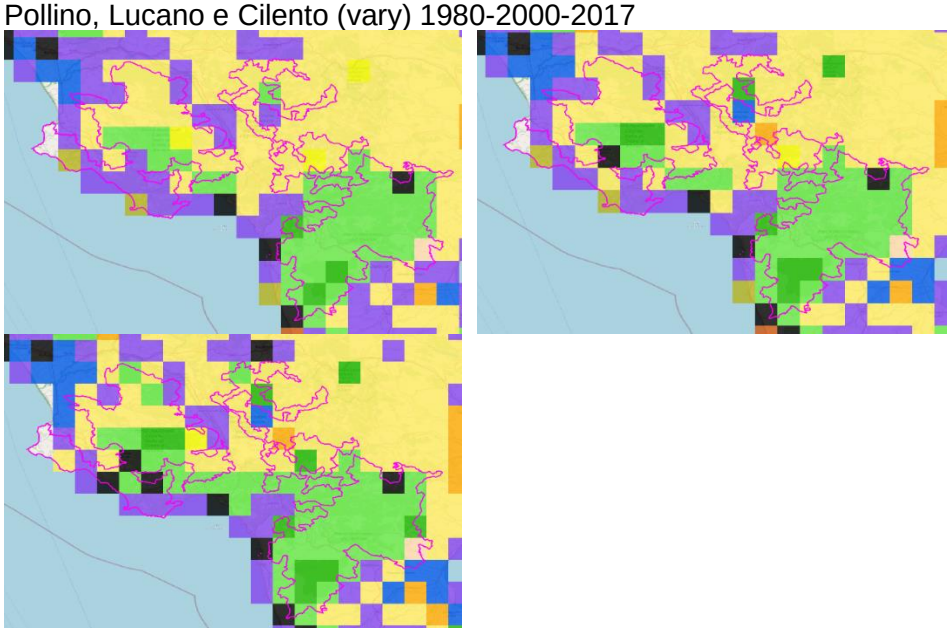


Gargano (1991) 1980-2017

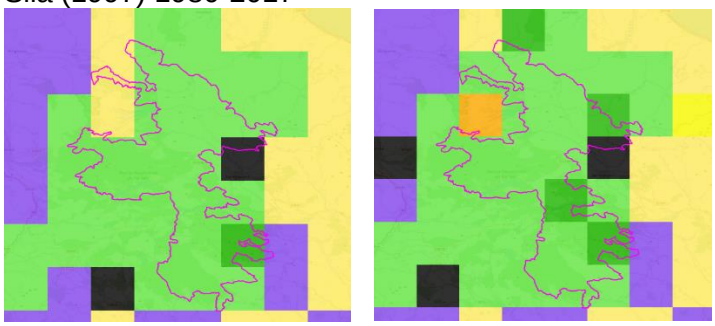
Alta Murgia (2004) 2000-2017



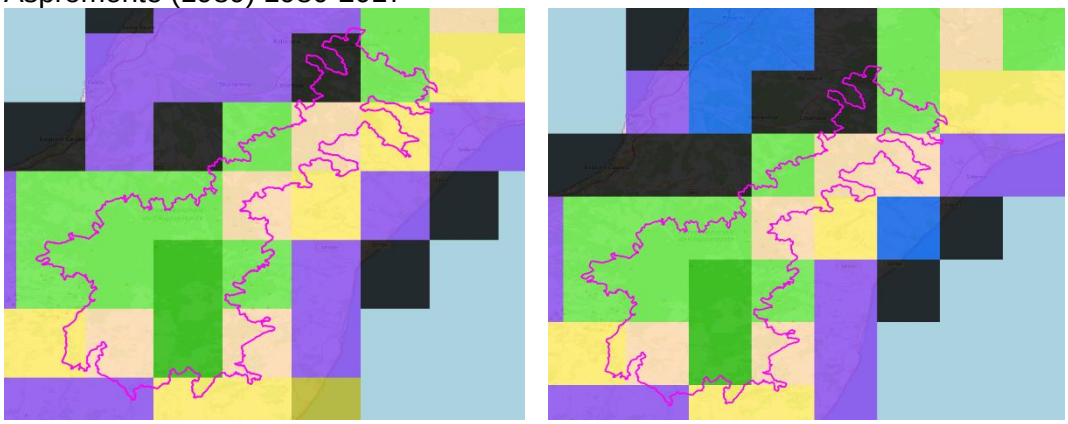
Pollino, Lucano e Cilento (vary) 1980-2000-2017



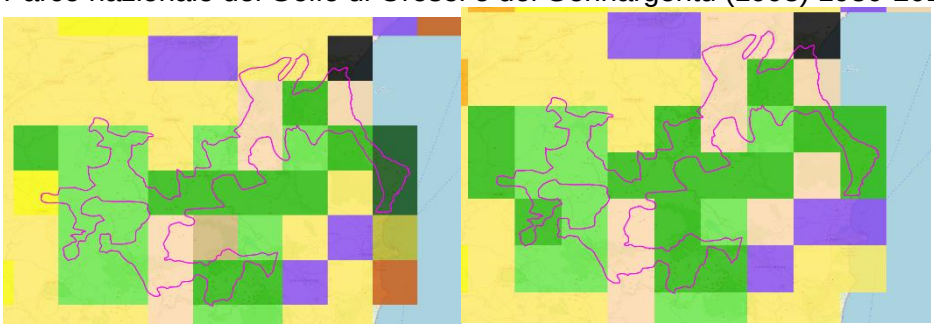
Sila (1997) 1980-2017



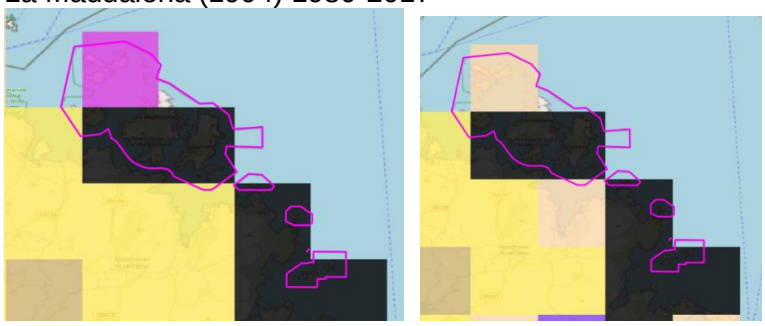
Aspromonte (1989) 1980-2017



Parco nazionale del Golfo di Orosei e del Gennargentu (1998) 1980-2017



La Maddalena (1994) 1980-2017



Appendix 3: EUAP Sites take into account

siteName	Foundation Year
Parco naturale regionale Appia Antica	1988
Parco naturale regionale Bosco e Paludi di Rauccio	2002
Parco naturale regionale Bosco Incoronata	2006
Parco naturale regionale Costa Otranto - Santa Maria di Leuca e Bosco di Tricase	2006
Parco naturale regionale dei Boschi di Carrega	1982
Parco naturale regionale del Beigua	1985
Parco naturale regionale del complesso lacuale Bracciano - Martignano	1999
Parco naturale regionale del Fiume Sile	1991
Parco naturale regionale del Monte San Bartolo	1994
Parco naturale regionale del Sasso Simone e Simoncello	1994
Parco naturale regionale della Gola della Rossa e di Frasassi	1997
Parco naturale regionale della Lessinia	1990
'Parco naturale regionale dell''Antola'	1989
'Parco naturale regionale dell''Aveto'	1989
Parco naturale regionale delle Alpi Apuane	1985
'Parco naturale regionale delle Dolomiti d''Ampezzo'	1990
Parco naturale regionale di Bric Tana	1985
Parco naturale regionale di Montemarcello - Magra	1982
Parco naturale regionale di Piana Crixia	1985
Parco naturale regionale di Porto Conte	1999
Parco naturale regionale di Portofino	1986
Parco naturale regionale di Portovenere	2006
Parco naturale regionale Dune costiere daTorre Canne a Torre San Leonardo	2006
Parco naturale regionale Fiume Ofanto	2007
'Parco naturale regionale Isola di Sant''Andrea e litorale di Punta Pizzo'	2006
Parco naturale regionale Litorale di Ugento	2007
Parco naturale regionale Molentargius - Saline	1999
Parco naturale regionale Monti Simbruini	1983
Parco naturale regionale Porto Selvaggio e Palude del Capitano	2006
Parco naturale regionale Salina di Punta della Contessa	2002
Parco naturale regionale Serre	1990
Parco naturale regionale Terra delle Gravine	2005
'Parco nazionale dell''Alta Murgia'	2004
Parco nazionale dei Monti Sibillini	1988
Parco nazionale del Cilento e Vallo di Diano	1991
Parco nazionale del Circeo	1934
Parco nazionale del Gargano	1991
Parco nazionale del Golfo di Orosei e del Gennargentu	1998
Parco nazionale del Gran Paradiso	1922
Parco nazionale del Gran Sasso e Monti della Laga	1991
Parco nazionale del Pollino	1988
Parco nazionale del Vesuvio	1991

'Parco nazionale dell'' Arcipelago Toscano'	1989
'Parco nazionale dell'' Asinara'	1997
Parco nazionale della Maiella	1991
Parco nazionale della Sila	1997
Parco nazionale della Val Grande	1991
'Parco nazionale dell''Abruzzo, Lazio e Molise'	1923
'Parco nazionale dell''Appennino Lucano - Val d''Agri - Lagonegrese'	2007
'Parco nazionale dell''Appennino Tosco-Emiliano'	1997
'Parco Nazionale dell''Arcipelago di La Maddalena'	1994
'Parco nazionale dell''Aspromonte'	1989
Parco nazionale delle Cinque Terre	1999
Parco Nazionale delle Dolomiti Bellunesi	1988
Parco nazionale delle Foreste Casentinesi, Monte Falterona e Campigna	1989
Parco nazionale dello Stelvio	1935
Parco Nazionale Isola di Pantelleria	2016
Parco regionale Bacino Fiume Sarno	2003
Parco regionale dei Campi Flegrei	1993
Parco regionale dei Castelli Romani	1984
Parco regionale dei Colli Euganei	1989
Parco regionale dei Gessi Bolognesi e Calanchi della Abbadessa	1988
Parco regionale dei Laghi Suviana e Brasimone	1995
Parco regionale dei Monti Lattari	2003
Parco regionale dei Sassi di Roccamalatina	1988
Parco regionale del Conero	1987
Parco regionale del Corno alle Scale	1988
Parco regionale del Delta del Po (VE)	1997
Parco regionale del Matese	1993
Parco regionale del Partenio	1993
Parco regionale del Taburno - Camposauro	1993
'Parco regionale dell'' Abbazia di Monteveglio'	1995
'Parco regionale dell'' Alto Appennino Modenese'	1988
Parco regionale della Valle del Lambro	2005
Parco regionale della Vena del Gesso Romagnola	2005
'Parco regionale dell''Adamello'	2003
Parco regionale delle Valli del Cedra e del Parma	1995
Parco regionale Delta del Po (ER)	1988
Parco regionale di Gianola e del Monte di Scauri	1987
Parco regionale di Roccamonfina - Foce Garigliano	1993
Parco regionale Diecimare	1980
Parco regionale La Mandria	1978
Parco regionale Marturanum	1984
Parco regionale Monti Picentini	1993
Parco regionale naturale dei Monti Lucretili	1989
Parco regionale naturale del Sirente - Velino	1989
Parco regionale storico di Monte Sole	1989
Parco regionale urbano di Aguzzano	1989
Parco regionale urbano Monte Orlando	1986
Parco regionale urbano Pineto	1987
Riserva naturale Montenero	1995
Riserva naturale Abbazia Acqualunga	1986
Riserva naturale Abetone	1977

Riserva naturale Acquerino	1977
Riserva naturale Acquerino Cantagallo	1998
Riserva naturale Adda Morta	1984
Riserva naturale Agoraie di sopra e Moggetto	1971
Riserva naturale Agromonte Spacciaboschi	1972
Riserva naturale Alto Merse	1996
'Riserva naturale Antiche Citta'' di Fregellae e Fabrateria Nova e del Lago di S. Giovanni Incarico'	1997
Riserva naturale Badia Prataglia	1977
Riserva naturale Bassa dei Frassini - Balanzetta	1971
Riserva naturale Basso Merse	1996
Riserva naturale Belagaio	1980
Riserva naturale Bibbona	1977
Riserva naturale Bocche di Po	1977
Riserva naturale Boschetto della Cascina Campagna	1991
Riserva naturale Boschetto di Scaldasole	1984
Riserva naturale Boschi del Giovetto di Palline	1985
'Riserva naturale Bosco de l'' Isola'	1991
Riserva naturale Bosco della Marisca	1989
Riserva naturale Bosco della Mesola	1977
Riserva naturale Bosco di Alcamo	1984
Riserva naturale Bosco di Barco	1989
Riserva naturale Bosco Fontana	1972
Riserva naturale Bosco Siro Negri	1973
Riserva naturale Bosco W.W.F. di Vanzago	1985
Riserva naturale Bus della Genziana	1987
Riserva naturale Calafuria	1977
Riserva naturale Camaldoli	1977
Riserva naturale Campigna	1977
Riserva naturale Campo di Mezzo - Pian Parrocchia	1977
Riserva naturale Campolino	1971
Riserva naturale Caselli	1977
Riserva naturale Castelvolturno	1977
Riserva naturale Cavagrande del Cassibile	1984
Riserva naturale Colle di Licco	1971
Riserva naturale Collemeluccio	1971
Riserva naturale Complesso morenico di Castellaro Lagusello	1984
Riserva naturale Contrafforte Pliocenico	2006
Riserva naturale controllata Borsacchio	2005
Riserva naturale controllata Castel Cerreto	1991
Riserva naturale controllata Grotta delle Farfalle	2007
Riserva naturale controllata Grotte di Luppa	2005
Riserva naturale controllata Lago di Penne	1987
Riserva naturale controllata Lago di Serranella	1990
Riserva naturale controllata Lago San Domenico	2005
Riserva naturale controllata Marina di Vasto	2007
'Riserva naturale controllata Punta dell''Acquabella'	2007
Riserva naturale controllata Ripari di Giobbe	2007
Riserva naturale Cornate e Fosini	1996
Riserva naturale Cornocchia	1980
Riserva naturale Coste Castello	1972
Riserva naturale Cote de Gargantua	1993

Riserva naturale Coturelle Piccione	1977
Riserva naturale Cratere degli Astroni	1987
'Riserva naturale Crete dell''Orcia'	2008
Riserva naturale Cropani - Micone	1977
Riserva naturale Cucco	1975
'Riserva naturale dei Laghi di Doberdo'' e Pietrarossa'	1996
Riserva naturale del Alta Valle del Tevere (Monte Nero)	1998
Riserva naturale del Bosco di Montalto	1998
'Riserva naturale del Bosco di Sant'' Agnese'	1996
Riserva naturale del Lago di Campotosto	1984
Riserva naturale del lago di Canterno	1997
Riserva naturale del Lago di Cornino	1996
Riserva naturale del Laurentino Acqua Acetosa	1997
Riserva naturale del Monte Lanaro	1996
Riserva naturale del Monte Orsario	1996
Riserva naturale del Monte Soratte	1997
Riserva naturale del Monti Rognosi	1998
Riserva naturale del Sasso di Simone	1995
'Riserva naturale dell'' Alpe della Luna'	1998
'Riserva naturale della Foce dell'' Isonzo'	1996
Riserva naturale della Macchia di Gattaceca e Macchia del Barco	1997
Riserva naturale della Marcigliana	1997
Riserva naturale della Palude di Casalbeltrame	1984
Riserva naturale della Sentina	2004
Riserva naturale della Tenuta dei Massimi	1997
Riserva naturale della Tenuta di Acquafredda	1997
Riserva naturale della Valle Canal Novo	1996
Riserva naturale della Valle Cavanata	1996
Riserva naturale della Valle dei Casali	1997
'Riserva naturale della Valle dell'' Inferno e Bandella'	1995
Riserva naturale della Valle Rosandra	1996
'Riserva naturale dell''Abbadia di Fiastra'	1985
Riserva naturale delle Falesie di Duino	1996
Riserva naturale delle Montagne della Duchessa	1990
'Riserva naturale dell''Insugherata'	1997
Riserva naturale Destra foce Fiume Reno	1980
Riserva naturale di Castelvecchio	1996
Riserva naturale di Decima Malafede	1997
Riserva naturale di interesse provinciale Pineta Dannunziana	2000
Riserva naturale di Lucciolabella	1996
Riserva naturale di Macchiatonda	1983
Riserva naturale di Monte Catillo	1997
Riserva naturale di Monte Mario	1997
Riserva naturale di Monterufoli - Caselli	1995
Riserva naturale di Nazzano, Tevere - Farfa	1979
Riserva naturale di Nomentum	1997
Riserva naturale di Ponte a Buriano e Penna	1995
Riserva naturale di Tuscania	1997
Riserva naturale Diaccia Botrona	1991
Riserva naturale Duna costiera di Porto Corsini	1983
Riserva naturale Duna costiera ravennate e foce torrente Bevano	1979
Riserva naturale Duna Feniglia	1971
Riserva naturale Dune e isole della Sacca di Gorino	1982
Riserva naturale Falascone	1971
Riserva naturale Fara San Martino Palombaro	1983
Riserva naturale Farma	1996
Riserva naturale Feudo Intramonti	1972
Riserva naturale Feudo Ugni	1981
Riserva naturale Fiume Ciane e Saline di Siracusa	1984
Riserva naturale Fiume Fiumefreddo	1984
Riserva naturale Foce del Crati	1990
Riserva naturale Foce del Fiume Belice e dune limitrofe	1984
Riserva naturale Foce del Fiume Platani	1984
Riserva naturale Foce Fiume Reno	1981
Riserva naturale Foce Sele - Tanagro	1993
Riserva naturale Foce Volturno - Costa di Licola	1993
Riserva naturale Foci dello Stella	1996
Riserva naturale Fontana del Guercio	1984
Riserva naturale Fontanile Brancaleone	1985
Riserva naturale Fontanile Nuovo	1984
Riserva naturale Foresta demaniale del Circeo	1977
Riserva naturale Foresta di Berignone	1995
Riserva naturale Foresta Umbra	1977
Riserva naturale Formole	1980
Riserva naturale Forra del Cellina	1998
Riserva naturale Fungaia	1977
Riserva naturale Gallopane	1977
Riserva naturale Gariglione - Pisarello	1977
Riserva naturale Garzaia del Bosco Basso	1986
Riserva naturale Garzaia della Carola	1989
Riserva naturale Garzaia della Cascina Isola	1988
Riserva naturale Garzaia della Roggia Torbida	1986
Riserva naturale Garzaia di Pomponesco	1988
Riserva naturale Garzaia di Porta Chiossa	1984
Riserva naturale Garzaia di Villa Biscossi	1984
Riserva naturale geologica del Piacenzano	1995
Riserva naturale Gole del Raganello	1987
Riserva naturale Golia Corvo	1977
Riserva naturale Grotticelle	1971
Riserva naturale Guadine Pradaccio	1971
Riserva naturale guidata Abetina di Rosello	1997
Riserva naturale guidata Bosco di Don Venanzio	1999
Riserva naturale guidata Calanchi di Atri	1995
Riserva naturale guidata Cascate del Verde	2001
Riserva naturale guidata del Fiume Vera	1983
Riserva naturale guidata della Scanuppia	1992
Riserva naturale guidata delle Sorgenti del Fiume Pescara	1986
Riserva naturale guidata di Campobrun	1971
Riserva naturale guidata Gole del Sagittario	1997
Riserva naturale guidata Gole di S. Venanzio	1998
Riserva naturale guidata Lecceta di Torino di Sangro	2001

Riserva naturale guidata Monte Genzana e Alto Gizio	1996
Riserva naturale guidata Monte Salviano	1999
Riserva naturale guidata Punta Aderci	1998
Riserva naturale guidata Zompo lo Schioppo	1987
Riserva naturale I Giganti della Sila	1987
Riserva naturale I Pisconi	1972
Riserva naturale Il Bogatto	2008
Riserva naturale Il Monte	1982
Riserva naturale in parte integrale e in parte orientata Valsolda	2007
Riserva naturale Incisioni rupestri di Ceto, Cimbergo e Paspardo	1988
Riserva naturale integrale Lago Preola e Gorghi Tondi	1998
Riserva naturale integrale Bosco Nordio	1971
Riserva naturale integrale Complesso Immacolatella e Micio Conti	1998
Riserva naturale integrale Complesso speleologico Villasmundo-S.Alfio	1998
Riserva naturale integrale della Madonna della Neve sul Monte Lera	1982
Riserva naturale integrale delle Tre Cime di Monte Bondone	1968
Riserva naturale integrale Gardesana Orientale	1971
Riserva naturale integrale Grotta Conza	1995
Riserva naturale integrale Grotta di Carburangeli	1995
Riserva naturale integrale Grotta di Entella	1995
Riserva naturale integrale Grotta di S.Angelo Muxaro	2000
Riserva naturale integrale Grotta di Santa Ninfa	1995
Riserva naturale integrale Grotta Monello	1998
Riserva naturale integrale Grotta Palombara	1998
Riserva naturale integrale Isola di Lachea e Faraglioni dei Ciclopi	1998
Riserva naturale integrale Lago Sfondato	1997
Riserva naturale integrale Lastoni Selva Pezzi	1971
Riserva naturale integrale Macalube di Aragona	1995
Riserva naturale integrale Monte Conca	1995
Riserva naturale integrale Piaie Longhe - Millifret	1971
Riserva naturale integrale Saline di Trapani e Paceco	1995
Riserva naturale integrale Vallone Calagna sopra Tortorici	2000
Riserva naturale Iona Serra della Guardia	1977
Riserva naturale Ischitella e Carpino	1977
Riserva naturale Isola Boschina	1985
Riserva naturale Isola Boscone	1987
Riserva naturale Isola di Montecristo	1971
Riserva naturale Isola Uccellanda	1989
Riserva naturale Isola Varano	1977
Riserva naturale La Pietra	1996
Riserva naturale Lago di Biandronno	1984
Riserva naturale Lago di Burano	1980
Riserva naturale Lago di Ganna	1984
Riserva naturale Lago di Lesina (parte orientale)	1981
Riserva naturale Lago di Montepulciano	1996
Riserva naturale Lago di Montorfano	1984
Riserva naturale Lago di Piano	1984
Riserva naturale Lago di Posta Fibreno	1983
Riserva naturale Lago di Sartirana	1984
Riserva naturale Lago di Vico	1982
Riserva naturale Lago di Villa	1992
Riserva naturale Lago Falciano	1993
Riserva naturale Lago Soprano	2000
Riserva naturale Laguna di Orbetello	1998
Riserva naturale Laguna di Orbetello di Ponente	1980
'Riserva naturale Lama Bianca di Sant'' Eufemia a Maiella'	1987
Riserva naturale Lamarossa	1977
Riserva naturale Lanca di Gabbioneta	1989
Riserva naturale Lanche di Azzanello	1989
Riserva naturale Le Bine	1987
Riserva naturale Le Cesine	1980
Riserva naturale Le Montagne delle Felci e dei Porri	1984
Riserva naturale Les Iles	1993
Riserva naturale Lestra della Coscia	1971
Riserva naturale Litorale romano	1987
Riserva naturale Lolair	1993
Riserva naturale Lozon	1993
Riserva naturale Macchia della Giumenta - S. Salvatore	1977
Riserva naturale Macchia Foresta del Fiume Irminio	1985
Riserva naturale Marais	1992
Riserva naturale Marchesale	1977
Riserva naturale marina di Miramare nel Golfo di Trieste	1986
Riserva naturale marina Isole Egadi	1991
Riserva naturale marina Isole Tremiti	1989
Riserva naturale marina Torre Guaceto	1991
Riserva naturale Marinella Stornara	1977
Riserva naturale Marmitte dei Giganti	1984
Riserva naturale Marsiliana	1980
Riserva naturale Masseria Combattenti	1980
Riserva naturale Metaponto	1972
Riserva naturale Mont Mars	1993
Riserva naturale Montagna di Torricchio	1977
Riserva naturale Montauto	1996
Riserva naturale Monte Alpe	1985
Riserva naturale Monte Barone	1977
Riserva naturale Monte Croccia	1971
Riserva naturale Monte Faverghera	1971
Riserva naturale Monte Labbro	1998
Riserva naturale Monte Mottac	1971
Riserva naturale Monte Navegna e Monte Cervia	1988
Riserva naturale Monte Pavione	1975
Riserva naturale Monte Penna	1996
Riserva naturale Monte Rotondo	1982
Riserva naturale Monte Rufeno	1983
Riserva naturale Monte Velino	1987
Riserva naturale Montecellesi	1980
Riserva naturale Montedimezzo	1971
Riserva naturale Montefalcone	1977

Riserva naturale Monti del Sole	1975
Riserva naturale Monti Eremita - Marzano	1993
Riserva naturale Monticchie	1988
Riserva naturale Murge Orientali	1972
Riserva naturale Naviglio di Melotta	1984
Riserva naturale Oasi del Simeto	1984
Riserva naturale Oasi Faunistica di Vendicari	1984
Riserva naturale Oasi WWF di Valpredina	1985
Riserva naturale Orecchiella	1980
Riserva naturale orientata Bosco della Ficuzza, Rocca Busambra, Bosco del Cappelliere e Gorgo d	2000
Riserva naturale orientata Bosco di Malabotta	1997
Riserva naturale orientata Isola di Alicudi	1997
Riserva naturale orientata Isola di Lampedusa	1995
Riserva naturale orientata Isola di Pantelleria	1998
Riserva naturale orientata Isola di Ustica	1986
Riserva naturale orientata La Timpa	1999
Riserva naturale orientata Monte Altesina	1997
Riserva naturale orientata Monte S. Calogero (Kronio)	2000
'Riserva naturale orientata Bagni di Cefala'' Diania e Chiarastella'	1997
Riserva naturale orientata Biviere di Gela	1997
Riserva naturale orientata Bosco dei Bordighi	1994
Riserva naturale orientata Bosco della Frattona	1984
Riserva naturale orientata Bosco di Favara e Bosco Granza	1997
Riserva naturale orientata Bosco di Santo Pietro	1999
Riserva naturale orientata Bosco di Scardavilla	1991
Riserva naturale orientata Bosco Pantano di Policoro	1999
Riserva naturale orientata Bosco Ronchetti	2002
Riserva naturale orientata Bosco Solivo	2006
Riserva naturale orientata Capo Gallo	2001
Riserva naturale orientata Capo Rama	2000
Riserva naturale orientata Cassa di espansione del Fiume Secchia	1996
Riserva naturale orientata della Vauda	1993
Riserva naturale orientata delle Baragge	1992
Riserva naturale orientata dello Zingaro	1981
Riserva naturale orientata di Monte Prinzera	1991
Riserva naturale orientata di Onferno	1991
Riserva naturale orientata di Sassoguidano	1995
Riserva naturale orientata Dune fossili di Massenzatica	1996
Riserva naturale orientata Fiumedinisi e Monte Scuderi	1998
Riserva naturale orientata Fontanili di Corte Valle Re	1992
Riserva naturale orientata geologica di Contrada Scaleri	1997
Riserva naturale orientata Isola Bella	1998
Riserva naturale orientata Isola delle Femmine	1997
Riserva naturale orientata Isola di Vulcano	2000
Riserva naturale orientata Laghetti di Marinello	1998
Riserva naturale orientata Laguna di Capo Peloro	2001
Riserva naturale orientata Lanca di Gerole	2001
Riserva naturale orientata Monte Cammarata	2000
'Riserva naturale orientata Monte Capodarso e Valle dell''Imera Meridionale'	1999
Riserva naturale orientata Monte Carcaci	1997
Riserva naturale orientata Monte Cofano	1997
Riserva naturale orientata Monte Genuardo e Santa Maria del Bosco	1997
Riserva naturale orientata Monte Pellegrino	1995
Riserva naturale orientata Monte S.Calogero	1998
Riserva naturale orientata Monti di Palazzo Adriano e Valle del Sosio	1997
'Riserva naturale orientata Pantalica, Valle dell''Anapo e Torrente Cava Grande'	1997
Riserva naturale orientata Parma Morta	1990
Riserva naturale orientata Pian di Landro Baldassare	1971
Riserva naturale orientata Pizzo Cane, Pizzo Trigna e Grotta Mazzamuto	2000
Riserva naturale orientata Rossomanno-Grottascura-Bellia	2000
Riserva naturale orientata Rupe di Campotrera	1999
Riserva naturale orientata Saline di Priolo	2000
Riserva naturale orientata Sambuchetti-Campanito	2000
Riserva naturale orientata Serre della Pizzuta	1998
Riserva naturale orientata Serre di Ciminna	1997
Riserva naturale orientata Sughereta di Niscemi	1997
Riserva naturale orientata Torre Salsa	2000
Riserva naturale orientata Vallone di Piano della Corte	2000
Riserva naturale orientata/integrale Isola di Filicudi e scogli Canna e Montenassari	1997
Riserva naturale orientata/integrale Isola di Panarea e scogli viciniori	1997
Riserva naturale orientata/Integrale Isola di Linosa e Lampione	1997
Riserva naturale orientata/integrale Isola di Stromboli e Strombolicchio	1997
Riserva naturale Orrido di Botri	1971
Riserva naturale Padule di Fucecchio (FI)	1998
Riserva naturale Padule di Fucecchio (PT)	1996
Riserva naturale Padule Orti-Bottagone	1998
Riserva naturale Palata Menasciutto	1988
Riserva naturale Palazzo	1980
Riserva naturale Paluaccio di Oga	1984
Riserva naturale Palude Brabbia	1984
Riserva naturale Palude di Frattarolo	1980
Riserva naturale Palude di Ostiglia	1984
Riserva naturale Palude Loja	1987
Riserva naturale Pania di Corfino	1971
'Riserva naturale Pantani dell'' Inferno'	1979
Riserva naturale Pantaniello	1972
Riserva naturale parziale Selva del Lamone	1994
Riserva naturale Pesche	1982
Riserva naturale Pescinello	1998
Riserva naturale Pian di Spagna - Lago di Mezzola	1985
Riserva naturale Pian Gembro	1988
Riserva naturale Piana Grande della Majelletta	1982
Riserva naturale Piani Eterni - Errera - Val Falcina	1975
Riserva naturale Piano degli Ontani	1977
Riserva naturale Piazza del Diavolo	1971

Riserva naturale Pietraporciana	1996
Riserva naturale Pigelleto	1996
Riserva naturale Pineta di Ravenna	1977
Riserva naturale Pineta di Santa Filomena	1977
'Riserva naturale Pino d'' Aleppo'	1990
Riserva naturale Piramidi di Postalesio	1984
Riserva naturale Piramidi di Zone	1984
Riserva naturale Piscina della Gattuccia	1971
Riserva naturale Piscina delle Bagnature	1975
Riserva naturale Po di Volano	1977
Riserva naturale Poggio Adorno	1980
'Riserva naturale Poggio all''Olmo'	1998
Riserva naturale Poggio Rosso	1977
Riserva naturale Poggio Tre Cancelli	1971
Riserva naturale Poverella Villaggio Mancuso	1977
'Riserva naturale provinciale Bosco della SS. Trinita''	2001
Riserva naturale provinciale Lago di Santa Luce	2000
Riserva naturale provinciale Lago di Sibolla	1996
Riserva naturale provinciale Monte Casoli di Bomarzo	1999
Riserva naturale provinciale Monte Serra di Sotto	2005
Riserva naturale provinciale Oasi della Contessa	2004
Riserva naturale provinciale Villa Borghese	1999
Riserva naturale Quarto Santa Chiara	1982
'Riserva naturale regionale dell'' Isola di Gallinara'	1989
Riserva naturale regionale delle Isole dello Stagnone di Marsala	1984
Riserva naturale regionale delle Salse di Nirano	1982
Riserva naturale regionale di Bergeggi	1985
Riserva naturale regionale di Rio Torsero	1985
Riserva naturale regionale Grotta dei Puntali	2001
Riserva naturale regionale orientata Boschi di Santa Teresa e dei Lucci	2002
'Riserva naturale regionale orientata Bosco delle Pianelle (gia'' Parco Comunale)'	1994
Riserva naturale regionale orientata Bosco di Cerano	2002
Riserva naturale regionale orientata del Litorale Tarantino Orientale	2002
Riserva naturale regionale orientata di Ripa Bianca	2003
Riserva naturale regionale orientata Laghi di Conversano e Gravina del Monsignore	2006
Riserva naturale regionale orientata Palude del Conte e Duna Costiera - Porto Cesareo	2006
Riserva naturale regionale orientata Palude La Vela	2006
Riserva naturale regionale Tor Caldara	1988
'Riserva naturale regionale Valle dell''Arcionello'	2008
Riserva naturale Rio Bianco	1975
'Riserva naturale Ripa d''Orcia'	2008
Riserva naturale Riva orientale del Lago di Alserio	1984
Riserva naturale Rocconi	1998
Riserva naturale Rovine di Circe	1971
Riserva naturale Rubbio	1972
Riserva naturale Sacca di Bellocchio	1972
Riserva naturale Sacca di Bellocchio II	1979
Riserva naturale Sacca di Bellocchio III	1981
Riserva naturale Salina di Cervia	1979
Riserva naturale Salina di Margherita di Savoia	1977
Riserva naturale Salina di Tarquinia	1980
Riserva naturale San Cataldo	1977
Riserva naturale Sasso Fratino	1971
Riserva naturale Sasso Malascarpa	1985
Riserva naturale Scarlino	1977
Riserva naturale Schiara occidentale	1975
Riserva naturale Scodella	1977
'Riserva naturale Serra Nicolino Piano d'' Albero'	1977
Riserva naturale Sfilzi	1971
Riserva naturale Somadida	1972
'Riserva naturale Sorgente Funtani''	1985
Riserva naturale Sorgenti della Muzzetta	1984
Riserva naturale speciale dei Canneti di Dormelletto	1993
Riserva naturale speciale dei Ciciu del Villar	1989
Riserva naturale speciale dei Monti Pelati e Torre Cives	1993
Riserva naturale speciale del Bosco del Vaj	1978
Riserva naturale speciale del Colle della Torre di Buccione	1993
Riserva naturale speciale del Monte Mesma	1993
Riserva naturale speciale del Parco Burcina - Felice Piacenza	1980
Riserva naturale speciale del popolamento di Juniperus Phoenicea di Rocca San Giovanni - Saben	1984
Riserva naturale speciale del Sacro Monte Calvario di Domodossola	1991
'Riserva naturale speciale del Sacro Monte della SS. Trinita'' di Ghiffa'	1987
Riserva naturale speciale del Sacro Monte di Belmonte	1991
Riserva naturale speciale del Sacro Monte di Oropa	2005
Riserva naturale speciale del Sacro Monte di Orta	1980
Riserva naturale speciale del Sacro Monte di Varallo	1980
Riserva naturale speciale del Torrente Orba	1987
'Riserva naturale speciale dell'' Isolone di Oldenico'	1978
'Riserva naturale speciale dell'' Oasi di Crava Morozzo'	1987
'Riserva naturale speciale dell'' Orrido e Stazione di Leccio di Chianocco'	1980
Riserva naturale speciale della Bessa	1985
Riserva naturale speciale della Garzaia di Carisio	1990
Riserva naturale speciale della Garzaia di Villarboit	1978
Riserva naturale speciale della Val Sarmassa	1993
Riserva naturale speciale della Valleandona, della Val Botto e della Valle Grande	1985
'Riserva naturale speciale dell''area di Augusta Bagiennorum'	1993
Riserva naturale speciale delle Grotte di Pietrasecca	1992
Riserva naturale speciale delle Sorgenti del Belbo	1993
Riserva naturale speciale dello Stagno di Oulx	2004
Riserva naturale speciale di Alfonsine	1990
Riserva naturale speciale di Fontana Gigante	2006
Riserva naturale speciale Fondo Toce	1990
Riserva naturale speciale Lago di Pergusa	1995
Riserva naturale speciale Palude di San Genuario	2006
Riserva naturale speciale Rocca di Cavour	1980
Riserva naturale Stagno di Holay	1993

Riserva naturale statale Gola del Furlo	2001
Riserva naturale statale Isola di Vivara	2002
Riserva naturale statale Isole di Ventotene e Santo Stefano	1999
Riserva naturale statale Tenuta di Castelporziano	1979
Riserva naturale statale Torre Guaceto	2000
Riserva Naturale Statale Tresero - Dosso del Vallon	2010
Riserva naturale Stornara	1977
Riserva naturale Tarsia	1990
Riserva naturale Tasso Camigliatello Silano	1977
Riserva naturale Tirone Alto Vesuvio	1972
Riserva naturale Tocchi	1977
Riserva naturale Tomboli di Follonica	1977
Riserva naturale Tombolo di Cecina	1977
'Riserva naturale Torbiere del Sebino d'' Iseo'	1984
Riserva naturale Torbiere di Marcaria	1989
Riserva naturale Torrente Callora	2003
Riserva naturale Trenta Coste	1977
Riserva naturale Tzatelet	1993
Riserva naturale Val Grande	1971
Riserva naturale Val Tovanella	1971
Riserva naturale Vallazza	1991
Riserva naturale Valle Bova	2007
Riserva naturale Valle del Fiume Argentino	1987
Riserva naturale Valle del Fiume Lao	1987
Riserva naturale Valle del Freddo	1985
'Riserva naturale Valle dell'' Orfento'	1971
'Riserva naturale Valle dell'' Orfento II'	1972
'Riserva naturale Valle dell''Aniene'	1997
Riserva naturale Valle delle Ferriere	1972
Riserva naturale Valle di Bondo	1985
'Riserva naturale Valle di Sant'' Antonio'	1985
Riserva naturale Valle Imperina	1975
Riserva naturale Valle Scura	1975
Riserva naturale Valli del Mincio	1984
Riserva naturale Vallombrosa	1977
Riserva naturale Vette Feltrine	1975
Riserva naturale Vincheto di Cellarda	1971
Riserva naturale Zuccaia	1977