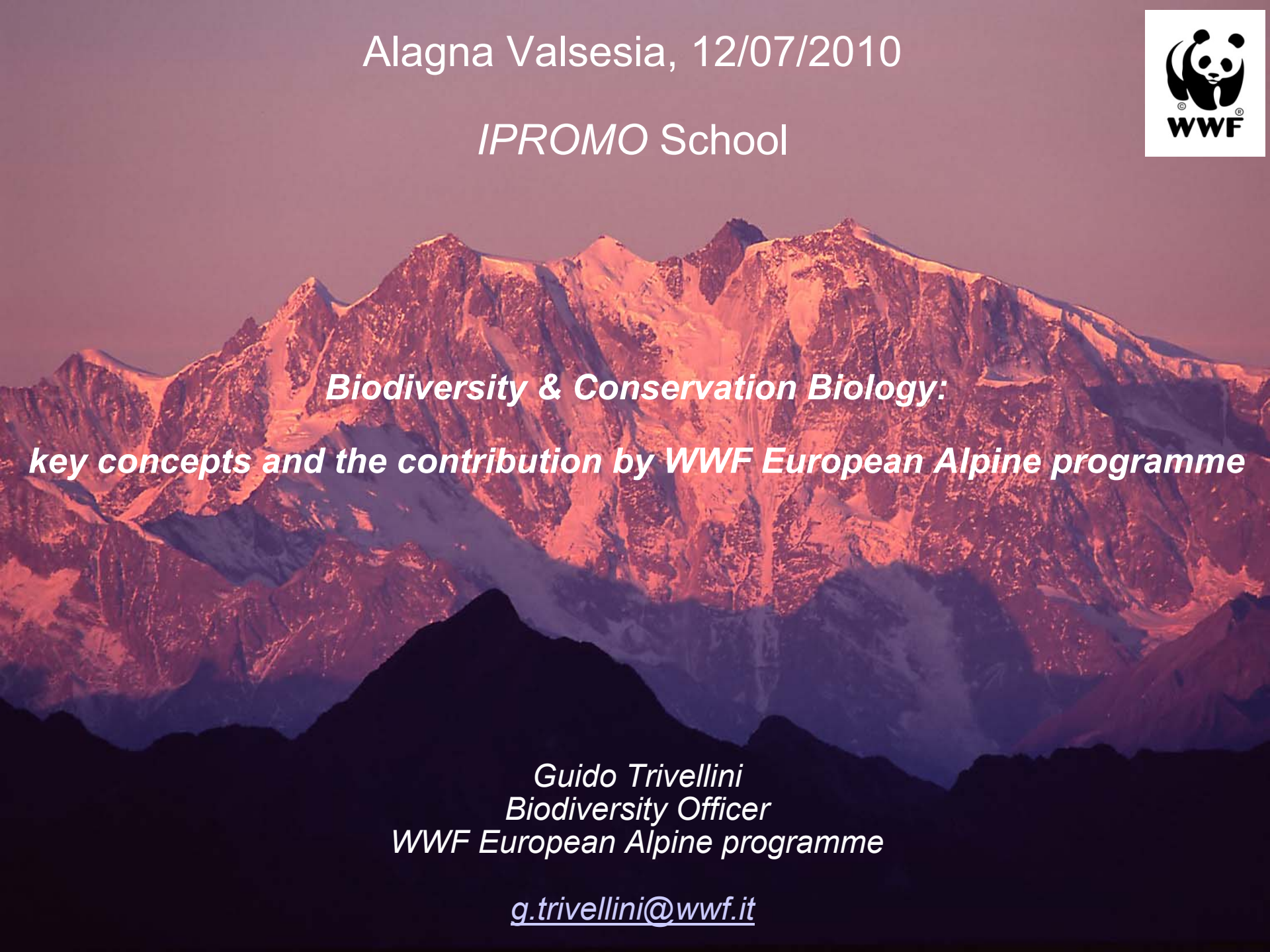

Alagna Valsesia, 12/07/2010

IPROMO School

Biodiversity & Conservation Biology:

key concepts and the contribution by WWF European Alpine programme

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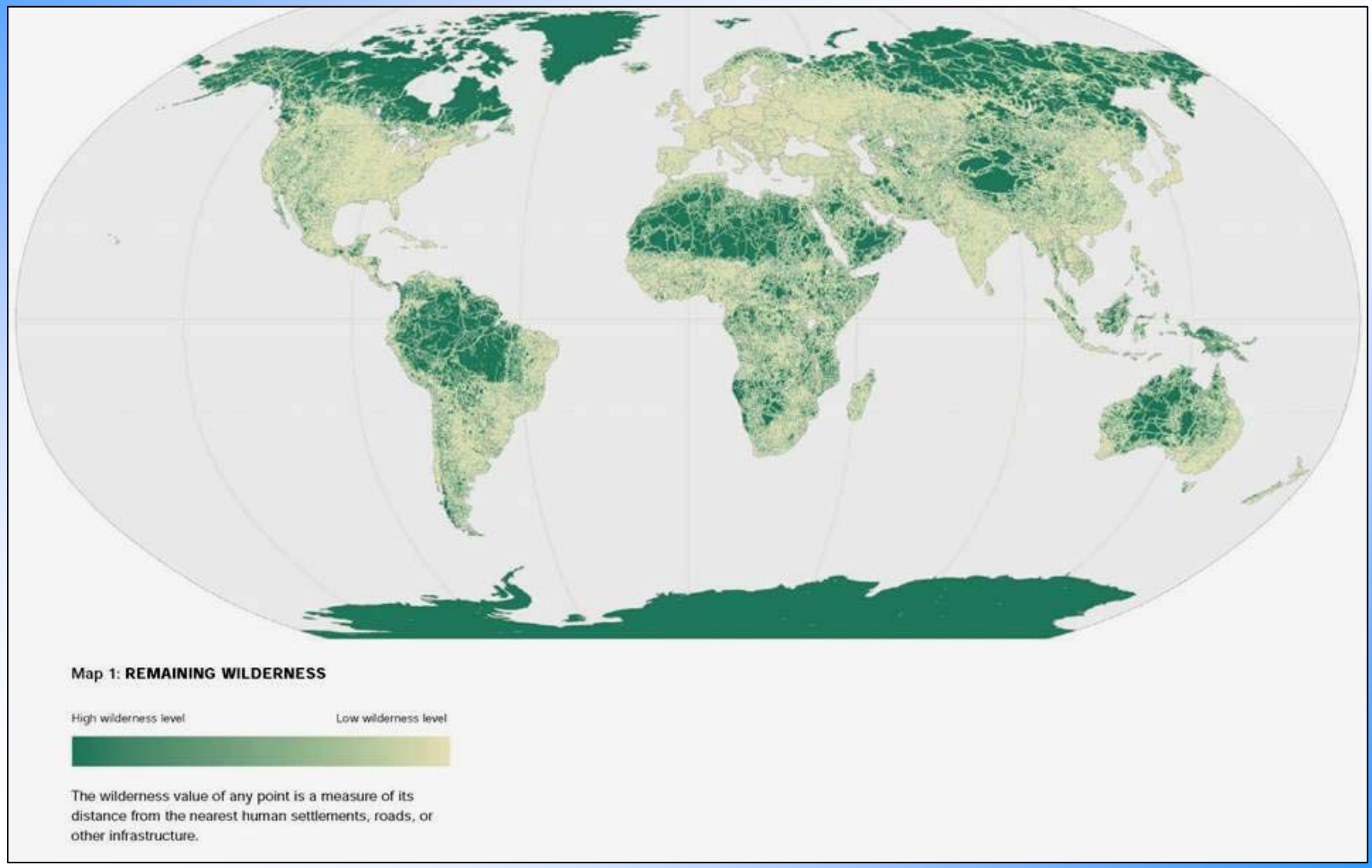
Alagna Valsesia, 12/07/2010

IPROMO School
(University of Torino and FAO Secretariat)

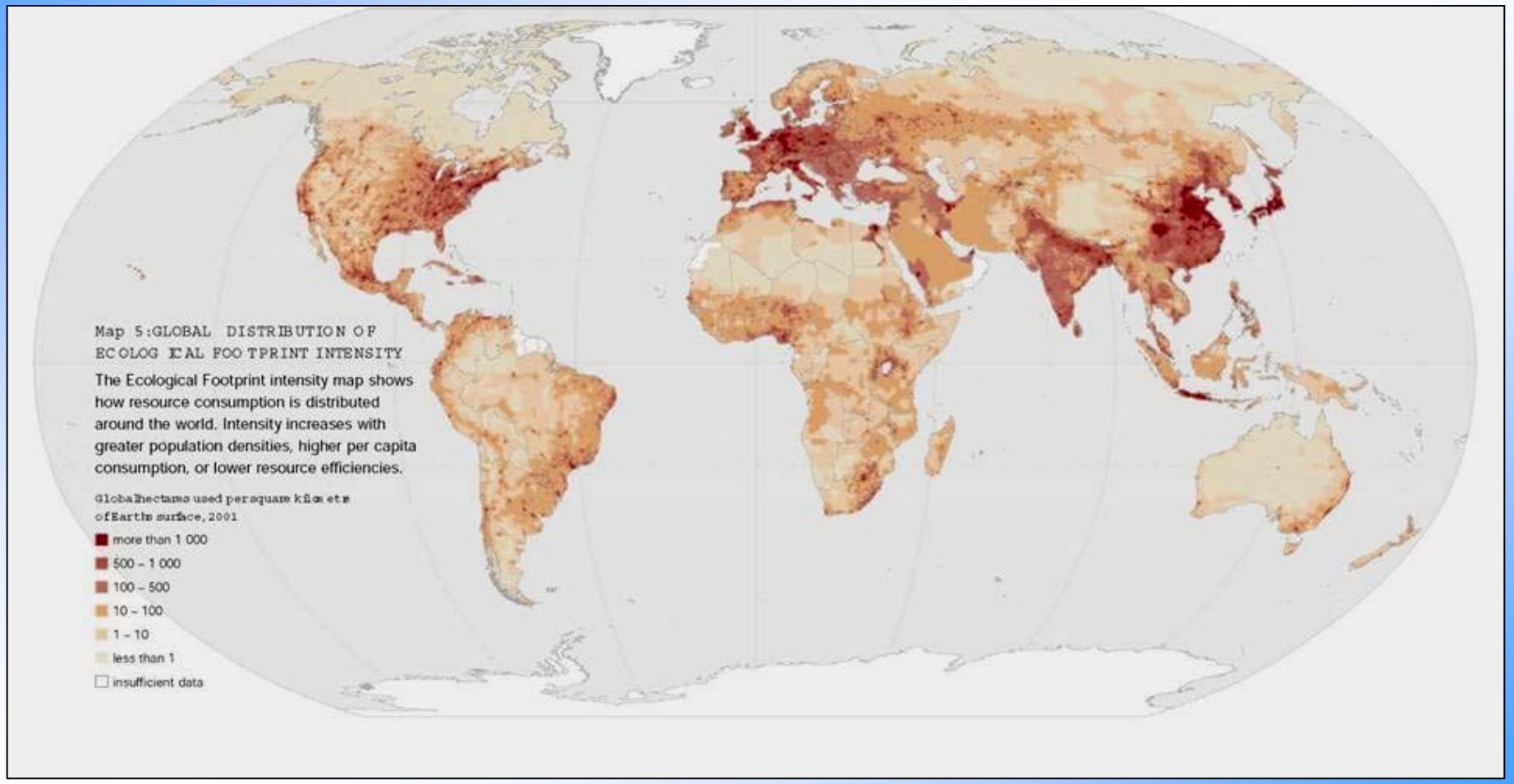
1. WWF: the World Wide Fund for Nature (international, Italy and EALP)
2. Key concepts on biodiversity, species, populations and Conservation Biology
3. Example of biodiversity monitoring project: methods and goals

4. Large scale biodiversity assessment
5. Drawing ecological corridors in the Alps
6. An ecological quantitative model for WWF EALP priority area “H1”
7. The expert-based approach in drawing hotspots and ecological networks
8. Conclusions and answer to questions

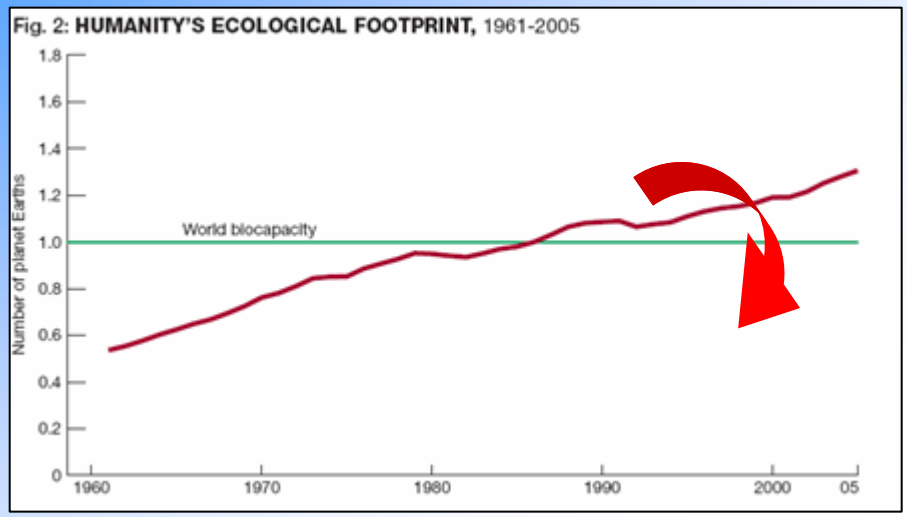
CONTEXT: natural areas subject to continuous reduction

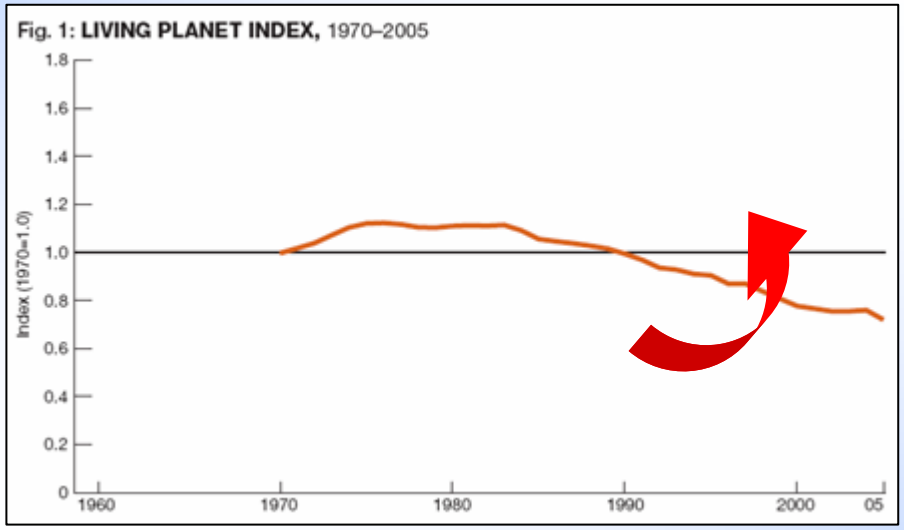


THE CONTEXT: human impact on Earth



THE "*LIVING PLANET REPORT*"





Declined in different forms of impact (marine, forest…)

Yearly realised with ZSL (London zoological society of London)

Indexes aimed to measure the extent of *world "consumption"*

↓

Sustainability before 2050?

The World Wide Fund for Nature

- il WWF is a large, widespread and **indipendent organisation** for the protection of nature and biodiversity

- **Started in 1961,** its supporters are now **5 millions** worldwide.

- It's a **global organisation**, working locally trough a network of **27 national offices** e di **24 international programmes**.

- WWF International is an indipendent foundation based in Gland (Switzerland), where are also based **IUCN** and other environmental organisations.

THE NETWORK INITIATIVES

AMAZON

ARTIC

INDONESIAN FORESTS

AND MUCH MORE …

WWF

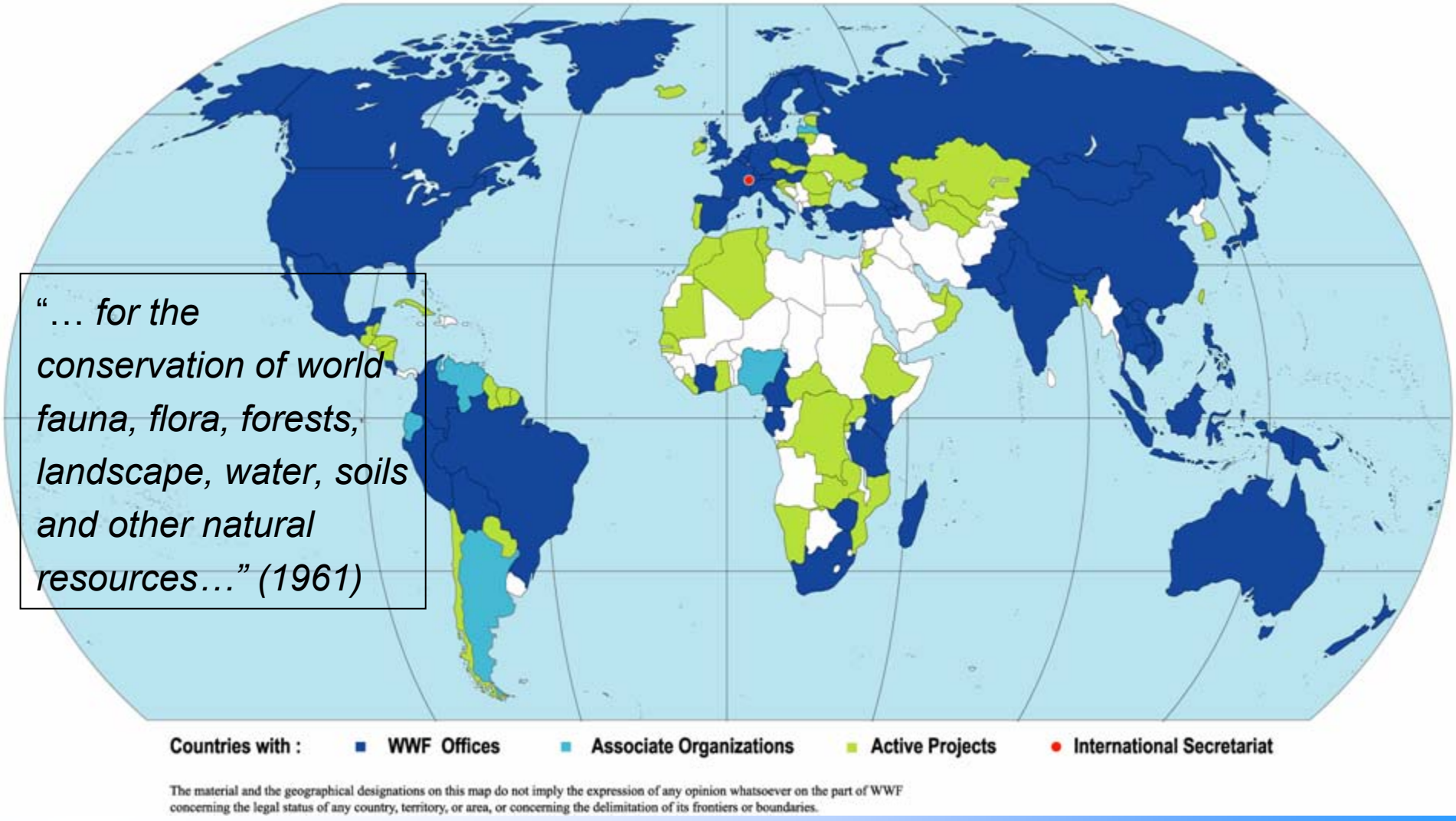
60
EARTH HOUR

Rome - Colosseum

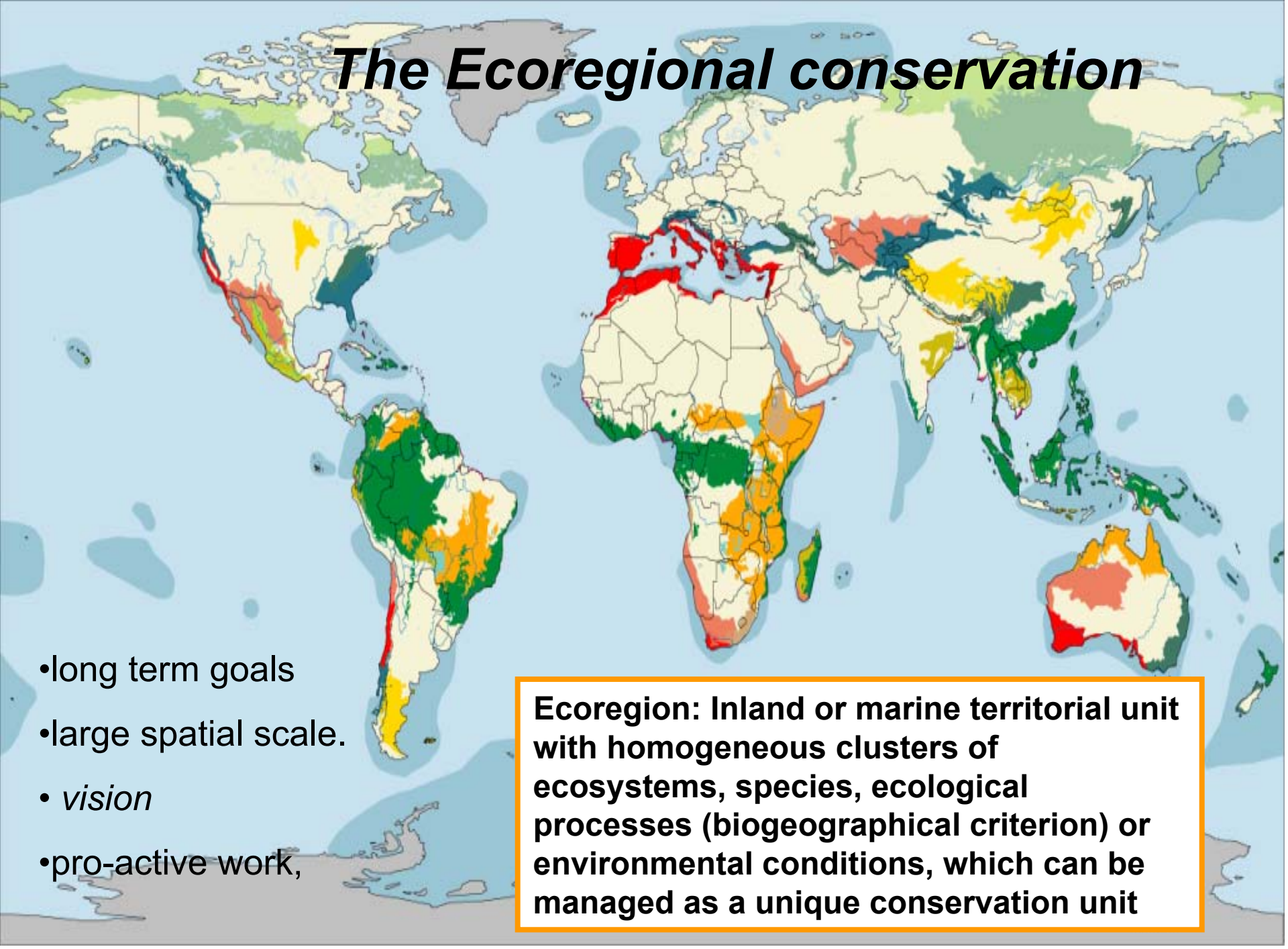
Sydney Harbour and Opera House

WWF IN THE WORLD

"… for the conservation of world fauna, flora, forests, landscape, water, soils and other natural resources…" (1961)



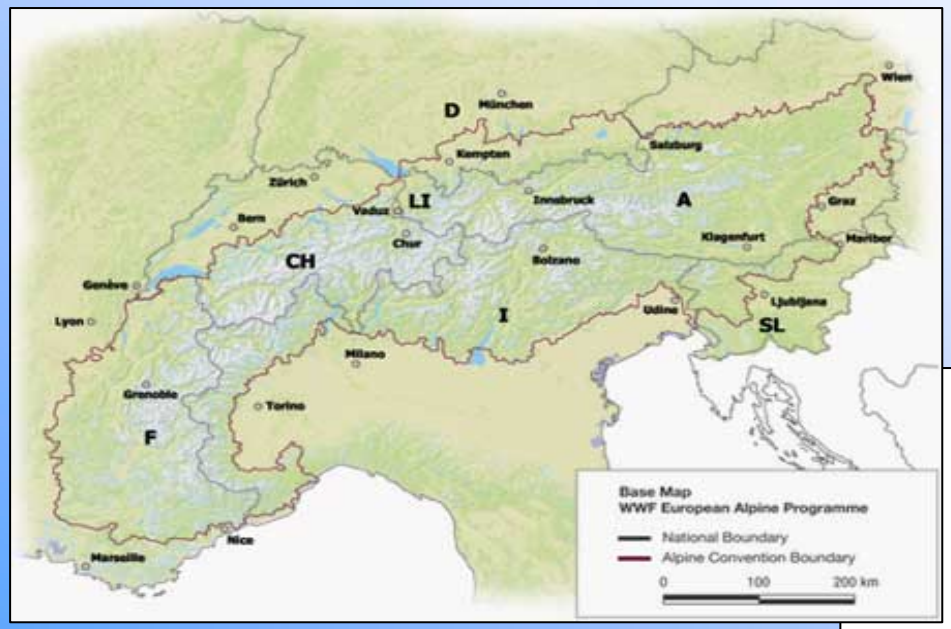
The Ecoregional conservation



- long term goals
- large spatial scale.
- *vision*
- pro-active work,

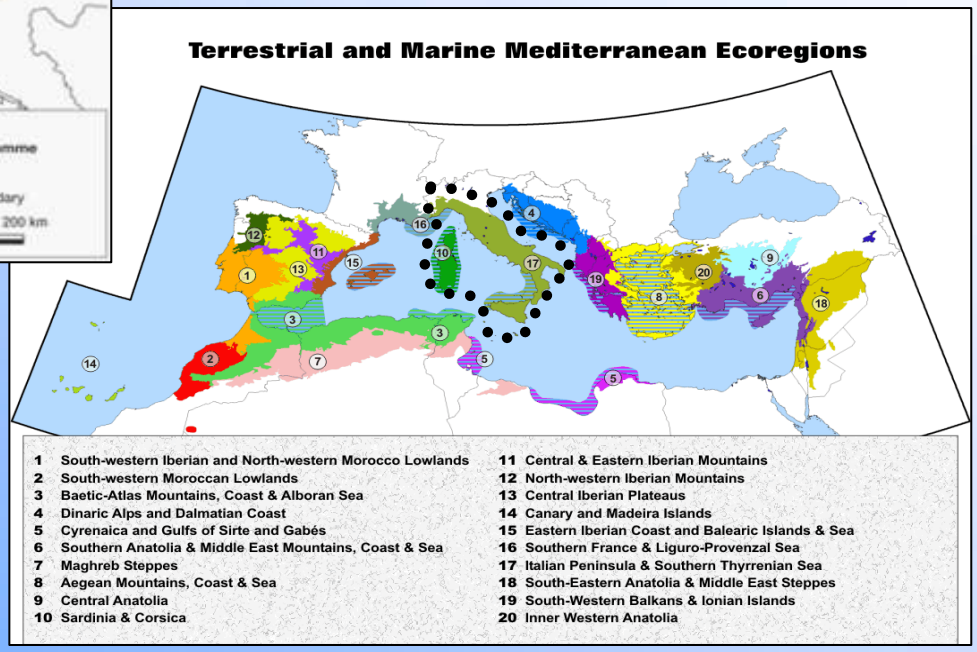
Ecoregion: Inland or marine territorial unit with homogeneous clusters of ecosystems, species, ecological processes (biogeographical criterion) or environmental conditions, which can be managed as a unique conservation unit

WWF Italy and the Ecoregional conservation



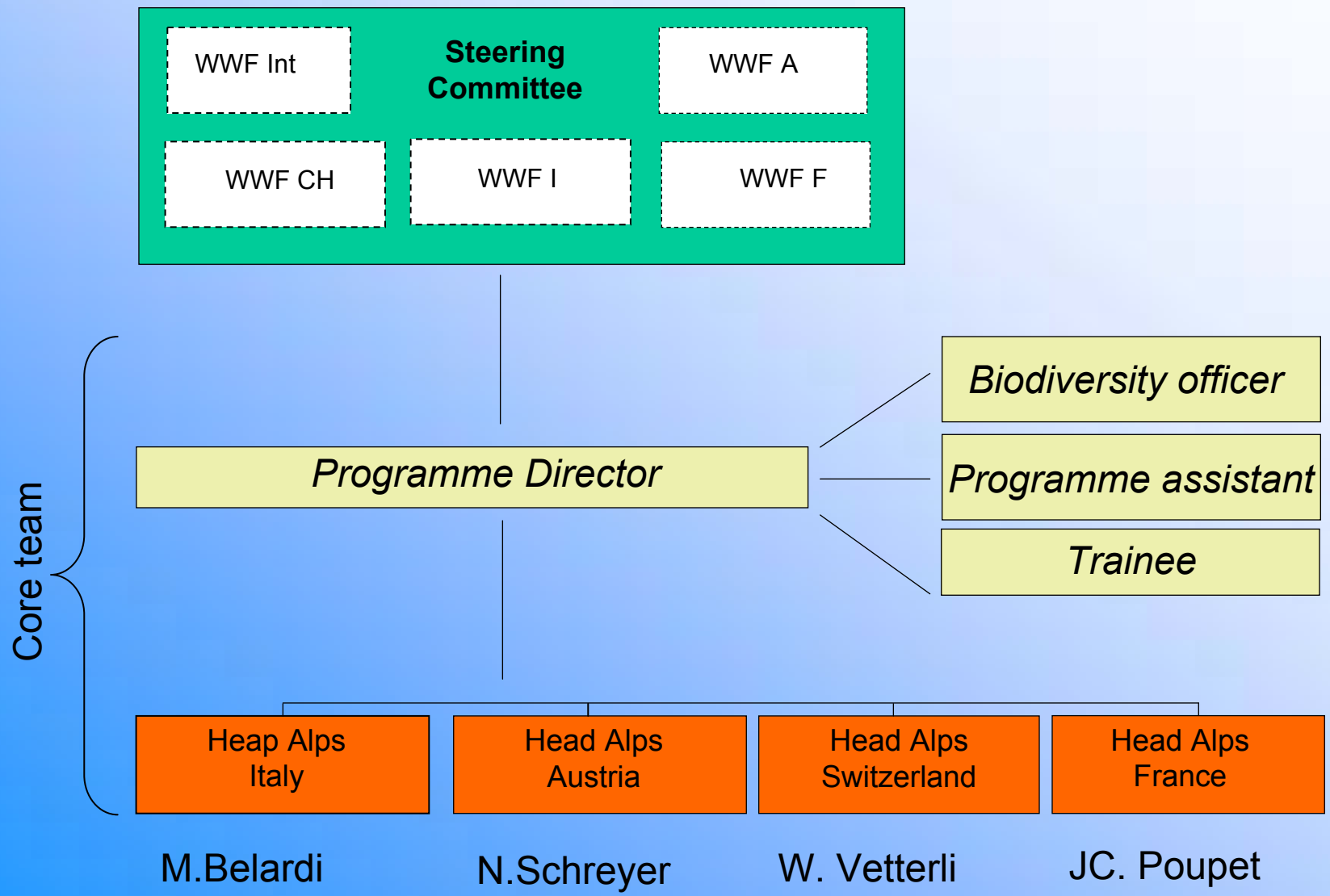
The Alps

European Alpine programme

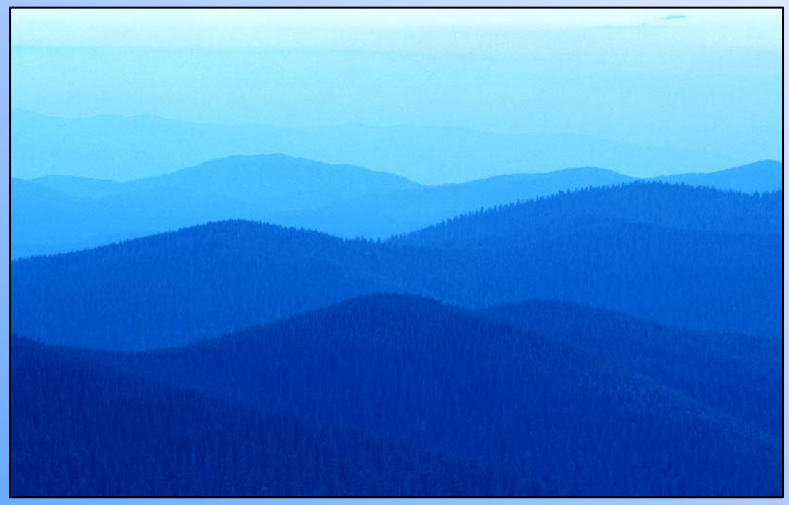


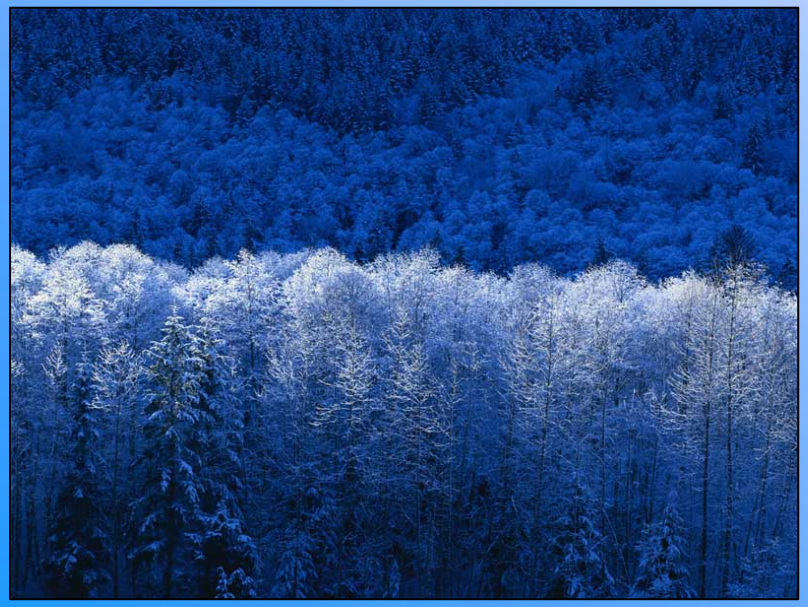
The Mediterranean Ecoregion *MED Po*

European Alpine Programme



The European Alpine Programme partners





ISCAR

International scientific committee for Alpine research

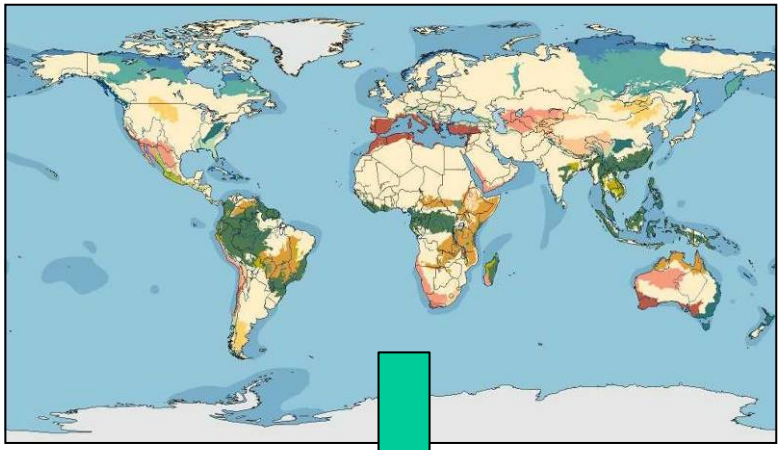
CIPRA

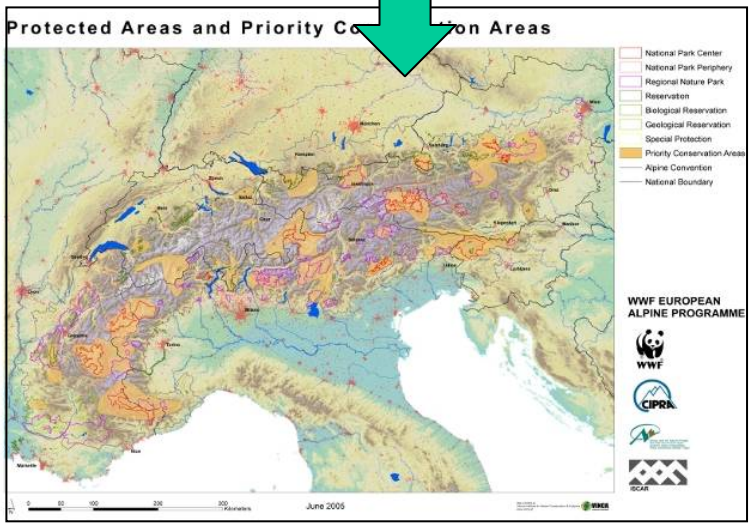
International Commission for the protection of the Alps

Network of Alpine protected areas

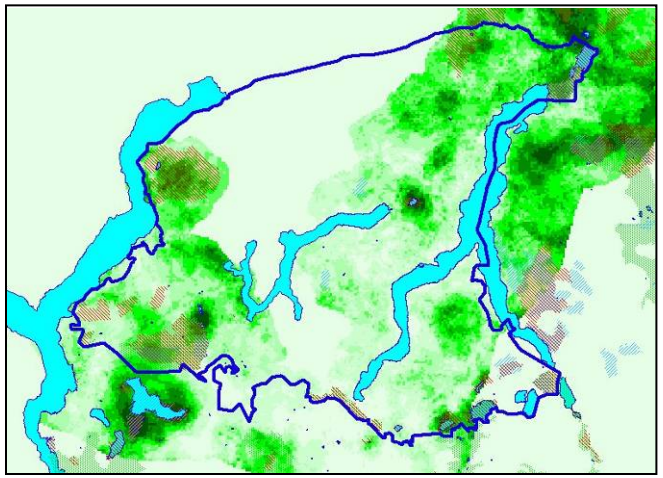
Réseau Alpin des Espaces Protégés
Rete delle Aree Protette Alpine
Netzwerk Alpiner Schutzgebiete
Mreža zavarovanih območij v Alpah

The ecoregional process:
24 priority conservation areas in the Alps

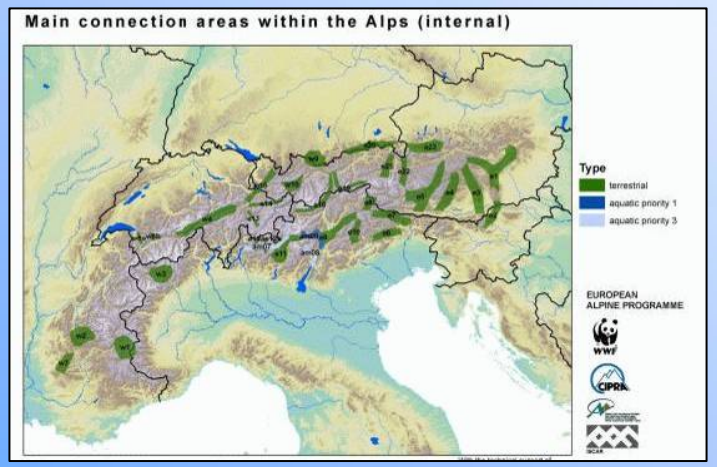


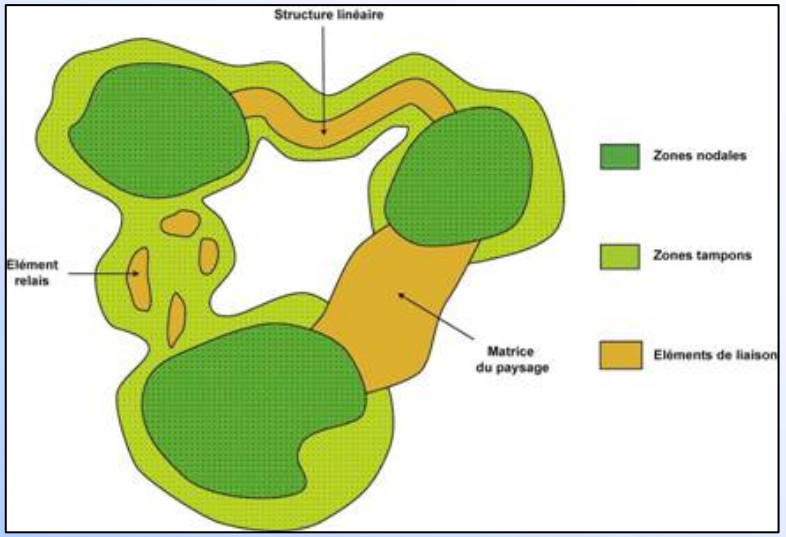


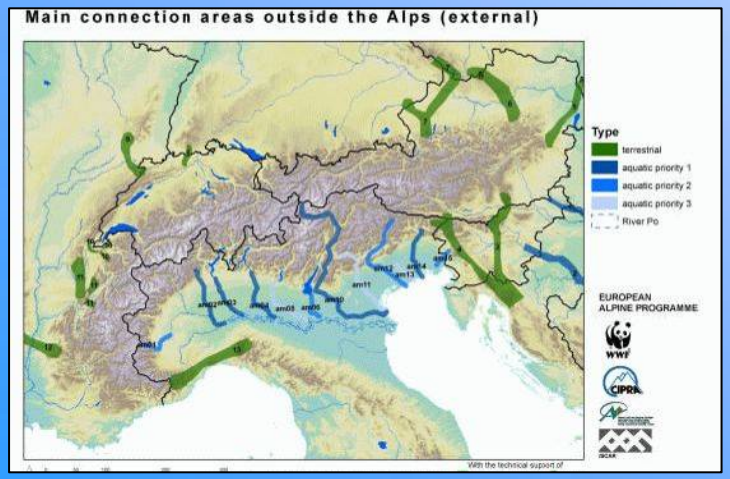
European Alpine Programme:
Priority area of the lake district
between Italy and Switzerland

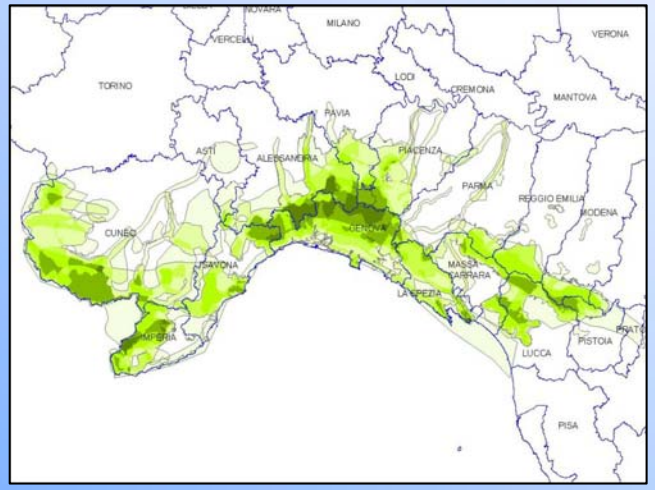


The ecoregional process: Developing ecological corridors in the Alps









The ecoregional process: Tourism in the Alps

tourism-related conservation activities (lobby)

Establishment of common policy in all Alpine NO's

Ranking/labelling of winter sports activities (lobby)

Special tourism projects (Ursina, Gîtes/Fattorie, Emerald trails, etc…)

The ecoregional process: freshwaters

Freshwater – definition of priority rivers, plus work on single projects

Tagliamento

- Opposition to hydraulic works threatening the river system
- Studies for alternative flood control measures
- Educational/lobbying video documentary

Ticino

- Revitalization in Switzerland
- Parco del Ticino management, improvement and conservation in Italy

La Romanche

- Demolition of dams with the help of Electricité de France
- Revitalization

Drava

- Sustainable flood control measures
- Revitalization

Rhône

- Large revitalization work

The ecoregional process: Large carnivores

Pan-Alpine contact group: a shared Alpine policy

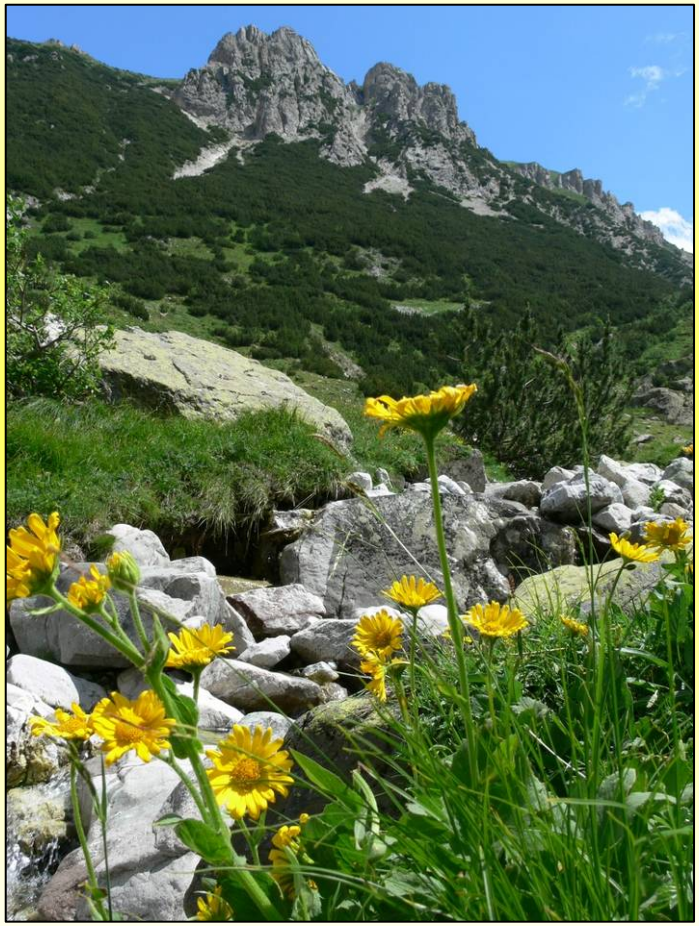
Specific projects:

Bear project (Ursina): community based conservation

Bear advocate (WWF Italy) + fences

Policy work (Alpine Convention, Convention of Bern, Slovenia…)

Wolf: a macrocorridor between the Alps and appennines

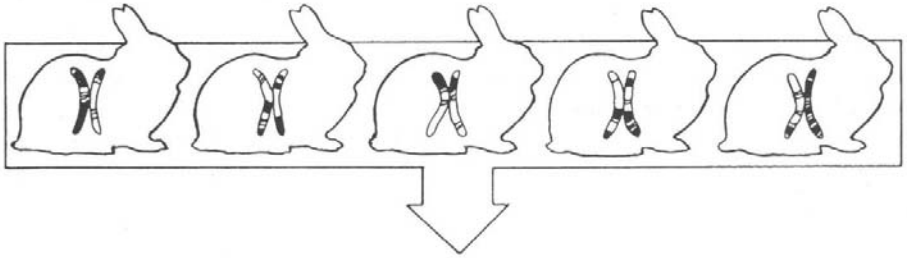


From species to populations and landscape:

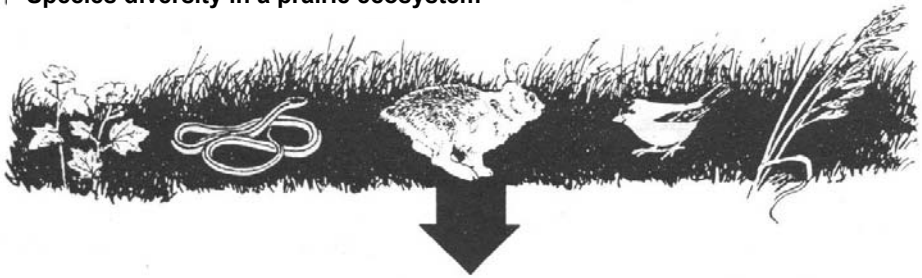
Biodiversity and Conservation Biology

BIODIVERSITY: TYPOLOGIES

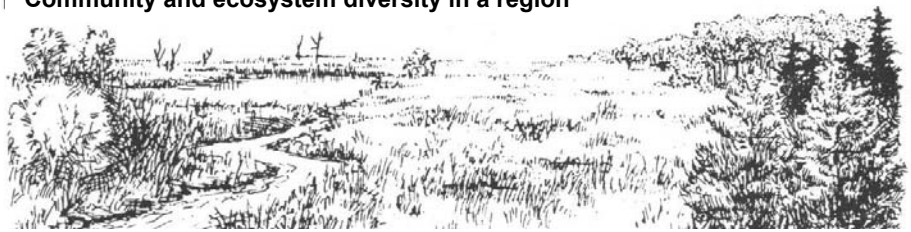
Genetic diversity in a rabbit population



Species diversity in a prairie ecosystem



Community and ecosystem diversity in a region



Levels of biological diversity: diversity at the genetic level (intraspecific genetic variability, thus within a given species), at the species level (interspecific variability, thus species present in a given ecosystem), and at the community/ecosystem level (variety of habitat and ecosystem processes on a given territory). (From Temple, 1991, modified. Designs by Tamara Sayre).

= Biodiversity sub-α (intraspecific)

= Biodiversity α (interspecific)

= Biodiversity β (of habitats)

= Biodiversity γ (landscape on a large scale)

Genetic diversity

- *Observable through morphological characteristics involved in the **reproduction (S.S.C)***

- *Indicates the **genetic quality** of an individual and its capacity of reaction to pathologies*

Species diversity

Absolute value *of species richness (or other indexes).*

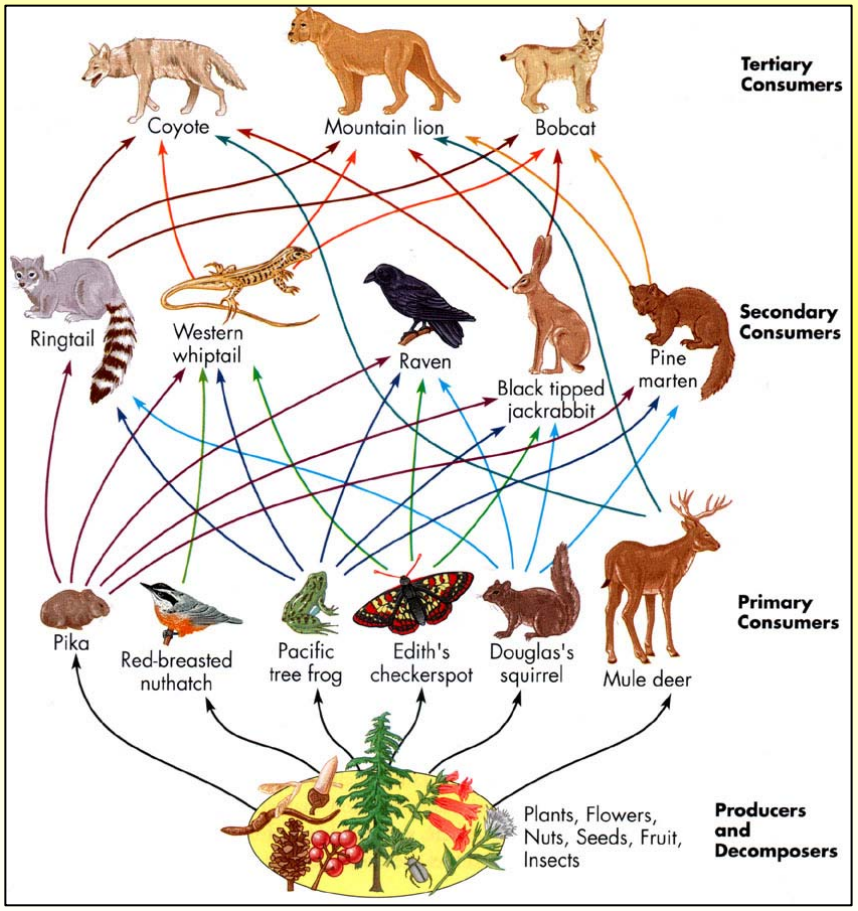
Represents the level of ***evolutionary and ecological adaption*** *of the species in different environments.*

Reconstructs the ***evolutionary history*** *of the different systematic groups (taxa)*

It is expressed in the ***taxonomy*** *(classification of the living beings)*

Why is “rich” also “good”?

- *The more complex an ecosystem is the more it is secure, since it can provide **alternatives** in its key roles (equal energy subdivision)*
- *The food chain is in reality a **food net***
- ***Simple** nets correspond to **fragile** ecosystems (e.g. : artic areas)*
- ***Complex** nets correspond to **stable** ecosystems*



Species diversity within different habitats

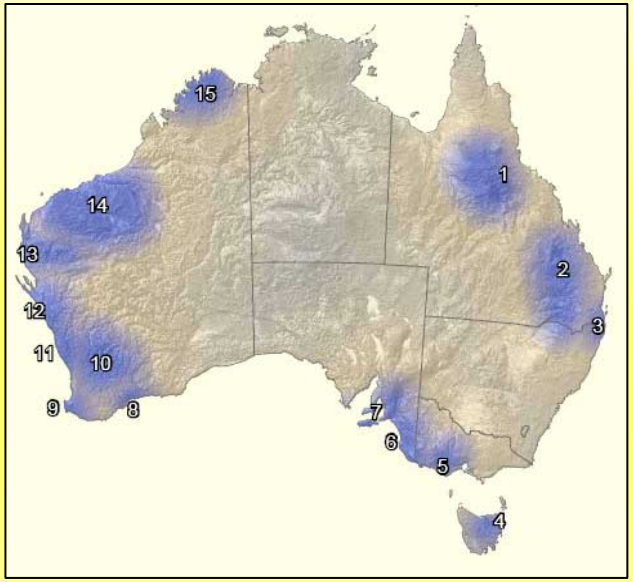
- ***Geologically stable environments*** *favour strong evolutionary radiations, thus a rich biodiversity. "Younger" environments have a minor evolutionary history.*

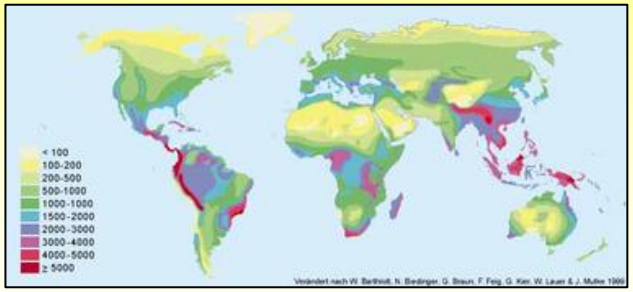
- ***Stable climates ensure a greater radiation*** *and minor restrictions in terms of environmental adaptation*

Biodiversity differences on a regional scale

*The concept of biodiversity "**hotspots**" implicates forced and often reduced choices*

*However it represents one of the few efficient methods to **maximize** the conservation **efforts***





Biodiversity and evolutionary strategies (1)

The beauty and the forms of living beings correspond to specific needs and environmental conditions: ***biodiversity is the result of evolution***

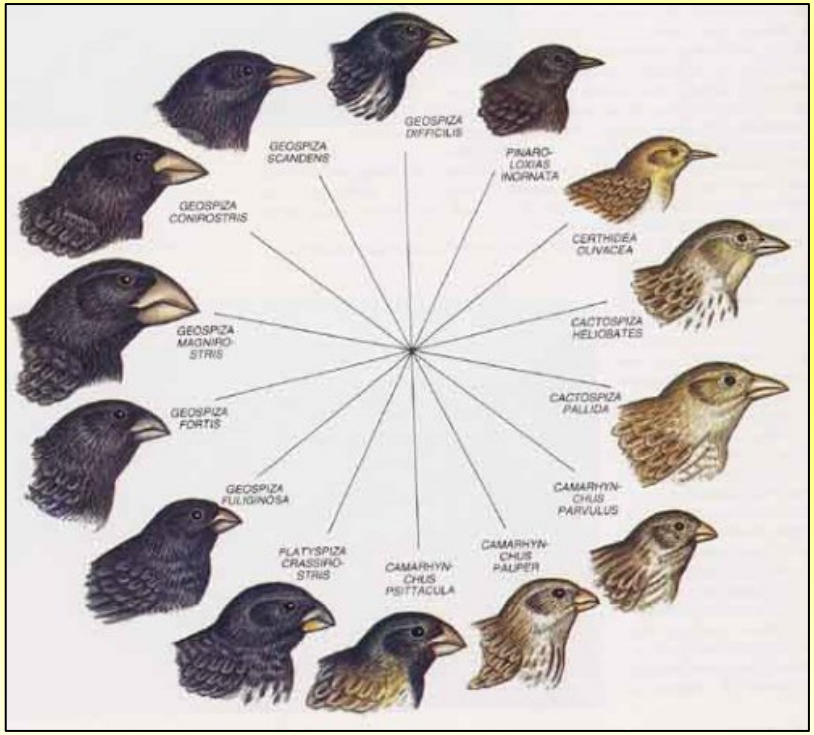
Leaf insects

(camouflage/ cryptic coloration)

Biodiversity and evoultionary strategies (2)

Other forms of mimicry

Biodiversity and evolutionary strategies (3)



"*Darwin's*" finches

Feeding specialization and differentiation of the trophic niche

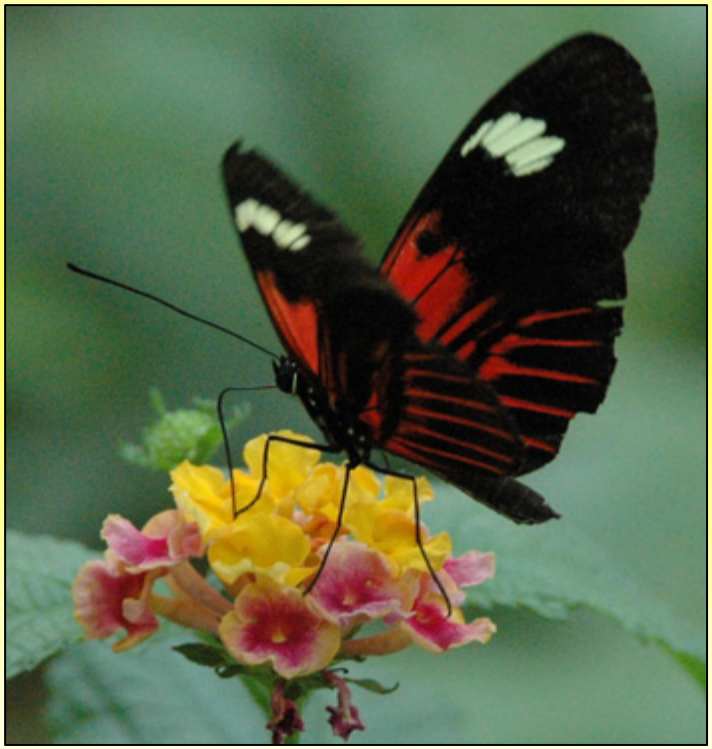
Convergent evolution

Humming bird (South America)

Sunbirds (Cina)

Distant and different evolutionary histories induce common functional results under similar evolutionary pressures

Co-evolution (1): prey and predator



*Prey and predator constitute a form of evolutionary selection and **pressure to each other**, with a constant change and **genetic improvement** for both species*

The "arms race" between Heliconius spp. and Passiflora spp.

Co-evolution (2): symbiosis

Some bi-unique relations become ***adaptational strategies*** *beneficial for both species*

The strategy persists while both species obtain an evolutionary benefit

University of Pavia
Italy

BIODIVERSITY ANALYSIS
OF INVERTEBRATES

PhD programme

Sampling methods and analysis

Possible goals of a research project

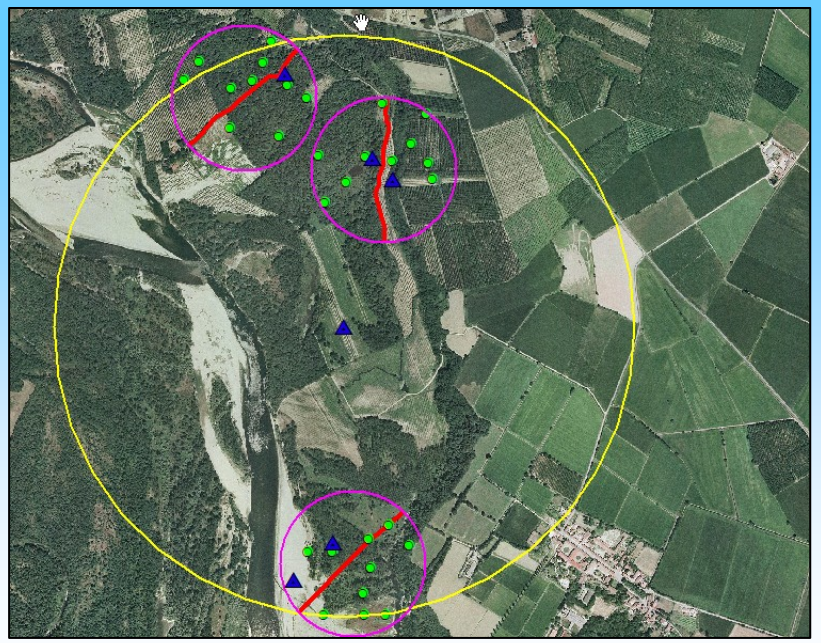
- Is there a **significative difference among** the biodiversity indexes of the coenosis of the **plots**?
- Are there **indicator groups** of a general diversity?
- Is there a **relation between indicators of preys and predators**?
- What is the **influence** of vegetation cover and **environmental conditions** on the zoocoenosis?

AN EMPIRICAL APPROACH TO THE STUDY OF BIODIVERSITY

- Field census
- Utilization of *n* taxa
- Analysis of the zoocoenosis (Indexes of Simpson, Shannon, analysis of the groups)
- Comparison between the indicator power of the different groups
- Sampling using line transects and plots, depending on the groups
- Data collection of the vegetation (horizontal and vertical profiles) and environment (multivarieted analysis)

Positioning of the collection points

- n = 6 plots (3+3)
- N = 2 macro-plots
- Independency of sampling
- The plot needs to have a standard dimension (diameter 500 m)

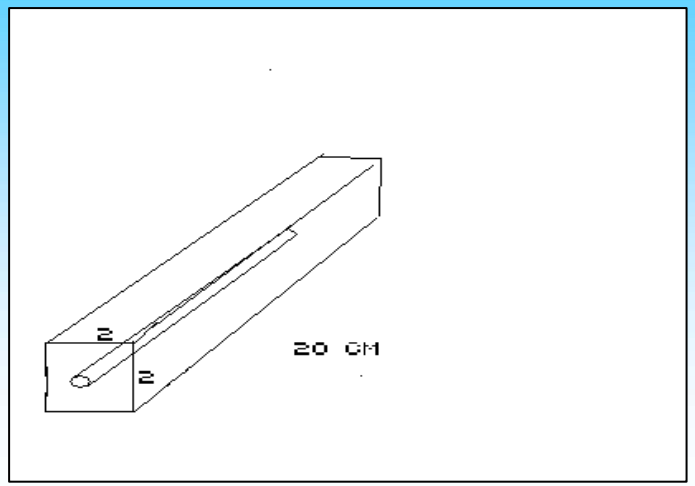


<u>Repeated sampling per plot</u>

- 6 transects
- 66 (11 x 6) pitfall-traps
- 6 sites for the lamps
- 60 (10 x 6) nest blocks traps

Phylum	Subphylum	Class	Order	Family	NOTE
Chelicerata		*Arachnida*	*Araneae*		
Uniramia	*Hexapoda*	*Pterigota*	*Coleoptera*	*Silphidae*	
Uniramia	*Hexapoda*	*Pterigota*	*Coleoptera*	*Staphilinidae*	
Uniramia	*Hexapoda*	*Pterigota*	*Coleotteri*	*Carabidae*	
Uniramia	*Hexapoda*	*Pterigota*	*Lepidoptera*	*Different families*	*Heterocera*
Uniramia	*Hexapoda*	*Pterigota*	*Lepidoptera*	*Papilionidae*	*rhopalocera*
Uniramia	*Hexapoda*	*Pterigota*	*Lepidoptera*	*Pieridae*	*rhopalocera*
Uniramia	*Hexapoda*	*Pterigota*	*Lepidoptera*	*Hesperiidae*	*rhopalocera*
Uniramia	*Hexapoda*	*Pterigota*	*Lepidoptera*	*Lycaenidae*	*rhopalocera*
Uniramia	*Hexapoda*	*Pterigota*	*Lepidoptera*	*Satyridae*	*rhopalocera*
Uniramia	*Hexapoda*	*Pterigota*	*Lepidoptera*	*Nymphalidae*	*rhopalocera*
Uniramia	Hexapoda	Pterigota	Hymenoptera	Sphecidae, Crabronidae; Eumenidae, Pompilidae	

Artificial nests for Hymenoptera (1)



Blocks of pine wood of 20 x 2 x 2 cm; depth of 10 -15 cm.

- Differential diameters
  (3 – 6 -10 mm for different species)
- Blocks covered from atmospheric agents and georeferentiation GPS (random position in the plot)
- 60 blocks of 45 nests in 6 plots
  (15 +15 +15 cells) = 2700

Pit-fall traps for beetles and spiders

- Collection every 10-15 days
- White vinegar - whine - beer as sugar source
- Detergent for dishes as surfactant
- Deposition of the insects in ethylic alcohol for subsequent identification

Trap lights (lepidoptera heterocera) (1)

. Positioning in the evening and collection in the morning

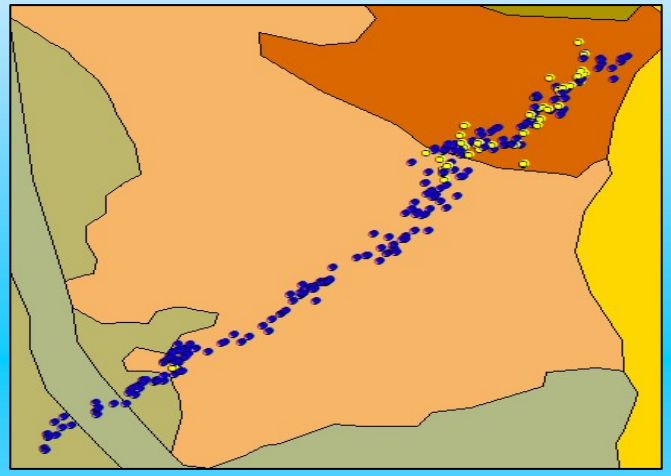
. Abundant data collection

(up to 70 morphospecies in one night)

Nocturnal micro- and macrolepidoptera:

1) Collection
2) Sample storage in the laboratory
3) Identification of the species

Linear transects for butterflies (1)

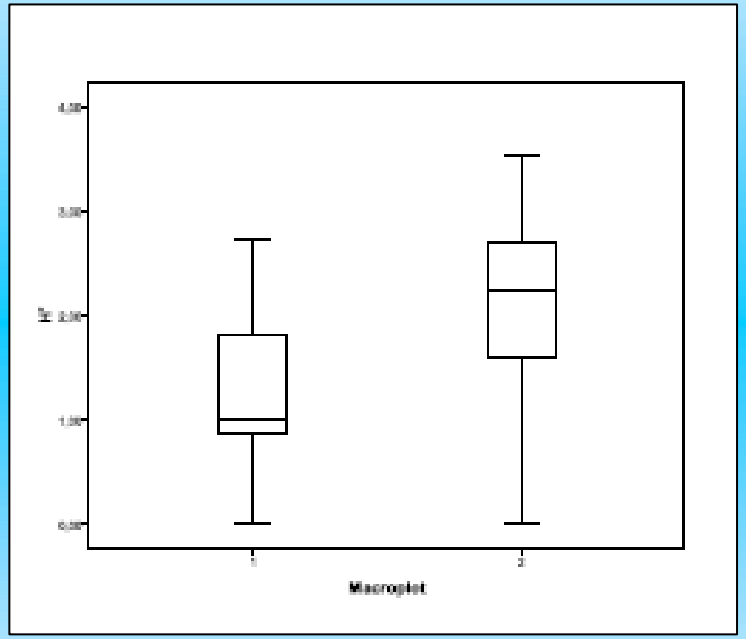


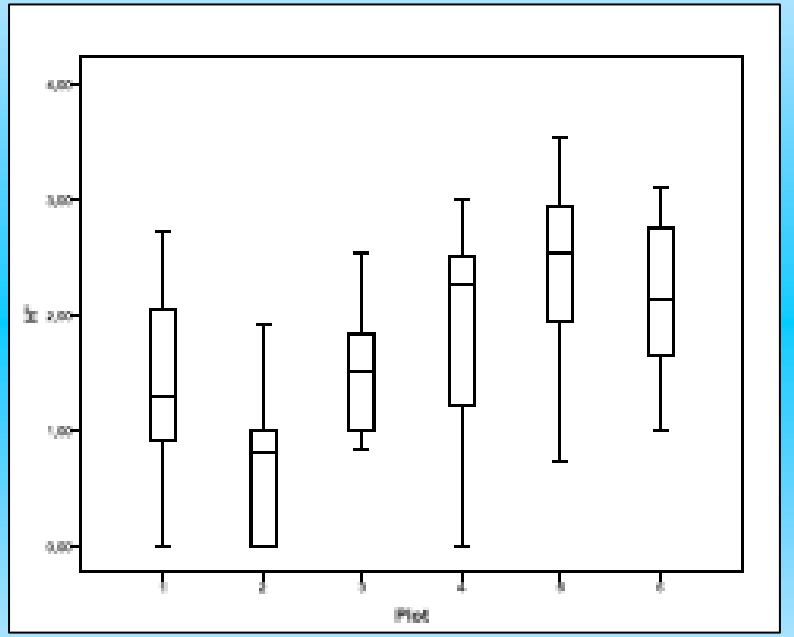
- Linear paths
- Standardized time period of the transect (net time)
- Standardized length and width (500 m x 5 m)
- **Registration of each collecting point using GPS (MARK)**

Linear transects for butterflies (2)

- Frequent collection (18*6=108 transects in two months)
- Very slow (3 steps, 1 minute)
- Identification of the butterflies on the field (minimal impact)
- Individuals not very frequently needled

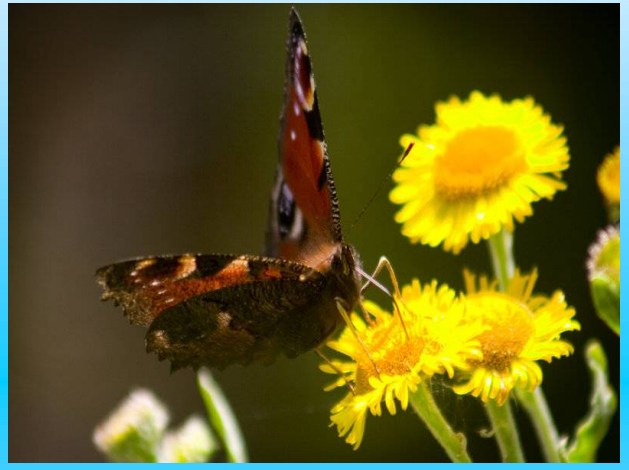
Differences among plots and study areas tra plot

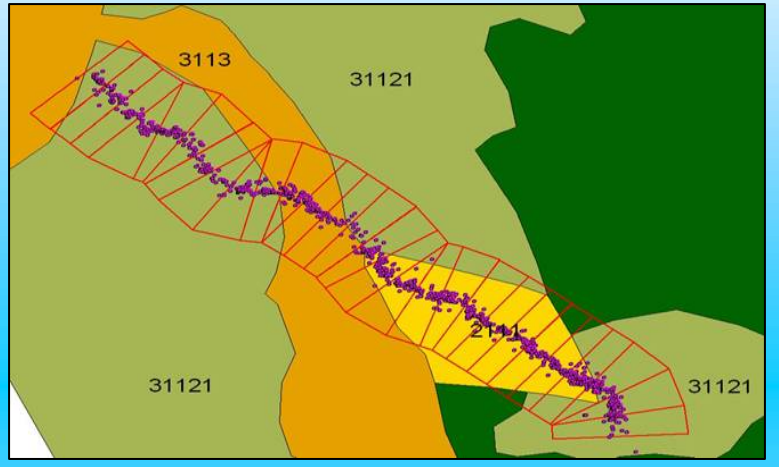


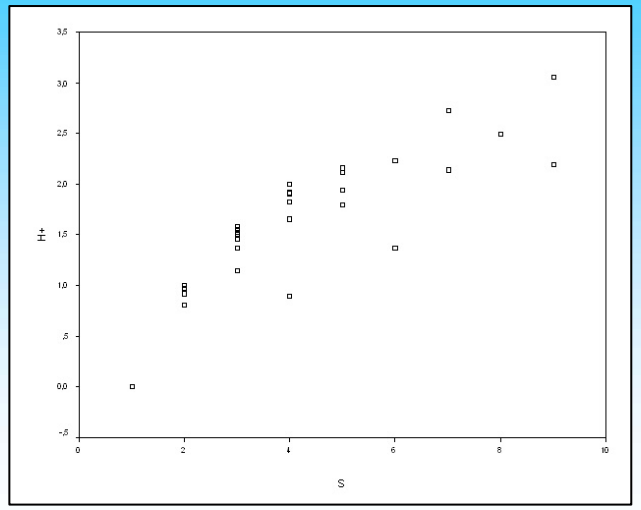


Biodiversity, species richness and abundance of individuals can be an index of wilderness

Bivariate relations with environmental variables



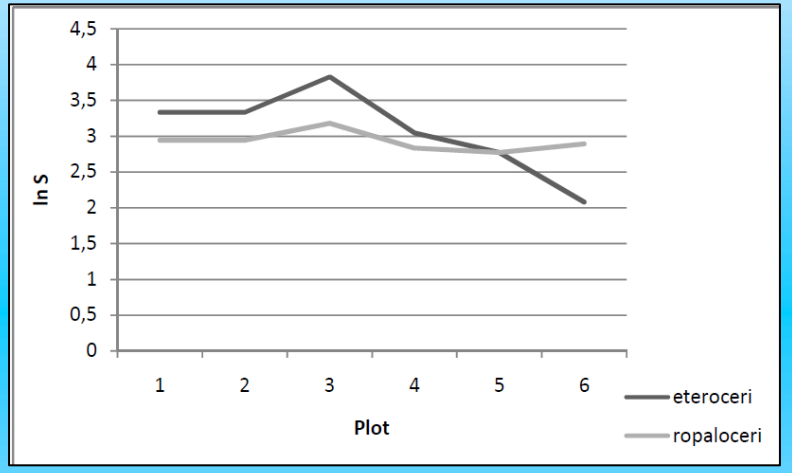




Some environmental variables favour taxon abundance, sampled species richness or diversity

Bio-indicators of biodioversity

Shannon		Araneae	Carabidi	Ropaloceri	Silfidi	Stafilinidi	Eteroceri
Araneae	r	1	0,77	0,598	-0,462	**0,942**	-0,566
	p		0,073	0,21	0,356	**0,005**	0,241
	N	6	6	6	6	**6**	6
Carabidi	r	0,77	1	0,255	-0,775	0,599	**-0,849**
	p	0,073		0,626	0,07	0,209	**0,033**
	N	6	6	6	6	6	**6**
Ropaloceri	r	0,598	0,255	1	0,089	**0,815**	-0,026
	p	0,21	0,626		0,866	**0,048**	0,96
	N	6	6	6	6	**6**	6
Silfidi	r	-0,462	-0,775	0,089	1	-0,229	0,447
	p	0,356	0,07	0,866		0,663	0,374
	N	6	6	6	6	6	6
Stafilinidi	r	**0,942**	0,599	**0,815**	-0,229	1	-0,396
	p	**0,005**	0,209	**0,048**	0,663		0,437
	N	**6**	6	**6**	6	6	6
Eteroceri	r	-0,566	**-0,849**	-0,026	0,447	-0,396	1
	p	0,241	**0,033**	0,96	0,374	0,437	
	N	6	**6**	6	6	6	6



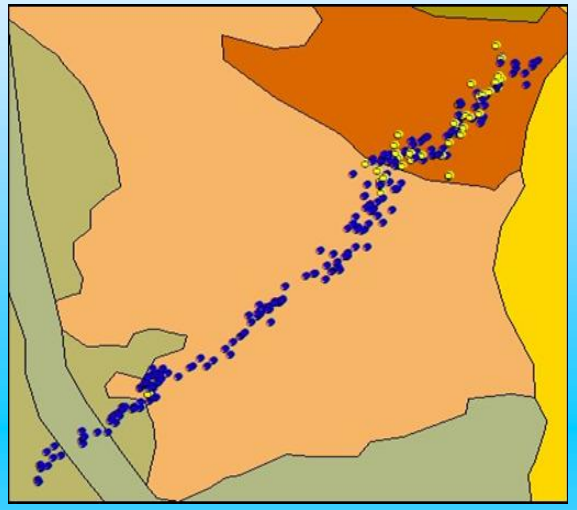
A bio-indicator is a *taxon whose indexes of abundance,*

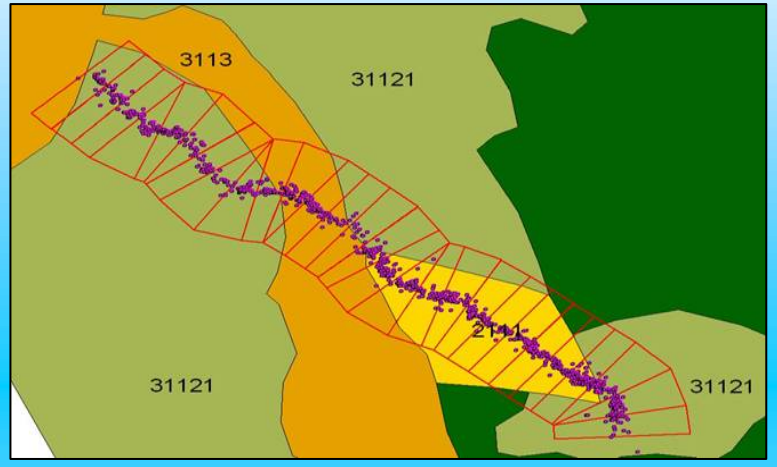
species richness and/or diversity

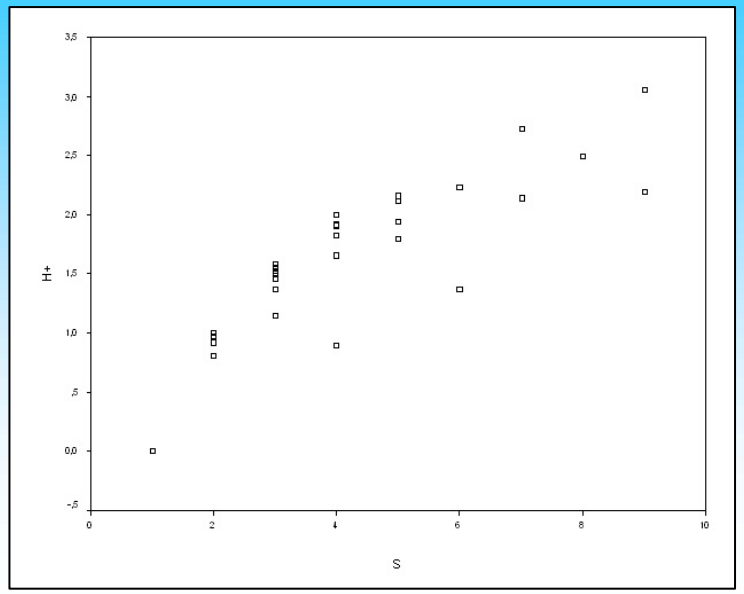
show positive and significant relations with the same parameters in

The highest possible number of other taxa

Spatial ecology of species: understanding the ecolocial niche







- Sampling habitat selection by species
- Positive relation with floristic species richness
- Negative relation with increasing number of Alloctonous floristic species

↓

Statistical evidences

Sampling of environmental variables (1)

Tabella1

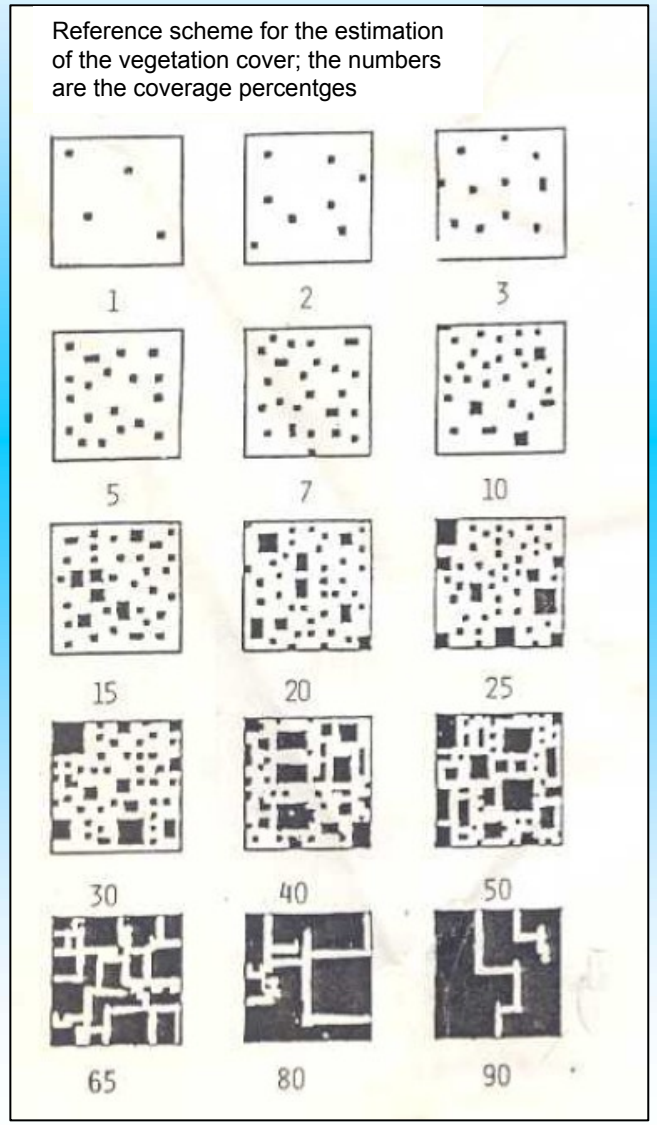
Rilievo condizioni ambientali			
DATA			
NSPALB		LOCALITA'	
NSPARB			
N_QC		PLOT	
N_CON			
N_ALN			
N_POP			
N_PRU		STAZIONE	
N_ROB			
ALNETO			
COP_VUOTO			
COP_MUSCHIO			
HARB			
DARB			
HALB			
LEGNAME			
ALB CAD		COP_ARB	
ALB_MOR		COP_ERB	
CEPPI		COP_ALL	
LETTIER		H_STRUTT	
COP_ALB		DBH	
COP_ARA		NND	

CHARACTERIZATION OF THE HABITAT

(pitfall e transect)

- Tree species
- Flora species (specific richness)
- Other biotic and abiotic variables (e.g: luminosity X/25)
- Structural variables

Sampling of environmental variables (2)



Characterization of the structural percentage in a 10 x 10 square around the pitfall

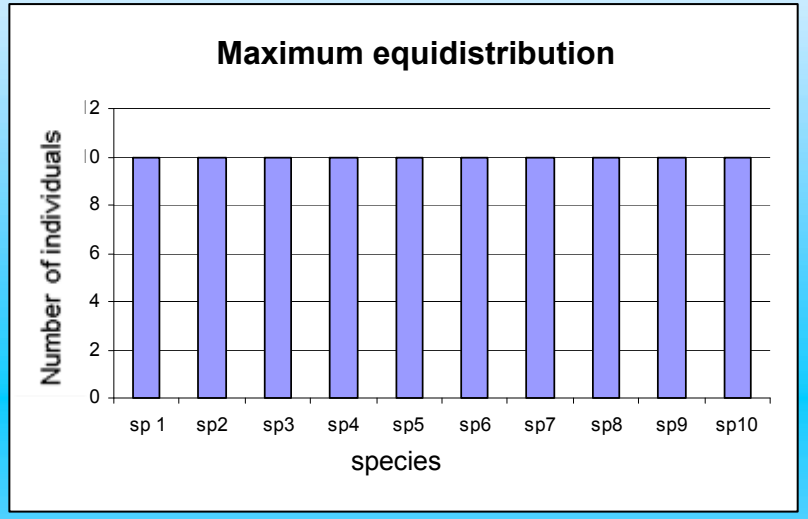
. Gras cover

. Tall shrub

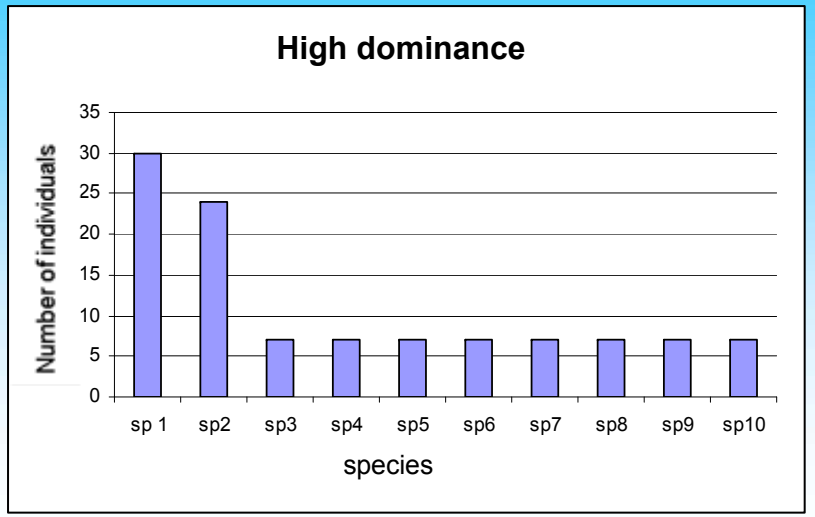
. Short shrub

. Bare ground

Biodiversity estimation (evenness and dominance, N species =10)



Maximum evennes



Maximum dominance (no diversity)

Biodiversity estimation

Shannon - Index

$$H = -\sum_{i=1}^{S} p_i \ln p_i$$

S = number of total species

p = n / N

n = number of individuals per species

N = number of total individuals

Biodiversity estimation

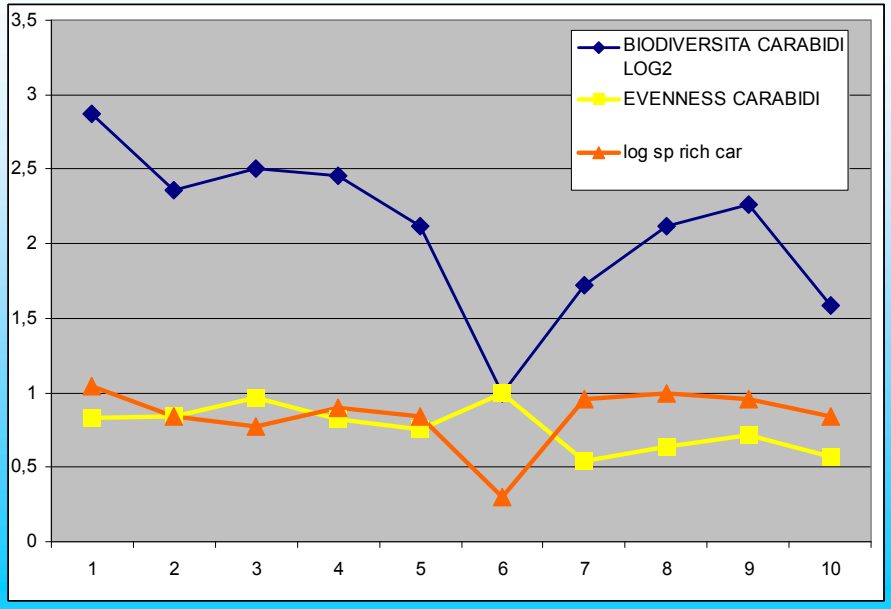
Pielou - Index (evenness)

$$e = H / \log S$$

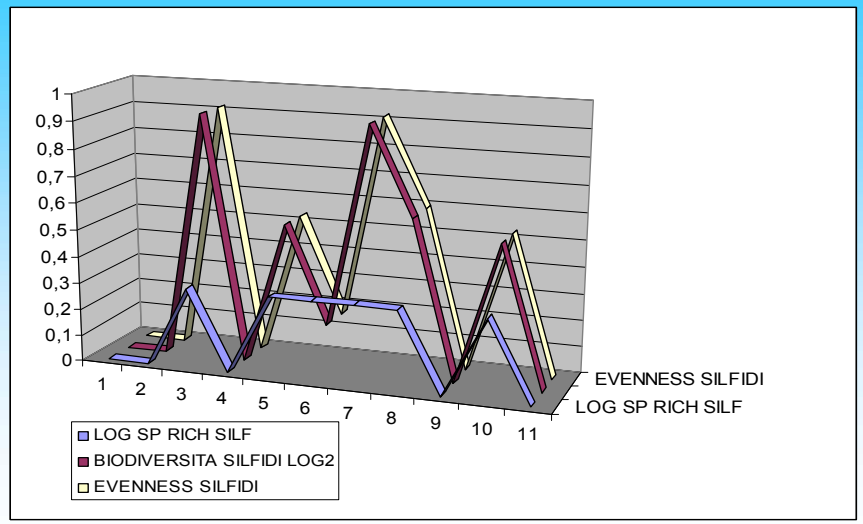
e = evenness

H = Shannon – Index

S = number of total species



BIODIVERSITA CARABIDI LOG2	EVENNESS CARABIDI	LOG SP RICH CARABIDI	SP. RICH CARABIDI
2,873	0,83	1,0413927	11
2,357	0,839	0,845098	7
2,503	0,968	0,7781513	6
2,458	0,819	0,90309	8
2,117	0,754	0,845098	7
0,996	0,996	0,30103	2
1,721	0,543	0,9542425	9
2,118	0,638	1	10
2,267	0,715	0,9542425	9
1,589	0,566	0,845098	7



LOG SP RICH SILF	BIODIVERSITA SILFIDI LOG2	EVENNESS SILFIDI	SP. RICH SILFIDI
0	0	0	1
0	0	0	1
0,301029996	0,918	0,918	2
0	0	0	1
0,301029996	0,529	0,529	2
0,301029996	0,169	0,169	2
0,301029996	0,918	0,918	2
0,301029996	0,592	0,592	2
0	0	0	1
0,301029996	0,529	0,529	2
0	0	0	1

Biodiversity loss: causes

Three modalities with which humans dominate the global ecosystem and alters its processes

1.Terrestrial surface

Soil use and resources demand transformed more than half of the terrestrial surfaces not covered by ice.

2.Nitrogen cycle

The quantity of nitrogen compounds released each year in the terrestrial systems and deriving from activities such as cultivation of nitrogen-fixing crops, the use of nitrogen fertilizers and the use of fossil fuels is higher than the quantity released by natural biological and physical processes.

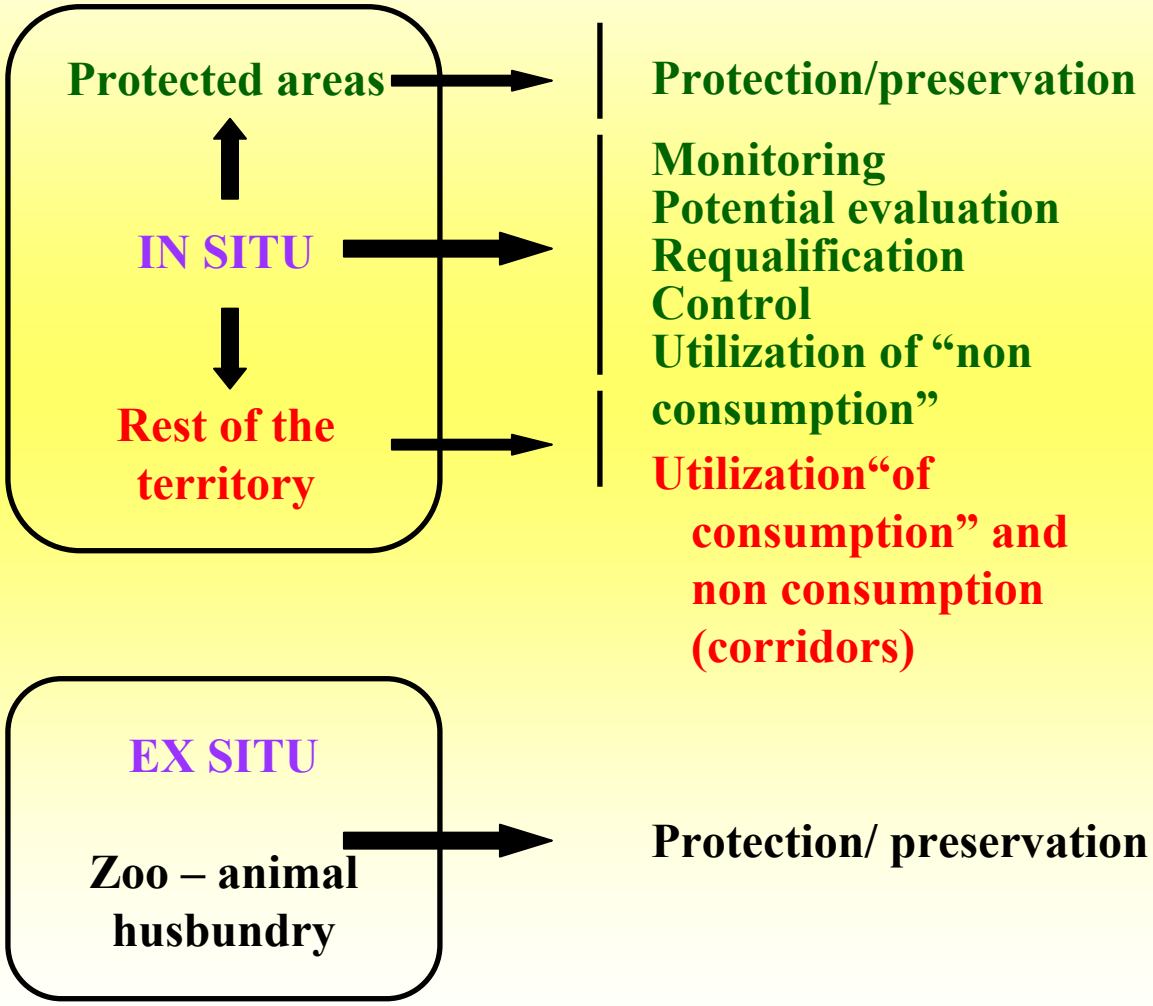
3.Atmospheric carbon cycle

By the end of the first half of the XXI century the use of fossil fuels will duplicate the quantity of carbon dioxide present in the atmosphere.

Source: Data from Vitusek, 1994; Vitousek et al., 1997.

From species to populations

From species to populations: conservation biology



Conservation

Populations: demography

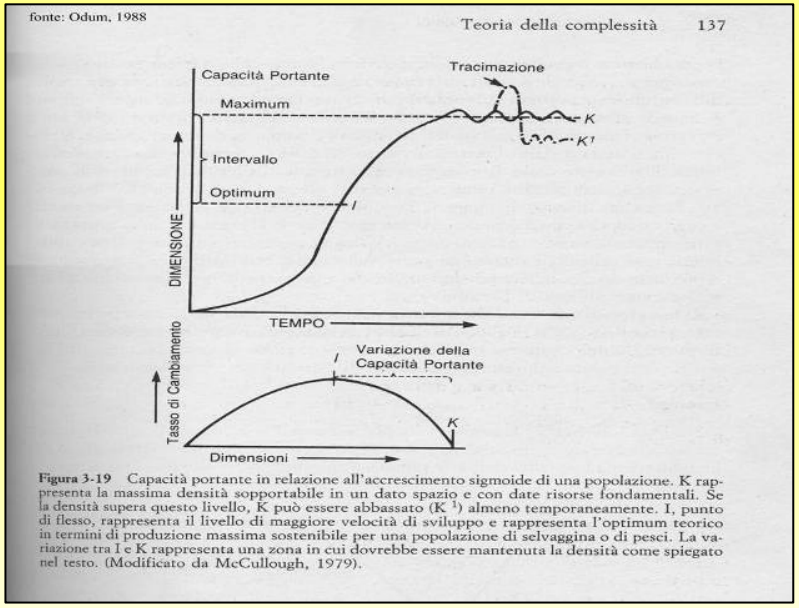
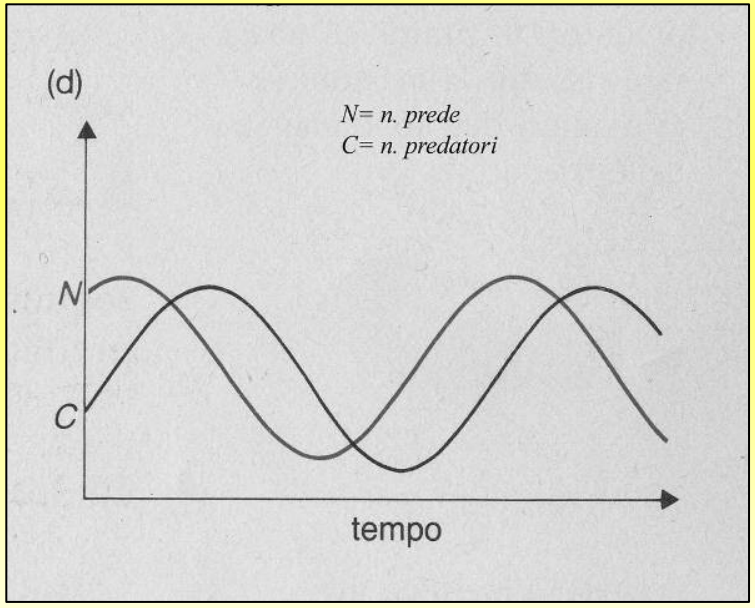


Figura 3-19 Capacità portante in relazione all'accrescimento sigmoide di una popolazione. K rappresenta la massima densità sopportabile in un dato spazio e con date risorse fondamentali. Se la densità supera questo livello, K può essere abbassato (K^1) almeno temporaneamente. I, punto di flesso, rappresenta il livello di maggiore velocità di sviluppo e rappresenta l'optimum teorico in termini di produzione massima sostenibile per una popolazione di selvaggina o di pesci. La variazione tra I e K rappresenta una zona in cui dovrebbe essere mantenuta la densità come spiegato nel testo. (Modificato da McCullough, 1979).



(Lotka Volterra, 1926)

Populations and metapopulations

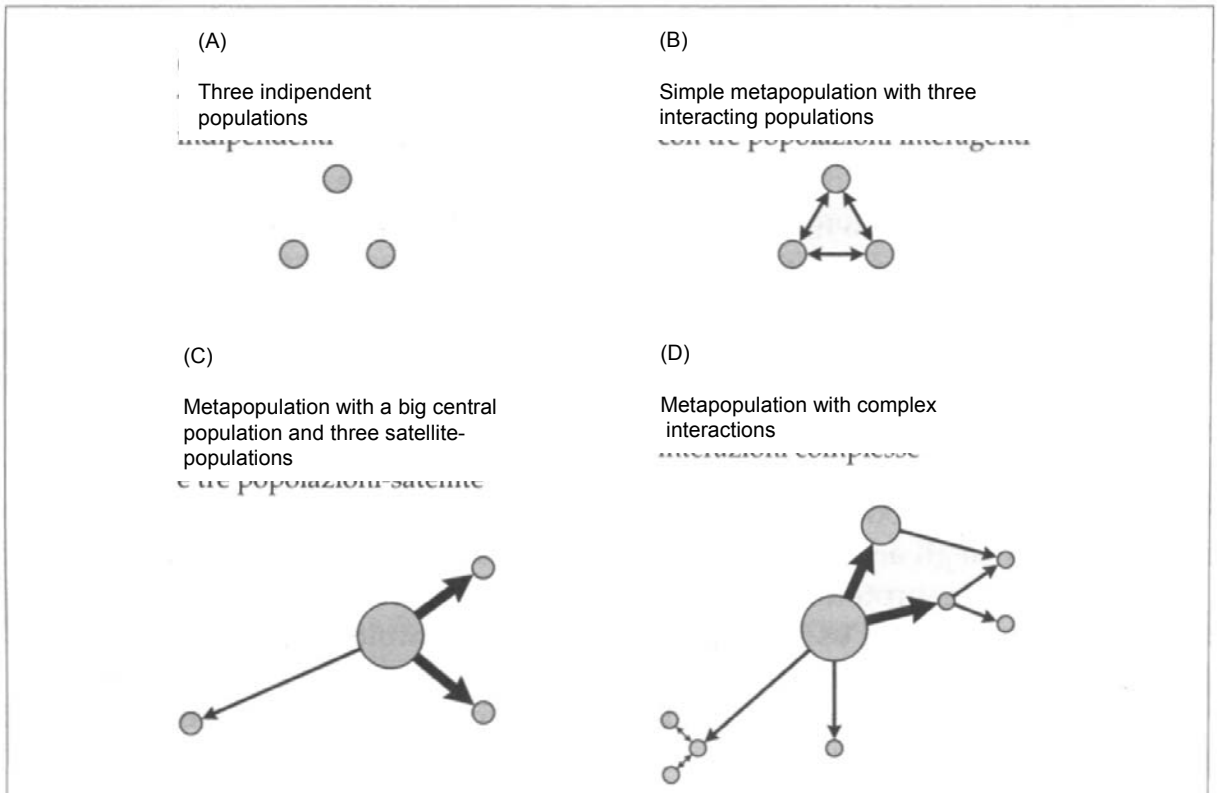


Figure 3.11 Possible patterns of metapopulations. The dimensions of the populations are indicated by the size of the circle which represents it. The arrows indicate the direction and the intensity of dispersion from a population to the other. (From White, 1996, modified).

della dispersione da una popolazione all'altra. (Da White, 1996, modificata.)

Population Viability Analysis:

Concept of minimum viable population

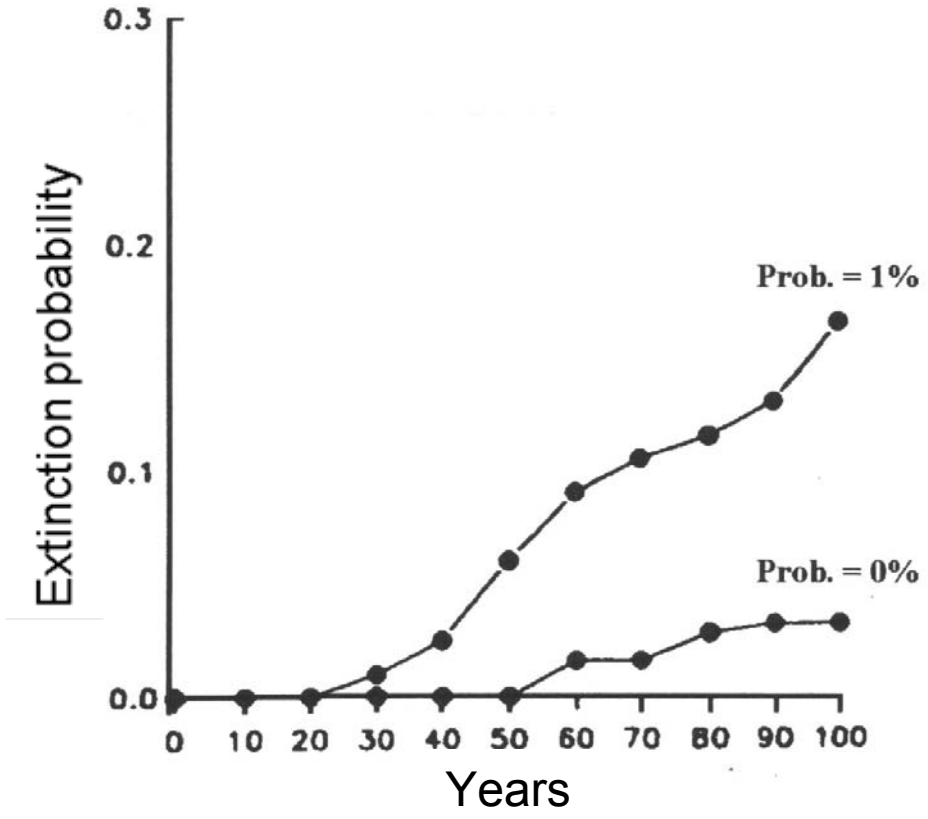
THE MINIMUM VIABLE POPULATION IS THE MINIMAL NUMBER

OF INDIVIDUALS NEEDED TO MANTAIN

HEALTH AND GENETIC AND DEMOGRAPHIC VITALITY OF

A POPULATION SUPPOSEDLY ISOLATED FROM THE OTHERS

Population Viability Analysis: theoretical models of probability with simultaneous analysis and integrated with biological , health, demographic and genetic information



Extinction probability of a golden lion tamarin (*Leontopithecus rosalia rosalia*), simulated on the computer using the program VORTEX (Lacy, 1992). The probability of an epidemy which causes a mortality rate of 75 % was set arbitrarily at 1%. The comparison with a population non affected by diseases, and therefore not at risk of extinction, shows an increase in the probability of extinction of 14%. This is a value which creates a minimum risk if calculated annually, however it can threaten population in the long-term (redesigned by Ballau, 1993).

Population Viability Analysis:

Concept of minimum viable area

The minimum viable area is the minimal surface area needed to maintain the resources and the life of one or more populations of one or more species characterized by a certain capacity of movement and by a given minimum viable population

Population Viability Analysis:

Extinction probability and pop viability

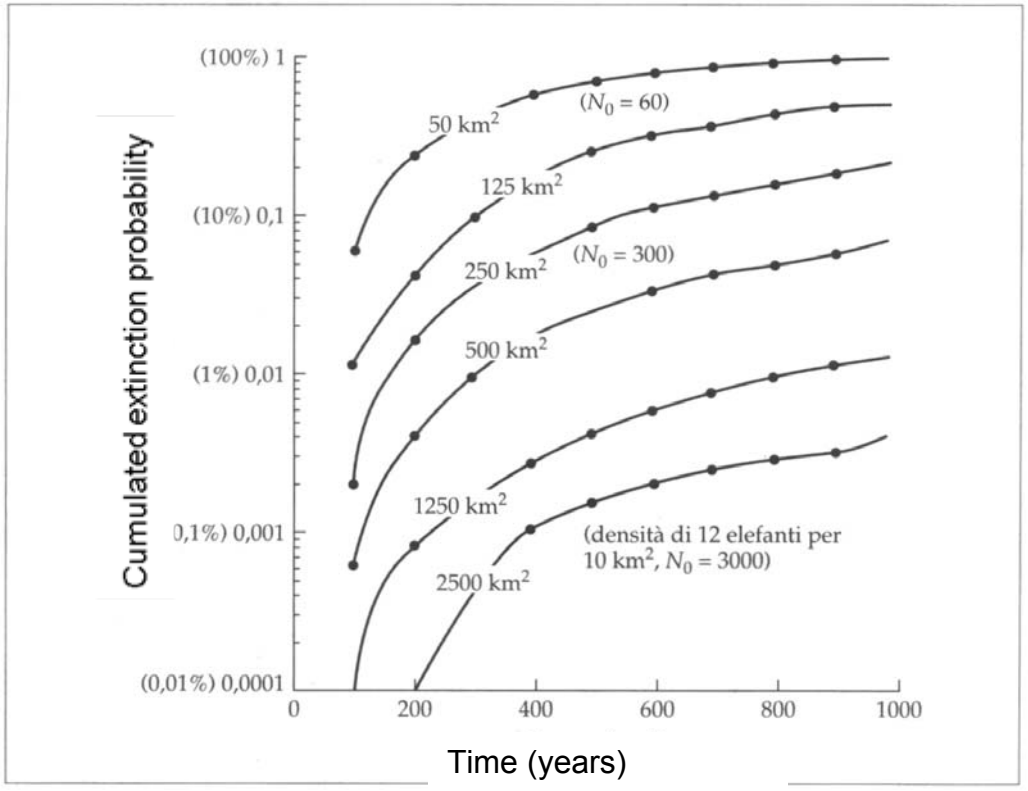
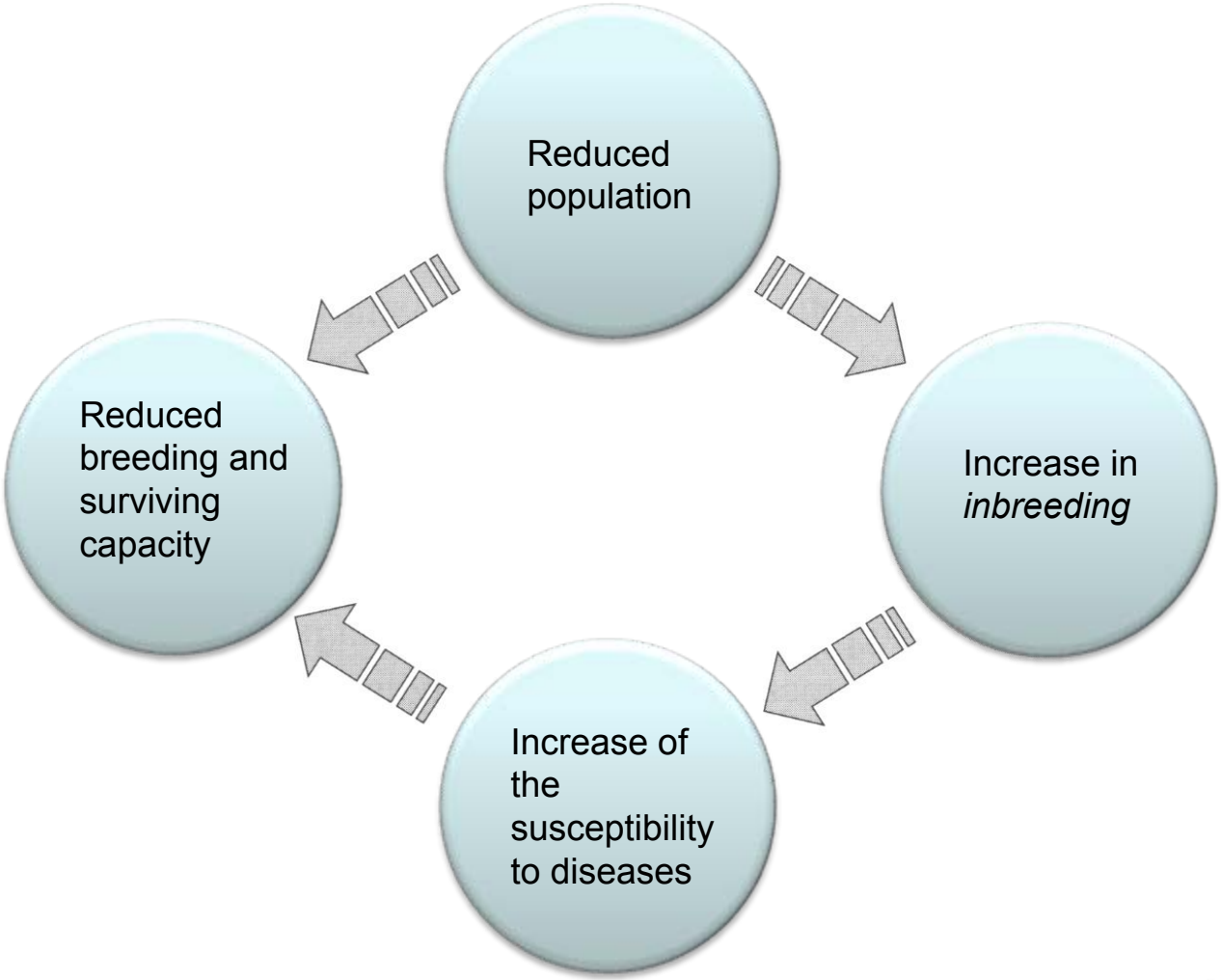


Figura 3.10 Probabilità cumulata di estinzione (scala logaritmica) in funzione del tempo per popolazioni di elefanti in aree protette di diversa estensione. Con una densità di popolazione di 12 individui per 10 km², un'area protetta di 2500 km² ha una popolazione iniziale N_0 di 3000 elefanti; la probabilità di estinzione in 100 anni è prossima a zero e in 1000 anni arriva a 0,4%. Una popolazione in un'area protetta di 250 km² con dimensione iniziale di 300 elefanti ha una probabilità del 20% di estinguersi in 1000 anni. (Da Armbruster e Lande, 1993, modificata.)

Density of 12 elefants per 10 km2, N0 = 60

Density of 12 elefants per 10 km2, N0 = 300

Density of 12 elefants per 10 km², N_0 = 3000



The extinction Loop

3.1 Reserves dimensions (Island Theory)

The number of species is proportional

to the surface area of the island

Teriofauna

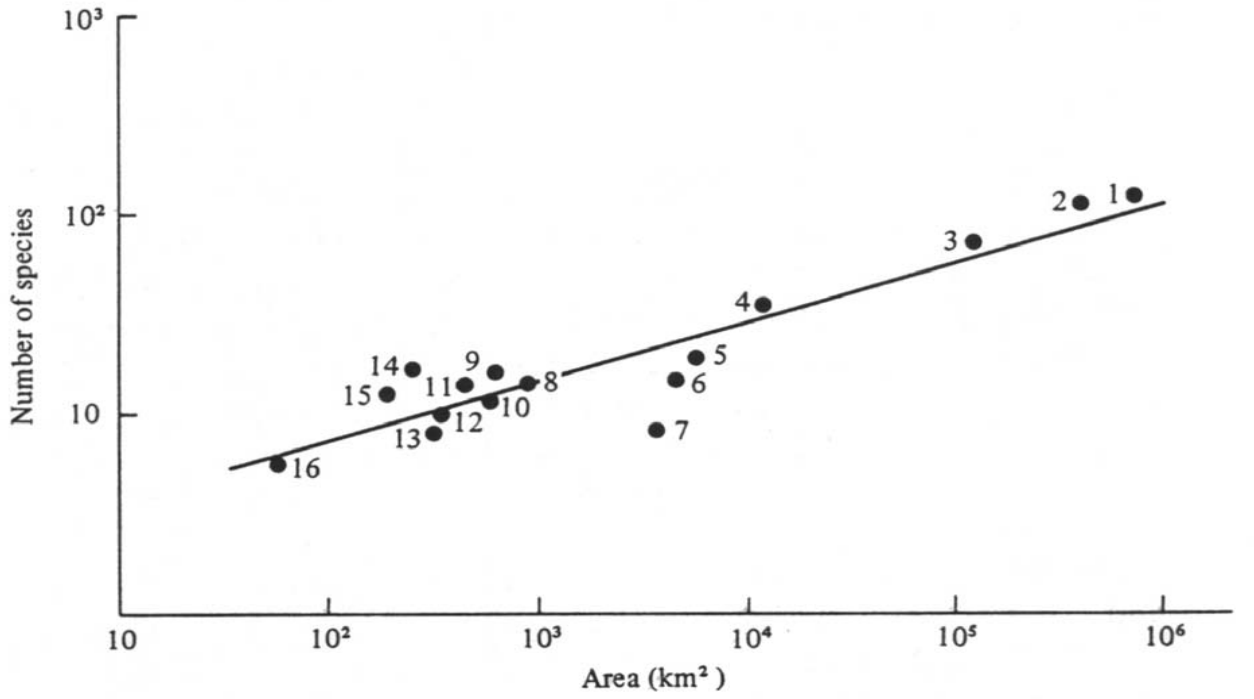


Fig. 5.1 Relationship between the number of land mammals (excluding bats) and island area for the Sunda Islands. (1) Borneo, (2) Sumatra, (3) Java, (4) Banka, (5) Bali, (6) Billiton, (7) Siberut, (8) S. Pagi, (9) Sipora, (10) Singapore, (11) Tanabala, (12) Tanamasa, (13) Pini, (14) Penang, (15) Tuangku, (16) Bangkaru. (After Wilcox, 1980; data from Medway and Wells, 1971 and Chasen, 1940.)

Dimensions of protected areas necessary to manage in the long-term viable populations of big species with broad home ranges and low densities

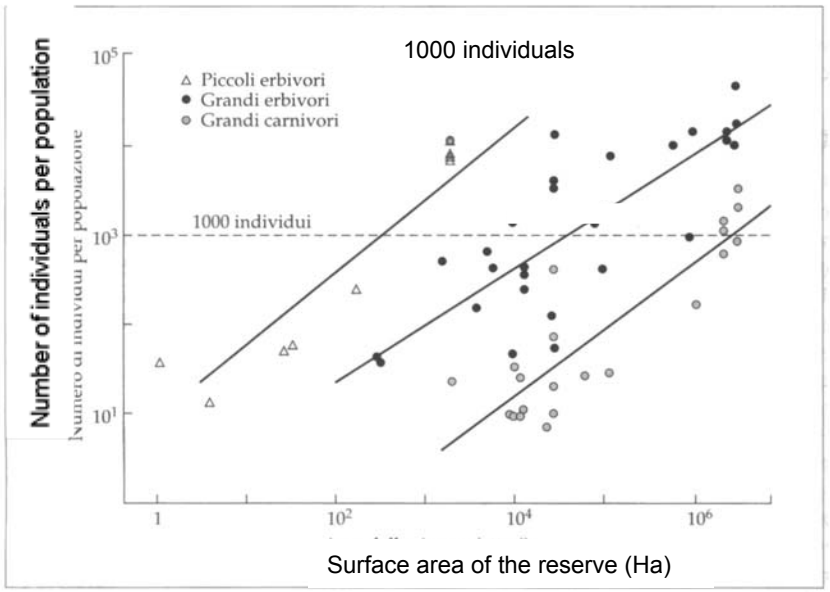
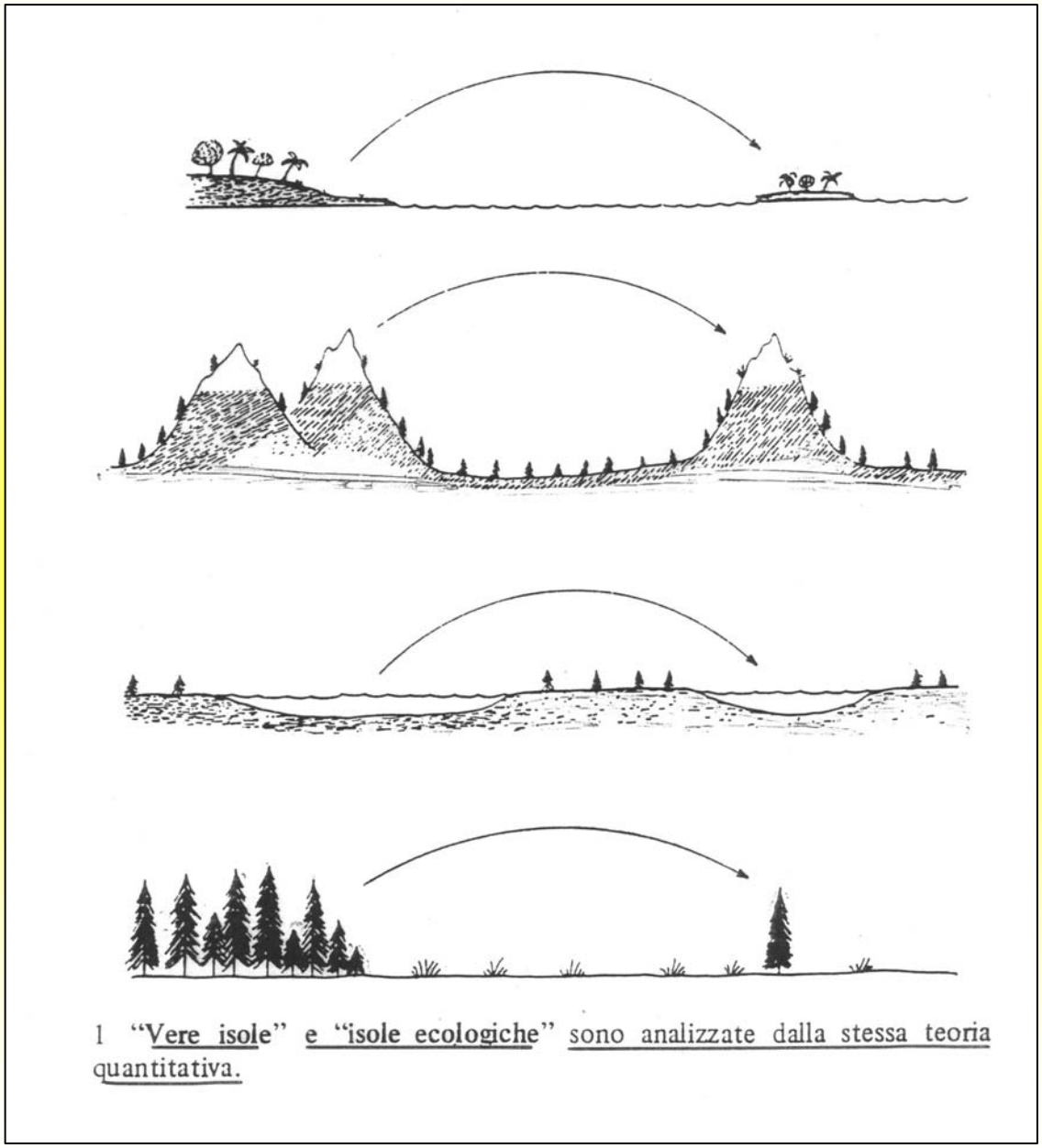


Figura 4.7 Relazione tra dimensione della popolazione e area della riserva per varie specie di erbivori e carnivori in Africa. Numerosi studi hanno mostrato che, per ogni specie esaminata, riserve più estese contengono più individui rispetto a riserve più piccole. Tuttavia solo le riserve in assoluto più grandi (parchi nazionali) riescono a contenere popolazioni vitali di molte specie di vertebrati. Nel grafico ogni simbolo rappresenta una popolazione. Se si assume che la minima popolazione vitale delle specie esaminate sia di 1000 individui (linea tratteggiata orizzontale), si ha che è necessaria una riserva di 100 ha (1 km^2) per i piccoli erbivori (per esempio conigli selvatici), una riserva di 10 000 ha (100 km^2) per i grandi erbivori (per esempio zebra, giraffa), mentre per i carnivori (leone, iena) è necessaria una riserva di almeno 1 milione di ha (10 000 km^2, una superficie pari all'incirca a quella dell'Abruzzo.) (Da Schonewald-Cox, 1983, modificata.)

MVA

- **Small herbivores: 100 ha**
- **Large herbivores: 10.000 ha**
- **Large carnivores: 1.000.000 ha**

If we assume that the minimum vital population of the examined species is n=Y, then a reserve of X ha is necessary



1 "Vere isole" e "isole ecologiche" sono analizzate dalla stessa teoria quantitativa.

3. How to react

Configuration criteria for the protected areas derived from the island biogeography model of Mc Arthur and Wilson (1963, 1967)

Protected areas = habitat islands

Real islands and ecological islands are analyzed using the same quantitative theory

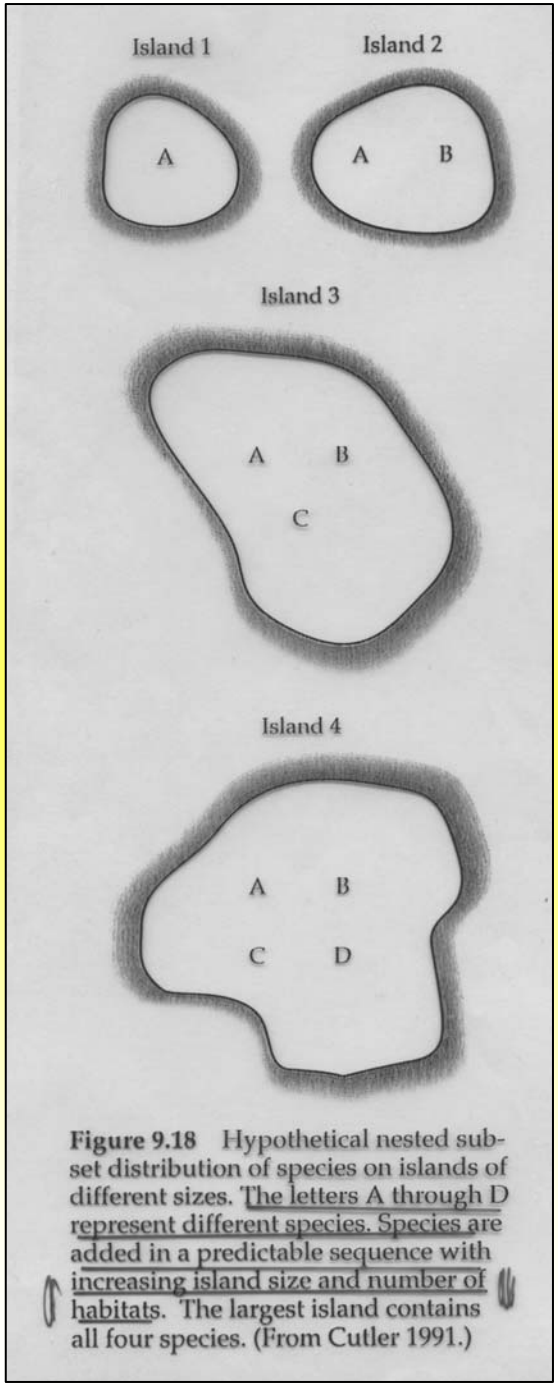


Figure 9.18 Hypothetical nested subset distribution of species on islands of different sizes. The letters A through D represent different species. Species are added in a predictable sequence with increasing island size and number of habitats. The largest island contains all four species. (From Cutler 1991.)

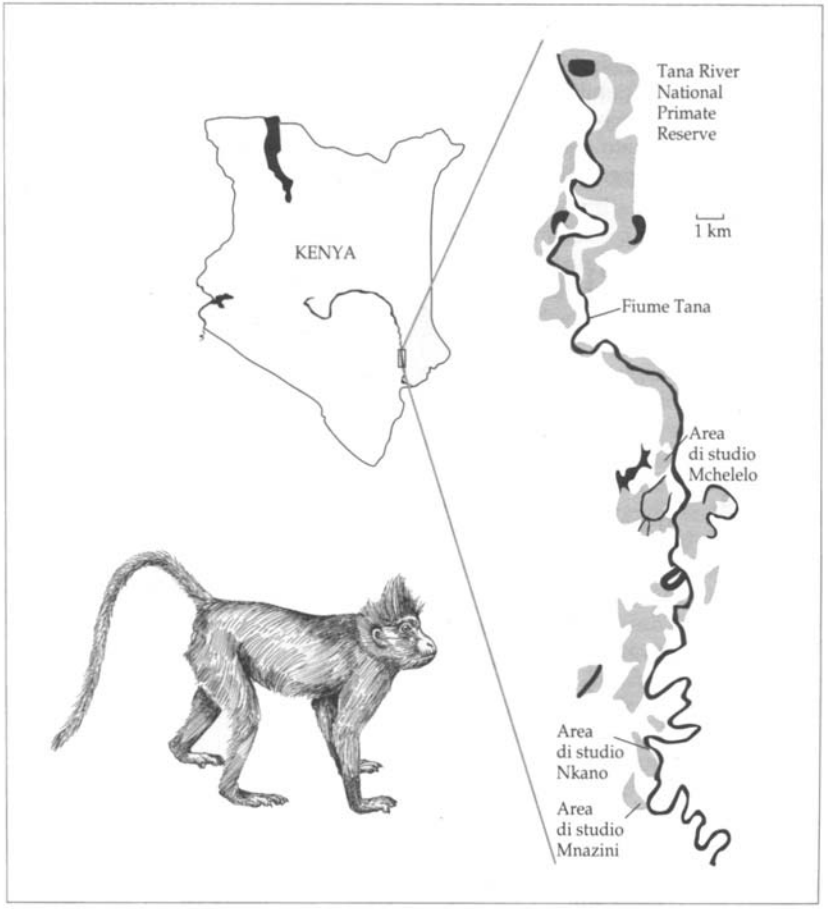
In general, the greater a protected area, the richer it is (such as on an island…)

From populations to landscape

Habitat fragmentation

Historical reconstruction of the fragmentation process of the Warwickshire forests (central England) from 400 a.D. until 1960 due to the anthropization of the territory. In the 400 the Romans settled into the forests with villages and encampments and started to build connecting roads and therewith to deforest in order to obtain land to cultivate. The population growth, the necessity to have more land for agriculture and livestock, the births of cities led to the drastic reduction of the forest within 1600 years. In 1960 the forest was limited to small patches surrounded by anthropized habitats. (from Wilcove et al., 1986.)

Habitat fragmentation causes

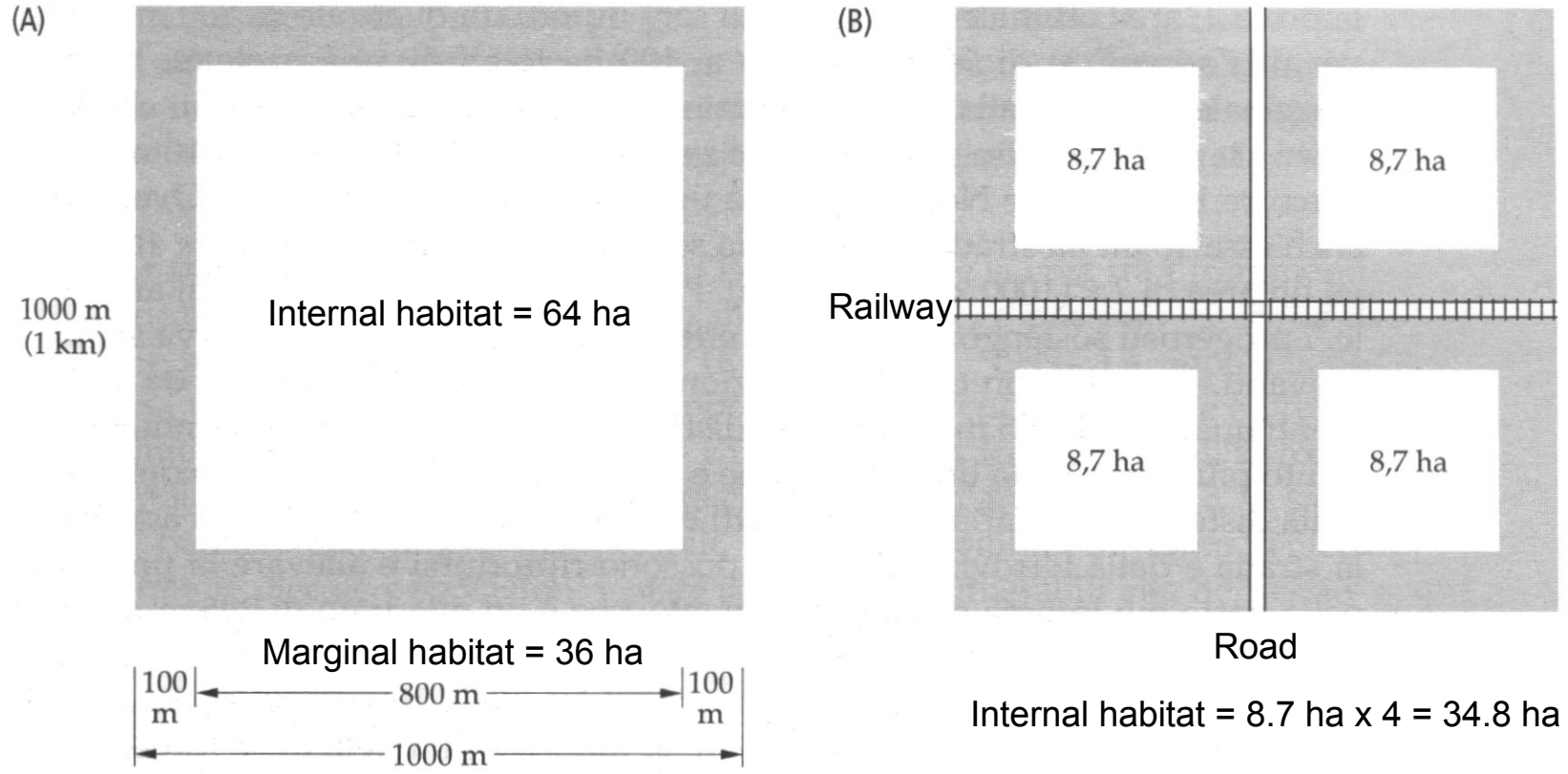


Schematic illustration of the Tana River National Primate Reserve (Kenya), where the last population of the primate *Cercocebus galeritus galeritus* lives. The grey areas correspond to the residual forests along the Tana river. The highly fragmented forest habitat is caused by agricultural expansion. (From Kinnaird e O'Brien, 1991, modified.)

- ***Agricultural expansion at the expenses of the natural habitat***
- ***urbanisation***

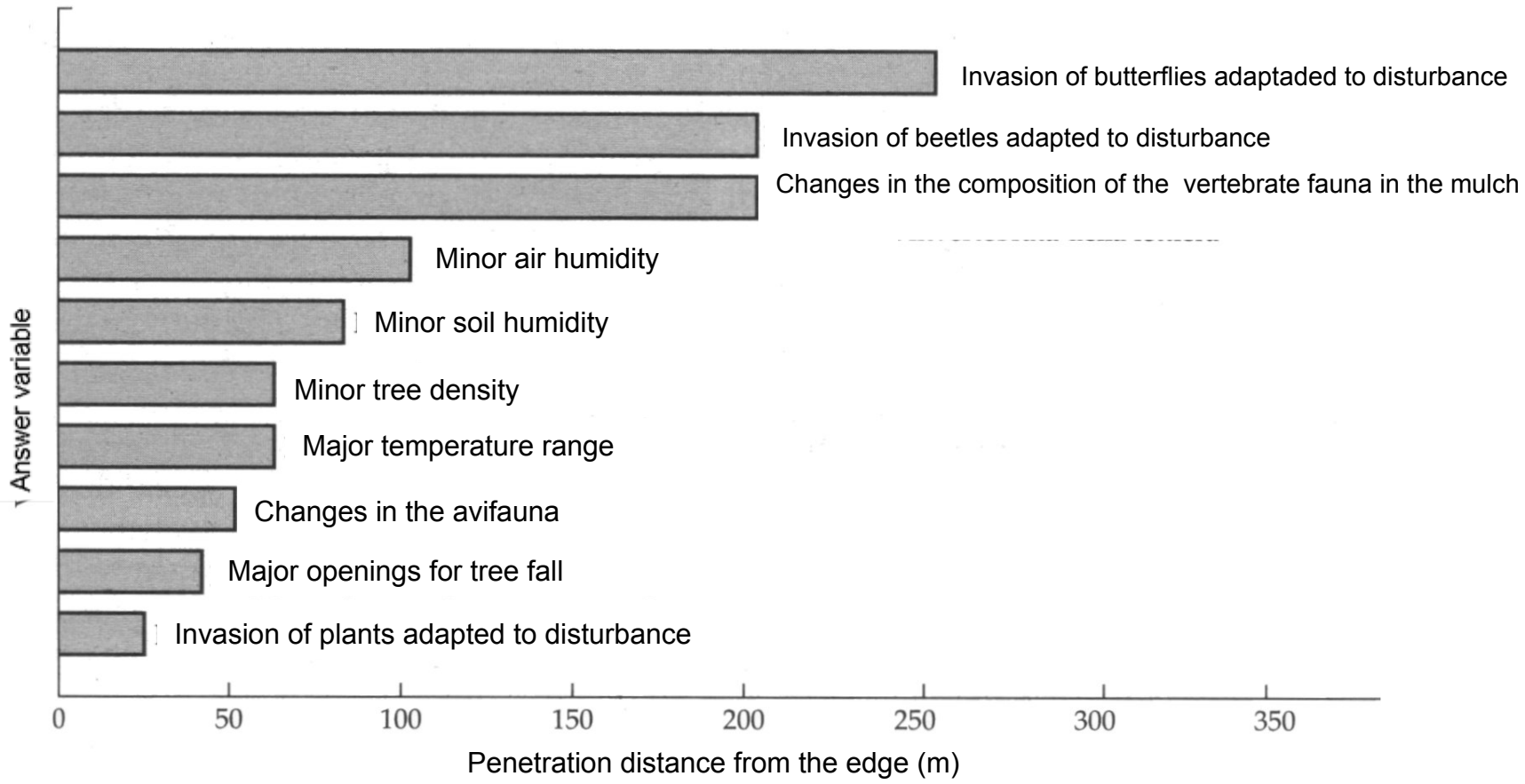
(Tana River National Primate Reserve, Kenya)

Habitat fragmentation: edge effect



Schematic illustration of habitat fragmentation and edge effect. (A) A natural reserve of 1 km^2 (100 ha) of surface area, occupied by a continuous forest. If we assume that the edge effect is expressed within the forest in a 100 m wide strip (grey area), the area available to birds is of 64 ha. (B) If the reserve is divided by a road and a railway **the edge effect will increase, even though the infrastructures do not occupy a lot of space**. The habitat available to birds is reduced to 34.8 ha, almost ½ of the starting point.

Habitat fragmentation: the edge effect



Effects of habitat fragmentation measured from the edge to the interior of areas in the Amazonian rainforest. The length of the bar indicates until where the different variables of the ecosystem are affected by the edge effect. For example, the butterflies used to live in disturbed environments move from the edge into the forest at 250 m, where the relative humidity decreases until 100 m towards the interior. (From Laurance and Bierregaard, 1997, modified).

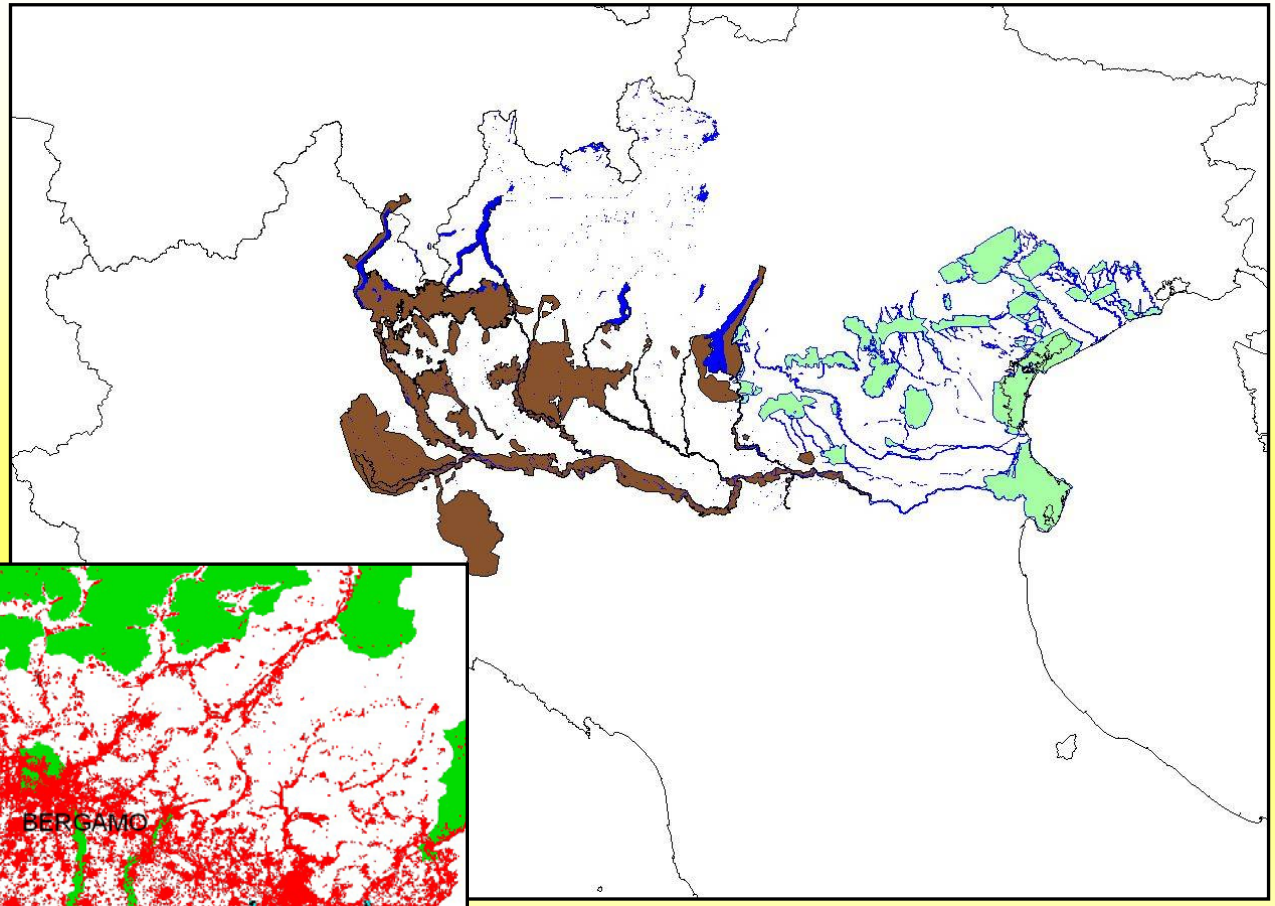
BIODIVERSITY LOSS: THE CAUSES

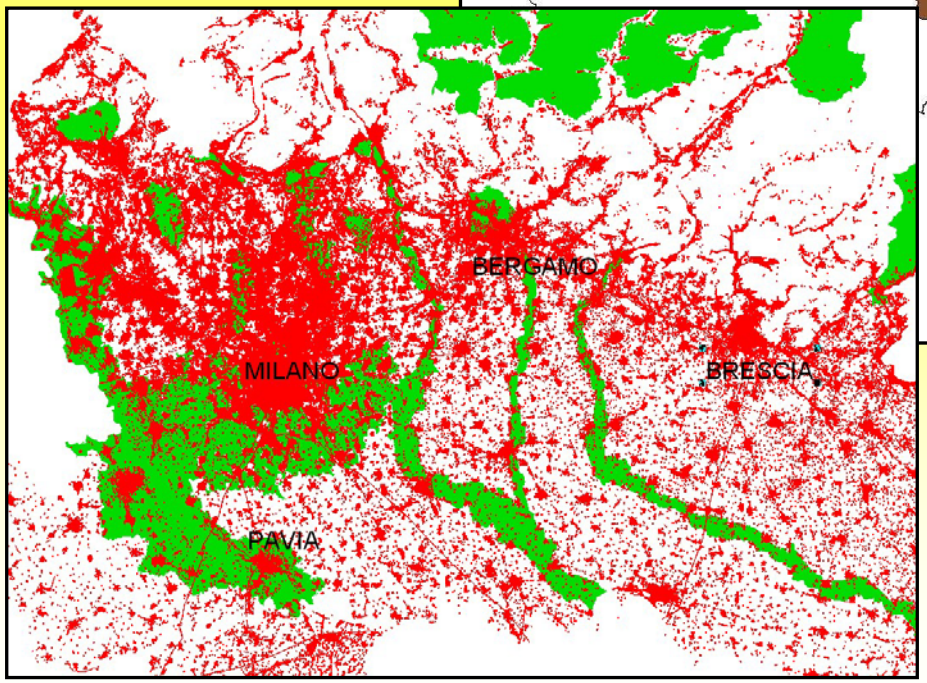
Threats to various groups of species in the USA

Groups of threaten species	Percentage of species negatively influenced by each factor[a]				
	Habitat destruction	Pollution	Over-exploitation	Competition/predation by exotic species	Diseases
All species (1880 species)	85	24	17	49	3
All vertebrates (494 species)	92	46	27	47	8
Mammals (85 species)	89	19	47	27	8
Birds (98 species)	90	22	33	69	37
Anfibians (60 species)	87	47	17	27	0
Fishes (60) species)	97	90	15	17	0
All invertebrates (331 species)	87	45	23	27	0
Fresh water mussels (102 species)	97	90	15	17	0
Butterflies (33 species)	97	24	30	36	0
Plants (1055 species)	81	7	10	57	1

Source: Data from Wilcove et al., 1998.

[a] The species can be influenced by one or more factors, therefore the percentage of each line is not equal to 100. For example 87% of the amphibian species is negatively influenced by habitat degradation and destruction and 47% of the same species is affected by pollution.

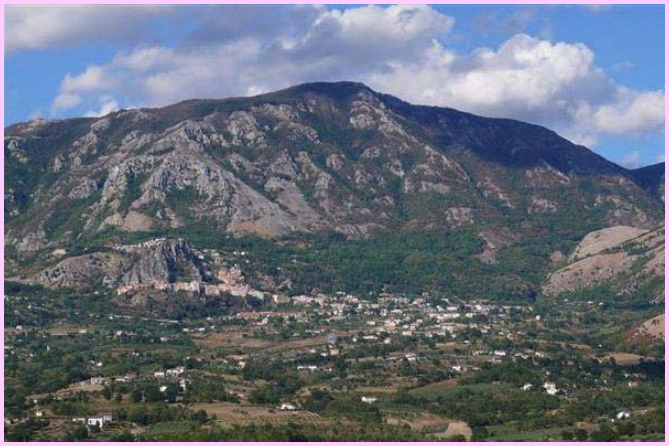


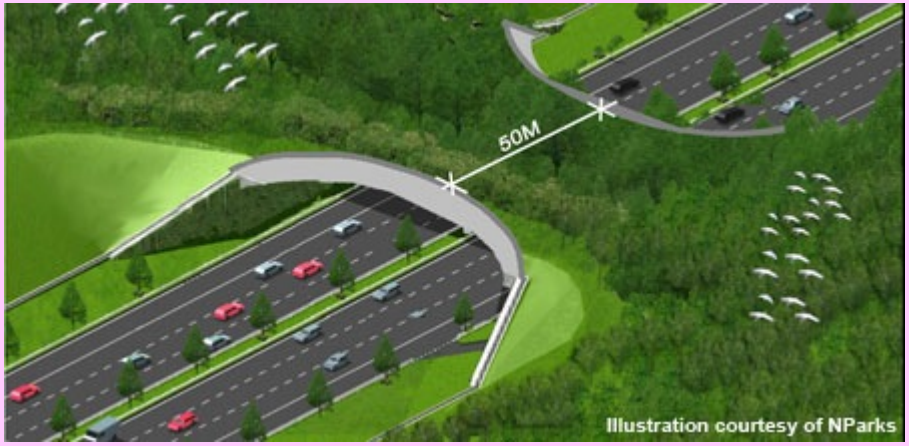


The need of developing Ecological corridors and ecological networks

Identification of corridors

A preliminary macro-scale GIS work
to identify “pilot areas”





Defining corridors

*A **wildlife corridor** is an area of habitat connecting wildlife populations genetically and fisically separated by human activities (such as roads, development, or logging).*

*Due to eto-ecological reasons i**deal corridor should be species-specific***

***BIODIVERSITY corridor** is not species – specific. Just clusters of green suitable(natural) habitat patches allowing connection of different species populations in fragmented macro-areas*

Structure of the work

- Identification of “yes areas” on the base of habitat suitability and protected areas (EU - NDA)

- Removal of “no areas” by adding:

  1) unsuitable habitat (anthropised and natural) + buffers
  2) highest altitude
  3) highest slope

- Gap analysis with high traffic roads, highways roads

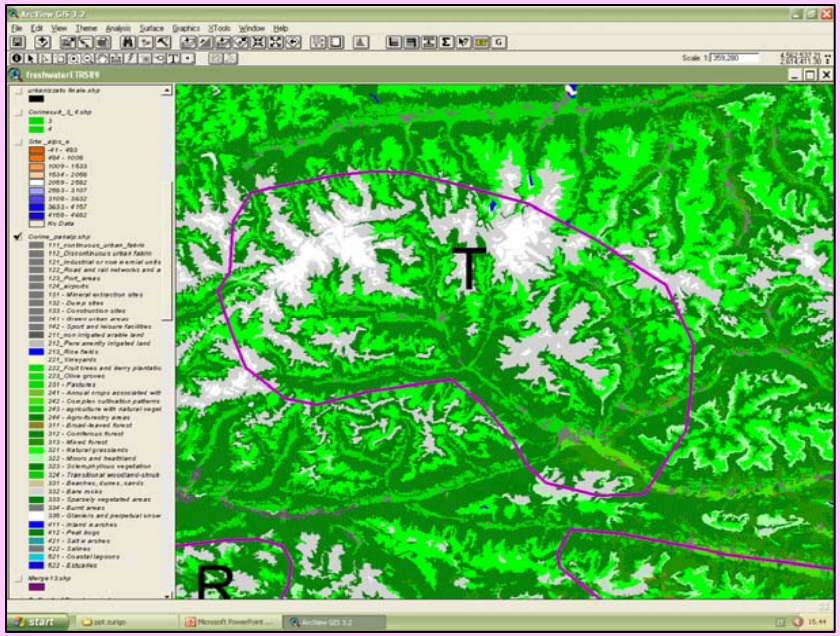
- Google Earth 3D view

NOTE:
Areas will need to be checked at a better scale
(preliminary tool)

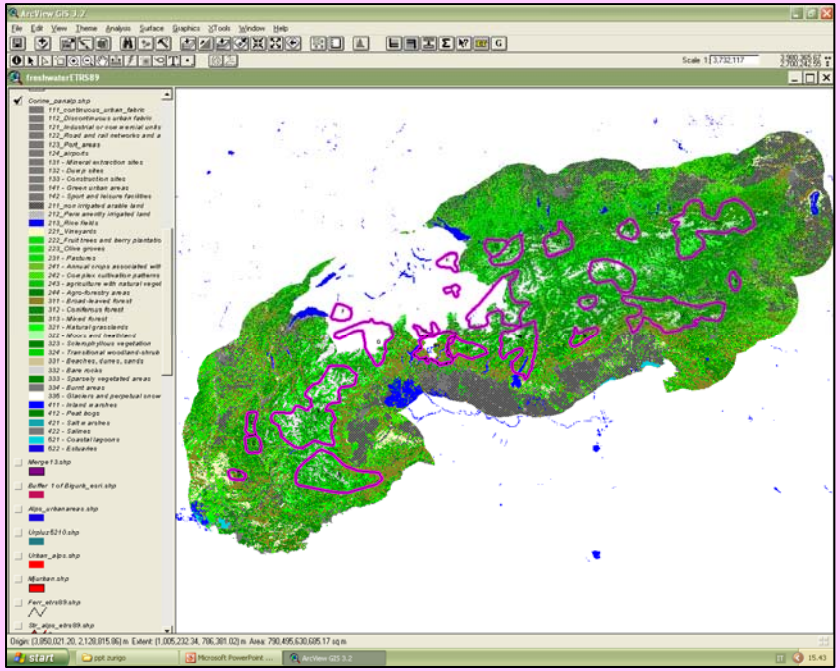
List of data

- **Corine habitat classes** (n=41; urban, agriculture, natural sites, wetlands, water areas)
  Divided in **1/2** – **3/4** levels
- **Nationally designated areas**
- Municipalities
- Regional and provincial
- Boundaries
- Main and other rivers
- lakes
- Digital elevation model (80m)
- Slope
- Highly traffic roads, highways, railways

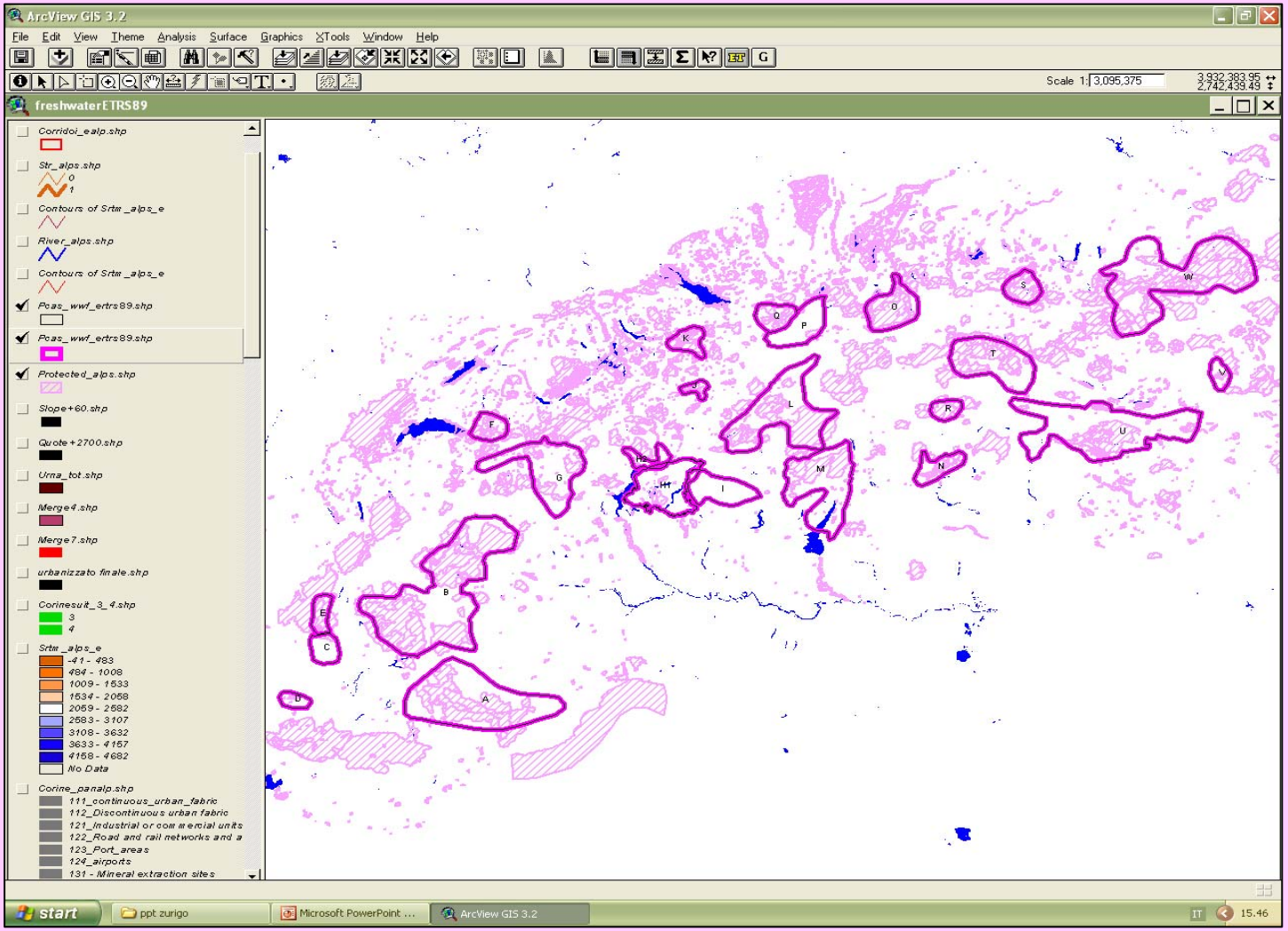
The corine land cover
(habitat land cover maps
From the EU)

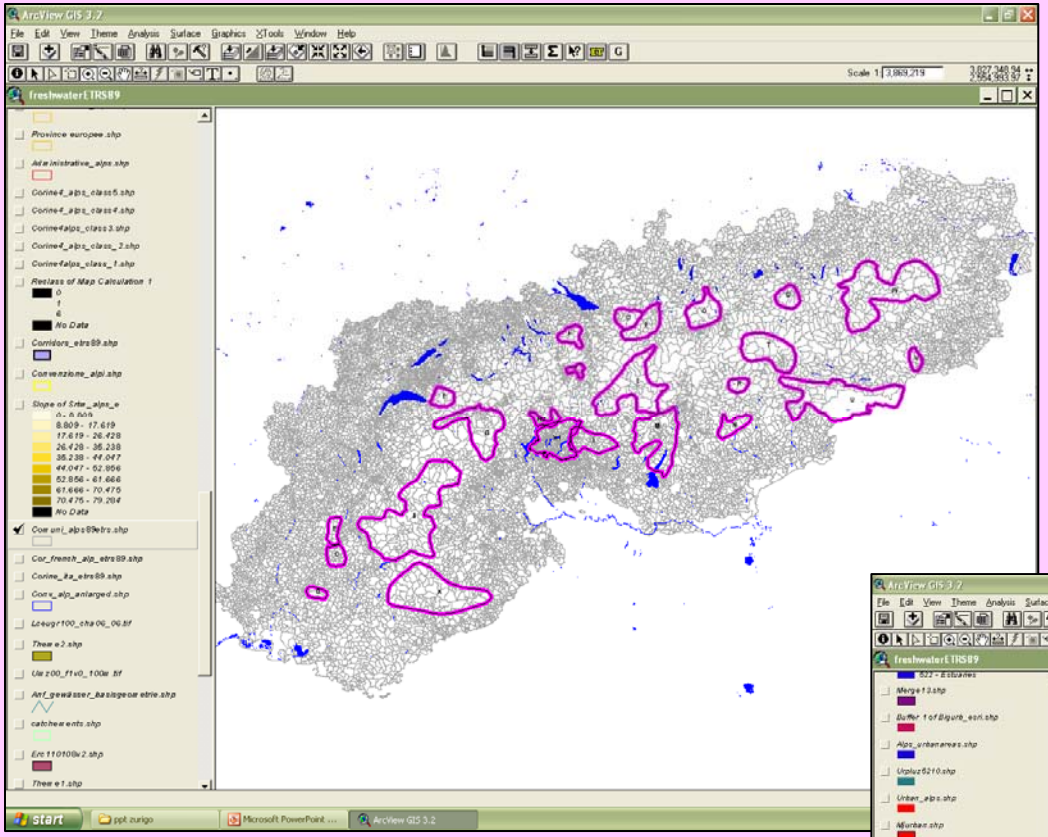


The problem
of Switzerland
(data needed)

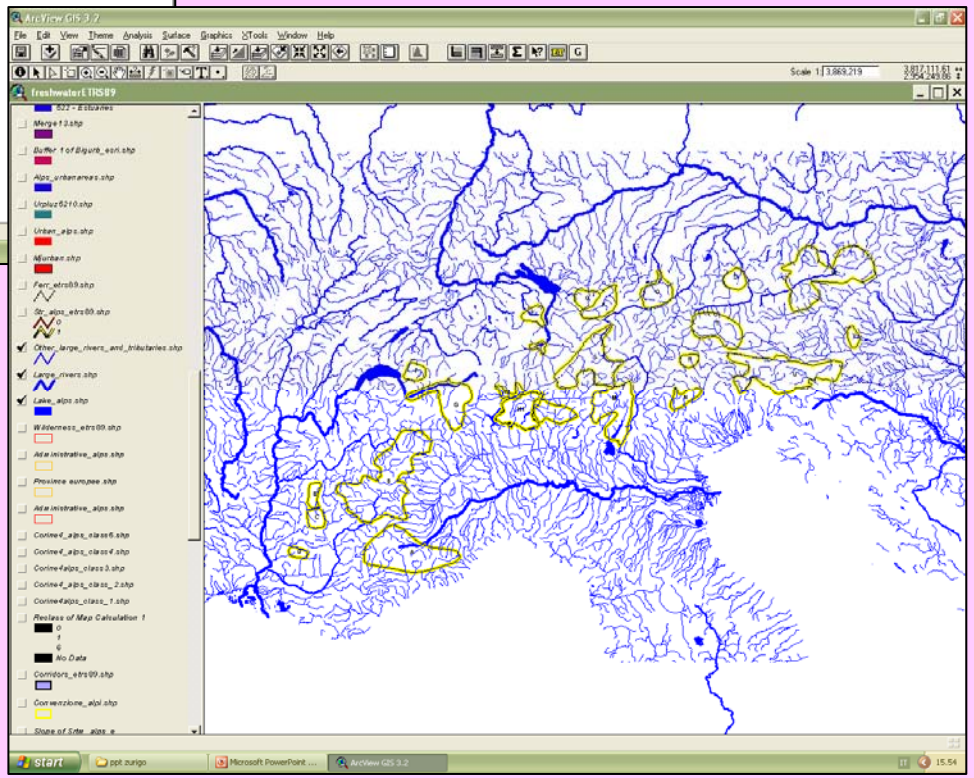


Nationally designated Areas (EU)

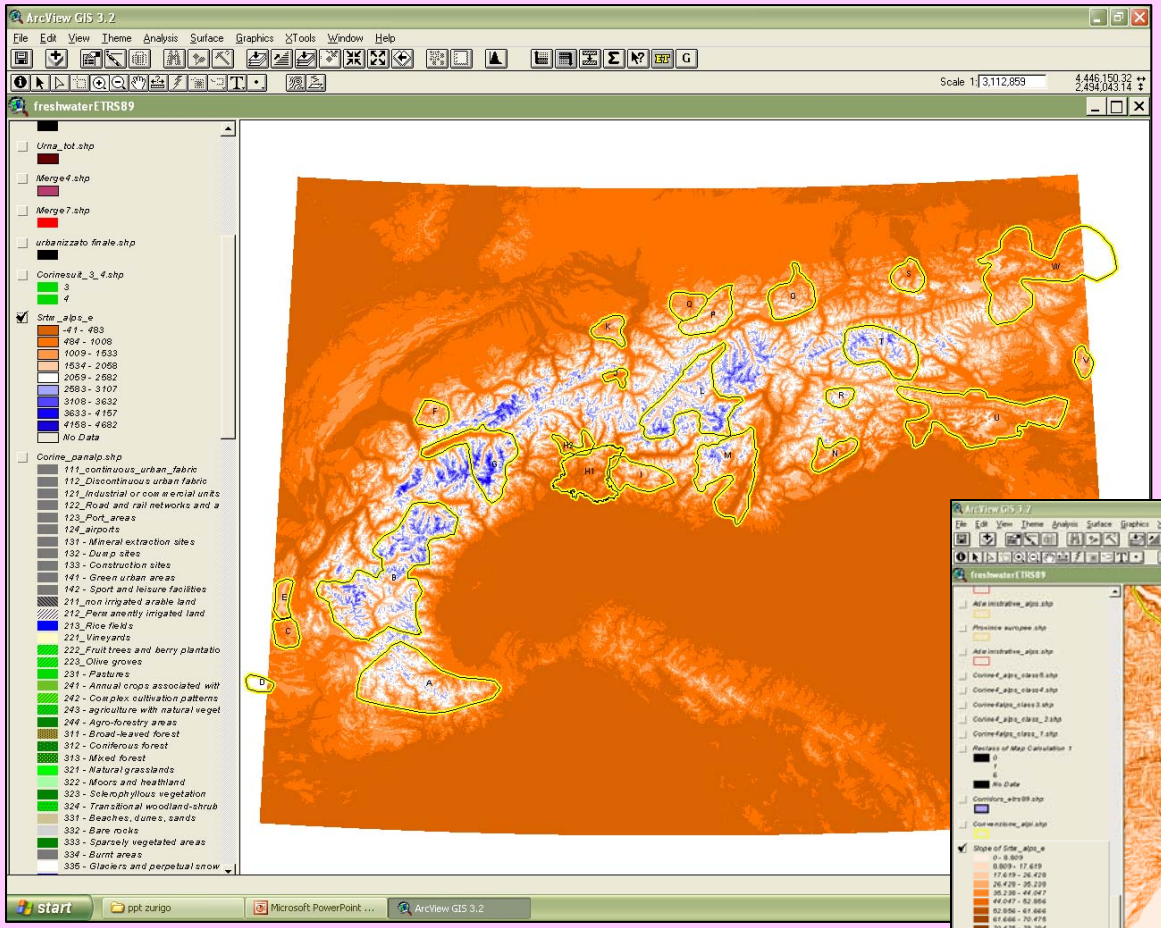




Municipalities

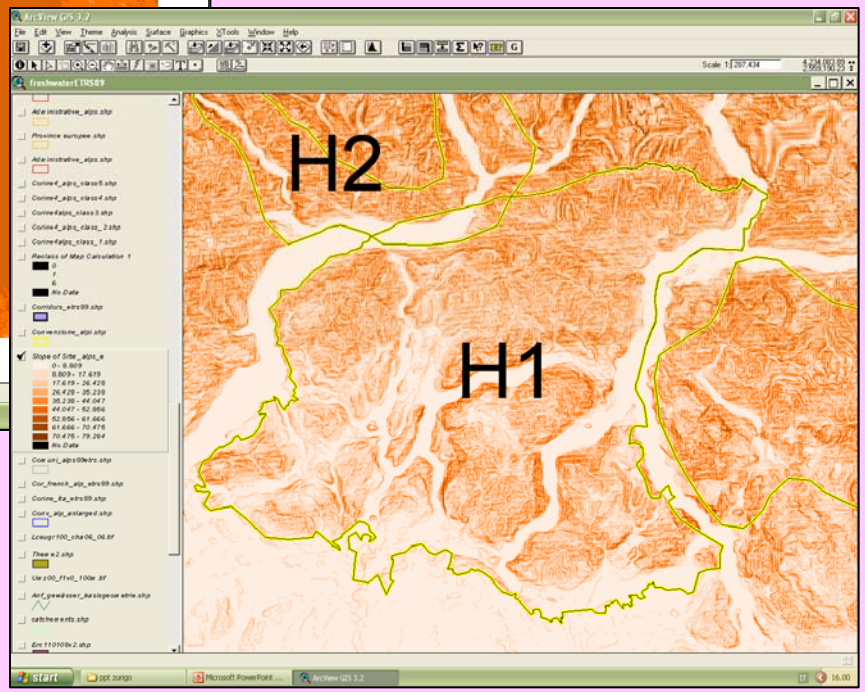


Rivers and lakes

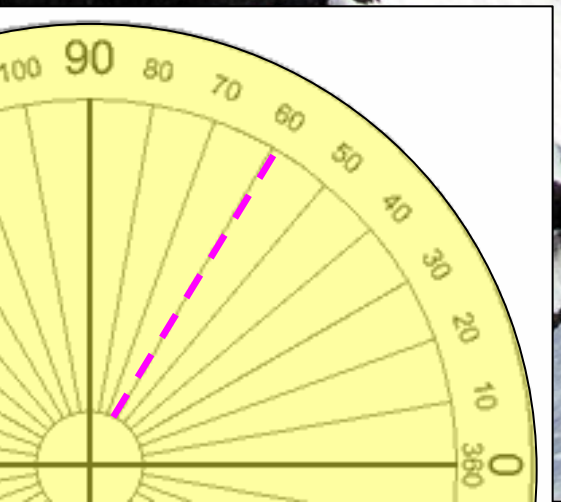


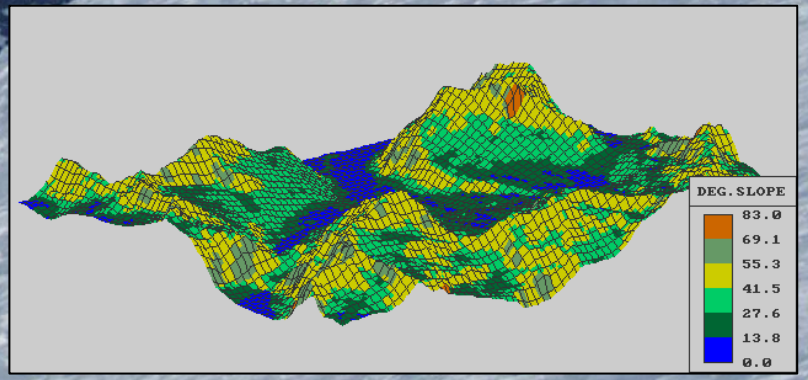
DEM
(Digital elevation model)

Slope

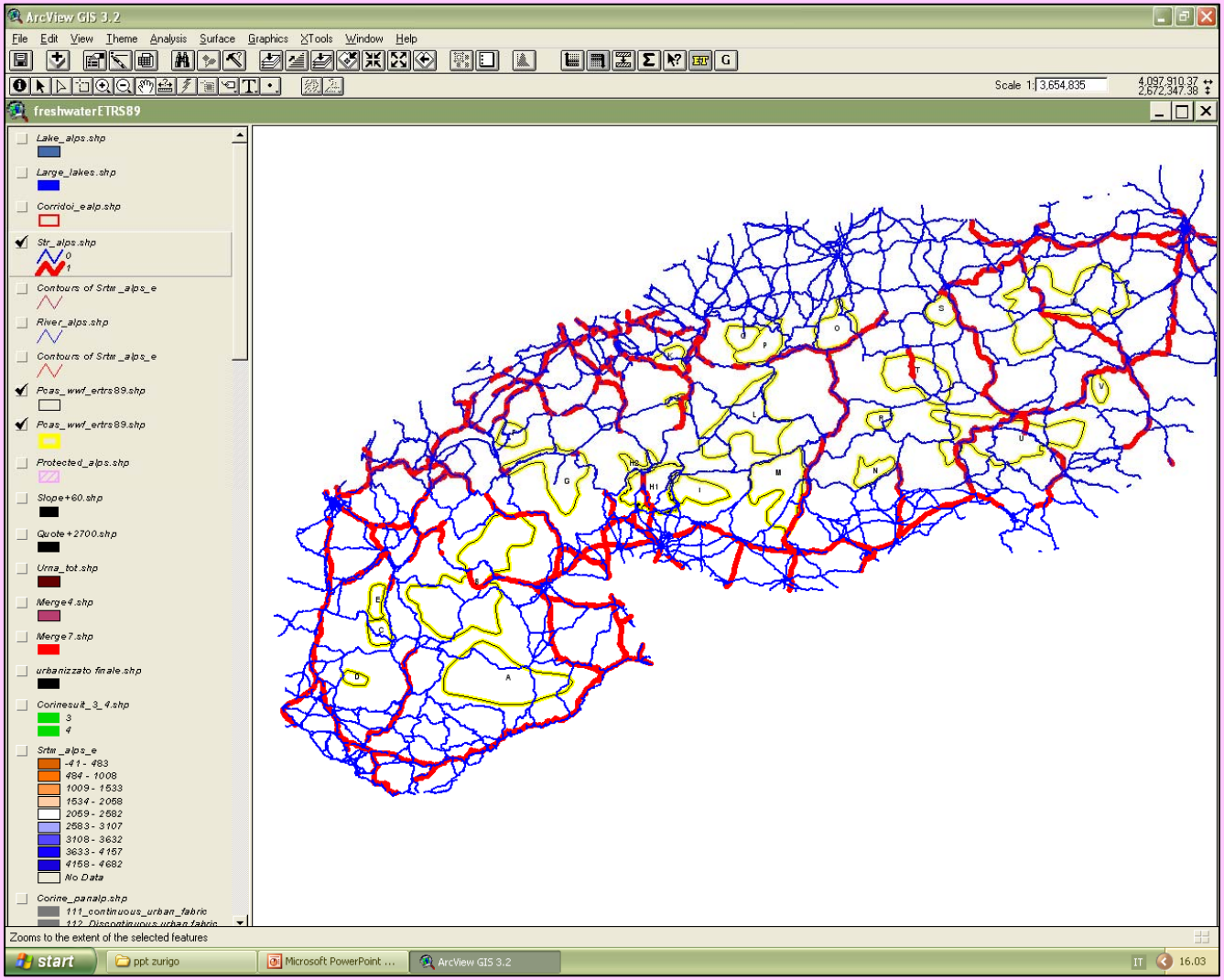


Slope degree
Excluding areas at slope > 60°





Fragmentation:
high traffic roads and highways



"NO" AREAS

A)Corine habitat classes re-classified as level 1 + level 2

B) Urbanised areas plus relative buffers

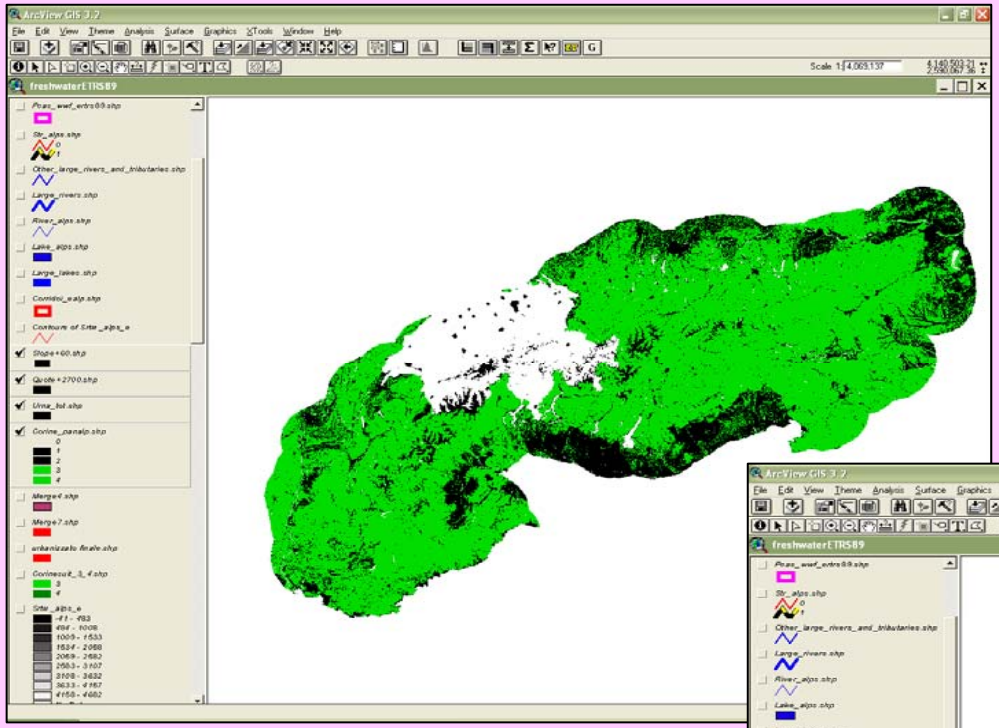
Buffers
Cities : 1 km
Urban < 600 m (altitude): 200 m
Urban > 600 m (altitude): 0

C) - Altitude > 2700 and/or Slope > 60°

"YES" AREAS

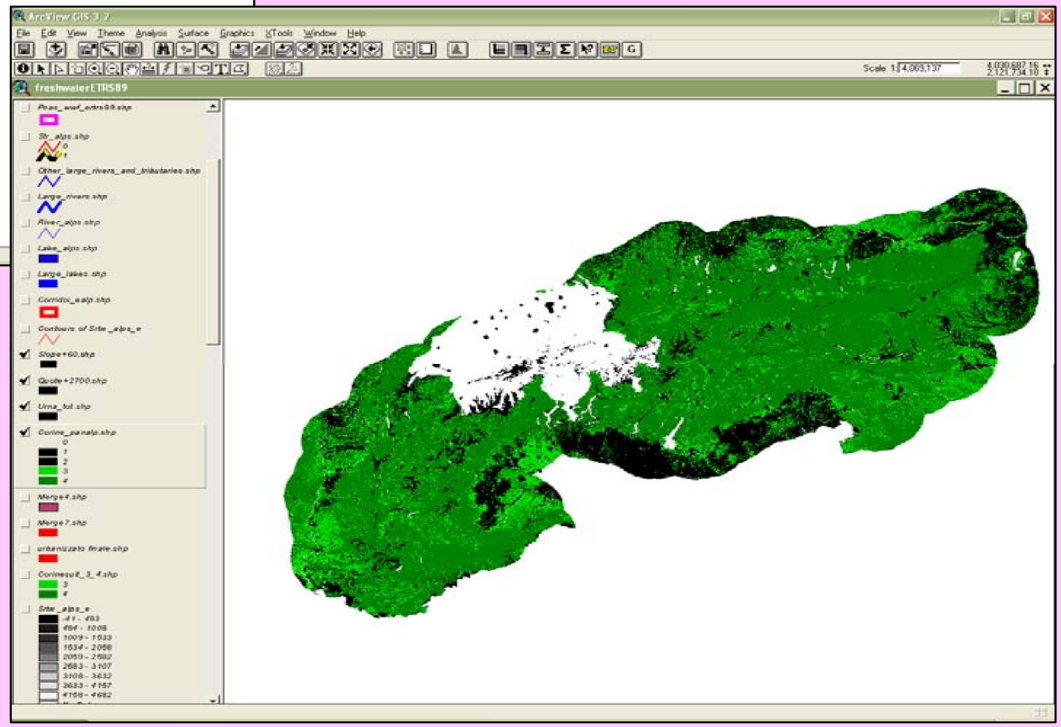
A)Corine habitat classes classified as level 3 + level 4

“*Yes*” vs. “*No*” area

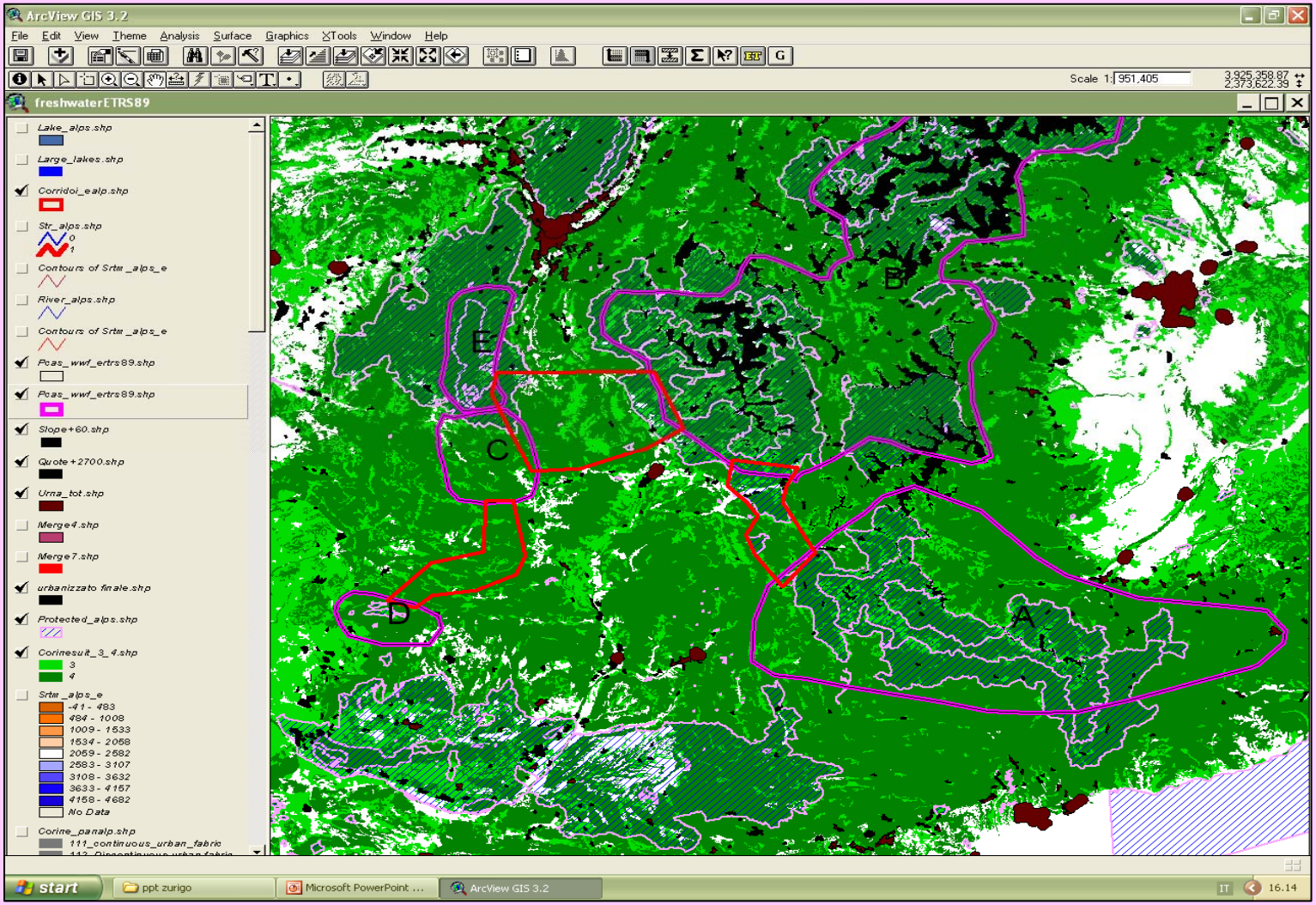


“Yes” or “no”

“Yes” or “no”
+
Better (3) and best (4)

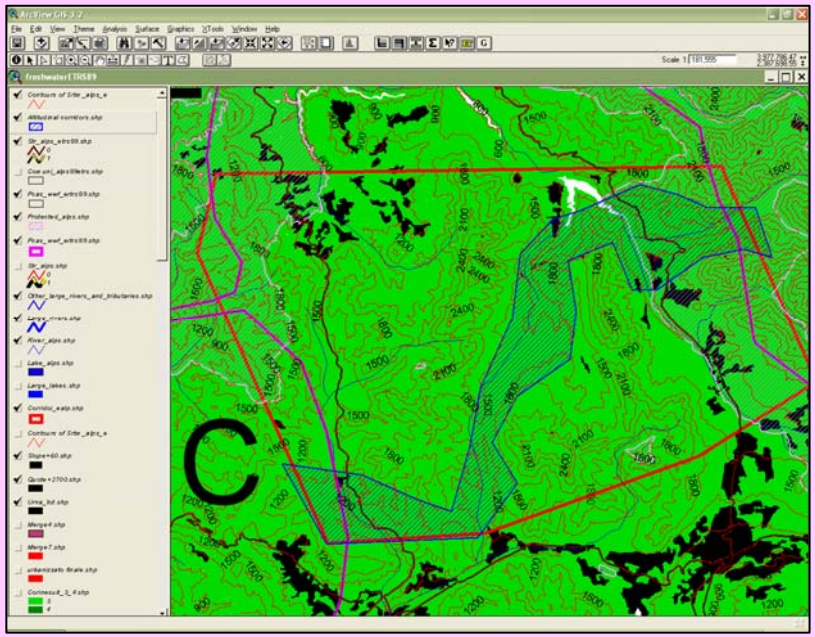


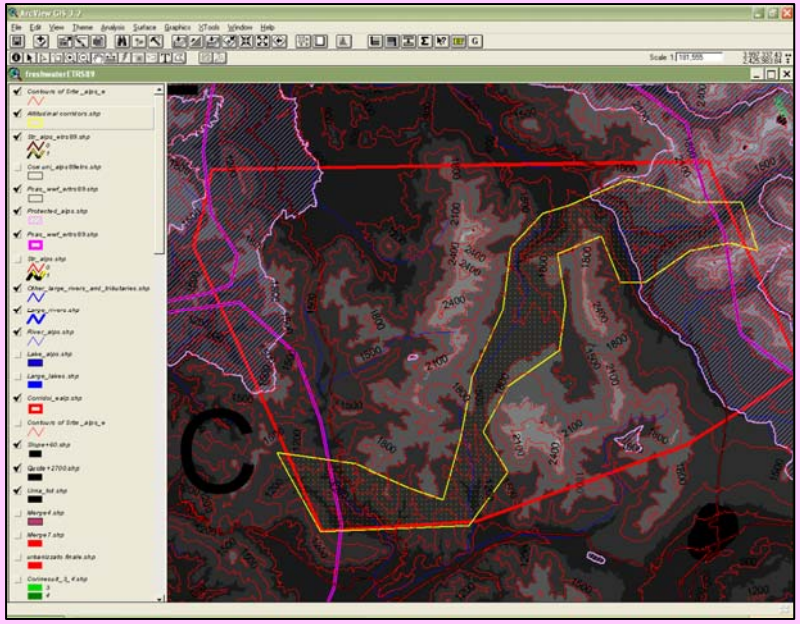
Proposing pilot study areas (1)

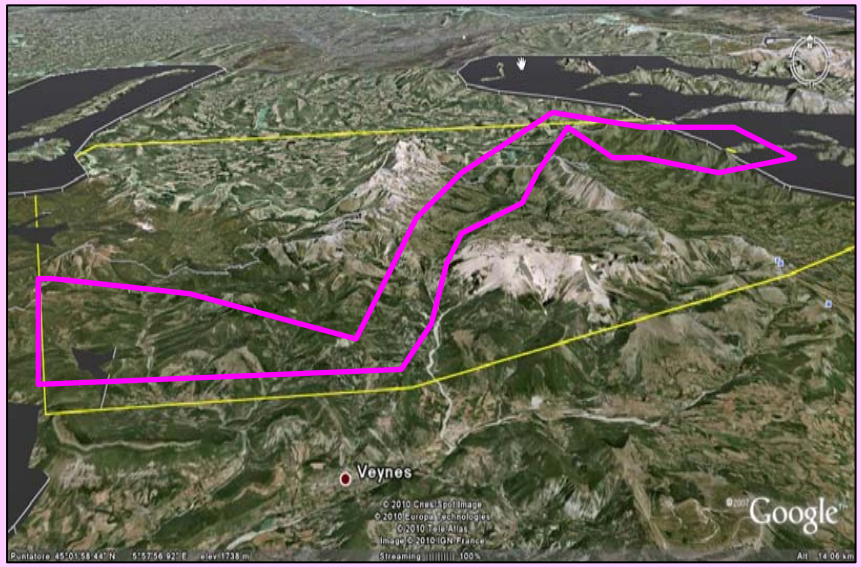


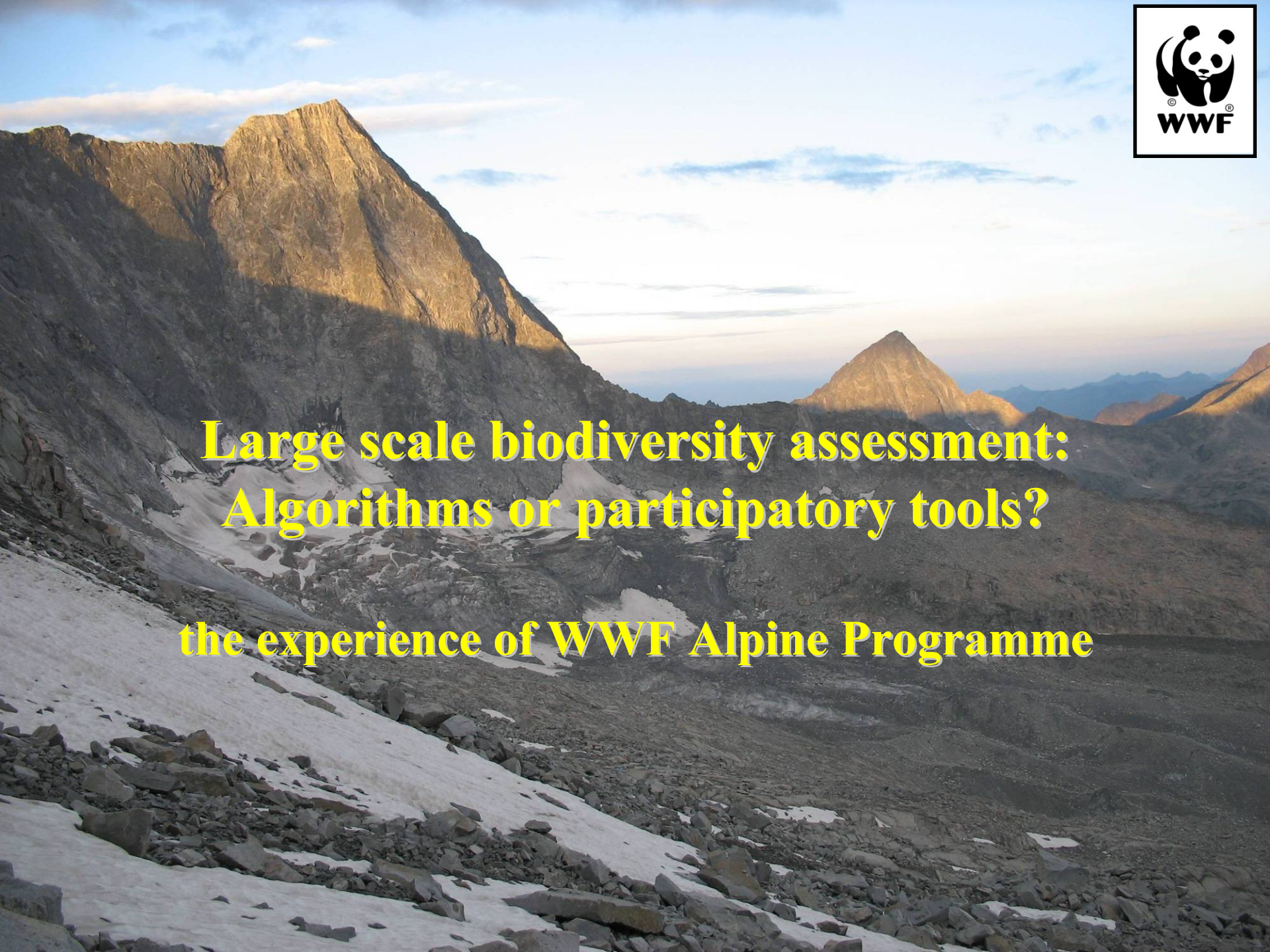
Trying to manage the altitude

Isoipse data and DTM can be used to draw a more precise corridor. This stage should be done anyway at PCA assessment scale.









Large scale biodiversity assessment: Algorithms or participatory tools?

the experience of WWF Alpine Programme

Biodiversity and conservation targets assessment

Threats assessment

Stakeholder analysis

PRELIMINARY SITUATION ANALYSIS

- ***Problem tree***
- ***Objectives tree***

- ***SWOT***
- ***Logical Framework…***

ACTION PLAN

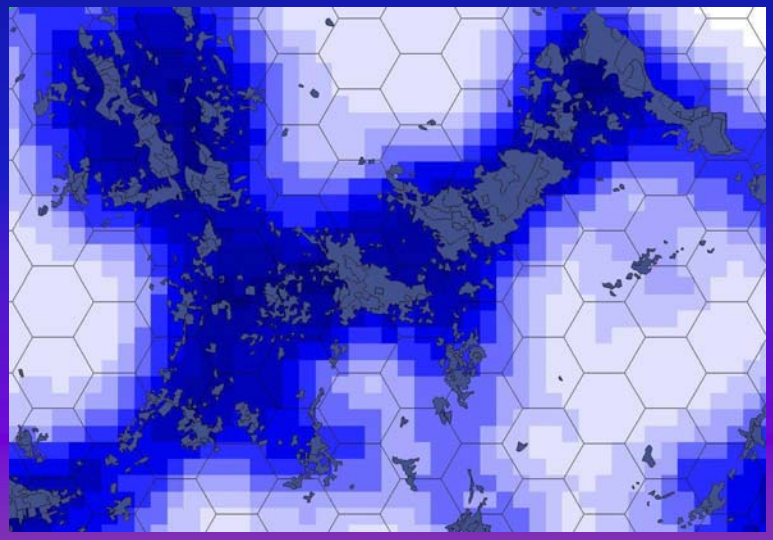
Participatory actions (A21)

Practical actions (e.g.: management plans)

Biodiversity and conservation targets assessment

Ecological modelling

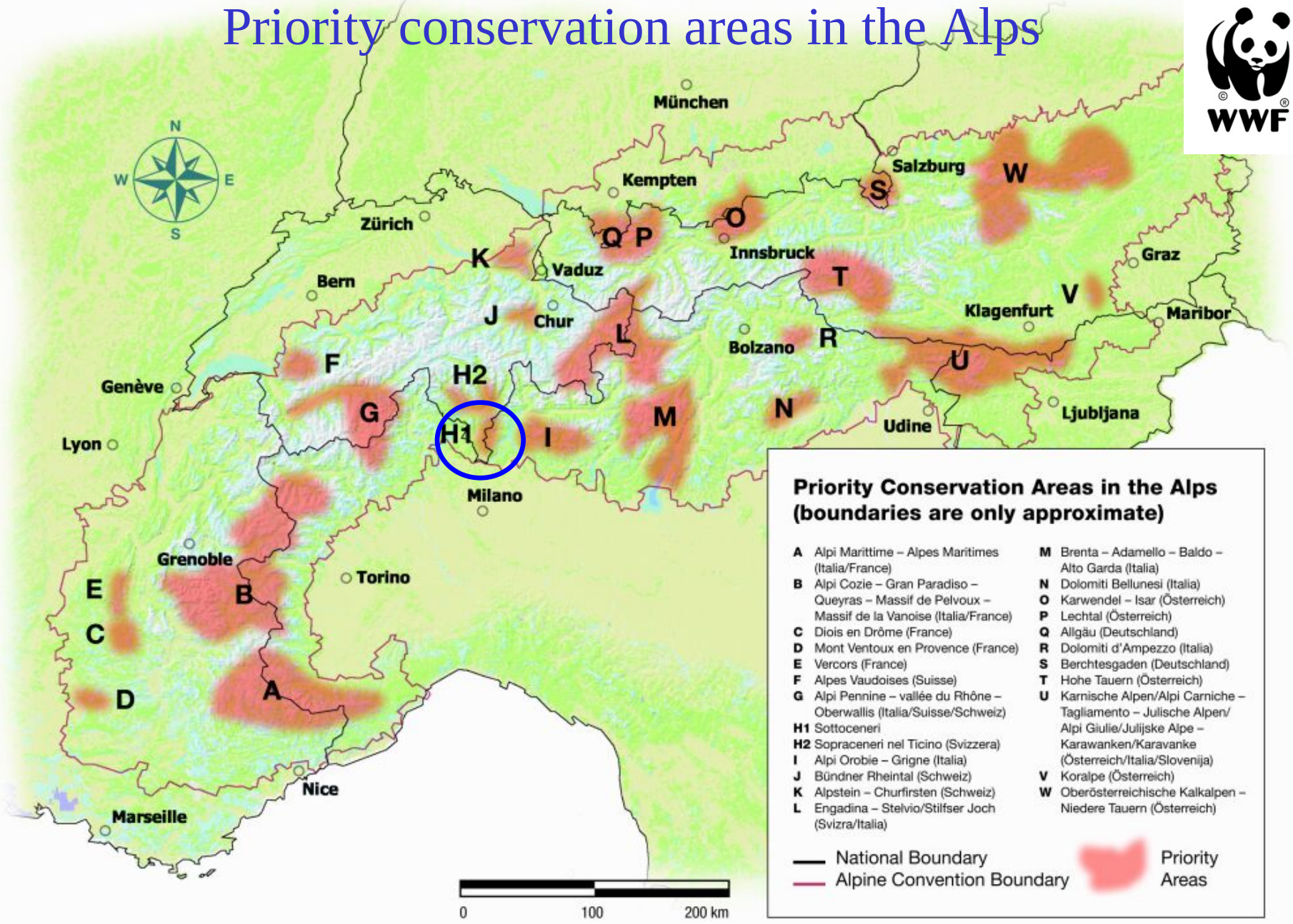
GIS based statistical predictive models useful to identify the most suitable areas for the highest number of species



The expert based approach

Participatory involvement of the scientific community. Selected people analyze the landscape assessing the priority areas at taxon and general level

Priority conservation areas in the Alps



A quantitative approach to biodiversity analysis: an application to terrestrial vertebrates in the Alpine Ecoregion, H1 Priority Conservation Area

Guido TRIVELLINI*,
Damiano G. PREATONI+,
Marco CANTINI#,
Andrea AGAPITO LUDOVICI*,
Guido TOSI+

* Programma Alpi, WWF Italia ONG - ONLUS
+Unità di Analisi e Gestione delle Risorse Ambientali, Dipartimento Ambiente-Salute-Sicurezza, Università degli Studi dell'Insubria
#Servizio Aree Protette, Paesaggio e Reti Ecologiche, Provincia di Como

Mapping diversity in H1 PCA

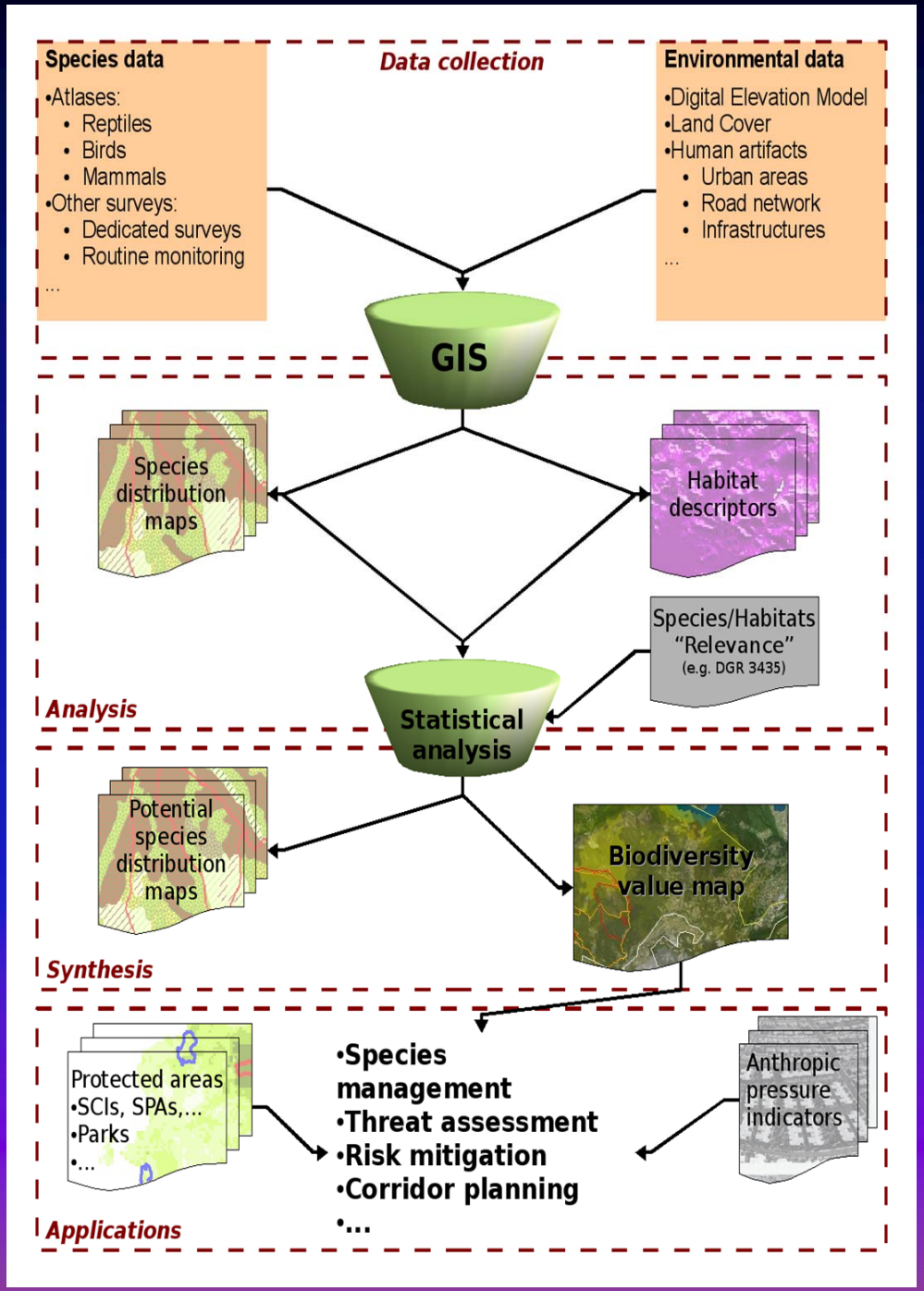
Aims:

evaluate biodiversity in H1 Area

identify "Diversity hotspots"

produce and test a repeatable methodology

transportable to other geographical contexts / PCAs ?



Modelling process

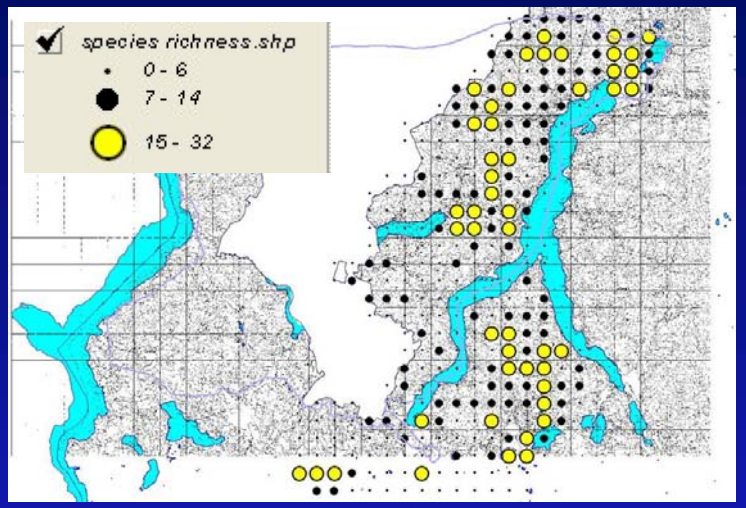
- Calculate potential distribution for each species
- Score each species by its "Conservation priority" $\rightarrow S_i$
- Calculate Vegetation type scores $\rightarrow V_i$
- Σs_i = wildlife value
- $\Sigma s_i + \Sigma v_i$ = total (landscape) value

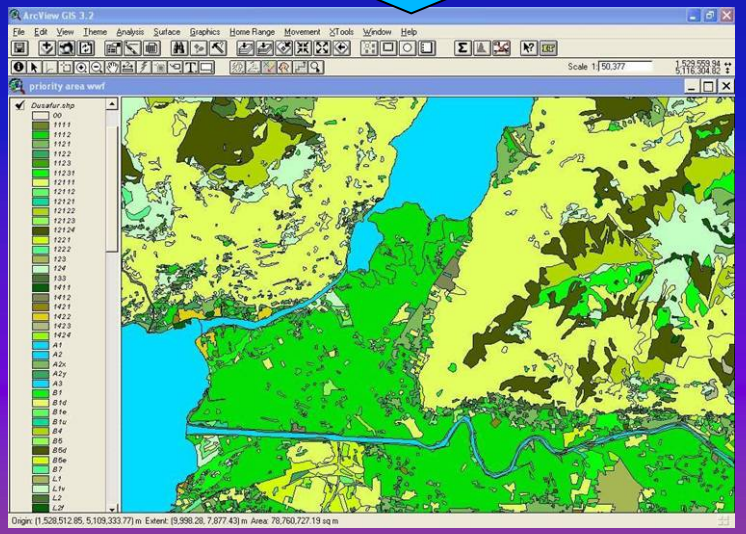
Availability of data (Italian side)

Data available

-**Wildlife**:
Provincial wildlife service database

Species presence data (binary coded 1/0) on 2 km square territorial units (grid cells)





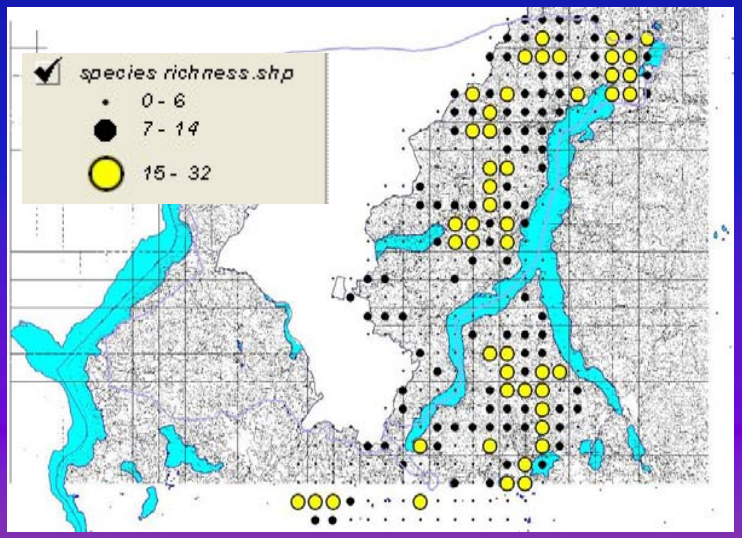
-**Land Use**:
Regional service vector cartography (40 m precision)

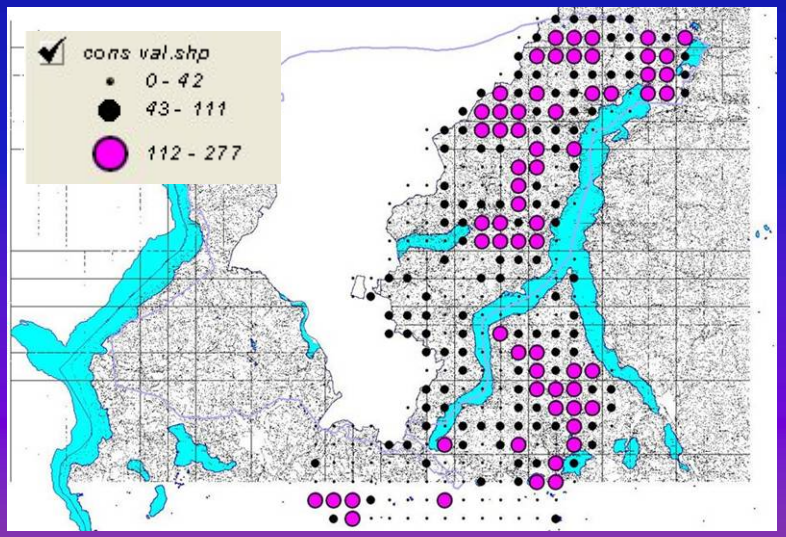
Conservation Priority Score (legally binding)

with partial scores based on:

- ***Rarity*** — ***red lists (IUCN, WWF)***
- **C**orology — distribution size
- **F**ragility — population trend, birth rate, population size
- **H**abitat selectivity — generalist or specialist species
- conservation **S**tatus — red lists (IUCN, WWF)

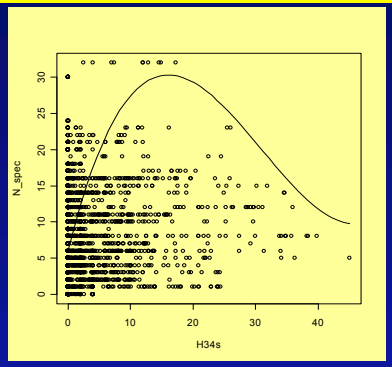
1 ≤ CPS ≤ 14



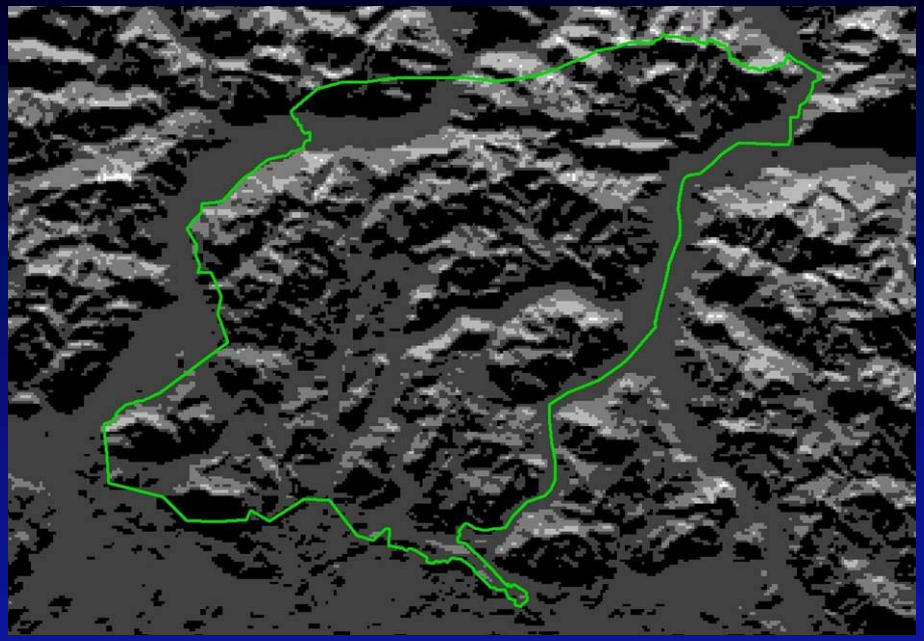


Indipendent variables (I)

Functional distances from:



lakes
rivers
roads
railroads
urban areas
power lines

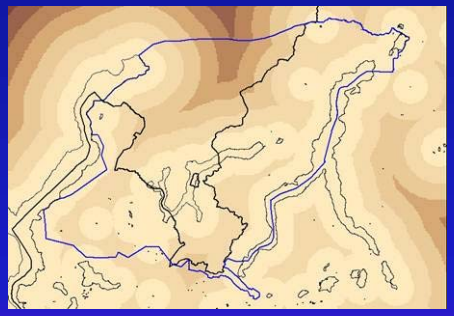


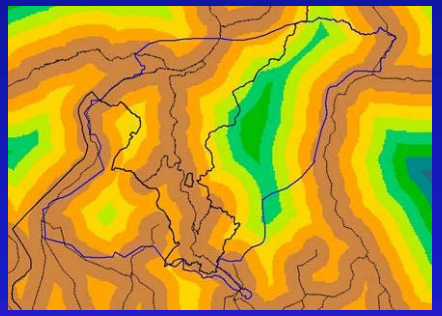
Digital elevation model and indirect variables:

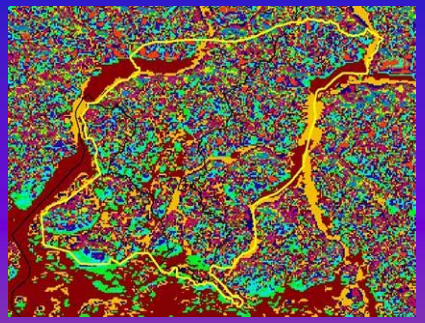
Elevation, slope, aspect

Ground roughness

Solar radiation (MJ/m^2/day)







Landscape metrics (patch level):

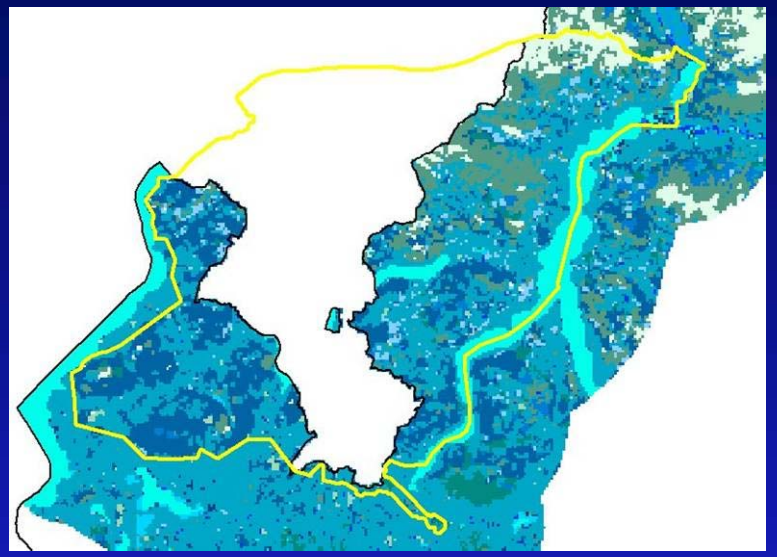
fragmentation indexes

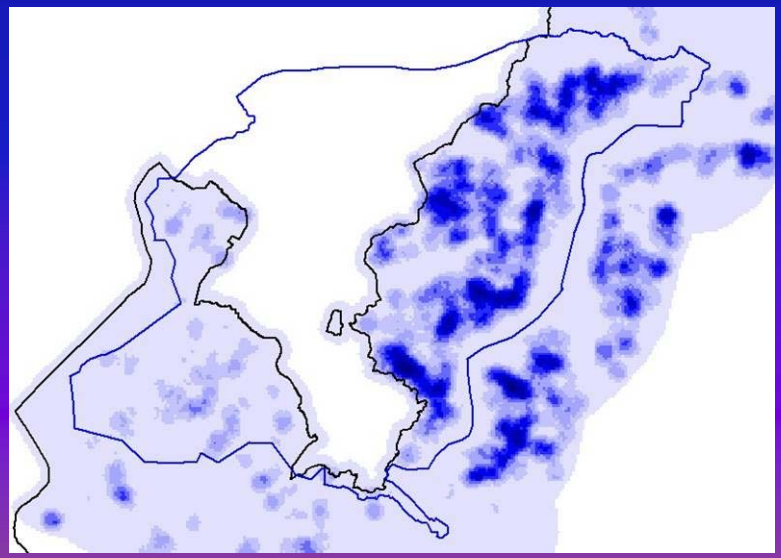
edge densities

Indipendent variables (II): habitat descriptors

Percentage of land cover class:

- Crop fields
- Rice crop fields
- Horticulture and complex agricultural systems
- Orchards and grapevines
- Wet pastures
- Livestock pastures
- Grasslands-crop fields mixed areas
- Coppice broadleaf forest
- Mature broadleaf forest (non-managed)
- Coniferous forest
- Mixed broadleaf and coniferous forest
- Shrubs
- Riverine vegetation
- Wetlands vegetation
- Sparse rock vegetation
- Shrubs – forest mixed areas
- Shrubs – abandoned agricultural land
- Quarries and other anthropic environments
- Dumps
- Glaciers
- Natural lakes
- Artificial lakes and canals
- Urbanised areas

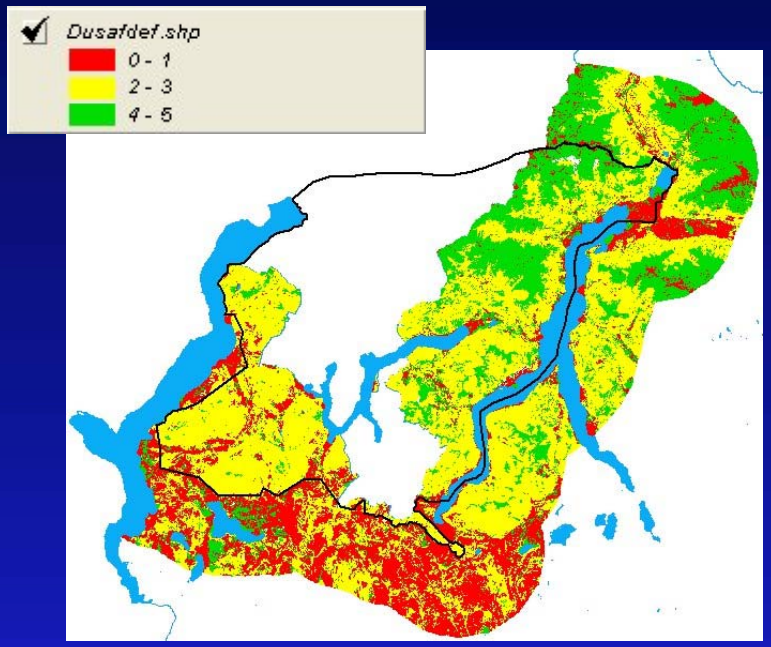




Vegetation Value

- Vegetation scored at habitat level
  (land use map classes)
- Factor-based, expert-based score
  - structure
  - distance from climax
  - floristic species richness
  - floristic species rarity
  - habitat peculiarity
  - wilderness level

Vegetation scores were used as a thematic layer in the final overlay with wildlife database data (%)

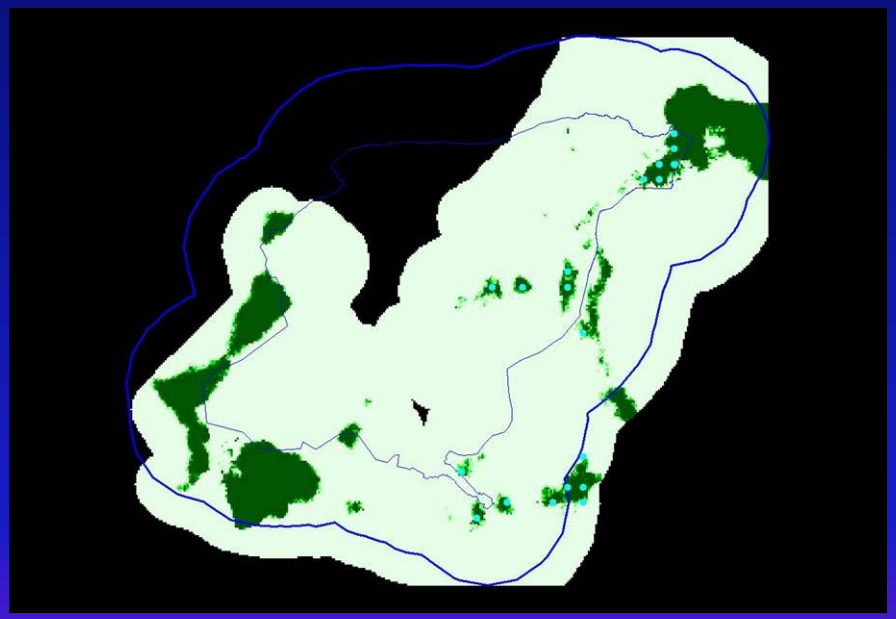


$$V = (x_1+x_2+x_3+x_4+x_5+x_6) / 6$$

$$1 < x_n < 5$$

Results

96 different single-species habitat suitability models (5 discarded): potential base for species-focused studies



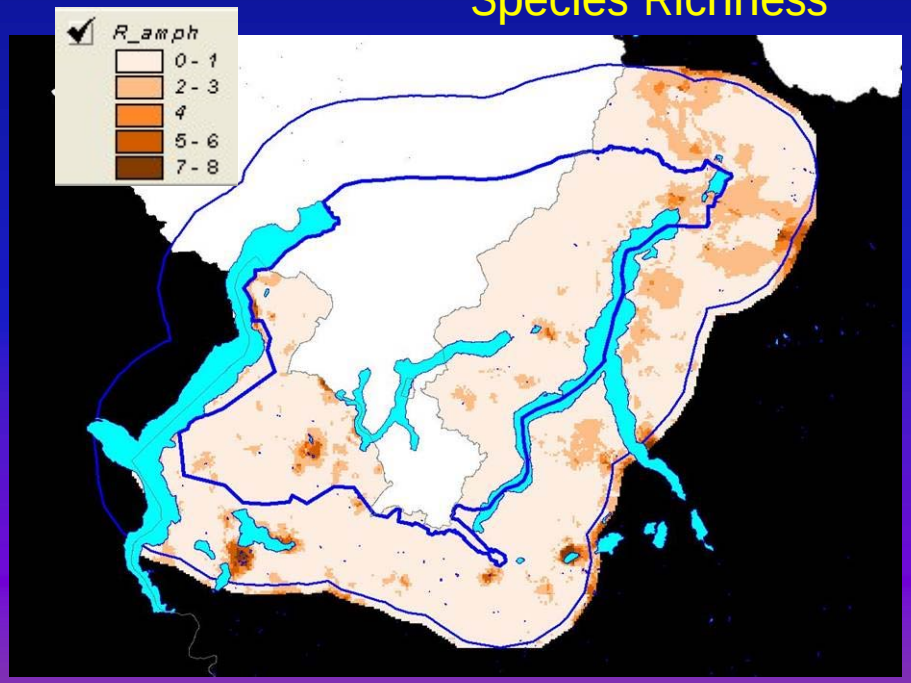
Alcedo atthis
(Kingfisher)

Lepus timidus
(Mountain hare)

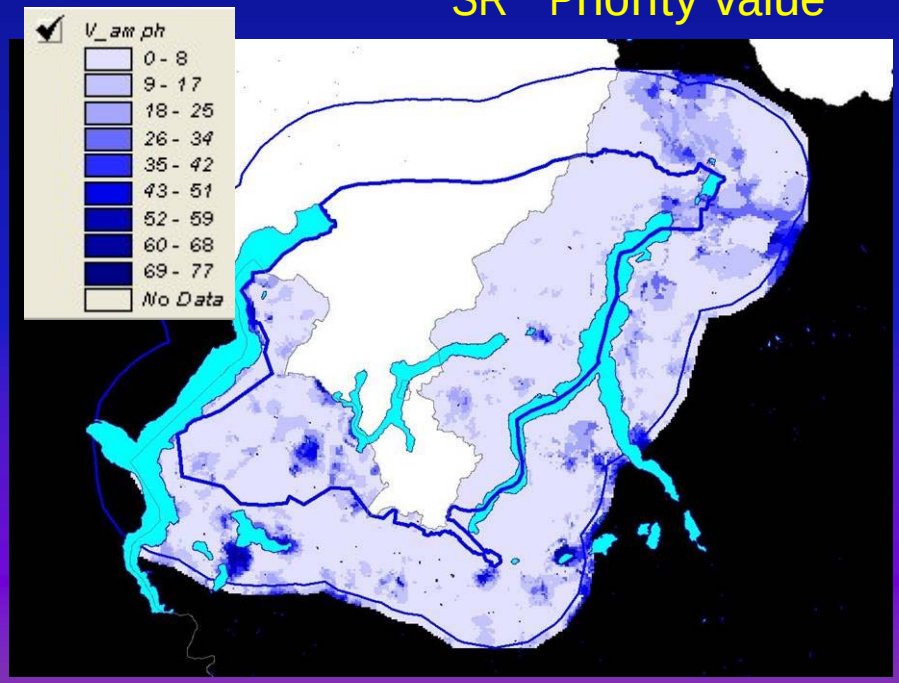
Results

Class-level hotspots and potential distributions (Amphibia)

Species Richness



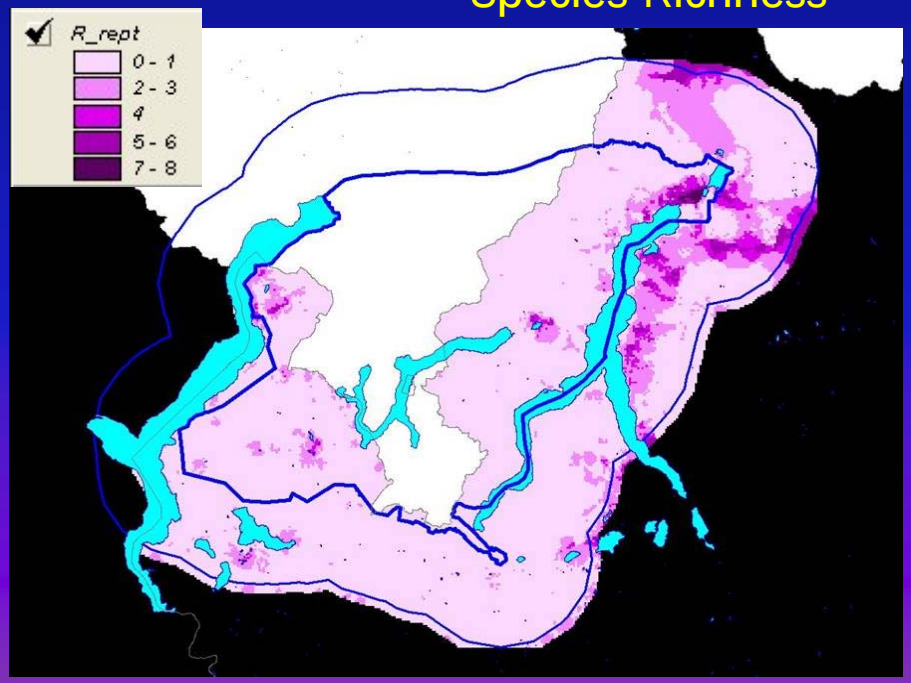
SR* Priority value



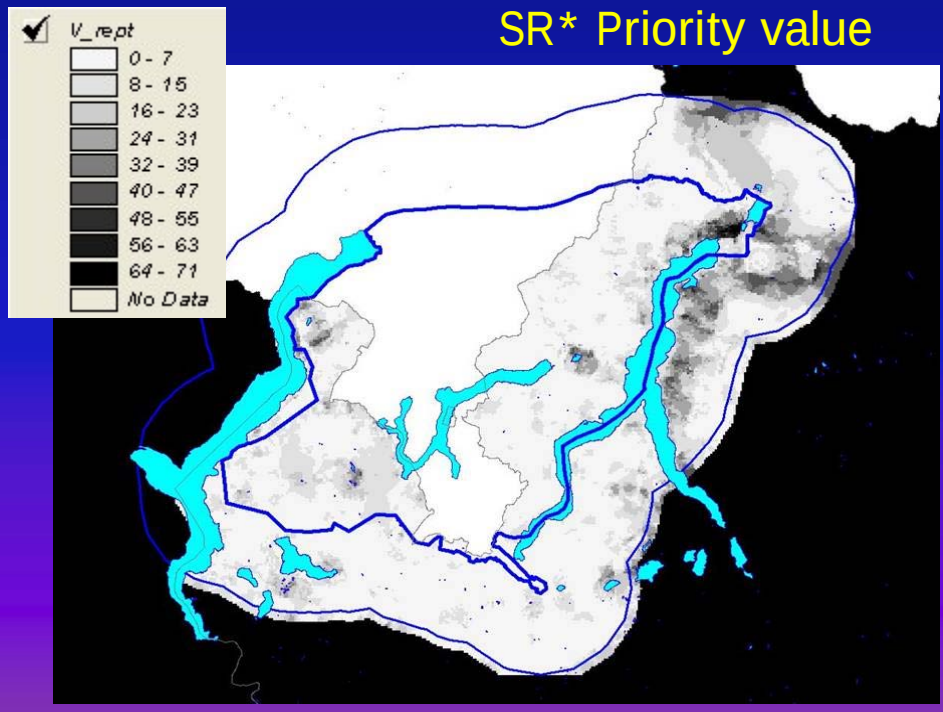
Results

Class-level hotspots and potential distributions (Sauropsida)

Species Richness



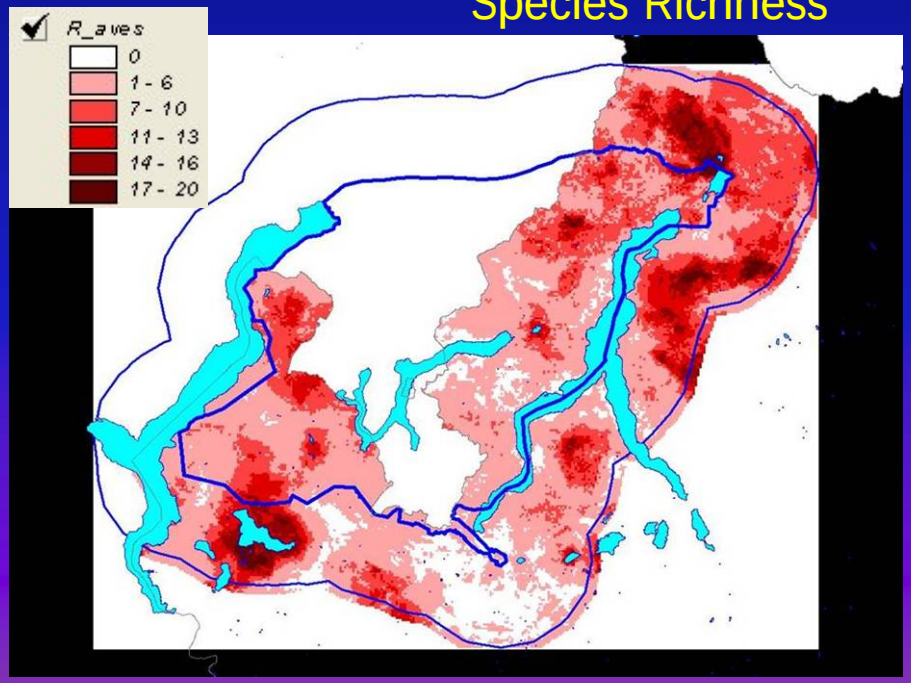
SR* Priority value



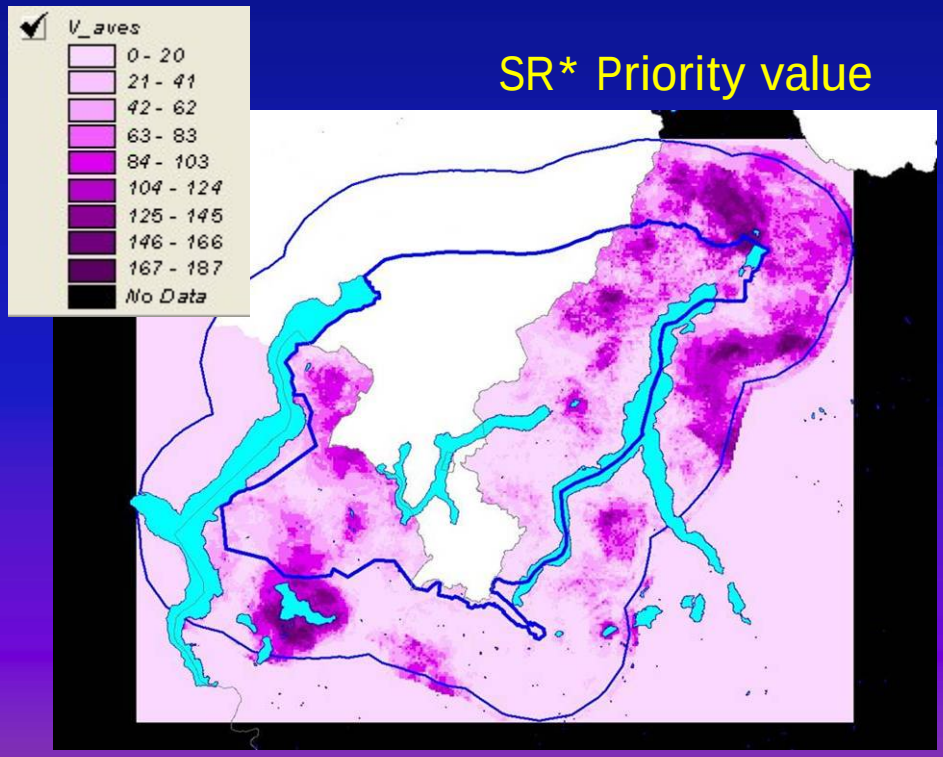
Results

Class-level hotspots and potential distributions (Aves)

Species Richness



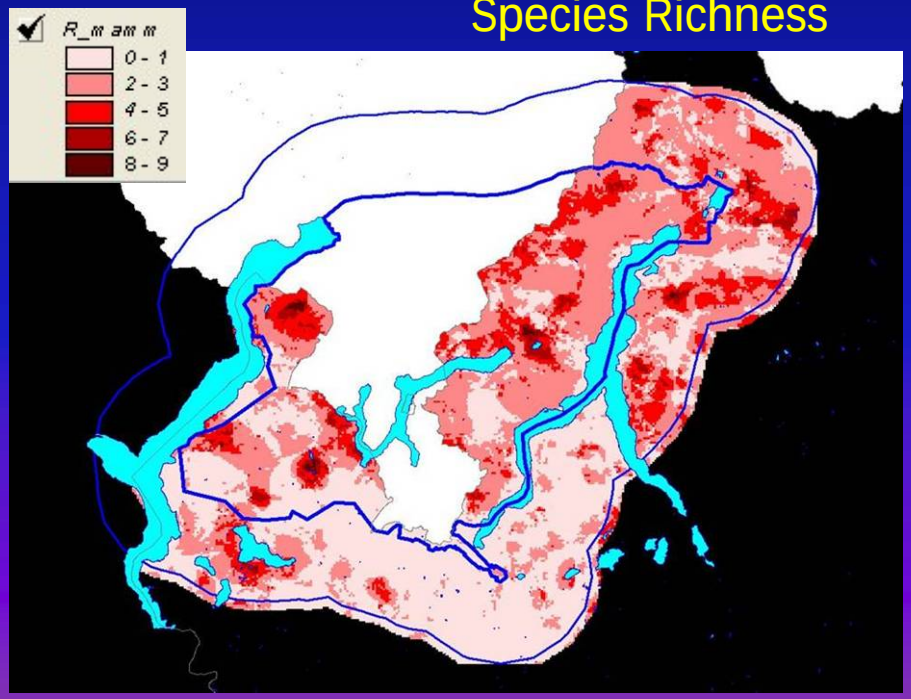
SR* Priority value



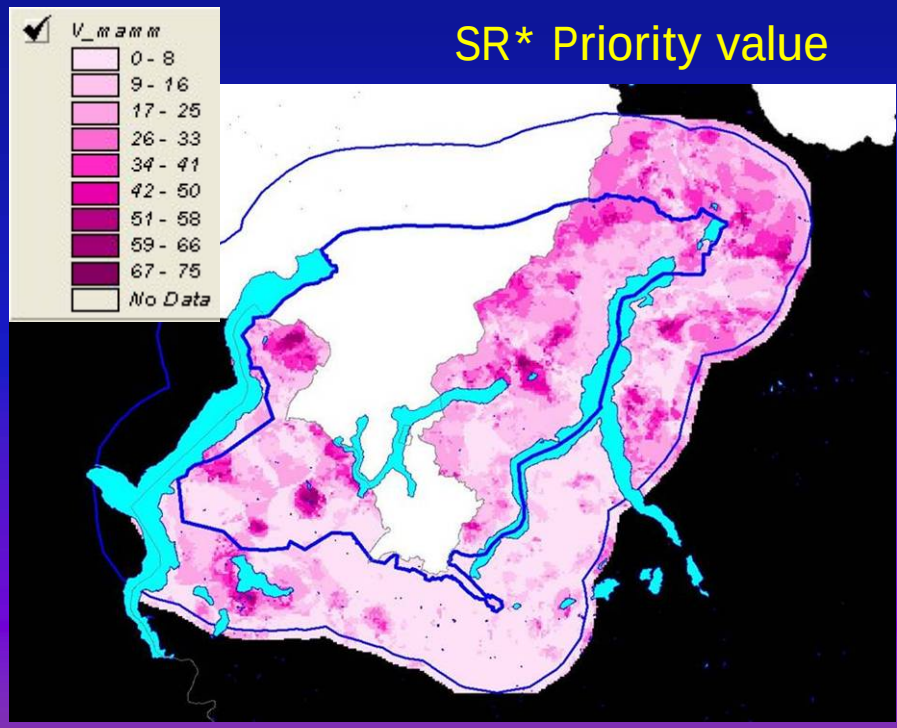
Results

Class-level hotspots and potential distributions (Mammalia)

Species Richness



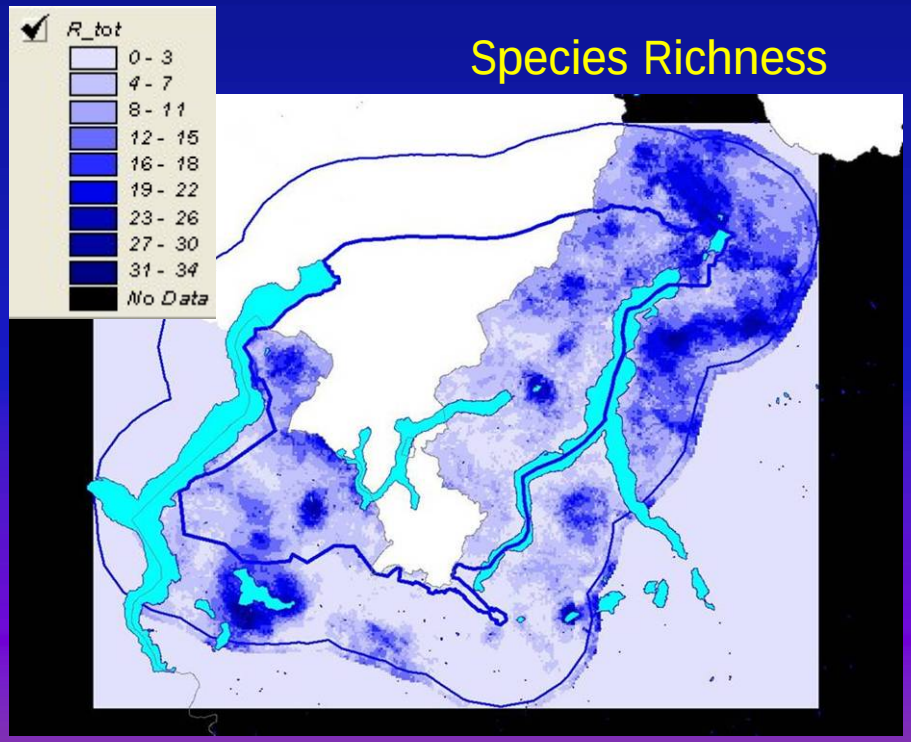
SR* Priority value



Results

Total Wildlife Value (all species)

Species Richness



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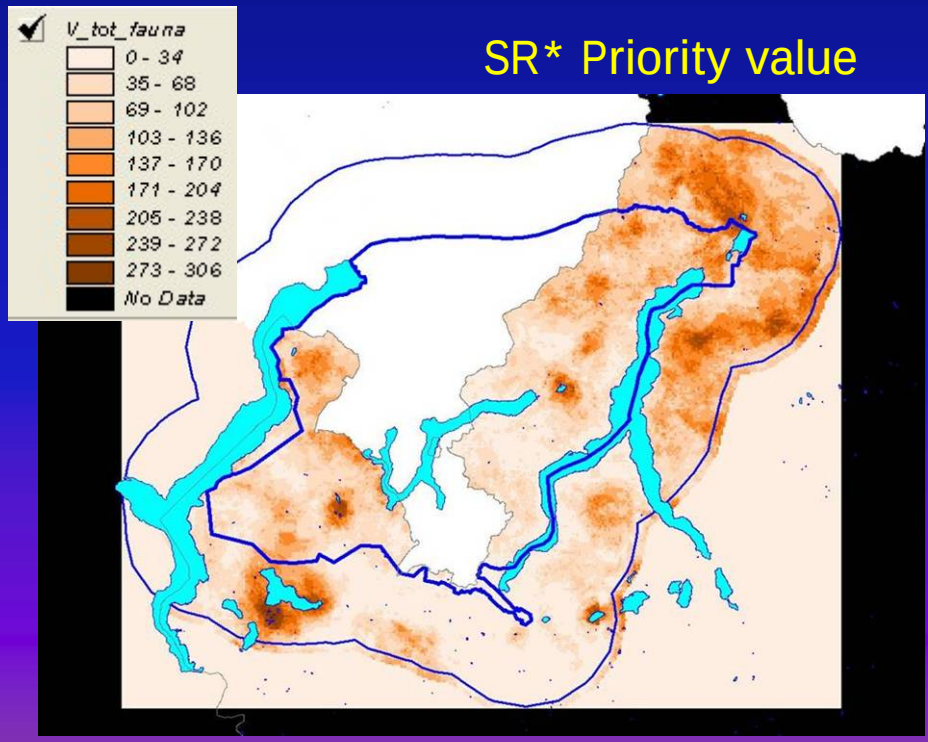


Is the model reliable?

class of species richness	fauna_val	Surface of SICs in the study area (Km2)	Surface of SICs in the study area (%)	percentage on total study area surface
0	lowest	2,375	0,85%	0,10%
1	low	19,5	6,98%	0,79%
2	medium	47,31	16,95%	1,90%
3	high	84,75	30,36%	3,41%
4	very high	125,25	44,86%	5,04%
	TOTALE	**279,185**	**100,00%**	**11,24%**

class of species richness	fauna_val	surface of ZPS (km2)	surface of ZPS (km2) (%)	percentage on total study area surface
0	lowest	0,125	0,13%	0,01%
1	low	3,44	3,56%	0,14%
2	medium	18	18,63%	0,72%
3	high	23,69	24,52%	0,95%
4	very high	51,37	53,16%	2,07%
	TOTALE	**96,625**	**100,00%**	**3,89%**

class of species richness	fauna_val	SIC + ZPS surface (Km2)	SIC + ZPS surface (Km2) (%)	percentage on total study area surface
0	lowest	48,5	12,56%	1,95%
1	low	22,44	5,81%	0,90%
2	medium	62,06	16,07%	2,50%
3	high	99,25	25,70%	4,00%
4	very high	153,94	39,86%	6,20%
	TOTALE	**386,19**	**100,00%**	**15,55%**

Overlay with SCIs ("Habitats" Directive Sites of Community Importance) and SPAs ("Birds" EU Directive)

SCIs and SPAs should account for high diversity values

Statistical "reliability":

ROC analysis (average predictive power)

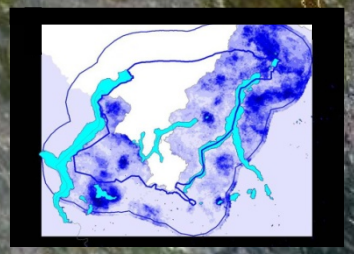
Minimum value: 77.8% (worse model)

Maximum accepted: 99.8% (best non-overfitting model)

Average AUC 93.6 %

From data analysis to practical conservation

Project approved for funding by
CARIPLO FOUNDATION, 2007
SCI IT2020009"Valle del Dosso" Management plan



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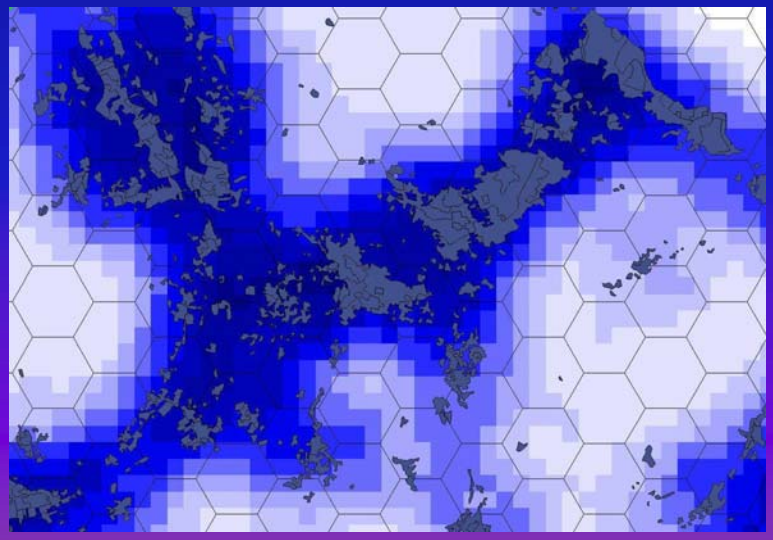


The expert based approach

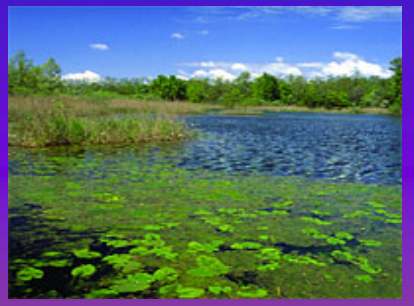
Participatory involvement of the scientific community. Selected people analyze the landscape assessing the priority areas at taxon and general level

WWF

Fondazione Lombardia per l'Ambiente

Fine participatory mapping of Po plain biodiversity: *An example of participatory research*

RegioneLombardia



Project title: An Ecological Network for the Padana Plain of Lombardia

Funded by: Regione Lombardia

Executors: Lombardia Ambiente Foundation

WWF Italia

co-ordinator Prof . G. Bogliani (University of Pavia)

Objectives

First step (2006-2007): identification of *Priority Areas* for biodiversity conservation in Central Padana Plain (15.000 km^2) according to the WWF ecoregion-based conservation (ERBC) approach; **output maps 1: 100.000**

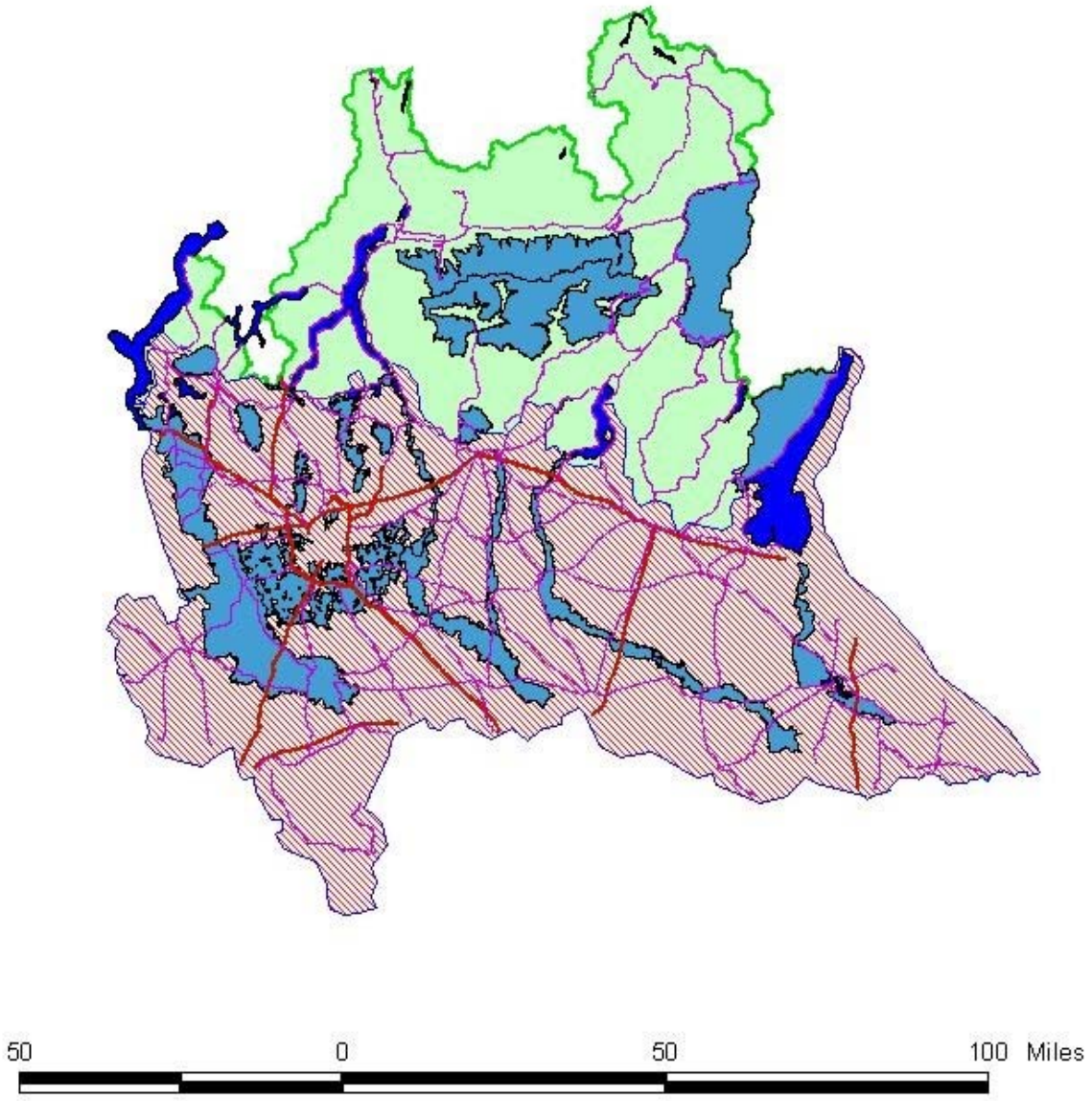
Second step (2007-2008): support to every provincial work (multiapproach) to create *Ecological Networks* for the Central Padana Plain; output maps **1: 25.000**

1. Study area

Ecoregion: Alps

Study area: Central Padana Plain

Ecoregion: Mediterranean



Methodology

The procedure of identification of Priority Areas is based on the **consultation of experts** who have:

- a specific knowledge of a **taxon, habitat or ecological process**;

- a good knowledge of all or a large part of the **whole study area**.

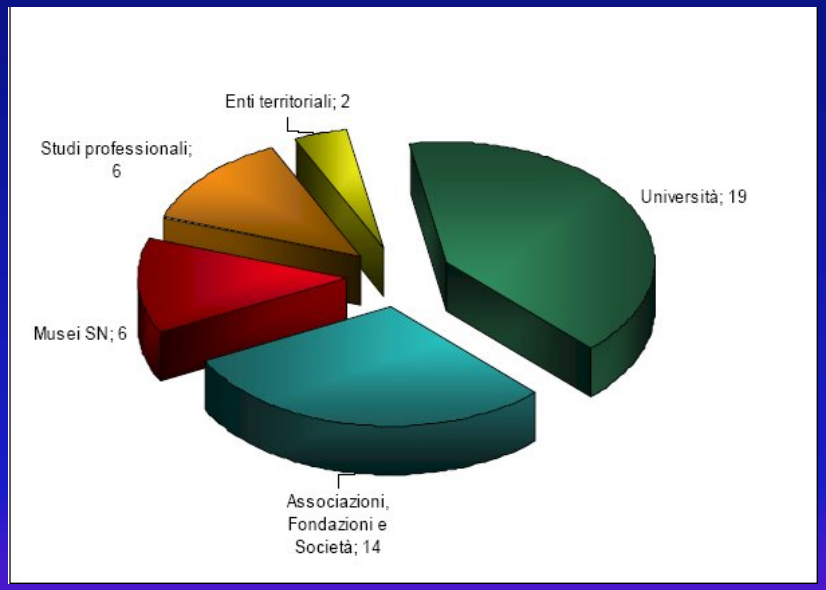
2. Groups of experts involved

1. Vascular Plants and Vegetation
2. Briophytes and Lichens
3. Mushrooms
4. Invertebrates
5. Fishes
6. Amphibians and Reptiles
7. Birds
8. Mammals
9. Ecological Processes

Experts affiliations

- 40.4% : universities
- 29.7% : associations, foundations
- 12,78 : museums
- 12.76% : technical offices
- 4,2% :territorial technical units (province, Region)

N = 47



2. Identification of focal species, habitats and ecological processes

Species, habitats and ecological processes that represent a good model for the conservation of entire ecosystems in the Padana Plain

DISCUSSION ABOUT FOCAL SPECIES

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FOCAL SPECIES: AMPHIBIANS

Species	Motivations
Pelobates fuscus insubricus	Rare, localized, endemic, Annex II* HD
Rana latastei	Endemic, Annex II HD, IUCN
Rana italica	Endemic, common in well preserved Appennine suitable habitats
Bufo bufo	Common and widespread, migration between wintering and breeding sites
Triturus carnifex	Annex II HD, linked to the last remnants of standing waters habitats in the Padana Plain
Salamandrina perspicillata	Endemic, Annex II HD

IDENTIFICATION OF IMPORTANT AREAS

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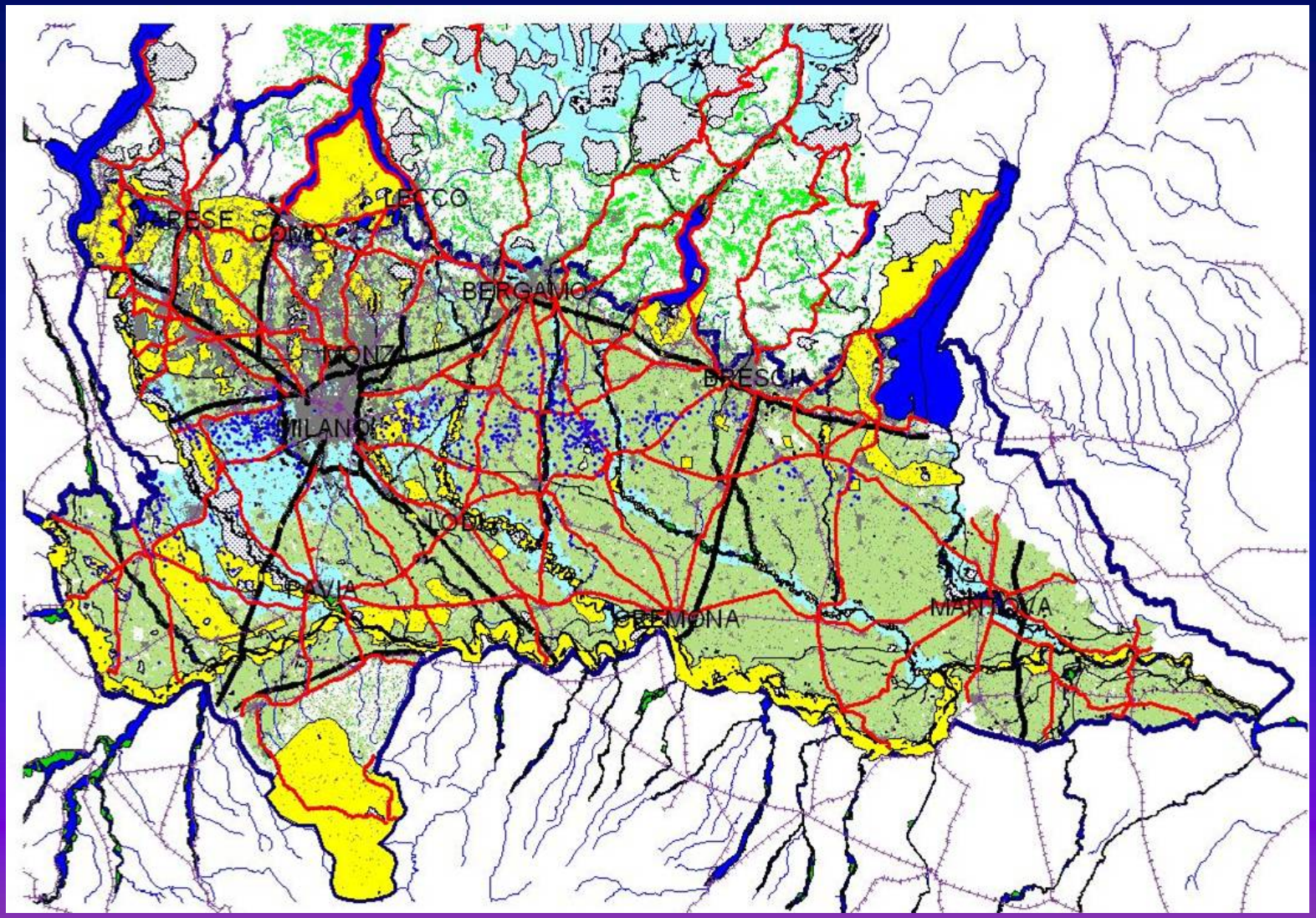
IDENTIFICATION OF IMPORTANT AREAS

IMPORTANT AREAS: MAMMALS



3. Priority Areas

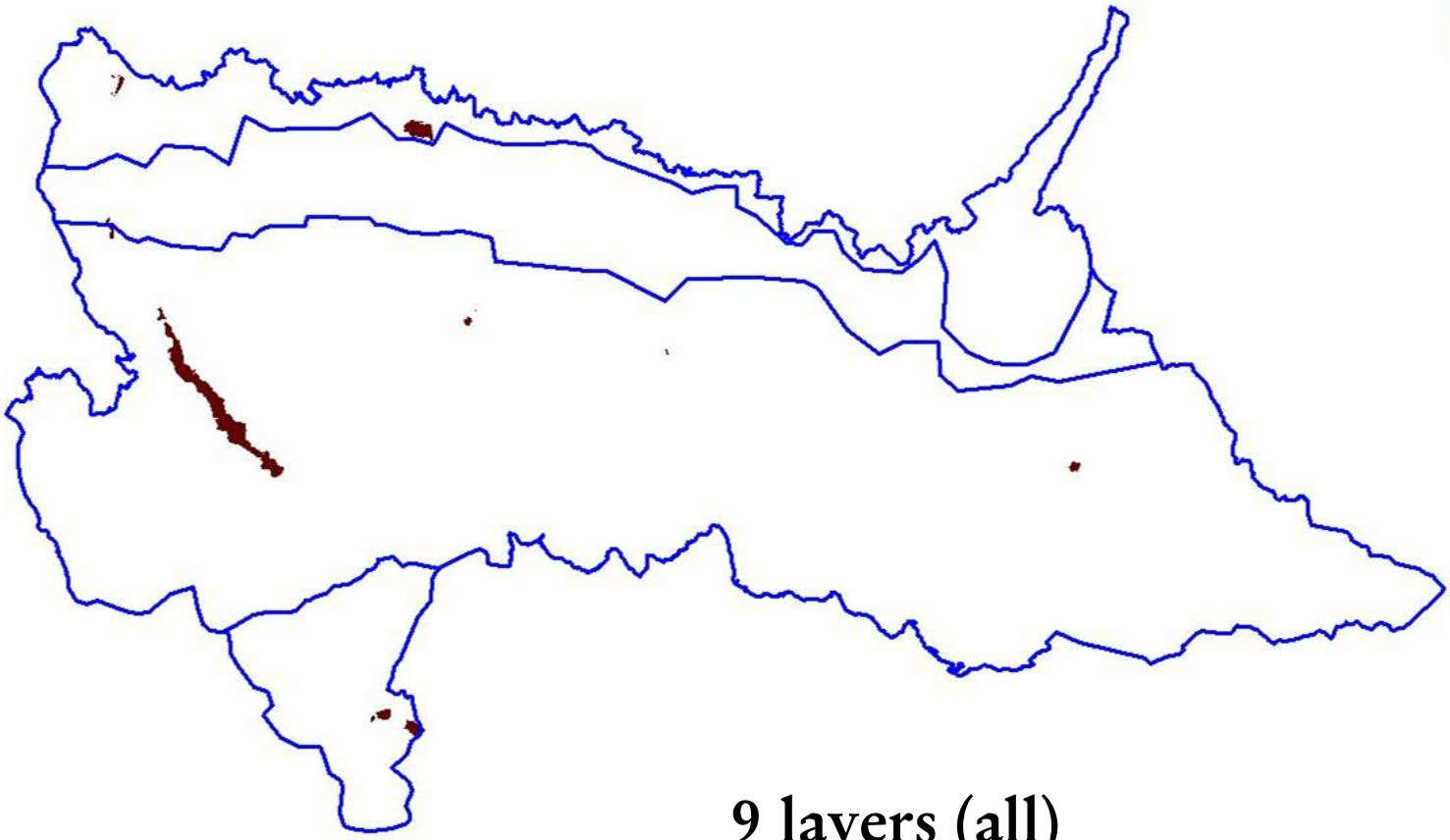
They are selected by a GIS overlay process of the taxon-specific important areas.

The scientific community decided

by a participatory action in plenary session (47 people) the necessary number of layers to be overlayed. This implies a

specific conservation goal (connectivity?) and has

political consequences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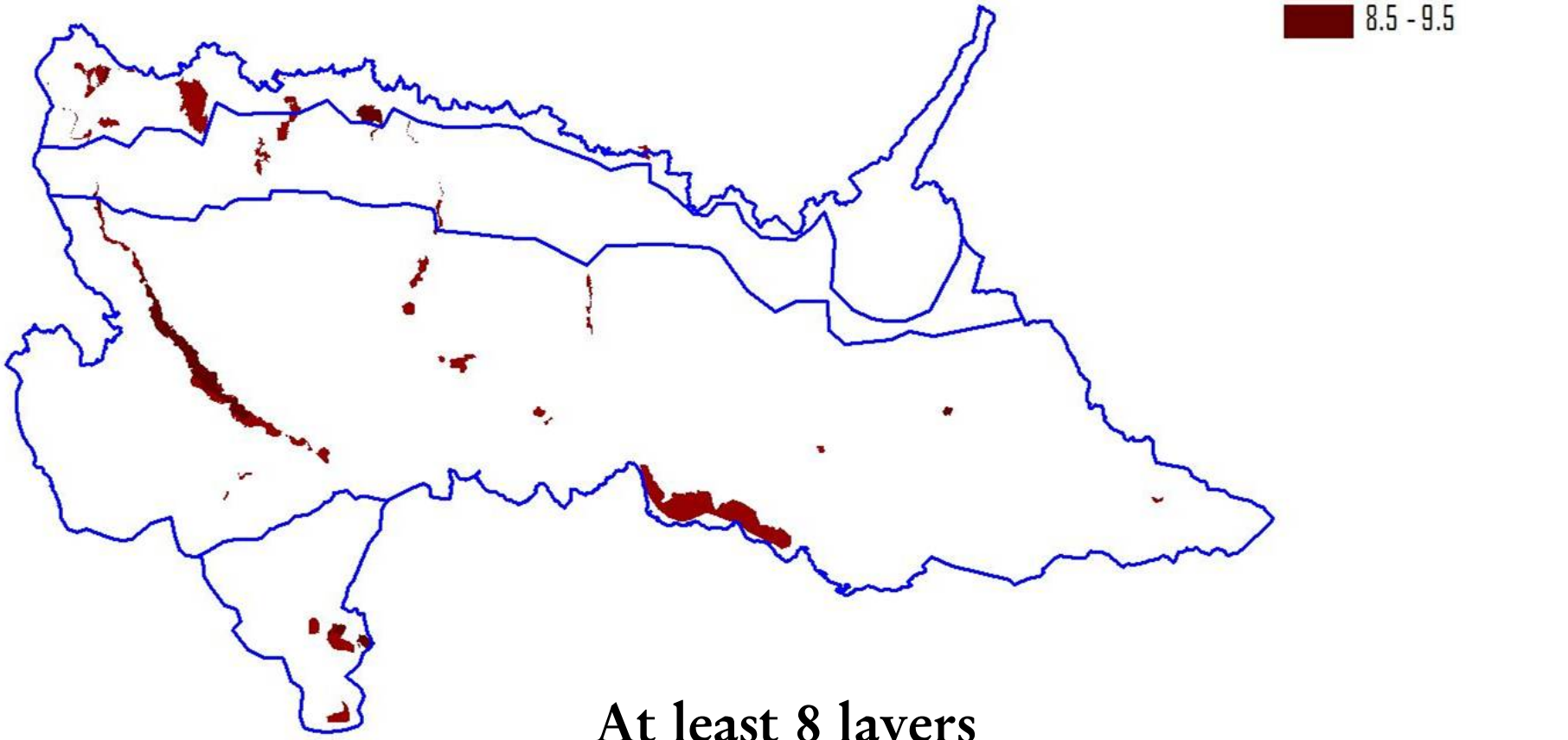
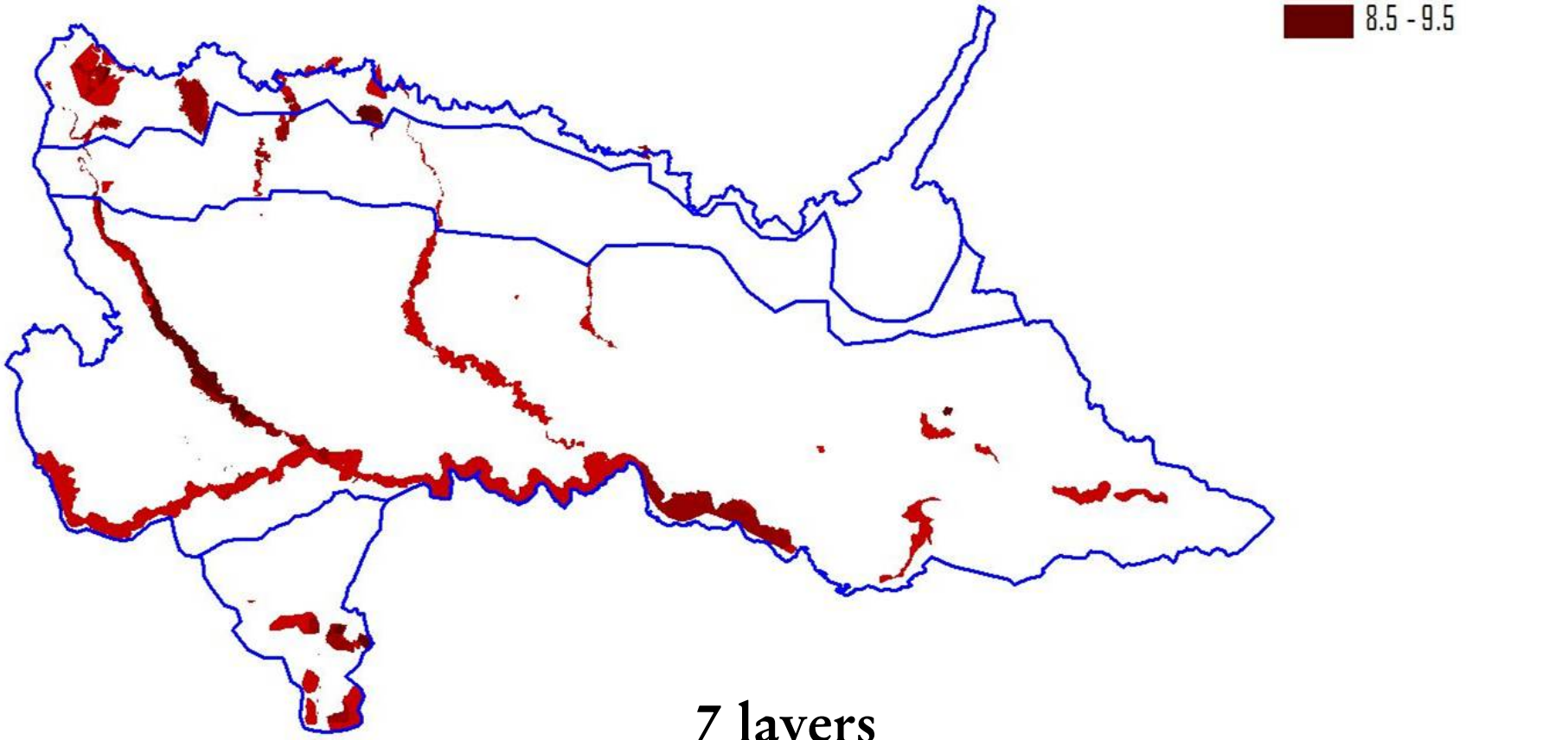
2.5 - 3.5
3.5 - 4.5
4.5 - 5.5
5.5 - 6.5
6.5 - 7.5
7.5 - 8.5
8.5 - 9.5

9 layers (all)



At least 8 layers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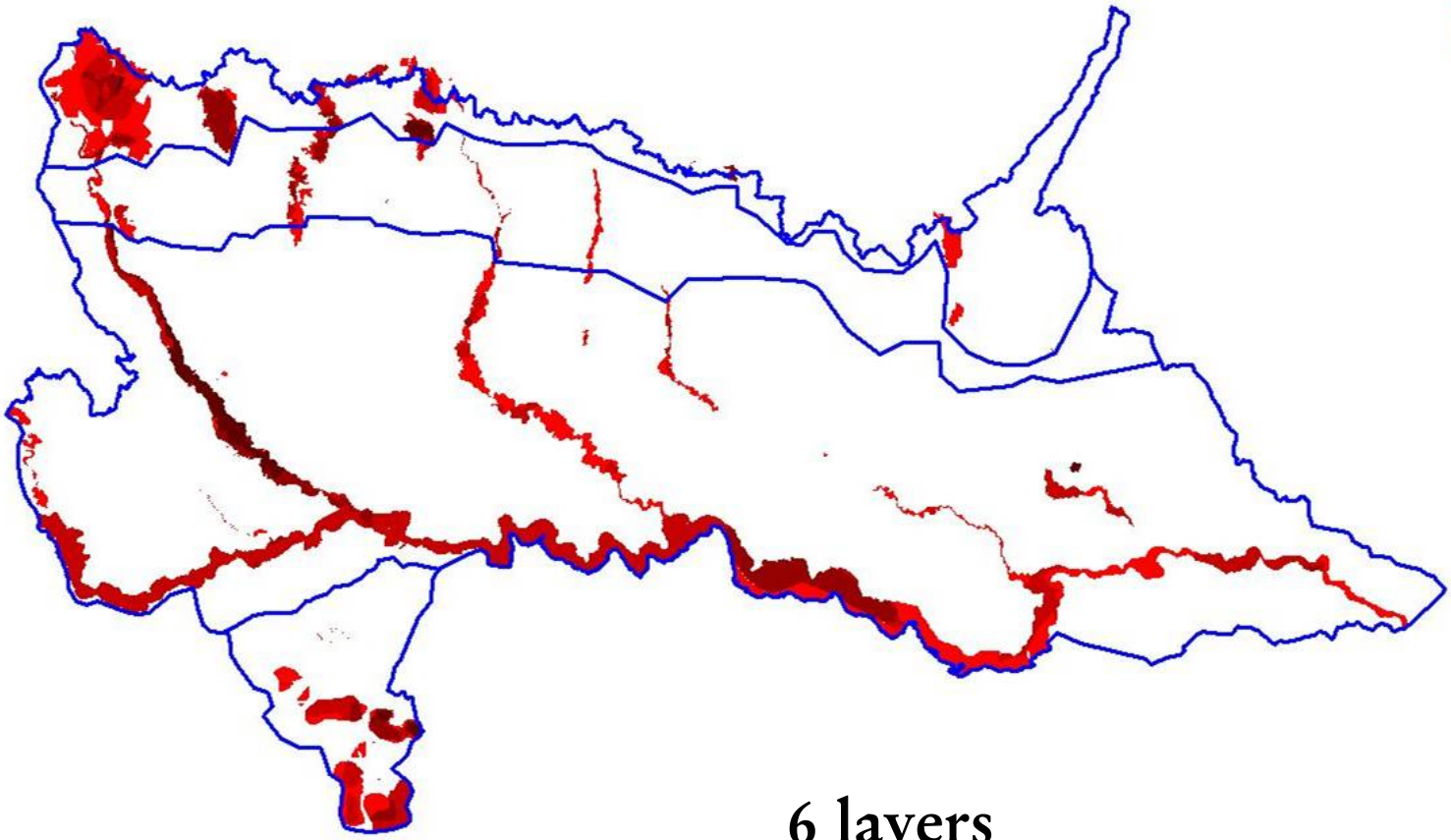
6.5 - 7.5
7.5 - 8.5
8.5 - 9.5

7 layers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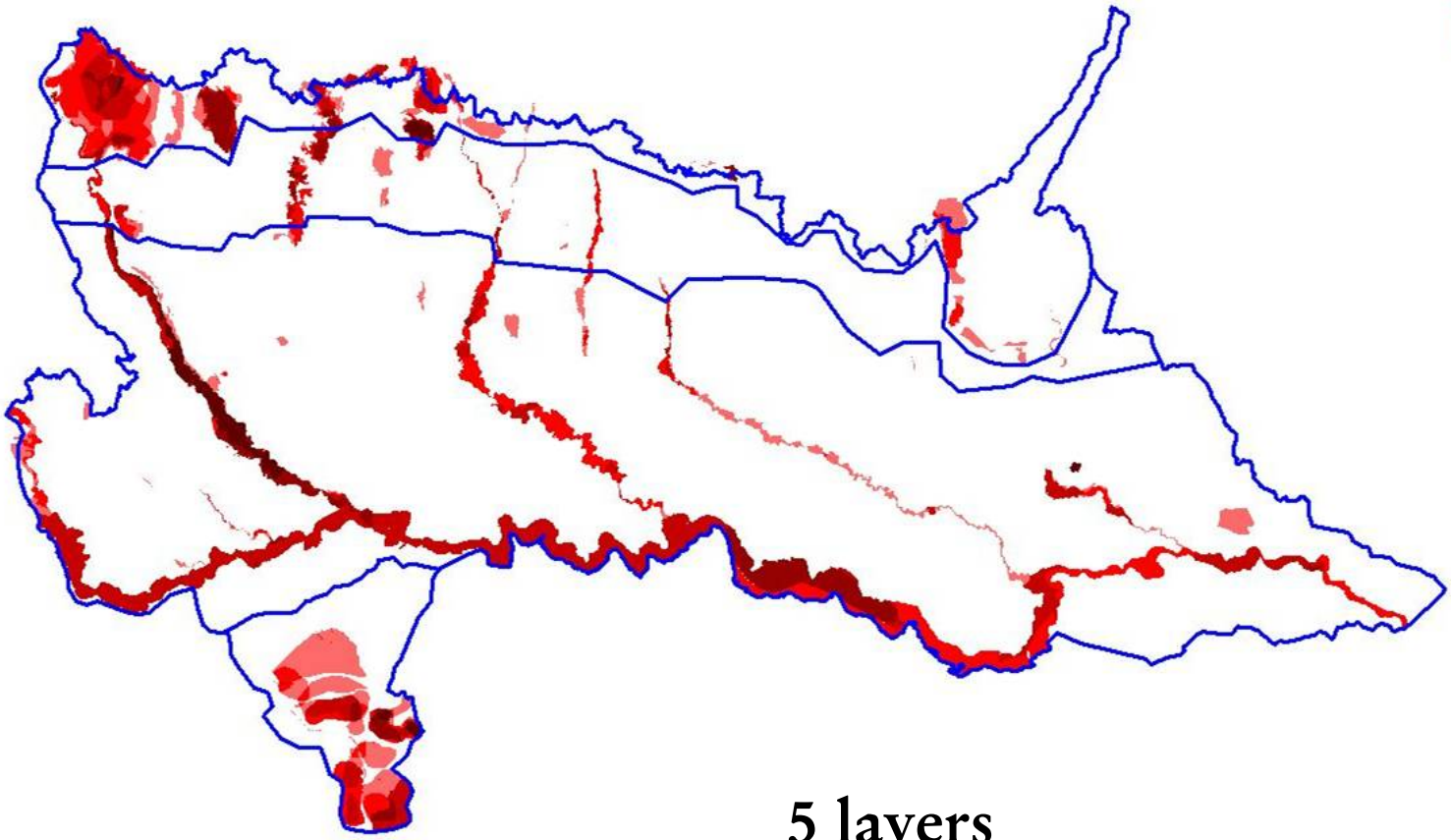
5.5 - 6.5
6.5 - 7.5
7.5 - 8.5
8.5 - 9.5

6 layers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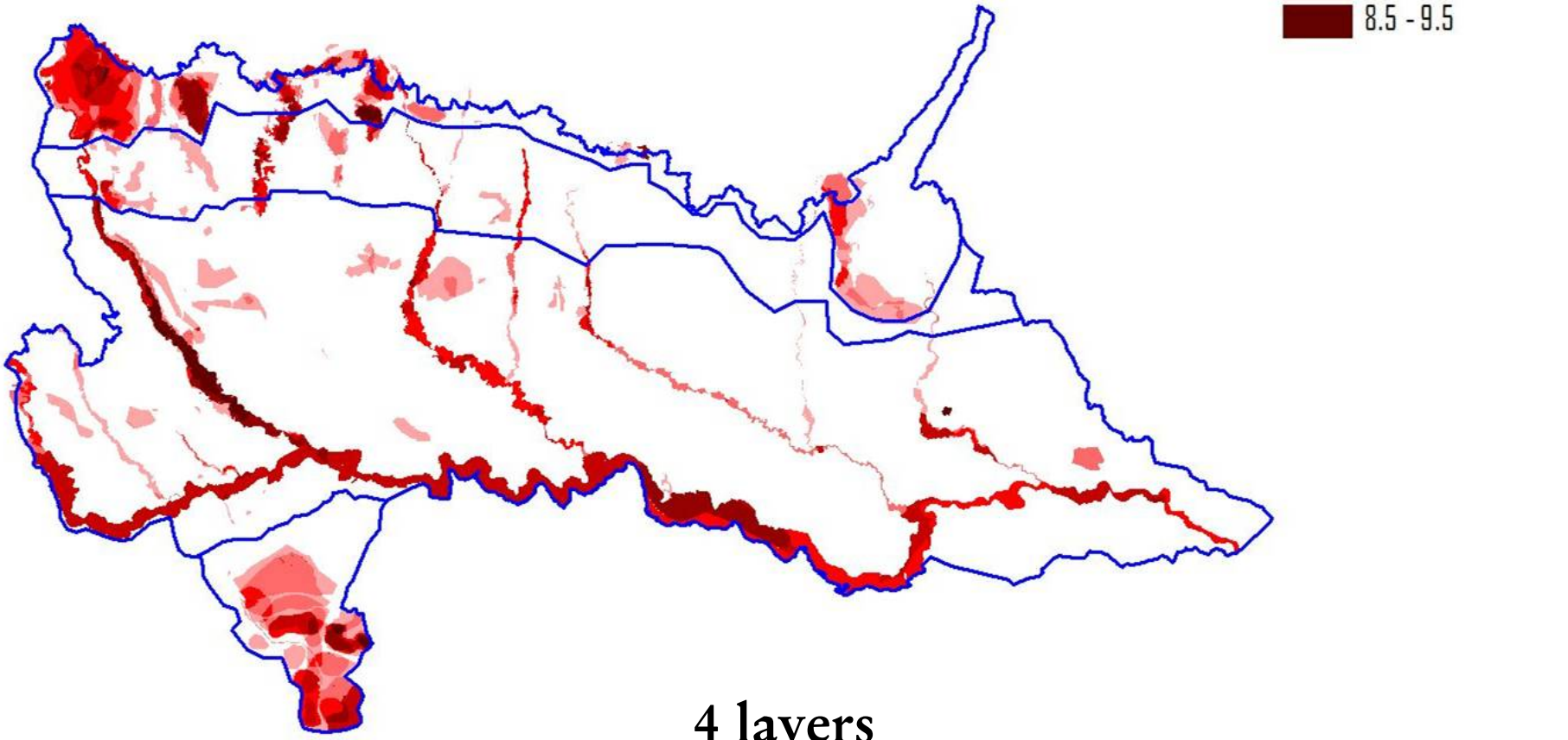
6.5 - 7.5
7.5 - 8.5
8.5 - 9.5

5 layers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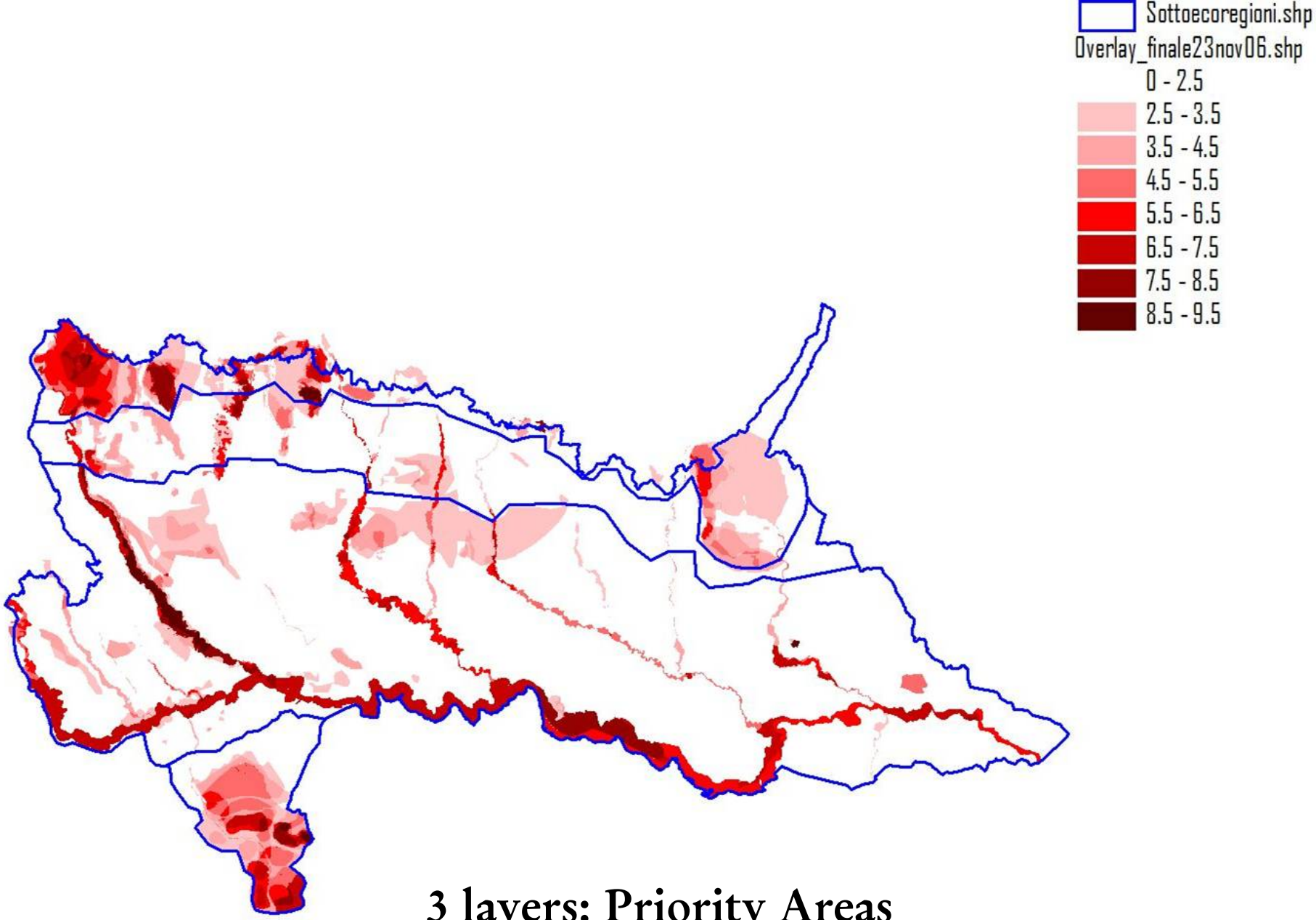
7.5 - 8.5
8.5 - 9.5

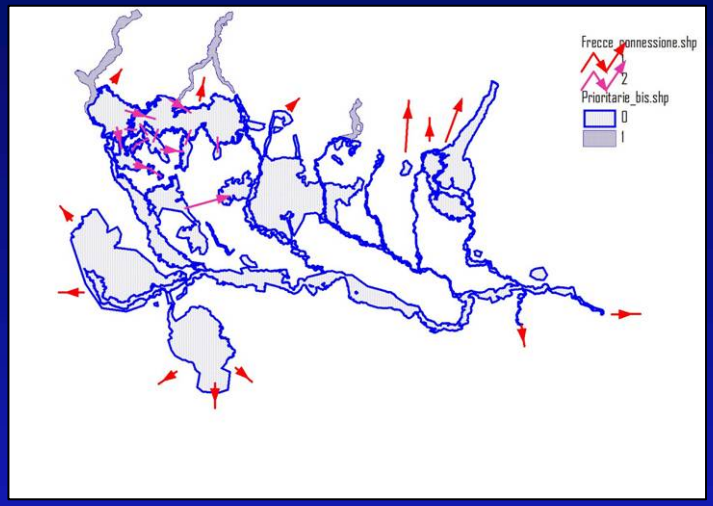
4 layers

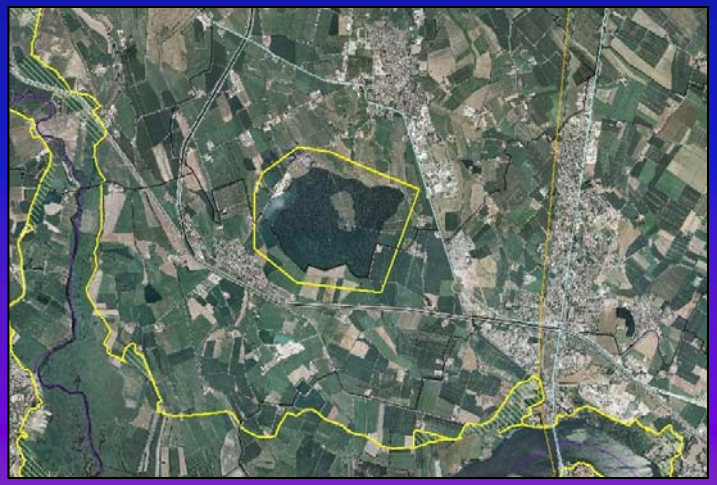


3 layers: Priority Areas

phase 2 (2007 – 2008)

- Mapping 1:25.000
- Identification of corridors (Alpine – Mediteranean ERC)
- Support to the provincial ecological nets design processes





ALPS – APPENNINES BIO-CORRIDOR

Aree Prioritarie Uccelli

Aree importanti Mammiferi (in verde scuro: Lupo)

Aree importanti Erpetofauna

NOVARA
MILANO
VERCELLI
LODI
CREMONA
PAVIA
ASTI
ALESSANDRIA
PIACENZA
PARMA
REGGIO EMILIA
MODENA
CUNEO
GENOVA
SAVONA
MASSA CARRARA
LA SPEZIA
IMPERIA
PRATO
PISTOIA
LUCCA
PISA

Aree importanti invertebrati

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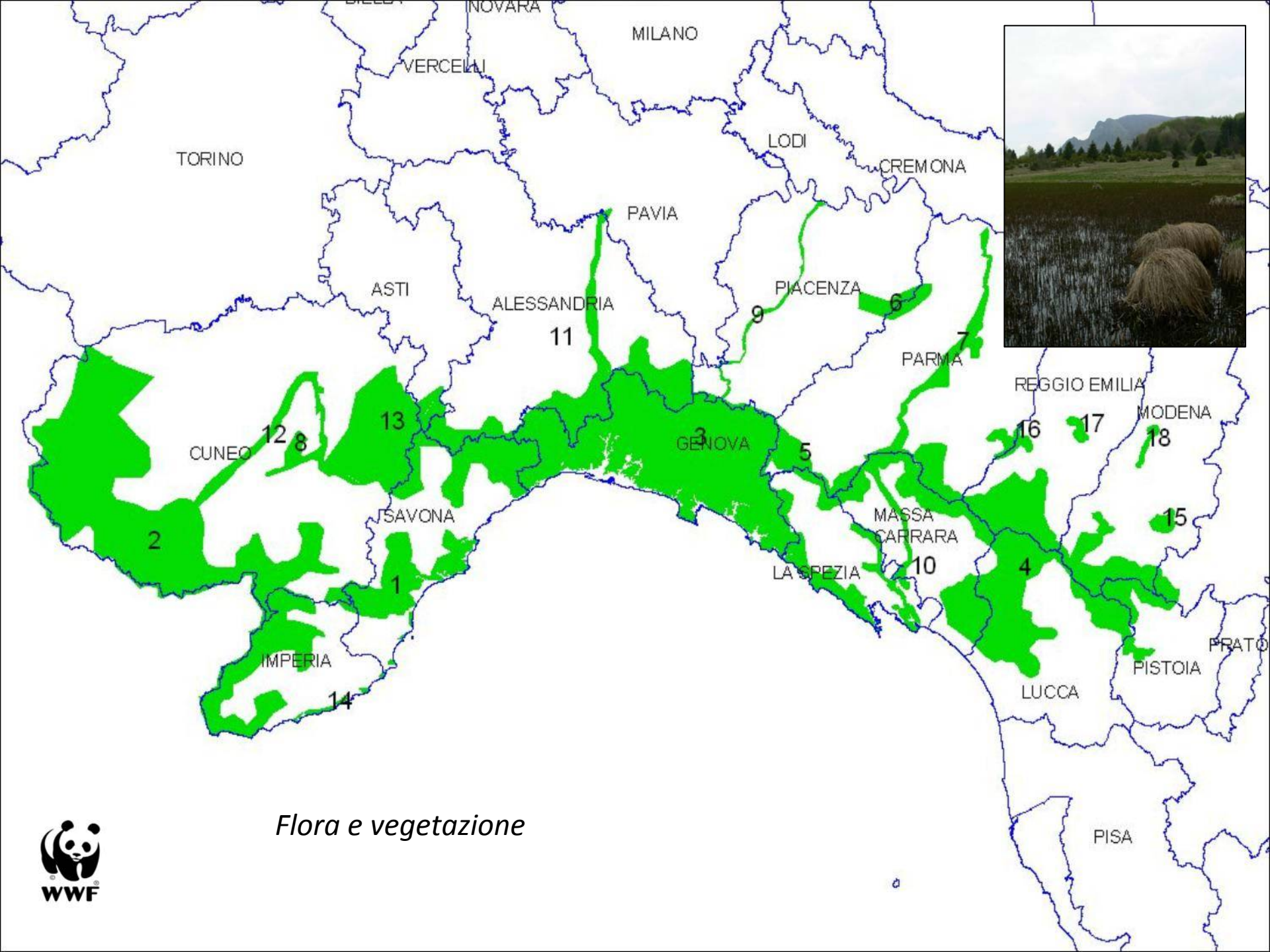
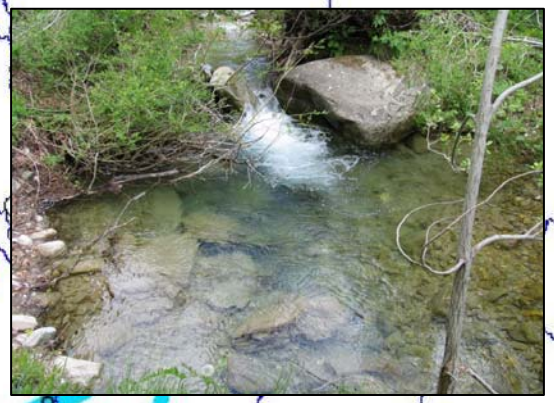
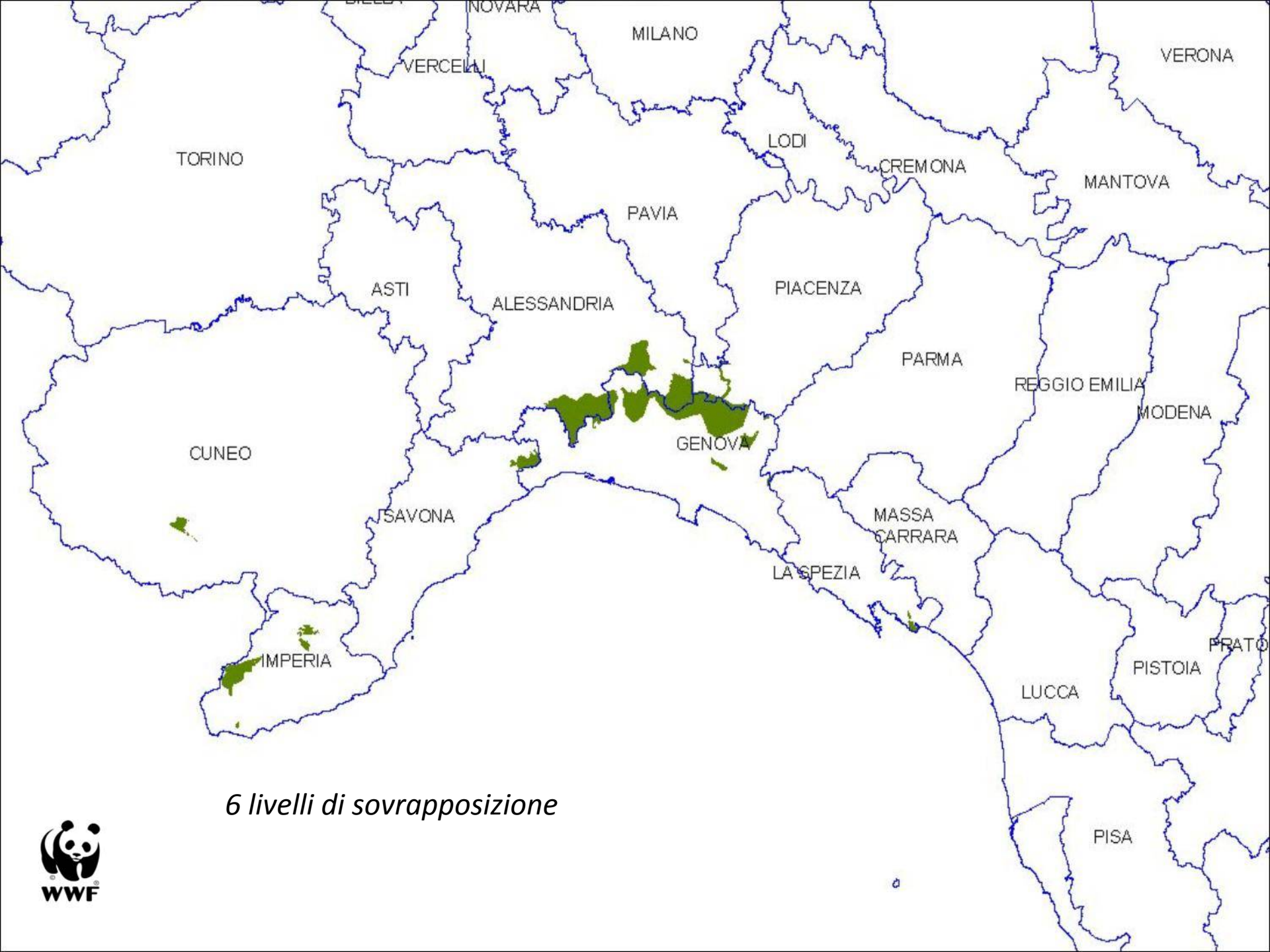


Flora e vegetazione

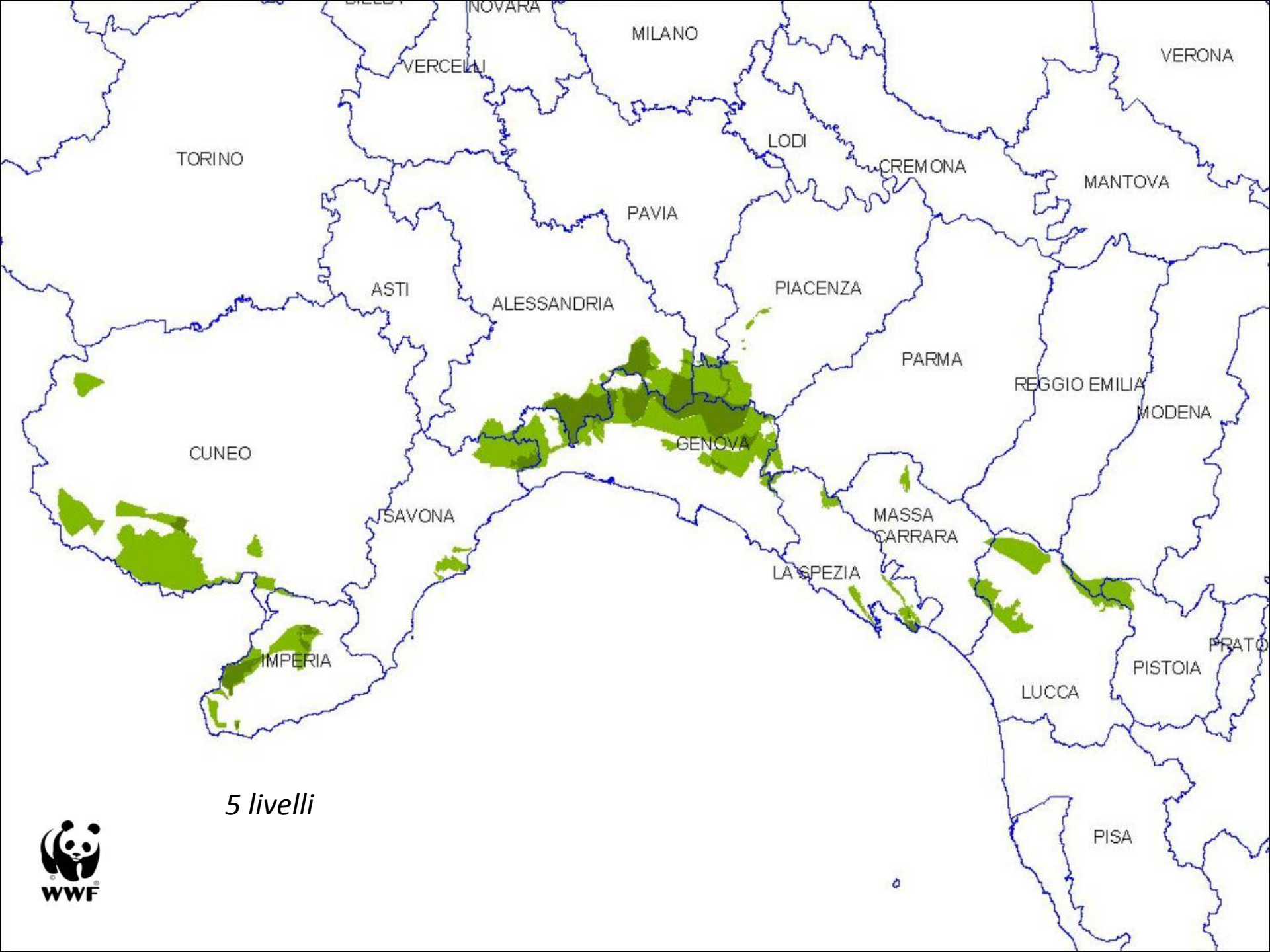


Aree importanti cenosi acquatiche


OVERLAY
of
IMPORTANT AREAS
WWF



6 livelli di sovrapposizione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ASTI
ALESSANDRIA
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REGGIO EMILIA
MODENA
CUNEO
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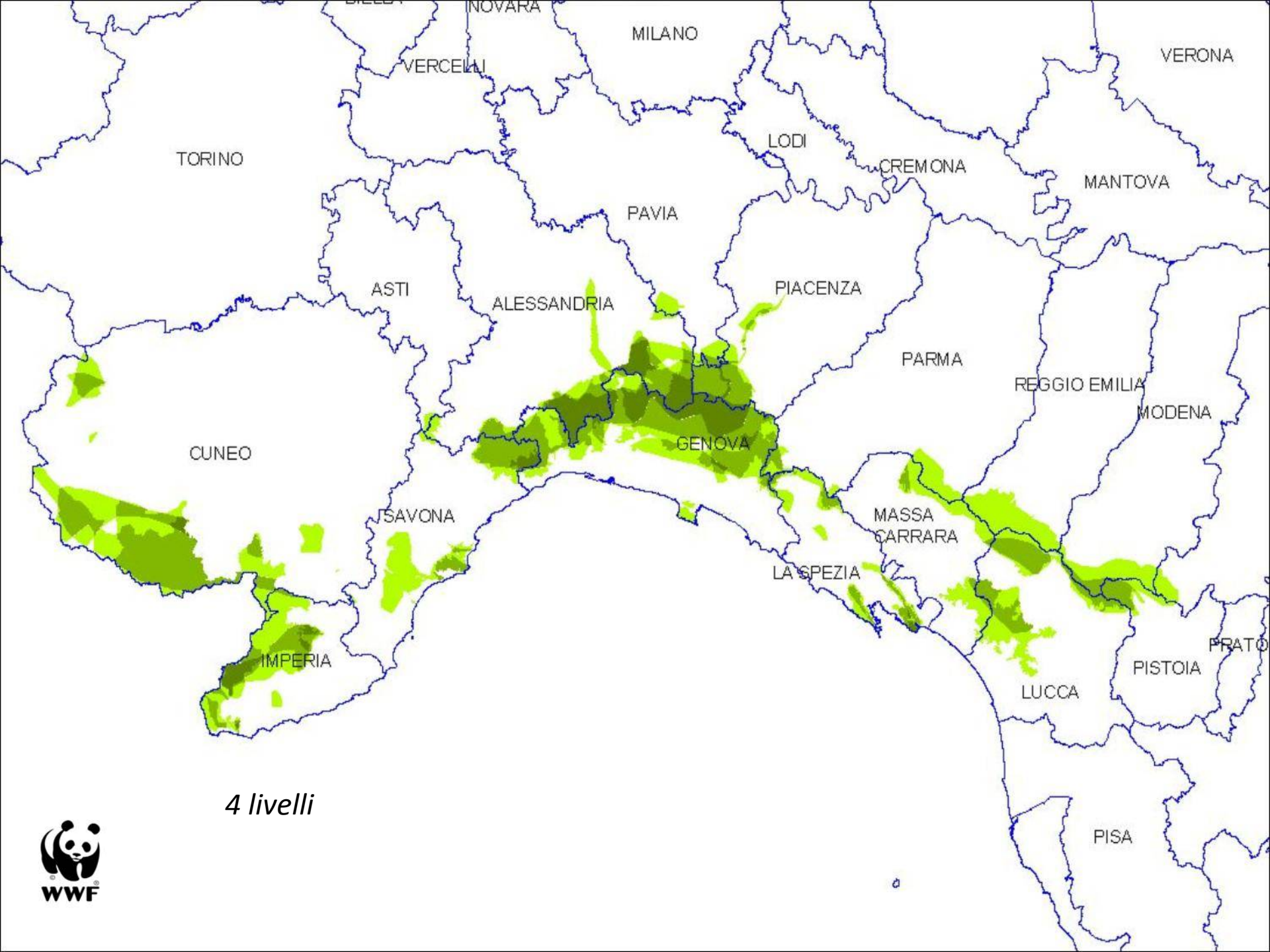
SAVONA
MASSA CARRARA
LA SPEZIA
IMPERIA
PRATO
PISTOIA
LUCCA
PISA

5 livelli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MASSA CARRARA
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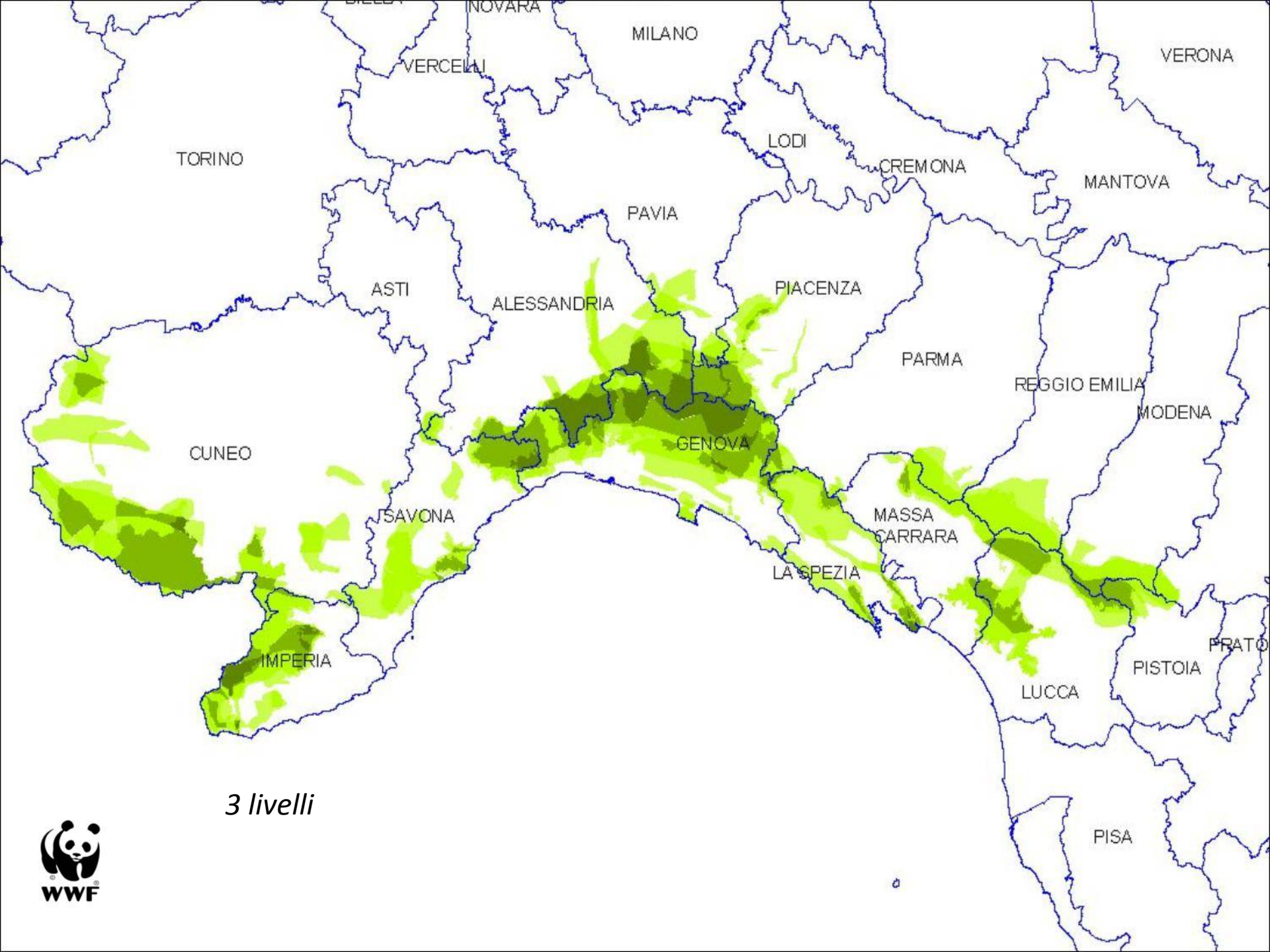
4 livelli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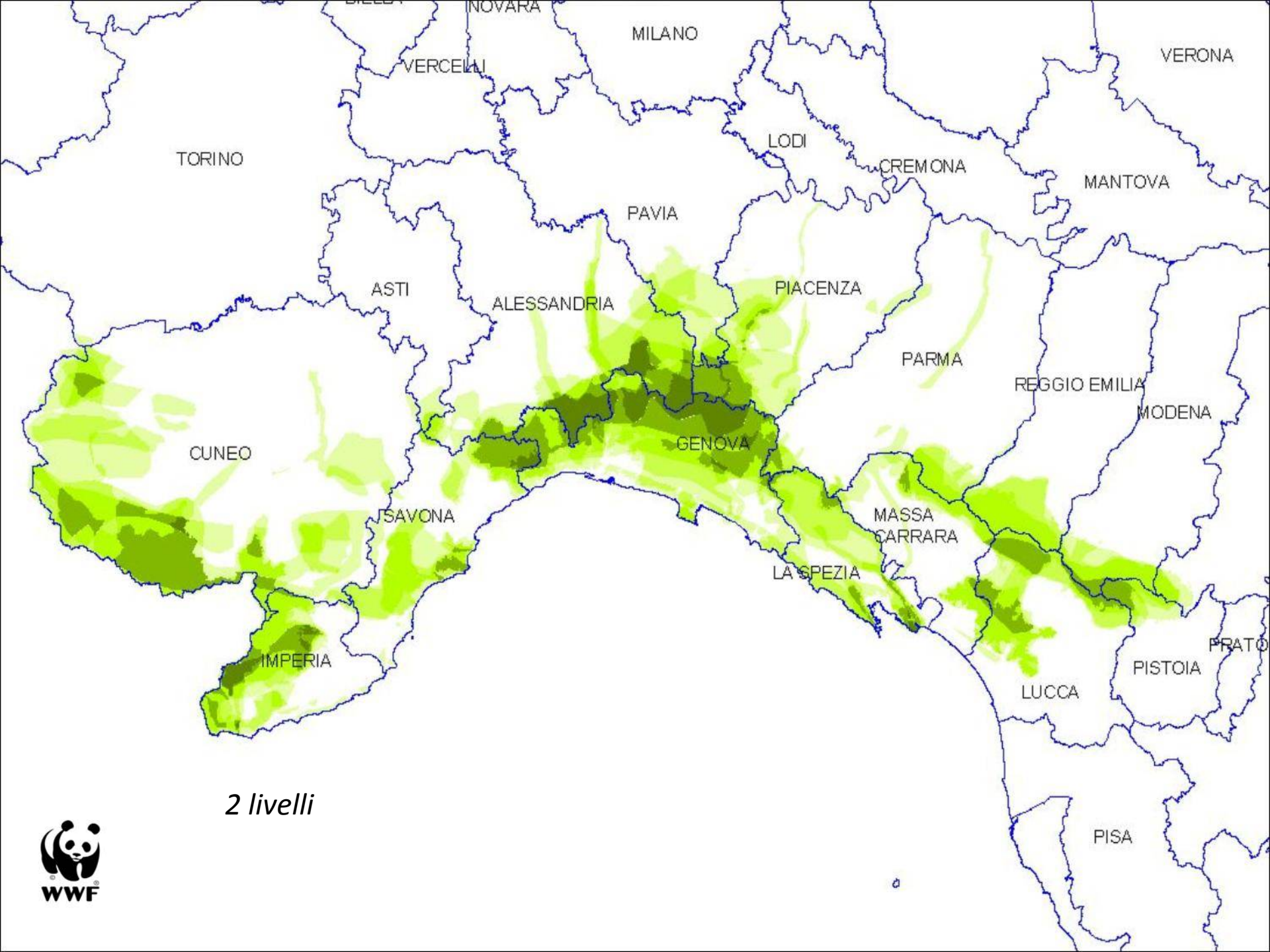
3 livelli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LUCCA
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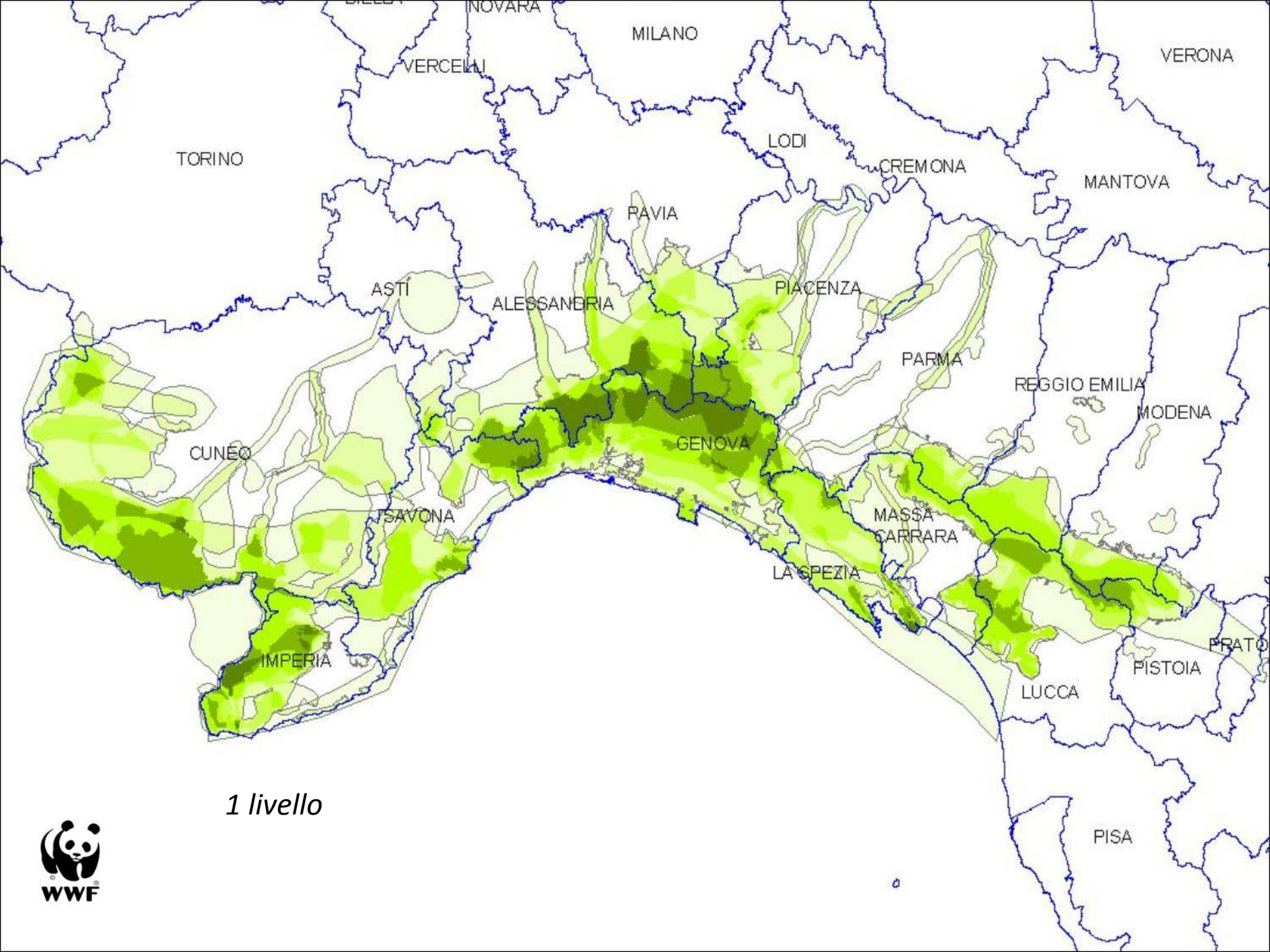
2 livelli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SAVONA
MASSA CARRARA
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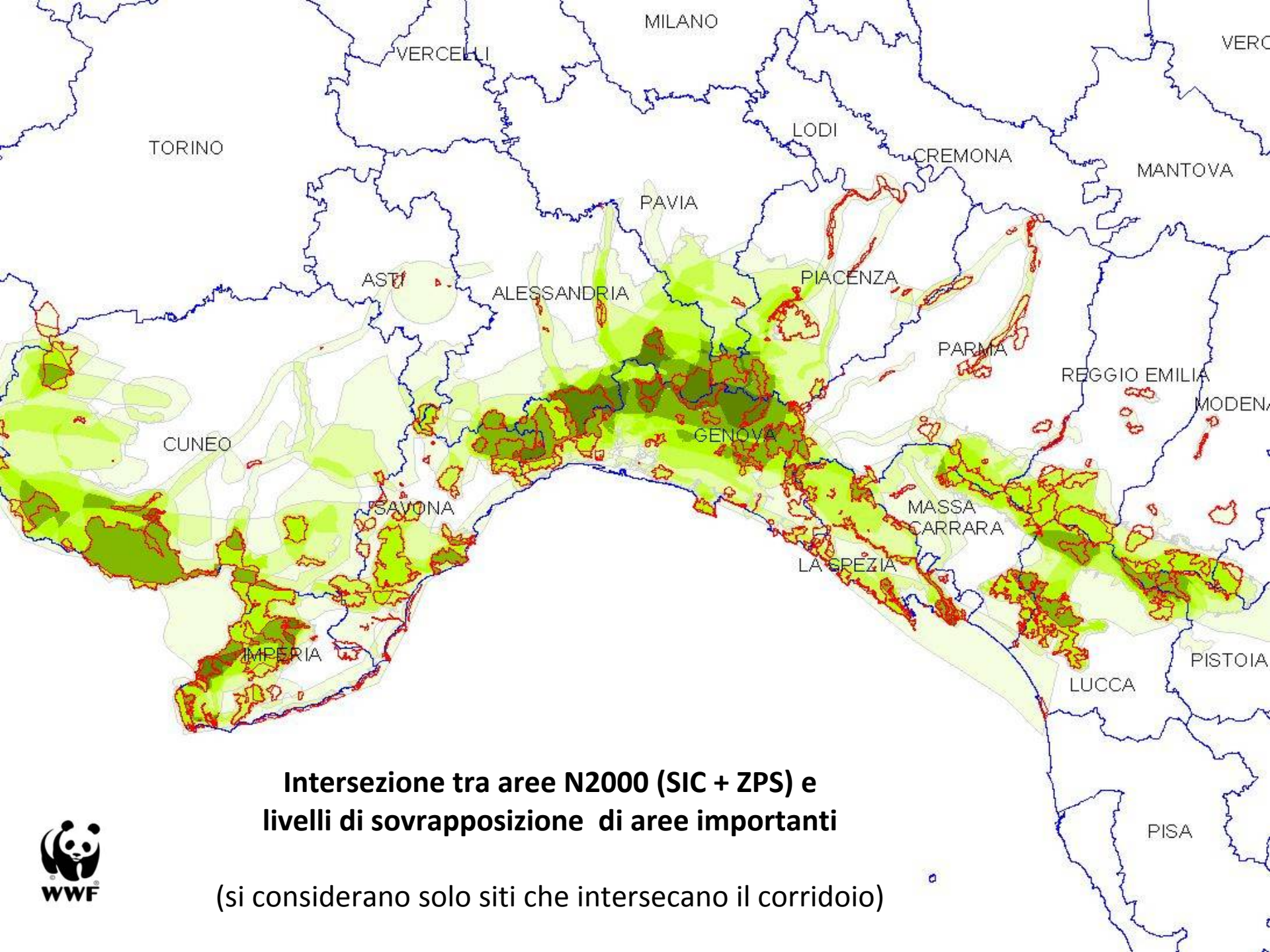
LUCCA
PISA

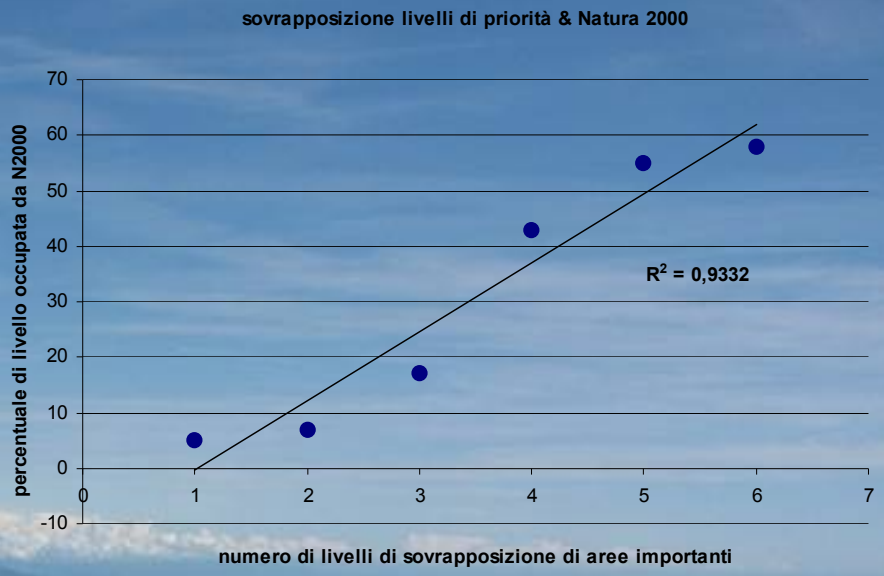
1 livello



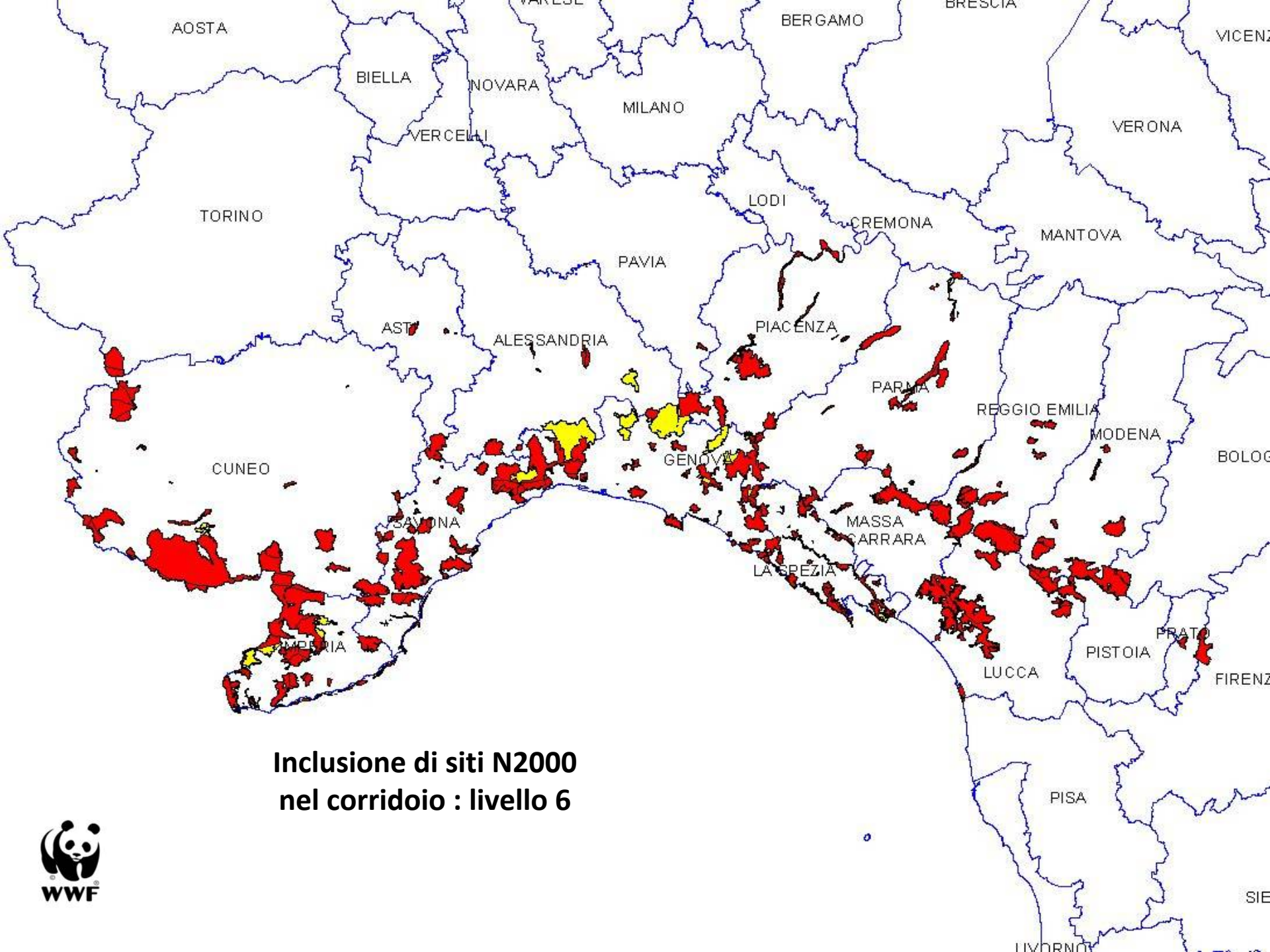
Intersezione tra aree N2000 (SIC + ZPS) e livelli di sovrapposizione di aree importanti

(si considerano solo siti che intersecano il corridoio)

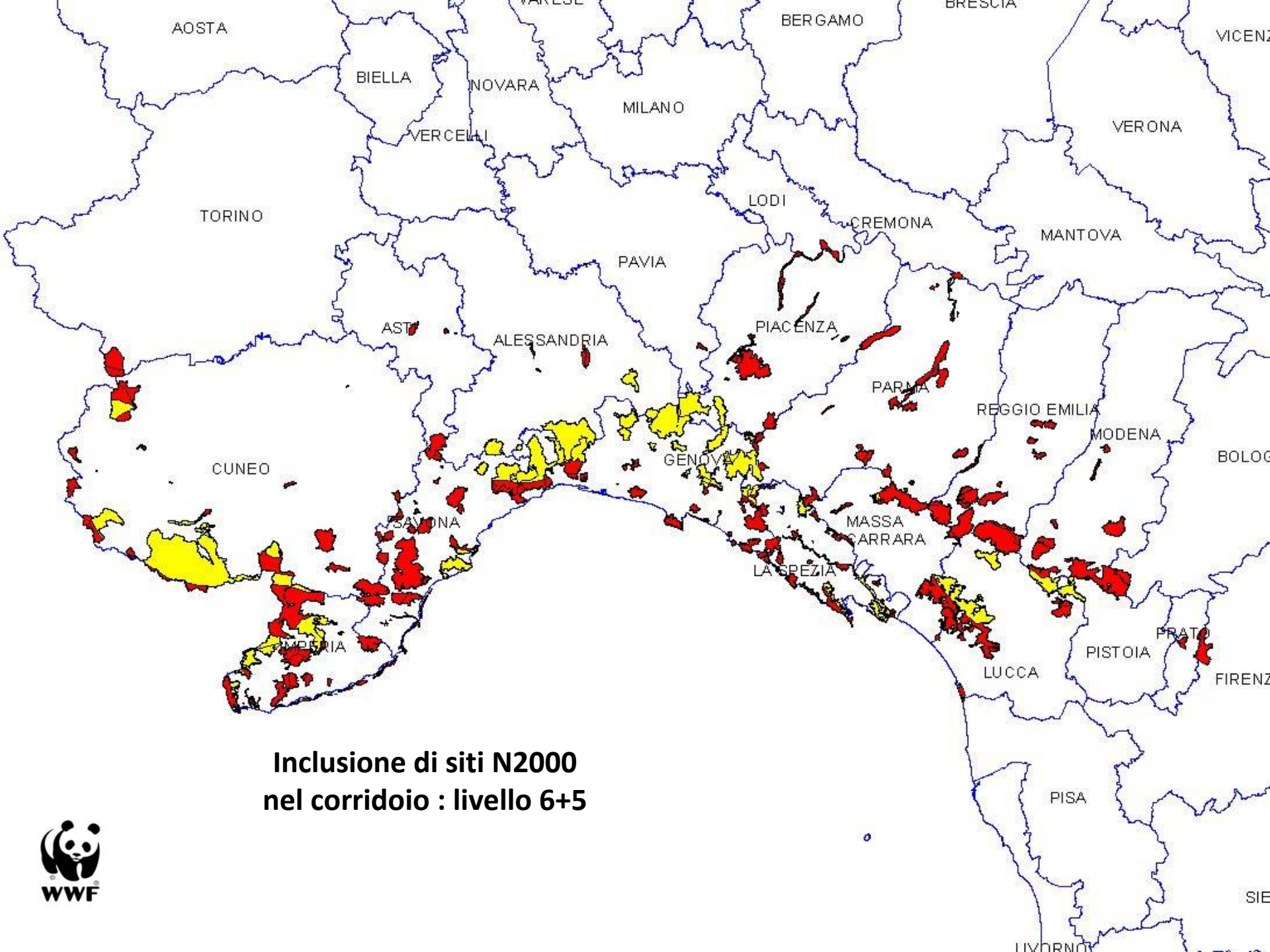
Percentuale di area occupata da N2000 nei diversi livelli di sovrapposizione



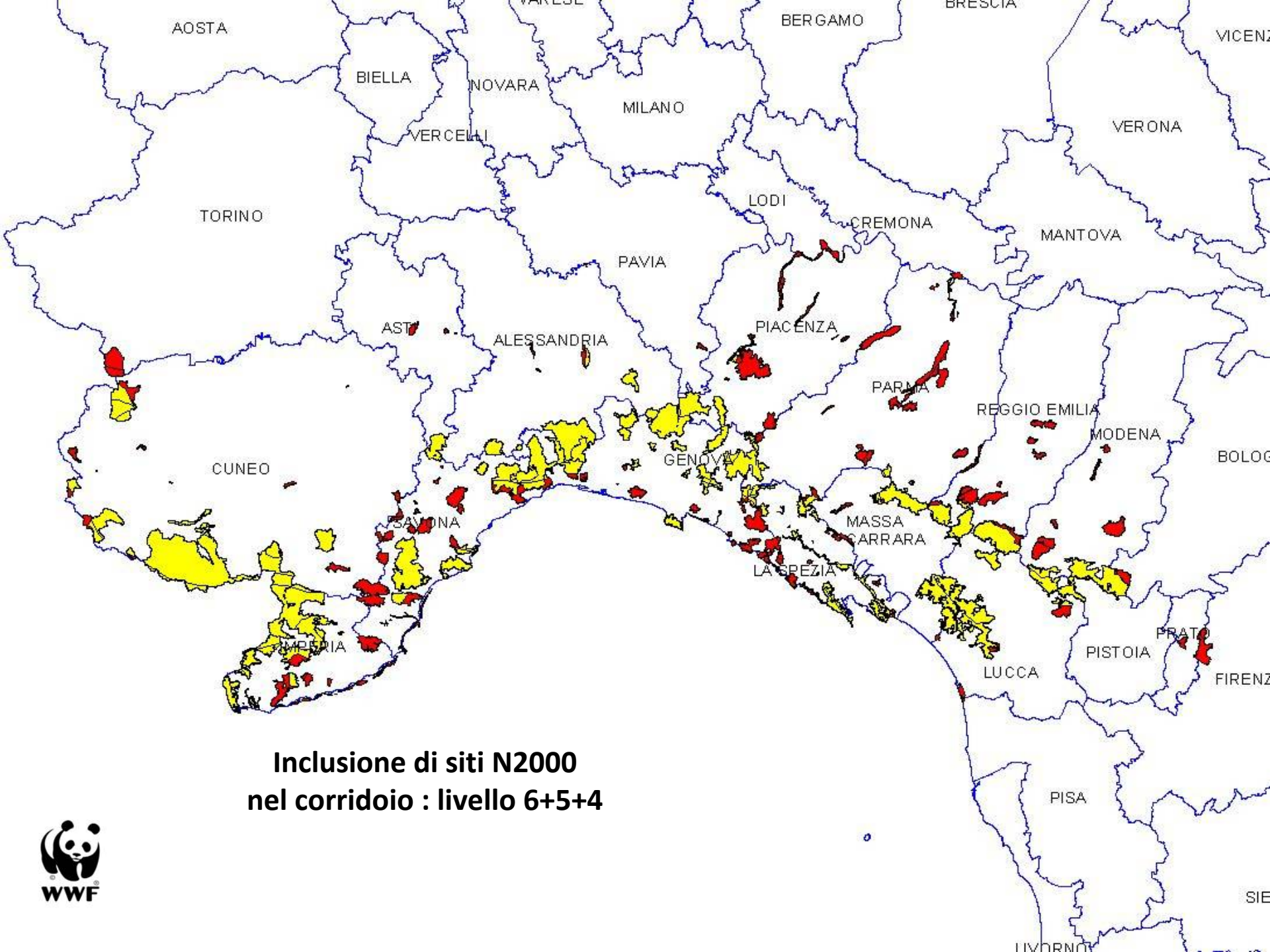
Numero di livelli sovrapposti tra aree importanti	*Percentuale di area occupata da N2000*
1	5
2	7
3	17
4	43
5	55
6	58



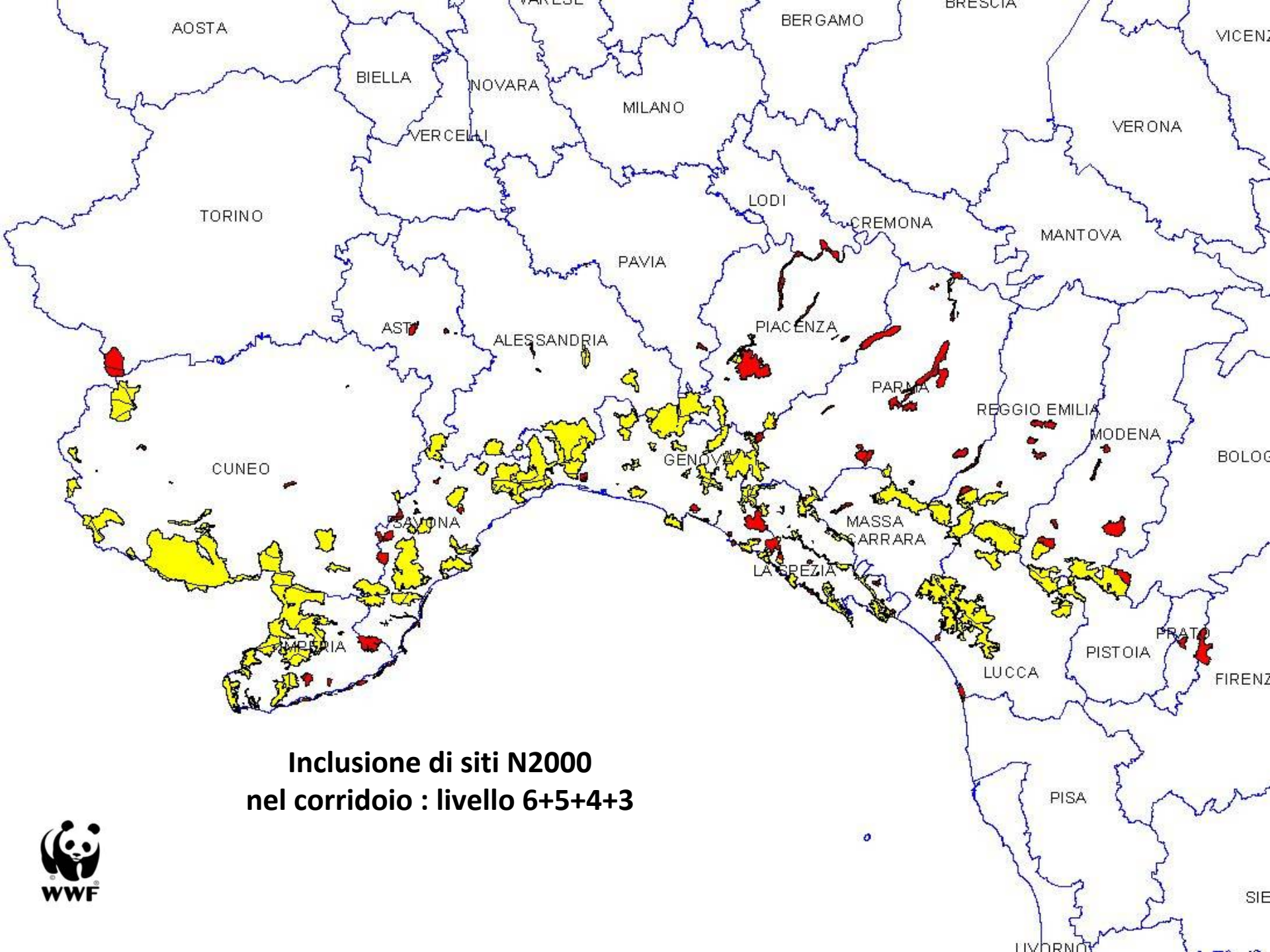
Inclusione di siti N2000 nel corridoio : livello 6



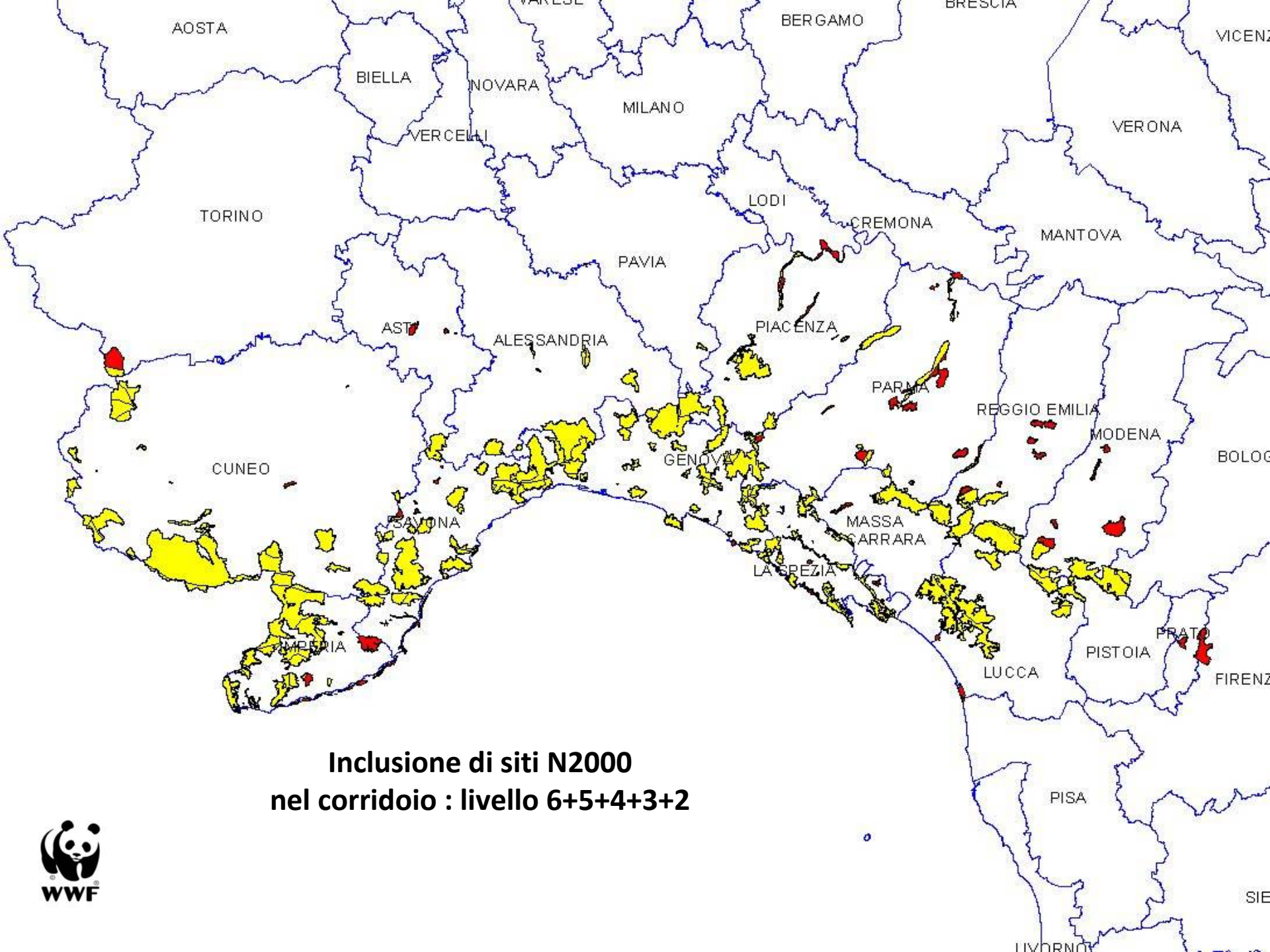
Inclusione di siti N2000
nel corridoio : livello 6+5



Inclusione di siti N2000
nel corridoio : livello 6+5+4



Inclusione di siti N2000
nel corridoio : livello 6+5+4+3



Inclusione di siti N2000
nel corridoio : livello 6+5+4+3+2

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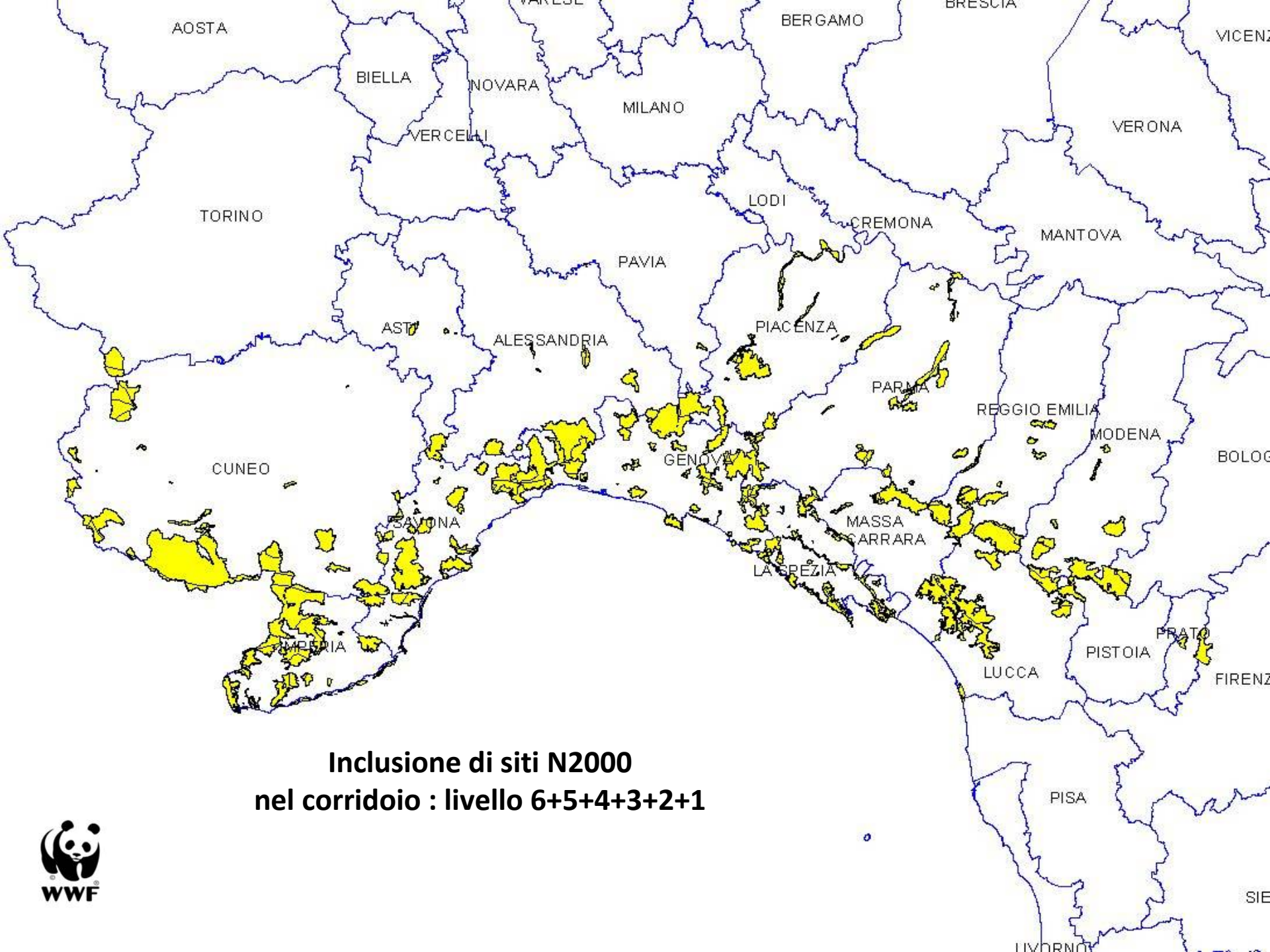
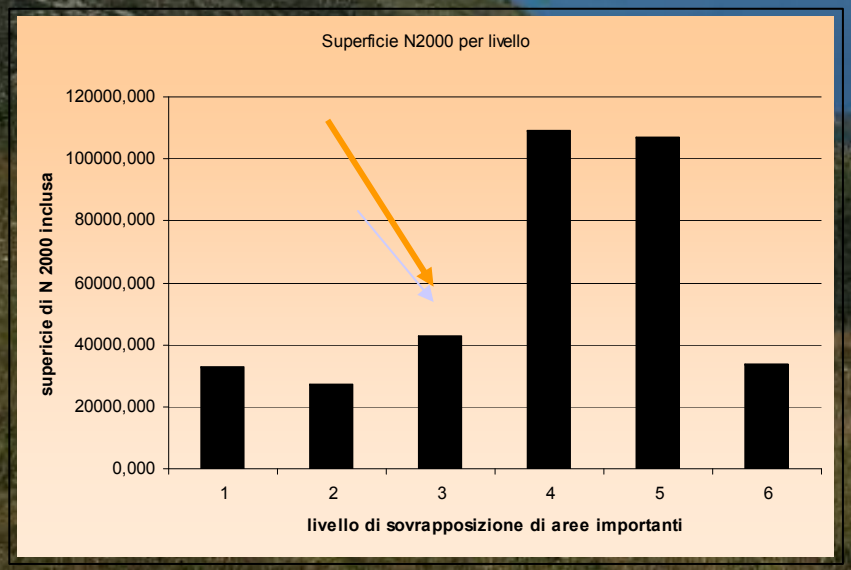


Inclusione di siti N2000
nel corridoio : livello 6+5+4+3+2+1

Superficie di N2000 per livello di sovrapposizione

LIVELLO DI SOVRAPPOSIZIONE TRA AREE IMPORTANTI	AREA DEL LIVELLO DI SOVRAPPOSIZIONE	AREA N2000 PER LIVELLO	PERC_N2000 PER LIVELLO	PERC_LEV SU N2000 tot
1	702917,0070	33067,642	5	198,7971
2	414760,3030	27444,640	7	117,3014
3	258121,6430	42900,617	17	73,0013
4	253251,7010	109114,003	43	71,6240
5	193526,1070	107079,617	55	54,7325
6	58687,6380	33978,617	58	16,5979



Conclusions: what should we choose for a large scale assesment ?

Ecological modelling	**The expert based approach (and participatory tools)**
Needs very good and detailed data sources	Allows the use of a synthesis knowledge
The method is objective	Subjective and dependent on the expert quality and number
Modelisation should be tested	Experts test one each other, but gap analyses are necessary anyway
It can be locally even more precise than requested	Precision limit dependent on the scale of work (and reasoning)
It needs "critical sense"	It needs "critical sense"
conclusions	
If the best data sources and databases are available, the method can be preferred	**At large scale datasets and checklists often lack.In such situation the expert based approach could be the most suitable choice**

a) You suddenly find yourself in the situation of being the responsible for the conservation of the hermelin (Mustela herminea, Mustelidae) outside protected areas in Piedmont. You do not have any distribution data on species and population but you have a lot of information on ecology and ethology of the species. Piedmont has very good and precise data on cartography and habitats. What do you do?

b) You suddenly find yourself in the situation of being the responsible for the conservation of the marmot (Marmota marmota, Sciuridae) outside protected areas in Piedmont. You do not have distribution data on the species in those areas but you have very precise localisations of marmots in Gran Paradiso National Park (Piedmont side). You don't have any information on ecology and ethology of the species. Piedmont has very good and precise data on cartography and land use. What do you do?

- *c) You suddenly find yourself in the situation of being the responsible for the general biodiversity assessment in the Serengeti ecosystem. A lot of data on species and population dynamics are present (Serengeti is investigated by at least 50 years) and you have a very few, or null, GIS data on land use and land cover, vegetation map etc…*

  What do you do?

d) You suddenly find yourself in the situation of being the responsible for the conservation of the a new species you have just found in a small protected area in the Indonesian forest. You do not have distribution data on the species in those areas neither any information on ecology and ethology of the species. There is no cartography at all, there.

What do you do?

TARGET	DISTRIBUTION DATA	ETHOLOGY /ECOLOGY KNOWN	GIS HABITAT DATA	SOLUTION
Mustela herminea	no	yes	yes	??
Marmota marmota	yes, elsewhere	no	yes (Piedmont)	??
Serengeti	expert based (50 years)	yes (focal species)	**NO**	??
new species (indonesian forest)	NO	NO	NO	??

TARGET	DISTRIBUTION DATA	ETHOLOGY /ECOLOGY KNOWN	GIS HABITAT DATA	SOLUTION
Mustela herminea	no	yes	yes	mono-specific ecological modelling
Marmota marmota	yes, elsewhere	no	yes (Piedmont)	mono-specific ecological modelling (habitat sampling model)
Serengeti	expert based (50 years)	Yes (focal species)	**NO**	expert based approach
new species (indonesian forest)	NO	NO	NO	census and fundamental research

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- Viciani D., 1999 - La valutazione della qualità degli aspetti floristico-vegetazionali negli Studi di Impatto Ambientale: una metodologia semplificata. Inf. Bot. Ital., 31: 213-217..

Thank you

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