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## The influence of Natura 2000 sites on land-taking processes at the regional level. An empirical analysis concerning Sardinia (Italy)



DICAAR

**Sabrina Lai & Corrado Zoppi**

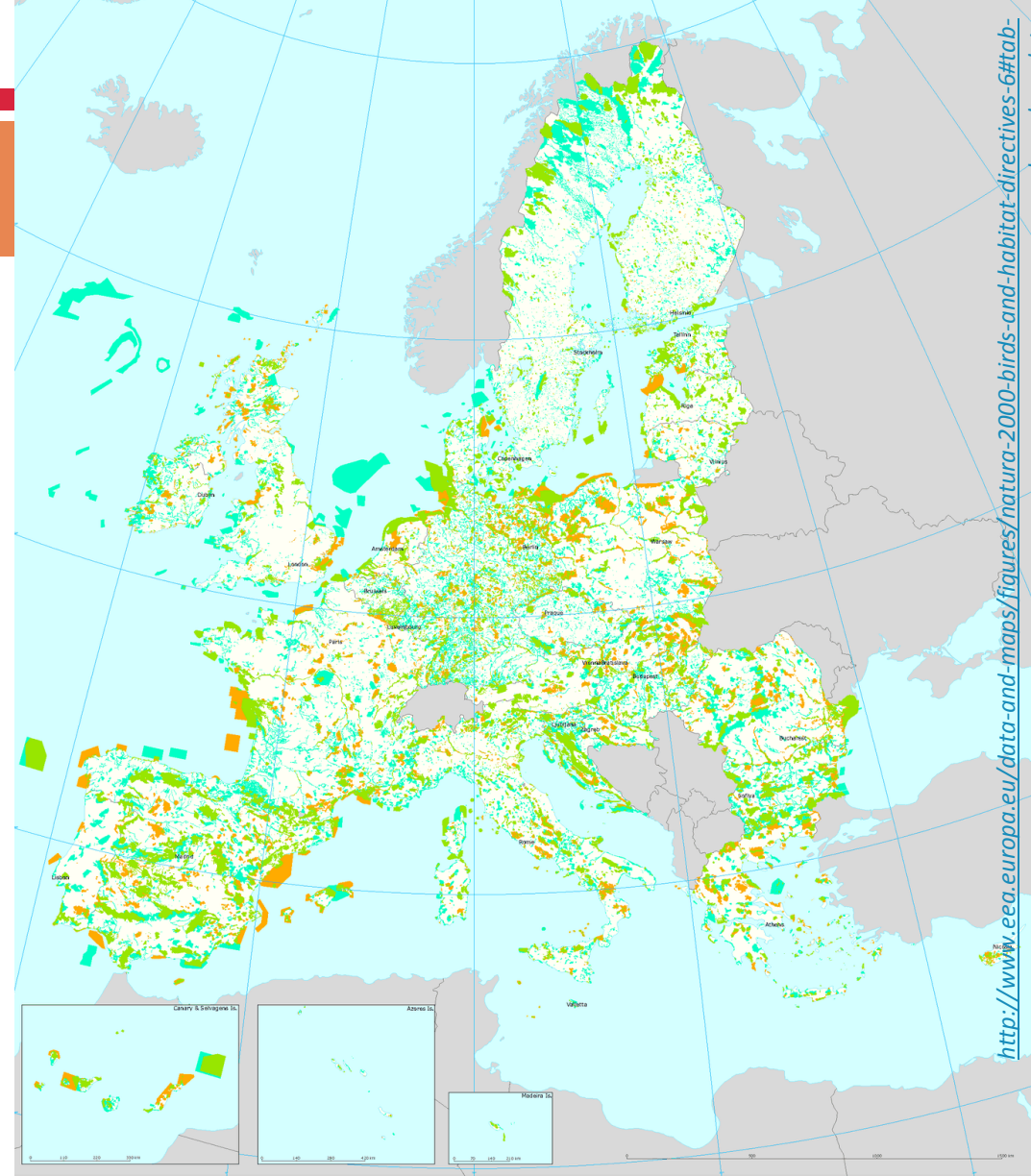
Università di Cagliari - Dipartimento di Ingegneria Civile, Ambientale e Architettura  
sabrinalai@unica.it – zoppi@unica.it

# LAYOUT

- Introduction
- Natura 2000 Network in Sardinia
- Definition of land take and of a land-take related variable
- Identification of potential determinants of land take
- Results of the econometric model
- Discussion and conclusions: the role of Natura 2000 sites in mitigating land taking processes

# 1. INTRODUCTION

- In the EU, the Birds and Habitats Directives are the cornerstone of nature legislation and of biodiversity policies.
- The Habitats Directive establishes Natura 2000, a network of core breeding and resting sites for rare and threatened species, and for rare and protected natural habitat types.
- Conservation measures are established to protect and maintain natural habitats and species of Community interest at a favorable conservation status.



## NATURA 2000

- Birds Directive sites (SPA)
- Habitats Directive sites pSCI, SCI, SAC
- Sites - or parts of sites - belonging to both Directives

European Environment Agency



Source: NATURA 2000 - DG ENV compiled from databases from the Member States. Source background map: © EuroGeographics/Eurogeographics and DG ESTAT. Network of NATURA 2000 sites for Europe, version 2014. Projection: Lambert Azimuthal Equal Area.

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# 1. INTRODUCTION

Within **Natura 2000 sites**: land cover is mostly non-artificial.

The Directives should aim at maintaining this present status, if natural habitats and species are to be preserved.

**“Land take”** (or “land uptake”): loss of agriculture, forest and other natural or semi-natural land resulting from urban and other artificial land developments .

Land take is significant issue in the EU, which established an ambitious goal (“Roadmap to a Resource Efficient Europe”, COM 571 /2011):

- no net land take by 2050
- impacts of EU policies on land take to be taken under control in 2014-20 funding programs.

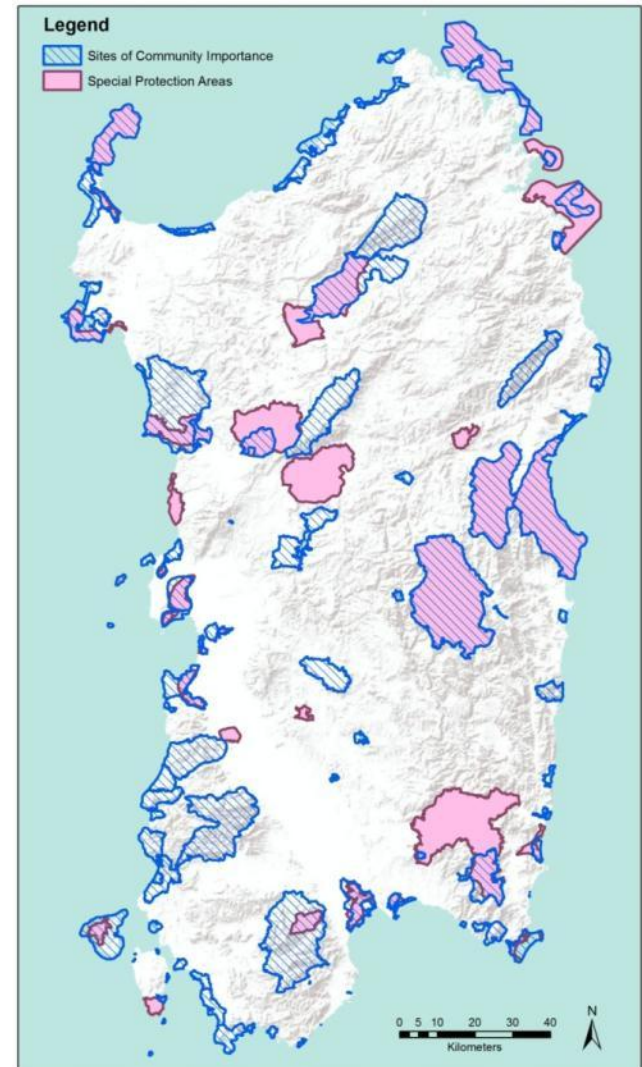
**Aim**: to understand what role Natura 2000 plays in affecting land-taking.

**Case study**: NUTS2 Italian region of Sardinia, where:

- strict rules on land development have been enforced through regional landscape plans
- an extensive Natura 2000 Network ( $\approx 19\%$  of the region) was set up

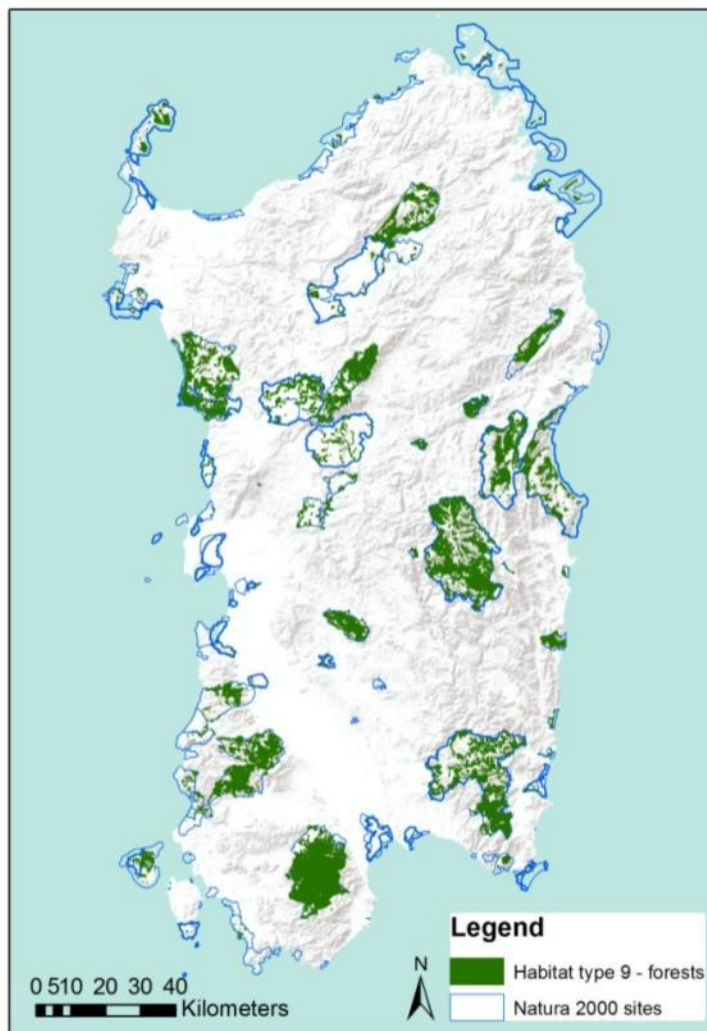
## 2. NATURA 2000 IN SARDINIA

- Why choosing Sardinia as a case study?
  - Detailed land cover data are available → a dynamic study of land take possible.
  - It is an island → the boundaries of the region where the Natura 2000 network is defined are straightforward, not fuzzy.
  - The correlation between the presence and size of the regional N2Ss and land take, if any, is clear-cut.
- Regional Natura 2000 network:
  - Sites of Community Interest (SCIs) were identified in 2000 and established in 2006.
  - Special Protection Areas (SPAs) were established in three steps between 2000 and 2007.
  - As of 2007: 92 SCIs and 37 SPAs.
  - The spatial distribution and conservation status of habitats and species is monitored (under reporting obligations art. 17 of the Directive) and mapped.

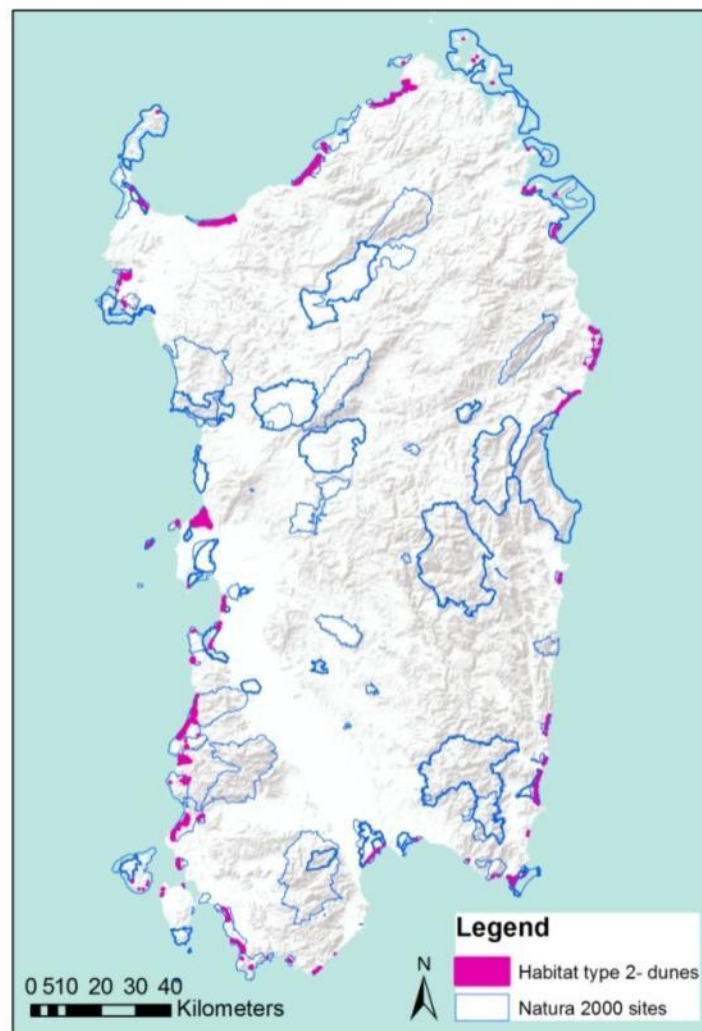


*Natura 2000 network in Sardinia as of 2007*

## 2. NATURA 2000 IN SARDINIA



*Habitats of community interest,  
group 9 "Forests"*



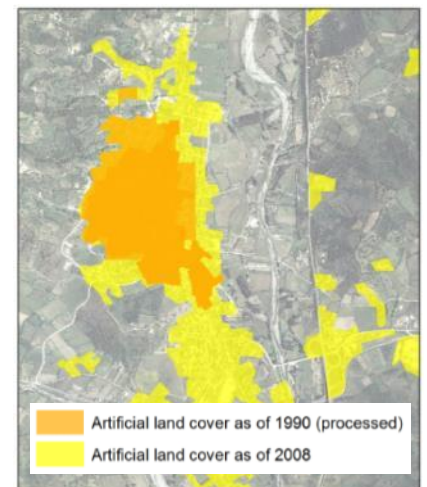
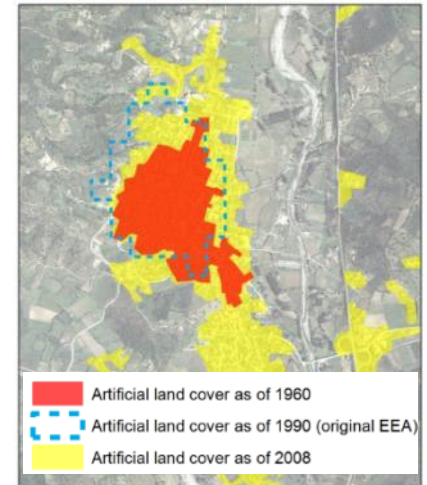
*Habitats of community interest,  
group 2 "Coastal sand dunes and inland dunes"*

### 3. DEFINITION OF A LAND-TAKE RELATED VARIABLE

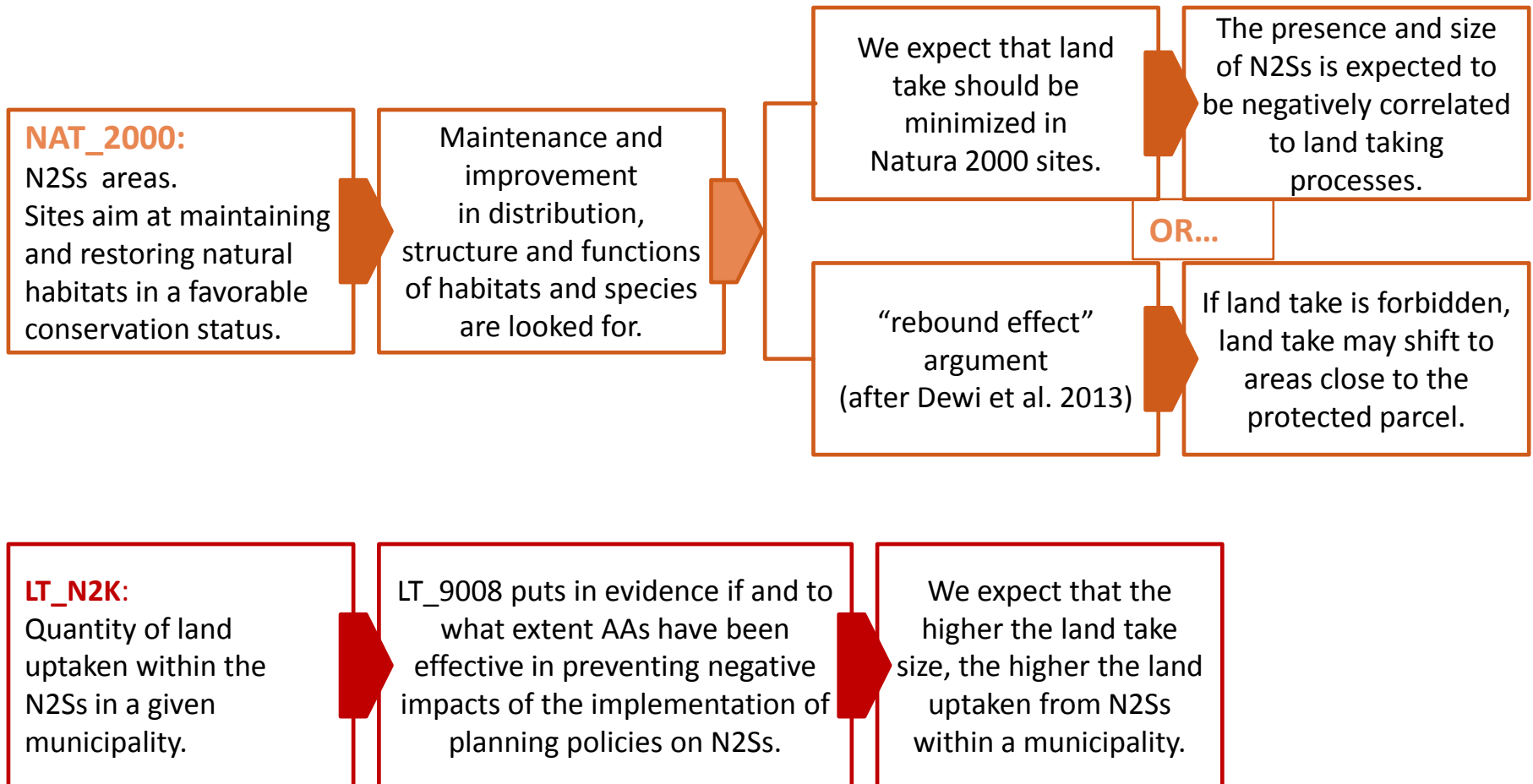
- **Land take** is the “Change of the amount of agriculture, forest and other semi-natural and natural land taken by urban and other artificial land development” (European Environment Agency, 2013).
- The **Corine Land Cover classification** is quite handy to assess land take, because it classes land cover according to 5 main groups:
  1. artificial land
  2. agricultural areas
  3. forests and semi-natural areas
  4. wetlands
  5. waterbodies.

**So land take occurs when a land parcel has a non-artificial status in a given time and an artificial one in a next one.**

- To study land take between 1990 and 2008, we put together data from two sources:
  1. the 1990 Urban Morphologic Zones map of the EEA
  2. the 2008 Regional Corine Land Cover (the 1990 map was preprocessed because of inconsistency in resolution).
- In Sardinia, land take between 1990 and 2008 amounted to  $\approx 3.2\%$ .



## 4. POTENTIAL DETERMINANTS OF LAND TAKE





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### DENS1990:

Municipal residential density in 1990.

In the literature, residential density is usually positively correlated to land take.

### INC\_2008:

Municipal per-capita income in 2008.

Could be negatively correlated to land take e.g. because a comparatively high municipal per-capita income pushes up investments in agriculture...

... or could be positively correlated to land take e.g. if investments spur new building developments.

### AUTOCORR:

Spatially-lagged variable.

*Everything is related to everything else, but near things are more related than distant things.*  
(Tobler's 1<sup>st</sup> law of geography)

## 4. POTENTIAL DETERMINANTS OF LAND TAKE

VARIABLES

**CS\_N2K:** municipal land area included in the coastal strip which is part of a N2S as well.

Under the provisions of the RLP, changes in land cover in the coastal strip are almost totally prevented.

Land take is forbidden whether the area is part of a N2S or not. The impact of this variable is expected to be negative.

**OLPL\_N2K:** Municipal land area classed in planning code in force before 2006 as "1", "2a", "2b" types.

Land transformations and new developments were prevented in these areas.

Land take is forbidden whether the area is part of a N2S or not. The impact of this variable is expected to be negative.

**WAT\_2K:** total municipal area classed as "Wetlands" or "Water bodies" in the land-use map and included in the Natura 2000 network.

This variable is almost invariant between 1990 and 2008

The impact of this variable is expected to be negative.

**SLOP:** Municipality's weighted average slope of areas included in the Natura 2000 network (weight = Natura 2000 area within that municipality).

This variable contributes to the stability of a N2S in terms of land take

The impact of this variable is expected to be negative.

CONTROL

## 4. POTENTIAL DETERMINANTS OF LAND TAKE

Variable	Definition	Source(s)	u.m.	Mean	St.dev.
<b>LT_9008</b>	Ratio of the total municipal area whose land cover changed from non-urbanized to urbanized between 1990 and 2008 to the municipal land area	CLC90 CLCMS08	% (ha/ha)	1.86	2.45
<b>NAT_2000</b>	Ratio of the total municipal land area belonging to the Natura 2000 network in 2008 to the municipal land area	SDRGISS	% (ha/ha)	31.16	24.65
<b>LT_N2K</b>	Total municipal area whose land cover changed from non-urbanized to urbanized between 1990 and 2008 within the Natura 2000 network	CLC90 CLCMS08 SDRGISS	ha	20.40	35.07
<b>CS_N2K</b>	Municipal land area classed as Natura 2000 and included in the coastal strip	SDRGISS RLP spatial dataset	ha	690.23	1785.09
<b>OLPL_N2K</b>	Municipal land area classed in planning code in force before 2006 as areas where land transformations and new developments were almost totally forbidden	SDRGISS	ha	1,357.25	2,558.73
<b>WAT_N2K</b>	Total municipal area classed as 4 "Wetlands" or 5 "Water bodies" in the 2008 regional land-use map and included in the Natura 2000 network	SDRGISS	ha	114.83	388.38
<b>SLOP</b>	Municipality's weighted average slope of areas included in the Natura 2000 network weight = area of the share of the municipality designated as Natura 2000 site(s)	SDRGISS	%	18.85	13.30
<b>DENS1990</b>	Municipal residential density in 1990	ISTAT	res./ km <sup>2</sup>	77.85	194.62
<b>INC_2008</b>	Municipal per-capita income in 2008	Italian Ministry of Economy & Finance	€	7,442.91	1,727.64
<b>AUTOCORR</b>	Municipal spatially lagged dependent variable 1990-2008		%	1.67	1.16

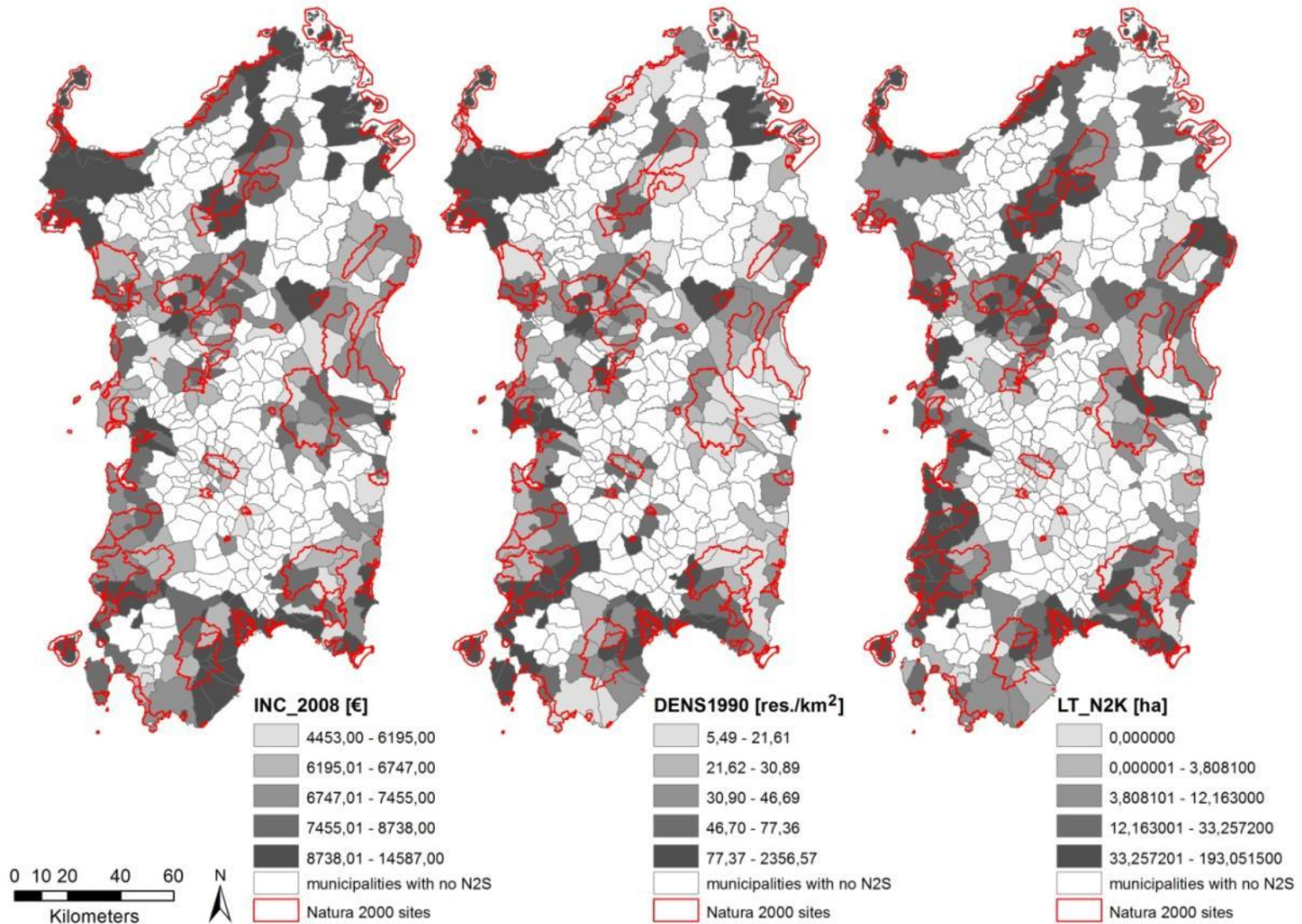
CLC90: CORINE Land Cover 1990 EEA map

CLCMS08: regional CORINE Land Cover Map of 2008

SDRGISS: Spatial Dataset of the Regional Geographic Information System of Sardinia

RLP: Regional landscape plan of Sardinia

# 4. MAPPING POTENTIAL DRIVERS OF LAND TAKE



## 5. RESULTS OF THE OSL MODEL (DEP. VARIABLE LT\_9008)

Variable	Coefficient	Stand.error	t-statistic	Hypothesis test: coefficient=0
Constant	-0.1040	0.8137	-0.128	0.8985
NAT_2000	— -0.0130	0.0066	-1.990	0.0484
LT_N2K	+ 0.0188	0.0050	3.774	0.0002
CS_N2K	+ 6.52E-06	0.0001	0.056	0.9551
OLPL_N2K	— -6.46E-05	8.74E-05	-0.740	0.4607
WAT_N2K	— -0.0022	0.0005	-4.232	0.0000
SLOP	— -0.0264	0.0121	-2.191	0.0300
DENS1990	+ 0.0034	0.0012	2.890	0.0044
INC_2008	+ 0.0002	0.0001	1.567	0.1192
AUTOCORR	+ 0.8224	0.1698	4.843	0.0000
<i>Adjusted R-squared = 0.5441</i>				

- Signs as expected
- All variables significant (98.8%) but two
- ■ The impact of N2Ss-based environmental protection on land take is not related to other conservative planning rules

## 6. DISCUSSION AND CONCLUSIONS

**NAT\_2000**  
(c. -0.0130)

- The presence and size of N2Ss prevent land take
- In the surroundings of N2Ss possible rebound effects are quite weaker than the conservative effect, if any
- On average, if the municipal area belonging to N2Ss triples, the municipal land uptaken will decrease by 2.6%

**LT\_N2K**  
(c. +0.0188)

- If the municipal area uptaken within N2Ss doubles (=LT\_N2K increases of about 21 ha), municipal non-artificial area decreases by 0.4%

**WAT\_N2K**  
(c. -0.0022)

- On average, if wetlands in N2Ss tripled (=WAT\_N2K increases by about 250 ha), the land uptaken would decrease by less than 0.1%

**SLOP**  
(c. -0.0264)

- The marginal effect of SLOP is slightly greater than that of LT\_N2K

**DENS1990**  
(c. 0.0034)

- Higher demand for areas for residential development increases land take (agglomeration effect)
- The more the quantity of land that is “taken”, the greater the municipal residential density
- Land-taking processes are positively related to intensive urbanization rather than to extensive urbanization
- On average, a 10-residents-per-hectare increase in residential density is related to a 3.4% increase of land uptaken

**INC\_2008**  
(c. 0.0002)

- Wealthier residents mean higher land take (income effect)
- More affluent communities show a comparatively higher demand for new developments (housing, services and infrastructure, etc)
- On average, a 5,000 € increase in per-capita income would imply a 1% increase in land take (quite a weak income effect)

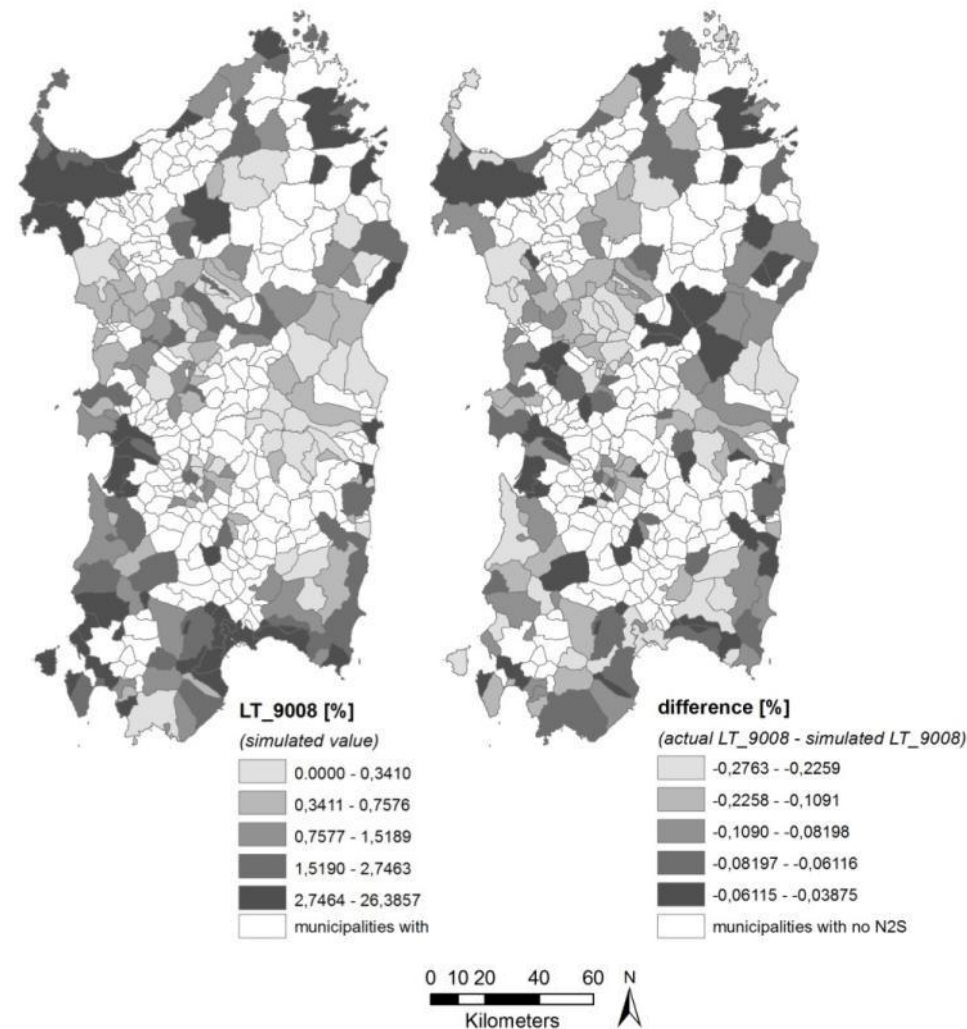
## 6. DISCUSSION AND CONCLUSIONS

With reference to establishment and management of N2Ss, **3 main implications** on the relationship between land-taking processes and environmental protection policies:

- 1. Robust negative influence of N2Ss on land take:**
  - The presence and size of N2Ss is correlated to a decrease in land take.
  - The reduction in land take as a consequence of N2Ss is significant in quantitative terms.
- 2. No evidence of the “rebound” effect** (Dewi et al., 2013) **in the close surroundings of N2Ss:**
  - Land saving spreads over the whole municipal land area as a consequence of the presence and size of the municipal N2Ss.
  - This finding is to be linked to the mandatory character of the A.A. procedure.
  - A.A. has to be applied even outside N2Ss boundaries, if plans and projects could impact on habitats and species within N2Ss.
- 3. No need for further restrictive planning rules in order to limit land take:**
  - N2Ss do not impose, in principle, any ban on specific land uses or developments.
  - Rather, it must be proved that project or planning proposals will not damage or generate loss of habitats and/or species.
  - This, according to the outcomes of our analysis, significantly reduces land-taking processes.

## 6. DISCUSSION AND CONCLUSIONS

- What if the size of N2Ss increased in each municipality?  
(by 10 percentiles in the distribution of NAT\_2000)
- For each local authority, the magnitude of the effect on LT\_9008 is calculated.
  - Left: values of the simulated LT\_9008
  - Right: difference between actual and simulated values of LT\_9008
- An increase by ten percentiles in the share of municipal land included in N2Ss brings about a decrease in land take ranging from -0.03875% to -0.2763%.





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