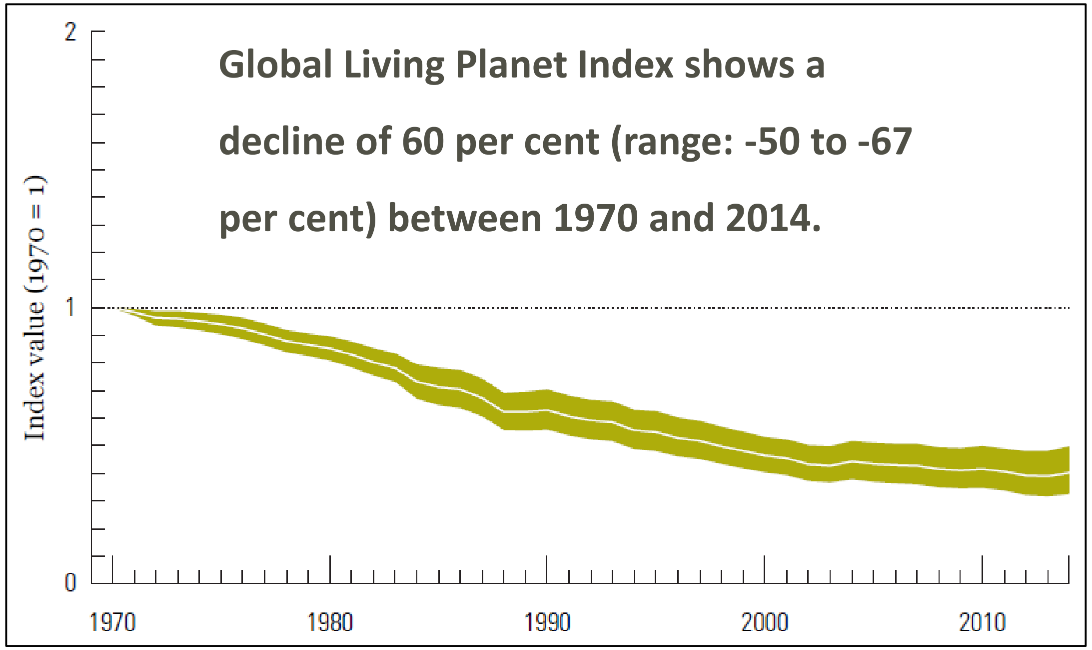
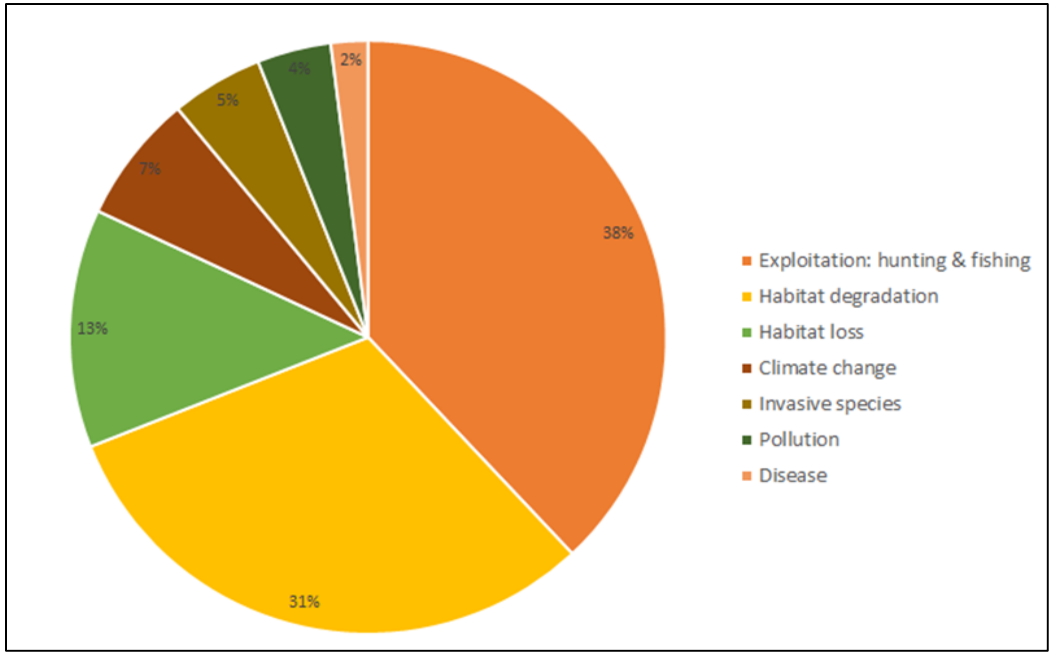
“Integrated Conservation Planning in Cyprus”

Stalo Leontiou

<u>State of the problem:</u> Decline of biodiversity.



<u>Figure 1: The Global Living Planet Index: 1970 to 2014</u>
Average abundance of 16,704 populations representing 4,005 species monitored across the globe declined by 60%. The white line shows the index values and the shaded areas represent the statistical certainty surrounding the trend (**Source:** WWF/ZSL, 2018).



<u>Figure 2:</u> Causes of biodiversity loss (**Source:** WWF/ZSL, 2018).

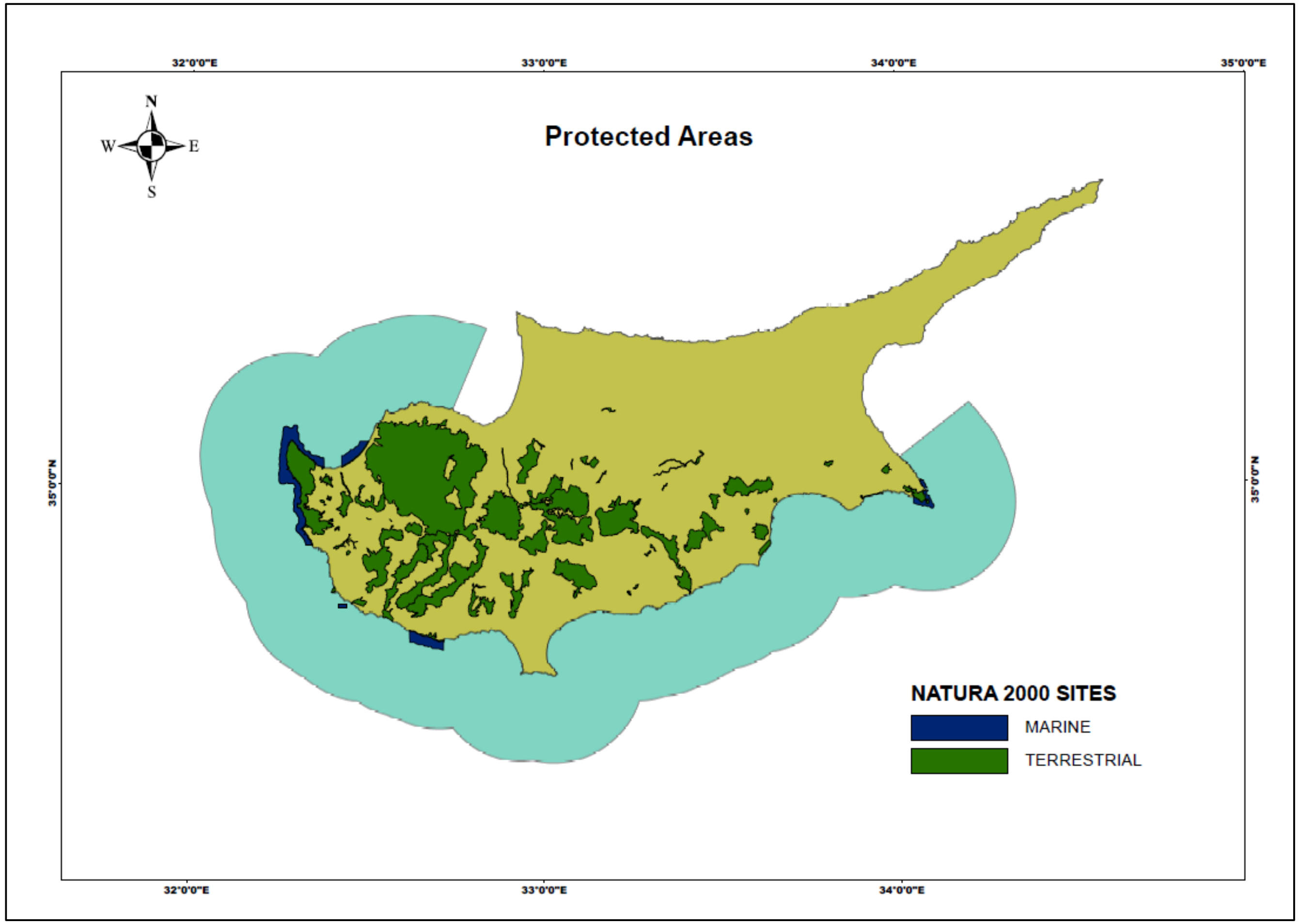
Aichi Target 11: Concerns the global coverage of protected areas.

By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, **ecologically representative and well connected systems of protected areas** and other effective area-based conservation measures, and **integrated into the wider landscapes and seascapes.**

Gaps in conservation of the biodiversity - Protected Areas (PAs)

Non quantitative selection of protected areas:

- Low economic interest
- Remoteness
- Scenic or touristic value
- PAs include one environmental realm (30% of the species of European concern use habitats in multiple realms (Giakoumi et al., 2018)).



State of the art: Systematic Conservation Planning (SCP)

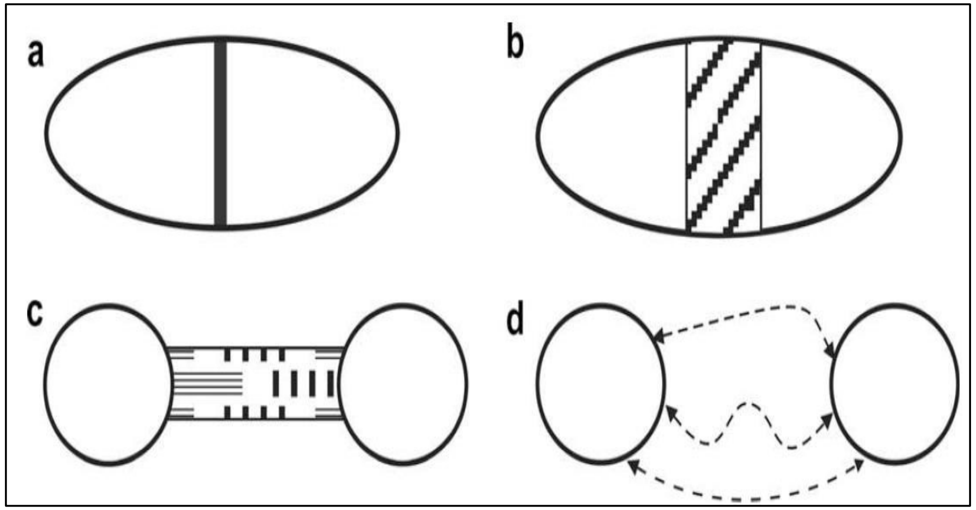
- Introduced in 2000 by C.R. Margules and R.L. Pressey.
- Quantitative methods for the identification of priority areas for conservation.
- Core concepts: representativeness, complementarity, adequacy, efficiency.
- Focuses on the selection of a minimum set of representative sites (network) which complement each other and achieve defined conservation objectives (Pressey et al. 1993).

"Find a solution that achieves conservation targets set at minimum cost".

State of the art: Systematic Conservation Planning Across Realms

- Ecosystem Connectivity: Ecological and biophysical processes that connect two or more realms and allow for the movement of species and the associated or independent transfer of energy and matter (Beger et al. 2010).
- Processes taking place at the interface of two realms, or processes that initiate in one realm and propagate to another (Beger et al., 2010).
- Species that use more than one realm during their daily or life cycle.

Narrow Broad



Constrained Diffuse

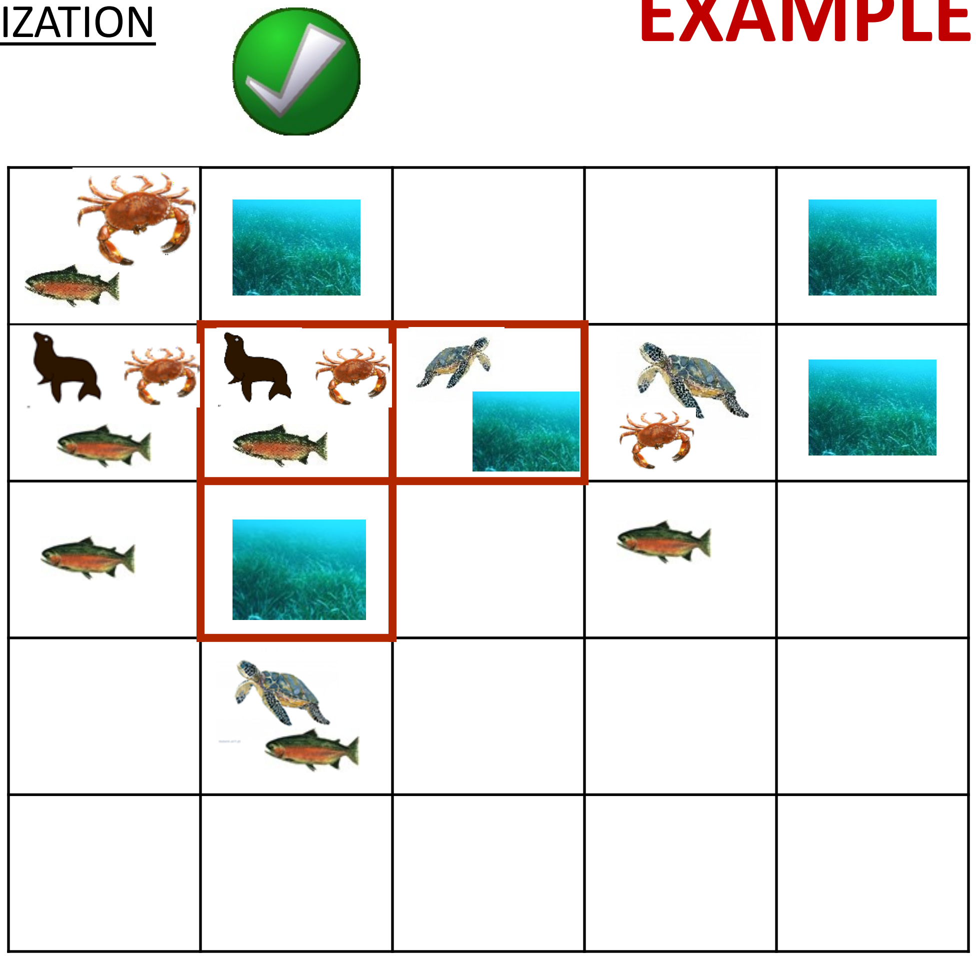
Beger et al., 2010

FUNDAMENTAL CONCEPTS OF SPATIAL PRIORITIZATION

EXAMPLE…

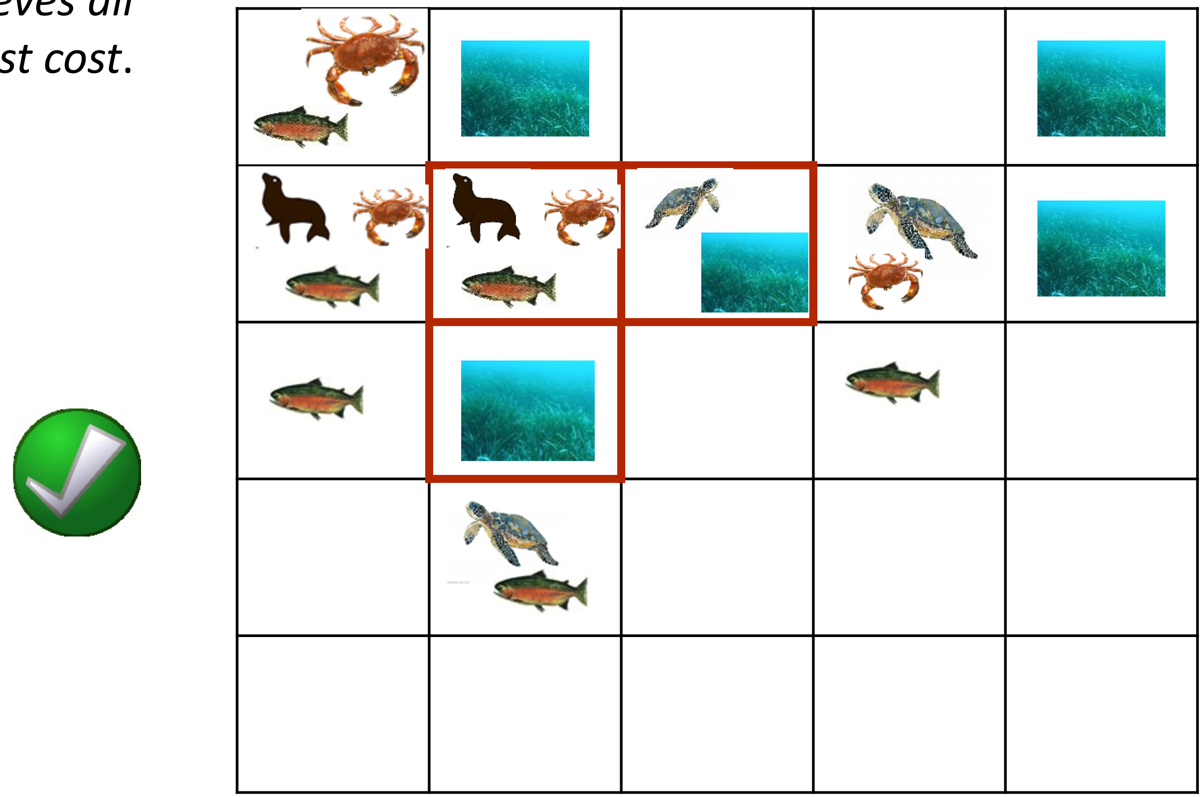
- Spatial process
- Representativeness
- Complementarity
- Adequacy
  - Representativeness (setting targets)

  - Connectivity
- Efficiency



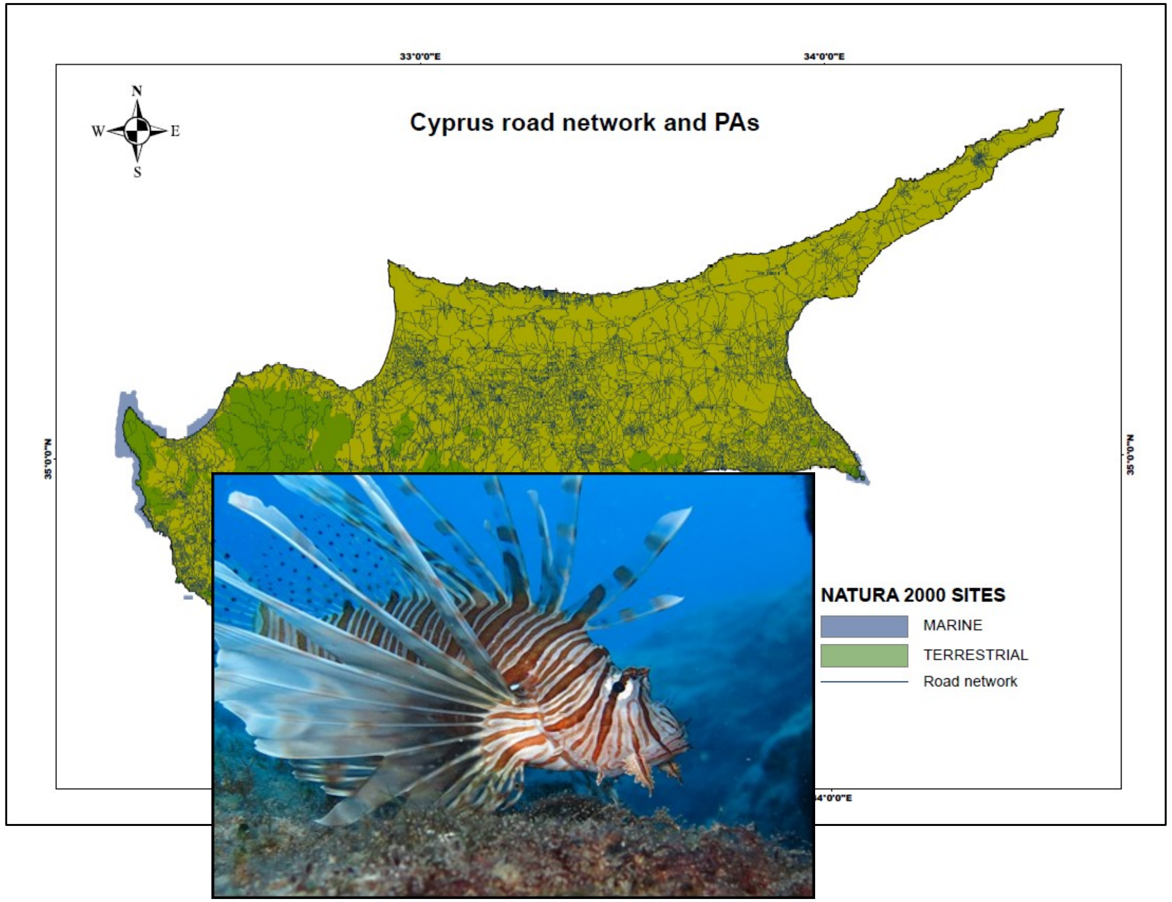
MINIMUM SET COVERAGE

Find the optimal solution that achieves all conservation targets set, at the least cost.



Gaps and problems in conservation of the biodiversity - Cyprus

- High fragmentation and loss of habitats.
- Invasive species in both land and sea.
- The overall conservation status of the marine fauna in all Marine PAs is insufficient (European Commission Assessment, 2018).
- Overlap of responsibilities between the different responsible authorities (Demetropoulos 2002).



RESEARCH QUESTIONS

1) How the conservation area network is selected when biological connectivity between and within realms is taken into account?

- That is take into account movements of the species from their breeding/nesting sites to foraging grounds.

2) How does the conservation area network change when cross system threats and socio – economic factors are integrated in the analysis?

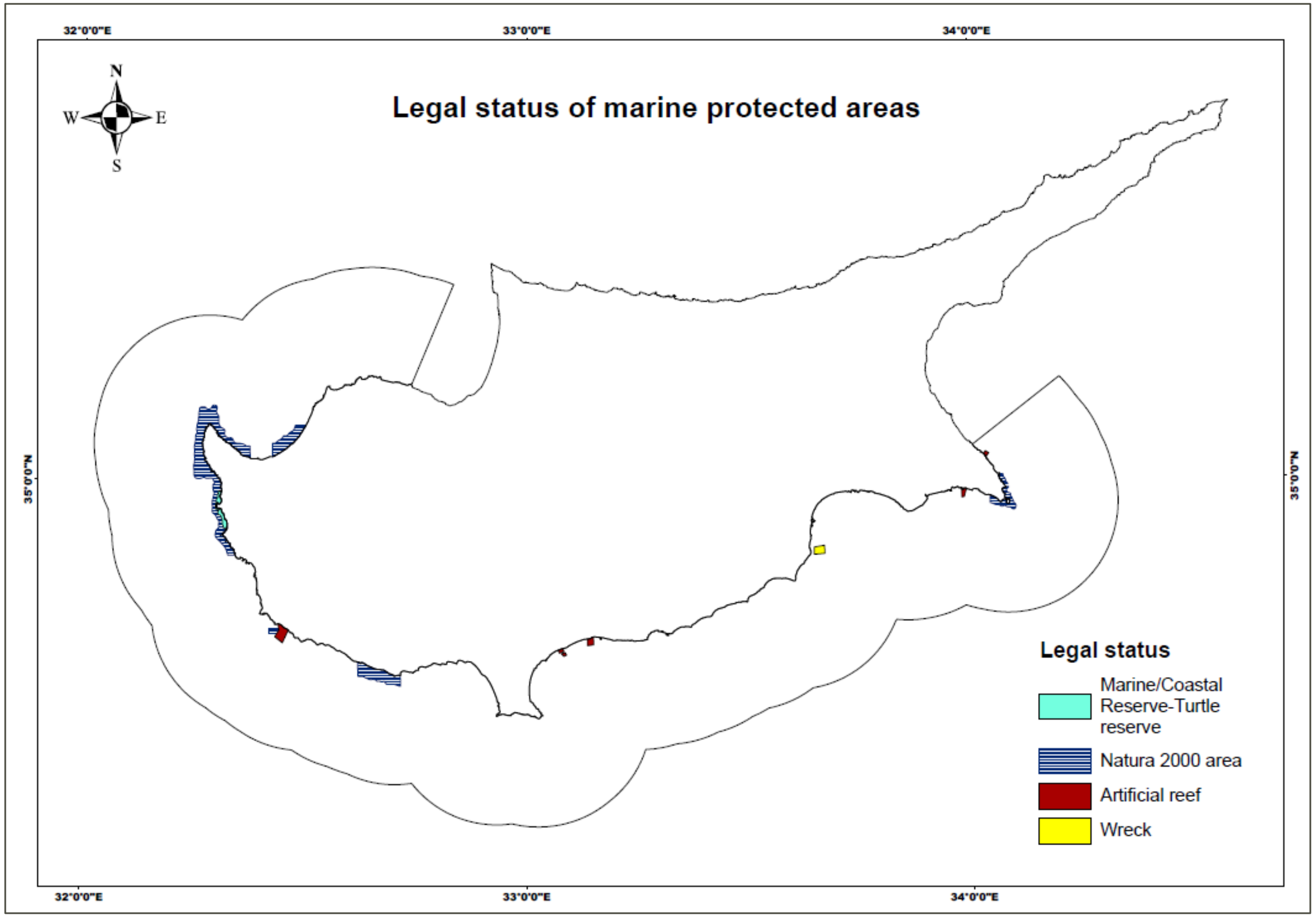
- Threats such as pollution, coastal development, shipping, agricultural runoff etc. Also, socio-economic factors such as important touristic areas or other economically important anthropogenic activities.

3) How does the conservation area network change when introducing climate change?

- Coupled atmosphere-ocean general circulation model to predict climatic variables, in line with IPCC scenarios.

METHODOLOGY

Study Area:


32°0'0"E
33°0'0"E
34°0'0"E
35°0'0"N
N
W
E
S
Legal status of marine protected areas
Legal status
Marine/Coastal Reserve-Turtle reserve
Natura 2000 area
Artificial reef
Wreck

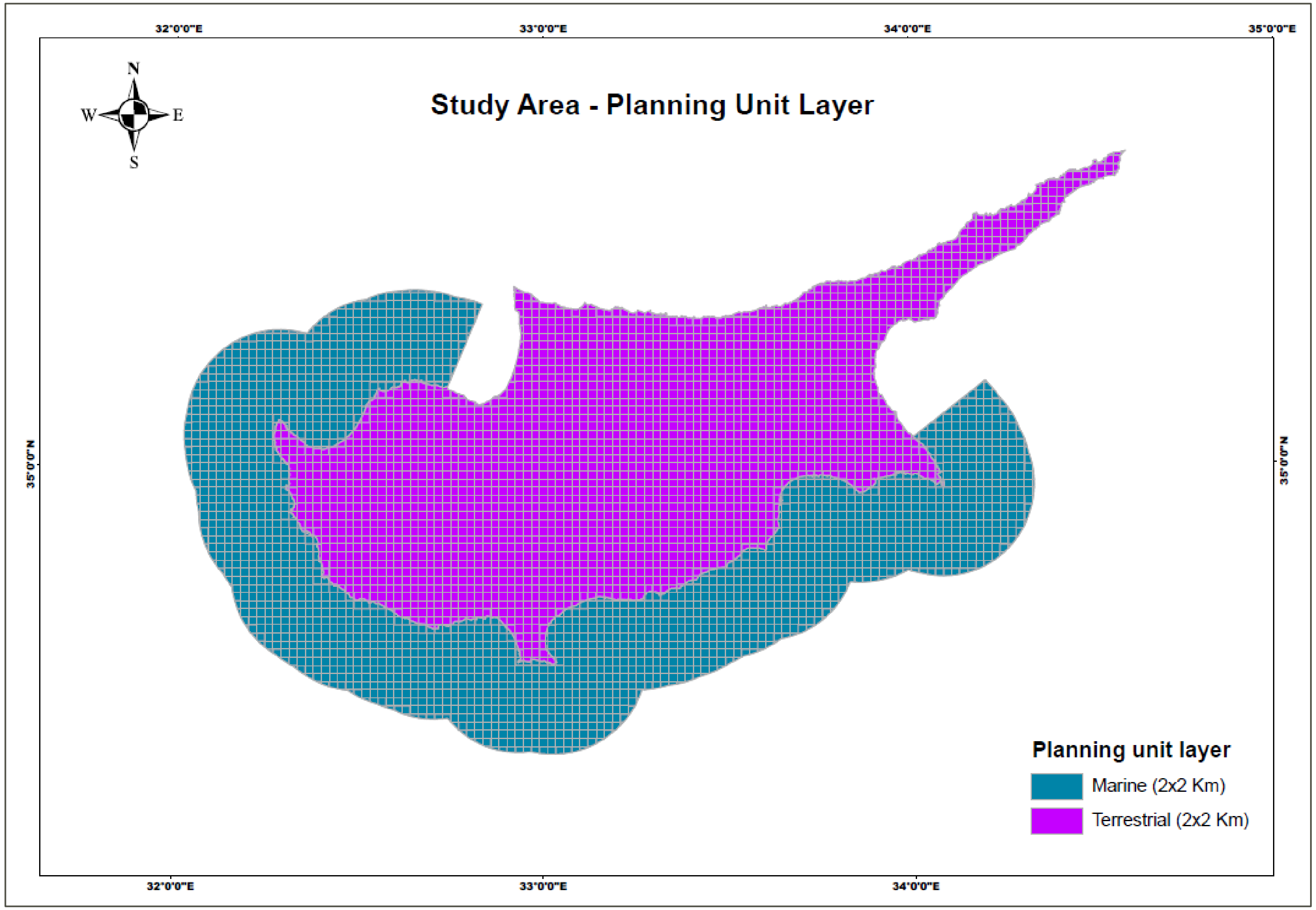
Conservation Features:

Conservation features	Category	Data type	Source
Chelonia mydas	Reptile	shapefile (polygons)	Department of Fisheries and Marine Research, 2012.
Caretta caretta	Reptile	shapefile (polygons)	Department of Fisheries and Marine Research, 2012.
Monachus moncachus	Mammal	shapefile (polygons)	Department of Fisheries and Marine Research, 2012.
Phalacrocorax aristotelis desmarestii	Seabird	shapefile (polygons)	Birdlife Cyprus; Expert data verification: Nikos Kassinis (Game and Fauna Services and Iris Charalambidou (University of Nicosia)
Charadrius alexandrinus	Waterbird	shapefile (polygons)	Birdlife Cyprus; A. Tye, J. Stylianou, V. Anastasi and C. Papazoglou (2012): A survey of the distribution, habitat use, populations and breeding of the Kentish Plover Charadrius alexandrinus and Black-winged Stilt Himantopus himantopus at the Akrotiri Wetlands, September 2011 to August 2012.
Falco eleonorae	Bird	shapefile (polygons)	Birdlife Cyprus; Expert data verification: Nikos Kassinis (Game and Fauna Services, Iris Charalambidou (University of Nicosia) and Thomas Chadjikyriakou (Akrotiri Environmental Center)
Posidoneia oceanica	Habitat	shapefile (polygons)	G. Kokosis, Ministry of the Interior, Department of Lands and Surveys (2017): http://eservices.dls.,oi.gov.cy/#/national/geoportalmapviewer.
Cymodocea nodosa	Habitat	shapefile (points)	MEDISEH - Meditteranean Sensitive Habitats - Marea Project
Sea caves	Habitat	shapefile (points)	Gerovasileiou Vasilis (HCMR) <bill_ger@yahoo.com>; www.wannadive.net/spot/Middle_East/Cyprus/The_Bends/index.html; Expert data verification: Antonis Petrou (Enalia Physis)
Hard substrate	Habitat	shapefile (polygons)	G. Kokosis, Ministry of the Interior, Department of Lands and Surveys (2017): http://eservices.dls.,oi.gov.cy/#/national/geoportalmapviewer.
Soft substrate	Habitat	shapefile (polygons)	G. Kokosis, Ministry of the Interior, Department of Lands and Surveys (2017): http://eservices.dls.,oi.gov.cy/#/national/geoportalmapviewer.

Table 1: List of conservation features.

Planning Unit Layer:

- Grid of 2 km x 2 km cells.
- Territorial waters (12nm).
- Economically and juridically more feasible to apply conservation plan over country’s territory.
- The marine area includes all of the targeted habitats and foraging grounds that the selected species use.
- Human activities and their impacts to marine biodiversity are predominantly concentrated in continental shelves and slopes (Giakoumi et al. 2013).



Marxan Decision Support Tool (Ian Ball and Hugh Possingham, 2000):

- Simulated annealing (stochastic algorithm).
- Produces multiple solutions for achieving conservation targets set.
- Data driven.
- Commonly used to plan reserves (>1300 users; >100 countries).
- Important applications: Great Barrier Reef Australia (re-zoning of the reef)
  Channel islands in California (informed the design of marine protected areas)

…Marxan tries to find the least expensive solution to the following objective function, using a simulated annealing algorithm:

$$\sum_{i=1}^{m} c_i x_i + b \sum_{i1=1}^{m} \sum_{i2=1}^{m} x_{i1}(1 - x_{i2}) cv_{i1,i2} + \sum_{j=1}^{n} FPF_j FR_j H(s)\left(\frac{s}{t_j}\right).$$

Marxan's Objective Function

$$Min \overbrace{\sum_{PUs} cost}^{1} + \overbrace{BLM \sum_{PUs} Boundary}^{2} + \overbrace{\sum_{ConV} SPF \times Penalty}^{3} = \text{Marxan score}$$

1. Sum of costs of all selected planning units
2. Sum of boundary penalties, weighted by the Boundary Length Modifier (**BLM**); higher BLM -> more compact network.
3. Sum of species penalties for not achieving the conservation target, weighted by the Species Penalty Factor (**SPF**).

EXPECTED OUTCOMES

1) Initiate a new path towards biodiversity conservation.
2) Improve the status and extent of coastal areas reserve network in Cyprus.
3) Inform policy makers and stakeholders in order to influence decision-making.

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THANK YOU VERY MUCH FOR YOUR ATTENTION!