
Linking species composition and biodiversity
Resilience of MPAs
to ecosystem resistance
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Resilience of MPAs



In this talk:

Diversity
- Trends
- Phase shifts

MPAs
- Success
- NEOLIs

Resilience
- Index
- MPA zones

Resistance
- Shift to…
- Quantitative

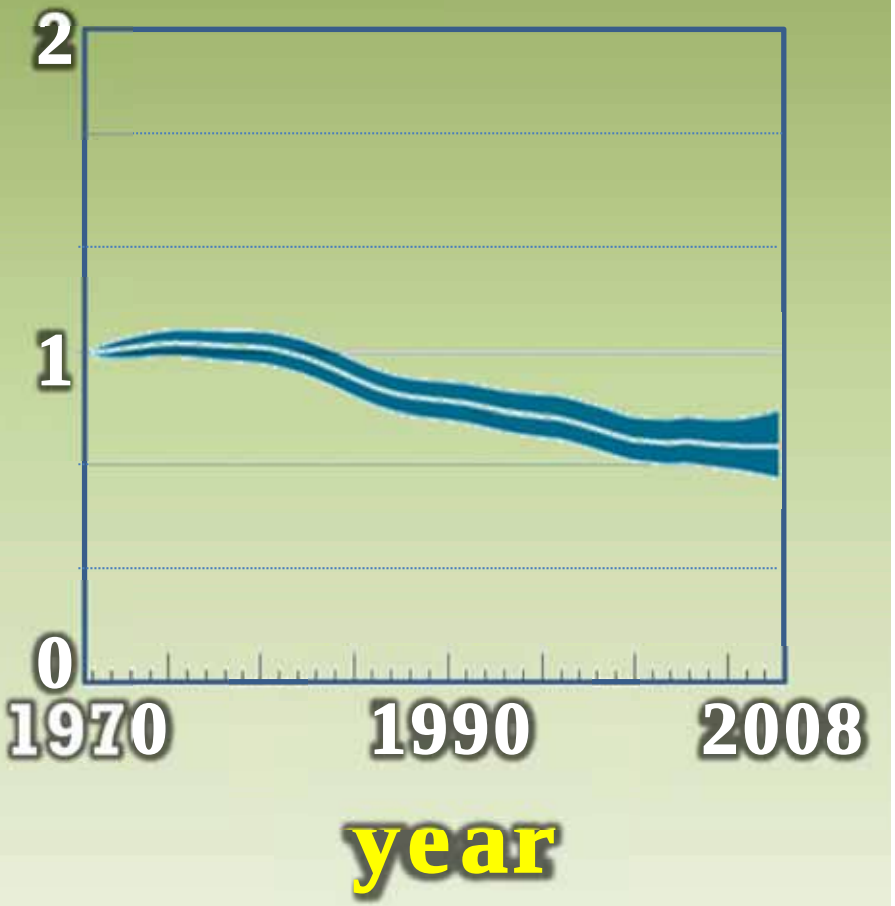
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The decline of biodiversity

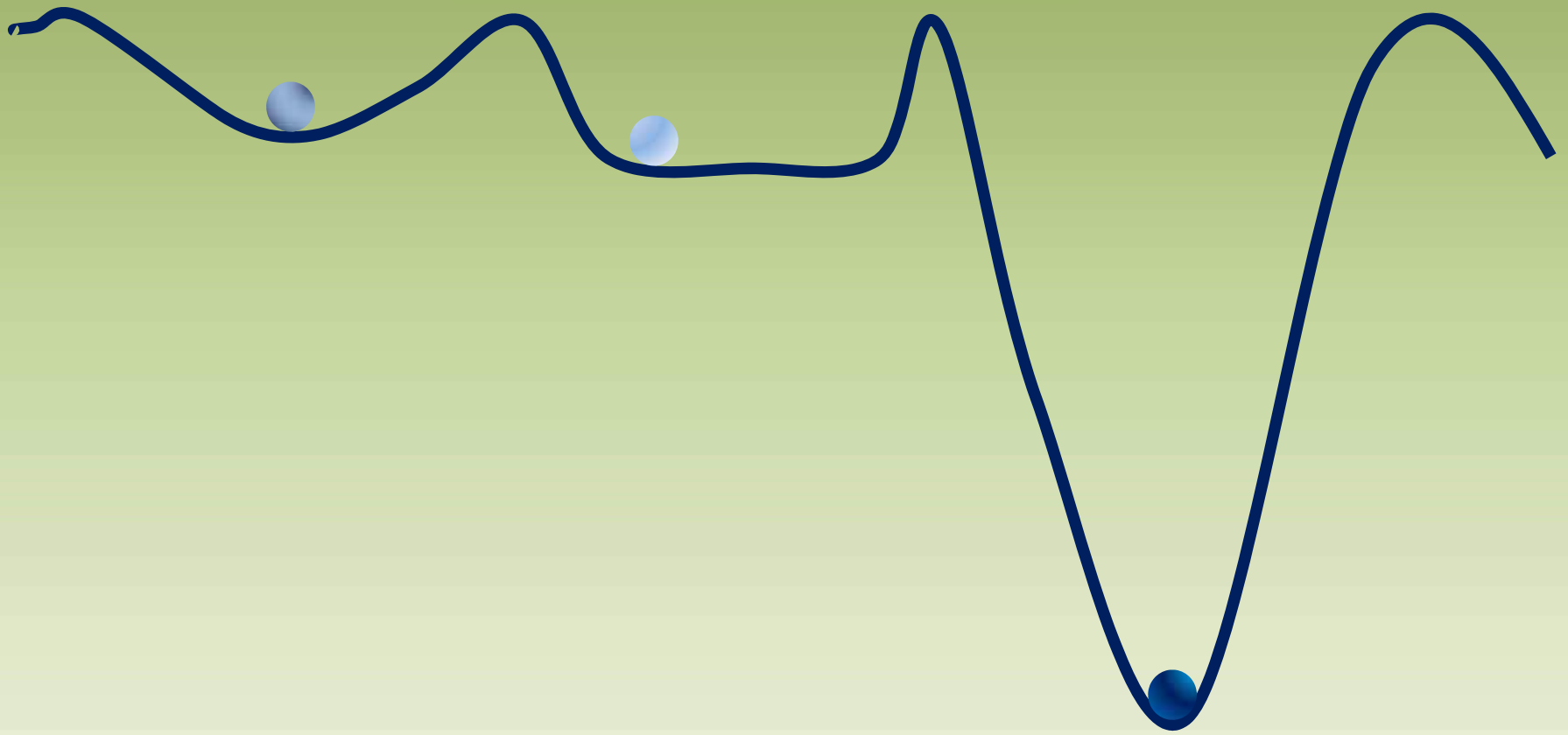
Living Planet Index

- ✓ 2,544 species
  - Birds
  - Mammals
  - Amphibians
  - Reptils
  - Fish
- ✓ 7,953 populations



The decline of biodiversity

Phase shifts



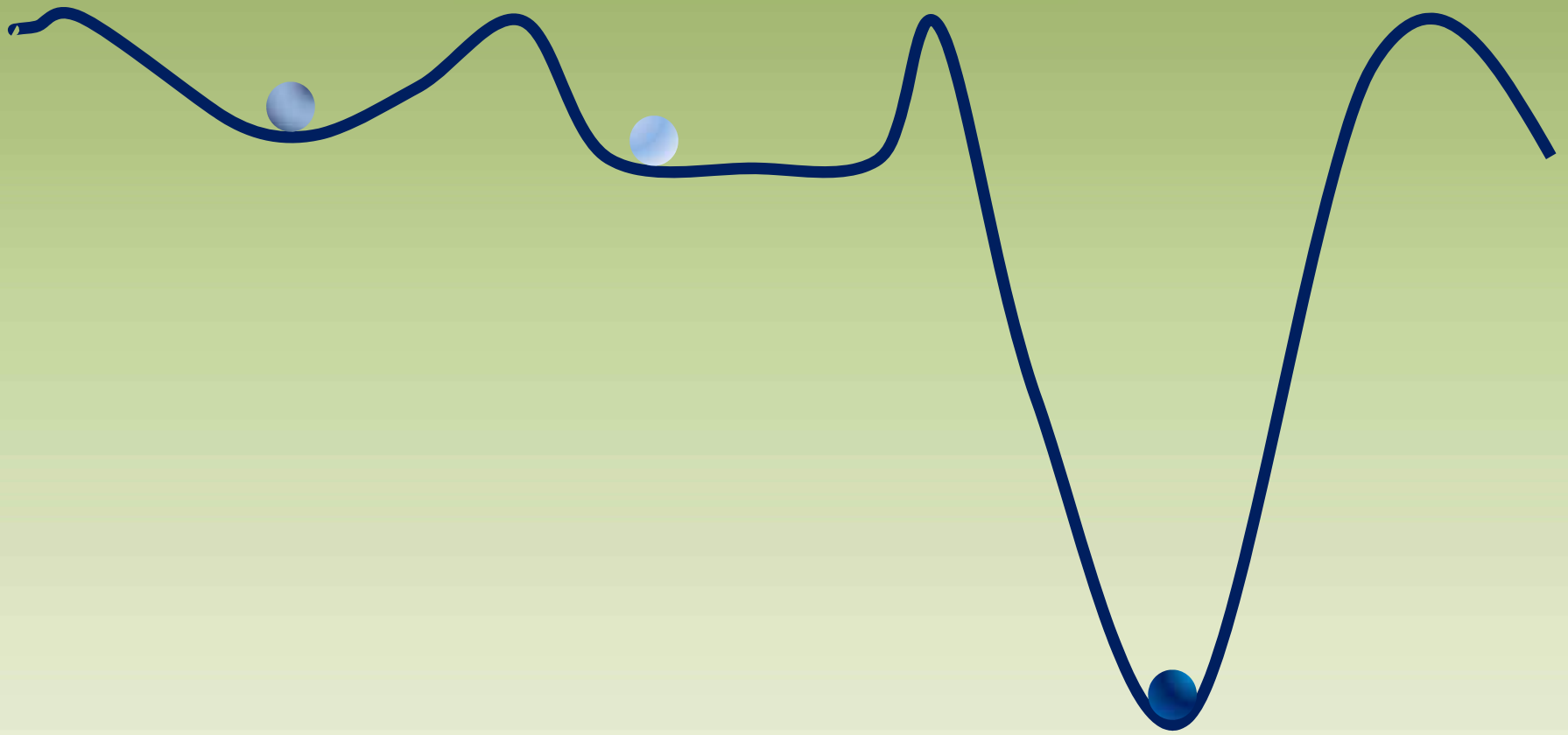
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Holling (1973) Ann Rev Ecol Sys

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The decline of biodiversity

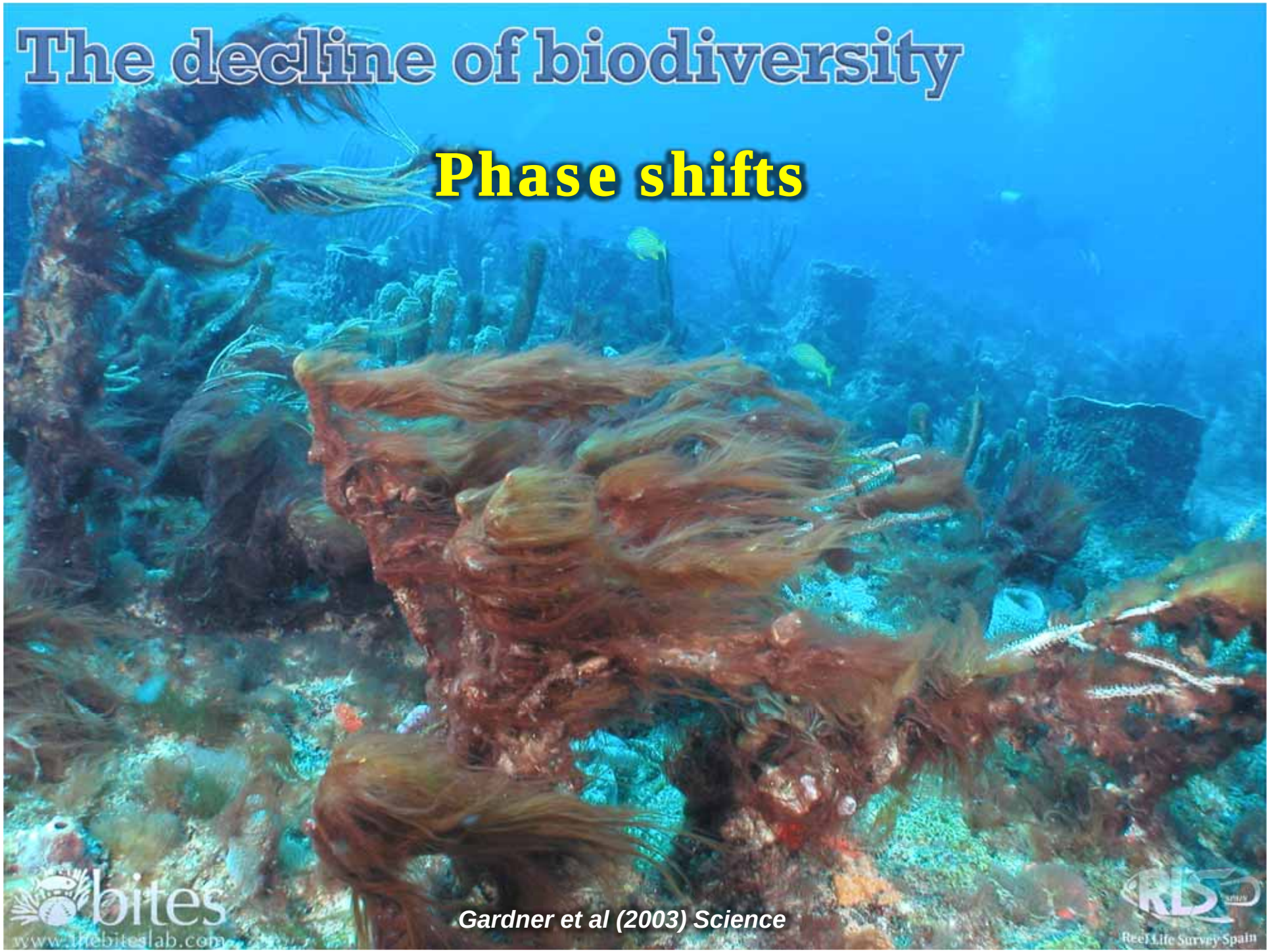
Phase shifts



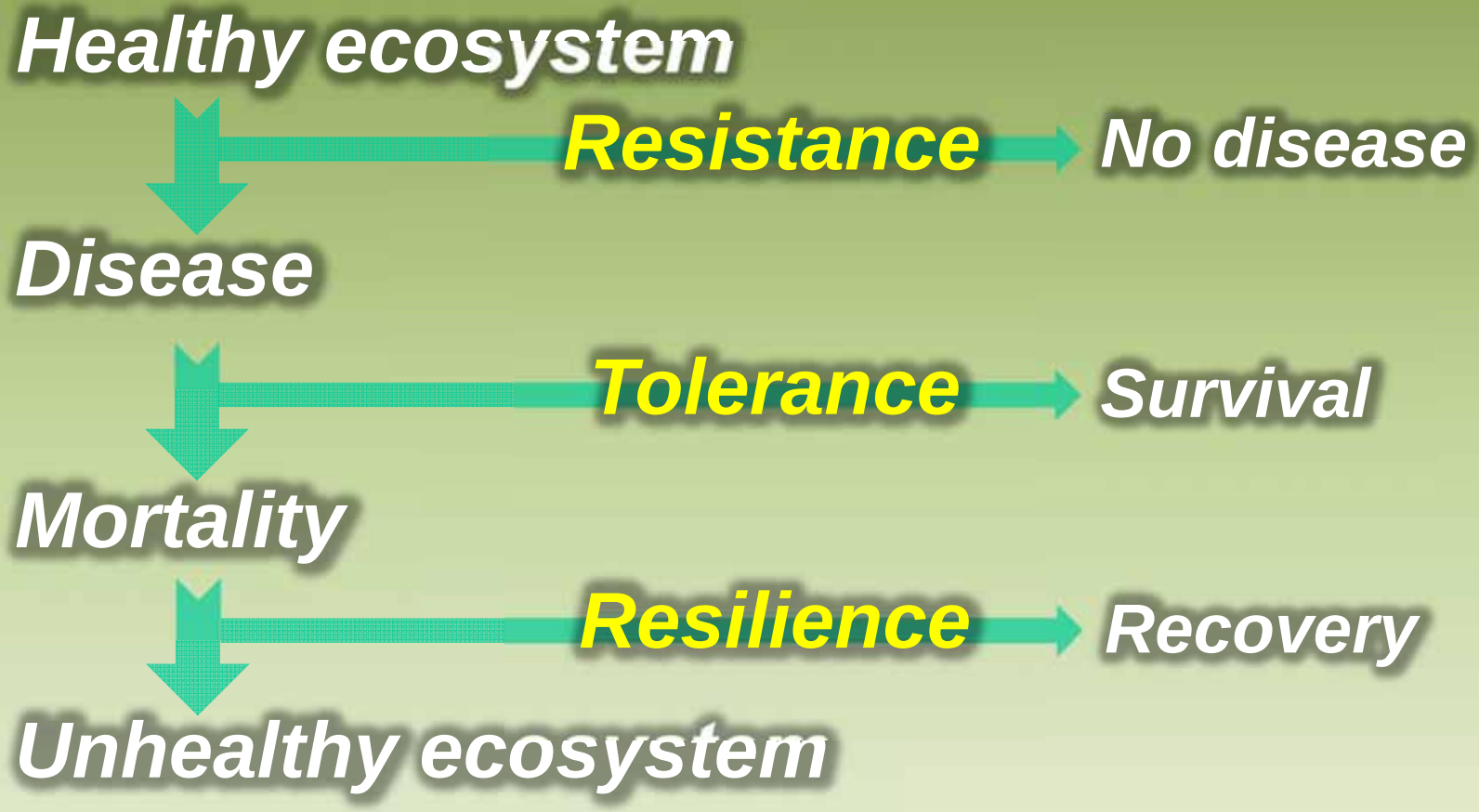
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The decline of biodiversity
Phase shifts
Gardner et al (2003) Science
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The components of resilience



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Obura (2005) Estuar Coast Shelf Sci

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The rise of biodiversity



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The rise of biodiversity

Publications



PAs (10^4)

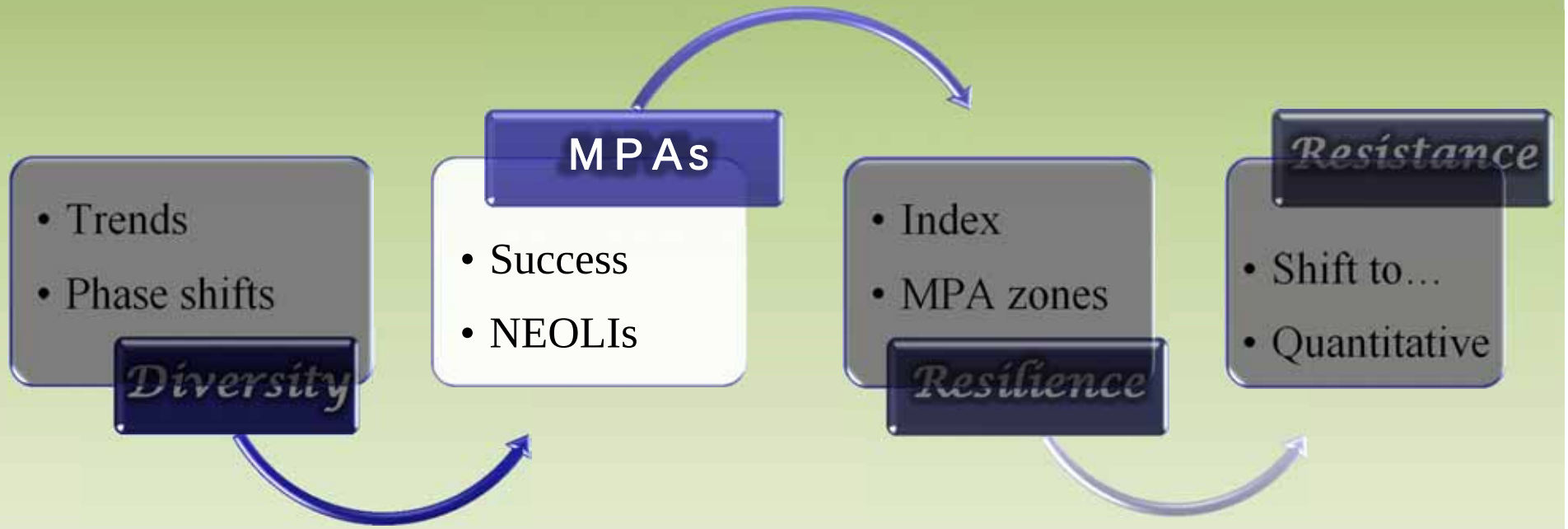


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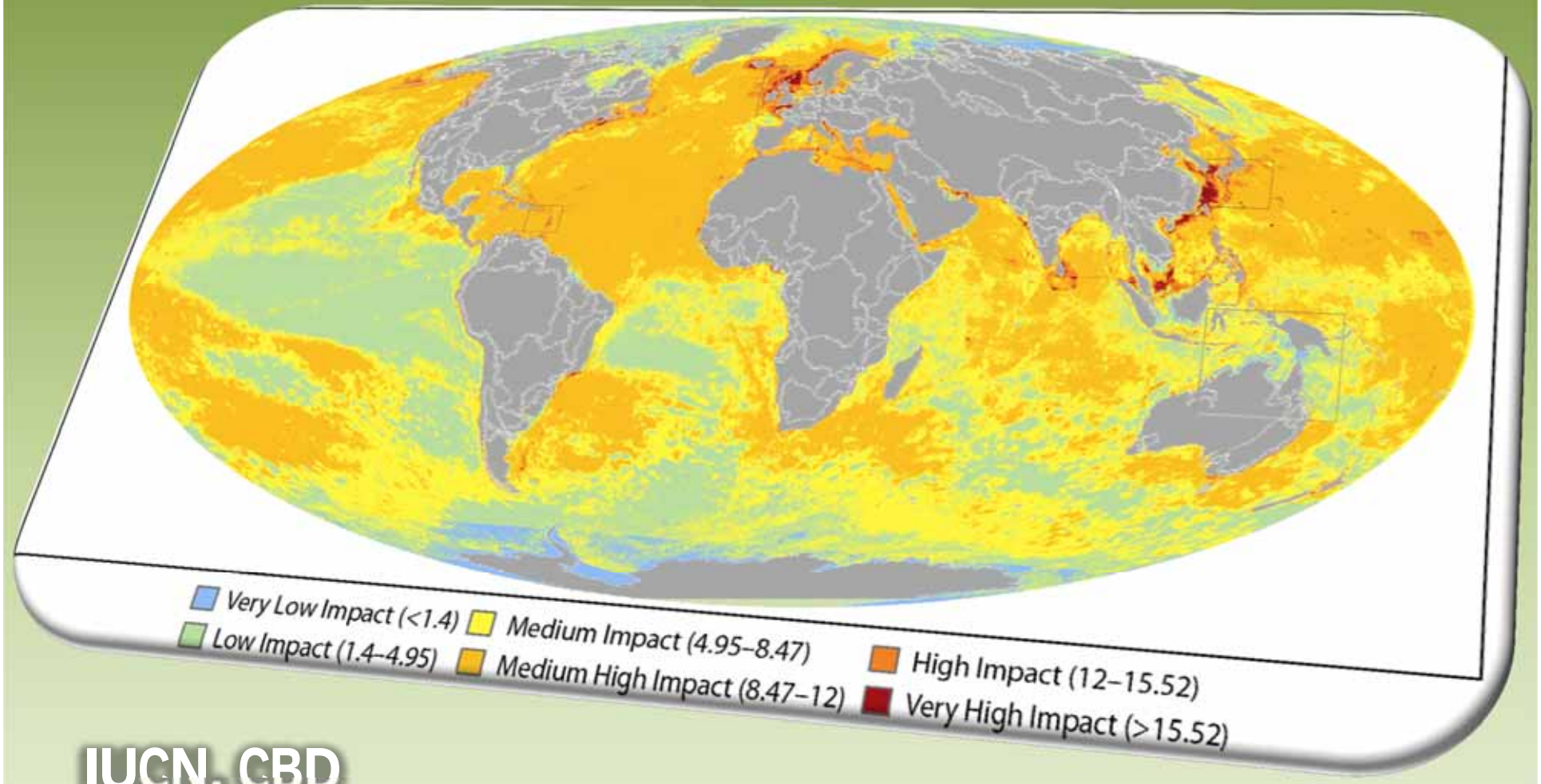
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Biodiversity and MPAs



IUCN, CBD

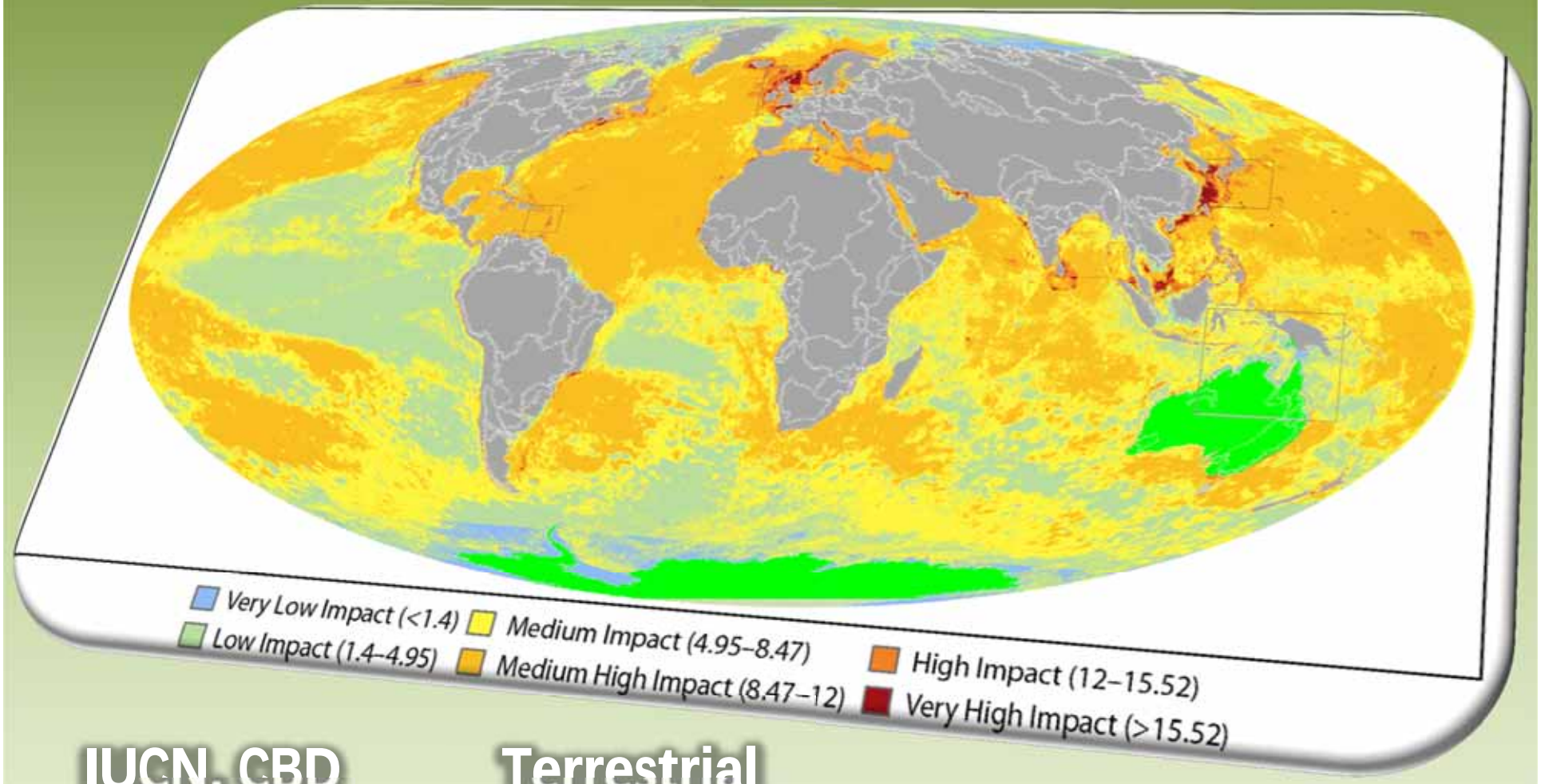
20%

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Halpern et al (2008) Science

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Biodiversity and MPAs



IUCN, CBD

20%

Terrestrial

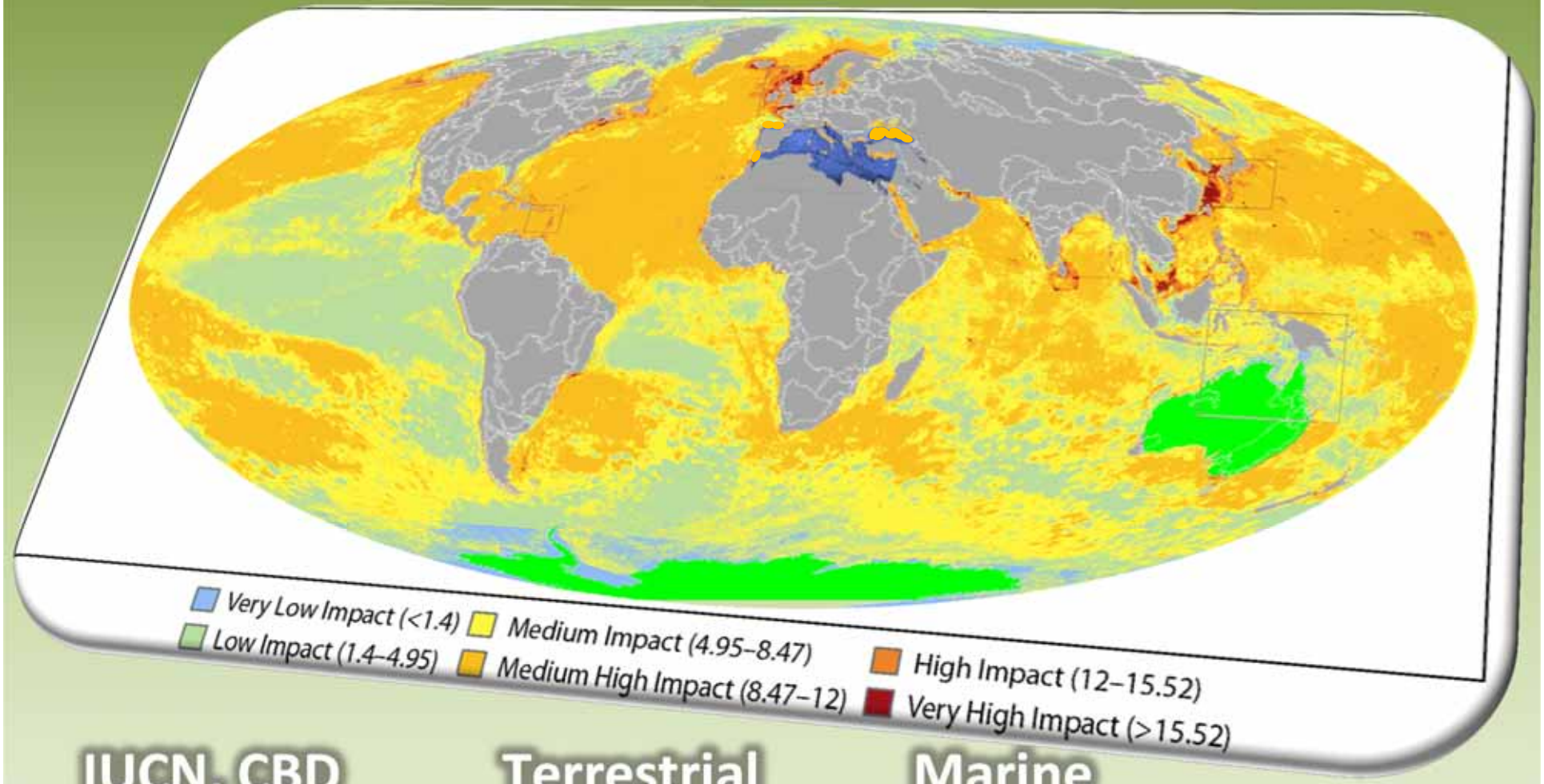
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Biodiversity and MPAs



IUCN, CBD	Terrestrial	Marine
20%	12%	1%

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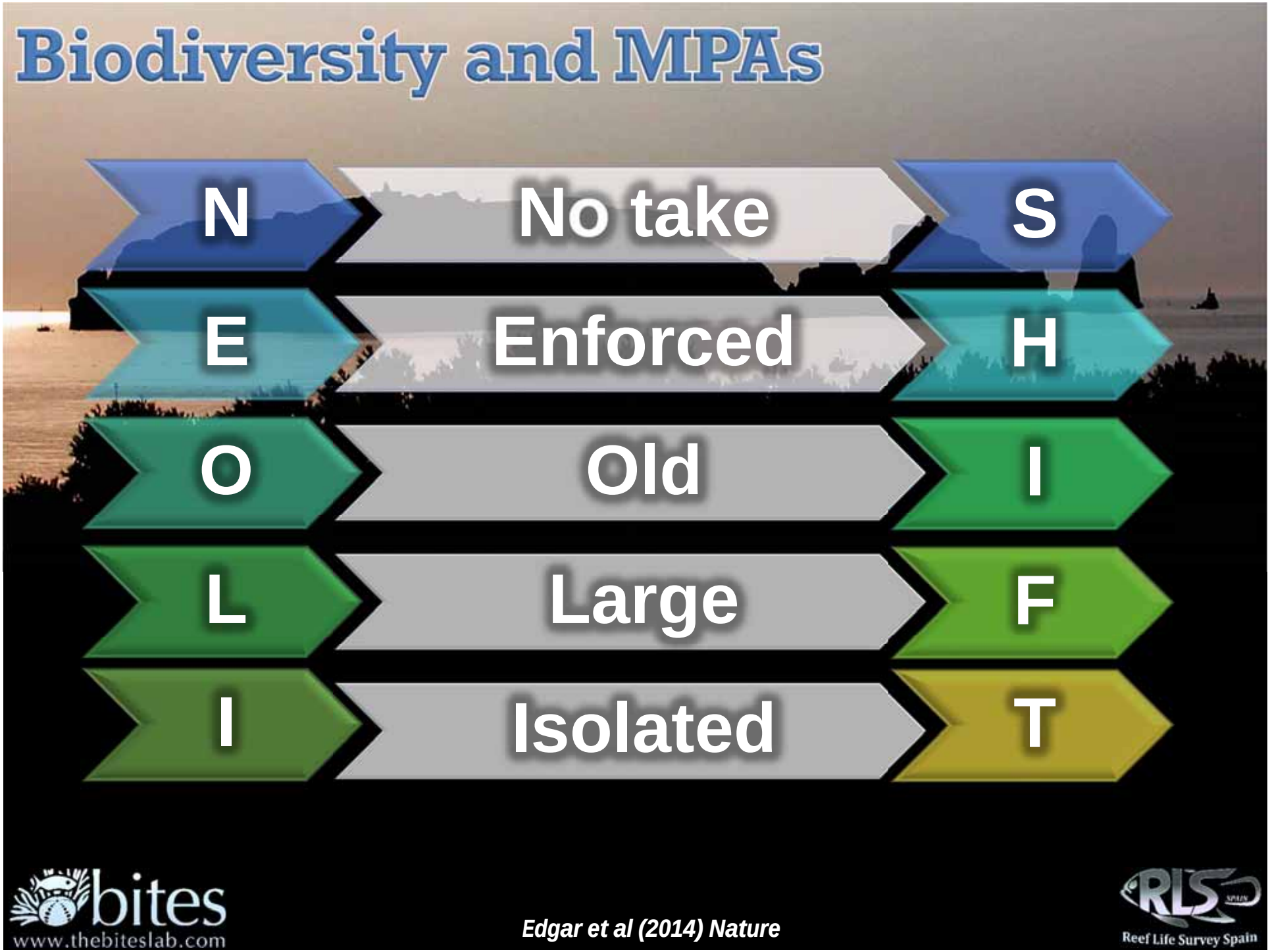
Halpern et al (2008) Science

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Biodiversity and MPAs

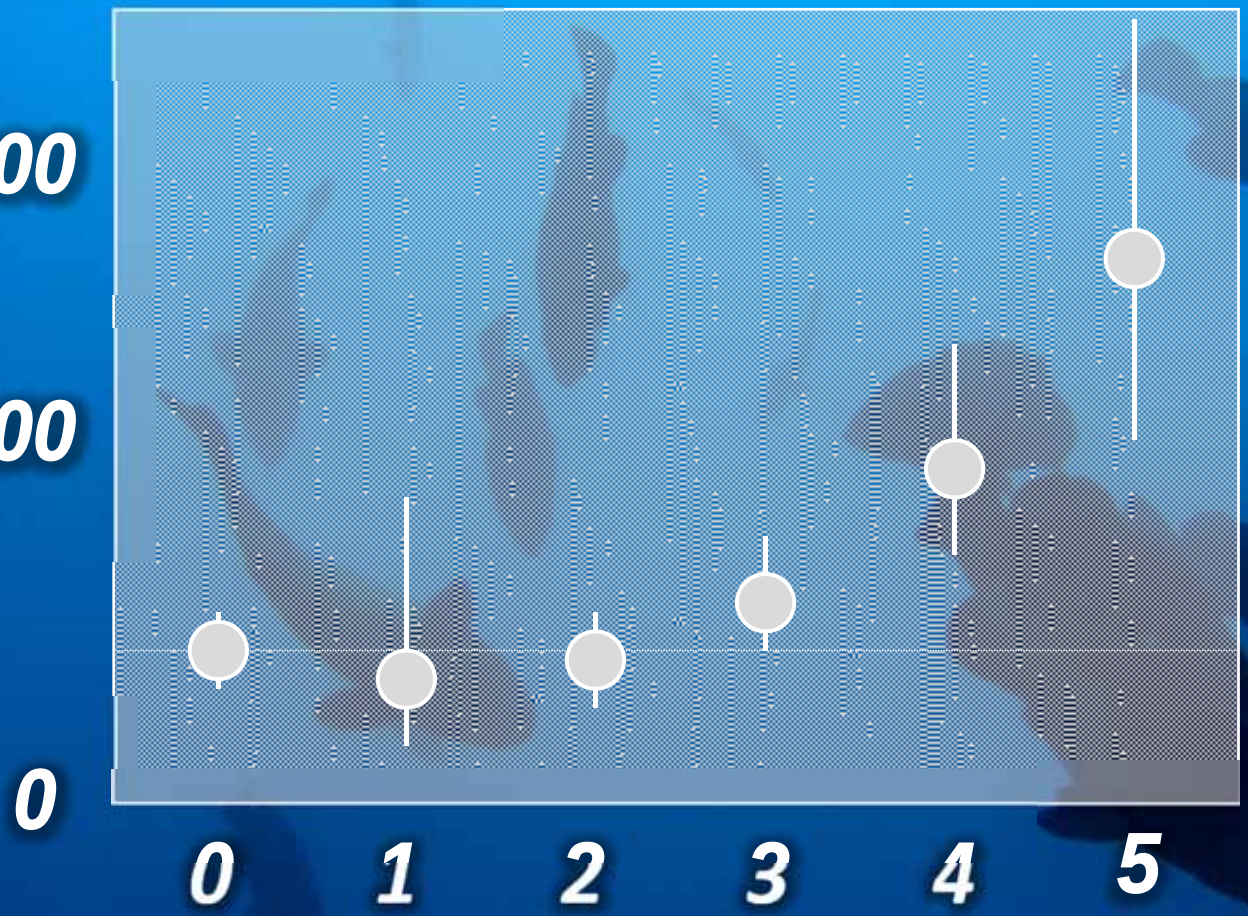


Edgar et al (2014) Nature


Biodiversity and MPAs
N
No take
S
E
Enforced
H
O
Old
I
L
Large
F
I
Isolated
T
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Edgar et al (2014) Nature
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Biodiversity and MPAs

Fish biomass



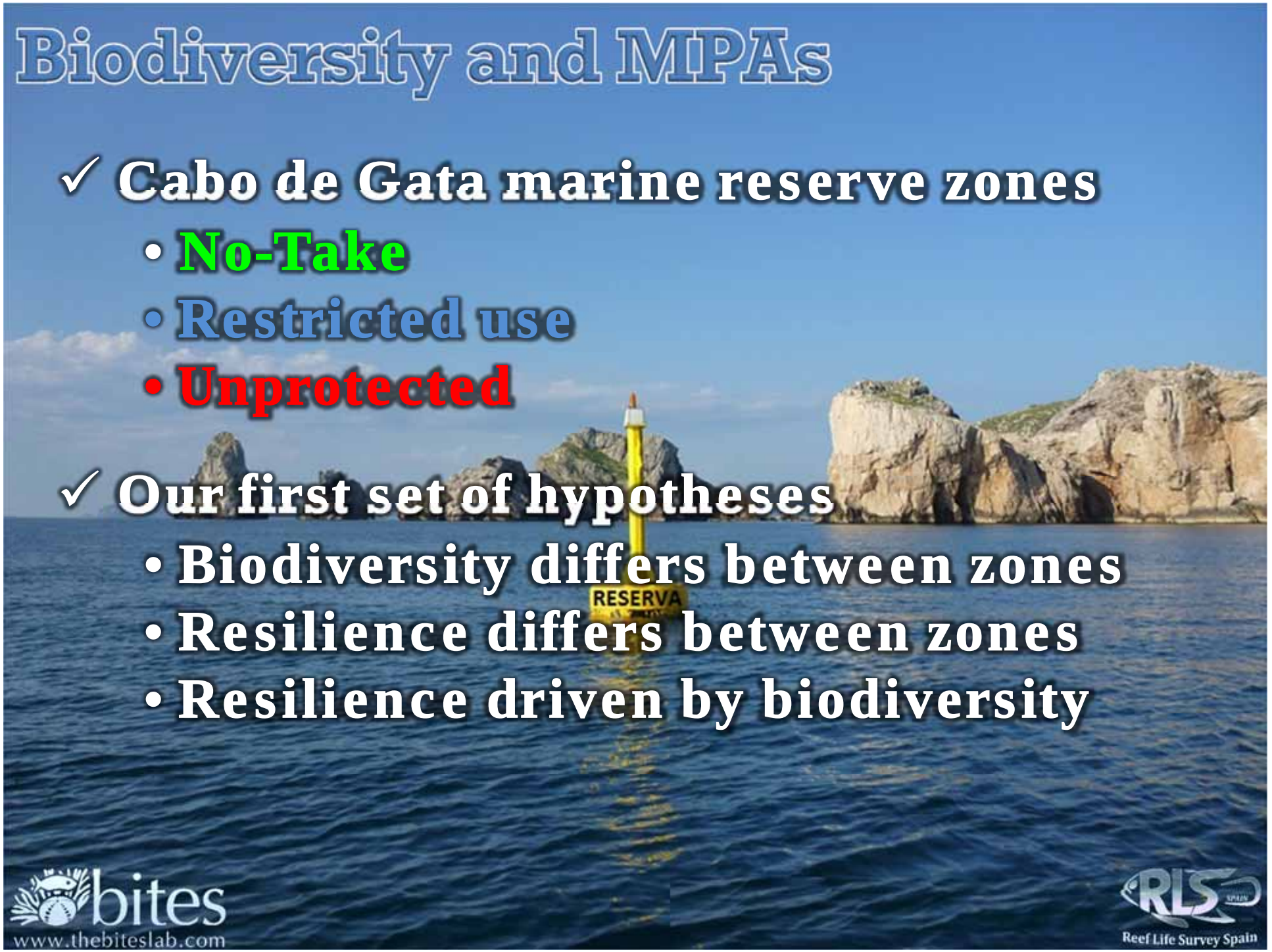
Number of NEOLIs

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Edgar et al (2014) Nature

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Biodiversity and MPAs



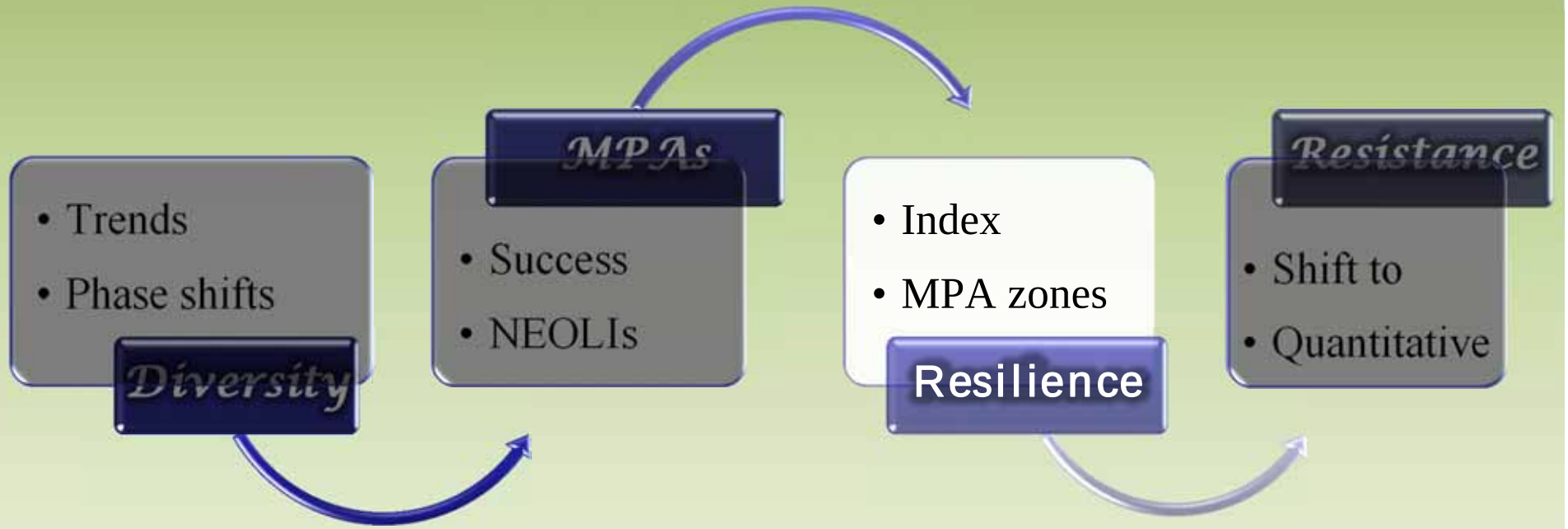
- ✓ Cabo de Gata marine reserve zones
  - No-Take
  - Restricted use
  - Unprotected
- ✓ Our first set of hypotheses
  - Biodiversity differs between zones
  - Resilience differs between zones
  - Resilience driven by biodiversity

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Resilience of MPAs

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Quantifying communities



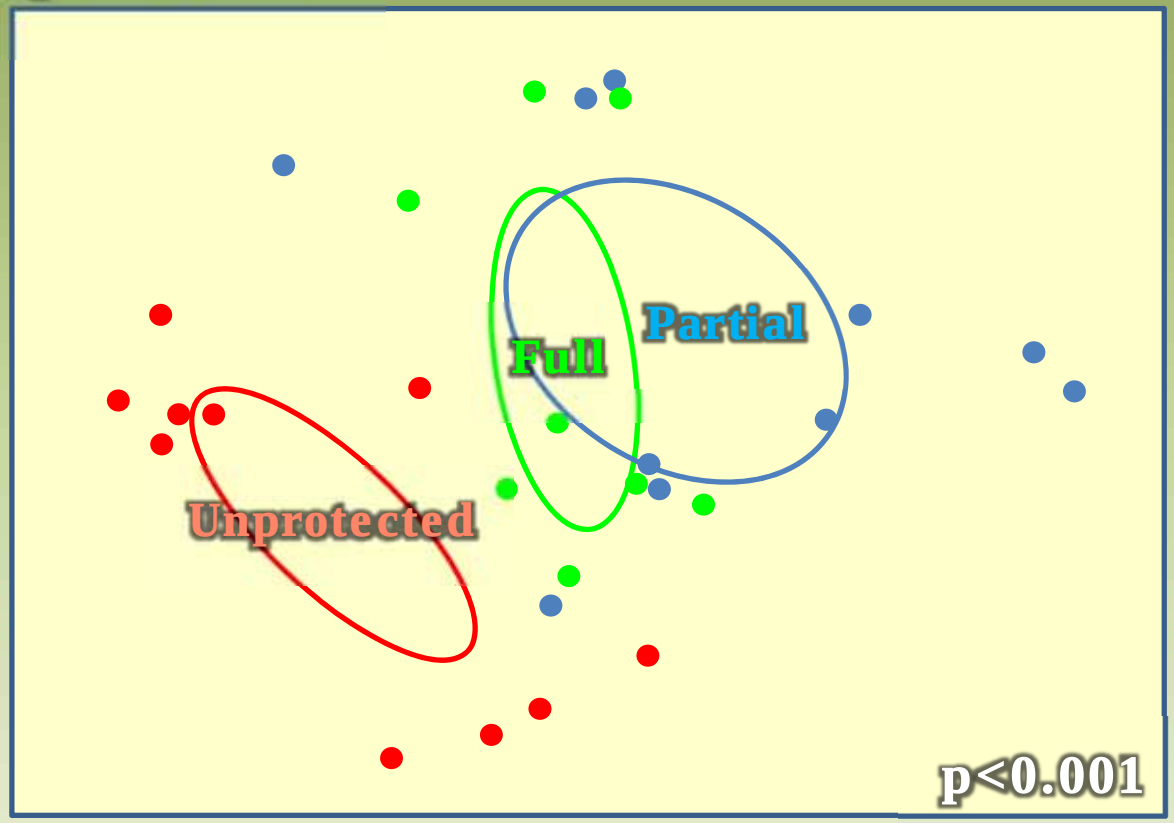
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Biodiversity and protection

Community level





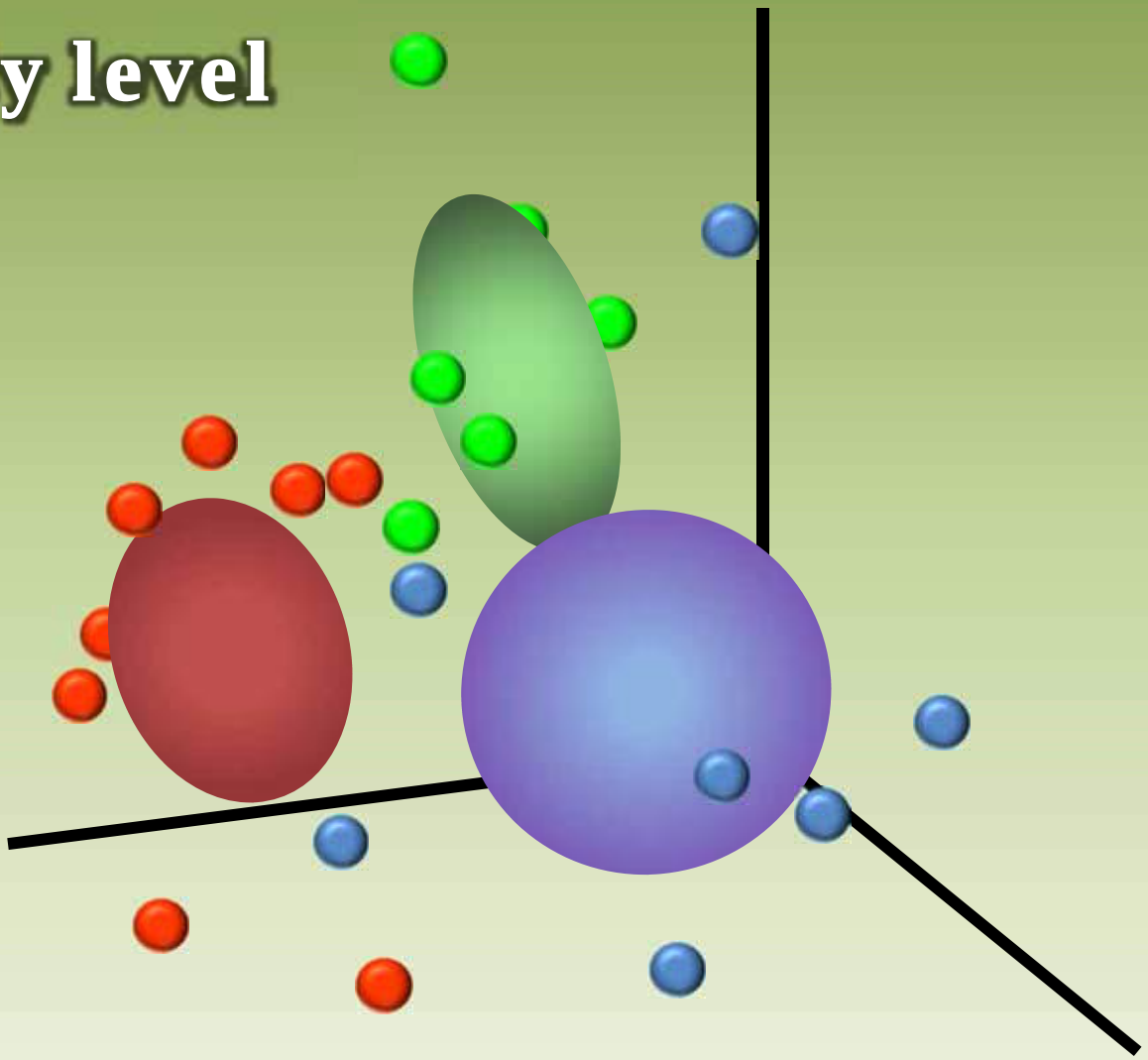
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Biodiversity and protection

Community level

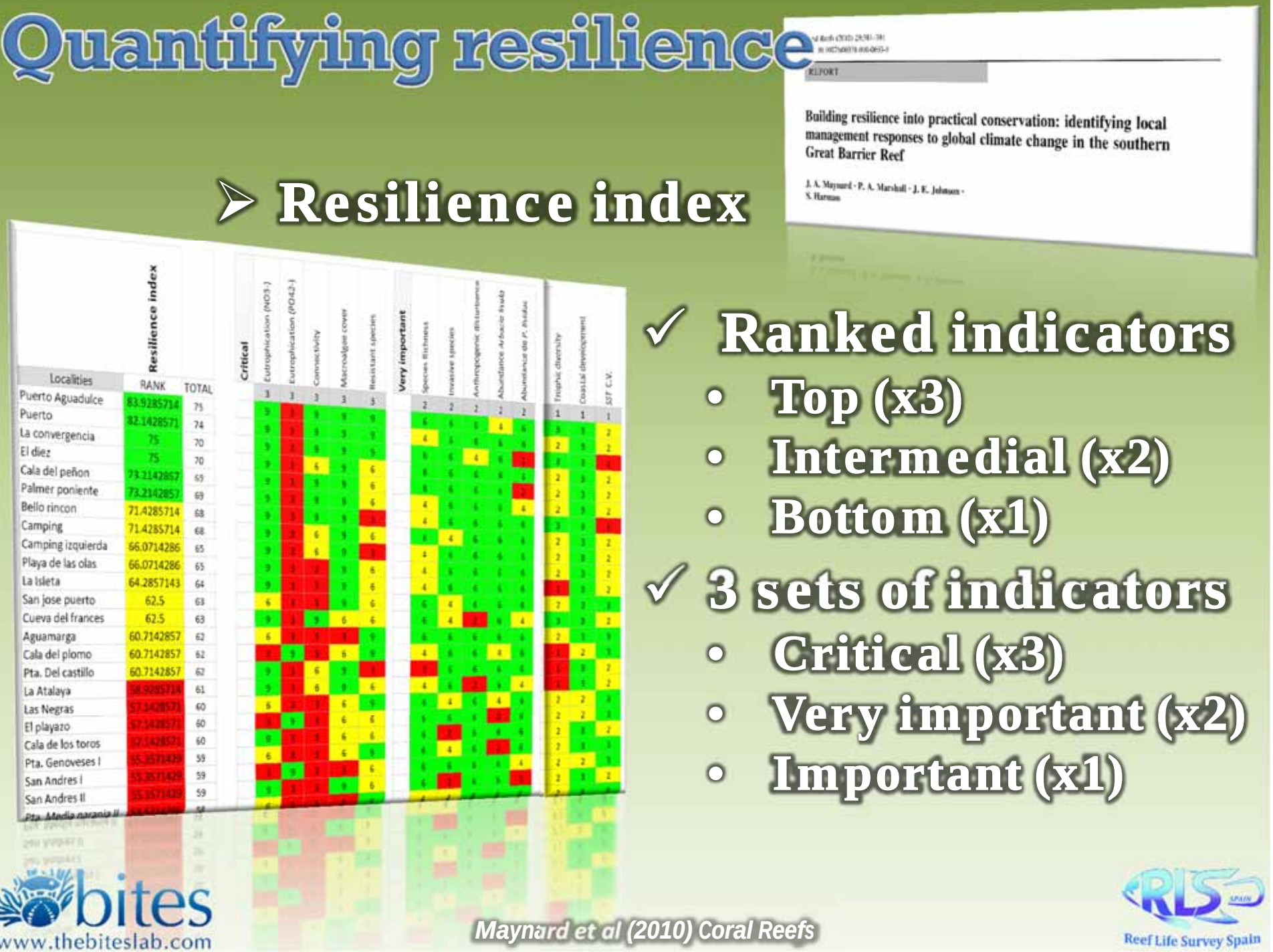




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Quantifying resilience



➢ Resilience index

Localities	Resilience index RANK	TOTAL
Puerto Aguadulce	83.9285714	75
Puerto	82.1428571	74
La convergencia	75	70
El diez	75	70
Cala del peñon	73.2142857	69
Palmer poniente	73.2142857	69
Bello rincon	71.4285714	68
Camping	71.4285714	68
Camping izquierda	66.0714286	65
Playa de las olas	66.0714286	65
La Isleta	64.2857143	64
San jose puerto	62.5	63
Cueva del frances	62.5	63
Aguamarga	60.7142857	62
Cala del plomo	60.7142857	62
Pta. Del castillo	60.7142857	62
La Atalaya	58.9285714	61
Las Negras	57.1428571	60
El playazo	57.1428571	60
Cala de los toros	57.1428571	60
Pta. Genoveses I	55.3571429	59
San Andres I	55.3571429	59
San Andres II	55.3571429	59

Critical: Eutrophication (NO_3^-), Eutrophication (PO_4^{2-}), Connectivity, Macroalgae cover, Resistant species

Very important: Species Richness, Invasive species, Anthropogenic disturbance, Abundance *Arbacia lixula*, Abundance de *P. lividus*

Important: Trophic diversity, Coastal development, SST C.V.

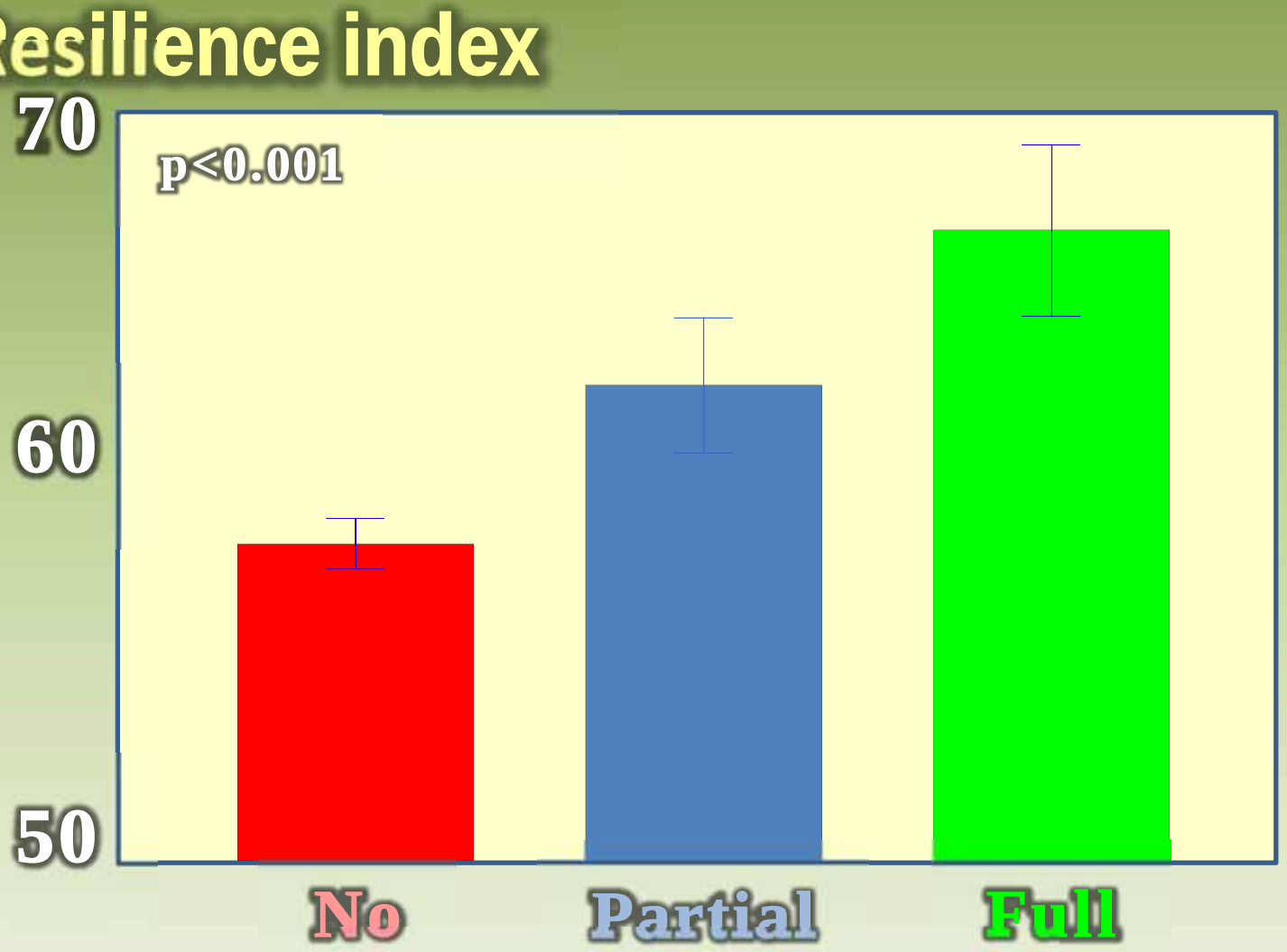
- ✓ **Ranked indicators**
  - Top (x3)
  - Intermedial (x2)
  - Bottom (x1)
- ✓ **3 sets of indicators**
  - Critical (x3)
  - Very important (x2)
  - Important (x1)

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Maynard et al (2010) Coral Reefs

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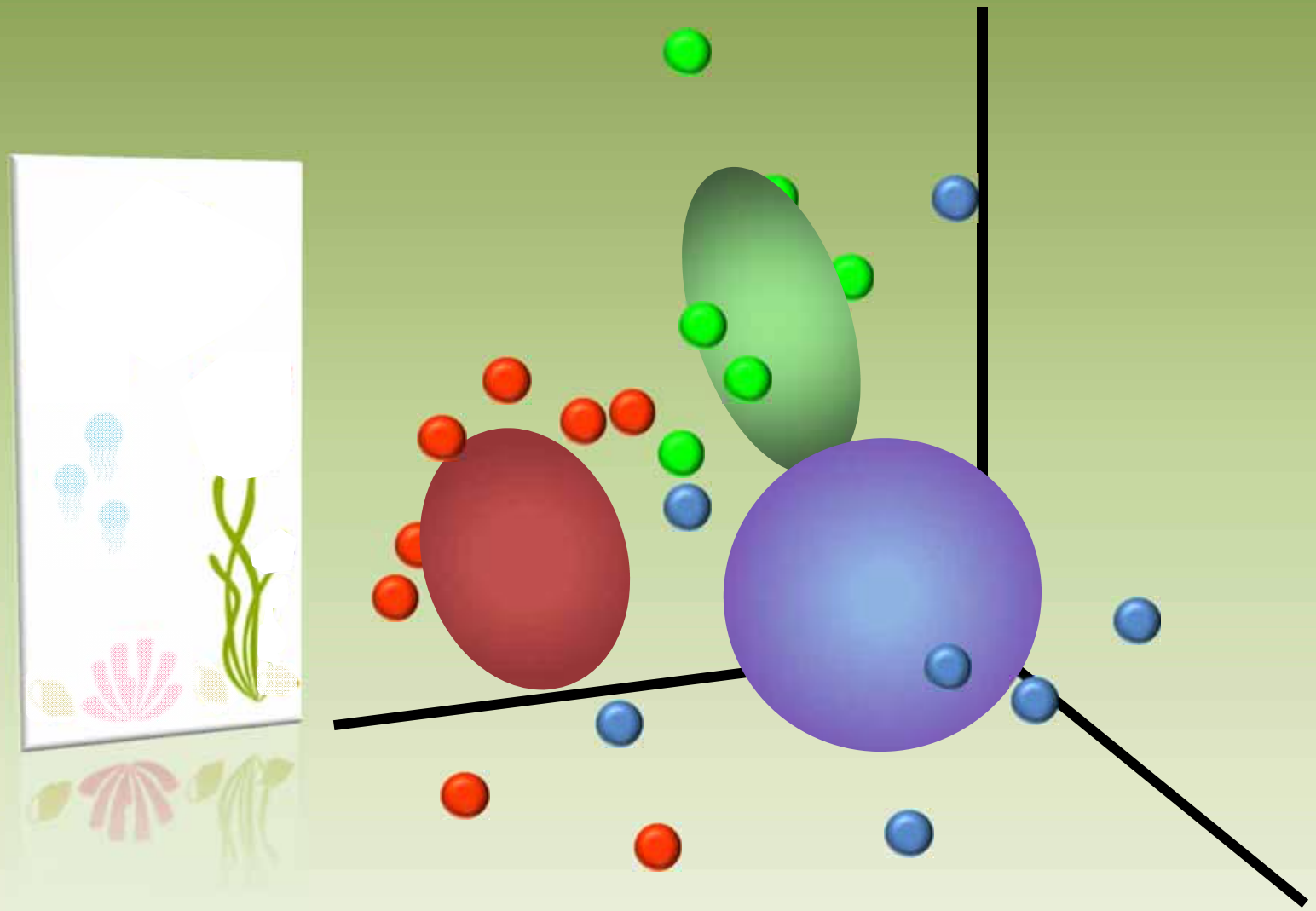
Resilience and protection



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Biodiversity and resilience



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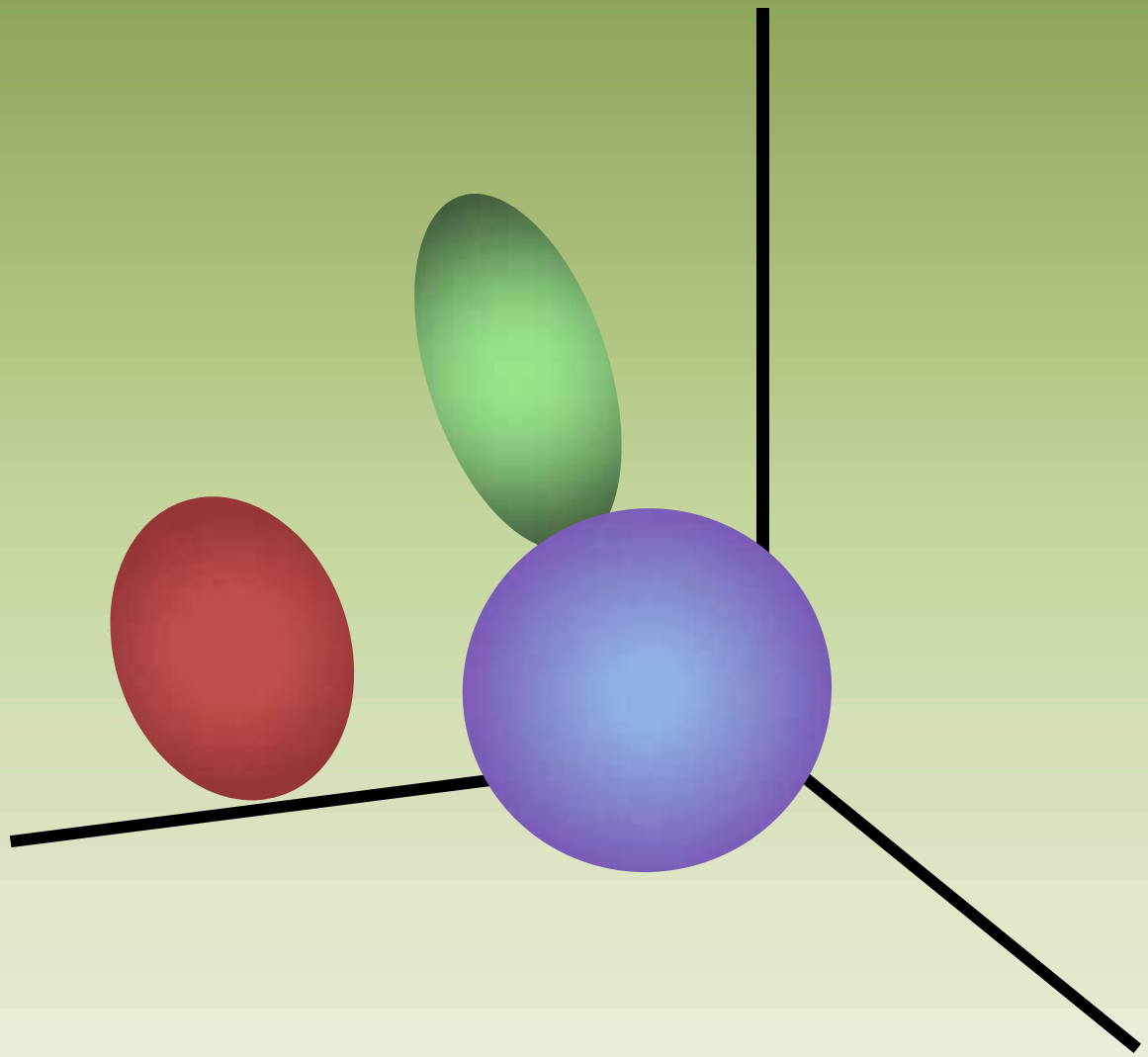
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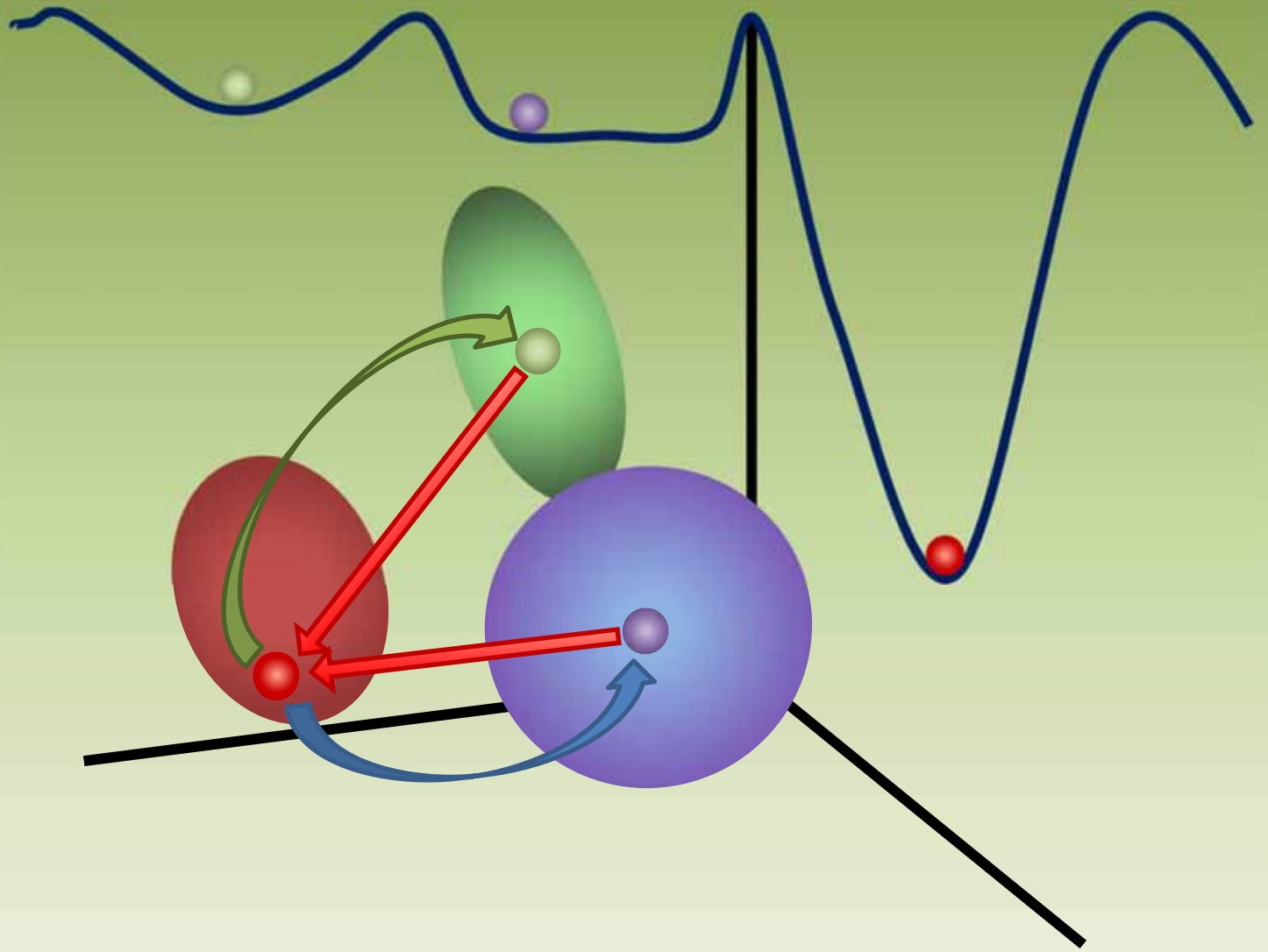
Resistance to change



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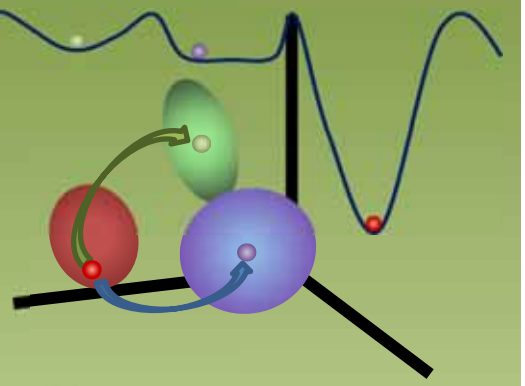
Resistance to change to…



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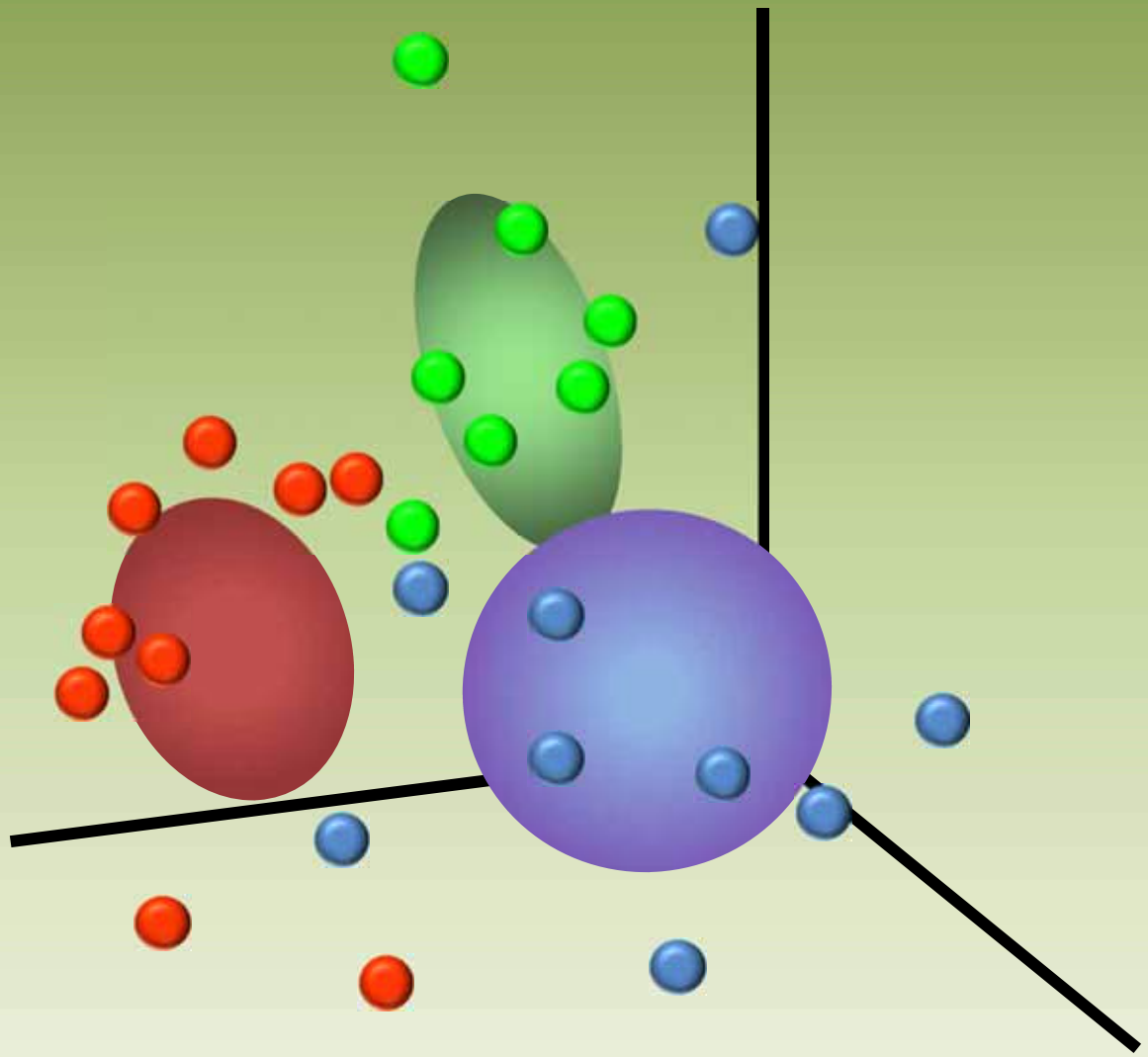
Resistance to change to…



✓ Our second set of hypotheses

- ⇧ resistance with ⇧ protection
- ⇩ resistance with species turnover

Quantifying resistance to…

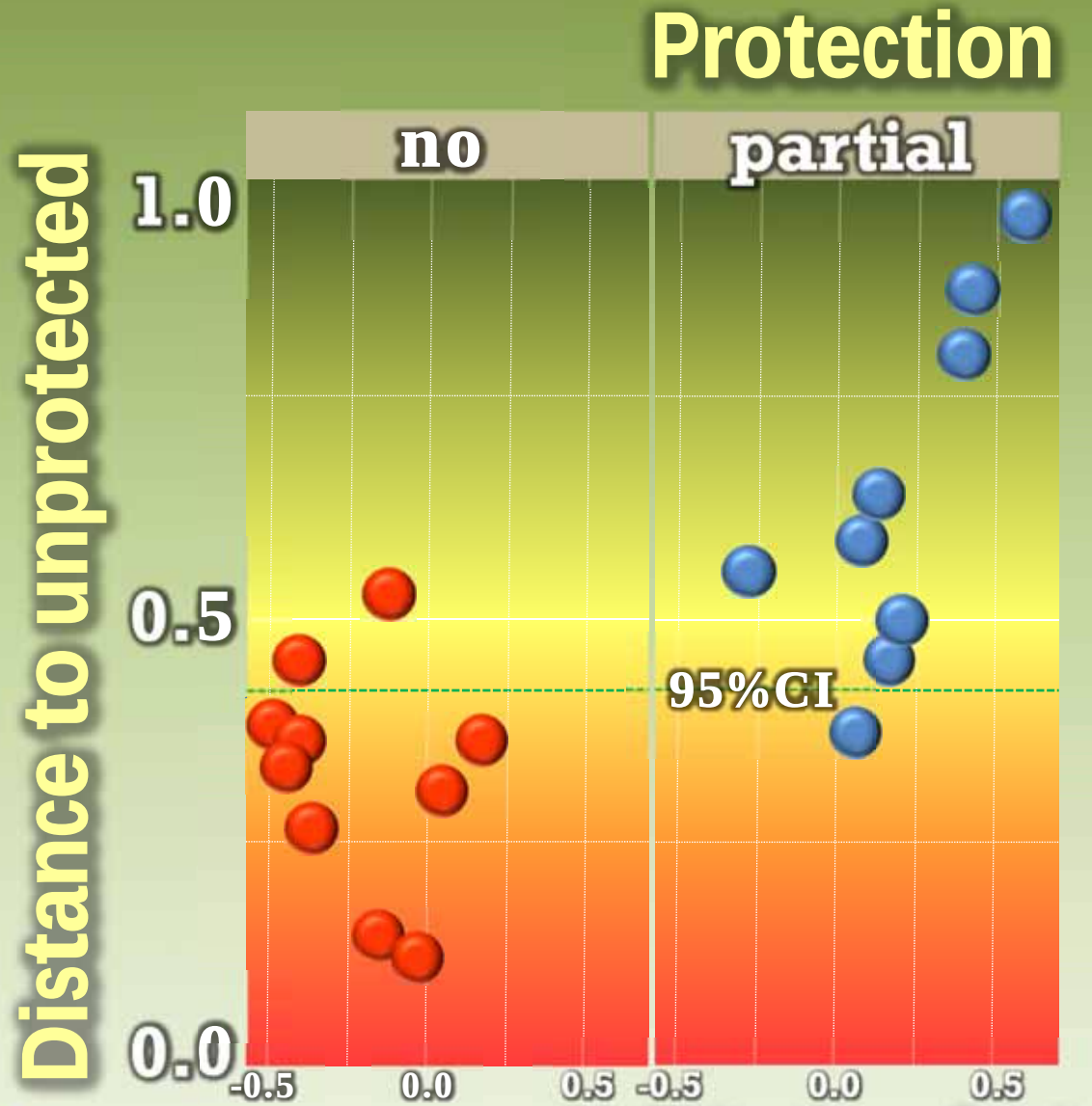


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Pimm (1984)

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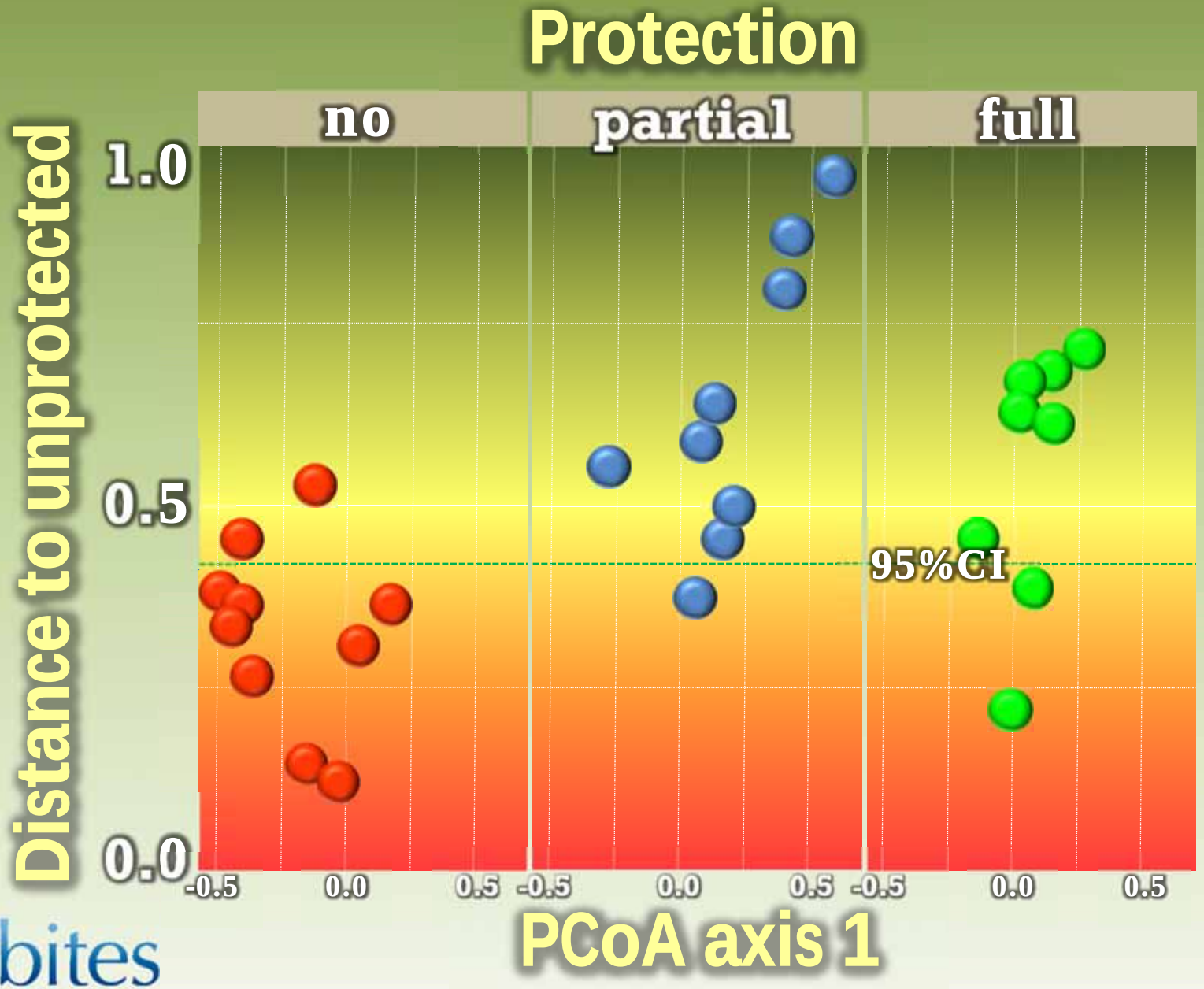
Quantifying resistance to…



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Quantifying resistance to...



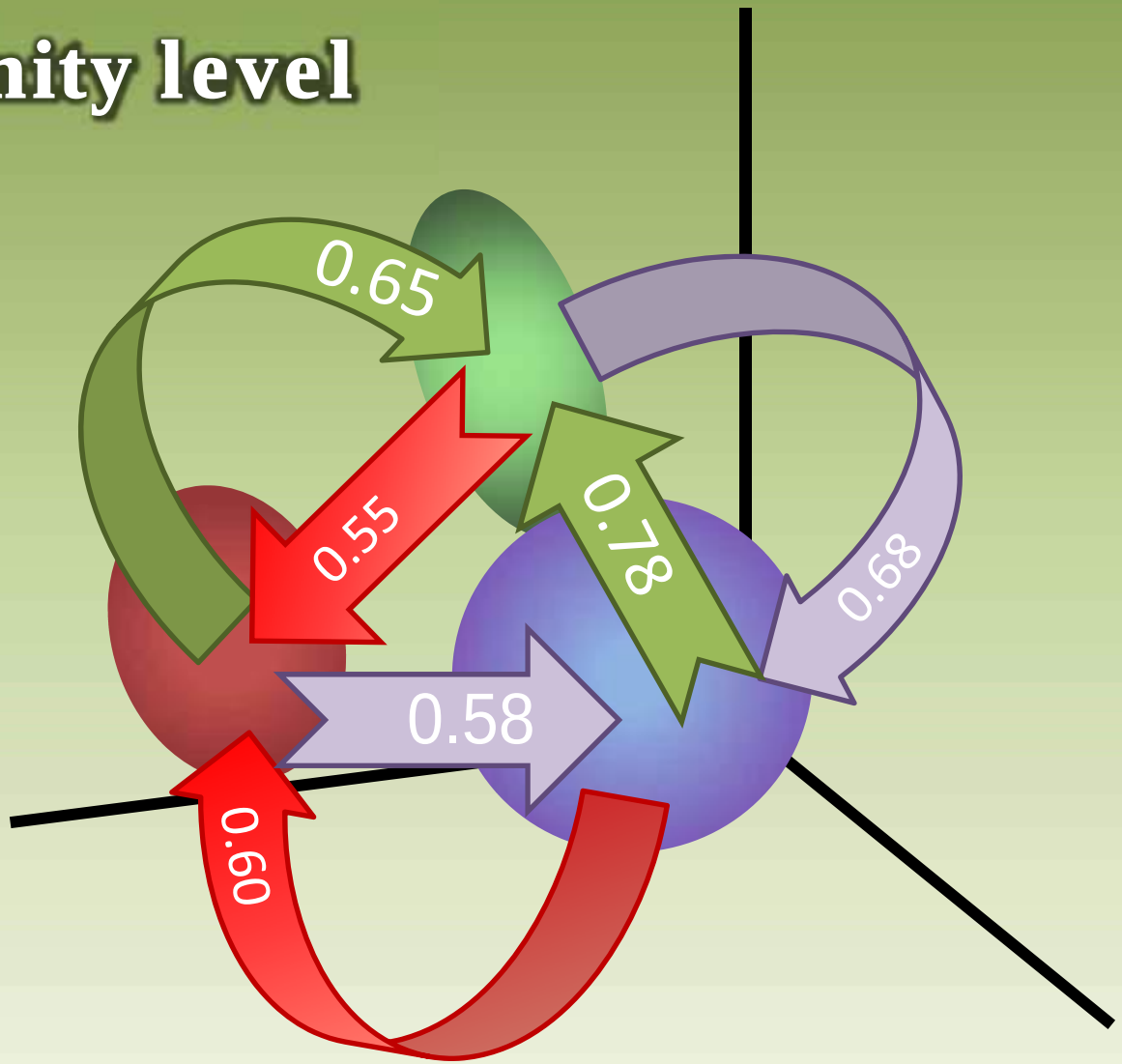
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Resistance between zones

Community level





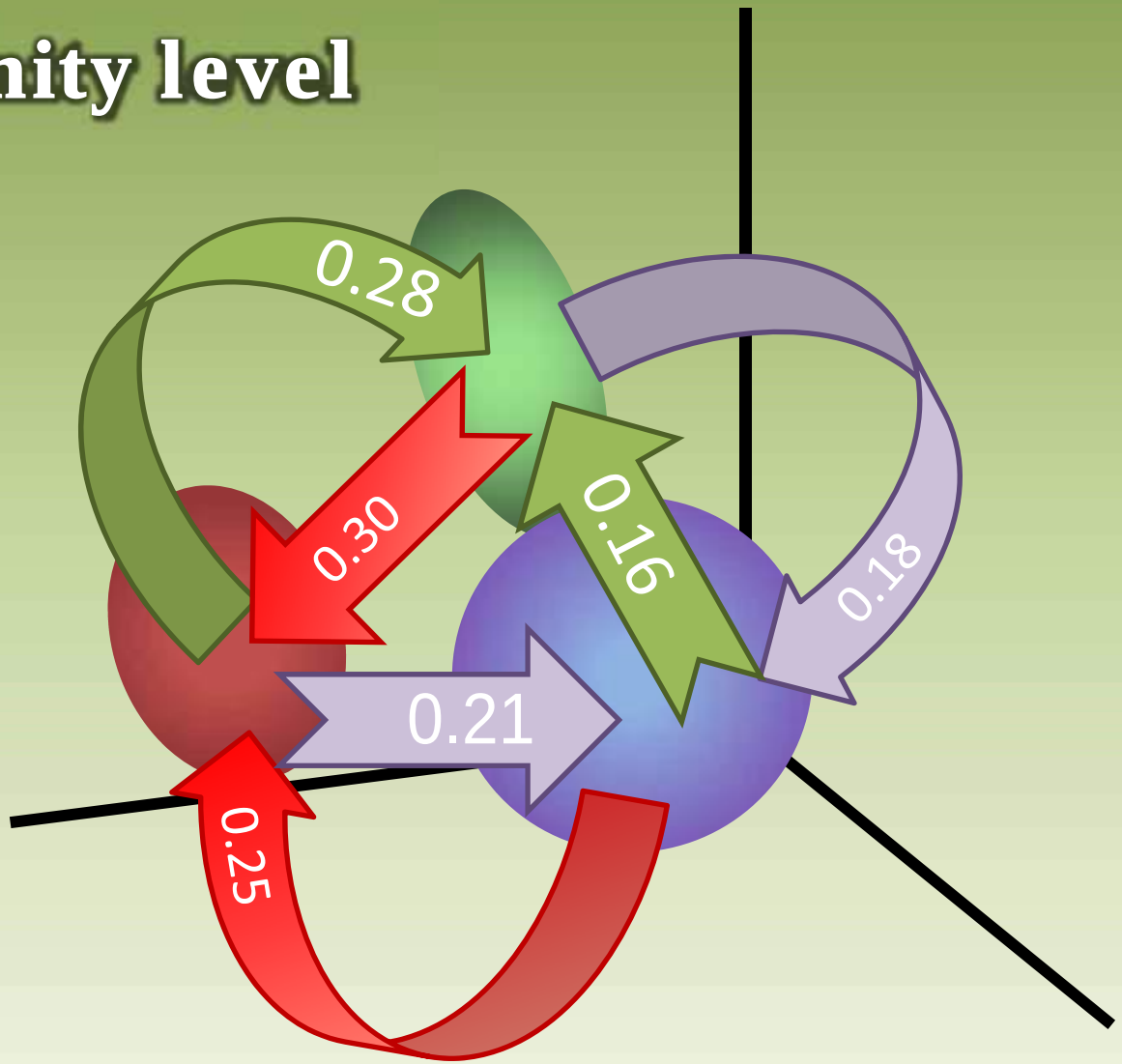
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Qualitative resistance

Community level

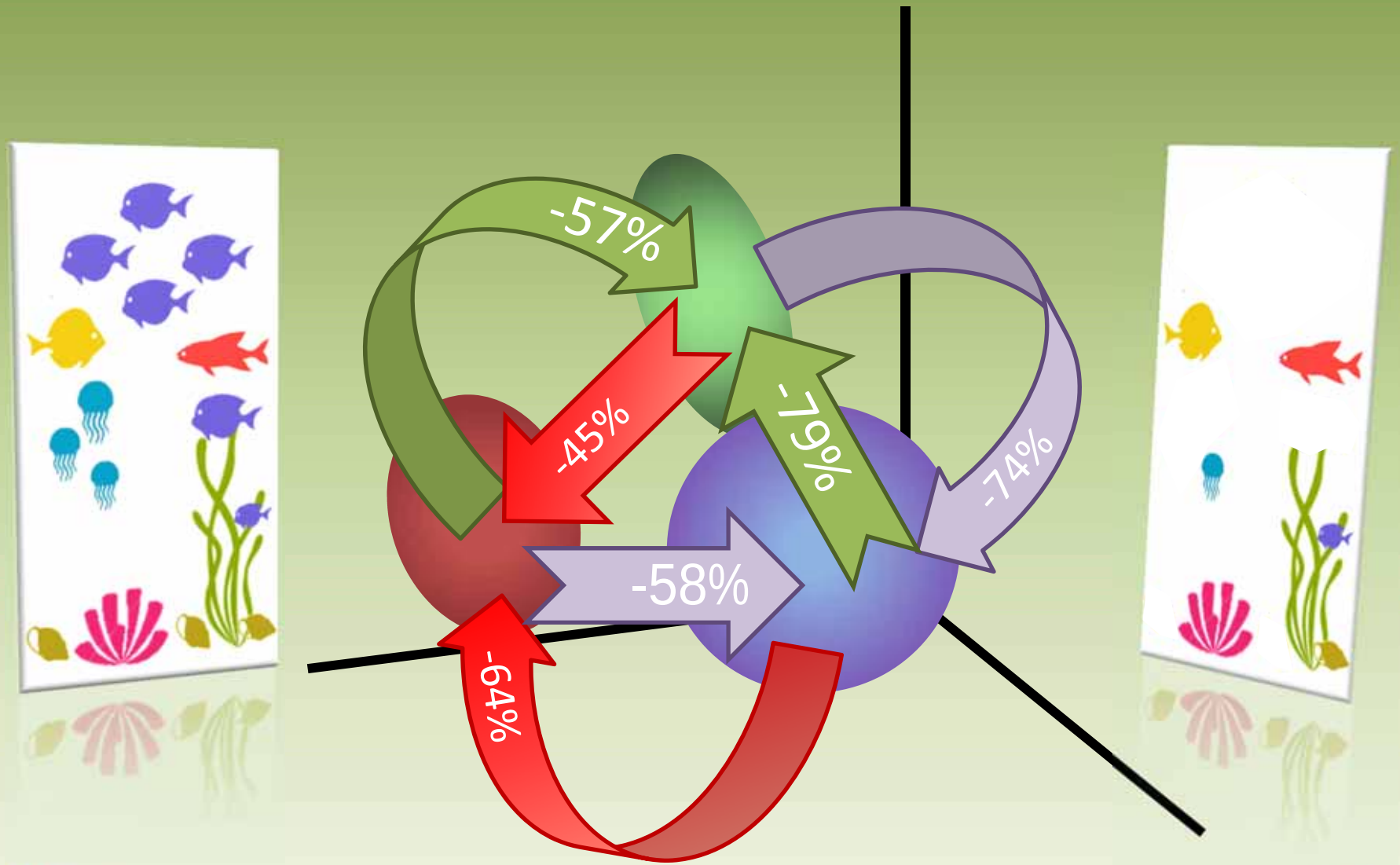




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Quantitative vs. qualitative

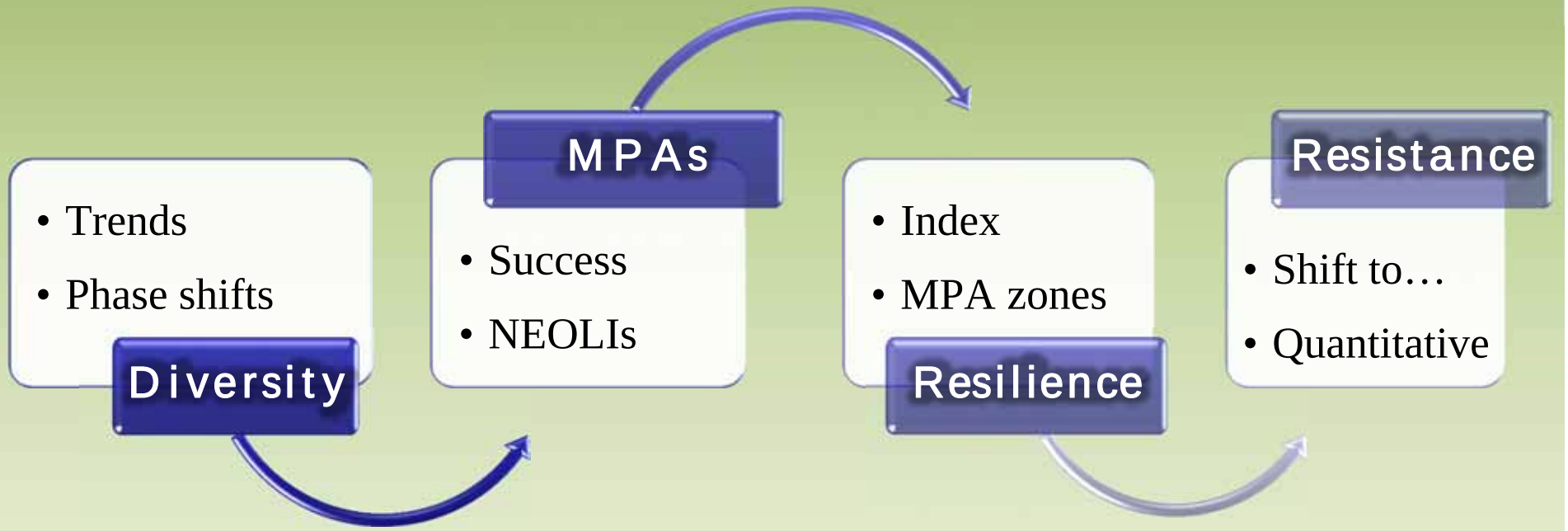


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