
Linking species composition and biodiversity
Resilience of MPAs
to ecosystem resistance
mikel.becerro@csic.es
www.thebiteslab.com
Jose A Sanabria
The bites lab, CSIC
Josu G Alday
University of Lleida
Natural Products and Agrobiology Institute
Spanish Research Council – CSIC
Tenerife, Canary Islands
bites
www.thebiteslab.com
RLS SPAIN
Reef Life Survey Spain

Resilience of MPAs

In this talk:

Diversity
- Trends
- Phase shifts

MPAs
- Success
- NEOLIs

Resilience
- Index
- MPA zones

Resistance
- Shift to…
- Quantitative

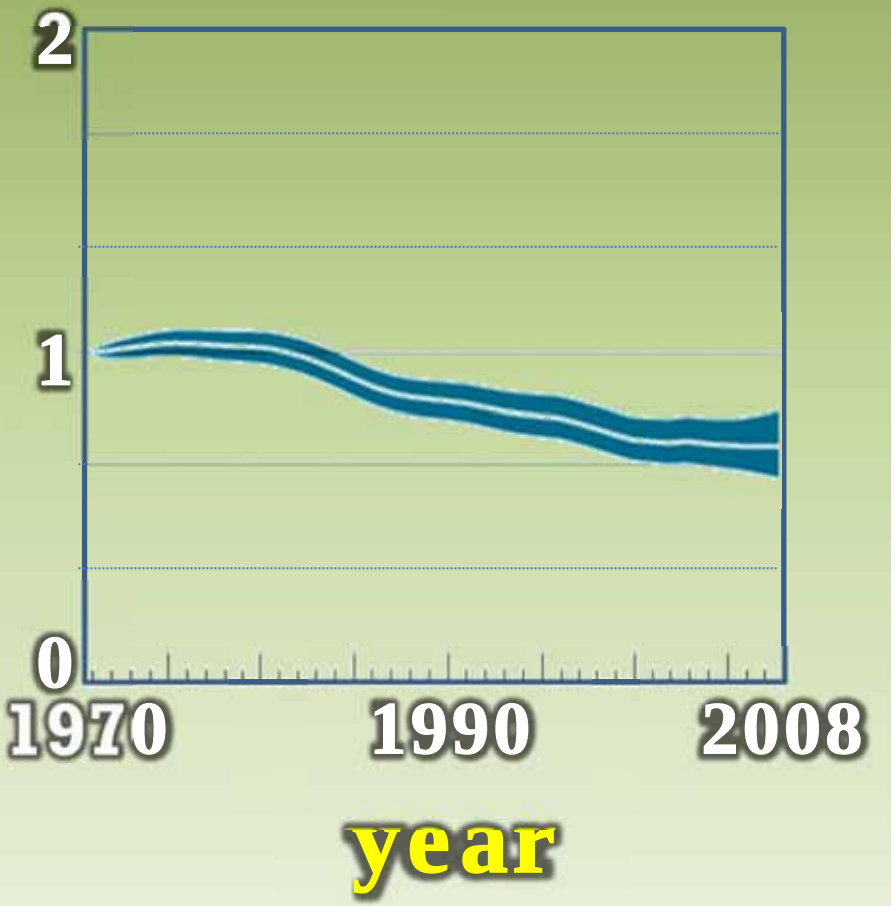
bites
www.thebiteslab.com

RLS SPAIN
Reef Life Survey Spain

The decline of biodiversity

Living Planet Index

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



bites
www.thebiteslab.com

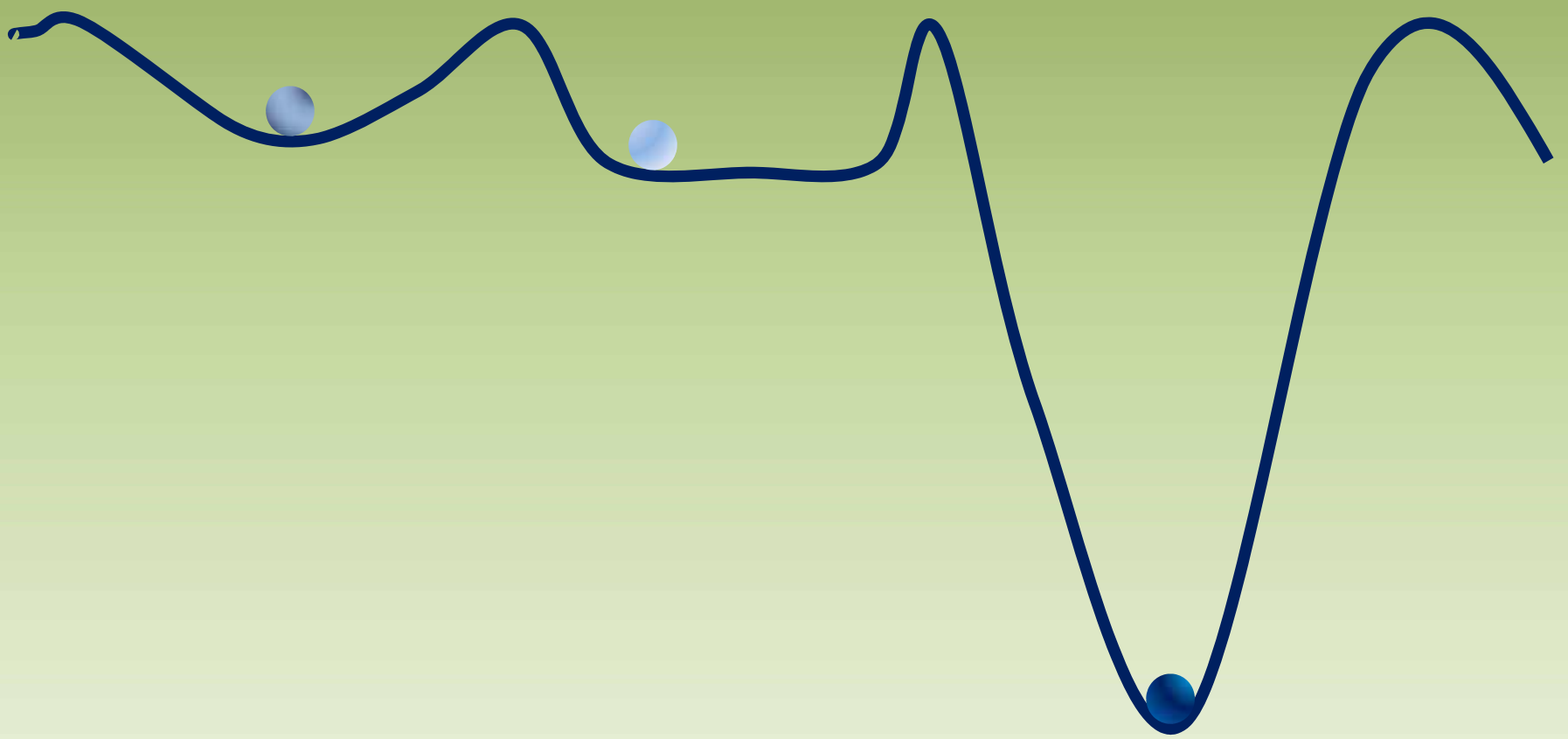
Loh et al (2005) Phil Trans R Soc

www.panda.org

RLS SPAIN
Reef Life Survey Spain

The decline of biodiversity

Phase shifts



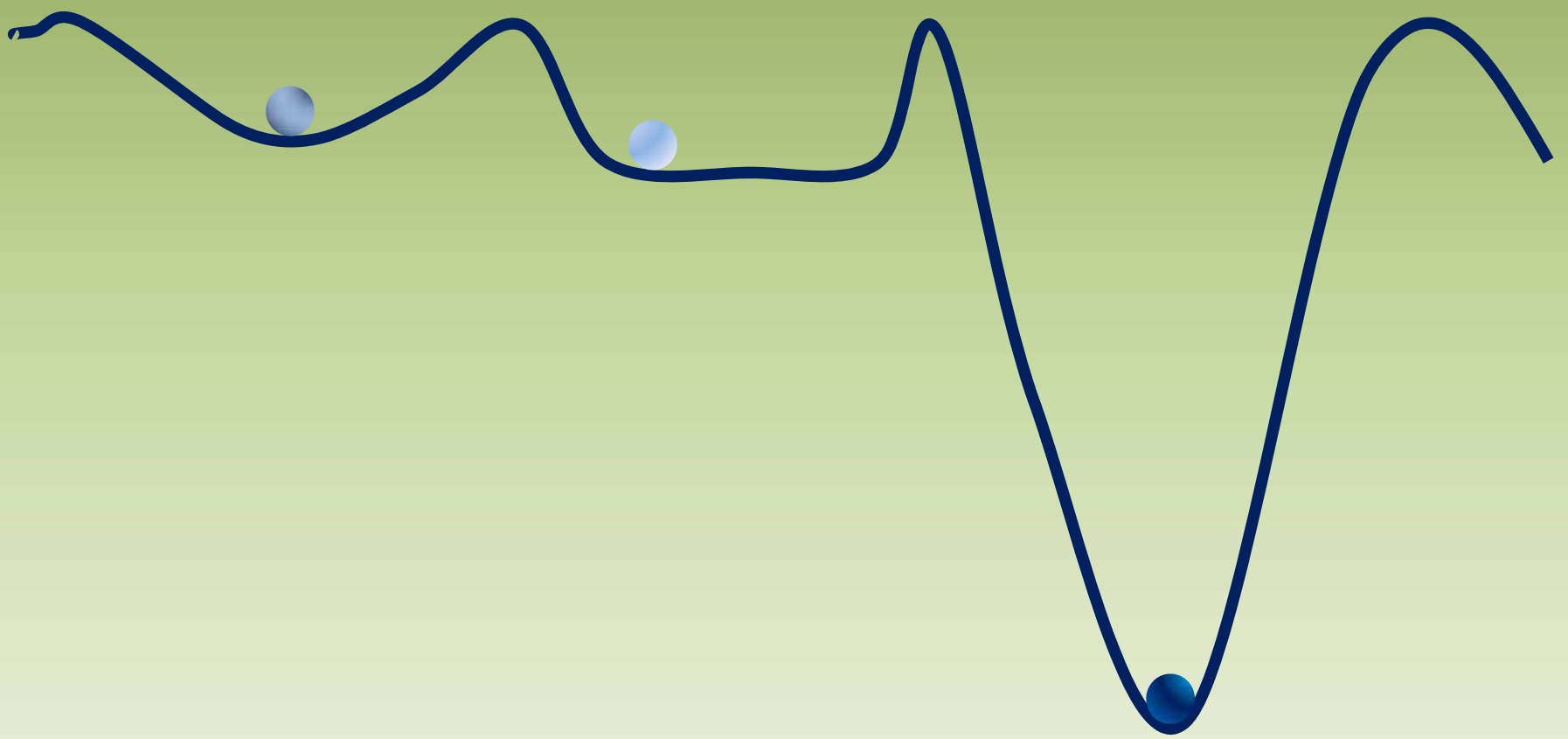
bites
www.thebiteslab.com

Holling (1973) Ann Rev Ecol Sys

Reef Life Survey Spain

The decline of biodiversity

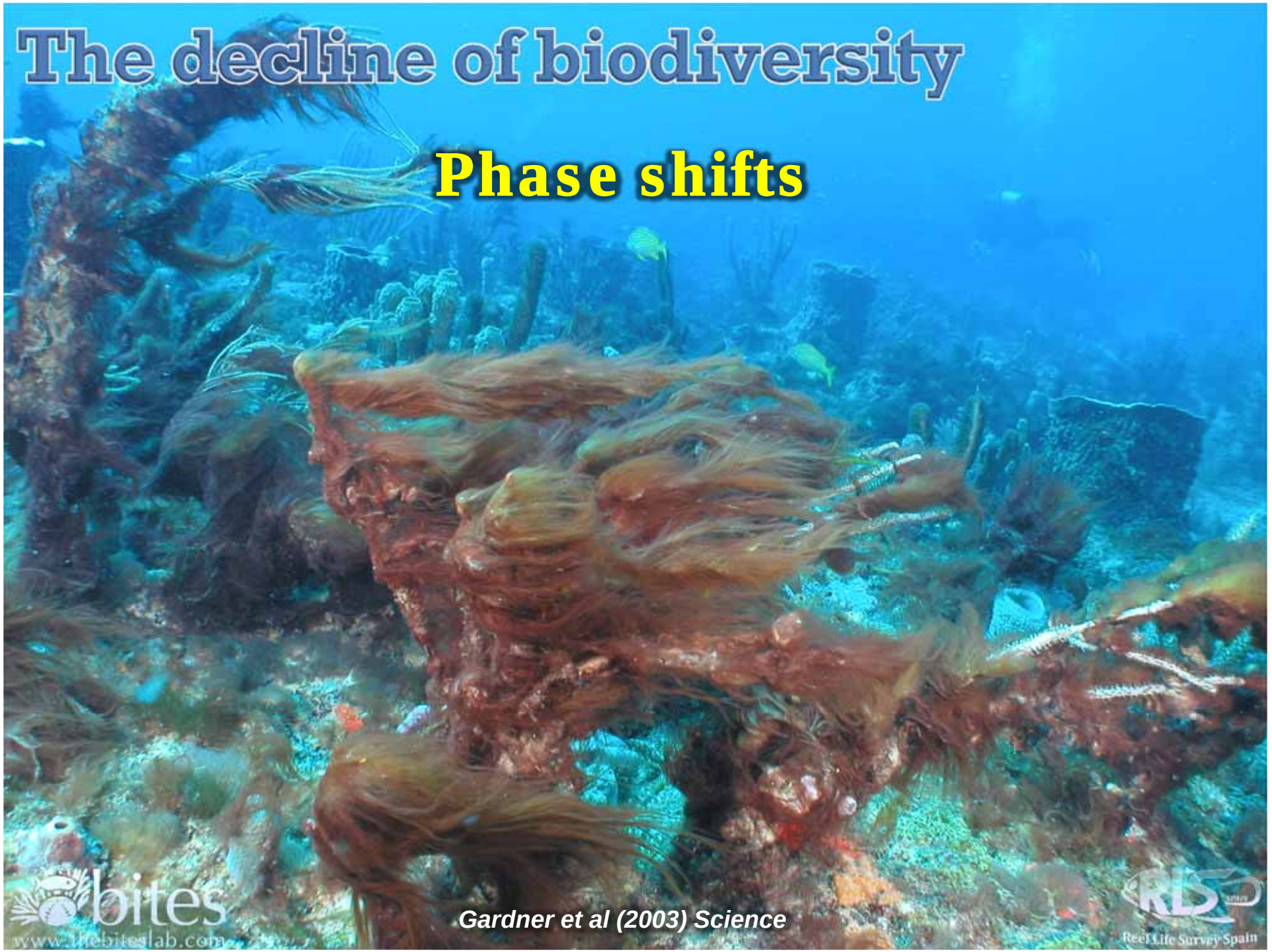
Phase shifts



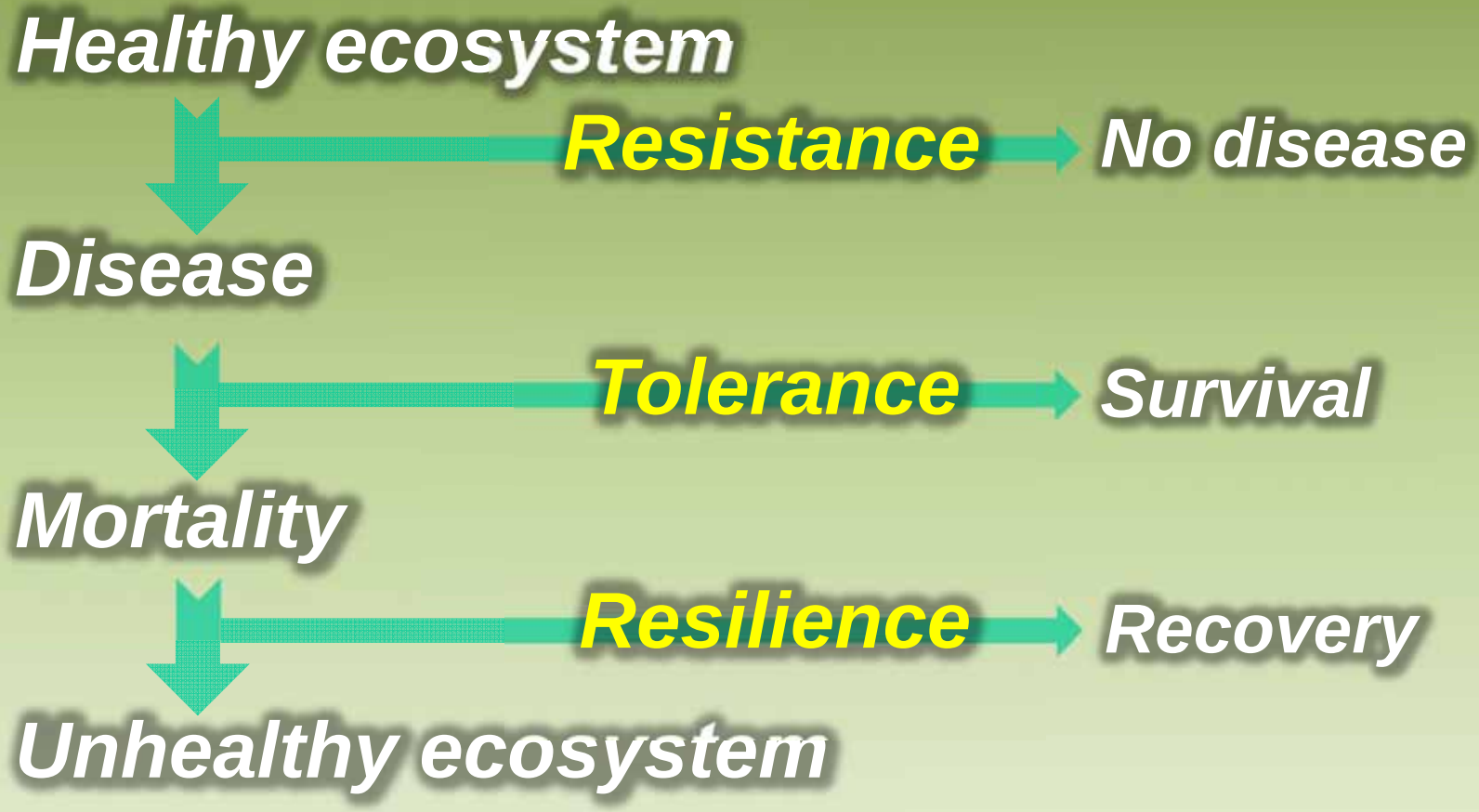
bites
www.thebiteslab.com

Holling (1973) Ann Rev Ecol Sys

Reef Life Survey Spain


The decline of biodiversity
Phase shifts
bites
www.thebiteslab.com
Gardner et al (2003) Science
Reef Life Survey Spain

The components of resilience



bites
www.thebiteslab.com

Obura (2005) Estuar Coast Shelf Sci

RLS SPAIN
Reef Life Survey Spain

The rise of biodiversity



bites
www.thebiteslab.com

RLS SPAIN
Reef Life Survey Spain

The rise of biodiversity

Publications



PAs (10^4)

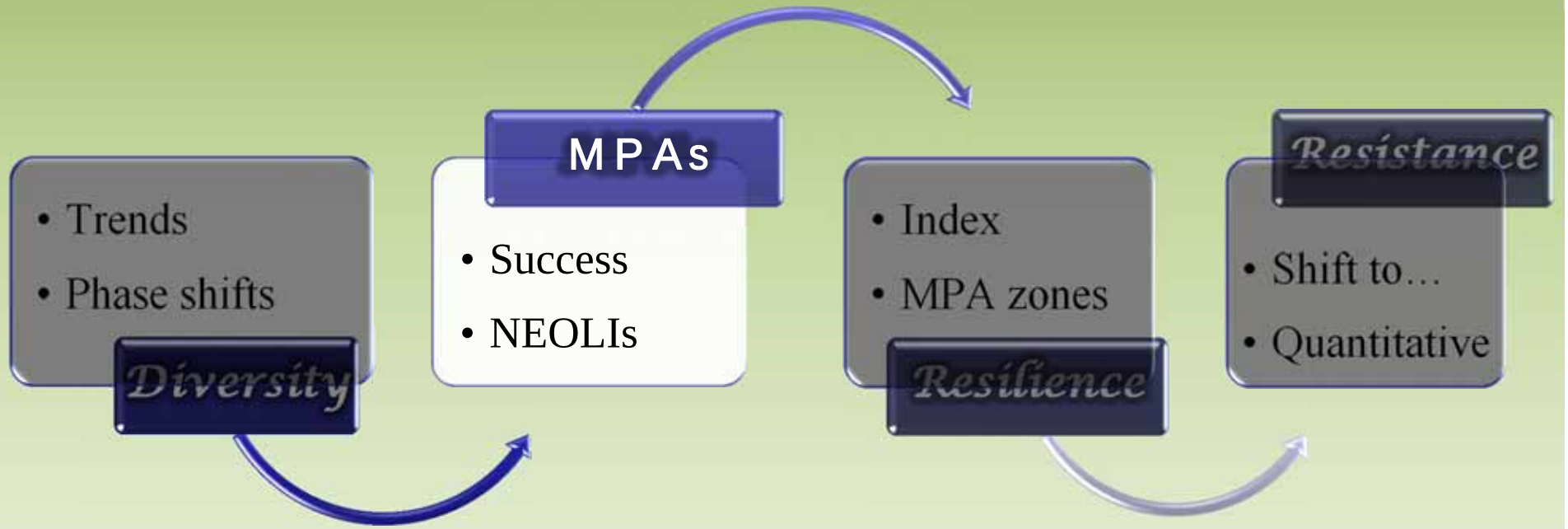


bites
www.thebiteslab.com

RLS SPAIN
Reef Life Survey Spain

Resilience of MPAs

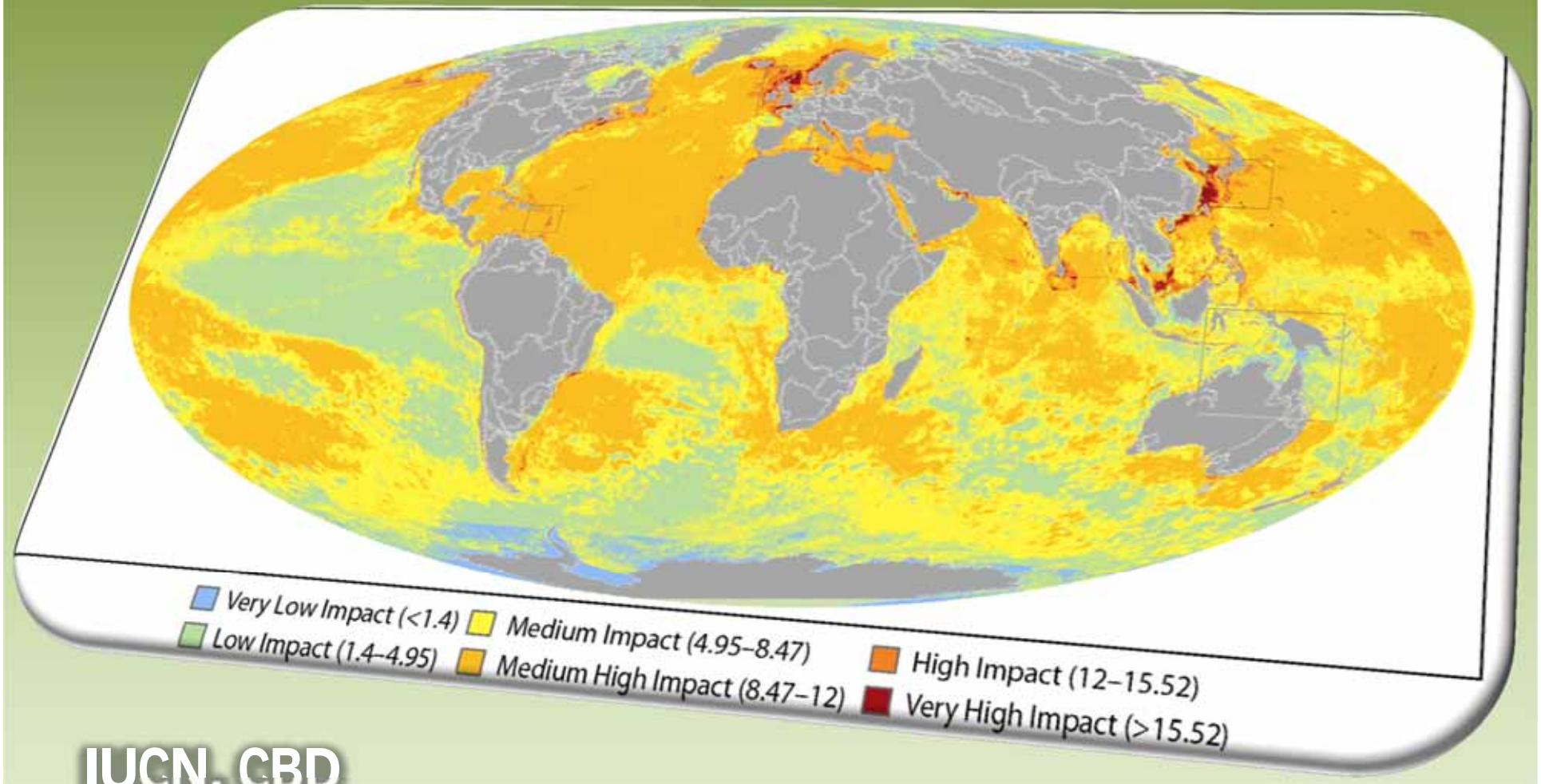
In this talk:



bites
www.thebiteslab.com

RLS SPAIN
Reef Life Survey Spain

Biodiversity and MPAs



IUCN, CBD

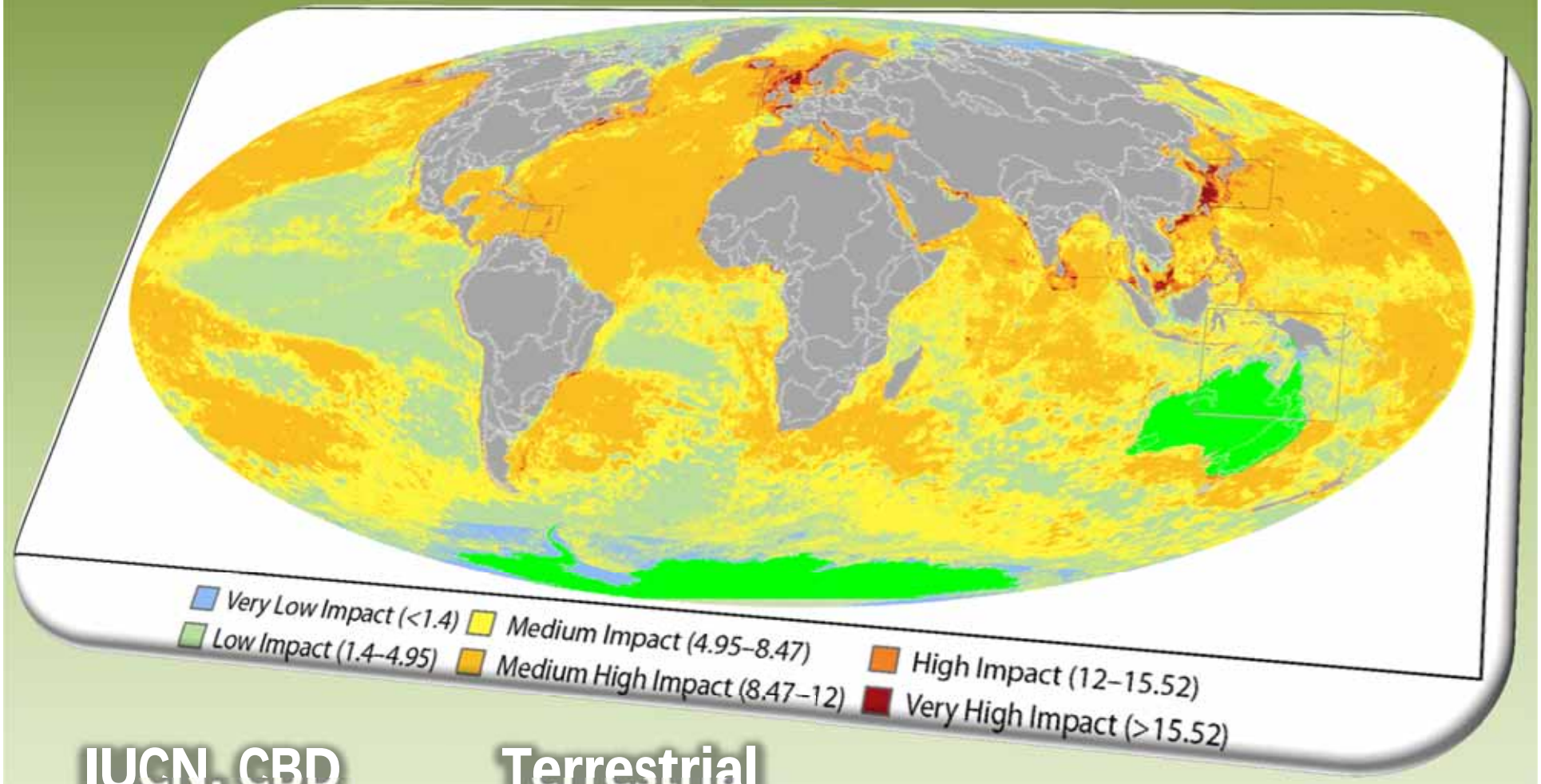
20%

bites
www.thebiteslab.com

Halpern et al (2008) Science

RLS SPAIN
Reef Life Survey Spain

Biodiversity and MPAs



IUCN, CBD

20%

Terrestrial

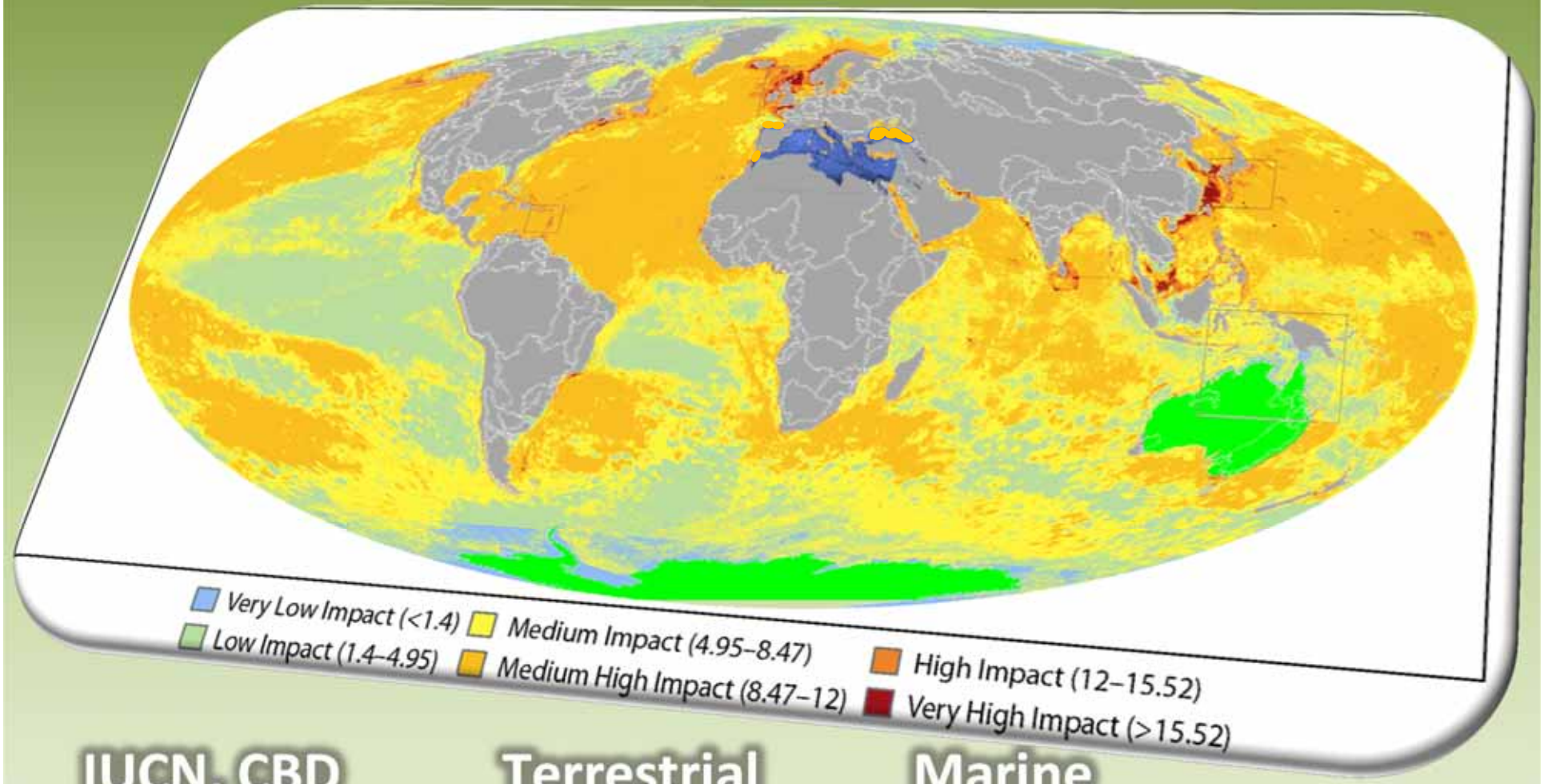
12%

bites
www.thebiteslab.com

Halpern et al (2008) Science

RLS SPAIN
Reef Life Survey Spain

Biodiversity and MPAs



IUCN, CBD	Terrestrial	Marine
20%	12%	1%

bites
www.thebiteslab.com

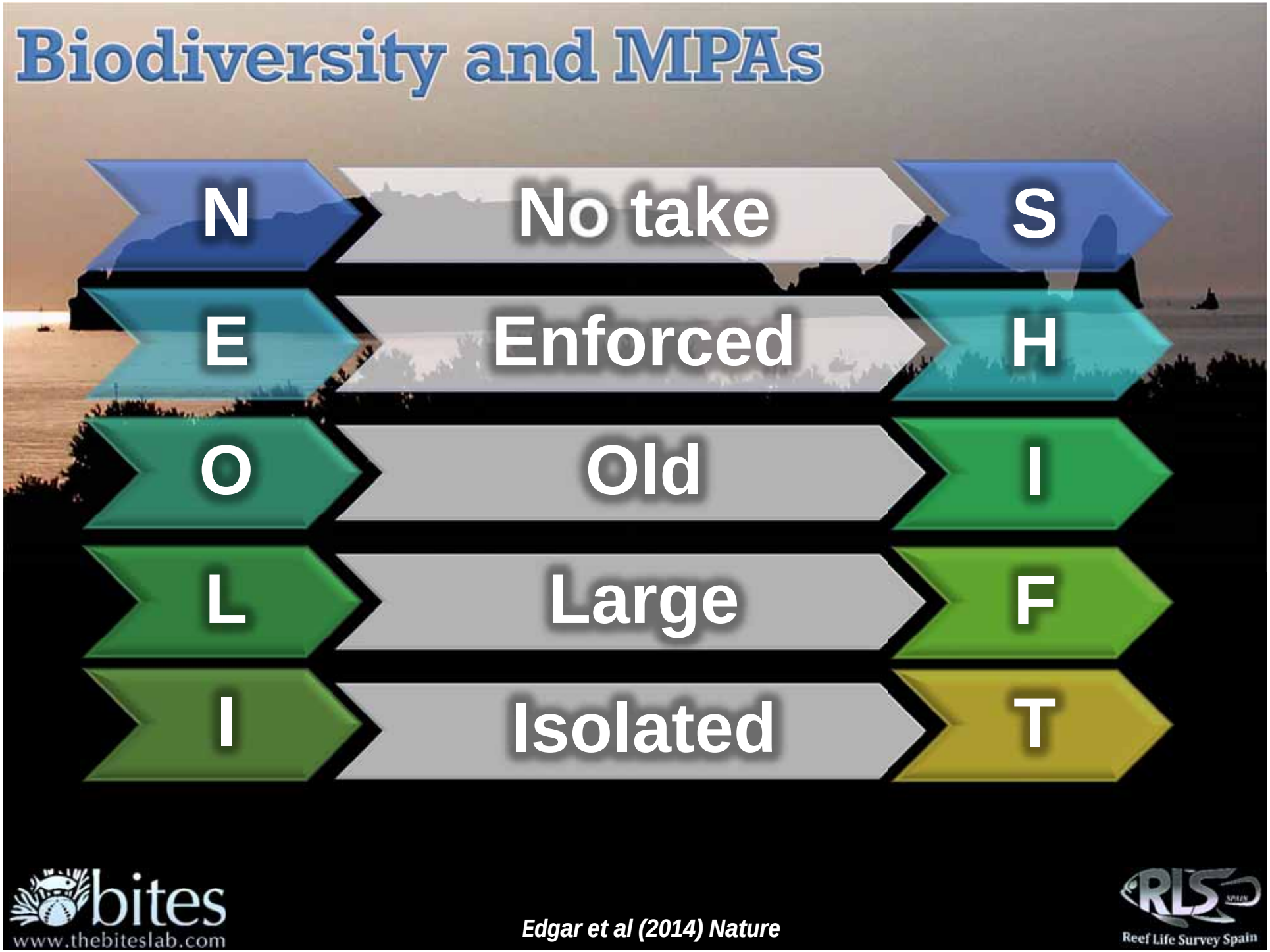
Halpern et al (2008) Science

RLS SPAIN
Reef Life Survey Spain

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
bites
www.thebiteslab.com
Edgar et al (2014) Nature
RLS SPAIN
Reef Life Survey Spain

Biodiversity and MPAs

Fish biomass

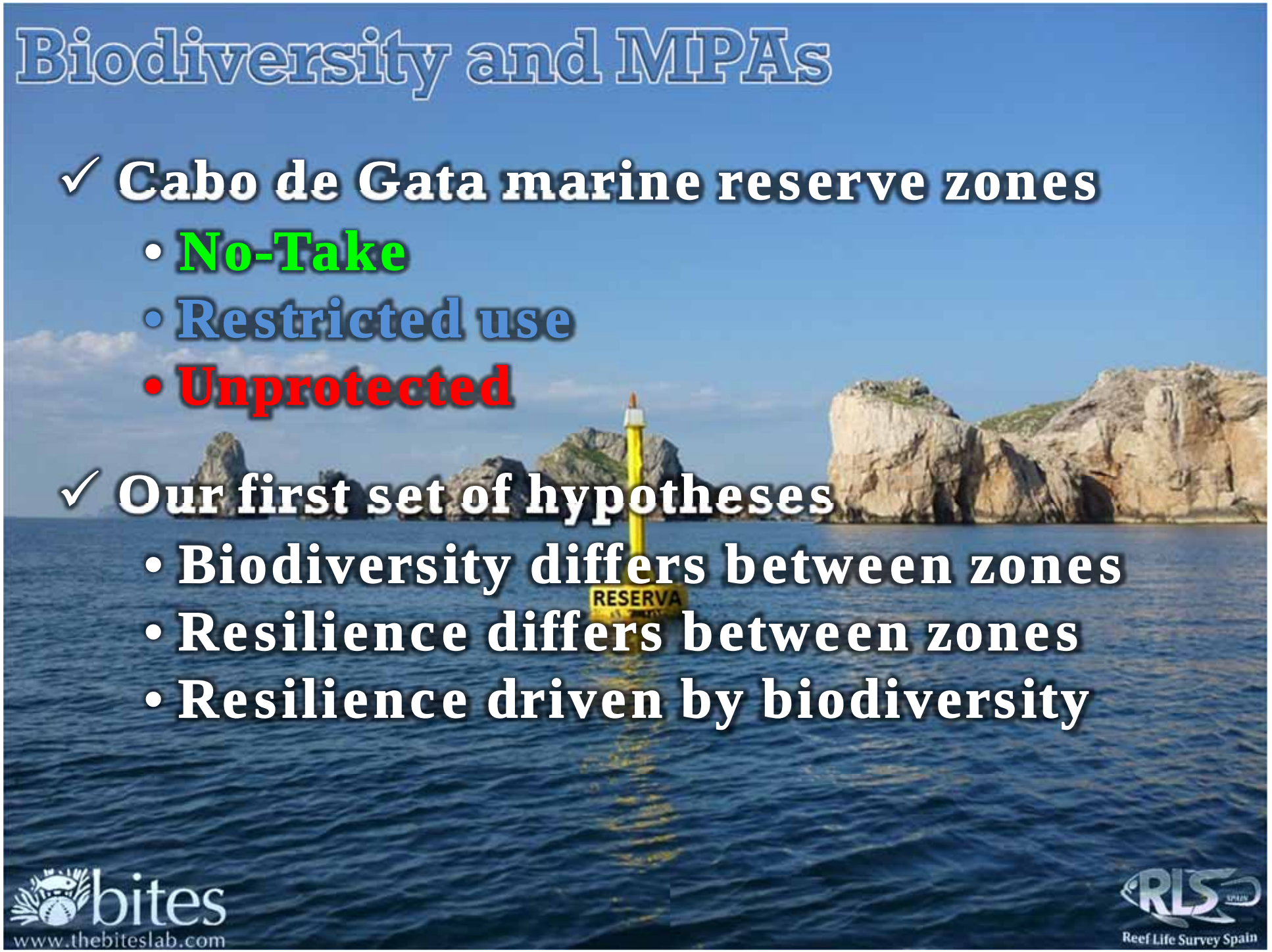


Edgar et al (2014) Nature

bites
www.thebiteslab.com

RLS SPAIN
Reef Life Survey Spain

Biodiversity and MPAs



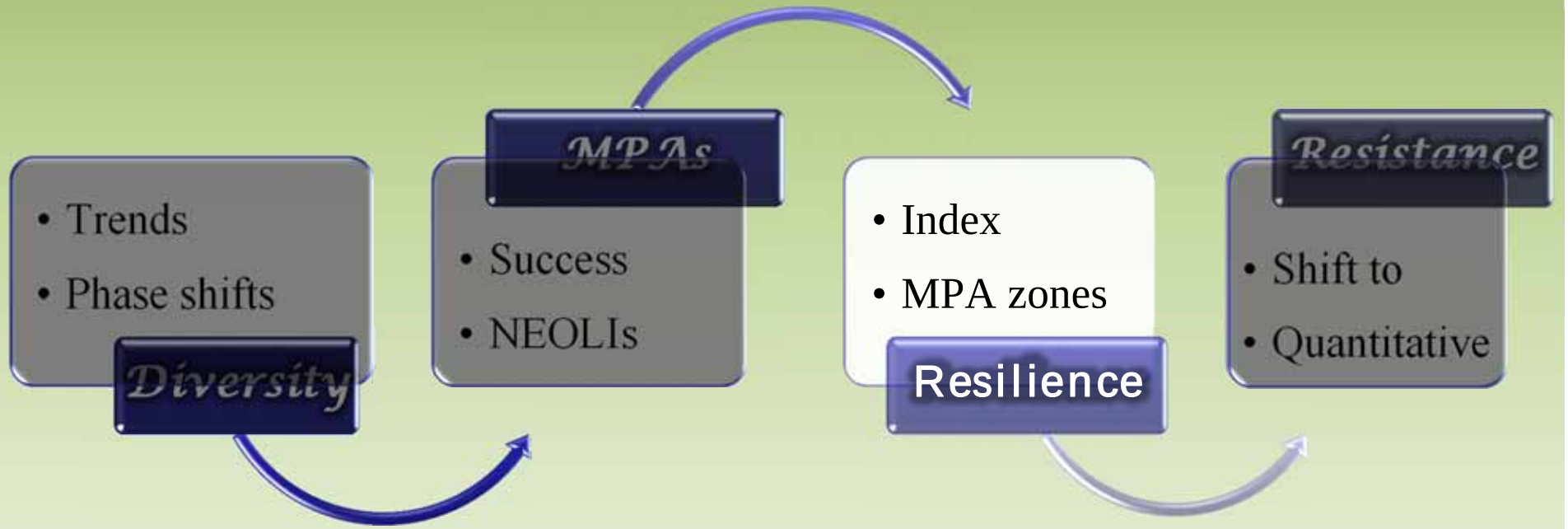
- ✓ Cabo de Gata marine reserve zones
  - No-Take
  - Restricted use
  - Unprotected
- ✓ Our first set of hypotheses
  - Biodiversity differs between zones
  - Resilience differs between zones
  - Resilience driven by biodiversity

bites
www.thebiteslab.com

RLS SPAIN
Reef Life Survey Spain

Resilience of MPAs

In this talk:



bites
www.thebiteslab.com

RLS SPAIN
Reef Life Survey Spain

Quantifying communities



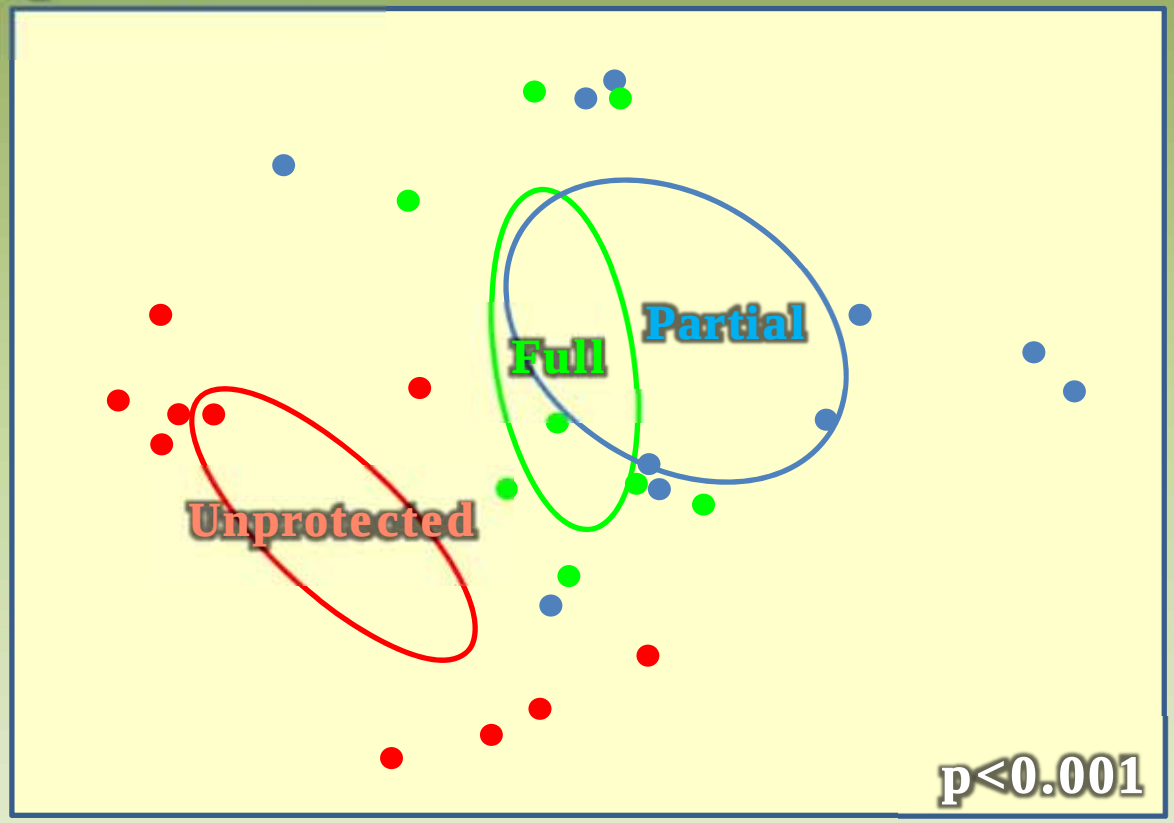
bites
www.thebiteslab.com

RLS SPAIN
Reef Life Survey Spain

Biodiversity and protection

Community level





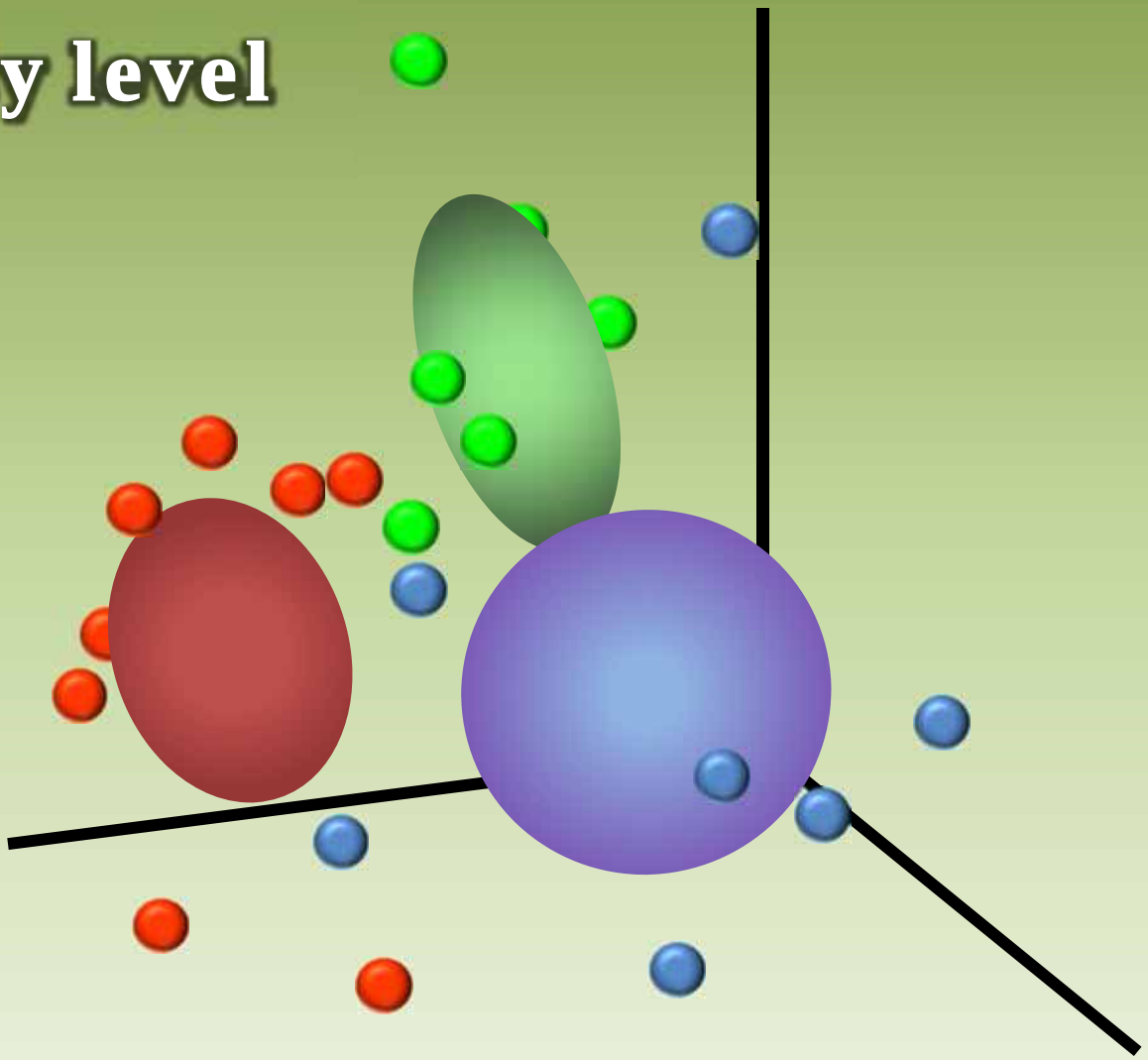
bites
www.thebiteslab.com

RLS SPAIN
Reef Life Survey Spain

Biodiversity and protection

Community level

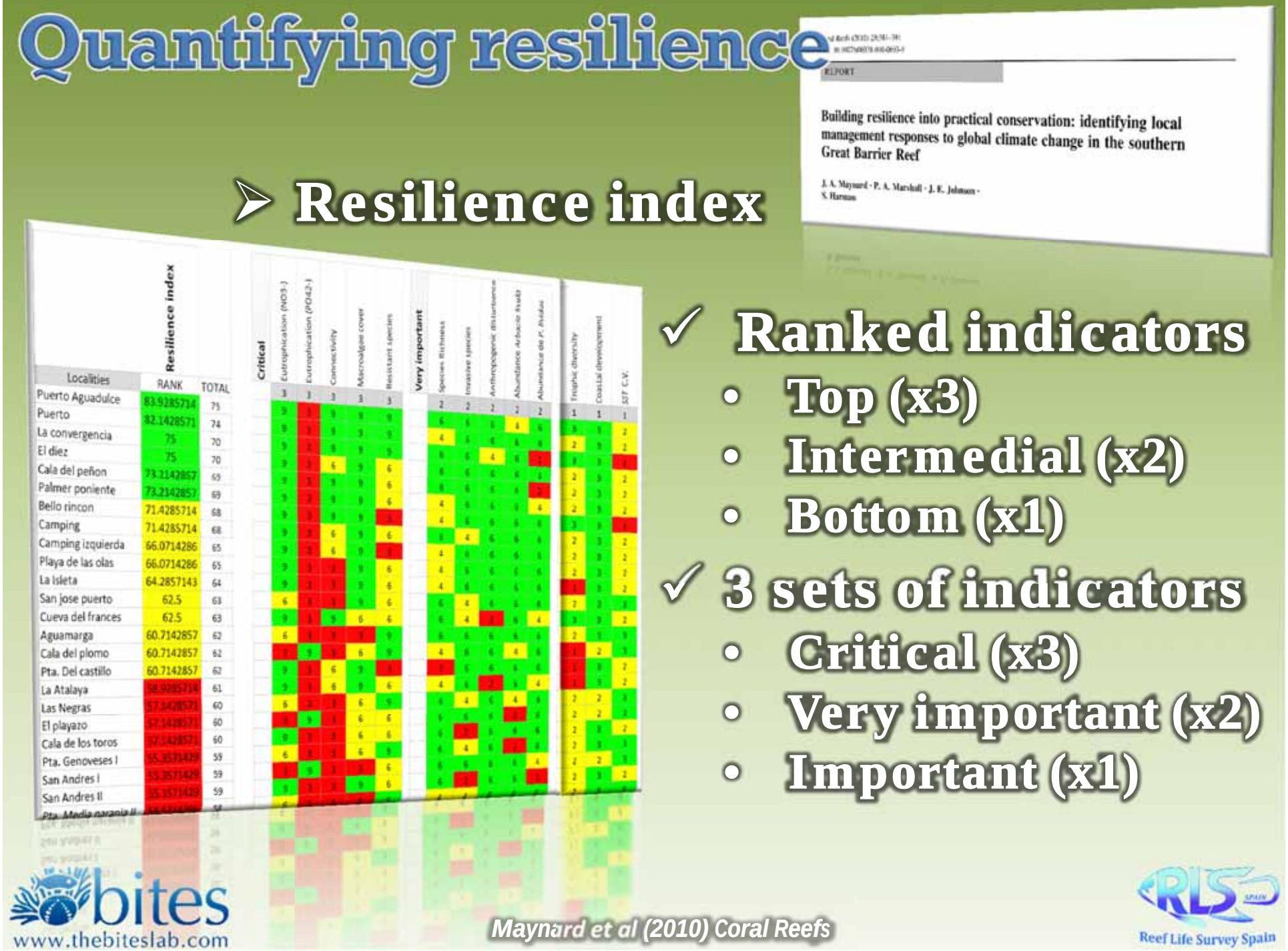




bites
www.thebiteslab.com

RLS SPAIN
Reef Life Survey Spain

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.

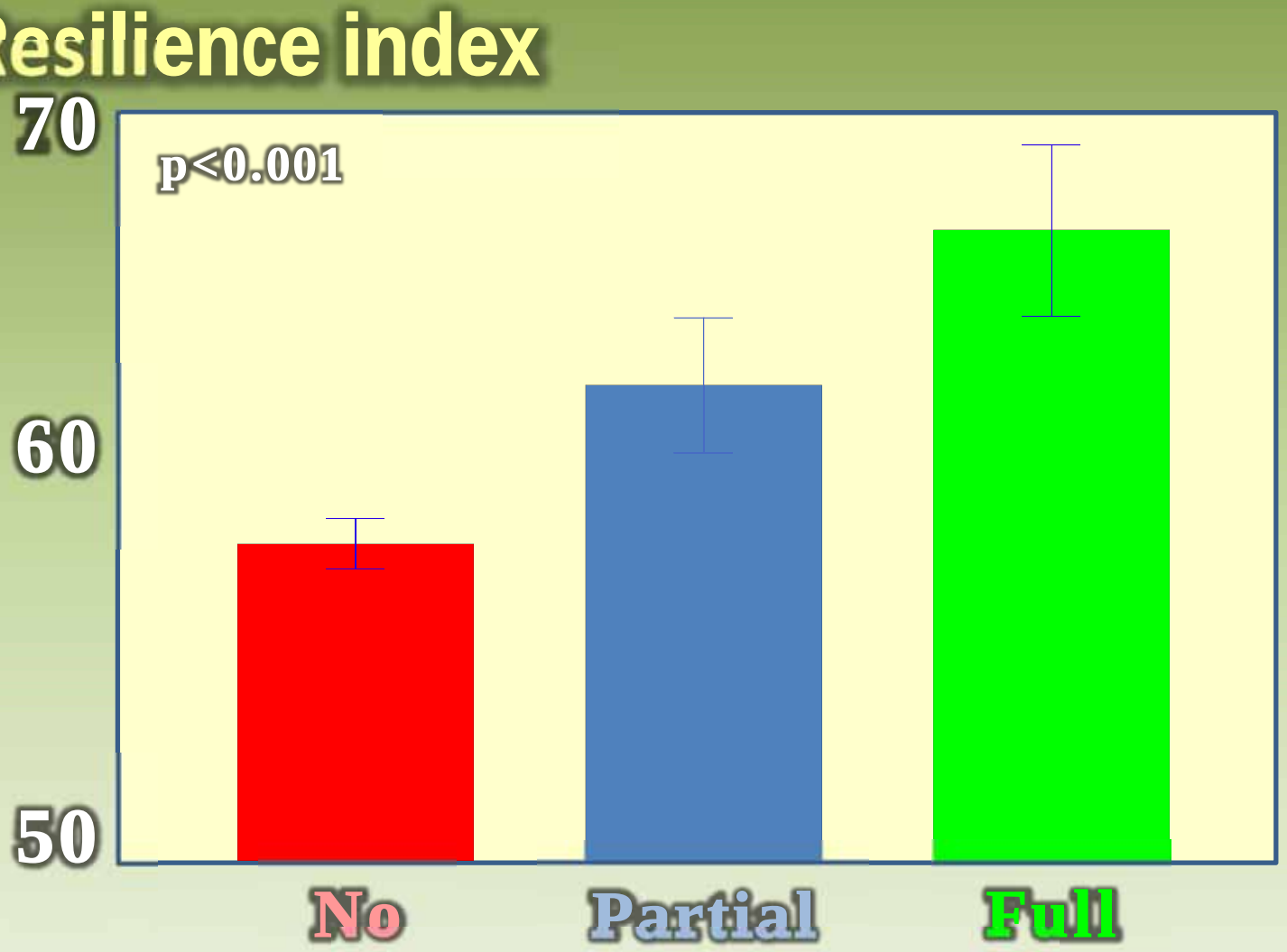
- ✓ **Ranked indicators**
  - Top (x3)
  - Intermedial (x2)
  - Bottom (x1)
- ✓ **3 sets of indicators**
  - Critical (x3)
  - Very important (x2)
  - Important (x1)

bites
www.thebiteslab.com

Maynard et al (2010) Coral Reefs

RLS SPAIN
Reef Life Survey Spain

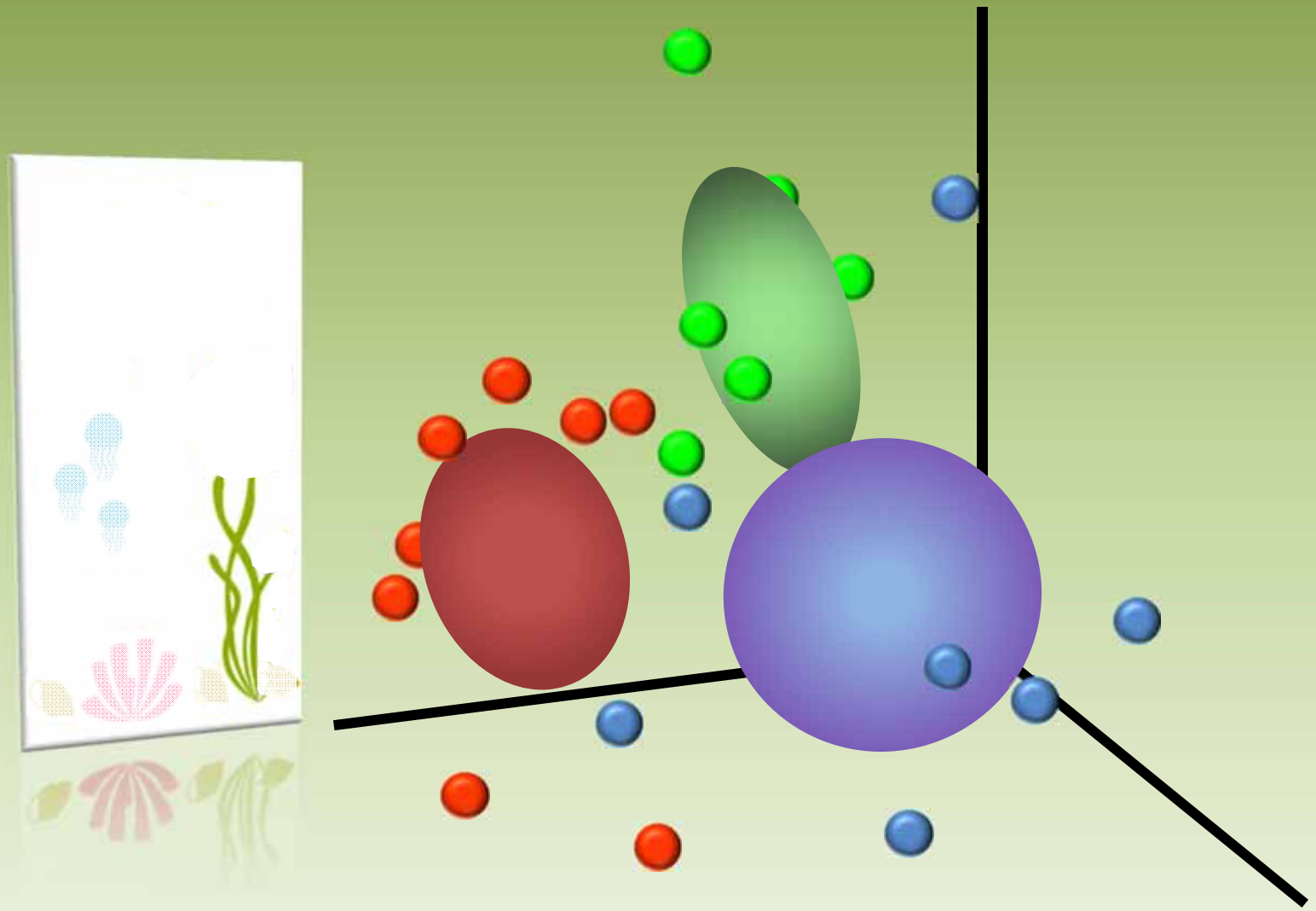
Resilience and protection



bites
www.thebiteslab.com

RLS SPAIN
Reef Life Survey Spain

Biodiversity and resilience

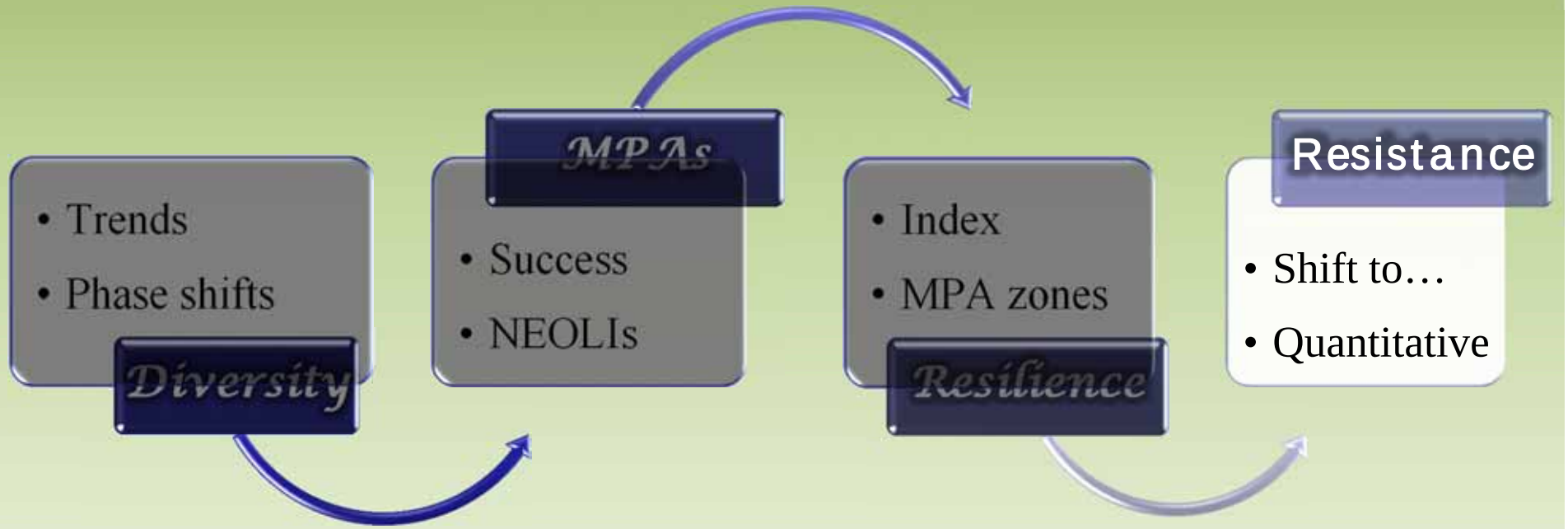


bites
www.thebiteslab.com

RLS SPAIN
Reef Life Survey Spain

Resilience of MPAs

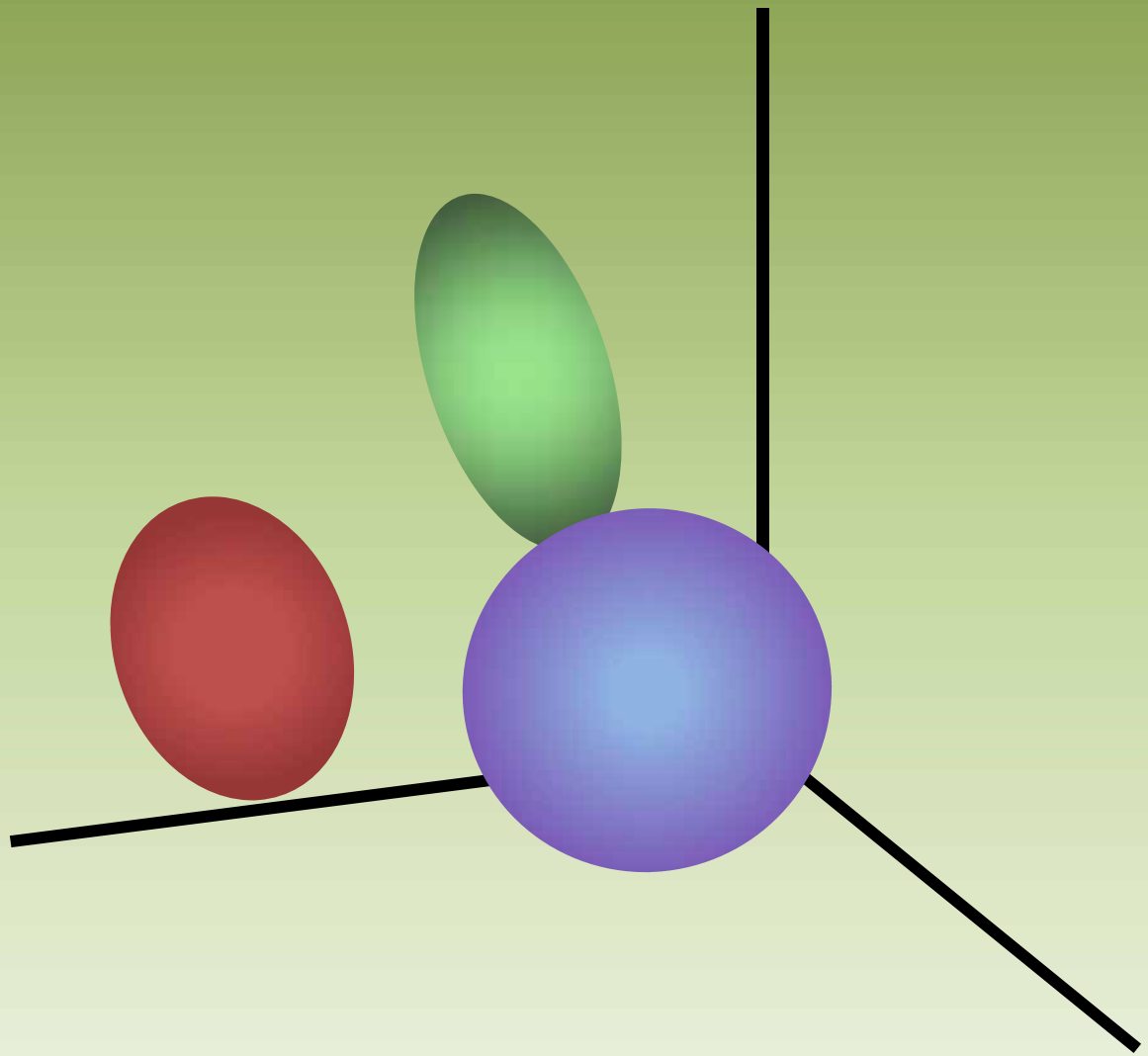
In this talk:



bites
www.thebiteslab.com

RLS SPAIN
Reef Life Survey Spain

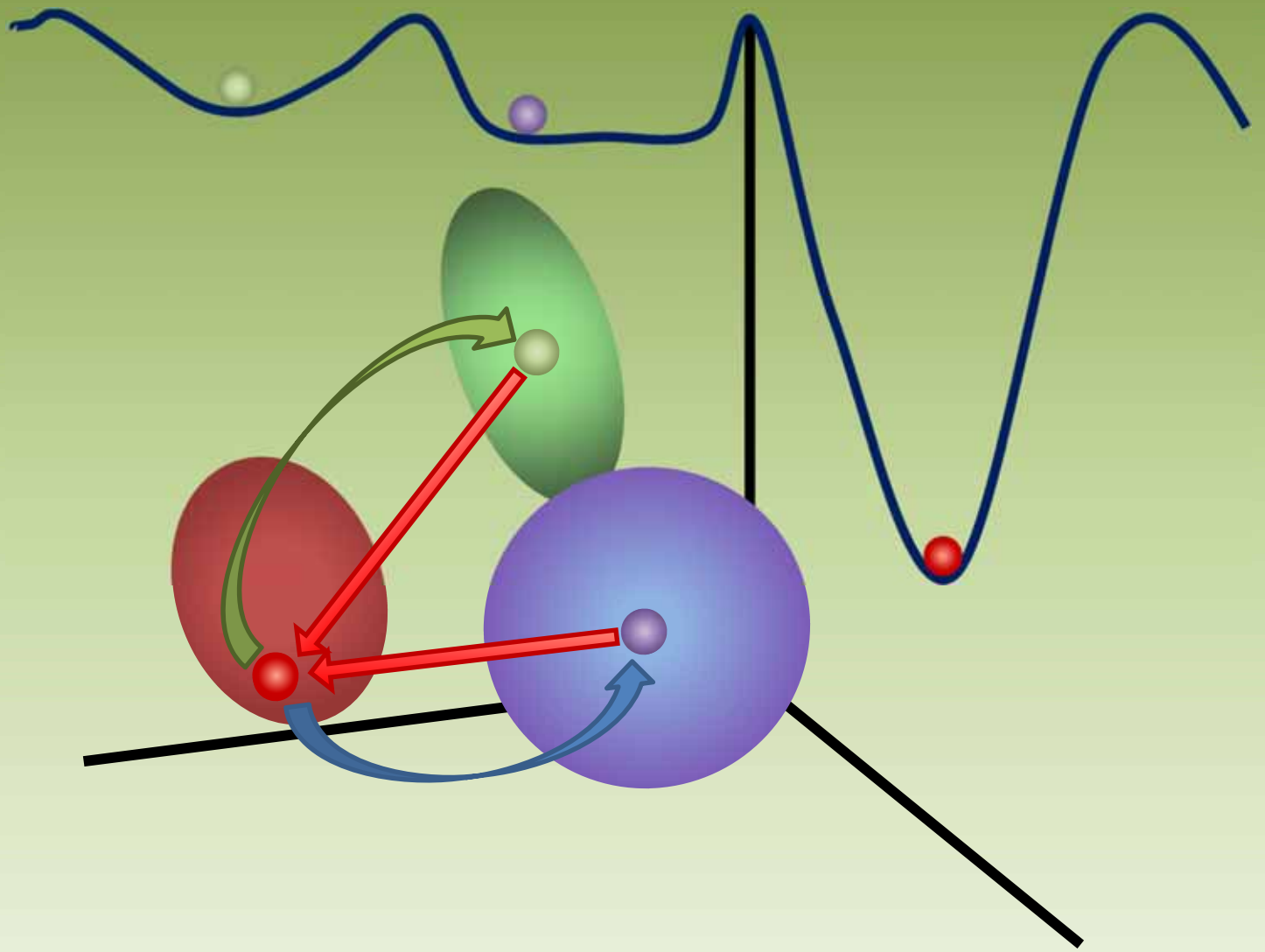
Resistance to change



bites
www.thebiteslab.com

RLS SPAIN
Reef Life Survey Spain

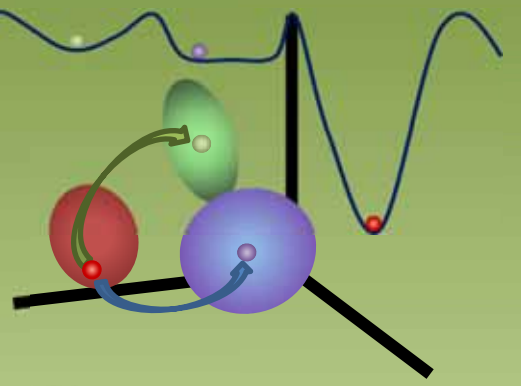
Resistance to change to…



bites
www.thebiteslab.com

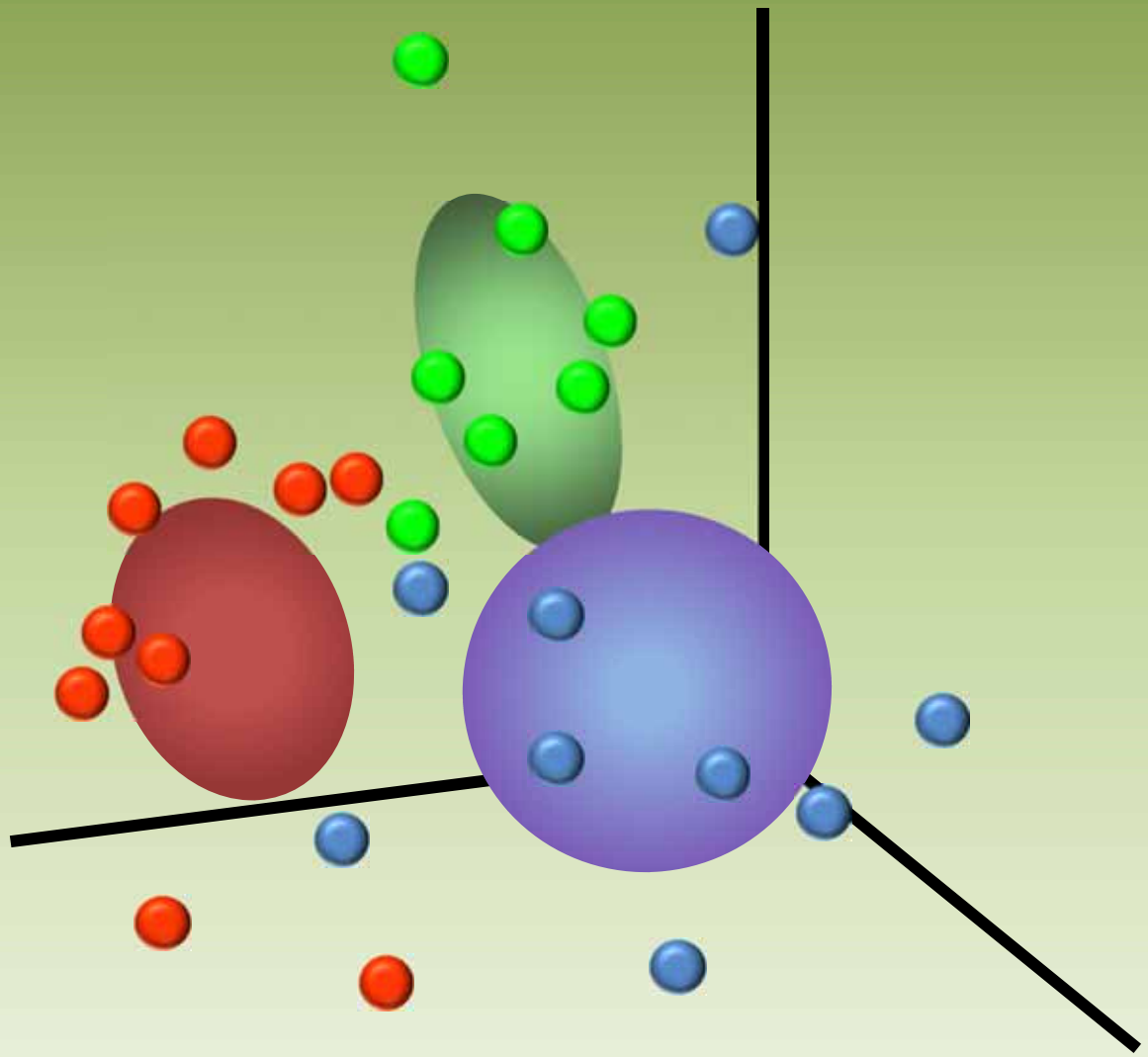
RLS SPAIN
Reef Life Survey Spain

Resistance to change to…



- ✓ Our second set of hypotheses
  - ⇧ resistance with ⇧ protection
  - ⇩ resistance with species turnover

Quantifying resistance to…

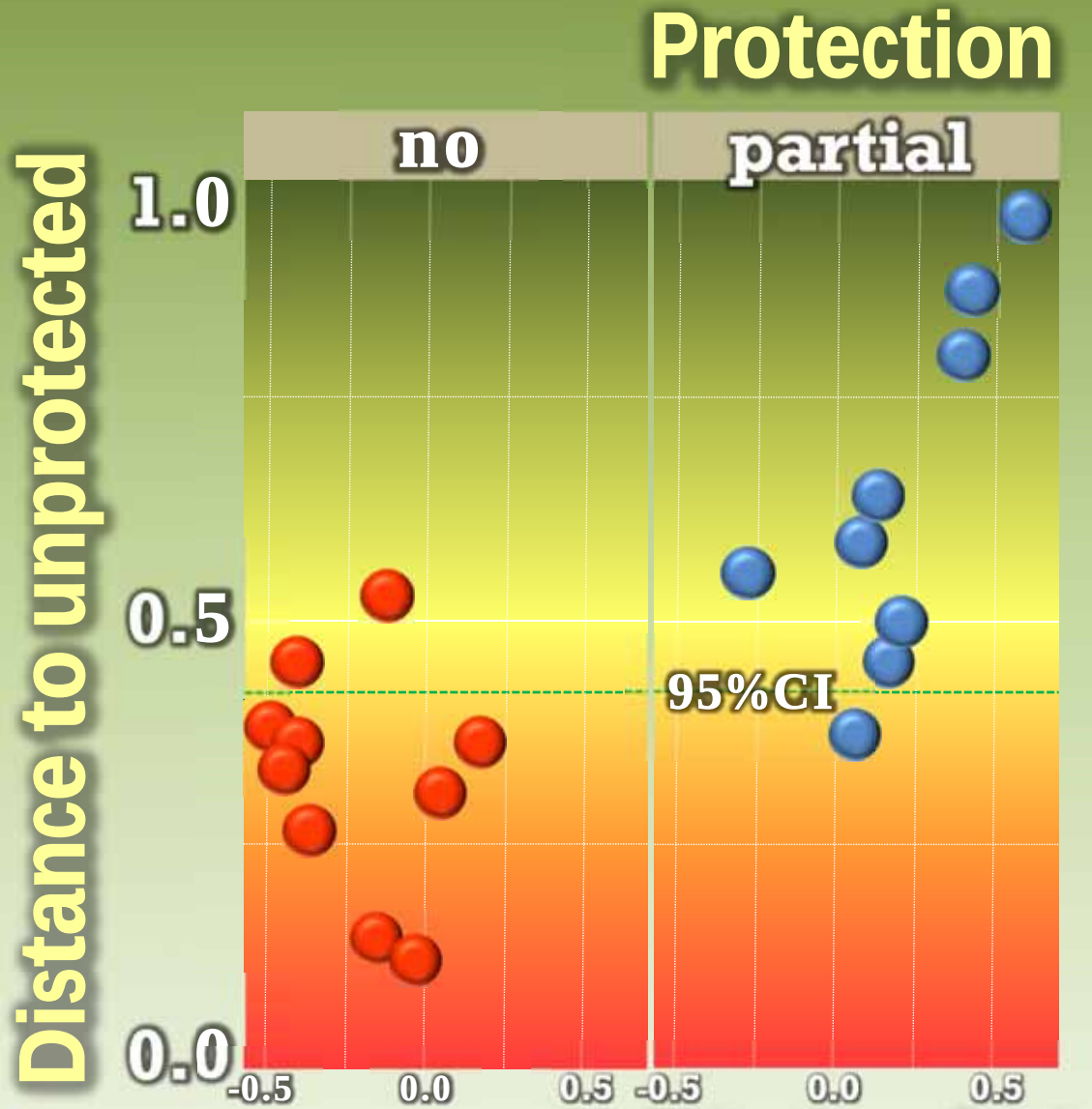


bites
www.thebiteslab.com

Pimm (1984)

RLS SPAIN
Reef Life Survey Spain

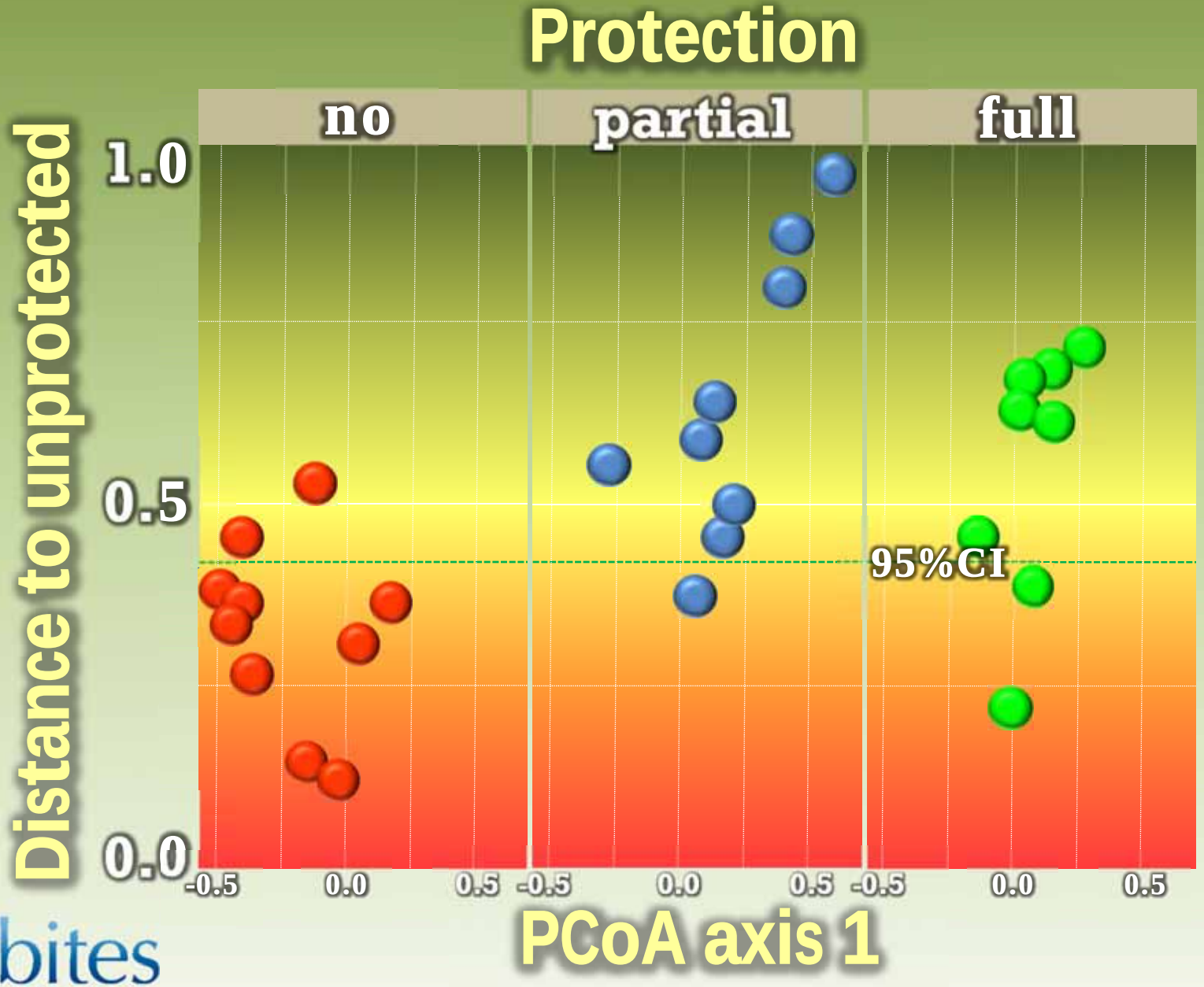
Quantifying resistance to...



bites
www.thebiteslab.com

RLS SPAIN
Reef Life Survey Spain

Quantifying resistance to...



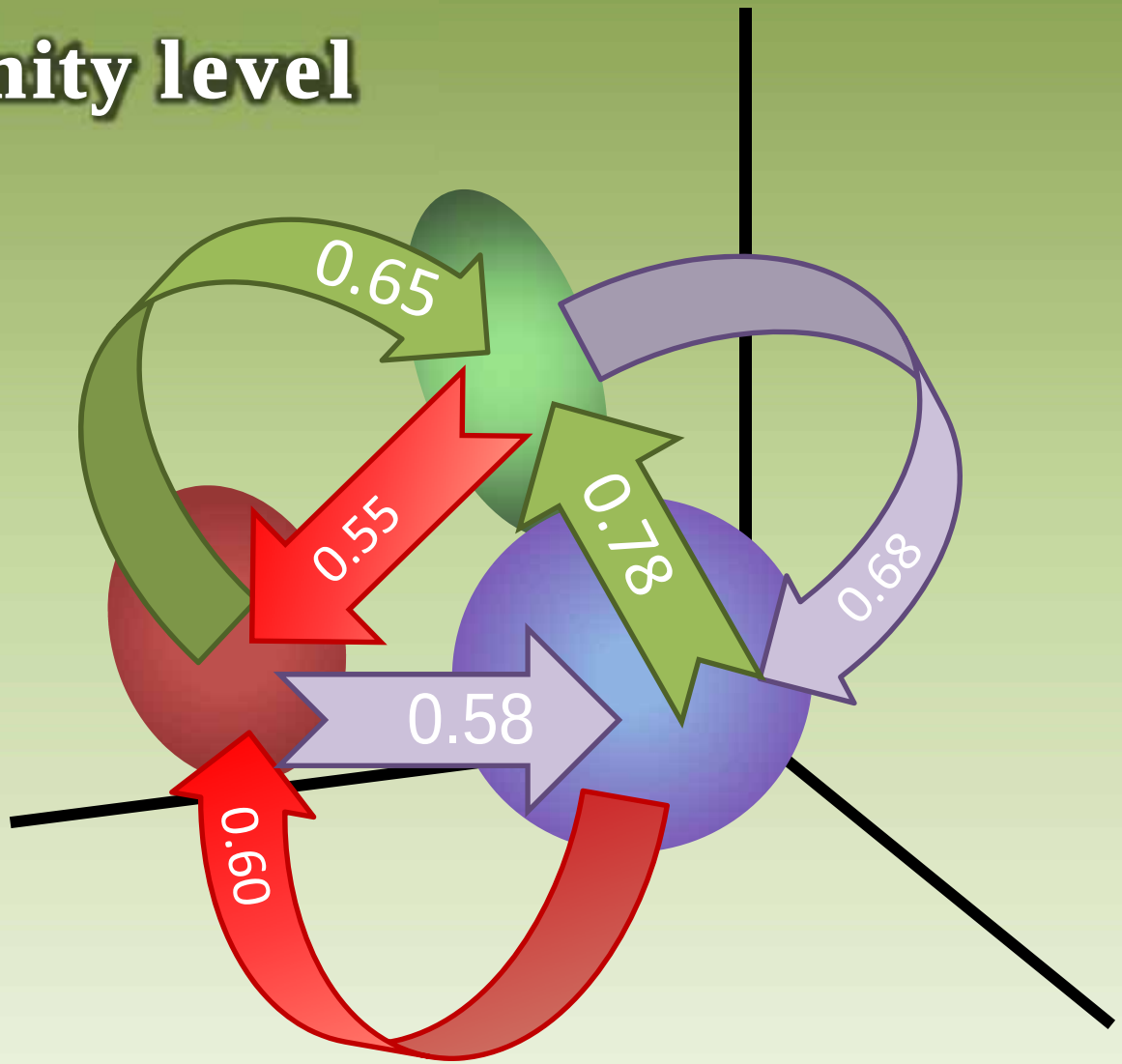
bites
www.thebiteslab.com

RLS SPAIN
Reef Life Survey Spain

Resistance between zones

Community level





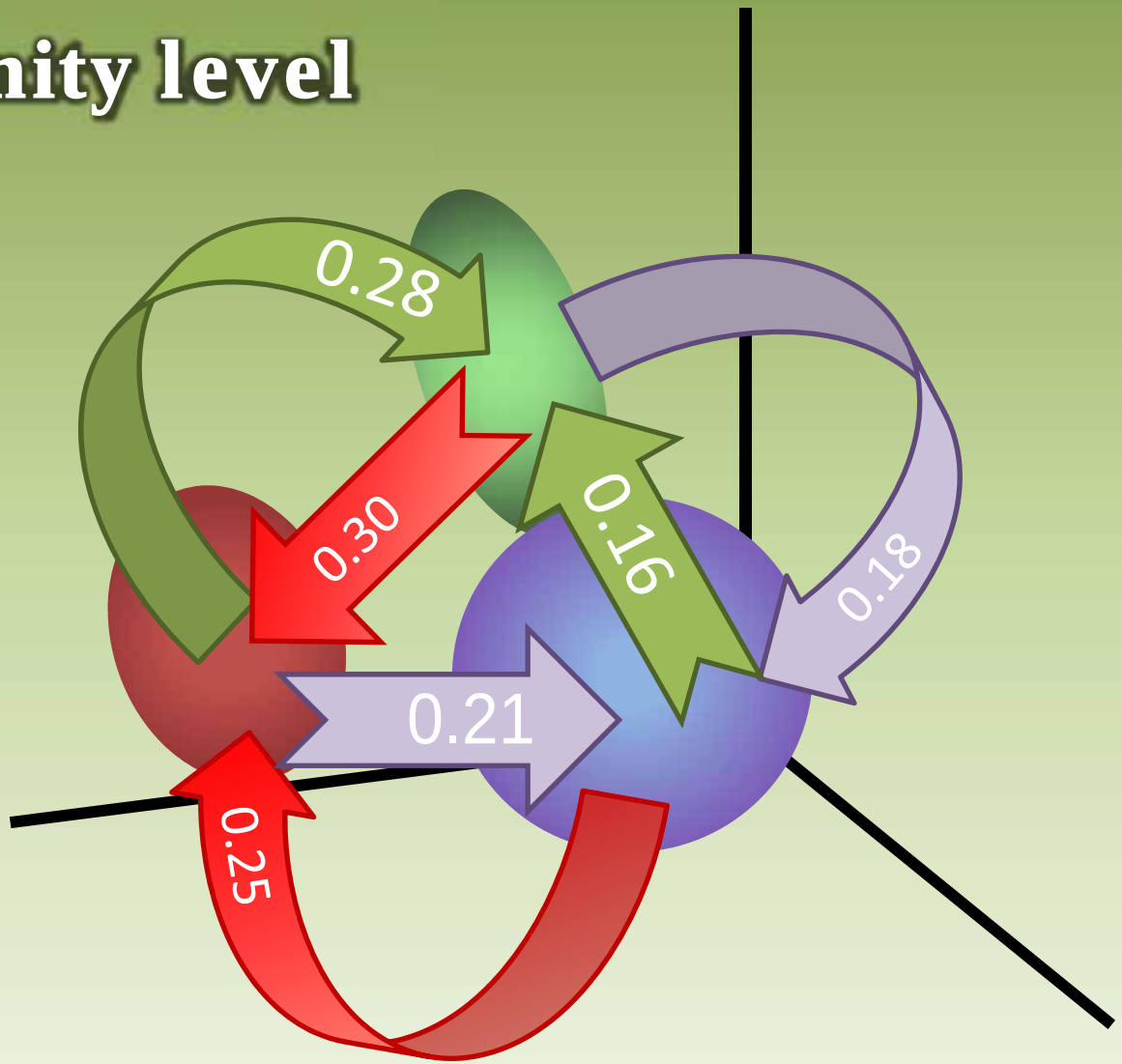
bites
www.thebiteslab.com

RLS SPAIN
Reef Life Survey Spain

Qualitative resistance

Community level

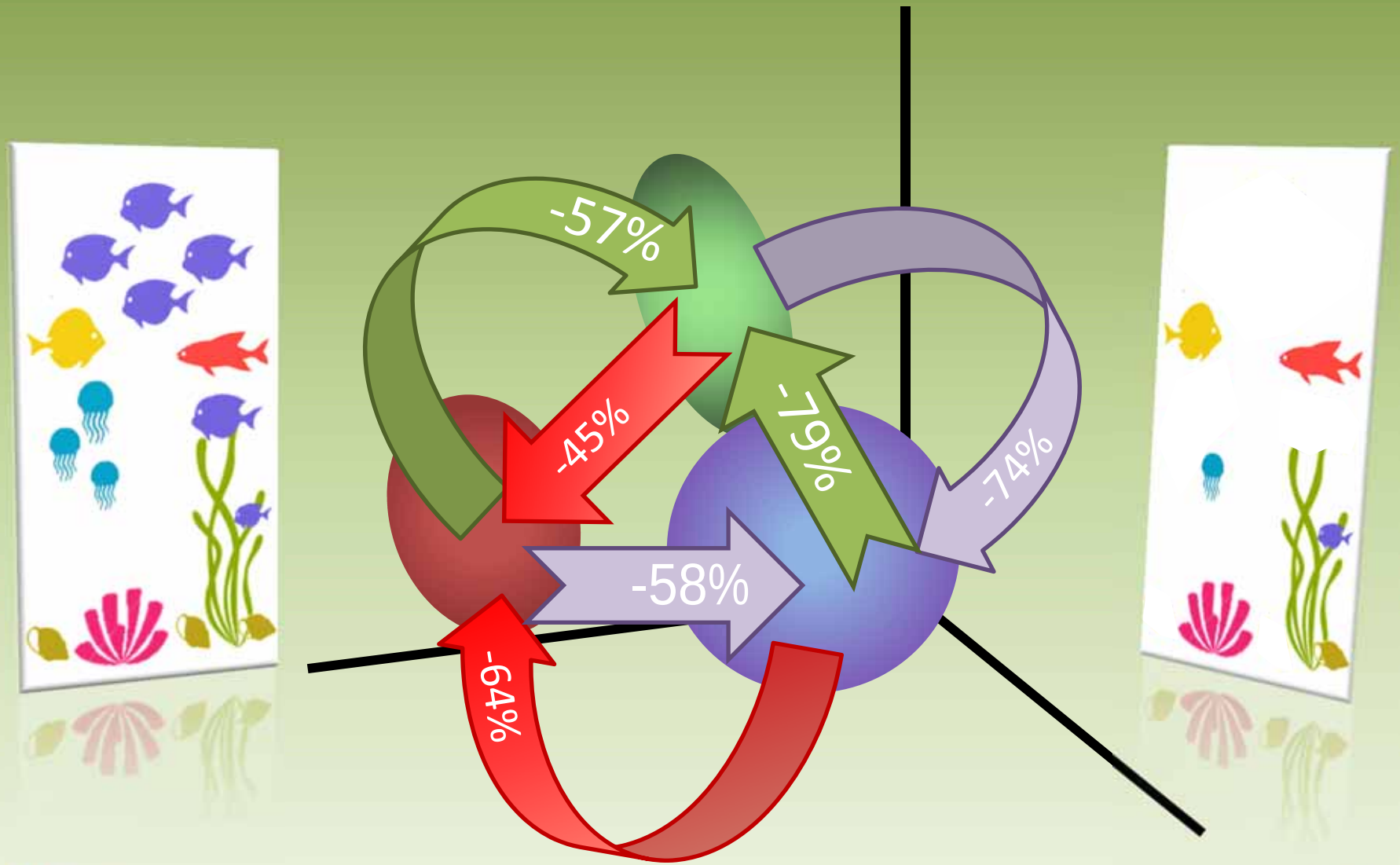




bites
www.thebiteslab.com

RLS SPAIN
Reef Life Survey Spain

Quantitative vs. qualitative



bites
www.thebiteslab.com

RLS SPAIN
Reef Life Survey Spain

Resilience of MPAs



In this talk:

Diversity
- Trends
- Phase shifts

MPAs
- Success
- NEOLIs

Resilience
- Index
- MPA zones

Resistance
- Shift to…
- Quantitative

bites
www.thebiteslab.com

RLS SPAIN
Reef Life Survey Spain

Resilience of MPAs



Thank you!

mikel.becerro@csic.es
www.thebiteslab.com

MARINERES

Funded by MINECO with FEDER

bites
www.thebiteslab.com

Unión Europea
Fondo Europeo
de Desarrollo Regional
"Una manera de hacer Europa"

GOBIERNO DE ESPAÑA
MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD

CSIC

RLS SPAIN
Reef Life Survey Spain