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Development of a quantitative methodology for defining and assessing response to coastal eutrophication

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Session SS72
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http://www.eutro.org

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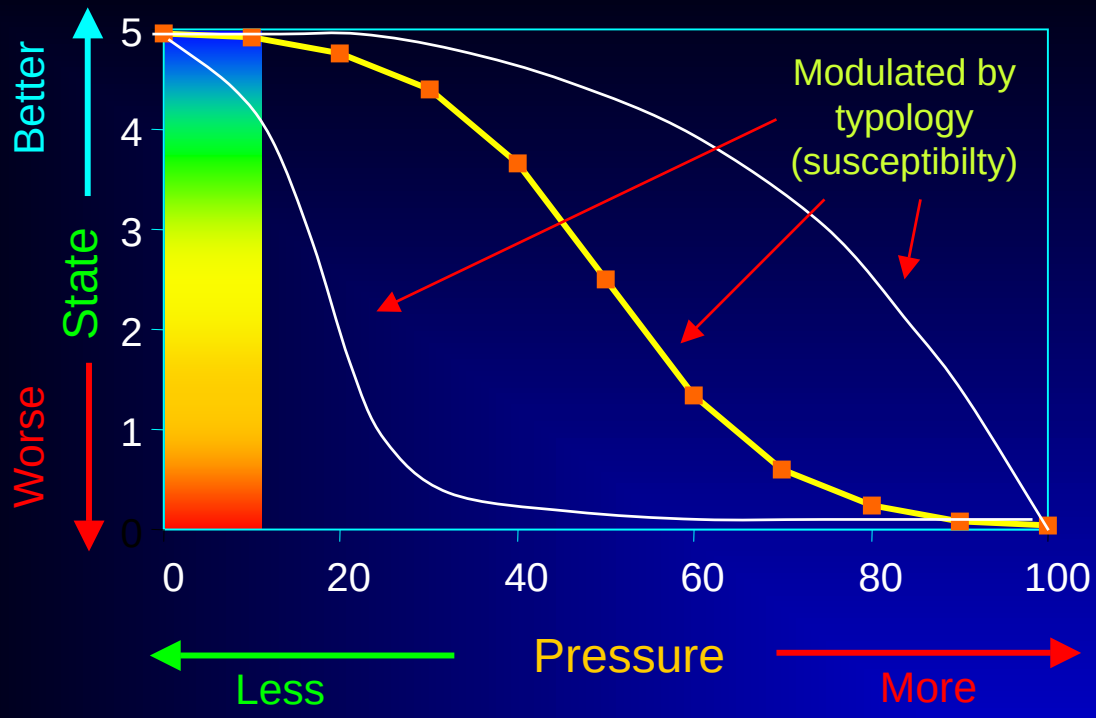
Topics

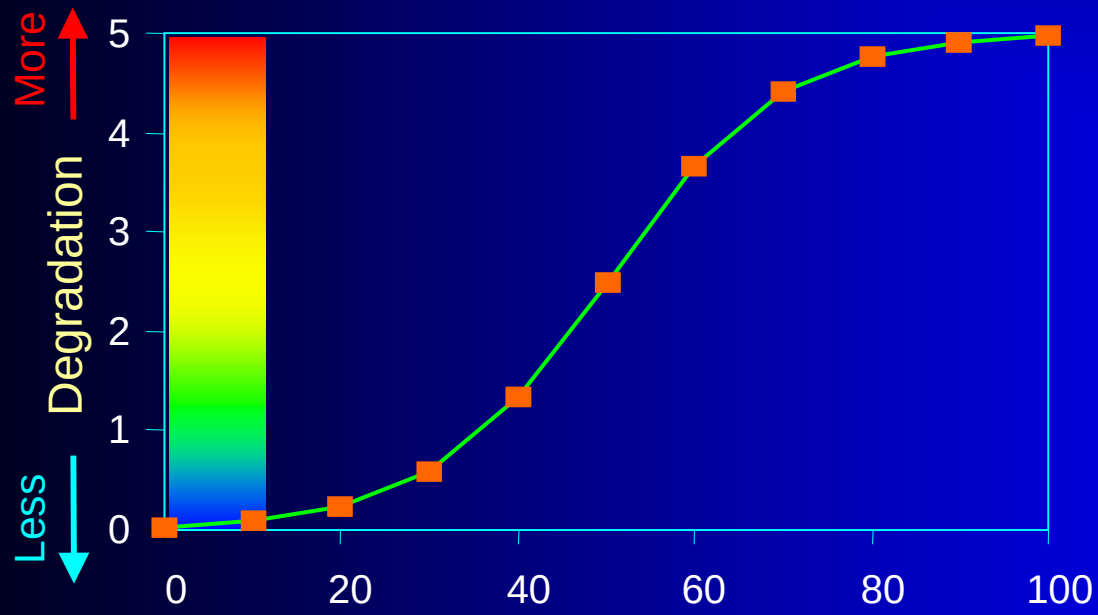
- Pressure-State relationships — 1
- Response and uncertainty — 2
- Evaluation of required response — 5
- Definition of Future Outlook (DFO) — 2
- Conclusions — 1

Slides: 11+2

Guincho, Portugal



State as a function of pressure



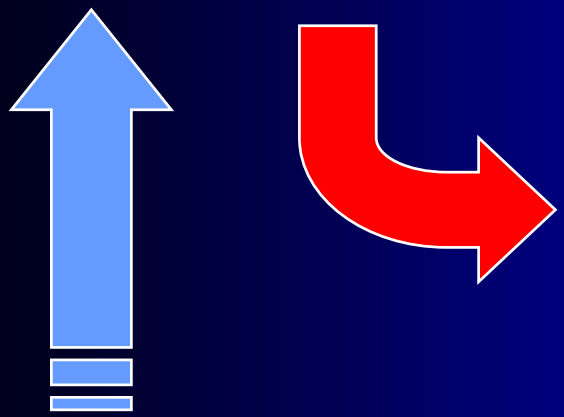
Degradation as a function of pressure

Pressure-State relationships

Coastal eutrophication Pressure-State-Response

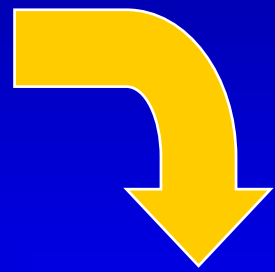
Drivers

- Agriculture – loss of fertilizer, etc
- Urban discharges (sewage)
- Industrial discharges
- Atmospheric deposition
- Internal (secondary) sources (e.g. P from sediments)
- Advection from offshore (e.g. N and P, certain types of HAB)



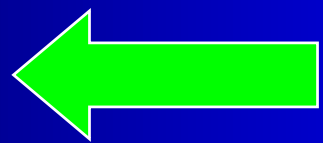
Pressure

- N and P loading to the coastal system
- HAB phytoplankton "loading" from offshore



State

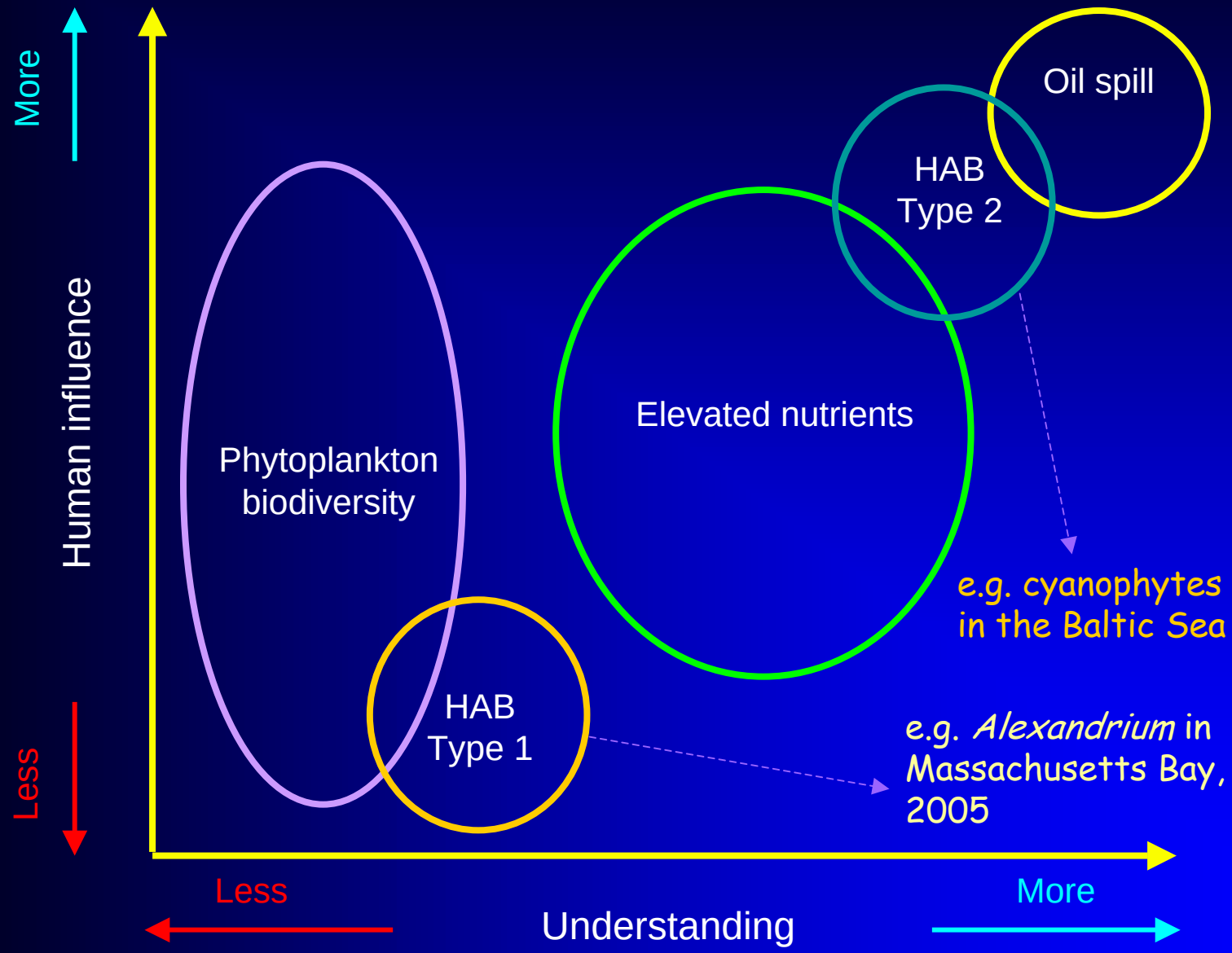
- Primary symptoms
  - Decreased light availability
  - Increased organic decomposition
  - Algal dominance changes
- Secondary symptoms
  - Loss of SAV
  - Low dissolved oxygen
  - Harmful algae



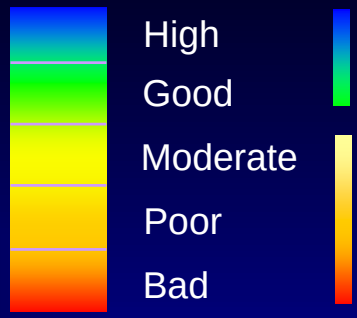
Response

- Fertilizer reduction
- WWTP (sewage, industry)
- Emmission controls
- Sediment dredging etc
- Time...
- Interdiction (e.g. HAB events)

Human influence and uncertainty



Evaluation of required response



Evaluation of State (OEC) based on primary and secondary eutrophication symptoms

Trend analysis

Up

Neutral

Down

Response
No change

Relate Pressure to State (modelling, heuristics, type comparisons…)

Anthropogenic

Natural

Determine (a) Pressures (b) Modifications to improve State (modelling etc)

Assess drivers i.e. source apportionment (measurements, modelling)

Interdiction, mitigation, enforcement

Nutrients
Sewage **Agriculture**
Industry **Atmosphere**

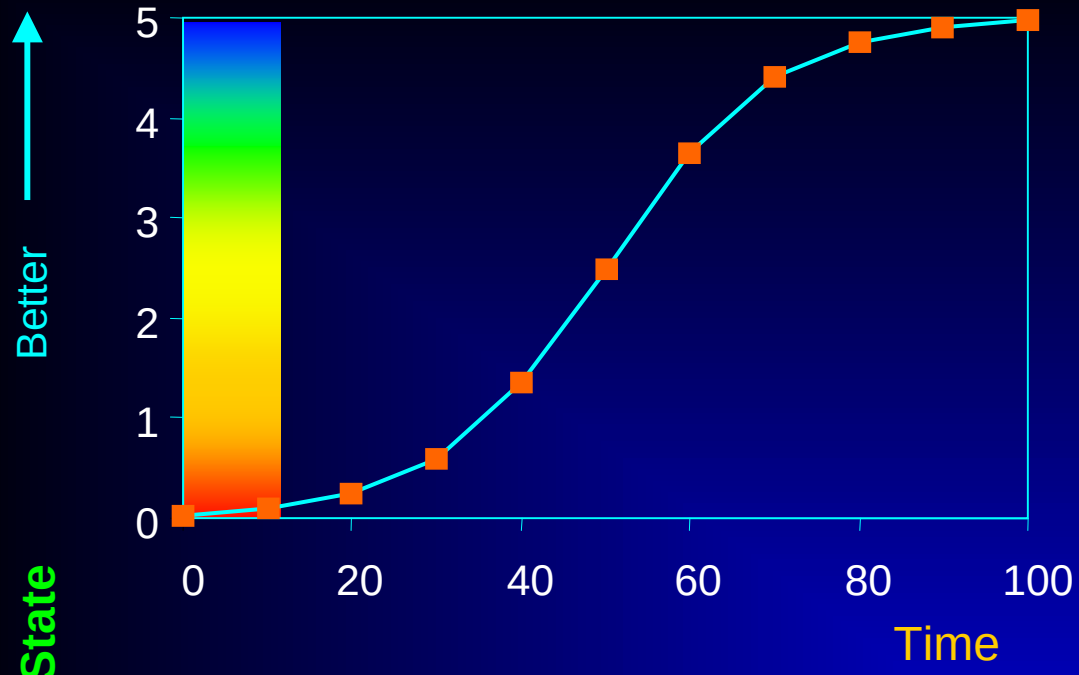
Make changes (i.e. implement measures)

Verify change in pressures

Monitor state

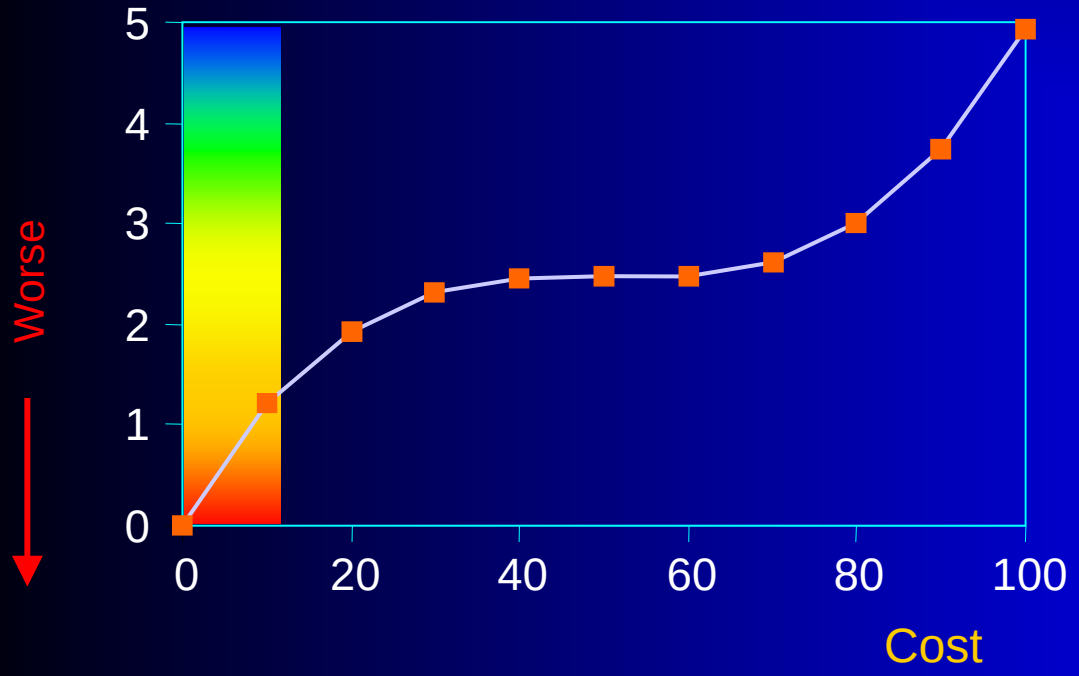
Monitoring response decision tree

Pressure	Susceptibility	State	Monitoring response: Surveillance	Operational	Investigative
H	H	H	☑		☑
H	H	G	☑	☑	
H	H	MPB	☑	☑	
H	L	H	☑		
H	L	G	☑	☑	
H	L	MPB	☑	☑	
M	H	H	☑		
M	H	G	☑	☑	
M	H	MPB	☑	☑	☑
M	L	H	☑		
M	L	G	☑	☑	
M	L	MPB	☑	☑	☑
L	H	H	☑		
L	H	G	☑	☑	
L	H	MPB	☑	☑	☑
L	L	H	☑		
L	L	G	☑		
L	L	MPB	☑	☑	☑



Restoration as a function of time

Restoration relationships



Restoration as a function of cost

Monitoring costs (estuaries)

	Portugal	United States	China
Project description	Environmental study of the Tagus estuary	Monitoring of Long Island Sound	Carrying capacity for aquaculture of Jiaozhou Bay and Sanggou Bay
Date/duration	1979-1983	Annual	1988-2001
Funding agency	UNDP, Portuguese government	U.S. Environmental Protection Agency	European Commission
Project cost for regular sampling activities (project time euros)	230,000	680,000	112,000
Stations	17	17 (31 in Summer)	7
Sampling events per station	54	35 (2 extra in Summer)	24
Total station-sample pairs	918	664	168
Unit cost for station-sample pair (project time euros)	250	1,024	667
Unit cost for station-sample pair (2004 euros)	1,447	1,024	698
Unit cost for station-sample pair (2004 PPP euros)	1,447	530	3,061
Ship (15-25m) cost per day (2004 euros)	2,500	2,924	2,611
Stations	3	5	7
Sampling events per station	2	1	1
Total station-sample pairs	6	5	7
Ship cost per station-sample pair (2004 euros)	417	585	373
Additional cost per station-sample pair (2004 euros)	1,030	439	324
Percentage ship cost	29%	57%	54%
Percentage technician cost	20%	20%	20%
Percentage analytical cost	51%	23%	26%

Economic Evaluation of Required Response

Assess drivers i.e. source apportionment (measurements, modelling)

Nutrients
Sewage Agriculture
Industry Atmosphere

Determine Least Cost Mix of Modifications to Reach Target State

Determine Human Use Value (and Non-Use Value) of State With and Without Modification Using Willingness-to-Pay Measures

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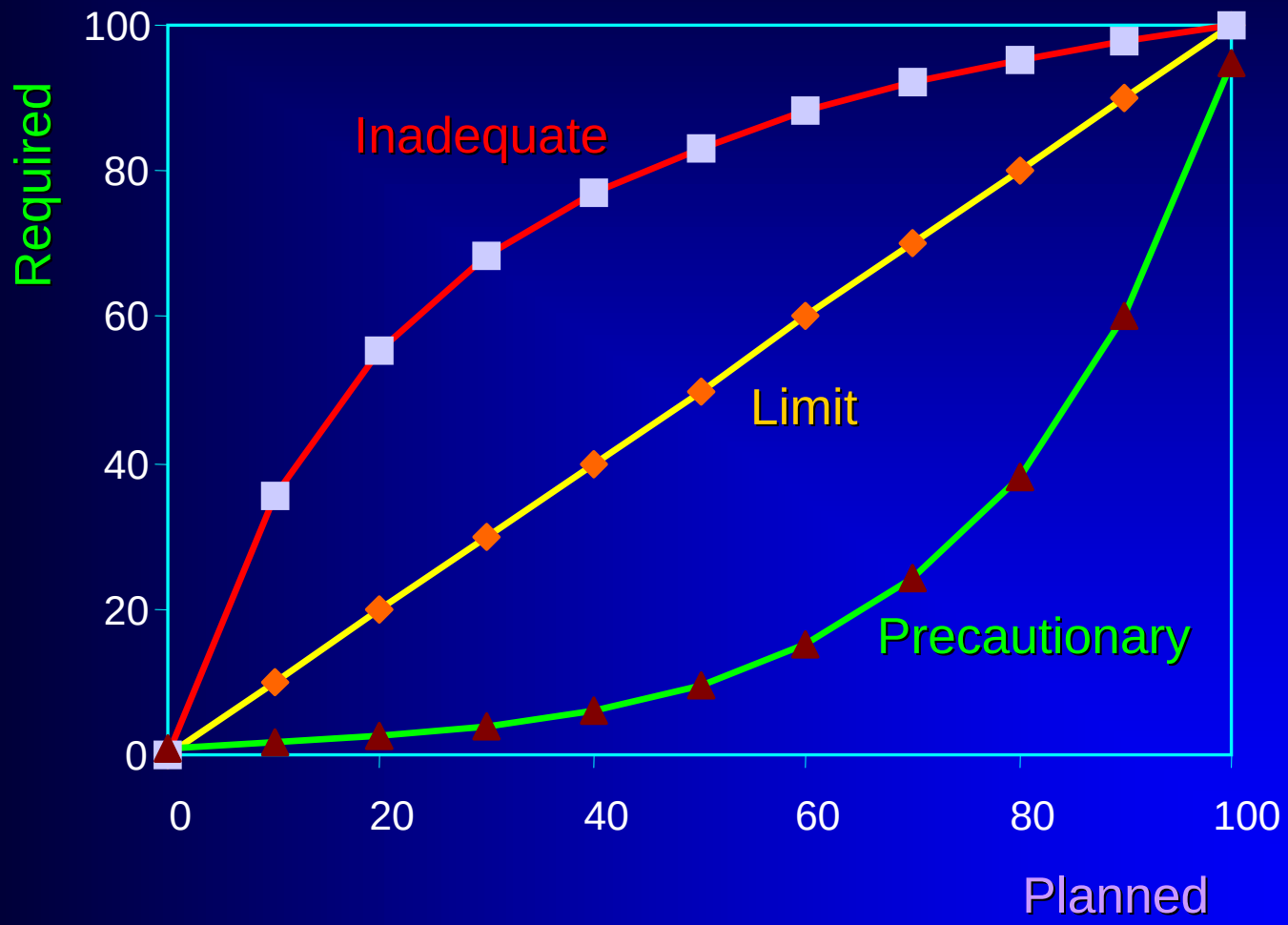
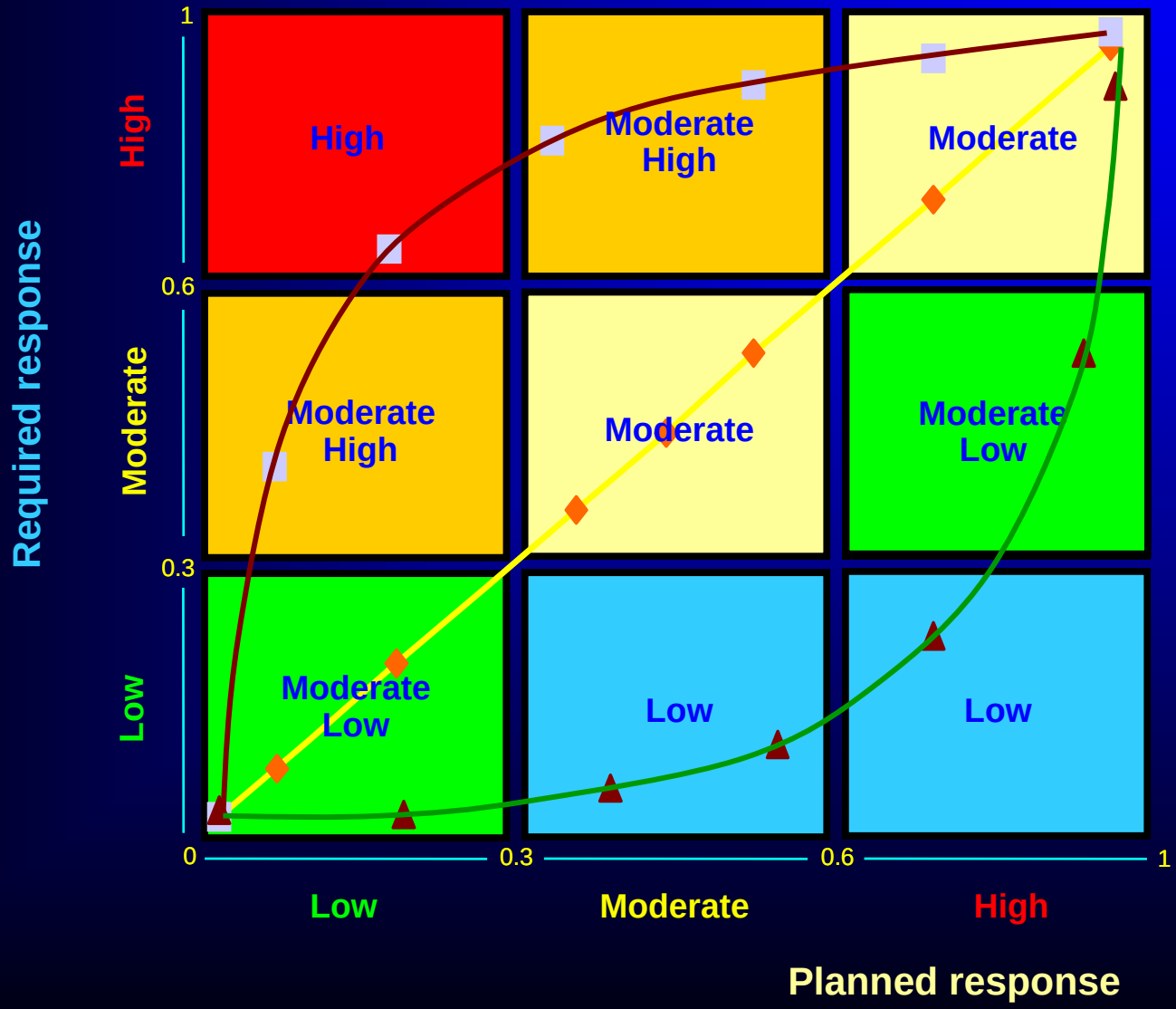
Determine Predicted Change in Total Economic Value of Estuary

Given Limited Budget for Modification, Implement Measures With the Highest Net Value (Change in Total Economic Value – Costs of Implementation)

Response curves



Definition of Future Outlook (response) matrix



Ria Formosa, Portugal

Strangford Lough, Northern Ireland

Final comments

- The inclusion of a component in ASSETS which allows an evaluation of *Management Response* provides the link to socio-economics for the PSR framework;
- The determination of appropriate *Response* may only be carried out after a clear relationship between *Pressure* and *State* is established;
- *Pressure* may be anthropogenic, natural or a combination – its effect on *State* is modulated by the system susceptibilty, which is linked to typology;
- The optimal economic *Response* solution requires (a) an analysis of the *Least Cost Set of Measures* which will achieve the required *State* change; and (b) a prediction of the change in *Total Economic Value* of the system;
- The ASSETS *Response* score may be determined by comparing the required and planned response – the outcome is integrated with the *Pressure* and *State* to provide a final grade for a system.

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