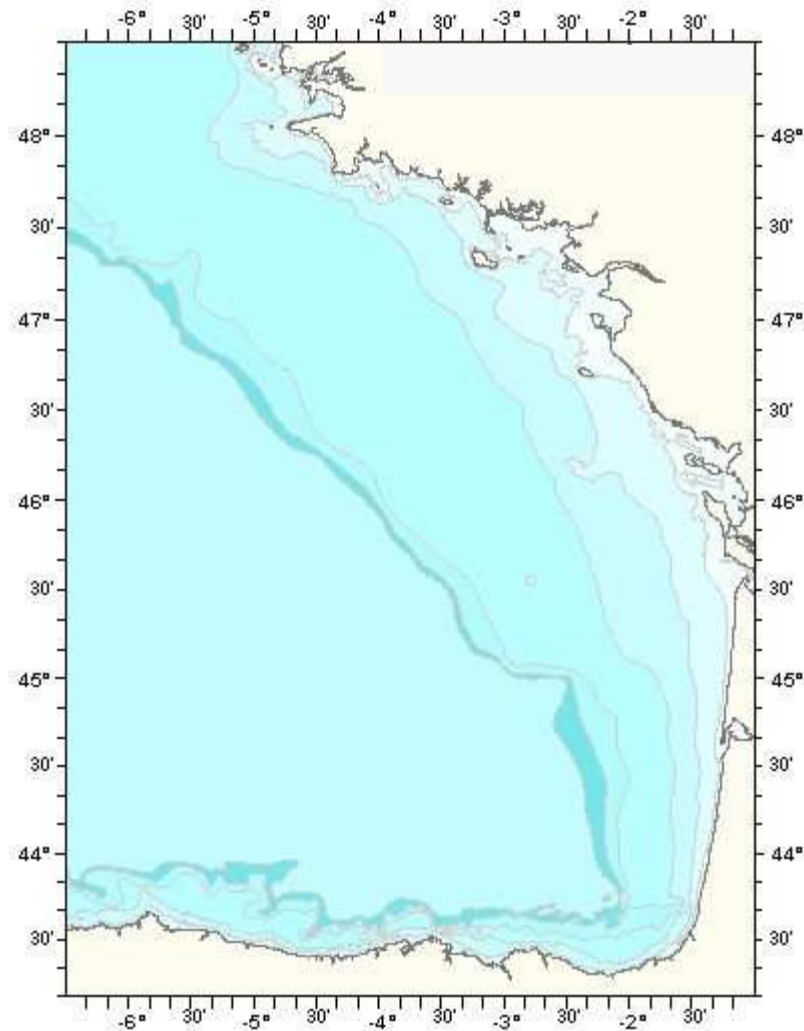


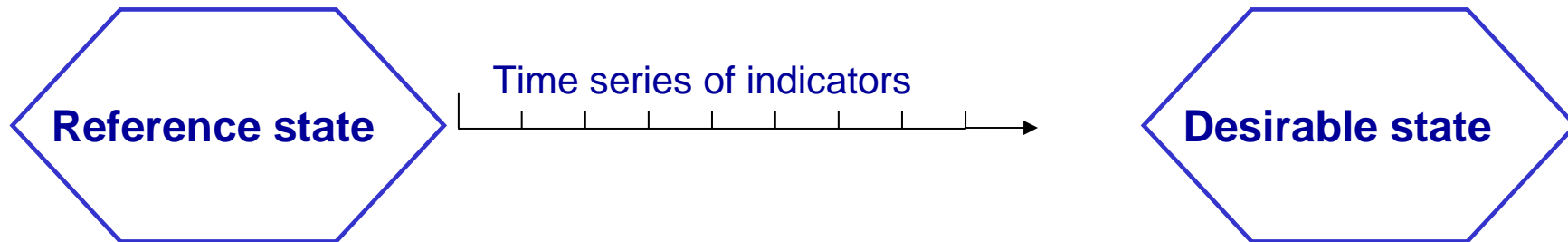
# Reference state of the Bay of Biscay Ecosystem



- P. Lorance
- A. Brind'Amour
- M.-J. Rochet
- V.M. Trenkel
- J.A. Bertrand

# Why a reference state?

- population and communities indicators of fish and large invertebrates : western IBTS time series since 1992



- initial assessment of each marine region requested by European Marine Strategy Directive

## Methods

- inventory : what are the components of the ecosystem ?
- synthetic description of each component
- assess the state of each component
- combine the assessments across components

Data:

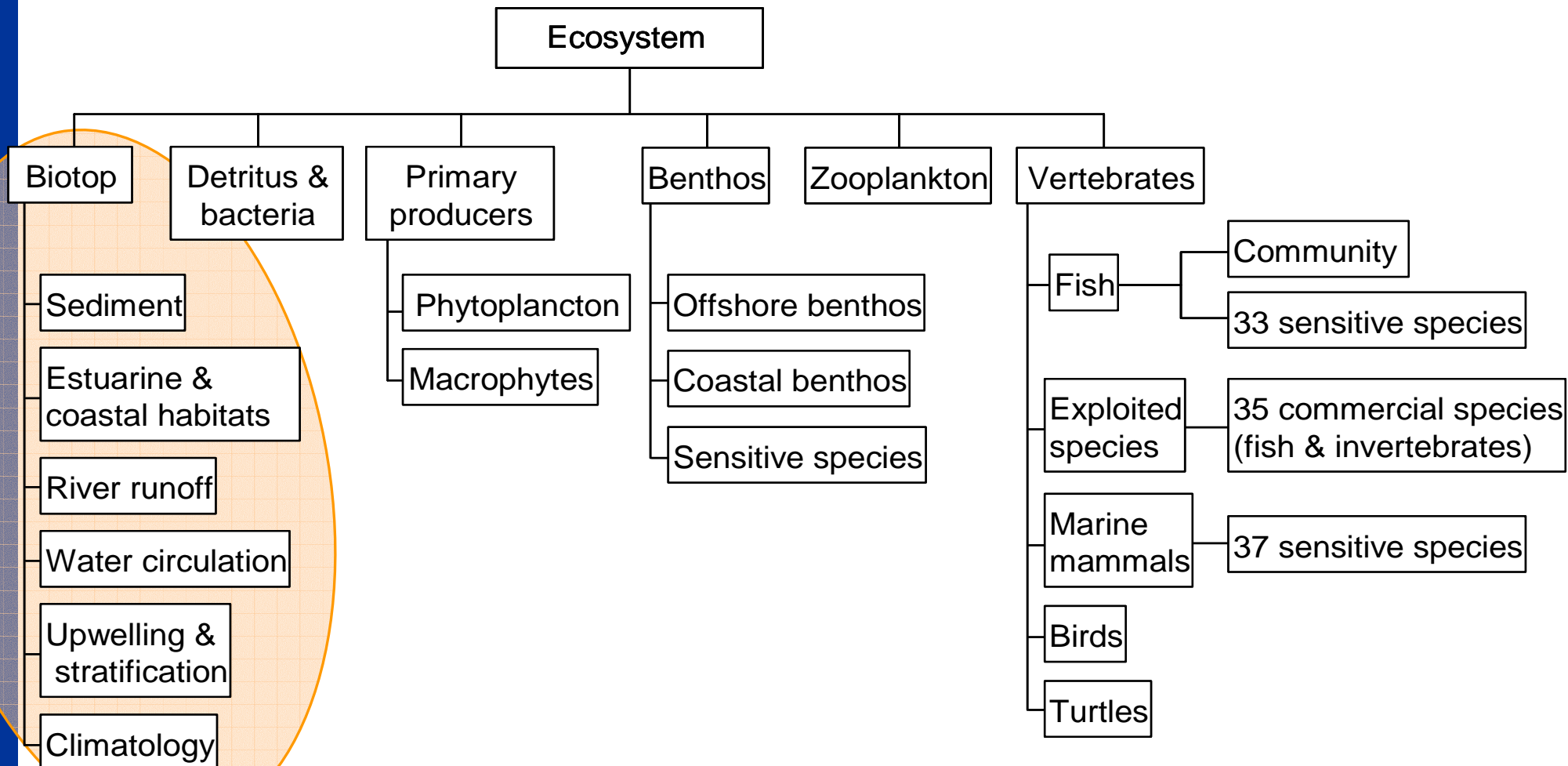
published & grey (mainly Ifremer) literature

existing time series (e.g. monitoring of contaminants, nutrients, HABs back to the 1980s)

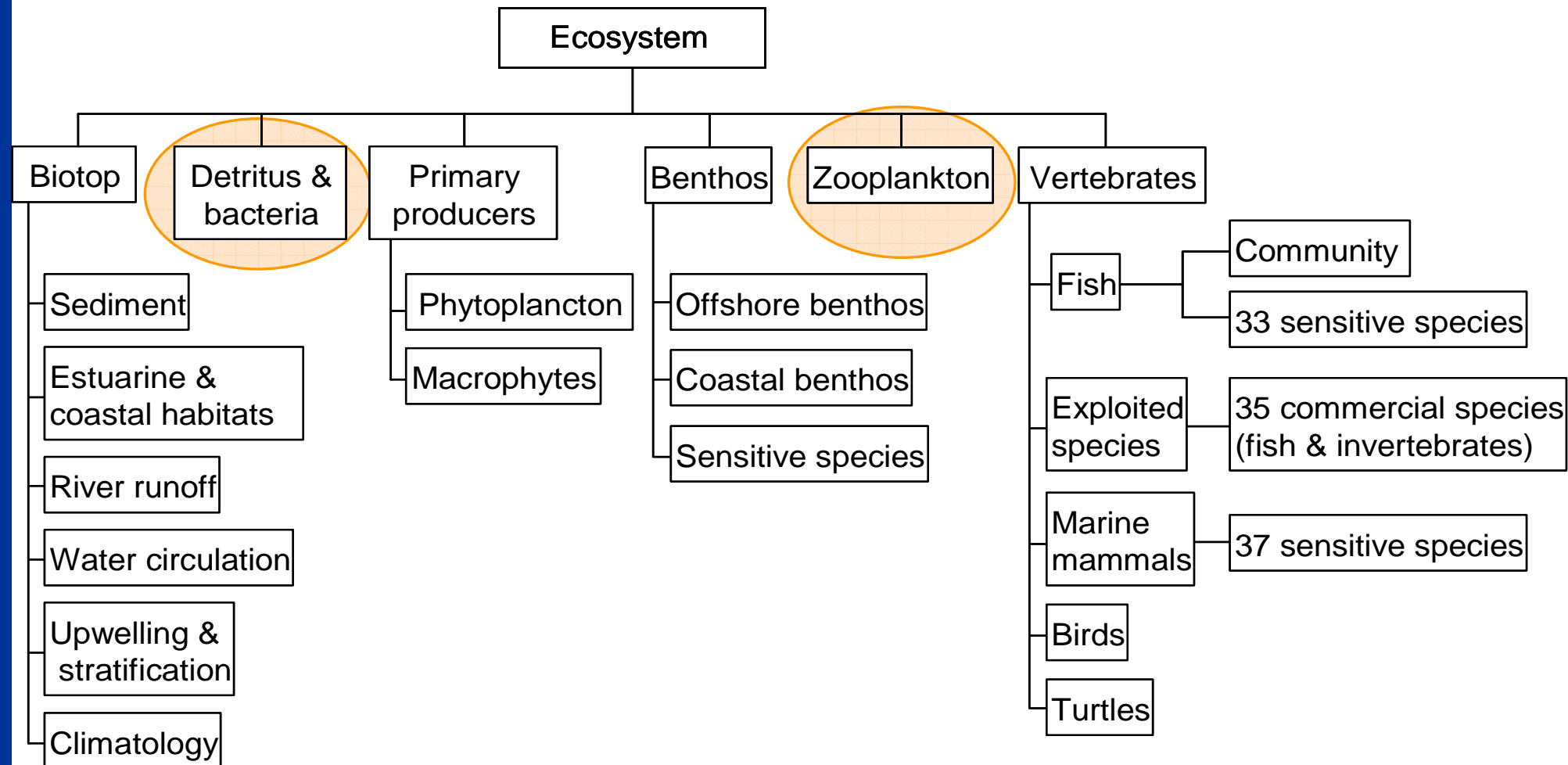
Stock assessment (ICES or national)

IUCN assessment of sensitive species

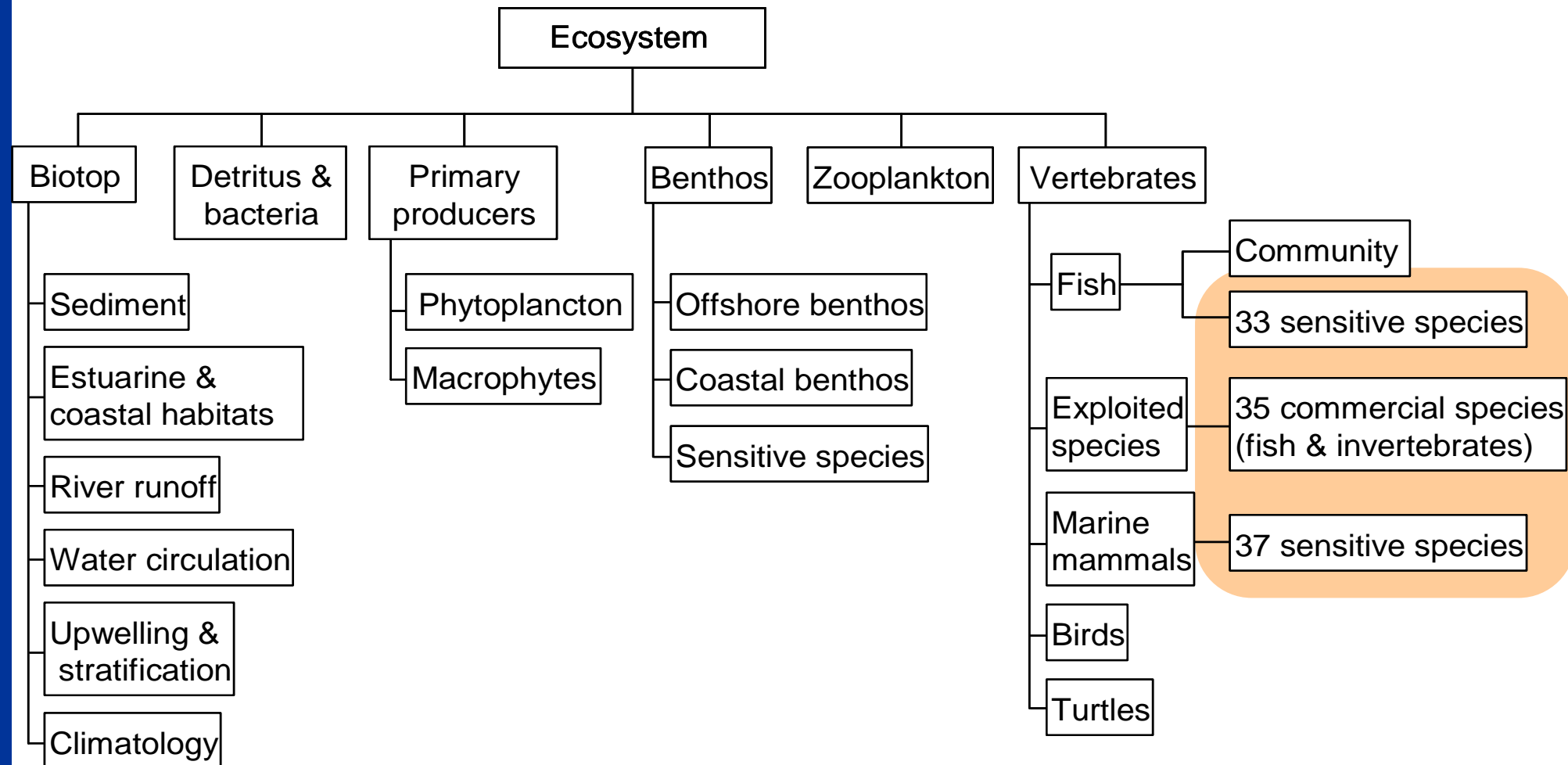
# Component tree



# Component tree



# Component tree



## Marine Strategy Framework Directive

<b>Descriptor</b>	<b>Good environmental status</b>
<b>Biodiversity:</b>	Biological diversity is maintained. [...]
<b>Introduced species:</b>	Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems.
<b>Commercial species:</b>	[...] age and size distribution that is indicative of a healthy stock.
<b>Food web:</b>	All elements [...] occur at normal abundance and diversity [...].
<b>Eutrophication:</b>	Human-induced eutrophication is minimised [...] biodiversity, [...] harmful algae blooms [...]
<b>Sea floor:</b>	Sea floor integrity is at a level that ensures that the structure and functions of the ecosystems [...]
<b>Hydrology:</b>	[No] Permanent alteration of hydrographical conditions [...]
<b>Contaminants:</b>	Concentrations of contaminants are at levels not giving rise to pollution effects.
<b>Seafood:</b>	Contaminants in fish and other seafood [...] do not exceed [...] relevant standards.
<b>Litter: [...]</b>	marine litter do not cause harm to the coastal and marine environment.
<b>Disturbance:</b>	Introduction of energy, [...] noise, [...] do not adversely affect the marine environment.

# Assessing components with MSF Qualitative Descriptors

	Biodi- versity	Introd. species	Comm. species	Food web	Eutrophi- cation	Sea floor	Hydro- graphy	Contam- inants	Sea- food	Litter	Disturb- ance
<b>Biotop</b>											
Sediments						✓D				✓D	
Estuarine and coastal habitats					✓D	✓D		✓D	✓D	✓	
River runoff							✓D				
Water circulation							✓				
Upwelling and stratification							✓				
Climatology							✓D				
Detritus and bacteria	✓			✓D	✓					✓D	
<b>Primary producers</b>											
Macrophytes	✓	✓D		✓	✓D	✓					
Phytoplankton	✓	✓		✓	✓D			✓	✓		
Zooplankton	✓	✓		✓	✓						
<b>Benthos</b>											
Offshore benthos	✓D	✓		✓		✓D				✓	
Coastal benthos	✓D	✓D		✓	✓D	✓		✓		✓	
Sensitive benthos	✓D			✓		✓					
<b>Vertebrates</b>											
Fish community	✓D	✓D		✓							
Exploited species	✓D		✓D	✓					✓		✓
Birds	✓D			✓				✓			✓
Marine mammals	✓D			✓				✓			✓
Turtles	✓D			✓						✓	



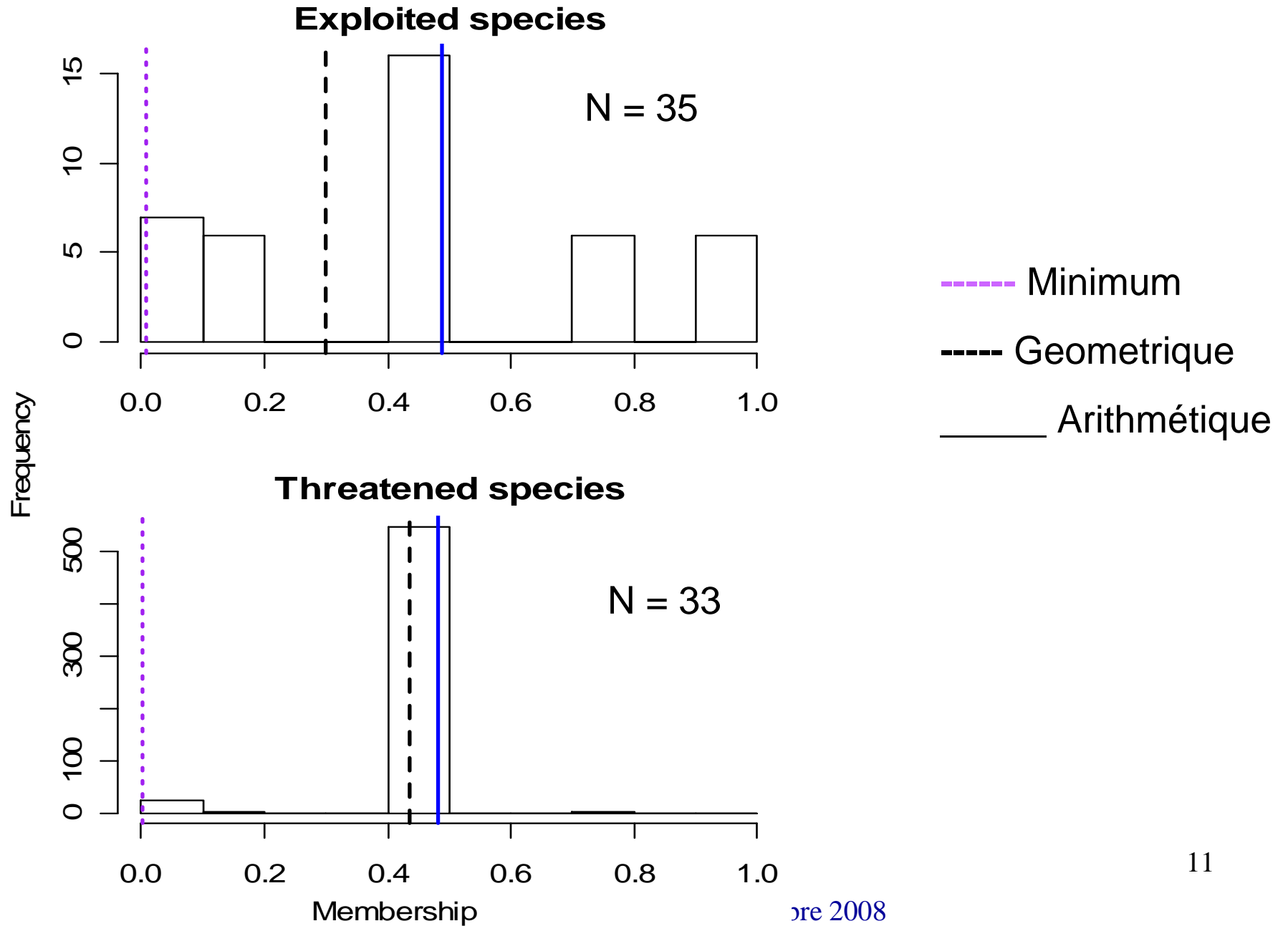
# Assessing components with MSF Qualitative Descriptors

	Biodiversity	Introd. species	Comm. species	Food web	Eutrophication	Sea floor	Hydrography	Contaminants	Sea-food	Litter	Disturbance
<b>Biotop</b>											
Sediments						✓D				✓D	
Estuarine and coastal habitats					✓D	✓D		✓D	✓D	✓	
River runoff							✓D				
Water circulation							✓				
Upwelling and stratification							✓				
Climatology							✓D				
<b>Detritus and bacteria</b>	✓			✓D	✓					✓D	
<b>Primary producers</b>											
Macrophytes	✓	✓D		✓	✓D	✓					
Phytoplankton	✓	✓		✓	✓D			✓	✓		
<b>Zooplankton</b>	✓	✓		✓	✓						
<b>Benthos</b>											
Offshore benthos	✓D	✓		✓		✓D				✓	
Coastal benthos	✓D	✓D		✓	✓D	✓		✓		✓	
Sensitive benthos	✓D			✓		✓					
<b>Vertebrates</b>											
Fish community	✓D	✓D		✓							
Exploited species	✓D										
<b>Birds</b>	✓D			✓				✓			✓
Marine mammals											✓
Turtles	✓D			✓						✓	

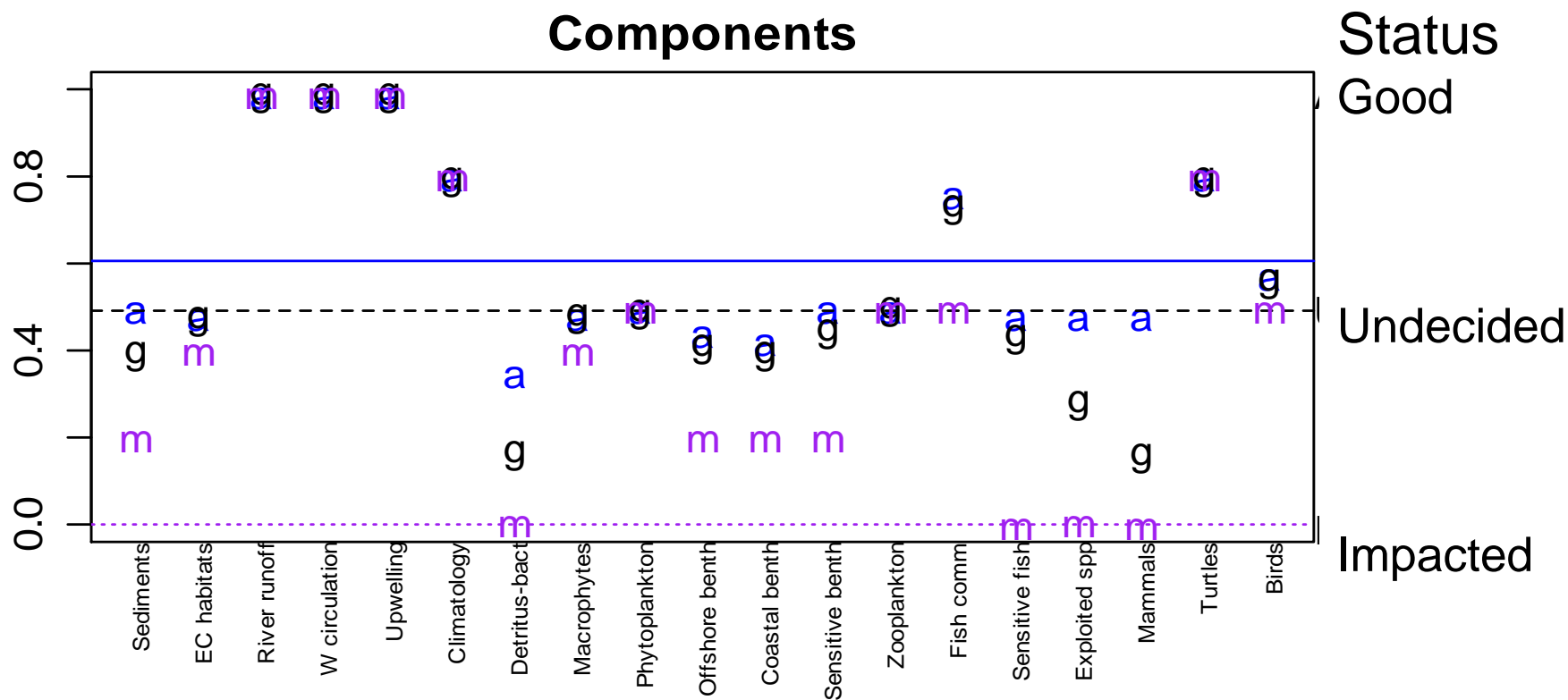
## Combination of assessments by ecosystem component using fuzzy logic

- **Components have a partial membership to the set of elements in « good environmental status »**
- **Example: exploited species**
  - Surexploited  $\Rightarrow$  0 (0%) membership to the set «good environmental status»
  - Sustainably exploited  $\Rightarrow$  1
  - Exploitation level unknown  $\Rightarrow$  0.5 membership to «good environmental status»
  
  - Accounting for uncertainty 100%  $\Rightarrow$  95% ; 0%  $\Rightarrow$  5%

# Distribution of components' membership



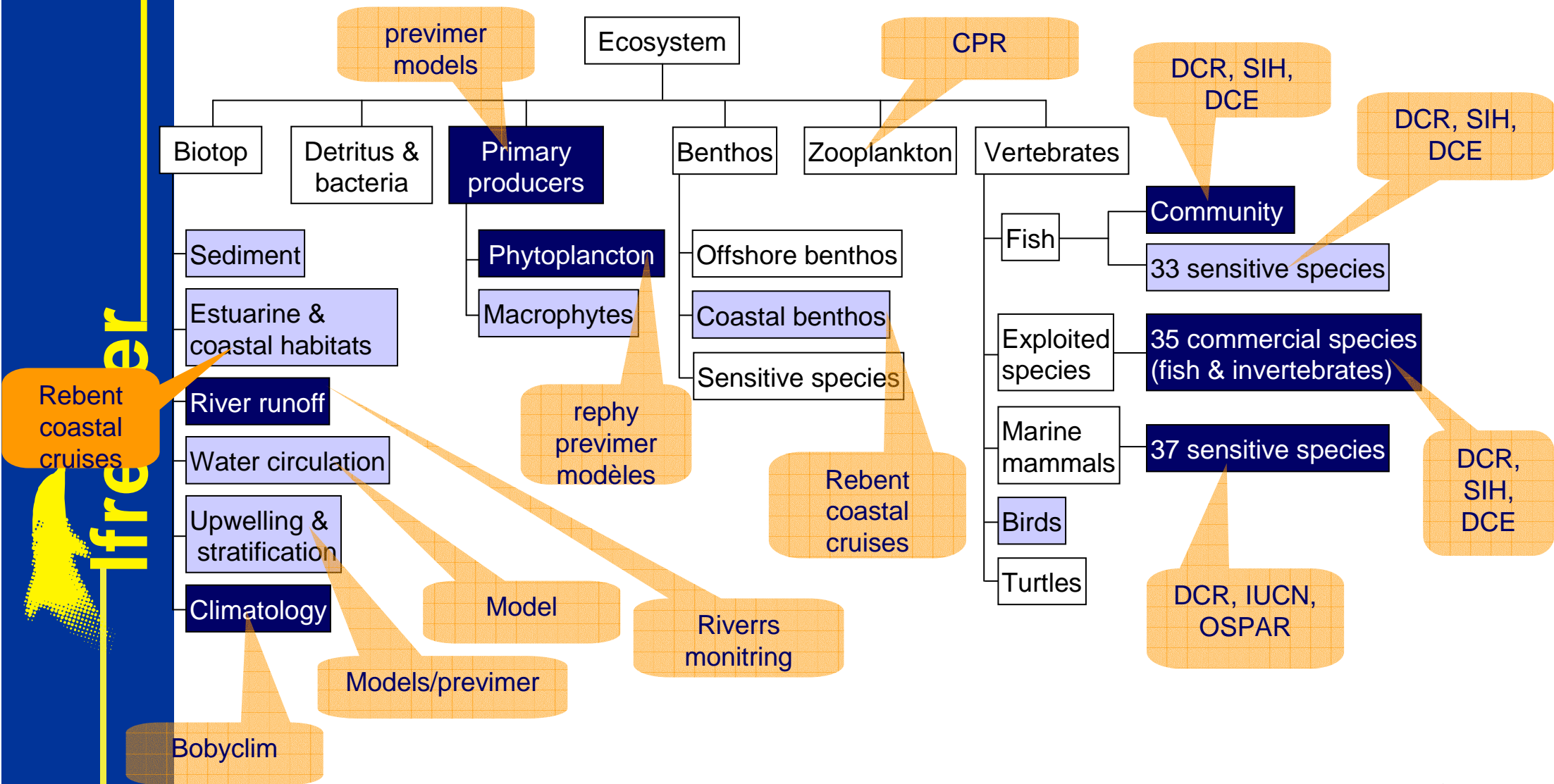
# Combination for all components



## Conclusion (1/2)

- **For several components, membership to the set «good environmental status» is close to 50%**
  - Assessments balance each other
  - Most components not assessed
- **Exploited species (the components which time series of indicators start from the 1990s) were on the impacted side**
- **Some (previously exploited) species were threatened (in the combination we did not weighted impacts as threaten/overexploited**
- **Human impact come from fishing (exploited species, sensitive marine mammals) but also from land-based activities (eutrophication of coastal ecosystems, contaminants..)**

# Conclusion (2/2)



# Remerciements

Remerciements

