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Small Journey around the vulnerability and viability of the coral reef heritage

Gilbert David

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Regional thematic school on the Vulnerability of Reef heritage DIDEM program

SMALL Journey around the vulnerability and viability of the coral reef heritage

Gilbert DAVID, IRD,
UMR Espace Dev, GDR LADIVA

June 10, 2024 – Blue Economy Research University of Seychelles



UNIVERSITY OF
SEYCHELLES
Knowledge hub of the Indian Ocean



Presentation of the journey

1. What means Heritage ?
2. Can the whole coral socio-ecological system act as heritage ?
3. The vulnerability of the coral reef heritage
4. Why should we reduce the vulnerability of coral reefs and how to do it?



What means *heritage* ?

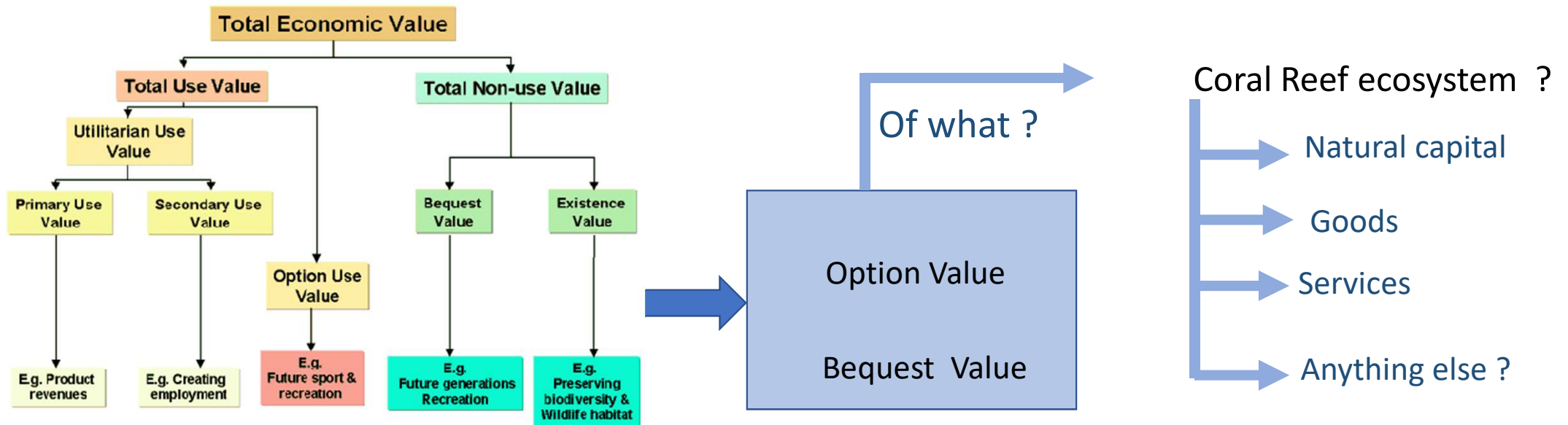
Places on Earth that are of outstanding universal value to humanity to be protected for future generations to appreciate and enjoy (UNESCO)

11

Value

Transferability to future generation

Places



Diapositive 3

I1

IRD; 03/06/2024

What about people ?



Users

With withdrawals from the natural capital and impacts on ecosystem services

Without withdrawals from the natural capital

Managers of the natural capital

No-Users

with representations of the reef (existence value)



Are they the human component of the coral reef social-ecological system ?

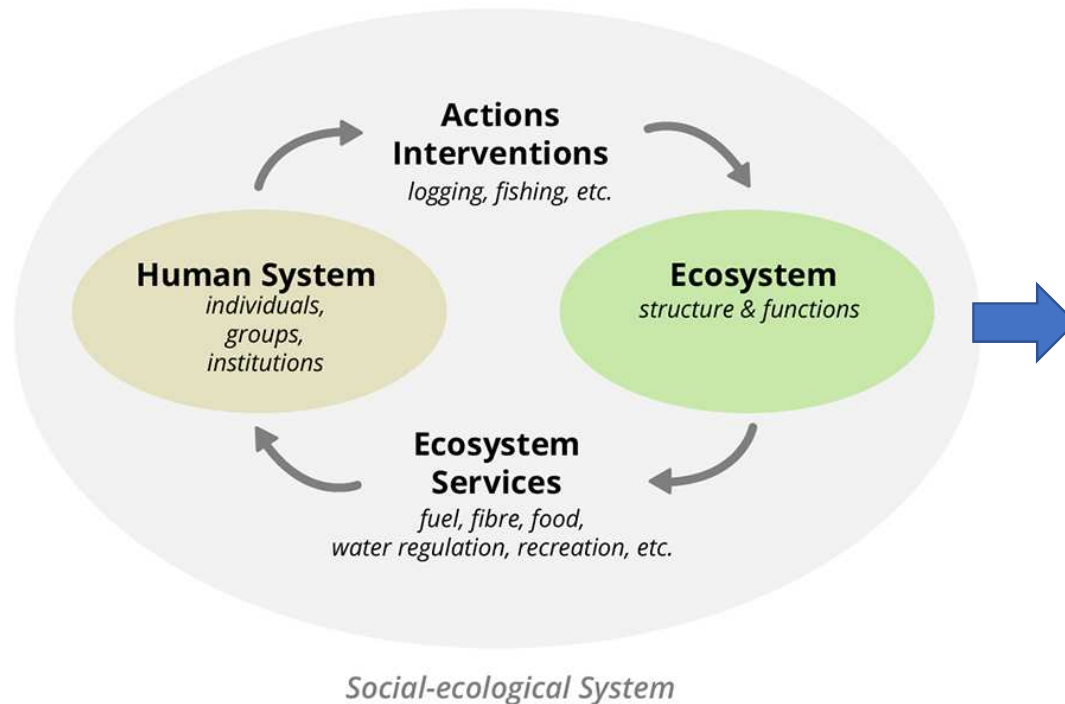
Can the whole coral socio-ecological system act as heritage ?



What means *socio-ecological system* ?

A bio-geo- physical unit and its associated social actors and institutions.

Social-ecological systems are complex adaptive systems in which people and nature are inextricably linked, in which both the social and ecological components exert strong influence over outcomes. The social dimension includes actors, institutions, cultures and economies, including livelihoods. The ecological dimension includes wild species and the ecosystem they inhabit (IPBES)



Does this definition works at all geographical scales ?



The proof of concept

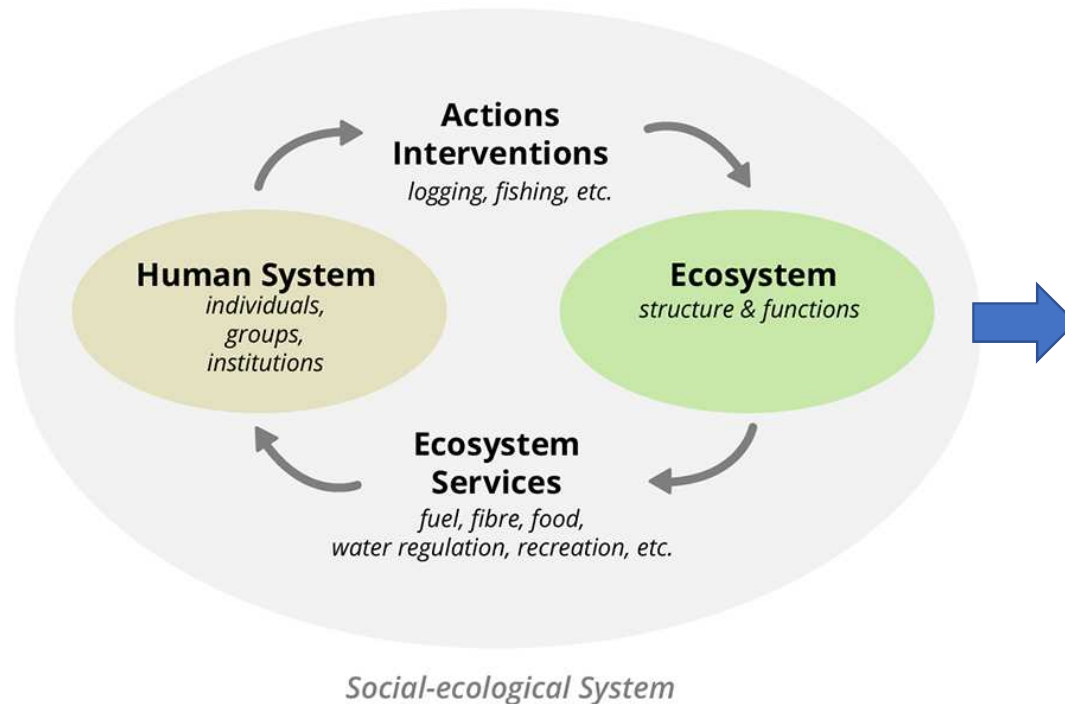
Lag Effects in the Impacts of Mass Coral Bleaching on Coral Reef Fish, Fisheries, and Ecosystems

NICHOLAS A. J. GRAHAM,*^{‡‡} SHAUN K. WILSON,*[†] SIMON JENNINGS,[‡]
NICHOLAS V. C. POLUNIN,* JAN ROBINSON,[§] JUDE P. BIJOUX,** AND TIM M.
DAW*^{††} **Conservation Biology, 2007**

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Abstract: Recent episodes of coral bleaching have led to wide-scale loss of reef corals and raised concerns over the effectiveness of existing conservation and management efforts. The 1998 bleaching event was most severe in the western Indian Ocean, where coral declined by up to 90% in some locations. Using fisheries-independent data, we assessed the long-term impacts of this event on fishery target species in the Seychelles, the overall size structure of the fish assemblage, and the effectiveness of two marine protected areas (MPAs) in protecting fish communities. **The biomass of fished species above the size retained in fish traps changed little between 1994 and 2005, indicating no current effect on fishery yields.** Biomass remained higher in MPAs, indicating they were effective in protecting fish stocks. Nevertheless, the size structure of the fish communities, as described with size-spectra analysis, changed in both fished areas and MPAs, with a decline in smaller fish (<30 cm) and an increase in larger fish (>45 cm). We believe this represents a time-lag response to a reduction in reef structural complexity brought about because fishes are being lost through natural mortality and fishing, and are not being replaced by juveniles. This effect is expected to be greater in terms of fisheries productivity and, because congruent patterns are observed for herbivores, suggests that MPAs do not offer coral reefs long-term resilience to bleaching events. Corallivores and planktivores declined strikingly in abundance, particularly in MPAs, and this decline was associated with a similar pattern of decline in their preferred corals. We suggest that climate-mediated disturbances, such as coral bleaching, be at the fore of conservation planning for coral reefs.

Extracts from this scientific paper

What are the consequences for reef fisheries? In Seychelles 50–60% of trap fishing effort occurs close to the shore and within the depth range of the data collected in this study, which **suggests that a future decline in biomass of target species will affect the trap fisheries.** Nevertheless, given that a substantial portion of trap fishing grounds lie on deeper shoals and submerged reefs of the Mahé Plateau, there is potential for a degree of **spatial mobility** in the fishery if declines in target-species biomass are restricted to the shallow fringing reefs...

Marine protected areas are not the only management tool available, however, and it is important to manage areas outside MPAs to minimize other stressors, such as overfishing and nutrient enrichment, to create conditions where a recovery may be possible if **brood stocks** are available

Comments

very attractive title **But**

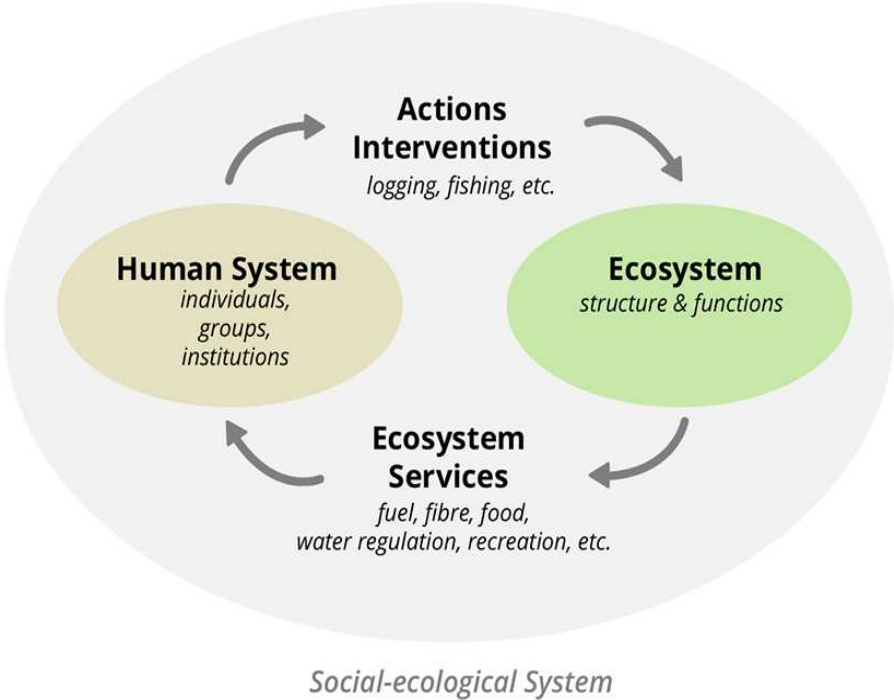
Poor information about the impact of coral bleaching on small scale fisheries

The spatial mobility of fishers suggests adaptive strategies

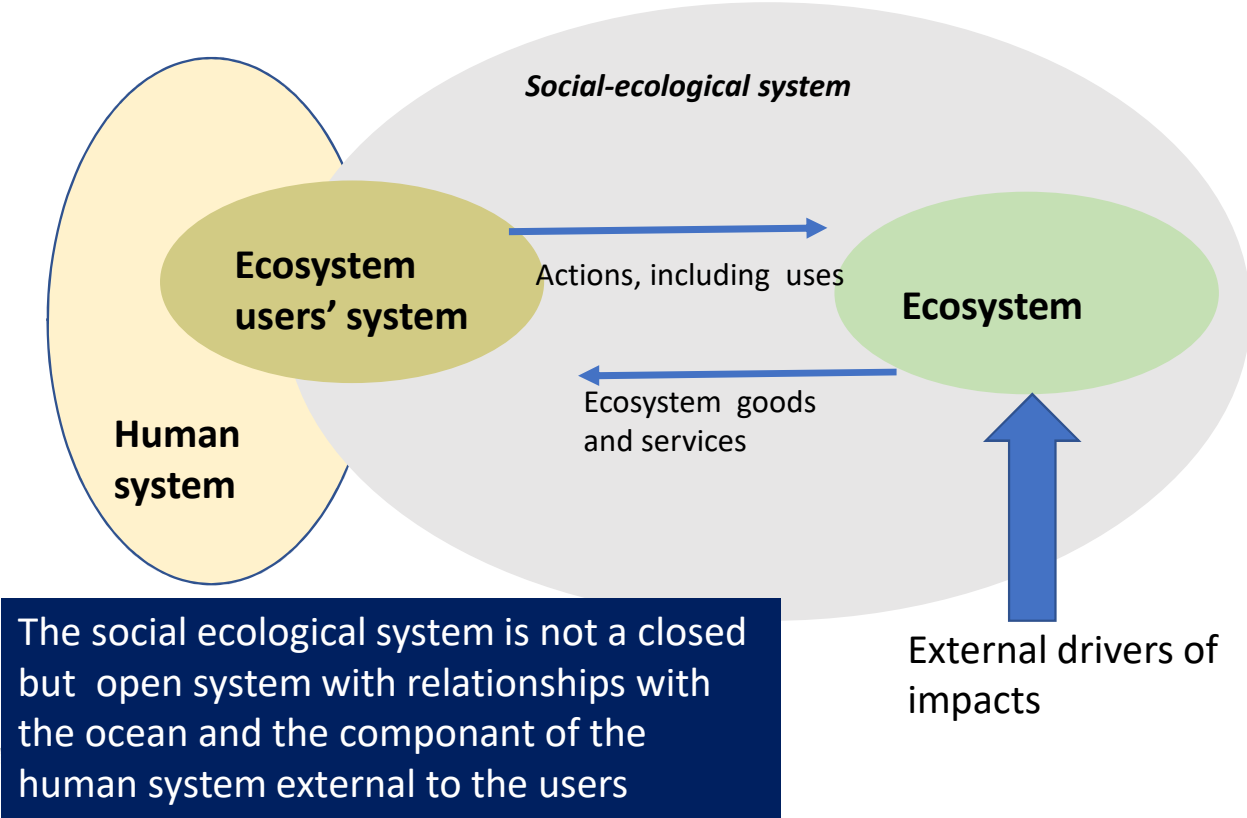
Does this IPBES definition of social-ecological system works at all geographical scales ?

- Very relevant at the global (world wide) scale
- Poor relevance at local scales → Problems of co-evolution between ecosystem and human system

What is expected!



What is observed!

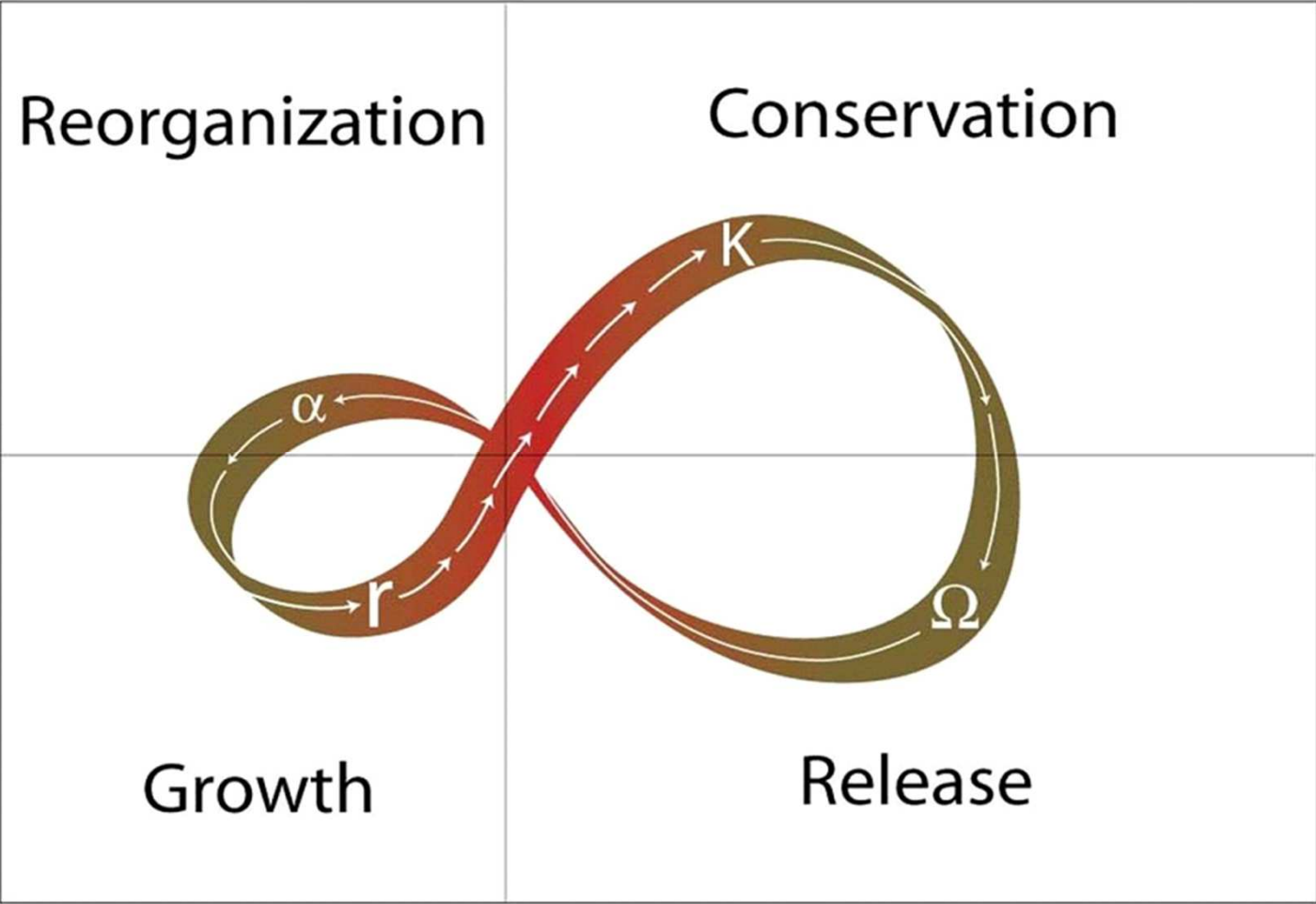


The social ecological system is not a closed but open system with relationships with the ocean and the component of the human system external to the users

Adapted from Resilience Alliance (2007) "Assessing and Managing Resilience in Social-Ecological Systems: Supplementary Notes to the Practitioners Workbook, Vol. 2"

System reorganization driven by its resilience

Stability, rigid structures and processes that conserve energy



Rapid accumulation (or exploitation) of resources and new reorganization in the system

Collapse of system structure and process.

The adaptative cycle as the evolution model of ecosystems and social systems

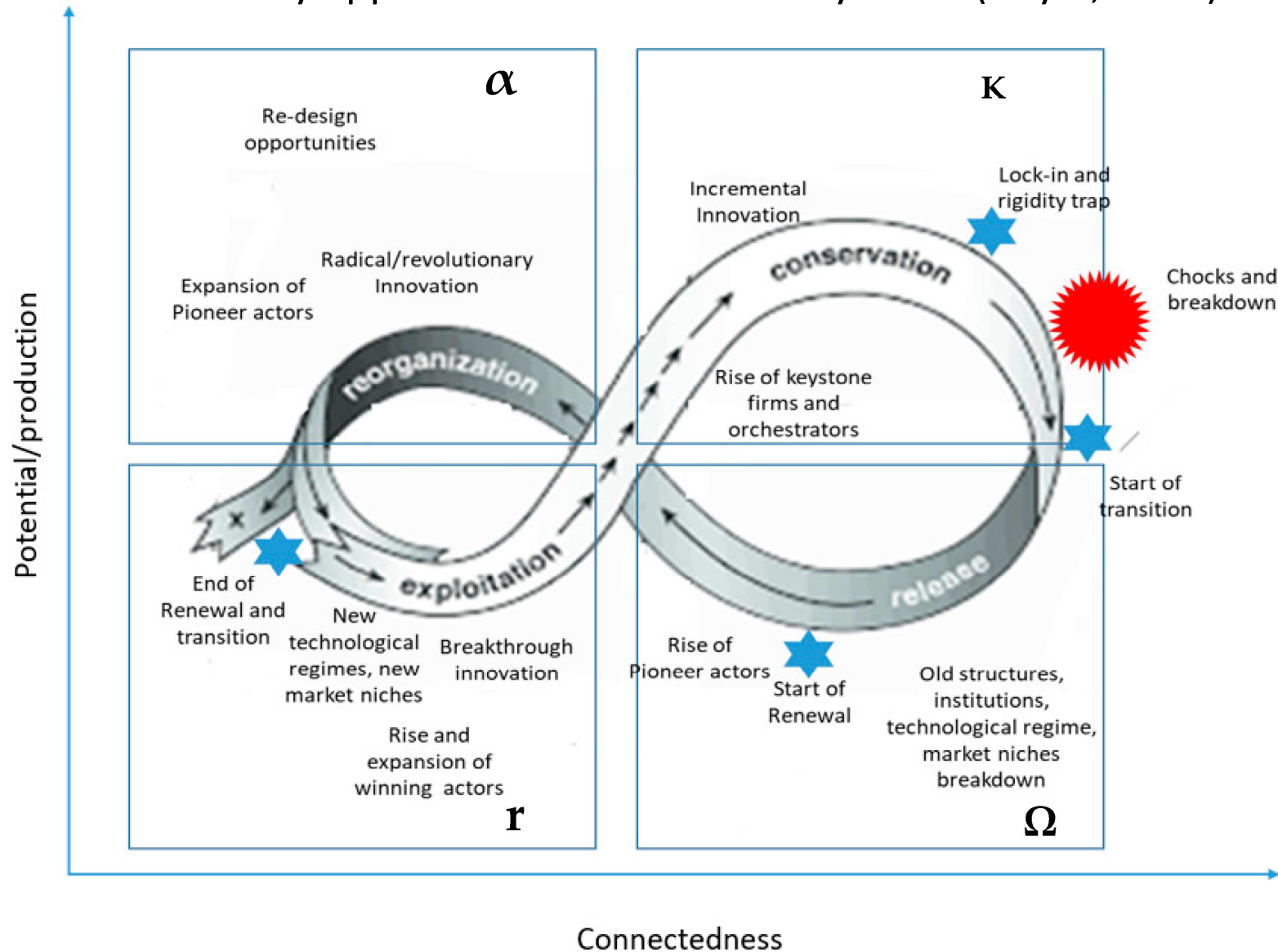
Main issues in terms of social-ecological systems:

- a) The temporal gap of resilience and resistance capacities between the ecosystem and the social system (ecosystem users),
- b) There are several temporal levels of resilience/resistance in human societies.

Ex 1. adaptation strategies in the event of cyclones, unit: the month.

Ex 2, recovery after a major disruption of the social system, unit: several human generations

Panarchy applied to Innovation “Ecosystem” (Boyer, 2020)

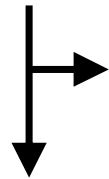


What part of the human system act as heritage ?



What means Place /Territory?

«The territory is a complex system, including not only urbanized, rural and other spaces, such as industrial lands, but also nature as a whole and the environment in which human beings live. It is the essential support and framework for the establishment and activity of man and therefore the basis of sustainable development» (13conf. European ministers responsible for regional planning)



The Territory: spatial support for public action and socio-economic processes of local development

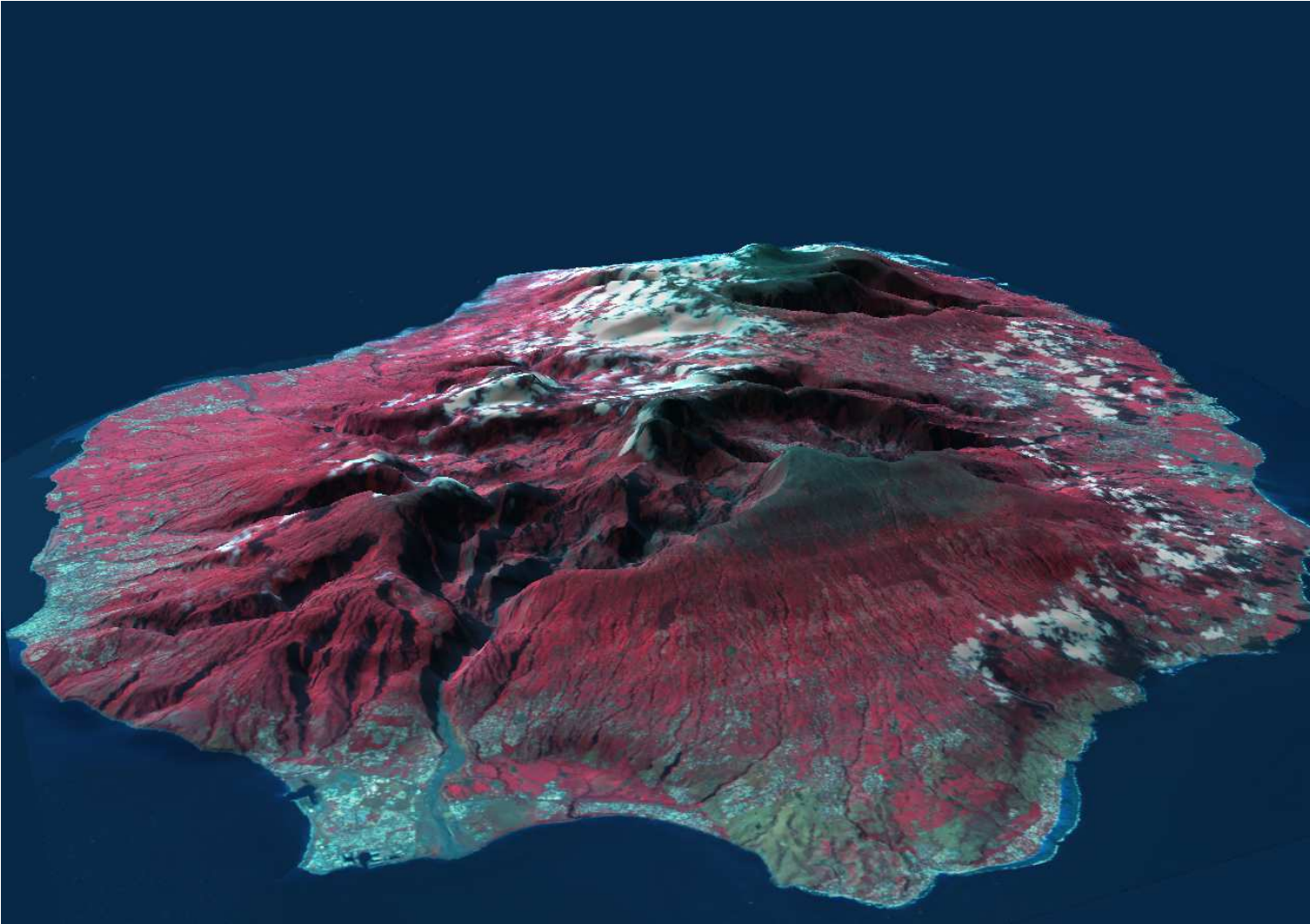
The Territory: support for natural heritage

« The territory is the portion of land surface appropriated by a social group to ensure its reproduction and the satisfaction of its vital needs » (Le berre, 1992)



The territory built by the stakeholders logics and representations

The Village territory, including coral reef, as heritage ?

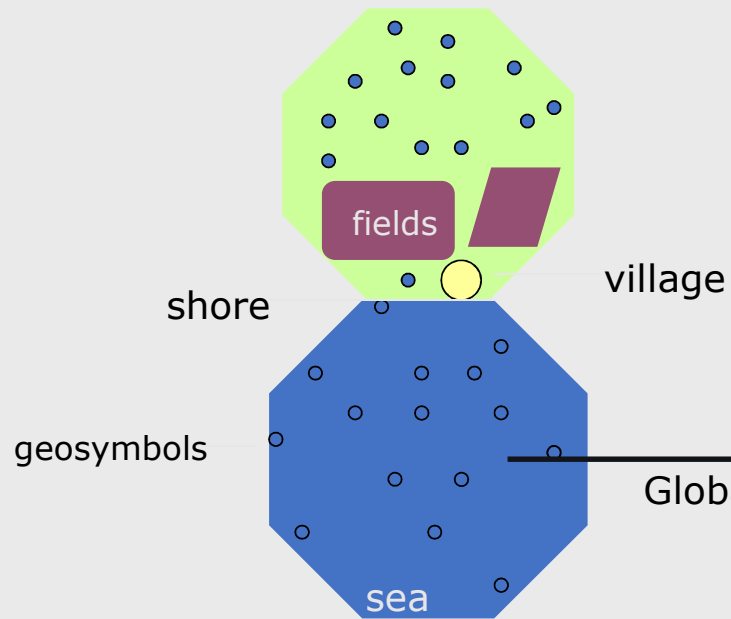


The village territory support of the coastal community viability,

Coral reef ecosystem, seashore ecosystems and inland ecosystems are parts of the village territory and major components of its viability.

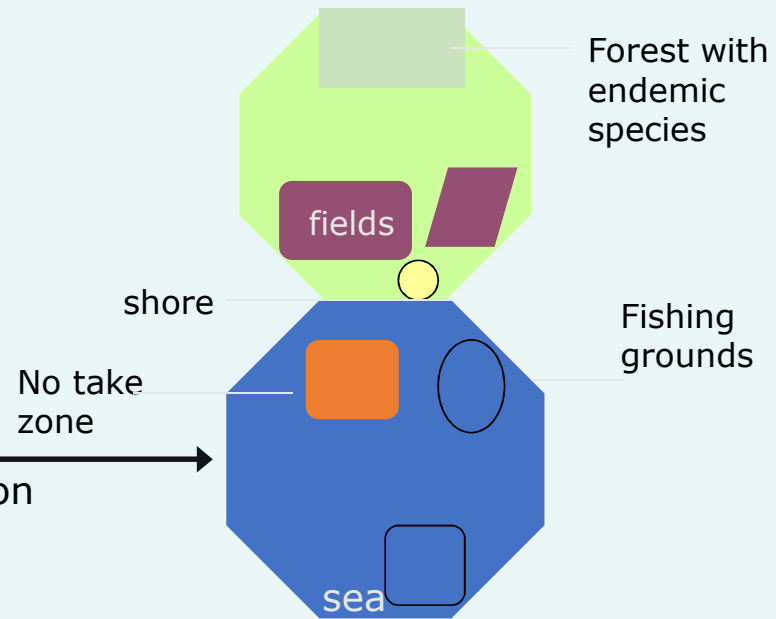
When differences in representation impose themselves on heritage management/governance

Nature is part of the familiar world, quoted by geosymbols, myths, beliefs, and endogeneous knowledge



The « traditionnal » coastal community

Nature is structured though outsider concepts (biodiversity, ecosystem), it is out of the familiar world



The community at the hour of globalization

Globalization

The Vulnerability of the coral reef heritage



Vulnerability

central concept in research question relating to:
the risk
livelihood and poverty
food security
climate change

=
Fuzzy and polysemous
concept

Vulnerability come from latin :

- *vulnus, vulneris* : the wound -*vulnerare* : to hurt

To be *vulnérable* means :

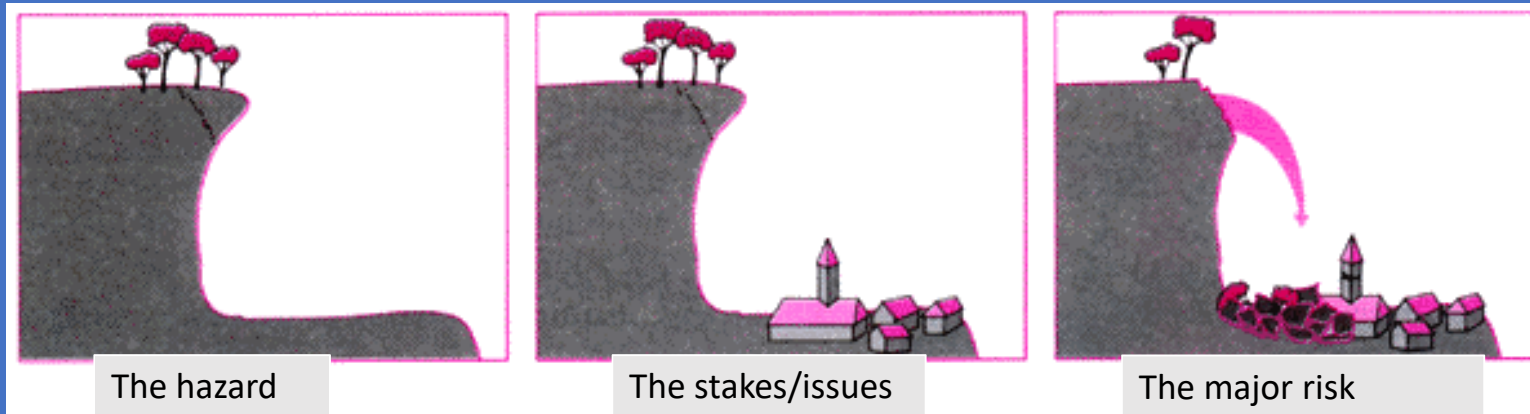
-Who is exposed to receiving injuries, blows

-Who is exposed to illness, who can serve as an easy target for an enemy's attacks

Three origins of the concept:

- Island studies from the 1990s, the concept of vulnerability succeeds to the viability one
- Study of living conditions and poverty
- Study of natural risks Risk: f (hazard, vulnerability). According to this logic, vulnerability corresponds to a degree of exposure to a hazard and to the potential damage of exposed elements.

Vulnerability according risk theories



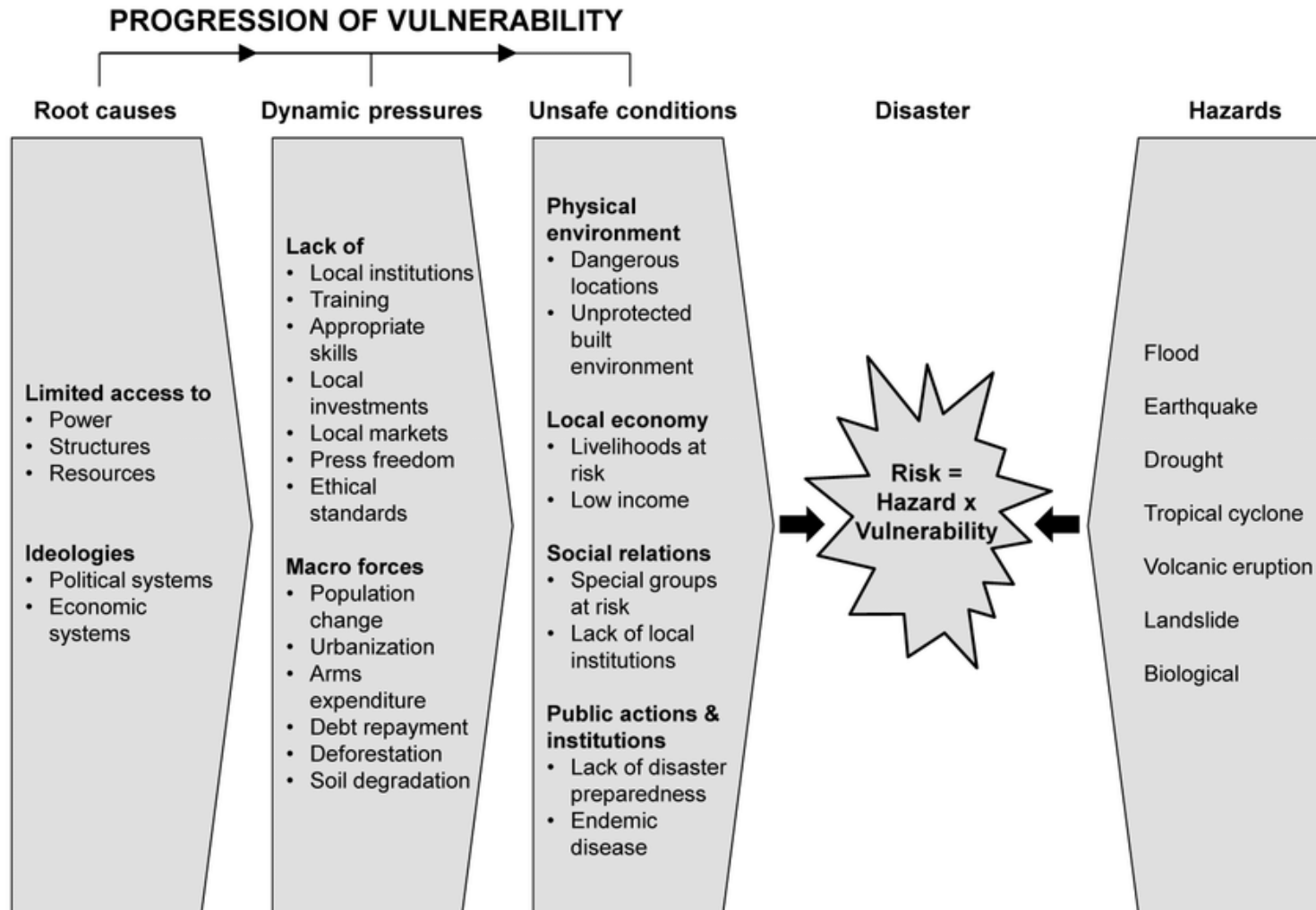
vulnerability = degree of exposure to a hazard + the potential damage to exposed elements.

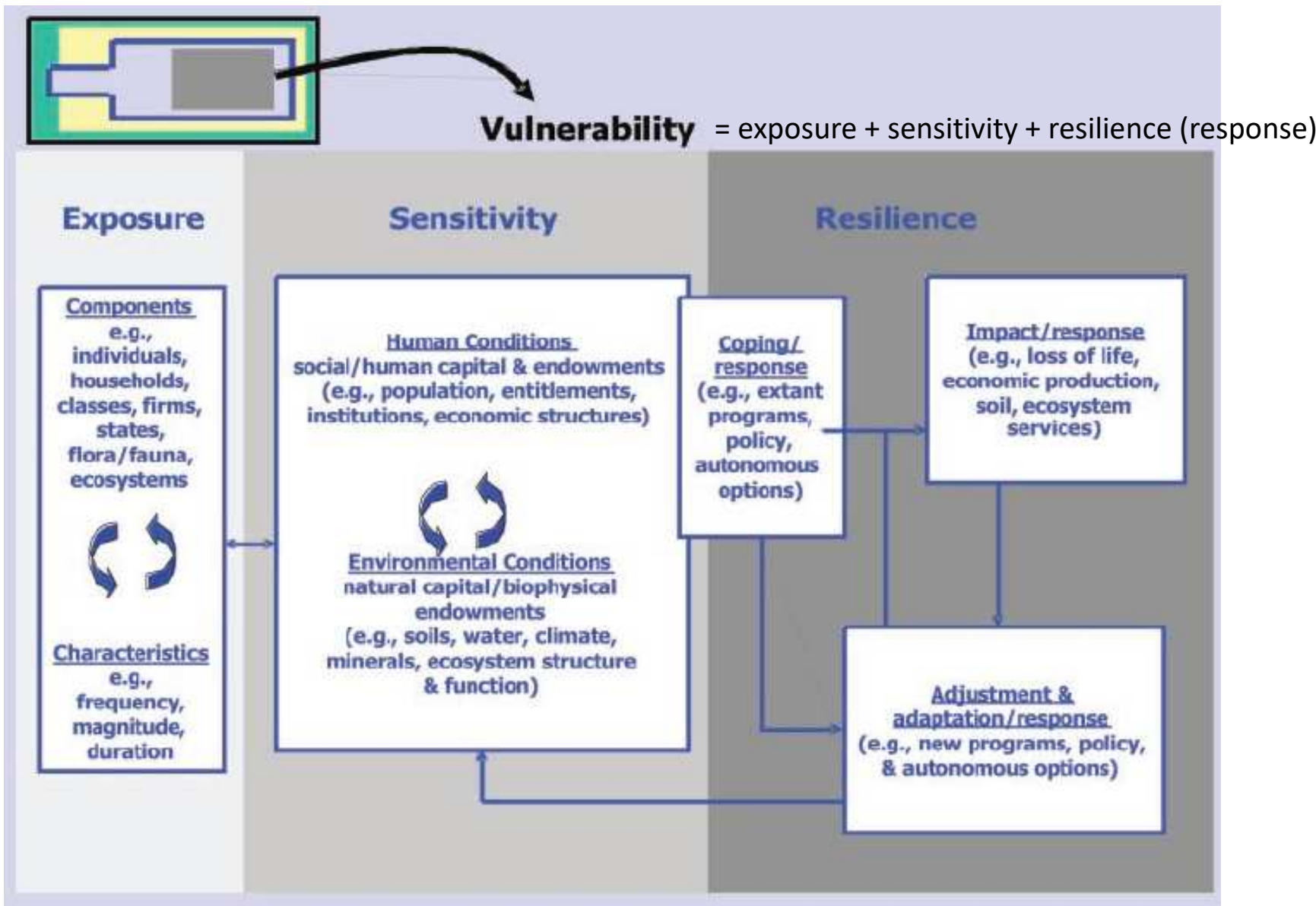
Risk: A potentially dangerous event - **hazard** - only becomes a risk if it applies to an area where human, economic or environmental **issues/stakes** are present (**vulnerable area**).

Vulnerability : *The degree to which a system, subsystem, or system component is likely to experience harm due to exposure to a hazard, either a perturbation or stress/stressor* » (Turner, 2003 ; Adger 2006)

For household economy approach (2008), Vulnerability = **Baselines** + Hazard + **Responses**

The baselines of vulnerability (Blaikie et al. 1994)

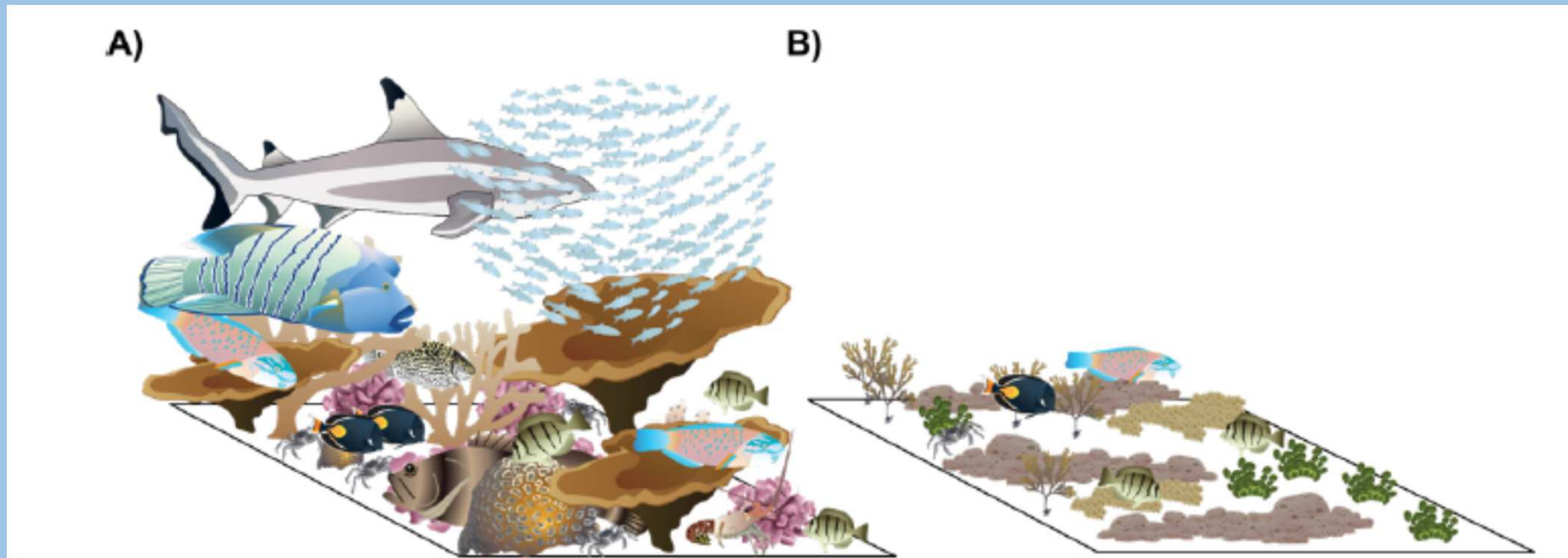




Turner et al., 2003

why should we reduce the vulnerability of coral reefs and how can we do it ?

Degradation of coral ecosystem → loss of biodiversity and productivity



Coral ecosystem showing a high diversity and productivity

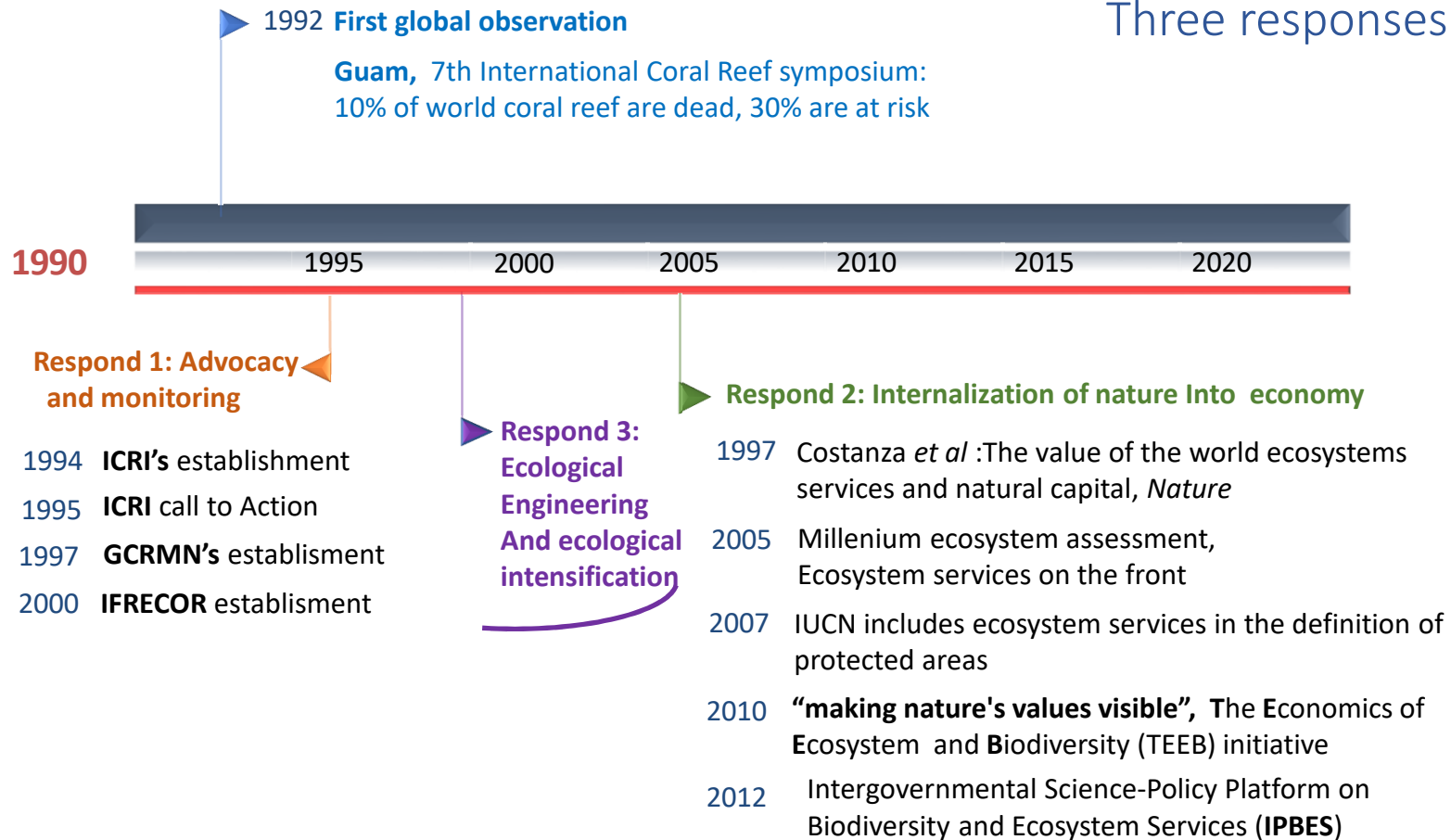
Degraded ecosystem, transition from a coral ecosystem to a new predominantly algal ecosystem

Small historical journey for reducing vulnerability

❖ Obvious fact : Continuous degradation of the reefs since 30 years

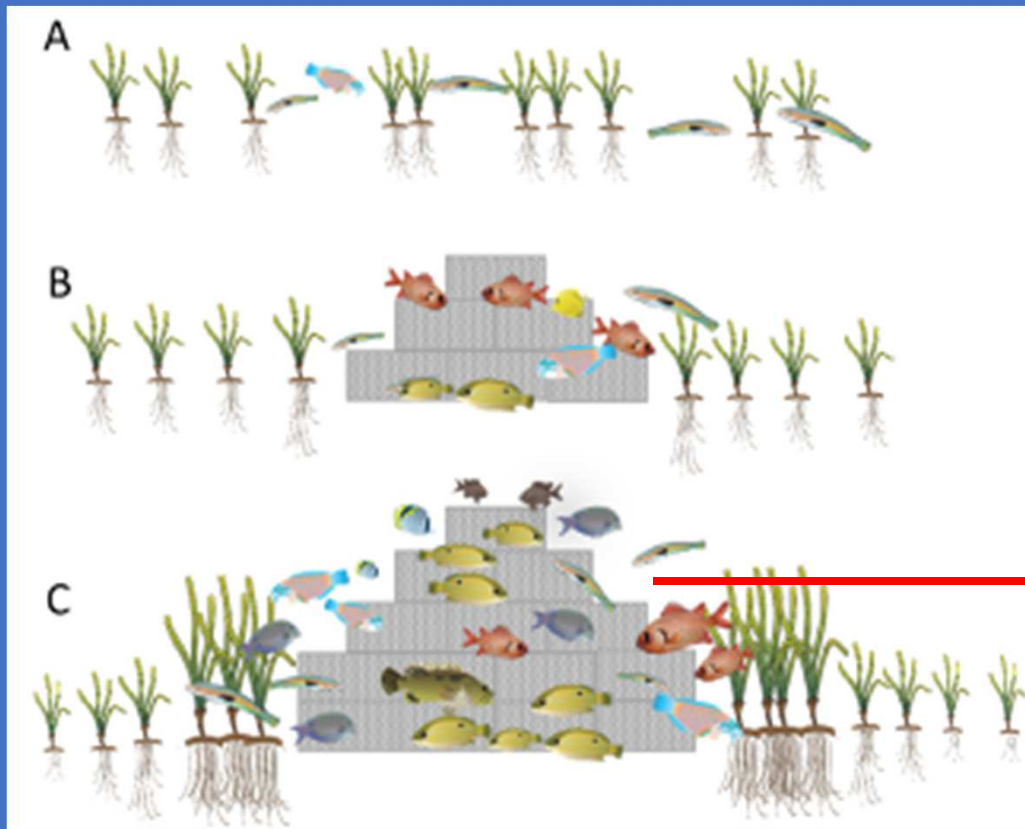


Three responses



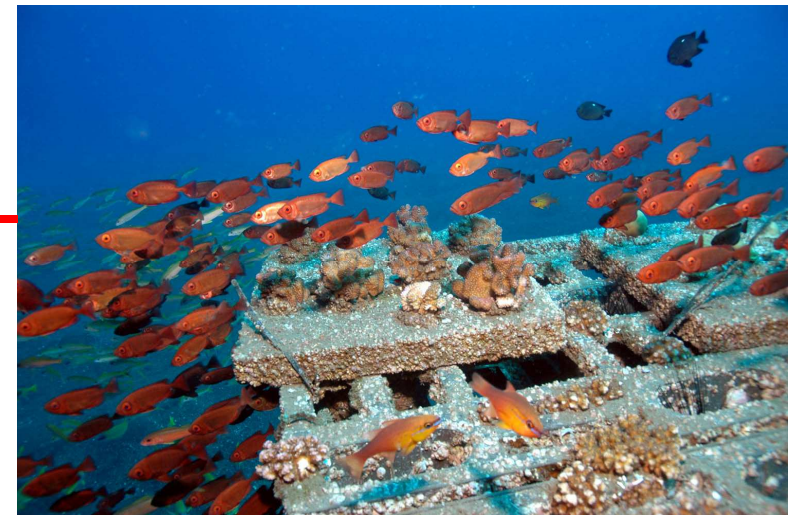
What means ecological intensification ?

Ecological intensification aims to better use the natural mechanisms or ecological processes of ecosystems to produce more efficiently, from available resources.

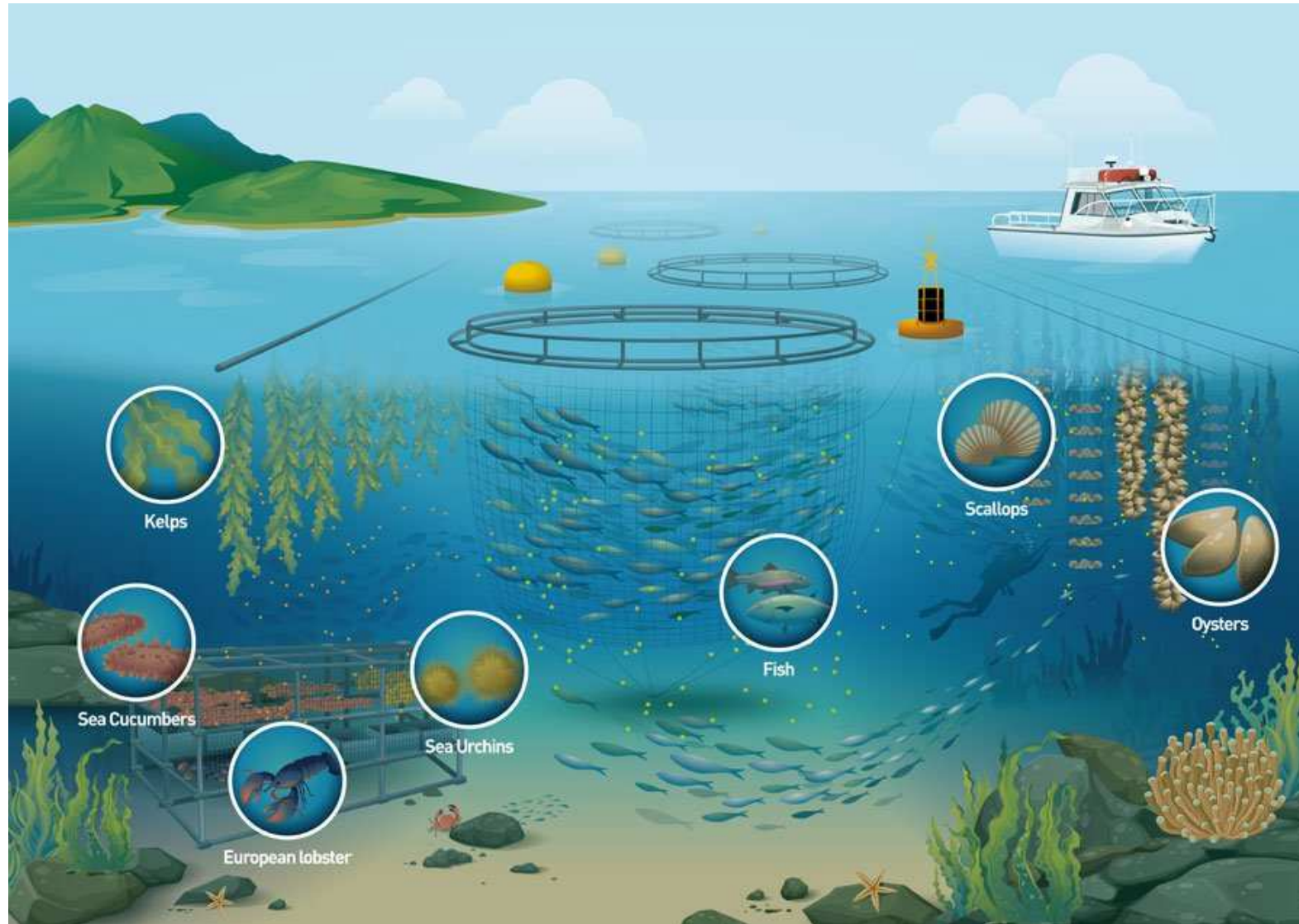


Example 1. The ampil fish project,
Haiti

Example 2. IMTA



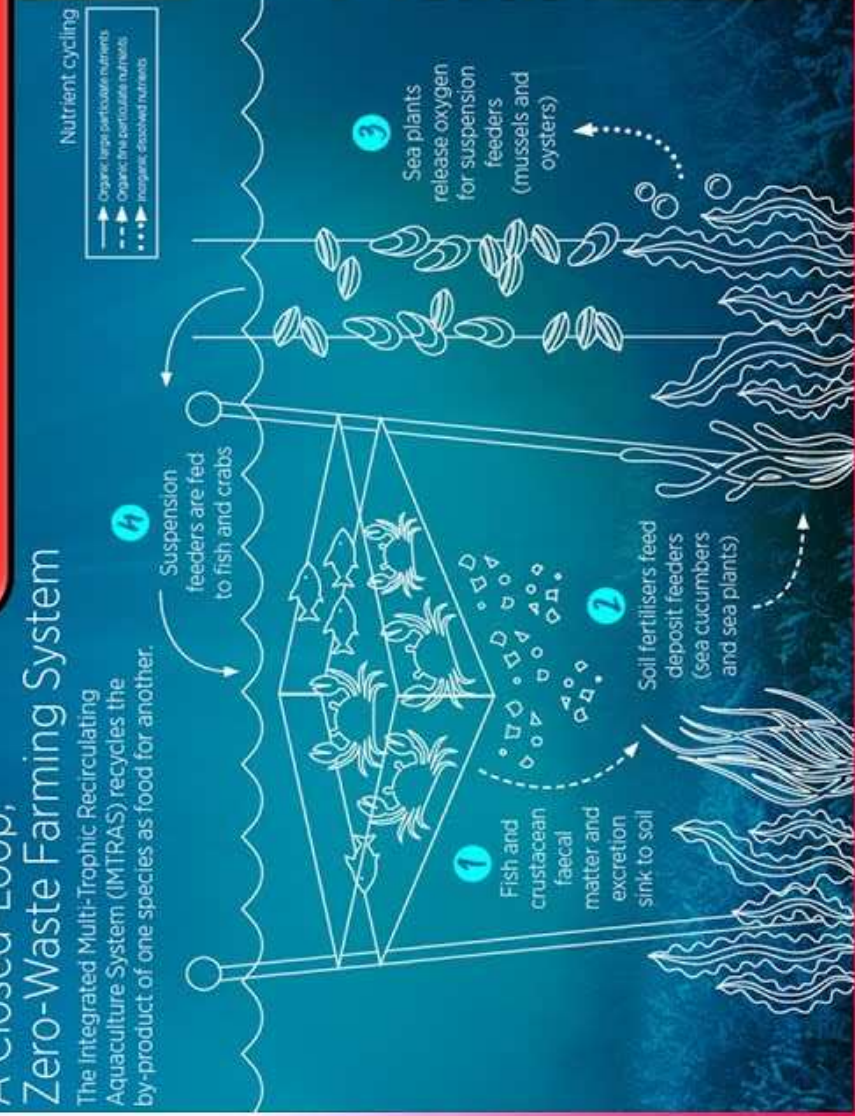
Example 2 Integrated Multi-Trophic aquaculture (ITMA)



IMTRAS SYSTEM

A Closed-Loop, Zero-Waste Farming System
 The Integrated Multi-Trophic Recirculating Aquaculture System (IMTRAS) recycles the by-product of one species as food for another.

INTEGRATED MULTI-TROPIC AQUACULTURE



Any Question ?

