Utilisation d'indicateurs pour évaluer l'état des communautés marines exploitées: le fil rouge

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Ifremer Nantes

Objective

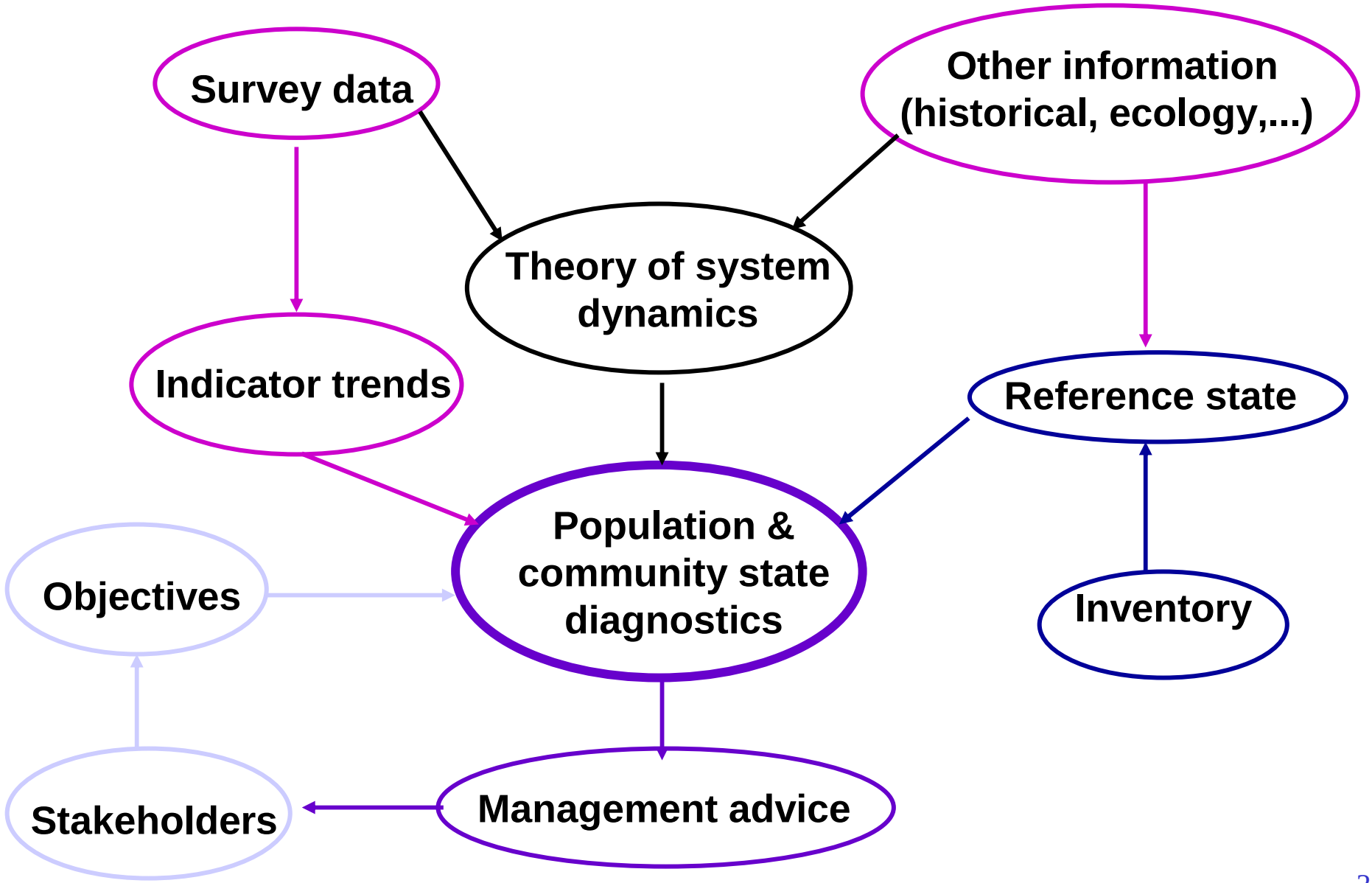
Assess the state of exploited marine communities to support sustainable exploitation and management

- **using time trends in indicators**
- **derived from survey data**

Indicator suitability and selection

- Rochet & Trenkel (2003) CJFAS 60: 86-99
- Trenkel & Rochet (2003) CJFAS 60: 67-85
- Rochet & Rice (2005) IJMS 62: 528 - 539
- Rice & Rochet (2005) IJMS 62: 516-527
- Shin et al (2005) IJMS 62: 384-396

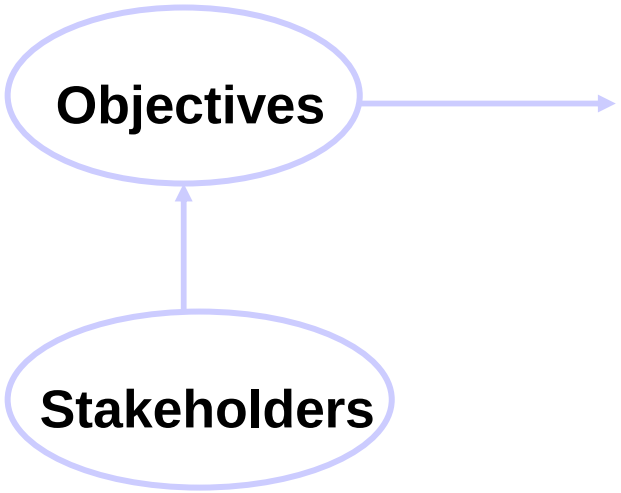
Approach

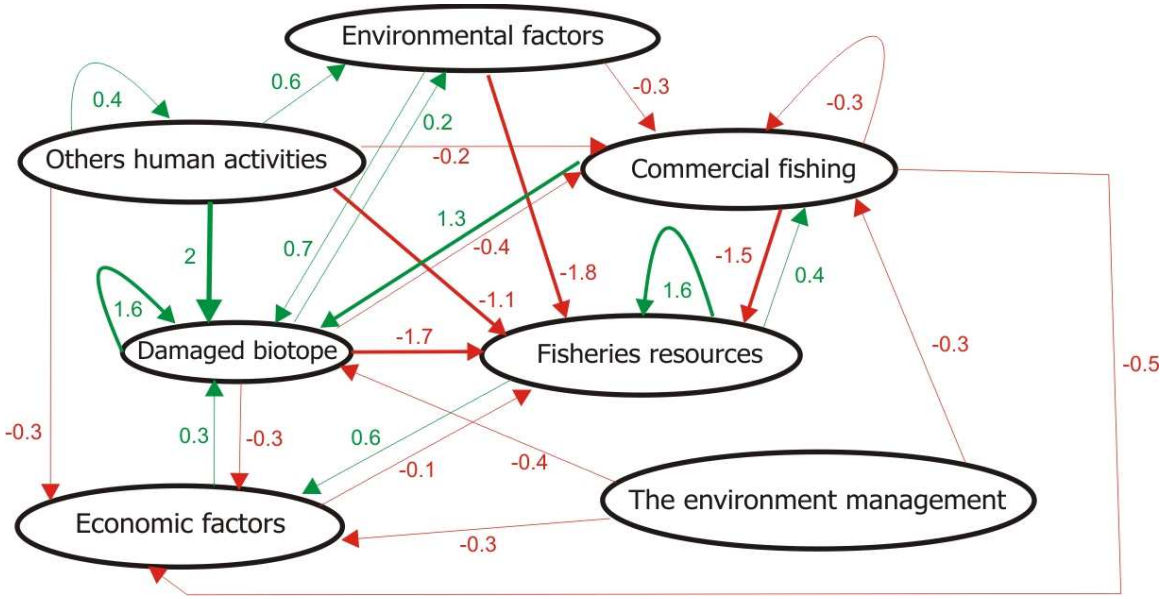

Survey data
Other information (historical, ecology,...)
Theory of system dynamics
Indicator trends
Reference state
Population & community state diagnostics
Objectives
Inventory
Stakeholders
Management advice

Management objectives

- **Common Fisheries Policy and Marine Strategy**
- **Cognitive maps for elucidating stakeholder objectives and views on ecosystem**

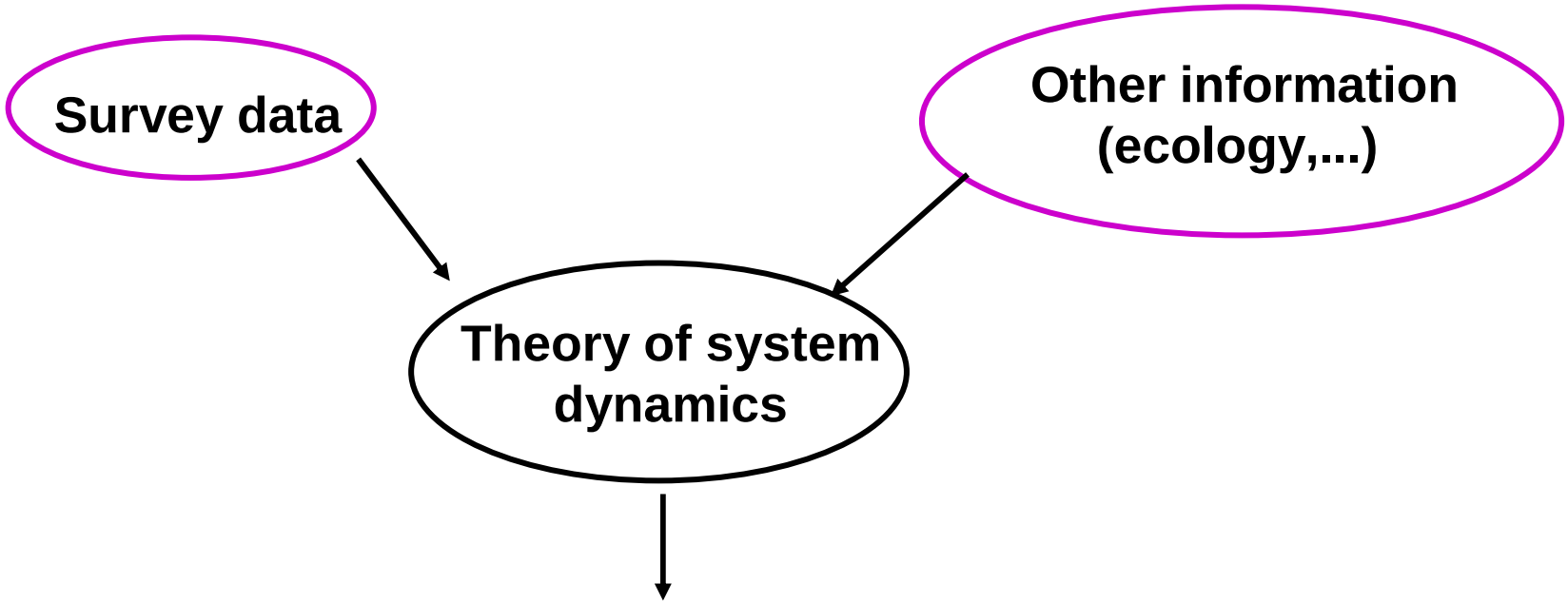
examples: Channel fishers and Western RAC





Prigent et al (2008) OCM 51: 450–462

Theory for using indicator trends



Objective: Interpretation of time trends in indicators

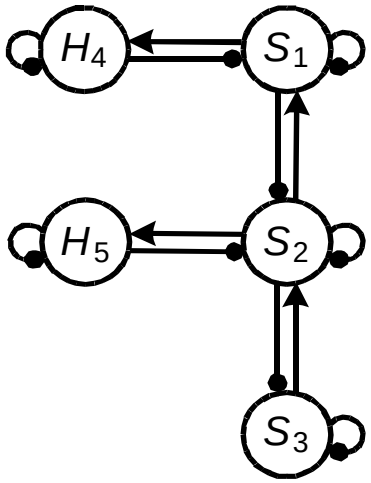
Theory of system dynamics: Populations

	Population indicators				
Cause	Z	ln-N	L_{bar}	$L_{25\%}$	$L_{75\%}$
↗ fishing mortality	↗	↘	↘	—	↘
↘ recruitment	—	↘	↗	↗	—
Faster growth	—	—	↗	—	↗
Smaller fish caught	↗	↘	↘	↘	—

Rochet et al (2005) IJMS 62: 516-527
Trenkel et al (2007) IJMS 64: 768-774

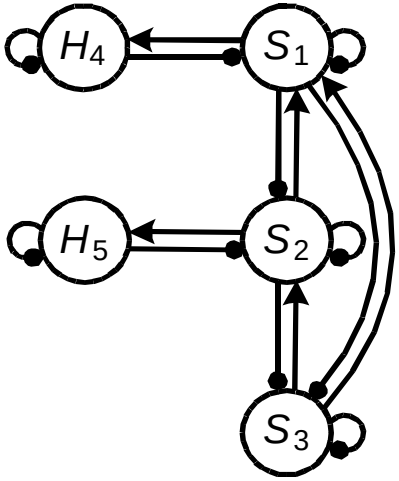
Theory of system dynamics: Community

Model A



core model

Model B



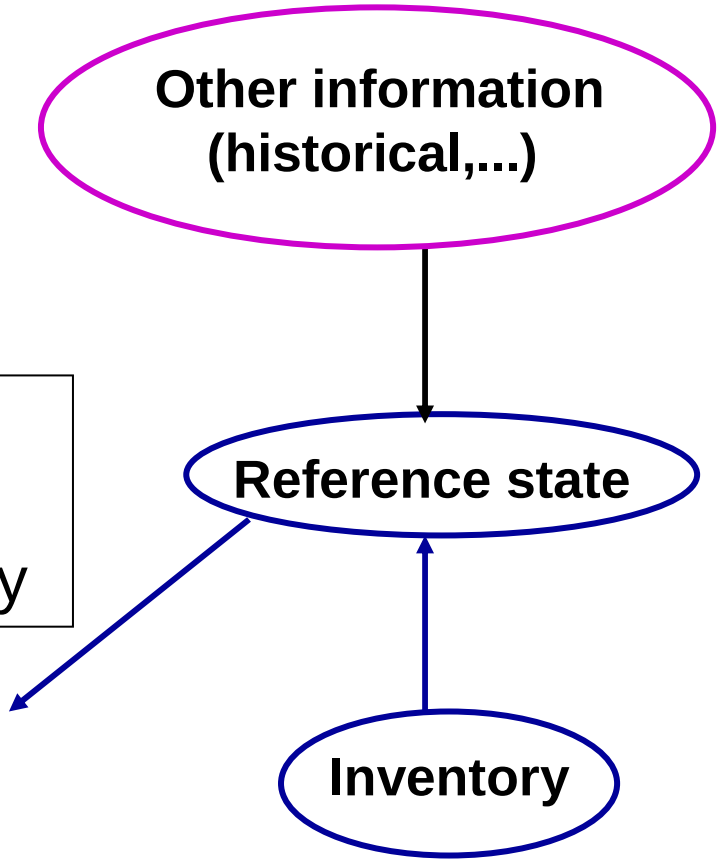
omnivory system

Use of qualitative modelling to determine expected change of population and assemblage indicators to various pressures

	Pressure		
Response variable	Increased q of S_1 by H_4	Increased pro-ductivity of S_3	Increased effort for H_5
Abundance			
S_1	–	+	A – (B?)
S_2	+	A+ (B?)	–
Mean size			
S_1	A – (B?)	–	A+ (B?)
S_2	A+ (B?)	–	–

Theory: Dambacher et al (in press) Fish & Fisheries
Empirical validation: Rochet et al. in prep

Reference state

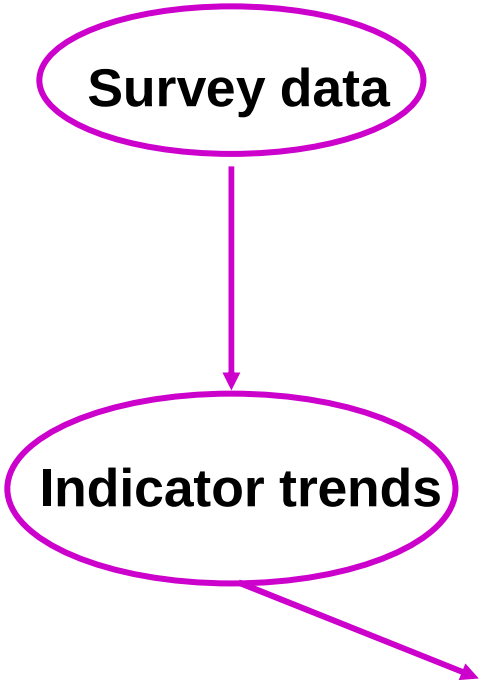


Friday 9:00
Lorance et al: Assessing the reference state in the Bay of Biscay

Objective: Determine state of health of the community at the beginning of the survey time series

Lorance et al ALR special issue

Indicator time trends

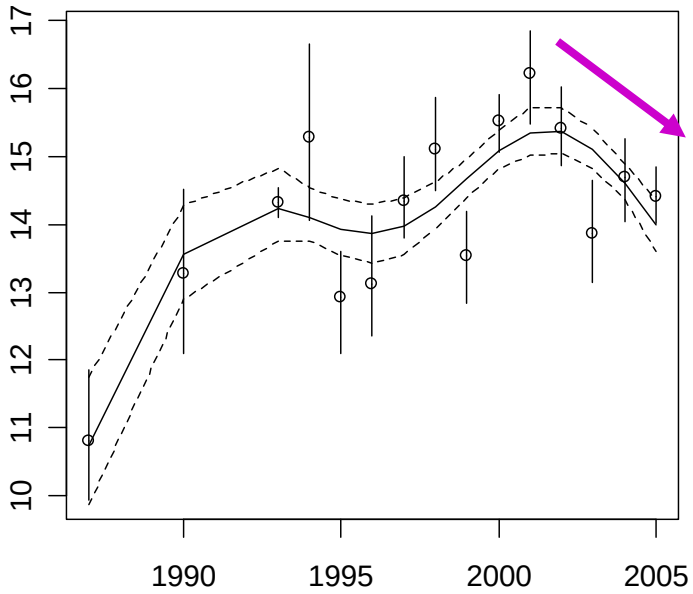


Objective: Determine temporal changes in indicator time series

Methods for determining time trends

1. **Long term trends: linear regression**
2. **Recent short term trends: GAM model with inter-section union test**

Hyperoplus lanceolatus



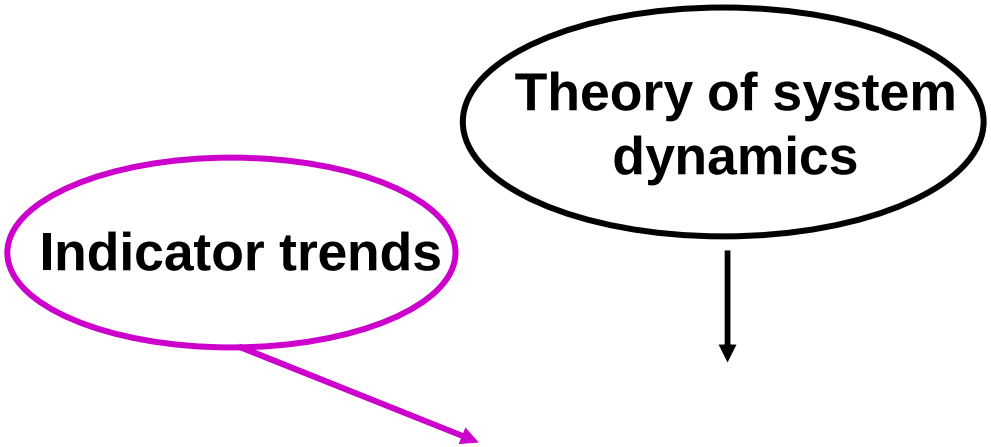
Significant recent decrease if:

C1: the maximum smoothed indicator value is not found within the most recent *n* years, and
C2: all annual slopes ≤ 0, for *t* = T-n+1,…T

n= 3 - 5

Trenkel & Rochet 2008 Ecol Ind

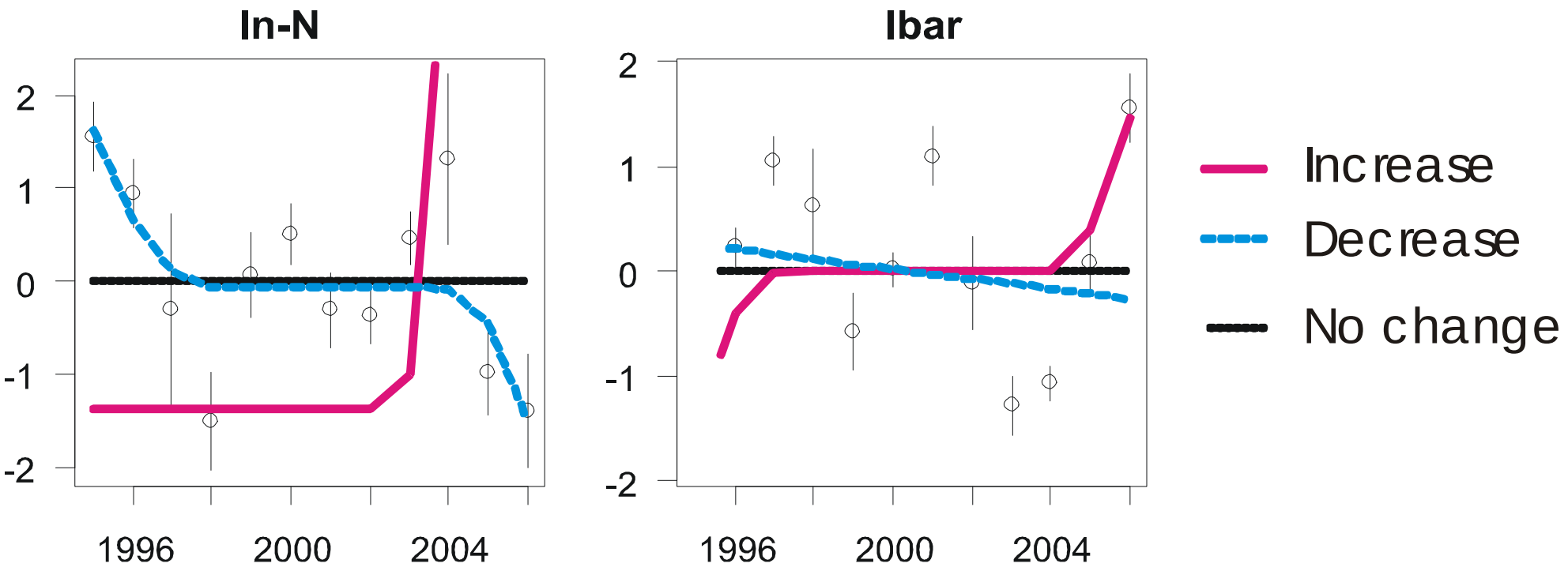
Causes for changes



Objective: Combine indicators to determine possible causes for joint indicator time trends

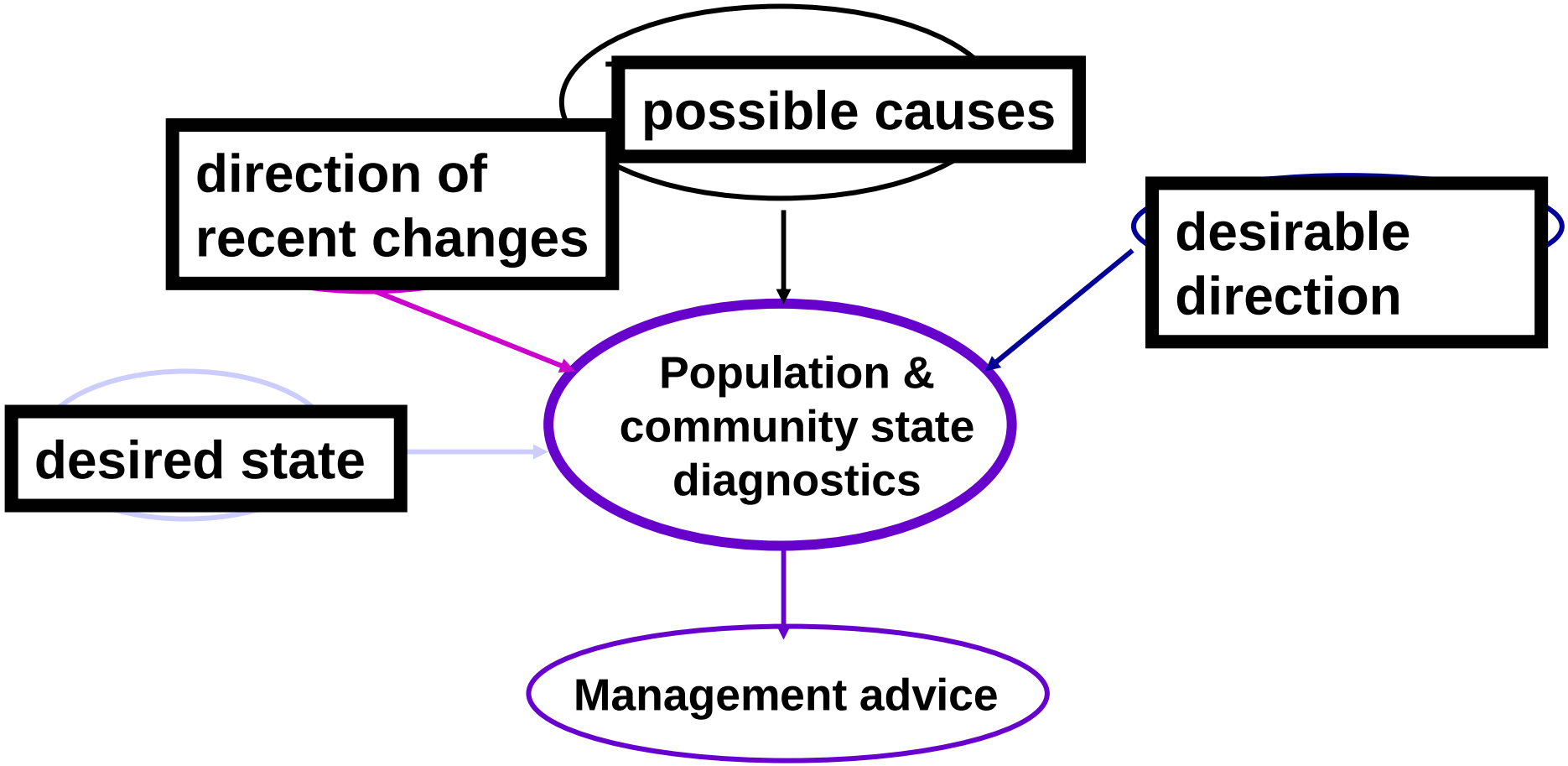
Methods for combining indicators

1. **Separate trend tests per indicator**
2. **Model based approach, selecting trend combinations with highest likelihood**



Trenkel & Rochet in prep

Diagnostic


possible causes
direction of recent changes
desirable direction
desired state
Population & community state diagnostics
Management advice

Management advice

Proposed measures

- **ΔF**
- **ΔTAC**
- ***status quo***
- **No recommendation possible**

Table 1. Expected effects of different causes on a fish population and fishing pressure (f) indicators and possible management measures for counterbalancing changes, depending on impacted and satisfactory reference states and changes in fishing pressure.

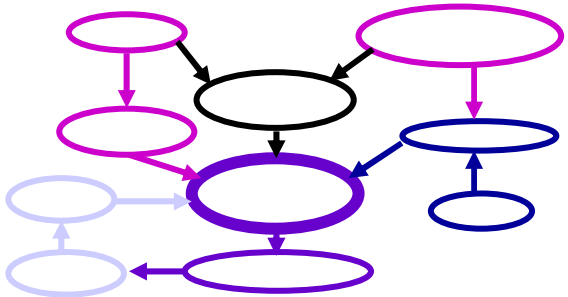
Dominant cause	Z	ln(N)	$\bar{L}$	$L_{25\%}$	$L_{75\%}$	Other	Management measures	
							Reference state impacted or f increasing	Reference state satisfactory and f not increasing
↗ Fishing mortality	↗	↘	↘	—	↘	f↗	$-\Delta F$, reduction in overall fishing mortality	$-\Delta F$
↘ Fishing mortality	↘	↗	↗	—	↗	f↘	*Status quo*	$+\Delta F$, increase in fishing mortality possible
↗ Recruitment	—	↗	↘	↘	—	R↗	*Status quo*	$+\Delta$TAC, increase in TAC possible
↘ Recruitment	—	↘	↗	↗	—	R↘	$-\Delta$TAC, reduction in TAC	$-\Delta$TAC
Faster growth	—	—	↗	—	↗	W_{age}↗	ΔS: increase selectivity to larger sizes	ΔS
Slower growth	—	—	↘	—	↘	W_{age}↘	*Status quo*	ΔS, selectivity could be decreased to smaller sizes
↘ Population overlap with survey area	↗	↘	—	—	—	ΔCG	No recommendation possible	No recommendation possible
↗ Population overlap with survey area	↘	↗	—	—	—		No recommendation possible	No recommendation possible
No change	—	—	—	—	—	None	$-\Delta$TAC or $-\Delta F$, reduction in fishing pressure	*Status quo*

Z, total mortality; ln(N), log-transformed total abundance; $\bar{L}$, mean length; $L_{25\%}$ and $L_{75\%}$, length distribution quartiles; R, recruitment; W_{age}, weight-at-age; CG, spatial centre of gravity, Δ, change; —, no trend; ↗, increasing; ↘, decreasing.

Trenkel et al (2007) IJMS 64: 768-774

Conclusions

- Many building blocks developped for indicator based ecosystem assessment and management



- Currently only ecological indicators, future work to include socio- and economical indicators, but also other ecosystem components