Diagnosis of the ecosystem impact of fishing and trophic interactions between fleets: a Mauritanian application

Beyah Meissa (IMROP, Mauritania)

Didier Gascuel (Agrocampus Ouest, France)

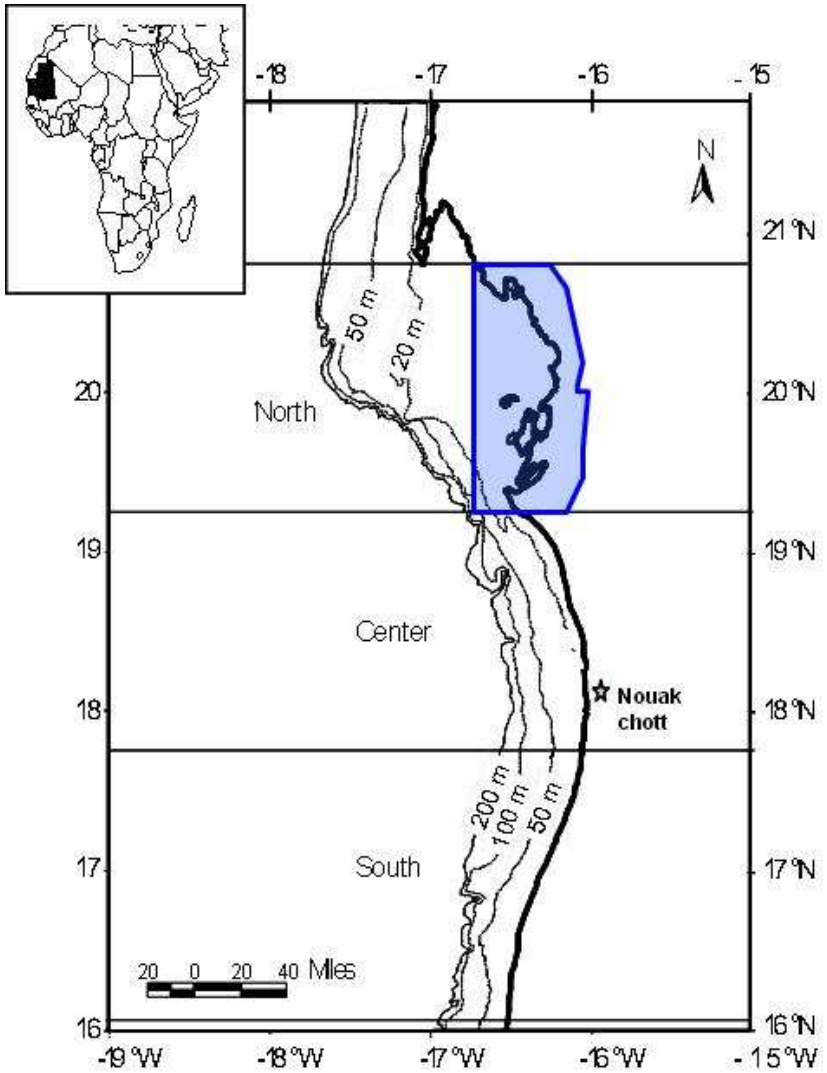
Sylvie Guénette (EcOceans, Canada)

Introduction

- The Mauritanian EEZ: a highly productive zone
- The Banc d'Arguin National Park: a large MPA (6 300 km^2)

➢ A first EwE model (Guénette et al. 2014) to evaluate the contribution of the Banc d'Arguin to the trophic functioning of the Mauritanian shelf

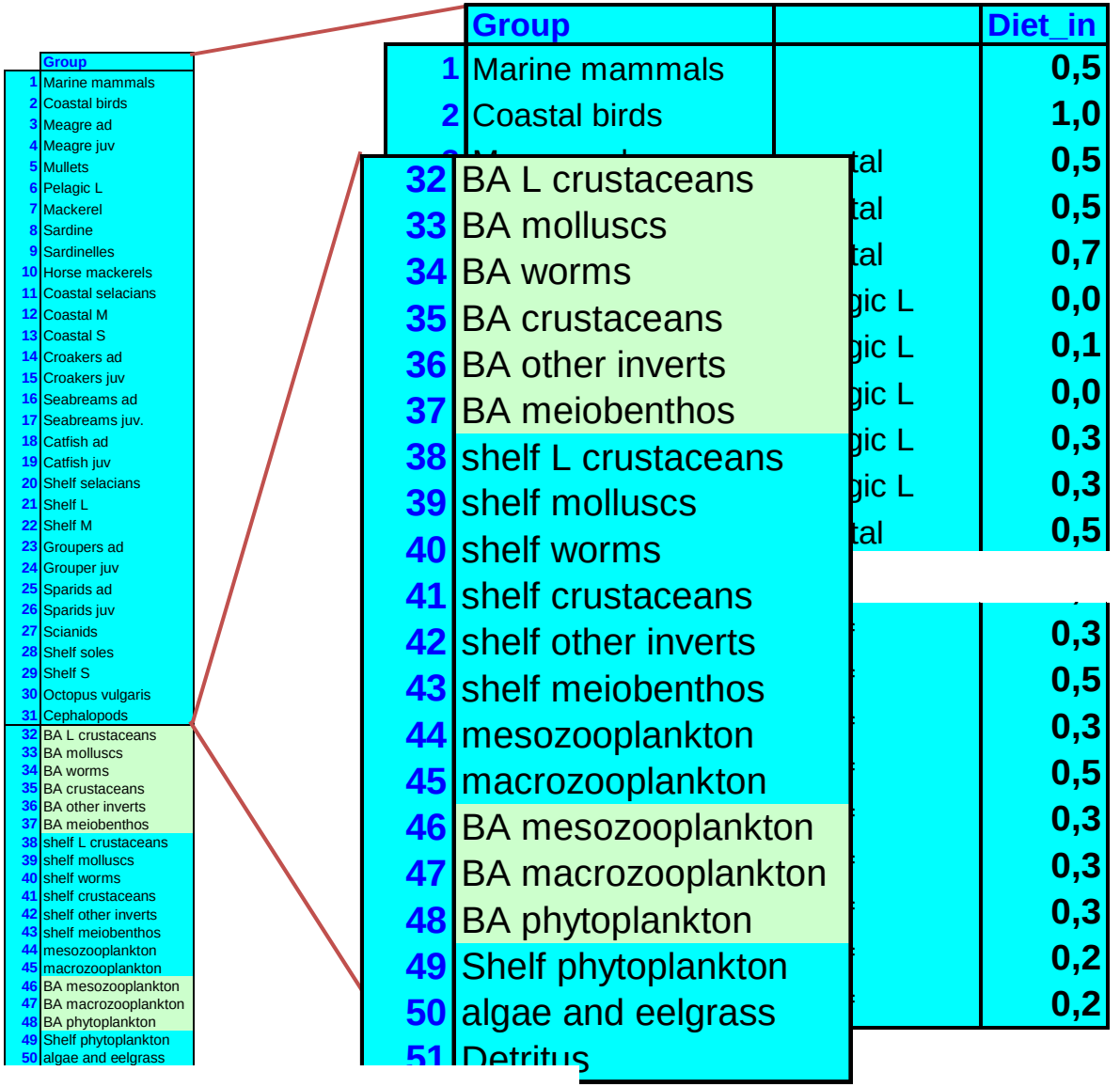
➢ Here: an update of the model, and an EcoTroph application to assess the fishing impact of the food web and interactions between fleets



Method

- An Ecopath model
  - for the whole Mauritanian EEZ, in 2010
  - 51 trophic groups
  - All invertebrates groups are split in two sub-groups: in/out the Banc d'Arguin

Tracing the trophic flow produced in the Banc d'Arguin, trough the food-web

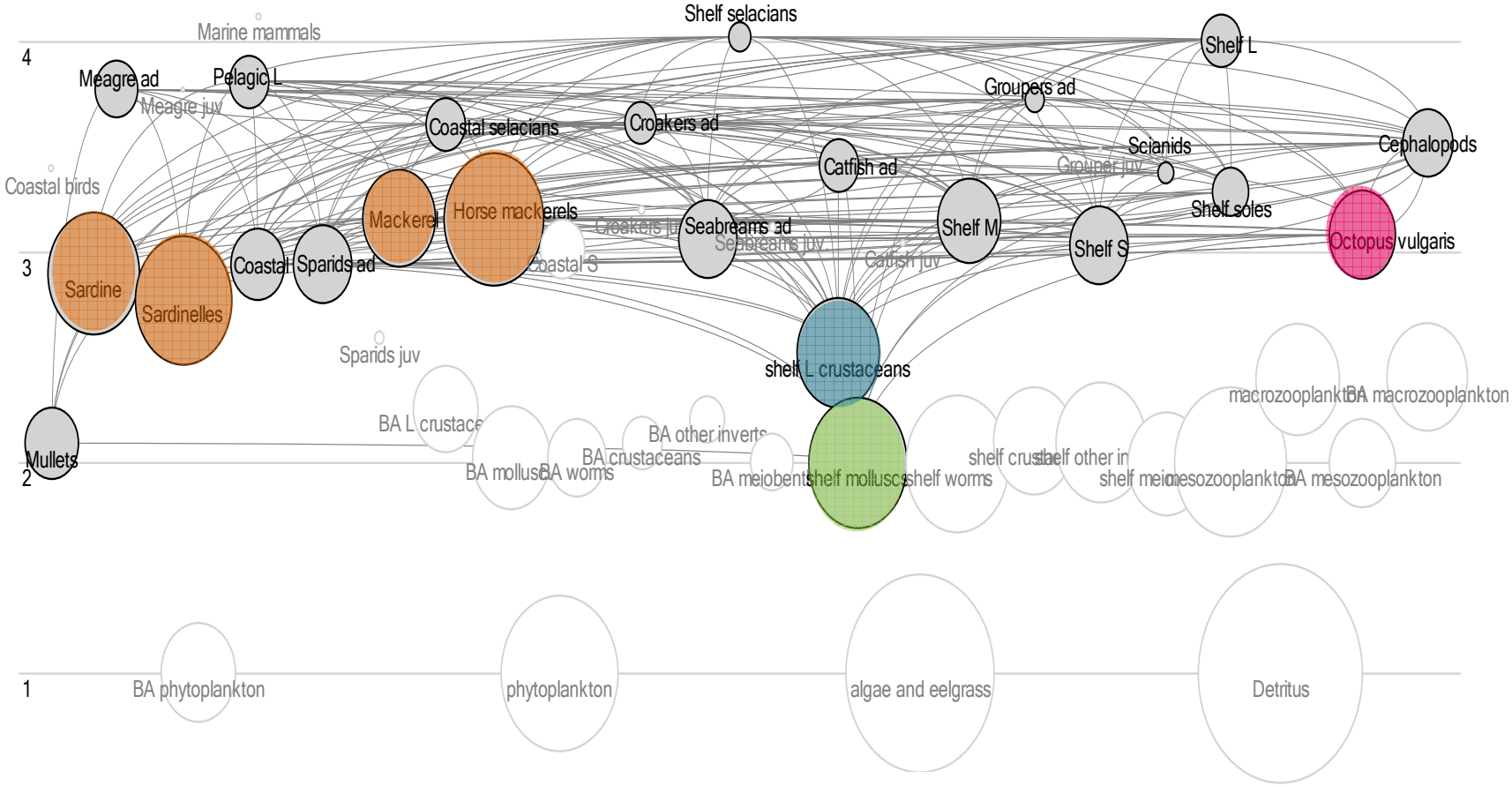


	Group
1	Marine mammals
2	Coastal birds
3	Meagre ad
4	Meagre juv
5	Mullets
6	Pelagic L
7	Mackerel
8	Sardine
9	Sardinelles
10	Horse mackerels
11	Coastal selacians
12	Coastal M
13	Coastal S
14	Croakers ad
15	Croakers juv
16	Seabreams ad
17	Seabreams juv.
18	Catfish ad
19	Catfish juv
20	Shelf selacians
21	Shelf L
22	Shelf M
23	Groupers ad
24	Grouper juv
25	Sparids ad
26	Sparids juv
27	Scianids
28	Shelf soles
29	Shelf S
30	Octopus vulgaris
31	Cephalopods
32	BA L crustaceans
33	BA molluscs
34	BA worms
35	BA crustaceans
36	BA other inverts
37	BA meiobenthos
38	shelf L crustaceans
39	shelf molluscs
40	shelf worms
41	shelf crustaceans
42	shelf other inverts
43	shelf meiobenthos
44	mesozooplankton
45	macrozooplankton
46	BA mesozooplankton
47	BA macrozooplankton
48	BA phytoplankton
49	Shelf phytoplankton
50	algae and eelgrass

	Group		Diet_in
1	Marine mammals		0,5
2	Coastal birds		1,0
		tal	0,5
		tal	0,5
		tal	0,7
		gic L	0,0
		gic L	0,1
		gic L	0,0
		gic L	0,3
		gic L	0,3
		tal	0,5
32	BA L crustaceans		0,3
33	BA molluscs		0,5
34	BA worms		0,3
35	BA crustaceans		0,5
36	BA other inverts		0,3
37	BA meiobenthos		0,3
38	shelf L crustaceans		0,3
39	shelf molluscs		0,2
40	shelf worms		0,2
41	shelf crustaceans		
42	shelf other inverts		
43	shelf meiobenthos		
44	mesozooplankton		
45	macrozooplankton		
46	BA mesozooplankton		
47	BA macrozooplankton		
48	BA phytoplankton		
49	Shelf phytoplankton		
50	algae and eelgrass		
51	Detritus		

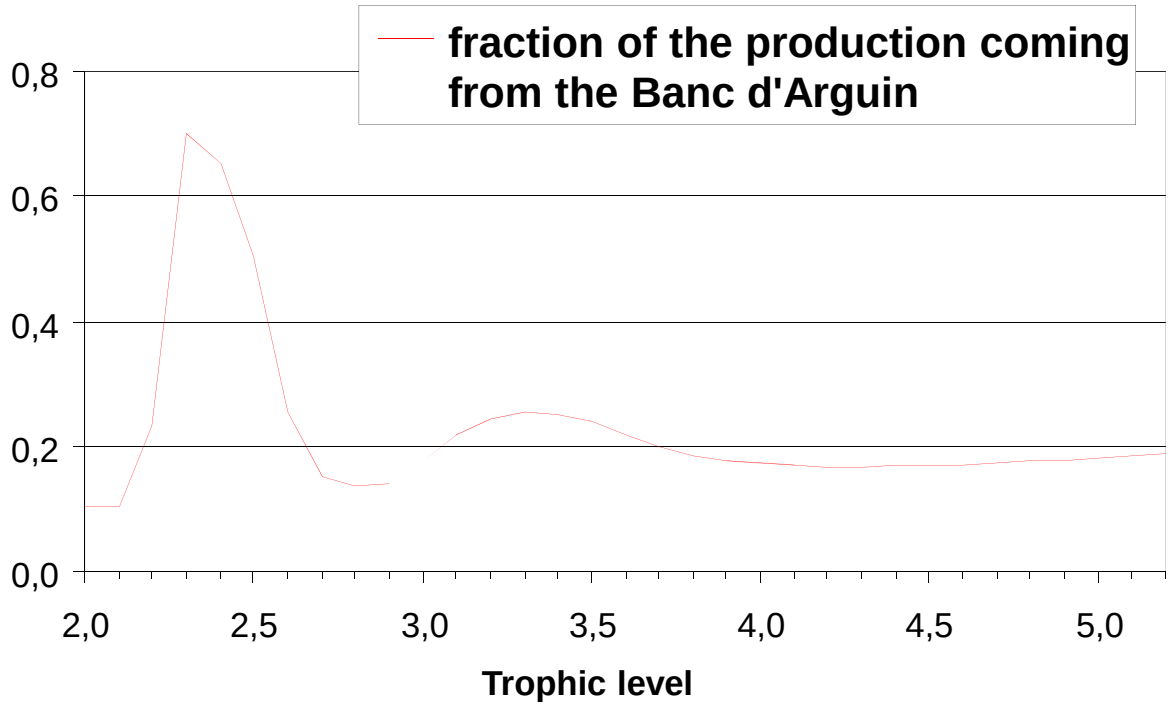
Flow chart and main groups

- Large abundance for small pelagics, crustaceans and octopus
- All high TLs are exploited



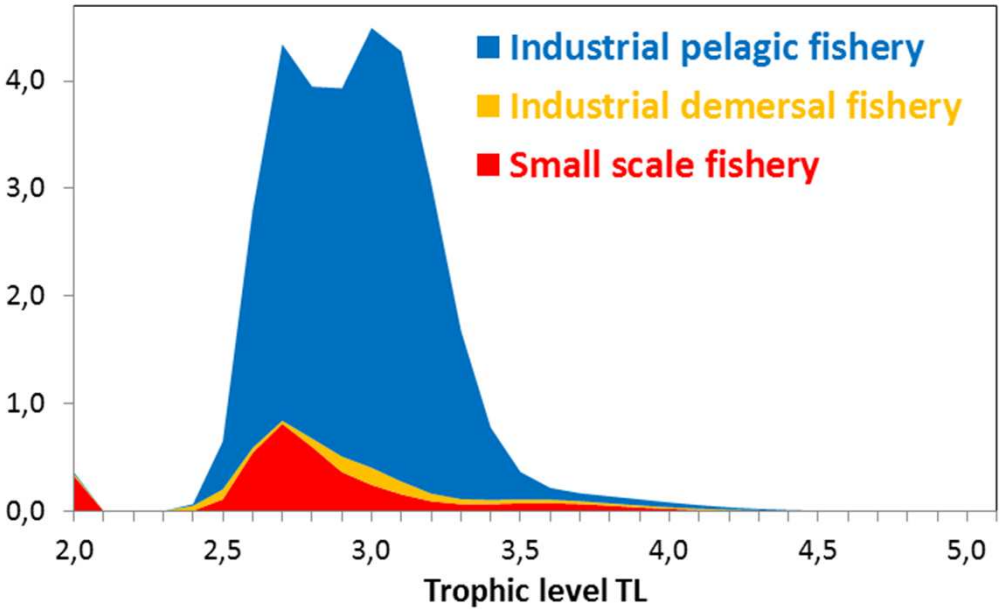
The Banc d'Arguin's contribution

- Originated from the banc d'Arguin (Guénette et al. 2014):
  - 12,4 % of the production of all animals groups
  - 17,8 % of the total EEZ catch and up to 50% for coastal fish



Landings and fleets

- Landings: more than 1 million tons each year
- Three main fleets:
  - Industrial foreign fishery (IPF) targeting pelagics (85% of total catch, TL=2.5 to 3.5)
  - Industrial (foreign and national) demersal fishery (3%, TL=2.7 to 4.5)
  - Small scale coastal fishery (SSCF) targeting a wide range of species (12% of total catch, TLs= 2.0 to 4.0)

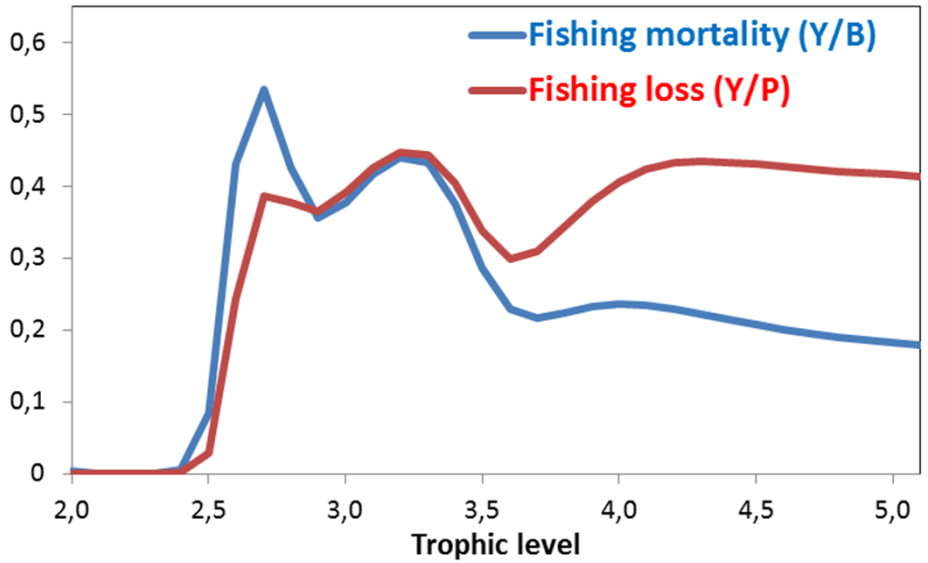


❑ **What is the specific impact of each fishery on the entire food web?**

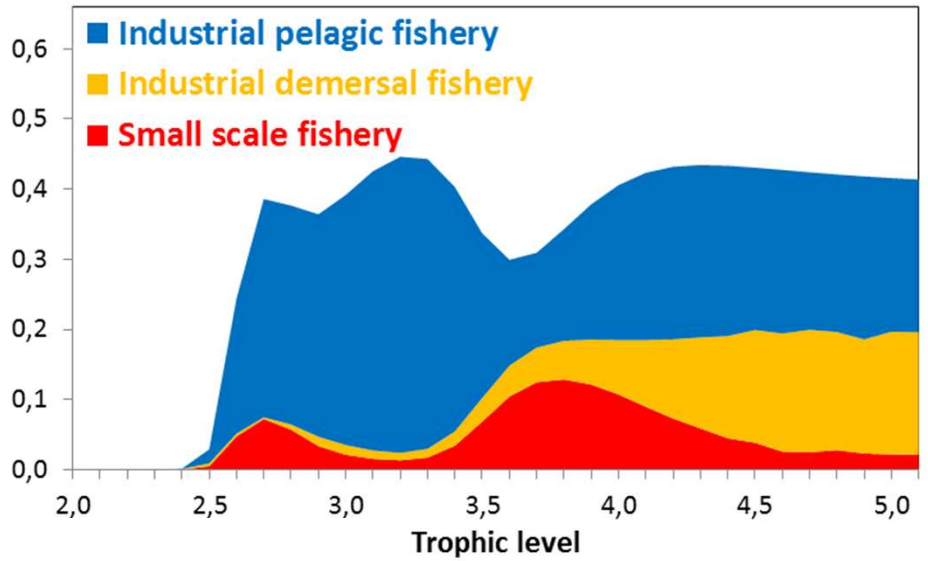
❑ **How industrial fisheries impact the small scale sector?**

Fishing pressure

- **Fishing mortality** (F=Y/B): witch TLs are targeted?
  - ➢ mainly TLs 2.6 / 3.5 (small pelagics and octopus)
  - ➢ and secondarily TLs > 3.5 (demersal fish)



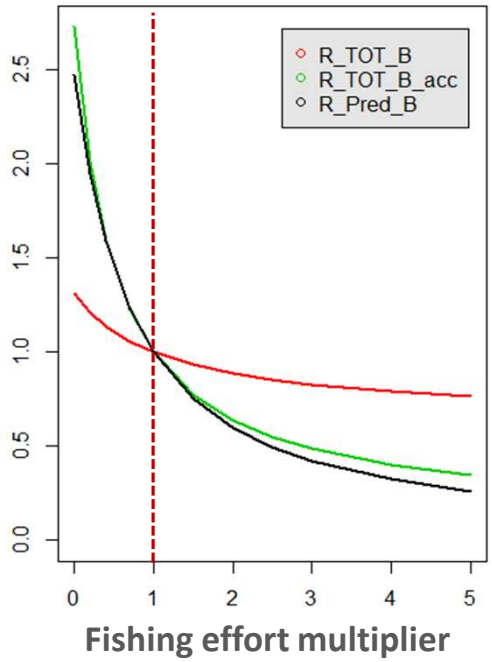
- **Fishing loss** (φ=Y/P): witch TLs are impacted?
  - ➢ All TLs > 2.6 (40% of P caught)
  - ➢ Impact on low TLs comes from the industrial pelagic fishery
  - ➢ Impact on high TLs due to the 3 sectors



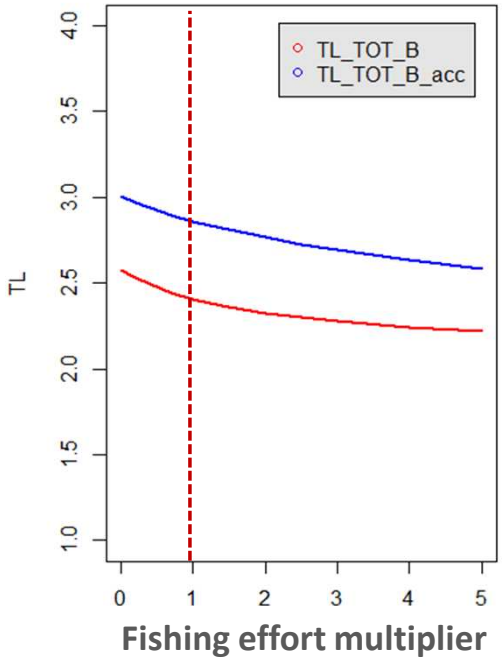
Fishing impact on biomass and TLs

- Compared to the unexploited state:
  - A 25% decrease in the total biomass, and a 65% decrease in the accessible biomass
  - A decrease in the mean TL of biomass (-0.12) and accessible biomass (-0,21)
  - High TLs are the most impacted (-78% for TL=4.5 and -45% for TL=3)

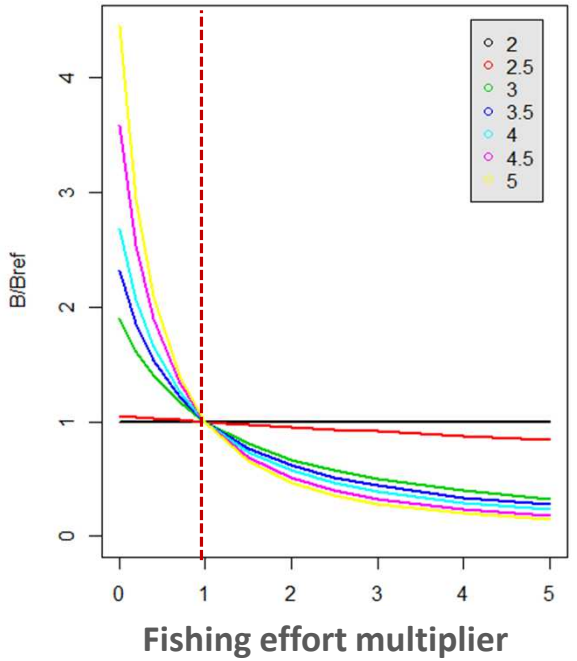
Biomass (B/Bcur)



Mean TL of biomass

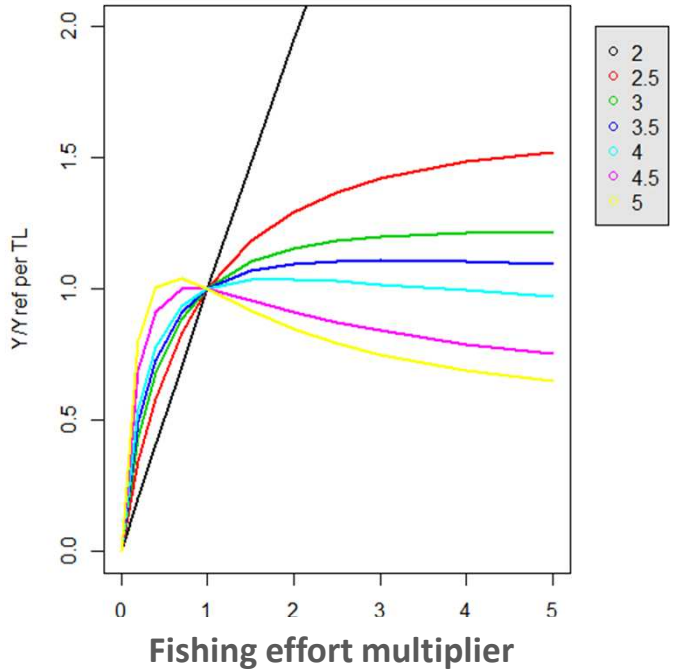


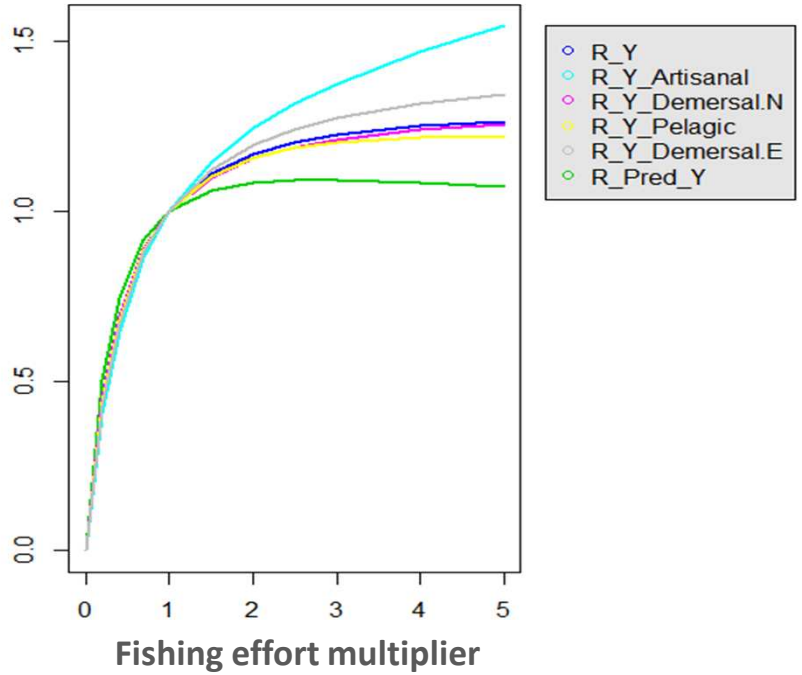
Biomass per trophic class



Simulation of catch

- In case of a global increase in the fishing effort:
  - Increase in catch would be limited
  - Only the small scale sector may significantly develop

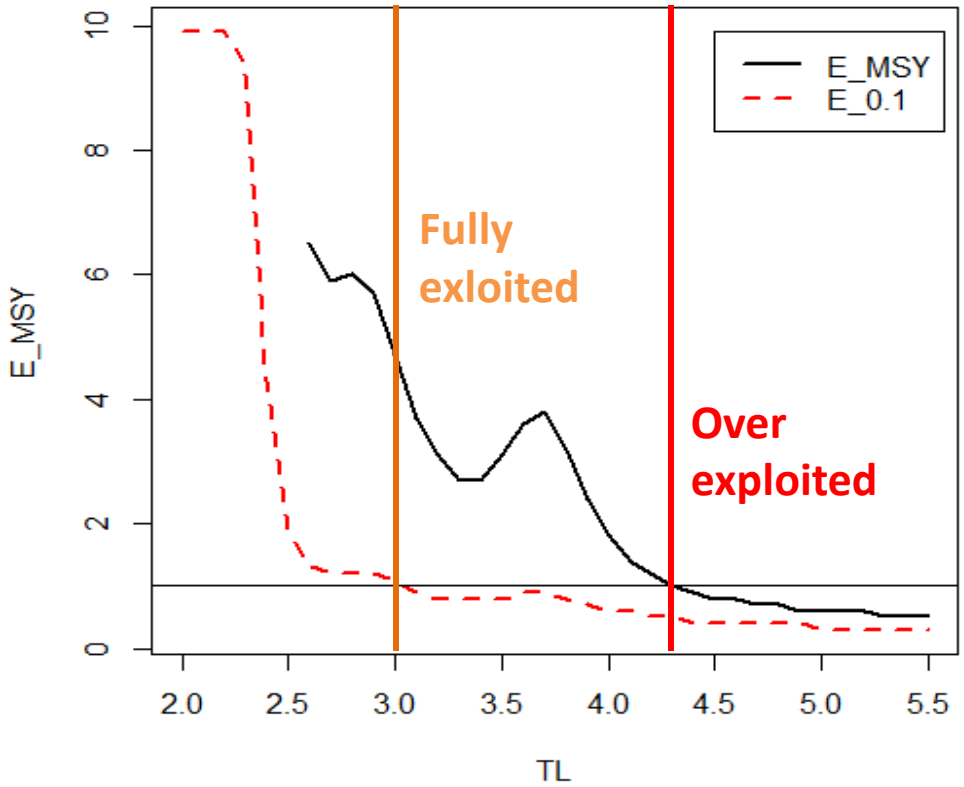




- Catch per trophic class as a function of the fishing effort:
  - TLS 4.5 and 5 are overexploited

Diagnosis

- Two indicators:
  - **Overexploitation** ⇔ $mE_{MSY} < 1$
  - **Full exploitation** ⇔ $mE_{0.1} < 1$



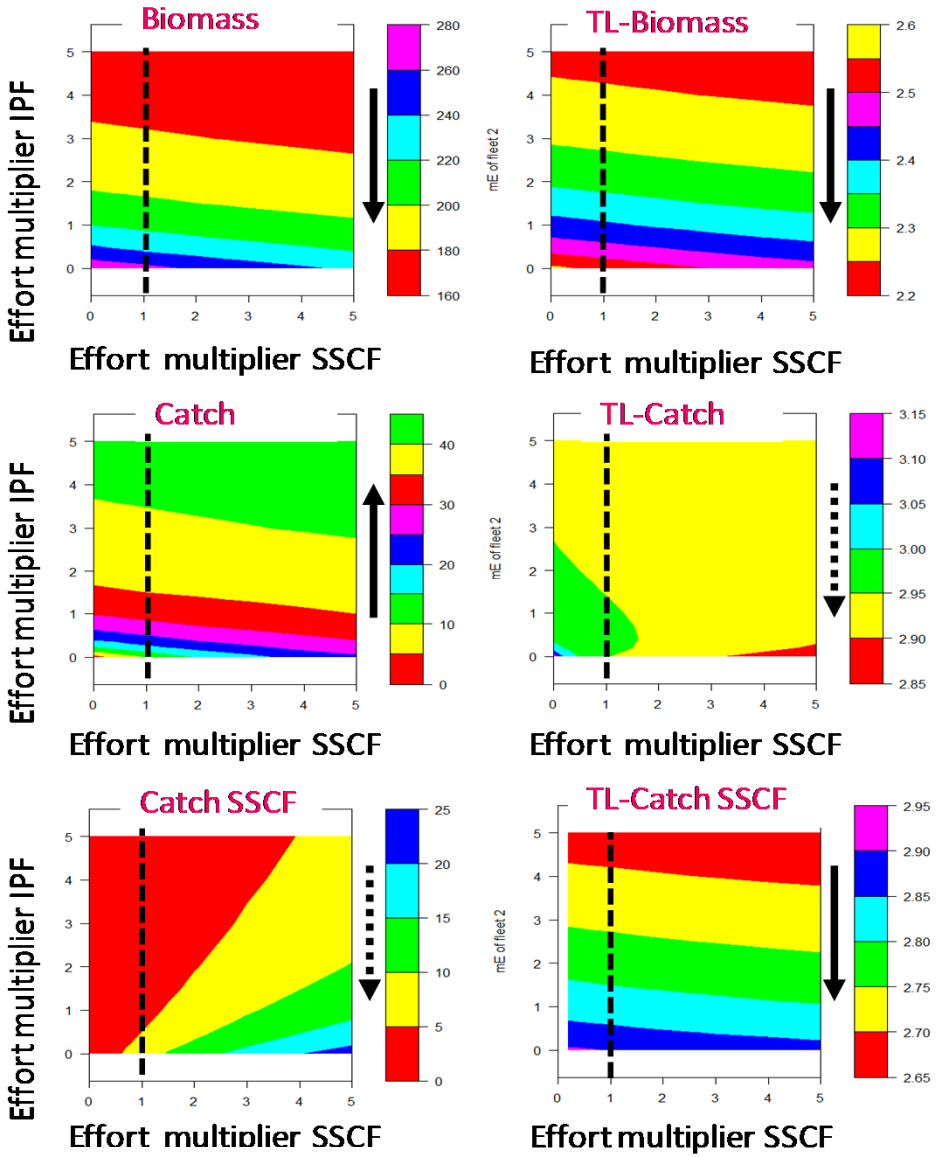
- TLs 4.4-5.0 overexploited
- TLs 3.0-4.3 fully exploited
- TLs 2.5-2.9 close to full exploitation

❑ A heavily fished ecosystem

Interactions between Indus.pelagic & small scale

- In case of increasing effort from the industrial **pelagic** fishery:
  - ➢ The total ecosystem biomass and the mean TL would decrease
  - ➢ The total catch would increase
  - ➢ … and the catch of the small scale sector would be impacted (lower TLs)

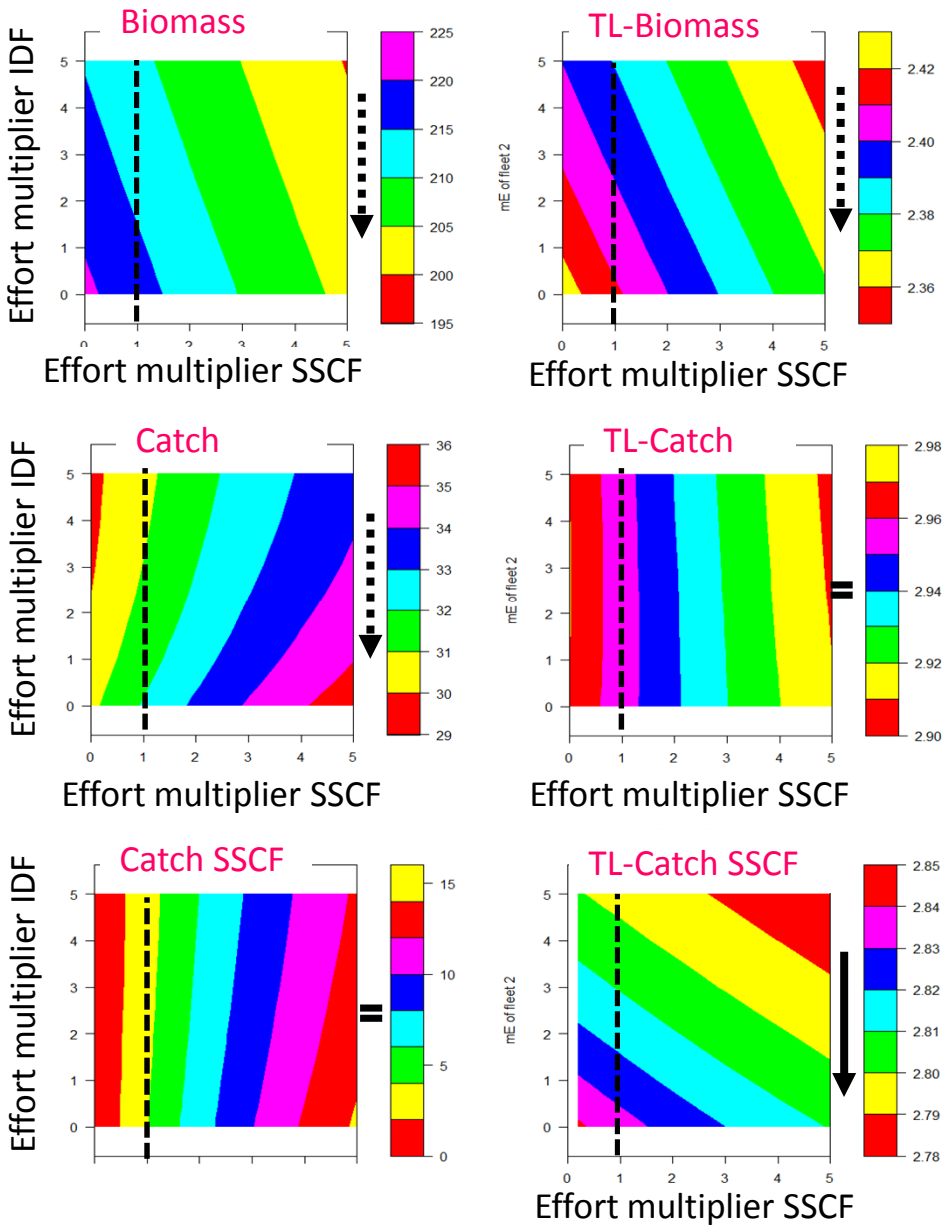
- ❑ **Large impacts (quantitative & qualitative) of the industrial pelagic fleet**
- ❑ **Limited impact of the small scale sector**



Interactions between Indus.demersal & small scale

- In case of increasing effort from the industrial **demersal** fishery:
  - ➢ Limited effect on the total ecosystem biomass
  - ➢ … and on total catch
  - ➢ Strong effect on the mean TL of the catch of SSFC

❑ **Interactions between the two fleets are mainly qualitative (on high TLs)**



Conclusion

Mauritania

- A 65% decrease in the fishable biomass
- High TLs overexploited, intermediate TLs fully exploited
- A large impact of the industrial fisheries on the small scale sector, especially for high TLS

EcoTroph to:

- Assess the global fishing impact on ecosystems
- Estimate production functions per trophic class and draw diagnosis
- Analyse the quantitative and qualitative impact of each fleet on the others, and to simulate scenarios

Merci!