

# Project *brief*

Thünen Institute of Sea Fisheries

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## Climate change causes declining productivity in the Atlantic

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- Climate change will enhance ocean stratification and impact coastal upwelling areas, both leading to reduced plankton productivity.
- In turn, in pelagic systems heterotrophic processes will show a significant increase.
- Horizontal exchange processes in the tropical and subtropical Atlantic indicate that both sides, i.e., the African as well as South American coastal states need to be considered in Atlantic ecosystem studies. For this purpose, research infrastructure needs to be enhanced and maintained, also with the help of the global North.

Nine research teams of 34 partner institutions of 13 countries of all Atlantic regions analysed the present state of the sub-tropical and tropical Atlantic, analysed dynamics of change and provided integrated modelling studies to predict ecosystem trends until 2100.

### Background and objectives

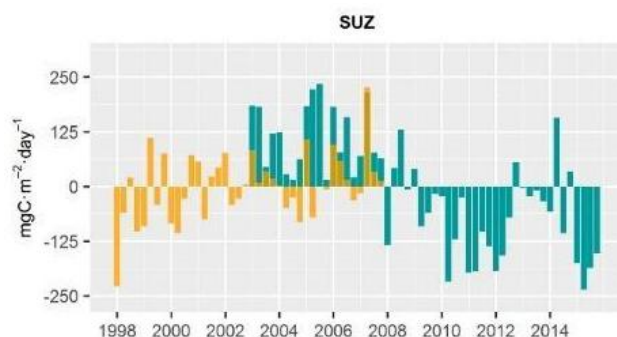
Research comprised studies on physical oceanography, phyto- and zooplankton up to marine mammals and human activities impacting the ecosystem. The Thünen Institute contributed to a work package dealing with the mesopelagic fauna.

The oceanic mesopelagic zone is confined to 200 to 1000 m water depth. It differs from the bathyal deep sea by low light availability but has no primary production. Its fauna is of high importance for the biological carbon pump and as food resource for epipelagic species such as tuna. Diversity and feeding relationships, distribution and biomass are analyzed for this ecosystem component.

Another important objective was to enhance marine research on both sides of the South Atlantic. Thünen Institute contributed to academic capacity building as well as to modern techniques for fisheries data collection.

### Approach

Analyses were conducted on two different levels. On the one side, six key areas were selected based on sufficient data availability (West African upwelling system, equatorial region and Gulf of Guinea, subtropical South Atlantic, NE Brazil, SW Brazil, and Benguela upwelling region). On the other side, based on remote sensing data, basin scales analyses were carried out.



**Figure 1:** Trend of primary production (in mg carbon, C, per m<sup>2</sup> and day) in the upwelling region off West Africa, 13°-20°N (SUZ = seasonal upwelling zone). Based upon SEAWIFS (orange) and MODIS-satellite data (blue) - (Source: Schwamborn et al., 2021).

### Results

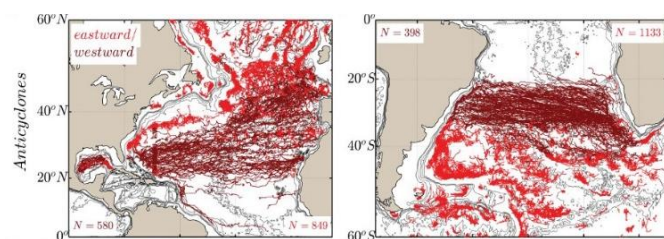
The already evident negative trend of primary production in the upwelling systems will propagate into the open ocean (Fig. 1). Change in the wind field and temperature will impact the West African upwelling and the southern Benguela system, while in the tropical Angolan upwelling freshwater discharge from the river Congo has an additional effect. Along the Brazilian coast, marine heat waves and tropical cyclones in conjunction with El Niño induced drops in precipitation in the Amazonas bight and will lead to negative production trends. In the pelagic realm, warming of the ocean surface layer will diminish diffusive exchange processes. In conjunction with temperature stress amplified through heat waves, this will lead to a reduction in primary and secondary production. TRIATLAS studies reveal that this will induce a shift in community composition in favor of heterotrophic ecosystem components with a lower production potential.

Accordingly, fisheries yields will decline, although the demand for fisheries products will increase in the future as a convenient source of animal protein. The decline in fisheries yields will regionally amount to 50% by 2050 (Table 1), while the demand for sea product will on average increase by 3.1% per year, dependent on the growing human population in Africa and Southern America.

Region	% decline
1 / West Africa	15
2 / Golf of Guinea	50
4 / NE Brasil	20
6 / Benguela	35

**Table 1:** Predicted decline in fisheries landings in 2050 as compared to 2010 in four TRIATLAS case study regions (Source: Fock et al., 2023).

Horizontal exchange processes indicate that basin scale studies are required to fully comprehend ecosystem dynamics of the Atlantic. In this respect, TRIATLAS helped closing some knowledge gaps. In turn, this further indicates that such research cooperation needs to be perpetuated to continuously retrieve ecosystem parameters and to assess ecosystem state (Fig. 2).



**Figure 2:** Meso-scale transport in North and South Atlantic by means of eddies in easterly and westerly directions (Source: Fock et al., 2023).

Built upon the [Belém-statement](#) detailing principles of collaboration between EU, southern Africa and South America, TRIATLAS can be seen as prototype of an international cooperation to achieve these goals.

## Conclusions

Recommendations for the future:

- It is important to establish a scientific network in the South Atlantic as it is already operational in the North Atlantic to provide decision makers with relevant information. The TRIATLAS derived [CANEMS](#) network (Cross Atlantic Network of Marine Science) may serve as an example how capacity building and decision support can work in the South Atlantic context.
- Dedicated build-up and development of scientific infrastructure for coastal countries in the tropical and subtropical Atlantic needs to be continued, together with opportunities for early career scientists to promote and interconnect.
- A key focus in data acquisition should be on automated systems, to lower costs and provide consistent time series data.

## References:

- [Schwammborn, R., Fock, H., et al. 2021](#). Report on food web metrics and physico-chemical and biological process rates of open ocean and neritic communities.
- [Fock, H., Schwammborn, R., et al. 2023](#). Assessing the current state of the tropical and subtropical Atlantic – The pelagic ecosystem, fisheries and its socio-economic dimension.

## Further information

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### Partner

A complete list can be found [here](#).

### Run time

6.2019-11.2023

### Project-ID

2145

### Publications

Fock, H. O., H. Andresen, et al. 2025. Seasonal changes of size spectra of the Benguela offshore mesopelagic ecosystem compartment in relation to primary production. *Marine Ecology* 46:e70040.

A complete list can be found [here](#).

### Funding

Horizon 2020 research and innovation programme grant agreement No 817578.



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