

TERMS OF REFERENCE FOR THE MEDITERRANEAN TUNA HABITAT OBSERVATORY INITIATIVE

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SUMMARY

We present the Terms of Reference for a case study on a Mediterranean eco-region focusing on the environmental component of the Ecosystem Report Card. The objective of this case study is to describe and monitor the variability of environmental processes in the Mediterranean Sea that affect the ecology of large pelagic fishes, with a particular attention on tunas, and the possible role of climate change on this variability. Here we define the objectives and activities of the initiative, the participant roles, primary indicators and the methodological approach.

RÉSUMÉ

Ce document présente les termes de référence d'une étude de cas sur une écorégion méditerranéenne consacrée à la composante environnementale de la fiche informative sur les écosystèmes. L'objectif de cette étude de cas est de décrire et de suivre la variabilité des processus environnementaux en mer Méditerranée qui affectent l'écologie des grands poissons pélagiques, en accordant une attention particulière aux thonidés, et de déterminer le rôle possible du changement climatique sur cette variabilité. Nous définissons ici les objectifs et les activités de l'initiative, les rôles des participants, les indicateurs primaires et l'approche méthodologique.

RESUMEN

En el documento se presentan los términos de referencia para un estudio de caso sobre una ecorregión mediterránea centrado en el componente medioambiental de la ficha informativa sobre ecosistemas. El objetivo de este estudio de caso es describir y hacer un seguimiento de la variabilidad de los procesos medioambientales en el mar Mediterráneo que afectan a la ecología de los grandes peces pelágicos, con especial atención a los túnidos, y el posible papel del cambio climático en esta variabilidad. A continuación, se definen los objetivos y actividades de la iniciativa, las funciones de los participantes, los indicadores principales y el enfoque metodológico.

KEYWORDS

*Mediterranean ecoregion, Ecosystem Report Card,
Ecosystem Approach for Fisheries Management, Environmental Monitoring, tuna habitat*

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Aims

The International Commission for the Conservation of Atlantic Tunas (ICCAT, www.iccat.int/en/) is responsible for the conservation of the resources of tuna and tuna-like fishes of the Atlantic Ocean and adjacent Seas. One of the main objectives of the Commission is to ensure the advance towards an effective “Ecosystem Approach for Fisheries Management” (EAFM), by integrating ecosystem aspects into the activities of the Commission, through a dedicated working group on “ecosystems”. The main approach to advance in this line is the development of an “ecosystem report card”, that summarizes impact indicators from a bidirectional perspective i) fisheries impacts on the ecosystem and ii) effects of human-driven environmental and ecosystem change on tuna species ecology. Currently, the ecosystem group is profiling a number of tuna ecoregions that will facilitate, among other issues, the workflow to obtain the regional indicators. Environmental monitoring of tuna variability is becoming especially relevant since a specific resolution of the Commission proposed recently to integrate climate change effects in the management of tuna species (ICCAT, 2022).

In the last Ecosystem Working Group of the ICCAT, a proposal was presented to implement an initiative in the Mediterranean tuna ecoregion for monitoring environmental effects on the ecology and habitats of large pelagic fish species -tunas mainly-. Following that, the Ecosystem Working Group resolved to support the initiative especially in providing indicators of environmental variability at Mediterranean scale meaningful for tuna species that will fulfill the “environmental section” of the future “ecosystem report card” (SCRS/ECO 2022 section 2.2.3).

Far beyond the management of the fisheries of tuna species, marine policy is making progress in implementing area-based conservation measures under the framework of the Barcelona Convention. Marine and Coastal Protected Areas (MCPAs) and Other Effective Area-Based Conservation Measures (OECMs) in the Mediterranean need to be extended from coastal areas to open waters to achieve the 2030 targets of the Convention on Biological Diversity (CBD) objectives (Strategic Pillar 2 of the post-2020 strategy for MCPAs and OECMs, UNEP/MAP-SPA/RAC, 2021). Ensuring that MPAs are climate-smart is visionary and challenging (designing the MPAs to have enhanced climate benefits, i.e., carbon sequestration, adaptation of local communities, Merwin et al. 2020, Hansen et al., 2010). Within this framework, we propose an initiative to develop a Mediterranean Tuna-Habitat Observatory, to address issues envisioned by ICCAT, such as the effects of environmental variability on tuna species fitness, with special focus on climate change, and to help to align tuna fisheries management with the CBD objectives.

This document presents the objectives of the observatory and the outcomes and outputs expected from it, while providing an open-framed space to foster discussion among the participants.

Objectives

The objective of this initiative is to identify and monitor the variability of environmental processes in the Mediterranean Sea that affects the ecology of large pelagic fishes -with special attention on tunas-, and to investigate the potential role of climate change on this variability.

The results will be integrated into an annual report (first version by December 2023) with specific indicators that could serve as the basis for the “ecosystem report card” in the Mediterranean, currently being prepared by the ICCAT’s “Ecosystem group”.

We will also take advantage of the information gained, and the networks established within this initiative to:

1. facilitate the connection among partners to ensure that institutional development planning is focused on common objectives regarding the integration of environmental variability into the population assessment of large pelagic species to ensure sustainable exploitation.
2. identify key research priorities to complement climate change analysis, environmental variability and fisheries/conservation management.

Specific activities to achieve objectives

The main activities proposed at this stage are:

- Develop a working plan for the next two years: this should be agreed after a first proposal is prepared and submitted to participants. The draft will be circulated among partners during the next months, and will be submitted to the Subcommittee of Ecosystem and Bycatch for revision and approval.
- Define specific roles of each institution and participants: this is being outlined through direct discussions between partners and the coordinator, and would be presented in a project meeting, once finalized in the prospective phase of the project.
- Propose a draft outline for the first version of the report (in progress, first draft is in preparation), and align that document to have the same structure as the Ecosystem Overview Reports of the ICCAT Ecosystem Working Group.
- Define an action plan (at this stage this is a voluntary initiative of specific people, we may want to identify a more official collaboration framework, supportive structure, location of the Observatory and financial aspects; e.g. an example of a MOU with ICCAT already exist for the Sargasso Sea Commission).

Methodological approach

The general methodology for this initiative is based on:

1. The identification of key areas, temporal windows and phenology for specific ecological processes of some large pelagic species (e.g. breeding/spawning hot spots for bluefin and albacore tuna, swordfish, others).
2. The identification of main environmental conditions driving the ecological processes identified in point 1 (e.g., surface temperature directly affects reproduction success and larval survival rate).
3. The development of indicators for environmental variability identified in point 2 (e.g., ocean temperature anomalies/marine heat waves in spawning areas/mesoscale oceanographic features).
4. Explore the mechanistic relationship between the environment and the ecology of target species and develop indicators that provide insight into the impacts on species ecology (e.g., modeling larval survival as a function of the sea surface temperature/retention processes, and inferring future recruitment and/or habitat contraction).
5. Publish the developed indicators in a dedicated report.
6. Facilitate the integration of these indicators into the fisheries assessment processes and share information on how key affected areas can interact with the CBD conservation policies.

Initial indicators (to be included in the first version of the report):

An initial set of indicators has already been selected and test methods are developed or well advanced. These will be monitored in key tuna ecological areas during key time periods:

- Marine heatwaves and sea surface temperature anomalies. Indicators expressing the frequency and intensity of heat waves and warming in key areas during early life ecology and reproductive aggregations along the Mediterranean Sea (following methods and tools from Juza & Tintoré, 2021; Juza *et al.*, 2022),
- Interannual variability of the ocean dynamics shaping tuna habitats. Surface mixing properties associated with coherent Lagrangian structures during the reproductive season will be monitored from finite size Lyapunov exponents (Diaz-Barroso *et al.*, 2021),

- Climate velocity: exposure of key tuna ecological areas to this fundamental physical parameter associated with ocean warming. Many species track climate velocity and follow their environmental niche with resulting redistributions (Pinksy *et al.*, 2020), becoming key for designing climate-smart networks of MPAs and OECMs in the Mediterranean (Arafteh-Dalmau *et al.*, 2021),
- Habitat condition for spawning process. Metrics for habitat expansion/contraction and environmental thresholds for spawning process (Alvarez-Berastegui *et al.*, 2016),
- Habitat conditions during early life stages. Expansion and contraction of tuna larval habitats and first mechanistic based indicator for monitoring the impact of environmental variability on survival potential of tuna at early life stages (Reglero *et al.*, 2019).

Tackling elements in the framework of the Ecosystem Approach for Fisheries Management

The various elements that compose the ecosystem approach are summarized in **Figure 1**. This scheme is commonly applied to organize the “Fishery-Ecosystem Overviews” (ICES, 2023). This case study directly addresses the following elements:

1. Summary of key signals, providing indicators to the ICCAT Ecosystem Report Card.
2. Mediterranean Ecoregion Description: Informing on climate and environmental processes that are particular for the ecoregion.
3. Environmental and Climate change effects, analyzing and monitoring environmental variability in key ecological areas of the ecoregion and impacts on tuna habitats.
4. Status of fisheries resources: Providing indicators of the evolution of particular species at specific developmental stages and potential survival (indicators that are integrated in the current population assessment models run by the fisheries assessment groups).

Participants and Roles

The initial participants and main roles on this initiative are the following.

IEO-CSIC: IEO Baleares: Diego Alvarez-Berastegui; Patricia Reglero; M. Pilar Tugores; Marina Sanz-Martín; Manuel Hidalgo, Miguel Cabanellas-Reboredo; IEO Málaga: David Macías, Jose Carlos Baez, Raul Láiz; IEO Madrid: María José Juan Jorda; IEO-Canarias: Francisco Abascal. Coordinate the activities of the observatory and provide indicators on environmental effects on tuna early live stages, larval abundances, tuna habitats and other climate change indicators. Determine key areas and ecological processes for tuna life cycle, with the contribution of other tuna experts.

SOCIB: Emma Reyes, Melanie Juza; Baptiste Moure, Joaquín Tintoré, ensure that current research and tools for understanding environmental variability through monitoring Essential Ocean Variables and developing derived ocean indicators (including marine heat waves) at SOCIB respond to the needs of the THObs in the frame of the Digital Twin international initiatives.

IMEDEA: Ismael Hernández-Carrasco, Alejandro Orfila: Assess and facilitate the development of indicators for the assessment of ocean dynamics based on the variability of lagrangian coherent structures in the key areas for tuna ecology in the Mediterranean.

MONGOOS: Vanessa Cardin, facilitates synergies between researchers and institutions involved in Mediterranean oceanography with the observatory, and strengthens the international perspective of the initiative.

PLAN-BLEU RAC UNEP/MAP: Gloria Lazaro; Antoine Lafitte: Support the monitoring of variability on environmental processes in the Mediterranean. Through its observatory Plan Bleu provides infrastructure and methodology to develop and visualize specific indicators. Ensure synergies between Plan Bleu missions, objectives and activities such as: 1) the “Plan Bleu observatory” capabilities, 2) liaising activities with its networks, such as the MedECC and 3) the potential integration of the observatory outputs in the different sustainability assessments on which Plan Bleu is involved.

OAPN (Organismo Autónomo Parques Nacionales): José Amengual Ramis: Revise and outline the development of the THObs objectives and outputs to maximize positive impact on Area-Based Conservation policies in the Mediterranean. Develop and propose area-based indicators for target species which can have both an impact on the conservation policy based on MPAs in the Mediterranean and propose the pelagic marine protected areas (PMPA) as a novel tool for the conservation of the species in the Mediterranean.

CNR -ISMed Palermo (Consiglio Nazionale delle Ricerche): Angela Cuttitta, Stefania Russo, Marco Torri. CNR-IAS Palermo: Bernardo Patti. Supervises the selection of key ecological areas and meaningful indicators in the Central Mediterranean regarding aspects affecting early life ecology of tunas.

Cukurova University: Sinan Mavruk supervises the selection of key ecological areas and meaningful indicators in the Eastern Mediterranean regarding aspects affecting early life ecology of tunas.

Although ICCAT is not included as a partner in the project proposal, it supports the initiative through the SCRCS-Ecosystem group, with participation of the group (chaired by Alex Hanke), and coordinators of other study cases to ensure alignment and transference of knowledge: Laurie Kell and David Die, M.J. Jodá.

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FISHERY-ECOSYSTEM OVERVIEW

<p>SUMMARY of key signals (EcoCard)</p>	<p>ECOREGION DESCRIPTION</p>	<p>WHO IS FISHING <i>main countries- fleets</i> <i>main fisheries</i></p>	<p>WHAT ARE WE FISHING <i>catches -landings and discards</i></p>
<p>STATUS OF FISHERY RESOURCES <i>target species</i></p>	<p>MIXED FISHERIES ADVISE <i>fisheries interactions</i> <i>species interactions</i></p>	<p>FISHERIES MANAGEMENT <i>bycatch mitigation</i> <i>measures</i></p>	<p>FISHERY MANAGEMENT PLANS</p>
<p>ENVIRONMENTAL & CLIMATE CHANGE EFFECTS</p>	<p>EFFECT OF FISHERIES ON THE ETP species & STATE OF ETP species <i>Shark/rays</i> <i>Seabirds</i> <i>Sea turtles</i> <i>Marine mammals</i></p>	<p>EFFECT OF FISHERIES ON THE FOODWEB & STATE OF FOODWEB</p>	<p>SOCIO-ECONOMIC CONTEXT</p>

Figure 1. Main elements of the Fishery-Ecosystem overviews (adapted from ICES, 2023).