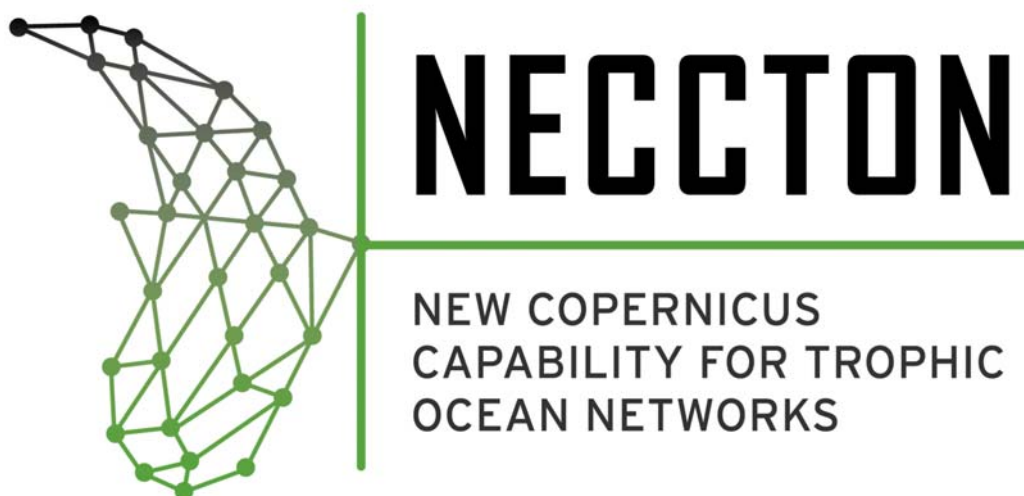


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Deliverable D7.1

Technical specification of the HTL products

Deliverable Contributors:	Name	Organisation	Role / Title
Deliverable Leader	Verena Trenkel	Ifremer	WP7 Lead
Contributing Author(s)	Marilaure Grégoire	UoL	WP7 Contributor
	Patrick Lehodey	MOi	WP7 Contributor
	Morgane Travers-Trolet	Ifremer	WP7 Contributor
	Ute Daewel	Hereon	WP7 Contributor
	Vijith Vijayakumaran	Hereon	WP7 Contributor
	Sergi Pérez-Jorge	IMAR	WP7 Contributor
	Ken H Andersen	DTU	WP7 Contributor
	Martin Huret	Ifremer	WP7 Contributor
	Helen Powley	PML	WP7 Contributor
	Sevrine Sailley	PML	WP7 Contributor
	Kostas Tsiaras	HCMR	WP7 Contributor
	Jeroen Steenbeek	EII	WP7 Contributor
	Anna Conchon	CLS	WP7 Contributor
Reviewer(s)	Jason Link	NOAA	External Reviewer



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	Aurore Bideau	MOi	Internal Reviewer
	Valentina Giunta	MOi	Internal Reviewer
	Corinne Derval	MOi	Internal Reviewer
Final review and approval	Stefano Ciavatta	MOi	Project lead

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Preface

This document is the deliverable D7.1 of the Task 7.1 of NECCTON. Its objective is to define the product and services for the higher trophic level component of ocean ecosystems, co-developed by work-package 7 and the project stakeholders.

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Glossary

Product	In NECCTON, a "product" is the output of a model, or of a coupled model, developed in the project. The product is assessed as a potential new variable for the Copernicus Marine Service. Each product can be delivered as a number of co-products, e.g., by different models in different regions. Each co-product is composed of a set of sub-variables and delivered as a model-output dataset.
Sub-variable	In NECCTON, a sub-variable is a single component of the product that is simulated by the model and used to estimate the desired product. For example, suspended particular matter is a product that may be estimated as the sum of sub-variables representing matter with different sizes.
Dataset	The NECCTON products will be delivered in the form of "datasets". These are aggregations of model outputs or observations, having the same geospatial structure or feature type (e.g., profiles, point-series, trajectories, points, grid-series, grids). A dataset contains data relative to one or more products developed by NECCTON. It is composed of one or several data files. The aggregation is done so that the content of the dataset is FAIR for the user (findable, accessible, interoperable, and reusable) and expandable when the product is updated (time axis).
Datacube	The NECCTON "datacube exploratory viewer" is an interactive application for exploring and visualizing the datasets, adapted to the visualization of the NECCTON products simulated by the integrated ecosystem model. This datacube is based on innovative cloud-based technologies and will use a serverless architecture that allows it to connect directly to files and not to a server. This viewer will guarantee high-availability, visual analysis, and flexible data dissemination to the users
Service	In NECCTON, a service is a tool (e.g., software) that transforms the data of a product into information needed by a stakeholder for a specific application. Most notably, the NECCTON datacube is a service that will map features of the data selected by the user.
Derived product	In NECCTON, a derived product is the output of a service, which is calculated from an original product and other relevant information, in response to user needs. For example, the space-time occurrence of suspended particulate matter above chosen thresholds is a derived product, that could be an output of the NECCTON datacube.

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Publishable Summary

The overall objective of NECCTON is to enable Copernicus Marine Service to deliver products that inform marine biodiversity conservation and food resources management, by fusing ocean ecosystem models and data. This report provides a description of five data products that will be developed by NECCTON for trophic levels above zooplankton, broadly referred to as higher trophic levels (HTL) as future potential new products for Copernicus Marine Service: small pelagics biomass, large pelagics, demersal fish biomass, unspecified fish biomass, and marine mammals habitat (a proxy for potential species distributions).

In NECCTON, the HTL products are prepared for different Copernicus Marine Service regions using a range of models of different complexity and type. The models fall into three categories, marine ecosystem biomass models (FEISTY - Petrik et al 2019, Denderen et al 2021; Ecospace - Libralato and Solidoro 2009; EcoOcean - Coll et al. 2020; MIZER - Bruggeman 2021; E2E - Daewel et al. 2019; SPF - Gkanasos et al., 2021), Species Distribution Models (SS-DBEM multi-species - Wilson et al. 2021; ESD-Med species - von Schuckmann et al. 2021; DEB-IBM small pelagics; NAWH-cetaceans - Romagosa et al 2019), and Species Population Models (DEB-IBM small pelagics - Gatti et al., 2017; Bueno-Pardo et al., 2020; Ev-OSMOSE - Morell et al. 2023). These particular models were selected to enable an ensemble approach for certain regions and gain insights into the suitability and readiness of various existing models to provide operational HTL products in the future. Some models have two-way links with lower trophic model products and models, others are only forced by lower trophic level products.

The report also describes the characteristics of 22 regional or global data sets produced for the five HTL products. For each data set, synthetic information on model set up and technical specifications of HTL data outputs is provided.

1. Introduction

1.1 Scope of document

The objective of this document is to provide a clear definition of the five products that will be delivered by NECCTON WP 7 in the future development of NECCTON, and to serve as a reference for internal and external users of the products. The definition is based on the requirements of users that emerged from the NECCTON workshop “Co-design of future products” which was held on-line in June 2023 (more than 100 stakeholders attending) and the survey “Product co-design” held from July to September 2023 (more than 220 respondents). In this document, the definition of the products includes a brief review of previous and ongoing efforts in defining and delivering the product in an operational framework, as well as a description of the expected exploitation by users and associated impact.

This document also describes the model datasets that will be produced by NECCTON to deliver the product to internal and external users. Such descriptions include a reference to the model producing the dataset, as well as features of the data, such as their spatial coverage and resolution, temporal

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extension and resolution. It also includes a description of the metadata provided in the files containing the datasets. The observations expected to be compared to the model data are also listed.

The models that will be developed by NECCTON WP5 as well as the accuracy and precisions of the products will be assessed using observations and quantitative metrics, consistently with the Copernicus Marine Service validation protocols, and will be the object of future deliverables.

We recall that all the products and datasets delivered by NECCTON follow the FAIR principle: they are findable, accessible, interoperable and reusable (see the “Data Management Plan” D1.1). In particular, NECCTON datacube is the main service for the dissemination and use of the products and datasets described here. Therefore, this document describes the compatibility of the datasets with the datacube.

We point out that the models producing the datasets in WP 7, the datacube developed in WP2 and potential derived products and the product quality/uncertainty are the specific focus of other future deliverables of NECCTON. Therefore, the description is out of the scope of the present document.

We note that the terminology in the glossary is consistent with the one in the Specification Sheets of the Essential Ocean Variables, defined by the Expert Panels of the Global Ocean Observing System (GOOS). GOOS is an Intergovernmental Oceanographic Commission (IOC)-led programme (<https://www.goosocean.org>). In NECCTON, whenever available, we used the Climate and Forecast (CF) standard metadata conventions or criteria to define the metadata of the NECCTON products and sub-variables (e.g., long-names, units; <https://cfconventions.org/>). However, standard metadata were not available for the products delivered by WP 7. In this document we made new metadata propositions, following the CF criteria, that might be refined through the engagement of experts and users during the future delivery of the project, by using this document as a discussion platform.

1.2 Intended audience and reference to user needs

This document is designed as a guide for the NECCTON partners as well as future users of the new products that will be delivered by WP 7 of NECCTON. WP 7 is working closely with WP1 (Management), WP 2 (Stakeholders) and WP9 (Case studies) to ensure that these products correspond to user needs.

The user needs for the WP 7 products emerged from the session on higher trophic-level products WP 7 of the NECCTON workshop “Co-design of future products” held on-line in June 2023 (more than 40 stakeholders attending the specific session) and the WP 7 dedicated section of the survey “Product co-design”, held from July to September 2023 (more than 220 respondents).

An analysis of the attendants and results of the above workshop session and survey section indicated that the potential users of the WP 7 products fell in the following categories:

- Blue economy (5 %), for applications such as modelling and forecasting stressor impacts, environmental impacts studies, policy development,
- Policy makers (0.4 %), for applications such as trophic level interactions, changes in distributions,

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- Academics (86%), for applications such as stock assessment, species mapping, ecosystem modelling and assessment, indicator calculation,

The feedback, expected use and impact for each single product, based on the analysis of the results, is provided in Section 3.

The engagement of the stakeholders to tailor the WP 7 NECCTON products to the user needs will continue throughout the duration of the project by co-designing thirteen case studies, dedicated workshops and engaging other European projects, initiatives and networks (including the Copernicus Marine Service user groups).

1.3 Structure of the document

The document is structured as follows. Section 2 provides a synthetic list of the products that will be delivered by WP 7. Section 3 provides a thorough description of each product, including: i) a general definition; ii) the user requirements, iii) the current state of the art, iv) planned evolution of the product delivery, v) the observations expected to be used to assess the model datasets, vi) the expected exploitation and impact of the product, and vii) key metadata of the product. Section 4 describes the datasets planned in NECCTON to deliver the products to users. A summary of possible challenges and expected impacts is given in Section 5.

2. Products summary

The NECCTON products (see definition in the glossary) that are delivered by WP 7 are listed in Table 2.1, along with selected, high-level information. This provides the reader and product users with an overview of the data delivered by NECCTON, as well as with identifiers to retrieve the product and dataset specifications in Sections 3 and 4. The datasets are delivered by hindcasts (H), i.e. model simulations of the past, which are named with unique numeric identifiers (H1, H2,).

Table 2.1 List of the co-products delivered by WP 7. First column: name of the product; second column: product ID; third column: ID dataset used to support the development of the product; fourth column: Copernicus Marine Service region; fifth column: model to be used for creating the product; and sixth column: NECCTON partner responsible for delivering the product.

Name product	ID co.product	ID datasets	Region	HTL model	Partners
Small-pelagic biomass	14.1	H19	MED	ERSEM-SPF	HCMR
Small-pelagic biomass	14.2	H26	Bay of Biscay	OSMOSE	Ifremer
Small-pelagic biomass	14.3	H25	Bay of Biscay	DEB-IBM	Ifremer
Small-pelagic biomass	14.4	H21	NWS	SS-DBEM	PML

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Small-pelagic biomass	14.5	H14	NWS	ERSEM-MIZER	PML
Small-pelagic biomass	14.6	H7	NWS	FEISTY	DTU
Small-pelagic biomass	14.7	H8	IBI	FEISTY	DTU
Small-pelagic biomass	14.8	H9	BAL	FEISTY	DTU
Small-pelagic biomass	14.9	H10	MED	FEISTY	DTU
Small-pelagic biomass	14.10	H11	Global	FEISTY	DTU
Small-pelagic biomass	14.11	H28	North Atlantic	SEAPODYM	CLS
Small-pelagic biomass	14.12	H22	MED	E-SDM	OGS
Small-pelagic biomass	14.13	H29	Bay of Biscay	SEAPODYM	MOi
Small-pelagic biomass	14.14	H23	BS	DEB/FESTY	UoL
Small-pelagic biomass	14.15	H13	Global	EcoOcean	EII
Large pelagics	15.1	H20	Global	SS-DBEM	PML
Large pelagics	15.2	H7	NWS	FEISTY	DTU
Large pelagics	15.3	H8	IBI	FEISTY	DTU
Large pelagics	15.4	H9	BAL	FEISTY	DTU
Large pelagics	15.5	H10	MED	FEISTY	DTU
Large pelagics	15.6	H11	Global	FEISTY	DTU
Large pelagics	15.7	H27	Global	SEAPODYM	MOi
Large pelagics	15.8	H13	Global	EcoOcean	EII
Demersal fish biomass	16.1	H7	NWS	FEISTY	DTU
Demersal fish biomass	16.2	H8	IBI	FEISTY	DTU
Demersal fish biomass	16.3	H9	BAL	FEISTY	DTU
Demersal fish biomass	16.4	H10	MED	FEISTY	DTU
Demersal fish biomass	16.5	H11	Global	FEISTY	DTU
Demersal fish biomass	16.6	H22	MED	E-SDM	OGS
Demersal fish biomass	16.7	H21	NWS	SS-DBEM	PML
Unspecified fish biomass	17.1	H26	Bay of Biscay	OSMOSE	Ifremer
Unspecified fish biomass	17.2	H14	NWS	ERSEM-MIZER	PML

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Unspecified fish biomass	17.3	H16	ARC	E2E	Hereon
Unspecified fish biomass	17.4	H17	BAL	E2E	Hereon
Unspecified fish biomass	17.5	H7	NWS	FEISTY	DTU
Unspecified fish biomass	17.6	H8	IBI	FEISTY	DTU
Unspecified fish biomass	17.7	H9	BAL	FEISTY	DTU
Unspecified fish biomass	17.8	H10	MED	FEISTY	DTU
Unspecified fish biomass	17.9	H11	Global	FEISTY	DTU
Marine mammal habitat	18.1	H12	Adriatic Sea	Ecospace	OGS
Marine mammal habitat	18.2	H24	Azores	GAM	IMAR

3. Product definition

The next sections provide thorough definitions of each product listed in table 2.1.

3.1 Product Small pelagic biomass

3.1.0 Introduction

Small pelagic fishes (SPF) are a key component of marine food webs, often present with a large but fluctuating biomass of mid-trophic level fish, therefore making the link between primary and secondary productions and top predators. They also constitute a group of major economic importance for several countries. Implementing operational models for such organisms is a challenge due to the complexity of biological systems, which results in a large diversity of models allowing to address multiple questions for management and conservation, ranging from ecosystem services to catch quotas or fishing area closures for specific species or fisheries.

3.1.1 User feedback and requirements

The user feedback showed that small pelagic biomass is the product which interests most potential users (64%). The majority of these potential users is interested in species-specific products followed by the biomass of by size-groups or functional groups. In terms of required spatial resolution, the smallest expressed requirement is a 1 km resolution, while for temporal resolution there is mainly interest in daily and monthly values. Hindcasts starting around 1990 are most demanded, with monthly or annual updates. Concerning scenario runs, standard IPCC meet the demand, while for fishing scenarios, no common needs emerge.

3.1.2 State-of-the-art on product delivery and gaps

Reconstructed time series of biomass and individuals from stock assessments for e.g. anchovy and sardine are available at portals of entities involved in stock assessment and fisheries management (e.g., SAC-GFCM, EU STECF, ICES). This information, however, is not spatialized. Furthermore, observational data (presence/absence) in time and space for some species might be available on

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portals such as EMODnet and OBIS, but they do not represent any elaborated product. There is currently no product on small pelagic fish in the Copernicus Marine Service.

3.1.3 How NECCTON will innovate the product and fill the gap

SPF biomass will be provided based on the development and comparison of several state-of-the-art HTL (high trophic levels) models, to be coupled to the improved operational physical-biogeochemical Copernicus Marine models. The HTL models used can be subdivided into marine ecosystem biomass models (EcoBM), Species Distribution Models (SpDM), and Species Population Models (SpPM). Several HTL models will be applied to the different areas: 6 in the Northwestern European Shelf, 3 for the Iberian Biscay Irish region, 1 for the Baltic Sea, 3 for the Mediterranean Sea, 1 for the Black Sea and 4 at global scale. The large number and diversity of HTL models is exploited to: i) assess the uncertainty of HTL products by assessing ensemble simulations and ii) cover diverse needs of Copernicus Marine Service stakeholders.

The EcoBM approach will be applied as follows to provide SPF biomass; linked lower trophic models in brackets:

- in the Mediterranean Sea (MED-ERSEM) using the SPF model developed by HCMR.
- at global (GLO-PISCES) or regional levels (NWS-ERSEM, IBI-PISCES, BALERGOM, MED-BFM) using the FEISTY model developed by DTU.
- in the northwest Atlantic (NWS-ERSEM) using the MIZER model developed by PML.
- in the Global Ocean (GLO-PISCES) using the EcoOcean model provided by EII.

The SpDM approach will also be applied in several regions to provide SPF:

- in the northwest Atlantic (NWS-ERSEM) using the SS-DEBM model developed by PML.
- in the Mediterranean Sea (MED-BFM) using the E-SDM model developed by OGS.
- In the Black Sea (BS-BAMHBI) using the DEB/FEISTY model developed by UoL.

Lastly, the SpPM approach will be applied as follows to provide:

- anchovy and sardine in the Bay of Biscay (NWS-ERSEM) using the DEB-IBM model developed by Ifremer.
- several SPF in the Bay of Biscay (NWS-ERSEM) using the OSMOSE model developed by Ifremer.
- mackerel in the North Atlantic (extraction of GLO-PISCES) with the model SEAPODYM and provided by CLS.
- anchovy in the Bay of Biscay (IBI-PISCES) with the model SEAPODYM and provided by MOI.

3.1.4 Observational data available for product calibration/assimilation/validation

Data requirements depend on the model considered, but often involve fisheries landings data, scientific survey indices, spatial and temporal distribution of SPF species, length or weight-at-age, fishing mortalities. See section 4 for details about data used for computing each dataset.

3.1.5 Expected users' uptake

NECCTON proposes new developments enabling Copernicus Marine Service to model and deliver small pelagic fish biomass by all Monitoring Forecasting Centres (MFCs) with the objective of providing

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new useful information for decision making to all stakeholders involved in the management of fisheries and the conservation of marine ecosystems.

SPF biomass product can be used for research purposes (e.g. to investigate the dynamics of specific species under a changing climate), as a management tool for public authorities (decision makers), the general public and lastly for fishing industries.

3.1.6 List of co-products, sub-variables and metadata in the data-files for this product.

For clarity there is one table by co-product listed in table 2.1. Note that standard names are preliminary as they have not been validated.

Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
14.1	Small pelagic biomass
Sub-variable name [unit]	<i>Anchovy adults biomass</i> [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European anchovy <i>Engraulis encrasicolus</i>
Long name	Anchovy adults biomass distribution per square kilometre
Short name	Anchovy_biom
Standard_name	mass_content_of_anchovy_adults_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	<i>Anchovy adults age 1 biomass</i> [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European anchovy <i>Engraulis encrasicolus</i> (adults age 1 group)
Long name	Anchovy adults age 1 group biomass distribution per square kilometre
Short name	Anchovy_adults_age_1_biom
Standard_name	mass_content_of_anchovy_adults_age_1_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	<i>Anchovy adults age 2 biomass</i> [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European anchovy <i>Engraulis encrasicolus</i> (adults age 2 group)
Long name	Anchovy adults age 2 group biomass distribution per square kilometre
Short name	Anchovy_adults_age_2_biom
Standard_name	mass_content_of_anchovy_adults_age_2_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	<i>Anchovy adults age 3 biomass</i> [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European anchovy <i>Engraulis encrasicolus</i> (adults age 3 group)
Long name	Anchovy adults age 3 group biomass distribution per square kilometre

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Short name	Anchovy_adults_age_3_biom
Standard_name	mass_content_of_anchovy_adults_age_3_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	Anchovy adults age 4 biomass [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European anchovy <i>Engraulis encrasicolus</i> (adults age 4 group)
Long name	Anchovy adults age 4 group biomass distribution per square kilometre
Short name	Anchovy_adults_age_4_biom
Standard_name	mass_content_of_anchovy_adults_age_4_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	Anchovy adult wet weight [g _{ww}]
Description	Average monthly European anchovy <i>Engraulis encrasicolus</i> wet weight of adults
Long name	Anchovy adults wet weight per square kilometre
Short name	Anchovy_adults_weight
Standard_name	anchovy_adults_wet_weight
Sub-variable name [unit]	Anchovy age 1 adult wet weight [g _{ww}]
Description	Average monthly European anchovy <i>Engraulis encrasicolus</i> wet weight of age 1 adults
Long name	Anchovy age 1 adults wet weight per square kilometre
Short name	Anchovy_age_1_adults_weight
Standard_name	anchovy_age_1_adults_wet_weight
Sub-variable name [unit]	Anchovy age 2 adults wet weight [g _{ww}]
Description	Average monthly European anchovy <i>Engraulis encrasicolus</i> wet weight of age 2 adults
Long name	Anchovy age 2 adults wet weight per square kilometre
Short name	Anchovy_age_2_adults_weight
Standard_name	anchovy_age_2_adults_wet_weight
Sub-variable name [unit]	Anchovy age 3 adults wet weight [g _{ww}]
Description	Average monthly European anchovy <i>Engraulis encrasicolus</i> wet weight of age 3 adults
Long name	Anchovy age 3 adults wet weight per square kilometre
Short name	Anchovy_age_3_adults_weight
Standard_name	anchovy_age_3_adults_wet_weight

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Sub-variable name [unit]	<i>Anchovy age 4 adults wet weight</i> [g _{ww}]
Description	Average monthly European anchovy <i>Engraulis encrasicolus</i> wet weight of age 4 adults
Long name	Anchovy age 4 adults wet weight per square kilometre
Short name	Anchovy_age_4_adults_weight
Standard_name	anchovy_age_4_adults_wet_weight
Sub-variable name [unit]	<i>Anchovy average monthly egg production</i> [#eggs/m ²]
Description	Average monthly European anchovy <i>Engraulis encrasicolus</i> egg production
Long name	Anchovy average monthly number of eggs per square kilometre
Short name	Anchovy_egg_production
Standard_name	anchovy_monthly_egg_production
Sub-variable name [unit]	<i>Sardine adults biomass</i> [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European sardine <i>Sardina pilchardus</i>
Long name	Sardine adults biomass distribution per square kilometre
Short name	Sardine_biom
Standard_name	mass_content_of_sardine_adults_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	<i>Sardine adults age 1 biomass</i> [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European sardine <i>Sardina pilchardus</i> (adults age 1 group)
Long name	Sardine adults age 1 group biomass distribution per square kilometre
Short name	Sardine_adults_age_1_biom
Standard_name	mass_content_of_sardine_adults_age_1_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	<i>Sardine adults age 2 biomass</i> [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European sardine <i>Sardina pilchardus</i> (adults age 2 group)
Long name	Sardine adults age 2 group biomass distribution per square kilometre
Short name	Sardine_adults_age_2_biom
Standard_name	mass_content_of_sardine_adults_age_2_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	<i>Sardine adults age 3 biomass</i> [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European sardine <i>Sardina pilchardus</i> (adults age 3 group)

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Long name	Sardine adults age 3 group biomass distribution per square kilometre
Short name	Sardine_adults_age_3_biom
Standard_name	mass_content_of_sardine_adults_age_3_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	Sardine adults age 4 biomass [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European sardine <i>Sardina pilchardus</i> (adults age 4 group)
Long name	Sardine adults age 4 group biomass distribution per square kilometre
Short name	Sardine_adults_age_4_biom
Standard_name	mass_content_of_sardine_adults_age_4_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	Sardine adults age 5 biomass [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European sardine <i>Sardina pilchardus</i> (adults age 5 group)
Long name	Sardine adults age 5 group biomass distribution per square kilometre
Short name	Sardine_adults_age_5_biom
Standard_name	mass_content_of_sardine_adults_age_5_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	Sardine adults wet weight [g _{ww}]
Description	Average monthly European sardine <i>Sardina pilchardus</i> wet weight of adults
Long name	Sardine adults wet weight per square kilometre
Short name	Sardine_adults_weight
Standard_name	Sardine_adults_wet_weight
Sub-variable name [unit]	Sardine age 1 adults wet weight [g _{ww}]
Description	Average monthly European sardine <i>Sardina pilchardus</i> wet weight of age 1 adults
Long name	Sardine age 1 adults wet weight per square kilometre
Short name	Sardine_age_1_adults_weight
Standard_name	Sardine_age_1_adults_wet_weight
Sub-variable name [unit]	Sardine age 2 adults wet weight [g _{ww}]
Description	Average monthly European sardine <i>Sardina pilchardus</i> wet weight of age 2 adults
Long name	Sardine age 2 adults wet weight per square kilometre
Short name	Sardine_age_2_adults_weight
Standard_name	Sardine_age_2_adults_wet_weight

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Sub-variable name [unit]	<i>Sardine age 3 adults wet weight</i> [g _{ww}]
Description	Average monthly European sardine <i>Sardina pilchardus</i> wet weight of age 3 adults
Long name	Sardine age 3 adults wet weight per square kilometre
Short name	Sardine_age_3_adults_weight
Standard_name	Sardine_age_3_adults_wet_weight
Sub-variable name [unit]	<i>Sardine age 4 adults wet weight</i> [g _{ww}]
Description	Average monthly European sardine <i>Sardina pilchardus</i> wet weight of age 4 adults
Long name	Sardine age 4 adults wet weight per square kilometre
Short name	Sardine_age_4_adults_weight
Standard_name	Sardine_age_4_adults_wet_weight
Sub-variable name [unit]	<i>Sardine age 5 adults wet weight</i> [g _{ww}]
Description	Average monthly European sardine <i>Sardina pilchardus</i> wet weight of age 5 adults
Long name	Sardine age 5 adults wet weight per square kilometre
Short name	Sardine_age_5_adults_weight
Standard_name	Sardine_age_5_adults_wet_weight
Sub-variable name [unit]	<i>Sardine average monthly egg production</i> [#eggs/m ²]
Description	Average monthly European sardine <i>Sardina pilchardus</i> egg production
Long name	Sardine average monthly number of eggs per square kilometre
Short name	Sardine_egg_production
Standard_name	Sardine_monthly_egg_production

Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
14.2	Small pelagic biomass
Sub-variable name [unit]	<i>Sardine biomass</i> [g _{ww} /cell]
Description	Total biomass of all sardine <i>Sardina pilchardus</i> fish individuals older than 6 months present in the 2D-cells of the OSMOSE model, averaged over 2 time steps (i.e. a 1 month).
Long name	Sardine biomass per cell from individuals older than 6 months
Short name	Sardine_biom
Standard_name	mass_content_of_sardine_expressed_as_wet_weight_in_sea_water

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Sub-variable name [unit]	<i>Anchovy biomass</i> [g _{ww} /cell]
Description	Total biomass of all anchovy <i>Engraulis encrasicolus</i> fish individuals older than 6 months present in the 2D-cells of the OSMOSE model, averaged over 2 time steps (i.e. 1 month).
Long name	Anchovy biomass per cell from individuals older than 6 months
Short name	Anchovy_biom
Standard_name	mass_content_of_anchovy_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	<i>Sprat biomass</i> [g _{ww} /cell]
Description	Total biomass of all sprat <i>Sprattus sprattus</i> fish individuals older than 6 months present in the 2D-cells of the OSMOSE model, averaged over 2 time steps (i.e. 1 month).
Long name	Sprat biomass per cell from individuals older than 6 months
Short name	Sprat_biom
Standard_name	mass_content_of_sprat_expressed_as_wet_weight_in_sea_water

Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
14.3	Small pelagic biomass
Sub-variable name [unit]	<i>Anchovy adults biomass</i> [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European anchovy <i>Engraulis encrasicolus</i>
Long name	Anchovy adult's biomass distribution per square kilometre
Short name	Anchovy_biom
Standard_name	mass_content_of_anchovy_adults_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	<i>Anchovy adults age 1 biomass</i> [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European anchovy <i>Engraulis encrasicolus</i> (adults age 1 group)
Long name	Anchovy adult's age 1 group biomass distribution per square kilometre
Short name	Anchovy_adults_age_1_biom
Standard_name	mass_content_of_anchovy_adults_age_1_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	<i>Anchovy adults age 2 biomass</i> [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European anchovy <i>Engraulis encrasicolus</i> (adults age 2 group)
Long name	Anchovy adult's age 2 group biomass distribution per square kilometre
Short name	Anchovy_adults_age_2_biom

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Standard_name	mass_content_of_anchovy_adults_age_2_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	Anchovy adults age 3 biomass [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European anchovy <i>Engraulis encrasicolus</i> (adults age 3 group)
Long name	Anchovy adult's age 3 group biomass distribution per square kilometre
Short name	Anchovy_adults_age_3_biom
Standard_name	mass_content_of_anchovy_adults_age_3_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	Anchovy adults age 4 biomass [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European anchovy <i>Engraulis encrasicolus</i> (adults age 4 group)
Long name	Anchovy adult's age 4 group biomass distribution per square kilometre
Short name	Anchovy_adults_age_4_biom
Standard_name	mass_content_of_anchovy_adults_age_4_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	Sardine adults biomass [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European sardine <i>Sardina pilchardus</i>
Long name	Sardine adult's biomass distribution per square kilometre
Short name	Sardine_biom
Standard_name	mass_content_of_sardine_adults_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	Sardine adults age 1 biomass [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European sardine <i>sardina pilchardus</i> (adults age 1 group)
Long name	Sardine adult's age 1 group biomass distribution per square kilometre
Short name	Sardine_adults_age_1_biom
Standard_name	mass_content_of_sardine_adults_age_1_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	Sardine adults age 2 biomass [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European sardine <i>sardina pilchardus</i> (adults age 2 group)
Long name	Sardine adult's age 2 group biomass distribution per square kilometre
Short name	Sardine_adults_age_2_biom

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Standard_name	mass_content_of_Sardine_adults_age_2_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	<i>Sardine adults age 3 biomass</i> [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European sardine <i>sardina pilchardus</i> (adults age 3 group)
Long name	Sardine adult's age 3 group biomass distribution per square kilometre
Short name	Sardine_adults_age_3_biom
Standard_name	mass_content_of_sardine_adults_age_3_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	<i>Sardine adults age 4 biomass</i> [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European sardine <i>sardina pilchardus</i> (adults age 4 group)
Long name	Sardine adult's age 4 group biomass distribution per square kilometre
Short name	Sardine_adults_age_4_biom
Standard_name	mass_content_of_sardine_adults_age_4_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	<i>Sardine adults age 5 biomass</i> [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European sardine <i>sardina pilchardus</i> (adults age 5 group)
Long name	Sardine adult's age 5 group biomass distribution per square kilometre
Short name	Sardine_adults_age_5_biom
Standard_name	mass_content_of_sardine_adults_age_5_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	<i>Sardine adults age 6+ biomass</i> [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European sardine <i>sardina pilchardus</i> (adults age 6+ group)
Long name	Sardine adult's age 6+ group biomass distribution per square kilometre
Short name	<i>Sardine_adults_age_6+_biom</i>
Standard_name	mass_content_of_sardine_adults_age_6+_expressed_as_wet_weight_in_sea_water

Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
14.4	Small pelagic biomass

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Sub-variable name [unit]	<Taxonomic name> biomass [g _{ww} /m ²]
Description	Annual spatially resolved biomass of various small pelagic species as identified by their taxonomic name (e.g. <i>Sardina pilchardus</i> outputs will be <i>Sardina pilchardus</i> biomass) in gram per m ²
Long name	<Taxonomic name> biomass distribution per square kilometer
Short name	<TaxonomicName>_Biomass
Standard_name	<TaxonomicName>_biomass_expressed_as_grams_per_kilometer_square
Sub-variable name [unit]	<Taxonomic name> abundance [ind/m ²]
Description	Annual spatially resolved abundance of various small pelagic species as identified by their taxonomic name (e.g. <i>Sardina pilchardus</i> outputs will be <i>Sardina pilchardus</i> abundance) in number of individuals per m ²
Long name	<Taxonomic name> abundance distribution per square kilometer
Short name	<TaxonomicName>_abundance
Standard_name	<TaxonomicName>_abundance_expressed_as_individuals_per_kilometer_square

Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
14.5	Small pelagic biomass
Sub-variable name [unit]	<i>Small pelagic fish biomass</i> [g _{ww} /m ²]
Description	Total pelagic fish biomass for all sizes less than 100g wet weight
Long name	Sum of pelagic fish less than 100 g wet weight
Short name	Small_pel_biom
Standard_name	mass_content_of_small_pelagic_fish_expressed_as_wet_weight_in_sea_water

Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
14.6, 14.7, 14.8, 14.9, 14.10	Small pelagic biomass
Sub-variable name [unit]	<i>Total small pelagic biomass</i> [g _{ww} /m ²]
Description	Average annual total biomass of small pelagic fish with an asymptotic (maximum) body length of < 30 cm
Long name	Annual average total small pelagic biomass
Short name	Small_pelagic_biom
Standard_name	total_wet_weight_of_small_pelagic_fish
Sub-variable name [unit]	<i>Small pelagic SSB</i> [g _{ww} /m ²]

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Description	Average annual spawning stock biomass (SSB; biomass of mature individuals) of small pelagic fish with an asymptotic (maximum) body length of < 30 cm
Long name	Annual average small pelagic SSB
Short name	Small_pelagic_SSB
Standard_name	SSB_wet_weight_of_small_pelagic_fish
Sub-variable name [unit]	<i>Small_pelagic_feeding_level [-]</i>
Description	Annual average feeding level of adult small pelagic fish with an asymptotic (maximum) body length of < 30 cm, defined as the ratio between consumption and maximum consumption.
Long name	Annual average small pelagic feeding level
Short name	small pelagic feeding level
Standard_name	small_pelagic_fish_feeding_level
Sub-variable name [unit]	<i>Small_pelagic_adult_weight [g_{ww}/m²]</i>
Description	Annual average wet weight of adult individuals of small pelagic fish with an asymptotic (maximum) body length of < 30 cm.
Long name	Annual average small pelagic adult wet weight
Short name	Small_pelagic_average_adult_weight
Standard_name	small_pelagic_fish_adult_weight
Sub-variable name [unit]	<i>Small_pelagic_maturation_flux [g_{ww} m⁻²/year]</i>
Description	Annual average flux of maturing individuals of small pelagic fish with an asymptotic (maximum) body length of < 30 cm.
Long name	Annual small pelagic maturation flux
Short name	Small_pelagic_average_maturity_flux
Standard_name	small_pelagic_fish_maturation_flux
Sub-variable name [unit]	<i>Small_pelagic_predation_mortality [1/year]</i>
Description	Annual average predation mortality on small pelagic fish with an asymptotic (maximum) body length of < 30 cm.
Long name	Annual small pelagic predation mortality
Short name	Small_pelagic_predation_mortality
Standard_name	small_pelagic_fish_predation_mortality

Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
14.11	Small pelagic biomass
Sub-variable name [unit]	<i>Mackerel juveniles biomass [g_{ww}/m²]</i>
Description	Average yearly spatial biomass distribution of North Atlantic Scomber scombrus (juveniles)
Long name	Mackerel juveniles biomass distribution per square kilometre

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Short name	mackerel_juveniles_biom
Standard_name	mass_content_of_mackerel_juvenile_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	<i>Mackerel adults biomass</i> [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of North Atlantic Scomber scombrus (adult)
Long name	Mackerel adults biomass distribution per square kilometre
Short name	mackerel_adults_biom
Standard_name	mass_content_of_mackerel_adults_age_1+_expressed_as_wet_weight_in_sea_water

Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
14.12	Small pelagic biomass
Sub-variable name [unit]	<i>Anchovy juveniles biomass</i> [g _{ww} /m ²]
Description	Average yearly spatial biomass distribution of European anchovy <i>Engraulis encrasicolus</i> (juveniles)
Long name	Anchovy juvenile's biomass distribution per square kilometre
Short name	Anchovy_juveniles_biom
Standard_name	mass_content_of_anchovy_juvenile_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	<i>Anchovy adults age 1+ biomass</i> [g _{ww} /m ²]
Description	Average yearly spatial biomass distribution of European anchovy <i>Engraulis encrasicolus</i> (adults age 1+ group)
Long name	Anchovy adult's age 1+ group biomass distribution per square kilometre
Short name	Anchovy_adults_biom
Standard_name	mass_content_of_anchovy_adults_age_1+_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	<i>Sardine juveniles biomass</i> [g _{ww} /m ²]
Description	Average yearly spatial biomass distribution of European sardine <i>Sardina pilchardus</i> (juveniles)
Long name	Sardine juveniles biomass distribution per square kilometre
Short name	Sardine_juveniles_biom
Standard_name	mass_content_of_sardine_juvenile_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	<i>Sardine adults age 1+ biomass</i> [g _{ww} /m ²]

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Description	Average monthly spatial biomass distribution of European sardine <i>Sardina pilchardus</i> (adults age 1+ group)
Long name	Sardine adult's age 1+ group biomass distribution per square kilometre
Short name	Sardine_adults_biom
Standard_name	mass_content_of_sardine_adults_age_1+_expressed_as_wet_weight_in_sea_water

Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
14.13	Small pelagic biomass
Sub-variable name [unit]	<i>Anchovy number of recruits</i> [#ind./m ²]
Description	Number of recruits of anchovy <i>Engraulis encrasicolus</i> expressed as number of individuals. Recruits are the number of individuals entering the first exploited cohort of the population; the age (size) being thus linked to the types of fishing gears in the fisheries.
Long name	Density distribution of anchovy recruits in number of individuals per square meter
Short name	anchovy_n_recruits
Standard_name	Number_of_recruits_of_anchovy_expressed_as_number_in_sea_water
Sub-variable name [unit]	<i>Immature anchovy biomass</i> [g _{ww} /m ²]
Description	Mass content of young immature anchovy <i>Engraulis encrasicolus</i> expressed as wet weight. Immature includes all age cohorts from age of recruitment to age at maturity.
Long name	Biomass distribution of immature anchovy in gram per square meter
Short name	anchovy_c_immature
Standard_name	mass_content_of_immature_anchovy_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	<i>Adult anchovy biomass</i> [g _{ww} /m ²]
Description	Mass content in wet weight of adult anchovy <i>Engraulis encrasicolus</i> expressed as wet weight. Adult biomass includes all age cohorts after age of maturity and can be used as spawning biomass.
Long name	Biomass distribution of adult anchovy in gram per square meter
Short name	anchovy_c_adult
Standard_name	mass_content_of_adult_anchovy_expressed_as_wet_weight_in_sea_water

Co-product I	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
14.14	Small pelagic biomass

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Sub-variable name [unit]	<i>Anchovy adults biomass</i> [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of European anchovy <i>Engraulis encrasicolus</i>
Long name	Anchovy adults biomass distribution per square kilometre
Short name	Anchovy_biom
Standard_name	mass_content_of_anchovy_adults_expressed_as_wet_weight_in_sea_water

Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
14.15	Small pelagic biomass
Sub-variable name [unit]	<i>Small pelagic fish biomass</i> [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of small pelagic fish: Anchoveta, Sand smelt, European anchovy, Capelin, Surf smelt, Hectors lanternfish, Atlantic silverside, Yellowstripe scad, Antarctic silverfish, Bay anchovy, Atlantic anchoveta, Pacific anchoveta, Shorthead anchovy, Broad-striped anchovy, European pilchard, European sprat, Rainbow sardine, Slender rainbow sardine, Red-eye round herring, Whiteheads round herring, Silverstriped round herring, Falkland sprat, Black Sea sprat, Redear herring, Pacific thread herring, Bluestripe herring, Brazilian sardinella, Goldstripe sardinella, Bali sardinella, Indian oil sardine, Japanese sardinella, Araucanian herring, Brazilian menhaden, Gulf menhaden, Pacific menhaden, Chinese gizzard shad, Blochs gizzard shad, Chacunda gizzard shad, Indian pellona, Argentine anchovy, Cape anchovy, Japanese anchovy, Californian anchovy, Bermuda anchovy, Japanese scad, Silverside, Unicorn cod, Feathered river-garfish, Baltic herring, Baltic sprat
Long name	Small pelagic fish biomass distribution per square kilometre
Short name	FG_small_pelagic_biomass
Standard_name	Aggregated_mass_content_of_small_pelagic_fish_expressed_as_wet_weight_in_sea_water

3.2 Product Large pelagics

3.2.0 Introduction

The current Copernicus Marine Service does not include operational models for large pelagic fish species and other higher trophic levels of marine ecosystems (HTL). This limitation prevents Copernicus Marine Service from providing stakeholders with products to assess the diversity and biomass of commercial or endangered marine species. Implementing operational models for HTL is a challenge due to the complexity of biological systems and hence their modelling. HTL models are also more diverse than physical or biogeochemical models since they target multiple questions for management and conservation, ranging from ecosystem services to catch quotas or fishing area closures for specific species or fisheries. NECCON propose new developments enabling Copernicus

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Marine Service to model and deliver HTL products by all MFCs with the objective of providing new useful decision-tools to all stakeholders involved in the management of fisheries and conservation of marine ecosystems.

3.2.1 User feedback and requirements

The user feedback indicated that the large pelagics product might be useful to around one third of the users. The majority of these potential users is interested in species-specific products followed by the biomass of by size-groups or functional groups. In terms of required spatial resolution, the smallest expressed requirement is a 1 km resolution, while for temporal resolution there is mainly interest in daily and monthly values. Hindcasts starting around 1990 are most demanded, with monthly or annual updates. Concerning scenario runs, standard IPCC meet the demand, while for fishing scenarios, no common needs emerge.

3.2.2 State-of-the-art on product delivery and gaps

There is currently no product on large pelagic species in the Copernicus Marine service.

3.2.3 How NECCTON will innovate the product and fill the gap

For large pelagic species (LPS), NECCTON will use two different modelling approaches to demonstrate the interest of integrating the improved and new ocean variables generated in the other NECCTON work packages. Large pelagic species can be included in ecosystem biomass models (EcoBM) with different degrees of details, either in a broad category with other similar species, a single species group or even separate juvenile and adult mature groups. This approach will be illustrated with:

- key LPS at global (GLO-PISCES) or regional levels (NWS-ERSEM, IBI-PISCES, BAL-ERGOM, MED-BFM) using the model FEISTY developed by DTU.
- key LPS in the Global Ocean (GLO_PISCES) using the model EcoOcean provided by EII.

The second approach used is Species Population Models (SpPM) that describe the dynamics of one or several species with much more details, e.g. movements, age structure, fishing and natural mortalities, reproduction processes. This approach will be used for:

- Tropical tunas (extraction of GLO-PISCES) with the model SEAPODYM and provided (in-kind) by MOi to develop a use case in WP9.

3.2.4 Observational data needs for product calibration/assimilation/validation

Data requirements depend on the model considered, but often involve landings database, scientific survey indices, spatial and temporal distributions of species, length or weight-at-age, fishing mortalities. See section 4 for details about data used for computing each dataset.

3.2.5 Expected users' uptake

Not all model developments are at the same operational readiness level. However, several of them for each modelling approach will be used in the WG9 to develop use cases in collaboration with concerned stakeholders, allowing to evaluate the interest of improved Copernicus Marine Service physical and biogeochemical products and their use in new generations of fish and ecosystem models.

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3.2.6 List of co-products, sub-variables and metadata in the data-files for this product

Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
15.1	Large pelagics
Sub-variable name [unit]	<Taxonomic name> biomass [g _{ww} /m ²]
Description	Annual spatially resolved biomass of tuna species of interest as identified by their taxonomic name (e.g. <i>Thunnus albacares</i> outputs will be ThunnusAlbacares_Biomass) in gram per m ²
Long name	<TaxonomicName> distribution per square kilometer
Short name	<TaxonomicName>_Biomass
Standard_name	<TaxonomicName> biomass_expressed_as_grams_per_kilometer_square
Sub-variable name [unit]	<Taxonomic name> abundance [#ind/m ²]
Description	Annual spatially resolved abundance of tuna species of interest as identified by their taxonomic name (e.g. <i>Thunnus albacares</i> outputs will be ThunnusAlbacares_Abundance) in number of individuals per m ²
Long name	<TaxonomicName> abundance distribution per square kilometer
Short name	<TaxonomicName>_Abundance
Standard_name	TaxonomicName_abundance_expressed_as_individuals_per_kilometer_square

Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
15.2, 15.3, 15.4, 15.5, 15.6	Large pelagics
Sub-variable name [unit]	Total large pelagic biomass [g _{ww} /m ²]
Description	Average annual total biomass of large pelagic fish with an asymptotic (maximum) body length of > 30 cm
Long name	Annual average total large pelagic biomass
Short name	Large_pelagic_biom
Standard_name	total_wet_weight_of_large_pelagic_fish
Sub-variable name [unit]	Large pelagic SSB [g _{ww} /m ²]
Description	Average annual spawning stock biomass (SSB; biomass of mature individuals) of large pelagic fish with an asymptotic (maximum) body length of > 30 cm
Long name	Annual average large pelagic SSB
Short name	Large_pelagic_SSB
Standard_name	SSB_wet_weight_of_large_pelagic_fish
Sub-variable name [unit]	Large pelagic feeding level [-]

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Description	Annual average feeding level of adult large pelagic fish with an asymptotic (maximum) body length of > 30 cm, defined as the ratio between consumption and maximum consumption.
Long name	Annual average large pelagic feeding level
Short name	Large_pelagic_feeding_level
Standard_name	large_pelagic_fish_feeding_level
Sub-variable name [unit]	Large pelagic adult weight [g _{ww} /m ²]
Description	Annual average wet weight of adult individuals of large pelagic fish with an asymptotic (maximum) body length of > 30 cm.
Long name	Annual average large pelagic adult wet weight
Short name	large_pelagic_average_adult_weight
Standard_name	large_pelagic_fish_adult_weight
Sub-variable name [unit]	Large pelagic maturation flux [g _{ww} m ⁻² /year]
Description	Annual average flux of maturing individuals of large pelagic fish with an asymptotic (maximum) body length of > 30 cm.
Long name	Annual large pelagic maturation flux
Short name	large_pelagic_average_maturity_flux
Standard_name	large_pelagic_fish_maturation_flux
Sub-variable name [unit]	Large pelagic predation mortality [1/year]
Description	Annual average predation mortality on large pelagic fish with an asymptotic (maximum) body length of > 30 cm.
Long name	Annual large pelagic predation mortality
Short name	Large_pelagic_predation_mortality
Standard_name	large_pelagic_fish_predation_mortality

Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
15.7	Large pelagics
Sub-variable name [unit]	<i>Skipjack number of recruits</i> [#ind./m ²]
Description	Number of recruits of skipjack tuna <i>Katsuwonus pelamis</i> expressed as number of individuals. Recruits are the number of individuals entering the first exploited cohort of the population; the age (size) being thus linked to the types of fishing gears in the fisheries.
Long name	Density distribution of skipjack tuna recruits in number of individuals per square meter
Short name	skj_n_recruits
Standard_name	Number_of_recruits_of_skipjack_expressed_as_number_in_sea_water
Sub-variable name [unit]	<i>Immature skipjack biomass</i> [g _{ww} /m ²]

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Description	Mass content of young immature skipjack tuna <i>Katsuwonus pelamis</i> expressed as wet weight. Immature includes all age cohorts from age of recruitment to age at maturity.
Long name	Biomass distribution of immature skipjack tuna in gram per square meter
Short name	skj_c_immature
Standard_name	mass_content_of_immature_skipjack_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	Adult skipjack biomass [g_{ww}/m^2]
Description	Mass content of adult skipjack tuna <i>Katsuwonus pelamis</i> expressed as wet weight. Adult biomass includes all age cohorts after age of maturity and can be used as spawning biomass.
Long name	Biomass distribution of adult skipjack tuna in gram per square meter
Short name	skj_c_adult
Standard_name	mass_content_of_adult_skipjack_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	Yellowfin number of recruits [#ind./ m^2]
Description	Number of recruits of yellowfin tuna <i>Thunnus albacares</i> expressed as number of individuals. Recruits are the number of individuals entering the first exploited cohort of the population; the age (size) being thus linked to the types of fishing gears in the fisheries.
Long name	Density distribution of yellowfin tuna recruits in number of individuals per square meter
Short name	yft_n_recruits
Standard_name	Number_of_recruits_of_yellowfin_expressed_as_number_in_sea_water
Sub-variable name [unit]	Immature yellowfin biomass [$g\ m^{-2}$]
Description	Mass content of young immature yellowfin tuna <i>Thunnus albacares</i> expressed as wet weight. Immature includes all age cohorts from age of recruitment to age at maturity.
Long name	Biomass distribution of immature yellowfin tuna in gram per square meter
Short name	yft_c_immature
Standard_name	mass_content_of_immature_yellowfin_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	Adult yellowfin biomass [g_{ww}/m^2]
Description	Mass content of adult yellowfin tuna <i>Thunnus albacares</i> expressed as wet weight. Adult biomass includes all age cohorts after age of maturity and can be used as spawning biomass.
Long name	Biomass distribution of adult yellowfin tuna in gram per square meter
Short name	yft_c_adult
Standard_name	mass_content_of_adult_yellowfin_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	Bigeye number of recruits [#ind./ m^2]
Description	Number of recruits of bigeye tuna <i>Thunnus obesus</i> expressed as number of individuals. Recruits are the number of individuals entering the first

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	exploited cohort of the population; the age (size) being thus linked to the types of fishing gears in the fisheries.
Long name	Density distribution of bigeye tuna recruits in number of individuals per square meter
Short name	bet_n_recruits
Standard_name	Number_of_recruits_of_bigeye_expressed_as_number_in_sea_water
Sub-variable name [unit]	Immature bigeye biomass [g_{ww}/m^2]
Description	Mass content of young immature bigeye tuna <i>Thunnus obesus</i> expressed as wet weight. Immature includes all age cohorts from age of recruitment to age at maturity.
Long name	Biomass distribution of immature bigeye tuna in gram per square meter
Short name	bet_c_immature
Standard_name	mass_content_of_immature_bigeye_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	Adult bigeye biomass [g_{ww}/m^2]
Description	Mass content of adult bigeye tuna <i>Thunnus obesus</i> expressed as wet weight. Adult biomass includes all age cohorts after age of maturity and can be used as spawning biomass.
Long name	Biomass distribution of adult bigeye tuna in gram per square meter
Short name	bet_c_adult
Standard_name	mass_content_of_adult_bigeye_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	Albacore number of recruits [# ind./ m^2]
Description	Number of recruits of albacore tuna <i>Thunnus alalunga</i> expressed as number of individuals. Recruits are the number of individuals entering the first exploited cohort of the population; the age (size) being thus linked to the types of fishing gears in the fisheries.
Long name	Density distribution of albacore tuna recruits in number of individuals in gram per square meter
Short name	alb_n_recruits
Standard_name	Number_of_recruits_of_albacore_expressed_as_number_in_sea_water
Sub-variable name [unit]	Immature albacore biomass [g_{ww}/m^2]
Description	Mass content of young immature bigeye tuna <i>Thunnus alalunga</i> expressed as wet weight. Immature includes all age cohorts from age of recruitment to age at maturity.
Long name	Biomass distribution of immature albacore tuna in gram per square meter
Short name	alb_c_immature
Standard_name	mass_content_of_immature_albacore_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	Adult albacore biomass [g_{ww}/m^2]
Description	Mass content of adult albacore tuna <i>Thunnus alalunga</i> expressed as wet weight. Adult includes all age cohorts after age of maturity and can be used as spawning biomass.

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Long name	Biomass distribution of adult albacore tuna in gram per square meter
Short name	alb_c_adult
Standard_name	mass_content_of_adult_albacore_expressed_as_wet_weight_in_sea_water

Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
15.8	Large pelagics
Sub-variable name [unit]	<i>Large pelagics fish biomass</i> [g _{ww} /m ²]
Description	Average monthly spatial biomass distribution of large pelagic fish: Common dolphinfish, Indo-Pacific sailfish, Atlantic sailfish, Wahoo, Kawakawa, Little tunny, Skipjack tuna, Plain bonito, Eastern Pacific bonito, Striped bonito, Atlantic bonito, Serra Spanish mackerel, Narrow-barred Spanish mackerel, Japanese Spanish mackerel, Pacific sierra, West African Spanish mackerel, Albacore, Yellowfin tuna, Blackfin tuna, Southern bluefin tuna, Bigeye tuna, Atlantic bluefin tuna, Longtail tuna, Atlantic blue marlin, Black marlin, Indo-Pacific blue marlin, Atlantic white marlin, Longbill spearfish, Striped marlin, Swordfish, Indo-Pacific tarpon, Bluefish, Rainbow runner, Leerfish, Flat needlefish, Hound needlefish, Tarpon, Great barracuda, Whitefin wolf-herring, Ocean sunfish, King of herrings, Cobia, Shortbill spearfish, Pacific bonito, Pacific bluefin tuna
Long name	Large pelagic fish biomass distribution per square kilometre
Short name	FG_large_pelagics_biomass
Standard_name	aggregated_mass_content_of_large_pelagic_fish_expressed_as_wet_weight_in_sea_water

3.3 Product Demersal fish biomass

3.3.0 Introduction

The demersal fish are those species that spend a fraction of their lives in close association with the seabed, feeding primarily on bottom organisms. A typical example of a demersal fish is cod (*Gadus morhua*). Demersal fish are often an important target of fisheries in marine shelf ecosystems. Demersal fish act as couplers of pelagic and benthic energy pathways.

3.3.1 User feedback and requirements

The user feedbacks and needs for a demersal fish biomass product are similar to those for unspecified fish biomass.

3.3.2 State-of-the-art on product delivery and gaps

Reconstructed time series of biomass and number individuals from stock assessments for the most important commercial species are available at portals of entities involved in stock assessment (e.g., SAC-GFCM, ICES). This information, however, is not spatialized. Furthermore, observational data (presence/absence) in time and space for some species might be available on portals such as EMODnet and OBIS, but they do not represent any elaborated product. For example, maps of nursery areas for

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demersal species habitats are available on the EMODnet Biology platform, but these products are limited in space. Other products such as distribution maps of demersal species, hot spots of aggregation and fishing ground maps for different areas are also available in different depositories (e.g. <https://doi.org/10.5281/zenodo.8383750>). There is currently no product on “Demersal fish biomass” in the Copernicus Marine Service.

3.3.3 How NECCTON will innovate the product and fill the gap

Demersal biomass is a new product. NECCTON uses inputs of depth and detrital flux to the sea floor to model the demersal biomass applying the ecosystem biomass model (EcoBM) at global (GLO-PISCES) or regional levels (NWS-ERSEM, IBI-PISCES, BALERGOM, MED-BFM) using the FEISTY model developed by DTU.

3.3.4 Observational data needs for product calibration/assimilation/validation

Data requirements depend on the model considered, but often involve landings database, scientific survey indices, spatial and temporal distribution of demersal species, length or weight-at-age, fishing mortalities. See section 4 for details about data used for computing each dataset.

3.3.5 Expected users’ uptake

Demersal fish biomass is particularly relevant for fisheries applications because demersal species are an important fisheries target by bottom trawling (in contrast to the pelagic species which are usually targeted by long lines, seines, or pelagic trawl).

3.3.6 List of co-products, sub-variables and metadata in the data-files for this product

Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
16.1, 16.2, 16.3, 16.4, 16.5	Demersal fish biomass
Sub-variable name [unit]	Total demersal fish biomass [g _{ww} /m ²]
Description	Average annual total biomass of demersal fish
Long name	Annual average total demersal fish biomass
Short name	demersal_fish_biom
Standard_name	total_wet_weight_of_demersal_fish
Sub-variable name [unit]	Demersal fish SSB [g _{ww} /m ²]
Description	Average annual spawning stock biomass (SSB; biomass of mature individuals) of demersal fish

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Long name	Annual average demersal fish SSB
Short name	demersal_fish_SSB
Standard_name	SSB_wet_weight_of_demersal_fish
Sub-variable name [unit]	<i>Demersal fish feeding level [-]</i>
Description	Annual average feeding level of adult demersal fish, defined as the ratio between consumption and maximum consumption.
Long name	Annual average demersal fish feeding level
Short name	demersal_fish_feeding_level
Standard_name	demersal_fish_feeding_level
Sub-variable name [unit]	<i>Demersal fish adult weight</i> [g _{ww} /m ²]
Description	Annual average wet weight of adult individuals of demersal fish.
Long name	Annual average demersal fish adult wet weight
Short name	<i>demersal_fish_average_adult_weight</i>
Standard_name	demersal_fish_adult_weight
Sub-variable name [unit]	<i>Demersal fish maturation flux</i> [g _{ww} m ² /year]
Description	Annual average flux of maturing individuals of demersal fish.
Long name	Annual demersal fish maturation flux
Short name	<i>Demersal_fish_average_maturity_flux</i>
Standard_name	Demersal_fish_maturation_flux
Sub-variable name [unit]	<i>Demersal fish predation mortality</i> [1/year]
Description	Annual average predation mortality on demersal fish.
Long name	Annual demersal fish predation mortality
Short name	demersal_fish_predation_mortality

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Standard_name	demersal_fish_predation_mortality
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Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
16.6	Demersal fish biomass
Sub-variable name [unit]	<i>Demersal fish species juvenile biomass</i> [g _{ww} /m ²]
Description	Average yearly spatial biomass distribution of demersal fish species (juveniles)
Long name	Demersal fish species juvenile's biomass distribution per square kilometre
Short name	demersal_fish_juveniles_biom
Standard_name	mass_content_of_demersal_fish_juvenile_expressed_as_wet_weight_in_sea_water
Sub-variable name [unit]	<i>Demersal fish species adults age 1+ biomass</i> [g _{ww} /m ²]
Description	Average yearly spatial biomass distribution of demersal fish species (adults age 1+ group)
Long name	Demersal fish species adult's age 1+ group biomass distribution per square kilometre
Short name	Demersal_fish_adults_biom
Standard_name	mass_content_of_demersal_fish_adults_age_1+_expressed_as_wet_weight_in_sea_water

Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
16.7	Demersal fish biomass
Sub-variable name [unit]	<Taxonomic name> <i>biomass</i> [g _{ww} /m ²]
Description	Annual spatially resolved biomass of various demersal species as identified by their taxonomic name in gram per m ²
Long name	<Taxonomic name> biomass distribution per square kilometer
Short name	<TaxonomicName>_Biomass
Standard_name	<TaxonomicName>_biomass_expressed_as_grams_per_kilometer_square
Sub-variable name [unit]	<Taxonomic name> <i>abundance</i> [ind/ m ²]
Description	Annual spatially resolved abundance of various demersal species as identified by their taxonomic name in number of individuals per m ²
Long name	<Taxonomic name> abundance distribution per square kilometer
Short name	<TaxonomicName>_abundance

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Standard_name	<TaxonomicName>_abundance_expressed_as_individuals_per_kilometer_square
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3.4 Product Unspecified fish biomass

3.4.0 Introduction

“Unspecified fish biomass” are those fish species that do not fall into the categories of small pelagic species, large pelagic species or demersal fish species (both small and large). In NECCTON this would be the total biomass of all fish, i.e. include all these biological subcomponents.

3.4.1 User feedback and requirements

Products for unspecified fish biomass was of interest for half the consulted potential future users for use in ecosystem-based management, gain ecological knowledge, and as input to ecosystem modelling. In terms of required spatial resolution, the smallest expressed requirement is a 1 km resolution, while for temporal resolution there is mainly interest in daily and monthly values. Hindcasts starting around 1990 are most demanded, with monthly or annual updates. Concerning scenario runs, standard IPCC meet the demand, while for fishing scenarios, no common needs emerge.

3.4.2 State-of-the-art on product delivery and gaps

There is currently no product on “unspecified fish biomass” in the Copernicus Marine service.

3.4.3 How NECCTON will innovate the product and fill the gap

The “unspecified fish biomass” product is typically the total biomass summed across species, or, in some cases, the unspecified planktivorous or piscivores/benthivorous fish biomass by size group or functional group.

For unspecified fish biomass, NECCTON will use the same types of modelling approaches as for small pelagics and large pelagics. The ecosystem biomass modelling (EcoBM) approach will be illustrated:

- at global (GLO-PISCES) or regional levels (NWS-ERSEM, IBI-PISCES, BALERGOM, MED-BFM) using the model FEISTY developed by DTU.
- in the northwest Atlantic (NWS-ERSEM) using the MIZER model developed by PML.
- in the Arctic (ARC-ECOSMO) and the Baltic Sea (BAL-ERGOM) using the model E2E provided by HEREON.

The species distribution modelling (SpDM) approach will be applied:

- in the northwest Atlantic (NWS-ERSEM) using the SS-DEBM model developed by PML.
- in the Mediterranean Sea (MED-BFM) using the E-SDM model developed by OGS.

Lastly, the species population models (SpPM) approach will be demonstrated:

- in the Bay of Biscay (NWS-ERSEM) using the OSMOSE model developed by Ifremer.

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3.4.4 Observational data available for product calibration/assimilation/validation

Data requirements depend on the model considered, but often involve landings database, scientific survey indices, spatial and temporal distribution of all fish species, length or weight-at-age, fishing mortalities. See section 4 for details about data used for computing each dataset.

3.4.5 Expected users' uptake

NECCTON propose new developments enabling Copernicus Marine Service to model and “unspecified fish biomass” by all MFCs with the objective of providing new useful decision-tools to all stakeholders involved in the management of fisheries and conservation of marine ecosystems.

3.4.6 List of co-products, sub-variables and metadata in the data-files for this product

Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
17.1	Unspecified fish biomass
Sub-variable name [unit]	<i>Fish biomass</i> [g _{ww} /cell]
Description	Total biomass of all fish individuals older than 6 months present in the 2D-cells of the OSMOSE model, averaged over 2 time steps (a time step corresponds to half a month). In OSMOSE, 18 species of fish are explicitly modelled through interacting individuals. Pelagic species, benthodemersal species are included and are all summed up here to produce a total biomass of fish.
Long name	Fish biomass per cell from individuals older than 6 months
Short name	Fish_biom
Standard_name	mass_content_of_fish_expressed_as_wet_weight_in_sea_water

Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
17.2	Unspecified fish biomass
Sub-variable name [unit]	<i>Fish biomass</i> [g _{ww} /m ²]
Description	Total fish biomass expressed as wet weight per m squared. In MIZER this equates to the sum of 100 different size classes of fish.
Long name	Total fish biomass expressed as wet weight per m squared.
Short name	Fish_biom
Standard_name	mass_content_of_fish_expressed_as_wet_weight_in_sea_water

Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
17.3, 17.4	Unspecified fish biomass

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Sub-variable name [unit]	<i>Planktivorous fish biomass</i> [g _{ww} /m ²]
Description	"planktivorous_fish_biomass" means the total predominantly planktivorous fish biomass. The product does not differentiate individual species and is calculated as a functional group in the E2E model parts of ECOSMO. Aside from mainly feeding on plankton, also other foodweb components (such as dead organic matter and Macrobenthos), to a lesser degree, are part of their diet. "Mass concentration" means mass per unit volume and is used in the construction "mass_concentration_of_X_in_Y", where X is a material constituent of Y.
Long name	Dominantly planktivorous fish biomass calculated as a functional group
Short name	Planktivorous_fish_biomass
Standard name	mass_concentration_of_planktivorous_fish_biomass_expressed_as_carbon_in_sea_water
Sub-variable name [unit]	<i>Piscivorous and benthivorous fish biomass</i> [g _{ww} /m ²]
Description	"piscivorous_and_benthivorous_fish_biomass" means the total predominantly piscivorous and benthivorous fish biomass. The product does not differentiate individual species and is considered as a functional group in the E2E model parts of ECOSMO. Besides mainly feeding on fish and macrobenthos, also other foodweb components (such as plankton and dead organic matter), to a lesser degree, are part of their diet. "Mass concentration" means mass per unit volume and is used in the construction "mass_concentration_of_X_in_Y", where X is a material constituent of Y.
Long name	Dominantly Piscivorous and benthivorous fish biomass calculated as a functional group
Short name	Piscivorous_and_benthivorous_fish_biomass
Standard name	mass_concentration_of_piscivorous_and_benthivorous_fish_biomass_expressed_as_carbon_in_sea_water

Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
17.5, 17.6, 17.7, 17.8, 17.9	Unspecified fish biomass

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Sub-variable name [unit]	Fish biomass [g _{ww} /m ²]
Description	Average annual biomass of all fish
Long name	Annual average fish biomass
Short name	Total_fish_biom
Standard_name	wet_weight_of_fish
Sub-variable name [unit]	Fish SSB [g _{ww} /m ²]
Description	Average annual spawning stock biomass (SSB; biomass of mature individuals) of all fish
Long name	Annual average fish SSB
Short name	total_fish_SSB
Standard_name	SSB_wet_weight_of_fish
Sub-variable name [unit]	Fish maturation flux [g _{ww} m ⁻² /year]
Description	Annual average flux of maturing individuals of all fish.
Long name	Annual fish maturation flux
Short name	total_fish_average_maturity_flux
Standard_name	fish_maturation_flux

3.5 Product Marine mammal habitat

3.5.0 Introduction

Understanding the distribution of marine mammals (MM) is essential to gain insights into their ecology and population dynamics, to implement conservation and management measures and assess their effectiveness, and to project the future of the ecosystem services and goods they provide (food provisioning, top-down control of the food web, carbon regulation, tourism, and leisure). The current Copernicus Marine Service does not include any products for large marine top predators such as marine mammals. This limitation prevents Copernicus Marine Service from providing stakeholders with products to assess the role of large marine top predators on the ecosystem. NECCON will provide a new HTL model for marine mammals with the objective of providing new useful decision-tools to all stakeholders involved in the management or conservation of high trophic levels.

3.5.1 User feedback and requirements

The stakeholder feedback stressed the strong demand for marine mammal products for use in conservation, environmental impact assessments and indicator calculation, or for defining shipping routes avoiding marine mammals. More than half of the questionnaire respondents were interested in marine mammal products. In terms of required spatial resolution, the smallest expressed requirement is a 1 km resolution, while for temporal resolution there is mainly interest in daily and monthly values. Hindcasts starting around 1990 are most demanded, with monthly or annual updates. Concerning scenario runs, standard IPCC meet the demand, while for fishing scenarios, no common needs emerge.

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NECCTON outputs will feed directly to the Copernicus Marine Service user community and will impact a wider range of application sectors and policies than currently covered by Copernicus Marine Service, as will be demonstrated in NECCTON’s case studies. This wider range includes an extended capacity for marine protected area management, biodiversity convention considerations, SDG reporting, fish stock management and biodiversity monitoring in a context of climate change.

3.5.2 State-of-the-art on product delivery and gaps

Observational data (presence/absence) in time and space for some marine mammal’s species might be available on portals such as OBIS but these are sparse data, scattered in space and are not resulting from elaboration with EOVs. There is currently no product on marine mammals and high trophic level in the Copernicus Marine Service.

3.5.3 How NECCTON will innovate the product and fill the gap

NECCTON will develop ecosystem biomass models (EcoBM) for explaining marine mammal observations with environmental factors and prey variables as well as species distribution models (SpDM) that statistically relate animal observations to environmental and prey variables and have been successfully used to explain and predict distribution patterns of marine predators in a variety of ecosystems and at multiple spatio-temporal scales. Both approaches can effectively forecast animal distributions but depend on the availability of ecologically meaningful environmental data at the appropriate spatial and temporal resolutions. NECCTON will use biogeochemical and lower trophic level products to provide new HTL products for marine mammals around the Azores using the generalised additive models (GAM) developed by IMAR.

The ecosystem biomass modelling (EcoBM) approach will be illustrated:

- for the Adriatic Sea (MED/Adriatic-BFM) using the ECOSPACE model developed by OGS.

The species distribution modelling (SpDM) approach will be applied:

- around the Azores (GLO/Atl.-PISCES-LMTL) using generalised additive models (GAM) developed by IMAR

NECCTON will develop high trophic level model that will account for dolphin observations, environmental factors and prey variables. The ECOSPACE ecosystem model have been successfully used to explain and predict distribution patterns of marine predators in a variety of ecosystems and at multiple spatio-temporal scales. Developing ECOSPACE can effectively forecast animals’ distribution depends on the availability of ecologically meaningful environmental data at the appropriate spatial and temporal resolutions. NECCTON will use biogeochemical, lower trophic level products and results from e-SDM for HTL to provide new HTL products for bottlenose dolphin in the Adriatic Sea using ECOSPACE modelling approach developed by OGS.

3.5.4 Observational data needs for product calibration/assimilation/validation

In NECCTON the ECOSPACE model uses bottlenose dolphin sightings and effort data, as collected by the Blue World Institute of Marine Research and Conservation (BWI) on-board of observatory vessels from 2000 to 2020. Data was collected in the central part of the Adriatic Sea and the model is used to extend it to the whole Adriatic. The SpDM for marine mammals uses dolphin sightings and effort data,

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as collected by the Azorean Fisheries Observer Program (POPA) on-board tuna fishing vessels from 2001 to 2016 (Silva et al., 2014; Tobeña et al., 2016). Data was collected from May to October within the Azores region. A cross-validation procedure was used to assess the accuracy of the final HTL models for each marine mammal species.

3.5.5 Expected users' uptake

NECCTON proposes new developments enabling Copernicus Marine Service to model and deliver feeding habitat distributions which will be tested for the Adriatic Sea. The habitat product can be used for research purposes (e.g. to investigate changes on the distribution of specific species), as a management tool for public authorities (decision makers), whale-watching companies and for the general public.

3.5.6 List of co-products, sub-variables and metadata in the data-files for this product

Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
18.1	Marine mammal habitat
Sub-variable name [unit]	<i>Feeding habitat bottlenose dolphin [range 0-1]</i>
Description	Predicted distribution of feeding habitat of the Adriatic bottlenose dolphin (<i>Tursiops truncatus</i>). Habitat preference scaled from 0 (low preference) to 1 (high preference)
Long name	Habitat preference from Adriatic bottlenose dolphin (<i>Tursiops truncatus</i>).
Short name	Habitat_bottlenose_dolphin
Standard_name	Habitat_feeding_bottlenose_dolphin

Co-product ID	Co-product in bold and green shade
	<i>Sub-variable in bold and italic</i>
18.2	Marine mammal habitat
Sub-variable name [unit]	<i>Habitat preference spotted dolphin [range 0-1]</i>
Description	Predicted distribution of Atlantic spotted dolphin (<i>Stenella frontalis</i>). Habitat preference scaled from 0 (low preference) to 1 (high preference)
Long name	Habitat preference for Atlantic spotted dolphin (<i>Stenella frontalis</i>)
Short name	Habitat_spotted_dolphin
Standard_name	Habitat_preference_spotted_dolphin
Sub-variable name [unit]	<i>Habitat preference common dolphin [range 0-1]</i>
Description	Predicted distribution of common dolphin (<i>Delphinus delphis</i>). Habitat preference scaled from 0 (low preference) to 1 (high preference)
Long name	Habitat preference from common dolphin (<i>Delphinus delphis</i>)
Short name	<i>Habitat_common_dolphin</i>

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Standard_name	Habitat_preference_common_dolphin
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4. Datasets description

The products described in Section 3 will be delivered in the form of “datasets” (see the definition in the glossary). All 22 datasets containing the products developed by WP 7 are described in the following sub-sections.

4.1 H7 – North Western Shelf

ID dataset	H7
Products names (product IDs)	Small pelagic biomass (14.6), Large pelagics (15.2), Demersal fish biomass (16.1), Unspecified fish biomass (17.5)
Name sub-variables	small_pelagic_biom, small_pelagic_SSB, small_pelagic_feeding_level, small_pelagic_average_adult_weight, small_pelagic_average_maturity_flux, small_pelagic_predation_mortality, large_pelagic_biom, large_pelagic_SSB, large_pelagic_feeding_level, large_pelagic_average_adult_weight, large_pelagic_average_maturity_flux, large_pelagic_predation_mortality, total_fish_biom, total_fish_SSB, total_pelagic_average_maturity_flux, demersal_fish_biom, demersal_fish_SSB, demersal_fish_feeding_level, demersal_fish_average_adult_weight, demersal_fish_average_maturity_flux, demersal_fish_predation_mortality
Geographical coverage	NWS
Horizontal resolution	2 km
Vertical resolution	none
Time period	1990-2020
Temporal resolution	Annual
Format	netCDF
Partner producer and contact	DTU Aqua, Ken H Andersen
Datasets used for calibration/validation/assimilation	A set of model parameters has been calibrated to observational estimates of peak catches in large marine ecosystems by implementing a fishing mortality that approximates maximum sustainable yield
Method	One-way coupled FEISTY
Name of output file(s)	FEISTY_NWS
Expected total max size of the data	1 Gb

4.2 H8 – Iberia Biscay Ireland

ID dataset	H8
Products names (product IDs)	Small pelagic biomass (14.7), Large pelagics (15.3), Demersal fish biomass (16.2), Unspecified fish biomass (17.6)

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Name sub-variables	small_pelagic_biom, small_pelagic_SSB, small_pelagic_feeding_level, small_pelagic_average_adult_weight, small_pelagic_average_maturity_flux, small_pelagic_predation_mortality, large_pelagic_biom, large_pelagic_SSB, large_pelagic_feeding_level, large_pelagic_average_adult_weight, large_pelagic_average_maturity_flux, large_pelagic_predation_mortality, total_fish_biom, total_fish_SSB, total_pelagic_average_maturity_flux, demersal_fish_biom, demersal_fish_SSB, demersal_fish_feeding_level, demersal_fish_average_adult_weight, demersal_fish_average_maturity_flux, demersal_fish_predation_mortality
Geographical coverage	IBI
Horizontal resolution	1/12 deg
Vertical resolution	none
Time period	1992-2022
Temporal resolution	Annual
Format	netCDF
Partner producer and contact	DTU Aqua, Ken H Andersen
Datasets used for calibration/validation/assimilation	A set of model parameters has been calibrated to observational estimates of peak catches in large marine ecosystems by implementing a fishing mortality that approximates maximum sustainable yield
Method	One-way coupled FEISTY
Name of output file(s)	FEISTY_NWS
Expected total max size of the data	1 Gb

4.3 H9 – Baltic Sea

ID dataset	H9
Products names (product IDs)	Small pelagic biomass (14.8), Large pelagics (15.4), Demersal fish biomass (16.3), Unspecified fish biomass (17.7)
Name sub-variables	small_pelagic_biom, small_pelagic_SSB, small_pelagic_feeding_level, small_pelagic_average_adult_weight, vsmall_pelagic_average_maturity_flux, vsmall_pelagic_predation_mortality, vlarge_pelagic_biom, large_pelagic_SSB, large_pelagic_feeding_level, large_pelagic_average_adult_weight, large_pelagic_average_maturity_flux, large_pelagic_predation_mortality, total_fish_biom, total_fish_SSB, total_pelagic_average_maturity_flux, demersal_fish_biom, demersal_fish_SSB, demersal_fish_feeding_level, demersal_fish_average_adult_weight, demersal_fish_average_maturity_flux, demersal_fish_predation_mortality
Geographical coverage	BAL
Horizontal resolution	1 nm

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Vertical resolution	none
Time period	2000-2020
Temporal resolution	Annual
Format	netCDF
Partner producer and contact	DTU Aqua, Ken H Andersen
Datasets used for calibration/validation/assimilation	A set of model parameters has been calibrated to observational estimates of peak catches in large marine ecosystems by implementing a fishing mortality that approximates maximum sustainable yield
Method	One-way coupled FEISTY
Name of output file(s)	FEISTY_NWS
Expected total max size of the data	1 Gb

4.4 H10 – Mediterranean Sea

ID dataset	H10
Products names (product IDs)	Small pelagic biomass (14.9), Large pelagics (15.5), Demersal fish biomass (16.4), Unspecified fish biomass (17.8)
Name sub-variables	small_pelagic_biom, small_pelagic_SSB, small_pelagic_feeding_level, small_pelagic_average_adult_weight, small_pelagic_average_maturity_flux, small_pelagic_predation_mortality, large_pelagic_biom, large_pelagic_SSB, large_pelagic_feeding_level, large_pelagic_average_adult_weight, large_pelagic_average_maturity_flux, large_pelagic_predation_mortality, total_fish_biom, total_fish_SSB, total_pelagic_average_maturity_flux, demersal_fish_biom, demersal_fish_SSB, demersal_fish_feeding_level, demersal_fish_average_adult_weight, demersal_fish_average_maturity_flux, demersal_fish_predation_mortality
Geographical coverage	MED
Horizontal resolution	1/24 deg
Vertical resolution	none
Time period	2011-2020
Temporal resolution	Annual
Format	netCDF
Partner producer and contact	DTU Aqua, Ken H Andersen
Datasets used for calibration/validation/assimilation	A set of model parameters has been calibrated to observational estimates of peak catches in large marine ecosystems by implementing a fishing mortality that approximates maximum sustainable yield

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Method	One-way coupled FEISTY
Name of output file(s)	FEISTY_NWS
Expected total max size of the data	1 Gb

4.5 H11 - Global

ID dataset	H11
Products names (product IDs)	Small pelagic biomass (14.10), Large pelagics (15.6), Demersal fish biomass (16.5), Unspecified fish biomass (17.9)
Name sub-variables	small_pelagic_biom, small_pelagic_SSB, small_pelagic_feeding_level, small_pelagic_average_adult_weight, small_pelagic_average_maturity_flux, small_pelagic_predation_mortality, large_pelagic_biom, large_pelagic_SSB, large_pelagic_feeding_level, large_pelagic_average_adult_weight, large_pelagic_average_maturity_flux, large_pelagic_predation_mortality, total_fish_biom, total_fish_SSB, total_pelagic_average_maturity_flux, demersal_fish_biom, demersal_fish_SSB, demersal_fish_feeding_level, demersal_fish_average_adult_weight, demersal_fish_average_maturity_flux, demersal_fish_predation_mortality
Geographical coverage	GLOBAL
Horizontal resolution	1/12 deg
Vertical resolution	none
Time period	1992-2022
Temporal resolution	Annual
Format	netCDF
Partner producer and contact	DTU Aqua, Ken H Andersen
Datasets used for calibration/validation/assimilation	A set of model parameters has been calibrated to observational estimates of peak catches in large marine ecosystems by implementing a fishing mortality that approximates maximum sustainable yield
Method	One-way coupled FEISTY
Name of output file(s)	FEISTY_NWS
Expected total max size of the data	5 Gb

4.6 H12 – Adriatic Sea

ID dataset	H12
Products names (product IDs)	Marine mammal habitat (18.1)
Name sub-variables	Habitat_bottlenose_dolphin
Geographical coverage	Adriatic Sea

Project	NECCTON No 101081273	Deliverable	D7.1
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Horizontal resolution	1/24 degree
Vertical resolution	N/A
Time period	2005-2020
Temporal resolution	annual
Format	Gridded. Output are produced as .csv and can be converted to netCDF
Partner producer and contact	OGS, Simone Libralato, slibralato@ogs.it
Datasets used for calibration/validation/assimilation	Observations from Blue World Institute of Marine Research and Conservation
Method	ECOSPACE Adriatic model
Name of output file(s)	Habitat_feeding_bottlenose dolphin_ECOSPACE_Adriatic_2005-2020
Expected total max size of the data	10 Mb

4.7 H13 – Global

ID dataset	H13
Products names (product IDs)	Small pelagic biomass (14.15), Large pelagic biomass (15.8)
Name sub-variables	FG_small_pelagic_biomass, FG_large_pelagic_biomass
Geographical coverage	Global
Horizontal resolution	[-180, 180] at 1dd
Vertical resolution	[-80, 90] at 1dd
Time period	1950-2100
Temporal resolution	monthly
Format	netCDF
Partner producer and contact	Ecopath International Initiative Jeroen Steenbeek jeroen@ecopathinternational.org
Datasets used for calibration/validation/assimilation	FISH-MIP ISIMIP3b protocol
Method	One-way forcing with GFDL-ESM4, IPSL_CMA6-LR estimates for thetao (150m, column, bottom) and phyc (lphy, sphy, diazotrophs)
Name of output file(s)	EcoOcean_NECCTON
Expected total max size of the data	10GB

4.8 H14 – North Western Shelf

ID dataset	H14
Products names (product IDs)	Small-pelagic biomass (14.5), Unspecified fish biomass (17.2)

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Name sub-variables	small_pel_biom, fish_biom
Geographical coverage	North West European Shelf; -19 to 10 E, 41 to 64 N
Horizontal resolution	7km
Vertical resolution	n/a (2D output variable)
Time period	1991-2020
Temporal resolution	Daily
Format	NetCDF
Partner producer and contact	PML, Helen Powley hpo@pml.ac.uk
Datasets used for calibration/validation/assimilation	ICES/STECF fish landing data
Method	2-way coupled NEMO-ERSEM-MIZER with benthic component, with surface, boundary and river inputs as for the Copernicus Marine NWS reanalysis.
Name of output file(s)	neccton-ukmo_h002_mod_nws_htl_hind_7km_P1D-m_mf-xxx
Expected total max size of the data	50 Gb

4.9 H16 – Arctic Ocean

ID dataset	H16
Products names (product IDs)	Unspecified fish biomass (17.3)
Name sub-variables	Planktivorous_fish_biomass, Piscivorous_and_benthivorous_fish_biomass
Geographical coverage	Arctic Ocean
Horizontal resolution	12 km
Vertical resolution	16 levels (0,10,20,30,40,50,60,70,80,90,100,125,150,175,200,bottom)
Time period	1991-2020
Temporal resolution	Monthly
Format	Netcdf
Partner producer and contact	Hereon; ute.daewel@hereon.de (in collaboration with NERSC)
Datasets used for calibration/validation/assimilation	ICES ecosystem-assessment data; Huse et al. 2014
Method	Fully coupled physical biogeochemical model including fish and Macrobenthos as additional functional groups coupled through FABM - ECOSMO E2E (Daewel et al. 2019)
Name of output file(s)	neccton_hereon_h016_mod_arctic_htl_hind_12km_F1B- yyyyymm neccton_hereon_h016_mod_arctic_htl_hind_12km_F2B- yyyyymm

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Expected total max size of the data	200GB
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4.10 H17 – Baltic Sea

ID dataset	H17
Products names (product IDs)	Unspecified fish biomass (17.4)
Name sub-variables	Planktivorous_fish_biomass, Piscivorous_and_benthivorous_fish_biomass
Geographical coverage	Baltic Sea
Horizontal resolution	2km
Vertical resolution	16 levels (0,10,20,30,40,50,60,70,80,90,100,125,150,175,200,bottom)
Time period	2-5 years
Temporal resolution	Monthly
Format	Netcdf
Partner producer and contact	Hereon ute.daewel@hereon.de (in collaboration with BSH)
Datasets used for calibration/validation/assimilation	ICES Stock assessment data
Method	Fully coupled physical biogeochemical model including fish and Macrobenothos as additional functional groups coupled through FABM - ECOSMO E2E (Daewel et al. 2019)
Name of output file(s)	neccton_hereon_h017_mod_baltic_htl_hind_2km_F1B- yyyyymm neccton_hereon_h017_mod_baltic_htl_hind_2km_F2B- yyyyymm
Expected total max size of the data	200GB

4.12 H19 – Mediterranean Sea

ID dataset	H19
Products names (product IDs)	Small pelagic biomass (14.1)
Name sub-variables	Anchovy_biom, Anchovy_adults_age_1_biom, Anchovy_adults_age_2_biom, Anchovy_adults_age_3_biom, Anchovy_adults_age_4_biom, Sardine_biom, Sardine_adults_age_1_biom, Sardine_adults_age_2_biom, Sardine_adults_age_3_biom, Sardine_adults_age_4_biom, Sardine_adults_age_5_biom
Geographical coverage	Mediterranean Sea
Horizontal resolution	0.1 degree grid
Vertical resolution	0.1 degree grid
Time period	2000-2020
Temporal resolution	Monthly
Format	gridded, NetCDF

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Partner producer and contact	HCMR, Kostas Tsiaras, ktsiaras@hcmr.gr
Datasets used for calibration/validation/assimilation	GFCM WGSASP Final Report (2017) Working Group on Stock Assessment of Small Pelagic Species 2022 Selected values for the model parameters from the listed literature.
Method	Two-way coupled biogeochemical POM-ERSEM (Kalaroni et al., 2021) model to a HTL SPF model (Gkanasos et al., 2021), forced by ERA5 meteo, Climatology (MODB, MEDATLAS) boundary conditions/Gibraltar, Ludwig et al., 2009 river inputs
Name of output file(s)	Biomass_anchovy_sardine_mediterranean_sea e.g.: neccton-hcmr_hXX_mod_med_htl_hind_10km_XX_XX
Expected total max size of the data	20GB

4.13 H20 – Global

ID dataset	H20
Products names (product IDs)	Large pelagics (15.1)
Name sub-variables	TaxonomicName_Biomass, TaxonomicName_Abundance
Geographical coverage	global
Horizontal resolution	0.5 degree grid
Vertical resolution	N/A
Time period	2000-2020
Temporal resolution	Annual
Format	Gridded. Output are produced as .csv and can be converted to netCDF
Partner producer and contact	PML, Sevrine Sailley, sesa@pml.ac.uk
Datasets used for calibration/validation/assimilation	Parameterisation/initialisatio : Sea Around Us Validation: ICES stock assessment survey
Method	SS-DBEM model (Fernandes et al., 2013)
Name of output file(s)	Tuna_Biomass_SsDBEM_Global_2000-2020 Tuna_Abundance_SsDBEM_Global_2000-2020
Expected total max size of the data	100GB

4.14 H21 – North Western Shelf

ID dataset	H21
Products names (product IDs)	Small pelagic biomass (14.4), Demersal fish biomass (16.7)
Name sub-variables	TaxonomicName_Biomass, TaxonomicName_Abundance
Geographical coverage	NWS
Horizontal resolution	0.5 degree grid
Vertical resolution	N/A
Time period	2000-2020
Temporal resolution	Annual

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Format	Gridded. Output are produced as .csv and can be converted to netCDF
Partner producer and contact	PML, Sevrine Sailley, sesa@pml.ac.uk
Datasets used for calibration/validation/assimilation	Parameterisation/initialisation : Sea Around Us Validation: ICES stock assessment survey; OBIS data on tuna
Method	SS-DBEM model (Fernandes et al., 2013)
Name of output file(s)	Small_Pelagic_Biomass_SSDBEM_NWS_2000-2020, Small_Pelagic_Abundance_SSDBEM_NWS_2000-2020, Demersal_Fish_Biomass_SSDBEM_NWS_2000-2020, Demersal_Fish_Abundance_SSDBEM_NWS_2000-2020
Expected total max size of the data	100GB

4.15 H22 – Mediterranean Sea

ID dataset	H22
Products names (product IDs)	Small pelagic biomass (14.12), Demersal fish biomass (16.6)
Name sub-variables	Anchovy_juveniles_biom, Anchovy_adult_biom, Sardine_juveniles_biom, Sardine_adult_biom, Demersal_fish_juveniles_biom, Demersal_fish_adult_biom
Geographical coverage	Mediterranean Sea
Horizontal resolution	1/24 degree
Vertical resolution	N/A
Time period	2000-2020
Temporal resolution	annual
Format	Gridded. Output are produced as .csv and can be converted to netCDF
Partner producer and contact	OGS, Simone Libralato, slibralato@ogs.it
Datasets used for calibration/validation/assimilation	Medits trawl survey data
Method	e-SDM model (Panzeri et al., 2023)
Name of output file(s)	Anchovy_juvenile_Biomass_eSDM_Mediterranean_2000-2020 Anchovy_adult_Biomass_eSDM_Mediterranean_2000-2020 Sardine_juvenile_Biomass_eSDM_Mediterranean_2000-2020 Sardine_adult_Biomass_eSDM_Mediterranean_2000-2020, Demersal fish_juvenile_Biomass_eSDM_Mediterranean_2000-2020 Demersal fish_adult_Biomass_eSDM_Mediterranean_2000-2020
Expected total max size of the data	100GB

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4.16 H23 – Black Sea

ID dataset	H23
Products names (product IDs)	Small pelagic biomass (14.14)
Name sub-variables	Anchovy_biom
Geographical coverage	Black Sea
Horizontal resolution	2.5 km
Vertical resolution	59 vertical levels
Time period	Hindcast: 1990-2023
Temporal resolution	weekly
Data-file(s):	neccton-uol_h3_mod_blk_htl_hind_2.5km_P1D-m_mf-000,
Expected total, max size of datafile(s) [Gb]:	100 Gb
Format	gridded, NetCDF
Partner producer and contact	Haloin Yu, yuhaolin777@outlook.com
Datasets used for calibration/validation/assimilation	FAO, SeaAroundUs data
Method	Coupled NEMO-BAMHBI forced by MAR atmospheric conditions, climatological river inputs, coupled with DEB model

4.17 H24 – Azores

ID dataset	H24
Products names (product IDs)	Marine mammal habitat (18.2)
Name sub-variables	Habitat_spotted_dolphin, Habitat_common_dolphin
Geographical coverage	Azores
Horizontal resolution	0.25x0.25 degrees
Vertical resolution	NA
Time period	2001-2016
Temporal resolution	Monthly (May to October)
Format	Raster
Partner producer and contact	IMAR, Sergi Pérez-Jorge; sergiperezjorge@gmail.com

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Datasets used for calibration/validation/assimilation	Sightings and effort data obtained from the Azorean Fisheries Observer Program (POPA) database. Data was collected from May to October within the Azores region. A cross-validation procedure was used to assess the accuracy of the final product.
Method	The products were developed through a species distribution model (SpDM) relating dolphin sightings to environmental and prey variables.
Name of output file(s)	Habitat_spotted_dolphin_month_year; Habitat_common_dolphin_month_year
Expected total max size of the data	<1Gb

4.18 H25 – Bay of Biscay

ID dataset	H25
Products names (product IDs)	Small pelagic biomass (14.3)
Name sub-variables	Anchovy_biom, Anchovy_adults_age_1_biom, Anchovy_adults_age_2_biom, Anchovy_adults_age_3_biom, Anchovy_adults_age_4_biom, Sardine_biom, Sardine_adults_age_1_biom, Sardine_adults_age_2_biom, Sardine_adults_age_3_biom, Sardine_adults_age_4_biom, Sardine_adults_age_5_biom, Sardine_adults_age_6+_biom
Geographical coverage	Bay of Biscay
Horizontal resolution	~2.5 km
Vertical resolution	1 level (2D)
Time period	2000-2020
Temporal resolution	Monthly
Format	gridded, NetCDF
Partner producer and contact	IFREMER, Martin Huret, martin.huret@ifremer.fr
Datasets used for calibration/validation/assimilation	PELGAS survey series: biomass and size-at-age data ICES WGHANSA biomass estimation Selected values for the model parameters from the listed literature.
Method	DEB-IBM (Gatti et al., 2017; Bueno-Pardo et al., 2020; Menu et al., 2023) coupled in 3D to CROCO (or MARS3D) hydrodynamic models, forced by zooplankton from SEAPODYM.
Name of output file(s)	Biomass_anchovy_sardine_bay_of_biscay
Expected total max size of the data	~200GB

4.19 H26 – Bay of Biscay

ID dataset	H26
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Products names (product IDs)	Small-pelagic biomass (14.2), Unspecified fish biomass (17.1)
Name sub-variables	anchovy_biom, sardine_biom, sprat_biom, fish_biom
Geographical coverage	Bay of Biscay
Horizontal resolution	10' lat x 15' lon
Vertical resolution	Vertically integrated
Time period	2000-2020
Temporal resolution	Monthly
Format	gridded, NetCDF
Partner producer and contact	IFREMER, Morgane Travers-Trolet, morgane.travers@ifremer.fr
Datasets used for calibration/validation/assimilation	ICES databases for time series of catch, length-at-age, survey indices
Method	Individual based multispecific model Ev-OSMOSE (Morell et al. 2023) forced by POLCOMS-ERSEM
Name of output file(s)	Probably something like Fish_biomass.nc
Expected total max size of the data	Probably < 1 GB

4.20 H27 – Global

ID dataset	H27
Products names (product IDs)	Large pelagics (15.7)
Name sub-variables	Skipjack number of recruits, Immature skipjack biomass, Adult skipjack biomass, Yellowfin number of recruits, Immature yellowfin biomass, Adult yellowfin biomass, Bigeye number of recruits, Immature bigeye biomass, Adult bigeye biomass, Albacore number of recruits, Immature albacore biomass, Adult albacore biomass
Geographical coverage	Pacific Ocean, Global
Horizontal resolution	2 or 1 degree squares
Vertical resolution	Vertically integrated
Time period	1979-2070
Temporal resolution	Monthly
Format	Gridded netCDF
Partner producer and contact	Mercator Ocean Patrick Lehodey, plehodey@mercator-ocean.fr
Datasets used for calibration/validation/assimilation	Public fishing data sets (catch, effort, size frequencies) from regional organisation (WCPFC, IATTC, IOTC)
Method	Spatial Ecosystem And Population Dynamics Model (SEAPODYM; www.seapodym.eu)
Name of output file(s)	neccton_moi_h027_mod_glo_<Tuna species code name>_B_immature_hind_2degree_P1M-m_sf-000 neccton_moi_h027_mod_glo_<Tuna species code name>_N_recruit_hind_2degree_P1M-m_sf-000

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	neccton_moi_h027_mod_glo<Tuna species code name>_B_adult_hind_2degree_P1M-m_sf-000
Expected total max size of the data	0.3 Gb

4.21 H28 – North Atlantic

ID dataset	H28
Products names (product IDs)	Small pelagic biomass (14.11)
Name sub-variables	mackerel_juveniles, mackerel_adults
Geographical coverage	North Atlantic
Horizontal resolution	¼°
Vertical resolution	1 level
Time period	1998-2018
Temporal resolution	Weekly
Format	Gridded NetCDF
Partner producer and contact	CLS, Anna Conchon aconchon@groupcls.com
Datasets used for calibration/validation/assimilation	Egg and larvae distribution (ICES (2019); Pitois pers. Com) Length frequency estimation (ICES database, Cambell and Olafsdottir pers. com. for Mission Atlantic) Catches (ICES Intercatch database, Cambell and Olafsdottir; ICES DATRAS database; Cambell pers. com.; French government database, Quimbert pers. com.; UE Fisheries Dependent Information database) Tagging data (Tenningen et al (2011) and Slotte et al, pers.com).
Method	SEAPODYM-MASS
Name of output file(s)	mackerel_YYYYMMDD.nc where YYYY is the year, MM is the month number and DD is the day
Expected total max size of the data	Probably less than 5Gb

4.22 H29 – Bay of Biscay

ID dataset	H29
Products names (product IDs)	Small pelagic biomass (14.13)
Name sub-variables	Anchovy number of recruits, Immature anchovy biomass, Adult anchovy biomass
Geographical coverage	Bay of Biscay
Horizontal resolution	1/4 deg ; 1/12 deg
Vertical resolution	Vertically integrated
Time period	1998-2020
Temporal resolution	Monthly; weekly
Format	Gridded NetCDF
Partner producer and contact	Mercator Ocean, Quentin Misi and

Project	NECCTON No 101081273	Deliverable	D7.1
Dissemination	Public	Nature	Report
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	Patrick Lehodey, plehodey@mercator-ocean.fr
Datasets used for calibration/validation/assimilation	Public fishing data and published available research cruise data (larvae and juvenile density)
Method	Spatial Ecosystem And Population Dynamics Model (SEAPODYM; www.seapodym.eu)
Name of output file(s)	neccton_moi_h029_mod_bis_<Tuna species code name>_B_immature_hind_1-12_P1W-m_sf-000 neccton_moi_h029_mod_bis_<Tuna species code name>_N_recruit_hind_1-12_P1W-m_sf-000 neccton_moi_h029_mod_bis_<Tuna species code name>_B_adult_hind_1-12_P1W-m_sf-000
Expected total max size of the data	0.15 Gb

5. Concluding remarks

None of the five higher-trophic level products described in this document are currently available at Copernicus Marine Service. Therefore, a diversity of modelling approaches is used in NECCTON for the different products. This will enable a more comprehensive evaluation of products and also the application of an ensemble modelling approach. Further, a subset of products and co-variables will be used in WP 9 case studies which will further test the products. The five HTL products delivered by WP 7 will be useful for researchers, fisheries and conservation managers and other stakeholder interested in marine higher trophic levels. The stakeholder engagement and feedback stressed the general expectations for such products.

Please note that that the proposed standard names for co-variables are not definitive as they have not been validated.

6. References

Agostini, V.N. and Bakun, A. (2002) ‘Ocean triads’ in the Mediterranean Sea: Physical mechanisms potentially structuring reproductive habitat suitability (with example application to European anchovy, *Engraulis encrasicolus*)’, *Fisheries Oceanography*, 11(3), pp. 129–142. doi:10.1046/j.1365-2419.2002.00201.x.

Basilone, G. *et al.* (2017) ‘European anchovy (*Engraulis encrasicolus*) age structure and growth rate in two contrasted areas of the Mediterranean Sea: The paradox of faster growth in oligotrophic seas’, *Mediterranean Marine Science*, p. 504. doi:10.12681/mms.2059.

Basilone, G. *et al.* (2023) ‘Age and growth of European sardine (*Sardina pilchardus*) in the central Mediterranean Sea: Implication for stock assessment’, *Fishes*, 8(4), p. 202. doi:10.3390/fishes8040202.

Project	NECCON No 101081273	Deliverable	D7.1
Dissemination	Public	Nature	Report
Date	31 st October 2023	Version	1.0

Brosset, P. *et al.* (2015) 'Influence of environmental variability and age on the body condition of small pelagic fish in the Gulf of Lions', *Marine Ecology Progress Series*, 529, pp. 219–231. doi:10.3354/meps11275.

Bruggeman, J. (2021). FABM-Mizer (0.8.1). Zenodo, doi:10.5281/zenodo.5575152.

Bueno-Pardo, J. *et al.* (2020) 'Integration of bioenergetics in an individual-based model to hindcast anchovy dynamics in the Bay of Biscay', *Ices Journal of Marine Science*, 77(2), pp. 655-667. doi:10.1093/icesjms/fsz239.

Coll, M. *et al.* (2020) 'Advancing global ecological modeling capabilities to simulate future trajectories of change in marine ecosystems', *Frontiers in Marine Science*, p. 7. doi:10.3389/fmars.2020.567877.

Daewel, U. *et al.* (2019) 'Towards end-to-end (E2E) modelling in a consistent NPZD-F modelling framework (ECOSMO E2E_v1.0): application to the North Sea and Baltic Sea', *Geosci. Model Dev.*, 12, pp. 1765–1789. doi: 10.5194/gmd-12-1765-2019.

Denderen, *et al.* (2021) 'Emergent global biogeography of marine fish food webs', *Global Ecology and Biogeography*, 30(9), pp. 1822-1834. doi:10.1111/geb.13348.

FAO (2017) *Working Group on Stock Assessment of Small Pelagic species (WGSASP) | General Fisheries Commission for the Mediterranean (GFCM) | Food and Agriculture Organization of the United Nations*. Available at: <https://www.fao.org/gfcm/technical-meetings/detail/en/c/1107436/> (Accessed: 05 September 2023).

Fernandes, J. A. *et al.* (2013). 'Modelling the effects of climate change on the distribution and production of marine fishes: Accounting for trophic interactions in a dynamic bioclimate envelope model', *Global Change Biology*, 19, pp. 2596–2607. doi:10.1111/gcb.12231.

Gatti, P., *et al.* (2017) 'Comparing biological traits of anchovy and sardine in the Bay of Biscay: A modelling approach with the Dynamic Energy Budget', *Ecological Modelling*, 348, pp. 93-109. doi.org/10.1016/j.ecolmodel.2016.12.018.

Gkanasos, A. *et al.* (2021) 'A three dimensional, full life cycle, anchovy and sardine model for the North Aegean Sea (Eastern Mediterranean): Validation, sensitivity and climatic scenario simulations', *Mediterranean Marine Science*, 22, pp. 653-668. doi:10.12681/mms.27407.

Huse, G. (2014) 'Spatially explicit estimates of length and biomass of *Clupea harengus* (Norwegian spring spawning herring) from acoustic and trawl surveys in the North-East Atlantic in May 2010.' Institute of Marine Research, Bergen, PANGAEA, doi: 10.1594/PANGAEA.827196

Project	NECCON No 101081273	Deliverable	D7.1
Dissemination	Public	Nature	Report
Date	31 st October 2023	Version	1.0

Katara, I. *et al.* (2011) 'Environmental drivers of the Anchovy/sardine complex in the Eastern Mediterranean', *Hydrobiologia*, 670(1), pp. 49–65. doi:10.1007/s10750-011-0693-5.

Lehodey, P. *et al.* (2008) 'A spatial ecosystem and populations dynamics model (SEAPODYM)–Modeling of tuna and tuna-like populations', *Progress in Oceanography*, 78(4), pp. 304-318. doi.org/10.1016/j.pocean.2008.06.004.

Libralato, S. and Solidoro, C. (2009) 'Bridging biogeochemical and food web models for an End-to-End representation of marine ecosystem dynamics: The Venice lagoon case study'. *Ecological Modelling*, 220(21), pp. 2960-2971. doi:10.1016/j.ecolmodel.2009.08.017.

Lleonart, J. and Maynou, F. (2003) 'Fish stock assessments in the Mediterranean: State of the art', *Scientia Marina*, 67(S1), pp. 37–49. doi:10.3989/scimar.2003.67s137.

Ludwig, W. *et al.* (2009) 'River discharges of water and nutrients to the Mediterranean and Black Sea: Major drivers for ecosystem changes during past and future decades?' *Progress in Oceanography*, 80(3-4), pp.199-217. doi:10.1016/j.pocean.2009.02.001.

Menu C., *et al.* (2023) 'Testing the bottom-up hypothesis for the decline in size of anchovy and sardine across European waters through a bioenergetic modeling approach', *Progress in Oceanography*, 210, p. 102943. doi.org/10.1016/j.pocean.2022.102943.

Morell, A. *et al.* (2023) 'Ev-OSMOSE: An eco-genetic marine ecosystem model', BioRxiv, doi:10.1101/2023.02.08.527669.

Morote, E. *et al.* (2010) 'A comparison of anchovy (*Engraulis encrasicolus*) and sardine (*Sardina pilchardus*) larvae feeding in the northwest Mediterranean: Influence of prey availability and ontogeny', *ICES Journal of Marine Science*, 67(5), pp. 897–908. doi:10.1093/icesjms/fsp302.

Mustać, B. *et al.* (2020) 'Comparison of growth parametres between sardine *Sardina pilchardus* (Walbaum, 1792) and anchovy *Engraulis encrasicolus* (Linnaeus, 1758) from the eastern Adriatic Sea', *Journal of Maritime & Transportation Science*, 3(3), pp. 325–333. doi:10.18048/2020.00.24. #

Panzeri D., *et al.* (2021) 'Developing spatial distribution models for demersal species by the integration of trawl surveys data and relevant ocean variables. Copernicus Marine Service Ocean State Report Issue 5', *Journal of Operational Oceanography*, 14:sup1, s114–s123; DOI: 10.1080/1755876X.2021.1946240.

Panzeri, D. *et al.* (2023) 'Identifying priority areas for spatial management of mixed fisheries using ensemble of multi-species distribution models'. *Fish and Fisheries* (in press).

Petrik, C.M. *et al.* (2019) 'Bottom-up drivers of global patterns of demersal, forage, and pelagic fishes', *Progress in Oceanography*, 176, p. 102124. doi: 10.1016/j.pocean.2019.102124.

Project	NECCON No 101081273	Deliverable	D7.1
Dissemination	Public	Nature	Report
Date	31 st October 2023	Version	1.0

Romagosa, M. et al. (2020), 'Differences in regional oceanography and prey biomass influence the presence of foraging odontocetes at two Atlantic seamounts', *Marine Mammal Science*, 36(1), pp. 158-179, doi:10.1111/mms.12626.

Saraux, C. et al. (2019) 'Small pelagic fish dynamics: A review of mechanisms in the Gulf of Lions', *Deep Sea Research Part II: Topical Studies in Oceanography*, 159, pp. 52–61. doi:10.1016/j.dsr2.2018.02.010.

Schismenou, E. et al. (2008) 'Modeling and predicting potential spawning habitat of anchovy (*Engraulis encrasicolus*) and round sardinella (*sardinella aurita*) based on satellite environmental information', *Hydrobiologia*, 612(1), pp. 201–214. doi:10.1007/s10750-008-9502-1.

Silva, M.A. et al. (2014) 'Spatial and temporal distribution of cetaceans in the mid-Atlantic waters around the Azores', *Marine Biological Resources*. 10, pp. 123–137. doi: 10.1080/17451000.2013.793814.

Somarakis, S. et al. (2004) 'Daily Egg production of Anchovy in European waters', *ICES Journal of Marine Science*, 61(6), pp. 944–958. doi:10.1016/j.icesjms.2004.07.018.

Somarakis, S. et al. (2019) 'Spawning stock, egg production and larval survival in relation to small pelagic fish recruitment', *Marine Ecology Progress Series*, 617–618, pp. 113–136. doi:10.3354/meps12642.

Tenningen, M. et al. (2011), 'Abundance estimation of Northeast Atlantic mackerel based on tag recapture data-A useful tool for stock assessment?' *Fisheries Research*, 107, 68-74, doi:10.1016/j.fishres.2010.10.009.

Tobeña, M. et al. (2016) 'Modeling the potential distribution and richness of cetaceans in the Azores from fisheries observer program data', *Frontiers in Marine Science*, 3, doi:10.3389/fmars.2016.00202.

Tsikliras, A.C. and Stergiou, K.I. (2014) 'Age at maturity of Mediterranean Marine Fishes', *Mediterranean Marine Science*, 16(1), p. 5. doi:10.12681/mms.659.

Tsikliras, A.C., Antonopoulou, E. and Stergiou, K.I. (2010) 'Spawning period of Mediterranean Marine Fishes', *Reviews in Fish Biology and Fisheries*, 20(4), pp. 499–538. doi:10.1007/s11160-010-9158-6.

Van Beveren, E. et al. (2014) 'Rapid changes in growth, condition, size and age of small pelagic fish in the Mediterranean', *Marine Biology*, 161(8), pp. 1809–1822. doi:10.1007/s00227-014-2463-1.

von Schuckmann, K. et al. (2021) 'Copernicus Marine Service Ocean State Report, Issue 5', *Journal of Operational Oceanography*, 14: 1-185. DOI: 10.1080/1755876X.2021.1946240