

Programme Area: GR02 - Integrated Marine & Inland Water Management

Predefined project

Implementation of an integrated marine monitoring program

in compliance with the requirements of the EU Marine Strategy
Framework Directive 2008/56/EC (article 11)

Hellenic Center for Marine Research, Institute of Oceanography

Scientific Responsible: Leonidas Perivoliotis

Project Identity

Funding:

EEA Financial Mechanism 2009-2014 (85%): Programme Area: GR02 - Integrated Marine & Inland Water Management

Greek National Contribution (15%)

Implementation: Hellenic Center for Marine Research (HCMR)

Total cost: 2.383.349 Euros

Duration: May 2015 – April 2017

Scientific Supervisor: *Leonidas Perivoliotis, Institute of Oceanography, HCMR*

Scientific Team

Athanasios Machias, Institute of Marine Biological Resources and Inland Waters, HCMR

Marianna Giannoulaki, Institute of Marine Biological Resources and Inland Waters, HCMR

Stefanos Kavadas, Institute of Marine Biological Resources and Inland Waters, HCMR

George Petihakis, Institute of Oceanography, HCMR

Gerasimos Korres, Institute of Oceanography, HCMR

- ✓ The monitoring programme is a continuation of, and will be partly built around the existing database from previous monitoring programmes, including the Poseidon monitoring system.
- ✓ The project plans to undertake capacity building activities and specific implementations in selected sites, focusing on the planning and implementation of new sensors deployments on existing open sea multi-parametric moorings and coastal stations that are located within selected key sea zones. It also plans to incorporate systems such as underwater acoustics that will provide information for fisheries purposes on both fish stock assessment and fisheries indicators. All these measures are based on Annex III and V of the EU Marine Strategy Framework Directive.

Overarching objectives of the project

Upgrade and expand an integrated and sustained system for the Greek Seas - Upgrade and expand the existing monitoring platforms with new sensors and technologies

Integrate new datasets and quality assessed timeseries that estimate qualitative descriptors such as eutrophication, alternations of hydrography, noise and distribution and abundance of small pelagic fish.

Increase the area coverage of marine waters' monitoring programs through the inclusion of the above activities into MFSD implementation plans

Deliver data through web tools and applications deriving from operational marine observations

Improve the fisheries data collected within the current monitoring programs and harmonize the estimation of the small pelagic fish stocks with the ecosystem approach to fisheries.

Oceanographic Station : Seawatch

Height: 7.9 m

Width: 1.75 m

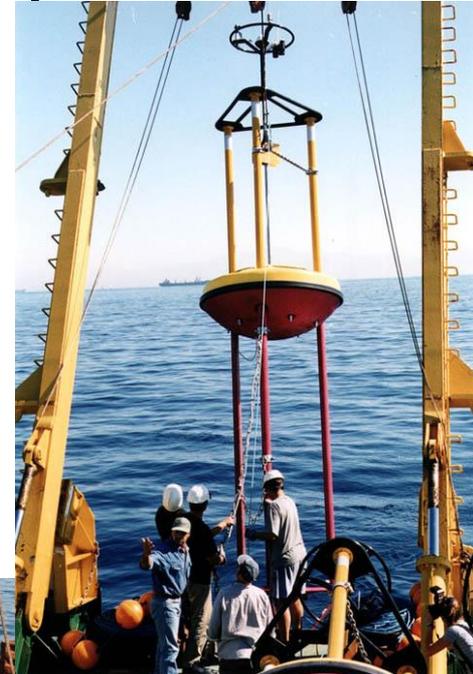
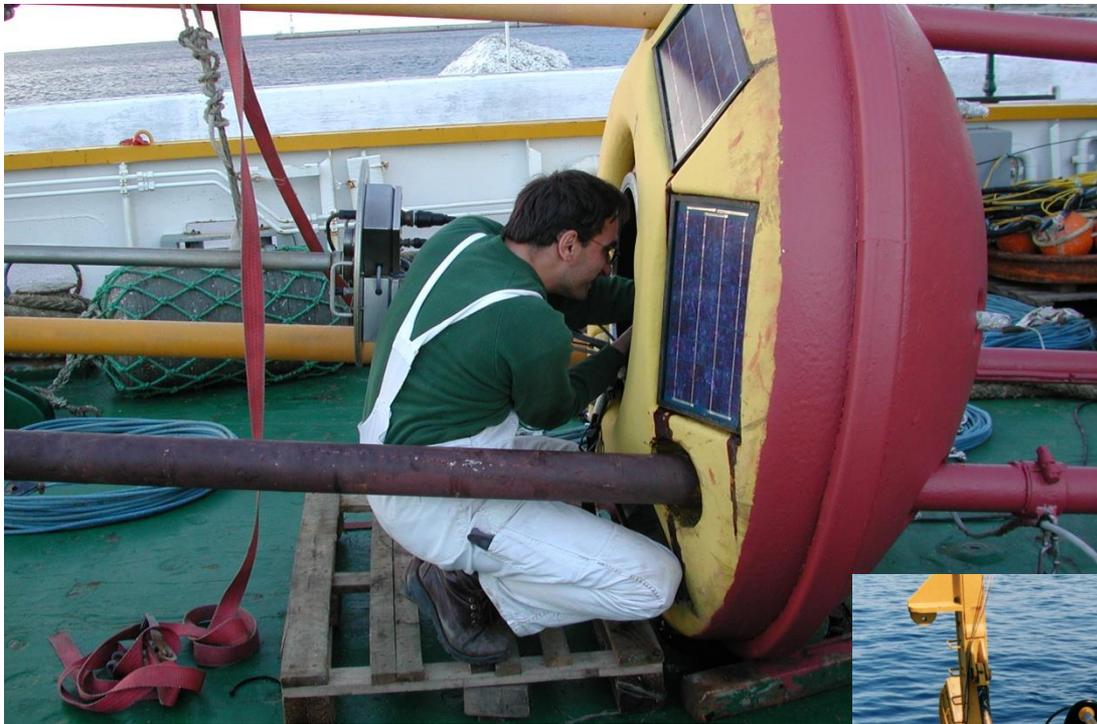
Weight: 900 kgr

*Power: Solar panels and
rechargeable batteries*

*Communication: Imarsat C,
GSM, GPRS*



Maintenance of the oceanographic stations



Maintenance of the oceanographic stations



...an easy



...or a difficult task

Problems (1)



to the installations



to the proper functioning

Problems (2)



Main body of the station



Current meter



Salinity sensor



Oxygen sensor

to the reliability of the recordings due to biofouling

Upgrade of the POSEIDON System fixed stations network

Sensors

Temperature
Salinity
Currents
Chlorophyll-A
Dissolved Oxygen
Turbidity
Waves
pCO₂
pH
Air temperature
Wind speed and direction
Incoming radiation

Supplementary equipment

Buoy hulls and legs, Solar panels, accumulators, mast cables, releasers, inductive cables....



Contribution to the MSFD implementation

Annex III of MFSD (related also with MSFD Articles 5(2iv) and 11 (1)):

Characteristics - Physical and chemical features

- annual and seasonal temperature regime, current velocity, upwelling, wave exposure, mixing characteristics, turbidity, residence time
- spatial and temporal distribution of salinity
- spatial and temporal distribution of oxygen

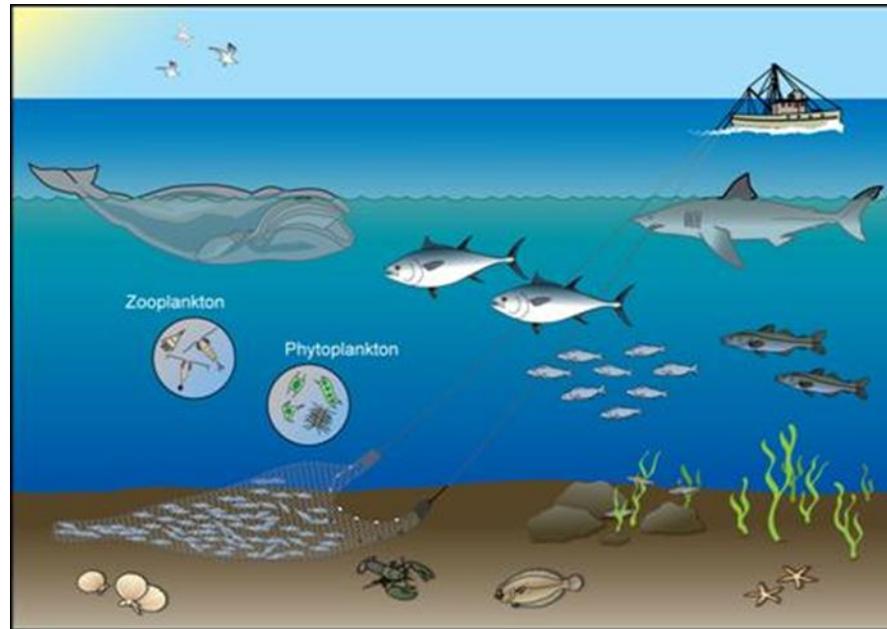
Pressure and Impacts – Other physical disturbance

- Underwater noise (e.g. from shipping, underwater acoustic equipment)

Pressure and impacts - Interference with hydrological processes

- Significant changes in thermal regime
- Significant changes in salinity regime

Underwater acoustics for ecosystem-based management



Dr Marianna Giannoulaki
Dr Athanassios Machias



HCMR-IMBRIW

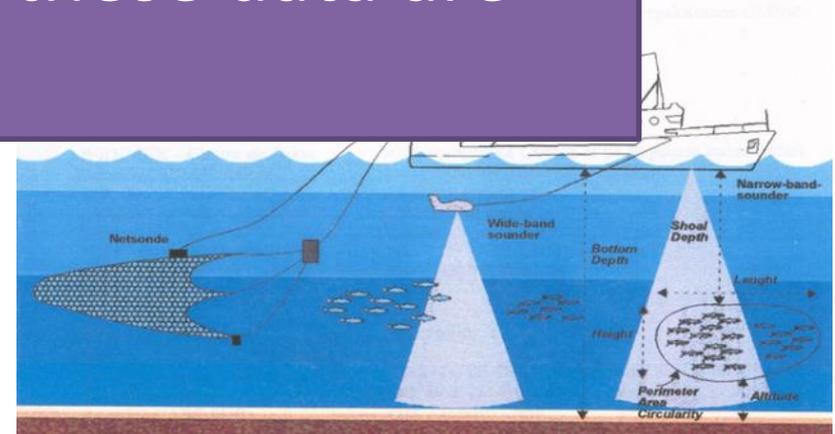
Underwater acoustics mostly used for assessing small pelagic fish populations & zooplankton species of commercial importance



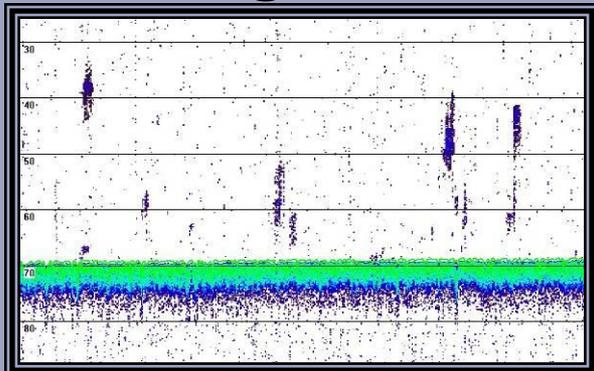
Worldwide fisheries institutes and agencies are carrying out regular acoustic surveys covering many marine shelf ecosystems, but these data are underutilized

Act
of

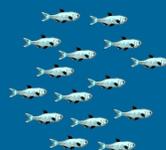
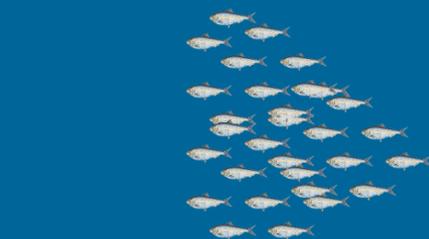
means
with



Echogram

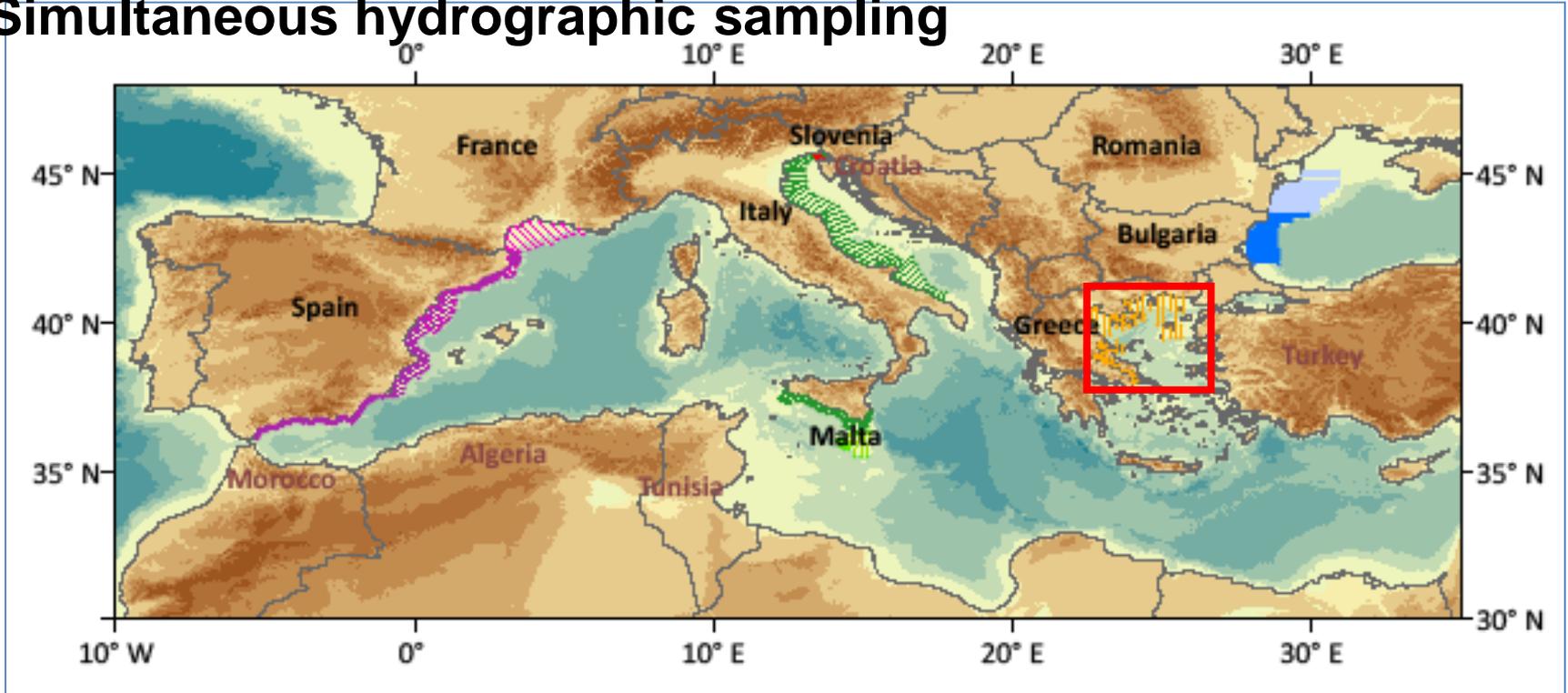


**Towed
echosounder**



HCMR (IMBRIW) is carrying out the monitoring of small pelagic fish populations in the Greek Seas since 1995

- Part of the Mediterranean Acoustic Survey since 2008
- Simultaneous ichthyoplankton surveys since 1995
- Simultaneous hydrographic sampling



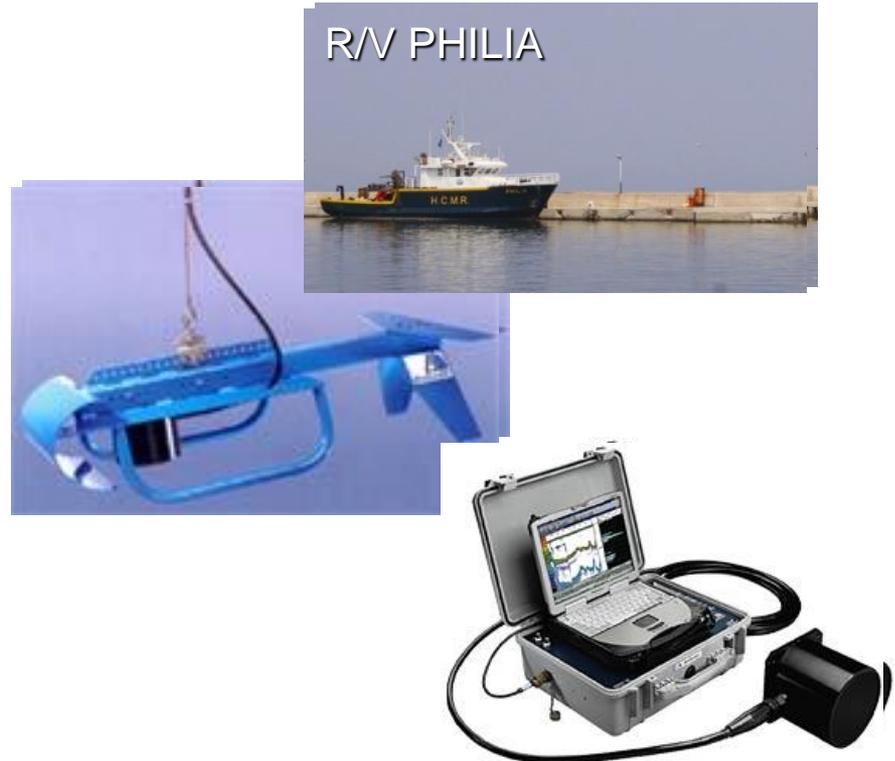
MEDIAS protocol supports the collection/estimation of Ecosystem Indicators instead of the target species abundance estimates

The way forward...

- Transitioning from single-species fisheries management to **Ecosystem Based Management** will require increased information regarding the state and functioning of biotic ecosystem components
- Active acoustic methods and technologies are characterised by their capacity to sample over a very wide range of spatial scales and resolutions for each transmission (i.e. 'ping').
- With the use of a sufficient range of acoustic frequencies, simultaneous sampling of organisms spanning body sizes from millimetres to metres is possible within seconds.

Until summer 2015, RV PHILIA was equipped with:

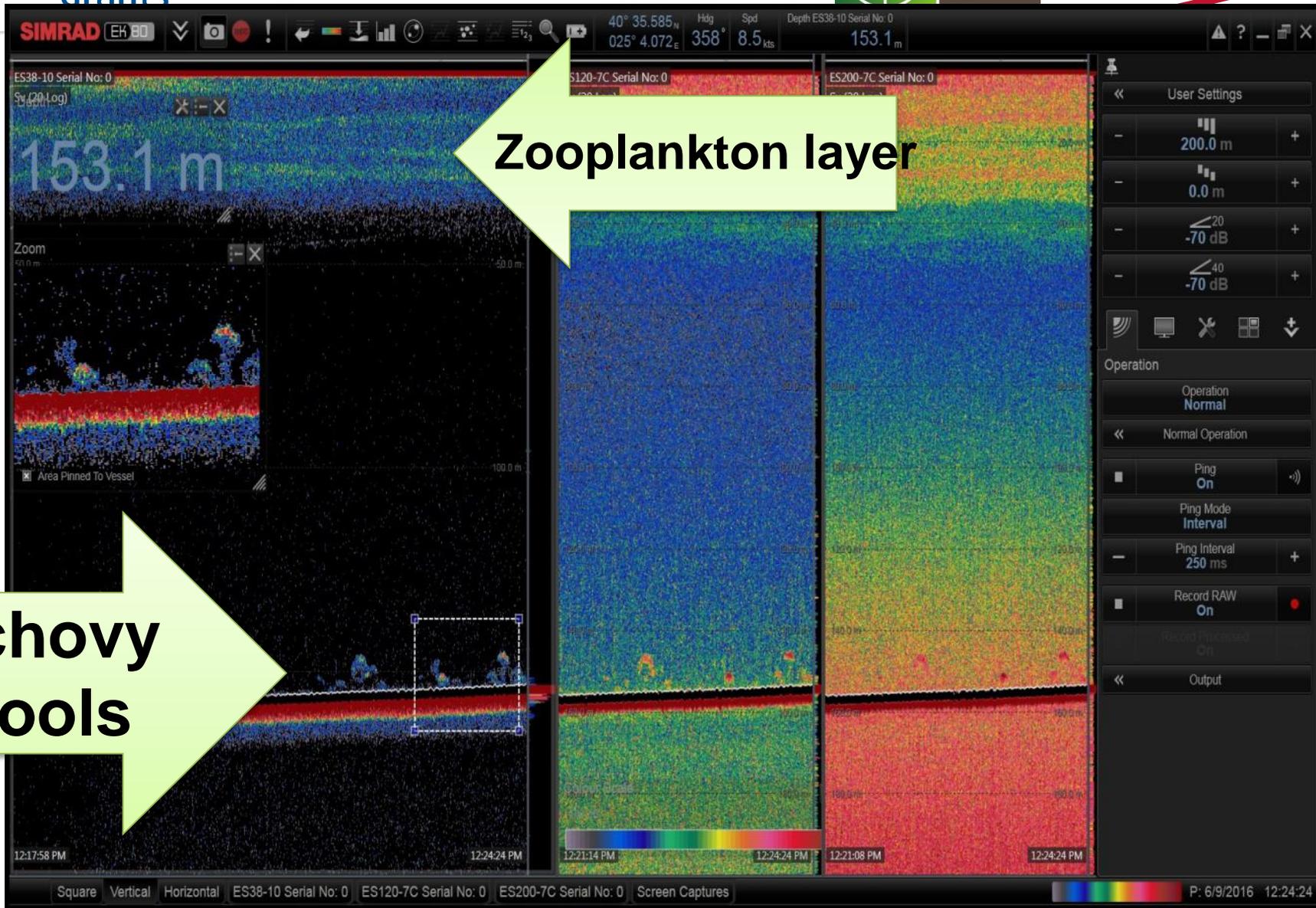
- ✓ Biosonics DTX
- ✓ Split beam echosounder in towed body (vessel speed limitation)
- ✓ Two frequencies 38 & 120 kHz
- ✓ Maximum echosounding depth at 240 m

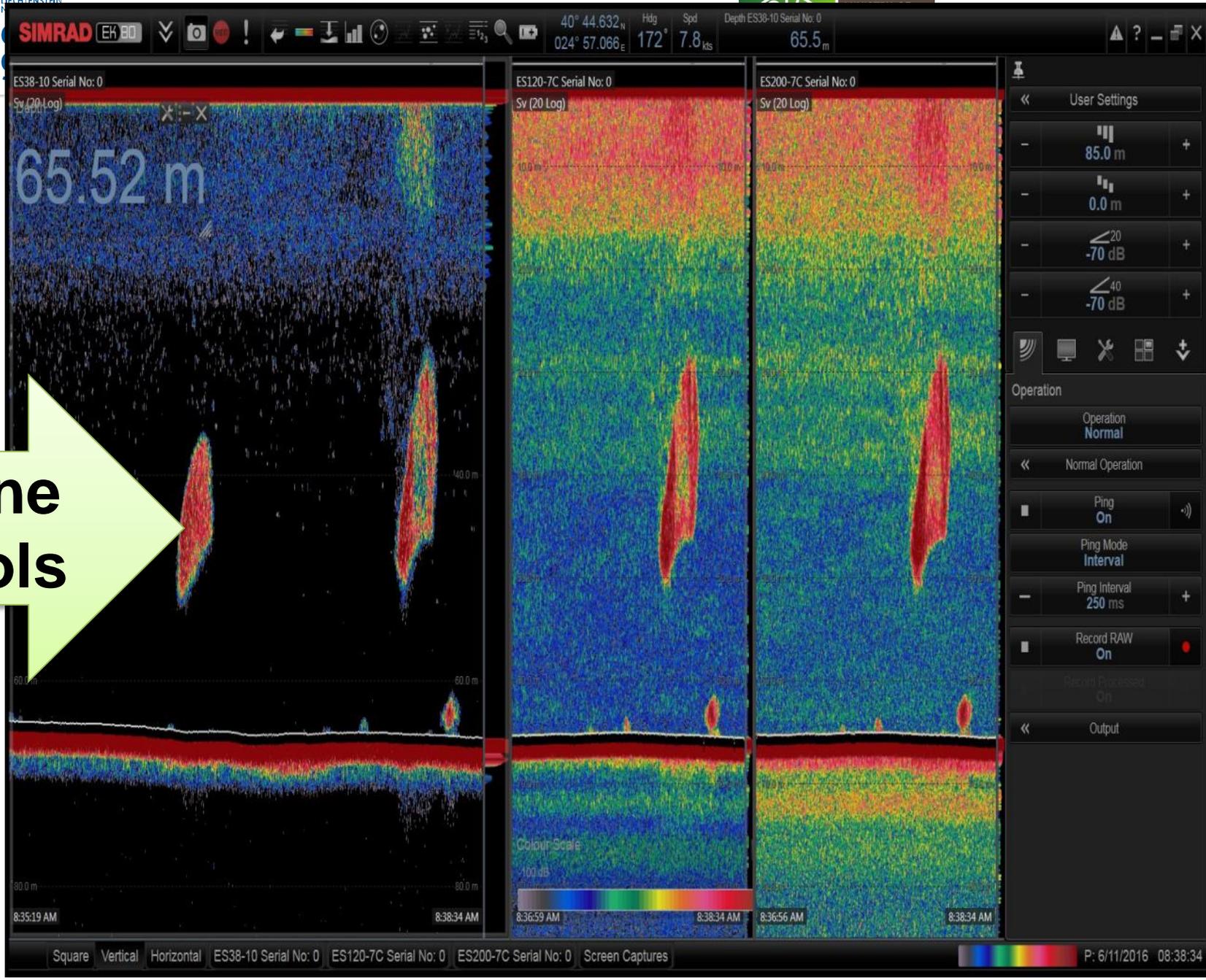


At end of 2015 it was upgraded into:

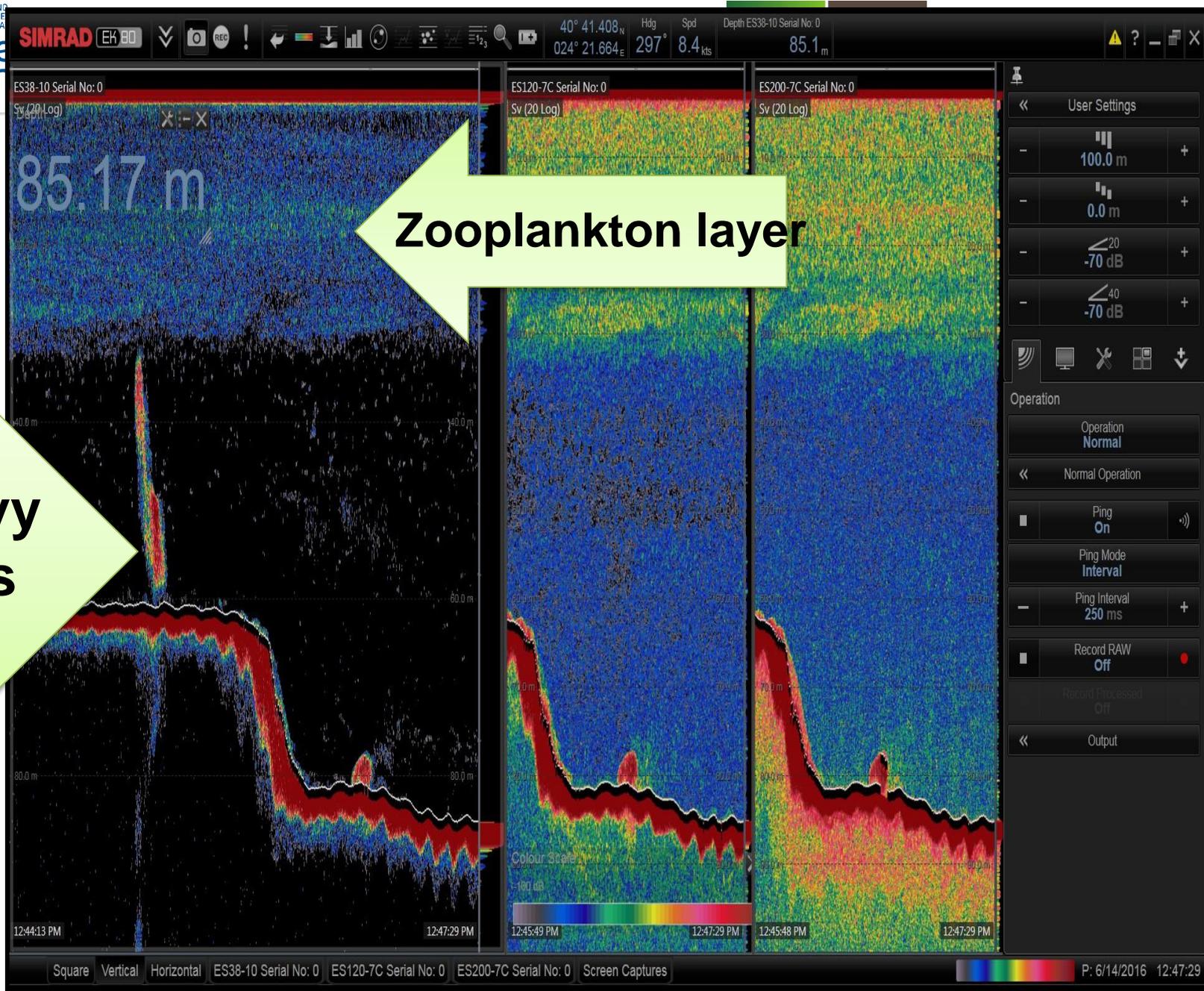
- Simrad EK 80 Split Beam
- Mounted in the RV PHILIA
- 3 frequencies: 38, 120, 200 kHz
- Allows an increase in vessel speed by 3 knots
- Maximum echosounding depth at 600 m with the 3 frequencies or down to 2000 m based on the 38 kHz





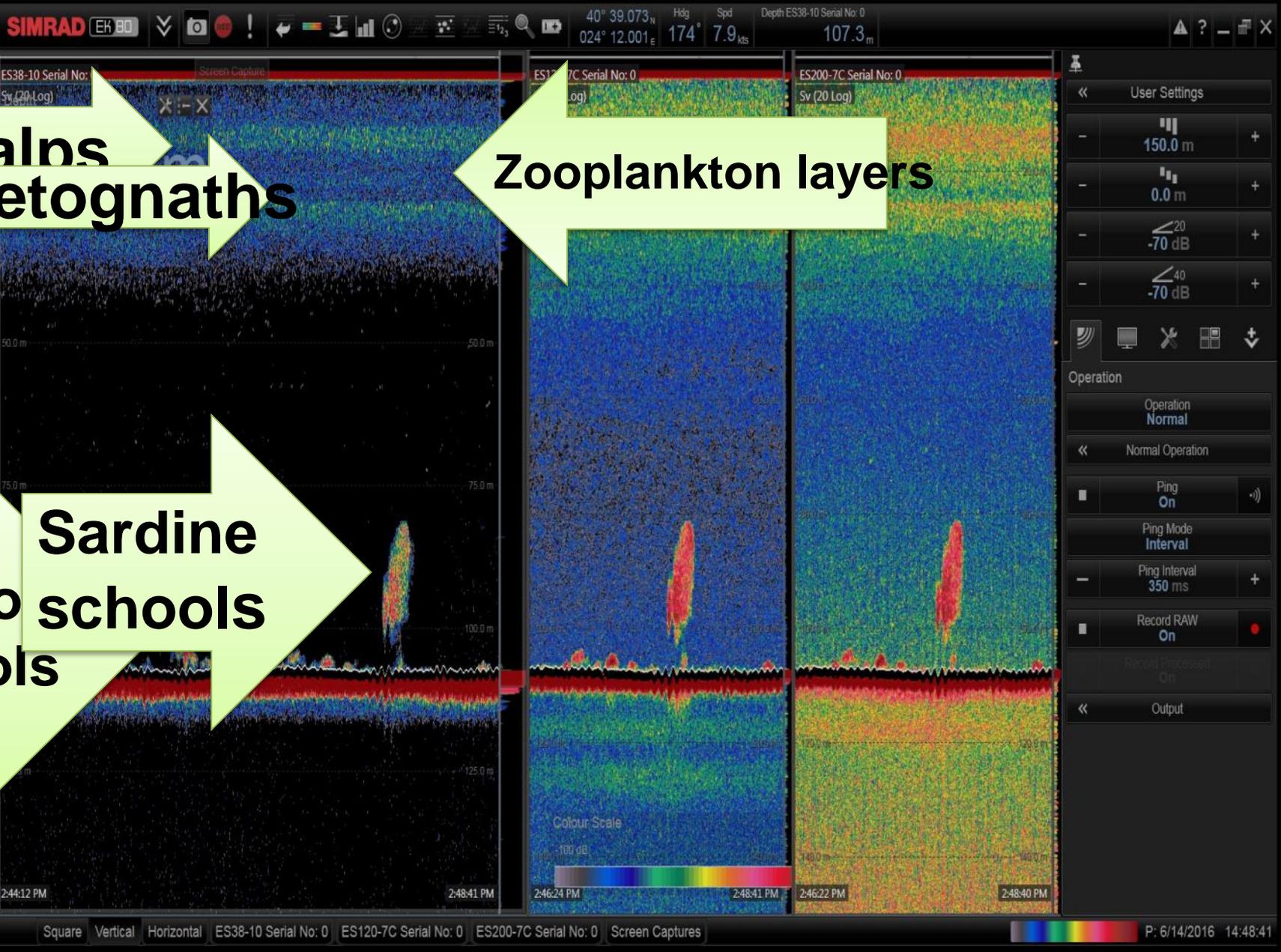


Sardine schools



Anchovy schools

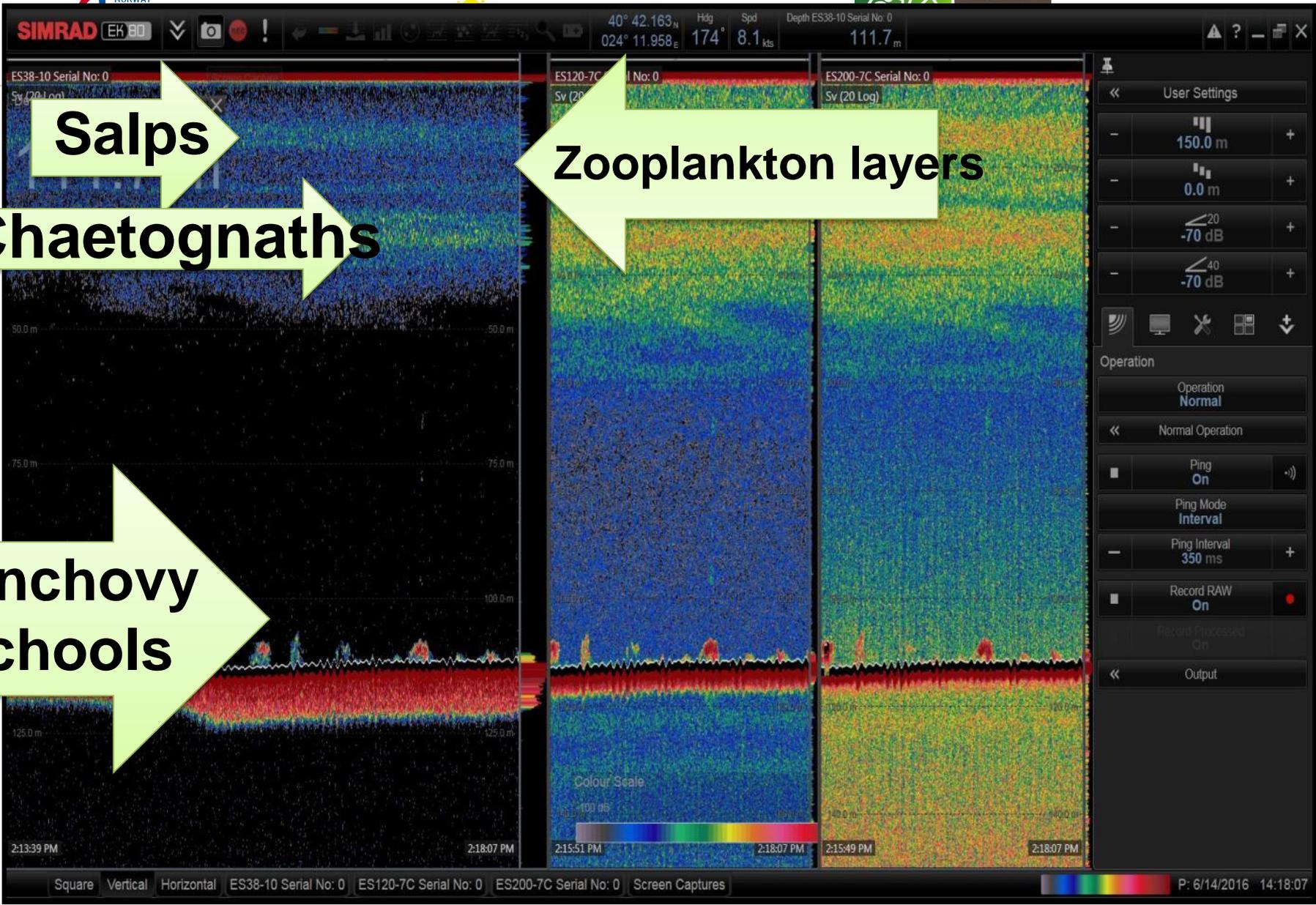
Zooplankton layer



**Salps
Chaetognaths**

Zooplankton layers

**Sardine
schools
Ancho
schools**



Salps

Zooplankton layers

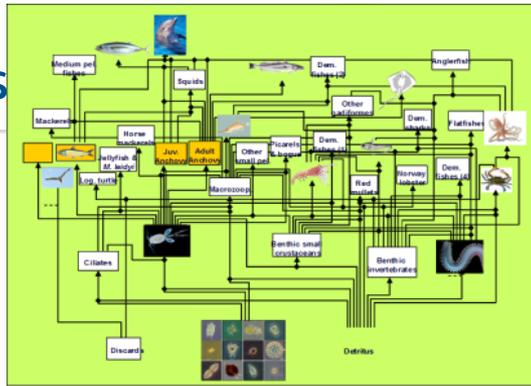
Chaetognaths

Anchovy schools

Within the framework of this project the upgrade of the available echo sounders equipment will include:

- Additional frequency at 333 kHz: necessary for mesozooplankton echo sampling like copepods and cladocerans
- Upgrade of the 38 kHz ES10 transducer into the 38 kHz 7c transducer
- Ensure better compatibility with the Simrad EK80 and the other two installed frequencies

- **Allow us to discriminate the acoustic properties of the different scattered layers, fish schools over a wider spatial scale and wider depth range**
- **The addition of the 333 kHz frequency will allow the simultaneous echosounding sampling of macrozooplankton, mesozooplankton and fish larvae layers and allow to identify the acoustic properties of these targets by frequency response curves**
- **Coupling acoustic data with complementary data on size and species composition is necessary for proper interpretation of acoustic data**
 - **For acoustic surveys of fish, trawl catches contribute information on species composition, size, and age structure**
 - **For zooplankton, acoustic information is often combined with species composition information from nets and/or optical methods**



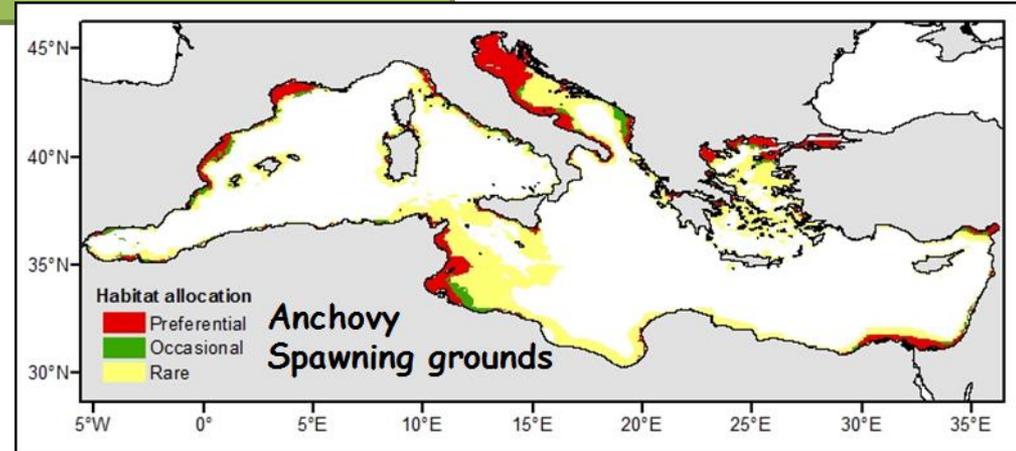
**FISH
ABUNDANCE**
estimated by
acoustics



- Food web modelling
- Feeding studies
- Essential Fish Habitat modelling



**MESOZOOPLANKTON
ABUNDANCE**
estimated by
acoustics

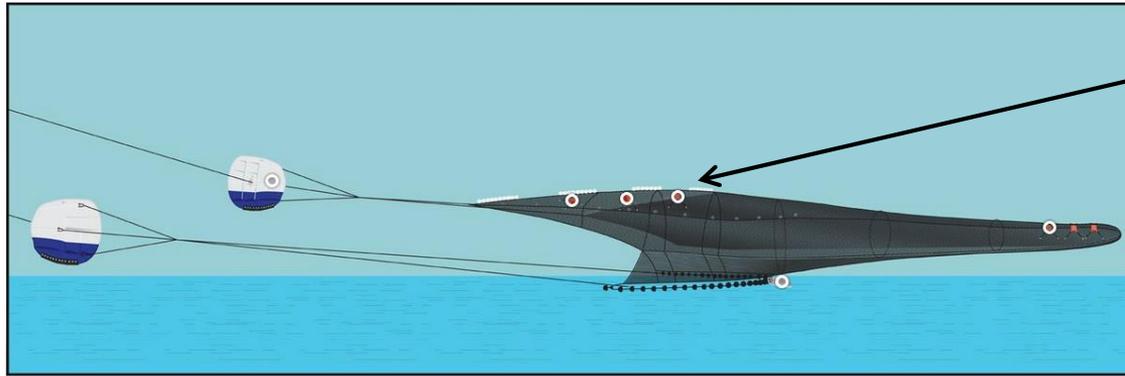


The use of hydro acoustic control system in bottom trawl surveys

A brief description and some results
from historical data

Stefanos Kavvadas – Danai Mantopoulou

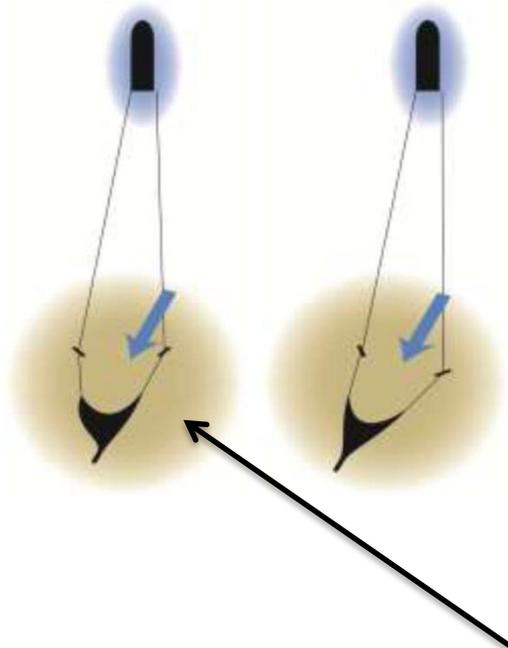
The hydro acoustic system consists of a set of sensors mounted on different parts of the trawl.



Various sensors
mounted on the
trawl

- Trawl horizontal opening
- Trawl vertical opening
- Gear depth
- Bottom contact
- Bottom temperature
- Doors distance and angle

Importance of the collection of the data from hydro acoustic system



- More precise estimation of Swept Area and Catch Per Unit Effort (CPUE)
- Clearer assessment of trawl performance during the tow
- Recognition and rejection of haul
- Avoid wrong towing direction

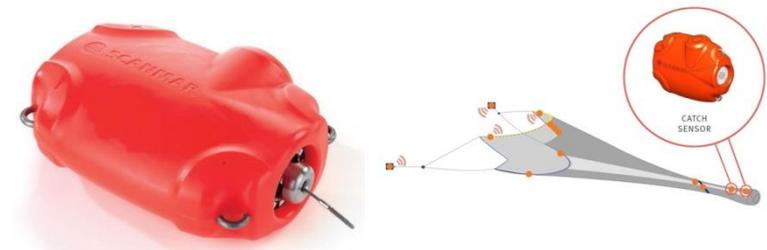
Wrong towing
direction

Description of the sensors

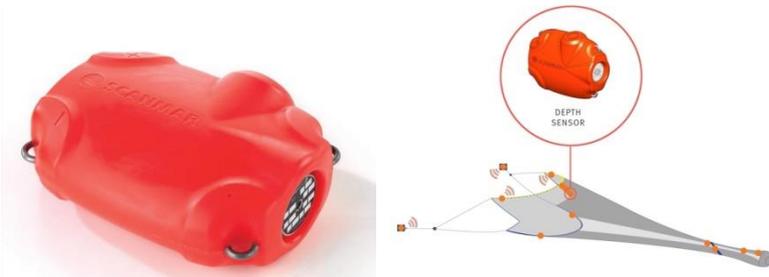
- Flow Sensor



- Catch sensor



- Depth Sensor



- Hydrophones



- Bridge System

- Trawl Eye



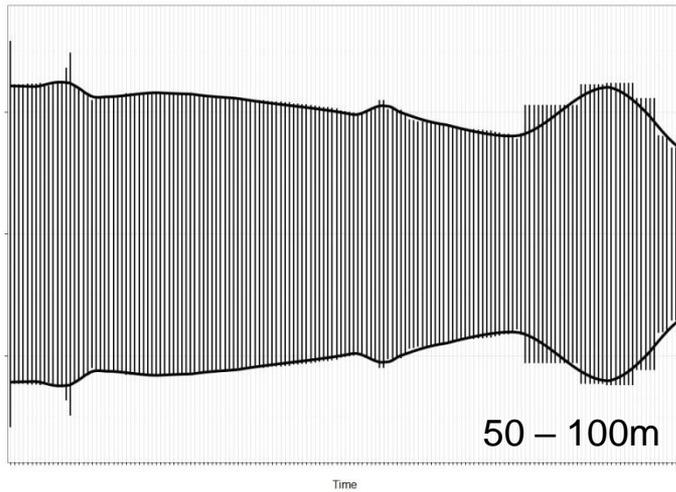
Use of historical data

MEDITS International Bottom Trawl
Survey years 1996 – 2003

- Calculation of Swept Area
$$\text{Swept Area} = \text{Distance} \cdot \text{Horizontal Opening}$$
- Catch per Unit Effort for Fish, Crustacean and Cephalopods
$$\text{CPUE} = \text{kilos} / \text{Swept Area}$$
- Schematic Representation of Trawl Trace

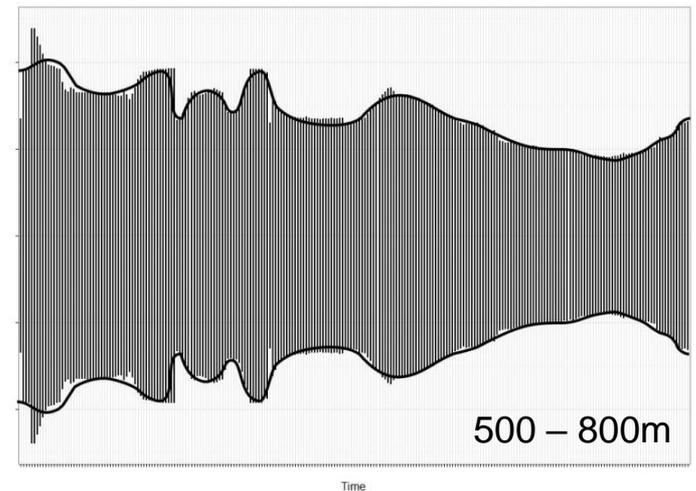


Trawl Trace



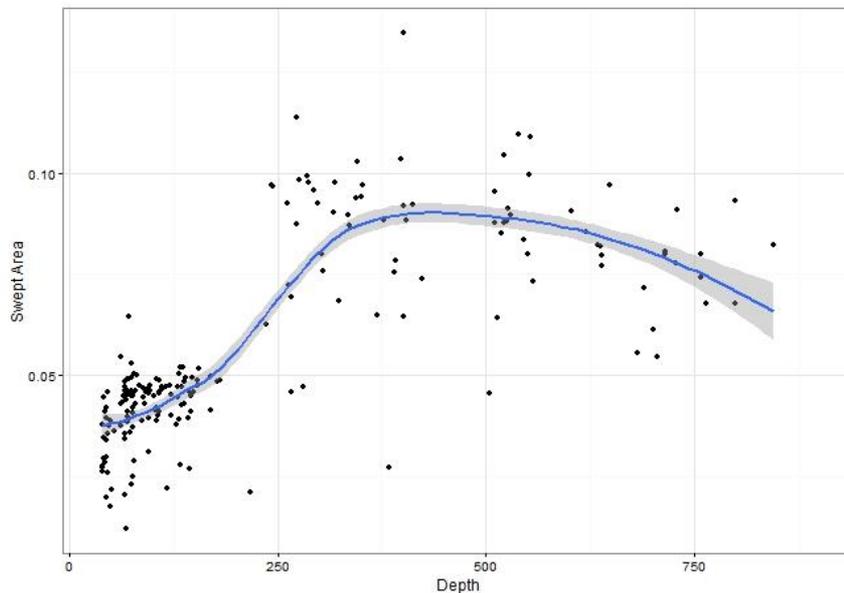
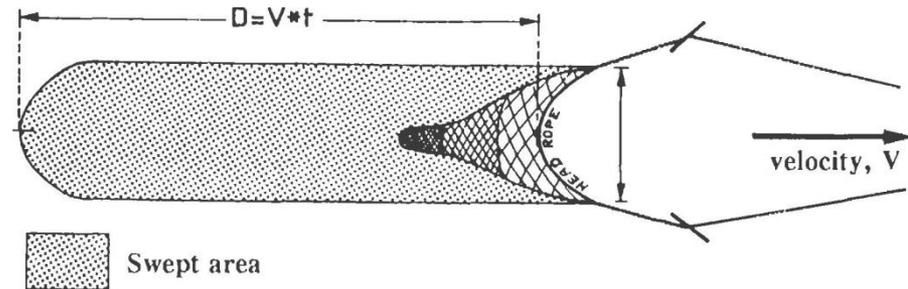
Continental Shelf
50 – 100 meters
Duration: ~30'
Year: 2001, Station: 18

Continental Slope
500 - 800 meters
Duration: ~60'
Year: 2003, Station: 11



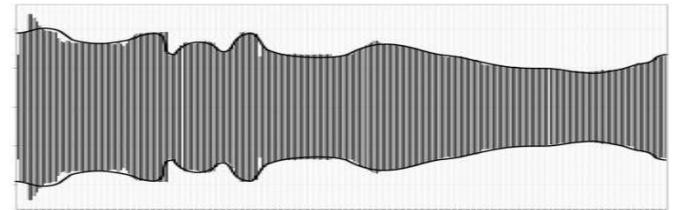
Swept Area

- *Before:*
Swept Area without
hydro acoustic data

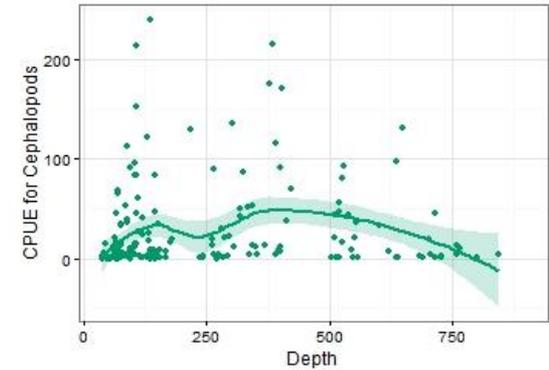
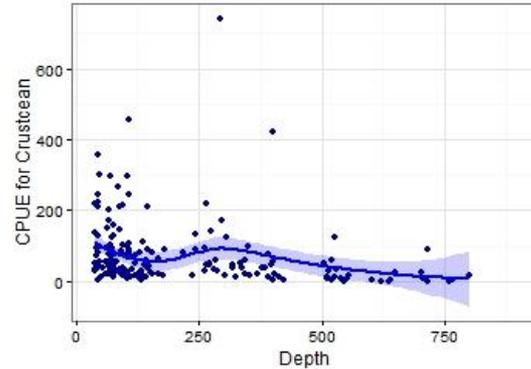
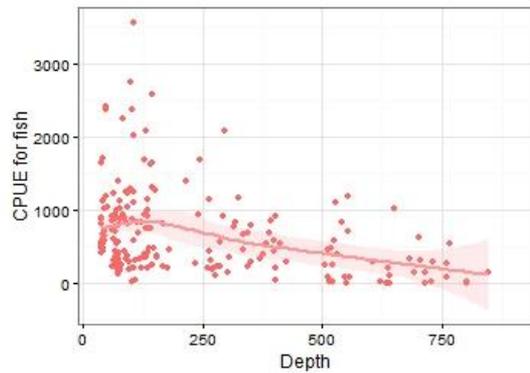


- *After:*
$$\text{Swept Area}_i = \sum_{j=1}^T v_j \cdot \Delta t \cdot h_j ,$$

 $T = \text{number of records in each station } i$
 $\text{and } \Delta t = 10''$



Catch per Unit Effort



$$CPUE_i = \frac{kg_i}{Swept Area_i}, \quad i = fish, crustacean, cephalopods$$

More precision in estimates due to precision in Swept Area



Benefits

1. Hydro acoustic systems help us have more precise and accurate data
2. Using these data we achieve precision in estimating biotic and abiotic parameters
3. We have better datasets to feed our prediction models in the future

T H A N K Y O U

Contribution to the implementation of MSFD

Indicator 1: Biological Diversity (e.g. Distributional range, Population abundance, Population demographic characteristics, Habitat area)

Indicator 3: Commercial Fish (e.g. Spawning stock - biomass, biomass indices, proportion of fish larger than size at first maturity, size at first sexual maturation)

Indicator 4: Food web (e.g. abundance trends of functionally important selected groups/species)

Indicator 7: Hydrological conditions (e.g. Changes in habitats and the functions provided: spawning, breeding, feeding, migration routes)

Work breakdown

Task 1: Procurement of atmospheric and oceanographic sensors for the POSEIDON monitoring buoys (International Tender)

Task 2: Procurement of an echo sounder system for the recording of fisheries population data (International Tender)

Task 3: Procurement of trawl scanning instrument that will be used for the collection of advanced fisheries data (International Tender)

Task 4: Procurement of spare parts and supporting hardware for the operation of the POSEIDON monitoring buoys (International Tender)

Task 5: Implementation of an integrated marine monitoring program –
Coordination of the project's implementation activities

Deliverables

Del. no.	Deliverable title
D.1	Announcement of a tender for the purchase of atmospheric and oceanographic instruments and other equipment for the upgrade and maintenance of POSEIDON's mooring network- evaluation and acceptance of new components
D.2	Announcement of a tender for the purchase of the echo sounder system and the trawl scanning instrument that will be used for the collection of advanced fisheries data
D.3	Upgrades of selected observatories with new sensors and expansion of the present network's observing capacity
D.4	Installation of echo sounder system and the trawl scanning instrument in the R/V "Philia"
D.5	Harmonization of QC and validation procedures of data collected through observation systems
D.6	Final report on the implementation and outcomes of the project

Expected outcome

The POSEIDON oceanographic units together with the new fisheries monitoring equipment will provide the facilities for the routine recording of the following characteristics, pressure and impacts referred to Annex III of MFSD (related also with MSFD Articles 5(2iv) and 11 (1)):

Characteristics - Physical and chemical features

*annual and seasonal temperature regime, current velocity, upwelling, wave exposure, mixing characteristics, turbidity, residence time
spatial and temporal distribution of salinity
spatial and temporal distribution of oxygen*

Characteristics – Biological features

information on the structure of fish populations, including the abundance, distribution and age/size structure of the populations

Pressure and Impacts – Other physical disturbance

*Underwater noise (e.g. from shipping, underwater acoustic equipment)
Pressure and impacts - Interference with hydrological processes
Significant changes in thermal regime
Significant changes in salinity regime*

Expected outcome

Regarding the geographical coverage, the system will provide data for the following marine subregions (defined in MSFD Article 4(2) :

the Ionian Sea and the Central Mediterranean Sea
the Aegean-Levantine Sea.

According to the above, the project's results will comply with the following expected outcomes and indicators for outputs described in Annex I of the Programme Agreement:

Expected Outcome: Improved monitoring of marine waters

Output: Upgrades of existing systems for an integrated marine monitoring programme.

Output indicator: Number of integrated marine monitoring programmes implemented, cf. MSFD Article 5 (2iv), **Target: 1**

Output: Increased area coverage of marine waters' monitoring programmes

Output indicator: Number of marine sub-regions [cf MSFD, Article 4(2)] where a monitoring programme has been implemented, **Target: 3**

Potential users of the project's outcome

- ✓ Public authorities related to the marine environment
- ✓ Academic and Research Institutions
- ✓ Regional authorities
- ✓ Non Governmental Organizations
- ✓ Scientific and Research staff

**Thank you very much for
your attention**