Mesopelagic fish community and deep scattering layers in an Eastern Mediterranean Sea enclosed deep basin

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Introduction

Mesopelagic fish, small species which inhabit the mesopelagic zone, constitute the most abundant vertebrate group in the marine environment. Together with other organisms they form Deep Scattering Layers (DSLs) detected by echo-sounders, while several species perform diel vertical migrations. The aim of this study was to describe echo-types, species composition and the horizontal and vertical distribution of the DSLs in the Gulf of Corinth, a relatively small, deep (>900 m), isolated basin located in the Eastern Ionian Sea (Eastern Mediterranean, Greece) that has some unique geomorphological and ecological features.
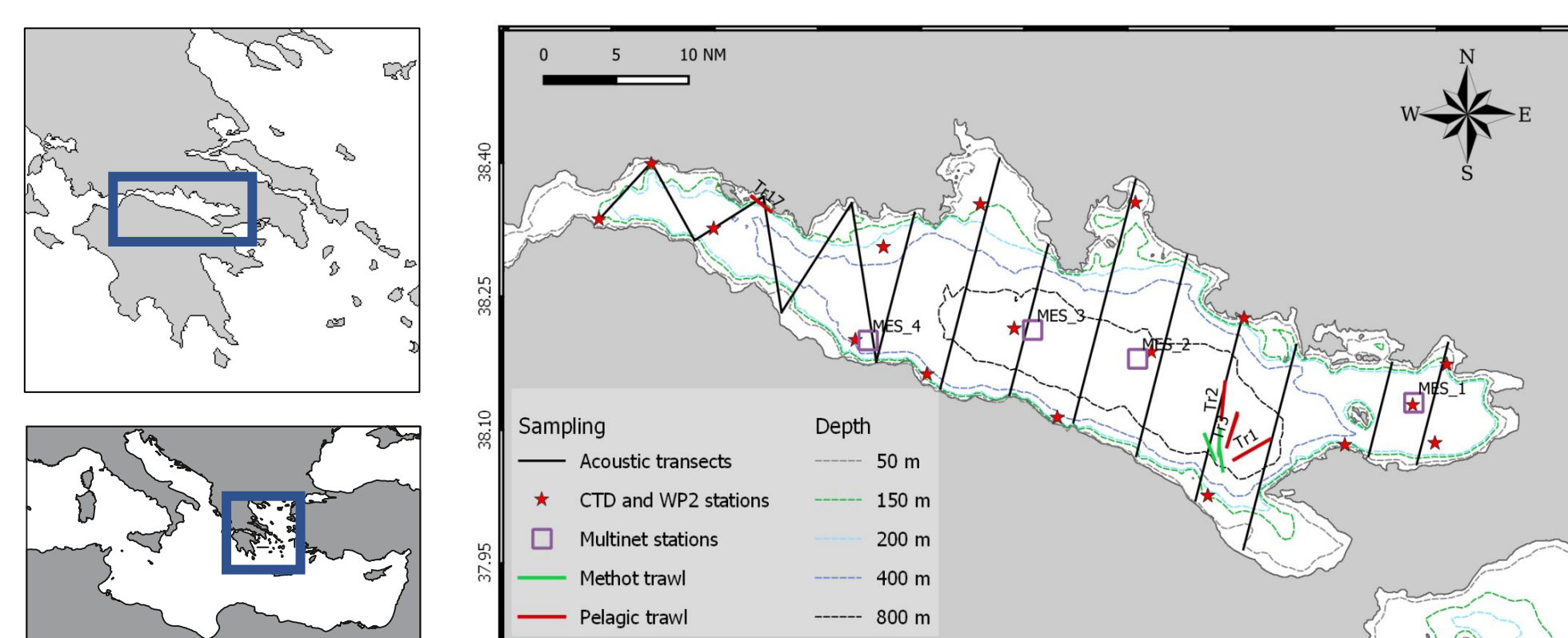

Figure 1. The Gulf of Corinth, bathymetry and sampling design in the first survey (November 2018).

Materials & Methods

Three acoustic surveys (November 2018, April 2019, October 2019) were performed on-board R/V PHILIA in the Gulf of Corinth. Acoustic sampling was performed with a SIMRAD EK80 38 kHz echosounder in predefined parallel transects and in zig-zag transects in the narrower part of the Gulf.

Table 1. Characteristics of sampling gears used in the surveys

	Midwater Trawl	"Sardonet" Trawl	Methot Frame	Multi-net
horizontal opening	~12 m	~3.7 m	1.5 m	0.5 m
vertical opening	~7 m	~2.1 m	1.5 m	0.5 m
stretched mesh size	16 mm	5 mm mesh	1 mm	300 μm
speed	3-4 knots	3-4 knots	2 knots	3 knots
main usage	Main sampling gear for fish	Backup gear and exploratory deployment	for juveniles, small sized species & ichthyoplankton	5 nets, plankton sampling, different layers

The Echoview software was used for scrutinization of echograms, while the Elementary Distance Sampling Unit (EDSU) for echo-integration was set to 1 nm.

For biological sampling, four gears were used (Table 1), either as main sampling gears or for exploratory sampling. Hauls were performed during daytime in order to sample the most important scattering layers as well as during the night to explore species composition in the migratory (i.e., near surface hauls) and the non-migratory (i.e., deeper hauls) layers. Trawl catches were sorted on-board to species level when possible and total numbers, weight and length distributions per species were counted/measured or estimated based on a sub-sample and total weight.

A Sea-Bird SBE 19plus V2 SeaCAT Profiler CTD was used to collect hydrographic parameters at different locations of the surveyed areas.

Results & Discussion

Mesopelagic fish dominated the pelagic ecosystem of the Gulf, as evidenced by the distribution of sound which extended in several depth strata all along the basin (Figure 3). The dominance of mesopelagic fish was confirmed by sampling with different gears; in total, at least 13 fish species were caught (Table 2), belonging to the families Myctophidae, Paralepididae, Sternoptychidae and Stomiidae, while the - elsewhere very abundant - families Gonostomatidae and Phosichthyidae were completely absent.

Table 2. Mesopelagic fishes caught in the surveys

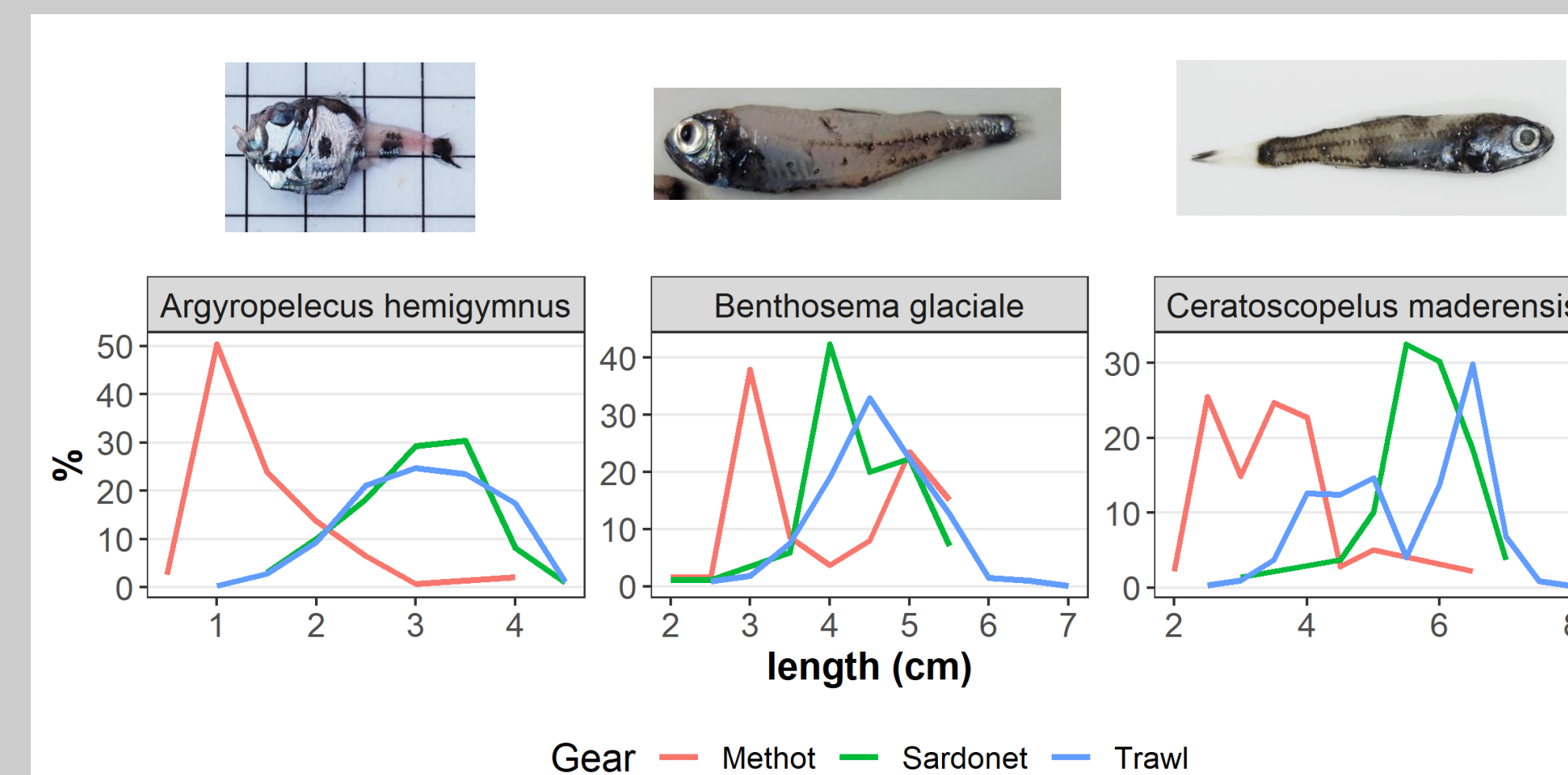| Myctophidae	Sternoptychidae
Benthosema glaciale	Maurolicus muelleri
Ceratoscopelus maderensis	Argyropelecus hemigymnus
Diaphus holti	Paralepididae
Hygophum benoiti	Lestidiops jayakari
Lampanyctus crocodilus	Lestidiops sp.
Myctophum punctatum	Paralepis speciosa
Notoscopelus sp.	Paralepis coregonoides
	Stomiidae
	Stomias boa

Figure 2. Length frequency distribution of selected species in the three gears used for fish sampling (pooled data).

The main echotrace types of the basin (Figure 3) included: a) shoals and schools usually located a few meters above the seabed along the shelf break, at approximately 75-275 m, which were formed by the silvery lightfish Maurolicus muelleri (M.m.), b) a thin scattering layer found through-out the deep (>200 m) parts of the Gulf at 160-250 m, dominated by juveniles half-naked hatchetfish Argyropelecus hemigymnus (A.h.) and c) one thick - or more than one but thinner - deep scattering layer(s) at 250-650 m, consisting of a mix of mesopelagic species ("mix" echotype), mainly myctophids. Less dense layers at depths 600 m down to the bottom were sometimes also present but were in close association with the thick dense layer above them. Vertical profiles of dissolved oxygen showed that oxygen concentrations were quite high and didn't restrict the vertical distribution of mesopelagic fish. Dusk/Dawn acoustic recordings in the area (Figure 4) were dominated by the partial migration of pattern the mixed layer, while the A.h. layer was non-migratory.

These results confirm (with small deviations) previous knowledge on species composition in the area, which was based on ichthyoplankton surveys (Somarakis et al. 2011).

The length frequency distribution of the species caught in the different sampling gears revealed that the catch of the Methot frame was dominated by smaller individuals, while the midwater trawl and the "Sardonet" trawl caught similar sizes, depending also on the species (Figure 2).
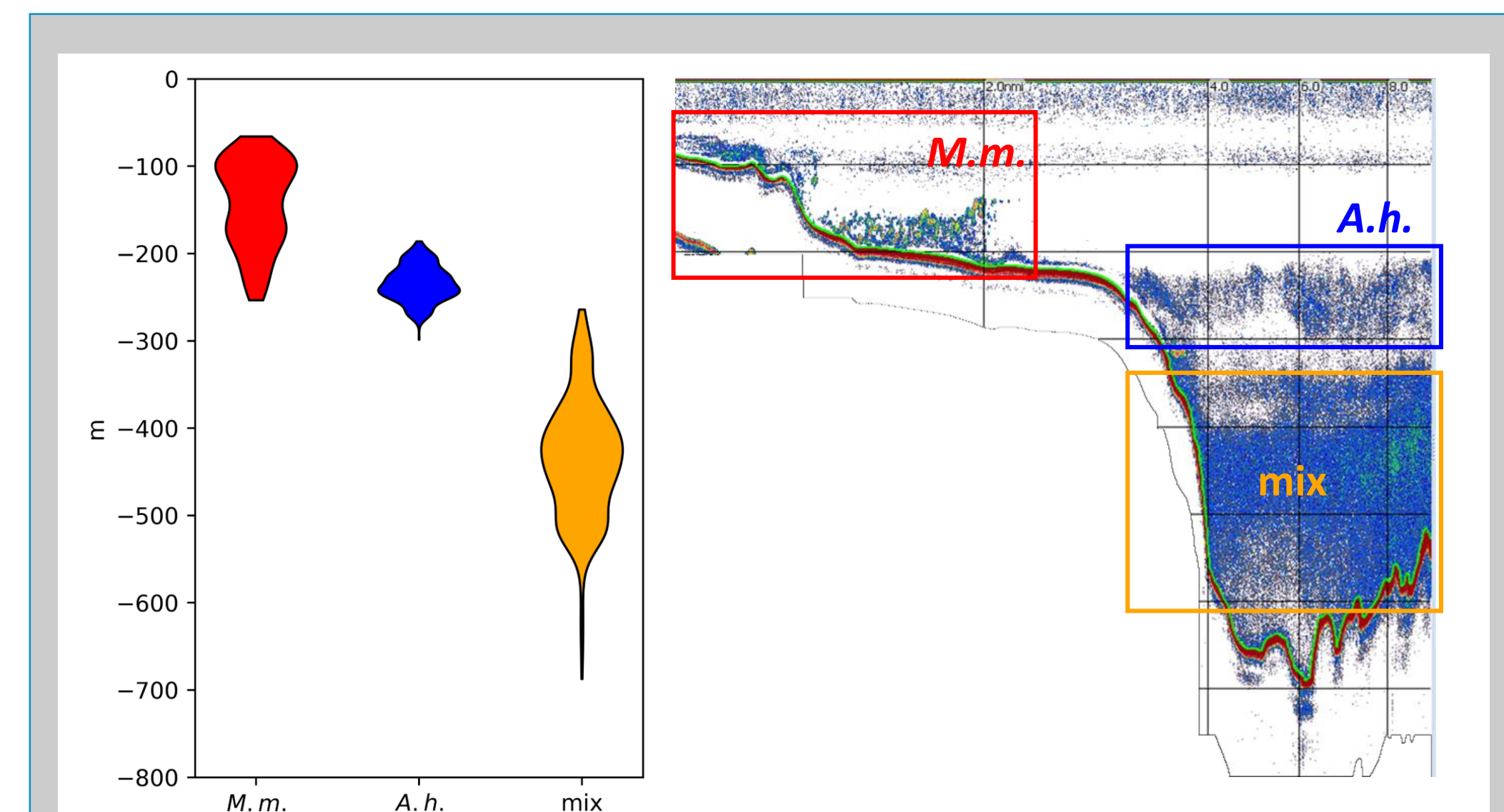

Figure 3. Depth distribution (300 m intervals, pooled data for all transects) and characteristic echograms (transect mk9) of the three main echotrace groups present in the basin.

Overall, even though biomass estimates have not been produced yet, the total backscatter values of the detected layers indicate that the Gulf of Corinth seems to sustain high densities of mesopelagic fish that constitute the basic food resource for the abundant dolphin populations that inhabit the area (Bonizzoni et al. 2019).
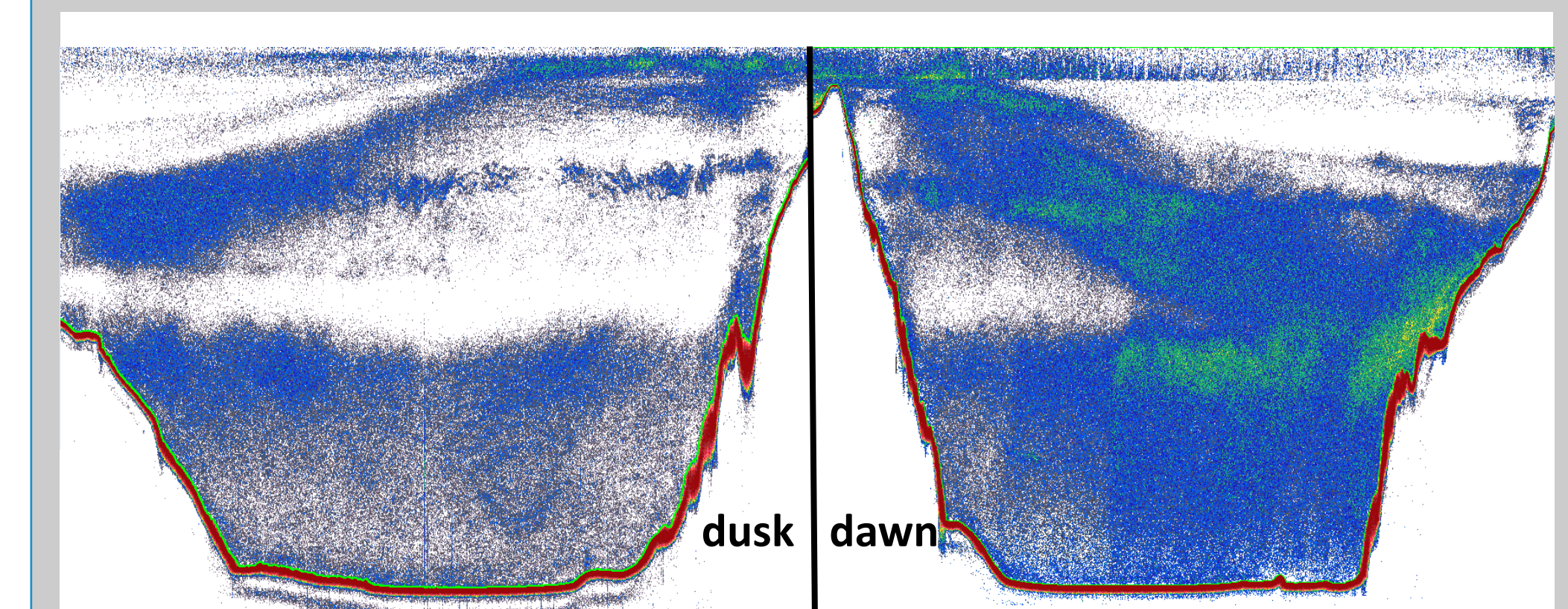

Figure 4. Migration pattern of the mixed DSL during dusk and dawn.

References

Bonizzoni, S. et al. (2019). Modelling dolphin distribution within an Important Marine Mammal Area in Greece to support spatial management planning. Aquat. Conserv. Mar. Freshw. Ecosyst. 29, 1665–1680

Somarakis, S., Isari, S. & Machias, A. (2011). Larval fish assemblages in coastal waters of central Greece: reflections of topographic and oceanographic heterogeneity. Sci. Mar. 75, 605–618