

Accumulation of northern krill (*Meganyctiphanes norvegica*) in a convergence zone at the Cap Breton Canyon (southern Bay of Biscay).

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Introduction

Physical-biological interactions generate spatial patterns in the distribution of plankton. In the last decade, it has been emphasized the importance of mesoscale physical structures in the distribution and production of plankton (Ressler and Jochens, 2003). Some authors have shown that organisms at the higher-trophic levels, including cephalopods, cetaceans and sea-birds also respond to these mesoscale features that control the availability of their prey (Davis et al. 2002).

Northern krill (*Meganyctiphanes norvegica*) plays a pivotal role in the transfer of energy from the lower to the higher trophic levels of the food-web (Warren et al. 2004). During an oceanography-fisheries cruise conducted in the Bay of Biscay in autumn, a thin and large layer (ca. 15 m height on average, 1 nautical mile length) of northern krill was acoustically detected, and confirmed by a fishing haul, at the sub-surface layer (between 15-30 m depth) over the shelf-edge at the Cap Breton Canyon. The position of this layer is concurrent with a converge zone associated to anticyclone eddy activity in this area. As far as we know, this is the first time that such a large layer of northern krill is reported in the Bay of Biscay.

Methods

The PELACUS-1007 cruise was carried out on board RV Thalassa in the Bay of Biscay from September 19th to October 13th of 2007, to evaluate the spatial distribution and abundance of the pelagic community, from plankton to small pelagic fishes, and to study its relationship with the oceanographic conditions. Information on abundance and distribution of marine mammals and birds was also acquired. During day-time, under-way measurements of acoustic backscatter at 18, 38, 70, 120 and 200 kHz (SIMRAD ER60 scientific echosounder), opportunistic fishing hauls for identification of echo-traces, surface oceanographic conditions (temperature, salinity and fluorescence) and observations of top predators were carried out. At night, a profiler package was lowered at prescribed oceanographic stations from the surface down to a maximum 500 m depth. The profiler package consists of a rosette with twelve 5 l Niskin bottles for water sampling, a SBE 911 CTD (conductivity-temperature-depth), a Wet Lab Eco-AFL fluorometer, a SBE 43 oxygen probe, a Wet Lab transmissometer for measuring the amount of suspended particulate matter and a laser optical plankton counter (LOPC from BOT) for counting and sizing plankton between 90 and 20•103 μm size range. Meteorological information was acquired continuously during the cruise. Additional satellite-derived information (sea surface temperature, color and altimetry) was also gathered at different stages.

Results and Discussion

The general oceanographic conditions during the cruise revealed the occurrence of coastal upwelling in the Cantabrian Sea (Fig. 1a), anti-cyclonic eddy activity in the inner part of the Bay (Fig. 1b) and river plumes, and associated fronts and meanders, in the French shelf. In a coastal-offshore transect off 2° 21' longitude, the tilt down of isotherms at the shelf edge were indicative of the presence of a converge area (Fig. 1c). Maximum fluorescence values were observed at the subsurface along the transect, but diminished notably at the outer stations (Fig. 1d). Contrastingly, zooplankton biovolume in the 0.5-1 mm equivalent spherical diameter size-range was higher offshore than at the coast (Fig. 1e).

Over the shelf edge of this transect, high acoustic backscattering was detected for all the operation frequencies at a sub-surface layer located between 20-30 m depth, and with dimensions of 15 m height on average and 1 nautical mile length (Fig. 2a). A fishing haul with a pelagic net (2 cm mesh-size at the cod-end) confirmed that the layer corresponded to almost pure northern krill (*Meganyctiphanes*

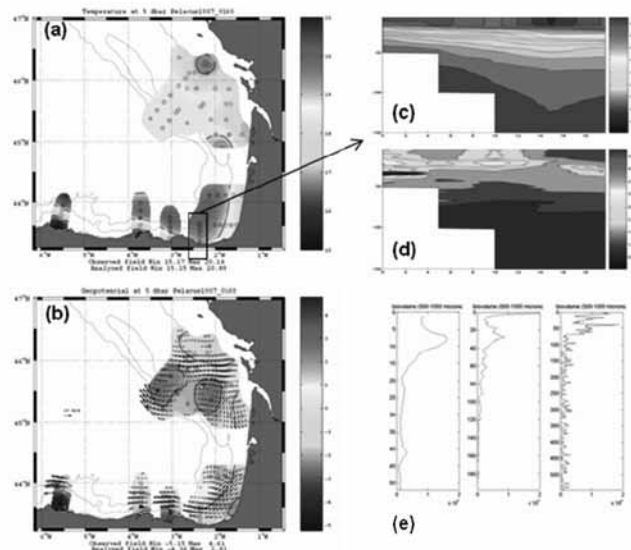


Figure 1. Oceanographic conditions in the Bay of Biscay between 19/09 and 04/10 of 2007 (a-b), and across the shelf at 2° 21' longitude on day 21 (c-d). (a) Temperature at 5 dbar (°C); (b) geopotential at 5 dbar (cm); (c) temperature and (d) fluorescence (arbitrary units) along the transect; (e) biovolume (μm^3) of particles in the 0.5-1 mm equivalent spherical diameter (ESD) size-class at stations 1, 3 and 5 of the transect.

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norvegica) of 21.4 mm average (16.7-26.2 mm range) standard length (from the posterior edge of the eye to the tip of the telson) (Fig. 2b).

The aspect of the layer changed from the sunset to night (Fig. 3). It become more disperse and the center of gravity of the ascend up to 15 m depth. The occurrence of the layer was concurrent with a drop of sub-surface chlorophyll (fluorescence) and with the presence of marine mammals in the area (José Cedeira and Salvador García, pers. com.).

Acknowledgements

The authors wish to thank all the crew of the RV Thalassa for their continuous assistance during the cruise. EN thanks also all the participants in the cruise. The cruise was carried out within the frame of the IEO structural project ECOPEL (Ecology of small pelagic fishes). G.G-N is a recipient of a pre doctoral fellowship from the ‘Consejería de Educación y Cultura del Principado de Asturias’.

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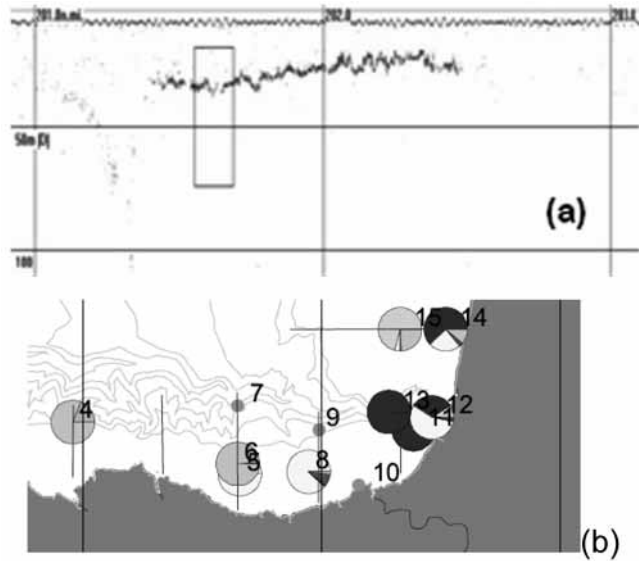


Figure 2. (a) Echogram at 38 kHz corresponding to *M. Norvegica*; and (b) location of the identification fishing haul (number 7).

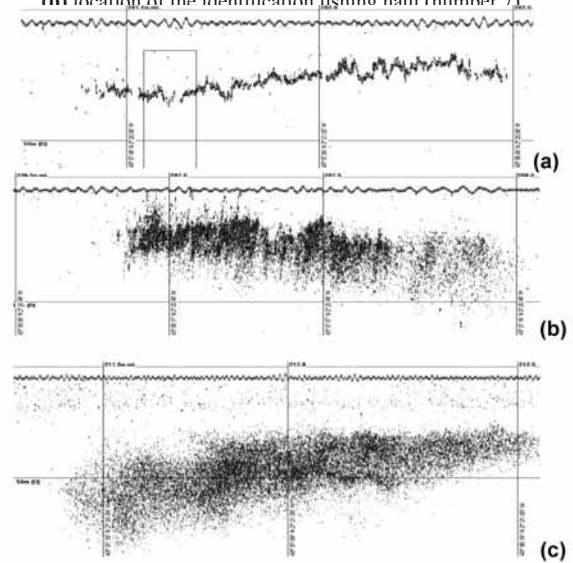


Figure 3. Three different echograms acquired at 38 kHz for the same patch of *M. norvegica*, (a) at dusk (19 GMT), (b) at night (21 GMT) and (c) during the fishing haul (22 GMT). Vessel speed 10 knots for echograms (a) and (b) and 4 knots for (c).