Monitoring salmon with broad band echo sounders – investigate acoustic parameters as indicators for welfare

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Salmon lice is challenging for salmon aquaculture. A new innovative preventative solution is to submerge the salmon net-pen to avoid the surface-dwelling infestative lice larvae. However, the physostomous salmon require daily air surface access or the swim bladder will deflate. The negative buoyancy lead to increased swimming and positive tilt angles. Over extended time (2-3 weeks), the appetite, growth rate is reduced, spine compressed and more injuries appear resulting in poor welfare. To study the swim bladder inflation level as an indicator for fish well-being, we deployed three split beam 70, 120 and 200 kHz broad-band transducers under a net-pen for 30 days. Using an underwater net roof, salmon was denied air access for 23 days and the change in swim bladder inflation and fish behavior was observed. A method for early detection of swim bladder deflation from acoustic FM pulses and CW pulses are being developed, and we already see clear patterns in the TS attenuating by 10 dB. Results can be used to develop automatic alarms on lack of swim bladder inflation/poor welfare and have already given us new key knowledge of backscattering from the salmon swim bladder with degree of fulness.

Comparative analysis of pelagic compartment organization by bathymetric strata in the Canary Current Large Marine Ecosystem

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The Canary Current Large Marine Ecosystem (CCLME) is located along the North West African coast from Morocco to Guinea Bissau. In this work, 14 Nansen fisheries acoustics surveys have been led from the southern border of Senegal (12.15°N) to the Cape Blanc (20.77°N) during the hot wet season, i.e., outside the seasonal upwelling period, from 1995 to 2015. The aim of this study was to scrutinize the water column organization in a bathymetric gradient starting from the coast to the offshore area, discretised in three areas: inshore (< 150m), transition (150-500m) and off shore (> 500m). Here, we worked on acoustic sound scattering layers (SSL) and on the whole water column through echointegrated data (EI). SSL and EI descriptors highlighted significant difference between the three depth strata. Study of the Diel Vertical Migration (DVM) highlighted that volume backscattering coefficient (proxy of pelagic abundance) vertical profile

from transition area has a pattern globally similar to offshore one while inshore presented an inversed pattern. Analyse of annual change using EI descriptors reveal one common trait: the number of SSLs significantly increase whatever the depth strata considered. This study highlights differences and similarity in water column organization between depth strata.

Switching off the Sun to observe the twilight zone spatial dynamics across Saint-Paul and New-Amsterdam Islands, Southern Indian Ocean

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Information on micronekton (> 1 cm organisms) is globally scarce in the open ocean, and its vertical and horizontal distribution in relation to oceanographic structures is poorly known. The complex biodiversity composing micronektonic functional groups lead to even more challenging interpretations of their spatial dynamics. Advanced generations of echosounders emit simultaneously several acoustic signals (multi-frequency device), allowing a finer view of the micronektonic community. While data becomes more abundant and complex, it is crucial to develop statistical tools aiming to objectively extract key components of its variability. In this study, we analyse data recorded onboard the R/V Marion Dufresne from an EK80 echosounder emitting at 18, 38, 70, 120 and 200 kHz. We developed a Multivariate Functional Data Analysis method to identify patterns in micronekton structures across Saint-Paul and New Amsterdam economic exclusive zone, at the boundary between vast oceanic domains. This approach proposes an objective method to analyse the vertical backscatter distribution and quantify temporal and spatial modes of variability in multivariate acoustic data. By filtering the temporal mode, we uncovered a latitudinal acoustic pattern in concordance with hydrological features and biological samples distribution. Such methods could be implemented at a global or local scale and allow 3-D modelling of micronekton structuring.

A finer look into the twilight zone: comparing acoustic records from an animal-borne miniature sonar and a multifrequency echosounder

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An animal-borne miniature active echo-sounder has been recently deployed on southern elephant seals (*Mirounga leonina*) from the Kerguelen and Argentinian colonies. This high frequency sonar (1.5 MHz) has shown a strong potential in detecting small mid-trophic level targets (zooplankton and micronekton). Relative abundance and distribution can be assessed, allowing to observe temporal (diel migration) and spatial patterns of plankton. However, the interpretation

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