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3D acoustic characterization of the spatial and temporal dynamics of large pelagic fish aggregations around moored Fish Aggregating Devices in Martinique (Lesser Antilles)

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In this work we aim at characterizing the spatial and temporal dynamics of pelagic fish aggregations distributed around moored Fish Aggregating Devices (FADs) in Martinique, in relation to environment and commercial fishing. We combined various observation techniques: scientific echosounder, underwater video, fishing and abiotic environment sensors. Radial and vertical acoustic surveys were conducted to sample a cylinder of 1500 m radius and 600 m height around 2 moored FADs. Echo integration by shoal was used to extract the fish aggregations and compute morphological and density descriptors. The inner dynamics of the fish aggregations were described through target strength analysis and video observations. Multivariate analysis were applied to assess the prominent morphological descriptors and propose a typology of the fish aggregations. Fish density estimates and associated variances were calculated by universal krigging in the sampled area. The temporal dynamics of the fish density and of the main morphological descriptors of the aggregations were analyzed with multiple and generalized linear regression methods to i) identify the temporal patterns ii) assess and compare the influence of social behaviour, environment and fishing on the aggregation process. During the day, the biomass was mainly distributed within 400m around the FADs, in the mixed layer (0–120m), in the form of a large 50 cm FL tuna aggregation. The density of the aggregation followed a diel cycle, reaching a maximum around noon and a minimum at night. Surprisingly, these tuna exhibited a low vulnerability to the gears of the local commercial fishermen, who specifically targeted scattered large predators.

Keywords: tuna fisheries, aggregative behavior, FAD, echosounder, geostatistics.

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The effect of seabed topography on the distribution of components of the pelagic ecosystem found off the coast of the sub-Antarctic Island of South Georgia

Cathy Goss

Swath data from the Simrad EM120 sounder on board the RRS James Clark Ross has provided a detailed bathymetry map of this study area, which has enabled acoustic data from the Simrad EK60 fisheries sounder to be examined in relation to topographic features on and off the continental shelf. Echoview software (SonarData) has been used to display data from series of cross-shelf transects, transformed to highlight different classes of scatterers, to facilitate detection of water column features which are associated with the topography. Environmental-biotic correlations detected in this way can then be examined statistically, and the clear differences explored between the off shelf habitat, subject to strong transverse current flows, and the near-shelf and on shelf habitats, subject to more complex flows.

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Detection of spatial distribution of acoustic categories

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There is a current desire to harvest marine resources by managing total marine ecosystems rather than single species of the ecosystems. Comprehension of the three dimensional and dynamic features of pelagic marine ecosystems is important for developing effective methodology to support ecosystem-based management of marine resources. Acoustic techniques may be used to look at aquatic ecosystems over a broad range of spatial and temporal scales. By means of algorithms applied on high-quality multi-frequency acoustic data, species, or rather acoustic categories, of the

ecosystem can be identified. This information may significantly increase the accuracy of acoustic survey estimates of fish and to some extent also for zooplankton. Multi-frequency split beam echo sounders with nearly identical and overlapping acoustic beams have been regularly used in acoustic surveys for direct generation of new, synthetic echograms, based upon the measured or modelled relative frequency response of the targets is one of the most useful features of the systems. The result of the categorisation process is used to show the spatial distribution of different acoustic categories in a single synthetic echogram, or to keep some and remove other acoustic categories in echograms at a single frequency.

Keywords: categorisation, species identification, synthetic echograms, relative frequency response, 3D, 2D.

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Employing nested survey techniques to identify the relationships between benthic and pelagic environments within a 3-Dimensional framework

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There is an emerging requirement for improved understanding of patterns of biodiversity, at local and regional scales, and the interaction and relative controls of broad scale biogeophysical processes affecting pelagic and benthonic habitat populations and distribution of ecological patterns. The Marine Institute of Ireland assembled a multi-disciplinary group to carry out a nested survey of two adjacent areas, off southern Ireland; a known herring spawning ground and a dredge spoil dumpsite. The program specifically targeted several critical questions which would improve our ability to implement and manage effective conservation strategies: (i) what are the most useful biophysical parameters (e.g., topography, sediment type, water masses) for resolving biotopes at EUNIS Level 3 and herring spawning habitats, (ii) what are the responses of the identified habitats to anthropogenic impacts (fishing and dumping), (iii) which acoustic or direct sampling technology are the most effective in defining both pelagic and benthonic habitats and what are the advantages and restrictions of the tools and, (iv) what are the logistical constraints to planning, executing and quantitatively interpreting a multi-resolution survey. Surveys were carried out from the "R.V. Celtic Voyager" utilizing a combination of multibeam and dual-frequency single beam echo sounder, acoustic ground discrimination systems, pinger sub-bottom profiler, video traverses, plankton hauls, grab and dredge sampling and oceanographic measurements. This paper discusses the adopted 3-Dimensional approach to data interpretation and demonstrates the success, repeatability and applicability of nested surveys, such as this for identifying relationships between the benthos and associated pelagic environment.

Keywords: nested multi-disciplinary surveys; habitat mapping; oceanography.

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The three-dimensional GIS using sonar information for coastal fisheries

Akira Hamano and Hideaki Tanoue

The imaging of acoustic data in 3D is an effective tool for examining the target distributions, and shoal behavior. In this study, the sector-scanning sonar was used for collecting the distribution of fish schools. The echo data as the base information of the present study were collected in November 2000 from the coastal area around the southern Japan Sea. Furthermore, the GIS technique was used to demonstrate the spatial distribution of the schools on a three-dimensional map. In order to extract the school area from the sonar image, the binarization method of discriminant analysis was used for determining the threshold value. The 3D view used this school area could be drawn using the GIS spatial analysis. This 3D view can provide the animation image for us, the images of fish schools could be easily observed from a different perspective, angle or altitude. From this visualization, it was found that (1) the distribution of schools were concentrated around the seamount and artificial reef areas, (2) about 56% of the fish schools are distributed in the layer from 20 m to the sea bottom, (3) the number of school images was 344 on the starboard side, 129 on the port side, and