sis performed with WL obtained 83.7% of correct classification. RMSAC and RMSECV are lower in the EFA model.

Length values predicted by PLS models were regressed on observed otolith length for both EFA and WL7 shape descriptions. PLS model generated values much efficiently related with measured lengths. In both cases a significant high correlation was found (puncorr.<0.01); EFA model showed an R2=0.98, while WL7 for R2=0.88.

K-means validation test reported that otolith growth of Caprolace eels, calculated between the otolith size and shape, is allometric and the trend of variation is continuous and not "step-shaped".

IV. CONCLUSIONS

From the methodological point of view Elliptic Fourier method applied to European eels otolith shape analysis has obtained better performances using the Partial Least Square regression between observed vs. predicted otolith length. Further studies are needed to verify and implement these results applying lower wavelet coefficients in order to be able to describe outlines at a higher resolution.

Many studies described a good linear correlation between fish length and the caudal otolith radius [11] which reflect its whole size. Our results confirm this evidence for eel population of Caprolace lagoon. Animals otolith growth showed an allometric and continuous trend. Therefore in this case it seems not possible to identify different typologies of otolith shape as a tool for indirect ageing as suggested by Doering e Ludwig (1990)[12].

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POTENTIAL APPLICATIONS OF AUTOMATED VIDEO-IMAGE ANALYSIS IN THE PELAGIC AND DEMERSAL ENVIRONMENT INCLUDING THE DEEP-SEA

J. Aguzzi[1], Costa C.[2], Menesatti P.[2], Manuel A.[3], Del Río J.[3], García J.A.[2] Fujiwara Y.[4], Iwase R.[4]
(1) Instituto de Ciencias del Mar (ICM-CSIC)
(2) AgritechLab - Agricultural Engineering Research Unit of the Agriculture Research Council (CRA-ING)
(3) SARTI (Remote Acquisition Systems and Information Treatment Development Center) – CTVG.
(4) Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

Keywords - Automated Video-Image Analysis, Activity Rhythms, Deep-Sea, OBSEA, Sagami Bay

I. INTRODUCTION

The identification of species, the estimation of their biomasses and associated behavioural rhythms is acquiring increasing importance for fishery management and biodiversity estimation in deep-water continental margin areas and the deep-sea [1].

In the past two decades, the number of submarine video-stations has progressively along with socio-economic interest ocean exploration. In this context, expandable Submarine Stations at different depths such as JAMSTEC's Real-Time Deep-Sea Floor Permanent Observatory of Sagami Bay (1100 m) and SARTI-UPC's western Mediterranean OBSEA (20 m) were installed to measure several submarine parameters, including videos [2].

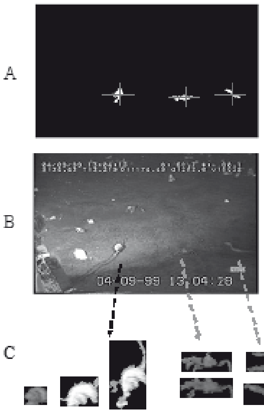
Accordingly, we have elaborated a novel morphometry-based protocol for automated video-image analysis of data from the JAMSTEC and UPC-SARTI cameras. Our approach accomplishes species identification with Fourier Descriptors and Standard K-Nearest Neighbours analyses on their outlines, and performs animal movement tracking (by frame subtraction), both in the demersal and in the pelagic realm.

II. MATERIALS AND METHODS

For Sagami Bay we analysed one week of footage (09-04-2009 to 16-04-1999), from the infrared 3CCD video-camera.

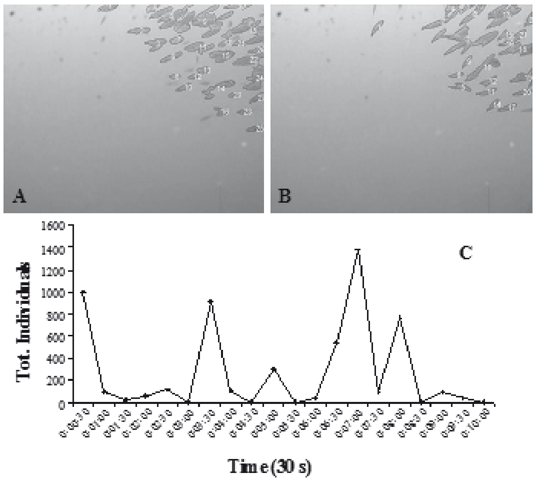
For OBSEA, ten minutes of footage were obtained at midday (23-06-2009), from the OceanCam OPT-06 video camera.

Video-image analysis for both cameras followed the same procedure: A) selection of the frame to be analyzed; B) definition of a region of interest; C) identification of displacing objects in consecutive frames by Area thresholding (within the circle (which circle?)); D) grey-level scale thresholding; E) display of original greyscale image with object identified in overlay representation for comparison Figure 1 illustrates the identification of unknown biological objects by a trained operator in Sagami footage. Object selection (Figure 1A); class attribution (Figure 1B); the saving of newly classified objects as single images for their later individual processing by Fourier Descriptors analysis (Figure 1C).



(left) Fig. 1. The object selection by Expert Supervision

(below) Fig. 2. Automated counting of fishes in the OBSEA footage. Two consecutive frames at 30 s distance (A, B) are reported as well as a time series of individuals per unit of time as an example of biomass counting applications



III. RESULTS AND DISCUSSION

Sagami bay footage.

Three displacing species were identified as the most recurrent: Zoarcid fishes (eelpouts), red crabs (Paralomis multispina), and snails (Buccinum soyomaruae) Double-plot actograms referring to the number of observed moving eelpouts, crabs, and snails are presented in Figure 3. Complex rhythmic patterns appeared with varying strengths in the corresponding time series, being especially(?) marked in fishes (Figure 3A). As revealed by the program analysis (Figure 3B), eelpout rhythmic behaviour presented a periodicity of 1049 minutes (equal to 17.5 hours), fitting inertial currents frequency.

OBSEA footage.

The automated protocol efficiently detected a variable number of fish specimens over consecutive frames. These data can be efficiently represented as a time series (Fig. 2C).

IV. CONCLUSIONS

The understanding of ecosystem dynamics in the sea is to date still constrained by datasets This situation is rapidly changing as systems that provide high-quality long-duration datasets are deployed. The analysis presented in our work can be potentially performed on diverse video sources form very different depth environments, where permanent stations are acquiring (or may acquire in the future) footage of very long duration spanning months or years.

V. ACKNOWLEDGEMENTS

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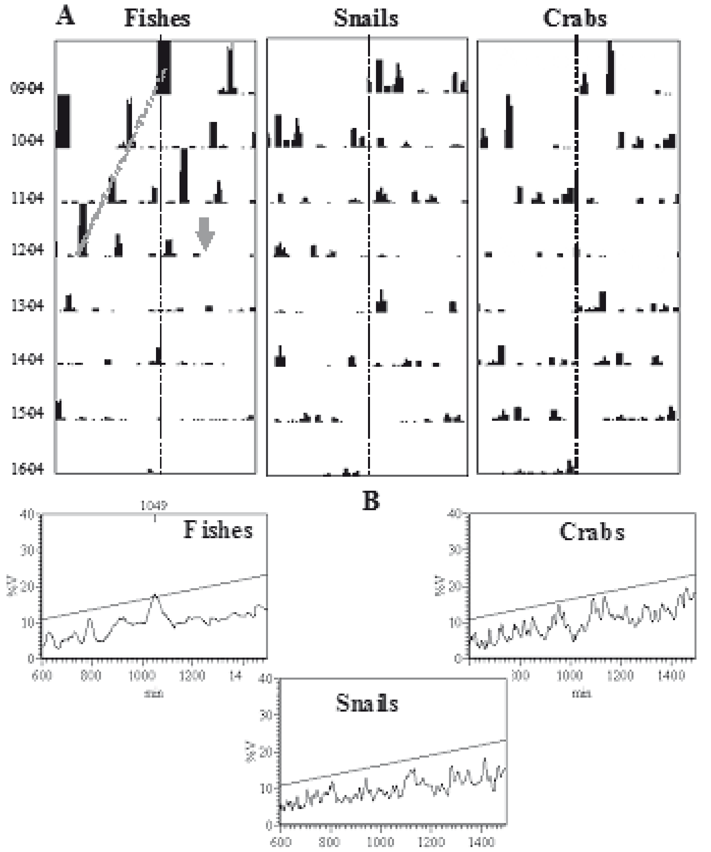

Fig. 3. Double-plot actograms (A; vertical dashed line is the 24-h based limit) and outputs of periodogram analysis (B).

APPLICATION OF GEOMETRIC-MORPHOMETRIC, HYPERSPECTRAL IMAGING AND MOLECULAR MARKERS TO THE STUDY OF DEPTH-DRIVEN DIFFERENCES IN POPULATIONS OF DECAPODS (CRUSTACEA)

Jacopo Aguzzi[1], Corrado Costa[2], Juan Batista Company[1], Francesca Antonucci[2], Federico Pallottino[2], Paolo Menesatti[2], Emiliano Canali[2], Stefano Giorgi[2], Claudio Angelini[3], Valerio Ketmaier[4]
(1) Instituto de Ciencias del Mar (ICM-CSIC)
(2) AgritechLab - Agricultural Engineering Research Unit of the Agriculture Research Council (CRA-ING)
(3) SARTI (Remote Acquisition Systems and Information Treatment Development Center) – CTVG.
(4) Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

Keywords - Image colour calibration, image analysis, color checker, multivariate analysis, mtDNA sequencing.

I. INTRODUCTION

The levels of environmental light experienced by animals during their phases of behavioural activity determine the type of experienced interspecific interactions [1]. The form and colour of an organism constrains its use of ecosystem resources. At the same time, resource accessibility contributes to the construction of its form. That process occurs via evolution through the confrontation of individuals with important ecological tasks such as feeding, mating, displacement, and predatory evasion [2].

The squat lobster, Munida tenuimana, is an ecologically key crustacean decapod of the Mediterranean slope [3]. Autoecological traits in relation to behaviour and population distributions are poorly understood. A curious depth-related variation in size has been reported [4]; smaller individuals are located at 900 m, while larger individuals occur both above (400-600 m) and below (1000-1500 m)

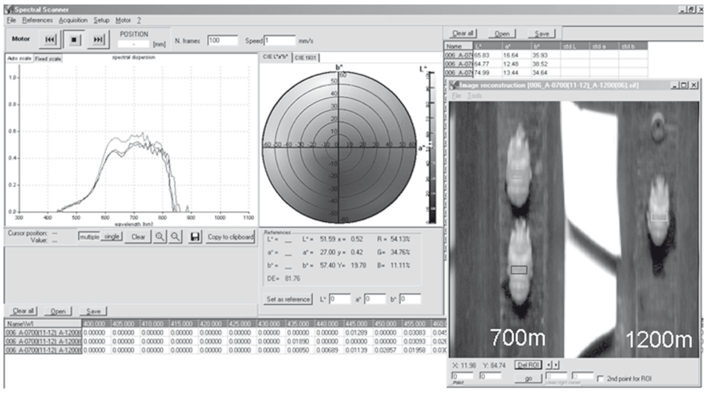

Fig. 1: Software output of the spectral and colour analysis via hyperspectral imaging of the ROI in Munida.