A SIMPLIFIED VISUAL CENSUS METHODOLOGY TO DETECT VARIABILITY TRENDS OF COASTAL MEDITERRANEAN FISHES UNDER CLIMATE CHANGE SCENARIOS

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Abstract
Here we tested a simplified visual census methodology in which the sampling unit consisted of snorkeling trials of 5 minutes. Censuses were conducted over 4 different Mediterranean locations, according to a hierarchical sampling design. Results discriminated the assemblages at different spatial levels and confirmed the importance of Latitude gradient for the distribution of *T. pavo* and *S. cretense*. Aim of this contribution is to discuss the potential of this method to detect variability trends of Mediterranean fish species.
Keywords: Fishes, Sampling Methods, Global Change

Introduction
The contemporary change in the species geographical ranges is one of the most apparent signals of climate warming worldwide [1] and now in the Mediterranean Sea, a number of thermophilic coastal fish species seems to be extending their distribution and increasing in abundance [2]. Our capacity to monitor and understand this phenomenon is limited by the pragmatic constraints that arise in encompassing large spatial and temporal scales, being the most of information generally given by the sum of sporadic observation. As recently emerged by a CIESM workshop [2], to select a reliable network of variables, to use simple methods and a minimal investment in extracting local information can help much in overcome these difficulties. Therefore, on the basis of these guidelines, we propose a simplified visual census methodology to monitor a set of coastal fish species. The method was specifically intended to be used by a wide group of observers over large geographical scales and, hopefully within long time series.

Materials and Methods
Our sampling unit (count) consisted of a snorkelling transect of 5 minutes, parallel to the shore. During this time, the observer takes abundance data for a set of species (i.e. *Epinephelus marginatus*, *Caranx cysos*, *Thalassoma pavo*, *Coris julis*, *Sparisoma cretense*, *Serranus scriba*, *Serranus cabrilla*, *Sarpa salpa*), that were chosen for their wide distribution and different affinity to temperature. The study, performed during September-October, 2009, was limited to rocky bottoms, in order to minimize the sources of variability. The sampling design consisted of 2 different latitude ranges (low and high) with 2 locations nested in each of it, 3 sites nested in each location and 4 replicate trials, for a total of 48 fish counts (Fig. 1). Data were overall square root transformed, univariate and multivariate analyses were performed by using the PRIMER 6+PERMANOVA software package.

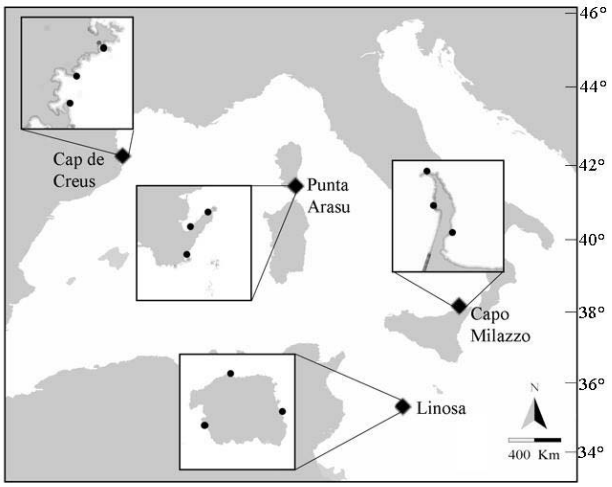

Fig. 1. Study locations (black diamonds) (low latitude: Linosa and Capo Milazzo; high latitude: Punta Arasu and Cap de Creus) and sites (black circles).

Results and Discussion
We counted 2257 individuals overall. According to PERMANOVA analysis (Tab. 1), significant differences in the fish assemblages were detected at the spatial scales of 'locations' and 'sites' but no significant differences were found for the factor 'latitude'.

Source	df	SS	MS	Pseudo-F	P(perm)
Latitude=La	1	23920	23920	1.9264	0.3388
Location (La)	2	24834	12417	19.583	0.0001
Sites(Location(La))	8	5072.5	634.06	1.7738	0.0455
Res	36	12868	357.45		
Total	47	66695			

Fig. 2. Permutational multivariate analysis of variance based on the Bray Curtis dissimilarity measure for square root transformed abundance data.

The lack of statistical significance for the factor 'latitude' can be explained by a inadequate number of replicates at the location level. Therefore we proceeded with the SIMPER analysis that indicated *T. pavo* (Contribution to the dissimilarity 28.79%), *S. salpa* (24.17%) and *S. cretense* (13.72%) as mostly important to discriminate between low and high latitudes. *T. pavo* and *S. cretense* are species that are typical of the south Mediterranean and these results confirmed the importance of latitude in shaping their distribution. According to 3-way PERANOVA, *T. pavo* resulted to vary significantly according to the factor latitude (Pseudo F= 120.71; p = 0.461), but also with the factors 'location' and 'site'. In sum, despite the poor quality of information that was extracted by each single trial, these preliminary data were effective in to discriminate spatial differences at the level of location and sites. The study represented an useful test to plan future sampling and hopefully an incentive to discuss the potential of this simple method to detect variability trends of Mediterranean fish species. We believe that powerful information could be obtained by means of a structured sampling design where many other similar observations are assembled to build a wider-scale picture. The census method was simplified to the maximum in order to be used also by not-specialist alike. Future investigation could be conceived to test for the influence of overriding factors that act at global scales. Hopefully, in a next future we could: 1) test the importance of latitudinal gradients and temperature in shaping species distribution; 2) start building long time series, which is one of the research priorities under climate change scenarios.

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References
1 - Perry A.L., Low P.J., Ellis J.R. and Reynolds J.D., 2005. Climate change and distribution shifts in marine fishes. *Science*, 308(5730): 1912-1915.
2 - CIESM., 2008. Climate warming and related changes in Mediterranean marine biota. N° 35 In: CIESM *Workshop Monographs*, F. Briand (ed.), 152 pages, Monaco.

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