GENERAL FISHERIES COMMISSION FOR THE MEDITERRANEAN

COMMISSION GÉNÉRALE DES PÊCHES POUR LA MÉDITERRANÉE

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WORKSHOP ON TRAWL SURVEY BASED MONITORING FISHERY SYSTEM IN THE MEDITERRANEAN

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ABSTRACTS

- Analysis of trawl survey time series from the Ligurian and Tyrrhenian Seas (by Ligas A., Baino R., Barone M., Belcari P., Belluscio A., Criscoli A., Mannini A., Relini G., Viva C.)

The existence of common patterns in a set of time series of data of five demersal species (Merluccius merluccius, Mullus barbatus, Eledone cirrhosa, Nephrops norvegicus and Parapenaeus longirostris) was investigated in the FAO-GFCM Geographic SubArea 9, including the Ligurian Sea and the northern and central Tyrrhenian Sea. The time series of density and biomass data from the MEDITS and GRU.N.D. surveys, since 1994 to 2003, were analysed using the multivariate time series analysis routine MAFA (min/max autocorrelation factor analysis). The analyses were performed to compare the time series of each species among the four Operative Unit areas in which the SubArea 9 is divided. The results showed significant differences among the four areas: each species was significantly correlated with different trends in each Operative Unit area. These observations emphasize the importance of looking at smaller spatial scales (in terms of environmental variables, fishing effort, etc.) for a more accurate management of SubArea 9.

- Use of trawl surveys data for the assessment of the status of the stocks through the application of simple variants of surplus production models (by Abella A.)

In this contribution two approaches based on surplus production models are presented. These approaches can be utilised for an assessment of the status of demersal stocks. Used data may proceed exclusively from trawl surveys. Necessary information regards size structure of the population at sea and an index of abundance. The first approach use spatial information of mortality rates and abundance indices proceeding from ecologically similar sub-areas which are exploited at different rates; in the second approach, couples of Z and a biomass index are used in order to fit a non-equilibrium production model approach and for the estimation of the parameters of the logistic population growth model.

- The use of trawl survey data in the ICES region for assessment purposes (by Armstrong M.)

This presentation gives an overview of the use of trawl surveys in stock assessments carried out by the ICES scientific community. Aspects of survey design and survey standardisation/inter-vessel calibration are covered. The primary use for the surveys is to provide time-series data on abundance and distribution by size or age, and the main use is in the "tuning" of different types of sequential population analysis (SPA). Survey-only models are also widely used for providing fishery-independent trends in stock abundance, and for investigating the quality of the survey data. North Sea haddock is given as an example of both approaches. An important issue for many catch-based assessments is dealing with bias due to apparent trends in survey catchability. The trends may be due to problems with the fishery data, or to actual changes in catchability. Some assessments of European cod stocks use survey data to estimate unaccounted-for removals, for example due to misreported or discarded catch. Surveys are also widely used for providing data on biological parameters of stocks, and increasingly for providing information in support of ecosystem approaches to fishery management.

- Hake nurseries identification in the FAO-GSA 9 using a Bayesian geostatistical approach (By G. Ardizzone[1], F. Colloca[1], G. Iona Lasinio[1], V. Bartolino[1], L. Maiorano[1], P. Carpentieri[1], A. Abella[2], A. Mannini[3], C. Viva[4], S. De Ranieri[4], G. Relini[3].)

Two time series of trawl survey data (GRUND project, 1985-2003, MEDITS project, 1996-2004) have been used to identify hake nurseries off the central-western coasts of Italy (FAO GFCM-GSA9). The study area covered the continental shelf and the upper and middle slope along the Ligurian and Tyrrhenian coasts. Density data of hake recruits, as mean number of individuals per squared kilometre (n km-2), has been computed considering only fish smaller than 14 cm in total length. A 2km x 2km estimation grid was built over the whole area (7290 cells). The mean and the covariance structure was modelled respectively as a first order spatial trend and assuming an exponential variogram. In the proposed Bayesian framework we adopted the estimated surface of MEDITS (carried in late spring-early summer) for every year as prior distribution for the estimation of GRUND (carried in autumn) for the same year. This provided a better use of the information contained in the data with improved estimations of recruits abundance and distribution. The proportion of significant estimated surface increased in the time series up to 80% for GRUND and 70% for MEDITS data. The Bayesian inference, respect to the classical kriging, which do not entirely accounts for uncertainty in the estimates, provides a way to incorporate parameter uncertainty in the prediction by treating the parameters as random variables and, integrating over the parameter space, and allows obtaining the predictive distribution of any quantity of interest (see for instance Diggle and Ribeiro, 2002). Furthermore, poorly sampled years do not need to be aggregated aiming at reducing the lack of spatial information, with a sensible advantage in the predictions of recruits spatial and temporal dynamics. In order to find hake juveniles hot spots (nurseries), different approaches have been used (e.g. G statistic, Kernel). Geostatistical aggregation curves have been used to describe the biomass-dependent spatial dynamic of hake recruits.

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Their spatial distribution was seasonally and yearly consistent and stable despite high temporal fluctuations in density.

- **Permanent control of the state of trawl fisheries started in 1997** (By Djurovic M.)

Estimated population dynamics parameters of important species: Pandora, Pagellus erythrinus, Red Mullet, Mullus barbatus, Hake, Merluccius merluccius, Pink shrimp, Parapaeneus longirostris. Estimated total biomass of economical important demersal resources on the shelf area (hake, red mullet, red pandora, squid, octopus, pink shrimp) was about 2 700 tons.. Estimated MSY of demersal resources was 600 tons per year. Estimated average catch per unit effort (CPUE) of demersal resources last four years was about 19.47 kg/h. In October 2004 and February 2007 in frame of FAO Adriamed Project has been performed AdriMed trawl survey (MEDITS protocol) in Montenegrin teritorial and adjacent waters. In 1997 CPUE has fallen to 20 kg/h and for the last few years this value did not change. This indicates that some kind of the state of equilibrium was reached between fishing effort and resources.

- **Medits working group "Species assemblages and biodiversity"** (By Gaertner JC, J.Bertrand, A. Kalianitotis, L. Gil de Sola, N. Ungaro, P. Vidoris, M. Murenu)

The MEDITS working group untitled "Species assemblages and biodiversity" aims to pursue and enlarge the investigations previously made in the frame of the former MEDITS Working Group dedicated to "Demersal assemblages" (Medits 2002, final report). We intend to describe and quantify spatio-temporal patterns in community organization of demersal assemblages.
The main questions addressed in this working group are :
- Which descriptors of community appear to be the most relevant for both ecological analysis and fishery management purpose?
- What are the main distributional patterns exhibited by these descriptors in the northern Mediterranean Sea?
- Which descriptors do offer complementary information on community organization? (and then which descriptors are redundant ?)
- What are the consequences for management and conservation purposes?
- Which natural and anthropogenic factors may explained the observed patterns?
Organizational patterns of assemblages are analysed through different kinds of descriptors (e.g. species composition, species diversity, total abundance, etc.). Most of the research effort is devoted to investigations conducted at large-scale spatial pattern. Both ecological and methodological contributions are welcome.

- **Hydraulic dredge surveys for the assessment of the clam resources (*Chamelea gallina*) in the Maritime Districts of Ancona and San Benedetto del Tronto, central Adriatic Sea, Italy** (by E.B. Morello, C. Froglia, E. Arneri)

A large fleet of hydraulic dredgers has been targeting the clam *Chamelea gallina* in the Adriatic Sea for the past 30 years. The fishery has progressively reached a status of great economical importance for the fishing community. Following request of the Italian Ministry of Agriculture and Forestry, the clam resources in the entire Adriatic Sea have been assessed through hydraulic dredge surveys annually from 1984 to 2001. This presentation is aimed at

summarising the methodologies adopted for such assessment in two Maritime Districts of the central Adriatic (Ancoan and S. Benedetto del Tronto) as well as the results obtained from 1984 to 2001.

- A proposal for reducing haul time in the Mediterranean experimental bottom trawl surveys (by F. Bertolino, M.L. Bianchini, S. Gancitano, G.B. Giusto, G. Sinacori, S. Ragonese)

Experimental bottom trawl surveys (EBTSs) must cope with the exigency of good estimates precision (i.e., many short hauls) and the need of gathering representative samples. Most Mediterranean EBTSs have adopted half to one hour effective haul bottom times (EHBT), which are set by adding a depth varying lag to the time at which the winch stop occurs. However, evidences have piled up outside the Mediterranean about the ability of the gear to yield representative biological samples even in short haul times, as a consequence of the interaction of different factors. From Minilog data gathered during an EBTS carried on in the Strait of Sicily (program Grund 2005), measured EHBT were compared by depth strata (shelf, upper and middle slope) with the corresponding nominal EHBT. Results indicate a not significant departure of measured and nominal EHBT, with different patterns among strata: measured EHBT was higher (+5 min), about the same (+1 min) and lower (2.5 min) in shelf, upper and middle slope respectively. Subsequently, hauls of the deepest stratum were split in 4 classes of increasing departure; notwithstanding departures of almost 15 min in some hauls, no substantial differences were appreciated in catch rates and LFD shapes, at least when considering the red shrimps (the most abundant target species). Even within the limits of the present study, it is suggested to consider the possibility of reducing, also for the Mediterranean EBTSs, the haul time to increase the precision of surveys.

- Real-time indexes of demersal resources status within the Mediterranean experimental bottom trawl survey context. (by M.L. Bianchini, G. Giusto, G.D. Nardone, G. Sinacori, S. Ragonese)

Trawls surveys are elective instruments for assessing the demersal resources status; still, they represent a snapshot of the present situation, and risk therefore of being not representative, especially in highly variable situations, such as those of the Mediterranean fisheries. Analyses based on single surveys may produce misleading impressions of the actual status of the fishery, and induce to wrong management decisions; on the other hand, a complete and detailed assessment requires long delays, with outcomes mirroring an obsolete situation, and resulting in untimely actions. Aim of this note is to suggest a compromise, using a software package (SeaTrim) developed for the Mediterranean context: first, for each target species, a quick exploratory analysis of the most recent trawl data, followed by a retrospective exam extended over not more than the real exploited phase (max 2 4 years), and concluded with a geographical meta analysis; subsequently, the overall status of multispecies fisheries, like those typical of the Mediterranean, could be treated with simple sign tests on multiple arrays of indicators. A few examples of this approach, applied to some of the most important target species of the Strait of Sicily, are presented and commented, showing the behaviour of the pertinent actual data.

Toward the establishment of length at age references for red mullet (Mullus barbatus) as a hint to support growth assessment in the Mediterranean geographical sub areas (GSA) (by M.L. Bianchini, S. Gancitano, S. Ragonese)

Length at age (LAA) data represent a basic tool for the assessment of exploited fish stocks, their use requiring the identification of the "unit stock". In the present paper, a different scenario is proposed, consisting in: a) reconstructing the historical Mediterranean data within a common frame; b) looking for spatial trends related to easy to acquire covariates (such as surface seawater temperature); and c) figuring out reference LAA to be used as an overall benchmark for analyses inside the GSAs. This approach has been evaluated using the red mullet (Mullus barbatus), among the most investigated stock of the whole basin, as case study. Published and grey literature was browsed, to get direct and/or indirect LAA estimations, obtaining more than 50 Mediterranean cases. To set a common baseline and maximize the use of partial information, a vBGF was fit to LAA data whenever possible. The vBGF parameters ($L\infty$ and K) vs. longitude/SST by sex were analyzed in order to figure out trends, checking their significance with parametric and non parametric tests; problems arose in the interpretation of old references and in the "circularities" of already elaborated values. Even if present results seem to confirm the existence of a W E gradient, this trend is confused by other variables related to the different sampling and methodologies employed; in fact, the bivariate scatterplots show not significant correlations in all cases, but the K SST relationship. Finally, an overall reference growth line was estimated by sex and its plausibility to the life traits of the species considered.

- The Italian trawl surveys: GRUND (by Relini G., Carpentieri P., Mannini A.)

A short review of national trawl surveys carried out since 1985 around the Italian coast is referred. After a summarized story of the campaigns and methodologies the main results are described.

- Analysis of the elasmobranches data collected in the frame of the MEDITS project and their potential use for stock assessment and management advice (by Serena F.)

Data on the chondrichthyan species, collected in the frame of the European Union program MEDITS, have been analysed and reported in a scientific document as indices of abundance for standardised area (km2). This preliminary paper analyses the results of the trawl surveys carried out in the whole European Mediterranean area and it is aimed at producing a global overview of species distribution and abundance in this area. Some aspects of the population size structure are also analysed. Future work foresees the analysis of the historical trend of abundance of chondrichthyan fishes caught during all Medits campaigns and the use of simple indicators and models potentially useful for stock assessment.

- Distribution mapping of elasmobranch species in the Greek seas based on the MEDITS data (by Peristeraki P., Tserpes G., Politou C-Y., Kallianiotis A. and Papaconstantinou C.)

- Application of a non-equilibrium surplus production model assessment using MEDITS data (by Tserpes G., Haralabous J. and Maravelias C.)

Estimates of MSY for the hake stock in the Aegean Sea are obtained from a non-equilibrium surplus model approach based on CPUE time series derived from the MEDITS surveys and fishery production data. The model is developed in the freely available R-language.

- Rapido trawl surveys for stock assessment of Solea solea and other benthic resources in the northern and central Adriatic Sea – methodological aspects (SoleMon project) (By G. Fabi, O. Giovanardi, F. Grati, I. Isajlović, S. Raicevich, A. Santojanni, G. Scarcella, N. Vrgoc)

Inside the VI National Triennal Plan for Fisheries and Aquaculture the Italian Ministry for the Agricultural and Forestry Policies (MiPAF) - D.G. for Marine Fisheries and Aquaculture - funded a 3-year coordinated project entitled "Stock assessment of Solea solea in the northern and central Adriatic Sea and evaluation of the impact of the different fishing activities".
One of the main tasks of the project was to assess distribution and biomass of S. solea stock and to identify spawning areas of this species in the northern and central Adriatic Sea (GSA 17) through surveys at sea.
The project started in 2004. Initially, it involved only two Italian Units – CNR, Istituto di Scienze Marine (ISMAR) Ancona (Coordinator of the project), and Istituto Centrale per la Ricerca scientifica e tecnologica Applicata al Mare (ICRAM) Chioggia - and was limited to the Italian and international waters but, as it was focused on a stock which is shared between the western and eastern side of the northern and central Adriatic Sea, thanks to the support of AdriaMed Project, as concerns stock assessment of sole it was extended to the national Croatian waters involving the Institute of Oceanography and Fisheries (IOF), Split, Croatia.
Materials and Methods
Two surveys at sea per year (one in spring and the other in fall) were carried out in 2005 and 2006 in the area extending from Trieste to the Pomo Pit northern limit and from the Italian coast to the Croatian one, for a total trawlable area of 44,880 km2 at depths ranging from 5 to 1156 m.
A systematic design was adopted in the first survey year to get a detailed picture of the spatial distribution of sole. It included 67 sampling sites in spring and 62 in fall placed at 15 nm from each other along horizontal transects 15 nm apart, extending from the Italian to the Croatian coast.
One haul was carried out at each sampling site towing 4 "rapido" trawls at the same time at about 5.5 knots of speed. The hauls lasted from 5 to 30 minutes, depending on the bottom type.
Rapido trawl was chosen for its higher efficiency in capturing bottom fish in respect to otter trawl net. The gears were standardized between the Operative Units and had the following technical features: 3.5 m of width; 225 kg of weight; four 120-mm wide skids and 48-mm codend mesh size (stretched). The fixed mouth of the gear and the use of DST Logic Temperature and Depth Recorders allowed to know exactly the area explored by each rapido trawl.
The following data were recorded at each haul, separately for each rapido trawl:

- weight of the total catch;
- individual length, sex, gonadic maturity stage (five-point maturity scale by Holden and Raitt, 1974) and total weight of sole specimens;
- individual length and total weight of all the other commercial species;
- total weight of discards.

Based on the observed abundance and relative variance of S. solea and other commercially important bottom species which are efficiently caught by rapido trawl, a post-stratification was applied and 3 depth strata were identified: 0-30 m; 30-50 m, and >50 m. The area delimited by the Croatian islands, sampled from fall 2005, was considered as a further stratum (stratum 4). Consequently, a random stratified sampling was adopted for the definitive surveys to be carried out in 2006, including 42 hauls in spring and 67 in fall.
Data analysis was carried out using the data bank AdriaMed Trawl Information System (ATrIS; Gramolini et al., 2005). Total mortality rate (Z) of sole was estimated through the linearized length-converted catch curve method, using the von Bertalanffy growth parameters $L\infty = 42.11$, estimated by means of the relationship $L\infty = Lmax / 0.95$ (Froese and Binohlan, 2000), $k = 0.25$ estimated by inserting the $L\infty = 42.11$ into the average $\Phi' = 2.64$ (Pauly and Munro, 1984) obtained from 12 cases relative to the Mediterranean reported by web site Fishbase, and $t0 = -1.26$ computed inserting the mentioned estimates of $L\infty$ and k in von Bertalanffy equation along with some pairs of age and length values from Froglia and Giannetti (1985, 1986). M was estimated by means of the relationship $M = 1.5\ k$ (Jensen, 1996).
Analysis of SoleMon data and comparison with similar investigations made at the same time and in the same area (MEDITSa and AdriaMed Trawl Survey) showed that rapido trawl is a more efficient tool for catching some benthic species than otter trawl (especially MEDITS net (GOC)). This is clearly visible for species as Solea solea, Lophius budegassa, and Pecten jacobaeus. Consequently, the logical conclusion is that rapiso trawl survey should be and additional tool for assessment of demersal resources.

- ALADYM (Age-Length Based Dynamic Model): a stochastic simulation tool to predict population dynamics and management scenarios using fishery-independent information (by Lembo G., S. Martino, A.J. Abella, F. Fiorentino and M.T. Spedicato)

ALADYM (Age-Length Based Dynamic Model) is an age-length based simulation model designed to predict, through simulations, the consequences of management scenarios on a single population, in terms of different metrics and indicators. Removals are simulated on the basis of the total mortality rate modulated using selectivity pattern and a fishing activity coefficient. Aladym can work in absence of fishery-dependent data and is composed of two complementary tools: the quasi-deterministic dynamic tool defined as Aladym-r and the stochastic dynamic tool defined as Aladym-q. The latter adds to the same mathematical formulations of the former the capability to deal with the stochastic representation, modelling the uncertainty of estimates related to recruitment, growth and maturity through stochastic processes (user selected pdfs). This make the model more suitable for estimating the probability associated to predicted metrics, indicators and reference points. A case study on the red mullet population of the GSA 10 is discussed.

- Usefulness of the spatial indices to define the distribution pattern of key life stages: an application on the red mullet population in the south Tyrrhenian sea (by Spedicato M.T., M. Woillez, J. Rivoirard, P. Petitgas, P. Carbonara, G. Lembo)

This study aims to explore the performance of the approach based on spatial indicators to characterise with quantitative metrics the spatial dynamics of red mullet life stages (recruits and adults), to identify areas where red mullet recruits are more concentrated, to establish

relationships with the adult distribution and to detect the ability of spatial indicators to capture the stability of the spatial occupation of preferential areas across the years. Data are from the GRU.N.D. experimental trawl surveys. The methodological approach used in this study is based on the estimate of spatial indicators as developed within the EU Fisboat project. The results proved that many of the 9 examined spatial indicators and pairwise relationships, between indicators and abundance, enabled us to better understand the spatial distribution and interannual variability of the red mullet population life stages and the relationships between spatial distribution and abundance. In addition, we identified the geographical area (southwards,- along the Calabria coast) where recruits of red mullet resulted mainly distributed and we also verified that these locations are stable across years.

- Nursery areas of hake (*Merluccius merluccius*) and deep-water rose shrimp (*Parapenaeus longirostris*) in the Central Mediterranean Sea: perspectives for fishery management (by Carlucci R.[5], D'Onghia G.[5], Lembo G.[6], Maiorano P.[5], Marano C.A.[7], Sion L.[5], Spedicato M.T.[6], Ungaro N.[8]

The spatial pattern of nursery areas of hake and deep-water rose shrimp was studied in Southern Adriatic and Northern Ionian Sea (Central Mediterranean) using geostatistical tools and data from trawl surveys time series conducted in the area. The analysed variables were: R (number of recruits/km^2) and R/Tot (fraction of recruits on the total sampled population). The structural analysis showed a spatial pattern of both variables characterized by continuity at a small scale level. Predictions of nursery areas localization with probability of finding recruits at different threshold values were obtained through median indicator kriging. The main concentration of hake juveniles were estimated within 100-200 m depth along the Gargano peninsula and in the Otranto Channel, where the nursery of deep-water rose shrimp was mainly localised. A depth overlapping, between 100 and 200 m, was identified for hake and deep-water rose shrimp nurseries. Protection of these areas through limitations of fishing pressure is discussed.

- FAO-Adriamed Bottom Trawl Survey and use of ATrlS (by Vrgoc N., Isajlovic I., Krstulovic Sifner S., Massa F., Joksimovic A., Marceta B., Osmani K., Piccinetti C., Ungaro N.)

The FAO-Adriamed Project (Scientific Cooperation to Support Responsible Fisheries in the Adriatic Sea) is a Regional Project conceived to contribute to the promotion of cooperative fishery management in the Adriatic Sea between the participating countries (Albania, Croatia, Italy, Slovenia and Montenegro). The Project has been operative since 1999. Among other activities of the project, annual Autumn-Winter bottom trawl surveys are held, covering the whole eastern Adriatic Sea. This survey is complementary (the same sampling period and methodology) to the GRUND survey held in the western Adriatic Sea. One of the main objectives of the Project is to develop a common basis to support international processes of fishery management. An important tool used to achieve this goal is ATrlS, a Regional Trawl Surveys Information System. ATrlS is developed in the scope of the Project and it includes a

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database from bottom trawl surveys with a wide range of data types and a geo-referenced database with data stored directly within GIS.