SOME ASPECTS OF GROWTH AND RECRUITMENT OF HAKE IN THE NORTHERN TYRRHENIAN SEA

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Growth performance of hake in the Mediterranean Sea has been studied with results not always in agreement by several authors. Age reading of otholiths of *Merluccius* is difficult, mainly for older individuals. Length frequency analyses are frequently used to estimate the Von Bertalanffy parameters assuming that the modes represent year classes. In this paper, the recent methodology for growth parameter estimation MULTIFAN (OTTER RESEARCH, 1992) has been utilized for the Northern Tyrrhenian Sea hake. It is an integrated data analysis system for simultaneously analyzing sets of length-frequency samples. It utilizes a robust maximum likelihood method to estimate the proportions of fish at age in each sample and the Von Bertalanffy growth model parameters. Extra restrictions can be introduced and superior estimates of the parameters could be obtained. The program tests some hypotheses of the occurrence of certain processes in the population sampled namely : sampling bias for the first cohort, age-dependent standard deviation in length-at-age, seasonally oscillating growth. ORSI RÉLINi *et al.* (1992), SARANO, (1986), ZUPANOVIC (1968) have found for hake multiple spawning and recruitment periods. It is quite difficult to trace a single reliable growth curve through the jumble of modes generated by "multiple" spawning strategies. Uncritical use of modal progression analysis algorithms leads to a possible underestimate of growth constant. K. MULTIFAN has no special routines for fitting growth curves when two or more cohorts are present each year but it has been demonstrated that it gives reliable estimates of growth parameters even for situations like the described above. Length distributions of 9 trawl-surveys performed from 1992 to 1994 with a stratified random design were analyzed separately by sex. Because macroscopic sex identification for individuals smaller than 9 cm was difficult, it was considered valid here to arbitrarily assign half part of them to each sex, considering negligible at this age sexual differences in size according to ALDEBERT *et al.* (1988). The incorporation of constrictions for the first length bias correction improved significantly the fit. The traditional mediterranean bottom trawl nets utilized as sampler during the trawl-surveys is not suitable for the catch of large individuals (ALDEBERT *et al.*, 1993). However, it has been considered that the scarce number of individuals of large size did not alter the precision of the estimates proposed here. In the table are reported the estimates of V.B. growth parameters :

| | **MALES** | | | **FEMALES** | | |
	ESTIMATE	C.V.	CONF.LIMITS	ESTIMATE	C.V.	CONF.LIMITS
Loo	53.40	.39	± 0.16	79.10	.24	± 0.142
K	.27	.48	± 0.0009	.19	.24	± 0.003

The hypothesis of seasonal growth has been tested but without producing any improvement of the estimates. Other estimates of $L\infty$ of 77.4 for males and 95.7 for females were obtained with the Powell-Wetherall method (SPARRE *et al.*, 1987). It has been studied the gear selectivity utilizing a cover at the net codend. Selection for the former year classes has been modelized with a logistic function. The partial recruitment was calculated by means of analyses of the left side of the "length converted catch curve". Recruitment patterns were obtained using the appropriate routine of ELEFAN II program (Figs.1 and 2). Two peaks have been detected in December and March for females and in November/December and February for males. In both cases the late Autumn peak was bigger. These indications are in agreement with the results given in ORSI RELINI *et al.* (1992), specially for females. These authors stated that recruitment occurs approximately 6 months after spawning. Figures 3a and 3b show the length frequency distributions for females and males during each trawl-survey. The length distributions have been corrected (in white) for gear selectivity. It is shown how well the estimated growth curves with departure from the two main recruitment moments fit the peaks of the length distributions ordered along the time.

Fig.1 ♀

Fig.2 ♂

% Recruitment

Fig.3a ♀

Fig.3b ♂

Months

Length (cm)
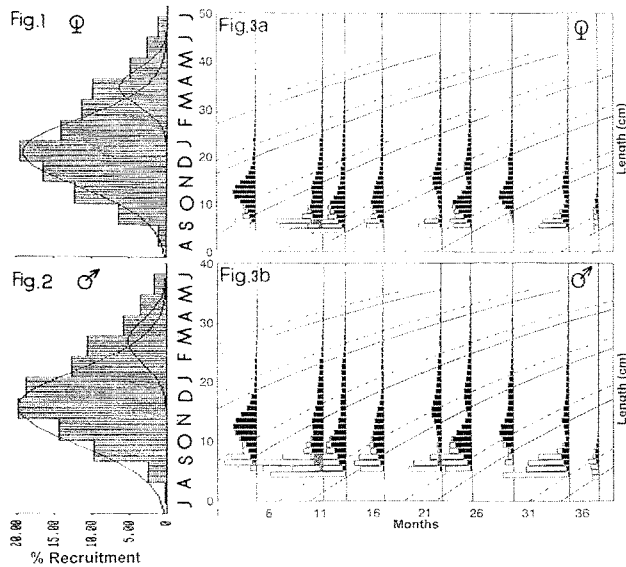
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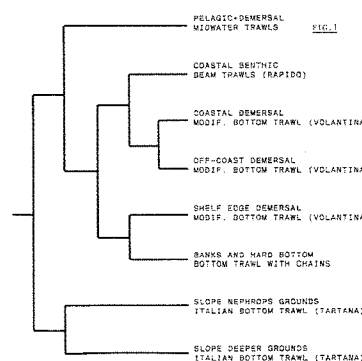

DEFINITION OF THE GROUNDFISH ASSEMBLAGES CAUGHT OFF THE TUSCANIAN COASTS FOR FISHERIES MANAGEMENT PURPOSES

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The demersal fisheries operating off the coasts of Viareggio, Tuscany are multispecific. Target species, fishing gears, fishing grounds change over the year. The "Italian bottom trawl net" ("tartana") is utilized in deep waters mainly for *Nephrops*, beam trawls ("rapido") in coastal waters with soles as target species, trawl nets with the groundrope with heavy chains in hard bottoms for sparids. A variant of the Italian otter trawl net ("volantina") is utilized near shore with gobies, cuttlefish, mantis shrimp, red mullet and *Eledone* spp. as target species. The midwater trawl catch includes some demersal species. Multivariate data of a catch assessment survey performed during 1992 were analyzed by arranging them in an ordered two-way table (TWINSPAN) and with the Detrended Correspondence Analysis (DECORANA). Both algorithms are included in the Cornell Ecology Programs Package, (1990). Species abundance data matrix contained information on 342 fishing trips with approximately 1200 tows and 282 species. Assemblages of co-occurring demersal fishes by fishing strategy represent seasonally invariant groupings by fishing gear and strategy and provide an accurate description of the commercially exploited species mixes. Clustering techniques can be applied to trawl-surveys data. However, the groups defined should not be consistent with those proceeding from the analysis of commercial landings. This is because trawl surveys utilize a standardized strategy and a single trawling gear. In this paper, clustering was performed with the aim to provide definitions of fisheries in particular area/gear/depth/month combinations with characteristic species mixes. Fig.1 shows the more consistent assemblages that have been derived. There is a strong agreement between the strategical goal (target species) and the corresponding assemblage designation. The clusters showed a very reduced degree of overlapping. The DCA program derived four axes in order of decreasing correspondence between the catch and species "scores". The first two axes represents a clear separation of catches determined mainly by the fishing gear. The *a priori* defined fishing strategy, based on gear, depth and target species appears accurate and effective and allows to predict the assemblages to be caught. Figs.2-4 show the geographical distribution of effort for the main groundfish fishing strategies in the area and the relative fishing pressure exercised by statistical division. Most of the smaller fishing trawlers utilize the "volantina" and are concentrated close to Viareggio. They represent approximately 60% of the total daily trips of the fleet. The importance of the single components for a certain fishing gear changes along the year. For example, *M. barbatus* landings are abundant in late Summer-Autumn, when age class 0 individuals are concentrated near the coast. The fluctuations regarding a single species (*Mullus, Sepia,* etc.) and areal shifting are detected with the clustering technique making subdivisions at the 5th or 6th level. During Summer, with good weather conditions, the fleet is able to go further in deeper waters and the "tartana" is more frequently used. *N. norvegicus, P. longirostris, M. poutassou,* the squids *T. eblane and I. coindetii, Lophius spp, L. boscii* are the main components of the "tartana" assemblage. Some fishing vessels exploit *Nephrops* grounds placed quite far from Viareggio. The beam-trawls are more utilized during Summer. *Solea* sp, *Penaeus kerathurus* and *Raja asterias* are the main components of this assemblage. During the whole year, but specially when anchovy schools are detected, part of the fleet changes strategy and utilizes the mid-water trawl net. Anchovy by-catch is mainly composed by *Sardina* sp. and other Clupeids and Mugilids, but also by demersal species as *Diplodus* spp and *M. merluccius*.

"VOLANTINA"

FIG.2

VIAREGGIO

"TARTANA"

FIG.3

VIAREGGIO

"RAPIDO"

FIG.4

VIAREGGIO

PELAGIC-DEMERSAL MIDWATER TRAWLS FIG.1

COASTAL BENTHIC BEAM TRAWLS (RAPIDO)

COASTAL DEMERSAL MODIF. BOTTOM TRAWL (VOLANTINA)

OFF-COAST DEMERSAL MODIF. BOTTOM TRAWL (VOLANTINA)

SHELF EDGE DEMERSAL MODIF. BOTTOM TRAWL (VOLANTINA)

BANKS AND HARD BOTTOM BOTTOM TRAWL WITH CHAINS

SLOPE NEPHROPS GROUNDS ITALIAN BOTTOM TRAWL (TARTANA)

SLOPE DEEPER GROUNDS ITALIAN BOTTOM TRAWL (TARTANA)

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