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METHODS OF APPROACH ON THE POPULATION DYNAMICS OF HAKE (*Merluccius merluccius*) IN MAJORCA (NW MEDITERRANEAN)

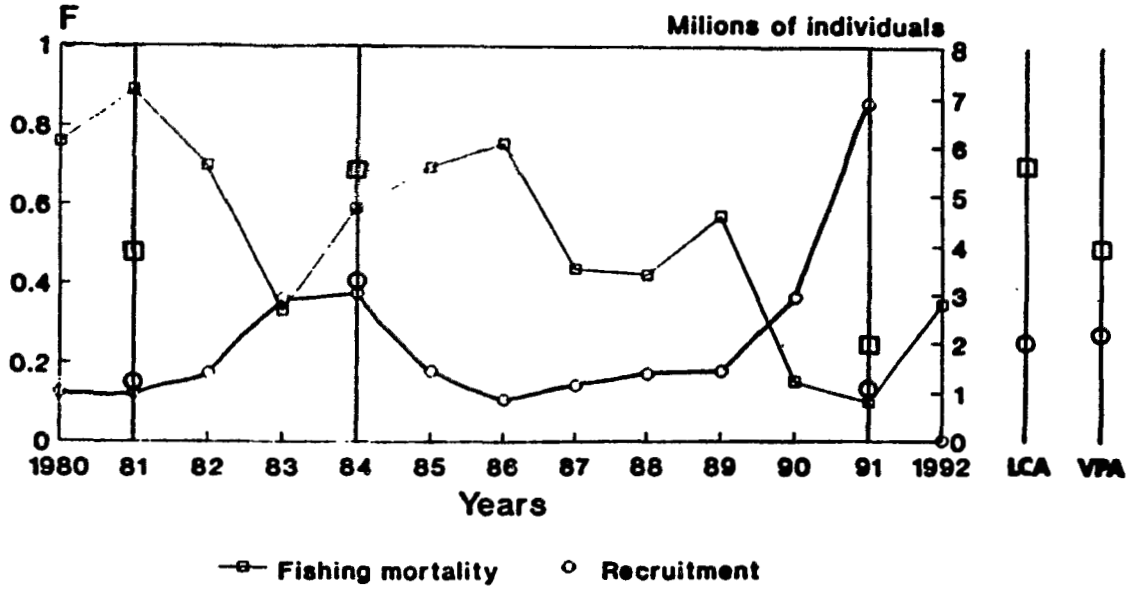
Pere Oliver, Enric Massutí and Olga Reñones

I.E.O. - Centre Oceanogràfic de Balears. Moll de Ponent s/n, Apdo. 291, 07080 Palma de Mallorca, Spain

ABSTRACT

Hake (*Merluccius merluccius*) is, like in other Mediterranean fisheries, one of the main target species in the trawl fishery developed off Majorca. This paper describes the results obtained with VPA and Y/R analysis for this species in the area, using cohort and pseudocohort assessment methods. The estimates of mortality and recruitment values obtained by means of different approaches are analysed and compared. Another methodological trial has been oriented towards the comparison of the Y/R values obtained when using an average pseudocohort over several years and annual pseudocohorts. In all cases, the results have shown a high level of fishing effort and an inadequacy of the exploitation pattern which is applied to hake stock in Majorca.

Key words: Hake, Mediterranean, population dynamics, methodology, assessment.



Comparison between VPA and LCA results. Evolution of mean fishing mortalities by year and annual recruitment, during the study period. Also the mean VPA values and the results of LCA applied to an average 1980-92 pseudocohort are presented.

VPA results. Fishing mortalities (F) per age-class, and average values of F per year and per age-class obtained during the study period.

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	Average F
0	0.005	0.075	0.003	0.001	0.023	0.038	0.001	0.000	0.004	0.001	0.000	0.000	0.350	0.039
1	1.404	1.099	0.516	0.478	1.657	1.367	1.172	0.583	0.712	1.008	0.393	0.165	0.350	0.839
2	1.732	1.261	1.450	1.028	1.007	1.236	1.738	1.036	1.064	1.199	0.702	0.350	0.350	1.090
3	1.501	1.759	0.911	0.619	0.879	1.708	1.421	0.629	0.922	0.548	0.651	0.717	0.350	0.970
4	1.264	1.543	0.857	0.449	0.790	1.115	1.343	0.584	0.433	0.273	0.484	0.518	0.350	0.770
5	0.792	0.654	0.569	0.433	0.482	0.489	0.958	0.655	0.382	0.101	0.298	0.249	0.350	0.493
6	0.550	1.510	0.268	0.319	0.287	0.090	0.441	0.320	0.249	0.136	0.084	0.330	0.350	0.456
7	0.350	1.015	0.075	0.000	0.263	0.243	0.201	0.194	0.000	0.639	0.161	0.060	0.350	0.350
8	0.000	0.000	0.350	0.000	0.178	0.350	0.350	0.350	0.000	0.350	0.350	0.392	0.350	0.232
9	0.000	0.000	0.000	0.000	0.350	0.350	0.000	0.000	0.000	0.350	0.000	0.000	0.350	0.108
Average F	0.760	0.892	0.700	0.333	0.592	0.696	0.760	0.441	0.427	0.574	0.154	0.101	0.350	0.535

VPA results. Effective populations at beginning of the year per age-class (expresed in Thousands of individuals) and average values for the 13 years period.

Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	Average
0	991.19	986.03	1385.06	2897.47	3002.71	1414.42	847.35	1135.29	1373.63	1425.64	2940.63	6886.96	0.92	0.00	1945.18
1	1175.14	824.11	763.90	1153.21	2416.74	2451.98	1137.28	707.20	948.05	1143.17	1189.68	2456.22	5752.47	0.54	1701.47
2	483.55	241.19	229.44	380.79	596.97	385.11	521.75	294.13	329.91	388.59	348.49	670.91	1739.37	3385.93	508.48
3	117.61	71.48	57.10	44.94	113.79	182.13	93.45	76.65	87.14	93.24	97.95	144.32	394.88	1023.80	121.13
4	38.87	21.89	10.29	19.19	20.21	39.44	27.58	18.85	34.12	28.95	45.01	42.65	58.85	232.43	31.22
5	10.06	9.17	3.91	3.65	10.23	7.66	10.80	6.01	8.78	18.48	18.40	23.17	21.23	34.64	11.66
6	4.84	3.81	3.98	1.85	1.98	5.28	3.92	3.46	2.61	5.01	13.96	11.41	15.08	12.49	5.94
7	0.00	2.33	0.70	0.94	1.12	1.24	4.03	2.11	2.10	1.70	3.65	10.72	6.85	8.88	2.88
8	0.00	0.00	0.71	0.20	0.78	0.72	0.81	2.75	1.45	1.75	0.75	2.60	8.43	4.03	1.61
9	0.00	0.00	0.00	0.00	0.17	0.55	0.00	0.00	0.00	1.21	0.00	0.00	1.47	4.96	0.26

Results obtained with the VIT programme. Output data of LCA and Y/R analysis applied to annual pseudocohorts for the years 1981, 1984 and 1991, and to an average pseudocohort for the period 1980-92. F mean is the mean of fishing mortalities by age weighted according to the effectives for every age-class, and critical values refer to the length or age at which the cohort biomass reaches its maximum. Y/R is the yield per recruit, MSY/R the maximum sustainable yield per recruit and E_{max} the optimum effort factor in relation to the actual fishing effort (if lower than 1 the stock appears to be overexploited and viceversa).

Population (annual values)	1980-92	1981	1984	1991
Recruits (nº)	1 565 850	1 177 819	3 105 023	947 784
Mean annual number	2 461 800	1 958 900	4 346 100	1 795 000
Mean annual biomass (Kg)	97 721	150 870	119 970	169 330
Estimates virgin biomass (Kg)	4 139 320	2 069 350	8 208 130	2 086 350
F mean	0.750	0.440	0.690	0.380
Mean length (cm)	12.76	14.70	11.40	15.90
Critical length (cm)	23.00	23.00	23.00	23.00
Mean age (years)	1.03	1.25	0.89	1.38
Critical age (years)	2.00	2.00	2.00	2.00
Y/R	63.98	68.84	46.79	87.36
MSY/R	147.94	91.23	106.73	106.20
E_{max}	0.23	0.45	0.25	0.50