Anchovy and sardine stock assessment in the GSA 17, according to GFCM

WG regionalisation MEDAC

Split, 8 October 2014

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Anchovy
(***Engraulis encrasicolus***)

Sardine
(***Sardina pilchardus***)

GFCM - Scientific Advisory Committee (SAC)

Subcommittee on Stock Assessment (SCSA)

Working Group on
Stock Assessment of Small Pelagic species (WGSASP)

Bar, Montenegro, 28 January - 1 February 2014

Fisheries Research Institute of Slovenia, Ljubljana (Slovenia)

Institute of Oceanography and Fisheries, Split (Croatia)

National Research Council - Institute of Marine Science, Ancona (Italy)

AdriaMed project of Food and Agriculture Organization, Roma (Italy)

General characteristics of the assessments

Anchovy and sardine stocks shared by Italy, Croatia, Slovenia: data used as well.

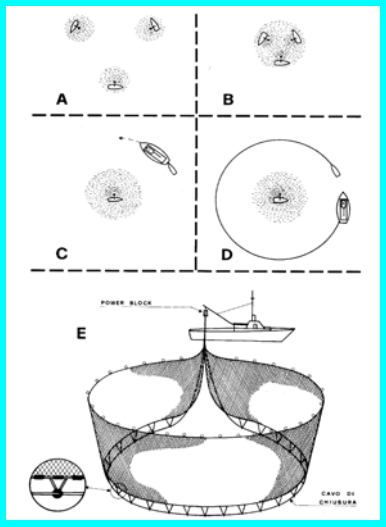
Stock assessment by means of age structured models:
- Integrated Catch-at-age Analysis or ICA
- State-space Assessment Model or SAM

Time series: from 1975 to 2012.
Split year data were used for anchovy assuming the first of June as the birth date of this species in Adriatic: for example split year 1976 is from 1 June 1975 to 31 May 1976.

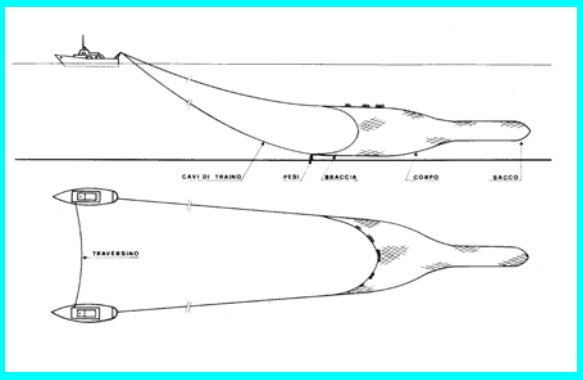
Abundance at age estimated by ICA and SAM tuned on abundance at age derived from echo-surveys carried out from 2004 to 2012, in both western and eastern side of the GSA 17.

Catch

Mid-water trawlers and purse seiners

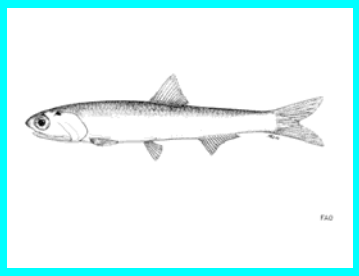


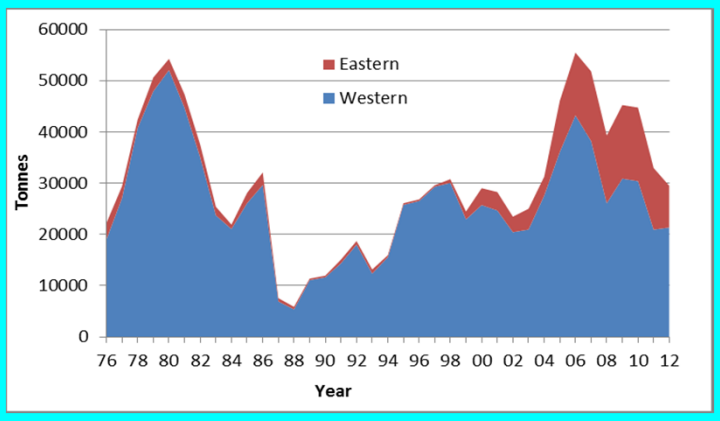
Purse seiners



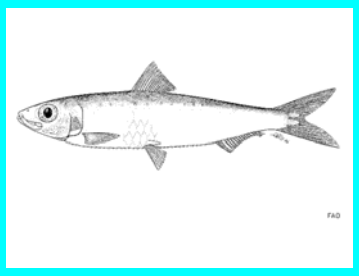
Mid-water trawlers

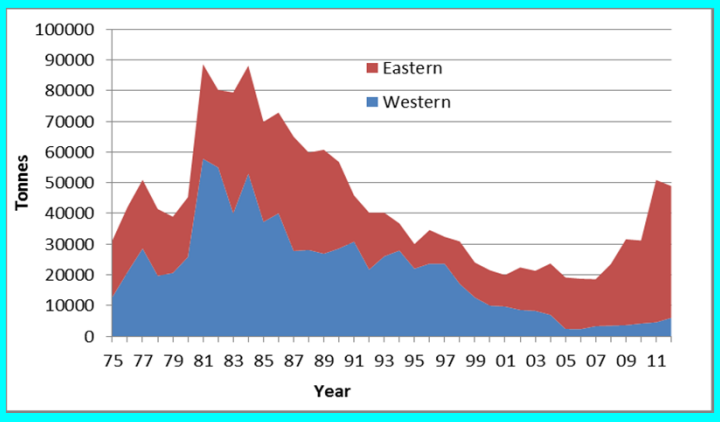
Anchovy catch



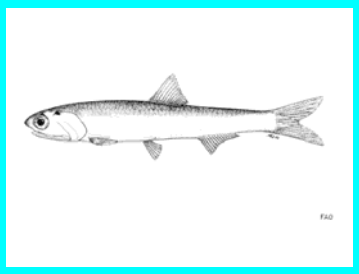


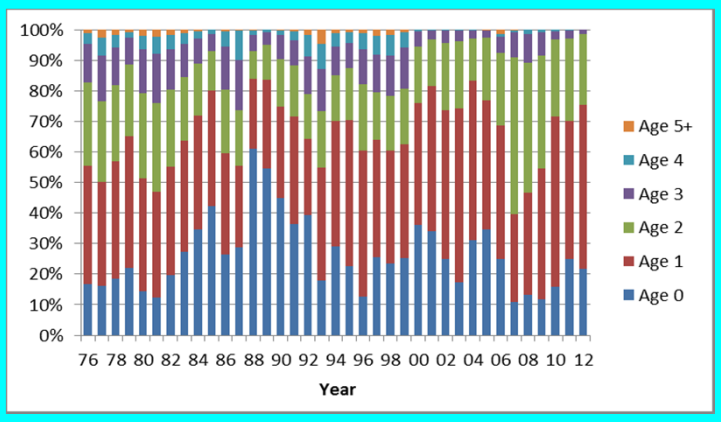
Sardine catch



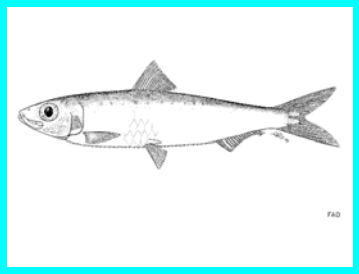


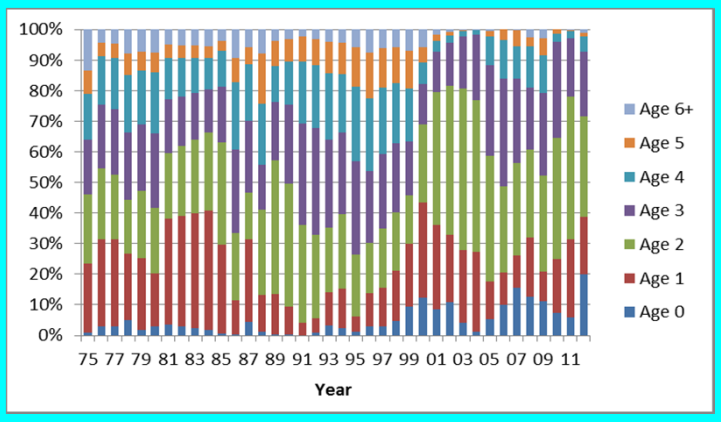
Anchovy catch at age



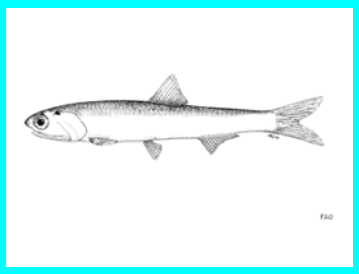


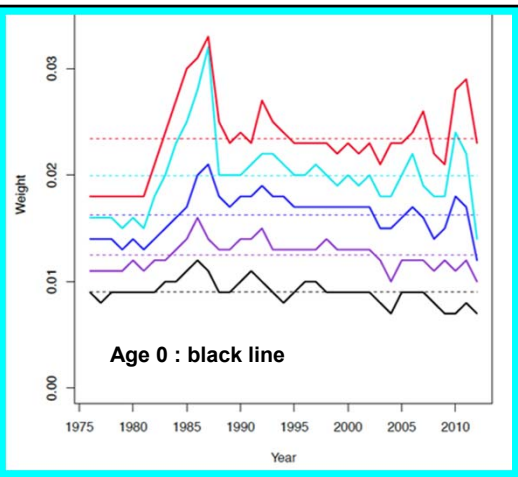
Sardine catch at age



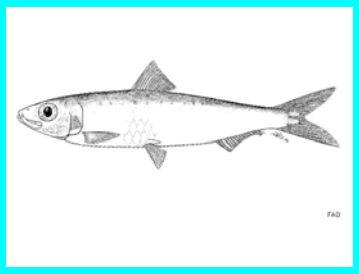


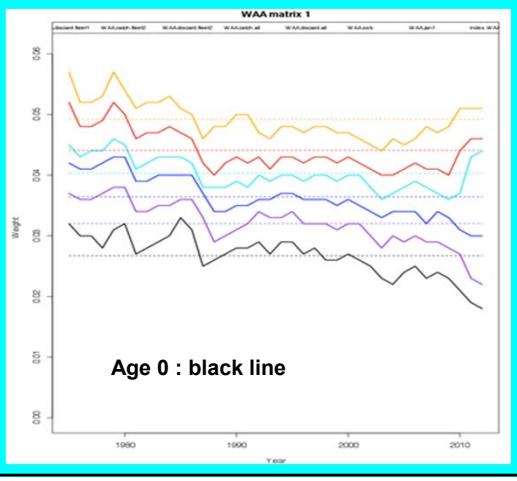
Anchovy weight at age (kg)





Sardine weight at age (kg)





Anchovy

- Growth parameters (Sinovcic, 2000)

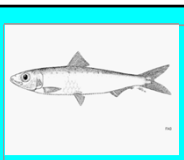
Linf (cm)	t0	k	a	b
19.4	-0.50	0.57	0.004	3.000

- Natural mortality vector (Gislason *et al*., 2010)

Age0	Age1	Age2	Age3	Age4	Age5
2.36	1.10	0.81	0.69	0.64	0.61

- Maturity at age (%)

Age0	Age1	Age2	Age3	Age4	Age5
75	100	100	100	100	100



Sardine

- Growth parameters (Sinovcic, 1986)

Linf (cm)	t0	k	a	b
20.5	-0.50	0.46	0.006	3.033

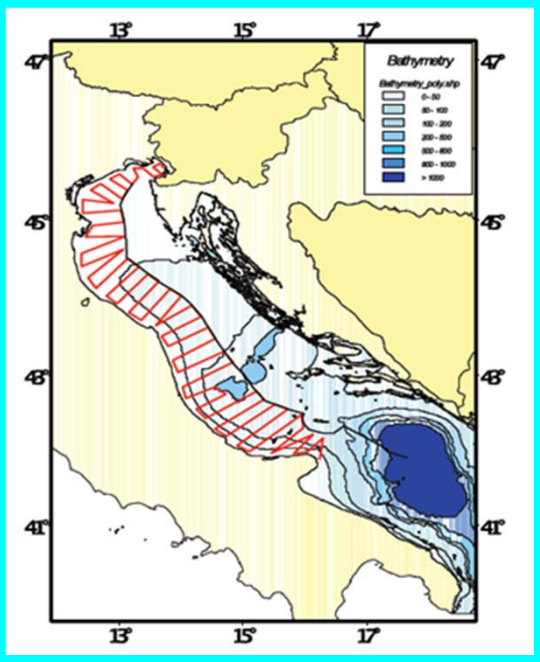
- Natural mortality vector (Gislason *et al*., 2010)

Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
2.51	1.10	0.76	0.62	0.56	0.52	0.50

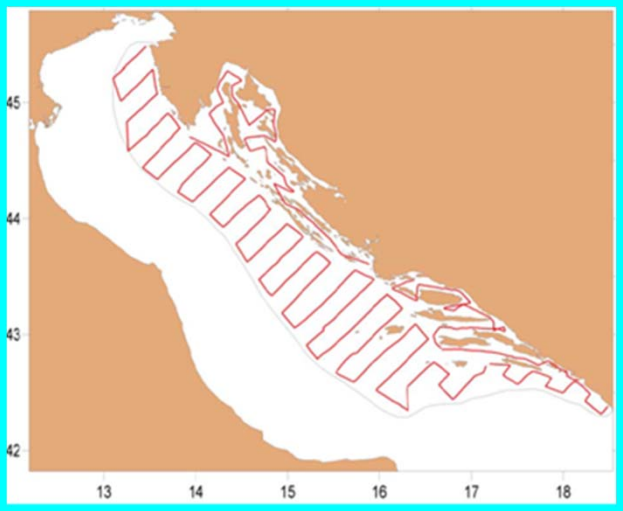
- Maturity at age (%)

Age 0	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
75	100	100	100	100	100	100

Area covered by echo-surveys

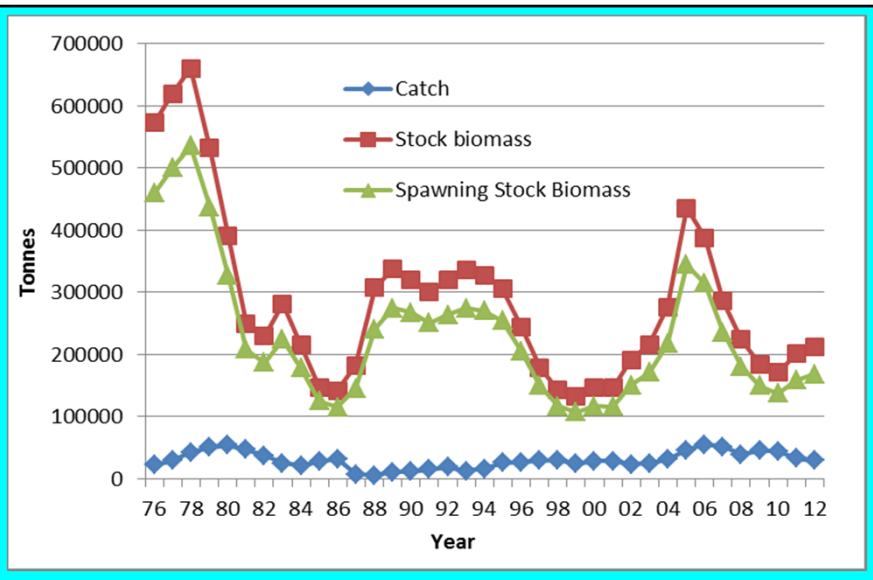


Western echo-surveys

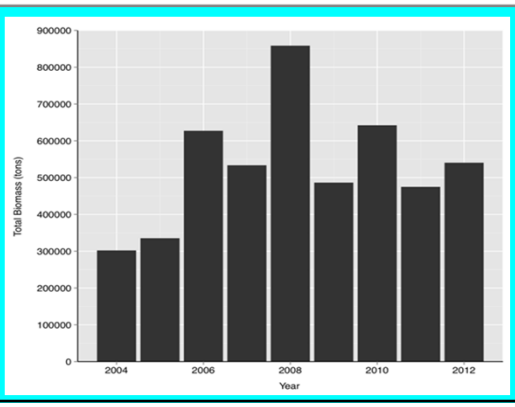


Eastern echo-surveys

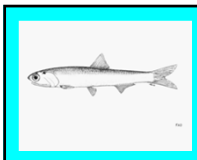
Anchovy



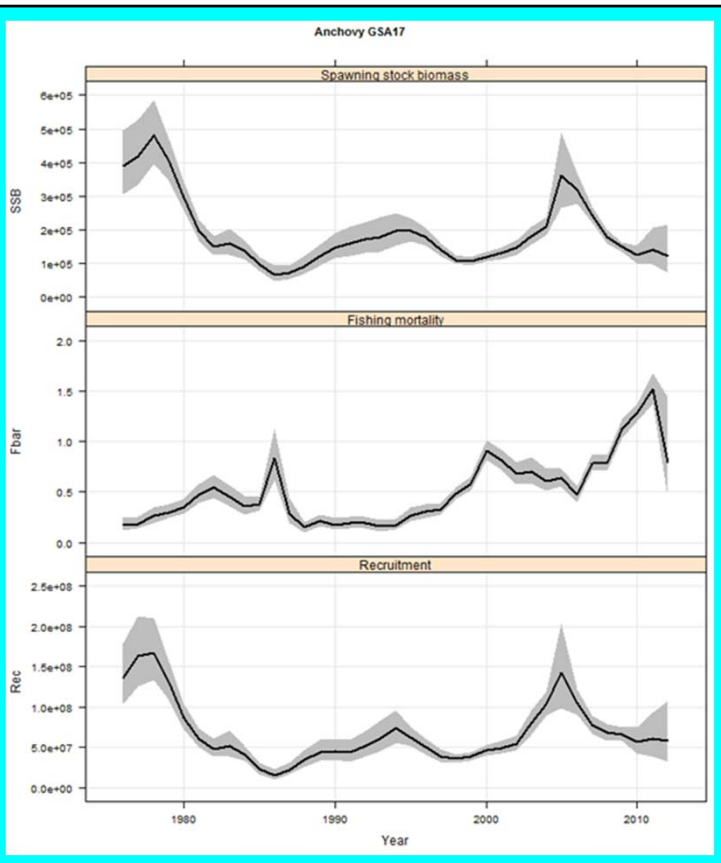
Estimates derived from ICA



Estimates derived from echo-surveys



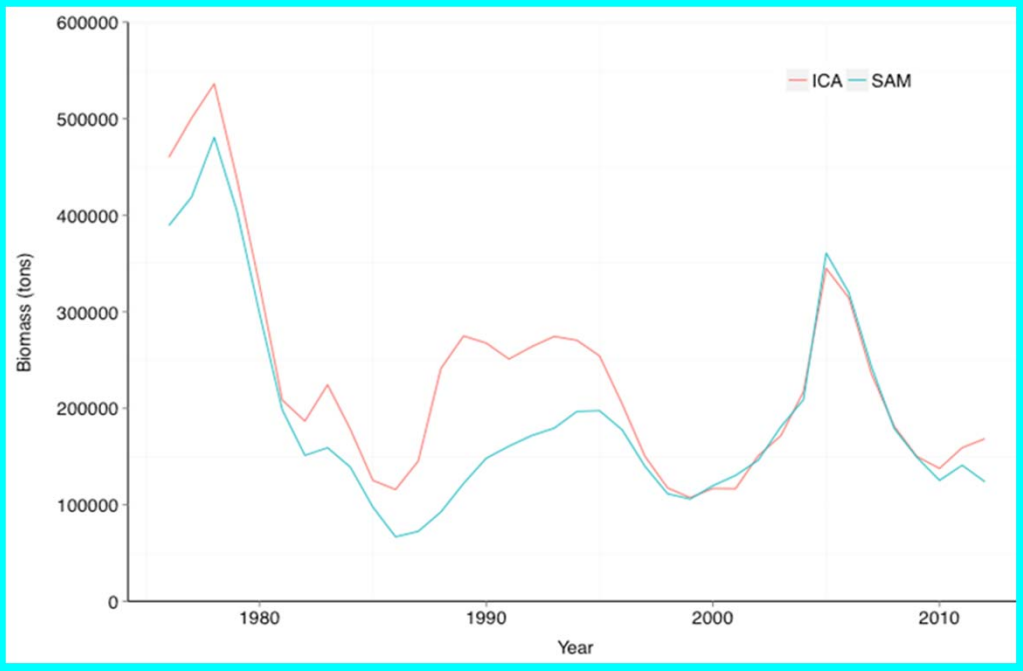
Anchovy



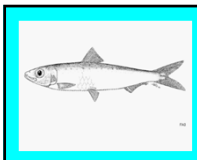
Estimates derived from SAM

Spawning Stock Biomass (in tonnes, top), Fbar (mean F 1-2, middle) and recruitment (in thousands of individuals, bottom), with the 95% confidence intervals.

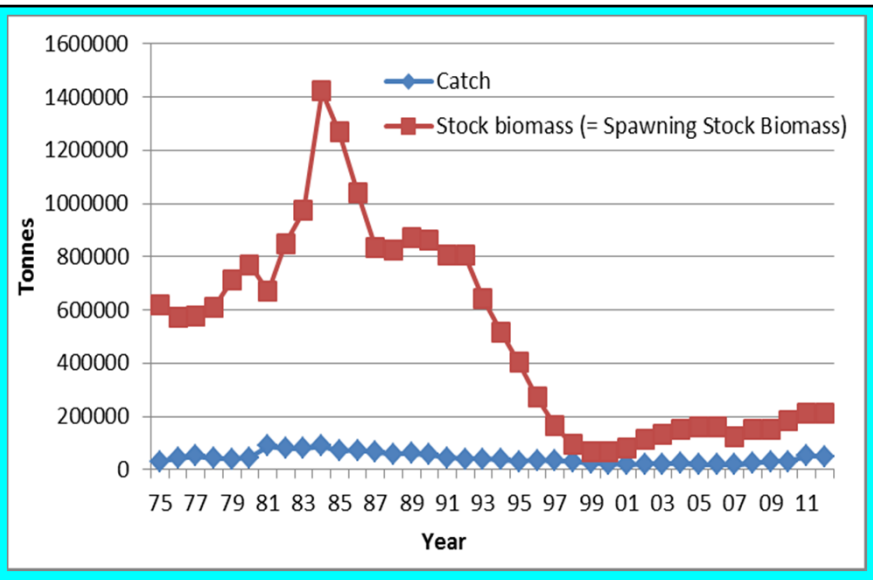
Anchovy



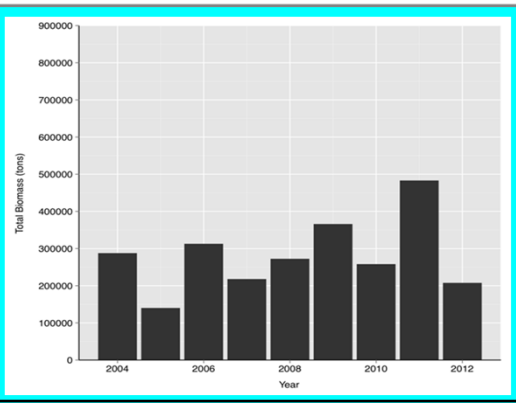
Comparison between ICA and SAM estimates of Spawning Stock Biomass (in tonnes) from 1976 to 2012.



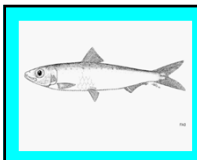
Sardine



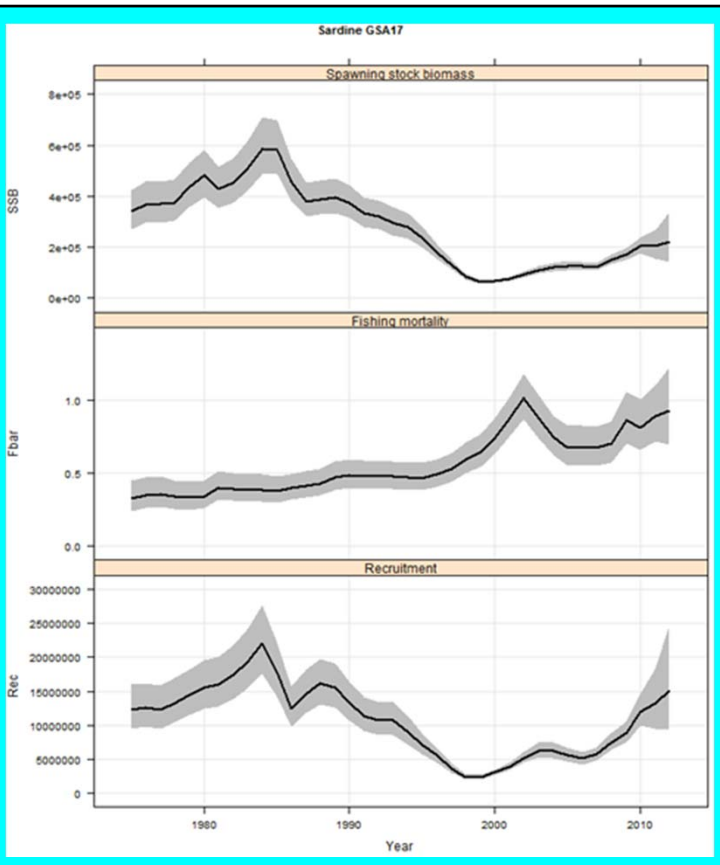
Estimates derived from ICA



Estimates derived from echo-surveys

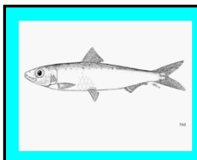


Sardine

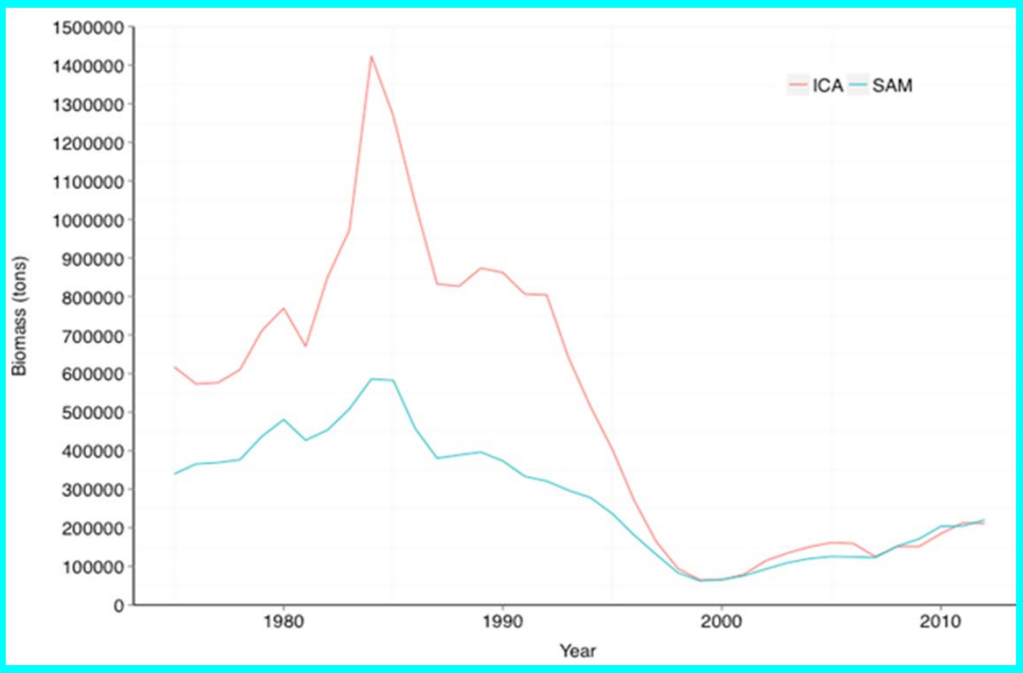


Estimates derived from SAM

Spawning Stock Biomass (= Stock biomass, in tonnes, top), Fbar (mean F 2-5, middle) and recruitment (in thousands of individuals, bottom), with the 95% confidence intervals.



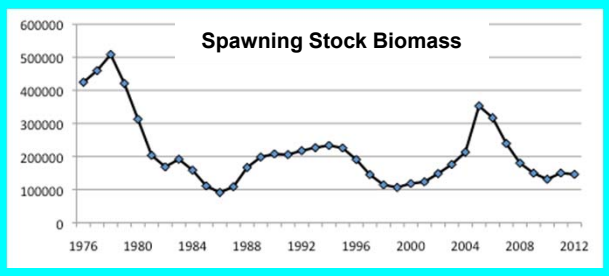
Sardine

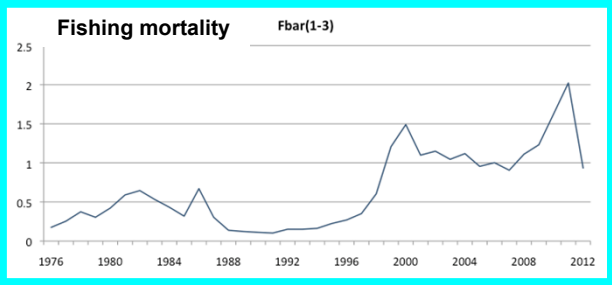


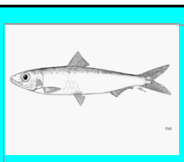
Comparison between ICA and SAM estimates of Spawning Stock Biomass (= Stock biomass, in tonnes) from 1975 to 2012.

Anchovy

Integrated Catch at Age Analysis (ICA) and Stock Assessment Model (SAM)
Average

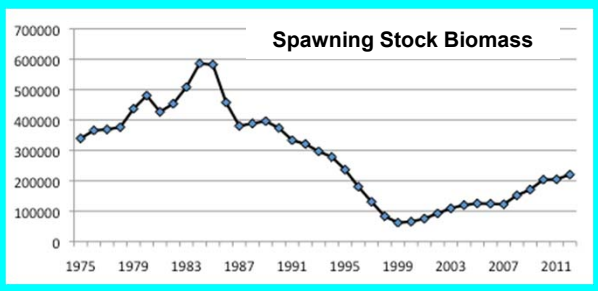


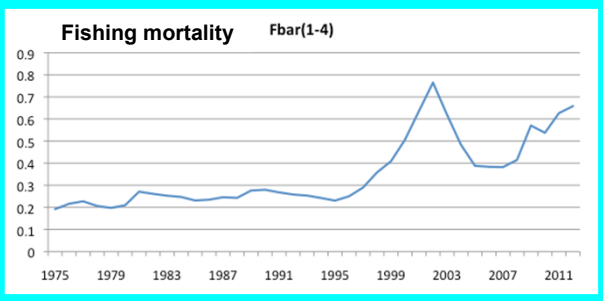




Sardine

Stock Assessment Model (SAM)





Reference point based on fishing mortality F

E = F / Z

with Z = F+M

M = natural mortality

Patterson K. 1992. Fisheries for small pelagic species: an empirical approach to management targets. Review of Fish Biology and Fisheries, 2: 321-338.

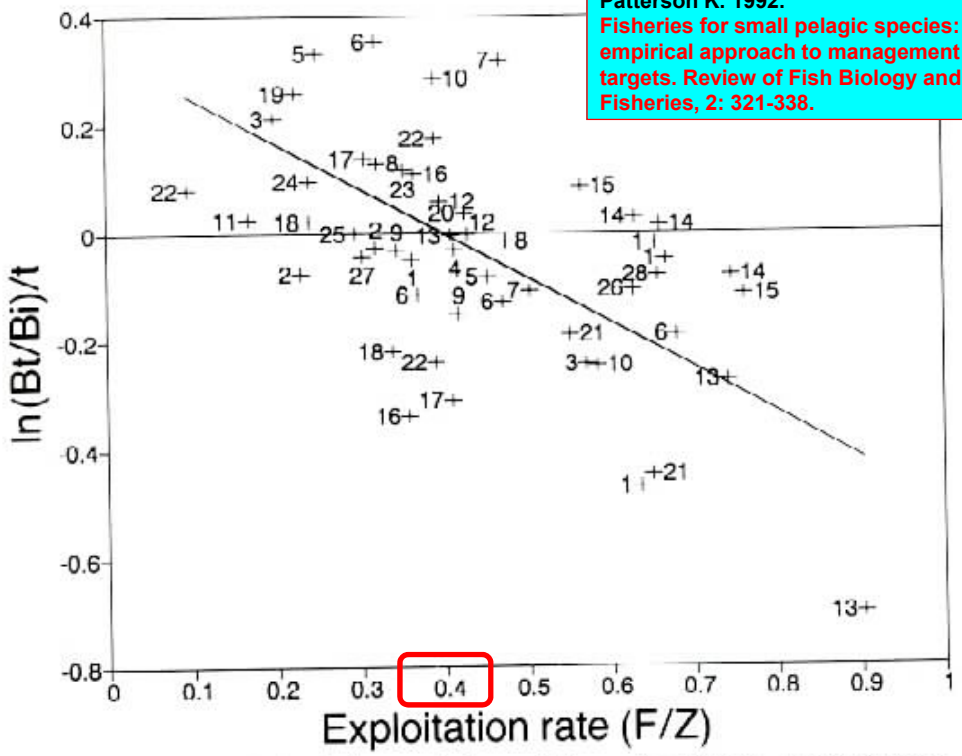


Fig. 2. Scatterplot of an index of the rate of change of biomass (as $\ln(B_t/B_{t-1})$/year) of various stocks and species of small pelagic fish in periods of 5 to 10 years, plotted against the mean exploitation rate in the corresponding period. A geometric mean regression line (Table 3) is also shown. B_t and B_{t+1} are the biomasses at the start and finish of the time periods. Numbers next to the points refer to stock numbers in Table 1. Data plotted are calculated from data in Table 2.

Reference point based on fishing mortality F

E = F / Z

with Z = F+M

M = natural mortality

Patterson K. 1992. Fisheries for small pelagic species: an empirical approach to management targets. Review of Fish Biology and Fisheries, 2: 321-338.

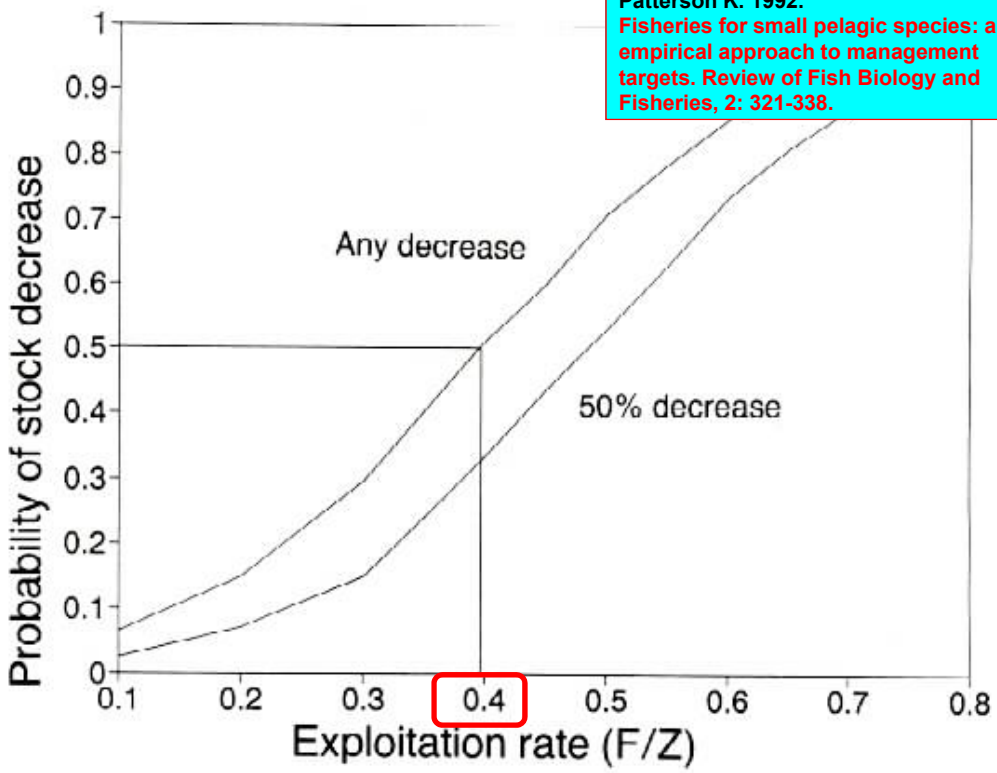
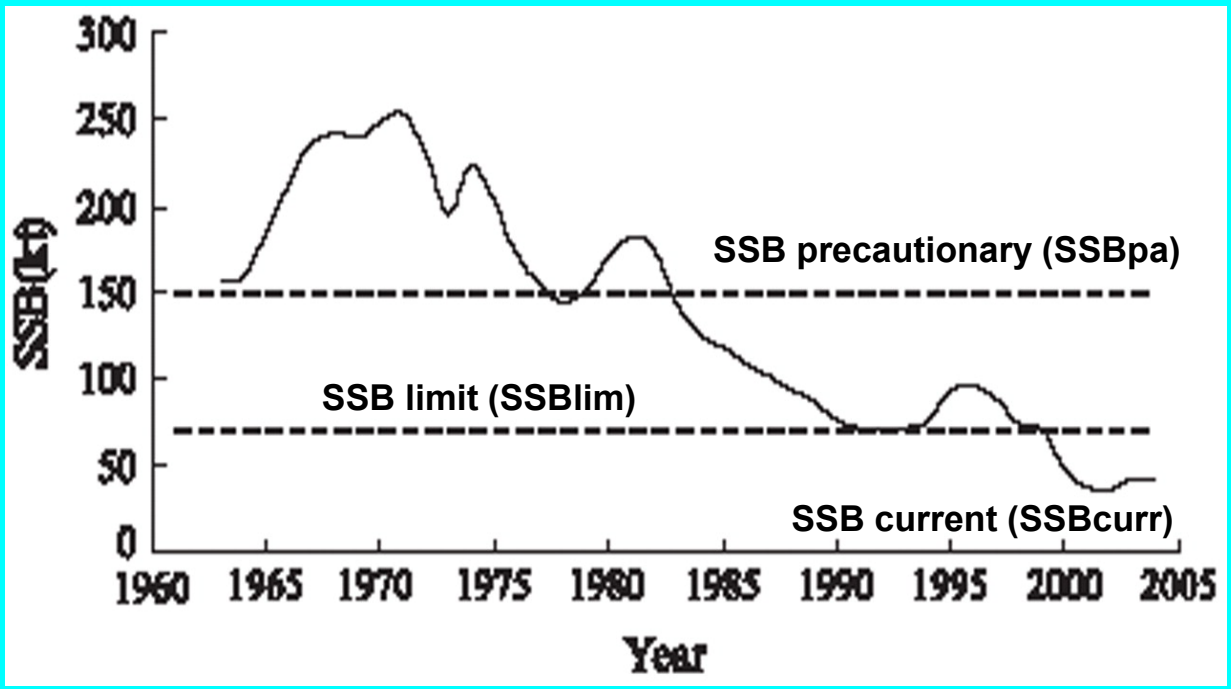


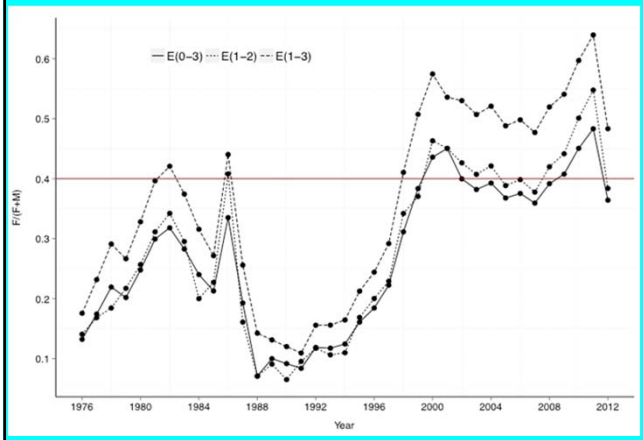
Fig. 3. Probability of decreases in stock at various levels of exploitation rate. Probability ogives of any stock decrease and of a 50% stock decrease at the end of a 10-year time period are given. Values are calculated from the GM regression fitted to data in Table 2. Note that 50% probability of stock decline corresponds approximately to $E = 0.4$.

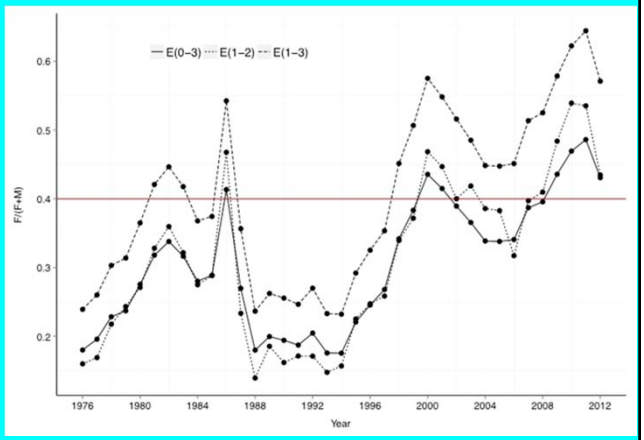
Reference points based on Spawning Stock Biomass or SSB



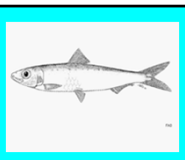
SSB in thousands of tonnes of North Sea cod (*Gadus morhua*). ICES SSB limit (70000 tonnes) and SSB precautionary (150000 tonnes) are included (Horwood *et al*. 2006 - ICES Journal of Marine Science, 63:961-968).

Exploitation rate of anchovy

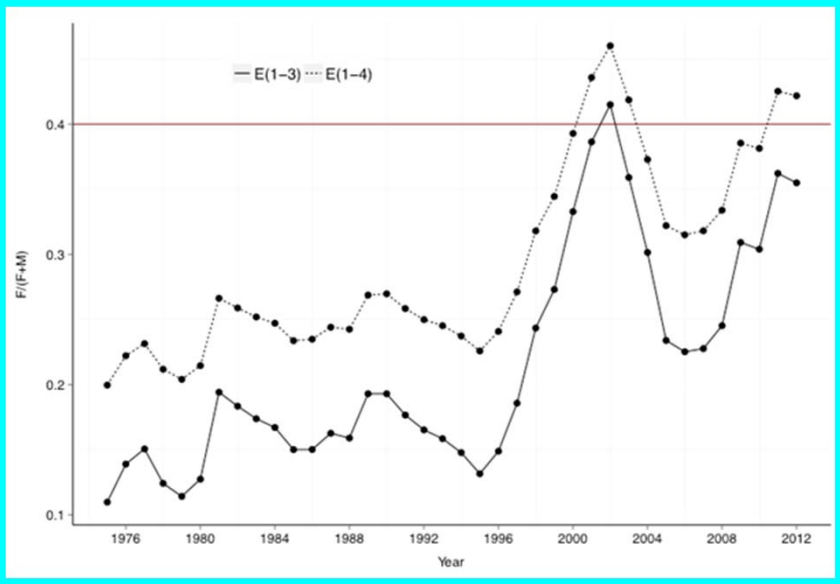




Exploitation rate E = F/(F+M) of different age groups (0-3, 1-2 and 1-3) compared to the reference point E = 0.4 suggested by Patterson (1992), on the basis of ICA (left) and SAM (right) results.



Exploitation rate of sardine



Exploitation rate E = F/(F+M) for age classes 1-3 and 1-4 compared to the reference point E = 0.4 suggested by Patterson (1992), on the basis of SAM results.

GFCM - Scientific Advisory Committee (SAC)
Subcommittee on Stock Assessment (SCSA)

Bar, Montenegro, 3 - 4 February 2014

Report of the Fifteenth Session

	GSA	Species	Methodology used	Stock status	Management advice	WGSASP comments	SCSA comments
Sardine 	GSA 17	Sardine, *Sardina pilchardus*	SAM tuned by acoustic Tests with ICA and ASAP tuned by acoustic	Increased risk of overexploitation. Exploitation rate is higher than the Patterson's reference point (E=0.42). $B_{current}$ is above both limit and precautionary reference point. Positive trend. Harvest rate is equal to 26%.	Do not increase fishing mortality and revise stock advice next year.	The WGSASP chose the SAM model as the final assessment due to better performance. All models tested provide similar estimates in the recent years, nevertheless there are discrepancies in the historical perspective. Catch data and acoustic data show some inconsistencies in the abundance by age trend (cohorts signal). Partial coverage of the eastern acoustic survey in the last two years: analysis of spatial variability should be desirable. Some differences in the ALK between the eastern and western data were identified. The WGSASP recommended a revision of the input-basic data (e.g. age structure) including testing the use of recent biological data (length structure and ALKs) from the Eastern area in the older part of the eastern landings time series, instead of data from the Western area.	In line with the discussion on reference point at SC level, SCSA suggested to consider the stock status as "increased risk of being overexploited and in overexploitation" and the management advice to be "reduce fishing mortality". In relation to the GFCM management plan approved for small pelagic fish in the Adriatic Sea the current status of the stock would be classified in option 16d – ii of the plan, and therefore the advice will be to adapt F by a ratio of 0.935
Anchovy 	GSA 17	Anchovy, *Engraulis encrasicolus*	Both ICA and SAM with acoustic tuning are considered for the advice.	Overexploited and in overexploitation Exploitation rate is higher than the Patterson's reference point (E=0.48-0.57). Biomass level is at a low level (between 12-19 percentile of the biomass estimates)	Fishing mortality should be reduced and the existing management plan should be applied.	Both models were retained to provide a comprehensive advice. The recent perspective is consistent, but models provide a different historical perspective; ICA 2012, ICA 2013 and SAM all give a different perspective in both maximum and minimum biomass and some variability in F for the more recent years. Terminal F shows a large drop (probably unreliable) with a large CI. Due to unclear historical perspective, previously adopted reference points were considered not reliable. Advice was therefore provided on a precautionary basis (exploitation rate and biomass percentiles). The WGSASP recommended that the discrepancies of the different models should be further investigated. Partial coverage of the Eastern acoustic survey in the last two years: analysis of spatial variability should be desirable. Some differences in the ALK between the Eastern and Western data were identified. The WG recommends a revision of the input-basic data (e.g. age structure) including testing the use of recent biological data (length structure and ALKs) from the eastern area in the older part of the Eastern landings time series, instead of data from the Western area.	The SCSA endorsed stock status and advice. In relation to the GFCM management plan approved for small pelagic fish in the Adriatic Sea the current status of the stock would be classified in option 16d – ii of the plan, and therefore the advice will be to adapt F by a ratio of 0.935

Recommendation GFCM/37/2013/1 on a multiannual management plan for fisheries on small pelagic stocks in the GFCM-GSA 17 (Northern Adriatic Sea) and on transitional conservation measures for fisheries on small pelagic stocks in GSA 18 (Southern Adriatic Sea).

16. *d* - When SAC considers that the size of the stock of one of the two species (either anchovy or sardine) is above the biomass threshold reference point (SSBpa) whilst the current size of the stock of the other species is between the biomass limit reference point (SSBlim) and the biomass threshold reference point (SSBpa) then GFCM shall decide on the modalities to ensure that the fishing effort exerted the previous year by the small pelagic fishing fleets, either in terms of capacity and/or fishing activity, shall be:

i) kept unchanged if the stock size is greater than halfway between the SSBlim and SSBpa

or

ii) adapted according to the difference between the precautionary biomass and the current biomass levels with respect to the difference between the precautionary biomass level and the minimum biomass acceptable level, *i.e*. **(SSBpa-SSBcurr)/(SSBpa-SSBlim)**.